OEM6™ Family Firmware Reference Manual

OEM6 Family of Receivers - Firmware Reference Manual

Publication Number: OM-20000129
Revision Level: 1A
Revision Date: 2011/07/30

This manual reflects firmware version 6.100.

Proprietary Notice

Information in this document is subject to change without notice and does not represent a commitment on the part of NovAtel Inc. The software described in this document is furnished under a license agreement or non-disclosure agreement. The software may be used or copied only in accordance with the terms of the agreement. It is against the law to copy the software on any medium except as specifically allowed in the license or non-disclosure agreement.

No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose without the express written permission of a duly authorized representative of NovAtel Inc.

The information contained within this manual is believed to be true and correct at the time of publication.

The information contained within this manual is believed to be true and correct at the time of publication.

ALIGN, GL1DE, NovAtel and RT-20 are registered trademarks of NovAtel Inc.

OEM6, RT-2 are trademarks of NovAtel Inc.

All other brand names are trademarks of their respective holders.

Manufactured and protected under U.S. patents:

#5,101,416
#5,390,207
#5,495,499
#5,809,064
#5,414,729
#5,736,961
#6,243,409 B1
#6,184,822 B1
#6,211,821 B1
#6,608,998 B1
#6,664,923 B1
#6,922,167 B2
#7,738,606 B2

© Copyright 2011 NovAtel Inc. All rights reserved. Unpublished rights reserved under International copyright laws. Printed in Canada on recycled paper. Recyclable.

Table of Contents

Foreword 17

1 Messages 19

1.1 Message Types ... 19
1.1.1 ASCII ... 21
1.1.2 Abbreviated ASCII ... 23
1.1.3 Binary ... 23
1.2 Responses ... 29
1.2.1 Abbreviated Response ... 29
1.2.2 ASCII Response ... 29
1.2.3 Binary Response ... 29
1.3 GLONASS Slot and Frequency Numbers ... 31
1.4 GPS Reference Time Status ... 32
1.5 Message Time Stamps ... 34
1.6 Decoding of the GPS Reference Week Number ... 34
1.7 32-Bit CRC ... 35

2 Commands 38

2.1 Command Formats ... 38
2.2 Command Settings ... 38
2.3 Commands by Function ... 39
2.4 Factory Defaults ... 55
2.5 Command Reference ... 55
2.5.1 ADJUST1PPS Adjusts the receiver clock ... 56
2.5.2 ALIGNAUTOMATION to configure ALIGN Plug and Play Feature ... 62
2.5.3 ANTENNAMODEL Enters/changes rover antenna model ... 63
2.5.4 ANTENNAPOWER Controls power to the antenna ... 65
2.5.5 APPLICATION ... 66
2.5.6 ASSIGN Assigns a channel to a PRN ... 67
2.5.7 ASSIGNALL Assigns all channels to a PRN ... 70
2.5.8 ASSIGNLBAND Sets L-band satellite communication parameters ... 73
2.5.9 ASSIGNLBAND2 Sets L-band satellite communication parameters ... 76
2.5.10 AUTH Adds authorization code for new model ... 78
2.5.11 BASEANTENNAMODEL Enters/changes base antenna model ... 80
2.5.12 CLOCKADJUST Enables clock adjustments ... 82
2.5.13 CLOCKCALIBRATE Adjusts clock steering parameters ... 84
2.5.14 CLOCKOFFSET Adjusts for delay in 1PPS output ... 88
2.5.15 CNOUPDATE Sets the C/No update rate and resolution ... 89
2.5.16 COM Configures the COM port ... 90
2.5.17 COMCONTROL Controls the RS232 hardware control lines ... 91

2.5.18 DATUM Chooses a datum name type 94
2.5.19 DGPSEPHEMDELAY Sets DGPS ephemeris delay 101
2.5.20 DGPSTIMEOUT Sets maximum age of differential data 102
2.5.21 DGPSTXID Sets DGPS station ID 103
2.5.22 DIFFCODEBIASCONTROL Enables or disables satellite differential code biases 104
2.5.23 DLLTIMECONST Sets carrier smoothing 105
2.5.24 DNSCONFIG Manually configures DNS servers 109
2.5.25 DYNAMICS Tunes receiver parameters 110
2.5.26 ECHO Sets port echo 112
2.5.27 ECUTOFF Sets satellite elevation cut-off for GPS Satellites 113
2.5.28 ETHCONFIG Configures Ethernet physical layer 115
2.5.29 EXTERNALCLOCK Sets external clock parameters 116
2.5.30 FIX Constrains to fixed height or position 120
2.5.31 FIXPOSDATUM Sets position in a specified datum 124
2.5.32 FORCEGLOL2CODE Forces receiver to track GLONASS satellite L2 P or L2 C/A code 125
2.5.33 FORCEGPSL2CODE Forces receiver to track GPS satellite L2 P or L2C code 126
2.5.34 FREQUENCYOUT Sets output pulse train available on VARF 127
2.5.35 FRESET Clears selected data from NVM and reset 130
2.5.36 GALECUTOFF Sets elevation cut-off angle for Galileo satellites 132
2.5.37 GENERATEALIGNCORRECTIONS to Configure ALIGN Master 133
2.5.38 GENERATEDIFFCORRECTIONS Sends a preconfigured set of differential corrections 134
2.5.39 GENERATERTKCORRECTIONS Sends a preconfigured set of RTK corrections 135
2.5.40 GGAQUALITY Customizes the GPGGA GPS quality indicator 136
2.5.41 GLOECUTOFF Sets GLONASS satellite elevation cut-off 138
2.5.42 HDTOUTTHRESHOLD Controls GPHDT log output 139
2.5.43 HEADINGOFFSET Adds heading and pitch offset values 140
2.5.44 HPSEED Specifies the initial OmniSTAR HP/XP position 141
2.5.45 HPSTATICINIT Sets OmniSTAR HP/XP static initialization 144
2.5.46 ICOMCONFIG Configures IP virtual COM port 145
2.5.47 INTERFACEMODE Sets receive or transmit modes for ports 147
2.5.48 IONOCONDITION Sets ionospheric condition 152
2.5.49 IPCONFIG Configures network IP settings 153
2.5.50 LOCALIZEDCORRECTIONDATUM Sets a Local Datum 154
2.5.51 LOCKOUT Prevents the receiver from using a satellite 156
2.5.52 LOCKOUTSYSTEM Prevents the receiver from using a system 157
2.5.53 LOG Requests logs from the receiver 158
2.5.54 MAGVAR Sets a magnetic variation correction 163
2.5.55 MARKCONTROL Controls processing of mark inputs 166

2.5.56 MODEL Switches to a previously authorized model 168
2.5.57 MOVINGBASESTATION Enables the use of a moving base station ... 169
2.5.58 NMEATALKER Sets the NMEA talker ID 171
2.5.59 NTRIPCONFIG Configures NTRIP 173
2.5.60 NTRIPSOURCETABLE Set NTRIPCASTER ENDPONTS 175
2.5.61 NVMRESTORE Restores NVM data after an NVM failure 176
2.5.62 OMNIUSEGLONASS Enbales/disables GLONASS in OmniStar 177
2.5.63 PDPFILTER Enables, disables or resets the PDP filter 178
2.5.64 PDPMODE Selects the PDP mode and dynamics 179
2.5.65 POSAVE Implements base station position averaging 180
2.5.66 POSTIMEOUT Sets the position time out 181
2.5.67 PPSCONTROL Controls the PPS output 182
2.5.68 PSRDIFFSOURCE Sets the pseudorange correction source 184
2.5.69 QZSSECUTOFF Sets QZSS Satellite Elevation Cutoff 187
2.5.70 RAIMMODE Configures RAIM mode 188
2.5.71 RESET Performs a hardware reset 190
2.5.72 RTKANTENNA Specifies L1 phase center (PC) or ARP and enables/disables PC modeling 191
2.5.73 RTKCOMMAND Resets or sets the RTK filter to its defaults 193
2.5.74 RTKDYNAMICS Sets the RTK dynamics mode 194
2.5.75 RTKELEVMASK Sets the RTK elevation mask 195
2.5.76 RTKNETWORK Specifies the RTK network mode 196
2.5.77 RTKQUALITYLEVEL Sets an RTK quality mode 199
2.5.78 RTKSOURCE Sets the RTK correction source 200
2.5.79 RTKSVENTRIES Sets number of satellites in corrections 202
2.5.80 RTKTIMEOUT Sets maximum age of RTK data 203
2.5.81 SAVECONFIG Save scurrent configuration in NVM 204
2.5.82 SBASCONTROL Sets SBAS test mode and PRN 205
2.5.83 SBASECUTOFF Sets SBAS satellite elevation cut-off 207
2.5.84 SELECTCHANCONFIG Sets the channel configuration 208
2.5.85 SEND Sends an ASCII message to a COM port 209
2.5.86 SENDHEX Send snon-printable characters in hex pairs 211
2.5.87 SERIALCONFIG Configures serial port settings 212
2.5.88 SETAPPROXPOS Sets an approximate position 216
2.5.89 SETAPPROXTIME Sets an approximate GPS reference time 217
2.5.90 SETBESTPOSCRITERIA Sets selection criteria for BESTPOS 219
2.5.91 SETCANNAME Sets the CAN name fields 220
2.5.92 SETDIFFCODEBIASES Sets satellite differential code biases 221
2.5.93 SETIONOTYPE Enables ionospheric models 222
2.5.94 SETNAV Sets start and destination waypoints 223
2.5.95 SETROVERID to Set ID for ALIGN Rovers 225
2.5.96 SETRTCM16 Enters ASCII text for RTCM data stream 226

2.5.97 SETRTCM36 Enters ASCII text with Russian characters 227
2.5.98 SETRTCMRXVERSION Sets the RTCM message standard..... 229
2.5.99 SETRTCMTXVERSION Sets the RTCM transmission standard 230
2.5.100 SETTIMEBASE Sets primary and backup systems for time base. 231
2.5.101 SETUTCLEAPSECONDS Sets future leap seconds 232
2.5.102 SOFTLOADCOMMIT Commits to the softload module..... 233
2.5.103 SOFTLOADDATA Uploads data for soft load 234
2.5.104 SOFTLOADRESET Restarts soft load process 235
2.5.105 SOFTLOADSETUP Configures the soft load process 236
2.5.106 SOFTLOADSREC Configures soft load process 237
2.5.107 STATUSCONFIG Configures RXSTATUSEVENT mask fields..... 238
2.5.108 TRACKSV Tracking Satellite 240
2.5.109 TUNNELESCAPE Breaks out of an established tunnel 241
2.5.110 UNASSIGN Unassigns a previously assigned channel..... 243
2.5.111 UNASSIGNALL Unassigns all previously assigned channels..... 244
2.5.112 UNDULATION Chooses undulation 245
2.5.113 UNLOCKOUT Reinstates a satellite in the solution 247
2.5.114 UNLOCKOUTALL Reinstates all previously locked out satellites 248
2.5.115 UNLOCKOUTSYSTEM Reinstates previously locked out system 249
2.5.116 UNLOG Removes a log from logging control 250
2.5.117 UNLOGALL Removes all logs from logging control 252
2.5.118 USERDATUM Sets user-customized datum 253
2.5.119 USEREXPDATUM Sets custom expanded datum..... 255
2.5.120 UTMZONE Sets UTM parameters 257
2.5.121 WAASTIMEOUT Sets the WAAS position time out..... 259
3 Data Logs 260
3.1 Log Types..... 260
3.1.1 Log Type Examples 261
3.2 Logs by Function 261
3.3 Log Reference..... 288
3.3.1 ALIGNBSLNENU ENU Baselines using ALIGN 288
3.3.2 ALIGNBSLNXYZ XYZ Baselines using ALIGN 290
3.3.3 ALIGNDOP Calculated DOP Values 292
3.3.4 ALMANAC Decoded Almanac..... 293
3.3.5 APPLICATIONSTATUS Application status information 295
3.3.6 AUTHCODES 296
3.3.7 AVEPOS Position Averaging..... 297
3.3.8 BESTPOS Best Position 299
3.3.9 BESTSATS Satellites used in BESTPOS 305
3.3.10 BESTUTM Best Available UTM Data 308
3.3.11 BESTVEL Best Available Velocity Data 310
3.3.12 BESTXYZ Best Available Cartesian Position and Velocity..... 313

3.3.13 BSLNXYZ RTK XYZ Baseline 316
3.3.14 CHANCONFIGLIST Channel configuration list 318
3.3.15 CLOCKMODEL Current Clock Model Status 320
3.3.16 CLOCKSTEERING Clock Steering Status 323
3.3.17 CMR Standard Logs 326
3.3.18 CMRDATADESC Base Station Description 329
3.3.19 CMRDATAGLOOBS CMR Data GLONASS Observations 331
3.3.20 CMRDATAOBS Base Station Satellite Observations 334
3.3.21 CMRDATAREF Base Station Position 337
3.3.22 CMRPLUS CMR+ Output Message 339
3.3.23 COMCONFIG 341
3.3.24 DIFFCODEBIASES Differential code biases being applied 342
3.3.25 ETHSTATUS Current Ethernet status 343
3.3.26 GLMLA NMEA GLONASS Almanac Data 344
3.3.27 GLOALMANAC Decoded Almanac 346
3.3.28 GLOCLOCK GLONASS Clock Information 348
3.3.29 GLOEPHEMERIS GLONASS Ephemeris Data 350
3.3.30 GLORAWALM Raw GLONASS Almanac Data 354
3.3.31 GLORAWEPHEM Raw GLONASS Ephemeris Data 356
3.3.32 GLORAWFRAME Raw GLONASS Frame Data 358
3.3.33 GLORAWSTRING Raw GLONASS String 359
3.3.34 GPALM Almanac Data 360
3.3.35 GPGGA GPS Fix Data and Undulation 362
3.3.36 GPGGALONG Fix Data, Extra Precision and Undulation 364
3.3.37 GPGGARTK Global Position System Fix Data 366
3.3.38 GPGLL Geographic Position 368
3.3.39 GPGRS GPS Range Residuals for Each Satellite 370
3.3.40 GPGSA GPS DOP and Active Satellites 372
3.3.41 GPGST Pseudorange Measurement Noise Statistics 374
3.3.42 GPGSV GPS Satellites in View 376
3.3.43 GPHDT NMEA Heading Log 378
3.3.44 GPRMB Navigation Information 379
3.3.45 GPRMC GPS Specific Information 381
3.3.46 GPSEPHEM Decoded GPS Ephemerides 383
3.3.47 GPVTG Track Made Good And Ground Speed 387
3.3.48 GPZDA UTC Time and Date 388
3.3.49 HEADING Heading Information 389
3.3.50 HEADING2 Heading information with multiple rovers 391
3.3.51 HEADINGSATS Heading information with multiple rovers 393
3.3.52 HWMONITOR Monitor Hardware Levels 394
3.3.53 IONUTC Ionospheric and UTC Data 397
3.3.54 IPSTATUS Current network configuration status 399

3.3.55 LBANDINFO L-band Configuration Information 400
3.3.56 LBANDSTAT L-band Status Information 404
3.3.57 LOGLIST List of System Logs 410
3.3.58 MARKPOS, MARK2POS Position at Time of Mark Input Event 413
3.3.59 MARKTIME, MARK2TIME Time of Mark Input Event 415
3.3.60 MASTERPOS Master Position using ALIGN 417
3.3.61 MATCHEDPOS Matched RTK Position 419
3.3.62 MATCHEDSATS Satellites used in MATCHEDPOS solution 421
3.3.63 MATCHEDXYZ Matched RTK Cartesian Position 422
3.3.64 NAVIGATE User Navigation Data 424
3.3.65 NMEA Standard Logs 427
3.3.66 OMNIHPPOS OmniSTAR HP/XP Position 429
3.3.67 OMNIHPSATS Satellites used in the OMNIHPPOS solution 431
3.3.68 OMNIVIS Omnistar Satellite Visibility List 432
3.3.69 PASSCOM, PASSXCOM, PASSAUX, PASSUSB, PASSETH1, PASSICOM, PASSNCOM Redirects Data 434
3.3.70 PASSTHROUGH Re-directed data from All Ports 439
3.3.71 PDPPOS PDP filter position 440
3.3.72 PDPSATS Satellites used in PDPPOS solution 441
3.3.73 PDPVEL PDP filter velocity 442
3.3.74 PDPXYZ PDP filter Cartesian position and velocity 443
3.3.75 PORTSTATS Port Statistics 445
3.3.76 PSRDOP Pseudorange DOP 447
3.3.77 PSRDOP2 Pseudorange DOP 449
3.3.78 PSRPOS Pseudorange Position 450
3.3.79 PSRSATS Satellites used in PSRPOS solution 452
3.3.80 PSRTIME Time Offsets from the Pseudorange Filter 453
3.3.81 PSRVEL Pseudorange Velocity 454
3.3.82 PSRXYZ Pseudorange Cartesian Position and Velocity 456
3.3.83 QZSSALMANAC Decoded Almanac Parameters 458
3.3.84 QZSSEPHEMERIS Displays Decoded Parameters 460
3.3.85 QZSSRAWALMANAC Raw QZSS Almanac Data 462
3.3.86 QZSSIONUTC Japan-specific and Time Information 463
3.3.87 QZSSRAWEPHEM QZSS Raw Ephermis Information 464
3.3.88 QZSSRAWSUBFRAME Raw QZSS Subframe Data 465
3.3.89 RAIMSTATUS RAIM status 466
3.3.90 RANGE Satellite Range Information 468
3.3.91 RANGECMP Compressed Version of the RANGE Log 473
3.3.92 RANGEGPSL1 L1 Version of the RANGE Log 476
3.3.93 RAWALM Raw Almanac Data 478
3.3.94 RAWCNAVFRAME Raw L2C frame data 480
3.3.95 RAWEPHEM Raw Ephemeris 481

3.3.96 RAWGPSSUBFRAME Raw Subframe Data....483
3.3.97 RAWGPSWORD Raw Navigation Word....484
3.3.98 RAWLBANDFRAME Raw L-band Frame Data....485
3.3.99 RAWLBANDPACKET Raw L-band Data Packet....487
3.3.100 RAWSBASFRAME Raw SBAS Frame Data....488
3.3.101 REFSTATION Base station position and health....489
3.3.102 REFSTATIONINFO Base Station Position Information....491
3.3.103 ROVERPOS Position using ALIGN....492
3.3.104 RTCA Standard Logs....494
3.3.105 RTCADATA1 Differential GPS Corrections....496
3.3.106 RTCADATAEPHEM Ephemeris and Time Information....499
3.3.107 RTCADATAOBS Base Station Observations....501
3.3.108 RTCADATA2OBS Base Station Observations 2....503
3.3.109 RTCADATAREF Base Station parameters....505
3.3.110 RTCAOBS3 Message for ALIGN....507
3.3.111 RTCM Standard Logs....508
3.3.112 RTCMDATA1 Differential GPS Corrections....512
3.3.113 RTCMDATA3 Base Station parameters....514
3.3.114 RTCMDATA9 Partial Differential GPS Corrections....516
3.3.115 RTCMDATA15 Ionospheric Corrections....517
3.3.116 RTCMDATA16 Special Message....519
3.3.117 RTCMDATA1819 Raw Measurements....521
3.3.118 RTCMDATA2021 Measurement Corrections....527
3.3.119 RTCMDATA22 Extended Base Station....531
3.3.120 RTCMDATA22GG Extended Base Station for GLONASS....533
3.3.121 RTCMDATA23 Antenna Type Definition....535
3.3.122 RTCMDATA24 Antenna Reference Point (ARP)....537
3.3.123 RTCMDATA31 GLONASS Differential Corrections....539
3.3.124 RTCMDATA32 GLONASS Base Station parameters....541
3.3.125 RTCMDATA36 Special Message....542
3.3.126 RTCMDATA59 Type 59N-0 NovAtel RT20....544
3.3.127 RTCMDATA59GLO NovAtel Proprietary GLONASS Differential Corrections....546
3.3.128 RTCMDATAOMNI1 RTCM1 from OmniSTAR VBS....548
3.3.129 RTCMV3 RTCMV3 Standard Logs....550
3.3.130 RTCMDATA1001 L1-Only GPS RTK Observables....554
3.3.131 RTCMDATA1002 Extended L1-Only GPS RTK Observables....558
3.3.132 RTCMDATA1003 L1/L2 GPS RTK Observables....560
3.3.133 RTCMDATA1004 Expanded L1/L2 GPS RTK Observables....562
3.3.134 RTCMDATA1005 Base Station Antenna Reference Point (ARP)....565
3.3.135 RTCMDATA1006 Base Station ARP with Antenna Height....567
3.3.136 RTCMDATA1007 Extended Antenna Descriptor and Setup Information..

569
3.3.137 RTCMDATA1008 Extended Antenna Descriptor and Setup Information . 571
3.3.138 RTCMDATA1009 GLONASS L1-Only RTK 573
3.3.139 RTCMDATA1010 Extended L1-Only GLONASS RTK 576
3.3.140 RTCMDATA1011 GLONASS L1/L2 RTK 578
3.3.141 RTCMDATA1012 Extended GLONASS L1/L2 RTK 580
3.3.142 RTCMDATA1019 GPS Ephemeris 583
3.3.143 RTCMDATA1020 GLONASS Ephemeris 586
3.3.144 RTCMDATA1033 Receiver and antenna descriptors 591
3.3.145 RTKDATA RTK Solution parameters 592
3.3.146 RTKDOP DOP Values from the RTK Fast Filter 596
3.3.147 RTKDOP2 DOP Values from the RTK Fast Filter 597
3.3.148 RTKPOS RTK Low Latency Position Data 598
3.3.149 RTKSATS Satellites used in RTKPOS solution 600
3.3.150 RTKVEL RTK Velocity 601
3.3.151 RTKXYZ RTK Cartesian Position and Velocity 603
3.3.152 RXCONFIG Receiver Configuration 605
3.3.153 RXHWLEVELS Receiver Hardware Levels 607
3.3.154 RXSTATUS Receiver Status 609
3.3.155 RXSTATUSEVENT Status Event Indicator 617
3.3.156 SATVIS Satellite Visibility 619
3.3.157 SATVIS2 Satellite Visibility 621
3.3.158 SATXYZ Satellite Positions in ECEF Cartesian Coordinates 623
3.3.159 SBAS0 Do Not Use for Safety Applications 625
3.3.160 SBAS1 PRN Mask Assignments 626
3.3.161 SBAS2 Fast Correction Slots 0-12 627
3.3.162 SBAS3 Fast Corrections Slots 13-25 630
3.3.163 SBAS4 Fast Correction Slots 26-38 632
3.3.164 SBAS5 Fast Correction Slots 39-50 634
3.3.165 SBAS6 Integrity Message 636
3.3.166 SBAS7 Fast Correction Degradation 639
3.3.167 SBAS9 GEO Navigation Message 642
3.3.168 SBAS10 Degradation Factor 644
3.3.169 SBAS12 SBAS Network Time and UTC 646
3.3.170 SBAS17 GEO Almanac Message 647
3.3.171 SBAS18 IGP Mask 649
3.3.172 SBAS24 Mixed Fast/Slow Corrections 650
3.3.173 SBAS25 Long-Term Slow Satellite Corrections 652
3.3.174 SBAS26 Ionospheric Delay Corrections 655
3.3.175 SBAS27 SBAS Service Message 656
3.3.176 SBAS32 Fast Correction Slots 0-10 657

3.3.177 SBAS33 Fast Correction Slots 11-21 659
3.3.178 SBAS34 Fast Correction Slots 22-32 661
3.3.179 SBAS35 Fast Correction Slots 33-43 663
3.3.180 SBAS45 Slow Corrections 665
3.3.181 SBASCORR SBAS Range Corrections Used 667
3.3.182 SOFTLOADSTATUS Status of the soft load process 669
3.3.183 SOURCETABLE NTRIP Sourcetable Entries 671
3.3.184 TIME Time Data 673
3.3.185 TIMESYNC Synchronize Time Between GNSS receivers 676
3.3.186 TRACKSTAT Tracking Status 677
3.3.187 VALIDMODELS Valid Model Information 680
3.3.188 VERSION Version Information 681

4 Responses **684**

Index 686

Tables

1 Field Types 19
2 Byte Arrangements 20
3 ASCII Message Header Structure 22
4 Binary Message Header Structure 24
5 Detailed Port Identifier 26
6 Binary Message Response Structure 30
7 Binary Message Sequence 31
8 GPS Reference Time Status 32
9 OEM6 Commands Sorted by Function 39
10 OEM6 Commands in Alphabetical Order 44
11 OEM6 Commands in Numerical Orderr 49
12 Channel State 67
13 Channel System 70
14 L-band Mode 74
15 Tx, DTR and RTS Availability 92
16 Reference Ellipsoid Constants 95
17 Datum Transformation Parameters 96
18 Signal Type 107
19 User Dynamics 110
20 Clock Type 118
21 Pre-Defined Values for Oscillators 118
22 FIX Parameters 121
23 Fix Types 122
24 GLONASS L2 Code Type. 125
25 GPS L2 Code Type. 126
26 FRESET Target 131
27 Seeding Mode 143
28 Serial Port Interface Modes 149
29 Satellite System 157
30 NMEA Talkers 172
31 DGPS Type 186
32 RAIM Mode Types 189
33 Dynamics Mode 194
34 Network RTK Mode 197
35 RTK Quality Mode 199
36 System Types 206
37 COM Port Identifiers 214
38 Parity 215
39 Handshaking 215
40 Selection Type 219
41 Ionospheric Correction Models 222
42 Russian Alphabet Characters (Ch) in Decimal (Dec) and Hexadecimal (Hex) 228
43 System used for timing 231
44 Available Set up Commands 236

45 Mask Types 239
46 TrackSV Command System 240
47 TrackSV Command Condition 240
48 UTM Zone Commands 258
49 SBAS Time Out Mode 259
50 Log Type Triggers 260
51 OEM6 Logs By Function 262
52 OEM6 Logs in Alphabetical Order 271
53 OEM6 Logs in Numerical Order 278
54 Position Averaging Status 297
55 Position or Velocity Type 301
56 Solution Status 302
57 BESTPOS Signal-Used Mask 303
58 Extended Solution Status 303
59 Observation Status 306
60 BESTSATS GPS Signal Mask 307
61 BESTSATS GLONASS Signal Mask 307
62 BESTSATS Galileo Signal Mask 307
63 CHANCONFIGLIST Signal Type 319
64 Clock Model Status 320
65 Clock Source 323
66 Steering State 324
67 Position Accuracy 337
68 Kp UTC Leap Second Descriptions 349
69 GLONASS Ephemeris Flags Coding 351
70 Bits 0 - 1: P1 Flag Range Values 351
71 Position Precision of NMEA Logs 368
72 NMEA Positioning System Mode Indicator 379
73 URA Variance 384
74 HWMONITOR Status Table 396
75 L-band Subscription Type 400
76 HP Subscription Mode 403
77 L-band Signal Tracking Status 405
78 OmniSTAR VBS Status Word 406
79 OmniSTAR HP/XP Additional Status Word 407
80 OmniSTAR HP/XP Status Word 408
81 Navigation Data Type 424
82 Integrity Status 467
83 PL Status 467
84 Tracking State 469
85 Correlator Type 470
86 Channel Tracking Example 470
87 Channel Tracking Status 470
88 Range Record Format (RANGECMP only) 474
89 Base Station Status 489
90 Station Type 489
91 RTCAOBS2 Satellite Type Offsets 503
92 RTCM1819 Data Quality Indicator 523

93 RTCM1819 Smoothing Interval 523
94 RTCM1819 Multipath Indicator 524
95 RTCM2021 Data Quality Indicator 528
96 RTCM2021 Multipath Indicator 528
97 SBAS PRN Codes 554
98 Carrier Smoothing Interval of Code Phase 555
99 Lock Time Indicator 555
100 GLONASS L1 and L2 Frequencies 574
101 SV Accuracy 583
102 GLONASS Ephemeris Word P1 586
103 M-Satellite User Range AccuracyC 586
104 Searcher Type 594
105 Ambiguity Type 594
106 RTK Information 594
107 Receiver Hardware parameters 607
108 Receiver Error 610
109 Receiver Status 611
110 Auxiliary 1 Status 613
111 Auxiliary 2 Status 614
112 Auxiliary 3 Status 614
113 Status Word 618
114 Event Type 618
115 Evaluation of UDREI 628
116 Evaluation of UDREI 657
117 Range Reject Code 678
118 Component Types 682
119 VERSION Log: Field Formats 682
120 Response Messages 684

Figures

1 1PPS Alignment 57
2 ADJUST1PPS Connections 59
3 Pulse Width and 1PPS Coherency 128
4 Illustration of Magnetic Variation & Correction 164
5 TTL Pulse Polarity 166
6 Moving Base Station ‘Daisy Chain’ Effect 170
7 Using the SEND Command 209
8 Illustration of SETNAV Parameters 223
9 Illustration of Undulation 245
10 The WGS84 ECEF Coordinate System 315
11 Navigation parameters 424
12 Pass-Through Log Data 437

Customer Support

NovAtel Knowledge Base

If you have a technical issue, visit the NovAtel Support page at http://www.novatel.com/support/welcome-to-novatel-support/.Through the *Support* page, you can access Customer Support's Helpdesk and Solutions, find papers and tutorials or download current manuals.

Before Contacting Customer Support

Before you contact NovAtel Customer Support about a software problem, perform the following steps:

1. Log the following data to a file on your computer for 15 minutes:

   RXSTATUSB once
   RAWEPHEMB onchanged
   RANGEB ontime 1
   BESTPOSB ontime 1
   RXCONFIGA once
   VERSIONB once

2. Send the log to NovAtel Customer Support using either the NovAtel ftp site at ftp://ftp.novatel.ca/incoming or the support@novatel.com e-mail address.
3. You can also issue a FRESET command to the receiver to clear any unknown settings.

> The FRESET command will erase all user settings. You should know your configuration and be able to reconfigure the receiver before you send the FRESET command.

If you are having a hardware problem, send a list of the troubleshooting steps taken and the results.

Contact Information

Use one of the following methods to contact NovAtel Customer Support:

Call the NovAtel Hotline at 1-800-NOVATEL (U.S. and Canada) or +1-403-295-4900 (international)	
Fax: +1-403-295-4901 E-mail: support@novatel.ca Website: http://www.novatel.com	Write: NovAtel Inc. Customer Support Department 1120 - 68 Avenue NE Calgary, AB Canada, T2E 8S5

Foreword

About this Manual

Thank you for purchasing your NovAtel product. Your receiver includes companion documents to this manual with informaiton on the hardware operatiol. Afterwards, this document will be your primary NovAtel product command and logging reference guide.

This manual describes each command and log the OEM6 family of receivers are capable of accepting or generating. Sufficient detail is provided so you can understand the purpose, syntax and structure of each command or log. You will also be able to effectively communicate with the receiver, enabling you to effectively use and write custom interfacing software for specific needs and applications.

Related Documents and Information

OEM6 products include the following:

- Satellite Based Augmentation System (SBAS) signal functionality
- Support for all current and upcoming GNSS constellations
- L-band capability including OmniSTAR
- National Marine Electronics Association (NMEA) standards, a protocol used by GNSS receivers to transmit data
- Differential Global Positioning System (DGPS)
- Real Time Kinematic (RTK)

For more information on these components, please refer the Support page on our website at www.novatel.com. For introductory information on GNSS technology, refer to our *An Introduction to GNSS* book found at http://www.novatel.com/support/knowledge-and-learning/published-papers-and-documents/gnss-book/.

This manual does not address any of the receiver hardware attributes or installation information. Please consult the *OEM6 Family Installation and Operation User Manual* for in formation about these topics. Furthermore, should you encounter any functional, operational or interfacing difficulties with the receiver, consult the same manual for NovAtel warranty and support information.

Conventions

The following conventions have been used in this manual.

	Note that provides information to supplement or clarify the accompanying text.
	Caution that a certain action, operation or configuration may result in incorrect or improper use of the product.
	Warning that a certain action, operation or configuration may result in regulatory noncompliance, safety issues or equipment damage.

Command Defaults and Structure

- The factory defaults for commands are shown in *Section 2.4, Factory Defaults* on *page 55*. Each factory default is also shown after the syntax but before the example of each command description starting on *page 57*.
- The letter H in the Binary Byte or Binary Offset columns of the commands and logs tables represents the header length for that command or log, see *Section 1.1.3, Binary* on *page 23*.
- The number following 0x is a hexadecimal number.
- Default values shown in command tables indicate the assumed values when optional parameters have been omitted. Default values do not imply the factory default settings, see *Chapter 2, page 55* for a list of factory default settings.
- Command descriptions' brackets, [ ], represent optional parameters.
- In tables where values are missing they are assumed to be reserved for future use.
- Status words in ASCII logs are output as hexadecimal numbers and must be converted to binary format (and in some cases then also to decimal). For an example of this type of conversion, please see the RANGE log, *Table 86* on *page 470*.
- Conversions and their binary or decimal results are always read from right to left. For a complete list of hexadecimal, binary and decimal equivalents, please refer to the *Unit Conversion* information available on our website at: http://www.novatel.com/support/knowledge-and-learning/.
- ASCII log examples may be split over several lines for readability. In reality, only a single [CR][LF] pair is transmitted at the end of an ASCII log.

You can download the most up-to-date version of this manual along with any addendums from the http://www.novatel.com/support/knowledge-and-learning/ section of the NovAtel website at www.novatel.com.

Prerequisites

As this reference manual is focused on the OEM6 family commands and logging protocol, it is necessary to ensure the receiver has been properly installed and powered up according to the instructions outlined in the companion *OEM6 Family Installation and Operation User Manual* before proceeding.

Chapter 1 Message

1.1 Message Types

The receiver handles incoming and outgoing NovAtel data in three different message formats: Abbreviated ASCII, ASCII, and Binary. This allows for a great deal of versatility in the way the OEM6 family of receivers can be used. All NovAtel commands and logs can be entered, transmitted, output or received in any of the three formats. The receiver also supports RTCA, RTCMV3, RTCM, CMR, CMRPLUS and NMEA format messaging. For more information about message logs, refer to the contents of Chapters 2 and 3.

When entering an ASCII or abbreviated ASCII command in order to request an output log, the message type is indicated by the character appended to the end of the message name. 'A' indicates the message is ASCII and 'B' indicates binary. No character means the message is Abbreviated ASCII. When issuing binary commands, the output message type is dependent on the bit format in the message's binary header (refer to *Binary* on *page 23)*.

Table 1 below, describes the field types used in the description of messages.

Table 1: Field Types

Type	Binary Size (bytes)	Description
Char	1	The **char** type is an 8-bit integer in the range -128 to +127. This integer value may be the ASCII code corresponding to the specified character. In ASCII or Abbreviated ASCII this comes out as an actual character.
UChar	1	The **uchar** type is an 8-bit unsigned integer. Values are in the range from +0 to +255. In ASCII or Abbreviated ASCII this comes out as a number.
Short	2	The short type is 16-bit integer in the range -32768 to +32767.
UShort	2	The same as Short except it is not signed. Values are in the range from +0 to +65535.
Long	4	The **long** type is 32-bit integer in the range -2147483648 to +2147483647.
ULong	4	The same as Long except it is not signed. Values are in the range from +0 to +4294967295.
Double	8	The **double** type contains 64-bits: 1 for sign, 11 for the exponent and 52 for the mantissa. Its range is ±1.7E308 with at least 15 digits of precision. This is IEEE 754.

Continued on next page

Type	Binary Size (bytes)	Description
Float	4	The **float** type contains 32-bits: 1 for the sign, 8 for the exponent and 23 for the mantissa. Its range is ±3.4E38 with at least 7 digits of precision. This is IEEE 754.
Enum	4	A 4-byte enumerated type beginning at zero (an unsigned long). In binary, the enumerated value is output. In ASCII or Abbreviated ASCII, the enumeration label is spelled out.
GPSec	4	This type has two separate formats dependant on whether you requested a binary or an ASCII format output. For binary, the output is in milliseconds and is a **long** type. For ASCII, the output is in seconds and is a **float** type.
Hex	n	Hex is a packed, fixed length (n) array of bytes in binary but in ASCII or Abbreviated ASCII is converted into 2 character hexadecimal pairs.
String	n	String is a variable length array of bytes that is null-terminated in the binary case and additional bytes of padding are added to maintain 4-byte alignment. The maximum byte length for each String field is shown in the row in the log or command tables.

Table 2: Byte Arrangements

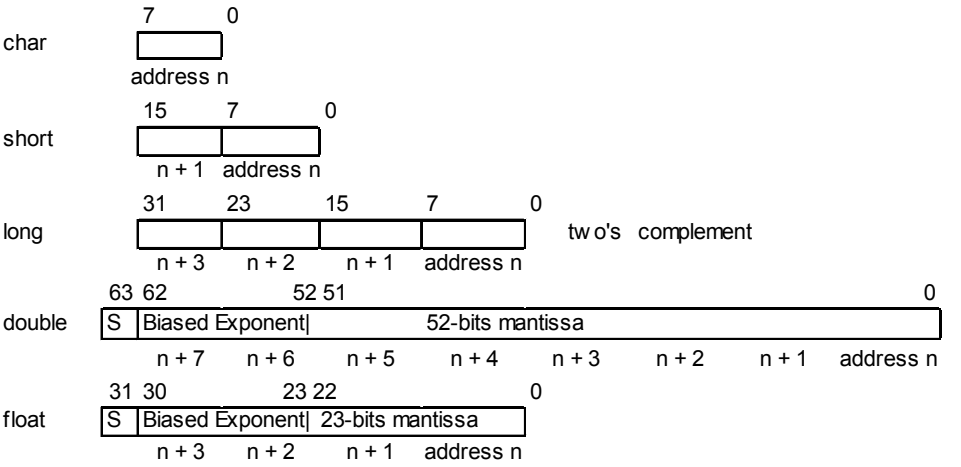


Table 2 shows the arrangement of bytes, within each field type, when used by IBM PC computers. All data sent to or from the OEM6 family of receivers, however, is read least significant bit (LSB) first, opposite to what is shown in _Table 2_. Data is then stored in the receiver LSB first. For example, in char type data, the LSB is bit 0 and the most significant bit (MSB) is bit 7. See _Table 86, Channel Tracking Example_ on _page 470_ for a more detailed example.

1.1.1 ASCII

ASCII messages are readable by both the user and a computer. The structures of all ASCII messages follow the general conventions as noted here:

1. The lead code identifier for each record is '#'.
2. Each log or command is of variable length depending on amount of data and formats.
3. All data fields are delimited by a comma ',' with two exceptions:
   - The first exception is the last header field which is followed by a ';' to denote the start of the data message.
   - The second exception is the last data field, which is followed by a * to indicate end of message data.
4. Each log ends with a hexadecimal number preceded by an asterisk and followed by a line termination using the carriage return and line feed characters.
   For example:
   *1234ABCD[CR][LF]. This value is a 32-bit CRC of all bytes in the log, excluding the '#' identifier and the asterisk preceding the four checksum digits.
   See _1.7, 32-Bit CRC_ on _page 35_ for the algorithm used to generate the CRC.
5. An ASCII string is one field and is surrounded by double quotation marks.
   For example:
   "ASCII string". If separators are surrounded by quotation marks then the string is still one field and the separator will be ignored (example, "xxx,xxx" is one field). Double quotation marks within a string are not allowed.
6. If the receiver detects an error parsing an input message, it returns an error response message. Please see _Chapter 4, Responses_ on _page 684_ for a list of response messages from the receiver.

Message Structure:

header;	data field...,	data field...,	data field...	*xxxxxxxx	[CR][LF]

The ASCII message header structure is described in _Table 3_ on the next page.

Table 3: ASCII Message Header Structure

Field #	Field Name	Field Type	Description	Ignored on Input
1	Sync	Char	Sync character. The ASCII message is always preceded by a single '#' symbol.	N
2	Message	Char	The ASCII name of the log or command (lists are in *Table 10, page 44* and *Table 51, page 262*).	N
3	Port	Char	The name of the port from which the log was generated. The string is made up of the port name followed by an _x where x is a number from 1 to 31 denoting the virtual address of the port. If no virtual address is indicated, it is assumed to be address 0.	Y
4	Sequence #	Long	Used for multiple related logs. It is a number that counts down from N-1 to 0, where 0 means it is the last one of the set. Most logs only come out one at a time in which case this number is 0.	N
5	% Idle Time	Float	The minimum percentage of time the processor is idle, between successive logs, with the same Message ID.	Y
6	Time Status	Enum	The value indicates the quality of the GPS reference time (see *Table 8, GPS Reference Time Status* on *page 32*)	Y
7	Week	Ulong	GPS reference week number.	Y
8	Seconds	GPSec	Seconds from the beginning of the GPS reference week; accurate to the millisecond level.	Y
9	Receiver Status	Ulong	An eight digit hexadecimal number representing the status of various hardware and software components of the receiver, between successive logs, with the same Message ID (see *Table 109, Receiver Status* on *page 611*).	Y
10	Reserved	Ulong	Reserved for internal use.	Y
11	Receiver s/w Version	Ulong	A value (0 - 65535) representing the receiver software build number.	Y
12	;	Char	The character indicates the end of the header.	N

Example Log:

```
#RAWEPHEMA,COM1,0,35.0,SATTIME,1364,496230.000,00100000,97b7,2310;
30,1364,496800,8b0550a1892755100275e6a09382232523a9dc04ee6f794a0000090394ee,8b05
50a189aa6ff925386228f97eabf9c8047e34a70ec5a10e486e794a7a,8b0550a18a2effc2f80061c
2fffc267cd09f1d5034d3537affa28b6ff0eb*7a22f279
```

1.1.2 Abbreviated ASCII

This message format is designed to make the entering and viewing of commands and logs by the user as simple as possible. The data is represented as simple ASCII characters, separated by spaces or commas, and arranged in an easy to understand format. There is also no 32-bit CRC for error detection because it is meant for viewing by the user.

Example Command:

```
log com1 loglist
```

Resultant Log:

```
<LOGLIST COM1 0 69.0 FINE 0 0.000 00240000 206d 0
<     4
<           COM1 RXSTATUSEVENTA ONNEW 0.000000 0.000000 NOHOLD
<           COM2 RXSTATUSEVENTA ONNEW 0.000000 0.000000 NOHOLD
<           COM3 RXSTATUSEVENTA ONNEW 0.000000 0.000000 NOHOLD
<           COM1 LOGLIST ONCE 0.000000 0.000000 NOHOLD
```

As you can see, the array of 4 logs are offset from the left hand side and start with '<'.

1.1.3 Binary

Binary messages are meant strictly as a machine readable format. They are also ideal for applications where the amount of data transmitted is fairly high. Due to the inherent compactness of binary as opposed to ASCII data, messages are much smaller. The smaller message size allows a larger amount of data to be transmitted and received by the receiver's communication ports. The structure of all Binary messages follows the general conventions as noted here:

1. Basic format of:

Header	3 Sync bytes plus 25-bytes of header information. The header length is variable as fields may be appended in the future. Always check the header length.
Data	variable
CRC	4 bytes

2. The 3 Sync bytes will always be:

Byte	Hex	Decimal
First	AA	170
Second	44	68
Third	12	18

3. The CRC is a 32-bit CRC (see *1.7, 32-Bit CRC* on *page 35* for the CRC algorithm) performed on all data including the header.
4. The header is in the format shown in *Table 4, Binary Message Header Structure* on *page 24*.

Table 4: Binary Message Header Structure

Field #	Field Name	Field Type	Description	Binary Bytes	Binary Offset	Ignored on Input
1	Sync	Char	Hexadecimal 0xAA	1	0	N
2	Sync	Char	Hexadecimal 0x44	1	1	N
3	Sync	Char	Hexadecimal 0x12	1	2	N
4	Header Lgth	Uchar	Length of the header.	1	3	N
5	Message ID	Ushort	This is the Message ID number of the log (see the log descriptions in *Table 53, OEM6 Logs in Numerical Order* on *page 278* for the Message ID values of individual logs).	2	4	N
6	Message Type	Char	Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response bit (see *Section , page 29*) 0 = Original Message 1 = Response Message	1	6	N
7	Port Address	Uchar	See *Table* on *page 26* (decimal values >=32 may be used) (lower 8-bits only) [a]	1	7	N [b]
8	Message Length	Ushort	The length in bytes of the body of the message, not including the header nor the CRC.	2	8	N
9	Sequence	Ushort	Used for multiple related logs. It is a number that counts down from N-1 to 0 where N is the number of related logs and 0 means it is the last one of the set. Most logs only come out one at a time in which case this number is 0.	2	10	N

Continued on next page

Field #	Field Name	Field Type	Description	Binary Bytes	Binary Offset	Ignored on Input
10	Idle Time	Uchar	Time the processor is idle, in the last second between successive logs, with the same Message ID. Take the time (0 - 200) and divide by two to give the percentage of time (0 - 100%).	1	12	Y
11	Time Status	Enum	Indicates the quality of the GPS reference time (see *Table 8, GPS Reference Time Status* on *page 32*).	1 [c]	13	N [d]
12	Week	Ushort	GPS reference week number	2	14	N [d]
13	ms	GPSec	Milliseconds from the beginning of the GPS reference week.	4	16	N [d]
14	Receiver Status	Ulong	32-bits representing the status of various hardware and software components of the receiver, between successive logs, with the same Message ID (see *Table 109, Receiver Status* on *page 611*).	4	20	Y
15	Reserved	Ushort	Reserved for internal use	2	24	Y
16	Receiver S/W Version	Ushort	A value (0 - 65535) representing the receiver software build number.	2	26	Y

a. The 8-bit size means you will only see 0xA0 to 0xBF when the top bits are dropped from a port value greater than 8-bits. For example, ASCII port USB1 will be seen as 0xA0 in the binary output.

b. Recommended value is THISPORT (binary 192).

c. This ENUM is not 4-bytes long but, as indicated in the table, is only 1-byte.

d. These time fields are ignored if Field #11, Time Status, is invalid. In this case, the current receiver time is used. The recommended values for the three time fields are 0, 0, 0.

Table 5: Detailed Port Identifier

ASCII Port Name	Hex Port Value	Decimal Port Value [a]	Description
NO_PORTS	0	0	No ports specified
COM1_ALL	1	1	All virtual ports for COM1
COM2_ALL	2	2	All virtual ports for COM2
COM3_ALL	3	3	All virtual ports for COM3
THISPORT_ALL	6	6	All virtual ports for the current port
ALL_PORTS	8	8	All virtual ports for all ports
XCOM1_ALL	9	9	All virtual ports for XCOM1
XCOM2_ALL	10	10	All virtual ports for XCOM2
USB1_ALL	d	13	All virtual ports for USB1
USB2_ALL	e	14	All virtual ports for USB2
USB3_ALL	f	15	All virtual ports for USB3
AUX_ALL	10	16	All virtual ports for the AUX[b]
XCOM3_ALL	11	17	All virtual XCOM3
ICOM1_ALL	17	23	All virtual ports for ICOM1
ICOM2_ALL	18	24	All virtual ports for ICOM2
ICOM3_ALL	19	25	All virtual ports for ICOM3
NCOM1_ALL	1a	26	All virtual ports for NCOM1
NCOM2_ALL	1b	27	All virtual ports for NCOM2
NCOM3_ALL	1c	28	All virtual ports for NCOM3
COM1	20	32	COM1, virtual port 0
COM1_1	21	33	COM1, virtual port 1
. . .			
COM1_31	3f	63	COM1, virtual port 31
COM2	40	64	COM2, virtual port 0
. . .			
COM2_31	5f	95	COM2, virtual port 31
COM3	60	96	COM3, virtual port 0

Table 5: Detailed Port Identifier

ASCII Port Name	Hex Port Value	Decimal Port Value [a]	Description
. . .			
COM3_31	7f	127	COM3, virtual port 31
SPECIAL	a0	160	Unknown port, virtual port 0
. . .			
SPECIAL_31	bf	191	Unknown port, virtual port 31
THISPORT	c0	192	Current COM port, virtual port 0
. . .			
THISPORT_31	df	223	Current COM port, virtual port 31
FILE	e0	224	User specified file destination, 0 [c]
FILE_1	e1	225	User specified file destination, 1 [c]
. . .			
FILE_31	ff	255	User specified file destination, 31 [c]
XCOM1	1a0	416	XCOM1, virtual port 0
XCOM1_1	1a1	417	XCOM1, virtual port 1
. . .			
XCOM1_31	1bf	447	XCOM1, virtual port 31
XCOM2	2a0	672	XCOM2, virtual port 0
XCOM2_1	2a1	673	XCOM2, virtual port 1
. . .			
XCOM2_31	2bf	703	XCOM2, virtual port 31
USB1	5a0	1440	USB1, virtual port 0
USB1_1	5a1	1441	USB1, virtual port 1
. . .			
USB1_31	5bf	1471	USB1, virtual port 31
USB2	6a0	1696	USB2, virtual port 0
. . .			
USB2_31	6bf	1727	USB2, virtual port 31
USB3	7a0	1952	USB3, virtual port 0
. . .			

Table 5: Detailed Port Identifier

ASCII Port Name	Hex Port Value	Decimal Port Value [a]	Description
USB3_31	7bf	1983	USB port 3, virtual port 31
AUX	8a0	2208	AUX port, virtual port 0 [b]
. . .			
AUX_31	8bf	2239	AUX port, virtual port 31 [b]
XCOM3	9a0	2464	XCOM3, virtual port 0
. . .			
XCOM3_31	9bf	2495	XCOM3, virtual port 31
ICOM1	fa0	4000	ICOM1, virtual port 0
. . .			
ICOM1_31	fbf	4031	ICOM1, virtual port 31
ICOM2	10a0	4256	ICOM2, virtual port 0
. . .			
ICOM2_31	10bf	4287	ICOM2, virtual port 31
ICOM3	11a0	4512	ICOM3, virtual port 0
. . .			
ICOM3_31	11bf	4543	ICOM3, virtual port 31
NCOM1	12a0	4768	NCOM1, virtual port 0
. . .			
NCOM1_31	12bf	4799	NCOM1, virtual port 31
NCOM2	13a0	5024	NCOM2, virtual port 0
. . .			
NCOM2_31	13bf	5055	NCOM2, virtual port 31
NCOM3	14a0	5280	NCOM3, virtual port 0
. . .			
NCOM3_31	14bf	5311	NCOM3, virtual port 31

a. Decimal port values 0 through 16 are only available to the UNLOGALL command (refer to *page 252*) and cannot be used in the UNLOG command (refer to *page 250)* or in the binary message header (see *Table 4* on *page 24).*

b. The AUX port is only available on specific products.

c. DL-V3 only. Refer to the *DL-V3 Firmware Reference Manual* and the **CDU**'s Help file.

COM1_ALL, COM2_ALL, COM3_ALL, THISPORT_ALL, ALL_PORTS, USB1_ALL, USB2_ALL, USB3_ALL, AUX_ALL, ICOM1_ALL, ICOM2_ALL, ICOM3_ALL, NCOM1_ALL, NCOM2_ALL, XCOM1_ALL, XCOM2_ALL, XCOM3_ALL and NCOM3_ALL are only valid for the UNLOGALL command.

1.2 Responses

By default, if you input a message you get back a response. If desired, the INTERFACEMODE command can be used to disable response messages (see *page 147*). The response will be in the exact format you entered the message (that is, binary input = binary response).

1.2.1 Abbreviated Response

Just the leading '<' followed by the response string, for example: <OK.

1.2.2 ASCII Response

Full header with the message name being identical except ending in an 'R' (for response). The body of the message consists of a 40 character string for the response string.
For example:

#BESTPOSR,COM1,0,67.0,FINE,1028,422060.400,00000000,a31b,0;"OK" *b867caad

1.2.3 Binary Response

Similar to an ASCII response except that it follows the binary protocols, see *Table 6, Binary Message Response Structure* on *page 30*.

Table 7, Binary Message Sequence on *page 31* is an example of the sequence for requesting and then receiving BESTPOSB. The example is in hex format. When you enter a hex command, you may need to add a ‘\x’ or ‘0x’ before each hex pair, depending on your code.
For example:

0xAA0x440x120x1C0x010x000x02 and so on).

Table 6: Binary Message Response Structure

	Field #	Field Name	Field Type	Description	Binary Bytes	Binary Offset
BINARY HEADER	1	Sync	Char	Hexadecimal 0xAA	1	0
	2	Sync	Char	Hexadecimal 0x44	1	1
	3	Sync	Char	Hexadecimal 0x12	1	2
	4	Header Lgth	Uchar	Length of the header.	1	3
	5	Message ID	Ushort	Message ID number	2	4
	6	Message Type	Char	Bit 7 = Response Bit 1 = Response Message	1	6
	7	Port Address	Uchar	See *Table* on *page 26*	1	7
	8	Message Length	Ushort	The length in bytes of the body of the message (not the CRC)	2	8
	9	Sequence	Ushort	Normally 0	2	10
	10	Idle Time	Uchar	Idle time	1	12
	11	Time Status	Enum	*Table 8* on *page 32*	1 [a]	13
	12	Week	Ushort	GPS reference week number	2	14
	13	ms	GPSec	Milliseconds into GPS reference week	4	16
	14	Receiver Status	Ulong	*Table 109* on *page 611*	4	20
	15	Reserved	Ushort	Reserved for internal use	2	24
	16	Receiver S/W Version	Ushort	Receiver software build number	2	26
ID	17	Response ID	Enum	*Table , The output format of the messages is dependent on the format of the input command. If the command is input as abbreviated ASCII, the output will be abbreviated ASCII. The same rule applies for both ASCII and binary formats.* on *page 684*	4	28
HEX	18	Response	Hex	String containing the ASCII response in hex coding to match the ID above (for example, 0x4F4B = OK)	variable	32

a. This ENUM is not 4-bytes long but as indicated in the table is only 1 byte.

Table 7: Binary Message Sequence

Direction	Sequence	Data
To Receiver	LOG Command Header	AA44121C 01000240 20000000 1D1D0000 29160000 00004C00 55525A80
	LOG Parameters	20000000 2A000000 02000000 00000000 0000F03F 00000000 00000000 00000000
	Checksum	2304B3F1
From Receiver	LOG Response Header	AA44121C 01008220 06000000 FFB4EE04 605A0513 00004C00 FFFF5A80
	Log Response Data	01000000 4F4B
	Checksum	DA8688EC
From Receiver	BESTPOSB Header	AA44121C 2A000220 48000000 90B49305 B0ABB912 00000000 4561BC0A
	BESTPOSB Data	00000000 10000000 1B0450B3 F28E4940 16FA6BBE 7C825CC0 0060769F 449F9040 A62A82C1 3D000000 125ACB3F CD9E983F DB664040 00303030 00000000 00000000 0B0B0000 00060003
	Checksum	42DC4C48

1.3 GLONASS Slot and Frequency Numbers

When a PRN in a log is in the range 38 to 61, then that PRN represents a GLONASS Slot where the Slot shown is the actual GLONASS Slot Number plus 37.

Similarly, the GLONASS Frequency shown in logs is the actual GLONASS Frequency plus 7.

For example:

```
#SATVISA,COM1,0,53.5,FINESTEERING,1363,234894.000,00000000,0947,2277;
TRUE,TRUE,46,
2,0,0,73.3,159.8,934.926,934.770,
...
43,8,0,-0.4,163.7,4528.085,4527.929,
...
3,0,0,-79.9,264.3,716.934,716.778*b94813d3
```

where 2 and 3 are GPS satellites and 43 is a GLONASS satellite. It's actual GLONASS Slot Number is 6. The SATVIS log shows 43 (6+ 37). It's actual GLONASS frequency is 1. The SATVIS log shows 8 (1+7). See also the SATVIS log on *page 619*.

Refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/ for more information.

1.4 GPS Reference Time Status

All reported receiver times are subject to a qualifying time status. The status indicates how well a time is known (see *Table 8*).

Table 8: GPS Reference Time Status

GPS Reference Time Status (Decimal)	GPS Reference Time Status [a] (ASCII)	Description
20	UNKNOWN	Time validity is unknown
60	APPROXIMATE	Time is set approximately
80	COARSEADJUSTING	Time is approaching coarse precision
100	COARSE	This time is valid to coarse precision
120	COARSESTEERING	Time is coarse set and is being steered
130	FREEWHEELING	Position is lost and the range bias cannot be calculated
140	FINEADJUSTING	Time is adjusting to fine precision
160	FINE	Time has fine precision
170	FINEBACKUPSTEERING	Time is fine set and is being steered by the backup system
180	FINESTEERING	Time is fine set and is being steered
200	SATTIME	Time from satellite. Only used in logs containing satellite data such as ephemeris and almanac

a. See also *Section 1.5, Message Time Stamps* on *page 34* and the *SETTIMEBASE* command on page *231*.

There are several distinct states the receiver goes through when CLOCKADJUST is enabled:

- UNKNOWN (initial state)
- COARSESTEERING (initial coarse time set)
- FINESTEERING (normal operating state)
- FINEBACKUPSTEERING (when the back-up system is used for time)
- FREEWHEELING (when range bias becomes unknown)

and when the CLOCKADJUST is disabled:

- UNKNOWN (initial state)
- COARSE (initial coarse time set)
- FINE (normal operating state)

On start up, and before any satellites are being tracked, the receiver can not possibly know the current time. As such, the receiver time starts counting at GPS reference week 0 and second 0.0. The time status flag is set to UNKNOWN.

If time is input to the receiver using the SETAPPROXTIME command (see *page 217*) or on receipt of an RTCAEPHEM message (see *page 499*) the time status will be APPROXIMATE.

After the first ephemeris is decoded, the receiver time is set to a resolution of ±10 milliseconds. This state is qualified by the COARSE or COARSESTEERING time status flag depending on the state of the CLOCKADJUST switch (for more information, refer to the CLOCKADJUST command on page 82).

Once a position is known and range biases are being calculated, the internal clock model will begin modeling the position range biases and the receiver clock offset.

Modelling will continue until the model is a good estimation of the actual receiver clock behavior. At this time, the receiver time will again be adjusted, this time to an accuracy of ±1 microsecond. This state is qualified by the FINE time status flag.

The final logical time status flag depends on whether CLOCKADJUST is enabled or not (see *page 82*). If CLOCKADJUST is disabled, the time status flag will never improve on FINE. The time will only be adjusted again to within ±1 microsecond if the range bias gets larger than ±250 milliseconds. If CLOCKADJUST is enabled, the time status flag is set to FINESTEERING and the receiver time is continuously updated (steered) to minimize the receiver range bias.

When the backup system is used, the time staus is set to FINEBACKUPSTEERING. If, for some reason, the position is lost and the range bias cannot be calculated, the time status is degraded to FREEWHEELING.

1.5 Message Time Stamps

All NovAtel format messages generated by the OEM6 family of receivers have a GPS reference time stamp in their header. GPS reference time is referenced to UTC with zero point defined as midnight on the night of January 5, 1980. The time stamp consists of the number of weeks since that zero point and the number of seconds since the last week number change (0 to 604,799). GPS reference time differs from UTC time since leap seconds are occasionally inserted into UTC and GPS reference time is continuous. In addition, a small error (less than 1 microsecond) can exist in synchronization between UTC and GPS reference time. The TIME log reports both GNSS and UTC time and the offset between the two.

The data in synchronous logs (for example, RANGE, BESTPOS, TIME) are based on a periodic measurement of satellite pseudoranges. The time stamp on these logs is the receiver estimate of GPS reference time at the time of the measurement. When setting time in external equipment, a small synchronous log with a high baud rate will be accurate to a fraction of a second. A synchronous log with trigger ONTIME 1 can be used in conjunction with the 1PPS signal to provide relative accuracy better than 250 ns.

Other log types (asynchronous and polled) are triggered by an external event and the time in the header may not be synchronized to the current GPS reference time. Logs that contain satellite broadcast data (for example, ALMANAC, GPSEPHEM) have the transmit time of their last subframe in the header. In the header of differential time matched logs (for example, MATCHEDPOS) is the time of the matched reference and local observation that they are based on. Logs triggered by a mark event (for example, MARKEDPOS, MARKTIME) have the estimated GPS reference time of the mark event in their header. In the header of polled logs (for example, LOGLIST, PORTSTATS, VERSION) is the approximate GPS reference time when their data was generated. However, when asynchronous logs are triggered ONTIME, the time stamp will represent the time the log was generated and not the time given in the data.

1.6 Decoding of the GPS Reference Week Number

The GPS reference week number provided in the raw satellite data is the 10 least significant bits (or 8 least significant bits in the case of the almanac data) of the full week number. When the receiver processes the satellite data, the week number is decoded in the context of the current era and therefore is computed as the full week number starting from week 0 or January 6, 1980. Therefore, in all log headers and decoded week number fields, the full week number is given. Only in raw data, such as the *data* field of the RAWALM log or the *subframe* field of the RAWEPHEM log, will the week number remain as the 10 (or 8) least significant bits.

1.7 32-Bit CRC

The ASCII and Binary OEM6 family message formats all contain a 32-bit CRC for data verification. This allows the user to ensure the data received (or transmitted) is valid with a high level of certainty. This CRC can be generated using the following C algorithm:

```
#define CRC32_POLYNOMIAL   0xEDB88320L
/* --------------------------------------------------------------------------
Calculate a CRC value to be used by CRC calculation functions.
-------------------------------------------------------------------------- */
unsigned long CRC32Value(int i)
{
   int j;
   unsigned long ulCRC;
   ulCRC = i;
   for ( j = 8 ; j > 0; j-- )
   {
      if ( ulCRC & 1 )
         ulCRC = ( ulCRC >> 1 ) ^ CRC32_POLYNOMIAL;
      else
         ulCRC >>= 1;
   }
   return ulCRC;
}
/* --------------------------------------------------------------------------
Calculates the CRC-32 of a block of data all at once
-------------------------------------------------------------------------- */
unsigned long CalculateBlockCRC32(
   unsigned long ulCount,     /* Number of bytes in the data block */
   unsigned char *ucBuffer ) /* Data block */
{
   unsigned long ulTemp1;
   unsigned long ulTemp2;
   unsigned long ulCRC = 0;
  while ( ulCount-- != 0 )
   {
      ulTemp1 = ( ulCRC >> 8 ) & 0x00FFFFFFL;
      ulTemp2 = CRC32Value( ((int) ulCRC ^ *ucBuffer++ ) & 0xff );
      ulCRC = ulTemp1 ^ ulTemp2;
   }
   return( ulCRC );
}
```

The NMEA checksum is an XOR of all the bytes (including delimiters such as ',' but excluding the * and $) in the message output. It is therefore an 8-bit and not a 32-bit checksum.

Not all logs may be available. Every effort is made to ensure examples are correct, however, a checksum may be created for promptness in publication. In this case it will appear as ‘9999’.

Example:

BESTPOSA and BESTPOSB from an OEM6 family receiver.

ASCII:

```
#BESTPOSA,COM1,0,78.0,FINESTEERING,1427,325298.000,00000000,6145,2748;
SOL_COMPUTED,SINGLE,51.11678928753,-114.03886216575,1064.3470,-16.2708,
WGS84,2.3434,1.3043,4.7300,"",0.000,0.000,7,7,0,0,0,06,0,03*9c9a92bb
```

BINARY:

0xaa, 0x44, 0x12, 0x1c 0x2a, 0x00, 0x02, 0x20, 0x48, 0x00, 0x00, 0x00, 0x90, 0xb4, 0x93, 0x05, 0xb0, 0xab, 0xb9, 0x12, 0x00, 0x00, 0x00, 0x00, 0x45, 0x61, 0xbc, 0x0a, 0x00, 0x00, 0x00, 0x00, 0x10, 0x00, 0x00, 0x00, 0x1b, 0x04, 0x50, 0xb3, 0xf2, 0x8e, 0x49, 0x40, 0x16, 0xfa, 0x6b, 0xbe, 0x7c, 0x82, 0x5c, 0xc0, 0x00, 0x60, 0x76, 0x9f, 0x44, 0x9f, 0x90, 0x40, 0xa6, 0x2a, 0x82, 0xc1, 0x3d, 0x00, 0x00, 0x00, 0x12, 0x5a, 0xcb, 0x3f, 0xcd, 0x9e, 0x98, 0x3f, 0xdb, 0x66, 0x40, 0x40, 0x00, 0x30, 0x30, 0x30, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0b, 0x0b, 0x00, 0x00, 0x00, 0x06, 0x00, 0x03, 0x***42***, 0x***dc,*** 0x***4c,*** 0x***48***

Below is a demonstration of how to generate the CRC from both ASCII and BINARY messages using the function described above.

When you pass the data into the code that follows, exclude the checksum shown in ***bold italics*** above.

ASCII:

```
#include <iostream.h>
#include <string.h>
void  main()
{
char *i = ”BESTPOSA,COM2,0,77.5,FINESTEERING,1285,160578.000,00000020,5941,11
64;
SOL_COMPUTED,SINGLE,51.11640941570,-114.03830951024,1062.6963,-16.2712,
WGS84,1.6890,1.2564,2.7826,\"\",0.000,0.000,10,10,0,0,0,0,0,0";
unsigned long iLen = strlen(i);
unsigned long CRC = CalculateBlockCRC32(iLen, (unsigned char*)i);
cout << hex << CRC <<endl;
}
```

BINARY:

```
#include <iostream.h>
#include <string.h>
int main()
{
unsigned char buffer[] = {0xAA, 0x44, 0x12, 0x1C, 0x2A, 0x00, 0x02, 0x20,
0x48, 0x00, 0x00, 0x00, 0x90, 0xB4, 0x93, 0x05, 0xB0, 0xAB, 0xB9, 0x12, 0x00,
0x00, 0x00, 0x00, 0x45, 0x61, 0xBC, 0x0A, 0x00, 0x00, 0x00, 0x00, 0x10, 0x00,
0x00, 0x00, 0x1B, 0x04, 0x50, 0xB3, 0xF2, 0x8E, 0x49, 0x40, 0x16, 0xFA, 0x6B,
0xBE, 0x7C, 0x82, 0x5C, 0xC0, 0x00, 0x60, 0x76, 0x9F, 0x44, 0x9F, 0x90, 0x40,
0xA6, 0x2A, 0x82, 0xC1, 0x3D, 0x00, 0x00, 0x00, 0x12, 0x5A, 0xCB, 0x3F, 0xCD,
0x9E, 0x98, 0x3F, 0xDB, 0x66, 0x40, 0x40, 0x00, 0x30, 0x30, 0x30, 0x00, 0x00,
0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x0B, 0x0B, 0x00, 0x00, 0x00, 0x06, 0x00,
0x03};
unsigned long crc = CalculateBlockCRC32(sizeof(buffer)buffer);
cout << hex << crc <<endl;
//Please note that this hex needs to be reversed due to Big Endian order where
the most significant value in the sequence is stored first (at the lowest
storage address). For example, the two bytes required for the hex number 4F52
is stored as 524F.
}
```

Chapter 2 Command

2.1 Command Formats

The receiver accepts commands in 3 formats as described in *Chapter 1*:

- Abbreviated ASCII
- ASCII
- Binary

Abbreviated ASCII is the easiest to use for your input. The other two formats include a CRC for error checking and are intended for use when interfacing with other electronic equipment.

Here are examples of the same command in each format:

Abbreviated ASCII Example:

```
LOG COM1 BESTPOSB ONTIME 1[CR]
```

ASCII Example:

```
LOGA,COM2,0,66.0,UNKNOWN,0,15.917,004c0000,5255,32858;COM1,
BESTPOSB,ONTIME,1.000000,0.000000,NOHOLD*F95592DD[CR]
```

Binary Example:

```
AA44121C 01000240 20000000 1D1D0000 29160000 00004C00 55525A80
20000000 2A000000 02000000 00000000 0000F03F 00000000 00000000
00000000 2304B3F1
```

2.2 Command Settings

There are several ways to determine the current command settings of the receiver:

1. Request an RXCONFIG log, see *page 605*. This log provides a listing of all commands issued to the receiver and their parameter settings. It also provides the most complete information.
2. For some specific commands, logs are available to indicate all their parameter settings. The LOGLIST log, see *page 410*, shows all active logs in the receiver beginning with the LOG command. The COMCONFIG log, see *page 341*, shows both the COM and INTERFACEMODE commands parameter settings for all serial ports.
3. Request a log of the specific command of interest to show the parameters last entered for that command. The format of the log produced is exactly the same as the format of the specific command with updated header information.

This is very useful for most commands, but for commands that are repeated with different parameters (for example, COM and LOG), this only shows the most recent set of parameters used. To see all sets of parameters try method 1 or 2 above.

Abbreviated ASCII Example:

```
log fix
<FIX COM1 0 45.0 FINE 1114 151898.288 00200000 dbfd 33123
<     NONE -10000.00000000000 -10000.00000000000 -10000.0000
```

2.3 Commands by Function

Table 9: OEM6 Commands Sorted by Function

Clock information status and time		
ADJUST1PPS	Adjusts the receiver clock	429
CLOCKADJUST	Enables clock adjustments	15
CLOCKCALIBRATE	Adjusts clock steering parameters	430
CLOCKOFFSET	Adjusts for delay in 1PPS output	596
EXTERNALCLOCK	Sets external clock parameters	230
SETAPPROXTIME	Sets an approximate GPS reference time	102
Communications, Control and Status		
APPLICATION	Starts/stops the application	413
ASSIGNLBAND	Sets L-band satellite communication parameters	729
ASSIGNLBAND2	Sets L-band satellite communication parameters	1200
COM	Sets COM port configuration	4
COMCONTROL	Controls the hardware control lines of the RS232 ports	431
DNSCONFIG	Configures DNS servers	1244
ECHO	Sets port echo	1247
ETHCONFIG	Configures Ethernet physical layer	1245
Communications, Control and Status		
FREQUENCYOUT	Sets the output pulse train available on VARF	232
GENERATEDIFFCORRECTIONS	Sends differential corrections	1296
GENERATERTKCORRECTIONS	Sends RTK corrections	1260

Communications, Control and Status		
ICOMCONFIG	Configures IP virtual COM port	1248
INTERFACEMODE	Sets interface type, Receive (Rx)/Transmit (Tx), for a port	3
IPCONFIG	Configures network IP settings	1243
LOG	Requests a log	1
MARKCONTROL	Controls processing of the mark inputs	614
NTRIPCONFIG	Configures NTRIP	1249
NTRIPSOURCETABLE	Sets the NTRIPCASTER ENDPOINTS to be used for the SOURCETABLE log	1343
PPSCONTROL	Controls the PPS output	613
SEND	Sends ASCII message to a port	177
SENDHEX	Sends non-printable characters to a port	178
SERIALCONFIG	Configures serial port settings	1246
SETCANNAME	Sets the CAN name fields	1091
SOFTLOADCOMMIT	Commits to the soft load module	475
SOFTLOADDATA	Uploads data for soft load process	1218
SOFTLOADRESET	Restarts soft load process	476
SOFTLOADSETUP	Configures the soft load process	1219
SOFTLOADSREC	Configures the soft load process	477
TUNNELESCAPE	Breaks out of a tunnel	962
UNLOG	Removes a log from the logging control	36
UNLOGALL	Removes all logs from the logging control	38
Differential Rover/Base Station		
ALIGNAUTOMATION	Configures the ALIGN plug and play feature	1323
ANTENNAMODEL	Enters/changes rover antenna model	841
BASEANTENNAMODEL	Enters/changes base antenna model	870
DGPSEPHEMDELAY	Sets DGPS ephemeris delay	142
DGPSTIMEOUT	Sets maximum age of differential data	127
DGPSTXID	Sets DGPS station ID	144
FIXPOSDATUM	Sets a datum position.	716
GENERATEALIGNCORRECTIONS	Configures the ALIGN Master and start sending out ALIGN RTCA corrections through the specified port	1349
HPSEED	Specifies the initial position for OmniSTAR HP/XP	782
HPSTATICINIT	Sets the static initialization of OmniSTAR HP/XP	780

Differential Rover/Base Station		
MOVINGBASESTATION	Enables a moving base station	763
POSAVE	Implements base station position averaging	173
POSTIMEOUT	Sets the position time out	612
PSRDIFFSOURCE	Sets the pseudorange correction source	493
RTKANTENNA	Specifies L1 phase center (PC) or ARP and enables/ disables PC modeling	858
RTKCOMMAND	Resets the RTK filter or set the filter to default settings	97
RTKDYNAMICS	Sets up the RTK dynamics mode	183
RTKNETWORK	Specifies the RTK network mode	951
RTKQUALITYLEVEL	Chooses an RTK quality mode	844
RTKSOURCE	Sets the RTK correction source	494
RTKSVENTRIES	Sets the number of satellites in corrections	92
RTKTIMEOUT	Sets the maximum age of RTK data	910
SETROVERID	Sets the Rover ID output in ROVERPOS, HEADING2, ALIGNBSLNXYZ and ALIGNBSLNENU logs	1135
SETRTCM16	Enters ASCII text for an RTCM data stream	131
Differential Rover/Base Station		
SETRTCM36	Enters ASCII text with Russian characters	880
SETRTCMRXVERSION	Sets the expected RTCM message standard input	1216
SETRTCMTXVERSION	Sets the expected RTCM transmission standard input	1322
WAASTIMEOUT	Sets maximum age of the WAAS data accepted	851
General Receiver Control		
ANTENNAPOWER	Controls power to low-noise amplifier (LNA) of an active antenna	98
AUTH	Adds the authorization code for a new model	49
FRESET	Resets the receiver to factory default	20
MODEL	Switches the receiver to an existing authorized model	22
NVMRESTORE	Restores NVM data after an NVM failure	197
RESET	Reset the hardware	18
SAVECONFIG	Saves the current configuration	19
SETTIMEBASE	Sets the primary and backup systems for time base	1237
SETUTCLEAPSECONDS	Sets when future leap seconds take effect	1150
STATUSCONFIG	Configures various status mask fields in RXSTATUSEVENT log	95

Position, Parameters, and Solution Filtering Control		
DATUM	Chooses a DATUM name type	160
DIFFCODEBIASCONTROL	Enables or disables satellite differential code biases	913
FIX	Constrains receiver height or position	44
GGAQUALITY	Customizes the GPGGA GPS quality indicator	691
HDTOUTTHRESHOLD	Controls the NMEA GPHDT log output	1062
HEADINGOFFSET	Adds heading and pitch offset values	1082
Posiiton, Parameters, and Solution Filtering Control		
IONOCONDITION	Sets ionospheric condition	1215
LOCALIZEDCORRECTION -DATUM	Sets a local datum	947
NMEATALKER	Sets the NMEA talker ID	861
OMNIUSEGLONASS	Enables/disables GLONASS in OmniStar	1199
PDPFILTER	Enables, disables or resets the Pseudorange/Delta-Phase (PDP) filter	424
PDPMODE	Selects the PDP mode and dynamics	970
RAIMMODE	Configures RAIM mode	1285
RTKELEVMASK	Sets the RTK elevation mask	91
SBASCONTROL	Sets SBAS test mode and PRN	652
SETAPPROXPOS	Sets an approximate position	377
SETBESTPOSCRITERIA	Sets selection criteria for BESTPOS	839
SETDIFFCODEBIASES	Sets satellite differential code biases	687
SETIONOTYPE	Sets the ionospheric corrections model	711
UNDULATION	Sets ellipsoid-geoid separation	214
USERDATUM	Sets user-customized datum	78
USEREXPDATUM	Sets custom expanded datum	783
UTMZONE	Sets UTM parameter	749
ASSIGN	Assigns individual satellite channel	27
ASSIGNALL	Assigns all satellite channels	28
CNOUPDATE	Sets the C/No update rate and resolution	849
DYNAMICS	Adjusts the tracking state transition time-out	258
ECUTOFF	Sets the satellite tracking elevation cut-off	50

Satellite Tracking and Channel Control		
FORCEGLOL2CODE	Forces the receiver to track L2C or P-code	1217
FORCEGPSL2CODE	Forces the receiver to track L2C or P-code	796
GALECUTOFF	Sets the Galileo satellite elevation cut-off angle	1114
GLOECUTOFF	Sets the GLONASS satellite elevation cut-off angle	735
LOCKOUT	Prevents the receiver from using a satellite	137
LOCKOUTSYSTEM	Prevents the receiver from using a system	871
QZSSECUTOFF	Sets the elevation cut-off angle for QZSS satellites	1350
SBASECUTOFF	Sets the SBAS satellite elevation cut-off	1000
TRACKSV	Overrides the automatic satellite/channel assignment for all satellites with manual instructions	1326
UNASSIGN	Unassigns a previously ASSIGNed channel	29
UNASSIGNALL	Unassigns all previously ASSIGNed channels	30
UNLOCKOUT	Reinstates a satellite in the solution	138
UNLOCKOUTALL	Reinstates all previously locked out satellites	139
Waypoint Navigation		
MAGVAR	Sets the magnetic variation correction	180
SETNAV	Sets waypoints	162

Table 10: OEM6 Commands in Alphabetical Order

OEM6 Commands in Alphabetical Order		
ASCIIName	**Description**	**Meassage ID**
ADJUST1PPS	Adjusts the receiver clock	429
ALIGNAUTOMATION	Configures the ALIGN plug and play feature	1323
ANTENNAMODEL	Enters/changes the rover antenna model	841
ANTENNAPOWER	Controls the power to low-noise amplifier (LNA) of an active antenna	98
APPLICATION	Starts/stops the application	413
ASSIGN	Assigns individual satellite channel	27
ASSIGNALL	Assigns all satellite channels	28
ASSIGNLBAND	Sets L-band satellite communication parameters	729
ASSIGNLBAND2	Sets L-band satellite communication parameters	1200
AUTH	Adds authorization code for new model	49
BASEANTENNAMODEL	Enters/changes base antenna model	870
CLOCKADJUST	Enables clock adjustments	15
CLOCKCALIBRATE	Adjusts clock steering parameters	430
CNOUPDATE	Sets C/No update rate and resolution	849
COM	Sets COM port configuration	4
COMCONTROL	Controls the hardware control lines of the RS232 ports	431
DATUM	Chooses a DATUM name type	160
DGPSEPHEMDELAY	Sets DGPS ephemeris delay	142
DGPSTIMEOUT	Sets maximum age of differential data	127
DGPSTXID	Sets DGPS station ID	144

OEM6 Commands in Alphabetical Order		
ASCIIName	**Description**	**Meassage ID**
DIFFCODEBIASCONTROL	Enables or disable satellite differential code biases	913
DNSCONFIG	Manually configures DNS servers	1244
DYNAMICS	Adjusts tracking state transition time-out	258
ECHO	Sets port echo	1247
ECUTOFF	Sets satellite tracking elevation cut-off	50
ETHCONFIG	Configures Ethernet physical layer	1245
FIX	Constrains receiver height or position	44
FIXPOSDATUM	Sets the position in a specified datum	716
FORCEGLOL2CODE	Forces the receiver to track L2C or P-code	1217
FORCEGPSL2CODE	Forces the receiver to track L2C or P-code	796
FREQUENCYOUT	Sets the output pulse train available on VARF	232
FRESET	Resets the receiver to factory default	20
GALECUTOFF	Sets elevation cut-off angle for Galileo satellites	1114
GENERATEALIGNCORRECTIONS	Configures the ALIGN Master and start sending out ALIGN RTCA corrections through the specified port	1349
GENERATEDIFFCORRECTIONS	Sends a preconfigured set of differential corrections	1296
GENERATERTKCORRECTIONS	Sends a preconfigured set of RTK corrections	1260
GGAQUALITY	Customizes the GPGGA GPS quality indicator	691
GLOECUTOFF	Sets the GLONASS satellite elevation cut-off angle	735
HDTOUTTHRESHOLD	Controls the NMEA GPHDT log output	1062
HEADINGOFFSET	Adds heading and pitch offset values	1082

OEM6 Commands in Alphabetical Order		
ASCIIName	**Description**	**Meassage ID**
HPSEED	Specifies the initial position for OmniSTAR HP/XP	782
HPSTATICINIT	Sets static initialization of OmniSTAR HP/XP	780
ICOMCONFIG	Configures IP virtual COM port	1248
INTERFACEMODE	Sets interface type, Receive (Rx)/Transmit (Tx), for a port	3
IONOCONDITION	Sets ionospheric condition	1215
IPCONFIG	Configures network IP settings	1243
LOCALIZEDCORRECTION-DATUM	Sets a local datum	947
LOCKOUT	Prevents the receiver from using a satellite by specifying its PRN	137
LOCKOUTSYSTEM	Prevents the receiver from using a system	871
LOG	Requests a log	1
MAGVAR	Sets magnetic variation correction	180
MARKCONTROL	Controls processing of the mark inputs	614
MODEL	Switches receiver to a previously AUTHed model	22
MOVINGBASESTATION	Sets ability to use a moving base station	763
NMEATALKER	Sets the NMEA talker ID	861
NTRIPCONFIG	Configures NTRIP	1249
NTRIPSOURCETABLE	Sets the NTRIPCASTER ENDPOINTS to be used for the SOURCETABLE log	1343
NVMRESTORE	Restores NVM data after a failure in NVM	197
OMNIUSEGLONASS	Enables/disables GLONASS in OmniStar	1199
PDPFILTER	Enables, disables or resets the Pseudorange/Delta-Phase (PDP) filter	424

OEM6 Commands in Alphabetical Order		
ASCIIName	**Description**	**Meassage ID**
PDPMODE	Selects the PDP mode and dynamics	970
POSAVE	Implements base station position averaging	173
POSTIMEOUT	Sets the position time out	612
PPSCONTROL	Controls the PPS output	613
PSRDIFFSOURCE	Sets the pseudorange correction source	493
QZSSECUTOFF	Sets the elevation cut-off angle for QZSS satellites	1350
RAIMMODE	Configures RAIM mode	1285
RESET	Performs a hardware reset	18
RTKANTENNA	Specifies L1 phase center (PC) or ARP and enable/disable PC modeling	858
RTKCOMMAND	Resets the RTK filter or sets the filter to default settings	97
RTKDYNAMICS	Sets up the RTK dynamics mode	183
RTKELEVMASK	Sets the RTK elevation mask	91
RTKNETWORK	Specifies the RTK network mode	951
RTKQUALITYLEVEL	Chooses an RTK quality mode	844
RTKSOURCE	Sets the RTK correction source	494
RTKSVENTRIES	Sets number of satellites in corrections	92
RTKTIMEOUT	Sets maximum age of RTK data	910
SAVECONFIG	Saves current configuration	19
SBASCONTROL	Set SBAS test mode and PRN	652
SBASECUTOFF	Sets SBAS satellite elevation cut-off	1000
SEND	Sends ASCII message to a port	177
SENDHEX	Sends non-printable characters to a port	178

OEM6 Commands in Alphabetical Order		
ASCIIName	**Description**	**Meassage ID**
SERIALCONFIG	Configures serial port settings	1246
SETAPPROXPOS	Sets an approximate position	377
SETAPPROXTIME	Sest an approximate GPS reference time	102
SETBESTPOSCRITERIA	Selects criteria for BESTPOS	839
SETCANNAME	Sets the CAN name fields	1091
SETDIFFCODEBIASES	Sets satellite differential code biases	687
SETIONOTYPE	Sets the ionospheric corrections model	711
SETNAV	Sets waypoints	162
SETROVERID	Sets the Rover ID output in ROVERPOS, HEADING2, ALIGNBSLNXYZ and ALIGNBSLNENU logs	1135
SETRTCM16	Enters ASCII text for RTCM data stream	131
SETRTCM36	Enters ASCII text with Russian characters	880
SETRTCMRXVERSION	Sets the expected RTCM standard input	1216
SETRTCMTXVERSION	Sets the expected RTCM transmission standard input	1322
SETTIMEBASE	Sets primary and backup systems for time base	1237
SETUTCLEAPSECONDS	Sets when future leap seconds take effect	1150
SOFTLOADCOMMIT	Commits to the soft load module	475
SOFTLOADDATA	Uploads data for soft load	1218
SOFTLOADRESET	Restart ssoft load process	476
SOFTLOADSETUP	Configures the soft load process	1219
SOFTLOADSREC	Configures soft load process	477
STATUSCONFIG	Configures various status mask fields in RXSTATUSEVENT log	95

OEM6 Commands in Alphabetical Order		
ASCIIName	**Description**	**Meassage ID**
TRACKSV	Overrides the automatic satellite/channel assignment for all satellites with manual instructions	1326
TUNNELESCAPE	Breaks out of an established tunnel	962
UNASSIGN	Unassigns a previously ASSIGNed channel	29
UNASSIGNALL	Unassigns all previously ASSIGNed channels	30
UNDULATION	Sets ellipsoid-geoid separation	214
UNLOCKOUT	Reinstates a satellite in the solution	138
UNLOCKOUTALL	Reinstates all previously locked out satellites	139
UNLOG	Removes a log from the logging control	36
UNLOGALL	Removes all logs from the logging control	38
USERDATUM	Sets user-customized datum	78
USEREXPDATUM	Sets custom expanded datum	783
UTMZONE	Sets UTM parameters	749
WAASTIMEOUT	Sets maximum age of WAAS data accepted	851

Table 11: OEM6 Commands in Numerical Orderr

OEM6 Commands in Numerical Order		
Meassage ID	**ASCIIName**	**Description**
1	LOG	Requests a log
3	INTERFACEMODE	Sets interface type, Receive (Rx)/Transmit (Tx), for a port
4	COM	Sets COM port configuration
15	CLOCKADJUST	Enables clock adjustments
18	RESET	Performs a hardware reset

OEM6 Commands in Numerical Order		
Meassage ID	**ASCIIName**	**Description**
19	SAVECONFIG	Saves current configuration
20	FRESET	Resets receiver to factory default
22	MODEL	Switches receiver to a previously AUTHed model
27	ASSIGN	Assigns individual satellite channel
28	ASSIGNALL	Assigns all satellite channels
29	UNASSIGN	Unassigns a previously ASSIGNed channel
30	UNASSIGNALL	Unassigns all previously ASSIGNed channels
36	UNLOG	Removes a log from the logging control
38	UNLOGALL	Removes all logs from the logging control
44	FIX	Constrains receiver height or position
49	AUTH	Adds authorization code for new model
50	ECUTOFF	Sets satellite tracking elevation cut-off
78	USERDATUM	Sets user-customized datum
91	RTKELEVMASK	Sets the RTK elevation mask
92	RTKSVENTRIES	Sets number of satellites in corrections
95	STATUSCONFIG	Configures various status mask fields in RXSTATUSEVENT log
97	RTKCOMMAND	Resets the RTK filter or sets the filter to default settings
98	ANTENNAPOWER	Controls power to low-noise amplifier (LNA) of an active antenna
102	SETAPPROXTIME	Sest an approximate GPS reference time
127	DGPSTIMEOUT	Sets maximum age of differential data
131	SETRTCM16	Enters ASCII text for RTCM data stream

OEM6 Commands in Numerical Order		
Meassage ID	**ASCIIName**	**Description**
137	LOCKOUT	Prevents the receiver from using a satellite by specifying its PRN
138	UNLOCKOUT	Reinstates a satellite in the solution
139	UNLOCKOUTALL	Reinstates all previously locked out satellites
142	DGPSEPHEMDELAY	Sets DGPS ephemeris delay
144	DGPSTXID	Sets DGPS station ID
160	DATUM	Chooses a DATUM name type
162	SETNAV	Sets waypoints
173	POSAVE	Implements base station position averaging
177	SEND	Sends ASCII message to a port
178	SENDHEX	Sends non-printable characters to a port
180	MAGVAR	Sets magnetic variation correction
183	RTKDYNAMICS	Sets up the RTK dynamics mode
197	NVMRESTORE	Restores NVM data after a failure in NVM
214	UNDULATION	Sets ellipsoid-geoid separation
232	FREQUENCYOUT	Sets the output pulse train available on VARF
258	DYNAMICS	Adjusts tracking state transition time-out
377	SETAPPROXPOS	Sets an approximate position
413	APPLICATION	Starts/stops the application
424	PDPFILTER	Enables, disables or resets the Pseudorange/ Delta-Phase (PDP) filter
429	ADJUST1PPS	Adjusts the receiver clock
430	CLOCKCALIBRATE	Adjusts clock steering parameters
431	COMCONTROL	Controls the hardware control lines of the RS232 ports

OEM6 Commands in Numerical Order		
Meassage ID	**ASCIIName**	**Description**
475	SOFTLOADCOMMIT	Commits to the soft load module
476	SOFTLOADRESET	Restart soft load process
477	SOFTLOADSREC	Configures soft load process
493	PSRDIFFSOURCE	Sets the pseudorange correction source
494	RTKSOURCE	Sets the RTK correction source
612	POSTIMEOUT	Sets the position time out
613	PPSCONTROL	Controls the PPS output
614	MARKCONTROL	Controls processing of the mark inputs
687	SETDIFFCODEBIASES	Sets satellite differential code biases
652	SBASCONTROL	Set SBAS test mode and PRN
691	GGAQUALITY	Customizes the GPGGA GPS quality indicator
711	SETIONOTYPE	Sets the ionospheric corrections model
716	FIXPOSDATUM	Sets the position in a specified datum
729	ASSIGNLBAND	Sets L-band satellite communication parameters
735	GLOECUTOFF	Sets the GLONASS satellite elevation cut-off angle
749	UTMZONE	Sets UTM parameters
763	MOVINGBASESTATION	Sets ability to use a moving base station
780	HPSTATICINIT	Sets static initialization of OmniSTAR HP/XP
782	HPSEED	Specifies the initial position for OmniSTAR HP/XP
783	USEREXPDATUM	Sets custom expanded datum
796	FORCEGPSL2CODE	Forces the receiver to track L2C or P-code
839	SETBESTPOSCRITERIA	Selects criteria for BESTPOS

OEM6 Commands in Numerical Order		
Meassage ID	**ASCIIName**	**Description**
841	ANTENNAMODEL	Enters/changes rover antenna model
844	RTKQUALITYLEVEL	Chooses an RTK quality mode
849	CNOUPDATE	Sets C/No update rate and resolution
851	WAASTIMEOUT	Sets maximum age of WAAS data accepted
858	RTKANTENNA	Specifies L1 phase center (PC) or ARP and enable/disable PC modeling
861	NMEATALKER	Sets the NMEA talker ID
870	BASEANTENNAMODEL	Enters/changes base antenna model
871	LOCKOUTSYSTEM	Prevents the receiver from using a system
880	SETRTCM36	Enters ASCII text with Russian characters
910	RTKTIMEOUT	Sets maximum age of RTK data
913	DIFFCODEBIASCONTROL	Enables or disable satellite differential code biases
947	LOCALIZEDCORRECTION-DATUM	Sets a local datum
951	RTKNETWORK	Specifies the RTK network mode
962	TUNNELESCAPE	Breaks out of an established tunnel
970	PDPMODE	Selects the PDP mode and dynamics
1000	SBASECUTOFF	Sets SBAS satellite elevation cut-off
1062	HDTOUTTHRESHOLD	Controls the NMEA GPHDT log output
1082	HEADINGOFFSET	Adds heading and pitch offset values
1091	SETCANNAME	Sets the CAN name fields
1114	GALECUTOFF	Sets elevation cut-off angle for Galileo satellites
1135	SETROVERID	Sets the Rover ID output in ROVERPOS, HEADING2, ALIGNBSLNXYZ and ALIGNBSLNENU logs

OEM6 Commands in Numerical Order		
Meassage ID	**ASCIIName**	**Description**
1150	SETUTCLEAPSECONDS	Sets when future leap seconds take effect
1199	OMNIUSEGLONASS	Enables/disables GLONASS in OmniStar
1200	ASSIGNLBAND2	Sets L-band satellite communication parameters
1215	IONOCONDITION	Sets ionospheric condition
1216	SETRTCMRXVERSION	Sets the expected RTCM standard input
1217	FORCEGLOL2CODE	Forces the receiver to track L2C or P-code
1218	SOFTLOADDATA	Uploads data for soft load
1219	SOFTLOADSETUP	Configures the soft load process
1237	SETTIMEBASE	Sets primary and backup systems for time base
1243	IPCONFIG	Configures network IP settings
1244	DNSCONFIG	Manually configures DNS servers
1245	ETHCONFIG	Configures Ethernet physical layer
1246	SERIALCONFIG	Configures serial port settings
1247	ECHO	Sets port echo
1248	ICOMCONFIG	Configures IP virtual COM port
1249	NTRIPCONFIG	Configures NTRIP
1260	GENERATERTKCORRECTIONS	Sends a preconfigured set of RTK corrections
1285	RAIMMODE	Configures RAIM mode
1296	GENERATEDIFFCORRECTIONS	Sends a preconfigured set of differential corrections
1322	SETRTCMTXVERSION	Sets the expected RTCM transmission standard input
1323	ALIGNAUTOMATION	Configures the ALIGN plug and play feature

OEM6 Commands in Numerical Order		
Meassage ID	**ASCIIName**	**Description**
1326	TRACKSV	Overrides the automatic satellite/channel assignment for all satellites with manual instructions
1343	NTRIPSOURCETABLE	Sets the NTRIPCASTER ENDPOINTS to be used for the SOURCETABLE log
1349	GENERATEALIGNCORRECTIONS	Configures the ALIGN Master and start sending out ALIGN RTCA corrections through the specified port
1350	QZSSECUTOFF	Sets the elevation cut-off angle for QZSS satellites

When the receiver is first powered up, or after a FRESET command, all commands revert to their factory default settings. The SAVECONFIG command can be used to modify the power-on defaults. Use the RXCONFIG log to determine command and log settings.

Ensure that all windows, other than the Console window, are closed in NovAtel's Control and Display Unit (CDU) user interface before you issue the SAVECONFIG command.

FRESET STANDARD causes all previously stored user configurations saved to non-volatile memory to be erased (including Saved Config, Saved Almanac, Saved Ephemeris, and L-band-related data, excluding subscription information).

2.4 Factory Defaults

When the receiver is first powered up, or after a FRESET command (see *page 127*), all commands revert to their factory default settings. When you use a command without specifying its optional parameters, it may have a different command default than the factory default. The SAVECONFIG command (see *page 204*) can be used to save these defaults. Use the RXCONFIG log (see *page 605*) to reference any default command and log settings.

2.5 Command Reference

When you use a command without specifying its optional parameters, it may have a different command default than the factory default. See *Section 2.4* starting on *Page 55* for the factory default settings and the individual commands in the sections that follow for their command defaults.

2.5.1 ADJUST1PPS Adjusts the receiver clock

Use this command to adjust the receiver clock or as part of the procedure to transfer time between receivers. The number of pulses per second (PPS) is always set to 1 Hz with this command. It is typically used when the receiver is not adjusting its own clock and is using an external reference frequency.

To disable the automatic adjustment of the clock, refer to the CLOCKADJUST command on *Page 82*. To configure the receiver to use an external reference oscillator, see the EXTERNALCLOCK command on *Page 116*.

The ADJUST1PPS command can be used to:

1. Manually shift the phase of the clock
2. Adjust the phase of the clock so that the output 1PPS signal matches an external signal
3. Set the receiver clock close to that of another GNSS receiver
4. Set the receiver clock exactly in phase of another GNSS receiver

1. The resolution of the clock synchronization is 50 ns.
2. To adjust the 1PPS output when the receiver's internal clock is being used and the CLOCKADJUST command is enabled, use the CLOCKOFFSET command on *Page 88*.
3. If the 1PPS rate is adjusted, the new rate does not start until the next second begins.

Figure 1 on *Page 57* shows the 1PPS alignment between a Fine and a Cold Clock receiver. See also the TIMESYNC log on *page 676* and the *Transfer Time Between Receivers* section in the *OEM6 Family Installation and Operation User Manual*.

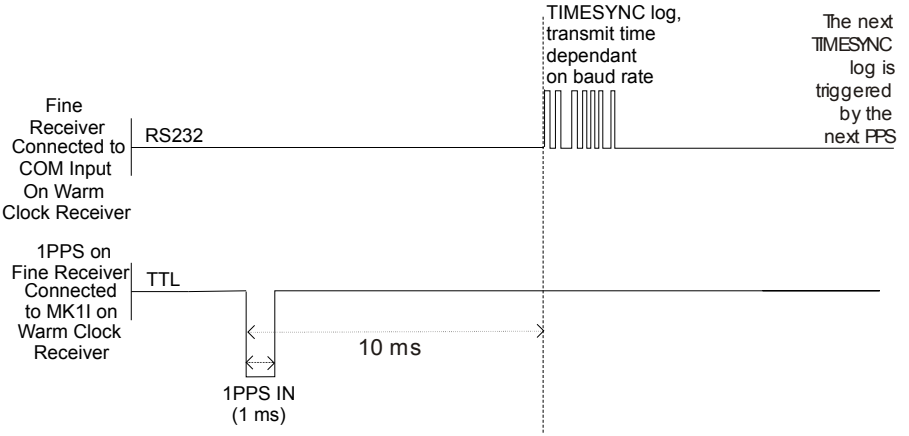


Figure 1: 1PPS Alignment

The 1PPS is obtained from different receivers in different ways. For more information about 1PPS alignmnet, refer to the OEM6 Installation and Operation Guide found on our website at http://www.novatel.com/support/firmware-software-and-manuals/.

Alternatively, the 1PPS signal can be set up to be output on the RTS signal of COM1, COM2, or COM3, or the DTR signal of COM2 using the COMCONTROL command, see *page 91*. The accuracy of the 1PPS is less using this method, but may be more convenient in some circumstances.

To find out the time of the last 1PPS output signal use the TIMESYNCA/B output message, see *page 676*, which can be output serially on any available COM port, for example:

```
LOG COM1 TIMESYNCA ONTIME 1
```

Abbreviated ASCII Syntax: **Message ID: 429**

ADJUST1PPS mode [period] [offset]

Factory Default:

adjust1pps off

ASCII Example:

adjust1pps mark continuous 240

You can use the ADJUST1PPS command to synchronize two OEM6 cards in a primary/secondary relationship to a common external clock.

At the Primary Receiver:

LOG COM2 TIMESYNCa ONTIME 1

clockadjust DISABLE

EXTERNALCLOCK OCXO (you can choose rubidium, cesium or user instead)

EXTERNALCLOCK FREQUENCY 10 (you can choose 5 instead)

At the Secondary Receiver:

interfacemode com2 novatel novatel

clockadjust disable

adjust1pps mark (or markwithtime or time depending on your connection, see *Figure 2* on *Page 59*)

externalclock ocxo (you can choose rubidium, cesium or user instead)

externalclock frequency 10 (you can choose 5 instead)

Connections:

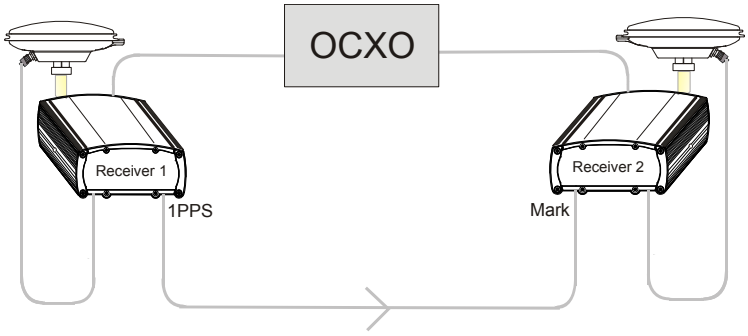
Null modem cable connected from Primary COM2 to Secondary COM2

OCXO signal sent through a splitter to feed both the Primary and Secondary external clock inputs

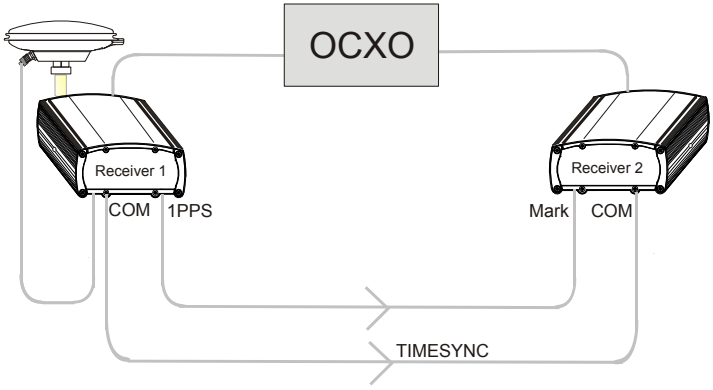
Primary 1PPS (pin# 2) connected to Secondary MKI (Mark Input, pin# 4)

Make sure that you connect everything before you apply power. If power is applied and the OEM6 receivers have acquired satellites before the OCXO and/or 1PPS = MKI is set up, the times reported by the TIMESYNC logs still diverge. We noted that after the clock model was stabilized at state 0, the time difference between the Primary and Secondary reported by the TIMESYNC log was less than 10 ns.

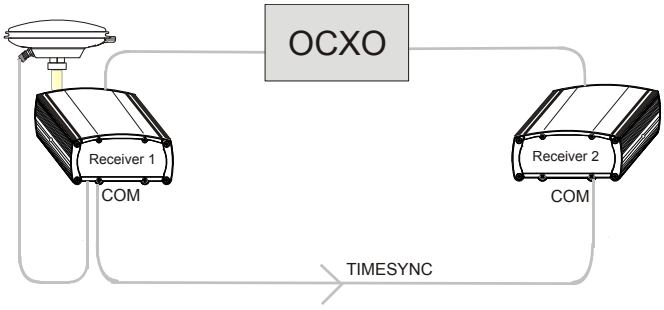
In *Figure 2* on *Page 59*, the examples are for the transfer of time. If you need position, you must be tracking satellites and your receiver must have a valid almanac.



adjust1pps mark (if Receiver 2 is not in coarsetime, the input is ignored)



adjust1pps markwithtime (will get to finetime)



adjust1pps time (will only get to coarsetime)

Figure 2: ADJUST1PPS Connections[1]

1. These examples are for the transfer of time. If you need position, you must be tracking satellites and your receiver must have a valid almanac.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ADJUST-1PPS header	-	-	This field contains the command name	-	H	0
2	mode	OFF	0	Disables ADJUST1PPS	Enum	4	H
		MANUAL	1	Immediately shifts the receivers time by the offset field in ns. The period field has no effect in this mode. This command does not affect the clock state			
		MARK[a]	2	Shifts the receiver time to align its 1PPS with the signal received in the MK1I port adjusted by the offset field in ns. The effective shift range is ± 0.5 s			
		MARKWITHTIME[b]	3	Shifts the receiver time to align its 1PPS with the signal received in the MK1I port adjusted by the offset field in ns, and sets the receiver TOW and week number, to that embedded in a received TIMESYNC log, see *Page 676*. It also sets the receiver Time Status to that embedded in the TIMESYNC log, which must have arrived between 800 and 1000 ms prior to the MK1I event (presumably the 1PPS from the Primary), or it is rejected as an invalid message			
		TIME	4	If the receiver clock is not at least COARSE adjusted, this command enables the receiver to COARSE adjust its time upon receiving a valid TIMESYNC log in any of the ports. The clock state embedded in the TIMESYNC log must be at least FINE or FINESTEERING before it is considered. The receiver does not use the MK1I event in this mode			

3	period	ONCE	0	The time is synchronized only once (default). The ADJUST1PPS command must be re-issued if another synchronization is required.	Enum	4	H+4
		CONTINUOUS	1	The time is continuously monitored and the receiver clock is corrected if an offset of more than 50 ns is detected.			
4	offset	-2147483648 to +2147483647		Allows the operator to shift the Secondary clock in 50 ns increments. In MANUAL mode, this command applies an immediate shift of this offset in ns to the receiver clock. In MARK and MARKWITHTIME mode, this offset shifts the receiver clock with respect to the time of arrival of the MK1I event. If this offset is zero, the Secondary aligns its 1PPS to that of the signal received in its MK1I port. For example, if this value was set to 50, then the Secondary would set its 1PPS 50 ns ahead of the input signal and if this value was set to -100 then the would set its clock to 100 ns behind the input signal. Typically this offset is used to correct for cable delay of the 1PPS signal (default=0).	Long	4	H+8

a. Only the MK1I input can be used to synchronize the 1PPS signal. Synchronization cannot be done using the MK2I input offered on some receivers.

b. It is presumed that the TIMESYNC log, see *Page 676*, was issued by a Primary GNSS receiver within 1000 ms, but not less than 800 ms, of the last 1PPS event, see *Figure 1, 1PPS Alignment on Page 57.* Refer also to the *Transfer Time Between Receivers* section in the *OEM6 Family Installation and Operation User Manual*.

2.5.2 ALIGNAUTOMATION to configure ALIGN Plug and Play Feature

This command configures the ALIGN plug and play feature. Use this command to enable/disable the plug and play feature, to set the rover com port to which master is connected, to set the baud rate for communication, to set the intended operation rate using this command, and to enable or disable sending the HEADINGEXTB back to the Master receiver.

On issuing this command at ALIGN Rover, Rover will automatically sync with Master and configure it to send corrections at the specified baud rate and specified data rate.

This command should only be issued at ALIGN Rover.

Abbreviated ASCII Syntax: **Message ID: 1323**

alignautomation option [comport] [baudrate][datarate][headingextboption]

Factory Default:

alignautomation disable

Example:

alignautomation enable com2 230400 10 on

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ALIGNAUTOMATION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	option	ENABLE or DISABLE		Enable or disable the plug and play feature	ENUM	4	H
3	comport	COM1, COM2 or COM3		Rover com port to which master is connected (default: COM2)	ENUM	4	H+4
4	baudrate	9600, 19200, 38400, 57600, 115200, 230400, 460800, or 921600		Intended baud rate for data transmission (default: 230400)	ULONG	4	H+8
5	datarate	1, 2, 4, 5, 10 or 20 Hz		Rate at which heading output is required (default: 10 Hz)	ULONG	4	H+12
6	headingextboption	ON or OFF		Enable or disable sending HEADINGEXTB back to the Master (default: ON)	ENUM	4	H+16

2.5.3 ANTENNAMODEL Enters/changes rover antenna model

This command allows you to enter or change an antenna model for a rover receiver. Setting this value changes the appropriate field in RTCM23, RTCM1007 and RTCM1008 messages.You can set the antenna set-up ID to any value from 0-255. See also BASEANTENNAMODEL, *page 80*, to set these parameters for the base, and RTKANTENNA, *page 191*.

Phase center offsets are entered as northing, easting and up. The PCV (phase center variation) entries follow the NGS standard, and correspond to the phase elevation at 5 degree increments starting at 90 degrees and decreasing to 0. All units are in mm.

1. L1/L2 processing should include both L1 and L2 values, or the resulting values might be incorrect. Since the phase measurement itself is corrected with the L1/L2 difference, failure to enter these values could result in bad position fixes.
2. For proper usage, the rover receiver needs to have both ANTENNAMODEL and BASEANTENNAMODEL data entered locally. Existing differential messaging standards do not include transmission of all data found in BASEANTENNAMODEL.
3. It is recommended that the ANTENNNAMODEL, BASEANTENNAMODEL and RTKANTENNA commands are used together and only used if complete antenna model information is available. These commands are best used in high-precision static survey situations where antenna models are available for the base and rover receivers.

Abbreviated ASCII Syntax: **Message ID: 841**

ANTENNAMODEL name SN setupID type [L1 offset N] [L1 offset E] [L1 offset UP] [L1 var] [L2 offset N] [L2 offset E] [L2 offset UP] [L2 var]

Factory Default:

antennamodel none none 0 none

ASCII Example:

```
antennamodel 702gg nae07070025 3 user 3.0 -1.0 68.4 0.0 0.0
0.1 0.0 0.0 -0.2 -0.5 -0.8 -1.1 -1.3 -1.4 -1.7 -1.7 -1.8
-1.8 -1.4  -0.4 0.0 0.0 -0.6 -1.4 70.9 0.0 -0.9 -1.3 -1.5
-1.5 -1.5 -1.6 -1.7 -2.0 -2.2 -2.4 -2.7 -2.8 -2.9 -2.8 -2.7
-2.3 0.0 0.0
```

This example is using absolute calibration values from NGS for a NovAtel 702 Antenna.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ANTENNA-MODEL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	name			Antenna name	String[32]	Vari-able [a]	H
3	SN			Antenna serial number	String[32]	Vari-able [a]	Variable
4	setupID			Setup identification - setting this value changes the appropriate field in RTCM23, RTCM1007 and RTCM1008, see *Pages 535, 569* and *571* respectively	Ulong	4	Variable
5	type[b]			Antenna model type None = No antenna 1 = User antenna	Enum	4	Variable
6	L1 offset N			L1 phase offsets northing (default = 0.0)	Double	8	Variable
7	L1 offset E			L1 phase offsets easting (default = 0.0)	Double	8	Variable
8	L1 offset UP			L1 phase offsets up (default = 0.0)	Double	8	Variable
9	L1 var			L1 phase center variations (default = 0.0 *for all 19*)	Double [19]	152	Variable
10	L2 offset N			L2 phase offsets northing (default = 0.0)	Double	8	Variable
11	L2 offset E			L2 phase offsets easting (default = 0.0)	Double	8	Variable
12	L2 offset UP			L2 phase offsets up (default = 0.0)	Double	8	Variable
13	L2 var			L2 phase center variations (default = 0.0 *for all 19*)	Double [19]	152	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

b. This should always be a user antenna when data is being entered manually for phase center offsets and/or phase center variation arrays.

2.5.4 ANTENNAPOWER Controls power to the antenna

This command enables or disables the supply of electrical power from the internal (refer to the *OEM6 Family Installation and Operation User Manual* for information about supplying power to the antenna) power source of the receiver to the low-noise amplifier (LNA) of an active antenna.

There are several bits in the receiver status (see *Table 109, Receiver Status* on *page 611*) that pertain to the antenna. These bits indicate whether the antenna is powered (internally or externally) and whether it is open circuited or short circuited.

On start-up, the ANTENNAPOWER is set to ON.

Abbreviated ASCII Syntax: **Message ID: 98**

ANTENNAPOWER switch

Factory Default:

antennapower on

ASCII Examples:

antennapower on

antennapower off

antennapower on3v3

For the OEM628 receiver, it is possible to supply power to the LNA of an active antenna either from the antenna port of the receiver itself or from an external source. The internal antenna power supply of the receiver can produce 5 VDC +/-5% at up to 100 mA. This meets the needs of any of NovAtel's dual-frequency GNSS antennas, so, in most cases, an additional LNA power supply is not required.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ANTENNAPOWER header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	OFF	0	Disables antenna power	Enum	4	H
		ON	1	Enables antenna power (5V)			
		ON3V3	2	Enables antenna power (3V)			

2.5.5 APPLICATION

Abbreviated ASCII Syntax: **Message ID: 413**

APPLICATION

Factory Default:

application start

ASCII Examples:

application remove

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	Application header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	Start	STOP	0	Stops application	Enum	4	H
		START	1	Starts applicaiton			
		REMOVE	2	Removes applicaiton			
3	Parameter	0-		Sets applicaiton parameter (defalt=0)	Ulong	4	H+4
4	Priority	0-		Sets applicaiotn priority (default=1)	Long	4	H+8
5	Stack size	0-		Sets applicaiton stack size (default=1000)	Long	4	H+12

2.5.6 ASSIGN Assigns a channel to a PRN

1. The ASSIGN command should only be used by advanced users.
2. Assigning a SV channel sets the forced assignment bit in the channel tracking status field which is reported in the RANGE and TRACKSTAT logs
3. Assigning a PRN to a SV channel does not remove the PRN from the search space of the automatic searcher; only the SV channel is removed (that is, the searcher may search and lock onto this PRN on another channel). The automatic searcher only searches for PRNs 1 to 32 for GPS channels, PRNs 38 to 61 for GLONASS (where available), PRNs 1-36 for Galileo (where available) and PRNs 120 to 138 for SBAS channels.
4. GLONASS SVs cannot be assigned if there is no information on GLONASS frequencies and matching slot numbers.

This command may be used to aid in the initial acquisition of a satellite by allowing you to override the automatic satellite/channel assignment and reacquisition processes with manual instructions. The command specifies that the indicated tracking channel search for a specified satellite at a specified Doppler frequency within a specified Doppler window.

The instruction remains in effect for the specified SV channel and PRN, even if the assigned satellite subsequently sets. If the satellite Doppler offset of the assigned SV channel exceeds that specified by the *window* parameter of the ASSIGN command, the satellite may never be acquired or re-acquired. If a PRN has been assigned to a channel and the channel is currently tracking that satellite, when the channel is set to *AUTO* tracking, the channel immediately idles and returns to automatic mode.

To cancel the effects of *ASSIGN*, you must issue one of the following:

- The *ASSIGN* command with the *state* set to *AUTO*
- The *UNASSIGN* command
- The *UNASSIGNALL* command

These return SV channel control to the automatic search engine immediately.

Table 12: Channel State

Binary	ASCII	Description
0	IDLE	Set the SV channel to not track any satellites
1	ACTIVE[a]	Set the SV channel active (default)
2	AUTO	Tell the receiver to automatically assign PRN codes to channels
3	NODATA	Tell the receiver to track without navigation data

a. A PRN number is required when using the ACTIVE channel state in this command.

Abbreviated ASCII Syntax: **Message ID: 27**

ASSIGN channel [state] [prn [Doppler [Doppler window]]]

ASCII Example 1:

assign 0 active 29 0 2000

In example 1, the first SV channel is acquiring satellite PRN 29 in a range from -2000 Hz to 2000 Hz until the satellite signal has been detected.

ASCII Example 2:

assign 11 28 -250 0

SV channel 11 is acquiring satellite PRN 28 at an offset of -250 Hz only.

ASCII Example 3:

assign 11 idle

SV channel 11 is idled and does not attempt to search for satellites.

OEM6 cards have 4 channels available for SBAS. They automatically use the GEO satellites with the highest elevations. You can use the ASSIGN command to enter a GEO PRN manually.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ASSIGN header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively (see *1.1, Message Types* on *page 19)*.	-	H	0
2	channel	0 to *n*, where *n* is the number of the last channel in the current channel configuration		Desired SV channel number where channel 0 is the first SV channel. The last channel depends on your model configuration.	ULong	4	H
3	state	See *Table , These return SV channel control to the automatic search engine immediately.* on *page 67*		Set the SV channel state.	Enum	4	H+4
4	prn	GPS: 1-32 SBAS: 120-138 GLONASS: see *Section 1.3* on *page 31*. Galileo: 1-36 QZSS: 193-197		Optional satellite PRN code from 1 to 32 for GPS channels, 38 to 61 for GLONASS, 1 to 36 for Galileo and 120 to 138 for SBAS channels. If not included in the command line, the state parameter must be set to IDLE.	Long	4	H+8
5	Doppler	-100 000 to 100 000 Hz		Current Doppler offset of the satellite Note: Satellite motion, receiver antenna motion and receiver clock frequency error must be included in the calculation of Doppler frequency. (default = 0)	Long	4	H+12
6	Doppler window	0 to 10 000 Hz		Error or uncertainty in the Doppler estimate above. Note: This is a ± value. Example: 500 for ± 500 Hz. (default = 4 500)	ULong	4	H+16

2.5.7 ASSIGNALL Assigns all channels to a PRN

The ASSIGNALL command should only be used by advanced users.

This command allows you to override the automatic satellite/channel assignment and reacquisition processes for all receiver channels with manual instructions.

Abbreviated ASCII Syntax: **Message ID: 28**

ASSIGNALL [system][state][prn [Doppler [Doppler window]]]

Table 13: Channel System

Binary	ASCII	Description
3	ALL	All systems
99	GPS	GPS system
100	SBAS	SBAS system
101	GLONASS	GLONASS system
102	GALILEO	GALILEO system
103	COMPASS	COMPASS system
104	QZSS	QZSS system

1. Only GLONASS satellites that are in the almanac are available to assign using a slot number in the ASSIGN command. The possible range is still 38 to 61.
2. The optional *system* field indicates the channel type the command is to use. For example, the command input `ASSIGNALL GPSL1 IDLE` idles all GPS L1 channels on the receiver (GPSL1 is the system in this case). If the receiver is not configured with any GPS L1 channels, the command has no effect.
3. The ASSIGNALL command cannot be used as a method of changing the receiver's channel configuration. For example, changing all the GPS L1 and GPS L2 channels to track L1 only. Channel configuration can only be modified by purchasing the appropriate software model.

ASCII Example 1:

assignall glol1l2 idle

In example 1, all GLONASS L1L2 channels are idled out essentially stopping the receiver from tracking GLONASS.

ASCII Example 2:

assignall glol1l2 auto

In example 2, all GLONASS L1L2 channels are enabled in auto mode. This enables the receiver to automatically assign channels to track the available GLONASS satellites.

This command is the same as ASSIGN except that it affects **all** SV channels.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ASSIGN-ALL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	system	See *Table*		System that SV channel is tracking	Enum	4	H
3	state	See *Table , These return SV channel control to the automatic search engine immediately.* on *page 67*		Set the SV channel state	Enum	4	H+4
4	prn	GPS: 1-32 SBAS: 120-138 GLONASS: see *Section 1.3* on *page 31*. Galileo: 1-36 QZSS: 193-197		Optional satellite PRN code from 1 to 32 for GPS channels, 38 to 61 for GLONASS, 1 to 36 for Galileo and 120 to 138 for SBAS channels. If not included in the command line, the state parameter must be set to idle.	Long	4	H+8
5	Doppler	-100 000 to 100 000 Hz		Current Doppler offset of the satellite Note: Satellite motion, receiver antenna motion and receiver clock frequency error must be included in the calculation of Doppler frequency. (default = 0)	Long	4	H+12
6	Doppler window	0 to 10 000 Hz		Error or uncertainty in the Doppler estimate above.This is a ± value (for example, 500 for ± 500 Hz). (default =4500)	ULong	4	H+16

These command examples are only applicable to specific receiver models.

1. The following command applies to receiver models tracking only L1 frequencies:

```
assignall gpsl1 active 29 0 2000
```

2. The following command applies to receiver models tracking both L1 and L2 frequencies:

```
assignall gpsl112,28,-250,0
```

3. If you use the *system* field with this command and the receiver has no channels configured with that channel system, the command has no effect on the receiver's tracking state.

2.5.8 ASSIGNLBAND Sets L-band satellite communication parameters

This command enables a receiver channel to track the specified L-band signal at a specified frequency and baud rate.

> In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR, or use of other DGPS service is required. Contact NovAtel Inc. for more details.

Abbreviated ASCII Syntax: **Message ID: 729**

ASSIGNLBAND mode [freq] [baud]

Factory Default:

assignlband idle

ASCII Example:

assignlband omnistar 1536782 1200

Beam Frequencies

The OmniSTAR beam frequency chart can be found at http://www.omnistar.com/chart.html.

For example:Use OmniSTAR VBS

assignlband omnistar <freq> 1200

psrdiffsource omnistar

Eastern US (Coverage is Northern Canada to southern Mexico) 1557835 or 1557835000

> OmniSTAR has changed channels (frequencies) on the AMSC Satellite that broadcasts OmniSTAR corrections for North America. NovAtel receivers do not need a firmware change. To change frequencies, connect your receiver and issue an ASSIGNLBAND or ASSIGNLBAND2 command. For example, the Western Beam frequency as stated on OmniSTAR's website is 1557.855 MHz. Input into the receiver with the ASSIGNLBAND command: assignlband omnistar 1557855 1200

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ASSIGNLBAND header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively (see *1.1, Message Types* on *page 19*).	-	H	0
2	mode	See *Table 14*		Set the mode and enter specific frequency and baud rate values	Enum	4	H
3	freq[a]	1525000 to 1560000 or 1525000000 to 1560000000		L-band service beam frequency of satellite (Hz or kHz). See also *Beam Frequencies* on *page 73*. (default = 1545000)	Ulong	4	H+4
4	baud	300, 600, 1200, 2400 or 4800		Data rate for communication with L-band satellite (default = 1200)	Ulong	4	H+8

a. The frequency assignment can be made in kHz or Hz. For example:
ASSIGNLBAND OMNISTAR 1557855000 1200
ASSIGNLBAND OMNISTAR 1557855 1200

Table 14: L-band Mode

Binary	ASCII	Description
0	Reserved	
1	OMNISTAR	When you select OmniSTAR, enter a dedicated frequency and baud rate.
2	Reserved	
3	IDLE	When you select IDLE, the receiver is configured to stop tracking any L-band satellites. The 'freq' and 'baud' fields are optional so that you may select IDLE without specifying the other fields.

Table 14: L-band Mode

Binary	ASCII	Description
4	OMNISTARAUTO	When you select OMNISTARAUTO, the receiver automatically selects the best OmniSTAR beam to track based on the receiver's position. This requires the receiver to have a downloaded satellite list from an OmniSTAR satellite. Therefore, a manual assignment is necessary the first time an OmniSTAR satellite is assigned on a new receiver. After collection, the satellite list is stored in NVM for subsequent auto assignments. Lists are considered valid for 6 months and are constantly updated while an OmniSTAR signal is tracking. If the receiver has a valid satellite list, it is reported in a status bit in the LBANDSTAT log, see *page 404*. [a]
5	OMNISTARNARROW	When you select OMNISTARNARROW, enter a dedicated frequency and baud rate. For re-acquisitions of the L-band signal, the receiver uses a 1500 Hz search window.

a. The receiver will always track an available local beam over a global beam. The receiver constantly monitors the satellite list to ensure it is tracking the best one and automatically switches beams if it is not tracking the best one. You can view the satellite list by logging the OMNIVIS message, see *page 432*.

2.5.9 ASSIGNLBAND2 Sets L-band satellite communication parameters

This command enables a receiver channel to track the specified L-band signal at a specified frequency and baud rate as ASSIGNLBAND but you can also specify the OmniSTAR satellite service ID number. In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR, or use of other DGPS service is required. Contact NovAtel Inc. for more details.

Abbreviated ASCII Syntax: **Message ID: 1200**

ASSIGNLBAND2 mode [freq] [baud] [id]

Factory Default:

assignlband2 idle

ASCII Example:

assignlband2 omnistar 1557855000 1200 c685

Beam Frequencies

Use OmniSTAR VBS

assignlband2 omnistar <freq> 1200

psrdiffsource omnistar

The OmniSTAR beam frequency chart can be found at http://www.omnistar.com/chart.html.

For example:

Eastern US (Coverage is Northern Canada to southern Mexico) 1557835 or 1557835000

OmniSTAR has changed channels (frequencies) on the AMSC Satellite that broadcasts OmniSTAR corrections for North America. NovAtel receivers do not need a firmware change. To change frequencies, connect your receiver and issue an ASSIGNLBAND or ASSIGNLAND2 command. For example, the Western Beam frequency as stated on OmniSTAR's website is 1557.8550 MHz. Input into the receiver with the ASSIGNLBAND command: assignlband omnistar 1557855 1200

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ASSIGNLBAND2 header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively (see *1.1, Message Types* on *page 19)*.	-	H	0
2	mode	See *Table 14*		Set the mode and enter specific frequency and baud rate values	Enum	4	H
3	freq[a]	1525000 to 1560000 or 1525000000 to 1560000000		L-band service beam frequency of satellite (Hz or kHz). See also *Beam Frequencies* on *page 73*. (default = 1545000)	Ulong	4	H+4
4	baud	300, 600, 1200, 2400 or 4800		Data rate for communication with L-band satellite (default = 1200)	Ulong	4	H+8
5	ID	0x0, 0xC685, 0x2873 or 0xFCEE		OmniSTAR satellite service ID number (default=0x0)	Ulong	4	H+12

a. The frequency assignment can be made in kHz or Hz. For example:
ASSIGNLBAND2 OMNISTAR 1557855000 1200 c685
ASSIGNLBAND2 OMNISTAR 1557855 1200 c685

2.5.10 AUTH Adds authorization code for new model

This command is used to add or remove authorization codes from the receiver. Authorization codes are used to authorize models of software for a receiver. The receiver is capable of keeping track of 5 authorization codes at one time. The MODEL command (see page *168*)can then be used to switch between authorized models. The VALIDMODELS log (see page *680*) lists the current available models in the receiver. This simplifies the use of multiple software models on the same receiver.

If there is more than one valid model in the receiver, the receiver either uses the model of the last auth code entered via the AUTH command or the model that was selected by the MODEL command, whichever was done last. Both the AUTH and MODEL commands cause a reset automatically.

Authorization codes are firmware version specific. If the receiver firmware is updated, it is necessary to acquire new authorization codes for the required models. If you wish to update the firmware in the receiver, please contact NovAtel Customer Support.

Removing an authorization code will cause the receiver to permanently lose this information.

Abbreviated ASCII Syntax: **Message ID: 49**

AUTH [state] part1 part2 part3 part4 part5 model [date]

Input Example:

auth add t48jf2,w25dbm,jh46bj,2wghmj,8jw5tw,g2sr0rccr,101114

When you want to easily upgrade your receiver without returning it to the factory, our unique field-upgradeable feature allows you buy the equipment that you need today, and upgrade them without facing obsolescence.

When you are ready to upgrade from one model to another, call 1-800-NOVATEL to speak with our Customer Support/Sales Personnel, who can provide the authorization code that unlocks the additional features of your GNSS receiver. This procedure can be performed at your work-site and takes only a few minutes.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	AUTH header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	state	REMOVE [a]	0	Remove the authcode from the system.	Enum	4	H
		ADD	1	Add the authcode to the system. (default)			
3	part1	6 character ASCII string		Authorization code section 1.	String	16	H+4
4	part2	6 character ASCII string		Authorization code section 2.	String	16	H+20
5	part3	6 character ASCII string		Authorization code section 3.	String	16	H+36
6	part4	6 character ASCII string		Authorization code section 4.	String	16	H+52
7	part5	6 character ASCII string		Authorization code section 5.	String	16	H+68
8	model	Alpha numeric	Null terminated	Model name of the receiver	String [max. 16]	Variable [b]	Variable
9	date	Numeric	Null terminated	Expiry date entered as yymmdd in decimal.	String [max. 7]	Variable [a]	Variable

a. For this parameter, the Part1-Part5 fields can be entered as 0 0 0 0 0, and only the model name entered.

b. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

2.5.11 BASEANTENNAMODEL Enters/changes base antenna model

This command allows you to enter or change an antenna model for a base receiver. Setting this value changes the appropriate field in RTCM23, RTCM1007 and RTCM1008 messages.You can set the antenna set-up ID to any value from 0-255. See also ANTENNAMODEL, *page 80*, to set these parameters at the rover, and RTKANTENNA, *page 191*.

Phase center offsets are entered as northing, easting and up. The PCV (phase center variation) entries follow the NGS standard, and correspond to the phase elevation at 5 degree increments starting at 90 degrees and decreasing to 0. All units are in mm.

1. L1/L2 processing should include both L1 and L2 values, or the resulting values might be incorrect. Since the phase measurement itself is corrected with the L1/L2 difference, failure to enter these values could result in bad position fixes.
2. It is recommended that the ANTENNNAMODEL, BASEANTENNAMODEL and RTKANTENNA commands are used together and only used if complete antenna model information is available. These commands are best used in high-precision static survey situations where antenna models are available for the base and rover receivers.

Abbreviated ASCII Syntax: **Message ID: 870**

BASEANTENNAMODEL name SN setupID type [L1 offset N] [L1 offset E] [L1 offset UP] [L1 var] [L2 offset N] [L2 offset E] [L2 offset UP] [L2 var]

Factory Default:

baseantennamodel none none 0 none

ASCII Example:

baseantennamodel 702 nvh05410007 1 user

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	BASE-ANTENNA-MODEL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	name			Antenna name	String[32]	Variable [a]	H
3	SN			Antenna serial number	String[32]	Variable [a]	Variable
4	setupID			Setup identification - setting this value changes the appropriate field in RTCM23, RTCM1007 and RTCM1008, see *535, 569* and *571* respectively	Ulong	4	Variable
5	type[b]			Antenna model type 0 = No antenna 1 = User antenna	Enum	4	Variable
6	L1 offset N			L1 phase offsets northing (default = 0.0)	Double	8	Variable
7	L1 offset E			L1 phase offsets easting (default = 0.0)	Double	8	Variable
8	L1 offset UP			L1 phase offsets up (default = 0.0)	Double	8	Variable
9	L1 var			L1 phase center variations (default = 0.0 *for all 19*)	Double [19]	152	Variable
10	L2 offset N			L2 phase offsets northing (default = 0.0)	Double	8	Variable
11	L2 offset E			L2 phase offsets easting (default = 0.0)	Double	8	Variable
12	L2 offset UP			L2 phase offsets up (default = 0.0)	Double	8	Variable
13	L2 var			L2 phase center variations (default = 0.0 *for all 19*)	Double [19]	152	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

b. This should always be a user antenna when data is being entered manually for phase center offsets and/or phase center variation arrays.

2.5.12 CLOCKADJUST Enables clock adjustments

All oscillators have some inherent drift. By default the receiver attempts to steer the receiver's clock to accurately match GPS reference time. If for some reason this is not desired, this behavior can be disabled using the CLOCKADJUST command. The TIME log can then be used to monitor clock drift.

1. .The CLOCKADJUST command should only be used by advanced users.
2. If the CLOCKADJUST command is ENABLED, and the receiver is configured to use an external reference frequency (set in the EXTERNALCLOCK command, see *Page 116*, for an external clock - TCXO, OCXO, RUBIDIUM, CESIUM, or USER), then the clock steering process takes over the VARF output pins and may conflict with a previously entered FREQUENCYOUT command, see *Page 127*.
3. When using the EXTERNALCLOCK and CLOCKADJUST commands together, issue the EXTERNALCLOCK command first to avoid losing satellites.
4. When disabled, the range measurement bias errors continue to accumulate with clock drift.
5. Pseudorange, carrier phase and Doppler measurements may jump if the CLOCKADJUST mode is altered while the receiver is tracking.
6. When disabled, the time reported on all logs may be offset from GPS reference time. The 1PPS output may also be offset. The amount of this offset may be determined from the TIME log, see *page 623*.
7. A discussion on GPS reference time may be found in *Section 1.4, GPS Reference Time Status* on *page 32*.

Abbreviated ASCII Syntax: **Message ID: 15**

CLOCKADJUST switch

Factory Default:

clockadjust enable

ASCII Example:

clockadjust disable

The CLOCKADJUST command can be used to calibrate an internal oscillator. Disable the CLOCKADJUST mode in order find out what the actual drift is from the internal oscillator. Watch the CLOCKMODEL log to see the drift rate and adjust the oscillator until the drift stops.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	CLOCKADJUST header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Disallow adjustment of internal clock	Enum	4	H
		ENABLE	1	Allow adjustment of internal clock			

2.5.13 CLOCKCALIBRATE Adjusts clock steering parameters

This command is used to adjust the control parameters of the clock steering loop. The receiver must be enabled for clock steering before these values can take effect. Refer to the CLOCKADJUST command, see *Page 82*, to enable or disable this feature.

To disable the clock steering process, issue the CLOCKADJUST DISABLE command.

The current values used by the clock steering process are listed in the CLOCKSTEERING log, see *Page 323*.

The values entered using the CLOCKCALIBRATE command are saved to non-volatile memory (NVM). To restore the values to their defaults, the FRESET CLKCALIBRATION command must be used. Issuing FRESET without the CLKCALIBRATION parameter will not clear the values. See *Section 2.5.35* on *page 130* for more details.

Abbreviated ASCII Syntax: **Message ID: 430**

CLOCKCALIBRATE [mode][period] [width] [slope] [bandwidth]

ASCII Example:

clockcalibrate auto

The receiver by default steers its INTERNAL VCTCXO but can be commanded to control an EXTERNAL reference oscillator. Use the EXTERNALCLOCK command, see *page 116*, to configure the receiver to use an external reference oscillator. If the receiver is configured for an external reference oscillator and configured to adjust its clock, then the clock steering loop attempts to steer the external reference oscillator through the use of the VARF signal. Note that the clock steering control process conflicts with the manual FREQUENCYOUT command, see *page 127*. It is expected that the VARF signal is used to provide a stable reference voltage by the use of a filtered charge pump type circuit (not supplied).

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	CLOCKCALIBRATE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	mode	SET	0	Sets the period, pulsewidth, slope, and bandwidth values into NVM for the currently selected steered oscillator (INTERNAL or EXTERNAL)	Enum	4	H
		AUTO	1	Forces the receiver to do a clock steering calibration to measure the slope (change in clock drift rate with a 1 bit change in pulse width), and required pulsewidth, to zero the clock drift rate. After the calibration, these values along with the period and bandwidth are entered into NVM and are then used from this point forward on the selected oscillator.			
		OFF	2	Terminates a calibration process currently underway (default)			
3	period	0 to 262144		Signal period in 25 ns steps. Frequency Output = 40,000,000 / Period. (default = 4400)	Ulong	4	H+4

Continued on next page

Field	Field Type	ASCII Value / Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
4	pulsewidth	The valid range for this parameter is 10% to 90% of the period.	Sets the initial pulse width that should provide a near zero drift rate from the selected oscillator being steered. The valid range for this parameter is 10% to 90% of the period. The default value is 2200. If this value is not known, (in the case of a new external oscillator) then it should be set to ½ the period and the mode should be set to AUTO to force a calibration (default=2200).	Ulong	4	H+8
5	slope		This value should correspond to how much the clock drift changes with a 1 bit change in the pulsewidth m/s/bit. The default values for the slope used for the INTERNAL and EXTERNAL clocks is -2.0 and -0.01 respectively. If this value is not known, then its value should be set to 1.0 and the mode should be set to AUTO to force a calibration. Once the calibration process is complete and using a slope value of 1.0, the receiver should be recalibrated using the measured slope and pulsewidth values (see the CLOCKSTEERING log, on *Page 323*). This process should be repeated until the measured slope value remains constant (less than a 5% change) (default=-2.0).	Float	4	H+12

Continued on next page

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
6	bandwidth			This is the value used to control the smoothness of the clock steering process. Smaller values result in slower and smoother changes to the receiver clock. Larger values result in faster responses to changes in oscillator frequency and faster start-up clock pull-in. The default values are 0.03 and 0.001 Hz respectively for the INTERNAL and EXTERNAL clocks (default=0.03).	Float	4	H+16

2.5.14 CLOCKOFFSET Adjusts for delay in 1PPS output

This command can be used to remove a delay in the PPS output. The PPS signal is delayed from the actual measurement time due to two major factors:

- A delay in the signal path from the antenna to the receiver
- An intrinsic delay through the RF and digital sections of the receiver

The second delay is automatically accounted for by the receiver using a nominal value determined for each receiver type. However, since the delay from the antenna to the receiver cannot be determined by the receiver, an adjustment cannot automatically be made. The CLOCKOFFSET command can be used to adjust for this delay.

Abbreviated ASCII Syntax: **Message ID: 596**

CLOCKOFFSET offset

Factory Default:

clockoffset 0

ASCII Example:

clockoffset -15

There may be small variances in the delays for each cable or card. The CLOCKOFFSET command can be used to characterize each setup. For example, for a cable with a delay of 10 ns, the offset can be set to -10 to remove the delay from the PPS output.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	CLOCKOFFSET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively (see *1.1, Message Types* on *page 19*).	-	H	0
2	offset	±200		Specifies the offset in nanoseconds	Long	4	H

2.5.15 CNOUPDATE Sets the C/No update rate and resolution

This command allows you to set the C/No update rate and resolution.

Abbreviated ASCII Syntax: **Message ID: 849**

CNOUPDATE rate

Factory Default:

cnoupdate default

ASCII Example (rover):

cnoupdate 20hz

Use the CNOUPDATE command for higher resolution C/No measurements, of the incoming GNSS signals, at a higher rate. By default, the C/No values are calculated at approximately 4 Hz, but this command allows you to increase that rate to 20 Hz.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	CNO-UPDATE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	rate	DEFAULT	0	C/No update rate: 0 = Turn off C/No enhancement default = 4 Hz (4 bits/s) 1 = 20 Hz C/No updates (20 bits/s)	ENUM	4	H
		20HZ	1				

2.5.16 COM Configures the COM port

The SERIALCONFIG command replaces this one, see page *212*.

2.5.17 COMCONTROL Controls the RS232 hardware control lines

This command is used to control the hardware control lines of the RS232 ports. The TOGGLEPPS mode of this command is typically used to supply a timing signal to a host PC computer by using the RTS or DTR lines. The accuracy of controlling the COM control signals is better than 900 µs. The other modes are typically used to control custom peripheral devices. Also, it is possible to communicate with all three serial ports simultaneously using this command.

1. If handshaking is disabled, any of these modes can be used without affecting regular RS232 communications through the selected COM port. However, if handshaking is enabled, it may conflict with handshaking of the selected COM port, causing unexpected results.
2. The PULSEPPSLOW control type cannot be issued for a TX signal.
3. Only PULSEPPSHIGH, FORCEHIGH and FORCELOW control types can be used for a TX signal.

Abbreviated ASCII Syntax: **Message ID: 431**

COMCONTROL port signal control

Factory Default:

comcontrol com1 rts default

comcontrol com2 rts default

comcontrol com3 rts default

ASCII Example 1:

serialconfig com1 9600 n 8 1 n (to disable handshaking)

comcontrol com1 rts forcelow

comcontrol com2 dtr togglepps

ASCII Example 2:

comcontrol com1 rts togglepps

comcontrol com2 rts togglepps

comcontrol com3 rts togglepps

ASCII Example 3:

To set a break condition on AUX:

comcontrol aux tx forcelow

A break condition remains in effect until it is cleared.

To clear a break condition on AUX:

comcontrol com1 tx default

or

comcontrol com1 tx forcehigh

Table 15: Tx, DTR and RTS Availability

	Tx Available On:	DTR Available On:	RTS Available On:
OEM628	COM1 and COM2	N/A	COM1 and COM2

COM1 on the OEM628 is user-configurable for RS-422. Refer to the *Technical Specifications* appendix and also the *Connecting Data Communication Equipment* section of the *OEM6 Family Installation and Operation User Manual*.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	COMCONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	port	COM1	1	RS232 port to control. Valid ports are COM1, COM2, and COM3	Enum	4	H
		COM2	2				
		COM3					
3	signal	RTS	0	COM signal to control. The controllable COM signals are RTS, DTR and TX. See also *Table 15, Tx, DTR and RTS Availability* on *page 92*	Enum	4	H+4
		DTR	1				
		TX	2				

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
4	control	DEFAULT	0	Disables this command and returns the COM signal to its default state	Enum	4	H+8
		FORCEHIGH	1	Immediately forces the signal high			
		FORCELOW	2	Immediately forces the signal low			
		TOGGLE	3	Immediately toggles the current sate of the signal			
		TOGGLEPPS	4	Toggles the state of the selected signal within 900 μs after each 1PPS event. The state change of the signal lags the 1PPS by an average value of 450 μs. The delay of each pulse varies by a uniformly random amount less than 900 μs.			
		PULSEPPSLOW	5	Pulses the line low at a 1PPS event and to high 1 ms after it. Not for TX.			
		PULSEPPSHIGH	6	Pulses the line high for 1 ms at the time of a 1PPS event			

2.5.18 DATUM Chooses a datum name type

This command permits you to select the geodetic datum for operation of the receiver. If not set, the factory default value is WGS84. See the USERDATUM command for user definable datums. The datum you select causes all position solutions to be based on that datum.

The transformation for the WGS84 to Local used in the OEM6 family is the Bursa-Wolf transformation or reverse Helmert transformation. In the Helmert transformation, the rotation of a point is counter clockwise around the axes. In the Bursa-Wolf transformation, the rotation of a point is clockwise. Therefore, the reverse Helmert transformation is the same as the Bursa-Wolf.

See *Table 16* on *page 95* for a complete listing of all available predefined datums. The offsets in the table are from your local datum to WGS84.

Abbreviated ASCII Syntax: **Message ID: 160**

DATUM datum

Factory Default:

datum wgs84

ASCII Example:

datum csrs

Also, as an example, you can achieve spatial integrity with Government of Canada maps and surveys if the coordinates are output using the CSRS datum (Datum ID# 64).

Table 16 on *page 95* contains the internal ellipsoid and transformation parameters used in the receiver. The values contained in these tables were derived from the following DMA reports:

1. TR 8350.2 Department of Defense World Geodetic System 1984 and Relationships with Local Geodetic Systems - Revised March 1, 1988.
2. TR 8350.2B Supplement to Department of Defense World Geodetic System 1984 Technical Report - Part II - Parameters, Formulas, and Graphics for the Practical Application of WGS84 - December 1, 1987.
3. TR 8350.2 Department of Defense World Geodetic System 1984 National Imagery and Mapping Agency Technical Report, Third Addition, Amendment 1 - January 3, 2000

By default, NovAtel receivers output positions in WGS84, with the following additional information to consider:

Single	Uses WGS84
SBAS	Corrects to WGS84
EGNOS	Corrects to International Terrestrial Reference System (ITRF) which is compatible with WGS84
OmniSTAR XP/HP	Corrects to ITRF which is compatible with WGS84
OmniSTAR VBS	Corrects to ITRF which is compatible with WGS84
PSRDIFF and RTK	Unknown, as the rover does not know how the user fixed the base position, but must be close to WGS84

Table 16: Reference Ellipsoid Constants

ELLIPSOID	ID CODE	a (metres)	1/f	f
Airy 1830	AW	6377563.396	299.3249646	0.00334085064038
Modified Airy	AM	6377340.189	299.3249646	0.00334085064038
Australian National	AN	6378160.0	298.25	0.00335289186924
Bessel 1841	BR	6377397.155	299.1528128	0.00334277318217
Clarke 1866	CC	6378206.4	294.9786982	0.00339007530409
Clarke 1880	CD	6378249.145	293.465	0.00340756137870
Everest (India 1830)	EA	6377276.345	300.8017	0.00332444929666
Everest (Brunei & E.Malaysia)	EB	6377298.556	300.8017	0.00332444929666
Everest (W.Malaysia & Singapore)	EE	6377304.063	300.8017	0.00332444929666
Geodetic Reference System 1980	RF	6378137.0	298.257222101	0.00335281068118
Helmert 1906	HE	6378200.0	298.30	0.00335232986926
Hough 1960	HO	6378270.0	297.00	0.00336700336700
International 1924	IN	6378388.0	297.00	0.00336700336700
Parameters of the Earth	PZ-90.02	6378136.0	298.26	0.00335280374302
South American 1969	SA	6378160.0	298.25	0.00335289186924
World Geodetic System 1972	WD	6378135.0	298.26	0.00335277945417
World Geodetic System 1984	WE	6378137.0	298.257223563	0.00335281066475

Table 17: Datum Transformation Parameters

Datum ID# [a]	NAME	DX [b]	DY [b]	DZ [b]	DATUM DESCRIPTION	ELLIPSOID
1	ADIND	-162	-12	206	This datum has been updated, see ID# 65 [c]	Clarke 1880
2	ARC50	-143	-90	-294	ARC 1950 (SW & SE Africa)	Clarke 1880
3	ARC60	-160	-8	-300	This datum has been updated, see ID# 66 [c]	Clarke 1880
4	AGD66	-133	-48	148	Australian Geodetic Datum 1966	Australian National
5	AGD84	-134	-48	149	Australian Geodetic Datum 1984	Australian National
6	BUKIT	-384	664	-48	Bukit Rimpah (Indonesia)	Bessel 1841
7	ASTRO	-104	-129	239	Camp Area Astro (Antarctica)	International 1924
8	CHATM	175	-38	113	Chatham 1971 (New Zealand)	International 1924
9	CARTH	-263	6	431	Carthage (Tunisia)	Clarke 1880
10	CAPE	-136	-108	-292	CAPE (South Africa)	Clarke 1880
11	DJAKA	-377	681	-50	Djakarta (Indonesia)	Bessel 1841
12	EGYPT	-130	110	-13	Old Egyptian	Helmert 1906
13	ED50	-87	-98	-121	European 1950	International 1924
14	ED79	-86	-98	-119	European 1979	International 1924
15	GUNSG	-403	684	41	G. Segara (Kalimantan - Indonesia)	Bessel 1841
16	GEO49	84	-22	209	Geodetic Datum 1949 (New Zealand)	International 1924
17	GRB36	375	-111	431	**Do not use.** Use ID# 76 instead. [d]	Airy 1830
18	GUAM	-100	-248	259	Guam 1963 (Guam Island)	Clarke 1866
19	HAWAII	89	-279	-183	**Do not use.** Use ID# 77 or ID# 81 instead. [d]	Clarke 1866

Table 17: Datum Transformation Parameters

Datum ID#	NAME	DX	DY	DZ	DATUM DESCRIPTION	ELLIPSOID
20	KAUAI	45	-290	-172	**Do not use.** Use ID# 78 or ID# 82 instead. [d]	Clarke 1866
21	MAUI	65	-290	-190	**Do not use.** Use ID# 79 or ID# 83 instead. [d]	Clarke 1866
22	OAHU	56	-284	-181	**Do not use.** Use ID# 80 or ID# 84 instead. [d]	Clarke 1866
23	HERAT	-333	-222	114	Herat North (Afghanistan)	International 1924
24	HJORS	-73	46	-86	Hjorsey 1955 (Iceland)	International 1924
25	HONGK	-156	-271	-189	Hong Kong 1963	International 1924
26	HUTZU	-634	-549	-201	This datum has been updated, see ID# 68 [c]	International 1924
27	INDIA	289	734	257	**Do not use.** Use ID# 69 or ID# 70 instead. [d]	Everest (EA)
28	IRE65	506	-122	611	**Do not use.** Use ID# 71 instead. [d]	Modified Airy
29	KERTA	-11	851	5	Kertau 1948 (West Malaysia and Singapore)	Everest (EE)
30	KANDA	-97	787	86	Kandawala (Sri Lanka)	Everest (EA)
31	LIBER	-90	40	88	Liberia 1964	Clarke 1880
32	LUZON	-133	-77	-51	**Do not use.** Use ID# 72 instead. [d]	Clarke 1866
33	MINDA	-133	-70	-72	This datum has been updated, see ID# 73 [c]	Clarke 1866
34	MERCH	31	146	47	Merchich (Morocco)	Clarke 1880
35	NAHR	-231	-196	482	This datum has been updated, see ID# 74 [c]	Clarke 1880
36	NAD83	0	0	0	N. American 1983 (Includes Areas 37-42)	GRS-80
37	CANADA	-10	158	187	N. American Canada 1927	Clarke 1866
38	ALASKA	-5	135	172	N. American Alaska 1927	Clarke 1866

Table 17: Datum Transformation Parameters

Datum ID#	NAME	DX	DY	DZ	DATUM DESCRIPTION	ELLIPSOID
39	NAD27	-8	160	176	N. American Conus 1927	Clarke 1866
40	CARIBB	-7	152	178	This datum has been updated, see ID# 75 [c]	Clarke 1866
41	MEXICO	-12	130	190	N. American Mexico	Clarke 1866
42	CAMER	0	125	194	N. American Central America	Clarke 1866
43	MINNA	-92	-93	122	Nigeria (Minna)	Clarke 1880
44	OMAN	-346	-1	224	Oman	Clarke 1880
45	PUERTO	11	72	-101	Puerto Rica and Virgin Islands	Clarke 1866
46	QORNO	164	138	-189	Qornoq (South Greenland)	International 1924
47	ROME	-255	-65	9	Rome 1940 Sardinia Island	International 1924
48	CHUA	-134	229	-29	South American Chua Astro (Paraguay)	International 1924
49	SAM56	-288	175	-376	South American (Provisional 1956)	International 1924
50	SAM69	-57	1	-41	South American 1969	S. American 1969
51	CAMPO	-148	136	90	S. American Campo Inchauspe (Argentina)	International 1924
52	SACOR	-206	172	-6	South American Corrego Alegre (Brazil)	International 1924
53	YACAR	-155	171	37	South American Yacare (Uruguay)	International 1924
54	TANAN	-189	-242	-91	Tananarive Observatory 1925 (Madagascar)	International 1924
55	TIMBA	-689	691	-46	This datum has been updated, see ID# 85 [c]	Everest (EB)
56	TOKYO	-128	481	664	This datum has been updated, see ID# 86 [c]	Bessel 1841
57	TRIST	-632	438	-609	Tristan Astro 1968 (Tristan du Cunha)	International 1924
58	VITI	51	391	-36	Viti Levu 1916 (Fiji Islands)	Clarke 1880

Table 17: Datum Transformation Parameters

Datum ID#	NAME	DX	DY	DZ	DATUM DESCRIPTION	ELLIPSOID
59	WAK60	101	52	-39	This datum has been updated, see ID# 67 [c]	Hough 1960
60	WGS72	0	0	4.5	World Geodetic System - 72	WGS72
61	WGS84	0	0	0	World Geodetic System - 84	WGS84
62	ZANDE	-265	120	-358	Zanderidj (Surinam)	International 1924
63	USER	0	0	0	User Defined Datum Defaults	User [a]
64	CSRS	Time-variable 7 parameter transformation				
65	ADIM	-166	-15	204	Adindan (Ethiopia, Mali, Senegal & Sudan) [c]	Clarke 1880
66	ARSM	-160	-6	-302	ARC 1960 (Kenya, Tanzania) [c]	Clarke 1880
67	ENW	102	52	-38	Wake-Eniwetok (Marshall Islands) [c]	Hough 1960
68	HTN	-637	-549	-203	Hu-Tzu-Shan (Taiwan) [c]	International 1924
69	INDB	282	726	254	Indian (Bangladesh) [d]	Everest (EA)
70	INDI	295	736	257	Indian (India, Nepal) [d]	Everest (EA)
71	IRL	506	-122	611	Ireland 1965 [d]	Modified Airy
72	LUZA	-133	-77	-51	Luzon (Philippines excluding Mindanoa Is.) [de]	Clarke 1866
73	LUZB	-133	-79	-72	Mindanoa Island [c]	Clarke 1866
74	NAHC	-243	-192	477	Nahrwan (Saudi Arabia) [c]	Clarke 1880
75	NASP	-3	142	183	N. American Caribbean [c]	Clarke 1866
76	OGBM	375	-111	431	Great Britain 1936 (Ordinance Survey) [d]	Airy 1830
77	OHAA	89	-279	-183	Hawaiian Hawaii [d]	Clarke 1866
78	OHAB	45	-290	-172	Hawaiian Kauai [d]	Clarke 1866

Table 17: Datum Transformation Parameters

Datum ID#	NAME	DX	DY	DZ	DATUM DESCRIPTION	ELLIPSOID
79	OHAC	65	-290	-190	Hawaiian Maui [d]	Clarke 1866
80	OHAD	58	-283	-182	Hawaiian Oahu [d]	Clarke 1866
81	OHIA	229	-222	-348	Hawaiian Hawaii [d]	International 1924
82	OHIB	185	-233	-337	Hawaiian Kauai [d]	International 1924
83	OHIC	205	-233	-355	Hawaiian Maui [d]	International 1924
84	OHID	198	-226	-347	Hawaiian Oahu [d]	International 1924
85	TIL	-679	669	-48	Timbalai (Brunei and East Malaysia) 1948 [c]	Everest (EB)
86	TOYM	-148	507	685	Tokyo (Japan, Korea and Okinawa) [c]	Bessel 1841

a. The default user datum is WGS84. See also the USERDATUM and USEREXPDATUM commands starting on *page 253.* The following logs report the datum used according to the OEM card Datum ID column: BESTPOS, BESTUTM, MATCHEDPOS and PSRPOS.

b. The DX, DY and DZ offsets are from your local datum to WGS84.

c. The updated datum have the new x, y and z translation values updated to the latest numbers. The old datum values can still be used for backwards compatibility.

d. Use the corrected datum only (with the higher ID#) as the old datum is incorrect.

e. The original LUZON values are the same as for LUZA but the original has an error in the code.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	Datum Type	See *Table 17*.		The datum to use	Enum	4	H

2.5.19 DGPSEPHEMDELAY Sets DGPS ephemeris delay

The DGPSEPHEMDELAY command is used to set the ephemeris delay when operating as a base station. The ephemeris delay sets a time value by which the base station continues to use the old ephemeris data. A delay of 120 to 300 seconds typically ensures that the rover stations have collected updated ephemeris. After the delay period is passed, the base station begins using new ephemeris data.

The factory default of 120 seconds matches the RTCM standard.

The RTCA Standard stipulates that a base station shall wait five minutes after receiving a new ephemeris before transmitting differential corrections to rover stations that are using the RTCA standard. This time interval ensures that the rover stations have received the new ephemeris, and have computed differential positioning based upon the same ephemeris. Therefore, for RTCA base stations, the recommended ephemeris delay is 300 seconds.

Abbreviated ASCII Syntax: **Message ID: 142**

DGPSEPHEMDELAY delay

Factory Default:

dgpsephemdelay 120

ASCII Example (base):

dgpsephemdelay 120

When using differential corrections, the rover receiver must use the same set of broadcast ephemeris parameters as the base station generating the corrections. The Issue of Ephemeris Data (IODE) parameter is transmitted as part of the differential correction so that the rover can guarantee that its and the base station ephemerides match. The DGPSEPHEMDELAY parameter should be large enough to ensure that the base station is not using a new set of ephemerides that has not yet been received at the rover receiver.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DGPSEPHEMDELAY header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	delay	0 to 600 s		Minimum time delay before new ephemeris is used	ULong	4	H

2.5.20 DGPSTIMEOUT Sets maximum age of differential data

This command is used to set the maximum age of pseudorange differential data to use when operating as a rover station. Pseudorange differential data received that is older than the specified time is ignored. RTK differential data is set at 60 seconds but can be changed using the RTKTIMEOUT command, see *Page 203*. See DGPSEPHEMDELAY on *page 101* to set the ephemeris changeover delay for base stations.

The RTCA Standard for SCAT-I stipulates that the maximum age of differential correction messages cannot be greater than 22 seconds. Therefore, for RTCA rover users, the recommended DGPS delay setting is 22.

Abbreviated ASCII Syntax: **Message ID: 127**

DGPSTIMEOUT delay

Factory Default:

dgpstimeout 300

ASCII Example (rover):

dgpstimeout 60

DGPSTIMEOUT applies to local pseudorange differential (RTCA, RTCM and OmniSTAR VBS) corrections as if they were from a local base station. This also applies to pseudorange differential positioning using RTK corrections.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DGPSTIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	delay	2 to 1000 s		Maximum pseudorange differential age	ULong	4	H

2.5.21 DGPSTXID Sets DGPS station ID

This command sets the station ID value for the receiver when it is transmitting corrections. This allows for the easy identification of which base station was the source of the data.

For example, if you want to compare RTCM and RTCMV3 corrections, you would be easily able to identify their base stations by first setting their respective DGPSTXID values.

Abbreviated ASCII Syntax: **Message ID: 144**

DGPSTXID type ID

Factory Default:

dgpstxid auto "any"

ASCII Examples:

dgpstxid rtcm 2	- using an rtcm type and id
dgpstxid cmr 30	- using a cmr type and id
dgpstxid cmr "any"	- using the default cmr id
dgpstxid rtca d36d	- using an rtca type and id
dgpstxid rtcmv3 2050	- using an rtcmv3 type and id

2.5.22 DIFFCODEBIASCONTROL Enables or disables satellite differential code biases

The purpose of the differential code biases is to correct pseudorange errors that affect the L1/L2 ionospheric corrections. This command enables/disables the biases. A set of biases is included in the firmware, and use of the biases is enabled by default. See also the SETDIFFCODEBIASES command on *page 221*.

Abbreviated ASCII Syntax: **Message ID: 913**

DIFFCODEBIASCONTROL switch

Factory Default:

diffcodebiascontrol enable

Example:

diffcodebiascontrol disable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DIFFCODE-BIAS-CONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Disable the differential code bias	Enum	4	H
		ENABLE	1	Enable the differential code bias			

2.5.23 DLLTIMECONST Sets carrier smoothing

This command replaces the GLOCSMOOTH and CSMOOTH commands. It sets the amount of carrier smoothing to be performed on the code measurements. An input value of 100 corresponds to approximately 100 seconds of smoothing. Upon issuing the command, the locktime (amount of continuous tracking in seconds) for all tracking satellites is reset to zero and each code smoothing filter is restarted. You must wait for at least the length of smoothing time for the new smoothing constant to take full effect. The optimum setting for this command depends on your application

1. This command may not be suitable for every GNSS application.
2. When using DLLTIMECONST in differential mode with the same recievers, the same setting should be used at both the base and rover station. If the base and rover stations use different types of receivers, it is recommended that you use the command default value is at each receiver (DLLTIMECONST <signaltype> 100).

3. There are several considerations when using the DLLTIMECONST command:
   - The attenuation of low frequency noise (multipath) in pseudorange measurements
   - The effect of time constants on the correlation of phase and code observations
   - The rate of “pulling-in” of the code tracking loop (step response)
   - The effect of ionospheric divergence on carrier smoothed pseudorange (ramp response)

   The primary reason for applying carrier smoothing to the measured pseudoranges is to mitigate the high frequency noise inherent in all code measurements. Adding more carrier smoothing by increasing the DLLTIMECONST value filters out lower frequency noise, including some multipath frequencies.

Continued on next page

There are also some adverse effects of higher DLLTIMECONST values on some performance aspects of the receiver. Specifically, the time constant of the tracking loop is directly proportional to the DLLTIMECONST value and affects the degree of dependence between the carrier phase and pseudorange information. Carrier phase smoothing of the code measurements (pseudoranges) is accomplished by introducing data from the carrier tracking loops into the code tracking system. Phase and code data collected at a sampling rate greater than about 3 time constants of the loop are correlated (the greater the sampling rate, the greater the correlation). This correlation is not relevant if only positions are logged from the receiver, but is an important consideration if the data is combined in some other process such as post-mission carrier smoothing. Also, a narrow bandwidth in a feedback loop impedes the ability of the loop to track step functions. Steps in the pseudorange are encountered during initial lock-on of the satellite and when working in an environment conducive to multipath. A low DLLTIMECONST value allows the receiver to effectively adapt to these situations.

Also, increased carrier smoothing may cause problems when satellite signals are strongly affected by the ionosphere. The rate of divergence between the pseudoranges and phase-derived ranges is greatest when a satellite is low in the sky since the GPS signal must travel through a much “thicker” ionosphere. The tracking error of the receiver is greatest at these times when a lot of carrier smoothing is implemented. In addition, changing periods of ionospheric activity (diurnal changes and the 11-year cycle) influences the impact of large DLLTIMECONST values. It is important to realize that the advantages of carrier smoothing do not come without some trade-off in receiver performance. The factory default DLLTIMECONST value of 100 was selected as an optimal compromise of the above considerations. For the majority of applications, this default value should be appropriate. However, the flexibility exists to adjust the parameter for specific applications by users who are familiar with the consequences

Abbreviated ASCII Syntax: **Message ID: 1011**

DLLTIMECONST signaltype timeconst

Factory Defaults:

dlltimeconst <signaltype>100

Example:

dlltimeconst gpsl2c 100

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DLLTIMECONST header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	signal type	See *Table 18*		Signal type	Enum	4	H
	time const			Time constant (sec)	Ulong	4	H+4

Table 18: Signal Type

Value (Binary)	Signal (ASCII)	Description
4161	GPSL1CA	GPS L1 C/A-code
4228	GPSL2Y	GPS L2 P(Y)-code
4229	GPSL2C	GPS L2 C/A-code
4230	GPSL2P	GPS L2 P-code
4295	GPSL5	GPS Safety of life
4296	GPSL5TEST	GPS L5 test
8449	GLOL1CA	GLONASS L1 C/A-code
8450	GLOL1P	GLONASS L1 P-code
8515	GLOL2CA	GLONASS L2 C/A code
8516	GLOL2P	GLONASS L2 P-code
12673	GALE1	Galileo E1

Value (Binary)	Signal (ASCII)	Description
12678	GALE1TEST	Galileo E1 test
12738	GALE5A	Galileo E5A
12743	GALE5ATEST	Galileo E5A test
12803	GALE5B	Galileo E5B
12808	GALE5BTEST	Galileo E5B test
12868	GALALTBOC	Galileo ALT-BOC
12873	GALALTBOCTEST	Galileo ALT-BOC test
16449	SBASL1	SBAS L1
16578	SBASL5	SBAS L5
21185	OMNISTAR	OMNIStar service

2.5.24 DNSCONFIG Manually configures DNS servers

This command is part of the Ethernet set up. It configures the Domain Name Servers (DNS) so that hostnames can be used instead of IP addresses.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1244**

DNSCONFIG number_of_DNS_servers IP

Factory Default:

dnsconfig 0

ASCII Example:

```
DNSCONFIG 2 192.168.1.223 192.168.74.10
```

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	DNSCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	NumDNSServer	None	0	Number of DNS servers	Enum	4	H
		-	1				
		-	2				
3	IP address	xxx.xxx.xxx.xxx (10.0.0.2)		IP address of primary DNS server	String	16	H+4
		xxx.xxx.xxx.xxx (10.0.0.2)		IP address of secondary DNS server			

2.5.25 DYNAMICS Tunes receiver parameters

This command adjusts the receiver dynamics to that of your environment. It is used to optimally tune receiver parameters.

The DYNAMICS command adjusts the Tracking State transition time-out value of the receiver, see *Table 84, Tracking State* on *page 469*. When the receiver loses the position solution, see *Table 56, Solution Status* on *page 302*, it attempts to steer the tracking loops for fast reacquisition (5 s time-out by default). The DYNAMICS command allows you to adjust this time-out value, effectively increasing the steering time. The three states 0, 1, and 2 set the time-out to 5, 10, or 20 s respectively.

1. The DYNAMICS command should only be used by advanced users. The default of AIR should **not** be changed except under very specific conditions.
2. The DYNAMICS command affects satellite reacquisition. The constraint of its filter with FOOT is very tight and is appropriate for a user on foot. A sudden tilted or up and down movement, for example while a tractor is moving slowly along a track, may trip the RTK filter to reset and cause the position to jump. AIR should be used in this case.

Abbreviated ASCII Syntax: **Message ID: 258**

DYNAMICS dynamics

Factory Default:

dynamics air

Example:

dynamics foot

Table 19: User Dynamics

Binary	ASCII	Description
0	AIR	Receiver is in an aircraft or a land vehicle, for example a high speed train, with velocity greater than 110 km/h (30 m/s). This is also the most suitable dynamic for a jittery vehicle at any speed. See also *Note #2* above.
1	LAND	Receiver is in a stable land vehicle with velocity less than 110 km/h (30 m/s)
2	FOOT	Receiver is being carried by a person with velocity less than 11 km/h (3 m/s)

Qualifying North American Solar Challenge cars annually weave their way through 1000's of miles between the US and Canada. GNSS keeps them on track through many intersections on secondary highways and gives the Calgary team constant intelligence on the competition's every move. In this case, with average speeds of 46 miles/hour and at times a jittery vehicle, air is the most suitable dynamic

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	DYNAMICS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	dynamics	See *Table*		Receiver dynamics based on your environment	Enum	4	H

2.5.26 ECHO Sets port echo

This command sets a port to echo.

> This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1247**

ECHO [port] echo

Factory Default:

echo com1 off
echo com2 off
echo com3 off
echo aux off
echo usb1 off
echo usb2 off
echo usb3 off
echo icom1 off
echo icom2 off
echo icom3 off
echo ncom1 off
echo ncom2 off
echo ncom3 off

ASCII Example:

```
echo icom1 on
```

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	ECHO Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See Table 37[a]		Port to configure. (default = THISPORT)	Enum	4	H
3	echo	OFF	0	Sets port echo to off	Enum	4	H+4
		ON	1	Sets port echo to on			

a. XCOM and NCOM ports are not supported.

2.5.27 ECUTOFF Sets satellite elevation cut-off for GPS Satellites

This command sets the elevation cut-off angle for tracked satellites. The receiver does not start automatically searching for a GPS satellite until it rises above the cut-off angle. Tracked satellites that fall below the cut-off angle are no longer tracked unless they were manually assigned (see the ASSIGN command).

In either case, satellites below the ECUTOFF angle are eliminated from the internal position and clock offset solution computations.

This command permits a negative cut-off angle; it could be used in these situations:

- The antenna is at a high altitude, and thus can look below the local horizon
- Satellites are visible below the horizon due to atmospheric refraction

1. Care must be taken when using ECUTOFF because the signals from lower elevation satellites are traveling through more atmosphere and are therefore degraded. Use of satellites below 5 degrees is not recommended.
2. Use the GLOECUTOFF command (see page *138*) to cut-off GLONASS satellites, the GALECUTOFF command (see page *132*) for Galileo satellites and the SBASCUTOFF command (see page *207*) for SBAS satellites.

Abbreviated ASCII Syntax: **Message ID: 50**

ECUTOFF angle

Factory Default:

ecutoff 5.0

ASCII Example:

ecutoff 10.0

A low elevation satellite is a satellite the receiver tracks "just" above the horizon. Generally, a satellite is considered low elevation if it is anywhere between 0 and 15 degrees above the horizon. Low elevation satellites are usually setting or rising.

There is no difference in the data transmitted from a low elevation satellite to that transmitted from a higher elevation satellite. However, differences in the signal path of a low elevation satellite make their use less desirable. Low elevation satellite signals are noisier due to the increased amount of atmosphere they must travel through. In addition, signals from low elevation satellites don't fit the assumption that a signal travels in air nearly the same as in a vacuum. As such, using low elevation satellites in the solution results in greater position inaccuracies.

The elevation cut-off angle is specified with ECUTOFF to ensure that noisy, low elevation satellite data below the cut-off is not used in computing a position. If post-processing data, it is still best to collect all data (even that below the cut-off angle). Experimenting with different cut-off angles can then be done to provide the best results. In cases where there are not enough satellites visible, a low elevation satellite may actually help in providing a useful solution.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	ECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	angle	±90.0 degrees		Elevation cut-off angle relative to horizon	Float	4	H

2.5.28 ETHCONFIG Configures Ethernet physical layer

Use this command to configure the Ethernet physical layer.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1245**

`ETHCONFIG` interface_name [speed] [duplex] [crossover] [power_mode]

Factory Default:

```
ethconfig etha auto auto auto powerdown
```

ASCII Example:

```
ethconfig etha 100 full mdix normal
```

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	ETHCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	interface	ETHA	2		Enum	4	H
3	speed	AUTO	1	Auto-negotiate speed (default)	Enum	4	H+4
		10	2	Force 10BaseT			
		100	3	Force 100BaseT			
4	duplex	AUTO	1	Auto-negotiate duplex (default)	Enum	4	H+8
		HALF	2	Force half duplex			
		FULL	3	Force full duplex			
5	crossover	AUTO	1	Auto-detect crossover (default)	Enum	4	H+12
		MDI	2	Force MDI (straight through)			
		MDIX	3	Force MDIX (crossover)			
6	power mode	AUTO	1	Energy detect mode (default)	Enum	4	H+16
		POWER DOWN	2	Soft power down mode			
		NORMAL	3	Normal mode			

2.5.29 EXTERNALCLOCK Sets external clock parameters

Overview

The EXTERNALCLOCK command allows the OEM6 card to operate with an optional external oscillator. You are able to optimally adjust the clock model parameters of these receivers for various types of external clocks.

1. This command affects the interpretation of the CLOCKMODEL log.
2. If the EXTERNALCLOCK command is enabled and set for an external clock (TCXO, OCXO, RUBIDIUM, CESIUM, or USER) and the CLOCKADJUST command, see *Page 82*, is ENABLED, then the clock steering process takes over the VARF output pins and may conflict with a previously entered FREQUENCYOUT command, see *Page 127*. If clocksteering is not used with the external oscillator, the clocksteering process must be disabled by using the CLOCKADJUST DISABLE command.
3. When using the EXTERNALCLOCK and CLOCKADJUST commands together, issue the EXTERNALCLOCK command first to avoid losing satellites.

There are three steps involved in using an external oscillator:

1. Follow the procedure outlined in the *OEM6 Family Installation and Operation User Manual* to connect an external oscillator to your OEM6.
2. Using the EXTERNALCLOCK command, select a standard oscillator and its operating frequency.
3. Using the CLOCKADJUST command, disable the clocksteering process if external clocksteering is not used.

Theory

An unsteered oscillator can be approximated by a three-state clock model, with two states representing the range bias and range bias rate, and a third state assumed to be a Gauss-Markov (GM) process representing the range bias error generated from satellite clock dither. The third state is included because the Kalman filter assumes an (unmodeled) white input error. The significant correlated errors produced by satellite clock dither are obviously not white and the Markov process is an attempt to handle this kind of short-term variation.

The internal units of the new clock model's three states (offset, drift and GM state) are metres, metres per second, and metres. When scaled to time units for the output log, these become seconds, seconds per second, and seconds, respectively. Note that the old units of the third clock state (drift rate) were metres per second per second.

The user has control over 3 process noise elements of the linear portion of the clock model. These are the h_0, h_{-1}, and h_{-2} elements of the power law spectral density model used to describe the frequency noise characteristics of oscillators:

$$S_y(f) = \frac{h_{-2}}{f^2} + \frac{h_{-1}}{f} + h_0 + h_1 f + h_2 f^2$$

where *f* is the sampling frequency and $S_y(f)$ is the clock's power spectrum. Typically only h_0, h_{-1}, and h_{-2} affect the clock's Allan variance and the clock model's process noise elements.

Usage

Before you use an optional external oscillator, several clock model parameters must be set. There are default settings for a voltage-controlled temperature-compensated crystal oscillator (VCTCXO), ovenized crystal oscillator (OCXO), Rubidium and Cesium standard, which are given in *Table 21* on *page 118*. You may alternatively choose to supply customized settings.

The EXTERNALCLOCK command determines whether the receiver uses its own internal temperature-compensated crystal oscillator, or that of an external oscillator, as a frequency reference. It also sets which clock model is used for an external oscillator.

To force the OEM6 to use the internal oscillator, use the EXTERNALCLOCK DISABLE command and physically disconnect the external oscillator input. Do not use the EXTERNALCLOCK OCXO, CESIUM, RUBIDIUM or USER parameters if there is no external oscillator connected to the OEM6.

Abbreviated ASCII Syntax: **Message ID: 230**

EXTERNALCLOCK clocktype [freq] [h_0[h_{-1}[h_{-2}]]]

Factory Default:

externalclock disable

ASCII Examples:

externalclock user 10mhz 1.0167e-23 6.87621e-25 8.1762e-26

externalclock tcxo 5mhz

Table 20: Clock Type

ASCII	Binary	Description
DISABLE	0	Turns the external clock input off, reverts back to the on-board VCTCXO
TCXO	1	Sets the pre-defined values for a VCTCXO
OCXO	2	Sets the pre-defined values for an OCXO
RUBIDIUM	3	Sets the pre-defined values for a rubidium oscillator
CESIUM	4	Sets the pre-defined values for a cesium oscillator
USER	5	Defines custom process noise elements

Table 21: Pre-Defined Values for Oscillators

Clock Type	h_0	h_{-1}	h_{-2}
VCTCXO	1.0 e-21	1.0 e-20	1.0 e-20
OCXO	2.51 e-26	2.51 e-23	2.51 e-22
Rubidium	1.0 e-23	1.0 e-22	1.3 e-26
Cesium	2.0 e-20	7.0 e-23	4.0 e-29

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	EXTERNALCLOCK header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	clocktype	See *Table* on *page 118*		Clock type	Enum	4	H
3	freq	0MHz	0	Optional frequency. If a value is not specified, the default is 5 MHz.	Enum	4	H+4
		5MHz	1				
		10MHz	2				
		20MHz	3				

Continued on next page

Field	Field Type	ASCII Value / Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
4	h_0	1.0 e-35 to 1.0 e-18	Optional timing standards. These fields are only valid when the USER clocktype is selected. Do not use h values with VCTCXO, OCXO, CESIUM, or RUBIDIUM clock types. The h values for these options are fixed, see *Table 21* (default=0.0).	Double	8	H+8
5	h_{-1}	1.0 e-35 to 1.0 e-18		Double	8	H+16
6	h_{-2}	1.0 e-35 to 1.0 e-18		Double	8	H+24

2.5.30 FIX Constrains to fixed height or position

This command fixes various parameters of the receiver such as height or position. For various applications, fixing these values can assist in improving acquisition times and accuracy of position or corrections. For example, fixing the position and height is a requirement for differential base stations as it provides a truth position to base the differential corrections from.

If you enter a FIXPOSDATUM command, see *page 124*, the FIX command is then issued internally with the FIXPOSDATUM command values translated to WGS84. It is the FIX command that appears in the RXCONFIG log. If the FIX or the FIXPOSDATUM command are used, their newest values overwrite the internal FIX values.

1. NovAtel strongly recommends that the FIX POSITION entered be good to within a few metres. This level of accuracy can be obtained from a receiver using single point positioning once 5 or 6 satellites are being tracked.
2. FIX POSITION should only be used for base station receivers. Applying FIX POSITION to a rover, switches it from RT20, or RT2, mode to a fixed position mode. Applying FIX POSITION to the rover does not speed up ambiguity resolution.
3. Any setting other than FIX POSITION disables output of differential corrections unless the MOVINGBASESTATION command is set to ENABLE, see also *page 169*.
4. You can fix the position of the receiver using latitude, longitude and height in Mean Sea Level (MSL) or ellipsoidal parameters depending on the UNDULATION setting. The factory default for the UNDULATION setting is TABLE where the height entered in the FIX command is set as MSL height. If you change the UNDULATION setting to USER 0, the height entered in the FIX command is set as ellipsoidal height. See also *page 245*.

Error checking is done on the entered fixed position. If less than 3 measurements are available, the solution status indicates PENDING. While the status is PENDING, the fixed position value is not used internally (for example, for updating the clock model, or controlling the satellite signal search). Once 3 or more measurements are available, error checking is performed. If the error check passes, the solution status changes to SOL_COMPUTED, and the fixed position is used internally. At the first level of error, when the fixed position is off by approximately 25-50 m, the output position log indicates INTEGRITY_WARNING in the solution status field, but the fixed position value is still used internally. If the error reaches the second level, a few km, the receiver does not use the fixed position at all and indicates INVALID_FIX in the solution status. Note that a fixed position obtained from the POSAVE function is treated the same way in the error checking as one entered manually.

Abbreviated ASCII Syntax: **Message ID: 44**

FIX type [param1 [param2 [param3]]]

Factory Default:

fix none

ASCII Example:

fix height 4.567

In order to maximize accuracy of an RTK survey, you must fix the base station coordinates to their known position using the FIX [lat][lon][hgt] command. This ensures the accuracy of their corrections.

Table 22: FIX Parameters

ASCII Type Name	Parameter 1	Parameter 2	Parameter 3
AUTO	Not used	Not used	Not used
HEIGHT	Default MSL height [a] [b] (-1000 to 20000000 m)	Not used	Not used
NONE	Not used	Not used	Not used
POSITION	Lat (-90 to 90 degrees) where a '-' sign denotes south and a '+' sign denotes north	Lon (-360 to 360 degrees) where a '-' sign denotes west and a '+' sign denotes east	Default MSL height [a] [b] (-1000 to 20000000 m)

a. For a discussion on height, refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

b. See also *Note #4* on *page 120*

Table 23: Fix Types

ASCII Name	Binary Value	Description
NONE	0	Unfix. Clears any previous FIX commands.
AUTO	1	Configures the receiver to fix the height at the last calculated value if the number of satellites available is insufficient for a 3-D solution. This provides a 2-D solution. Height calculation resumes when the number of satellites available allows a 3-D solution.
HEIGHT	2	Configures the receiver in 2-D mode with its height constrained to a given value. This command is used mainly in marine applications where height in relation to mean sea level may be considered to be approximately constant. The height entered using this command is referenced to the mean sea level, see the BESTPOS log on *Page 299*, and is in metres. The receiver is capable of receiving and applying differential corrections from a base station while FIX HEIGHT is in effect. The FIX HEIGHT command overrides any previous FIX HEIGHT or FIX POSITION command. This command only affects pseudorange corrections and solutions.
POSITION	3	Configures the receiver with its position fixed. This command is used when it is necessary to generate differential corrections. For both pseudorange and differential corrections, this command must be properly initialized before the receiver can operate as a GNSS base station. Once initialized, the receiver computes differential corrections for each satellite being tracked. The computed differential corrections can then be output to rover stations by utilizing any of the following receiver differential corrections data log formats: RTCM, RTCMV3, RTCA, or CMR. See the *OEM6 Family Installation and Operation User Manual* for information about using the receiver for differential applications. The values entered into the FIX POSITION command should reflect the precise position of the base station antenna phase center. Any errors in the FIX POSITION coordinates directly bias the corrections calculated by the base receiver. The receiver performs all internal computations based on WGS84 and the datum command is defaulted as such. The datum in which you choose to operate (by changing the DATUM command) is internally converted to and from WGS84. Therefore, all differential corrections are based on WGS84, regardless of your operating datum. The FIX POSITION command overrides any previous FIX HEIGHT or FIX POSITION command settings.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FIX header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	type	See *Table* on *page 122*		Fix type	Enum	4	H
3	param1	See *Table*		Parameter 1	Double	8	H + 4
4	param2			Parameter 2	Double	8	H + 12
5	param3			Parameter 3	Double	8	H + 20

2.5.31 FIXPOSDATUM Sets position in a specified datum

This command sets the position by referencing the position parameters through a specified datum. The position is transformed into the same datum as that in the receiver's current setting. The FIX command, see *page 120*, is then issued internally with the FIXPOSDATUM command values. It is the FIX command that appears in the RXCONFIG log. If the FIX or the FIXPOSDATUM command are used, their newest values overwrite the internal FIX values.

Abbreviated ASCII Syntax: **Message ID: 761**

FIXPOSDATUM datum lat lon height

Factory Default:

fixposdatum none

ASCII Example:

fixposdatum user 51.11633810554 -114.03839550586 1048.2343

You can use the FIXPOSDATUM command in a survey to fix the position with values from another known datum, rather than transforming them into WGS84 yourself.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FIXPOSDATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	datum	See *Table 16* on *page 95*		Datum ID	Enum	4	H
3	lat	±90		Latitude (degrees)	Double	8	H + 4
4	lon	±360		Longitude (degrees)	Double	8	H + 12
5	height	-1000 to 20000000		Mean sea level (MSL) height (m) [a]	Double	8	H + 20

a. For a discussion on height, refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

2.5.32 FORCEGLOL2CODE Forces receiver to track GLONASS satellite L2 P or L2 C/A code

This command allows you to force the receiver to track GLONASS satellite L2 P-code or L2 C/A code.

Abbreviated ASCII Syntax: **Message ID: 1217**

FORCEGLOL2CODE L2type

Factory Default:

forceglol2code default

ASCII Example:

forceglol2code p

Table 24: GLONASS L2 Code Type.

Binary	ASCII	Description
1	P	L2 P-code or L2 Precise code
2	C	L2 C/A code or L2 Coarse/ Acquisition code
3	DEFAULT	Set to channel default

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FORCEGLOL2-CODE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	L2type	See *Table 25* above		GLONASS L2 code type	Enum	4	H

2.5.33 FORCEGPSL2CODE Forces receiver to track GPS satellite L2 P or L2C code

This command allows you to force the receiver to track L2 P-code or L2C code. AUTO tells the receiver to use L2C code type if available and L2 P-code if L2C code is not available.

Abbreviated ASCII Syntax: **Message ID: 796**

FORCEGPSL2CODE L2type

Factory Default:

forcegpsl2code default

ASCII Example:

forcegpsl2code p

Table 25: GPS L2 Code Type.

Binary	ASCII	Description
0	AUTO	Receiver uses the best L2 code type available. For RTK positioning, AUTO changes the L2 code type being tracked to match the L2 code type found in the base station corrections to ensure the greatest number of satellites are used in the solution.
1	P	L2 P-code or L2 Precise code
2	C	L2C code or L2 Civilian code
3	DEFAULT	Set to channel default

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FORCEGPSL2-CODE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	L2type	See *Table 25* above		GPS L2 code type	Enum	4	H

2.5.34 FREQUENCYOUT Sets output pulse train available on VARF

This command sets the output pulse train available on the variable frequency (VARF) pin. The output waveform is coherent with the 1PPS output, see the usage note and *Figure 3* below.

1. If the CLOCKADJUST command is ENABLED, see *Page 82*, and the receiver is configured to use an external reference frequency (set in the EXTERNALCLOCK command, see *Page 116*, for an external clock - TCXO, OCXO, RUBIDIUM, CESIUM, or USER), then the clock steering process takes over the VARF output pins and may conflict with a previously entered FREQUENCYOUT command.
2. *Figure 3* shows how the chosen pulse width is frequency locked but not necessarily phase locked.

Abbreviated ASCII Syntax: **Message ID: 232**

FREQUENCYOUT [switch] [pulsewidth] [period]

Factory Default:

frequencyout disable

ASCII Example:

frequencyout enable 2 4

This example generates a 50% duty cycle 25MHz square wave.

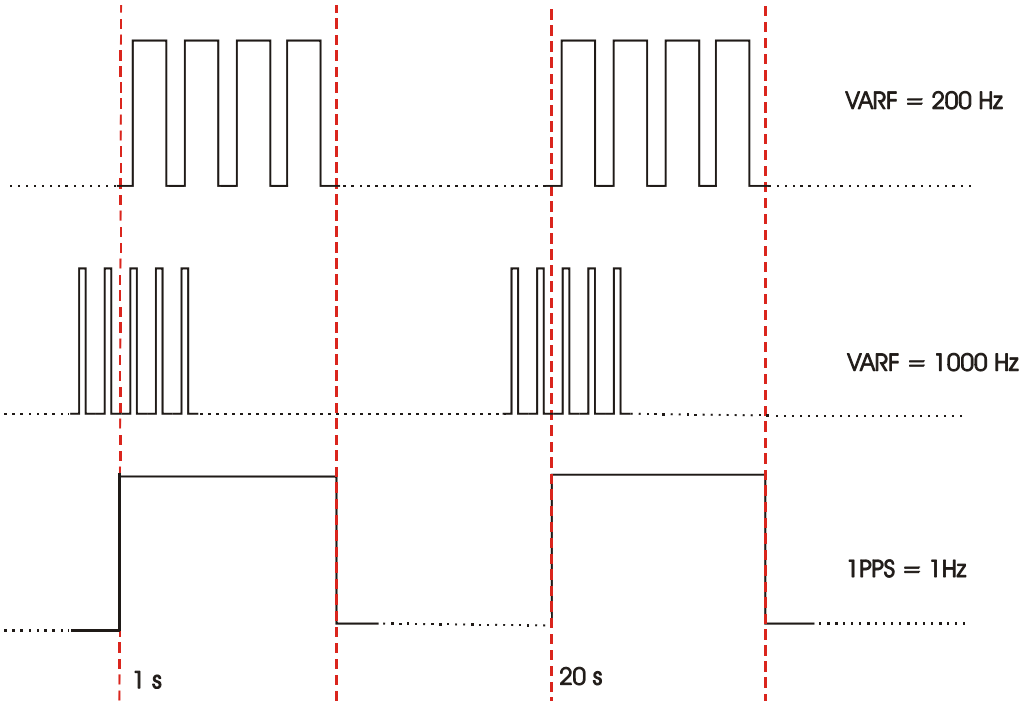


Figure 3: Pulse Width and 1PPS Coherency

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FREQUENCYOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Disable causes the output to be fixed low (default)	Enum	4	H
		ENABLE	1	Enables customized frequency output			
3	pulsewidth	(0 to 536870912)		Number of 10ns steps for which the output is high. Duty cycle = pulsewidth / period. If pulsewidth is greater than or equal to the period, the output is a high DC signal. If pulsewidth is 1/2 the period, then the output is a square wave (default = 0)	Ulong	4	H+4
4	period	(0 to 536870912)		Signal period in 10ns steps. Frequency Output = 100,000,000 / Period (default = 0)	Ulong	4	H+8

2.5.35 FRESET Clears selected data from NVM and reset

This command clears data which is stored in non-volatile memory. Such data includes the almanac, ephemeris, and any user-specific configurations. The commands, ephemeris, almanac, and L-band related data, excluding the subscription information, can be cleared by using the STANDARD target. The model can only be cleared by using the MODEL target. The receiver is forced to hardware reset. In addition, values entered using the CLOCKCALIBRATE command can only be cleared by using the CLKCALIBRATION target.

FRESET STANDARD (which is also the default) causes any commands, ephemeris, GNSS and almanac data previously saved to NVM to be erased.

Abbreviated ASCII Syntax: **Message ID: 20**

FRESET [target]

Input Example:

freset command

If you are receiving no data or random data from your receiver, try these before contacting NovAtel:

- Verify that the receiver is tracking satellites
- Check the integrity and connectivity of power and data cables
- Verify the baud rate settings of the receiver and terminal device (your PC, data logger, or laptop)
- Switch COM ports

Issue a FRESET command

Table 26: FRESET Target

Binary	ASCII	Description
0	STANDARD	Resets commands, ephemeris, and almanac (default). Also resets all L-band related data except for the subscription information.
1	COMMAND	Resets the stored commands (saved configuration)
2	GPSALMANAC	Resets the stored GPS almanac
3	GPSEPHEM	Resets the stored GPS ephemeris
4	GLOEPHEM	Resets the stored GLONASS ephemeris
5	MODEL	Resets the currently selected model
11	CLKCALIBRATION	Resets the parameters entered using the CLOCKCALIBRATE command
20	SBASALMANAC	Resets the stored SBAS almanac
21	LAST_POSITION	Resets the position using the last stored position
31	GLOALMANAC	Resets the stored GLONASS almanac

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	FRESET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	target	See *Table 26*		What data is to be reset by the receiver (default=STANDARD)	Enum	4	H

2.5.36 GALECUTOFF Sets elevation cut-off angle for Galileo satellites

This command sets the elevation cut-off angle for tracked Galileo satellites. The receiver does not start automatically searching for a satellite until it rises above the cut-off angle. Tracked satellites that fall below the cut-off angle are no longer tracked unless they were manually assigned (see the ASSIGN command).

In either case, satellites below the GALECUTOFF angle are eliminated from the internal position and clock offset solution computations. See also the ECUTOFF (page *113*) and GLOECUTOFF (page *138*) commands for more information about elevation cut-off commands.

This command permits a negative cut-off angle; it could be used in these situations:

- The antenna is at a high altitude, and thus can look below the local horizon
- Satellites are visible below the horizon due to atmospheric refraction

1. Care must be taken when using GALECUTOFF because the signals from lower elevation satellites are traveling through more atmosphere and are therefore degraded. Use of satellites below 5 degrees is not recommended.
2. Use the ECUTOFF command (see page *113*) to cut-off GPS satellites, the GLOECUTOFF command (see page *138*) for GLONASS satellites and the SBASCUTOFF command (see page *207*) for SBAS satellites.

Abbreviated ASCII Syntax: **Message ID: 1114**

GALECUTOFF angle

Factory Default:

galecutoff 5.0

ASCII Example:

galecutoff 10.0.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GALECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	angle	±90.0 degrees		Elevation cut-off angle relative to horizon	Float	4	H

2.5.37 GENERATEALIGNCORRECTIONS to Configure ALIGN Master

This command configures the ALIGN Master and start sending out ALIGN RTCA corrections through the specified port. This command is equivalent to sending following commands to the Master:

unlogall [port]

fix none

movingbasestation enable

interfacemode [port] novatel rtca

com [port] [baud] N 8 1 N OFF ON

log [port] rtcaobs3 ontime [rate = 1/ obsreqrate]

log [port] rtcarefext ontime [rate = 1/ refextreqrate]

Abbreviated ASCII Syntax: **Message ID: 1349**

generatealigncorrections port [baud] [obsreqrate] [refextreqrate]

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GENERATEALIGNCORRECTIONS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	port	See Table 37 of OEM6 Manual		Port through which correction should be sent out	ENUM	4	H
3	baud	9600, 19200, 38400, 57600, 115200, 230400, 460800 or 921600		Communication baud rate	ULONG	4	H+4
4	obsreqrate	1, 2, 4, 5, 10 or 20		RTCAOBS3 data rate in Hz	ULONG	4	H+8
5	refextreqrate	0, 1, 2, 4, 5, 10 or 20		RTCAREFEXT data rate in Hz	ULONG	4	H+12

2.5.38 GENERATEDIFFCORRECTIONS Sends a preconfigured set of differential corrections

Configures the receiver to send a preconfigured set of differential corrections.

Abbreviated ASCII Syntax: **Message ID: 1296**

GENERATEDIFFCORRECTIONS mode port

ASCII Example:

generatediffcorrections rtcm com2

Preconfigured set of differential corrections sent when RTCM:

rtcm1 ontime 1
rtcm31 ontime 1
rtcm3 ontime 10

Preconfigured set of differential corrections sent when RTCA:

rtca1 ontime 1
rtcaref ontime 10

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GENERATE DIFFCORR ECTIONS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	mode	RTCM	2	Serial port interfece mode identifier. See *Table 28, Serial Port Interface Modes* on *page 149* for more information	Enum	4	H
		RTCA	3				
		CMR	4				
		RTCMV3	14				
3	port	See *Table 37, COM Port Identifiers* on *page 214*		Port to configure	Enum	8	H+4

2.5.39 GENERATERTKCORRECTIONS Sends a preconfigured set of RTK corrections

Configures the receiver to send a preconfigured set of RTK corrections.

Abbreviated ASCII Syntax: **Message ID: 1260**

GENERATERTKCORRECTIONS mode port

ASCII Example:

generatertkcorrections rtcmv3 com2

Preconfigured set of differential corrections sent when RTCM:

rtcm18/19 ontime 1
rtcm3 ontime 10
rtcm22 ontime 10
rtcm23 ontime 60
rtcm24 ontime 60

Preconfigured set of differential corrections sent when RTCMV3:

rtcm1004 ontime 1
rtcm1012 ontime 1
rtcm1006 ontime 10
rtcm1008 ontime 10
rtcm1033 ontime 10

Preconfigured set of differential corrections sent when RTCA:

rtcaobs2 ontime 1
rtcaref ontime 10

Preconfigured set of differential corrections sent When CMR:

cmrobs ontime 1
cmrgloobs ontime 1
cmrref ontime 10

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GENERATERTKCORRECTIONS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	mode	RTCM	2	Serial port interface mode identifier. For more information, see *Table 28, Serial Port Interface Modes* on *page 149*	Enum	4	H
		RTCA	3				
		CMR	4				
		RTCMV3	14				
3	port	See *Table 37, COM Port Identifiers* on *page 214*		Port to configure	Enum	8	H+4

2.5.40 GGAQUALITY Customizes the GPGGA GPS quality indicator

This command allows you to customize the NMEA GPGGA GPS quality indicator. See also the GPGGA log on *page 362*.

Abbreviated ASCII Syntax: **Message ID: 691**

GGAQUALITY #entries [pos type1][qual1] [pos type2] [qual2]...

Input Example 1:

ggaquality 1 sbas 2

Makes the SBAS solution type show 2 as the quality indicator.

Input Example 2:

ggaquality 2 sbas 2 narrow_float 3

Makes the SBAS solution type show 2, and the NARROW_FLOAT solution type show 3, as their quality indicators.

Input Example 3:

ggaquality 0

Sets all the quality indicators back to the default.

Some solution types, see *Table 55, Position or Velocity Type* on *page 301*, store a quality indicator. For example, OmniSTAR_HP, OmniSTAR_XP and NARROW_FLOAT all share an indicator of 2. This command can be used to customize an application to have unique indicators for each solution type.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GGAQUALITY header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	#entries	0-20		The number of position types that are being re-mapped (20 max.)	Ulong	4	H+4
3	pos type1	See *Table 55, Position or Velocity Type* on *page 301*		The 1st position type that is being re-mapped	Enum	4	H+8
4	qual1	See *page 362*		The number that appears in the GPGGA log for the 1st position type	Ulong	4	H+12
5	pos type2	See *Table 55* on *page 301*		The 2nd position type that is being re-mapped, if applicable	Enum	4	H+16
6	qual2	See *page 362*		The number that appears in the GPGGA log for the 2nd solution type, if applicable	Ulong	4	H+20
...	Next solution type and quality indicator set, if applicable				Variable		

2.5.41 GLOECUTOFF Sets GLONASS satellite elevation cut-off

This command sets the elevation cut-off angle for tracked GLONASS satellites. The receiver does not start automatically searching for a satellite until it rises above the cut-off angle. Tracked satellites that fall below the cut-off angle are no longer tracked unless they were manually assigned (see the ASSIGN command).

In either case, satellites below the GLOECUTOFF angle are eliminated from the internal position and clock offset solution computations. See also the ECUTOFF (page *113*) and SBASECUTOFF (page *207*) commands for more information about elevation cut-off commands.

This command permits a negative cut-off angle; it could be used in these situations:

- The antenna is at a high altitude, and thus can look below the local horizon
- Satellites are visible below the horizon due to atmospheric refraction

1. Care must be taken when using GLOECUTOFF because the signals from lower elevation satellites are traveling through more atmosphere and are therefore degraded. Use of satellites below 5 degrees is not recommended.
2. Use the ECUTOFF command (see page *113*) to cut-off GPS satellites, the GALECUTOFF command (see page *132*) for Galileo satellites and the SBAS-CUTOFFcommand (see page *207*) for SBAS satellites.

Abbreviated ASCII Syntax: **Message ID: 735**

GLOECUTOFF angle

Factory Default:

gloecutoff 5.0

ASCII Example:

gloecutoff 0

Refer to the GLONASS section in our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	GLO-ECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	angle	±90.0 degrees		Elevation cut-off angle relative to horizon	Float	4	H

2.5.42 HDTOUTTHRESHOLD Controls GPHDT log output

This command controls the output of the NMEA GPHDT heading log, see *page 378*. It sets a heading standard deviation threshold. Only heading information with a standard deviation less than this threshold can be output into a GPHDT message.

Abbreviated ASCII Syntax: **Message ID: 1062**

HDTOUTTHRESHOLD thresh

Factory Default:

hdtoutthreshold 2.0

ASCII Example:

hdtoutthreshold 2.0

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	HDTOUT-THRESHOLD header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	thresh	0.0 - 180.0		Heading standard deviation threshold (degrees)	Float	4	H

2.5.43 HEADINGOFFSET Adds heading and pitch offset values

Puts an offset in the heading and pitch values in output of the HEADING, HEADING2 and GPHDT logs. See pages *389*, *391* and *378* for more information.

Abbreviated ASCII Syntax: **Message ID: 1082**

HEADINGOFFSET headingoffsetindeg [pitchoffsetindeg]

Factory Default:

headingoffset 0 0

ASCII Example:

headingoffset 2 -1

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	HEADING OFFSET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	headingoffsetindeg	-180.0 - 180.0		Offset added to heading output (degrees)	Float	4	H
3	pitchoffsetindeg	-90.0 - 90.0		Offset added to pitch output (degrees)	Float	4	H+4

2.5.44 HPSEED Specifies the initial OmniSTAR HP/XP position

This OmniSTAR HP/XP command allows you to specify the initial position for OmniSTAR HP/XP. It allows you to specify the datum and undulation for the position entered. Position is then transformed into the datum currently set in the receiver. You can use STORE or RESTORE as a variable.

The HPSEED command does not get saved when you use the SAVECONFIG command. Rather, if STORE is issued with the HPSEED command, it stores in it NVM. The RESTORE variable re-sends the stored HPSEED command.

Abbreviated ASCII Syntax: **Message ID: 782**

HPSEED mode [lat lon hgt latσ lonσ hgtσ [datum undulation]]

Factory Default:

hpseed reset

1. Here are some ASCII Examples:
   - To store the current HP/XP position so that it can be used as the seed in the future:

     HPSEED STORE
   - To use the stored HP/XP position as the seed:

     HPSEED RESTORE
   - To use a known position in the native datum of OmniSTAR HP/XP as the seed:

     HPSEED SET 51.11633810554 -114.03839550586 1048.2343 0.0086,0.0090,0.0191
   - To use a known position from a datum other than the native OmniSTAR HP/XP datum as the seed:

     HPSEED SET 51.11633810554 -114.03839550586 1048.2343 0.0086,0.0090,0.0191 CANADA EGM96
2. HP/XP seeding is restarting the HP/XP filter from known coordinates with a known accuracy as a starting point such that it is already converged. This is implemented by using the HPSEED command. There are two ways of using our implementation of HP/XP seeding:

Continued on next page

a. Seed HP/XP from a stored HP/XP position:

- When HP/XP is converged and the vehicle is stopped, enter HPSEED STORE to save the current HP/XP position to NVM.
- When the vehicle is restarted, enter HPSEED RESTORE to feed the previously known position into the HP/XP process so it can start from the previous accuracy.

b. Seed HP/XP from an externally generated known position and accuracy:

- Consider the case of survey customers who enter the known antenna location with HPSEED SET <latitude> <longitude> <msl height> <lat stdev> <long stdev> <height stdev>
- If the source of the position is in a different datum than the native datum of HP/XP, or if a different undulation has been used, the transformation can be specified after <height stdev> with <datum id> <undulation type>.

Initial position estimate for HP/XP and fallback when HP/XP is lost:

When HP/XP starts up, it requests the current position to get itself started. In the start-up time line that we have implemented, this is the first valid position available when the task running HP/XP receives its first L-band data. This may or may not be a VBS position when VBS is also enabled. It depends on how things start up - whatever pseudorange filter position is available is used. If you want to hold off on HP/XP using the position estimate until you've confirmed that the VBS corrections have started and plenty of satellites are in the solution, you can start up with PSRDIFFSOURCE OMNISTAR and RTKSOURCE NONE, wait for the condition of the VBS position to be satisfactory and then set RTKSOURCE OMNISTAR as well. The HP/XP start-up will be waiting until you set the RTKSOURCE. This may give some minor improvement to the convergence time of HP/XP.

This is somewhat related to the position falling back to VBS when HP/XP is lost. If both PSRDIFFSOURCE OMNISTAR and RTKSOURCE OMNISTAR is set, the BESTPOS log contains the best available of the two. There is normally an offset between the HP/XP solution and VBS.

Table 27: Seeding Mode

Binary Value	ASCII Mode Name	Description
0	RESET	Clear current seed and restart HP/XP [a]
1	SET	Specify a position and inject it into HP/XP as seed
2	STORE	Store current HP/XP position in NVM for use as a future seed [a]
3	RESTORE	Inject NVM-stored position into HP/XP as seed [a]

a. No further parameters are needed in the syntax

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	HPSEED header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	mode	See *Table 27* on *page 143*		Seeding mode	Enum	4	H
3	lat	±90		Latitude (degrees)	Double	8	H+4
4	lon	±360		Longitude (degrees)	Double	8	H+12
5	hgt	-1000 to 20000000		Height above mean sea level (m)	Double	8	H+20
6	latσ			Latitude standard deviation (m)	Float	4	H+28
7	lonσ			Longitude standard deviation (m)	Float	4	H+32
8	hgtσ			Height standard deviation (m)	Float	4	H+36
9	datum	See *Table 16, Reference Ellipsoid Constants* on *page 95*		Datum ID (default = WGS84)	Enum	4	H+40
10	undulation	see the UNDULATION command's *option* field values on *page 245*		Undulation type (default = TABLE)	Enum	4	H+44

2.5.45 HPSTATICINIT Sets OmniSTAR HP/XP static initialization

This command enables or disables static initialization of OmniSTAR HP/XP. If the OmniSTAR HP/XP process knows that the receiver is stationary, it can converge more quickly.

If the HP/XP filter perceives receiver motion, it may abort static initialization. See the Static Initialization Mode bit in the HP/XP Status field of the LBANDSTAT log, details starting on *page 404*, to confirm that static initialization is in progress.

Abbreviated ASCII Syntax: **Message ID: 780**

HPSTATICINIT switch

Factory Default:

hpstaticinit disable

ASCII Example:

hpstaticinit enable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	HPSTATICINIT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	The receiver is not stationary	Enum	4	H
		ENABLE	1	The receiver is stationary			

2.5.46 ICOMCONFIG Configures IP virtual COM port

This command is used for Ethernet set up. It allows you to configure the transport/application layer of the configuration.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1248**

```
ICOMCONFIG [port] protocol [endpoint[interface_name]]
```

Factory Default:

icomconfig icom1 tcp :3001

icomconfig icom2 tcp :3002

icomconfig icom3 tcp :3003

ASCII Examples:

```
icomconfig icom1 tcp :2000 etha
```

Due to security concerns, the configuration `ICOMCONFIG UDP :3000` and TCP should only be used by customers on a closed system, that is, board to board. NovAtel is not liable for any security breaches that may occur if not used on a closed system

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	ICOMCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	THISPORT	6	Name of the port (default = THISPORT). For more information, see *Table 37* on *page 214*	Enum	4	H
		ICOM1	23				
		ICOM2	24				
		ICOM#	25				
3	protocol	DISABLE	1	Disable this service	Enum	4	H+4
		TCP	2	Use Raw TCP			
		UDP	3	Use Raw UDP			
4	endpoint	Host:Port For example: 10.0.3.1:8000 mybase.com:3000:2000		Endpoint to wait on, or to connect to where host is a hostname or IP address and port is the TCP/uDP port number. If host is blank, act as a server	String	80	H+8
5	bindInterface	ALL (default)	1	All, or an interface that supports TCP/IP	Enum	4	H+88
		ETHA	2				

2.5.47 INTERFACEMODE Sets receive or transmit modes for ports

This command allows the user to specify what type of data a particular port on the receiver can transmit and receive. The receive type tells the receiver what type of data to accept on the specified port. The transmit type tells the receiver what kind of data it can generate. For example, you would set the receive type on a port to RTCA in order to accept RTCA differential corrections.

This command also acts as a collection response ether and can be used as a log.

It is also possible to disable or enable the generation or transmission of command responses for a particular port. Disabling of responses is important for applications where data is required in a specific form and the introduction of extra bytes may cause problems, for example RTCA, RTCM, RTCMV3 or CMR. Disabling a port prompt is also useful when the port is connected to a modem or other device that responds with data the receiver does not recognize.

When INTERFACEMODE *port* NONE NONE OFF is set, the specified port are disabled from interpreting any input or output data. Therefore, no commands or differential corrections are decoded by the specified port. When GENERIC is set for a port, it is also disabled but data can be passed through the disabled port and be output from an alternative port using the pass-through logs PASSCOM, PASSXCOM, PASSAUX and PASSUSB. See *Page 434* for details on these logs and the *Operation* chapter, in the *OEM6 Family Installation and Operation User Manual*, for information about pass-through logging. See also the COMCONFIG log on *Page 341*.

If you intend to use the SERIALCONFIG command, ensure you do so before the INTERFACEMODE command on each port. The SERIALCONFIG command can remove the INTERFACEMODE command setting if the baud rate is changed after the interface mode is set. You can also turn break detection off using the SERIALCONFIG command, see *page 212*, to stop the port from resetting because it is interpreting incoming bits as a break command.

OmniSTAR External Stream

This feature allows you to use OmniSTAR VBS, HP or XP when you are not tracking an L-band signal on the OEM6. This is useful on an L-band-capable receiver where the OmniSTAR signals are unavailable. There is an OmniSTAR option for the INTERFACEMODE command (OMNISTAR), see *Table* on *page 149*.

For example, set the incoming INTERFACEMODE command to OMNISTAR on COM2:

```
INTERFACEMODE COM2 OMNISTAR NONE
```

where COM2 is expecting raw OmniSTAR L-band data from an external source.

1. OMNISTAR is not a valid setting for an INTERFACEMODE output command.
2. Receiver data only comes from one port at a time.
3. When setting up a demodulator, use this command to output all raw L-band

Abbreviated ASCII Syntax: **Message ID: 3**

INTERFACEMODE [port] rxtype txtype [responses]

Factory Default:

interfacemode com1 novatel novatel on
interfacemode com2 novatel novatel on
interfacemode com3 novatel novatel on
interfacemode aux novatel novatel on
interfacemode usb1 novatel novatel on
interfacemode usb2 novatel novatel on
interfacemode usb3 novatel novatel on
interfacemode xcom1 novatel novatel on
interfacemode xcom2 novatel novatel on
interfacemode xcom3 novatel novatel on
interfacemode icom1 novatel novatel on
interfacemode icom2 novatel novatel on
interfacemode icom3 novatel novatel on
interfacemode ncom1 rtcmv3 none off
interfacemode ncom2 rtcmv3 none off
interfacemode ncom3 rtcmv3 none off

ASCII Example 1:

interfacemode com1 rtca novatel on

ASCII Example 2:

interfacemode com2 mrtca none

Are NovAtel receivers compatible with others on the market?

All GNSS receivers output two solutions: position and time. The manner in which they output them makes each receiver unique. Most geodetic and survey grade receivers output the position in electronic form (typically RS-232), which makes them compatible with most computers and data loggers. All NovAtel receivers have this ability. However, each manufacturer has a unique way of formatting the messages. A NovAtel receiver is not directly compatible with a Trimble or Ashtech receiver (which are also incompatible with each other) unless everyone uses a generic data format.

But there are several generic data formats available. For position and navigation output there is the NMEA format. Real-time differential corrections use RTCM or RTCA format. Receiver code and phase data use RINEX format. NovAtel and all other major manufacturers support these formats and can work together using them.

You must understand your post-processing and real-time software requirements. Good software supports a generic standard while poor software locks you into one brand of GNSS equipment. For the most flexibility, insist on generic data format support for all hardware and software solutions

.

Table 28: Serial Port Interface Modes

Binary Value	ASCII Mode Name	Description
0	NONE	The port accepts/generates nothing. The port is disabled.
1	NOVATEL	The port accepts/generates NovAtel commands and logs
2	RTCM	The port accepts/generates RTCM corrections
3	RTCA	The port accepts/generates RTCA corrections
4	CMR	The port accepts/generates CMR corrections
5	OMNISTAR	The port accepts OMNISTAR corrections, see also *OmniSTAR External Stream* on *page 147*
6-7	Reserved	
8	RTCMNOCR	RTCM with no CR/LF appended [a]
9	Reserved	

Table 28: Serial Port Interface Modes

Binary Value	ASCII Mode Name	Description
10	TCOM1	INTERFACEMODE tunnel modes. To configure a full duplex tunnel, configure the baud rate on each port. Once a tunnel is established, the baud rate does not change. Special characters, such as a BREAK condition, do not route across the tunnel transparently and the serial port is altered, see the SERIALCONFIG command on *page 212*. Only serial ports may be in a tunnel configuration: COM1, COM2, COM3 or AUX may be used. For example, configure a tunnel at 115200 bps between COM1 and AUX: COM AUX 115200 COM COM1 115200 INTERFACEMODE AUX TCOM1 NONE OFF INTERFACEMODE COM1 TAUX NONE OFF The tunnel is fully configured to receive/transmit at a baud rate of 115200 bps.
11	TCOM2	
12	TCOM3	
13	TAUX [b]	
14	RTCMV3	The port accepts/generates RTCM Version 3.0 corrections
15	NOVATELBINARY	The port only accepts/generates binary messages. If an ASCII command is entered when the mode is set to binary only, the command is ignored. Only properly formatted binary messages are responded to and the response is a binary message.
16-17	Reserved	
18	GENERIC	The port accepts/generates nothing. SEND/SENDHEX commands from another port generate data on this port. Any incoming data on this port can be seen with PASSCOM logs on another port, see *page 434.*
19	Reserved	
20	MRTCA	The port accepts/generates MRTCA corrections (Modified Radio Technical Commission for Aeronautics)
21-26	Reserved	
27	AUTO	For autodetecting different RTK correction formats

a. An output interfacemode of RTCMNOCR is identical to RTCM but with the CR/LF appended. An input interfacemode of RTCMNOCR is identical to RTCM and functions with or without the CR/LF.

b. Only available on specific models.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	INTERFACEMODE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	port	See *Table 37, COM Port Identifiers* on *page 214*		Serial port identifier (default = THISPORT)	Enum	4	H
3	rxtype	See *Table 28, Serial Port Interface Modes* on *page 149*		Receive interface mode	Enum	4	H+4
4	txtype			Transmit interface mode	Enum	4	H+8
5	responses	OFF	0	Turn response generation off	Enum	4	H+12
		ON	1	Turn response generation on (default)			

2.5.48 IONOCONDITION Sets ionospheric condition

This command changes the level of ionosphere activity that is assumed by the RTK positioning algorithms.

Abbreviated ASCII Syntax: **Message ID: 1215**

IONOCONDITION mode

Factory Default:

ionocondition quiet

ASCII Example:

ionocondition normal

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	IONOCONDITION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively		H	
2	mode	QUIET	0	Receiver assumes a low level of ionosphere activity	Enum	4	H
		NORMAL	1	Receiver assumes a medium level of ionosphere activity			
		DISTURBED	2	Receiver assumes a high level of ionosphere activity			

2.5.49 IPCONFIG Configures network IP settings

This command configures static/dynamic TCP/IP properties for the Ethernet connection.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID: 1243**

`IPCONFIG` [interface_name] address_mode [ip [mask [gateway]]]

Factory Default:

ipconfig etha dhcp

ASCII Examples:

```
ipconfig etha static 192.168.74.10 255.255.255.0
192.168.74.1
```

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	IPCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	interface	ALL	1	Name of the Ethernet interface (default = ETHA)	Enum	4	H
		ETHA	2				
4	mode	DHCP	1	Use Dynamic IP address	Enum	4	H+4
		STATIC	2	Use Static IP address			
5	IP address	xxx.xxx.xxx.xxx (For example: 10.0.0.2)		IP Address – decimal dot notation	String	16	H+8
6	netmask	xxx.xxx.xxx.xxx (For example: 255.255.255.0)		Netmask – decimal dot notation	String	16	H+24
7	gateway	xxx.xxx.xxx.xxx (For example: 10.0.0.1)		Gateway – decimal dot notation	String	16	H+40

2.5.50 LOCALIZEDCORRECTIONDATUM Sets a Local Datum

Use this command to select a localized correction datum before you use localized wide area corrections. The choices are World Geodetic System 84 (WGS84) and North American 1983 (NAD83) including Areas 37-42. The default is WGS84, however when the receiver receives OmniSTAR data, and you issue a LOCALIZEDCORRECTIONDATUM NAD83 command, it bases its localized wide area corrections on NAD83

RTCM corrections are always with respect to the datum selected at the base. For example, if you set the LOCALIZEDCORRECTIONDATUM to NAD83 at a base station, the datum of the positions produced at the rover receiver using these localized corrections will be NAD83. This is true even though the datum in the rover BESTPOS log shows WGS84.

Localized Wide Area Corrections Mode

The local wide area corrections

enhancement allows a NovAtel receiver to receive OmniSTAR VBS corrections, compute an equivalent DGPS correction and then output it in RTCM format to any GNSS receiver. You can select to output corrections in the WGS84 or NAD83 datum.

Localized OmniSTAR corrections are available on products with L-band capability. Supported datums provide these corrections with WGS84 as the default.

This enhancement also uses the following logs:

RTCMOMNI1/RTCMDATAOMNI1, see *page 548* and *OmniSTAR Local Wide Area Corrections* on *page 511*

Use the SAVECONFIG command to save local wide area corrections interface settings.

Abbreviated ASCII Syntax: **Message ID: 947**

LOCALIZEDCORRECTIONDATUM type

ASCII Example:

localizedcorrectiondatum nad83

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	LOCALIZED-CORRECTION-DATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	type	WGS84	1	Localised correction datum type	Enum	4	H
		NAD83	2				

2.5.51 LOCKOUT Prevents the receiver from using a satellite

This command prevents the receiver from using a satellite in the solution computations.

1. The LOCKOUT command does not prevent the receiver from tracking an undesirable satellite.
2. LOCKOUT and UNLOCKOUT commands (see page *247*) cannot be used with Galileo PRNs.

This command must be repeated for each satellite to be locked out. See also the UNLOCKOUT (page *247*) and UNLOCKOUTALL(page *248*) commands.

Abbreviated ASCII Syntax: **Message ID: 137**

LOCKOUT prn

Input Example:

lockout 8

The LOCKOUT command allows you to remove one or more satellites from the solution while leaving other satellites available.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	LOCKOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	prn	GPS: 1-32 SBAS: 120-138 38-61 for GLONASS: see *Section 1.3* on *page 31* Galilleo: 1-36		A single satellite PRN number to be locked out	Ulong	4	H

2.5.52 LOCKOUTSYSTEM Prevents the receiver from using a system

This command prevents the receiver from using satellites in a system in the solution computations.

> The LOCKOUTSYSTEM command does not prevent the receiver from tracking an undesirable satellite.

This command must be repeated for each system to be locked out. See also the UNLOCKOUTSYSTEM on *page 249* and UNLOCKOUTALL on *page 248*.

Abbreviated ASCII Syntax: **Message ID: 871**

LOCKOUTSYSTEM system

Input Example:

lockoutsystem glonass

> The LOCKOUTSYSTEM command allows you to remove one or more systems from the solution while leaving other systems available.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	LOCKOUT SYSTEM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	system	See Table 29		A single satellite system to be locked out	Enum	4	H

Table 29: Satellite System

Binary Value	ASCII Mode Name
0	GPS
1	GLONASS
2	SBAS
5	Galileo

2.5.53 LOG Requests logs from the receiver

Many different types of data can be logged using several different methods of triggering the log events. Every log element can be directed to any combination of the three COM ports and three USB ports. The ONTIME trigger option requires the addition of the *period* parameter. See *Chapter 3, Data Logs* on page *260* for further information and a complete list of data log structures. The *LOG* command tables in this section show the binary format followed by the ASCII command format.

The optional parameter [hold] prevents a log from being removed when the UNLOGALL command, with its defaults, is issued. To remove a log which was invoked using the [hold] parameter requires the specific use of the UNLOG command, see *page 250*. To remove all logs that have the [hold] parameter, use the UNLOGALL command with the *held* field set to 1, see *page 252*.

The [port] parameter is optional. If [port] is not specified, [port] is defaulted to the port that the command was received on.

1. The OEM6 family of receivers can handle 64 logs at a time. If you attempt to log more than 64 logs at a time, the receiver responds with an Insufficient Resources error.
2. Maximum flexibility for logging data is provided to the user by these logs. The user is cautioned, however, to recognize that each log requested requires additional CPU time and memory buffer space. Too many logs may result in lost data and degraded CPU performance. Receiver overload can be monitored using the idle-time field and buffer overload bits of the Receiver Status in any log header.
3. Polled log types do not allow fractional offsets or ONTIME rates faster than 1Hz.
4. Use the ONNEW trigger with the MARKTIME, MARK2TIME, MARKPOS or MARK2POS logs.
5. Only the MARKPOS, MARK2POS, MARKTIME or MARK2TIME logs, and ‘polled’ log types are generated ‘on the fly’ at the exact time of the mark. Synchronous and asynchronous logs output the most recently available data.
6. If you do use the ONTIME trigger with asynchronous logs, the time stamp in the log does not necessarily represent the time the data was generated, but rather the time when the log is being transmitted.

Abbreviated ASCII Syntax: **Message ID: 1**

LOG [port] message [trigger [period [offset [hold]]]]

Factory Default:

log com1 rxstatuseventa onnew 0 0 hold

log com2 rxstatuseventa onnew 0 0 hold

log com3 rxstatuseventa onnew 0 0 hold

log aux rxstatuseventa onnew 0 0 hold

log usb1 rxstatuseventa onnew 0 0 hold

log usb2 rxstatuseventa onnew 0 0 hold

log usb3 rxstatuseventa onnew 0 0 hold

log icom1 rxstatuseventa onnew 0 0 hold

log icom2 rxstatuseventa onnew 0 0 hold

log icom3 rxstatuseventa onnew 0 0 hold

Abbreviated ASCII Example 1:

log com1 bestpos ontime 7 0.5 hold

The above example shows BESTPOS logging to COM port 1 at 7 second intervals and offset by 0.5 seconds (output at 0.5, 7.5, 14.5 seconds and so on). The [hold] parameter is set so that logging is not disrupted by the UNLOGALL command.

To send a log only one time, the trigger option can be ignored.

Abbreviated ASCII Example 2:

log com1 bestpos once 0.000000 0.000000 nohold

See *Section 2.1, Command Formats* on *page 38* for additional examples.

In CDU there are two ways to initiate data logging to the receiver's serial ports. You can either enter the LOG command in the *Console* window, or use the interface provided in the *Logging Control* window. Ensure the Power Settings on your PC are not set to go into Hibernate or Standby modes. Data is lost if one of these modes occurs during a logging session.

Field	Field Name	Binary Value	Description	Field Type	Binary Bytes	Binary Offset
1	LOG (binary) header	(See *Table 4, Binary Message Header Structure* on *page 24*)	This field contains the message header.	-	H	0
2	port	See *Table* , on *page 26*	Output port	Enum	4	H
3	message	Any valid message ID	Message ID of log to output	UShort	2	H+4
4	message type	Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response Bit (see *page 29*) 0 = Original Message 1 = Response Message	Message type of log	Char	1	H+6
5	Reserved			Char	1	H+7
6	trigger	0 = ONNEW	Does not output current message but outputs when the message is updated (not necessarily changed)	Enum	4	H+8
		1 = ONCHANGED	Outputs the current message and then continue to output when the message is changed			
		2 = ONTIME	Output on a time interval			
		3 = ONNEXT	Output only the next message			
		4 = ONCE	Output only the current message			
		5 = ONMARK	Output when a pulse is detected on the mark 1 input, MK1I [a] [b]			
7	period	Valid values for the high rate logging are 0.05, 0.1, 0.2, 0.25 and 0.5. For logging slower than 1Hz any integer value is accepted.	Log period (for ONTIME trigger) in seconds [c]	Double	8	H+12

Continued on next page

Field	Field Name	Binary Value	Description	Field Type	Binary Bytes	Binary Offset
8	offset	A valid value is any integer smaller than the period. These decimal values, on their own, are also valid: 0.1, 0.2, 0.25 or 0.5	Offset for period (ONTIME trigger) in seconds. If you wished to log data at 1 second after every minute you would set the period to 60 and the offset to 1	Double	8	H+20
9	hold	0 = NOHOLD	Allow log to be removed by the UNLOGALL command	Enum	4	H+28
		1 = HOLD	Prevent log from being removed by the default UNLOGALL command			

a. Refer to the *Technical Specifications* appendix in the *OEM6 Family Installation and Operation User Manual* for more details on the MK1I pin. ONMARK only applies to MK1I. Events on MK2I (if available) do not trigger logs when ONMARK is used. Use the ONNEW trigger with the MARKTIME, MARK2TIME, MARKPOS or MARK2POS logs.

b. Once the 1PPS signal has hit a rising edge, for both MARKPOS and MARKTIME logs, a resolution of both measurements is 49 ns. As for the ONMARK trigger for other logs that measure latency, for example RANGE and position log such as BESTPOS, it takes typically 20-30 ms (50 ms maximum) for the logs to output information from the 1PPS signal. Latency is the time between the reception of the 1PPS pulse and the first byte of the associated log. See also the MARKPOS and MARKTIME logs starting on *page 413*.

c. See *Appendix A* in the *OEM6 Family Installation and Operation User Manual* for the maximum raw measurement rate to calculate the minimum period. If the value entered is lower than the minimum measurement period, the value is ignored and the minimum period is used.

Field	Field Name	ASCII Value	Description	Field Type
1	LOG (ASCII) header	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII or ASCII respectively.	-
2	port	See *Table , Abbreviated ASCII Syntax: Message ID: 1246* on *page 213*	Output port (default = THISPORT)	Enum
3	message	Any valid message name, with an optional A or B suffix.	Message name of log to output	Char [ ]
4	trigger	ONNEW	Output when the message is updated (not necessarily changed)	Enum
		ONCHANGED	Output when the message is changed	
		ONTIME	Output on a time interval	
		ONNEXT	Output only the next message	
		ONCE	Output only the current message. (default)	
		ONMARK	Output when a pulse is detected on the mark 1 input, MK1I (see *Footnotes a* and *b* on *page 161*)	

Continued on next page

5	period	Any positive double value larger than the receiver's minimum raw measurement period	Log period (for ONTIME trigger) in seconds (default = 0) (see *Footnote c* on *page 161*)	Double
6	offset	Any positive double value smaller than the period.	Offset for period (ONTIME trigger) in seconds. If you wished to log data at 1 second after every minute you would set the period to 60 and the offset to 1 (default = 0)	Double
7	hold	NOHOLD	Allow log to be removed by the UNLOGALL command (default)	Enum
		HOLD	Prevent log from being removed by the UNLOGALL command	

2.5.54 MAGVAR Sets a magnetic variation correction

The receiver computes directions referenced to True North. Use this command (magnetic variation correction) if you intend to navigate in agreement with magnetic compass bearings. The correction value entered here causes the "bearing" field of the NAVIGATE log to report bearing in degrees Magnetic. The receiver computes the magnetic variation correction if you use the auto option. See *Figure 4, Illustration of Magnetic Variation & Correction on Page 164*.

The receiver calculates values of magnetic variation for given values of latitude, longitude and time using the International Geomagnetic Reference Field (IGRF) 2010 spherical harmonic coefficients and IGRF time corrections to the harmonic coefficients. The model is intended for use up to the year 2015. The receiver will compute for years beyond 2015 but accuracy may be reduced.

Abbreviated ASCII Syntax: **Message ID: 180**

MAGVAR type [correction] [std dev]

Factory Default:

magvar correction 0 0

ASCII Example 1:

magvar auto

ASCII Example 2:

magvar correction 15 0

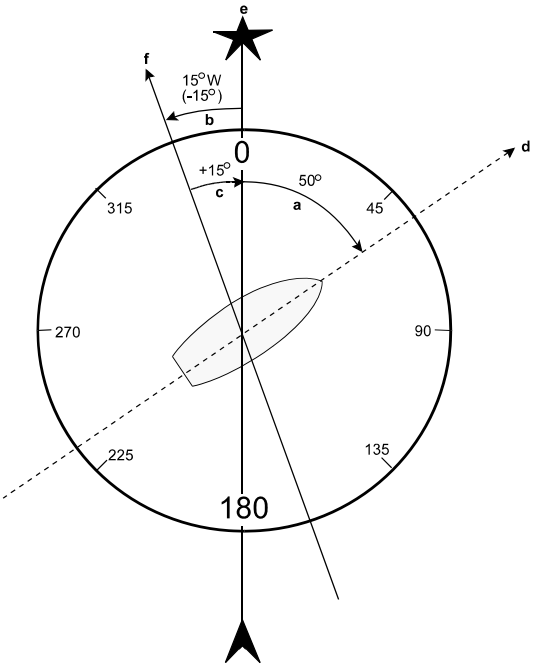


Figure 4: Illustration of Magnetic Variation & Correction

Reference	Description
a	True Bearing
b	Local Magnetic Variation
c	Local Magnetic Variation Correction (inverse of magnetic variation)
a + c	Magnetic Bearing
d	Heading: 50° True, 60° Magnetic
e	True North
f	Local Magnetic North

How does GNSS determine what Magnetic North is? Do the satellites transmit a database, or some kind of look-up chart to determine the declination for your given latitude and longitude? How accurate is it?

Magnetic North refers to the location of the Earth's Magnetic North Pole. Its position is constantly changing in various cycles over centuries, years, and days. These rates of change vary and are not well understood. However, we are able to monitor these changes.

True North refers to the earth's celestial pole, that is, at 90° north latitude or the location where the lines of longitude converge. This position is always the same and does not vary.

The locations of these two poles do not coincide. Thus, a relationship is required between these two values for users to relate GNSS bearings to their compass bearings. This value is called the magnetic variation correction or declination.

GNSS does not determine where Magnetic North is nor do the satellites provide magnetic correction or declination values. However, OEM6 receivers store this information internally in look-up tables so that when you specify that you want to navigate with respect to Magnetic North, this internal information is used. These values are also available from various information sources such as the United States Geological Survey (USGS). The USGS produces maps and has software which enables you to determine these correction values. By identifying your location (latitude and longitude), you can obtain the correction value. Refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning, for USGS contact information.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	MAGVAR header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	type	AUTO	0	Use IGRF corrections	Enum	4	H
		CORRECTION	1	Use the correction supplied			
3	correction	± 180.0 degrees		Magnitude of correction (Required field if type = Correction)	Float	4	H+4
4	std_dev	± 180.0 degrees		Standard deviation of correction (default = 0)	Float	4	H+8

2.5.55 MARKCONTROL Controls processing of mark inputs

This command provides a means of controlling the processing of the mark 1 (MK1I) and mark 2 (MK2I) inputs for the OEM6. Using this command, the mark inputs can be enabled or disabled, the polarity can be changed, and a time offset and guard against extraneous pulses can be added.

The MARKPOS and MARKTIME logs, see their descriptions starting on *page 413*, have their outputs (and extrapolated time tags) pushed into the future (relative to the MKI event) by the amount entered into the time bias field. In almost all cases, this value is set to 0, which is also the default setting.

Abbreviated ASCII Syntax: **Message ID: 614**

MARKCONTROL signal [switch [polarity [timebias [timeguard]]]

Factory Default:

markcontrol mark1 disable

markcontrol mark2 disable

ASCII Example:

markcontrol mark1 enable negative 50 100

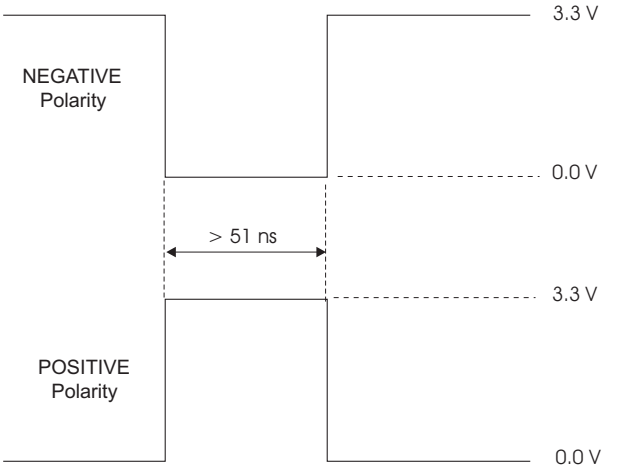


Figure 5: TTL Pulse Polarity

You may have a user point device, such as a video camera device. Connect the device to the receiver's I/O port. Use a cable that is compatible to both the receiver and the device. A MARKIN pulse can be a trigger from the device to the receiver. See also the MARKPOS and MARKTIME logs starting on *page 413*.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	MARKCONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	signal	MARK1	0	Specifies which mark input the command should be applied to. Set to MARK1 for the MK1I input and MARK2 for MK2I. Both mark inputs have 10K pull-up resistors to 3.3 V and are leading edge triggered.	Enum	4	H
		MARK2	1				
3	switch	DISABLE	0	Disables or enables processing of the mark input signal for the input specified. If DISABLE is selected, the mark input signal is ignored (default = ENABLE).	Enum	4	H+4
		ENABLE	1				
4	polarity	NEGATIVE	0	Optional field to specify the polarity of the pulse to be received on the mark input. See *Figure 5* for more information (default= NEGATIVE)	Enum	4	H+8
		POSITIVE	1				
5	timebias	Any valid long value		Optional value to specify an offset, in nanoseconds, to be applied to the time the mark input pulse occurs (default =0).	Long	4	H+12
6	timeguard	Any valid ulong value larger than the receiver's minimum raw measurement period [a]		Optional field to specify a time period, in milliseconds, during which subsequent pulses after an initial pulse are ignored (default =0)	ULong	4	H+16

a. See *Appendix A* in the *OEM6 Family Installation and Operation User Manual* for the maximum raw measurement rate to determine the minimum period. If the value entered is lower than the minimum measurement period, the value is ignored and the minimum period is used.

2.5.56 MODEL Switches to a previously authorized model

This command is used to switch the receiver between models previously added with the AUTH command. When this command is issued, the receiver saves this model as the active model. The active model is now used on every subsequent start-up. The MODEL command causes an automatic reset.

Use the VALIDMODELS log to output a list of available models for your receiver. The VALIDMODELS log is described on *Page 680*. Use the VERSION log to output the active model, see *Page 681*.

If you switch to an expired model, the receiver will reset and enter into an error state. You will need to switch to a valid model to continue.

Abbreviated ASCII Syntax: **Message ID: 22**

MODEL model

Input Example:

model d2lr0rccr

NovAtel receivers use the concept of models to enable different levels of functionality in the receiver firmware. For example, a receiver may be purchased with an L1 only enabled version of firmware and be easily upgraded at a later time to a more feature-intensive model. All that is required to upgrade is an authorization code for the higher model and the AUTH command (see *page 78*). Reloading the firmware or returning the receiver for service to upgrade the model is not required. Upgrades are available from NovAtel Customer Support. Contact information is avaiable on our website at www.novatel.com or on page *16*.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	MODEL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	model	Max 16 character null-terminated string (including the null)		Model name	String [max. 16]	Vari-able[a]	Vari-able

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

2.5.57 MOVINGBASESTATION Enables the use of a moving base station

This command enables or disables a receiver from transmitting corrections without a fixed position.

The moving base function allows you to obtain a cm level xyz baseline estimate when the base station and possibly the rover are moving. It is very similar to normal RTK, that is, one base station and potentially more than one rover depending on the data link. Communication with each receiver is done in the usual way (refer to the *Transmitting and Receiving Corrections* section of the *Operation* chapter in the *OEM6 Family Installation and Operation User Manual*). The BSLNXYZ log is an asynchronous 'matched' log that can be logged with the onchanged trigger to provide an accurate baseline between the base and rover.

At the rover, it is recommended that you only use the PSRPOS log for position when in moving base station mode. PSRPOS has normal accuracy with good standard deviations. Other position logs, for example BESTPOS, can have error levels of 10's to 100's of metres and should be considered invalid. Also, the standard deviation in these logs does not correctly reflect the error level. Other rover position logs, where accuracy and standard deviations are affected by the moving base station mode, are BESTXYZ, GPGST, MARKPOS, MARK2POS, MATCHEDPOS, MATCHEDXYZ, RTKPOS and RTKXYZ.

The MOVINGBASESTATION command must be used to allow the base to transmit messages without a fixed position.

1. Use the PSRPOS position log at the rover. It provides the best accuracy and standard deviations when the MOVINGBASESTATION mode is enabled.
2. This command supports RTCM V2.3 messages (except RTCM2021), RTCM V3 operation and CMR GLONASS.
3. RTCA, RTCM1819 and RTCM V3 support includes GPS + GLONASS operation.
4. The MOVINGBASESTATION mode is functional if any of the following RTK message formats are in use: RTCAOBS, RTCAOBS2, CMROBS, RTCAREF or CMRREF.

Abbreviated ASCII Syntax: **Message ID: 763**

MOVINGBASESTATION switch

Factory Default:

movingbasestation disable

ASCII Example:

movingbasestation enable

1. Consider the case where there is a fixed base and an airplane flying with a moving base station near its front and a rover station at its tail end.
Corrections can be sent between the receivers in a ‘daisy chain’ effect where the fixed base station sends corrections to the moving base station which in turn can send corrections to the rover.

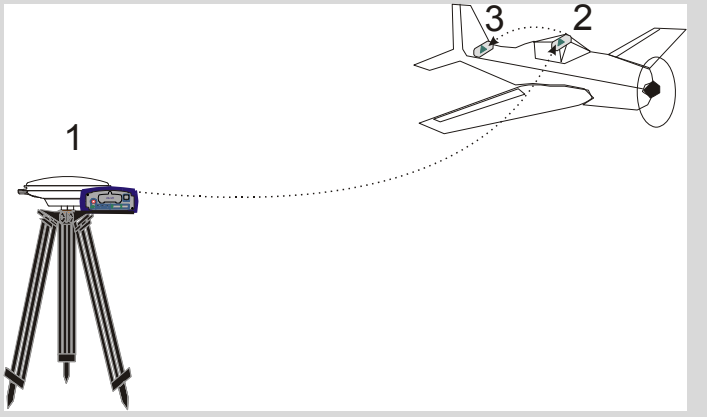


Figure 6: Moving Base Station ‘Daisy Chain’ Effect

Be cautious however when using this method as a check on the position type is only done at the fixed base station. Moving base stations will continue to operate under any conditions.

2. This command is useful for moving base stations doing RTK positioning at sea. A rover station is used to map out local areas (for marking shipping lanes, hydrographic surveying, and so on), while the base station resides on the control ship. The control ship may not move much (parked at sea), but there is a certain amount of movement due to the fact that it is floating in the ocean. By using the MOVINGBASESTATION command, the control ship is able to use RT2-level RTK positioning and move to new survey sites

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	MOVING-BASESTATION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Do not transmit corrections without a fixed position	Enum	4	H
		ENABLE	1	Transmit corrections without a fixed position			

2.5.58 NMEATALKER Sets the NMEA talker ID

This command allows you to alter the behavior of the NMEA talker ID. The talker is the first 2 characters after the $ sign in the log header of the GPGLL, GPGRS, GPGSA, GPGST, GPGSV, GPRMB, GPRMC, GPVTG, and GPZDA log outputs.

The default GPS NMEA messages (`nmeatalker gp`) include specific information about only the GPS satellites and have a 'GP' talker solution even when GLONASS satellites are present. The `nmeatalker auto` command changes this behavior so that the NMEA messages include all satellites in the solution, and the talker ID changes according to those satellites.

If `nmeatalker` is set to `auto`, and there are both GPS and GLONASS satellites in the solution, two sentences with the GN talker ID are output. The first sentence contains information about the GPS, and the second sentence on the GLONASS, satellites in the solution.

If `nmeatalker` is set to `auto` and there are only GLONASS satellites in the solution, the talker ID of this message is GL.

Abbreviated ASCII Syntax: **Message ID: 861**

NMEATALKER id

Factory Default:

nmeatalker gp

ASCII Example:

nmeatalker auto

The NMEATALKER command only affects NMEA logs that are capable of a GPS output. For example, GLMLA is a GLONASS-only log and its output will always use the GL talker. *Table 30* on *page 172* shows the NMEA logs and whether they use GPS (GP), GLONASS (GL) or combined (GN) talkers with `nmeatalker auto`.

Table 30: NMEA Talkers

Log	Talker IDs
GLMLA	GL
GPALM	GP
GPGGA	GP
GPGLL	GP or GN
GPGRS	GP or GN
GPGSA	GP or GN
GPGST	GP or GN
GPGSV	GP and GL
GPRMB	GP or GN
GPRMC	GP or GN
GPVTG	GP or GN
GPZDA	GP

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	NMEA-TALKER header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	ID	GP	0	GPS only	Enum	4	H
		AUTO	1	GPS, GLONASS, combined			

2.5.59 NTRIPCONFIG Configures NTRIP

This command sets up and configures NTRIP communication.

This command also acts as a collection response ether and can be used as a log.

Abbreviated ASCII Syntax: **Message ID 1249**

`NTRIPCONFIG` port type [protocol [endpoint [mountpoint [usernam [password [interface]]]]]]

Mountpoint, username, password are all set up on the caster.

Factory Default:

ntriptconfig ncom1 disabled

ntriptconfig ncom2 disabled

ntriptconfig ncom3 disabled

ntripconfig ncomx disable

ASCII Example:

ntripconfig ncom1 client v1 :2000 calg0

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	NTRIPCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	this port	6	Name of the port see *Table 37* on *page 214*	Enum	4	H
		ncom1	26				
		ncom2	27				
		ncom3	28				
3	type	DISABLE	1	NTRIP type	Enum	4	H+4
		Client	2				
		Server	3				
4	protocol	V1 (default)	2	Protocol	Enum	4	H+8
		V2	3				
4	endpoint	Max 80 character string		Endpoint to wait on, or to connect to where host is a hostname or IP address and port is the TCP/UDP port number.	String	80	H+12
5	mountpoint	Max 80 character string.		Which mount point to use	String	80	H+92
6	user	Max 30 character string.		Login user name	String	30	H+172
7	password	Max 30 character string.		Password	String	30	H+202
5	bindInterface	ALL (default)	1	All, or an interface that supports TCP/IP	Enum	4	H+232
		ETHA	2				

2.5.60 NTRIPSOURCETABLE Set NTRIPCASTER ENDPONTS

This command sets the NTRIPCASTER ENDPOINTS to be used for the SOURCETABLE log.

Abbreviated ASCII Syntax: **Message ID 1343**

ntripsourcetable [endpoint]

Factory Default:

none

ASCII Example:

ntripsourcetable hera.novatel.com:2101
ntripsourcetable 198.161.64.11:2101

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	NTRIPSOURCETABLE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	Endpoint	Max 80 character string		Endpoint, in format of host:port, to connect to where the host is a hostname or IP address and port is the TCP/IP port number.	STRING	80	H
3	Reserved1	Reserved		Reserved	ULONG	4	H+80
4	Reserved2	Reserved		Reserved	ULONG	4	H+84

2.5.61 NVMRESTORE Restores NVM data after an NVM failure

This command restores non-volatile memory (NVM) data after a NVM Fail error. This failure is indicated by bit 13 of the receiver error word being set (see also *RXSTATUS, Page 607* and *RXSTATUSEVENT, Page 617*). If corrupt NVM data is detected, the receiver remains in the error state and continues to flash an error code on the Status LED until the NVMRESTORE command is issued (refer to the chapter on *Built-In Status Tests* in the *OEM6 Family Installation and Operation User Manual* for further explanation).

If you have more than one auth-code and the saved model is lost then the model may need to be entered using the MODEL command or it is automatically saved in NVM on the next start-up. If the almanac was lost, a new almanac is automatically saved when the next complete almanac is received (after approximately 15 minutes of continuous tracking). If the user configuration was lost it has to be re-entered by the user. This could include communication port settings.

The factory default for the COM ports is 9600, n, 8, 1.

After entering the NVMRESTORE command and resetting the receiver, the communications link may have to be re-established at a different baud rate from the previous connection.

Abbreviated ASCII Syntax: **Message ID: 197**

NVMRESTORE

The possibility of NVM failure is extremely remote, however, if it should occur it is likely that only a small part of the data is corrupt. This command is used to remove the corrupt data and restore the receiver to an operational state. The data lost could be the user configuration, almanac, model, or other reserved information.

2.5.62 OMNIUSEGLONASS Enbales/disables GLONASS in OmniStar

Abbreviated ASCII Syntax: **Message ID: 1199**

OMNIUSEGLONASS switch

Factory Default:

omniuseglonass disable

ASCII Example:

omniuseglonass enable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	OMNIUSEGLONASS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Enables/disables GLONASS in OmniStar	Enum	4	H
		ENABLE	1				

2.5.63 PDPFILTER Enables, disables or resets the PDP filter

This command enables, disables or resets the Pseudorange/Delta-Phase (PDP) filter. The main advantages of the Pseudorange/Delta-Phase (PDP) implementation are:

- Smooths a jumpy position
- Bridges outages in satellite coverage (the solution is degraded from normal but there is at least a reasonable solution without gaps)

1. Enable the PDP filter to output the PDP solution in BESTPOS, BESTVEL and NMEA logs.
2. Refer to the *Operation* chapter of the OEM6 Installation and Operation Manual for a section on configuring your receiver for PDP or GL1DE ® operation.

GL1DE Position Filter

GL1DE is a mode of the PDP[1] filter that optimizes the position for consistency over time rather than absolute accuracy. This is ideally in clear sky conditions where the user needs a tight, smooth, and consistent output. The GL1DE filter works best with SBAS. The PDP filter is smoother than a least squares fit but is still noisy in places. The GL1DE filter produces a very smooth solution with consistent rather than absolute position accuracy. There should be less than 1 cm difference in error from epoch to epoch. GL1DE also works in single point, DGPS and OmniSTAR VBS modes. See also the PDPMODE command on *page 179* and the PDPPOS, PSRVEL and PSRXYZ logs starting on *page 440*.

Abbreviated ASCII Syntax: **Message ID: 424**

PDPFILTER switch

Factory Default:

pdpfilter disable

ASCII Example:

pdpfilter enable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PDPFILTER header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Enable/disable/reset the PDP filter. A reset clears the filter memory so that the pdp filter can start over.	Enum	4	H
		ENABLE	1				
		RESET	2				

1. Refer also to our application note on *Pseudorange/Delta-Phase (PDP)*, available on our website as APN-038 at http://www.novatel.com/support/applicationnotes.htm

2.5.64 PDPMODE Selects the PDP mode and dynamics

This command allows you to select the mode and dynamics of the PDP filter.

1. You must issue a PDPFILTER ENABLE command before the PDPMODE command. See also *Section 2.5.63* on *page 178*.
2. It is recommended that the ionotype be left at "AUTO" when using either normal mode pdp or GL1DE.
   See also *Section 2.5.93* starting on *Page 222* for details on the SETIONOTYPE command.

Abbreviated ASCII Syntax: **Message ID: 970**

PDPMODE mode dynamics

Factory Default:

pdpmode normal auto

ASCII Example:

pdpmode relative dynamic

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PDPMODE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	mode	NORMAL	0	In relative mode, GL1DE, performance is optimized to obtain a consistent error in latitude and longitude over time periods of 15 minutes or less rather than to obtain the smallest absolute position error. See also *GL1DE Position Filter* on *page 178*.	Enum	4	H
		RELATIVE	1				
3	dynamics	AUTO	0	Auto detect dynamics mode	Enum	4	H+4
		STATIC	1	Static mode			
		DYNAMIC	2	Dynamic mode			

2.5.65 POSAVE Implements base station position averaging

This command implements position averaging for base stations. Position averaging continues for a specified number of hours or until the estimated averaged position error is within specified accuracy limits. Averaging stops when the time limit or the horizontal standard deviation limit or the vertical standard deviation limit is achieved. When averaging is complete, the FIX POSITION command is automatically invoked.

If you initiate differential logging, then issue the POSAVE command followed by the SAVECONFIG command, the receiver averages positions after every power-on or reset, and then invokes the FIX POSITION command to enable it to send differential corrections.

Abbreviated ASCII Syntax: **Message ID: 173**

POSAVE [state] maxtime [maxhstd [maxvstd]]

Factory Default:

posave off

ASCII Example 1:

posave on 24 1 2

ASCII Example 2:

posave off

The POSAVE command can be used to establish a new base station in any form of survey or RTK data collection by occupying a site and averaging the position until either a certain amount of time has passed, or position accuracy has reached a user-specified level. User-specified requirements can be based on time, or horizontal or vertical quality of precision.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	POSAVE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	state	ON	1	Enable or disable position averaging (default = ON)	Enum	4	H
		OFF	0				
3	maxtime	0.01 - 100 hours		Maximum amount of time that positions are to be averaged. Only becomes optional if: State = OFF	Float	4	H+4
4	maxhstd	0 - 100 m		Desired horizontal standard deviation (default = 0)	Float	4	H+8
5	maxvstd	0 - 100 m		Desired vertical standard deviation (default = 0)	Float	4	H+12

2.5.66 POSTIMEOUT Sets the position time out

This commands allows you to set the time out value for the position calculation in seconds.

In position logs, for example BESTPOS or PSRPOS, when the position time out expires, the *Position Type* field is set to NONE. Other field values in these logs remain populated with the last available position data. Also, the position is no longer used in conjunction with the almanac to determine what satellites are visible.

Abbreviated ASCII Syntax: **Message ID: 612**

POSTIMEOUT sec

Factory Default:

postimeout 600

ASCII Example:

postimeout 1200

When performing data collection in a highly dynamic environment (for example, urban canyons or in high-speed operations), you can use POSTIMEOUT to prevent the receiver from using calculated positions that are too old. Use POSTIMEOUT to force the receiver position type to NONE. This ensures that the position information being used in BESTPOS or PSRPOS logs is based on a recent calculation. All position calculations are then re-calculated using the most recent satellite information.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	POSTIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	sec	0-86400		Time out in seconds	Ulong	4	H

2.5.67 PPSCONTROL Controls the PPS output

This command provides a method for controlling the polarity, periode and pulse width of the PPS output on the OEM6. You can also disable the PPS output using this command.

The leading edge of the 1PPS pulse is always the trigger/reference:

```
PPSCONTROL ENABLE NEGATIVE
```

generates a normally high, active low pulse with the falling edge as the reference, while:

```
PPSCONTROL ENABLE POSITIVE
```

generates a normally low, active high pulse with the rising edge as the reference.

The pulse width is user-adjustable. The adjustable pulse width feature generates these uses for the PPS signal:

- Supporting triggers/systems that need longer, or shorter, pulse widths than the default to register the pulse
- Enabling a type of GPIO line for manipulation of external hardware control lines

Abbreviated ASCII Syntax: **Message ID: 613**

PPSCONTROL [switch [polarity [period [pulse width]]]]

Factory Default:

ppscontrol enable negative 1.0 1000

ASCII Example:

ppscontrol enable positive 0.5 2000

This command is used to setup the PPS signal coming from the receiver. Suppose you wanted to take measurements such as temperature or pressure in synch with your GNSS data. The PPS signal can be used to trigger measurements in other devices.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PPSCONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Disables or enables output of the PPS pulse. (default =ENABLE)	Enum	4	H+4
		ENABLE	1				
3	polarity	NEGATIVE	0	Optional field to specify the polarity of the pulse to be generated on the PPS output. See *Figure 5* for more information (default= NEGATIVE)	Enum	4	H+8
		POSITIVE	1				
4	period	0.05, 0.1, 0.2, 0.25, 0.5, 1.0, 2.0, 3.0,...20.0		Optional field to specify the period of the pulse, in seconds (default=1.0)	Double	8	H+12
5	pulse width	Any positive value less than or equal to half the period		Optional field to specify the pulse width of the PPS signal in microseconds. This value should always be less than or equal to half the period. (default=1000)	ULong	4	H+20

2.5.68 PSRDIFFSOURCE Sets the pseudorange correction source

This command lets you identify from which base station to accept differential corrections. This is useful when the receiver is receiving corrections from multiple base stations. See also the RTKSOURCE command on *Page 200*.

1. When a valid PSRDIFFSOURCE command is received, the current correction is removed immediately rather than in the time specified in DGPSTIMEOUT.
2. To use L-band differential corrections, an L-band receiver and the OmniSTAR service or use of a DGPS service is required. Contact NovAtel for details.
3. For ALIGN users: the ALIGN rover will not use RTK corrections automatically to do PSRDIFF positioning, as ALIGN is commonly used with a moving base. If you have a static base and want a PSRDIFF position at the ALIGN rover, set the PSRDIFFSOURCE RTK.

Abbreviated ASCII Syntax: **Message ID: 493**

PSRDIFFSOURCE type [id]

Factory Default:

psrdiffsource auto "any"

ASCII Examples:

1. Enable only SBAS:
   rtksource none
   psrdiffsource sbas
   sbascontrol enable auto
2. Enable OmniSTAR VBS, and HP or XP:
   rtksource omnistar
   psrdiffsource omnistar
3. Enable RTK and PSRDIFF from RTCM, with a fall-back to SBAS:
   rtksource rtcm any
   psrdiffsource rtcm any
   sbascontrol enable auto
4. Disable all corrections:
   rtksource none
   psrdiffsource none

Since several errors affecting signal transmission are nearly the same for two receivers near each other on the ground, a base at a known location can monitor the errors and generate corrections for the rover to use. This method is called Differential GPS, and is used by surveyors to obtain submetre accuracy.

Major factors degrading GPS signals, which can be removed or reduced with differential methods, are atmospheric, satellite orbit errors and satellite clock errors. Errors not removed include receiver noise and multipath.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	PSRDIFFSOURCE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	type	See *Table 31* on *page 186*		ID Type. All types (except NONE) may revert to SBAS (if enabled) or SINGLE position types. See also *Table 55, Position or Velocity Type* on *page 301.* [a]	Enum	4	H
3	Base Station ID	Char [5] or ANY		ID string	Char[5]	8 [b]	H+4

a. If you choose ANY, the receiver ignores the ID string. Specify a Type when you are using base station IDs.

b. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

Table 31: DGPS Type

Binary	ASCII	Description
0	RTCM [d]	RTCM ID: 0 ≤ RTCM ID ≤ 1023 **or** ANY
1	RTCA [d]	RTCA ID: A four character string containing only alpha (a-z) or numeric characters (0-9) **or** ANY
2	CMR [da]	CMR ID: 0 ≤ CMR ID ≤ 31 **or** ANY
3	OMNISTAR [b d]	In the PSRDIFFSOURCE command, OMNISTAR enables OmniSTAR VBS and disables other DGPS types. OmniSTAR VBS produces RTCM-type corrections. In the RTKSOURCE command, OMNISTAR enables OmniSTAR HP/XP (if allowed) and disables other RTK types. OmniSTAR HP/XP has its own filter, which computes corrections in RTK float mode or within about 10 cm accuracy.
Reserved		
5	SBAS [c d]	In the PSRDIFFSOURCE command, when enabled, SBAS, such as WAAS, EGNOS and MSAS, forces the use of SBAS as the pseudorange differential source. SBAS is able to simultaneously track two SBAS satellites, and incorporate the SBAS corrections into the position to generate differential-quality position solutions. An SBAS-capable receiver permits anyone within the area of coverage to take advantage of its benefits. **If SBAS is set in the RTKSOURCE command, it can not provide carrier phase positioning and returns an error.**
6	RTK[c]	In the PSRDIFFSOURCE command, RTK enables using RTK correction types for PSRDIFF positioning.The correction type used is determined by the setting of the RTKSOURCE command (see page *200*)
10	AUTO [c d]	In the PSRDIFFSOURCE command, AUTO means that if any correction format is received then it will be used. If multiple correction formats are available, then RTCM, RTCA, and RTK will be preferred over OmniSTAR, which will be preferred over SBAS messages. If RTCM, RTCA, and RTK are all available then the type of the first received message will be used. In the RTKSOURCE command, AUTO means that both the NovAtel RTK filter and the OmniSTAR HP/XP filter (if authorized) are enabled. The NovAtel RTK filter selects the first received RTCM, RTCA, RTCMV3 or CMR message. The BESTPOS log selects the best solution between NovAtel RTK and OmniSTAR HP/XP.
11	NONE [c d]	Disables all differential correction types
12	Reserved	
13	RTCMV3 [ba]	RTCM Version 3.0 ID: 0 ≤ RTCMV3 ID ≤ 4095 **or** ANY

a. This cannot be used in the PSRDIFFSOURCE command.
b. Base station ID parameter is ignored.
c. Available only with the PSRDIFFSOURCE command, see *page 184.*
d. All PSRDIFFSOURCE entries fall back to SBAS (except NONE).

2.5.69 QZSSECUTOFF Sets QZSS Satellite Elevation Cutoff

This command sets the elevation cut-off angle for QZSS satellites. The receiver does not start automatically searching for a QZSS satellite until it rises above the cut-off angle. Tracked QZSS satellites that fall below the QZSSECUTOFF angle are no longer tracked unless they are manually assigned (see the ASSIGN command).

This command does not affect the tracking of GPS satellites. Similarly, the ECUTOFF command does not affect QZSS satellites.

Abbreviated ASCII Syntax: **Message ID: 1350**

QZSSECUTOFF angle

Factory Default:

qzssecutoff 5.0

ASCII Example

qzssecutoff 10.0

[note] this command permits a negative cut-off angle. it could be used in these situations:

- the antenna is at a high altitude, and thus can look below the local horizon
- satellites are visible below the horizon due to atmospheric refraction

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	angle	±90 degrees		Elevation cutoff angle relative to the horizon	FLOAT	4	H

2.5.70 RAIMMODE Configures RAIM mode

This command is used to configure RAIM operation. This command uses RTCA MOPS characteristics which defines the positioning accuracy requirements for airborne lateral navigation (LNAV) and vertical navigation (VNAV) at 3 stages of flight:

1. En route travel
2. Terminal (within range of air terminal)
3. Non-precision approach

In order to ensure that the required level of accuracy is available in these phases of flight, MOPS requires the computation of protection levels (HPL and VPL). MOPS has the following definitions that apply to NovAtel's RAIM feature:

Horizontal Protection Level (HPL): is a radius of the circle in the horizontal plane, with its center being at the true position that describes the region that is assured to contain the indicated horizontal position. It is horizontal region where the missed alert and false alert requirements are met using autonomous fault detection.

Vertical Protection Level (VPL): is a half the length of the segment on the vertical axis with its center being at the true position that describes the region that is assured to contain the indicated vertical position when autonomous fault detection is used.

Horizontal Alert Limit (HAL): a radius of the circle in the horizontal plane, with its center being at the true position that describes the region that is required to contain the indicated horizontal position with the required probability.

Vertical Alert Limit (VAL): half of the length of the segment on the vertical axis with its center being at the true position that describes the region that is required to contain the indicated vertical position with certain probability.

Probability of False Alert (P_{fa}): A false alert is defined as the indication of a positioning failure when a positioning failure has not occurred (as a result of false detection). A false alert would cause a navigation alert.

Detection strategy

NovAtel's RAIM detection strategy uses the weighted least-squares detection method. This method computes a solution using a least-squares adjustment (LSA) and is based on the sum of squares of weighted residuals. It is a comparison between a root sum of squares of residuals and a decision threshold to determine a pass/fail decision.

Isolation strategy

NovAtel RAIM uses the maximum residual method. Logically it is implemented as a second part of Fault Detection and Exclusion (FDE) algorithm for LSA detection method. Weighted LSA residuals are standardized individually and the largest residual is compared to a decision threshold. If it is more than the threshold, the observation corresponding to this residual is declared faulty.

Abbreviated ASCII Syntax: **Message ID: 1285**

RAIMMODE mode [hal [val [pfa]]]

Factory Default:

raimmode default

Input Example:

raimmode user 100 100 0.01

raimmode terminal

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	RAIMMODE Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	MODE	See *Table 32* on *page 189*.			-	4	H
3	HAL	5 ≤ HAL ≤ 9999.99		Horizontal akert limit (m) (Default = 0.0)	Double	8	H+4
4	VAL	5 ≤ VAL ≤ 9999.99		Vertical alert limit (m) (Default = 0.0)	Double	8	H+12
5	PFA	$(P_{fa})= 1e^{-7} \leq P_{fa} \leq 0.25$		Probability of false alert (Default = 0.0)	Double	8	H+20

Table 32: RAIM Mode Types

Binary	ASCII	Description
0	DISABLE	Do not do integrity monitoring of least squares solution
1	USER	User will specify alert limits and probability of false alert
2	DEFAULT	Use OEMV (NovAtel) RAIM (default)
3	APPROACH	Default numbers for non-precision approach navigation mode are used - HAL = 556 m (0.3 nm), VAL = 50 m for LNAV/VNAV
4	TERMINAL	Default numbers for terminal navigation mode are used - HAL = 1855 m (1 nm), no VAL requirement
5	ENROUTE	Default numbers for en-route navigation mode are used - HAL = 3710m (2 nm), no VAL requirement

2.5.71 RESET Performs a hardware reset

This command performs a hardware reset. Following a RESET command, the receiver initiates a cold-start boot up. Therefore, the receiver configuration reverts either to the factory default, if no user configuration was saved, or the last SAVECONFIG settings. See also the FRESET and SAVECONFIG commands on *Pages 130* and *204* respectively.

The optional delay field is used to set the number of seconds the receiver is to wait before resetting.

Abbreviated ASCII Syntax: **Message ID: 18**

RESET [delay]

Input Example

reset 120

1. The RESET command can be used to erase any unsaved changes to the receiver configuration.
2. Unlike the FRESET command, the RESET command does not erase data stored in the NVM, such as Almanac and Ephemeris data.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RESET header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	delay			Seconds to wait before resetting. (default = 0)	Ulong	4	H

2.5.72 RTKANTENNA Specifies L1 phase center (PC) or ARP and enables/disables PC modeling

Use this command to specify whether to use L1 phase center or Antenna Reference Point (ARP) positioning.

You can also decide whether or not to apply phase center variation modeling. If there are any conditions that make a selected mode impossible, the solution status in the position logs indicate an error or warning. Status information is in the *rtk info* field of the RTKDATA log, see *page 592*.

L1 ARP offsets, L2 ARP offsets and phase center variation parameters can be entered using the ANTENNAMODEL and BASEANTENNAMODEL commands on *page 63* and *page 80* respectively.

Error states occur if either the rover does not have the necessary antenna information entered or the base is not sending sufficient information to work in the requested mode. Some examples of these error conditions are:

- RTCM Types 23 and 24 messages are received from the base and no model is available for the specified base antenna
- Phase center modeling is requested but the base is only sending RTCM Types 3 and 22
- Position reference to the ARP is requested but no rover antenna model is available

Abbreviated ASCII Syntax: **Message ID: 858**

RTKANTENNA posref pcv

Factory Default:

rtkantenna unknown disable

ASCII Example:

rtkantenna arp enable

This command is used for high-precision RTK positioning allowing application of antenna offset and phase center variation parameters

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKANTENNA header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	posref	L1PC	0	L1 phase center position reference	Enum	4	H
		ARP	1	ARP position reference			
		UNKNOWN	2	Unknown position reference			
3	pcv	DISABLE	0	Disable PCV modelling	Enum	4	H+4
		ENABLE	1	Enable PCV modelling			
4	Reserved				Bool	4	H+8
5	Reserved				Bool	4	H+12

2.5.73 RTKCOMMAND Resets or sets the RTK filter to its defaults

This command provides the ability to reset the RTK filter and clear any set RTK parameters. The RESET parameter causes the AdVance RTK algorithm to undergo a complete reset, forcing the system to restart the ambiguity resolution calculations. The USE_DEFAULTS action executes the following command: RTKDYNAMICS DYNAMIC.

Abbreviated ASCII Syntax: **Message ID: 97**

RTKCOMMAND action

Factory Default:

rtkcommand use_defaults

ASCII Example:

rtkcommand reset

See the descriptions for the above commands in the following pages.

..

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKCOMMAND header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	action	USE_DEFAULTS	0	Reset to defaults	Enum	4	H
		RESET	1	Reset RTK algorithm			

2.5.74 RTKDYNAMICS Sets the RTK dynamics mode

This command provides the ability to specify how the receiver looks at the data. There are three modes: STATIC, DYNAMIC, and AUTO. The STATIC mode forces the RTK software to treat the rover station as though it were stationary, regardless of the output of the motion detector.

DYNAMIC forces the software to treat the receiver as though it were in motion. If the receiver is undergoing very slow steady motion (<2.5 cm/s for more than 5 seconds), you should use DYNAMIC mode (as opposed to AUTO) to prevent inaccurate results and possible resets.

On start-up, the receiver defaults to the DYNAMIC setting.

For reliable performance the antenna should not move more than 1-2 cm when in static mode.

Abbreviated ASCII Syntax: **Message ID: 183**

RTKDYNAMICS mode

Factory Default:

rtkdynamics dynamic

ASCII Example:

rtkdynamics static

Table 33: Dynamics Mode

ASCII	Binary	Description
AUTO	0	Automatically determine dynamics mode.
STATIC	1	Static mode.
DYNAMIC	2	Dynamic mode.

Use the static option to decrease the time required to fix ambiguities and reduce the amount of noise in the position solution. If you use STATIC mode when the antenna is not static, the receiver will have erroneous solutions and unnecessary RTK resets

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKDYNAMICS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	mode	See *Table 33*		Set the dynamics mode	Enum	4	H

2.5.75 RTKELEVMASK Sets the RTK elevation mask

This command sets the elevation mask for generating RTK corrections at a base station. Any satellites below the elevation mask will not be included in the correction messages. Intended for RTCA, it works only with RTCAOBS or RTCAOBS2, see page *494*. This command is useful when the amount of bandwidth available for transmitting corrections is limited.

Abbreviated ASCII Syntax: **Message ID: 91**

RTKELEVMASK masktype [angle]

Factory Default:

rtkelevmask auto 0.0

ASCII Example:

rtkelevmask auto 2.0

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKELEVMASK header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	MaskType	0	AUTO	Type of elevation mask for RTK	Enum	4	0
		1	USER				
3	Angle			Elevation mask angle (default=-1.0)	Enum	4	H+4

2.5.76 RTKNETWORK Specifies the RTK network mode

Network RTK uses permanent base station installations, allowing kinematic GNSS users to achieve centimetre accuracies without the need of setting up a GNSS base station at a known site. This command sets the RTK network mode for a specific network. For more details on Network RTK, refer to the Network RTK application note available on our website as APN-041 at:

http://www.novatel.com/support/applicationnotes.htm.

Abbreviated ASCII Syntax: **Message ID: 951**

RTKNETWORK mode [network#]

Factory Default:

rtknetwork auto

Input Example:

rtknetwork imax

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTK-NETWORK header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	mode	See *Table 34 on page 197*		RTK network mode, see *Table 34 on page 197*. The factory default is auto where the receiver switches to the first available network RTK source.	Enum	4	H
3	network#	4-24		Specify a number for the network (default = 0)	Ulong	4	H+4

Table 34: Network RTK Mode

Binary	ASCII	Description
0	DISABLE	Single reference station RTK mode. All received network RTK corrections are ignored.
1-4	Reserved	
5	VRS	The virtual reference station (VRS), or virtual base station (VBS), idea, introduced by Trimble, is that a base station is artificially created in the vicinity of a rover receiver. All baseline-length-dependent errors, such as abnormal troposphere variation, ionospheric disturbances and orbital errors, are reduced for this VRS. The rover receiving VRS information has a lower level of these errors than a distant base station. The VRS is calculated for a position, supplied by the rover during communication start-up, with networking software. The VRS position can change if the rover is far away from the initial point. The format for sending the rover's position is standard NMEA format. Most rovers receive VRS data for a calculated base station that is within a couple of metres away. The VRS approach requires bi-directional communication for supplying the rover's position to the networking software.
6	IMAX	The iMAX idea, introduced by Leica Geosystems, is that networking software corrections, based on the rover's position, are calculated as with VRS. However, instead of calculating the base station observations for the provided position, or another position closer to the base station, original observation information is corrected with the calculated corrections and broadcast. VRS works so that although the rover is unaware of errors the VRS is taking care of, there still might be ionospheric remains in the base station observations. iMAX provides actual base station position information. The rover may assume the base station is at a distance and open its settings for estimation of the remaining ionospheric residuals. The iMAX method may trigger the rover to open its settings further than required since the networking software removes at least part of the ionospheric disturbances. However, compared to VRS above, this approach is safer since it notifies the rover when there might be baseline-length-dependent errors in the observation information.iMAX requires bi-directional communication to the networking software for supplying the base station observation information.
7	FKP	The FKP method delivers the information from a base station network to the rover. No precise knowledge of the rover's position is required for providing the correct information. The corrections are deployed as gradients to be used for interpolating to the rover's actual position.

Table 34: Network RTK Mode

Binary	ASCII	Description
8	MAX	The basic principle of the master-auxiliary concept is to provide, in compact form, as much of the information from the network and the errors it is observing to the rover as possible. With more information about the state and distribution of the dispersive and non-dispersive errors across the network, the rover is able to use more intelligent algorithms in the determination of its position solution. Each supplier of reference station software will have their own proprietary algorithms for modeling or estimating these error sources. The rover system can decide to use or to neglect the network RTK information depending on its own firmware algorithm performance.
9	Reserved	
10	AUTO	Default value, assume single base. If network RTK corrections are detected then the receiver will switch to the appropriate mode. iMAX and VRS can only be detected using RTCMV3 however it is not possible to distinguish between iMAX or VRS. If iMAX or VRS is detected then iMAX will be assumed.

2.5.77 RTKQUALITYLEVEL Sets an RTK quality mode

Abbreviated ASCII Syntax: **Message ID: 844**

RTKQUALITYLEVEL mode

Factory Default:

rtkqualitylevel normal

ASCII Example:

rtkqualitylevel extra_safe

Table 35: RTK Quality Mode

ASCII	Binary	Description
NORMAL	1	Normal RTK
EXTRA_SAFE	4	Extra Safe RTK

The EXTRA_SAFE command is needed in areas where the signal is partially blocked, by trees for example, and the position solution in NORMAL mode shows NARROW_INT even though the real position solution is out by several metres. Using EXTRA_SAFE in these types of environments means the solution will be slower getting to NARROW_INT but it is less likely to be erroneous

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKQUALITY-LEVEL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	mode	See *Table 35*		Set the RTK quality level mode	Enum	4	H

2.5.78 RTKSOURCE Sets the RTK correction source

This command lets you identify from which base station to accept RTK (RTCM, RTCMV3, RTCA, CMR and OmniSTAR (HP/XP)) differential corrections. This is useful when the receiver is receiving corrections from multiple base stations. See also the PSRDIFFSOURCE command on *Page 184*.

To use OmniSTAR HP/XP differential corrections, a NovAtel receiver with L-band capability and a subscription to the OmniSTAR service are required. Contact NovAtel for details. Contact information may be found on the back of this manual or you can refer to the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.

Abbreviated ASCII Syntax: **Message ID: 494**

RTKSOURCE type [id]

Factory Default:

rtksource auto "any"

ASCII Examples:

1. Specify the format before specifying the base station IDs:
   rtksource rtcmv3 5
   rtksource rtcm 6
2. Select only SBAS:
   rtksource none
   psrdiffsource sbas
   sbascontrol enable auto
3. Enable OmniSTAR HP and VBS:
   rtksource omnistar
   psrdiffsource omnistar
4. Enable RTK and PSRDIFF from RTCM, with a fall-back to SBAS:
   rtksource rtcm any
   psrdiffsource rtcm any
   sbascontrol enable auto

Consider an agricultural example where a farmer has his/her own RTCM base station set up but, either due to obstructions or radio problems, occasionally experience a loss of corrections. By specifying a fall back to SBAS, the farmer could set up his/her receiver to use transmitted RTCM corrections when available, but fall back to SBAS. Also, if he/she decided to get an OmniSTAR subscription, he/she could switch to the OmniSTAR corrections

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKSOURCE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	type	See *Table 31, DGPS Type* on *page 186*		ID Type [a]	Enum	4	H
3	Base Station ID	Char [5] or ANY		ID string	Char[5]	8 [b]	H+4

a. If you choose ANY, the receiver ignores the ID string. Specify a Type when you are using base station IDs.

b. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

2.5.79 RTKSVENTRIES Sets number of satellites in corrections

This command sets the number of satellites (at the highest elevation) that are transmitted in the RTK corrections from a base station receiver. Intended for RTCA, it works only with RTCAOBS or RTCAOBS2, see *Page 494*. This is useful when the amount of bandwidth available for transmitting corrections is limited.

Abbreviated ASCII Syntax: **Message ID: 92**

RTKSVENTRIES number

Factory Default:

rtksventries 24

ASCII Example:

rtksventries 7

GPS devices have enabled many transit and fleet authorities to provide Automatic Vehicle Location (AVL). AVL systems track the position of individual vehicles and relay that data back to a remote dispatcher location, that can store or better utilize the information. Consider the implementation of an AVL system within a police department, to automatically log and keep track of the location of each cruiser. Typically a fleet uses a 9600 bps connection where AVL data is relayed back to headquarters. The limited bandwidth of the radio must be shared amongst the AVL and other systems in multiple cruisers.

When operating with a low baud rate radio transmitter (9600 or lower), especially over a long distance, the AVL system could limit the number of satellites for which corrections are sent using the RTKSVENTRIES command.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKSVENTRIES header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	number	4-24		The number of SVs to be transmitted in correction messages	ULong	4	H

2.5.80 RTKTIMEOUT Sets maximum age of RTK data

This command is used to set the maximum age of RTK data to use when operating as a rover station. RTK data received that is older than the specified time is ignored.

Abbreviated ASCII Syntax: **Message ID: 910**

RTKTIMEOUT delay

Factory Default:

rtktimeout 60

ASCII Example (rover):

rtktimeout 20

See the DGPSEPHEMDELAY command on *page 99* to set the ephemeris changeover delay for base stations.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	RTKTIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	delay	5 to 60 s		Maximum RTK data age	ULong	4	H

2.5.81 SAVECONFIG Save scurrent configuration in NVM

This command saves the user's present configuration in non-volatile memory. The configuration includes the current log settings, FIX settings, port configurations, and so on. Its output is in the RXCONFIG log, see *page 605*. See also the FRESET command, *page 130*.

If you are using this command in CDU, ensure that you have all windows other than the Console window closed. Otherwise, log commands used for the various windows are saved as well. This will result in unnecessary data being logged.

Abbreviated ASCII Syntax: **Message ID: 19**

SAVECONFIG

2.5.82 SBASCONTROL Sets SBAS test mode and PRN

This command allows you to dictate how the receiver handles Satellite Based Augmentation System (SBAS) corrections. The receiver automatically switches to Pseudorange Differential (RTCM or RTCA) or RTK if the appropriate corrections are received, regardless of the current setting.

To enable the position solution corrections, you must issue the SBASCONTROL ENABLE command. The receiver does not attempt to track any GEO satellites until you use the SBASCONTROL command to tell it to use either WAAS, EGNOS, or MSAS corrections.

When in AUTO mode, if the receiver is outside the defined satellite system's corrections grid, it reverts to ANY mode and chooses a system based on other criteria.

Once tracking satellites from one system in ANY or AUTO mode, it does not track satellites from other systems. This is because systems such as WAAS, EGNOS and MSAS do not share broadcast information and have no way of knowing each other are there.

The "testmode" parameter in the example is to get around the test mode of these systems. EGNOS at one time used the IGNOREZERO test mode. At the time of printing, ZEROTOTWO is the correct setting for all SBAS, including EGNOS, running in test mode. On a simulator, you may want to leave this parameter off or specify NONE explicitly.

When you use the SBASCONTROL command to direct the receiver to use a specific correction type, the receiver begins to search for and track the relevant GEO PRNs for that correction type only.

You can force the receiver to track a specific PRN using the ASSIGN command. You can force the receiver to use the corrections from a specific SBAS PRN using the SBASCONTROL command.

Disable stops the corrections from being used.

Abbreviated ASCII Syntax: **Message ID: 652**

SBASCONTROL switch [system] [prn] [testmode]

Factory Default:

sbascontrol disable

Abbreviated ASCII Example 1:

sbascontrol disable none 0 none

NovAtel's OEM6 receivers work with SBAS systems including EGNOS (Europe), MSAS (Japan) and WAAS (North America).

Table 36: System Types

ASCII	Binary	Description
NONE	0	Don't use any SBAS satellites
AUTO	1	Automatically determine satellite system to use and prevents the receiver from using satellites outside of the service area (default)
ANY	2	Use any and all SBAS satellites found
WAAS	3	Use only WAAS satellites
EGNOS	4	Use only EGNOS satellites
MSAS	5	Use only MSAS satellites

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SBASCONTROL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	switch	DISABLE	0	Receiver does not use the SBAS corrections it receives (default)	Enum	4	H
		ENABLE	1	Receiver uses the SBAS corrections it receives			
3	system	See *Table 36* on *page 206*		Choose the SBAS the receiver will use (default=auto)	Enum	4	H+4
4	prn	0		Receiver uses any PRN (default)	ULong	4	H+8
		120-138		Receiver uses SBAS corrections only from this PRN			
5	testmode	NONE	0	Receiver interprets Type 0 messages as they are intended (as do not use) (default)	Enum	4	H+12
		ZEROTOTWO	1	Receiver interprets Type 0 messages as Type 2 messages			
		IGNOREZERO	2	Receiver ignores the usual interpretation of Type 0 messages (as do not use) and continues			

2.5.83 SBASECUTOFF Sets SBAS satellite elevation cut-off

This command sets the elevation cut-off angle for SBAS satellites. The receiver does not start automatically searching for an SBAS satellite until it rises above the cut-off angle. Tracked SBAS satellites that fall below the SBASECUTOFF angle are no longer tracked unless they are manually assigned (see the ASSIGN command).

This command does not affect the tracking of GPS satellites. Similarly, the ECUTOFF command does not affect SBAS satellites.

Abbreviated ASCII Syntax: **Message ID: 1000**

SBASECUTOFF angle

Factory Default:

sbasecutoff -5.0

ASCII Example:

sbasecutoff 10.0

This command permits a negative cut-off angle. It could be used in these situations:

- The antenna is at a high altitude, and thus can look below the local horizon
- Satellites are visible below the horizon due to atmospheric refraction

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SBASECUTOFF header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	angle	±90.0 degrees		Elevation cut-off angle relative to horizon	Float	4	H

2.5.84 SELECTCHANCONFIG Sets the channel configuration

Some software models come with support for more than one channel configuration, which can be verified by logging CHANCONFIGLIST (see *page 318*). SELECTCHANCONFIG allows the user to pick a different channel configuration from the allowable set. If a different channel configuration from the current configuration is selected via the SELECTCHANCONFIG command, the receiver will reset and start back up with the new configuration. The *Set in Use* number in the CHANCONFIGLIST log should change as a result.

Abbreviated ASCII Syntax: **Message ID: 1149**

SELECTCHANCONFIG chanconfigsetting

Factory Default:

selectchanconfig 1

ASCII Example:

selectchanconfig 2

Field	Field Type	Description	Binary Format	Binary Bytes	Binary Offset
1	SELECTCHANCONFIG header	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	chanconfigsetting	Channel configuration to use	Ulong	4	H

2.5.85 SEND Sends an ASCII message to a COM port

This command is used to send ASCII printable data from any of the COM or USB ports to a specified communications port. This is a one-time command, therefore the data message must be preceded by the SEND command and followed by <CR> each time you wish to send data. If the data string contains delimiters (that is, spaces, commas, tabs, and so on), the entire string must be contained within double quotation marks. Carriage return and line feed characters (for example, 0x0D, 0x0A) are appended to the sent ASCII data.

Abbreviated ASCII Syntax: **Message ID: 177**

SEND port data

ASCII Example

send com1 “log com1 rtcaobs ontime 5”

Scenario: Assume that you are operating receivers as base and rover stations. It could also be assumed that the base station is unattended but operational and you wish to control it from the rover station. From the rover station, you could establish the data link and command the base station receiver to send differential corrections

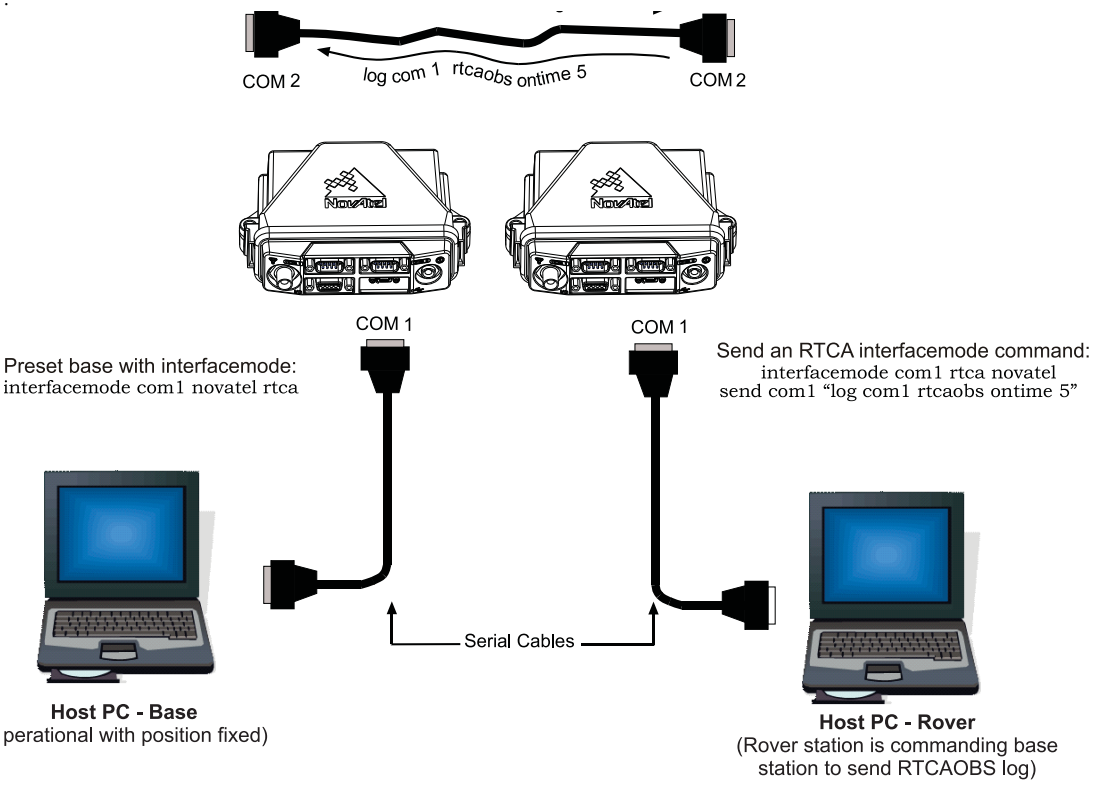


Figure 7: Using the SEND Command

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SEND header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	port	See *Table 37, COM Port Identifiers* on *page 214*		Output port	Enum	4	H
3	message	Max 100 character string (99 typed visible chars and a null char added by the firmware automatically)		ASCII data to send	String [max. 100]	Variable [a]	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

2.5.86 SENDHEX Send snon-printable characters in hex pairs

This command is like the SEND command except that it is used to send non-printable characters expressed as hexadecimal pairs. Carriage return and line feed characters (for example, 0x0D, 0x0A) will **not** be appended to the sent data and so must be explicitly added to the data if needed.

Abbreviated ASCII Syntax: **Message ID: 178**

SENDHEX port length data

Input Example:

sendhex com1 6 143ab5910d0a

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SENDHEX header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	port	See *Table 37, COM Port Identifiers* on *page 214*		Output port	Enum	4	H
3	length	0 - 700		Number of hex pairs	ULong	4	H+4
4	message	limited to a 700 maximum string (1400 pair hex) by command interpreter buffer even number of ASCII characters from set of 0-9, A-F no spaces are allowed between pairs of characters		Data	String [max. 700]	Vari-able[a]	Vari-able

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

2.5.87 SERIALCONFIG Configures serial port settings

1. This replaces the COM command.
2. This command also acts as a collection response ether and can be used as a log.

This command permits you to configure the receiver's asynchronous serial port communications drivers.

The current SERIALCONFIG port configuration can be reset to its default state at any time by sending it two hardware break signals of 250 milliseconds each, spaced by fifteen hundred milliseconds (1.5 seconds) with a pause of at least 250 milliseconds following the second break. This will:

- Stop the logging of data on the current port (see UNLOGALL on *page 252)*
- Clear the transmit and receive buffers on the current port
- Return the current port to its default settings (see *page 55* for details)
- Set the interface mode to NovAtel for both input and output (see the INTERFACEMODE command on *page 147*)

See also *Section 2.4, Factory Defaults* on *page 55* for a description of the factory defaults, and the COMCONFIG log on *page 341*.

1. The COMCONTROL command, see *page 91*, may conflict with handshaking of the selected COM port. If handshaking is enabled, then unexpected results may occur.
2. Baud rates higher than 115,200 bps are not supported by standard PC hardware. Special PC hardware may be required for higher rates, including 230400 bps, 460800 bps and 921600 bps. Also, some PC's have trouble with baud rates beyond 57600 bps.Watch for situations where the COM ports of two receivers are connected together and the baud rates do not match. Data transmitted through a port operating at a slower baud rate may be misinterpreted as break signals by the receiving port if it is operating at a higher baud rate. This is because data transmitted at the lower baud rate is stretched relative to the higher baud rate. In this case, configure the receiving port to have break detection disabled using the SERIALCONFIG command.

Use the SERIALCONFIG command before using the INTERFACEMODE command on each port. Turn break detection off using the SERIALCONFIG command to stop the port from resetting because it is interpreting incoming bits as a break command.

Abbreviated ASCII Syntax: **Message ID: 1246**

SERIALCONFIG [port] baud [parity[databits[stopbits[handshaking[break]]]]]

Factory Defaults:

serialconfig com1 9600 n 8 1 n on

serialconfig com2 9600 n 8 1 n on

serialconfig com3 9600 n 8 1 n on

ASCII Example:

serialconfig com1 9600 n 8 1 n off

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	SERIALCONFIG Header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	port	See Table 37		Port to configure (default = THISPORT)	Enum	4	H
3	bps/baud	300, 600, 900, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800 and 921600		Communication baud rate (bps).	ULong	4	H+4
4	parity	See Table 38		Parity	Enum	4	H+8
5	databits	7 or 8		Number of data bits (default = 8)	Ulong	4	H+12
6	stopbits	1 or 2		Number of stop bits (default = 1)	Ulong	4	H+16
7	handshake[a]	See Table 39		Handshaking	Enum	4	H+20
8	break	OFF	0	Disable break detection (default)	Enum	4	H+24
		ON	1	Enable break detection			
		AUTO	2				
		DEFAULT	3				

a. The OEM6 AUX and COM3 ports do not support hardware handshaking. Only transmit and receive lines exist for these ports on the OEM6.

Table 37: COM Port Identifiers

Binary	ASCII	Description
1	COM1	COM port 1
2	COM2	COM port 2
3	COM3	COM port 3
6	THISPORT	The current COM port
8	ALL	All COM ports
9	XCOM1	Virtual COM1 port
10	XCOM2	Virtual COM2 port
13	USB1	USB port 1
14	USB2	USB port 2
15	USB3	USB port 3
16	AUX	AUX port
17	XCOM3	Virtual COM3 port
23	ICOM1	Virtual serial ports (over Ethernet)
24	ICOM2	
25	ICOM3	
26	NCOM1	NTRIP ports (over Ethernet)
27	NCOM2	
28	NCOM3	

Table 38: Parity

Binary	ASCII	Description
0	N	No parity (default)
1	E	Even parity
2	O	Odd parity

Table 39: Handshaking

Binary	ASCII	Description
0	N	No handshaking (default)
1	XON	XON/XOFF software handshaking
2	CTS	CTS/RTS hardware handshaking

2.5.88 SETAPPROXPOS Sets an approximate position

This command sets an approximate latitude, longitude, and height in the receiver. Estimating these parameters, when used in conjunction with an approximate time (see the SETAPPROXTIME command on *Page 217*), can improve satellite acquisition times and time to first fix. For more information about TTFF and Satellite Acquisition, please refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

The horizontal position entered should be within 200 km of the actual receiver position. The approximate height is not critical and can normally be entered as zero. If the receiver cannot calculate a valid position within 2.5 minutes of entering an approximate position, the approximate position is ignored.

The approximate position is not visible in any position logs. It can be seen by issuing a SETAPPROXPOS log. See also the SATVIS log on *Page 619*.

Abbreviated ASCII Syntax: **Message ID: 377**

SETAPPROXPOS lat lon height

Input Example:

setapproxpos 51.116 -114.038 0

For an example on the use of this command, please see the SETAPPROXTIME command on *page 217*.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETAPPROXPOS header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	Lat	± 90 degrees		Approximate latitude	Double	8	H
3	Lon	± 180 degrees		Approximate longitude	Double	8	H+8
4	Height	-1000 to +20000000 m		Approximate height	Double	8	H+16

2.5.89 SETAPPROXTIME Sets an approximate GPS reference time

This command sets an approximate time in the receiver. The receiver uses this time as a system time until a coarse time can be acquired. This can be used in conjunction with an approximate position (see the SETAPPROXPOS command on *page 216*) to improve time to first fix. For more information TTFF and Satellite Acquisition, please refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

The time entered should be within 10 minutes of the actual GPS reference time.

If the week number entered does not match the broadcast week number, the receiver resets.

See also the SATVIS log on *page 619*.

Abbreviated ASCII Syntax: **Message ID: 102**

SETAPPROXTIME week sec

Input Example:

setapproxtime 1605 425384

Upon power-up, the receiver does not know its position or time, and therefore, cannot use almanac information to aid satellite acquisition. You can set an approximate GPS reference time using the SETAPPROXTIME command or RTCAEPHEM message. The RTCAEPHEM message contains GPS reference week and seconds and the receiver uses that GPS reference time if the time is not yet known. Several logs provide base station coordinates and the receiver uses them as an approximate position allowing it to compute satellite visibility. Alternately, you can set an approximate position by using the SETAPPROXPOS command.

Approximate time and position must be used in conjunction with a current almanac to aid satellite acquisition. See the table below for a summary of the OEM6 family commands and logs used to inject an approximated time or position into the receiver:

:

Approximate	Command	Log
Time	SETAPPROXTIME	RTCAEPHEM
Position	SETAPPROXPOS	RTCAREF *or* CMRREF *or* RTCM3

Base station aiding can help in these environments. A set of ephemerides can be injected into a rover station by broadcasting the RTCAEPHEM message from a base station. This is also useful in environments where there is frequent loss of lock (GPS ephemeris is three frames long within a sequence of five frames. Each frame requires 6 s of continuous lock to collect the ephemeris data. This gives a minimum of 18 s and a maximum of 36 s continuous lock time.) or, when no recent ephemerides (new or stored) are available.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETAPPROXTIME header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	week	0-9999		GPS reference week number	Ulong	4	H
3	sec	0-604800		Number of seconds into GPS reference week	Double	8	H+4

2.5.90 SETBESTPOSCRITERIA Sets selection criteria for BESTPOS

Use this command to set the criteria for the BESTPOS log. It allows you to select between 2D and 3D standard deviation to obtain the best position from the BESTPOS log. It also allows you to specify the number of seconds to wait before changing the position type. This delay provides a single transition that ensures position types do not skip back and forth. See also BESTPOS on *page 299*.

Abbreviated ASCII Syntax: **Message ID: 839**

SETBESTPOSCRITERIA type delay

Factory Default:

setbestposcriteria pos3d 0

Input Example:

setbestposcriteria pos2d 5

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SET-BESTPOS-CRITERIA header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	type	See *Table 40*		Select a 2D or 3D standard deviation type to obtain the best position from the BESTPOS log	Enum	4	H
3	delay	0 to 100 s		Set the number of seconds to wait before changing the position type	Ulong	4	4

Table 40: Selection Type

ASCII	Binary	Description
POS3D	0	3D standard deviation (default)
POS2D	1	2D standard deviation

2.5.91 SETCANNAME Sets the CAN name fields

This commands sets the CAN device name fields.

Abbreviated ASCII Syntax: **Message ID: 1091**

SETCANNAME

Input Example:

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETCANNAME header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	ManufacturerCode			CAN module's Manufacturer Code	ULong	4	H
3	IndustryGroup			Industry group number (default = 2)	ULong	4	H+4
4	DeviceClass			11783-5 Device class (default = 0)	ULong	4	H+8
5	DeviceClassInstance			11783-5 Device class instance (default = 0)	ULong	4	H+12
6	Function			11783-5 Function (default = 23)	ULong	4	H+16
7	FunctionInstance			11783-5 Function instance (default = 0)	ULong	4	H+20
8	ECUInstance			11783-5 ECU Instance (default = 0)	ULong	4	H+24
9	PreferredAddress			Deviice default address on start up (default=28)	ULong	4	H+28
10	Reserved				ULong	4	H+32

2.5.92 SETDIFFCODEBIASES Sets satellite differential code biases

Changing the biases may negatively affect positioning accuracy. NovAtel recommends that only advanced users modify the biases.

Use this command to set the differential code biases that correct pseudorange errors affecting the L1/L2 ionospheric corrections. Bias values are restricted to between -3 ns and +3 ns. A set of biases is included in the firmware, and use of the biases is enabled by default. See also the DIFFCODEBIASCONTROL command on *page 104*.

The receiver uses the C/A code on L1 and the P code on L2 to calculate a dual-frequency ionospheric correction. However, the GNSS clock corrections are broadcast as if the P codes on both L1 and L2 are used to calculate this correction. The biases account for the differences between the P and C/A codes on L1, and improve the estimate of the ionospheric correction.

The biases are calculated by the International GNSS Service (IGS). Calculation details, analysis, and results are available at http://aiuws.unibe.ch/spec/dcb.php. The most recent 30 day average bias values can be downloaded from http://aiuws.unibe.ch/ionosphere/p1c1.dcb.

Abbreviated ASCII Syntax: **Message ID: 687**

SETDIFFCODEBIASES bias_type biases

Factory Default:

```
SETDIFFCODEBIASES GPS_C1P1 -0.542 -0.069 -0.597 1.030 -1.289
0.089 -1.878 -0.686 0.044 -1.982 0.528 1.285 1.405 0.029
1.696 -0.838 1.237 -0.514 -2.094 -1.482 -0.543 0.473 0.629
-0.343 0.337 0.911 -0.498 -0.440 1.783 1.808 1.542 -1.031
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETDIFF-CODE-BIASES header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	bias_type	GPS_C1P1	0	Code pair to which biases refer	Enum	4	H
		GPS_C2P2	1				
3	biases	-		Array of 40 biases (ns)	Float[40]	160	4

2.5.93 SETIONOTYPE Enables ionospheric models

Use this command to set which ionospheric corrections model the receiver should use. If the selected model is not available, the receiver reverts to AUTO.

L1-only models automatically use SBAS ionospheric grid corrections, if available.

Abbreviated ASCII Syntax: **Message ID: 711**

SETIONOTYPE model

Factory Default:

setionotype auto

ASCII Example:

setionotype klobuchar

An ionotype of AUTO is recommended for PDP and GL1DE.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETIONO-TYPE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	model	See *Table 41* below		Choose an ionospheric corrections model.	Enum	4	H

Table 41: Ionospheric Correction Models

ASCII	Binary	Description
NONE	0	Don't use ionosphere modelling
KLOBUCHAR	1	Use the Klobuchar model broadcast by GPS
GRID	2	Use the SBAS grid model
L1L2	3	Use the L1/L2 model
AUTO	4	Automatically determine the ionospheric model to use

2.5.94 SETNAV Sets start and destination waypoints

This command permits entry of one set of navigation waypoints (see *Figure 8* on *Page 223*). The origin (FROM) and destination (TO) waypoint coordinates entered are considered on the ellipsoidal surface of the current datum (default WGS84). Once SETNAV has been set, you can monitor the navigation calculations and progress by observing the NAVIGATE log messages.

Track offset is the perpendicular distance from the great circle line drawn between the FROM lat-lon and TO lat-lon waypoints. It establishes the desired navigation path, or track, that runs parallel to the great circle line, which now becomes the offset track, and is set by entering the track offset value in metres. A negative track offset value indicates that the offset track is to the left of the great circle line track. A positive track offset value (no sign required) indicates the offset track is to the right of the great circle line track (looking from origin to destination). See *Figure 8* on *Page 223* for clarification.

Abbreviated ASCII Syntax: **Message ID: 162**

SETNAV fromlat fromlon tolat tolon track offset from-point to-point

Factory Default:

setnav 90.0 0.0 90.0 0.0 0.0 from to

ASCII Example:

setnav 51.1516 -114.16263 51.16263 -114.1516 -125.23 from to

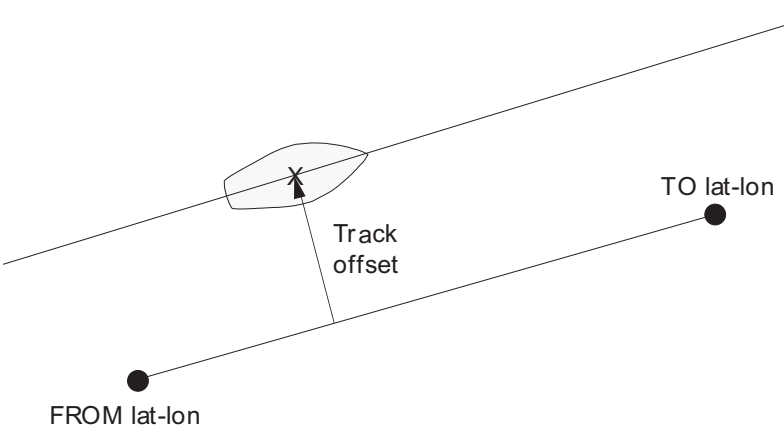


Figure 8: Illustration of SETNAV Parameters

Consider the case of setting waypoints in a deformation survey along a dam. The surveyor enters the From and To point locations on either side of the dam using the SETNAV command. They then use the NAVIGATE log messages to record progress and show them where they are in relation to the *From* and *To* points

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETNAV header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	fromlat	± 90 degrees		Origin latitude in units of degrees/decimal degrees. A negative sign for South latitude. No sign for North latitude.	Double	8	H
3	fromlon	± 180 degrees		Origin longitude in units of degrees/decimal degrees. A negative sign for West longitude. No sign for East longitude.	Double	8	H+8
4	tolat	± 90 degrees		Destination latitude in units of degrees/decimal degrees	Double	8	H+16
5	tolon	± 180 degrees		Destination longitude in units of degrees/decimal degrees	Double	8	H+24
6	track offset	± 1000 km		Waypoint great circle line offset (in kilometres); establishes offset track; positive indicates right of great circle line; negative indicates left of great circle line.	Double	8	H+32
7	from-point	5 characters maximum		ASCII station name	String [max. 5]	Variable [a]	Variable
8	to-point	5 characters maximum		ASCII station name	String [max. 5]	Variable [a]	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

2.5.95 SETROVERID to Set ID for ALIGN Rovers

This command sets the Rover ID output in ROVERPOS, HEADING2, ALIGNBSLNXYZ and ALIGNBSLNENU logs.

The default value for the ID is set using the last six characters of the receiver PSN Number. For example, if the receiver PSN number is DAB07170027, ID is set as R027, i.e. 17 is represented as R and last three characters are filled in as is.

It is not guaranteed that each receiver will have a unique ID. It is user's responsibility to make sure that each of the receivers ID is unique if they own multiple receivers. If the ID overlaps, user can set the ID using this command.

Abbreviated ASCII Syntax: **Message ID: 1135**

setroverid ROV1

Factory Default:

If the receiver PSN is: DAB07170027

setroverid R027

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETROVERID header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	ID	4 Character String e.g. ROV1		ID String	CHAR[4]	4	H

2.5.96 SETRTCM16 Enters ASCII text for RTCM data stream

The RTCM type 16 message allows ASCII text to be transferred from a GNSS base station to rover GNSS receivers. The SETRTCM16 command is used to define the ASCII text at the base station. The text defined by the SETRTCM16 command can be verified in the RXCONFIG log. Once the ASCII text is defined it can be broadcast periodically by the base station with the command "log <port> RTCM16 ONTIME <interval>". The received ASCII text can be displayed at the rover by logging RTCM16T.

This command limits the input message length to a maximum of 90 ASCII characters. If the message string contains any delimiters (that is, spaces, commas, tabs, and so on) the entire string must be contained in double quotation marks.

Abbreviated ASCII Syntax: **Message ID: 131**

SETRTCM16 text

Input Example:

setrtcm16 “base station will shut down in 1 hour”

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETRTCM16 header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	text	Maximum 90 character string		The text string	String [max. 90]	Variable[a]	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

2.5.97 SETRTCM36 Enters ASCII text with Russian characters

The RTCM Type 36 message is the GLONASS equivalent of the RTCM Type 16 message except that the RTCM36 message can contain characters from an extended character set including Russian characters. *Table 42* on *page 228* provides the standard decimal and hex codes to use when transmitting Cyrillic characters to provide Russian language messages. Codes from 0 to 127 correspond to standard ASCII codes.

To support the 8-bit character data in the ASCII version, 8-bit characters are represented as \xnn (or \dnnn) which are the hexadecimal (or decimal) values of the characters. A "\" is represented as "\\".

In the RTCMDATA36 and RTCM36T logs, the ascii output displays the 8-bit characters in the decimal \dnnn representation. However, in the SETRTCM36 command, you can enter the 8-bit characters using the \x or \d prefix.

This command limits the input message length to a maximum of 90 ASCII characters. If the message string contains any delimiters (that is, spaces, commas, tabs, and so on) the entire string must be contained in double quotation marks.

Abbreviated ASCII Syntax: **Message ID: 880**

SETRTCM36 extdtext

Input Example:

To set the message “QUICK ШТОРМ”, enter any of the following commands (colour added, or grayscale in printed versions, to aid understanding):

setrtcm36 “quick \d166\d146\d174\d144\d140”

setrtcm36 “quick \xa6\x92\xae\x90\x8c ”

setrtcm36 “\x51\x55\x49\x43\x4b\x20\xa6\x92\xae\x90\x8c ”

setrtcm36 “\x51\x55\x49\x43\x4b\xa6\x92\xae\x90\x8c ”

The corresponding RTCMDATA36A log, see *page 542*, looks like:

#RTCMDATA36A,COM1,0,64.5,FINESTEERING,1399,237113.869,00500000,
F9F5,35359;36,0,5189,0,0,6,11,"QUICK\D166\D146\D174\D144\D140"
*8BDEAE71

Similarly, the corresponding RTCM36T message, see *page 507*, looks like:

#RTCM36TA,COM1,0,77.5,FINESTEERING,1399,237244.454,00000000,
2E54,35359;"QUICK \D166\D146\D174\D144\D140"*4AA7F340

Similar to the RTCM type 16 message, the SETRTCM36 command is used to define the ASCII text at the base station and can be verified in the RXCONFIG log. Once the ASCII text is defined it can be broadcast periodically by the base station with the command, for example "log port RTCM36 ONTIME 10". The received ASCII text can be displayed at the rover by logging RTCM36T.

Table 42: Russian Alphabet Characters (Ch) in Decimal (Dec) and Hexadecimal (Hex)

Hex Code	Dec Code	Ch	Hex Code	Dec Code	Ch	Hex Code	Dec Code	Ch	Hex Code	Dec Code	Ch
80	128	А	90	144	Р	A0	160	а	B0	176	р
81	129	Б	91	145	С	A1	161	б	B1	177	с
82	130	В	92	146	Т	A2	162	в	B2	178	т
83	131	Г	93	147	У	A3	163	г	B3	179	у
84	132	Д	94	148	Ф	A4	164	д	B4	180	ф
85	133	Е	95	149	Х	A5	165	е	B5	181	х
86	134	Ж	96	150	Ц	A6	166	ж	B6	182	ц
87	135	З	97	151	Ч	A7	167	з	B7	183	ч
88	136	И	98	152	Ш	A8	168	и	B8	184	ш
89	137	Й	99	153	Щ	A9	169	й	B9	185	щ
8A	138	К	9A	154	Ъ	AA	170	к	BA	186	ъ
8B	139	Л	9B	155	Ы	AB	171	л	BB	187	ы
8C	140	М	9C	156	Ь	AC	172	м	BC	188	ь
8D	141	Н	9D	157	Э	AD	173	н	BD	189	э
8E	142	О	9E	158	Ю	AE	174	о	BE	190	ю
8F	143	П	9F	159	Я	AF	175	п	BF	191	я

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETRTCM36 header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	extdtext	Maximum 90 character string		The RTCM36 text string	String [max. 90]	Variable[a]	Variable

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

2.5.98 SETRTCMRXVERSION Sets the RTCM message standard

This command sets RTCM corrections to RTCM 2.2 or 2.3 message standards.

For RTCM correction message types, see *Table 28, Serial Port Interface Modes* on *page 149*.

Abbreviated ASCII Syntax: **Message ID: 1216**

SETRTCMRXVERSION version

Factory Default:

setrtcmrxversion v23

Input Example:

setrtcmrxversion v23

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETRTCMRXVERSION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	version	v23	0	RTCM version 2.3	-	4	0
		v22	1	RTCM version 2.2	-		0

2.5.99 SETRTCMTXVERSION Sets the RTCM transmission standard

This command sets RTCM corrections to RTCM 2.2 or 2.3 transmission standards.

For RTCM correction message types, see *Table 28, Serial Port Interface Modes* on *page 149*.

Abbreviated ASCII Syntax: **Message ID: 1322**

SETRTCMTXVERSION version

Factory Default:

setrtcmtxversion v23

Input Example:

setrtcmtxversion v23

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETRTCMTXVERSION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	version	v23	0	RTCM version 2.3	-	4	0
		v22	1	RTCM version 2.2	-		0

2.5.100 SETTIMEBASE Sets primary and backup systems for time base.

This command configures the primary and backup steering system(s) for timing. The primary system is the system that the receiver steers the clock to. Upon startup, the primary system must be present long enough to steer the clock to be valid once, otherwise, the backup system cannot be used. The backup system is used whenever the primary system is not present.

SETTIMEBASE primarysystem number of backups [system[backupsystem timeout]]

Factory Default:

For Glonass-only receiver:

settimebase glonass 0

For GPS capable receiver:

settimebase gps 1 auto 0

Input Example:

settimebase gps 1 glonass 30

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETTIMEBASE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	primarysystem	See *Table 43* on *page 231*		The primary system for steering the receiver clock	Enum	4	H
3	number of backups	0 or 1		The number of records to follow (see *Table 43* on *page 231* for the message options).	Ulong	4	H+4
4	system	See *Table 43* on *page 231*		The system to be used for backup	Enum	4	H+8
5	backup system timeout	0 to +4294967295		Duration that the backup system is used to steer the clock. 0 means ongoing	Ulong	4	H+12

Table 43: System used for timing

Binary	ASCII
0	GPS
1	GLONASS

2.5.101 SETUTCLEAPSECONDS Sets future leap seconds

Abbreviated ASCII Syntax: **Message ID: 1150**

SETUTCLEAPSECONDS

Factory Default:

Input Example:

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SETUTCLEAPSECONDS header		-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	Seconds	0-			ULONG	4	0
3	Future week number	0-1000		GPS Week when future leap seconds will take effect (default = 0)	ULONG	4	H+4
4	Future day number	0-7		Day of the week when future leap seconds will take effect (default = 0)	ULONG	4	H+8
8	Future seconds	0-		Future leap second offset that will take effect at ulFutureWeekNumber on the ulFutureDayNumber (default = 0)	ULONG	4	H+12

2.5.102 SOFTLOADCOMMIT Commits to the softload module

This command completes the soft load process by writing the uploaded image to flash. Refer to *The OEM6 Installation and Operation Guide* found on our website at http://www.novatel.com/support/firmware-software-and-manuals/ for more information about the softload process.

Abbreviated ASCII Syntax: **Message ID: 475**

softloadcommit [source]

Input Example:

softloadcommit userapp

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADCOMMIT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	Soft load source	COM	1	Source is from COM port (default)	Enum	4	0
		USERAPP	128	Source is a user application through API			

2.5.103 SOFTLOADDATA Uploads data for soft load

This command is used to upload data to the receiver for the soft load process. Refer to *The OEM6 Installation and Operation Guide* found on our website at http://www.novatel.com/support/firmware-software-and-manuals/ for more information about the softload process.

This command is only valid in binary mode.

Abbreviated ASCII Syntax: **Message ID: 1218**

Not applicable

Factory Default:

Not applicable

Input Example:

Not applicable

Field	Field Type	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADDATA header	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	Offset	-	Block-based offset of the data	ULONG	4	0
3	Data Length	-	Number of bytes of data	ULONG	4	H
4	Data	-	Incoming data	UCHAR	4096	H+4

2.5.104 SOFTLOADRESET Restarts soft load process

This command clears the upload buffer and restarts the soft load process. Refer to *The OEM6 Installation and Operation Guide* found on our website at http://www.novatel.com/support/firmware-software-and-manuals/ for more information about the softload process.

The command does not affect the flash and does not reset the receiver.

Abbreviated ASCII Syntax: **Message ID: 476**

softloadreset [source]

Input Example:

softloadreset

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADREST header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	Soft load source	COM	1	Source is from COM port (default)	Enum	4	0
		USERAPP	128	Source is a user application through API			

2.5.105 SOFTLOADSETUP Configures the soft load process

Use this command to configure the soft load process. Refer to *The OEM6 Installation and Operation Guide* found on our website at http://www.novatel.com/support/firmware-software-and-manuals/ for more information about the softload process.

Abbreviated ASCII Syntax: **Message ID: 1219**

softloadsetup setuptype setupdata

Input Example:

softloadsetup datatype app

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADREST header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	Setup type	See *Table 44*		The type of setup command	Enum	4	0
3	Setup data	-	-	Setup data string. See *Table 44* for details on this data. This data can be pulled from the S0 records of the hex file being loaded onto the receiver.	String	512	H+4

Table 44: Available Set up Commands

Binary	ASCII	Description
1	Platform	Comma-separated list of platforms supported by the data to be uploaded
2	Version	Version of the data to be uploaded
3	Datatype	Intended data block for the data to be uploaded
4	Authcode	PSN and auth code for the data to be uploaded. The format is: PSN:AuthCode. For example: BFN10260115:T48JF2,W25DBM,JH46BJ,2WGHMJ,8JW5TW,G2SR0RCCR,101114

2.5.106 SOFTLOADSREC Configures soft load process

Use this command to send S-Records to the receiver for the soft load process.

Abbreviated ASCII Syntax: **Message ID: 477**

softloadsrec s-record [source]

Input Example:

```
softloadsrec s30900283c10faa9f000ef
```

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	SOFTLOADSREC header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	SREC	-		SREC data variable hex pairs - This data can be pulled from the firmware hex file.	String	SREC_MAX_SERC+1	0
2	Soft load source	COM	1	Source is from COM port (default)	Enum	4	0
		USERAPP	128	Source is a user application through API			

2.5.107 STATUSCONFIG Configures RXSTATUSEVENT mask fields

This command is used to configure the various status mask fields in the RXSTATUSEVENT log, see *page 617*. These masks allow you to modify whether various status fields generate errors or event messages when they are set or cleared.

Receiver Errors automatically generate event messages. These event messages are output in RXSTATUSEVENT logs. It is also possible to have status conditions trigger event messages to be generated by the receiver. This is done by setting/clearing the appropriate bits in the event set/clear masks. The set mask tells the receiver to generate an event message when the bit becomes set. Likewise, the clear mask causes messages to be generated when a bit is cleared. If you wish to disable all these messages without changing the bits, simply UNLOG the RXSTATUSEVENT logs on the appropriate ports. Refer also to the *Built in Status Tests* chapter in the *OEM6 Family Installation and Operation User Manual*.

Abbreviated ASCII Syntax: **Message ID: 95**

STATUSCONFIG type word mask

Factory Default:

statusconfig priority status 0
statusconfig priority aux1 0x00000008
statusconfig priority aux2 0
statusconfig set status 0x00000000
statusconfig set aux1 0
statusconfig set aux2 0
statusconfig clear status 0x00000000
statusconfig clear aux1 0
statusconfig clear aux2 0

ASCII Example:

statusconfig set status 0028a51d

The receiver gives the user the ability to determine the importance of the status bits.In the case of the Receiver Status, setting a bit in the priority mask causes the condition to trigger an error. This causes the receiver to idle all channels, set the ERROR strobe line, flash an error code on the status LED, turn off the antenna (LNA power), and disable the RF hardware, the same as if a bit in the Receiver Error word is set. Setting a bit in an Auxiliary Status priority mask causes that condition to set the bit in the Receiver Status word corresponding to that Auxiliary Status.

Table 45: Mask Types

ASCII	Binary	Description
PRIORITY	0	Replace the Priority mask
SET	1	Replace the Set mask
CLEAR	2	Replace the Clear mask

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	STATUSCONFIG header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	type	See *Table 45*		Type of mask to replace	Enum	4	H
3	word	STATUS	1	Receiver Status word	Enum	4	H+4
		AUX1	2	Auxiliary 1 Status word			
4	mask	8 digit hexadecimal		The hexadecimal bit mask	Ulong	4	H+8

2.5.108 TRACKSV Tracking Satellite

This command allows you to override the automatic satellite/channel assignment for all satellites with manual instructions.

Abbreviated ASCII Syntax: **Message ID 1326**

TRACKSV [SYSTEM] [ID] [CONDITION]

Factory Default:

the conditions for gps, glonass, galileo and qzss are default as goodhealth.

the condition for sbas is default as anyhealth.

Table 46: TrackSV Command System

Binary	ASCII
0	GPS
1	GLONASS
2	SBAS
5	GALILEO
7	QZSS

Table 47: TrackSV Command Condition

Binary	ASCII	Description
1	NEVER	Never track this satellite
2	GOODHEALTH	Track this satellite if the health is indicated as healthy in both the almanaca and ephemeris
3	ANYHEALTH	Track this satellite no matter what the health is
4	ALWAYS	Always track this satellite

Field #	Field Type	ASCII Value	Binary Value	Data Description	Format	Binary Bytes	Binary Offset
1	TRACKSV header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively	-	H	0
2	System	See Table 46		System that SV channel is tracking	ENUM	4	H
3	SVID	GPS: 1-32 SBAS: 120-138 GLONASS:1-24 (see section 1.3 on page 32) GALILEO: 1-36 QZSS: 193-197		Satellite ID number	ULONG	4	H+4
4	Condition	see Table 47		Tracking condition	ENUM	4	H+8

2.5.109 TUNNELESCAPE Breaks out of an established tunnel

The tunnel escape sequence feature allows you to break out of a tunnel between two ports by sending a pre-defined sequence of bytes through the tunnel in-line with the data stream. While the Bluetooth implementation on DL-V3 products utilizes the tunnel mode of OEM receivers, the tunnel escape sequence feature is applicable to any tunneling application.

Use the TUNNELESCAPE command to specify the tunnel escape sequence. The escape sequence is applied independently to all active tunnels. Use the SAVECONFIG command to save the escape sequence in case of a power cycle.

This command allows you to define an escape sequence that, when detected in a byte stream between any two COM (or AUX) ports, resets the interface mode to `NOVATEL NOVATEL` on those ports. The baud rate and other port parameters remain unaffected.

The TUNNELESCAPE command accepts three parameters. The first is the *switch* parameter with `ENABLE` or `DISABLE` options. The second is the *length* parameter. It is a number from 1 to 8 and must be present if the *switch* parameter is set to `ENABLE`. The third parameter, *esc seq*, consists of a series of pairs of digits representing hexadecimal numbers where the number of pairs are equal to the value entered for the second parameter. The series of hexadecimal pairs of digits represent the escape sequence. The receiver detects a sequence in a tunnel exactly as it was entered.

For example, the command `TUNNELESCAPE ENABLE 4 61626364` searches for the bytes representing “abcd” in a tunnel stream. `TUNNELESCAPE ENABLE 3 AA4412` searches for the NovAtel binary log sync bytes.

You must first set up a tunnel. For example, create a tunnel between COM1 and COM2 by entering `INTERFACEMODE COM1 TCOM2 NONE OFF`. The commands can be entered in any order.

1. All bytes, leading up to and including the escape sequence, pass through the tunnel before it is reset. Therefore, the escape sequence is the last sequence of bytes that passes through the tunnel. Configure the receiver to detect and interpret the escape sequence. For example, use this information to reset equipment or perform a shutdown process.
2. The receiver detects the escape sequence in all active tunnels in any direction.
3. Create tunnels using the INTERFACEMODE command, see *page 147*.
4. SAVECONFIG WARNING: If you are using the SAVECONFIG command in **CDU**, ensure that you have all windows other than the *Console* window closed. Otherwise, **CDU** also saves log commands used for its various windows. This will result in unnecessary data being logged.

Abbreviated ASCII Syntax: **Message ID: 962**

TUNNELESCAPE switch length [esc seq]

Factory Default:

tunnelescape disable 0

ASCII Example:

tunnelescape enable

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	TUNNEL-ESCAPE header	-	-	This field contains the command name	H	0	-
2	switch	DISABLE	0	Enable or disable the tunnel escape mode (default = DISABLE)	ENUM	4	H
		ENABLE	1				
3	length	0 to 8		Specifies the number of hexbytes to follow.	ULONG	4	H+4
4	esc seq			Escape sequence where Hex pairs are entered without spaces, for example, AA4412	Uchar[8]	8	H+8

2.5.110 UNASSIGN Unassigns a previously assigned channel

This command cancels a previously issued ASSIGN command and the SV channel reverts to automatic control (the same as ASSIGN AUTO).

Abbreviated ASCII Syntax: **Message ID: 29**

UNASSIGN channel

Input Example:

unassign 11

Issuing the UNASSIGN command to a channel that was not previously assigned by the ASSIGN command will have no effect.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNASSIGN header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	channel	0 to *n*, where *n* is the number of the last channel in the current channel configuration		Reset SV channel to automatic search and acquisition mode	ULong	4	H
3	state	See *Table , These return SV channel control to the automatic search engine immediately.* on *page 67*		Set the SV channel state (currently ignored)	Enum	4	H+4

2.5.111 UNASSIGNALL Unassigns all previously assigned channels

This command cancels all previously issued ASSIGN commands for all SV channels (same as ASSIGNALL AUTO). Tracking and control for each SV channel reverts to automatic mode. See ASSIGN AUTO for more details.

Abbreviated ASCII Syntax: **Message ID: 30**

UNASSIGNALL [system]

Input Example:

unassignall gpsl1

Issuing the UNASSIGNALL command has no effect on channels that were not previously assigned using the ASSIGN command.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNASSIGNALL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	system	See *Table , ASSIGNALL [system][state][prn [Doppler [Doppler window]]]* on *page 70*		System that the SV channel is tracking (default=ALL)	Enum	4	H

2.5.112 UNDULATION Chooses undulation

This command permits you to either enter a specific geoidal undulation value or use the internal table of geoidal undulations. In the *option* field, the EGM96 table provides ellipsoid heights at a 0.25° by 0.25° spacing while the OSU89B is implemented at a 2° by 3° spacing. In areas of rapidly changing elevation, you could be operating somewhere within the 2° by 3° grid with an erroneous height. EGM96 provides a more accurate model of the ellipsoid which results in a denser grid of heights. It is also more accurate because the accuracy of the grid points themselves has also improved from OSU89B to EGM96. For example, the default grid (EGM96) is useful where there are underwater canyons, steep drop-offs or mountains.

The undulation values reported in the BESTPOS, BESTUTM, MARKPOS, MATCHEDPOS, OMNIHPPOS, PSRPOS and RTKPOS logs are in reference to the ellipsoid of the chosen datum.

Abbreviated ASCII Syntax: **Message ID: 214**

UNDULATION option [separation]

Factory Default:

undulation egm96

ASCII Example 1:

undulation osu89b

ASCII Example 2:

undulation user -5.599999905

Refer to the application note titled *Geoid Issue*, available on our website at http://www.novatel.com/support/applicationnotes.htm, for a description of the relationships in *Figure 9*.

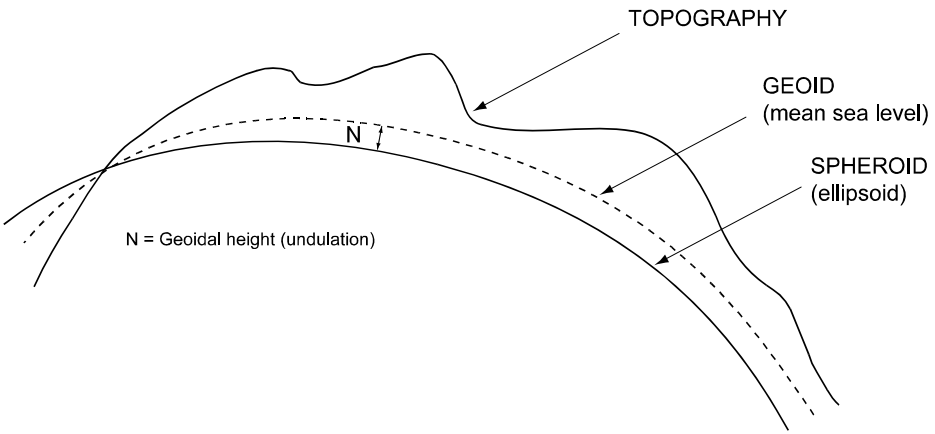


Figure 9: Illustration of Undulation

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNDULATION header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	option	TABLE	0	Use the internal undulation table (same as EGM96)	Enum	4	H
		USER	1	Use the user specified undulation value			
		OSU89B	2	Use the OSU89B undulation table			
		EGM96	3	Use global geoidal height model EGM96 table (default)			
3	separation	± 1000.0 m		The undulation value (required for the USER option)	Float	4	H+4

2.5.113 UNLOCKOUT Reinstates a satellite in the solution

This command allows a satellite which has been previously locked out (LOCKOUT command) to be reinstated in the solution computation. If more than one satellite is to be reinstated, this command must be reissued for each satellite reinstatement.

Abbreviated ASCII Syntax: **Message ID: 138**

UNLOCKOUT prn

Input Example:

unlockout 8

The UNLOCKOUT command allows you to reinstate a satellite while leaving other locked out satellites unchanged.

This command cannot be used wuth Galileo PRNs.

s

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNLOCKOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	prn	GPS: 1-32 SBAS: 120-138 GLONASS: see *Section 1.3* on *page 31*.		A single satellite PRN number to be reinstated	Ulong	4	H

2.5.114 UNLOCKOUTALL Reinstates all previously locked out satellites

This command allows all satellites which have been previously locked out (LOCKOUT OR LOCKOUT SYSTEM commands) to be reinstated in the solution computation.

Abbreviated ASCII Syntax: **Message ID: 139**

UNLOCKOUTALL

Input Example:

unlockoutall

2.5.115 UNLOCKOUTSYSTEM Reinstates previously locked out system

This command allows a system which has been previously locked out (LOCKOUTSYSTEM command) to be reinstated in the solution computation.

> If more than one system is to be reinstated, this command must be reissued for each system reinstatement.

Abbreviated ASCII Syntax: **Message ID: 908**

UNLOCKOUTSYSTEM system

Input Example:

unlockoutsystem glonass

> The UNLOCKOUTSYSTEM command allows you to reinstate a system while leaving other locked out systems unchanged.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNLOCKOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	system	See Table 29		A single satellite system to be reinstated	Enum	4	H

2.5.116 UNLOG Removes a log from logging control

This command permits you to remove a specific log request from the system.

The [*port*] parameter is optional. If [*port*] is not specified, it is defaulted to the port on which the command was received. This feature eliminates the need for you to know which port you are communicating on if you want logs to be removed on the same port as this command.

Abbreviated ASCII Syntax: **Message ID: 36**

UNLOG [port] message

Input Example:

unlog com1 bestposa

unlog bestposa

The UNLOG command allows you to remove one or more logs while leaving other logs unchanged.

Field	Field Name	Binary Value	Description	Field Type	Binary Bytes	Binary Offset
1	UNLOG (binary) header	(See *Table 4, Binary Message Header Structure* on *page 24*)	This field contains the message header.	-	H	0
2	port	See *Table* on *page 26* (decimal values greater than 16 may be used)	Port to which log is being sent (default = THISPORT)	Enum	4	H
3	message	Any valid message ID	Message ID of log to output	UShort	2	H+4
4	message type	Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response Bit (see *Section* on *page 29*) 0 = Original Message 1 = Response Message	Message type of log	Char	1	H+6
5	Reserved			Char	1	H+7

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNLOG (ASCII) header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	port	See *Table* on *page 26* (decimal values greater than 16 may be used)		Port to which log is being sent (default = THISPORT)	Enum	4	H
3	message	Message Name	N/A	Message Name of log to be disabled	ULong	4	H+4

2.5.117 UNLOGALL Removes all logs from logging control

If [*port*] is specified this command disables all logs on the specified port only. All other ports are unaffected. If [*port*] is not specified this command defaults to the ALL_PORTS setting.

Abbreviated ASCII Syntax: **Message ID: 38**

UNLOGALL [port] [held]

Input Example:

unlogall com2_15

The UNLOGALL command allows you to remove all log requests currently in use.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UNLOGALL header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	port	See *Table* on *page 26* (decimal values greater than 16 may be used)		Port to clear (default = ALL_PORTS)	Enum	4	H
3	held	FALSE	0	Does not remove logs with the HOLD parameter (default)	Enum	4	H+4
		TRUE	1	Removes previously held logs, even those with the HOLD parameter			

2.5.118 USERDATUM Sets user-customized datum

This command permits entry of customized ellipsoidal datum parameters. This command is used in conjunction with the DATUM command, see *page 94*. If used, the command default setting for USERDATUM is WGS84.

When the USERDATUM command is entered, the USEREXPDATUM command, see *page 255*, is then issued internally with the USERDATUM command values. It is the USEREXPDATUM command that appears in the RXCONFIG log. If the USEREXPDATUM or the USERDATUM command are used, their newest values overwrite the internal USEREXPDATUM values.

The transformation for the WGS84 to Local used in the OEM6 family is the Bursa-Wolf transformation or reverse Helmert transformation. In the Helmert transformation, the rotation of a point is counter clockwise around the axes. In the Bursa-Wolf transformation, the rotation of a point is clockwise. Therefore, the reverse Helmert transformation is the same as the Bursa-Wolf.

Abbreviated ASCII Syntax: **Message ID: 78**

USERDATUM semimajor flattening dx dy dz rx ry rz scale

Factory Default:

userdatum 6378137.0 298.2572235628 0.0 0.0 0.0 0.0 0.0 0.0 0.0

ASCII Example:

userdatum 6378206.400 294.97869820000 -12.0000 147.0000 192.0000 0.0000 0.0000 0.0000 0.000000000

You can use the USERDATUM command in a survey to fix the position with values from another known datum so that the GNSS calculated positions are reported in the known datum rather than WGS84.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	USERDATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	semimajor	6300000.0 - 6400000.0 m		Datum Semi-major Axis (a) in metres	Double	8	H
3	flattening	290.0 - 305.0		Reciprocal Flattening, 1/f = a/(a-b)	Double	8	H+8
4	dx	± 2000.0		Datum offsets from local to WGS84. These are the translation values between the user datum and WGS84 (internal reference).	Double	8	H+16
5	dy	± 2000.0			Double	8	H+24
6	dz	± 2000.0			Double	8	H+32
7	rx	± 10.0 radians		Datum rotation angle about X, Y and Z. These values are the rotation from your local datum to WGS84. A positive sign is for counter clockwise rotation and a negative sign is for clockwise rotation.	Double	8	H+40
8	ry	± 10.0 radians			Double	8	H+48
9	rz	± 10.0 radians			Double	8	H+56
10	scale	± 10.0 ppm		Scale value is the difference in ppm between the user datum and WGS84	Double	8	H+64

2.5.119 USEREXPDATUM Sets custom expanded datum

Like the USERDATUM command, this command allows you to enter customized ellipsoidal datum parameters. However, USEREXPDATUM literally means user expanded datum allowing you to enter additional datum information such as velocity offsets and time constraints. The 7 expanded parameters are rates of change of the initial 7 parameters. These rates of change affect the initial 7 parameters over time relative to the Reference Date provided by the user.

This command is used in conjunction with the datum command, see *Page 94*. If you use this command without specifying any parameters, the command defaults to WGS84. If you enter a USERDATUM command, see *page 253*, the USEREXPDATUM command is then issued internally with the USERDATUM command values. It is the USEREXPDATUM command that appears in the RXCONFIG log. If the USEREXPDATUM or the USERDATUM command are used, their newest values overwrite the internal USEREXPDATUM values.

Abbreviated ASCII Syntax: **Message ID: 783**

USEREXPDATUM semimajor flattening dx dy dz rx ry rz scale xvel yvel zvel xrvel yrvel zrvel scalev refdate

Factory Default:

userexpdatum 6378137.0 298.25722356280 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

ASCII Example:

```
USEREXPDATUM 6378137.000 298.25722356280 0.000000000
0.000000000 0.000000000 0.00000000 0.000000000 0.000000000
0.000000000 0.000000000 0.000000000 0.000000000 0.0000
0.000000000 0.000000000 0.000000000 0.000000000
```

You can use the USEREXPDATUM command in a survey to fix the position with values from another known datum so that the GPS calculated positions are reported in the known datum rather than WGS84. For example, it is useful for places like Australia, where the continent is moving several centimetres a year relative to WGS84. With USEREXPDATUM you can also input the velocity of the movement to account for drift over the years.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	USEREXPDATUM header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	semimajor	6300000.0 - 6400000.0 m		Datum semi-major axis (a) in metres	Double	8	H
3	flattening	290.0 - 305.0		Reciprocal Flattening, 1/f = a/(a-b)	Double	8	H+8
4	dx	± 2000.0 m		Datum offsets from local to WGS84. These are the translation values between the user datum and WGS84 (internal reference).	Double	8	H+16
5	dy	± 2000.0 m			Double	8	H+24
6	dz	± 2000.0 m			Double	8	H+32
7	rx	± 10.0 radians		Datum rotation angle about X, Y and Z. These values are the rotation from your local datum to WGS84. A positive sign is for counter clockwise rotation and a negative sign is for clockwise rotation.	Double	8	H+40
8	ry	± 10.0 radians			Double	8	H+48
9	rz	± 10.0 radians			Double	8	H+56
10	scale	± 10.0 ppm		Scale value is the difference in ppm between the user datum and WGS84	Double	8	H+64
11	xvel	± 2000.0 m/yr		Velocity vector along X-axis	Double	8	H+72
12	yvel	± 2000.0 m/yr		Velocity vector along Y-axis	Double	8	H+80
13	zvel	± 2000.0 m/yr		Velocity vector along Z-axis	Double	8	H+88
14	xrvel	± 10.0 radians/ yr		Change in the rotation about X over time	Double	8	H+96
15	yrvel	± 10.0 radians/ yr		Change in the rotation about Y over time	Double	8	H+104
16	zrvel	± 10.0 radians/ yr		Change in the rotation about Z over time	Double	8	H+112
17	scalev	± 10.0 ppm/yr		Change in scale from WGS84 over time	Double	8	H+120
18	refdate	0.0 year		Reference date of parameters Example: 2011.00 = Jan 1, 2011 2011.19 = Mar 11, 2011	Double	8	H+128

2.5.120 UTMZONE Sets UTM parameters

This command sets the UTM persistence, zone number or meridian. Please refer to http://earth-info.nga.mil/GandG/coordsys/grids/referencesys.html for more information and a world map of UTM zone numbers.

1. The latitude limits of the UTM System are 80°S to 84°N, so if your position is outside this range, the BESTUTM log outputs a northing, easting, and height of 0.0, along with a zone letter of "*" and a zone number of 0, so that it is obvious that the data in the log is dummy data.
2. If the latitude band is X, then the Zone number should not be set to 32, 34 or 36. These zones were incorporated into other zone numbers and do not exist.

Abbreviated ASCII Syntax: **Message ID: 749**

UTMZONE command [parameter]

Factory Default:

utmzone auto 0

ASCII Example 1:

utmzone set 10

ASCII Example 2:

utmzone current

The UTM grid system is displayed on all National Topographic Series (NTS) of Canada maps and United States Geological Survey (USGS) maps. On USGS 7.5-minute quadrangle maps (1:24,000 scale), 15-minute quadrangle maps (1:50,000, 1:62,500, and standard-edition 1:63,360 scales), and Canadian 1:50,000 maps the UTM grid lines are drawn at intervals of 1,000 metres, and are shown either with blue ticks at the edge of the map or by full blue grid lines. On USGS maps at 1:100,000 and 1:250,000 scale and Canadian 1:250,000 scale maps a full UTM grid is shown at intervals of 10,000 metres.

Table 48: UTM Zone Commands

Binary	ASCII	Description
0	AUTO	UTM zone default that automatically sets the central meridian and does not switch zones until it overlaps by the set persistence. This a spherical approximation to the earth unless you are at the equator. (default = 0) (m)
1	CURRENT	Same as UTMZONE AUTO with infinite persistence of the current zone. The parameter field is not used.
2	SET	Sets the central meridian based on the specified UTM zone. A zone includes its western boundary, but not its eastern boundary, Meridian. For example, zone 12 includes (108°W, 114°W] where 108° < longitude ≤ 114°.
3	MERIDIAN	Sets the central meridian as specified in the parameter field. In BESTUTM, the zone number is output as 61 to indicate the manual setting (zones are set by pre-defined central meridians not user-set ones).

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	UTMZONE header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	command	See *Table 48 above*			Enum	4	H
3	parameter				Enum	4	H+4

2.5.121 WAASTIMEOUT Sets the WAAS position time out

This command is used to set the amount of time the receiver remains in an SBAS position if it stops receiving SBAS corrections. See the DGPSEPHEMDELAY command on *page 101* to set the ephemeris change-over delay for base stations.

Abbreviated ASCII Syntax: **Message ID: 851**

WAASTIMEOUT mode [delay]

Factory Default:

waastimeout auto

ASCII Example (rover):

waastimeout set 100

When the time out mode is AUTO, the time out delay is 180 s.

.

Field	Field Type	ASCII Value	Binary Value	Description	Binary Format	Binary Bytes	Binary Offset
1	WAAS-TIMEOUT header	-	-	This field contains the command name or the message header depending on whether the command is abbreviated ASCII, ASCII or binary, respectively.	-	H	0
2	mode	See *Table 49* below		Time out mode	Enum	4	H
3	delay	2 to 1000 s		Maximum SBAS position age	Double	8	H+4
4	Reserved				Double	8	H+12

Table 49: SBAS Time Out Mode

Binary	ASCII	Description
0	Reserved	
1	AUTO	Set the default value (180 s)
2	SET	Set the delay in seconds

Chapter 3 Data Logs

3.1 Log Types

See the LOG command on *page 158*, for details about requesting logs.

The receiver is capable of generating three type of logs: synchronous, asynchronous, and polled. The data for synchronous logs is generated on a regular schedule. In order to output the most current data as soon as it is available, Asynchronous data is generated at irregular intervals. The data in polled logs is generated on demand. The following table outlines the log types and the valid triggers to use:

Table 50: Log Type Triggers

Type	Recommended Trigger	Illegal Trigger
Synch	ONTIME	ONNEW, ONCHANGED
Asynch	ONCHANGED	-
Polled	ONCE or ONTIME [a]	ONNEW, ONCHANGED

a. Polled log types do not allow fractional offsets and cannot do ontime rates faster than 1Hz.

See *Section 1.5, Message Time Stamps* on *page 34* for information about how the message time stamp is set for each type of log.

1. The OEM6 family of receivers can handle 64 logs at a time. If you attempt to log more than 64 logs at a time, the receiver responds with an Insufficient Resources error.
2. The following logs do not support the ONNEXT trigger: GPSEPHEM, RAWEPHEM, RAWGPSSUBFRAME, RAWSBASFRAME, RAWWAASFRAME, RXSTATUSEVENT and SBAS9.
3. Asynchronous logs, such as MATCHEDPOS, should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may result in inaccurate time tags.
4. Use the ONNEW trigger with the MARKTIME or MARKPOS logs.
5. Before the output of fields for ASCII and binary logs, there is an ASCII or binary header respectively. See also *Table 3, ASCII Message Header Structure* on *page 22* and *Table 4, Binary Message Header Structure* on *page 24*. There is no header information before Abbreviated ASCII output, see *page 23*.

3.1.1 Log Type Examples

For polled logs, the receiver only supports an offset that is:

- smaller than the logging period
- an integer

The following are valid examples for a polled log:

```
log comconfig ontime 2 1
log portstats ontime 4 2
log version once
```

For polled logs, the following examples are invalid:

```
log comconfig ontime 1 2      [offset is larger than the logging period]
log comconfig ontime 4 1.5    [offset is not an integer]
```

For synchronous and asynchronous logs, the receiver supports any offset that is:

- smaller than the logging period
- a multiple of the minimum logging period

For example, if the receiver supports 20 Hz logging, the minimum logging period is 1/20 Hz or 0.05 s. The following are valid examples for a synchronous, or asynchronous log, on a receiver that can log at rates up to 20 Hz:

```
log bestpos ontime 1                  [1 Hz]
log bestpos ontime 1 0.1
log bestpos ontime 1 0.90
log avepos ontime 1 0.95
log avepos ontime 2                   [0.5 Hz]
log avepos ontime 2 1.35
log avepos ontime 2 1.75
```

For synchronous and asynchronous logs, the following examples are invalid:

```
log bestpos ontime 1 0.08   [offset is not a multiple of the minimum logging period]
log bestpos ontime 1 1.05   [offset is larger than the logging period]
```

3.2 Logs by Function

Table 51: OEM6 Logs By Function

LOGS	DESCRIPTIONS	TYPE
GENERAL RECEIVER CONTROL AND STATUS		
AUTHCODES	Contains all authorization codes (auth codes) entered into the system since the last complete firmware reload	Polled
APPLICATIONSTATUS	Provides application status information	Asynch
ETHSTATUS	Current Ethernet status	Asynch
HWMONITOR	Monitor hardware levels	Polled
IPSTATUS	Current network configuration status	Asynch
LOGLIST	List of system logs	Polled
PASSCOM1, PASSXCOM1, PASSAUX, PASSUSB1, PASSETH1	Pass-through log, also PASSCOM2, PASSCOM3, PASSXCOM2, PASSXCOM3, PASSUSB2, PASSUSB3, PASSICOM1, PASSICOM2, PASSICOM3 PASSNCOM1, PASSNCOM2 and PASSNCOM3	Asynch
PORTSTATS	Displays port statistics	Polled
RTCAOBS3	Proprietary message that carries dual-frequency GPS and GLO measurements and is used in ALIGN.Also carries SBAS measurements if the Master receiver is single-frequency (L1-only) receiver to enable SBAS-ALIGN at the L1-only ALIGN Rover.	Synch
RXCONFIG	Receiver configuration status	Polled
RXHWLEVELS	Receiver hardware levels	Polled
RXSTATUS	Self-test status	Asynch
RXSTATUSEVENT	Status event indicator	Asynch
SOURCETABLE	Outputs the NTRIP sourcetable entries from the NTRIPCASTER set by the NTRIPSOURCETABLE command	1344
VALIDMODELS	Model and expiry date information for receiver	Asynch
VERSION	Receiver hardware and software version numbers	Polled

LOGS	DESCRIPTIONS	TYPE
POSITION, PARAMETERS, AND SOLUTION FILTERING CONTROL		
ALIGNDOP	Outputs the DOP computed using the satellites used in solution	Asynch
ALIGNBSLNXYZ	Outputs the RTK quality XYZ baselines from ALIGN.	Asynch
ALIGNBSLNENU	Outputs outputs the RTK quality ENU baselines from ALIGN. The XYZ baselines (output in ALIGNBSLNXYZ log) are rotated relative to master position (output in MASTERPOS) to compute ENU baselines.	Asynch
AVEPOS	Position averaging log	Asynch
BESTPOS [a]	Best position data	Synch
BESTUTM	Best available UTM data	Synch
BESTXYZ	Cartesian coordinates position data	Synch
BSLNXYZ	RTK XYZ baseline	Synch
DIFFCODEBIASES	Differential code biases being applied	Polled
GPGGA	NMEA, fix and position data	Synch
GPGGARTK	NMEA, global position system fix data	Synch
GPGLL	NMEA, position data	Synch
GPGRS	NMEA, range residuals	Synch
GPGSA	NMEA, DOP information	Synch
GPGST	NMEA, measurement noise statistics	Synch
GPHDT	NMEA, heading from True North	Synch
HEADING	Heading information with the ALIGN feature	Asynch
HEADING2	Outputs same information as HEADING log with an additional Rover ID field	Asynch
IONUTC	Ionospheric and UTC model information	Asynch
MASTERPOS	Displays the master position with the ALIGN feature	Asynch
MATCHEDPOS [a]	Computed position	Asynch

LOGS	DESCRIPTIONS	TYPE
MATCHEDXYZ	Cartesian coordinates computed position data	Asynch
MARKPOS, MARK2POS	Position at time of mark input event	Asynch
MARKTIME, MARK2TIME	Time of mark input event	Asynch
OMNIHPPOS	OmniSTAR HP/XP position data	Synch
PSRDOP	DOP of SVs currently tracking	Asynch
RAIMSTATUS	RAIM status	Synch
ROVERPOS	Displays the rover position with the ALIGN feature	Asynch
RTKDOP	Values from the RTK fast filter	Synch
RTKDOP2	Values from the RTK fast filter	Synch
RTKPOS [a]	RTK low latency position	Synch
RTKVEL[b]	RTK Velocity	Synch
RTKVEL2[b]	RTK Velocity	Synch
RTKXYZ	RTK Cartesian coordinate position	Synch

a. The RTK system in the receiver provides two kinds of position solutions. The Matched RTK position is computed with buffered observations, so there is no error due to the extrapolation of base station measurements. This provides the highest accuracy solution possible at the expense of some latency which is affected primarily by the speed of the differential data link. The MATCHEDPOS log contains the matched RTK solution and can be generated for each processed set of base station observations. The RTKDATA log provides additional information about the matched RTK solution.

The Low-Latency RTK position is computed from the latest local observations and extrapolated base station observations. This supplies a valid RTK position with the lowest latency possible at the expense of some accuracy. The degradation in accuracy is reflected in the standard deviation and is summarized in our *An Introduction to GNSS* book, available through our website at www.novatel.com through *Support | Knowledge and Learning > Learn About GNSS > GNSS Book*. The amount of time that the base station observations are extrapolated is in the "differential age" field of the position log. The Low-Latency RTK system extrapolates for 60 seconds. The RTKPOS log contains the Low-Latency RTK position when valid, and an "invalid" status when a low-latency RTK solution could not be computed. The BESTPOS log contains either the low-latency RTK, OmniSTAR HP or XP, or pseudorange-based position, whichever has the smallest standard deviation.

b. The RTK velocity is computed from successive low-latency RTK position solutions. The RTKVEL log contains the RTK velocity, when valid, and outputs an 'invalid' status if a low-latency RTK velocity solution cannot be computed. The BESTVEL log contains the low-latency RTK velocity when the BESTPOS log contains the low-latency RTK position.

In a BESTVEL, PSRVEL or RTKVEL log, the actual speed and direction of the receiver antenna over ground is provided. The receiver does not determine the direction a vessel, craft, or vehicle is pointed (heading), but rather the direction of motion of the GNSS antenna relative to ground.

LOG	DESCRIPTION	TYPE
WAYPOINT NAVIGATION		
BESTPOS	Best position data	Synch
BESTVEL[a]	Velocity data	Synch
GPHDT	NMEA, heading from True North	Synch
GPRMB	NMEA, waypoint status	Synch
GPRMC	NMEA, navigation information	Synch
GPVTG	NMEA, track made good and speed	Synch
NAVIGATE	Navigation waypoint status	Synch
OMNIHPPOS	OmniSTAR HPXP position data	Synch
PSRPOS	Pseudorange position	Synch
PSRVEL[a]	Pseudorange velocity	Synch
PSRXYZ	Pseudorange Cartesian coordinate position	Synch

a. In a BESTVEL, PSRVEL or RTKVEL log, the actual speed and direction of the receiver antenna over ground is provided. The receiver does not determine the direction a vessel, craft, or vehicle is pointed (heading), but rather the direction of motion of the GNSS antenna relative to ground

CLOCK INFORMATION, STATUS, AND TIME		
CLOCKMODEL	Range bias information	Synch
CLOCKSTEERING	Clock steering status	Asynch
GLOCLOCK	GLONASS clock information	Asynch
GPZDA	NMEA, UTC time and data	Synch
PSRTIME	Time offsets from the pseudorange filter	Synch
TIME	Receiver time information	Synch
TIMESYNC	Synchronize time between receivers	Synch

POST PROCESSING DATA		
GPSEPHEM	Decoded GPS ephemeris information	Asynch
IONUTC	Ionospheric and UTC model information	Asynch
RAWEPHEM	Raw ephemeris	Asynch
RANGE	Satellite range information	Synch
RANGECMP	Compressed version of the RANGE log	Synch
RANGEGPSL1	L1 version of the RANGE log	Synch
RTKDATA	RTK related data such as baselines and satellite counts.	Asynch
TIME	Receiver clock offset information	Synch

LOG	DESCRIPTION	TYPE
SATELLITE TRACKING AND CHANNEL CONTROL		
ALMANAC	Current decoded almanac data	Asynch
BESTSATS	Satellites used in BESTPOS	Synch
CHANCONFIGLIST	Channel configuration list	Polled
GLMLA	NMEA GLONASS almanac data	Asynch
GLOALMANAC	GLONASS almanac data	Asynch

LOG	DESCRIPTION	TYPE
GLOEPHEMERIS	GLONASS ephemeris data	Asynch
GLORAWALM	Raw GLONASS almanac data	Asynch
GLORAWEPHEM	Raw GLONASS ephemeris data	Asynch
GLORAWFRAME	Raw GLONASS frame data	Asynch
GLORAWSTRING	Raw GLONASS string data	Asynch
GPALM	NMEA, almanac data	Asynch
GPGSA	NMEA, SV DOP information	Synch
GPGSV	NMEA, satellite-in-view information	Synch
GPSEPHEM	Decoded GPS ephemeris information	Asynch
OMNIHPSATS	Satellites used in the OMNIHPPOS solution	Synch
OMNIVIS	OmniSTAR satellite visibility list	Synch
QZSSALMANAC	Contains the decoded almanac parameters as received from the satellite with the parity information removed and appropriate scaling applied	Asynch
QZSSIONUTC	Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC) for QZSS are provided	Asynch
QZSSRAWEPHEM	contains the raw binary information for subframes one, two and three from the satellite with the parity information removed	Asynch
QZSSEPHEMERIS	single set of QZSS ephemeris parameters	Asynch
QZSSRAWALMANAC	contains the undecoded almanac subframes as received from the QZSS satellite	Asynch

LOG	DESCRIPTION	TYPE
QZSSRAWSUBFRAME	A raw QZSS subframe is 300 bits in total, includes the parity bits which are interspersed with the raw data ten times, in six bit chunks, for a total of 60 parity bits	Asynch
PDPSATS	Satellites used in PDPPOS solution	Synch
PSRDOP	DOP of SVs currently tracking	Asynch
PSRDOP2	Pseudorange Least Squares DOP	Asynch
RANGE	Satellite range information	Synch
RANGEGPSL1	L1 version of the RANGE log	Synch
RAWALM	Raw almanac	Asynch
RAWCNAVFRAME	Raw L2C frame data	Asynch
SATELLITE TRACKING AND CHANNEL CONTROL		
RAWEPHEM	Raw ephemeris	Asynch
RAWGPSSUBFRAME	Raw subframe data	Asynch
RAWGPSWORD	Raw navigation word	Asynch
RAWWAASFRAME	Raw SBAS frame data	Asynch
RTKSATS	Satellites used in RTKPOS solution	Synch
SATVIS	Satellite visibility	Synch
SATVIS2	Satellite visibility	Synch
SATXYZ	SV position in ECEF Cartesian coordinates	Synch
SBAS0	Removes PRN from the solution	Asynch
SBAS1	PRN mask assignments	Asynch
SBAS2	Fast correction slots 0-12	Asynch
SBAS3	Fast correction slots 13-25	Asynch
SBAS4	Fast correction slots 26-38	Asynch

LOG	DESCRIPTION	TYPE
SBAS5	Fast correction slots 39-50	Asynch
SBAS6	Integrity message	Asynch
SBAS7	Fast correction degradation	Asynch
SBAS9	GEO navigation message	Asynch
SBAS10	Degradation factor	Asynch
SBAS12	SBAS network time and UTC	Asynch
SBAS17	GEO almanac message	Asynch
SBAS18	IGP mask	Asynch
SBAS24	Mixed fast/slow corrections	Asynch
SBAS25	Long-term slow satellite corrections	Asynch
SBAS26	Ionospheric delay corrections	Asynch
SATELLITE TRACKING AND CHANNEL CONTROL		
SBAS27	SBAS service message	Asynch
SBAS32	Fast correction slots 0-10	Asynch
SBAS33	Fast correction slots 11-21	Asynch
SBAS34	Fast correction slots 22-32	Asynch
SBAS35	Fast correction slots 39-50	Asynch
SBAS45	Slow corrections	Asynch
SBASCORR	SBAS range corrections used	Synch
TRACKSTAT	Satellite tracking status	Synch
DIFFERENTIAL BASE STATION		
ALMANAC	Current almanac information	Asynch
BESTPOS	Best position data	Synch
BESTVEL	Velocity data	Synch

BSLNXYZ	RTK XYZ baseline	Asynch
CMRDATADESC	Base station description	Synch
CMRDATAOBS	Base station satellite observations	Synch
CMRDATAREF	Base station position	Synch
GPGGA	NMEA, position fix data	Synch
GPGGARTK	NMEA, global position system fix data	Synch
LBANDINFO	L-band configuration information	Synch
LBANDSTAT	L-band status information	Synch
MATCHEDPOS	Computed Position – Time Matched	Asynch
OMNIHPPOS	OmniSTAR HP/XP position data	Synch
PSRPOS	Pseudorange position	Synch
LOG	**DESCRIPTION**	**TYPE**
DIFFERENTIAL BASE STATION		
PSRVEL	Pseudorange velocity	Synch
RANGE	Satellite range information	Synch
RANGECMP	Compressed version of the RANGE log	Synch
RAWLBANDFRAME	Raw L-band frame data	Asynch
RAWLBANDPACKET	Raw L-band data packet	Asynch
REFSTATION	Base station position and health	Asynch
REFSTATIONINFO	Reference station position and health	Asynch
RTCADATA1	Differential GPS corrections	Synch
RTCADATA2OBS	Base station observations 2	Synch
RTCADATAEPHEM	Ephemeris and time information	Synch
RTCADATAOBS	Base station observations	Synch
RTCADATAREF	Base station parameters	Synch

RTKDATA	RTK related data such as baselines and satellite counts	Asynch
RTKPOS	RTK low latency position	Synch

RTCA, RTCM, RTCMV3 or CMR data logs, for example CMRDATADESC, RTCADATA1, RTCMDATA1 and RTCM1001.

See also *Table 52*, that follows, for a complete list of logs in alphabetical order.

Table 52: OEM6 Logs in Alphabetical Order

DATATYPE	MESSAGE ID	DESCRIPTION
ALIGNBSLNENU	1315	Outputs the RTK quality ENU baselines from ALIGN
ALIGNBSLNXYZ	1314	Outputs the RTK quality XYZ baselines from ALIGN
ALIGNDOP	1332	Outputs the DOP computed using the satellites used in solution
ALMANAC	73	Current almanac information
APPLICATIONSTATUS	520	Provides application status information
AUTHCODES	1348	contains all authorization codes (auth codes) entered into the system since the last complete firmware reload
AVEPOS	172	Position averaging
BESTPOS	42	Best position data
BESTSATS	1194	Satellites used in BESTPOS
BESTUTM	726	Best available UTM data
BESTVEL	99	Velocity data
BESTXYZ	241	Cartesian coordinate position data
BSLNXYZ	686	RTK XYZ baseline
CHANCONFIGLIST	1148	Channel configuration list
CLOCKMODEL	16	Current clock model matrices
CLOCKSTEERING	26	Clock steering status
CMRDATADESC	389	Base station description information
CMRDATAGLOOBS	1003	CMR Type 3 GLONASS observations
CMRDATAOBS	390	Base station satellite observation information
CMRDATAREF	391	Base station position information
CMRPLUS	717	CMR+ output message
COMCONFIG	317	Current COM port configuration
DIFFCODEBIASES	914	Differential code biases being applied
ETHSTATUS	1288	Current Ethernet status
GLOALMANAC	718	GLONASS almanac data
GLOCLOCK	719	GLONASS clock information

Table 52: OEM6 Logs in Alphabetical Order

DATATYPE	MESSAGE ID	DESCRIPTION
GLOEPHEMERIS	723	GLONASS ephemeris data
GLORAWALM	720	Raw GLONASS almanac data
GLORAWEPHEM	792	Raw GLONASS ephemeris data
GLORAWFRAME	721	Raw GLONASS frame data
GLORAWSTRING	722	Raw GLONASS string data
GPSEPHEM	7	GPS ephemeris data
HEADING	971	Heading information with the ALIGN feature
HEADING2	1335	Outputs same information as HEADING log with an additional Rover ID field
HEADINGSATS	1316	Outputs the satellite information from ALIGN filter
HWMONITOR	963	Monitor Hardware Levels
IONUTC	8	Ionospheric and UTC model information
IPSTATUS	1289	Current network configuration status
LBANDINFO	730	L-band configuration information
LBANDSTAT	731	L-band status information
LOGLIST	5	A list of system logs
MARKPOS, MARK2POS	181, 615	Position at time of mark input event
MARKTIME, MARK2TIME	231, 616	Time of mark input event
MASTERPOS	1051	Displays master position with the ALIGN feature
MATCHEDPOS	96	RTK Computed Position – Time Matched
MATCHEDXYZ	242	RTK Time Matched cartesian coordinate position data
NAVIGATE	161	Navigation waypoint status
OMNIHPPOS	495	OmniSTAR HP/XP position data
OMNIHPSATS	1197	Satellites used in the OMNIHPPOS solution
OMNIVIS	860	OmniSTAR satellite visibility list
PASSCOM1, PASSCOM2, PASSCOM3,PASSXCOM 1, PASSXCOM2, PASSXCOM3 PASSAUX, PASSUSB1, PASSUSB2, PASSUSB3 PASSETH1, PASSICOM1, PASSICOM2, PASSICOM3 PASSNCOM1, PASSNCOM2, PASSNCOM3	233, 234, 235, 405, 406, 795 690, 607, 608, 609, 1209,1250, 1251, 1252, , 1253, 1254, 1255	Pass-through logs
PDPPOS	469	PDP filter position

Table 52: OEM6 Logs in Alphabetical Order

DATATYPE	MESSAGE ID	DESCRIPTION
PDPDSATS	1234	Satellites used in PDPPOS solution
PDPVEL	470	PDP filter velocity
PDPXYZ	471	PDP filter Cartesian position and velocity
PORTSTATS	72	COM or USB port statistics
PSRDOP	174	DOP of SVs currently tracking
PSRDOP2	1163	Pseudorange Least Squares DOP
PSRPOS	47	Pseudorange position information
PSRTIME	881	Time offsets from the pseudorange filter
PSRVEL	100	Pseudorange velocity information
PSRXYZ	243	Pseudorange Cartesian coordinate position information
QZSSALMANAC	1346	Contains the decoded almanac parameters as received from the satellite with the parity information removed and appropriate scaling applied
QZSSEPHEMERIS	1336	single set of QZSS ephemeris parameters
QZSSIONUTC	1347	Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC) for QZSS are provided
QZSSRAWALMANAC	1345	contains the undecoded almanac subframes as received from the QZSS satellite
QZSSRAWEPHEM	1330	contains the raw binary information for subframes one, two and three from the satellite with the parity information removed
QZSSRAWSUBFRAME	1331	A raw QZSS subframe is 300 bits in total, includes the parity bits which are interspersed with the raw data ten times, in six bit chunks, for a total of 60 parity bits
RAIMSTATUS	1286	RAIM status
RANGE	43	Satellite range information
RANGECMP	140	Compressed version of the RANGE log
RANGEGPSL1	631	L1 version of the RANGE log
RAWALM	74	Raw almanac
RAWCNAVFRAME	1066	Raw L2C frame data
RAWEPHEM	41	Raw ephemeris
RAWGPSSUBFRAME	25	Raw subframe data
RAWGPSWORD	407	Raw navigation word
RAWLBANDFRAME	732	Raw L-band frame data

Table 52: OEM6 Logs in Alphabetical Order

DATATYPE	MESSAGE ID	DESCRIPTION
RAWLBANDPACKET	733	Raw L-band data packet
RAWWAASFRAME	287	Raw SBAS frame data
REFSTATION	175	Base station position and health
REFSTATIONINFO	1325	Reference station position and health information
ROVERPOS	1052	Displays over position with the ALIGN feature
RTCADATA1	392	Type 1 differential GPS corrections
RTCADATA2OBS	808	Type 7 base station observations 2
RTCADATAEPHEM	393	Type 7 ephemeris and time information
RTCADATAOBS	394	Type 7 base station observations
RTCADATAREF	395	Type 7 base station parameters
RTCAOBS3	1340	A NovAtel proprietary message that carries dual-frequency GPS and GLO measurements and is used in ALIGN. Also carries SBAS measurements if the Master receiver is single-frequency (L1-only) receiver to enable SBAS-ALIGN at the L1-only ALIGN Rover.
RTCMDATA1	396	Type 1 differential GPS corrections
RTCMDATA3	402	Type 3 base station parameters
RTCMDATA9	404	Type 9 partial differential GPS corrections
RTCMDATA15	397	Type 15 ionospheric corrections
RTCMDATA16	398	Type 16 special message
RTCMDATA1819	399	Type18 and Type 19 raw measurements
RTCMDATA2021	400	Type 20 and Type 21 measurement corrections
RTCMDATA22	401	Type 22 Extended Base Station parameters
RTCMDATA22GG	964	Extend Base Station parameters for GLONASS
RTCMDATA23	663	Type 23 Antenna Type Definition
RTCMDATA24	664	Type 24 Antenna Reference Point (ARP)
RTCMDATA31	868	Type 31 GLONASS Differential Corrections
RTCMDATA32	878	Type 32 GLONASS Base Station parameters
RTCMDATA36	879	Type 36 Special Message
RTCMDATA59	403	Type 59N-0 NovAtel Proprietary: RT20 Differential
RTCMDATA59GLO	905	NovAtel proprietary GLONASS differential corrections
RTCMDATA1001	784	L1-Only GPS RTK Observables
RTCMDATA1002	785	Extended L1-Only GPS RTK Observables
RTCMDATA1003	786	L1/L2 GPS RTK Observables
RTCMDATA1004	787	Extended L1/L2 GPS RTK Observables

Table 52: OEM6 Logs in Alphabetical Order

DATATYPE	MESSAGE ID	DESCRIPTION
RTCMDATA1005	788	RTK Base Station ARP
RTCMDATA1006	789	RTK Base Station ARP with Antenna Height
RTCMDATA1007	856	Extended Antenna Descriptor and Setup
RTCMDATA1008	857	Extended Antenna Reference Station Description and
RTCMDATA1009	897	GLONASS L1-Only RTK
RTCMDATA1010	898	Extended GLONASS L1-Only RTK
RTCMDATA1011	899	GLONASS L1/L2 RTK
RTCMDATA1012	900	Extended GLONASS L1/L2 RTK
RTCMDATA1019	901	GPS Ephemerides
RTCMDATA1020	902	GLONASS Ephemerides
RTCMDATA1033	1099	Receiver and antenna descriptors
RTCMDATAOMNI1	960	RTCM1 from OmniSTAR
RTKDATA	215	RTK specific information
RTKDOP	952	Values from the RTK fast filter
RTKDOP2	1172	Values from the RTK fast filter
RTKPOS	141	RTK low latency position data
RTKSATS	1174	Satellites used in RTKPOS solution
RTKVEL	216	RTK velocity
RTKVEL2	1231	RTK velocity
RTKXYZ	244	RTK Cartesian coordinate position data
RXCONFIG	128	Receiver configuration status
RXHWLEVELS	195	Receiver hardware levels
RXSTATUS	93	Self-test status
RXSTATUSEVENT	94	Status event indicator
SATVIS	48	Satellite visibility
SATVIS2	1043	Satellite visibility
SATXYZ	270	SV position in ECEF Cartesian coordinates
SBAS0	290	Remove PRN from the solution
SBAS1	291	PRN mask assignments
SBAS2	296	Fast correction slots 0-12
SBAS3	301	Fast correction slots 13-25
SBAS4	302	Fast correction slots 26-38
SBAS5	303	Fast correction slots 39-50
SBAS6	304	Integrity message

Table 52: OEM6 Logs in Alphabetical Order

DATATYPE	MESSAGE ID	DESCRIPTION
SBAS7	305	Fast correction degradation
SBAS9	306	GEO navigation message
SBAS10	292	Degradation factor
SBAS12	293	SBAS network time and UTC
SBAS17	294	GEO almanac message
SBAS18	295	IGP mask
SBAS24	297	Mixed fast/slow corrections
SBAS25	298	Long term slow satellite corrections
SBAS26	299	Ionospheric delay corrections
SBAS27	300	SBAS service message
SBAS32	696	Fast correction slots 0-10
SBAS33	697	Fast correction slots 11-21
SBAS34	698	Fast correction slots 22-32
SBAS35	699	Fast correction slots 39-50
SBAS45	700	Slow corrections
SBASCORR	313	SBAS range corrections used
SOFTLOADSTATUS	1235	Describes the status of the Sof tLoad process
SOURCETABLE	1344	outputs the NTRIP sourcetable entries from the NTRIPCASTER set by the NTRIPSOURCETABLE command
TIME	101	Receiver time information
TIMESYNC	492	Synchronize time between receivers
TRACKSTAT	83	Satellite tracking status
VALIDMODELS	206	Model and expiry date information for receiver
VERSION	37	Receiver hardware and software version numbers
CMR Format Logs [a]		
CMRDESC	310	Base station description information
CMRGLOOBS	882	CMR Type 3 GLONASS observations
CMROBS	103	Base station satellite observation information
CMRREF	105	Base station position information
CMRPLUS	717	CMR+ output message
RTCA FORMAT LOGS [a]		
RTCA1	10	Type 1 Differential GPS Corrections
RTCAEPHEM	347	Type 7 Ephemeris and Time Information

Table 52: OEM6 Logs in Alphabetical Order

DATATYPE	MESSAGE ID	DESCRIPTION
RTCAOBS	6	Type 7 Base Station Observations
RTCAOBS2	805	Type 7 Base Station Observations II
RTCAREF	11	Type 7 Base Station parameters
RTCM FORMAT LOGS [a]		
RTCM1	107	Type 1 Differential GPS Corrections
RTCM3	117	Type 3 Base Station parameters
RTCM9	275	Type 9 Partial Differential GPS Corrections
RTCM15	307	Type 15 Ionospheric Corrections
RTCM16	129	Type16 Special Message
RTCM16T	131	Type16T Special Text Message
RTCM1819	260	Type18 and Type 19 Raw Measurements
RTCM2021	374	Type 20 and Type 21 Measurement Corrections
RTCM22	118	Type 22 Extended Base Station parameters
RTCM23	665	Type 23 Antenna Type Definition
RTCM24	667	Type 24 Antenna Reference Point (ARP)
RTCM31	864	Type 31 Differential GLONASS Corrections
RTCM32	873	Type 32 GLONASS Base Station parameters
RTCM36	875	Type 36 Special Message
RTCM36T	877	Type 36T Special Text Message
RTCM59	116	Type 59N-0 NovAtel Proprietary: RT20
RTCM59GLO	903	NovAtel proprietary GLONASS differential
RTCMV3 FORMAT LOGS [a]		
RTCMOMNI1	957	RTCM1 from OmniSTAR
RTCM1001	772	L1-Only GPS RTK Observables
RTCM1002	774	Extended L1-Only GPS RTK Observables
RTCM1003	776	L1/L2 GPS RTK Observables
RTCM1004	770	Extended L1/L2 GPS RTK Observables
RTCM1005	765	RTK Base Station ARP
RTCM1006	768	RTK Base Station ARP with Antenna Height
RTCM1007	852	Extended Antenna Descriptor and Setup
RTCM1008	854	Extended Antenna Reference Station Description and Serial Number
RTCM1009	885	GLONASS L1-Only RTK

RTCM1010	887	Extended GLONASS L1-Only RTK
RTCM1011	889	GLONASS L1/L2 RTK
RTCM1012	891	Extended GLONASS L1/L2 RTK
RTCM1019	893	GPS Ephemerides
RTCM1020	895	GLONASS Ephemerides
RTCM1033	1097	Receiver and antenna descriptors
NMEA FORMAT DATA LOGS		
GLMLA	859	NMEA GLONASS almanac data
GPALM	217	Almanac Data
GPGGA	218	GPS Fix Data and Undulation
GPGGALONG	521	GPS Fix Data, Extra Precision and Undulation
GPGGARTK	259	GPS Fix Data with Extra Precision
GPGLL	219	Geographic Position - latitude/longitude
GPGRS	220	GPS Range Residuals for Each Satellite
GPGSA	221	GPS DOP and Active Satellites
GPGST	222	Pseudorange Measurement Noise Statistics
GPGSV	223	GPS Satellites in View
NMEA FORMAT DATA LOGS		
GPHDT	1045	Heading in Degrees True
GPRMB	224	Generic Navigation Information
GPRMC	225	GPS Specific Information
GPVTG	226	Track Made Good and Ground Speed
GPZDA	227	UTC Time and Date

a. CMR, RTCA, and RTCM logs may be logged with an A or B extension to give an ASCII or Binary output with a NovAtel header followed by Hex or Binary data respectively

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
5	LOGLIST	A list of system logs
7	GPSEPHEM	GPS ephemeris data
8	IONUTC	Ionospheric and UTC model information
16	CLOCKMODEL	Current clock model matrices
25	RAWGPSSUBFRAME	Raw subframe data
26	CLOCKSTEERING	Clock steering status
37	VERSION	Receiver hardware and software version numbers
41	RAWEPHEM	Raw ephemeris

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
42	BESTPOS	Best position data
43	RANGE	Satellite range information
47	PSRPOS	Pseudorange position information
48	SATVIS	Satellite visibility
72	PORTSTATS	COM or USB port statistics
73	ALMANAC	Current almanac information
74	RAWALM	Raw almanac
83	TRACKSTAT	Satellite tracking status
93	RXSTATUS	Self-test status
94	RXSTATUSEVENT	Status event indicator
96	MATCHEDPOS	RTK Computed Position – Time Matched
99	BESTVEL	Velocity data
100	PSRVEL	Pseudorange velocity information
101	TIME	Receiver time information
128	RXCONFIG	Receiver configuration status
140	RANGECMP	Compressed version of the RANGE log
141	RTKPOS	RTK low latency position data
161	NAVIGATE	Navigation waypoint status
172	AVEPOS	Position averaging
174	PSRDOP	DOP of SVs currently tracking
175	REFSTATION	Base station position and health
181	MARKPOS	Position at time of mark input event
195	RXHWLEVELS	Receiver hardware levels
206	VALIDMODELS	Model and expiry date information for receiver
215	RTKDATA	RTK specific information
216	RTKVEL	RTK velocity
231	MARKTIME	Time of mark input event
233, 234, 235	PASSCOM1, PASSCOM2, PASSCOM3	Pass-through logs
241	BESTXYZ	Cartesian coordinate position data
242	MATCHEDXYZ	RTK Time Matched cartesian coordinate position data
243	PSRXYZ	Pseudorange cartesian coordinate position
244	RTKXYZ	RTK cartesian coordinate position data
270	SATXYZ	SV position in ECEF Cartesian coordinates

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
287	RAWWAASFRAME	Raw SBAS frame data
290	SBAS0	Remove PRN from the solution
291	SBAS1	PRN mask assignments
292	SBAS10	Degradation factor
293	SBAS12	SBAS network time and UTC
294	SBAS17	GEO almanac message
295	SBAS18	IGP mask
296	SBAS2	Fast correction slots 0-12
297	SBAS24	Mixed fast/slow corrections
298	SBAS25	Long term slow satellite corrections
299	SBAS26	Ionospheric delay corrections
300	SBAS27	SBAS service message
301	SBAS3	Fast correction slots 13-25
302	SBAS4	Fast correction slots 26-38
303	SBAS5	Fast correction slots 39-50
304	SBAS6	Integrity message
305	SBAS7	Fast correction degradation
306	SBAS9	GEO navigation message
313	SBASCORR	SBAS range corrections used
317	COMCONFIG	Current COM port configuration
389	CMRDATADESC	Base station description information
390	CMRDATAOBS	Base station satellite observation information
391	CMRDATAREF	Base station position information
392	RTCADATA1	Type 1 Differential GPS Corrections
393	RTCADATAEPHEM	Type 7 Ephemeris and Time Information
394	RTCADATAOBS	Type 7 Base Station Observations
395	RTCADATAREF	Type 7 Base Station parameters
396	RTCMDATA1	Type 1 Differential GPS Corrections
397	RTCMDATA15	Type 15 Ionospheric Corrections
398	RTCMDATA16	Type 16 Special Message
399	RTCMDATA1819	Type18 and Type 19 Raw Measurements
400	RTCMDATA2021	Type 20 and Type 21 Measurement Corrections
401	RTCMDATA22	Type 22 Extended Base Station parameters
402	RTCMDATA3	Type 3 Base Station parameters

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
403	RTCMDATA59	Type 59N-0 NovAtel Proprietary: RT20 Differential
404	RTCMDATA9	Type 9 Partial Differential GPS Corrections
405, 406	PASSXCOM1, PASSXCOM2	Pass-through logs
407	RAWGPSWORD	Raw navigation word
469	PDPPOS	PDP filter position
470	PDPVEL	PDP filter velocity
471	PDPXYZ	PDP filter Cartesian position and velocity
492	TIMESYNC	Synchronize time between receivers
495	OMNIHPPOS	OmniSTAR HP/XP position data
520	APPLICATIONSTATUS	Provides application status information
607, 608, 609	PASSUSB1, PASSUSB2, PASSUSB3	Pass-through logs (for receivers that support USB)
615	MARK2POS	Time of mark input event
616	MARK2TIME	Position at time of mark input event
631	RANGEGPSL1	L1 version of the RANGE log
663	RTCMDATA23	Type 23 Antenna Type Definition
664	RTCMDATA24	Type 24 Antenna Reference Point (ARP)
686	BSLNXYZ	RTK XYZ baseline
690	PASSAUX	Pass-through log for AUX port
696	SBAS32	Fast correction slots 0-10
697	SBAS33	Fast correction slots 11-21
698	SBAS34	Fast correction slots 22-32
699	SBAS35	Fast correction slots 39-50
700	SBAS45	Slow corrections
718	GLOALMANAC	GLONASS almanac data
719	GLOCLOCK	GLONASS clock information
720	GLORAWALM	Raw GLONASS almanac data
721	GLORAWFRAME	Raw GLONASS frame data
722	GLORAWSTRING	Raw GLONASS string data
723	GLOEPHEMERIS	GLONASS ephemeris data
726	BESTUTM	Best available UTM data

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
730	LBANDINFO	L-band configuration information
731	LBANDSTAT	L-band status information
732	RAWLBANDFRAME	Raw L-band frame data
733	RAWLBANDPACKET	Raw L-band data packet
784	RTCMDATA1001	L1-Only GPS RTK Observables
785	RTCMDATA1002	Extended L1-Only GPS RTK Observables
786	RTCMDATA1003	L1/L2 GPS RTK Observables
787	RTCMDATA1004	Extended L1/L2 GPS RTK Observables
788	RTCMDATA1005	RTK Base Station ARP
789	RTCMDATA1006	RTK Base Station ARP with Antenna Height
792	GLORAWEPHEM	Raw GLONASS ephemeris data
795	PASSXCOM3	Pass through log
808	RTCADATA2OBS	Type 7 Base Station Observations 2
856	RTCMDATA1007	Extended Antenna Descriptor and Setup
857	RTCMDATA1008	Extended Antenna Reference Station Description and Serial Number
860	OMNIVIS	OmniSTAR satellite visibility list
868	RTCMDATA31	Type 31 GLONASS Differential Corrections
878	RTCMDATA32	Type 32 GLONASS Base Station parameters
879	RTCMDATA36	Type 36 Special Message
881	PSRTIME	Time offsets from the pseudorange filter
897	RTCMDATA1009	GLONASS L1-Only RTK
898	RTCMDATA1010	Extended GLONASS L1-Only RTK
899	RTCMDATA1011	GLONASS L1/L2 RTK
897	RTCMDATA1009	GLONASS L1-Only RTK
898	RTCMDATA1010	Extended GLONASS L1-Only RTK
899	RTCMDATA1011	GLONASS L1/L2 RTK
900	RTCMDATA1012	Extended GLONASS L1/L2 RTK
901	RTCMDATA1019	GPS Ephemerides
902	RTCMDATA1020	GLONASS Ephemerides

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
905	RTCMDATA59GLO	NovAtel proprietary GLONASS differential corrections
914	DIFFCODEBIASES	Differential code biases being applied
952	RTKDOP	Values from the RTK fast filter
960	RTCMDATAOMNI1	RTCM1 from OmniSTAR
963	HWMONITOR	Monitor Hardware Levels
964	RTCMDATA22GG	Extended base station parameters for GLONASS
971	HEADING	Heading information with the ALIGN feature
1043	SATVIS2	Satellite visibility
1051	MASTERPOS	Displays the master position with the ALIGN feature
1052	ROVERPOS	Displays the rover position with the ALIGN feature
1066	RAWCNAVFRAME	Raw L2C frame data
1148	CHANCONFIGLIST	Channel configuration list
1162	PSRSATS	Satellites used in PSRPOS solution
1163	PSRDOP2	Pseudorange Least Squares DOP
1170	CLOCKMODEL2	Clock bias
1172	RTKDOP2	Values from the RTK Fast Filter
1174	RTKSATS	Satellites used in RTKPOS solution
1194	BESTSATS	Satellites used in BESTPOS
1197	OMNIHPSATS	Satellites used in the OMNIHPPOS solution
1209	PASSETH1	Pass through log
1231	RTKVEL2	RTKVEL2
1234	PDPSATS	Satellites used in PDPPOS solution
1235	SOFTLOADSTATUS	Status of the soft load process
1250	PASSICOM1	Pass through log
1251	PASSICOM2	Pass through log
1252	PASSICOM3	Pass through log
1253	PASSNCOM1	Pass through log
1254	PASSNCOM2	Pass through log

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
1255	PASSNCOM3	Pass through log
1286	RAIMSTATUS	RAIM status
1288	ETHSTATUS	Current Ethernet status
1289	IPSTATUS	Current network configuration status
1314	ALIGNBSLNXYZ	Outputs the RTK quality XYZ baselines from ALIGN
1315	ALIGNBSLNENU	Outputs the RTK quality ENU baselines from ALIGN
1316	HEADINGSATS	Outputs the satellite information from ALIGN filter
1325	REFSTATIONINFO	Reference station position and health information
1330	QZSSRAWEPHEM	Contains the raw binary information for subframes one, two and three from the satellite with the parity information removed
1331	QZSSRAWSUBFRAME	A raw QZSS subframe is 300 bits in total, includes the parity bits which are interspersed with the raw data ten times, in six bit chunks, for a total of 60 parity bits
1332	ALIGNDOP	Outputs the DOP computed using the satellites used in solution
1335	HEADING2	Outputs same information as HEADING log with an additional Rover ID field
1336	QZSSEPHEMERIS	Single set of QZSS ephemeris parameters
1340	RTCAOBS3	Proprietary message that carries dual-frequency GPS and GLO measurements and is used in ALIGNAlso carries SBAS measurements if the Master receiver is single-frequency (L1-only) receiver to enable SBAS-ALIGN at the L1-only ALIGN Rover.
1344	SOURCETABLE	outputs the NTRIP sourcetable entries from the NTRIPCASTER set by the NTRIPSOURCETABLE command
1345	QZSSRAWALMANAC	contains the undecoded almanac subframes as received from the QZSS satellite
1346	QZSSALMANAC	contains the decoded almanac parameters as received from the satellite with the parity information removed and appropriate scaling applied
1347	QZSSIONUTC	Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC) for QZSS are provided

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
1348	AUTHCODES	contains all authorization codes (auth codes) entered into the system since the last complete firmware reload
CMR FORMAT LOGS [a]		
103	CMROBS	Base station satellite observation information
105	CMRREF	Base station position information
310	CMRDESC	Base station description information
717	CMRPLUS	CMR+ output message
882	CMRGLOOBS	CMR Type 3 GLONASS observations
1003	CMRDATAGLOOBS	CMR Type 3 GLONASS observations
RTCA FORMAT LOGS [a]		
6	RTCAOBS	Type 7 Base Station Observations
10	RTCA1	Type 1 Differential GPS Corrections
11	RTCAREF	Type 7 Base Station parameters
347	RTCAEPHEM	Type 7 Ephemeris and Time Information
805	RTCAOBS2	Type 7 Base Station Observations 2
RTCM FORMAT LOGS [a]		
107	RTCM1	Type 1 Differential GPS Corrections
116	RTCM59	Type 59N-0 NovAtel Proprietary: RT20 Differential
117	RTCM3	Type 3 Base Station parameters
118	RTCM22	Type 22 Extended Base Station parameters
129	RTCM16	Type16 Special Message
131	RTCM16T	Type16T Special Text Message
260	RTCM1819	Type18 and Type 19 Raw Measurements
275	RTCM9	Type 9 Partial Differential GPS Corrections
307	RTCM15	Type 15 Ionospheric Corrections
374	RTCM2021	Type 20 and Type 21 Measurement Corrections
665	RTCM23	Type 22 Extended Base Station parameters
667	RTCM24	Type 23 Antenna Type Definition
864	RTCM31	Type 31 Differential GLONASS Corrections
873	RTCM32	Type 32 GLONASS Base Station parameters
875	RTCM36	Type 36 Special Message

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
RTCMV3 FORMAT LOGS [a]		
877	RTCM36T	Type 36T Special Text Message
903	RTCM59GLO	NovAtel proprietary GLONASS differential NovAtel
957	RTCMOMNI1	RTCM1 from OmniSTAR
765	RTCM1005	RTK Base Station ARP
768	RTCM1006	RTK Base Station ARP with Antenna Height
770	RTCM1004	Extended L1/L2 GPS RTK Observables
772	RTCM1001	L1-Only GPS RTK Observables
774	RTCM1002	Extended L1-Only GPS RTK Observables
776	RTCM1003	L1/L2 GPS RTK Observables
852	RTCM1007	Extended Antenna Descriptor and Setup
854	RTCM1008	Extended Antenna Reference Station Description and Serial Number
885	RTCM1009	GLONASS L1-Only RTK
887	RTCM1010	Extended GLONASS L1-Only RTK
889	RTCM1011	GLONASS L1/L2 RTK
891	RTCM1012	Extended GLONASS L1/L2 RTK
893	RTCM1019	GPS Ephemerides
895	RTCM1020	GLONASS Ephemerides
1097	RTCM1033	Receiver and antenna descriptors
NMEA FORMAT DATA LOGS		
217	GPALM	Almanac Data
218	GPGGA	GPS Fix Data and Undulation
219	GPGLL	Geographic Position - latitude/longitude
220	GPGRS	GPS Range Residuals for Each Satellite
221	GPGSA	GPS DOP and Active Satellites
222	GPGST	Pseudorange Measurement Noise Statistics
223	GPGSV	GPS Satellites in View
224	GPRMB	Generic Navigation Information
225	GPRMC	GPS Specific Information
226	GPVTG	Track Made Good and Ground Speed
227	GPZDA	UTC Time and Date

Table 53: OEM6 Logs in Numerical Order

MESSAGE ID	DATATYPE	DESCRIPTION
NMEA FORMAT DATA LOGS		
259	GPGGARTK	GPS Fix Data with Extra Precision
521	GPGGALONG	GPS Fix Data, Extra Precision and Undulation
859	GLMLA	NMEA GLONASS Almanac Data
1045	GPHDT	Heading in Degrees True

a. CMR, RTCA, RTCM and RTCMV3 logs may be logged with an A or B extension to give an ASCII or Binary output with a NovAtel header followed by Hex or Binary data respectively

3.3 Log Reference

3.3.1 ALIGNBSLNENU ENU Baselines using ALIGN

This log outputs the RTK quality ENU baselines from ALIGN. The XYZ baselines (output in ALIGNBSLNXYZ log) are rotated relative to master position (output in MASTERPOS) to compute ENU baselines.

Message ID: **1315 (ALIGNBSLNENU)**
Log Type: **Asynch**

Recommended Input:

log alignbslnenua onnew

ASCII Example:

#ALIGNBSLNENUA,COM1,0,29.0,FINESTEERING,1629,259250.000,00040000,100b,39448;SOL_COMPUTED,NARROW_INT,4.1586,-1.9197,-0.0037,0.0047,0.0050,0.0062,"0092","AAAA",22,16,16,16,0,01,0,33*11e1d4c0

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	ALIGNBSLNENU	Log Header		H	0
2	sol stat	Solution status, *see Table 54 on Page 285 of OEM6 Manual*	ENUM	4	H
3	pos type	Position type, *see Table 53 on Page 284 of OEM6 Manual*	ENUM	4	H+4
4	East	East Baseline (relative to master position) in metres	DOUBLE	8	H+14
5	North	North Baseline (relative to master position) in metres	DOUBLE	8	H+16
6	Up	Up Baseline (relative to master position) in metres	DOUBLE	8	H+24
7	East σ	East Baseline STD in metres	FLOAT	4	H+32
8	North σ	North Baseline STD in metres	FLOAT	4	H+36
9	Up σ	Up Baseline STD in metres	FLOAT	4	H+40
10	Rover id	Rover Receiver ID *Set using SETROVERID command on ROVER* *e.g. setroverid RRRR*	CHAR[4]	4	H+44
11	Master id	Master Receiver ID *Set using DGPSTXID command on MASTER* *Default: AAAA*	UCHAR	1	H+48
12	#SVs	Number of satellites tracked	UCHAR	1	H+52

Continued on next page

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
13	#solnSVs	Number of satellites in solution	UCHAR	1	H+53
14	#obs	Number of satellites above elevation mask angle	UCHAR	1	H+54
15	#multi	Number of satellites above elevation mask angle with L2	UCHAR	1	H+55
16	Reserved		UCHAR	1	H+44
17	ext sol stat	Extended solution status, *see Table 56 on Page 286 of OEM6 Manual*	HEX	1	H+57
18	Reserved		HEX	1	H+46
19	sig mask	Signals used mask - if 0, signals used in solution are unknown, *see Table 55 on Page 286 of OEM6 Manual*	HEX	1	H+59
20	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+60
21	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.2 ALIGNBSLNXYZ XYZ Baselines using ALIGN

This log outputs the RTK quality XYZ baselines from ALIGN.

Message ID: **1314 (ALIGNBSLNXYZ)**
Log Type: **Asynch**

Recommended Input:

log alignbslnxyza onnew

ASCII Example:

#ALIGNBSLNXYZA,COM1,0,29.0,FINESTEERING,1629,259250.000,00040000,9d28,39448;SOL_COMPUTED,NARROW_INT,3.1901,-3.0566,
1.2079,0.0050,0.0054,0.0056,"0092","AAAA",22,16,16,16,0,01,0,33*ac372198

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	ALIGNBSLNXYZ	Log Header		H	0
2	sol stat	Solution status, see Table 54 on Page 285 of OEM6 Manual	ENUM	4	H
3	pos type	Position type, see Table 53 on Page 284 of OEM6 Manual	ENUM	4	H+4
4	dX	X Baseline in metres	DOUBLE	8	H+8
5	dY	Y Baseline in metres	DOUBLE	8	H+16
6	dZ	Z Baseline in metres	DOUBLE	8	H+24
7	dX σ	X Baseline STD in metres	FLOAT	4	H+32
8	dY σ	Y Baseline STD in metres	FLOAT	4	H+36
9	dZ σ	Z Baseline STD in metres	FLOAT	4	H+40
10	Rover id	Rover Receiver ID *Set using SETROVERID command on ROVER* *e.g. setroverid RRRR*	UCHAR[4]	4	H+44
11	Master id	MASTER RECEIVER ID *SET DGPSTXID COMMAND ON MASTER* *DEFAULT: AAAA*	UCHAR[4]	1	H+48
12	#SVs	Number of satellites tracked	UCHAR	1	H+52
13	#solnSVs	Number of satellites in solution	UCHAR	1	H+53
14	#obs	Number of satellites above elevation mask angle	UCHAR	1	H+54
15	#multi	Number of satellites above elevation mask angle with L2	UCHAR	1	H+55

Continued on next page

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
16	Reserved		UCHAR	1	H+56
17	ext sol stat	Extended solution status, *see Table 56 on Page 286 of OEM6 Manual*	Hex	1	H+57
18	Reserved		Hex	1	H+58
19	sig mask	Signals used mask - if 0, signals uded in solution are unknown, *see Table 55 on Page 286 of OEM6 Manual*	Hex	1	H+59
20	xxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+60
21	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.3 ALIGNDOP Calculated DOP Values

This log outputs the DOP computed using the satellites used in heading solution. This log comes out at a default 1 Hz rate. Additional logs will come out in the middle of second if DOP changes and ALIGN is operating at >1 Hz.

Message ID: **1332**
Log Type: **Asynch**

Recommended Input:

log aligndopa onnew

ASCII Example:

#ALIGNDOPA,COM1,0,22.5,FINESTEERING,1629,259250.000,00040000,de2d,39448;1.6160,1.2400,0.6900,0.9920,0.7130,10.0,16,4,32,23,10,7,20,13,30,16,47,43,46,53,54,44,45*90a72971

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	ALIGNDOP	Log Header		H	0
2	GDOP	Geometric DOP	FLOAT	4	H
3	PDOP	Position DOP	FLOAT	4	H+4
4	HDOP	Horizontal DOP	FLOAT	4	H+8
5	HTDOP	Horizontal and Time DOP	FLOAT	4	H+12
6	TDOP	Time DOP	FLOAT	4	H+16
7	Elev mask	Elevation mask angle	FLOAT	4	H+20
8	#sats	Number of satellites to follow	ULONG	4	H+24
9	sats	Satellites in use at time of calculation	ULONG [#sats]	4 x (#sats)	H+28
10	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	variable
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.4 ALMANAC Decoded Almanac

This log contains the decoded almanac parameters from Subframe four and five as received from the satellite with the parity information removed and appropriate scaling applied. Multiple messages are transmitted, one for each SV almanac collected. For more information about almanac data, refer to the GPS SPS Signal Specification.

The OEM6 family of receivers automatically save almanacs in their non-volatile memory (NVM), therefore creating an almanac boot file is not necessary.

Message ID: **73**
Log Type: **Asynch**

Recommended Input:

log almanaca onchanged

ASCII Example:

```
#ALMANACA,COM1,0,54.0,SATTIME,1364,409278.000,00000000,06de,2310;
29,
1,1364,589824.0,6.289482e-03,-7.55460039e-09,-2.2193421e+00,-1.7064776e+00,
-7.94268362e-01,4.00543213e-05,3.63797881e-12,1.45856541e-04,2.6560037e+07,
4.45154034e-02,1,0,0,FALSE,
2,1364,589824.0,9.173393e-03,-8.16033991e-09,1.9308788e+00,1.9904300e+00,
6.60915023e-01,-1.62124634e-05,0.00000000,1.45860023e-04,2.6559614e+07,
8.38895743e-03,1,0,0,FALSE,
3,1364,589824.0,7.894993e-03,-8.04604944e-09,7.95206128e-01,6.63875501e-01,
-2.00526792e-01,7.91549683e-05,3.63797881e-12,1.45858655e-04,2.6559780e+07,
-1.59210428e-02,1,0,0,TRUE,
...
28,1364,589824.0,1.113367e-02,-7.87461372e-09,-1.44364969e-01,-2.2781989e+00,
1.6546425e+00,3.24249268e-05,0.00000000,1.45859775e-04,2.6559644e+07,
1.80122900e-02,1,0,0,FALSE,
29,1364,589824.0,9.435177e-03,-7.57745849e-09,-2.2673888e+00,-9.56729511e-01,
1.1791713e+00,5.51223755e-04,1.09139364e-11,1.45855297e-04,2.6560188e+07,
4.36225787e-02,1,0,0,FALSE,
30,1364,589824.0,8.776665e-03,-8.09176563e-09,-1.97082451e-01,1.2960786e+00,
2.0072936e+00,2.76565552e-05,0.00000000,1.45849410e-04,2.6560903e+07,
2.14517626e-03,1,0,0,FALSE*de7a4e45
```

The speed at which the receiver locates and locks onto new satellites is improved if the receiver has approximate time and position, as well as an almanac. This allows the receiver to compute the elevation of each satellite so it can tell which satellites are visible and their Doppler offsets, improving time to first fix (TTFF).

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	ALMANAC header	Log header		H	0
2	#messages	The number of satellite PRN almanac messages to follow. Set to zero until almanac data is available.	Long	4	H
3	PRN	Satellite PRN number for current message, dimensionless	Ulong	4	H+4
4	week	Almanac reference week (GPS reference week number)	Ulong	4	H+8
5	seconds	Almanac reference time, seconds into the week	Double	8	H+12
6	ecc	Eccentricity, dimensionless - defined for a conic section where e = 0 is a circle, e = 1 is a parabola, 0<e<1 is an ellipse and e>1 is a hyperbola.	Double	8	H+20
7	$\dot{\omega}$	Rate of right ascension, radians/ second	Double	8	H+28
8	ω_0	Right ascension, radians	Double	8	H+36
9	ω	Argument of perigee, radians - measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion.	Double	8	H+44
10	M_o	Mean anomaly of reference time, radians	Double	8	H+52
11	a_{fo}	Clock aging parameter, seconds	Double	8	H+60
12	a_{f1}	Clock aging parameter, seconds/ second	Double	8	H+68
13	N	Corrected mean motion, radians/ second	Double	8	H+76
14	A	Semi-major axis, metres	Double	8	H+84
15	incl-angle	Angle of inclination relative to 0.3 π, radians	Double	8	H+92
16	SV config	Satellite configuration	Ulong	4	H+100
17	health-prn	SV health from Page 25 of subframe 4 or 5 (6 bits)	Ulong	4	H+104
18	health-alm	SV health from almanac (8 bits)	Ulong	4	H+108
19	antispoof	Anti-spoofing on? 0 = FALSE 1 = TRUE	Enum	4	H+112
20...	Next PRN offset = H + 4 + (#messages x 112)				
21	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4 + (112 x #messages)
22	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.5 APPLICATIONSTATUS Application status information

This log contains API status informaiton.

Message ID: **520**
Log Type: **Asynch**

Recommended Input:

log applicationstatus once

ASCII Example:

#APPLICATIONSTATUSA,COM2,0,86.0,UNKNOWN,0,1.693,00040000,3314,6096;1,FALSE,00000000,00000000,"IndividualTest","1.00","2010/Sep/14","09:31:08"*e3667131

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	ulAPIVersion	Version of the API header	ULONG	4	H
2	bRunning	TRUE if the application is running. FALSE otherwise.	BOOL	4	H+4
3	ulBaseAddress	Base address of the loaded application	ULONG	4	H+8
4	ulSize	Size of the loaded application	ULONG	4	H+12
5	szName	Name of the loaded application	FixedChar Array[16]	16	H+16
6	szVersion	Version of the loaded application	FixedChar Array[16]	16	H+32
7	szCompileDate	Compile data of the loaded application	FixedChar Array[12]	12	H+48
8	szCompileTime	Compile time of the loaded application	FixedChar Array[12]	12	H+60

3.3.6 AUTHCODES

This log contains all authorization codes (auth codes) entered into the system since the last complete firmware reload. Signature authorization codes will be maintained through a Softload. The log also indicates the status of the firmware signature, if present. For more information about firmware signatures see the “Upgrading Using the AUTH Command” section of the Installationa nd Operation User Manual.

The following situations will cause an authorization code to be marked invalid. If you require new authorization codes, please contact NovAtel Customer Service.

- Authorization Code is for a different receiver
- Authorization Code is for a different firmware version
- Authorization Code has expired
- Authorization Code was entered incorrectly
- Authorization Code requires a firmware signature, but one is not present.

Message ID: **1348**
Log Type: **Polled**

Recommended Input:

log authcodesa once

NO ASCII Example:

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	AUTHCODES Signature Status	Status of the Firmware Signature 1 = NONE 2 = INVALID 3 = VALID	ENUM	4	H
2	Number of Auth Codes	# of Auth Codes to follow (max is 24)	ULONG	4	H+4
3	Auth code type	1=STANDARD 2=SIGNATURE	ENUM	4	H+8
4	Valid	TRUE if the Auth Code has been verified	BOOL	4	H+12
5	Auth Code String	ASCII String of the Auth Code	STRING	80	H+16
6	Next AuthCode offset =H+8 (#AuthCodes x 88)				
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.7 AVEPOS Position Averaging

When position averaging is underway, the various fields in the AVEPOS log contain the parameters being used in the position averaging process. *Table 54* below shows the possible position averaging status values seen in field #8 of the AVEPOS log table on the next page.

See the description of the POSAVE command on *page 180*. For general positioning information, refer also to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

1. All quantities are referenced to the geoid (average height above sea level), regardless of the use of the DATUM or USERDATUM commands, except for the height parameter (field #4 in the AVEPOS log table on the next page). The relation between the geoid and WGS84 ellipsoid is the geoidal undulation, and can be obtained from the PSRPOS log, see *page 450*.
2. Asynchronous logs should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Message ID: **172**
Log Type: **Asynch**

Recommended Input:

log aveposa onchanged

ASCII Example:

```
#AVEPOSA,COM1,0,48.5,FINESTEERING,1364,492100.000,80000000,e3b4,2310;
51.11635589900,-114.03833558937,1062.216134356,1.7561,0.7856,1.7236,
INPROGRESS,2400,2*72a550c1
```

Table 54: Position Averaging Status

Binary	ASCII	Description
0	OFF	Receiver is not averaging
1	INPROGRESS	Averaging is in progress
2	COMPLETE	Averaging is complete

When a GNSS position is computed, there are four unknowns being solved: latitude, longitude, height and receiver clock offset (often just called time). The solutions for each of the four unknowns are correlated to satellite positions in a complex way. Since satellites are above the antenna (none are below it) there is a geometric bias. Therefore geometric biases are present in the solutions and affect the computation of height. These biases are called DOPs (Dilution Of Precision). Smaller biases are indicated by low DOP values. VDOP (Vertical DOP) pertains to height. Most of the time, VDOP is higher than HDOP (Horizontal DOP) and TDOP (Time DOP). Therefore, of the four unknowns, height is the most difficult to solve. Many GNSS receivers output the standard deviations (SD) of the latitude, longitude and height. Height often has a larger value than the other two.

Accuracy is based on statistics, reliability is measured in percent. When a receiver says that it can measure height to one metre, this is an accuracy. Usually this is a one sigma value (one SD). A one sigma value for height has a reliability of 68%. In other words, the error is less than one metre 68% of the time. For a more realistic accuracy, double the one sigma value (one metre) and the result is 95% reliability (error is less than two metres 95% ocf the time). Generally, GNSS heights are 1.5 times poorer than horizontal positions. See also *page 374* for CEP and RMS definitions.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	AVEPOS header	Log header		H	0
2	lat	Average WGS84 latitude (degrees)	Double	8	H
3	lon	Average WGS84 longitude (degrees)	Double	8	H+8
4	ht	Average height above sea level (m)	Double	8	H+16
5	lat σ	Estimated average standard deviation of latitude solution element (m)	Float	4	H+24
6	lon σ	Estimated average standard deviation of longitude solution element (m)	Float	4	H+28
7	hgt σ	Estimated average standard deviation of height solution element (m)	Float	4	H+32
8	posave	Position averaging status (see *Table 54*)	Enum	4	H+36
9	ave time	Elapsed time of averaging (s)	Ulong	4	H+40
10	#samples	Number of samples in the average	Ulong	4	H+44
11	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
12	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.8 BESTPOS Best Position

This log contains the best available combined GNSS and inertial navigation system (INS - if available) position (in metres) computed by the receiver. In addition, it reports several status indicators, including differential age, which is useful in predicting anomalous behavior brought about by outages in differential corrections. A differential age of 0 indicates that no differential correction was used.

With the system operating in an RTK mode, this log reflects the latest low-latency solution for up to 60 seconds after reception of the last base station observation. After this 60 second period, the position reverts to the best solution available; the degradation in accuracy is reflected in the standard deviation fields. If the system is not operating in an RTK mode, pseudorange differential solutions continue for the time specified in the DGPSTIMEOUT command, see *page 102*.

See also the table footnote for position logs on *page 264* as well as the MATCHEDPOS, PSRPOS and RTKPOS logs, on *pages 417, 450* and *598* respectively.

Message ID: **42**
Log Type: **Synch**

Recommended Input:

log bestposa ontime 1

See *Section 2.1, Command Formats* on *page 38* for more examples of log requests.

Different logging rates that are possible with different engines. For example, RTK 100 Hz, LSQS 100 Hz, PDP 20Hz, HP/G2/XP 20Hz.

ASCII Example 1:

```
#BESTPOSA,COM1,0,83.5,FINESTEERING,1419,336148.000,00000040,6145,2724;
SOL_COMPUTED,SINGLE,51.11636418888,-114.03832502118,1064.9520,-16.2712,
WGS84,1.6961,1.3636,3.6449,"",0.000,0.000,8,8,0,0,0,06,0,03*6f63a93d
```

ASCII Example 2:

```
#BESTPOSA,COM1,0,78.5,FINESTEERING,1419,336208.000,00000040,6145,2724;
SOL_COMPUTED,NARROW_INT,51.11635910984,-114.03833105168,1063.8416,-16.2712,
WGS84,0.0135,0.0084,0.0172,"AAAA",1.000,0.000,8,8,8,8,0,01,0,03*3d9fbd48
```

Multi-frequency GNSS receivers offer two major advantages over single frequency equipment:

1. Ionospheric errors that are inherent in all GNSS observations can be modelled and significantly reduced by combining satellite observations made on two different frequencies.
2. Observations on two frequencies allow for faster ambiguity resolution times.

In general, multi-frequency GNSS receivers provide a faster, more accurate, and more reliable solution than single frequency equipment. They do, however, cost significantly more to purchase, thus it is important for potential GNSS buyers to carefully consider their current and future needs.

Table 55: Position or Velocity Type

Type (binary)	Type (ASCII)	Description
0	NONE	No solution
1	FIXEDPOS	Position has been fixed by the FIX POSITION command
2	FIXEDHEIGHT	Position has been fixed by the FIX HEIGHT/AUTO command
8	DOPPLER_VELOCITY	Velocity computed using instantaneous Doppler
16	SINGLE	Single point position
17	PSRDIFF	Pseudorange differential solution
18	SBAS	Solution calculated using corrections from an SBAS
19	PROPAGATED	Propagated by a Kalman filter without new observations
20	OMNISTAR [a]	OmniSTAR VBS position (L1 sub-metre)
32	L1_FLOAT	Floating L1 ambiguity solution
33	IONOFREE_FLOAT	Floating ionospheric-free ambiguity solution
34	NARROW_FLOAT	Floating narrow-lane ambiguity solution
48	L1_INT	Integer L1 ambiguity solution
49	WIDE_INT	Integer wide-lane ambiguity solution
50	NARROW_INT	Integer narrow-lane ambiguity solution
64	OMNISTAR_HP [a]	OmniSTAR HP position
65	OMNISTAR_XP [a]	OmniSTAR XP or OmniSTAR G2 (GPS+GLONASS) position

a. In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR, or use of a DGPS, service is required. Contact NovAtel for details.

Table 56: Solution Status

Solution Status		Description
(Binary)	(ASCII)	
0	SOL_COMPUTED	Solution computed
1	INSUFFICIENT_OBS	Insufficient observations
2	NO_CONVERGENCE	No convergence
3	SINGULARITY	Singularity at parameters matrix
4	COV_TRACE	Covariance trace exceeds maximum (trace > 1000 m)
5	TEST_DIST	Test distance exceeded (maximum of 3 rejections if distance > 10 km)
6	COLD_START	Not yet converged from cold start
7	V_H_LIMIT	Height or velocity limits exceeded (in accordance with export licensing restrictions)
8	VARIANCE	Variance exceeds limits
9	RESIDUALS	Residuals are too large
10	DELTA_POS	Delta position is too large
11	NEGATIVE_VAR	Negative variance
12	Reserved	
13	INTEGRITY_WARNING	Large residuals make position unreliable
18	PENDING	When a FIX POSITION command is entered, the receiver computes its own position and determines if the fixed position is valid [a]
19	INVALID_FIX	The fixed position, entered using the FIX POSITION command, is not valid
20	UNAUTHORIZED	Position type is unauthorized - HP or XP on a receiver not authorized for it
21	ANTENNA_WARNING	One of the antenna warnings listed in the RTKANTENNA command description, see *page 191*

a. PENDING implies there are not enough satellites being tracked to verify if the FIX POSITION entered into the receiver is valid. Under normal conditions you should only see PENDING for a few seconds on power up before the GNSS receiver has locked onto its first few satellites. If your antenna is obstructed (or not plugged in) and you have entered a FIX POSITION command, then you may see PENDING indefinitely.

Table 57: BESTPOS Signal-Used Mask

Bit	Mask	Description
0	0x01	GPS L1 used in Solution
1	0x02	GPS L2 used in Solution
2	0x04	GPS L5 used in Solution
3	0x08	Reserved
4	0x10	GLONASS L1 used in Solution
5	0x20	GLONASS L2 used in Solution
6-7	0x40-0x80	Reserved

Table 58: Extended Solution Status

Bit	Mask	Description
0	0x01	AdVance RTK Verified[a] 0 = Not Verified 1 = Verified
1-3	0x0E	Pseudorange Iono Correction 0 = Unknown[b] 1 = Klobuchar Broadcast 2 = SBAS Broadcast 3 = Multi-frequency Computed 4 = PSRDiff Correction 5 = NovAtel Blended Iono Value
4-7	0xF0	Reserved

a. If the solution is not RTK, then a bit 0 value of 1 indicates the output solution is from GL1DE.

b. Unknown can indicate that the Iono Correction type is None or that the default Klobuchar parameters are being used.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTPOS header	Log header		H	0
2	sol stat	Solution status, see *Table 56* on *page 302*	Enum	4	H
3	pos type	Position type, see *Table 55* on *page 301*	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	Undulation - the relationship between the geoid and the ellipsoid (m) of the chosen datum [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Table 16, Reference Ellipsoid Constants* on *page 95*)	Enum	4	H+36
9	lat σ	Latitude standard deviation	Float	4	H+40
10	lon σ	Longitude standard deviation	Float	4	H+44
11	hgt σ	Height standard deviation	Float	4	H+48
12	stn id	Base station ID	Char[4]	4	H+52
13	diff_age	Differential age in seconds	Float	4	H+56
14	sol_age	Solution age in seconds	Float	4	H+60
15	#SVs	Number of satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65
17	#ggL1	Number of GPS and GLONASS L1 used in RTK solution	Uchar	1	H+66
18	#ggL1L2	Number of GPS and GLONASS L1 and L2 used in RTK solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84

3.3.9 BESTSATS Satellites used in BESTPOS

This log lists the used and unused satellites for the corresponding BESTPOS solution. It also describes the signals of the used satellites or reasons for exclusions.

Message ID: **1194**
Log Type: **Synch**

Recommended Input:

log bestsatsa ontime 1

ASCII Example:

```
#BESTSATSA,COM1,0,91.5,FINESTEERING,1603,405520.000,00000008,be05,38926;17,GPS,8,GOOD,00000003,GPS,26,GOOD,00000003,GPS,19,GOOD,00000003,
GPS,28,GOOD,00000003,GPS,24,GOOD,00000003,GPS,11,GOOD,00000003,GPS,7,GOOD,00000003,GPS,15,GOOD,00000003,GPS,17,GOOD,00000003,GPS,3,
GOOD,00000003,GLONASS,5+1,GOOD,00000003,GLONASS,24+2,GOOD,00000003,GLONASS,23+3,GOOD,00000003,GLONASS,13-2,GOOD,00000003,GLONASS,14-7,
GOOD,00000003,GLONASS,15,GOOD,00000003,GLONASS,17+4,GOOD,00000003*664ee7e8
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTSATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	System	See *Table 29* on *page 157*.	Enum	4	H+4
4	Satellite ID	In binary logs, the satellite ID field is 4 bytes. The 2 lowest-order bytes, interpreted as a USHORT, are the system identifier: for instance, the PRN for GPS, or the slot for GLONASS. The 2 highest-order bytes are the frequency channel for GLONASS, interpreted as a SHORT, and zero for all other systems. In ASCII and abbreviated ASCII logs, the satellite ID field is the system identifier. If the system is GLONASS and the frequency channel is not zero, then the signed channel is appended to the system identifier. For example, slot 13, frequency channel -2 is output as 13-2.	Simple	4	H+8
5	Status	Satellite status. See *Table 59*	Enum	4	H+16
6	Status mask	See *Table 60* on *page 307*.	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 59: Observation Status

ASCII	Binary	Description
0	GOOD	Observation is good
1	BADHEALTH	Bad satellite health in ephemeris
2	OLDEPHEMERIS	Ephemeris > 3 hrs old
6	ELEVATIONERROR	Satellite was below the elevation cutoff
7	MISCLOSURE	Estimated/actual gap too large
8	NODIFFCORR	No differential correction available
9	NOEPHEMERIS	No ephemeris available
10	INVALIDIODE	IODE used is invalid
11	LOCKEDOUT	Satellite has been locked out
12	LOWPOWER	Not enough signal power
13	OBSL2	Observation is on L2
15	UNKNOWN	Status is unknown
16	NOIONOCORR	No ionosphere delay correction was available
25	NOSIGNALMATCH	Signal type doesn't match
99	NA	Not applicable, no observations available
100	BAD_INTEGRITY	Observation was an outlier and was eliminated from the solution
101	LOSSOFLOCK	Lock broken
102	NOAMBIGUITY	No RTK ambiguity type resolved

Table 60: BESTSATS GPS Signal Mask

Bit	Mask	Description
0	0x01	GPS L1 used in Solution
1	0x02	GPS L2 used in Solution
2	0x04	GPS L5 used in Solution

Table 61: BESTSATS GLONASS Signal Mask

Bit	Mask	Description
0	0x01	GLONASS L1 used in Solution
1	0x02	GLONASS L2 used in Solution

Table 62: BESTSATS Galileo Signal Mask

Bit	Mask	Description
0	0x01	Galileo E1 used in Solution

3.3.10 BESTUTM Best Available UTM Data

This log contains the best available position computed by the receiver in UTM coordinates.

See also the UTMZONE command on *page 257* and the BESTPOS log on *page 299*.

Message ID: **726**
Log Type: **Synch**

The latitude limits of the UTM System are 80°S to 84°N. If your position is outside this range, the BESTUTM log outputs a northing, easting and height of 0.0, along with a zone letter of '*'and a zone number of 0, so that it is obvious that the data in the log is unusable.

Recommended Input:

log bestutma ontime 1

ASCII Example:

```
#BESTUTMA,COM1,0,73.0,FINESTEERING,1419,336209.000,00000040,eb16,2724;
SOL_COMPUTED,NARROW_INT,11,U,5666936.4417,707279.3875,1063.8401,-16.2712,
WGS84,0.0135,0.0084,0.0173,"AAAA",1.000,0.000,8,8,8,8,0,01,0,03*a6d06321
```

Please refer to http://earth-info.nga.mil/GandG/coordsys/grids/referencesys.html for more information and a world map of UTM zone numbers.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTUTM header	Log header		H	0
2	sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	pos type	Position type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	z#	Longitudinal zone number	Ulong	4	H+8
5	zletter	Latitudinal zone letter	Ulong	4	H+12
6	northing	Northing (m) where the origin is defined as the equator in the northern hemisphere and as a point 10000000 metres south of the equator in the southern hemisphere (that is, a 'false northing' of 10000000 m)	Double	8	H+16
7	easting	Easting (m) where the origin is 500000 m west of the central meridian of each longitudinal zone (that is, a 'false easting' of 500000 m)	Double	8	H+24
8	hgt	Height above mean sea level	Double	8	H+32
9	undulation	Undulation - the relationship between the geoid and the ellipsoid (m) of the chosen datum [a]	Float	4	H+40
10	datum id#	Datum ID number (see *Chapter 2, Table 16, Reference Ellipsoid Constants* on *page 95*)	Enum	4	H+44
11	N σ	Northing standard deviation	Float	4	H+48
12	E σ	Easting standard deviation	Float	4	H+52
13	hgt σ	Height standard deviation	Float	4	H+56
14	stn id	Base station ID	Char[4]	4	H+60
15	diff_age	Differential age in seconds	Float	4	H+64
16	sol_age	Solution age in seconds	Float	4	H+68
17	#SVs	Number of satellite vehicles tracked	Uchar	1	H+72
18	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+73
19	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+74
20	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+75
21	Reserved		Uchar	1	H+76
22	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+77
23	Reserved		Hex	1	H+78
24	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+79
25	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+80
26	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84

3.3.11 BESTVEL Best Available Velocity Data

This log contains the best available velocity information computed by the receiver. In addition, it reports a velocity status indicator, which is useful in indicating whether or not the corresponding data is valid. The velocity measurements sometimes have a latency associated with them. The time of validity is the time tag in the log minus the latency value. See also the table footnote for velocity logs on *page 264*.

The velocity type is from the same source that was chosen for BESTPOS. So if BESTPOS is from the pseudorange filter, the BESTVEL velocity type is the same as for PSRVEL, see *page 454*. If BESTPOS is from RTK, the BESTVEL velocity type is the same as for RTKVEL, see *601*. If BESTPOS is from PDP, the BESTVEL velocity type is the same as for PDPVEL, see *442*. If BESTPOS is from OMNIHPPOS, the BESTVEL velocity type is OMNISTAR_HP or OMNISTAR_XP.

The RTK, OmniSTAR HP and OmniSTAR XP velocities are computed from the average change in position over the time interval or the RTK Low Latency filter. As such, it is an average velocity based on the time difference between successive position computations and not an instantaneous velocity at the BESTVEL time tag. The velocity latency to be subtracted from the time tag is normally half the time between filter updates. Under default operation, the positioning filters are updated at a rate of 2 Hz. This average velocity translates into a velocity latency of 0.25 seconds.

To reduce the latency, increase the update rate of the positioning filter being used by requesting the BESTVEL or BESTPOS messages at a rate higher than 2 Hz. For example, a logging rate of 10 Hz would reduce the velocity latency to 0.05 seconds. For integration purposes, the velocity latency should be applied to the record time tag.

While the receiver is static, the velocity may jump several centimetres per second. If the velocity in the BESTVEL log comes from the pseudorange filter, it has been computed from instantaneous doppler measurements. You know that you have an instantaneous doppler velocity solution when you see PSRDIFF, WAAS, OMNISTAR, or DOPPLER_VELOCITY in field #3 (*vel type*). The instantaneous doppler velocity has low latency and is not delta position dependent. If you change your velocity quickly, you can see this in the DOPPLER_VELOCITY solution. This instantaneous doppler velocity translates into a velocity latency of 0.15 seconds.

Message ID: **99**

Log Type: **Synch**

Recommended Input:

```
log bestvela ontime 1
```

ASCII Example:

```
#BESTVELA,COM1,0,61.0,FINESTEERING,1337,334167.000,00000000,827b,1984;
SOL_COMPUTED,PSRDIFF,0.250,4.000,0.0206,227.712486,0.0493,0.0*0e68bf05
```

Velocity vector (speed and direction) calculations involve a difference operation between successive satellite measurement epochs and the error in comparison to the position calculation is reduced. As a result you can expect velocity accuracy approaching plus or minus 0.03 m/s, 0.07 m.p.h., or 0.06 knots assuming phase measurement capability and a relatively high measurement rate (that is, 1 Hz or better) by the GNSS receiver.

Direction accuracy is derived as a function of the vehicle speed. A simple approach would be to assume a worst case 0.03 m/s cross-track velocity that would yield a direction error function something like:

$$d\,(\text{speed}) = \tan^{-1}(0.03/\text{speed})$$

For example, if you are flying in an airplane at a speed of 120 knots, or 62 m/s, the approximate directional error will be:

$$\text{an}^{-1}\,(0.03/62) = 0.03 \text{ degrees}$$

Consider another example applicable to hiking at an average walking speed of 3 knots or 1.5 m/s. Using the same error function yields a direction error of about 1.15 degrees.

You can see from both examples that a faster vehicle speed allows for a more accurate heading indication. As the vehicle slows down, the velocity information becomes less and less accurate. If the vehicle is stopped, a GNSS receiver still outputs some kind of movement at speeds between 0 and 0.5 m/s in random and changing directions. This represents the random variation of the static position.

In a navigation capacity, the velocity information provided by your GNSS receiver is as, or more, accurate than that indicated by conventional instruments as long as the vehicle is moving at a reasonable rate of speed. It is important to set the GNSS measurement rate fast enough to keep up with all major changes of the vehicle's speed and direction. It is important to keep in mind that although the velocity vector is quite accurate in terms of heading and speed, the actual track of the vehicle might be skewed or offset from the true track by plus or minus 0 to 1.8 metres as per the standard positional errors.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTVEL header	Log header		H	0
2	sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	vel type	Velocity type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results.	Float	4	H+8
5	age	Differential age in seconds	Float	4	H+12
6	hor spd	Horizontal speed over ground, in metres per second	Double	8	H+16
7	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	Double	8	H+24
8	vert spd	Vertical speed, in metres per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	Double	8	H+32
9	Reserved		Float	4	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.12 BESTXYZ Best Available Cartesian Position and Velocity

This log contains the receiver's best available position and velocity in ECEF coordinates. The position and velocity status fields indicate whether or not the corresponding data is valid. See *Figure 10, page 315* for a definition of the ECEF coordinates.

See also the BESTPOS and BESTVEL logs, on *pages 299 and 308* respectively.

These quantities are always referenced to the WGS84 ellipsoid, regardless of the use of the DATUM or USERDATUM commands.

Message ID: **241**
Log Type: **Synch**

Recommended Input:

log bestxyza ontime 1

ASCII Example:

```
#BESTXYZA,COM1,0,55.0,FINESTEERING,1419,340033.000,00000040,d821,2724;
SOL_COMPUTED,NARROW_INT,-1634531.5683,-3664618.0326,4942496.3270,
0.0099,0.0219,0.0115,SOL_COMPUTED,NARROW_INT,0.0011,-0.0049,-0.0001,
0.0199,0.0439,0.0230,"AAAA",0.250,1.000,0.000,12,11,11,11,0,01,0,33*e9eafeca
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BESTXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	pos type	Position type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P-Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H+44
11	vel type	Velocity type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m/s)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m/s)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m/s)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m/s)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m/s)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m/s)	Float	4	H+84
18	stn ID	Base station identification	Char[4]	4	H+88
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results.	Float	4	H+92
20	diff_age	Differential age in seconds	Float	4	H+96
21	sol_age	Solution age in seconds	Float	4	H+100
22	#SVs	Number of satellite vehicles tracked	Uchar	1	H+104
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+105
24	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+106
25	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+107
26	Reserved		Char	1	H+108
27	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+109
28	Reserved		Hex	1	H+110
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

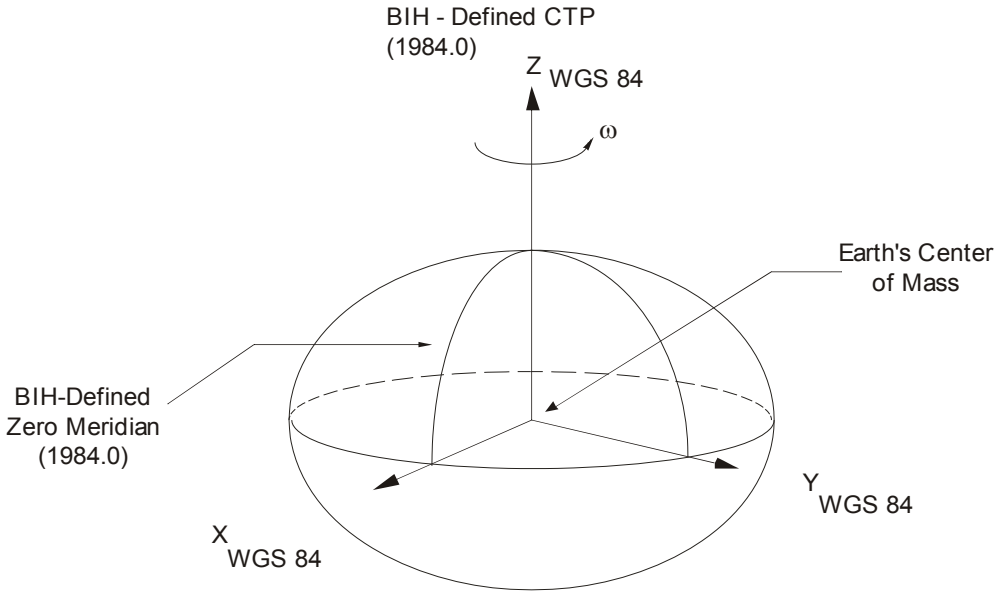
- Definitions - *

Origin = Earth's center of mass

Z-Axis = Parallel to the direction of the Conventional Terrestrial Pole (CTP) for polar motion, as defined by the Bureau International de l'Heure (BIH) on the basis of the coordinates adopted for the BIH stations.

X-Axis = Intersection of the WGS 84 Reference Meridian Plane and the plane of the CTP's Equator, the Reference Meridian being parallel to the Zero Meridian defined by the BIH on the basis of the coordinates adopted for the BIH stations.

Y-Axis = Completes a right-handed, earth-centered, earth-fixed (ECEF) orthogonal coordinate system, measured in the plane of the CTP Equator, 90° East of the X-Axis.



* Analogous to the BIH Defined Conventional Terrestrial System (CTS), or BTS, 1984.0.

Figure 10: The WGS84 ECEF Coordinate System

3.3.13 BSLNXYZ RTK XYZ Baseline

This log contains the receiver's RTK baseline in ECEF coordinates. The position status field indicates whether or not the corresponding data is valid. See *Figure 10, page 315* for a definition of the ECEF coordinates.

The BSLNXYZ log comes from time-matched base and rover observations such as in the MATCHEDXYZ log on *page 422*.

Asynchronous logs, such as BSLNXYZ, should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Message ID: **686**

Log Type: **Asynch**

Recommended Input:

```
log bslnxyza onchanged
```

ASCII Example:

```
#BSLNXYZA,COM1,0,59.5,FINESTEERING,1419,340033.000,00000040,5b48,2724;
SOL_COMPUTED,NARROW_INT,0.0012,0.0002,-0.0004,0.0080,0.0160,0.0153,
"AAAA",12,12,12,12,0,01,0,33*1a8a1b65.
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	BSLNXYZ header	Log header		H	0
2	sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	bsln type	Baseline type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	B-X	X-axis offset (m)	Double	8	H+8
5	B-Y	Y-axis offset (m)	Double	8	H+16
6	B-Z	Z-axis offset (m)	Double	8	H+24
7	B-X σ	Standard deviation of B-X (m)	Float	4	H+32
8	B-Y σ	Standard deviation of B-Y (m)	Float	4	H+36
9	B-Z σ	Standard deviation of B-Z (m)	Float	4	H+40
10	stn ID	Base station identification	Char[4]	4	H+44
11	#SVs	Number of satellite vehicles tracked	Uchar	1	H+48
12	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+49
13	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+50
14	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+51
15	Reserved		Uchar	1	H+52
16	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+53
17	Reserved		Hex	1	H+54
18	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+55
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+56
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.14 CHANCONFIGLIST Channel configuration list

This log provides the channel configuration list including the number of Ss and signal types. If more than one channel configuration is available, then it can be switched using the SELECTCHANCONFIG command. For more information about the SELECTCHANCONFIG command, see page *208*.

Message ID: **1148**
Log Type: **Polled**

Recommended Input:

log chanconfiglista once

ASCII Example:

CHANCONFIGLIST COM1 0 94.0 FINESTEERING 1610 333241.675 00000000 D1C0 38637 1 2 2 16 GPSL1L2 4 SBASL1 2 16 GPSL1L2PL2C 4 SBASL1

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CHANCONFIGLIST header	Log header		H	0
2	SetInUse	Current channel configuration being used. For example, if SetInUse is 2 then the second channel configuration listed in this log is the current channel configuration.	ULong	4	H
3	#chanconfigs	Number of channel configurations to follow	ULong	4	H+4
4	#signaltypes	Total number of signal types in this channel configuration	ULong	4	H+8
5	NumChans	Number of channels for individual signal type	ULong	4	H+12
6	SignalType	See *Table 63* on *page 319*	ULong	4	H+16
7..	Next chanconfig offset = H + 12+ 4* #signaltypes				
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+20
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Table 63: CHANCONFIGLIST Signal Type

Value	Name
0	GPSL1
1	GPSL1
4	SBASL1
5	GPSL5
6	GPSL1L2C
7	GPSL1L2AUTO
8	GLOL1L2
9	LBAND
10	GLOL1
11	GALE1
12	GALE5A
13	GALE5B
14	GALALTBOC
16	GPSL1L2PL2C
17	GPSL1L5
18	SBASL1L5
19	GPSL1L2PL2CL5
20	GPSL1L2PL5
21	GALE1E5AE5B
22	GALE1E5AE5BALTBOC
23	GALE1E5A
24	GLOL1L2C
25	GLOL1L2PL2C

3.3.15 CLOCKMODEL Current Clock Model Status

The CLOCKMODEL log contains the current clock-model status of the receiver.

Monitoring the CLOCKMODEL log allows you to determine the error in your receiver reference oscillator as compared to the GNSS satellite reference.

All logs report GPS reference time not corrected for local receiver clock error. To derive the closest GPS reference time, subtract the clock offset from the GPS reference time reported. The clock offset can be calculated by dividing the value of the range bias given in field *6* of the CLOCKMODEL log by the speed of light (*c*).

The following symbols are used throughout this section:

B = range bias (m)

BR = range bias rate (m/s)

SAB = Gauss-Markov process representing range bias error due to satellite clock dither (m)

The standard clock model now used is as follows:

clock parameters array = [B BR SAB]

covariance matrix =

$$\begin{bmatrix} \sigma_B^2 & \sigma_B \sigma_{BR} & \sigma_B \sigma_{SAB} \\ \sigma_{BR} \sigma_B & \sigma_{BR}^2 & \sigma_{BR} \sigma_{SAB} \\ \sigma_{SAB} \sigma_B & \sigma_{SAB} \sigma_{BR} & \sigma_{SAB}^2 \end{bmatrix}$$

Table 64: Clock Model Status

Clock Status (Binary)	Clock Status (ASCII)	Description
0	VALID	The clock model is valid
1	CONVERGING	The clock model is near validity
2	ITERATING	The clock model is iterating towards validity
3	INVALID	The clock model is not valid
4	ERROR	Clock model error

Message ID: **16**
Log Type: **Synch**

Recommended Input:

log clockmodela ontime 1

ASCII Example:

```
#CLOCKMODELA,COM1,0,52.0,FINESTEERING,1364,489457.000,80000000,98f9,2310;
VALID,0,489457.000,489457.000,7.11142843e+00,6.110131956e-03,
-4.93391151e+00,3.02626565e+01,2.801659017e-02,-2.99281529e+01,
2.801659017e-02,2.895779736e-02,-1.040643538e-02,-2.99281529e+01,
-1.040643538e-02,3.07428979e+01,2.113,2.710235665e-02,FALSE*3d530b9a
```

The CLOCKMODEL log can be used to monitor the clock drift of an internal oscillator once the CLOCKADJUST mode has been disabled. Watch the CLOCKMODEL log to see the drift rate and adjust the oscillator until the drift stops.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CLOCKMODEL header	Log header		H	0
2	clock status	Clock model status as computed from current measurement data, see *Table 64, Clock Model Status* on *page 320*	Enum	4	H
3	reject	Number of rejected range bias measurements	Ulong	4	H+4
4	noise time	GPS reference time of last noise addition	GPSec	4	H+8
5	update time	GPS reference time of last update	GPSec	4	H+12
6	parameters	Clock correction parameters (a 1x3 array of length 3), listed left-to-right	Double	8	H+16
7				8	H+24
8				8	H+32
9	cov data	Covariance of the straight line fit (a 3x3 array of length 9), listed left-to-right by rows	Double	8	H+40
10				8	H+48
11				8	H+56
12				8	H+64
13				8	H+72
14				8	H+80
15				8	H+88
16				8	H+96
17				8	H+104
18	range bias	Last instantaneous measurement of the range bias (metres)	Double	8	H+112
19	range bias rate	Last instantaneous measurement of the range bias rate (m/s)	Double	8	H+120
20	change	Is there a change in the constellation? 0 = FALSE 1 = TRUE	Enum	4	H+128
21	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+132
22	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.16 CLOCKSTEERING Clock Steering Status

The CLOCKSTEERING log is used to monitor the current state of the clock steering process. All oscillators have some inherent drift. By default the receiver attempts to steer the receiver's clock to accurately match GPS reference time. If for some reason this is not desired, this behavior can be disabled using the CLOCKADJUST command, see *page 82*.

If the CLOCKADJUST command is ENABLED, and the receiver is configured to use an external reference frequency (set in the EXTERNALCLOCK command, see *page 116*, for an external clock - TCXO, =OCXO, RUBIDIUM, CESIUM, or USER), then the clock steering process takes over the VARF output pins and may conflict with a previously entered FREQUENCYOUT command, see *page 127*.

Message ID: **26**

Log Type: **Asynch**

Recommended Input:

log clocksteeringa onchanged

ASCII Example:

```
#CLOCKSTEERINGA,COM1,0,56.5,FINESTEERING,1337,394857.051,00000000,0f61,1984;
INTERNAL,SECOND_ORDER,4400,1707.554687500,0.029999999,-2.000000000,-0.224,
0.060*0e218bbc
```

To configure the receiver to use an external reference oscillator, see the EXTERNALCLOCK command on *page 116*.

Table 65: Clock Source

Binary	ASCII	Description
0	INTERNAL	The receiver is currently steering its internal VCTCXO using an internal VARF signal
1	EXTERNAL	The receiver is currently steering an external oscillator using the external VARF signal

Table 66: Steering State

Binary	ASCII	Description
0	FIRST_ORDER	Upon start-up, the clock steering task adjusts the VARF pulse width to reduce the receiver clock drift rate to below 1 ms using a 1st order control loop. This is the normal start-up state of the clock steering loop.
1	SECOND_ORDER	Once the receiver has reduced the clock drift to below 1 m/s, it enters a second order control loop and attempts to reduce the receiver clock offset to zero. This is the normal runtime state of the clock steering process.
2	CALIBRATE_HIGH [a]	This state corresponds to when the calibration process is measuring at the "High" pulse width setting
3	CALIBRATE_LOW [a]	This state corresponds to when the calibration process is measuring at the "Low" pulse width setting
4	CALIBRATE_CENTER [b]	This state corresponds to the "Center" calibration process. Once the center has been found, the modulus pulse width, center pulse width, loop bandwidth, and measured slope values are saved in NVM and are used from now on for the currently selected oscillator (INTERNAL or EXTERNAL).

a. These states are only seen if you force the receiver to do a clock steering calibration using the CLOCKCALIBRATE command, see *page 84*. With the CLOCKCALIBRATE command, you can force the receiver to calibrate the slope and center pulse width, of the currently selected oscillator, to steer. The receiver measures the drift rate at several "High" and "Low" pulse width settings.

b. After the receiver has measured the "High" and "Low" pulse width setting, the calibration process enters a "Center calibration" process where it attempts to find the pulse width required to zero the clock drift rate.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CLOCKSTEERING header	Log header		H	0
2	source	Clock source, see *Table 65, Clock Source* on *page 323.*	Enum	4	H
3	steeringstate	Steering state, see *Table 66, Steering State* on *page 324*.	Enum	4	H+4
4	period	Period of the FREQUENCYOUT signal used to control the oscillator, refer to the FREQUENCYOUT command. This value is set using the CLOCKCALIBRATE command.	Ulong	4	H+8
5	pulsewidth	Current pulse width of the FREQUENCYOUT signal. The starting point for this value is set using the CLOCKCALIBRATE command. The clock steering loop continuously adjusts this value in an attempt to drive the receiver clock offset and drift terms to zero.	Double	8	H+12
6	bandwidth	The current band width of the clock steering tracking loop in Hz. This value is set using the CLOCKCALIBRATE command.	Double	8	H+20
7	slope	The current clock drift change in m/s/bit for a 1 LSB pulse width. This value is set using the CLOCKCALIBRATE command.	Float	4	H+28
8	offset	The last valid receiver clock offset computed (m). It is the same as Field # 18 of the CLOCKMODEL log, see *page 316*.	Double	8	H+32
9	driftrate	The last valid receiver clock drift rate received (m/s). It is the same as Field # 19 of the CLOCKMODEL log.	Double	8	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.17 CMR Standard Logs

CMRDESC BASE STATION DESCRIPTION INFORMATION
Message ID: 310

CMRGLOOBS CMR DATA GLONASS OBSERVATIONS (CMR TYPE 3 MESSAGE)
Message ID: 882

CMROBS BASE STATION SATELLITE OBSERVATION INFORMATION
Message ID: 103

CMRPLUS CMR+ OUTPUT INFORMATION
Message ID: 717

CMRREF BASE STATION POSITION INFORMATION
Message ID: 105

The Compact Measurement Record (CMR) Format, is a standard communications protocol used in Real-Time Kinematic (RTK) systems to transfer GNSS carrier phase and code observations from a base station to one or more rover stations.

1. The above messages can be logged with an A or B suffix for an ASCII or Binary output with a NovAtel header followed by Hex or Binary raw data respectively.
2. CMRDATA logs output the details of the above logs if they have been sent.
3. No guarantee is made that the OEM6 will meet its performance specifications if non-NovAtel equipment is used.
4. Trimble rovers must receive CMRDESC messages from a base.

The Compact Measurement Record (CMR) message format was developed by Trimble Navigation Ltd. as a proprietary data transmission standard for use in RTK applications. In 1996, Trimble publicly disclosed this standard and allowed its use by all manufacturers in the GNSS industry[1].

The NovAtel implementation allows a NovAtel rover receiver to operate in RTK mode while receiving pseudorange and carrier phase data via CMR messages (version 3.0) from either a NovAtel or non-NovAtel base-station receiver. The NovAtel receiver can also transmit CMR messages (version 3.0). The station ID must be ≤ 31 when transmitting CMR corrections. The CMRPLUS output message distributes the base station information over 14 updates, see *page 339*.

The maximum message lengths of the four CMR messages are as follows:

CMROBS = 6 *(frame)* + 6 *(header)* + (14*L1 channels) + (14*L2 channels) = (222 bytes max.)
CMRREF = 6 *(frame)* + 6 *(header)* + 19 = (31 bytes)
CMRDESC = 6 (*frame*) + 6 (*header*) + (variable: 26 to 75) = (38 bytes minimum; 87 bytes max.)
CMRPLUS = 6 (*frame*) + 3 (*header*) + 7 = (16 bytes)

1. Talbot, N.C. (1996) “Compact Data Transmission Standard for High-Precision GPS”. ION GPS-96 Conference Proceedings, Kansas, MO, Sept. 1996, Vol. I, pp. 861-871

CMR Type 3 RTK Formats

NovAtel CMR Type 3 messages are CMR Type 3 messages as defined by Leica and Topcon.

CMR Type 3 format messages are for GLONASS CMR observations. CMRGLOOBS and CMRDATAGLOOBS logs are similar to the existing CMROBS and CMRDATAOBS logs. See also *CMR Standard Logs* starting on *page 326*.

CMR Type 3 message types (CMRGLOOBS and CMRDATAGLOOBS) have their Z count stamped to GLONASS UTC time instead of GPS reference time (the *epoch* field in the CMR Header part of the message).

When you use CMRGLOOBS in conjunction with CMRREF and CMROBS, you can perform GPS + GLONASS RTK positioning (provided you have a GLONASS-capable receiver model).

CMR Type 3 Example Setup

In the example below, apply *Steps #1* and *#2* to the base, and *Step #3* to the rover:

1. Use the INTERFACEMODE command to set up the base port's receive mode as NONE and transmit mode as CMR:

```
interfacemode com2 none cmr
```

2. Log out CMRREF, CMROBS and CMRGLOOBS [1] messages:

```
log com2 CMRREF ontime 10
log com2 CMROBS ontime 1
log com2 CMRGLOOBS ontime 1
log com2 CMRDATADESC ontime 10
```

We recommend that you log CMROBS and CMRGLOOBS messages out at the same rate.

3. Set up the rover receiver to use incoming CMR messages by setting the rover port's receive mode as CMR and the transmit mode as NONE:

```
interfacemode com2 CMR none
```

Using AdVance RTK with CMR Format Messages

To enable receiving CMR messages, follow these steps:

1. Issue the SERIALCONFIGcommand, see *page 212*, to the rover receiver to set its serial port parameters to the proper bit rate, parity, and so on.
2. Issue the "INTERFACEMODE COMn CMR" command to the rover receiver, where "COMn" refers to the communication port that is connected to the data link. See also *page 147*.

1. These correspond to reference station data, GPS observations, and GLONASS observations respectively.

Assuming that the base station is transmitting valid data, your rover receiver begins to operate in AdVance RTK mode. To send CMR messages, periodically transmit the three following CMR messages at the base station:

- A CMROBS message that contains base station satellite observation information, and should be sent once every 1 or 2 seconds.
- A CMRREF message that contains base station position information, and should be sent once every 10 seconds. Also, the rover receiver automatically sets an approximate position from this message if it does not already have a position. Therefore, this message can be used in conjunction with an approximate time to improve TTFF. For more information about TTFF, refer to our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.
- A CMRDESC message that contains base station description information and should be sent once every 10 seconds. However, it should be interlinked with the CMRREF message.

1. For CMR, the station ID must be less than 31 (refer to the DGPSTXID and RTKSOURCE commands on *pages 103* and *200* respectively).
2. CMRDESC is logged with an offset of 5 to allow interleaving with CMRREF. Note that Trimble rovers must receive CMRDESC messages from a base.
3. NovAtel CMR Type 2 messages are for compatibility only.Type 2 provides a reference station description message that is required by some manufacturers' rovers before CMR messages are used. When received, a Type 2 message is discarded. For transmission, all fields are permanently set as follows:

Record Length	=	33 bytes
Short Station ID	=	"cref"
COGO Code	=	""
Long Station ID	=	"UNKNOWN"

Example Input:

```
interfacemode com2 none CMR
fix position 51.113 -114.044 1059.4
log com2 cmrobs ontime 1
log com2 cmrref ontime 10
log com2 cmrdesc ontime 10 5
```

3.3.18 CMRDATADESC Base Station Description

See *Section 3.3.17, CMR Standard Logs* starting on *page 326* for information about CMR standard logs.

Message ID: **389**
Log Type: **Synch**

Recommended Input:

log cmrdatadesca ontime 10 5

ASCII Example:

```
#CMRDATADESCA,COM1,0,76.5,FINESTEERING,1117,162906.461,00100020,b467,399;
2,0,147,39,3,0,2,
FALSE,FALSE,0,TRUE,0,180000,1,0,33,32,32,32,32,99,114,101,102,0,0,0,0,0,0,0,
0,0,0,0,0,0,0,0,8,85,78,75,78,79,87,78,0*482add29
```

where the bolded 33 in the example above represents the total length of the records that follow:

Short ID:

```
32,32,32,32,99,114,101,102, (8 bytes)
```

COGO Code:

```
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0, (16 bytes)
```

ID Length:

```
8, (1 byte)
```

Long ID:

```
85,78,75,78,79,87,78,0 (8 bytes)
```

Here are some CMR terminology facts:

- In the CMR format description, the base station description log is referred to as Type 2
- COGO is an acronym for coordinate geometry (COordinate GeOmetry)

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CMRDATA-DESC header	Log header	-	H	0
2	CMR header	Synch character for the message	Ulong	4	H
3		Message status	Ulong	4	H+4
4		CMR message type	Ulong	4	H+8
5		Message body length	Ulong	4	H+12
6		Version	Ulong	4	H+16
7		Station ID	Ulong	4	H+20
8		Message Type	Ulong	4	H+24
9	battery	Is the battery low? 0 = FALSE 1 = TRUE	Enum	4	H+28
10	memory	Is memory low? 0 = FALSE 1 = TRUE	Enum	4	H+32
11	Reserved		Ulong	4	H+36
12	L2	Is L2 enabled? 0 = FALSE 1 = TRUE	Enum	4	H+40
13	Reserved		Ulong	4	H+44
14	epoch	Epoch time (milliseconds)	Ulong	4	H+48
15	motion	Motion state 0 = UNKNOWN 1 = STATIC 2 = KINEMATIC	Ulong	4	H+52
16	Reserved		Ulong	4	H+56
17	rec length	Record length (bytes). The length altogether of the four fields that follow.	Double	8	H+60
18	short ID	Short station ID. A sequence of eight numbers.	Uchar[8]	8	H+68
19	code	COGO code. A sequence of 16 numbers.	Uchar[16]	16	H+76
20	ID length	Long ID length. The length of the long ID field that follows.	Ulong	4	H+92
21	long ID	Long station ID, variable length, see field #20	Uchar[50]	52[a]	H+96
22	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+148
23	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case an additional 2 bytes of padding are added to maintain 4 byte alignment

3.3.19 CMRDATAGLOOBS CMR Data GLONASS Observations

See *Section 3.3.17, CMR Standard Logs* starting on *page 326* for information about CMR standard logs.

Message ID: **1003**
Log Type: **Synch**

Recommended Input:

log cmrdatagloobsa ontime 10

ASCII Example:

```
#CMRDATAGLOOBSA,COM1,0,69.5,FINESTEERING,1464,426413.000,00100000,d9fe,3186;
2,0,147,51,3,0,3,3,159000,3,0,3,
7,FALSE,TRUE,TRUE,6872924,281,6,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,401,326,11,1,
6,FALSE,TRUE,TRUE,10410661,-124,4,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,185,-16,11,1,
23,FALSE,TRUE,TRUE,11322704,99,4,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,724,-140,11,1
*442e2924
```

CMRGLOOBS

This CMR Type 3 message is based closely on the CMR observables, or message 0, and is intended to allow GLONASS corrections to be broadcast using the CMR format.

NovAtel, Leica and Topcon support this CMR message type but it is not compatible with Trimble's unpublished GLONASS CMR messages.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CMRDATA-GLOOBS header	Log header	-	H	0
2	CMR header	Synch character for the message	Ulong	4	H
3		Message status	Ulong	4	H+4
4		CMR message type	Ulong	4	H+8
5		Message body length	Ulong	4	H+12
6		Version	Ulong	4	H+16
7		Station ID	Ulong	4	H+20
8		Message Type	Ulong	4	H+24
9	#sv	Number of SVs	Ulong	4	H+28
10	epoch	Epoch time (milliseconds)	Ulong	4	H+32
11	clock bias	Is clock bias valid? 0 = NOT VALID 3 = VALID	Ulong	4	H+36
12	clock offset	Clock offset (nanoseconds)	Long	4	H+40
13	# obs	Number of satellite observations with information to follow	Ulong	4	H+44
14	slot#	GLONASS satellite slot number	Ulong	4	H+48
15	P code?	Is P code collected? 0 = FALSE = C/A 1 = TRUE = P	Enum	4	H+52
16	L1 phase?	Is L1 phase valid? 0 = FALSE 1 = TRUE	Enum	4	H+56
17	L2?	Is L2 present? 0 = FALSE 1 = TRUE	Enum	4	H+60
18	L1 psr	L1 pseudorange (1/8 L1 cycles)	Ulong	4	H+64
19	L1 carrier	L1 carrier-code measurement (1/256 L1 cycles)	Long	4	H+68
20	L1 S/N_0	L1 signal-to-noise density ratio	Ulong	4	H+72
21	L1 slip	L1 cycle slip count (number of times that tracking has not been continuous)	Ulong	4	H+76

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
22	L2 code	Is L2 code available? 0 = FALSE 1 = TRUE	Enum	4	H+80
23	C/A code?	Is C/A code collected on L2? 0 = FALSE = P 1 = TRUE = C/A	Enum	4	H+84
24	L2 code?	Is L2 code valid? 0 = FALSE 1 = TRUE	Enum	4	H+88
25	L2 phase?	Is L2 phase valid? 0 = FALSE 1 = TRUE	Enum	4	H+92
26	phase full?	Is phase full? 0 = FALSE 1 = TRUE	Enum	4	H+96
27	Reserved		Ulong	4	H+100
28	L2 r offset	L2 range offset (1/100 metres)	Long	4	H+104
29	L2 c offset	L2 carrier offset (1/256 cycles) The L2 frequency used is that of the broadcasting satellite.	Long	4	H+108
30	L2 S/N_0	L2 signal-to-noise density ratio	Ulong	4	H+112
31	L2 slip	L2 cycle slip count (number of times that tracking has not been continuous)	Ulong	4	H+116
32...	Next PRN offset = H+48 + (#prns x 72)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.20 CMRDATAOBS Base Station Satellite Observations

See *Section 3.3.17, CMR Standard Logs* starting on *page 326* for information about CMR standard logs.

Message ID: **390**
Log Type: **Synch**

Recommended Input:

log cmrdataobsa ontime 2

ASCII Example:

```
#CMRDATAOBSA,COM1,0,74.0,FINESTEERING,1117,162981.000,00100020,b222,399;
2,0,147,93,3,0,0,
10,21000,3,0,10,
3,FALSE,TRUE,TRUE,8684073,-505,10,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,368,-512,11,1,
15,FALSE,TRUE,TRUE,11936394,129,11,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,270,78,12,1,
18,FALSE,TRUE,TRUE,5334926,186,11,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,164,164,12,1,
21,FALSE,TRUE,TRUE,10590427,-770,10,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,
366,-850,11,1,
17,FALSE,TRUE,TRUE,3262859,32,11,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,325,216,12,1,
26,FALSE,TRUE,TRUE,211264,1213,10,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,390,1069,10,1,
23,FALSE,TRUE,TRUE,8098,209,11,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,265,236,12,1,
28,FALSE,TRUE,TRUE,5090047,-160,6,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,535,-227,9,1,
31,FALSE,TRUE,TRUE,1857322,-1027,7,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,
513,-1063,8,1,
9,FALSE,TRUE,TRUE,51623,-1245,6,1,TRUE,TRUE,TRUE,TRUE,TRUE,0,
599,-1244,9,1*9fe706b0
```

The CMRDATAOBS log is analogous to the RTCADATAOBS logs when using RTCA messages. In the CMR format description, the CMRDATAOBS log is referred to as Type 0.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CMRDATA-OBS header	Log header	-	H	0
2	CMR header	Synch character for the message	Ulong	4	H
3		Message status	Ulong	4	H+4
4		CMR message type	Ulong	4	H+8
5		Message body length	Ulong	4	H+12
6		Version	Ulong	4	H+16
7		Station ID	Ulong	4	H+20
8		Message Type	Ulong	4	H+24
9	#sv	Number of SVs	Ulong	4	H+28
10	epoch	Epoch time (milliseconds)	Ulong	4	H+32
11	clock bias	Is clock bias valid? 0 = NOT VALID 3 = VALID	Ulong	4	H+36
12	clock offset	Clock offset (nanoseconds)	Long	4	H+40
13	# obs	Number of satellite observations with information to follow	Ulong	4	H+44
14	prn	Satellite PRN number	Ulong	4	H+48
15	code flag	Is code P Code? 0 = FALSE 1 = TRUE	Enum	4	H+52
16	L1	Is L1 phase valid? 0 = FALSE 1 = TRUE	Enum	4	H+56
17	L2	Is L2 present? 0 = FALSE 1 = TRUE	Enum	4	H+60
18	L1 psr	L1 pseudorange (1/8 L1 cycles)	Ulong	4	H+64
19	L1 carrier	L1 carrier-code measurement (1/256 L1 cycles)	Long	4	H+68
20	L1 S/N_0	L1 signal-to-noise density ratio	Ulong	4	H+72
21	L1 slip	L1 cycle slip count (number of times that tracking has not been continuous)	Ulong	4	H+76
22	L2 code	Is L2 code available? 0 = FALSE 1 = TRUE	Enum	4	H+80
23	Code type	Is code X-correlation? 0 = FALSE 1 = TRUE	Enum	4	H+84
24	L2 c valid	Is L2 code valid? 0 = FALSE 1 = TRUE	Enum	4	H+88

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
25	L2 p valid	Is L2 phase valid? 0 = FALSE 1 = TRUE	Enum	4	H+92
26	phase full	Is phase full? 0 = FALSE 1 = TRUE	Enum	4	H+96
27	Reserved		Ulong	4	H+100
28	L2 r offset	L2 range offset (1/100 metres)	Long	4	H+104
29	L2 c offset	L2 carrier offset (1/256 cycles)	Long	4	H+108
30	L2 S/N_0	L2 signal-to-noise density ratio	Ulong	4	H+112
31	L2 slip	L2 cycle slip count (number of times that tracking has not been continuous)	Ulong	4	H+116
32...	Next PRN offset = H+48 + (#prns x 72)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.21 CMRDATAREF Base Station Position

See *Section 3.3.17, CMR Standard Logs* starting on *page 326* for information about CMR standard logs. See also *Figure 10* on *page 315* for a definition of the ECEF coordinates.

Message ID: **391**
Log Type: **Synch**

Recommended Input:

log cmrdatarefa ontime 10

ASCII Example:

```
#CMRDATAREFA,COM1,0,70.0,FINESTEERING,1269,147115.000,00100000,5db6,1516;2,0,
147,25,3,0,1,FALSE,FALSE,0,TRUE,0,234000,1,0,-1634529233.1026337146759033,
0,-3664611941.5660152435302734,0,-2054717277,0,15,0*c21a9c26
```

The CMRDATAREF log is analogous to the RTCADATAREF log when using RTCA messages. In the CMR format description, the CMRDATAREF log is referred to as Type 1.

Table 67: Position Accuracy

Code	Position Accuracy
0	Unknown
1	5 km
2	1 km
3	500 m
4	100 m
5	50 m
6	10 m
7	5 m
8	1 m
9	50 cm
10	10 cm
11	5 cm
12	1 cm
13	5 mm
14	1 mm
15	Exact

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CMRDATAREF header	Log header	-	H	0
2	CMR header	Synch character for the message	Ulong	4	H
3		Message status	Ulong	4	H+4
4		CMR message type	Ulong	4	H+8
5		Message body length	Ulong	4	H+12
6		Version	Ulong	4	H+16
7		Station ID	Ulong	4	H+20
8		Message Type	Ulong	4	H+24
9	battery	Is the battery low? 0 = FALSE 1 = TRUE	Enum	4	H+28
10	memory	Is memory low? 0 = FALSE 1 = TRUE	Enum	4	H+32
11	Reserved		Ulong	4	H+36
12	L2	Is L2 enabled? 0 = FALSE 1 = TRUE	Enum	4	H+40
13	Reserved		Ulong	4	H+44
14	epoch	Epoch time (milliseconds)	Ulong	4	H+48
15	motion	Motion state: 0 = UNKNOWN 1 = STATIC 2 = KINEMATIC	Ulong	4	H+52
16	Reserved		Ulong	4	H+56
17	ECEF-X	Reference ECEF-X position (millimetres)	Double	8	H+60
18	ant hgt	Antenna height (millimetres)	Ulong	4	H+68
19	ECEF-Y	Reference ECEF-Y position (millimetres)	Double	8	H+72
20	e offset	Easting offset (millimetres)	Ulong	4	H+80
21	ECEF-Z	Reference ECEF-Z position (millimetres)	Double	8	H+84
22	n offset	Northing offset (millimetres)	Ulong	4	H+92
23	pos acc	Position accuracy relative to WGS84, see *Table 67, Position Accuracy* on *page 337*	Ulong	4	H+96
24	Reserved		Ulong	4	H+100
25	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+104
26	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.22 CMRPLUS CMR+ Output Message

The CMRPLUS message distributes the base station information over 14 updates. For example, if you log:

CMRPLUS ontime 1

the receiver outputs the complete base station information in 14 seconds.

Refer to the chapter on *Message Formats* in the *OEM6 Family Installation and Operation User Manual* for information about CMR standard logs.

Message ID: **717**
Log Type: **Asynch**

Recommended Input:

log cmrplusa ontime 1

ASCII Example:

```
#CMRPLUSA,COM1,0,83.0,FINESTEERING,1317,318534.915,00180040,30aa,1855;
2,0,148,10,0,4,14,1b,00,00,00,00,62,61*64e0c9ea
```

The CMRPLUS log can be used in place of the CMRREF log. The advantage of the CMRPLUS log is that it requires less transmission bandwidth because of the way the information is spread over 14 separate updates. This may be especially useful in difficult communication environments, for example, when a radio repeater is required.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	CMRPLUS header	Log header	-	H	0
2	CMR header	Synch character for the message	Ulong	4	H
3		Message status	Ulong	4	H+4
4		CMR message type	Ulong	4	H+8
5		Message body length	Ulong	4	H+12
6		Version	Ulong	4	H+16
7		Station ID	Ulong	4	H+20
8		Message Type	Ulong	4	H+24
9	stnID	Station ID	Ulong	4	H+28
10	page	Current page index	Ulong	4	H+32
11	#pages	Maximum number of page indexes	Ulong	4	H+36
12	data	Data for this page	Uchar[7]	8 [a]	H+40
13	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+104
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional byte of padding is added to maintain 4-byte alignment

3.3.23 COMCONFIG

This has been replaced with SERIALCONFIG. See page *212* for more information.

3.3.24 DIFFCODEBIASES Differential code biases being applied

This log outputs the differential code biases that are being applied to the L1/L2 ionospheric corrections.

Message ID: **914**
Log Type: **Polled**

Recommended Input:

log diffcodebiases once

ASCII example:

```
#DIFFCODEBIASESA,COM1,0,61.5,UNKNOWN,0,4294967.295,004c0000,15ba,35548;
1,GPS_C1P1,-0.472,-0.006,-0.482,1.154,-1.153,0.250,-1.319,-0.535,0.119,
-1.945,0.522,1.425,1.489,0.090,0.000,-0.727,1.361,-0.416,-2.066,-1.347,
-0.380,0.543,0.414,-0.172,0.394,0.923,-0.422,-0.326,0.481,1.937,1.753,
-1.088,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000*417eef8e0
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	DIFFCODE-BIASES header	Log header		H	0
2	#bias_sets	Number of sets of bias code arrays	Long	4	H
3	bias_type	Bias type (there is currently only one type): 0 = GPS_C1P1	Enum	4	H+4
4	bias_array	Array of 40 biases (ns)	Float[40]	160	H+8
5	next bias_sets offset = H + 4 + (#bias_sets x 164)				
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#bias_sets x 164)
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.25 ETHSTATUS Current Ethernet status

This log provides the current status of the Ethernet ports.

Message ID: **1288**
Log Type: **Async**

Recommended Input:

```
log ethstatusa once
```

ASCII Example:

```
#ethstatusa,com1,0,89.5,finesteering,1609,500138.174,00000000,e89d,6259;1,etha,"00-21-66-00-05-a2",100_full*98d86b04
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	ETHSTATUS Header	Log header	-	H	0
2	#of interfaces	Number of records to follow	Ulong	4	H
3	interface	ETHA	Enum	4	H+4
4	MAC address	This is an identifier assigned to your network adapters or network interface card	String	18	H+8
Reserved					
5	interface configuration	Current connectivity, speed and duplex settings of the Ethernet interface		4	H+28
	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	
	[CR][LF]	Sentence terminator (ASCII only)			

3.3.26 GLMLA NMEA GLONASS Almanac Data

This log outputs almanac data for GLONASS satellites. Multiple sentences are transmitted, one for each satellite.

GLONASS satellites:

GLO PRN# $_{\text{NovAtel}}$ = GLO PRN# $_{\text{NMEA}}$ - 24

Slot# $_{\text{To match NovAtel format logs or GLONASS status website}}$ = GLO PRN# $_{\text{NMEA}}$ -24 -37

Message ID: **859**
Log Type: **Asynch**

Recommended Input:

log glmlaa onchanged

ASCII Example:

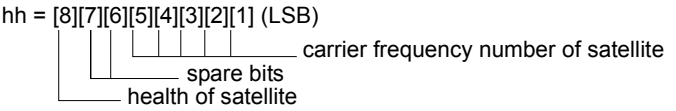
```
$GLMLA,16,01,65,1176,07,0496,4c,5ff2,8000,34c05e,0e93e8,04b029,001fa2,099,213*68
$GLMLA,16,02,66,1176,01,12e3,4c,42cc,8000,34c08e,10fae9,02f48c,00224e,099,003*64
$GLMLA,16,03,67,1176,8c,08f6,4a,ef4d,8000,34c051,13897b,00d063,001b09,099,000*63
$GLMLA,16,04,68,1176,06,116b,48,3a00,8000,34c09d,02151f,0e49e8,00226e,099,222*63
$GLMLA,16,05,70,1176,01,140f,49,45c4,8000,34c0bc,076637,0a3e40,002214,099,036*37
$GLMLA,16,06,71,1176,05,0306,4c,5133,8000,34c025,09bda7,085d84,001f83,099,21d*6E
$GLMLA,16,07,72,1176,06,01b1,4c,4c19,8000,34c021,0c35a0,067db8,001fca,099,047*3D
$GLMLA,16,08,74,1176,84,076b,45,7995,8000,34c07b,104b6d,0e1557,002a38,099,040*35
$GLMLA,16,09,78,1176,84,066c,46,78cf,8000,34c07b,0663f0,1a6239,0029df,099,030*38
$GLMLA,16,10,79,1176,80,0afc,45,8506,8000,34c057,08de48,1c44ca,0029d7,099,000*6B
$GLMLA,16,11,82,1176,8a,12d3,0f,e75d,8000,34be85,10aea6,1781b7,00235a,099,207*6E
$GLMLA,16,12,83,1176,03,0866,0f,6c08,8000,34c009,11f32e,18839d,002b22,099,214*36
$GLMLA,16,13,85,1176,88,01a6,0d,9dc9,8000,34bff8,031887,02da1e,002838,099,242*6D
$GLMLA,16,14,86,1176,8a,00e1,0e,4b15,8000,34c016,058181,010433,0027f0,099,227*6F
$GLMLA,16,15,87,1176,03,0383,0f,824c,8000,34bfda,081864,1104ea,002b04,099,00c*60
$GLMLA,16,16,88,1176,02,0821,0f,8ac8,8000,34c05b,0a8510,12dcb6,002b6f,099,020*3F
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

Field	Structure	Field Description	Symbol	Example
1	$GLMLA	Log header		$GLMLA
2	#alm	Number of NMEA almanac messages in the set	x.x	16
3	alm#	Current message number	x.x	13
4	slot	Slot number for satellite (65-96) [a]	xx	85
5	N	Calendar day count within the four year period from the last leap year	x.x	1176
6	hlth & freq	Health and frequency for satellite [b]	hh	88
7	ecc	Eccentricity [c]	hhhh	01a6
8	ΔTdot	Rate of change of orbital period (s/orbital period^2) [c]	hh	0d
9	ω	Argument of perigee (PZ-90.02), in radians [c]	hhhh	9dc9
10	τ_{16MSB}	Clock offset, in seconds [c]	hhhh	8000
11	ΔT	Correction to the mean value of the Draconian period (s/orbital period) [c]	hhhhhh	34bff8
12	tλ	GLONASS Time of ascending node equator crossing, in seconds [c]	hhhhhhh	031887
13	λ	Longitude of ascending node equator crossing (PZ-90.02), in radians [c]	hhhhhhh	02da1e
14	Δi	Correction to nominal inclination, in radians [c]	hhhhhhh	002838
15	τ_{12LSB}	Clock offset, in seconds [c]	hhh	099
16	t	Coarse value of the time scale shift [c]	hhh	242
17	xxxx	32-bit CRC (ASCII and Binary only)	Hex	*6D
18	[CR][LF]	Sentence terminator (ASCII only)	-	[CR][LF]

a. The NMEA GLONASS PRN numbers are 64 plus the GLONASS slot number. Current slot numbers are 1 to 24 which give the range 65 to 88. PRN numbers 89 to 96 are available if slot numbers above 24 are allocated to on-orbit spares.

b. Health and carrier frequency number are represented in this 2-character Hex field as:



c. The LSB of the Hex data field corresponds to the LSB of the word indicated in the Table 4.3 of the GLONASS Interface Control Document, 1995. If the number of available bits in the Hex field is greater than the word, the MSB (upper bits) are unused and filled with zeroes.

3.3.27 GLOALMANAC Decoded Almanac

The GLONASS almanac reference time and week are in GPS reference time coordinates. GLONASS ephemeris information is available through the GLMLA log.

Nominal orbit parameters of the GLONASS satellites are as follows:

- Draconian period - 11 hours 15 minutes 44 seconds (see fields 14 and 15 on *page 347*)
- Orbit altitude - 19100 km
- Inclination - 64.8 (see field 11)
- Eccentricity - 0 (see field 12)

Message ID: **718**
Log Type: **Asynch**

Recommended Input:

log gloalmanaca onchanged

ASCII Example:

```
#GLOALMANACA,COM1,0,52.5,SATTIME,1364,410744.000,00000000,ba83,2310;
24,
1364,336832.625,1,2,0,0,2018.625000000,-2.775537500,0.028834045,0.001000404,
2.355427500,-2656.076171875,0.000000000,0.000091553,
1364,341828.437,2,1,0,0,7014.437500000,-3.122226146,0.030814438,0.004598618,
1.650371580,-2656.160156250,0.000061035,0.000095367,
1364,347002.500,3,12,0,0,12188.500000000,2.747629236,0.025376596,0.002099991,
-2.659059822,-2656.076171875,-0.000061035,-0.000198364,
1364,351887.125,4,6,0,0,17073.125000000,2.427596502,0.030895332,0.004215240,
1.438586358,-2656.167968750,-0.000061035,0.000007629,
.
.
.
1364,364031.187,23,11,0,1,29217.187500000,0.564055522,0.030242192,
0.001178741,2.505278248,-2655.957031250,0.000366211,0.000019073,
1364,334814.000,24,3,0,1,0.000000000,0.000000000,0.000000000,0.000000000,
0.000000000,0.000000000,0.000000000,0.000000000*4dc981c7
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLOALMANAC header	Log header		H	0
2	#recs	The number of GLONASS almanac records to follow. Set to zero until almanac data is available.	Long	4	H
3	week	GPS reference week, in weeks	Ulong	4	H+4
4	time	GPS reference time, in milliseconds (binary data) or seconds (ASCII data)	GPSec	4	H+8
5	slot	Slot number for satellite, ordinal	Uchar	1	H+12
6	frequency	Frequency for satellite, ordinal (frequency channels are in the range -7 to +13)	Char	1	H+13
7	sat type	Satellite type where 0 = GLO_SAT 1 = GLO_SAT_M (new M type)	Uchar	1	H+14
8	health	Almanac health where 0 = GOOD 1 = BAD	Uchar	1	H+15
9	TlambdaN	GLONASS Time of ascending node equator crossing, in seconds	Double	8	H+16
10	lambdaN	Longitude of ascending node equator crossing (PZ-90.02), in radians	Double	8	H+24
11	deltaI	Correction to nominal inclination, in radians	Double	8	H+32
12	ecc	Eccentricity	Double	8	H+40
13	ArgPerig	Argument of perigee (PZ-90.02), in radians	Double	8	H+48
14	deltaT	Correction to the mean value of the Draconian period (s/orbital period)	Double	8	H+56
15	deltaTD	Rate of change of orbital period (s/orbital period^2)	Double	8	H+64
16	tau	Clock offset, in seconds	Double	8	H+72
17...	Next message offset = H + 4 + (#recs x 76)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4 + (76 x #recs)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.28 GLOCLOCK GLONASS Clock Information

This log contains the time difference information between GPS and GLONASS time as well as status flags. The status flags are used to indicate the type of time processing used in the least squares adjustment. GPS and GLONASS time are both based on the Universal Time Coordinated (UTC) time scale with some adjustments. GPS reference time is continuous and does not include any of the leap second adjustments to UTC applied since 1980. The result is that GPS reference time currently leads UTC time by 14 seconds.

GLONASS time applies leap seconds but is also three hours ahead to represent Moscow time. The nominal offset between GPS and GLONASS time is therefore due to the three hour offset minus the leap second offset. Currently this value is at 10787 seconds with GLONASS leading. As well as the nominal offset, there is a residual offset on the order of nanoseconds which must be estimated in the least squares adjustment. The GLONASS-M satellites broadcasts this difference in the navigation message.

This log also contains information from the GLONASS navigation data relating GLONASS time to UTC.

Message ID: **719**
Log Type: **Asynch**

Recommended Input:

log gloclocka onchanged

ASCII Example:

```
#GLOCLOCKA,COM1,0,54.5,SATTIME,1364,411884.000,00000000,1d44,2310;
0,0.000000000,0.000000000,0,0,-0.000000275,792,-0.000001207,
0.000000000,0.000000000,0*437e9afaf
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLOCLOCK header	Log header		H	0
2	Reserved		Ulong	4	H
3			Double	8	H+4
4			Double	8	H+12
5	sat type	Satellite type where 0 = GLO_SAT 1 = GLO_SAT_M (new M type)	Uchar	1	H+20
6	N^4	Four-year interval number starting from 1996	Uchar	1 [a]	H+21 [a]
7	τ_{GPS}	GPS reference time scale correction to UTC(SU) given at beginning of day N^4, in seconds	Double	8	H+24
8	N^A	GLONASS calendar day number within a four year period beginning since the leap year, in days	Ushort	2 [a]	H+32 [a]
9	τ_C	GLONASS time scale correction to UTC time, in seconds	Double	8	H+36
10	b1	Beta parameter 1st order term	Double	8	H+44
11	b2	Beta parameter 2nd order term	Double	8	H+52
12	Kp	Kp provides notification of the next expected leap second. For more information, see *Table 68*.	Uchar	1	H+60
13	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+61
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional bytes of padding are added to maintain 4-byte alignment

Table 68: Kp UTC Leap Second Descriptions

Kp	Information on UTC Leap Second[a]
00	No UTC update for this quarter.
01	UTC update of plus 1 second at the end of current quarter.
11	UTC update of minus 1 second at end of current quarter.

a. Based on GLONASS ICD version 5.1, 2008.

3.3.29 GLOEPHEMERIS GLONASS Ephemeris Data

GLONASS ephemeris information is available through the GLOEPHEMERIS log. GLONASS ephemerides are referenced to the PZ90.02 geodetic datum. No adjustment between the GPS and GLONASS reference frames are made for positioning.

Message ID: **723**
Log Type: **Asynch**

Recommended Input:

log gloephemerisa onchanged

Example:

```
#GLOEPHEMERISA,COM1,3,49.0,SATTIME,1364,413624.000,00000000,6b64,2310;
43,8,1,0,1364,413114000,10786,792,0,0,87,0,9.0260864257812500e+06,
-6.1145468750000000e+06,2.2926090820312500e+07,1.4208841323852539e+03,
2.8421249389648438e+03,1.9398689270019531e+02,0.00000000000000000,
-2.79396772384643555e-06,-2.79396772384643555e-06,2.12404876947402954e-04,
-1.396983862e-08,-3.6379788070917129 5e-12,78810,3,15,0,12*a02ce18b
#GLOEPHEMERISA,COM1,2,49.0,SATTIME,1364,413626.000,00000000,6b64,2310;
44,11,1,0,1364,413116000,10784,792,0,0,87,13,-1.2882617187500000e+06,
-1.9318657714843750e+07,1.6598909179687500e+07,9.5813846588134766e+02,
2.0675134658813477e+03,2.4769935607910156e+03,2.79396772384643555e-06,
-3.72529029846191406e-06,-1.86264514923095703e-06,6.48368149995803833e-05,
-4.656612873e-09,3.63797880709171295e-12,78810,3,15,3,28*e2d5ef15
#GLOEPHEMERISA,COM1,1,49.0,SATTIME,1364,413624.000,00000000,6b64,2310;
45,13,0,0,1364,413114000,10786,0,0,0,87,0,-1.1672664062500000e+07,
-2.2678505371093750e+07,4.8702343750000000e+05,-1.1733341217041016e+02,
1.3844585418701172e+02,3.5714883804321289e+03,2.79396772384643555e-06,
-2.79396772384643555e-06,0.00000000000000000,-4.53162938356399536e-05,
5.587935448e-09,-2.36468622460961342e-11,78810,0,0,0,8*c15abfeb
#GLOEPHEMERISA,COM1,0,49.0,SATTIME,1364,413624.000,00000000,6b64,2310;
59,17,0,0,1364,413114000,10786,0,0,0,87,0,-2.3824853515625000e+05,
-1.6590188964843750e+07,1.9363733398437500e+07,1.3517074584960938e+03,
-2.2859592437744141e+03,-1.9414072036743164e+03,1.86264514923095703e-06,
-3.72529029846191406e-06,-1.86264514923095703e-06,7.92574137449264526e-05,
4.656612873e-09,2.72848410531878471e-12,78810,0,0,0,12*ed7675f5
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at www.novatel.com through *Support | Knowledge and Learning > Learn About GNSS > GNSS Book*.

Table 69: GLONASS Ephemeris Flags Coding

| N 0 <- <- Nibble Number | | |

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLO-EPHEMERIS header	Log header		H	0
2	sloto	Slot information offset - PRN identification (Slot + 37). This is also called SLOTO in CDU	Ushort	2	H
3	freqo	Frequency channel offset for satellite in the range 0 to 20	Ushort	2	H+2
4	sat type	Satellite type where 0 = GLO_SAT 1 = GLO_SAT_M (new M type)	Uchar	1	H+4
5	Reserved			1	H+5
6	e week	Reference week of ephemeris (GPS reference time)	Ushort	2	H+6
7	e time	Reference time of ephemeris (GPS reference time) in ms	Ulong	4	H+8
8	t offset	Integer seconds between GPS and GLONASS time. A positive value implies GLONASS is ahead of GPS reference time.	Ulong	4	H+12
9	Nt	Current data number. This field is only output for the new M type satellites. See example output from both satellite types (field 4) on *page 350*.	Ushort	2	H+16
10	Reserved			1	H+18
11				1	H+19
12	issue	15-minute interval number corresponding to ephemeris reference time	Ulong	4	H+20
13	health	Ephemeris health where 0 = GOOD 1 = BAD	Ulong	4	H+24
14	pos x	X coordinate for satellite at reference time (PZ-90.02), in metres	Double	8	H+28
15	pos y	Y coordinate for satellite at reference time (PZ-90.02), in metres	Double	8	H+36
16	pos z	Z coordinate for satellite at reference time (PZ-90.02), in metres	Double	8	H+44
17	vel x	X coordinate for satellite velocity at reference time (PZ-90.02), in metres/s	Double	8	H+52
18	vel y	Y coordinate for satellite velocity at reference time (PZ-90.02), in metres/s	Double	8	H+60
19	vel z	Z coordinate for satellite velocity at reference time (PZ-90.02), in metres/s	Double	8	H+68
20	LS acc x	X coordinate for lunisolar acceleration at reference time (PZ-90.02), in metres/s/s	Double	8	H+76
21	LS acc y	Y coordinate for lunisolar acceleration at reference time (PZ-90.02), in metres/s/s	Double	8	H+84

Continued on next page

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
22	LS acc z	Z coordinate for lunisolar acceleration at reference time (PZ-90.02), in metres/s/s	Double	8	H+92
23	tau_n	Correction to the nth satellite time t_n relative to GLONASS time t_c, in seconds	Double	8	H+100
24	delta_tau_n	Time difference between navigation RF signal transmitted in L2 sub-band and navigation RF signal transmitted in L1 sub-band by nth satellite, in seconds	Double	8	H+108
25	gamma	Frequency correction, in seconds/second	Double	8	H+116
26	Tk	Time of frame start (since start of GLONASS day), in seconds	Ulong	4	H+124
27	P	Technological parameter	Ulong	4	H+128
28	Ft	User range	Ulong	4	H+132
29	age	Age of data, in days	Ulong	4	H+136
30	Flags	Information flags, see *Table 69, GLONASS Ephemeris Flags Coding* on *page 351*	Ulong	4	H+140
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+144
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.30 GLORAWALM Raw GLONASS Almanac Data

This log contains the raw almanac subframes as received from the GLONASS satellite.

Message ID: **720**
Log Type: **Asynch**

Recommended Input:

log glorawalma onchanged

Example:

```
#GLORAWALMA,COM1,0,44.5,SATTIME,1364,419924.000,00000000,77bb,2310;
1364,419954.069,54,
0563100000a4000000006f,0,
0681063c457a12cc0419be,0,
075ff807e2a69804e0040b,0,
0882067fcd80141692d6f2,0,
09433e1b6676980a40429b,0,
0a838d1bfcb4108b089a8c,0,
0bec572f9c869804f05882,0,
.
.
.
06950201e02e13d3819564,0,
07939a4a16fe97fe814ad0,0,
08960561cecc13b0014613,0,
09469a5d70c69802819466,0,
0a170165bed413b704d416,0,
0b661372213697fd41965a,0,
0c18000000000000000006,0,
0d00000000000000000652,0,
0e000000000000000000d0,0*b516623b
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLORAWALM header	Log header		H	0
2	week	GPS reference week, in weeks	Ulong	4	H
3	time	GPS reference time, in milliseconds (binary data) or seconds (ASCII data)	GPSec	4	H+4
4	#recs	Number of records to follow.	Ulong	4	H+8
5	string	GLONASS data string	Uchar [string size] [a]	variable	H+12
6	Reserved		Uchar	1	variable
7...	Next record offset = H + 16 + (#recs x [string size + 1])				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 12 + (#recs x [string size+1])
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

3.3.31 GLORAWEPHEM Raw GLONASS Ephemeris Data

This log contains the raw ephemeris frame data as received from the GLONASS satellite.

Message ID: **792**
Log Type: **Asynch**

Recommended Input:

log glorawephema onchanged

Example:

```
#GLORAWEPHEMA,COM1,3,47.0,SATTIME,1340,398653.000,00000000,332d,2020;
38,9,0,1340,398653.080,4,
0148d88460fc115dbdaf78,0,0218e0033667aec83af2a5,0,
038000b9031e14439c75ee,0,0404f22660000000000065,0*17f3dd17
…
#GLORAWEPHEMA,COM1,0,47.0,SATTIME,1340,398653.000,00000000,332d,2020;
41,13,0,1340,398653.078,4,
0108d812532805bfa1cd2c,0,0208e0a36e8e0952b111da,0,
03c02023b68c9a32410958,0,0401fda44000000000002a,0*0b237405
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLORAWEPHEM header	Log header		H	0
2	sloto	Slot information offset - PRN identification (Slot + 37). Ephemeris relates to this slot and is also called SLOTO in CDU.	Ushort	2	H
3	freqo	Frequency channel offset in the range 0 to 20	Ushort	2	H+2
4	sigchan	Signal channel number	Ulong	4	H+4
5	week	GPS reference week, in weeks	GPSec	4	8
6	time	GPS reference time, in milliseconds (binary data) or seconds (ASCII data)	Ulong	4	12
7	#recs	Number of records to follow	Ulong	4	H+16
8	string	GLONASS data string	Uchar [string size] [a]	variable	H+20
9	Reserved		Uchar	1	variable
10...	Next record offset = H + 20 + (#recs x [string size + 1])				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 20 + (#recs x [string size+1])
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

3.3.32 GLORAWFRAME Raw GLONASS Frame Data

This log contains the raw GLONASS frame data as received from the GLONASS satellite.

Message ID: **721**
Log Type: **Asynch**

Recommended Input:

log glorawframea onchanged

Example:

```
#GLORAWFRAMEA,COM1,19,53.0,SATTIME,1340,398773.000,00000000,8792,2020;
3,39,8,1340,398773.067,44,44,15,
0148dc0b67e9184664cb35,0,
0218e09dc8a3ae8c6ba18d,0,
…
0f00000000000000000000,0*11169f9e
…
#GLORAWFRAMEA,COM1,0,53.0,SATTIME,1340,398713.000,00000000,8792,2020;
1,41,13,1340,398713.077,36,36,15,
0108da12532805bfa1cded,0,
0208e0a36e8e0952b111da,0,
03c02023b68c9a32410958,0,
…
0f6efb59474697fd72c4e2,0*0a6267c8
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning.

3.3.33 GLORAWSTRING Raw GLONASS String

This log contains the raw string data as received from the GLONASS satellite.

Message ID: **722**
Log Type: **Asynch**

Recommended Input:

log glorawstringa onchanged

Example:

```
#GLORAWSTRINGA,COM1,0,51.0,SATTIME,1340,399113.000,00000000,50ac,2020;
4,6,06100000000000000004f,0*5b215fb2
```

Refer to the GLONASS section of our *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GLORAWSTRING header	Log header		H	0
2	slot	Slot identification	Uchar	2	H
3	freq	Frequency channel (frequency channels are in the range -7 to +13)	Char	2	H+2
4	string	GLONASS data string	Uchar [string size] [a]	variable	H+4
5	Reserved		Uchar	1	variable
6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	(H +4 + string size +1)
7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment.

3.3.34 GPALM Almanac Data

This log outputs raw almanac data for each GPS satellite PRN contained in the broadcast message. A separate record is logged for each PRN, up to a maximum of 32 records. GPALM outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. UTC time is then set to VALID. It takes a minimum of 12.5 minutes to collect a complete almanac following receiver boot-up. In the case of a GLONASS-capable receiver, the UTC offset can be determined once the GLONASS ephemeris is decoded, which takes about 50 seconds. If an almanac was stored in NVM, the stored values are reported in the GPALM log once time is set on the receiver.

To obtain copies of ICD-GPS-200, seen in the GPALM table footnotes, refer to ARINC in the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/. Refer also to NMEA contact information there.

Message ID: **217**

Log Type: **Asynch**

Recommended Input:

log gpalm onchanged

Example:

```
$GPALM,28,01,01,1337,00,305a,90,1b9d,fd5b,a10ce9,ba0a5e,2f48f1,cccb76,006,001
*27
$GPALM,28,02,02,1337,00,4aa6,90,0720,fd50,a10c5a,4dc146,d89bab,0790b6,fe4,000
*70
.
.
.
$GPALM,28,24,26,1337,00,878c,90,1d32,fd5c,a10c90,1db6b6,2eb7f5,ce95c8,00d,000
*23
$GPALM,28,25,27,1337,00,9cde,90,07f2,fd54,a10da5,adc097,562da3,6488dd,00e,000
*2F
$GPALM,28,26,28,1337,00,5509,90,0b7c,fd59,a10cc4,a1d262,83e2c0,3003bd,02d,000
*78
$GPALM,28,27,29,1337,00,47f7,90,1b20,fd58,a10ce0,d40a0b,2d570e,221641,122,006
*7D
$GPALM,28,28,30,1337,00,4490,90,0112,fd4a,a10cc1,33d10a,81dfc5,3bdb0f,178,004
*28
```

Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPALM	Log header		$GPALM
2	# msg	Total number of messages logged. Set to zero until almanac data is available.	x.x	17
3	msg #	Current message number	x.x	17
4	PRN	Satellite PRN number: GPS = 1 to 32	xx	28
5	GPS wk	GPS reference week number [a].	x.x	653
6	SV hlth	SV health, bits 17-24 of each almanac page [b]	hh	00
7	ecc	e, eccentricity [c d]	hhhh	3EAF
8	alm ref time	toa, almanac reference time [c]	hh	87
9	incl angle	$(sigma)_i$, inclination angle [c]	hhhh	OD68
10	omegadot	OMEGADOT, rate of right ascension [c]	hhhh	FD30
11	rt axis	$(A)^{1/2}$, root of semi-major axis [c]	hhhhhh	A10CAB
12	omega	omega, argument of perigee [c e]	hhhhhh	6EE732
13	long asc node	$(OMEGA)_o$,longitude of ascension node [c]	hhhhhh	525880
14	M_o	Mo, mean anomaly [c]	hhhhhh	6DC5A8
15	a_{f0}	af0, clock parameter [c]	hhh	009
16	a_{f1}	af1, clock parameter [c]	hhh	005
17	*xx	Checksum	*hh	*37
18	[CR][LF]	Sentence terminator		[CR][LF]

a Variable length integer, 4-digits maximum from (2) most significant binary bits of Subframe 1, Word 3 reference Table 20-I, ICD-GPS-200, Rev. B, and (8) least significant bits from subframe 5, page 25, word 3 reference Table 20-I, ICD-GPS-200

b Reference paragraph 20.3.3.5.1.3, Table 20-VII and Table 20-VIII, ICD-GPS-200, Rev. B

c Reference Table 20-VI, ICD-GPS-200, Rev. B for scaling factors and units.

d A quantity defined for a conic section where e= 0 is a circle, e = 1 is an ellipse, 0<e<1 is a parabola and e>1 is a hyperbola.

e A measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion

3.3.35 GPGGA GPS Fix Data and Undulation

Time, position and fix-related data of the GNSS receiver. For greater precision, but with the loss of the undulation fields, use the GPGGARTK log (see *page 364*). See also *Table 71, Position Precision of NMEA Logs* on *page 368.*

The GPGGA log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **218**
Log Type **Synch**

Recommended Input:

log gpgga ontime 1

Example:

```
$GPGGA,134658.00,5106.9792,N,11402.3003,W,2,09,1.0,1048.47,M,-16.27,M,
08,AAAA*60
```

The NMEA (National Marine Electronics Association) has defined standards that specify how electronic equipment for marine users communicate. GNSS receivers are part of this standard and the NMEA has defined the format for several GNSS data logs otherwise known as 'sentences'.

Each NMEA sentence begins with a '$' followed by the prefix 'GL' or ‘GN’followed by a sequence of letters that define the type of information contained in the sentence. Data contained within the sentence is separated by commas and the sentence is terminated with a two digit checksum followed by a carriage return/line feed. Here is an example of an NMEA sentence that describes time, position, and fix related data:

$GPGGA,134658.00,5106.9792,N,11402.3003,W,2,09,1.0,1048.47,M
,
-16.27,M,08,AAAA*60

The GPGGA sentence shown above, and other NMEA logs, are output the same no matter what GNSS receiver is used, providing a standard way to communicate and process GNSS information. For more information about NMEA, see the NMEATALKER command on page *171*.

Field	Structure	Field Description	Symbol	Example
1	$GPGGA	Log header		$GPGGA
2	utc	UTC time status of position (hours/minutes/ seconds/ decimal seconds)	hhmmss.ss	202134.00
3	lat	Latitude (DDmm.mm)	llll.ll	5106.9847
4	lat dir	Latitude direction (N = North, S = South)	a	N
5	lon	Longitude (DDDmm.mm)	yyyyy.yy	11402.2986
6	lon dir	Longitude direction (E = East, W = West)	a	W
7	GPS qual	GPS Quality indicator 0 = fix not available or invalid 1 = GPS fix 2 = C/A differential GPS, OmniSTAR HP, OmniSTAR XP, OmniSTAR VBS, 4 = RTK fixed ambiguity solution (RT2), see also *Table* on *page 592* 5 = RTK floating ambiguity solution (RT20), OmniSTAR HP or OmniSTAR XP 6 = Dead reckoning mode 7 = Manual input mode (fixed position) 8 = Simulator mode 9 = WAAS [a]	x	1
8	# sats	Number of satellites in use. May be different to the number in view	xx	10
9	hdop	Horizontal dilution of precision	x.x	1.0
10	alt	Antenna altitude above/below mean sea level	x.x	1062.22
11	a-units	Units of antenna altitude (M = metres)	M	M
12	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid	x.x	-16.271
13	u-units	Units of undulation (M = metres)	M	M
14	age	Age of Differential GPS data (in seconds) [b]	xx	*(empty when no differential data is present)*
15	stn ID	Differential base station ID, 0000-1023	xxxx	*(empty when no differential data is present)*
16	*xx	Checksum	*hh	*48
17	[CR][LF]	Sentence terminator		[CR][LF]

a. An indicator of 9 has been temporarily set for WAAS (NMEA standard for WAAS not decided yet). This indicator can be customized using the GGAQUALITY command.

b. The maximum age reported here is limited to 99 seconds.

3.3.36 GPGGALONG Fix Data, Extra Precision and Undulation

Time, position, undulation and fix-related data of the GNSS receiver. This is output as a GPGGA log but the GPGGALONG log differs from the normal GPGGA log by its extra precision. See also *Table 71, Position Precision of NMEA Logs* on *page 368*.

The GPGGALONG log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **521**
Log Type: **Synch**

Recommended Input:

```
log gpggalong ontime 1
```

Example 1:

```
$GPGGA,181126.00,5106.9802863,N,11402.3037304,W,7,11,0.9,1048.234,M,
-16.27,M,,*51
```

Example 2:

```
$GPGGA,134658.00,5106.9802863,N,11402.3037304,W,2,09,1.0,1048.234,M,
-16.27,M,08,AAAA
```

Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPGGA-LONG	Log header		$GPGGA
2	utc	UTC time status of position (hours/minutes/ seconds/ decimal seconds)	hhmmss.ss	202126.00
3	lat	Latitude (DDmm.mm)	llll.ll	5106.9847029
4	lat dir	Latitude direction (N = North, S = South)	a	N
5	lon	Longitude (DDDmm.mm)	yyyyy.yy	11402.2986286
6	lon dir	Longitude direction (E = East, W = West)	a	W
7	GPS qual	GPS Quality indicator 0 = fix not available or invalid 1 = GPS fix 2 = C/A differential GPS, OmniSTAR HP, OmniSTAR XP, OmniSTAR VBS 4 = RTK fixed ambiguity solution (RT2), see also *Table* on *page 592* 5 = RTK floating ambiguity solution (RT20), OmniSTAR HP or OmniSTAR XP 6 = Dead reckoning mode 7 = Manual input mode (fixed position) 8 = Simulator mode 9 = WAAS [a]	x	1
8	# sats	Number of satellites in use (00-12). May be different to the number in view	xx	10
9	hdop	Horizontal dilution of precision	x.x	1.0
10	alt	Antenna altitude above/below msl	x.x	1062.376
11	units	Units of antenna altitude (M = metres)	M	M
12	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid	x.x	-16.271
13	u-units	Units of undulation (M = metres)	M	M
14	age	Age of Differential GPS data (in seconds) [b]	xx	10 *(empty when no differential data is present)*
15	stn ID	Differential base station ID, 0000-1023	xxxx	AAAA *(empty when no differential data is present)*
16	*xx	Checksum	*hh	*48
17	[CR][LF]	Sentence terminator		[CR][LF]

a. An indicator of 9 has been temporarily set for WAAS (NMEA standard for WAAS is not decided yet).

b. The maximum age reported here is limited to 99 seconds.

3.3.37 GPGGARTK Global Position System Fix Data

Time, position and fix-related data of the GNSS receiver. This is output as a GPGGA log but the GPGGARTK log differs from the normal GPGGA log by its extra precision. In order for the position to be output with this extra precision, the undulation fields are unavailable (see the GPGGA log on *page 362*). See also *Table 71, Position Precision of NMEA Logs* on *page 368.*

The GPGGARTK log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **259**
Log Type: **Synch**

Recommended Input:

log gpggartk ontime 1

Example:

```
$GPGGA,135324.00,5106.9791988,N,11402.3002127,W,2,09,1.0,1047.606,M,,,04,AAAA
*1C
```

The GPGGARTK log is ideal for RTK positioning applications where mm-level position precision is required. See also the GPGGA usage box that applies to all NMEA logs on *page 362.*

Field	Structure	Field Description	Symbol	Example
1	$GPGGA	Log header		$GPGGA
2	utc	UTC time status of position (hours/minutes/ seconds/ decimal seconds)	hhmmss.ss	220147.50
3	lat	Latitude (DDmm.mm)	llll.ll	5106.7194489
4	lat dir	Latitude direction (N = North, S = South)	a	N
5	lon	Longitude (DDDmm.mm)	yyyyy.yy	11402.3589020
6	lon dir	Longitude direction (E = East, W = West)	a	W
7	GPS qual	GPS Quality indicator 0 = fix not available or invalid 1 = GPS fix 2 = C/A differential GPS, OmniSTAR HP, OmniSTAR XP, OmniSTAR VBS 4 = RTK fixed ambiguity solution (RT2), see also *Table* on *page 592* 5 = RTK floating ambiguity solution (RT20), OmniSTAR HP or OmniSTAR XP 6 = Dead reckoning mode 7 = Manual input mode (fixed position) 8 = Simulator mode 9 = WAAS [a]	x	1
8	# sats	Number of satellites in use. May be different to the number in view	xx	08
9	hdop	Horizontal dilution of precision	x.x	0.9
10	alt	Antenna altitude above/below mean sea level	x.x	1080.406
11	units	Units of antenna altitude (M = metres)	M	M
12	null	(This field not available on OEM6 family receivers)		*(empty when no differential data is present)*
13	null	(This field not available on OEM6 family receivers)		
14	age	Age of Differential GPS data (in seconds) [b]	xx	
15	stn ID	Differential base station ID, 0000-1023	xxxx	
16	*xx	Checksum	*hh	*48
17	[CR][LF]	Sentence terminator		[CR][LF]

a. An indicator of 9 has been temporarily set for WAAS. The NMEA standard for WAAS has not been decided yet.

b. The maximum age reported here is limited to 99 seconds.

3.3.38 GPGLL Geographic Position

Latitude and longitude of present vessel position, time of position fix, and status.

Table 71 compares the position precision of selected NMEA logs.

The GPGLL log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

If the NMEATALKER command, see *page 171*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).

Message ID: **219**
Log Type: **Synch**

Recommended Input:

```
log gpgll ontime 1
```

Example 1 (GPS only):

```
$GPGLL,5107.0013414,N,11402.3279144,W,205412.00,A,A*73
```

Example 2 (Combined GPS and GLONASS):

```
$GNGLL,5107.0014143,N,11402.3278489,W,205122.00,A,A*6E
```

Table 71: Position Precision of NMEA Logs

NMEA Log	Latitude (# of decimal places)	Longitude (# of decimal places)	Altitude (# of decimal places)
GPGGA	4	4	2
GPGGALONG	7	7	3
GPGGARTK	7	7	3
GPGLL	7	7	N/A
GPRMC	7	7	N/A

Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPGLL	Log header		$GPGLL
2	lat	Latitude (DDmm.mm)	llll.ll	5106.7198674
3	lat dir	Latitude direction (N = North, S = South)	a	N
4	lon	Longitude (DDDmm.mm)	yyyyy.yy	11402.3587526
5	lon dir	Longitude direction (E = East, W = West)	a	W
6	utc	UTC time status of position (hours/ minutes/seconds/decimal seconds)	hhmmss.ss	220152.50
7	data status	Data status: A = Data valid, V = Data invalid	A	A
8	mode ind	Positioning system mode indicator, see *Table 72* on *page 379*	a	A
9	*xx	Checksum	*hh	*1B
10	[CR][LF]	Sentence terminator		[CR][LF]

3.3.39 GPGRS GPS Range Residuals for Each Satellite

Range residuals can be computed in two ways, and this log reports those residuals. Under mode 0, residuals output in this log are used to update the position solution output in the GPGGA message. Under mode 1, the residuals are re-computed after the position solution in the GPGGA message is computed. The receiver computes range residuals in mode 1. An integrity process using GPGRS would also require GPGGA (for position fix data), GPGSA (for DOP figures), and GPGSV (for PRN numbers) for comparative purposes.

The GPGRS log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

1. If the range residual exceeds ± 99.9, then the decimal part is dropped. Maximum value for this field is ± 999. The sign of the range residual is determined by the order of parameters used in the calculation as follows:
   - range residual = calculated range - measured range
2. If the NMEATALKER command, see *page 171*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).
3. There is no residual information available from the OmniSTAR HP/XP service, so the GPGRS contains the pseudorange position values when using it. For the OmniSTAR VBS service, residual information is available.

Message ID: **220**
Log Type: **Synch**

Recommended Input:

```
log gpgrs ontime 1
```

Example 1 (GPS only):

```
$GPGRS,142406.00,1,-1.1,-0.1,1.7,1.2,-2.0,-0.5,1.2,-1.2,-0.1,,,*67
```

Example 2 (Combined GPS and GLONASS):

```
$GNGRS,143209.00,1,-0.2,-0.5,2.2,1.3,-2.0,-1.3,1.3,-0.4,-1.2,-0.2,,*72
$GNGRS,143209.00,1,1.3,-6.7,,,,,,,,,*73
```

Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPGRS	Log header		$GPGRS
2	utc	UTC time status of position (hours/ minutes/seconds/ decimal seconds)	hhmmss.ss	192911.0
3	mode	Mode 0 =residuals were used to calculate the position given in the matching GGA line (apriori) (not used by OEM6 receivers) Mode 1 =residuals were recomputed after the GGA position was computed (preferred mode)	x	1
4 - 15	res	Range residuals for satellites used in the navigation solution. Order matches order of PRN numbers in GPGSA.	x.x,x.x,.....	-13.8,-1.9,11.4,-33.6,0.9, 6.9,-12.6,0.3,0.6, -22.3
16	*xx	Checksum	*hh	*65
17	[CR][LF]	Sentence terminator		[CR][LF]

3.3.40 GPGSA GPS DOP and Active Satellites

GNSS receiver operating mode, satellites used for navigation and DOP values.

The GPGSA log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

1. If the DOP values exceed 9999.0, or there is an insufficient number of satellites to calculate a DOP value, 9999.0 is reported for PDOP and HDOP. VDOP is reported as 0.0 in this case.
2. If the NMEATALKER command, see *page 171*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).

Message ID: **221**

Log Type: **Synch**

Recommended Input:

```
log gpgsa ontime 1
```

Example 1 (GPS only):

```
$GPGSA,M,3,17,02,30,04,05,10,09,06,31,12,,,1.2,0.8,0.9*35
```

Example 2 (Combined GPS and GLONASS):

```
$GNGSA,M,3,17,02,30,04,05,10,09,06,31,12,,,1.2,0.8,0.9*2B
$GNGSA,M,3,87,70,,,,,,,,,,,1.2,0.8,0.9*2A
```

The DOPs provide a simple characterization of the user-satellite geometry. DOP is related to the volume formed by the intersection points of the user-satellite vectors, with the unit sphere centered on the user. Larger volumes give smaller DOPs. Lower DOP values generally represent better position accuracy. The role of DOP in GNSS positioning, however, is often misunderstood. A lower DOP value does not automatically mean a low position error. The quality of a GNSS-derived position estimate depends upon both the measurement geometry as represented by DOP values, and range errors caused by signal strength, ionospheric effects, multipath and so on.
Please see also the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPGSA	Log header		$GPGSA
2	mode MA	A = Automatic 2D/3D M = Manual, forced to operate in 2D or 3D	M	M
3	mode 123	Mode: 1 = Fix not available; 2 = 2D; 3 = 3D	x	3
4 - 15	prn	PRN numbers of satellites used in solution (null for unused fields), total of 12 fields GPS = 1 to 32 SBAS = 33 to 64 (add 87 for PRN number) GLO = 65 to 96 [a]	xx,xx,.....	18,03,13, 25,16, 24,12, 20,,,,
16	pdop	Position dilution of precision	x.x	1.5
17	hdop	Horizontal dilution of precision	x.x	0.9
18	vdop	Vertical dilution of precision	x.x	1.2
19	*xx	Checksum	*hh	*3F
20	[CR][LF]	Sentence terminator		[CR][LF]

a. The NMEA GLONASS PRN numbers are 64 plus the GLONASS slot number. Current slot numbers are 1 to 24 which give the range 65 to 88. PRN numbers 89 to 96 are available if slot numbers above 24 are allocated to on-orbit spares.

3.3.41 GPGST Pseudorange Measurement Noise Statistics

Pseudorange measurement noise statistics are translated in the position domain in order to give statistical measures of the quality of the position solution.

This log reflects the accuracy of the solution type used in the BESTPOS, see *page 299*, and GPGGA, see *page 362*, logs except for the RMS field. The RMS field, since it specifically relates to pseudorange inputs, does not represent carrier-phase based positions. Instead it reflects the accuracy of the pseudorange position which is given in the PSRPOS log, see *page 450*.

The GPGST log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

If the NMEATALKER command, see *page 171*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).

Message ID: **222**

Log Type: **Synch**

Recommended Input:

```
log gpgst ontime 1
```

Example 1 (GPS only):

```
$GPGST,141451.00,1.18,0.00,0.00,0.0000,0.00,0.00,0.00*6B
```

Example 2 (Combined GPS and GLONASS):

```
$GNGST,143333.00,7.38,1.49,1.30,68.1409,1.47,1.33,2.07*4A
```

1. Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.
2. Accuracy is based on statistics, reliability is measured in percent. When a receiver can measure height to one metre, this is an accuracy. Usually this is a one sigma value (one SD). A one sigma value for height has a reliability of 68%, that is, the error is less than one metre 68% of the time. For a more realistic accuracy, double the one sigma value (1 m) and the result is 95% reliability (error is less than 2 m 95% of the time). Generally, GNSS heights are 1.5 times poorer than horizontal positions.
   As examples of statistics, the GPGST message and NovAtel performance specifications use root mean square RMS. Specifications may be quoted in CEP:
   - RMS:root mean square (a probability level of 68%)
   - CEP:circular error probable (the radius of a circle such that 50% of a set of events
     occur inside the boundary)

Field	Structure	Field Description	Symbol	Example
1	$GPGST	Log header		$GPGST
2	utc	UTC time status of position (hours/minutes/seconds/ decimal seconds)	hhmmss.ss	173653.00
3	rms	RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include pseudoranges and DGPS corrections.	x.x	2.73
4	smjr std	Standard deviation of semi-major axis of error ellipse (m)	x.x	2.55
5	smnr std	Standard deviation of semi-minor axis of error ellipse (m)	x.x	1.88
6	orient	Orientation of semi-major axis of error ellipse (degrees from true north)	x.x	15.2525
7	lat std	Standard deviation of latitude error (m)	x.x	2.51
8	lon std	Standard deviation of longitude error (m)	x.x	1.94
9	alt std	Standard deviation of altitude error (m)	x.x	4.30
10	*xx	Checksum	*hh	*6E
11	[CR][LF]	Sentence terminator		[CR][LF]

3.3.42 GPGSV GPS Satellites in View

Number of SVs in view, PRN numbers, elevation, azimuth and SNR value. Four satellites maximum per message. When required, additional satellite data sent in 2 or more messages (a maximum of 9). The total number of messages being transmitted and the current message being transmitted are indicated in the first two fields.

The GPGSV log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

1. Satellite information may require the transmission of multiple messages. The first field specifies the total number of messages, minimum value 1. The second field identifies the order of this message (message number), minimum value 1.
2. If the NMEATALKER command, see *page 171*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only) or GL (GLONASS satellites only) , or GN (satellites from both systems).
3. A variable number of 'PRN-Elevation-Azimuth-SNR' sets are allowed up to a maximum of four sets per message. Null fields are not required for unused sets when less than four sets are transmitted.

Message ID: **223**
Log Type: **Synch**

Recommended Input:

```
log gpgsv ontime 1
```

Example (Including GPS and GLONASS sentences):

```
$GPGSV,3,1,11,18,87,050,48,22,56,250,49,21,55,122,49,03,40,284,47*78
$GPGSV,3,2,11,19,25,314,42,26,24,044,42,24,16,118,43,29,15,039,42*7E
$GPGSV,3,3,11,09,15,107,44,14,11,196,41,07,03,173,*4D
$GLGSV,2,1,06,65,64,037,41,66,53,269,43,88,39,200,44,74,25,051,*64
$GLGSV,2,2,06,72,16,063,35,67,01,253,*66
```

The GPGSV log can be used to determine which satellites are currently available to the receiver. Comparing the information from this log to that in the GPGSA log shows you if the receiver is tracking all available satellites.

Please see also the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPGSV	Log header		$GPGSV
2	# msgs	Total number of messages (1-9)	x	3
3	msg #	Message number (1-9)	x	1
4	# sats	Total number of satellites in view. May be different than the number of satellites in use (see also the GPSGSA log on *page 362*).	xx	09
5	prn	Satellite PRN number GPS = 1 to 32 SBAS = 33 to 64 (add 87 for PRN#s) GLO = 65 to 96 [a]	xx	03
6	elev	Elevation, degrees, 90 maximum	xx	51
7	azimuth	Azimuth, degrees True, 000 to 359	xxx	140
8	SNR	SNR (C/No) 00-99 dB, null when not tracking	xx	42
... ...	... ...	Next satellite PRN number, elev, azimuth, SNR, ... Last satellite PRN number, elev, azimuth, SNR,		
variable	*xx	Checksum	*hh	*72
variable	[CR][LF]	Sentence terminator		[CR][LF]

a. The NMEA GLONASS PRN numbers are 64 plus the GLONASS slot number. Current slot numbers are 1 to 24 which give the range 65 to 88. PRN numbers 89 to 96 are available if slot numbers above 24 are allocated to on-orbit spares.

3.3.43 GPHDT NMEA Heading Log

Actual vessel heading in degrees True (from True North). See also a description of heading on *page 389*. You can also set a standard deviation threshold for this log, see *page 139*. You must have an ALIGN-capable receiver to use this log.

1. If the NMEATALKER command, see *page 171*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).
2. Asynchronous logs, such as GPHDT, should only be logged ONCHANGED otherwise, the most current data is not available or included in the output. An example of this occurance is in the ONTIME trigger. If this trigger is not logged ONCHANGED, it may cause inaccurate time tags.

Message ID: **1045**
Log Type: **ASynch**

Recommended Input:

```
log gphdt onchanged
```

Example 1 (GPS only):

```
$GPHDT,75.5664,T*36
```

Example 2 (Combined GPS and GLONASS):

```
$GNHDT,75.5554,T*45
```

Field	Structure	Field Description	Symbol	Example
1	$GPHDT	Log header		$GPHDT
2	heading	Heading in degrees	x.x	75.5554
3	True	Degrees True	T	T
4	*xx	Checksum	*hh	*36
5	[CR][LF]	Sentence terminator		[CR][LF]

3.3.44 GPRMB Navigation Information

Navigation data from present position to a destination waypoint. The destination is set active by the receiver SETNAV command.

The GPRMB log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **224**
Log Type: **Synch**

Recommended Input:

log gprmb ontime 1

Example 1 (GPS only):

```
$GPRMB,A,5.14,L,FROM,TO,5109.7578000,N,11409.0960000,W,5.1,303.0,-0.0,V,A*6F
```

Example 2 (Combined GPS and GLONASS):

```
$GNRMB,A,5.14,L,FROM,TO,5109.7578000,N,11409.0960000,W,5.1,303.0,-0.0,V,A*71
```

1. If the NMEATALKER command, see *page 171*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).
2. Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Table 72: NMEA Positioning System Mode Indicator

Mode	Indicator
A	Autonomous
D	Differential
E	Estimated (dead reckoning) mode
M	Manual input
N	Data not valid

Field	Structure	Field Description	Symbol	Example
1	$GPRMB	Log header		$GPRMB
2	data status	Data status: A = data valid; V = navigation receiver warning	A	A
3	xtrack	Cross track error [a]	x.x	5.14
4	dir	Direction to steer to get back on track (L/R) [b]	a	L
5	origin ID	Origin waypoint ID [c]	c--c	FROM
6	dest ID	Destination waypoint ID [C]	c--c	TO
7	dest lat	Destination waypoint latitude (DDmm.mm [c]	llll.ll	5109.7578000
8	lat dir	Latitude direction (N = North, S = South) [c]	a	N
9	dest lon	Destination waypoint longitude (DDDmm.mm) [c]	yyyyy.yy	11409.0960000
10	lon dir	Longitude direction (E = East, W = West) [c]	a	W
11	range	Range to destination, nautical miles [d]	x.x	5.1
12	bearing	Bearing to destination, degrees True	x.x	303.0
13	vel	Destination closing velocity, knots	x.x	-0.0
14	arr status	Arrival status: A = perpendicular passed V = destination not reached or passed	A	V
15	mode ind	Positioning system mode indicator, see *Table 72* on *page 379*	a	A
16	*xx	Checksum	*hh	*6F
17	[CR][LF]	Sentence terminator		[CR][LF]

a. - If cross track error exceeds 9.99 NM, display 9.99
   - Represents track error from intended course
   - One nautical mile = 1,852 metres

b. Direction to steer is based on the sign of the crosstrack error, that is, L = xtrack error (+); R = xtrack error (-)

c. Fields 5, 6, 7, 8, 9, and 10 are tagged from the SETNAV command, see *page 223*.

d. If range to destination exceeds 999.9 NM, display 999.9

3.3.45 GPRMC GPS Specific Information

Time, date, position, track made good and speed data provided by the GPS navigation receiver. RMC and RMB are the recommended minimum navigation data to be provided by a GNSS RECEIVER.

A comparison of the position precision between this log and other selected NMEA logs can be seen in *Table 71, Position Precision of NMEA Logs* on *page 368*.

The GPRMC log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

If the NMEATALKER command, see *page 171*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).

Message ID: **225**

Log Type: **Synch**

Recommended Input:

log gprmc ontime 1

Example 1 (GPS):

```
$GPRMC,144326.00,A,5107.0017737,N,11402.3291611,W,0.080,323.3,210307,0.0,E,A*
20
```

Example 2 (Combined GPS and GLONASS):

```
$GNRMC,143909.00,A,5107.0020216,N,11402.3294835,W,0.036,348.3,210307,0.0,E,A*
31
```

Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPRMC	Log header		$GPRMC
2	utc	UTC of position	hhmmss.ss	144326.00
3	pos status	Position status: A = data valid, V = data invalid	A	A
4	lat	Latitude (DDmm.mm)	llll.ll	5107.0017737
5	lat dir	Latitude direction N = North, S = South	a	N
6	lon	Longitude (DDDmm.mm)	yyyyy.yy	11402.3291611
7	lon dir	Longitude direction E = East, W = West	a	W
8	speed Kn	Speed over ground, knots	x.x	0.080
9	track true	Track made good, degrees True	x.x	323.3
10	date	Date: dd/mm/yy	xxxxxx	210307
11	mag var	Magnetic variation, degrees [a]	x.x	0.0
12	var dir	Magnetic variation direction E/W [b]	a	E
13	mode ind	Positioning system mode indicator, see *Table 72* on *page 379*	a	A
14	*xx	Checksum	*hh	*20
15	[CR][LF]	Sentence terminator		[CR][LF]

a. Note that this field is the actual magnetic variation and will always be positive. The direction of the magnetic variation is always positive.

b. Easterly variation (E) subtracts from True course and Westerly variation (W) adds to True course.

3.3.46 GPSEPHEM Decoded GPS Ephemerides

A single set of GPS ephemeris parameters.

Message ID: 7
Log Type: Asynch

Recommended Input:

log gpsephema onchanged

ASCII Example:

```
#GPSEPHEMA,COM1,12,59.0,SATTIME,1337,397560.000,00000000,9145,1984;
3,397560.0,0,99,99,1337,1337,403184.0,2.656004220e+07,4.971635660e-09,
-2.752651501e+00,7.1111434372e-03,6.0071892571e-01,2.428889275e-06,
1.024827361e-05,1.64250000e+02,4.81562500e+01,1.117587090e-08,
-7.078051567e-08,9.2668266314e-01,-1.385772009e-10,-2.098534041e+00,
-8.08319384e-09,99,403184.0,-4.190951586e-09,2.88095e-05,3.06954e-12,
0.00000,TRUE,1.458614684e-04,4.00000000e+00*0f875b12
#GPSEPHEMA,COM1,11,59.0,SATTIME,1337,397560.000,00000000,9145,1984;
25,397560.0,0,184,184,1337,1337,403200.0,2.656128681e+07,4.897346851e-09,
1.905797220e+00,1.1981436634e-02,-1.440195331e+00,-1.084059477e-06,
6.748363376e-06,2.37812500e+02,-1.74687500e+01,1.825392246e-07,
-1.210719347e-07,9.5008501632e-01,2.171519024e-10,2.086083072e+00,
-8.06140722e-09,184,403200.0,-7.450580597e-09,1.01652e-04,9.09495e-13,
0.00000,TRUE,1.458511425e-04,4.00000000e+00*18080b24
.
.
.
#GPSEPHEMA,COM1,0,59.0,SATTIME,1337,397560.000,00000000,9145,1984;
1,397560.0,0,224,224,1337,1337,403200.0,2.656022490e+07,3.881233098e-09,
2.938005195e+00,5.8911956148e-03,-1.716723741e+00,-2.723187208e-06,
9.417533875e-06,2.08687500e+02,-5.25625000e+01,9.126961231e-08,
-7.636845112e-08,9.8482911735e-01,1.325055194e-10,1.162012787e+00,
-7.64138972e-09,480,403200.0,-3.259629011e-09,5.06872e-06,2.04636e-12,
0.00000,TRUE,1.458588731e-04,4.00000000e+00*97058299
```

The GPSEPHEM log can be used to monitor changes in the orbits of GPS satellites.

Table 73: URA Variance

Index Value (m)	A: Standard Deviations (m)	Variance: A^2 (m^2)
0	2.0	4
1	2.8	7.84
2	4.0	16
3	5.7	32.49
4	8	56
5	11.3	127.69
6	16.0	256
7	32.0	1024
8	64.0	4096
9	128.0	16384
10	256.0	65536
11	512.0	262144
12	1024.0	1048576
13	2048.0	4194304
14	4096.0	16777216
15	8192.0	67108864

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	GPSEPHEM header	Log header		H	0
2	PRN	Satellite PRN number	Ulong	4	H
3	tow	Time stamp of subframe 0 (seconds)	Double	8	H+4
4	health	Health status - a 6-bit health code as defined in ICD-GPS-200 [a]	Ulong	4	H+12
5	IODE1	Issue of ephemeris data 1	Ulong	4	H+16
6	IODE2	Issue of ephemeris data 2	Ulong	4	H+20
7	week	GPS reference week number	Ulong	4	H+24
8	z week	Z count week number. This is the week number from subframe 1 of the ephemeris. The 'toe week' (field #7) is derived from this to account for rollover.	Ulong	4	H+28
9	toe	Reference time for ephemeris, seconds	Double	8	H+32
10	A	Semi-major axis, metres	Double	8	H+40
11	ΔN	Mean motion difference, radians/second	Double	8	H+48
12	M_0	Mean anomaly of reference time, radians	Double	8	H+56
13	ecc	Eccentricity, dimensionless - quantity defined for a conic section where e= 0 is a circle, e = 1 is a parabola, 0<e<1 is an ellipse and e>1 is a hyperbola.	Double	8	H+64
14	ω	Argument of perigee, radians - measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion.	Double	8	H+72
15	cuc	Argument of latitude (amplitude of cosine, radians)	Double	8	H+80
16	cus	Argument of latitude (amplitude of sine, radians)	Double	8	H+88
17	crc	Orbit radius (amplitude of cosine, metres)	Double	8	H+96
18	crs	Orbit radius (amplitude of sine, metres)	Double	8	H+104
19	cic	Inclination (amplitude of cosine, radians)	Double	8	H+112
20	cis	Inclination (amplitude of sine, radians)	Double	8	H+120
21	I_0	Inclination angle at reference time, radians	Double	8	H+128
22	$\dot{I}$	Rate of inclination angle, radians/second	Double	8	H+136
23	ω_0	Right ascension, radians	Double	8	H+144
24	$\dot{\omega}$	Rate of right ascension, radians/second	Double	8	H+152
25	iodc	Issue of data clock	Ulong	4	H+160
26	toc	SV clock correction term, seconds	Double	8	H+164
27	tgd	Estimated group delay difference, seconds	Double	8	H+172
28	a_{f0}	Clock aging parameter, seconds (s)	Double	8	H+180

Continued on next page

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
29	a_{f1}	Clock aging parameter, (s/s)	Double	8	H+188
30	a_{f2}	Clock aging parameter, (s/s/s)	Double	8	H+196
31	AS	Anti-spoofing on:0 = FALSE 1 = TRUE	Enum	4	H+204
32	N	Corrected mean motion, radians/second	Double	8	H+208
33	URA	User Range Accuracy variance, m^2. The ICD [a] specifies that the URA index transmitted in the ephemerides can be converted to a nominal standard deviation value using an algorithm listed there. We publish the square of the nominal value (variance). The correspondence between the original URA index and the value output is shown in *Table 73*.	Double	8	H+216
34	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+224
35	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. To obtain copies of ICD-GPS-200, refer to ARINC in the *Standards and References* page of our website at www.novatel.com through *Support | Knowledge and Learning > Learn About GNSS*.

3.3.47 GPVTG Track Made Good And Ground Speed

The track made good and speed relative to the ground.

The GPVTG log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **226**

Log Type: **Synch**

Recommended Input:

```
log gpvtg ontime 1
```

Example 1 (GPS only):

```
$GPVTG,172.516,T,155.295,M,0.049,N,0.090,K,D*2B
```

Example 2 (Combined GPS and GLONASS):

```
$GNVTG,134.395,T,134.395,M,0.019,N,0.035,K,A*33
```

If the NMEATALKER command, see *page 171*, is set to AUTO, the talker (the first 2 characters after the $ sign in the log header) is set to GP (GPS satellites only), GL (GLONASS satellites only), or GN (satellites from both systems).

Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPVTG	Log header		$GPVTG
2	track true	Track made good, degrees True	x.x	24.168
3	T	True track indicator	T	T
4	track mag	Track made good, degrees Magnetic; Track mag = Track true + (MAGVAR correction) See the *MAGVAR* command, *page 163*.	x.x	24.168
5	M	Magnetic track indicator	M	M
6	speed Kn	Speed over ground, knots	x.x	0.4220347
7	N	Nautical speed indicator (N = Knots)	N	N
8	speed Km	Speed, kilometres/hour	x.x	0.781608
9	K	Speed indicator (K = km/hr)	K	K
10	mode ind	Positioning system mode indicator, see *Table 72 on page 379*	a	A
11	*xx	Checksum	*hh	*7A
12	[CR][LF]	Sentence terminator		[CR][LF]

3.3.48 GPZDA UTC Time and Date

The GPZDA log outputs these messages with contents without waiting for a valid almanac. Instead, it uses a UTC time, calculated with default parameters. In this case, the UTC time status is set to WARNING since it may not be 100% accurate. When a valid almanac is available, the receiver uses the real parameters. Then the UTC time status is set to VALID.

Message ID: **227**

Log Type: **Synch**

Recommended Input:

log gpzda ontime 1

Example:

```
$GPZDA,143042.00,25,08,2005,,*6E
```

Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field	Structure	Field Description	Symbol	Example
1	$GPZDA	Log header		$GPZDA
2	utc	UTC time status	hhmmss.ss	220238.00
3	day	Day, 01 to 31	xx	15
4	month	Month, 01 to 12	xx	07
5	year	Year	xxxx	1992
6	null	Local zone description - not available	xx	*(empty when no data is present)*
7	null	Local zone minutes description - not available [a]	xx	*(empty when no data is present)*
8	*xx	Checksum	*hh	*6F
9	[CR][LF]	Sentence terminator		[CR][LF]

a. Local time zones are not supported by OEM6 family receivers. Fields 6 and 7 are always null.

3.3.49 HEADING Heading Information

The heading is the angle from True North of the base to rover vector in a clockwise direction. You must have an ALIGN-capable receiver to use this log. This log can be output at both Master and Rover ends.

Asynchronous logs, such as HEADING, should only be logged ONCHANGED or ONNEWotherwise, the most current data is not available or included in the output. An example of this occurance is in the ONTIME trigger. If this trigger is not loggged ONCHANGED, it may cause inaccurate time tags.

The HEADING log is dictated by the output frequency of the master receiver sending out RTCAOBS2 or RTCAOBS3 messages. For the OEM628, HEADING now supports 20Hz output rate. Please ensure sufficient radio bandwidth is available between the ALIGN Master and the ALIGN Rover.

Message ID: **971**

Log Type: **Asynch**

Recommended Input:

log headinga onchanged

ASCII Example:

```
#HEADINGA,COM1,0,77.0,FINESTEERING,1481,418557.000,00000000,3663,36137;
SOL_COMPUTED,L1_INT,5.913998127,75.566444397,-0.152066842,0.0,0.104981117,
0.222061798,"AAAA",13,10,10,0,0,00,0,11*481a5bab
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	HEADING header	Log header		H	0
2	sol stat	Solution status, see *Table 56* on *page 302*	Enum	4	H
3	pos type	Position type, see *Table 55* on *page 301*	Enum	4	H+4
4	length	Baseline length (0 to 3000 m)[a] For Z ALIGN Rovers, this field outputs decimal portion of the baseline	Float	4	H+8
5	heading	Heading in degrees (0 to 360.0 degrees)	Float	4	H+12
6	pitch	Pitch (±90 degrees)	Float	4	H+16
7	Reserved		Float	4	H+20
8	hdg std dev	Heading standard deviation in degrees	Float	4	H+24
9	ptch std dev	Pitch standard deviation in degrees	Float	4	H+28
10	stn ID	Station ID string	Char[4]	4	H+32
11	#SVs	Number of observations tracked	Uchar	1	H+36
12	#solnSVs	Number of satellites in solution	Uchar	1	H+37
13	#obs	Number of satellites above the elevation mask angle	Uchar	1	H+38
14	#multi	Number of satellites above the mask angle with L2	Uchar	1	H+39
15	Reserved		Uchar	1	H+40
16	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Uchar	1	H+41
17	Reserved		Uchar	1	H+42
18	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Uchar	1	H+43
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. This is only true for L1 GPS + GLONASS Heading. If the user has a dual-frequency heading model, traditional RTK baseline lengths apply.

3.3.50 HEADING2 Heading information with multiple rovers

The heading is the angle from True North of the base to rover vector in a clockwise direction. You must have an ALIGN-capable receiver to use this log. This log is similar to the Heading log with additional rover ID field. This log can be output at both Master and Rover ends.

Asynchronous logs, such as HEADING and HEADING2, should only be logged ONCHANGED or ONNEW otherwise, the most current data is not available or included in the output. An example of this occurance is in the ONTIME trigger. If this trigger is not loggged ONCHANGED, it may cause inaccurate time tags.

The HEADING2 log is dictated by the output frequency of the master receiver sending out RTCAOBS2 or RTCAOBS3 messages. For the OEM628, HEADING2 now supports 20Hz output rate. Ensure sufficient radio bandwidth is available between the ALIGN Master and the ALIGN Rover (s).

Message ID: **1335**

Log Type: **Asynch**

Recommended Input:

log heading2a onnew

ASCII Example:

```
#HEADING2A,COM1,0,39.5,FINESTEERING,1622,422892.200,00040000,f9bf,6521;SOL_
COMPUTED,NARROW_INT,0.927607417,178.347869873,-
1.303741455,0.0,0.261901051,0.391376048,"R222","AAAA",18,17,17,16,0,01,0,33
*7be836f6
```

Field #	Field type	Field Description	Binary Format	Binary Bytes	Binary Offset
1	**HEADING2**	Log header		H	0
2	sol stat	Solution status, see *Table 56* on *page 302*	ENUM	4	H
3	pos type	Position type, see *Table 55* on *page 301*	ENUM	4	H+4
4	length	Baseline length in metres For Z ALIGN Rovers, this field outputs decimal portion of the baseline	FLOAT	4	H+8
5	heading	Heading in degrees (0° to 359.999°)	FLOAT	4	H+12
6	pitch	Pitch (±90 degrees)	FLOAT	4	H+16
7	Reserved		FLOAT	4	H+32
8	hdg std dev	Heading standard deviation in degrees	FLOAT	4	H+24
9	ptch std dev	Pitch standard deviation in degrees	FLOAT	4	H+28
10	rover stn ID	Rover Receiver ID *Set using SETROVERID command on ROVER* *e.g. setroverid RRRR*	CHAR[4]	4	H+32
11	Master stn ID	Master Receiver ID *Set using DGPSTXID command on MASTER* *Default: AAAA*	CHAR[4]	4	H+36
12	#SVs	Number of observations tracked	UCHAR	1	H+40
13	#solnSVs	Number of satellites in solution	UCHAR	1	H+41
14	#obs	Number of satellites above the elevation mask angle	UCHAR	1	H+42
15	#multi	Number of satellites above the mask angle with L2	UCHAR	1	H+43
16	Reserved		UCHAR	1	H+44
17	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	UCHAR	1	H+45
18	Reserved		UCHAR	1	H+46
19	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	UCHAR	1	H+47
20	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+48
21	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.51 HEADINGSATS Heading information with multiple rovers

This log provides information on the satellites that are used in a heading solution.

Message ID: **1316**
Log Type: **Asynch**

Recommended Input:

log headingsatsa onnew

ASCII Example:

```
#HEADINGSATSA,COM1,0,26.0,FINESTEERING,1625,344654.600,00000008,f5b0,6569;1
7,GPS,31,GOOD,00000003,GPS,23,GOOD,00000003,GPS,30,GOOD,00000003,GPS,16,GOO
D,00000003,GPS,20,GOOD,00000003,GPS,25,GOOD,00000003,GPS,4,GOOD,00000003,GP
S,24,GOOD,00000003,GPS,11,GOOD,00000003,GPS,32,GOOD,00000003,GPS,14,GOOD,00
000003,GLONASS,20+2,GOOD,00000003,GLONASS,14-7,GOOD,00000001,GLONASS,2-
4,GOOD,00000003,GLONASS,13-2,GOOD,00000003,GLONASS,12-1,GOOD,00000003,GLO-
NASS,19+3,GOOD,00000001*15ec53a6
```

Field #	Field type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	**HEADINGSATS**	Log header		H	0
2	#entries	Number of records to follow	ULONG	4	H
3	System	see Table 29 on page 156 of OEM6 Manual	ENUM	4	H+4
4	Satellite ID	Satellite identities, see Page 290 of OEM6 Manual	SIMPLE	4	H+8
5	Status	see Table 57 of OEM6 Manual	ENUM	4	H+12
6	Status Mask	see Table 58 on page 290 of OEM Manual	HEX	4	H+16
10	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+20
11	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.52 HWMONITOR Monitor Hardware Levels

The HWMONITOR log allows you to monitor temperature, antenna current and various voltages.

Message ID: **963**
Log Type: **Polled**

Recommended Input:

log hwmonitora ontime 10

ASCII Example:

```
#HWMONITORA,COM1,0,88.0,FINESTEERING,1610,322827.106,00000000,52db,38637;
11,40.750000000,VALUE_OK,0.000000000,VALUE_OK,3.249071598,OVER_LIMIT_ERROR,1.
971749663,OVER_LIMIT_ERROR,2.783382177,OVER_LIMIT_ERROR,4.992524624,OVER_LIMI
T_ERROR,0.000000000,VALUE_OK,1.211827874,OVER_LIMIT_ERROR,1.310752630,OVER_LI
MIT_ERROR,1.809872866,OVER_LIMIT_ERROR,2.299999952,OVER_LIMIT_ERROR*de794881
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	HWMONITOR header	Log header		H	0
2	#values	Number of values to follow (currently set to 11)	Ulong	4	H
3	temperature	Board temperature in degrees Celsius	Float	4	H+4
4	temperature status	See *Table 74* on *page 396*. Below -40 or above 100 causes a warning, above 110 causes an error.	Enum	4	H+8
5	antenna current	Antenna current in amps	Float	4	H+12
6	antenna current status	See *Table 74* on *page 396*.	Enum	4	H+16
7	MID3V3 voltage	MID3V3 voltage in volts	Float	4	H+20
8	MID3V3 voltage status	See *Table 74* on *page 396*.	Enum	4	H+24
9	VNIOL voltage	VNIOL voltage in volts	Float	4	H+28
10	VNIOL voltage status	See *Table 74* on *page 396*.	Enum	4	H+32
11	VNIOH voltage	VNIOH voltage in volts	Float	4	H+36
12	VNIOH voltage status	See *Table 74* on *page 396*.	Enum	4	H+40
13	Supply voltage	Supply voltage in volts	Float	4	H+44
14	Supply voltage status	See *Table 74* on *page 396*.	Enum	4	H+48
15	Antenna current voltage	Antenna current voltage in volts	Float	4	H+52
16	Antenna current voltage status	See *Table 74* on *page 396*.	Enum	4	H+56
17	MINOS core voltage	MINOS core voltage in volts	Float	4	H+60
18	MINOS core voltage status	See *Table 74* on *page 396*.	Enum	4	H+64
19	VCC core voltage	VCC core voltage in volts	Float	4	H+68

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
20	VCC core voltage status	See *Table 74* on *page 396*.	Enum	4	H+72
21	VCC mem voltage	VCC Mem voltage in volts	Float	4	H+76
22	VCC Mem voltage status	See *Table 74* on *page 396*.	Enum	4	H+80
23	Atlas voltage	Atlas voltage in volts	Float	4	H+84
24	Atlas voltage status	See *Table 74* on *page 396*.	Enum	4	H+88

Table 74: HWMONITOR Status Table

Status (Binary)	Status (ASCII)	Description
0	VALUE_OK	Value falls within acceptable bounds
1	UNDER_LIMIT_WARNING	Value is under the lower warning limit
2	UNDER_LIMIT_ERROR	Value is under the lower error limit
3	OVER_LIMIT_WARNING	Value is over the upper warning limit
4	OVER_LIMIT_ERROR	Value is over the upper error limit

3.3.53 IONUTC Ionospheric and UTC Data

The Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC) are provided.

Message ID: **8**
Log Type: **Asynch**

Recommended Input:

log ionutca onchanged

ASCII Example:

```
#IONUTCA,COM1,0,58.5,FINESTEERING,1337,397740.107,00000000,ec21,1984;
1.210719347000122e-08,2.235174179077148e-08,-5.960464477539062e-08,
-1.192092895507812e-07,1.003520000000000e+05,1.146880000000000e+05,
-6.553600000000000e+04,-3.276800000000000e+05,1337,589824,
-1.210719347000122e-08,-3.907985047e-14,1355,7,13,14,0*c1dfd456
```

The Receiver-Independent Exchange (RINEX1[a]) format is a broadly-accepted, receiver-independent format for storing GPS data. It features a non-proprietary ASCII file format that can be used to combine or process data generated by receivers made by different manufacturers.

Use the Convert4 utility to produce RINEX files from NovAtel receiver data files. For the best results, the NovAtel receiver input data file should contain the logs as specified in the *PC Software and Firmware* chapter of the *OEM6 Family Installation and Operation User Manual* including IONUTC.

a. Refer to the U.S. National Geodetic Survey website at:

http://www.ngs.noaa.gov/CORS/Rinex2.html

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	IONUTC header	Log header		H	0
2	a0	Alpha parameter constant term	Double	8	H
3	a1	Alpha parameter 1st order term	Double	8	H+8
4	a2	Alpha parameter 2nd order term	Double	8	H+16
5	a3	Alpha parameter 3rd order term	Double	8	H+24
6	b0	Beta parameter constant term	Double	8	H+32
7	b1	Beta parameter 1st order term	Double	8	H+40
8	b2	Beta parameter 2nd order term	Double	8	H+48
9	b3	Beta parameter 3rd order term	Double	8	H+56
10	utc wn	UTC reference week number	Ulong	4	H+64
11	tot	Reference time of UTC parameters	Ulong	4	H+68
12	A0	UTC constant term of polynomial	Double	8	H+72
13	A1	UTC 1st order term of polynomial	Double	8	H+80
14	wn lsf	Future week number	Ulong	4	H+88
15	dn	Day number (the range is 1 to 7 where Sunday = 1 and Saturday = 7)	Ulong	4	H+92
16	deltat ls	Delta time due to leap seconds	Long	4	H+96
17	deltat lsf	Future delta time due to leap seconds	Long	4	H+100
18	deltat utc	Time difference	Ulong	4	H+104
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+108
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.54 IPSTATUS Current network configuration status

This log provides the configuration of IP address, netmask, gateway and a list of DNS servers currently in use.

Message ID: **1289**

Log Type: **Async**

Recommended Input:

log ipstatus a once

ASCII Example:

#ipstatusa,com1,0,90.5,finesteering,1609,500464.121,00000000,7fe2,6259;1,etha,"10.4
.44.131","255.255.255.0","10.4.44.1",1,"198.161.72.85"*ec22236c

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	IPSTATUS Header	Log header	-	H	0
2	IP status	Number of records to follow.	Ulong	4	H
3	interface	ETHA	Enum	4	H+4
4	IP address	IP Address - decimal dot notation	String	16	H+8
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+34
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.55 LBANDINFO L-band Configuration Information

This log outputs configuration information for an L-band service.

> In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR service, or use of a DGPS service is required. Contact NovAtel for details. Contact NovAtel for details, through our website at www.novatel.com through *Support*, or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **730**
Log Type: **Asynch**

Recommended Input:

log lbandinfoa ontime 1

ASCII Example 1 (OmniSTAR HP):

```
#LBANDINFOA,COM2,0,81.5,FINESTEERING,1295,152639.184,00000240,c51d,34461;
1547547,4800,c685,0,762640,EXPIRED,0,0,FIXEDTIME,1199,259199,0*8cc5e573
```

Table 75: L-band Subscription Type

Binary	ASCII	Description
0	EXPIRED	The L-band subscription has expired or does not exist.
1	FIXEDTIME	The L-band subscription expires at a fixed date and time.
2	COUNTDOWN	The L-band subscription expires after the specified amount of running time.
3	COUNTDOWNOVERRUN	The COUNTDOWN subscription has expired but has entered a brief grace period. Resubscribe immediately.
16	UNKNOWN	Unknown subscription

What is the real accuracy of the Coast Guard's DGPS as compared to the commercial DGPS? The Coast Guard claims a 10 metre accuracy for their DGPS. Some commercial DGPS vendors offer 5 m (or better) accuracy. Are the commercial vendors really supplying something more accurate than the Coast Guard signal?

The real accuracy of the Coast Guard's DGPS signal is likely better than 10 metres. However, there a number of factors which are involved in determining the accuracy of a DGPS system. These include:

- your proximity to the base station which is transmitting DGPS corrections,
- the GNSS receiver used by the Coast Guard,
- the GNSS receiver used by the commercial DGPS services,
- your GNSS receiver, and the statistical qualifier used in conjunction with the stated accuracy.

If you were to compare the Coast Guard and commercial DGPS services under the same situations, for example, a base to user proximity of 1 km and stated accuracy at 2drms (95% confidence), you would probably find that the Coast Guard's DGPS is at least equivalent to, if not better than, commercial DGPS services.

Also of note is that the Coast Guard's DPGS service is available to all users (marine, land and air), similar to a public utility without any charge. In addition, the Coast Guard's service acts as an integrity monitor, which provides an independent check of each GPS satellite's signal and reports whether it is good or bad. Commercial DGPS vendors usually have a monthly or yearly subscription fee.

All of the previous discussions have been dealing with code data. Some commercial DGPS services are now also provide high accuracy carrier-phase data along with code data. With this type of data, depending on your equipment, you will be able to achieve decimetre and even centimetre level accuracies.

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	LBANDINFO header	Log header		H	0
2	freq	Selected frequency for L-band service (Hz or kHz, depending on how the frequency was specified in the ASSIGNLBAND or ASSIGNLBAND2 command)	Ulong	4	H
3	baud	Communication baud rate from L-band satellite	Ulong	4	H+4
4	ID	L-band signal service ID	Ushort	2	H+8
5	Reserved		Ushort	2	H+10
6	OSN	L-band serial number	Ulong	4	H+12
7	vbs sub	L-band VBS subscription type (see *Table 75* on *page 400*)	Enum	4	H+16
8	vbs exp week	GPS reference week number of L-band VBS expiration date [a]	Ulong	4	H+20
9	vbs exp secs	Number of seconds into the GPS reference week of L-band VBS expiration date [a]	Ulong	4	H+24
10	hp sub	OmniSTAR HP or XP subscription type (see *Table 75* on *page 400*)	Enum	4	H+28
11	hp exp week	GPS reference week number of OmniSTAR HP or XP expiration date [a]	Ulong	4	H+32
12	hp exp secs	Number of seconds into the GPS reference week of OmniSTAR HP or XP expiration date [a]	Ulong	4	H+36
13	hp sub mode	HP or XP subscription mode if the subscription is valid. Refer to *Table 76* on *page 403*:	Hex	4	H+40
14	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. If the subscription type is COUNTDOWN, see Field #7 above, the expiration week and expiration seconds into the GPS reference week contain the amount of running time remaining in the subscription.

If the subscription type is COUNTDOWNOVERRUN, the expiration week and expiration seconds into GPS reference week count the amount of the overrun time.

Table 76: HP Subscription Mode

Bit Number	Mask	Description[a]	Value
0	0x00000001	XP	1=subscribed
1	0x00000002	HP	1=subscribed
2	0x00000004	G2	1=subscribed
3-7	0x000000f8	Reserved	
9	0x00000100	GPS measurements	1=enabled
10	0x00000200	GLONASS measurements	1=enabled

a. All other bits are reserved.

3.3.56 LBANDSTAT L-band Status Information

This log outputs status information for a standard L-band, OmniSTAR XP (Extra Precision) or OmniSTAR HP (High Performance) service.

> In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR service, or use of a DGPS, service is required. Contact NovAtel for details, through our website at www.novatel.com through *Support*, or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **731**
Log Type: **Asynch**

Recommended Input:

log lbandstata ontime 1

ASCII Example:

```
#LBANDSTATA,COM1,0,73.5,FINESTEERING,1314,494510.000,00000000,c797,1846;
1551488896,43.19,62.3,0.00,0082,0000,7235,11,0,0000,0001,7762,04000000,0
*93f7d2af
```

> In binary, the receiver outputs 48 bytes without the checksum when the LBANDSTATB log is requested.

Table 77: L-band Signal Tracking Status

Nibble #	Bit #	Mask	Description	Range Value
N0	0	0x0001	Tracking State	0 = Searching, 1 = Pull-in, 2 = Tracking, 3 = Idle
	1	0x0002		
	2	0x0004	Reserved	
	3	0x0008		
N1	4	0x0010		
	5	0x0020		
	6	0x0040	Bit Timing Lock	0 = Not Locked, 1 = Locked
	7	0x0080	Phase Locked	0 = Not Locked, 1 = Locked
N2	8	0x0100	DC Offset Unlocked	0 = Good, 1 = Warning
	9	0x0200	AGC Unlocked	0 = Good, 1 = Warning
	10	0x0400	Reserved	
	11	0x0800		
N3	12	0x1000		
	13	0x2000		
	14	0x4000		
	15	0x8000	Error	0 = Good, 1 = Error

Table 78: OmniSTAR VBS Status Word

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Subscription Expired [a]	False	True
	1	0x00000002	Out of Region [a]	False	True
	2	0x00000004	Wet Error [a]	False	True
	3	0x00000008	Link Error [a]	False	True
N1	4	0x00000010	No Remote Sites	False	True
	5	0x00000020	No Almanac	False	True
	6	0x00000040	No Position	False	True
	7	0x00000080	No Time	False	True
N2-N4	8-19	Reserved			
N5	20				
	21				
	22				
	23	0x00800000	Wet Warning [a]	False	True
N6	24-27	Reserved			
N7	28				
	29				
	30				
	31	0x80000000	Updating Data	False	True

a. Contact OmniSTAR for subscription support. All other status values are updated by collecting OmniSTAR data for 20-35 minutes.

Table 79: OmniSTAR HP/XP Additional Status Word

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x0001	Solution not fully converged	False	True
	1	0x0002	OmniStar satellite list available	False	True
	2	0x0004	Reserved		
	3	0x0008			
N1	4	0x0010	HP not authorized [a]	Authorized	Unauthorized
	5	0x0020	XP not authorized [a]	Authorized	Unauthorized
	6	0x0040	Reserved		
	7	0x0080			
N2	8	0x0100			
	9	0x0200			
	10	0x0400			
	11	0x0800			
N3	12	0x1000			
	13	0x2000			
	14	0x4000			
	15	0x8000			

a. This authorization is related to the receiver model and not the OmniStar subscription. To view OmniSTAR subscription information use the LBANDINFO log, see *page 400*.

Table 80: OmniSTAR HP/XP Status Word

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Subscription Expired [a]	False	True
	1	0x00000002	Out of Region [a]	False	True
	2	0x00000004	Wet Error [a]	False	True
	3	0x00000008	Link Error [a]	False	True
N1	4	0x00000010	No Measurements	False	True
	5	0x00000020	No Ephemeris	False	True
	6	0x00000040	No Initial Position	False	True
	7	0x00000080	No Time Set	False	True
N2	8	0x00000100	Velocity Error	False	True
	9	0x00000200	No base stations	False	True
	10	0x00000400	No Mapping Message	False	True
	11	0x00000800	Altitude Error	False	True
N3-N5	12-23	Reserved			
N6	24-25				
	26	0x04000000	Static Initialization Mode	False	True
	27	Reserved			
N7	28-30				
	31	0x80000000	Updating Data	False	True

a. Contact OmniSTAR for subscription support. All other status values are updated by collecting the OmniSTAR data for 20-35 minutes.

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	LBANDSTAT header	Log header		H	0
2	freq	Measured frequency of L-band signal (Hz)	Ulong	4	H
3	C/No	Carrier to noise density ratio C/No = $10[\log_{10}(S/N_0)]$ (dB-Hz)	Float	4	H+4
4	locktime	Number of seconds of continuous tracking (no cycle slipping)	Float	4	H+8
5	Reserved		Float	4	H+12
6	tracking	Tracking status of L-band signal (see *Table 77* on *page 405*)	Hex	2	H+16
7	Reserved		Hex	2	H+18
8	#bytes	Number of bytes fed to the standard process	Ulong	4	H+20
9	#good dgps	Number of standard updates	Ulong	4	H+24
10	#bad data	Number of missing standard updates	Ulong	4	H+28
11	Reserved (the *hp status 1* field is obsolete and has been replaced by the longer OmniSTAR HP Status field. The shorter legacy status here is maintained for backward compatibility)		Hex	2	H+32
12	hp status 2	Additional status pertaining to the HP or XP process (see *Table 79* on *page 407*)	Hex	2	H+34
13	#bytes hp	Number of bytes fed to the HP or XP process	Ulong	4	H+36
14	hp status	Status from the HP or XP process (see *Table 80* on *page 408*)	Hex	4	H+40
15	VBS status	Status word for OmniSTAR (see *Table 78* on *page 406*)	Hex	4	H+44
16	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.57 LOGLIST List of System Logs

Outputs a list of log entries in the system. The following tables show the binary ASCII output. See also the RXCONFIG log on *page 605* for a list of current command settings.

Message ID: **5**
Log Type: **Polled**

Recommended Input:

log loglista once

ASCII Example:

```
#LOGLISTA,COM1,0,60.5,FINESTEERING,1337,398279.996,00000000,c00c,1984; 8,
COM1,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
COM2,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
COM3,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
USB1,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
USB2,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
USB3,RXSTATUSEVENTA,ONNEW,0.000000,0.000000,HOLD,
COM1,BESTPOSA,ONTIME,10.000000,0.000000,NOHOLD,
COM1,LOGLISTA,ONCE,0.000000,0.000000,NOHOLD*5b29eed3
```

Do not use undocumented logs or commands! Doing so may produce errors and void your warranty.

Before contacting NovAtel Customer Support regarding software concerns, please do the following:

1. Issue a FRESET command
2. Log the following data to a file on your PC/laptop for 30 minutes:
   - RXSTATUSB once
   - RAWEPHEMB onchanged
   - RANGEB ontime 1
   - BESTPOSB ontime 1
   - RXCONFIGA once
   - VERSIONB once
3. Send the file containing the logs to NovAtel Customer Support, using the support@novatel.com e-mail address.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	LOGLIST (binary) header	Log header		H	0
2	#logs	Number of messages to follow, maximum = 64	Long	4	H
3	port	Output port, see *Table ,* on *page 26*	Enum	4	H+4
4	message	Message ID of log	Ushort	2	H+8
5	message type	Bits 0-4 = Reserved Bits 5-6 = Format 00 = Binary 01 = ASCII 10 = Abbreviated ASCII, NMEA 11 = Reserved Bit 7 = Response Bit (see *Section ,* on *page 29*) 0 = Original Message 1 = Response Message	Char	1	H+10
6	Reserved		Char	3[a]	H+11
7	trigger	0 = ONNEW 1 = ONCHANGED 2 = ONTIME 3 = ONNEXT 4 = ONCE 5 = ONMARK	Enum	4	H+14
8	period	Log period for ONTIME	Double	8	H+18
9	offset	Offset for period (ONTIME trigger)	Double	8	H+26
10	hold	0 = NOHOLD 1 = HOLD	Enum	4	H+32
11...	Next log offset = H + 4 + (#logs x 32)				
variable	xxxx	32-bit CRC	Hex	4	H+4+(#logs x 32)

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

Field #	Field type	Data Description	Format
1	LOGLIST (ASCII) header	Log header	
2	#port	Number of messages to follow, maximum = 64	Long
3	port	Output port, see *Table ,* on *page 26*	Enum
4	message	Message name of log with no suffix for abbreviated ascii, an A suffix for ascii and a B suffix for binary.	Char [ ]
5	trigger	ONNEW ONCHANGED ONTIME ONNEXT ONCE ONMARK	Enum
6	period	Log period for ONTIME	Double
7	offset	Offset for period (ONTIME trigger)	Double
8	hold	NOHOLD HOLD	Enum
9...	Next port		
variable	xxxx	32-bit CRC	Hex
variable	[CR][LF]	Sentence terminator	-

3.3.58 MARKPOS, MARK2POS Position at Time of Mark Input Event

This log contains the estimated position of the antenna when a pulse is detected at a mark input. MARKPOS is a result of a pulse on the MK1I input and MARK2POS is generated when a pulse occurs on a MK2I input. Refer to the *Technical Specifications* appendix in the *OEM6 Family Installation and Operation User Manual* for mark input pulse specifications and the location of the mark input pins.

The position at the mark input pulse is extrapolated using the last valid position and velocities. The latched time of mark impulse is in GPS REFERENCE WEEKs and seconds into the week. The resolution of the latched time is 49 ns. See also the notes on MARKPOS in the MARKTIME log on *page 415*.

Message ID: **181 (MARKPOS)** and **615 (MARK2POS)**
Log Type: **Asynch**

Recommended Input:

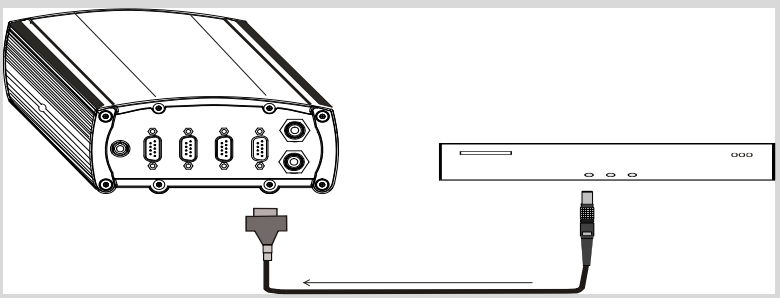
```
log markposa onnew
```

Use the ONNEW trigger with the MARKTIME or MARKPOS logs.

Abbreviated ASCII Example:

```
SOL_COMPUTED,NARROW_INT,51.11637234389,-114.03824932277,1063.8475,-16.2713,
WGS84,0.0095,0.0078,0.0257,"AAAA",1.000,0.000,17,10,10,9,0,1,0,03
```

Consider the case where you have a user point device such as video equipment. Connect the device to the receiver's I/O port using a cable that is compatible to both the receiver and the device. Refer to your device's documentation for information about its connectors and cables. The arrow along the cable in the figure below indicates a MARKIN pulse, from the user device on the right to the receiver I/O port:



Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MARKPOS/ MARK2POS header	Log header		H	0
2	sol status	Solution status (see *Table 56* on *page 302*)	Enum	4	H
3	pos type	Position type (see *Table 55* on *page 301*)	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Chapter 2, Table 16, Reference Ellipsoid Constants* on *page 95*)	Enum	4	H+36
9	lat σ	Latitude standard deviation	Float	4	H+40
10	lon σ	Longitude standard deviation	Float	4	H+44
11	hgt σ	Height standard deviation	Float	4	H+48
12	stn id	Base station ID	Char[4]	4	H+52
13	diff_age	Differential age in seconds	Float	4	H+56
14	sol_age	Solution age in seconds	Float	4	H+60
15	#SVs	Number of satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65
17	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+66
18	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84

3.3.59 MARKTIME, MARK2TIME Time of Mark Input Event

This log contains the time of the leading edge of the detected mark input pulse. MARKTIME gives the time when a pulse occurs on the MK1I input and MARK2POS is generated when a pulse occurs on a MK2I input. Refer to the *Technical Specifications* appendix in the *OEM6 Family Installation and Operation User Manual* for mark input pulse specifications and the location of the mark input pins. The resolution of this measurement is 49 ns.

1. Use the ONNEW trigger with this or the MARKPOS logs.
2. Only the MARKPOS logs, the MARKTIME logs, and 'polled' log types are generated 'on the fly' at the exact time of the mark. Synchronous and asynchronous logs output the most recently available data.

Message ID: **231 (MARKTIME) and 616 (MARK2TIME)**
Log Type: **Asynch**

Recommended Input:

log marktimea onnew

Example:

```
#MARKTIMEA,COM1,0,77.5,FINESTEERING,1358,422621.000,00000000,292e,2214;
1358,422621.000000500,-1.398163614e-08,7.812745577e-08,-14.000000002,
VALID*d8502226
```

These logs allow you to measure the time when events are occurring in other devices (such as a video recorder). See also the MARKCONTROL command on *page 166*.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MARKTIME/ MARK2TIME header	Log header		H	0
2	week	GPS reference week number	Long	4	H
3	seconds	Seconds into the week as measured from the receiver clock, coincident with the time of electrical closure on the Mark Input port.	Double	8	H+4
4	offset	Receiver clock offset, in seconds. A positive offset implies that the receiver clock is ahead of GPS reference time. To derive GPS reference time, use the following formula: GPS reference time = receiver time - (offset)	Double	8	H+12
5	offset std	Standard deviation of receiver clock offset (s)	Double	8	H+20
6	utc offset	This field represents the offset of GPS reference time from UTC time, computed using almanac parameters. UTC time is GPS reference time plus the current UTC offset plus the receiver clock offset. UTC time = GPS reference time + offset + UTC offset[a]	Double	8	H+28
7	status	Clock model status, see *Table 64, Clock Model Status* on *page 320*	Enum	4	H+36
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+40
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. 0 indicates that UTC time is unknown because there is no almanac available in order to acquire the UTC offset.

3.3.60 MASTERPOS Master Position using ALIGN

ALIGN generates distance and bearing information between a Master and Rover receiver. This log outputs the position information of the master when using the ALIGNfeature. This log can be output from both Y and Z ALIGN models and can be output at both Master and Rover ends.

1. ALIGN is useful for obtaining the relative directional heading of a vessel/body, separation heading between two vessels/bodies, or heading information with moving base and pointing applications.
2. You must have an ALIGN -capable receiver to use this log.
3. The log can be output at both Y and Z model Rover if it is receiving the RTCAREFEXT message from the Master. The log can be output at any Master if Master is receiving HEADINGEXTB from the Rover.
4. MASTERPOS logging is dictated by the output frequency of the RTCAREFEXT output frequency.

Message ID: **1051 (MASTERPOS)**
Log Type: **ASynch**

Recommended Input:

log masterposa onchanged

Example 1:

```
#MASTERPOSA,COM1,0,21.5,FINESTEERING,1544,340322.000,00000008,5009,4655;
SOL_COMPUTED,NARROW_INT,51.11604599076,-114.03855412002,1055.7756,
16.9000,WGS84,0.0090,0.0086,0.0143,"AAAA",0.0,0.0,13,13,13,12,0,0,0,0*a72e8d3
f
```

Asynchronous logs, such as MASTERPOS, should only be logged ONCHANGED or ONNEW. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Field #	Field Type	Field Description	Binary Format	Binary Bytes	Binary Offset
1	MASTERPOS header	Log Header		H	0
2	sol stat	Solution Status, see *Table 56* on *page 302*	Enum	4	H
3	pos type	Position Type see *Table 55* on *page 301*	Enum	4	H+4
4	lat	Master WGS84 Latitude in degrees	Double	8	H+8
5	long	Master WGS84 Longitude in degrees	Double	8	H+16
6	hgt	Master MSL Height in metres	Double	8	H+24
7	undulation	Undulation in metres	Float	4	H+32
8	datum id#	WGS84 (default)	Enum	4	H+36
9	lat σ	Latitude Std in metres	Float	4	H+40
10	long σ	Longitude Std in metres	Float	4	H+44
11	hgt σ	Height Std in metres	Float	4	H+48
12	stn id	Receiver ID can be set using the DGPSTXID command, see *page 103*.	Char[4]	4	H+52
13	Reserved		Float	4	H+56
14			Float	4	H+60
15	#SVs	Number of satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65
17	#obs	Number of satellites above elevation mask angle	Uchar	1	H+66
18	#multi	Number of satellites above the mask angle with L2	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20			Uchar	1	H+69
21			Uchar	1	H+70
22			Uchar	1	H+71
23	xxxx		HEX	1	H+72
24	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.61 MATCHEDPOS Matched RTK Position

This log represents positions that have been computed from time matched base and rover observations. There is no base extrapolation error on these positions because they are based on buffered measurements; they lag real time by some amount depending on the latency of the data link. If the rover receiver has not been enabled to accept RTK differential data, or is not actually receiving data leading to a valid solution, this is shown in fields #2 (*sol status*) and #3 (*pos type*).

This log provides the best accuracy in static operation. For lower latency in kinematic operation, see the RTKPOS or BESTPOS logs. The data in the logs changes only when a base observation (RTCM, RTCMV3, RTCA, CMRPLUS or CMR) changes.

A good message trigger for this log is ONCHANGED. Then, only positions related to unique base station messages are produced, and the existence of this log indicates a successful link to the base.

Asynchronous logs, such as MATCHEDPOS, should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Message ID: **96**

Log Type: **Asynch**

Recommended Input:

log matchedposa onchanged

ASCII Example:

```
#MATCHEDPOSA,COM1,0,63.0,FINESTEERING,1419,340034.000,00000040,2f06,2724;
SOL_COMPUTED,NARROW_INT,51.11635908660,-114.03833102484,1063.8400,-16.2712,
WGS84,0.0140,0.0075,0.0174,"AAAA",0.000,0.000,12,12,12,12,0,01,0,33*feac3a3a
```

Measurement precision is different from the position computation precision measurement precision is a value that shows how accurately the actual code or carrier phase is measured by the GNSS receiver. Position precision is a value that shows the accuracy of the position computation that is made from the code and/or carrier phase measurements. The P-code L2 measurement precision is not as good as the C/A measurement precision because the NovAtel GNSS receiver is a civilian grade GPS device, and thus does not have direct access to the decrypted military L2 P(Y) code. This means that our semi-codeless P-code L2 measurements are noisier than the civilian band C/A code measurements. Refer to the *OEM6 Installation and Operation Manual* for the technical specification of the OEM6 card.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MATCHED-POS header	Log header		H	0
2	sol status	Solution status (see *Table 56* on *page 302*)	Enum	4	H
3	pos type	Position type (see *Table 55* on *page 301*)	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Table 17* on *page 96*)	Enum	4	H+36
9	lat σ	Latitude standard deviation	Float	4	H+40
10	lon σ	Longitude standard deviation	Float	4	H+44
11	hgt σ	Height standard deviation	Float	4	H+48
12	stn id	Base station ID	Char[4]	4	H+52
13	Reserved		Float	4	H+56
14			Float	4	H+60
15	#SVs	Number of satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65
17	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+66
18	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84

3.3.62 MATCHEDSATS Satellites used in MATCHEDPOS solution

This log lists the used and unused satellites for the corresponding MATCHEDPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: **1176**
Log Type: **Asynch**

Recommended Input:

log matchedsatsa onchanged

ASCII Example:

```
#MATCHEDSATSA,COM1,0,77.5,FINESTEERING,1594,335430.000,00000008,b555,5945;16,
GPS,26,GOOD,00000003,GPS,15,GOOD,00000003,GPS,19,GOOD,00000003,GPS,17,GOOD,00
000003,GPS,7,GOOD,00000003,GPS,8,GOOD,00000003,GPS,28,GOOD,00000003,GPS,24,GO
OD,00000003,GPS,11,GOOD,00000003,GLONASS,14-7,GOOD,00000003,GLONASS,13-
2,GOOD,00000003,GLONASS,15,GOOD,00000003,GLONASS,5+1,GOOD,00000003,GLONASS,24
+2,GOOD,00000003,GLONASS,23+3,GOOD,00000003,GLONASS,17+4,GOOD,00000003*4bcdd7
5b
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MATCHED SATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 157*.	Enum	4	H+4
4	Satellite ID	Satellite identifier see *page 307*	Simple	4	H+8
5	Status	Satellite status. See *Table 59*	Enum	4	H+16
6	Status mask	See *Table 60* on *page 307*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.63 MATCHEDXYZ Matched RTK Cartesian Position

This log contains the receiver's matched position in ECEF coordinates. It represents positions that have been computed from time matched base and rover observations. There is no base station extrapolation error on these positions because they are based on buffered measurements; they lag real time by some amount depending on the latency of the data link. If the rover receiver has not been enabled to accept RTK differential data, or is not actually receiving data leading to a valid solution, this is reflected by the code shown in field #2 (solution status) and #3 (position type). See *Figure 10, page 315* for a definition of the ECEF coordinates.

This log provides the best accuracy in static operation. For lower latency in kinematic operation, see the BESTXYZ or RTKXYZ logs on *pages 313* and *603* respectively. The data in the logs changes only when a base observation (RTCM, RTCMV3, RTCA, or CMR) changes.

The time stamp in the header is the time of the matched observations that the computed position is based on, not the current time.

Message ID: **242**
Log Type: **Asynch**

Recommended Input:

```
log matchedxyza onchanged
```

Asynchronous logs, such as MATCHEDXYZ, should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

ASCII Example:

```
#MATCHEDXYZA,COM1,0,62.5,FINESTEERING,1419,340035.000,00000040,b8ed,2724;
SOL_COMPUTED,NARROW_INT,-1634531.5703,-3664618.0321,4942496.3280,0.0080,
0.0159,0.0154,"AAAA",12,12,12,12,0,01,0,33*e4b84015
```

A good message trigger for this log is ONCHANGED. Then, only positions related to unique base station messages are produced, and the existence of this log indicates a successful link to the base station.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	MATCHEDXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	pos type	Position type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P-Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
18	stn ID	Base station ID	Char[4]	4	H+44
22	#SVs	Number of satellite vehicles tracked	Uchar	1	H+48
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+49
24	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+50
25	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+51
26	Reserved		Char	1	H+52
27	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+53
28	Reserved		Hex	1	H+54
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+55
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+56
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

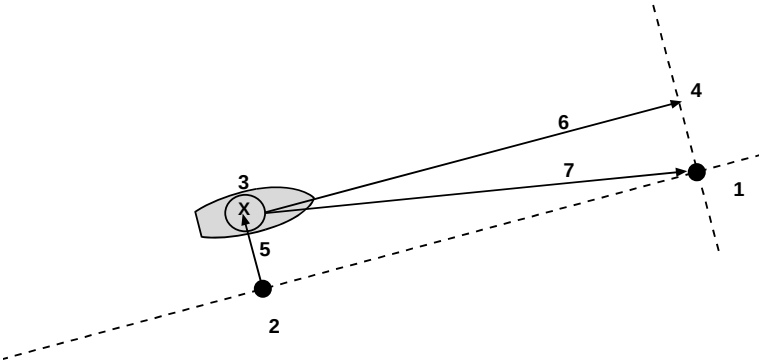
3.3.64 NAVIGATE User Navigation Data

This log reports the status of the waypoint navigation progress. It is used in conjunction with the SETNAV command, see *page 223*.

See *Figure 11, below,* for an illustration of navigation parameters.

> The SETNAV command must be enabled before valid data will be reported from this log.

Message ID: **161**
Log Type: **Synch**



Reference	Description
1	TO lat-lon
2	X-Track perpendicular reference point
3	Current GPS position
4	A-Track perpendicular reference point
5	X-Track (cross track)
6	A-Track (along track)
7	Distance and bearing from 3 to 1

Figure 11: Navigation parameters

Table 81: Navigation Data Type

Navigation Data Type		Description
Binary	ASCII	
0	GOOD	Navigation is good
1	NOVELOCITY	Navigation has no velocity
2	BADNAV	Navigation calculation failed for an unknown reason
3	FROM_TO_SAME	“From” is too close to “To” for computation
4	TOO_CLOSE_TO_TO	Position is too close to “To” for computation
5	ANTIPODAL_WAYPTS	Waypoints are antipodal on surface

Recommended Input:

log navigatea ontime 1

ASCII Example:

```
#NAVIGATEA,COM1,0,56.0,FINESTEERING,1337,399190.000,00000000,aece,1984;
SOL_COMPUTED,PSRDIFF,SOL_COMPUTED,GOOD,9453.6278,303.066741,133.7313,
9577.9118,1338,349427.562*643cd4e2
```

Use the NAVIGATE log in conjunction with the SETNAV command to tell you where you currently are with relation to known To and From points. You can find a specific latitude, longitude or height knowing where you started from. A backpacker for example, could use these two commands to program a user-supplied graphical display on a digital GPS compass to show their progress as they follow a specific route.

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	NAVIGATE header	Log header		H	0
2	sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	pos type	Position type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	vel type	Velocity type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+8
5	nav type	Navigation data type (see *Table 81, Navigation Data Type* on *page 424*).	Enum	4	H+12
6	distance	Straight line horizontal distance from current position to the destination waypoint, in metres (see *Figure 11* on *page 424).* This value is positive when approaching the waypoint and becomes negative on passing the waypoint.	Double	8	H+16
7	bearing	Direction from the current position to the destination waypoint in degrees with respect to True North (or Magnetic if corrected for magnetic variation by MAGVAR command)	Double	8	H+24
8	along track	Horizontal track distance from the current position to the closest point on the waypoint arrival perpendicular; expressed in metres. This value is positive when approaching the waypoint and becomes negative on passing the waypoint.	Double	8	H+32
9	xtrack	The horizontal distance (perpendicular track-error) from the vessel's present position to the closest point on the great circle line that joins the FROM and TO waypoints. If a "track offset" has been entered in the SETNAV command, xtrack is the perpendicular error from the "offset track". Xtrack is expressed in metres. Positive values indicate the current position is right of the Track, while negative offset values indicate left.	Double	8	H+40
10	eta week	Estimated GPS reference week number at time of arrival at the "TO" waypoint along track arrival perpendicular based on current position and speed, in units of GPS reference weeks. If the receiving antenna is moving at a speed of less than 0.1 m/s in the direction of the destination, the value in this field is "9999".	Ulong	4	H+48
11	eta secs	Estimated GPS seconds into week at time of arrival at destination waypoint along track arrival perpendicular, based on current position and speed, in units of GPS seconds into the week. If the receiving antenna is moving at a speed of less than 0.1 m/s in the direction of the destination, the value in this field is "0.000".	Double	8	H+52
12	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+60
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.65 NMEA Standard Logs

GLMLA	**GLONASS ALMANAC DATA**
GPALM	**ALMANAC DATA**
GPGGA	**GLOBAL POSITION SYSTEM FIX DATA AND UNDULATION**
GPGGALONG	**GPS FIX DATA, EXTRA PRECISION AND UNDULATION**
GPGGARTK	**GPS FIX DATA**
GPGLL	**GEOGRAPHIC POSITION**
GPGRS	**GPS RANGE RESIDUALS FOR EACH SATELLITE**
GPGSA	**GPS DOP AN ACTIVE SATELLITES**
GPGST	**PSEUDORANGE MEASUREMENT NOISE STATISTICS**
GPGSV	**GPS SATELLITES IN VIEW**
GPHDT	**NMEA HEADING LOG (ALIGN)**
GPRMB	**NAVIGATION INFORMATION**
GPRMC	**GPS SPECIFIC INFORMATION**
GPVTG	**TRACK MADE GOOD AND GROUND SPEED**
GPZDA	**UTC TIME AND DATE**

The NMEA log structures follow format standards as adopted by the National Marine Electronics Association. The reference document used is "Standard For Interfacing Marine Electronic Devices NMEA 0183 Version 3.01". For further information, refer to the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/. The following table contains excerpts from Table 6 of the NMEA Standard which defines the variables for the NMEA logs. The actual format for each parameter is indicated after its description.

Please see the GPGGA usage box that applies to all NMEA logs on *page 362*.

Field Type	Symbol	Definition
Special Format Fields		
Status	A	Single character field: A = Yes, Data Valid, Warning Flag Clear V = No, Data Invalid, Warning Flag Set
Latitude	llll.ll	Fixed/Variable length field: degrees|minutes.decimal - 2 fixed digits of degrees, 2 fixed digits of mins and a variable number of digits for decimal-fraction of mins. Leading zeros always included for degrees and mins to maintain fixed length. The decimal point and associated decimal-fraction are optional if full resolution is not required.
Longitude	yyyyy.yy	Fixed/Variable length field: degrees|minutes.decimal - 3 fixed digits of degrees, 2 fixed digits of mins and a variable number of digits for decimal-fraction of mins. Leading zeros always included for degrees and mins to maintain fixed length. The decimal point and associated decimal-fraction are optional if full resolution is not required
Time	hhmmss.ss	Fixed/Variable length field: hours|minutes|seconds.decimal - 2 fixed digits of hours, 2 fixed digits of mins, 2 fixed digits of seconds and variable number of digits for decimal-fraction of seconds. Leading zeros always included for hours, mins and seconds to maintain fixed length. The decimal point and associated decimal-fraction are optional if full resolution is not required.
Defined field		Some fields are specified to contain pre-defined constants, most often alpha characters. Such a field is indicated in this standard by the presence of one or more valid characters. Excluded from the list of allowable characters are the following which are used to indicate field types within this standard: "A", "a", "c", "hh", "hhmmss.ss", "llll.ll", "x", "yyyyy.yy"
Numeric Value Fields		
Variable numbers	x.x	Variable length integer or floating numeric field. Optional leading and trailing zeros. The decimal point and associated decimal-fraction are optional if full resolution is not required (example: 73.10 = 73.1 = 073.1 = 73)
Fixed HEX	hh___	Fixed length HEX numbers only, MSB on the left
Information Fields		
Variable text	c--c	Variable length valid character field.
Fixed alpha	aa___	Fixed length field of uppercase or lowercase alpha characters
Fixed	xx___	Fixed length field of numeric characters
Fixed text	cc___	Fixed length field of valid characters

NOTES:

1. Spaces may only be used in variable text fields.
2. A negative sign "-" (HEX 2D) is the first character in a Field if the value is negative. The sign is omitted if the value is positive.
3. All data fields are delimited by a comma (,).
4. Null fields are indicated by no data between two commas (,,). Null fields indicate invalid data or no data available.
5. The NMEA Standard requires that message lengths be limited to 82 characters.

3.3.66 OMNIHPPOS OmniSTAR HP/XP Position

Outputs L-band Extra Performance (XP) or High Performance (HP) position information.

In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR service is required. Contact NovAtel for details, through our website at www.novatel.com through *Support*, or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **495**
Log Type: **Synch**

Recommended Input:

log omnihpposa ontime 1

ASCII Example:

```
#OMNIHPPOSA,COM1,0,67.5,FINESTEERING,1419,320435.000,00000000,808d,2724;
SOL_COMPUTED,OMNISTAR_HP,51.11635489609,-114.03819540112,1063.8314,-16.2713,
WGS84,0.1258,0.2135,0.2342,"1000",8.000,0.000,13,10,10,10,0,00,0,03*e8510806
```

OmniSTAR HP/XP service is particularly useful for agricultural machine guidance and many surveying tasks. It operates in real time, and without the need for local Base Stations or telemetry links. It usually has a 2-sigma Horizontal RMS (68%) = 10cm for HP and 15cm for XP.

.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	OMNIHPPOS header	Log header		H	0
2	sol status	Solution status, see *Table 56* on *page 302*	Enum	4	H
3	pos type	Position type, see *Table 55* on *page 301*	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Chapter 2, Table 16, Reference Ellipsoid Constants* on *page 95*)	Enum	4	H+36
9	lat σ	Latitude standard deviation	Float	4	H+40
10	lon σ	Longitude standard deviation	Float	4	H+44
11	hgt σ	Height standard deviation	Float	4	H+48
12	stn id	Base station ID	Char[4]	4	H+52
13	diff_age	Differential age in seconds	Float	4	H+56
14	sol_age	Solution age in seconds	Float	4	H+60
15	#SVs	Number of satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65
17	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+66
18	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84

3.3.67 OMNIHPSATS Satellites used in the OMNIHPPOS solution

This log lists the used and unused satellites for the corresponding OMNIHPPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: **1197**
Log Type: **Synch**

Recommended Input:

log omnihpsatsa ontime 1

ASCII Example:

```
#OMNIHPSATSA,COM2,0,85.0,FINESTEERING,1610,241351.000,00000000,2577,6293;17,G
PS,17,GOOD,00000003,GPS,2,GOOD,00000003,GPS,10,GOOD,00000003,GPS,4,GOOD,00000
003,GPS,29,GOOD,00000003,GPS,5,NOTUSED,00000000,GPS,25,GOOD,00000003,GPS,9,GO
OD,00000003,GPS,12,GOOD,00000003,GLONASS,15,NOTUSED,00000000,GLONASS,2-4,
NOTUSED,00000000,GLONASS,18-3,NOTUSED,00000000,GLONASS,9-2,NOTUSED,
00000000,GLONASS,1+1,NOTUSED,00000000,GLONASS,17+4,NOTUSED,00000000,GLONASS,1
6-1,NOTUSED,00000000,GLONASS,19+3,NOTUSED,00000000*F9EB4605
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	OMNIHPS ATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 157*.	Enum	4	H+4
4	Satellite ID	Satellite idendifier see *page 307*.	Simple	4	H+8
5	Status	Satellite status. See *Table 59*	Enum	4	H+16
6	Status mask	See *Table 60* on *page 307*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.68 OMNIVIS Omnistar Satellite Visibility List

This log contains OmniSTAR satellite and visibility information.

For local OmniSTAR beams, the satellite with the smallest local ellipsoid distance is the best one to use. For global beams, the satellite with the highest elevation is the best one. See also the *Usage Box* below.

Message ID: **860**

Log Type: **Synch**

Recommended Input:

```
log omnivisa ontime 1
#OMNIVISA,COM1,0,60.5,FINESTEERING,1419,396070.000,00000020,0041,2710;
TRUE,8,
10,0,"MSVW_",0,0.000,1536782000,1200,c685,-1.16,-90.00,
11,0,"MSVC_",0,0.000,1534741000,1200,c685,8.28,-90.00,
12,0,"MSVE_",0,0.000,1530359000,1200,c685,22.97,-90.00,
8,0,"AMSAT",0,0.000,1535137500,1200,c685,34.87,31.09,
7,0,"EASAT",0,0.000,1535152500,1200,c685,91.01,-41.76,
3,0,"AFSAT",0,0.000,1535080000,1200,c685,110.73,-41.76,
4,0,"APSAT",0,0.000,1535137500,1200,2873,185.25,-40.66,
13,0,"OCSAT",0,0.000,1535185000,1200,2873,235.91,-18.57*b35c9cdf
```

ASCII Example 2:

```
#OMNIVISA,COM1,0,62.5,FINESTEERING,1419,334202.000,00000020,0041,2710;
FALSE,0*9e0f9078
```

Local Beams: When the value is negative, the user is inside the local beam footprint and a signal should be available. Beams with small positive values may be available but their availability is not guaranteed.

Global Beams: Any beams above 0 degrees are visible, however the tracking may be marginal for elevations less than 10 degrees.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	OMNIVIS header	Log header		H	0
2	valid	Is the list of satellites valid? 0 = FALSE 1 = TRUE	Bool	4	H
3	#recs	Number of records to follow	Ulong	4	H+4
4	link ID	Satellite link ID	Uchar	1	H+8
5	app flag	Time of applicability flag: 0 = Valid Now 1 = Invalid 2 = Valid Until 3 = Valid After 4-7 = Reserved	Uchar	1	H+9
6	sat name	Satellite name	String	6	H+10
7	app week	Time of applicability week	Ulong	4	H+16
8	app sec	Time of applicability (s into the week)	GPSec	4	H+20
9	freq	Satellite broadcast frequency (Hz)	Ulong	4	H+28
10	bit rate	Satellite data bit rate	Ushort	2	H+32
11	service id	Satellite service ID	Hex	2	H+34
12	ellip dist	Local ellipsoid distance parameter	Float	4	H+36
13	global elev	Global beam elevation (degrees)	Float	4	H+40
14	Next satellite offset = H + 8 + (#recs x 32)				
15	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+8+ (#recs x 32)
16	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.69 PASSCOM, PASSXCOM, PASSAUX, PASSUSB, PASSETH1, PASSICOM, PASSNCOM Redirects Data

The pass-through logging feature enables the receiver to redirect any ASCII or binary data that is input at a specified port to any specified receiver port. It allows the receiver to perform bi-directional communications with other devices such as a modem, terminal or another receiver. See also the *INTERFACEMODE* command on *page 147*.

There are several pass-through logs. PASSCOM1, PASSCOM2, PASSCOM3, PASSXCOM1, PASSXCOM2, PASSXCOM3, PASSAUX, PASSETH1, PASSICOM1, PASSICOM2, PASSICOM3, PASSNCOM1, PASSNCOM2, PASSNCOM3 allow for redirection of data that is arriving at COM1, COM2, COM3, virtual COM1, virtual COM2 or AUX, respectively. The AUX port is available on some products. PASSUSB1, PASSUSB2, PASSUSB3 are only available on receivers that support USB and can be used to redirect data from USB1, USB2, or USB3. PASSETH1 is only available on receivers that support Ethernet and can be used to redirect data from ETH1.

A pass-through log is initiated the same as any other log, that is, LOG [to-port] [data-type] [trigger]. However, pass-through can be more clearly specified as: LOG [to-port] [from-port-AB] [onchanged]. Now, the [from-port-AB] field designates the port which accepts data (that is, COM1, COM2, COM3, AUX, USB1, USB2, or USB3) as well as the format in which the data is logged by the [to-port] (A for ASCII or B for Binary).

When the [from-port-AB] field is suffixed with an [A], all data received by that port is redirected to the [to-port] in ASCII format and logs according to standard NovAtel ASCII format. Therefore, all incoming ASCII data is redirected and output as ASCII data. However, any binary data received is converted to a form of ASCII hexadecimal before it is logged.

When the [from-port-AB] field is suffixed with a [B], all data received by that port is redirected to the [to-port] exactly as it is received. The log header and time-tag adhere to standard NovAtel Binary format followed by the pass-through data as it was received (ASCII or binary).

Pass-through logs are best utilized by setting the [trigger] field as onchanged or onnew.

If the data being injected is ASCII, then the data is grouped together with the following rules:

- blocks of 80 characters
- any block of characters ending in a <CR>
- any block of characters ending in a <LF>
- any block remaining in the receiver code when a time-out occurs (100 ms)

If the data being injected is binary, or the port INTERFACEMODE mode is set to GENERIC, then the data is grouped as follows:

- blocks of 80 bytes
- any block remaining in the receiver code when a time-out occurs (100 ms)

If a binary value is encountered in an ASCII output, then the byte is output as a hexadecimal byte preceded by a backslash and an x. For example 0A is output as \x0A. An actual ‘\’ in the data is output as \\. The output counts as one pass-through byte although it is four characters.

The first character of each pass-through record is time tagged in GPS REFERENCE WEEKs and seconds.

PASSCOM1 Message ID:233

PASSCOM2 Message ID:234

PASSCOM3 Message ID:235

PASSXCOM1 Message ID: 405

PASSXCOM2 Message ID: 406

PASSXCOM3 Message ID: 795

PASSUSB1 Message ID: 607

PASSUSB2 Message ID: 608

PASSUSB3 Message ID: 609

PASSAUX Message ID: 690

PASSETH1 Message ID: 1209

PASSICOM1 Message ID: 1251

PASSICOM2 Message ID: 1252

PASSICOM3 Message ID: 1253

PASSNCOM1 Message ID: 1254

PASSNCOM2 Message ID: 1255

PASSNCOM3 Message ID: 1256

Log Type: Asynch

Recommended Input:

log passcom1a onchanged

Asynchronous logs should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

ASCII Example 1:

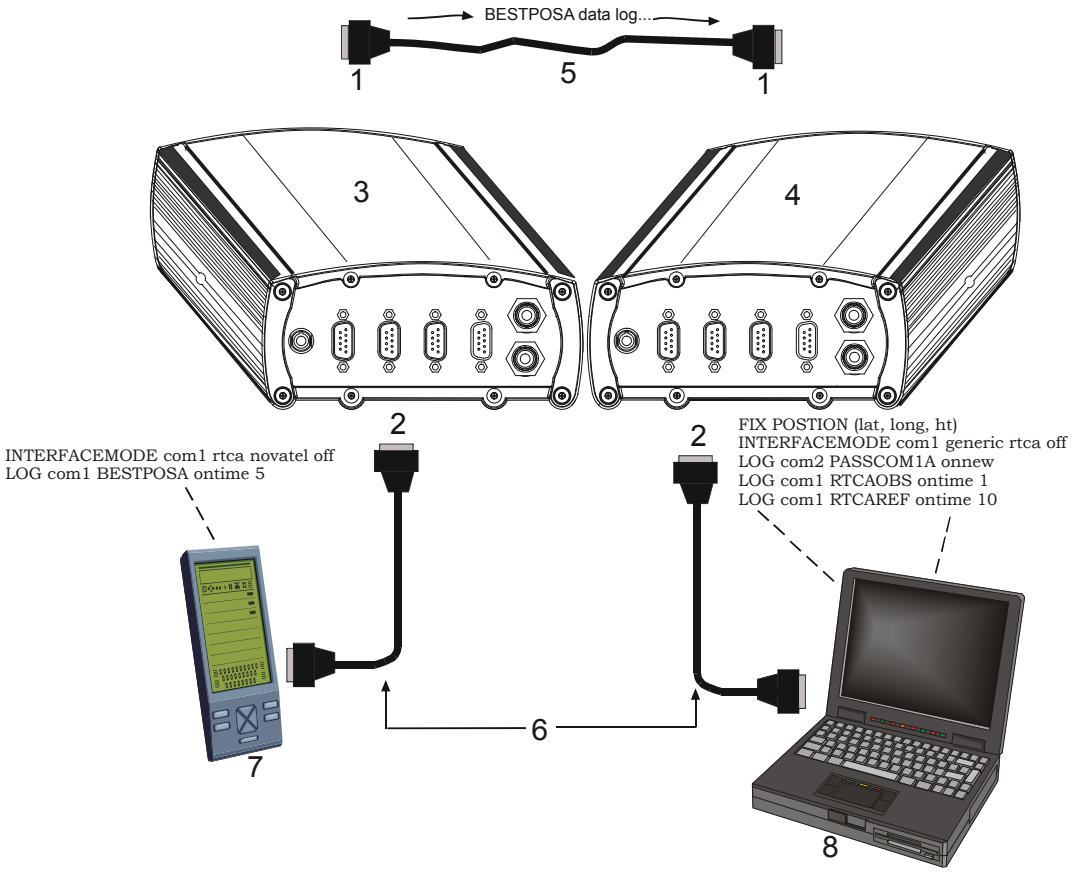
```
#PASSCOM2A,COM1,0,59.5,FINESTEERING,1337,400920.135,00000000,2b46,1984;
80,#BESTPOSA,COM3,0,80.0,FINESTEERING,1337,400920.000,00000000,4ca6,1899;
SOL_COMPUT*f9dfab46
#PASSCOM2A,COM1,0,64.0,FINESTEERING,1337,400920.201,00000000,2b46,1984;
80,ED,SINGLE,51.11636326036,-114.03824210485,1062.6015,-16.2713,WGS84,
1.8963,1.0674*807fd3ca
#PASSCOM2A,COM1,0,53.5,FINESTEERING,1337,400920.856,00000000,2b46,1984;
49,,2.2862,"",0.000,0.000,9,9,0,0,0,0,0,0*20b24878\x0d\x0a*3eef4220
#PASSCOM1A,COM1,0,53.5,FINESTEERING,1337,400922.463,00000000,13ff,1984;
17,unlog passcom2a\x0d\x0a*ef8d2508
```

ASCII Example 2:

```
#PASSCOM2A,COM1,0,53.0,FINESTEERING,1337,400040.151,00000000,2b46,1984;
80,\x99A\x10\x04\x07yN &\xc6\xea\xf10\x00\x01\xde\x00\x00\x10\xfe\xbf\xfe1\
xfe\x9c\xf4\x03\xe2\xef\x9f\x1f\xf3\xff\xd6\xff\xc3_A~z \xaa\xfe\xbf\xf9\
xd3\xf8\xd4\xf4-\xe8kHo\xe2\x00>\xe0QOC>\xc3\x9c\x11\xff\x7f\xf4\xa1\xf3t\
xf4'\xf4xvo\xe6\x00\x9d*dcd2e989
```

In the example, note that '~' is a printable character.

For example, you could connect two OEM6 family receivers together via their COM1 ports such as in the figure below (a rover station to base station scenario). If the rover station is logging BESTPOSA data to the base station, it is possible to use the pass-through logs to pass through the received BESTPOSA data to a disk file (let's call it diskfile.log) at the base station host PC hard disk.



Reference	Description	Reference	Description
1	To COM1	5	Data link
2	To COM2	6	Serial cables
3	Rover receiver	7	Pocket PC - rover
4	Base receiver	8	Laptop PC - base

Figure 12: Pass-Through Log Data

Under default conditions the two receivers "*chatter"* back and forth with the *Invalid Command Option* message (due to the command interpreter in each receiver not recognizing the command prompts of the other receiver). This *chattering* in turn causes the accepting receiver to transmit new pass-through logs with the response data from the other receiver. To avoid this chattering problem, use the INTERFACEMODE command on the accepting port to disable error reporting from the receiving port command interpreter.

If the accepting port's error reporting is disabled by INTERFACEMODE, the BESTPOSA data record passes through and creates two records.

The reason that two records are logged from the accepting receiver is because the first record was initiated by receipt of the BESTPOSA first terminator <CR>. Then the second record followed in response to the BESTPOSA second terminator <LF>.

Note that the time interval between the first character received and the terminating <LF> can be calculated by differencing the two GPS REFERENCE TIME tags. This pass-through feature is useful for time tagging the arrival of external messages. These messages can be any user-related data. If you are using this feature for tagging external events, it is recommended that the rover receiver be disabled from interpreting commands, so that the receiver does not respond to the messages, using the INTERFACEMODE command, see *page 147*.

If the BESTPOSB binary log data is input to the accepting port (log com2 passcom1a onchanged), the BESTPOSB binary data at the accepting port is converted to a variation of ASCII hexadecimal before it is passed through to COM2 port for logging.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PASSCOM header	Log header		H	0
2	#bytes	Number of bytes to follow	Ulong	4	H
3	data	Message data	Char [80]	80	H+4
4	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+8+(#bytes)
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.70 PASSTHROUGH Re-directed data from All Ports

This log outputs pass-through data from all receiver ports. Its behavior is the same as the port-specific pass-though logs described in *Section 3.3.69* on *page 434*.

Message ID: **1342**

Log Type: **ASynch**

Recommended Input:

```
log passthrougha onchanged
```

ASCII Example:

```
#PASSTHROUGHA,COM1,0,73.0,FINESTEERING,1625,165965.067,00040008,5fa3,39275;USB1,80,i\xd3\x00\x87>\xb0\x00'\x91\xb3"\xa0D?\xaa\xb2\x00\x07op\x18@\x05\xe9\xd4\x08\xe7\x03\x7f\xfd\x18{\x80w\xff\xf2N_cy\x11\x80\x0bC\xdc\x01@\x00\xdfr\xb1`\x873\xff\x81]\x7f\xe3\xff\xea\x83v\x08M\xd8?\xfcr\xf7\x01\x18\x00\x17\x1d2\xd1\xd1b\x00*5cb8bd9a
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PASSTHROUGH header	Log header		H	0
2	Port	See *Table 37, COM Port Identifiers* on *page 214 in Chapter 2* of this manual	Enum	4	H
3	#bytes	Number of bytes to follow	ULONG	80	H+4
4	data	Message data	CHAR[80]	80	H+8
10	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+8+#+bytes
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.71 PDPPOS PDP filter position

The PDPPOS log contains the pseudorange position computed by the receiver with the PDP filter enabled. See also the PDPFILTER command on *page 178*.

Message ID: **469**

Log Type: **Synch**

Recommended Input:

```
log pdpposa ontime 1
```

ASCII Example:

```
#PDPPOSA,COM1,0,75.5,FINESTEERING,1431,494991.000,00040000,a210,35548;
SOL_COMPUTED,SINGLE,51.11635010310,-114.03832575772,1065.5019,-16.9000,
WGS84,4.7976,2.0897,5.3062,"",0.000,0.000,8,8,0,0,0,0,0,0*3cbfa646
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PDPPOS header	Log header		H	0
2	sol status	Solution status	Enum	4	H
3	pos type	Position type	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number	Enum	4	H+36
9	lat σ	Latitude standard deviation	Float	4	H+40
10	lon σ	Longitude standard deviation	Float	4	H+44
11	hgt σ	Height standard deviation	Float	4	H+48
12	stn id	Base station ID	Char[4]	4	H+52
13	diff_age	Differential age in seconds	Float	4	H+56
14	sol_age	Solution age in seconds	Float	4	H+60
15	#sats	Number of satellite vehicles tracked	Uchar	1	H+64
16	#sats soln	Number of satellites in the solution	Uchar	1	H+65
17	Reserved		Uchar	1	H+66
18			Uchar	1	H+67
19			Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 58* on *page 303*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84

3.3.72 PDPSATS Satellites used in PDPPOS solution

This log lists the used and unused satellites for the corresponding PDPPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: **1234**
Log Type: **Synch**

Recommended Input:

log pdpsatsa ontime 1

ASCII Example:

```
#PDPSATSA,COM1,0,69.0,FINESTEERING,1597,573807.000,00000000,be33,6034;18,GPS,
20,GOOD,00000001,GPS,6,GOOD,00000001,GPS,7,GOOD,00000001,GPS,32,GOOD,00000001
,GPS,10,GOOD,00000001,GPS,23,GOOD,00000001,GPS,3,GOOD,00000001,GPS,16,GOOD,00
000001,GPS,2,GOOD,00000001,GPS,13,GOOD,00000001,GPS,4,GOOD,00000001,GLONASS,2
-4,GOOD,00000001,GLONASS,13-
2,GOOD,00000001,GLONASS,11,GOOD,00000001,GLONASS,1+1,GOOD,00000001,GLONASS,20
+2,GOOD,00000001,GLONASS,21+4,GOOD,00000001,GLONASS,3+5,GOOD,00000001*a59c985
1
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PDPSATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 157*.	Enum	4	H+4
4	Satellite ID	Satellite identifier. See *page 307*	Simple	4	H+8
5	Status	Satellite status. See *Table 59*	Enum	4	H+16
6	Status mask	See *Table 60* on *page 307*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.73 PDPVEL PDP filter velocity

The PDPVEL log contains the pseudorange velocity computed by the receiver with the PDP filter enabled. See also the PDPFILTER command on *page 178*.

Message ID: **470**
Log Type: **Synch**

Recommended Input:

log pdpvela ontime 1

ASCII Example:

```
#PDPVELA,COM1,0,75.0,FINESTEERING,1430,505990.000,00000000,b886,2859;
SOL_COMPUTED,SINGLE,0.150,0.000,27.4126,179.424617,-0.5521,0.0*7746b0fe
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PDPVEL header	Log header		H	0
2	sol status	Solution status	Enum	4	H
3	vel type	Velocity type	Enum	4	H+4
4	latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results.	Float	4	H+8
5	age	Differential age in seconds	Float	4	H+12
6	hor spd	Horizontal speed over ground, in metres per second	Double	8	H+16
7	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	Double	8	H+24
8	height	Height in metres where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	Double	8	H+32
9	Reserved		Float	4	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.74 PDPXYZ PDP filter Cartesian position and velocity

The PDPXYZ log contains the Cartesian position in X, Y and Z coordinates as computed by the receiver with the PDP filter enabled. See also the PDPFILTER command on *page 178*.

Message ID: **471**
Log Type: **Synch**

Recommended Input:

```
log pdpxyza ontime 1
```

ASCII Example:

```
#PDPXYZA,COM1,0,75.5,FINESTEERING,1431,494991.000,00040000,33ce,35548;
SOL_COMPUTED,SINGLE,-1634531.8128,-3664619.4862,4942496.5025,2.9036,
6.1657,3.0153,SOL_COMPUTED,SINGLE,-2.5588e-308,-3.1719e-308,3.9151e-308,
0.0100,0.0100,0.0100,"",0.150,0.000,0.000,8,8,0,0,0,0,0,0*a20dbd4f
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PDPXYZ header	Log header		H	0
2	P-sol status	Solution status	Enum	4	H
3	pos type	Position type	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P- Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status	Enum	4	H+44
11	vel type	Velocity type	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m)	Float	4	H+84
18	stn ID	Base station ID	Char[4]	4	H+88
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results.	Float	4	H+92
20	diff_age	Differential age in seconds	Float	4	H+96
21	sol_age	Solution age in seconds	Float	4	H+100
22	#sats	Number of satellite vehicles tracked	Uchar	1	H+104
23	#sats soln	Number of satellite vehicles used in solution	Uchar	1	H+105
24	Reserved		Uchar	1	H+106
25			Uchar	1	H+107
26			Uchar	1	H+108
27	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+109
28	Reserved		Hex	1	H+110
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.75 PORTSTATS Port Statistics

This log conveys various status parameters of the receiver's communication ports. The receiver maintains a running count of a variety of status indicators of the data link. This log outputs a report of those indicators.

Message ID: **72**
Log Type: **Polled**

Recommended Input:

log portstatsa once

ASCII example:

```
#PORTSTATSA,COM1,0,89.0,FINESTEERING,1609,500694.175,00000000,a872,6259;15,CO
M1,313,3477,313,0,755,0,0,0,0,COM2,0,6,0,0,6,0,0,0,0,COM3,0,6,0,0,6,0,0,0,0,U
SB1,0,0,0,0,0,0,0,0,0,0,USB2,0,0,0,0,0,0,0,0,0,0,USB3,0,0,0,0,0,0,0,0,0,0,XCOM1,0,7
,0,0,0,0,0,0,0,XCOM2,0,7,0,0,0,0,0,0,0,XCOM3,0,7,0,0,0,0,0,0,0,ICOM1,0,0,0,0,
0,0,0,0,0,ICOM2,0,0,0,0,0,0,0,0,0,ICOM3,0,0,0,0,0,0,0,0,0,NCOM1,0,0,0,0,0,0,0
,0,0,NCOM2,0,0,0,0,0,0,0,0,0,NCOM3,0,0,0,0,0,0,0,0,0*8f33f6ef
```

Parity and framing errors occur for COM ports if poor transmission lines are encountered or if there is an incompatibility in the data protocol. If errors occur, you may need to confirm the bit rate, number of data bits, number of stop bits and parity of both the transmit and receiving ends. Characters may be dropped when the CPU is overloaded

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PORTSTATS header	Log header		H	0
2	#port	Number of ports with information to follow	Long	4	H
3	port	Port identifier, see *Table ,* on *page 26*	Enum	4	H+4
4	rx chars	Total number of characters received through this port	Ulong	4	H+8
5	tx chars	Total number of characters transmitted through this port	Ulong	4	H+12
6	acc rx chars	Total number of accepted characters received through this port	Ulong	4	H+16
7	dropped chars	Number of software overruns	Ulong	4	H+20
8	interrupts	Number of interrupts on this port	Ulong	4	H+24
9	breaks	Number of breaks (only for serial ports)	Ulong	4	H+28
10	par err	Number of parity errors (only for serial ports)	Ulong	4	H+32
11	fram err	Number of framing errors (only for serial ports))	Ulong	4	H+36
12	overruns	Number of hardware overruns	Ulong	4	H+40
13	Next port offset = H + 4 + (#port x 40)				
14	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#port x 40)
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.76 PSRDOP Pseudorange DOP

The dilution of precision data is calculated using the geometry of only those satellites that are currently being tracked and used in the position solution by the receiver. This log is updated once every 60 seconds or whenever a change in the satellite constellation occurs. Therefore, the total number of data fields output by the log is variable and depends on the number of SVs that are being tracked.

1. If a satellite is locked out using the LOCKOUT command, it will still be shown in the PRN list, but it will be significantly de-weighted in the DOP calculation
2. The vertical dilution of precision can be calculated by: $vdop = \sqrt{pdop^2 - hdop^2}$

Message ID: 174
Log Type: Asynch

Recommended Input:

log psrdopa onchanged

ASCII Example:

```
#PSRDOPA,COM1,0,56.5,FINESTEERING,1337,403100.000,00000000,768f,1984;
1.9695,1.7613,1.0630,1.3808,0.8812,5.0,10,14,22,25,1,24,11,5,20,30,7*106de10a
```

When operating in differential mode, you require at least four common satellites at the base and rover. The number of common satellites being tracked at large distances is less than at short distances. This is important because the accuracy of GPS and DGPS positions depend a great deal on how many satellites are being used in the solution (redundancy) and the geometry of the satellites being used (DOP). DOP stands for dilution of precision and refers to the geometry of the satellites. A good DOP occurs when the satellites being tracked and used are evenly distributed throughout the sky. A bad DOP occurs when the satellites being tracked and used are not evenly distributed throughout the sky or grouped together in one part of the sky.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRDOP header	Log header		H	0
2	gdop	Geometric dilution of precision - assumes 3-D position and receiver clock offset (all 4 parameters) are unknown.	Float	4	H
3	pdop	Position dilution of precision - assumes 3-D position is unknown and receiver clock offset is known.	Float	4	H+4
4	hdop	Horizontal dilution of precision.	Float	4	H+8
5	htdop	Horizontal position and time dilution of precision.	Float	4	H+12
6	tdop	Time dilution of precision - assumes 3-D position is known and only the receiver clock offset is unknown.	Float	4	H+16
7	cutoff	Elevation cut-off angle.	Float	4	H+20
8	#PRN	Number of satellites PRNs to follow.	Long	4	H+24
9	PRN	PRN of SV PRN tracking, null field until position solution available.	Ulong	4	H+28
10...	Next PRN offset = H + 28 + (#prn x 4)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+28+ (#prn x 4)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.77 PSRDOP2 Pseudorange DOP

This log is similar to the PSRDOP log, but contains the per-system TDOPs.

Message ID: 1163
Log Type: Asynch

Recommended Input:

log psrdop2a onchanged

ASCII Example:

```
#PSRDOP2A,COM1,0,89.5,FINESTEERING,1613,164820.000,00000008,0802,39031;1.6740
,1.3010,0.6900,1.1030,2,GPS,0.6890,GLONASS,0.7980*5dd123d0.
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRDOP2 header	Log header		H	0
2	GDOP	Geometric dilution of precision - assumes 3-D position and receiver clock offset (all 4 parameters) are unknown.	Float	4	H
3	PDOP	Position dilution of precision - assumes 3-D position is unknown and receiver clock offset is known.	Float	4	H+4
4	HDOP	Horizontal dilution of precision	Float	4	H+8
5	VDOP	Vertical dilution of precision	Float	4	H+12
6	#systems	Number of systems	ULong	4	H+16
6	system	See *Table 29* on *page 157*	Enum	4	H+20
8	TDOP	Time dilution of precision	Long	4	H+24
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+28+
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.78 PSRPOS Pseudorange Position

This log contains the pseudorange position (in metres) computed by the receiver, along with three status flags. In addition, it reports other status indicators, including differential age, which is useful in predicting anomalous behavior brought about by outages in differential corrections.

Message ID: **47**
Log Type: **Synch**

Recommended Input:

log psrposa ontime 1

ASCII Example:

```
#PSRPOSA,COM1,0,58.5,FINESTEERING,1419,340037.000,00000040,6326,2724;
SOL_COMPUTED,SINGLE,51.11636177893,-114.03832396506,1062.5470,-16.2712,
WGS84,1.8532,1.4199,3.3168,"",0.000,0.000,12,12,0,0,0,06,0,33*d200a78c
```

There are variations of DGPS which can easily be perceived as using only one receiver. For example, the US Coast Guard operates a differential correction service which broadcasts GPS differential corrections over marine radio beacons. As a user, all you need is a marine beacon receiver and a GNSS receiver to achieve positioning accuracy of less than 1 metre. In this case, the Coast Guard owns and operates the base receiver at known coordinates. Other examples of users appearing to use only one GNSS receiver include FM radio station correction services, privately owned radio transmitters, and corrections carried by communication satellites. Some of the radio receivers have built-in GNSS receivers and combined antennas, so they even appear to look as one self-contained unit.

The major factors degrading GPS signals which can be removed or reduced with differential methods are the atmosphere, ionosphere, satellite orbit errors, and satellite clock errors. Some errors which are not removed include receiver noise and multipath.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRPOS header	Log header		H	0
2	sol status	Solution status (see *Table 56, Solution Status* on *page 302*)	Enum	4	H
3	pos type	Position type (see *Table 55, Position or Velocity Type* on *page 301*)	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Table 16, Reference Ellipsoid Constants* on *page 95*)	Enum	4	H+36
9	lat σ	Latitude standard deviation	Float	4	H+40
10	lon σ	Longitude standard deviation	Float	4	H+44
11	hgt σ	Height standard deviation	Float	4	H+48
12	stn id	Base station ID	Char[4]	4	H+52
13	diff_age	Differential age in seconds	Float	4	H+56
14	sol_age	Solution age in seconds	Float	4	H+60
15	#SVs	Number of satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65
17	Reserved		Uchar	1	H+66
18			Uchar	1	H+67
19			Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84

3.3.79 PSRSATS Satellites used in PSRPOS solution

This log lists the used and unused satellites for the corresponding PSRPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: **1162**
Log Type: **Synch**

Recommended Input:

log psrsatsa ontime 1

ASCII Example:

```
#PSRSATSA,COM1,0,78.0,FINESTEERING,1594,335430.000,00000008,fea4,5945;16,GPS,
26,GOOD,00000001,GPS,15,GOOD,00000001,GPS,19,GOOD,00000001,GPS,17,GOOD,000000
01,GPS,7,GOOD,00000001,GPS,8,GOOD,00000001,GPS,28,GOOD,00000001,GPS,24,GOOD,0
0000001,GPS,11,GOOD,00000001,GLONASS,14-7,GOOD,00000001,GLONASS,13-
2,GOOD,00000001,GLONASS,15,GOOD,00000001,GLONASS,5+1,GOOD,00000001,GLONASS,24
+2,GOOD,00000001,GLONASS,23+3,GOOD,00000001,GLONASS,17+4,GOOD,00000001*e20299
c4
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRSATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 157*.	Enum	4	H+4
4	Satellite ID	Satellite identifier. See *page 307*	Simple	4	H+8
5	Status	Satellite status. See *Table 59*	Enum	4	H+16
6	Status mask	See *Table 60* on *page 307*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.80 PSRTIME Time Offsets from the Pseudorange Filter

This log contains the instantaneous receiver clock offsets calculated in the pseudorange filter for each GNSS used in the solution.

Message ID: **881**
Log Type: **Synch**

Recommended Input:

log psrtimea ontime 1

ASCII Example:

```
#PSRTIMEA,COM1,0,62.5,FINESTEERING,1423,231836.000,00000000,462f,35520;
2,
GPS,-1.2631e-09,7.1562e-09,
GLONASS,-7.0099e-07,2.4243e-08*40aa2af1
```

Uses for this log include the following:

1. Estimating the difference between GPS and GLONASS satellite system times.
2. Estimating the difference between UTC and GLONASS system time.

.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRTIME header	Log header		H	0
2	#recs	Number of records to follow	Ulong	4	H
3	system	Navigation System 0 = GPS 1 = GLONASS	Enum	4	H+4
4	offset	GNSS time offset from the pseudorange filter	Double	8	H+8
5	offset stdv	Time offset standard deviation	Double	8	H+12
variable	Next binary offset = H+4+(#recs x 20)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.81 PSRVEL Pseudorange Velocity

In the PSRVEL log the actual speed and direction of the receiver antenna over ground is provided. The velocity measurements sometimes have a latency associated with them. The time of validity is the time tag in the log minus the latency value. See also the table footnote for velocity logs on *page 264*.

The velocity in the PSRVEL log is determined by the pseudorange filter. Velocities from the pseudorange filter are calculated from the Doppler.

The velocity status indicates varying degrees of velocity quality. To ensure healthy velocity, the velocity sol-status must also be checked. If the sol-status is non-zero, the velocity is likely invalid. It should be noted that the receiver does not determine the direction a vessel, craft, or vehicle is pointed (heading), but rather the direction of the motion of the GPS antenna relative to the ground.

The latency of the instantaneous Doppler velocity is always 0.15 seconds. The latency represents an estimate of the delay caused by the tracking loops under acceleration of approximately 1 G. For most users, the latency can be assumed to be zero (instantaneous velocity).

Message ID: **100**
Log Type: **Synch**

Recommended Input:

```
log psrvela ontime 1
```

ASCII Example:

```
#PSRVELA,COM1,0,52.5,FINESTEERING,1337,403362.000,00000000,658b,1984;
SOL_COMPUTED,PSRDIFF,0.250,9.000,0.0698,26.582692,0.0172,0.0*a94e5d48
```

Consider the case where vehicles are leaving a control center. The control center's coordinates are known but the vehicles are on the move. Using the control center's position as a reference, the vehicles are able to report where they are with PSRPOS and their speed and direction with PSRVEL at any time.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRVEL header	Log header		H	0
2	sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	vel type	Velocity type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results.	Float	4	H+8
5	age	Differential age in seconds	Float	4	H+12
6	hor spd	Horizontal speed over ground, in metres per second	Double	8	H+16
7	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	Double	8	H+24
8	vert spd	Vertical speed, in metres per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	Double	8	H+32
9	Reserved		Float	4	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.82 PSRXYZ Pseudorange Cartesian Position and Velocity

This log contains the receiver's pseudorange position and velocity in ECEF coordinates. The position and velocity status field's indicate whether or not the corresponding data is valid. See *Figure 10, page 315* for a definition of the ECEF coordinates.

The velocity status indicates varying degrees of velocity quality. To ensure healthy velocity, the velocity sol-status must also be checked. If the sol-status is non-zero, the velocity is likely invalid. It should be noted that the receiver does not determine the direction a vessel, craft, or vehicle is pointed (heading), but rather the direction of the motion of the GNSS antenna relative to the ground.

The latency of the instantaneous Doppler velocity is always 0.15 seconds. The latency represents an estimate of the delay caused by the tracking loops under acceleration of approximately 1 G. For must users, the latency can be assumed to be zero (instantaneous velocity).

Message ID: **243**
Log Type: **Synch**

Recommended Input:

```
log psrxyza ontime 1
```

ASCII Example:

```
#PSRXYZA,COM1,0,58.5,FINESTEERING,1419,340038.000,00000040,4a28,2724;
SOL_COMPUTED,SINGLE,-1634530.7002,-3664617.2823,4942495.5175,1.7971,
2.3694,2.7582,SOL_COMPUTED,DOPPLER_VELOCITY,0.0028,0.0231,-0.0120,
0.2148,0.2832,0.3297,"",0.150,0.000,0.000,12,12,0,0,0,06,0,33*4fdbcdb1
```

The instantaneous Doppler is the measured Doppler frequency which consists of the satellite's motion relative to the receiver (Satellite Doppler + User Doppler) and the clock (local oscillator) drift.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	PSRXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	pos type	Position type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P- Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H+44
11	vel type	Velocity type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m)	Float	4	H+84
18	stn ID	Base station ID	Char[4]	4	H+88
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results.	Float	4	H+92
20	diff_age	Differential age in seconds	Float	4	H+96
21	sol_age	Solution age in seconds	Float	4	H+100
22	#SVs	Number of satellite vehicles tracked	Uchar	1	H+104
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+105
24	Reserved		Char	1	H+106
25			Char	1	H+107
26			Char	1	H+108
27	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+109
28	Reserved		Hex	1	H+110
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.83 QZSSALMANAC Decoded Almanac Parameters

This log contains the decoded almanac parameters as received from the satellite with the parity information removed and appropriate scaling applied. Multiple messages are transmitted, one for each SV almanac collected. For more information about almanac data, refer to the QZSS Interface Specification.

Message ID: 1346

Log Type: Asynch

Recommended Input:

log qzssalmanaca onchanged

ASCII Examples:

```
#QZSSALMANACA,COM1,0,89.5,SATTIME,1642,148584.000,00000008,67d2,39655;
1,
193,1642,208896.0,7.587582e-02,-2.94869425e-09,-1.4441238e+00,-
1.5737385e+00,1.7932513e+00,0.00000000,0.00000000,7.29336435e-
05,4.2159360e+07,7.11809030e-01,7,7*fb648921
```

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSALMANAC Header	Log header		H	0
2	#messages	Number of satellite PRN almanac messages to follow. Set to zero until almanac data is available	ULONG	4	H
3	PRN	Satellite PRN number for current message, dimensionless	ULONG	4	H+4
4	week	Almanac reference week	ULONG	4	H+8
5	seconds	Almanac reference time, seconds into the week	DOUBLE	8	H+12
6	ecc	Eccentricity, dimensionless - defined for a conic section where e = 0 is a circle, e = 1 is a parabola, 0<e<1 is an ellipse and e>1 is a hyperbola.	DOUBLE	8	H+20
7	ώ	Rate of right ascension, radians/second	DOUBLE	8	H+28
8	ω_0	Right, ascension, radians	DOUBLE	8	H+36
9	ω	Argument of perigee, radians - measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion.	DOUBLE	8	H+44
10	M_0	Mean anomaly of reference time, radians	DOUBLE	8	H+52
11	a_{f0}	Clock againg parameter, seconds	DOUBLE	8	H+60
12	a_{f1}	Clock aging parameter, seconds/second	DOUBLE	8	H+68

Continued on next page

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
13	N	Corrected mean motion, radians/secondy	DOUBLE	8	H+76
14	A	Semi-major axis, metres	DOUBLE	8	H+84
15	inclination angle	Angle of inclination	DOUBLE	8	H+92
16	health-prn	SV health from Page 25 of subframe 4 or 5 (6 bits)	ULONG	4	H+100
17	health-alm	SV health from almanac (8 bits)	ULONG	4	H+104
18	Next PRN offset = H+4+(#messages x 104)				
19	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+4+(104x#messages)
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.84 QZSSEPHEMERIS Displays Decoded Parameters

A single set of QZSS ephemeris parameters.

Message ID: 1336

Log Type: Asynch

Recommended Input:

log qzssephemerisa onchanged

ASCII Examples:

```
#QZSSEPHEMERISA,COM1,0,93.5,SATTIME,1642,153690.000,00000008,1e9d,39655;
193,153690.000000000,7,201,201,1642,1642,154800.000000000,4.216030971806980e+07,2.11
5802417e-09,-2.152109479,0.075863329,-1.573817810,-0.000007546,0.000009645,-
177.375000000,-219.875000000,-0.000000797,-0.000002151,0.711859299,-2.978695503e-
10,-1.443966112,-1.636139580e-09,713,154800.000000000,-5.122274160e-09,-
0.000000163,1.250555215e-
12,0.000000000,FALSE,0.000072933,4.000000000,0,0,0,0*fbb52c7f
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	QZSSEPHEMERIS Header	Log header		H	0
2	PRN	Satellite PRN number	ULONG	4	H
3	tow	Time stamp of subframe 0 (seconds)	DOUBLE	8	H+4
4	health	Health status - a 6-bit health code as defined in QZSS Interface Specification	ULONG	4	H+12
5	IODE1	Issue of ephermis data 1	ULONG	4	H+16
6	IODE2	Issue of ephermis data 2	ULONG	4	H+20
7	week	GPS reference week number	ULONG	4	H+24
8	z week	Z count week number. This is the week number from subframe 1 of the ephemeris. The ‘toe week’ (field #7) is derived from this to account for rollover.	ULONG	4	H+28
9	toe	Reference time for ephemeris, seconds	DOUBLE	8	H+32
10	A	Semi-major axis, metres	DOUBLE	8	H+40
11	ΔN	Mean motion difference, radians/second	DOUBLE	8	H+48
12	M_0	Mean anomaly of reference time/ radius	DOUBLE	8	H+56
13	ecc	Eccentricity, dimensionless – quantity defined for a conic section where e= 0 is a circle, e = 1 is a parabola, 0<e<1 is an ellipse and e>1 is a hyperbola.	DOUBLE	8	H+64
14	ω	Argument of perigee, radians – measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion.	DOUBLE	8	H+72
15	cuc	Argument of latitude (amplitude of cosine, radians)	DOUBLE	8	H+80

Continued on next page

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
16	cus	Argument of latitude (amplitude of sine, radians)	DOUBLE	8	H+88
17	crc	Orbit radius (amplitude of cosine, metres)	DOUBLE	8	H+96
18	crs	Orbit radius (amplitude of sine, metres)	DOUBLE	8	H+104
19	cic	Inclination (amplitude of cosine, radians)	DOUBLE	8	H+112
20	cis	Inclination (amplitude of sine, radians)	DOUBLE	8	H+120
21	I_0	Inclination angle at reference time, radians	DOUBLE	8	H+128
22	$\dot{I}$	Rate of inclination angle, radians/second	DOUBLE	8	H+136
23	ω_0	Right ascention, radians	DOUBLE	8	H+144
24	$\dot{\omega}$	Rate of right ascention, radians/seconds	DOUBLE	8	H+152
25	iodc	issue of data clock	ULONG	8	H+160
26	toc	SV clock correction term, seconds	DOUBLE	8	H+164
27	tgd	Estimated group delay difference, seconds	DOUBLE	8	H+172
28	a_{fo}	Clock aging parameter, seconds (s)	DOUBLE	8	H+180
29	a_{f1}	clock aging parameter, (s/s)	DOUBLE	8	H+188
30	a_{r2}	clock againg parameter, (s/s/s)	BOOL	4	H+196
31	AS	Anti-spoofing on: 0= FALSE 1=TRUE	ENUM	4	H+204
32	N	Corrected mean motion, radians/second	DOUBLE	8	H+208
33	URA	User Range Accuracy variance, m2. The ICD a specifies that the URA index transmitted in the ephemerides can be converted to a nominal standard deviation value using an algorithm listed there. We publish the square of the nominal value (variance).	DOUBLE	8	H+216
34	Fit Interval	Curve fit interval: 0 = Ephemeris data are effective for 2 hours 1 = Ephemeris data are effective for more than 2 hours	UCHAR	1	H+224
35	Reserved		UCHAR	1	H+225
36	Reserved		UCHAR	1	H+226
37	Reserved		UCHAR	1	H+227
38	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+228
39	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.85 QZSSRAWALMANAC Raw QZSS Almanac Data

This log contains the undecoded almanac subframes as received from the QZSS satellite.

Message ID: 1345

Log Type: Asynch

Recommended Input:

log qzssrawalmanaca onchanged

ASCII Examples:

```
ASCII Example:

#QZSSRAWALMANACA,COM1,0,93.5,SATTIME,1642,153300.000,00480008,64c4,39655;
1642,208896.000,7,
1,8b000031c390c1820e33d007fefe07cae831c5293ebfe15049104a000001,
51,8b000031c613f3336a1fffffffffffffffffffffffffffffffffff000000,
49,8b000031cd90f14e6a7cf3cf1cf1cf3cf3c73cf1cf1cf3cf3cf3cf000002,
50,8b000031ce14f24e6a0cf3cf1df1cffffffffffffffffffffffff000002,
56,8b000031d511f80ff70003292ef496000006fffffffa4b6a0fe8040f0002,
52,8b000031e692f4a00a0fff83f060f208018008208208208208208002080381,
53,8b000031e717f5808208208208208208
```

3.3.86 QZSSIONUTC Japan-specific and Time Information

The Ionospheric Model parameters (ION) and the Universal Time Coordinated parameters (UTC) for QZSS are provided.

Message ID: 1347

Log Type: Asynch

Recommended Input:

log qzssionutca onchanged

ASCII Examples:

```
#QZSSIONUTCA,COM1,0,94.0,FINESTEERING,1642,153300.565,00480008,158b,39655;
1.396983861923218e-08,-6.705522537231444e-8,0.000000000000000e+000,1.7881393432

61719e-07,8.396800000000000e+04,7.536640000000000e+05,-7.864320000000000e+05,-
6.946816000000000e+06,1642,307200,-5.587935447692871e-09,5.329070518e-
15,1768,4,15,15,0*0204eec1
```

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSIONUTC Header	Log header		H	0
2	a0	Alpha parameter constant term	DOUBLE	8	H
3	a1	Alpha parameter 1st order term	DOUBLE	8	H+8
4	a2	Alpha parameter 2nd order term	DOUBLE	8	H+16
5	a3	Alpha parameter 3rd order term	DOUBLE	8	H+24
6	b0	Beta parameter constant term	DOUBLE	8	H+28
7	b1	Beta parameter 1st order term	DOUBLE	8	H+36
8	b2	Beta parameter 2nd order term	DOUBLE	8	H+44
9	b3	Beta parameter 3rd order term	DOUBLE	8	H+52
10	utc wn	UTC reference wekk number	ULONG	4	H+60
11	tot	Reference time of UTC parameters	ULONG	4	H+64
12	A0	UTC constant term of polynomial	DOUBLE	8	H+68
13	A1	UTC 1st order term of polynomial	DOUBLE	8	H+76
14	wn lsf	Future week number	ULONG	4	H+84
15	dn	Day number (the range is 1 to 7 where Sunday=1 and Saturday=7)	ULONG	4	H+88
16	deltat ls	Delta time due to leap seconds	LONG	4	H+92
17	deltat lsf	Future delta time due to leap seconds	LONG	4	H+96
18	delta utc	Time difference	ULONG	4	H+100
19	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+108
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.87 QZSSRAWEPHEM QZSS Raw Ephermis Information

This log contains the raw binary information for subframes one, two and three from the satellite with the parity information removed. Each subframe is 240 bits long (10 words - 24 bits each) and the log contains a total 720 bits (90 bytes) of information (240 bits x 3 subframes). This information is preceded by the PRN number of the satellite from which it originated. This message is not generated unless all 10 words from all 3 frames have passed parity.

Message ID: 1330
Log Type: Asynch

Recommended Input:

log qzssrawsubframea onnew

ASCII Examples:
#QZSSRAWEPHEMA,COM1,0,84.5,SATTIME,1642,230580.000,00000008,2f9e,39655;193,1642,234000,8b00004b0f879aa01c80000000000000000000000f6df3921fe0005fffdbd,8b00004b1009dfd2bb1ec493a98277e8fd26d924d5062dcae8f5b739210e,8b00004b108ffe5bc52864ae00591d003b8b02b6bfe13f3affe2afdff1e7*d2bd151e

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSRAWEPHEM Header	Log header		H	0
2	PRN	Satellite PRN number	ULONG	4	H
3	subfr id	Subframe ID	ULONG	4	H+4
4	data	Raw subframe data	HEX [30]	32[a]	H+8
5	chan	Signal channel number that the frame was decoded on	ULONG	4	H+40
6	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+44
7	[CR][LF]	Sentence terminator	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

3.3.88 QZSSRAWSUBFRAME Raw QZSS Subframe Data

This log contains the raw QZSS subframe data.

A raw QZSS subframe is 300 bits in total. This includes the parity bits which are interspersed with the raw data ten times in six bit chunks, for a total of 60 parity bits. Note that in Field #5, the 'data' field below, we have stripped out these 60 parity bits, and only the raw subframe data remains, for a total of 240 bits. There are two bytes added onto the end of this 30 byte packed binary array to pad out the entire data structure to 32 bytes in order to maintain 4 byte alignment.

Message ID: 1331
Log Type: Asynch

Recommended Input:

log qzssrawephema onnew

ASCII Examples:

```
#QZSSRAWSUBFRAMEA,COM1,0,85.5,SATTIME,1642,230604.000,00000008,e56b,39655;193,5,8b00
004b11970637984efbf7fd4d0fa10ca49631ace140740a08fe0dfd43,65*6a7b9123
```

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	QZSSRAWSUBFRAME Header	Log header		H	0
2	prn	Satellite PRN number	ULONG	4	H
3	ref week	Ephermis reference week number	ULONG	4	H+4
4	ref secs	Ephermis reference time (s)	ULONG	4	H+8
5	subframe1	Subframe 1 data	HEX	30	H+12
6	subframe2	Subframe 2 data	HEX	30	H+42
7	subframe3	Subframe 3 data	HEX	30	H+72
8	xxxx	32-bit CRC (ASCII and Binary only)	HEX	4	H+102
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.89 RAIMSTATUS RAIM status

This log provides information on RAIM status. See *Section 2.5.70, RAIMMODE Configures RAIM mode* starting on *page 188*.

Message ID: 1286

Log Type: Synch

Recommended Input:

log raimstatusa ontime 1

ASCII Examples:

```
#RAIMSTATUSA,COM1,0,93.5,FINESTEERING,1595,387671.500,00000008,bf2d,5968;DEFA
ULT,PASS,NOT_AVAILABLE,0.000,NOT_AVAILABLE,0.000,0*96a129ee
```

```
#RAIMSTATUSA,COM1,0,95.5,FINESTEERING,1595,387672.000,00000008,bf2d,5968;APPR
OACH,PASS,PASS,17.037,PASS,25.543,0*2a53f2b9
```

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	RAIMSTATUS Header	Log header	-	H	0
2	RAIM Mode	RAIM mode, see *Table 32* on *page 189*	enum	4	H
3	Integrity status	Integrity Status, see *Table 82* on *page 467*	enum	4	H+4
4	HPL status	Horizontal protection level status, see *Table 83* on *page 467*	enum	4	H+8
5	HPL	Horizontal protection level	double	8	H+12
6	VPL status	Vertical protection level status, see *Table 83* on *page 467*	enum	4	H+20
7	VPL	Vertical protection level	double	8	H+24
8	Num of SVs	Number of excluded satellites	ulong	4	H+32
9	System	Satellite system	enum	4	H+36
10	Satellite ID	In binary logs, the satellite ID field is 4 bytes. The 2 lowest-order bytes, interpreted as a USHORT, are the system identifier: for instance, the PRN for GPS, or the slot for GLONASS. The 2 highest-order bytes are the frequency channel for GLONASS, interpreted as a SHORT, and zero for all other systems. In ASCII and abbreviated ASCII logs, the satellite ID field is the system identifier. If the system is GLONASS and the frequency channel is not zero, then the signed channel is appended to the system identifier. For example, slot 13, frequency channel -2 is output as 13-2.	ulong	4	H+40
…	….	Next excluded satellite system	….	….	
…	….	Next excluded satellite ID	….	….	
	xxxx	32-bit CRC (ASCII and Binary only)	hex	4	
	[CR][LF]	Sentence terminator (ASCII only)			

Table 82: Integrity Status

Binary	ASCII	Description
0	NOT_AVAILABLE	RAIM is unavailable because either there is no solution, or because the solution is unique, that is, there is no redundancy.
1	PASS	RAIM succeeded. Either there were no bad observations, or the bad observations were successfully removed from the solution.
2	FAIL	RAIM detected a failure, but was unable to isolate the bad observations.

Table 83: PL Status

Binary	ASCII	Description
0	NOT_AVAILABLE	When RAIM is not available for example, after issuing a FRESET command, or when there are not enough satellites tracked to produce the required redundant observations.
1	PASS	Current protection levels are below alert limits, meaning that positioning accuracy requirements are fulfilled. HPL < HAL VPL < VAL
2	ALERT	Current protection levels are above alert limits, meaning that required positioning accuracy cannot be guaranteed by RAIM algorithm. HPL ≥ HAL VPL ≥ VAL

3.3.90 RANGE Satellite Range Information

RANGE contains the channel measurements for the currently tracked satellites. When using this log, please keep in mind the constraints noted along with the description.

It is important to ensure that the receiver clock has been set. This can be monitored by the bits in the *Receiver Status* field of the log header. Large jumps in pseudorange as well as accumulated Doppler range (ADR) occur as the clock is being adjusted. If the ADR measurement is being used in precise phase processing, it is important not to use the ADR if the "parity known" flag in the *ch-tr-status* field is not set as there may exist a half (1/2) cycle ambiguity on the measurement. The tracking error estimate of the pseudorange and carrier phase (ADR) is the thermal noise of the receiver tracking loops only. It does not account for possible multipath errors or atmospheric delays.

If both the L1 and L2 signals are being tracked for a given PRN, two entries with the same PRN appear in the range logs. As shown in *Table 87, Channel Tracking Status* on *page 470*, these entries can be differentiated by bit 20, which is set if there are multiple observables for a given PRN, and bits 21-22, which denotes whether the observation is for L1 or L2. This is to aid in parsing the data.

Message ID: **43**
Log Type: **Synch**

Recommended Input:

log rangea ontime 30

ASCII Example:

```
#RANGEA,COM1,0,63.5,FINESTEERING,1429,226979.000,00000000,5103,2748;
26,
6,0,23359924.081,0.078,-122757217.106875,0.015,-3538.602,43.3,19967.080,
08109c04,
6,0,23359926.375,0.167,-95654966.812027,0.019,-2757.355,36.7,19960.461,
01309c0b,
21,0,20200269.147,0.038,-106153137.954409,0.008,-86.289,49.5,13397.470,
08109c44,
21,0,20200268.815,0.056,-82716721.366921,0.008,-67.242,46.1,13391.980,
01309c4b,
16,0,23945650.428,0.091,-125835245.287192,0.024,-2385.422,41.9,10864.640,
08109c64,
16,0,23945651.399,0.148,-98053428.283142,0.028,-1858.773,37.7,10859.980,
01309c6b,
.
.
.
44,12,19388129.378,0.335,-103786179.553598,0.012,975.676,36.6,3726.656,
18119e24,
44,12,19388136.659,0.167,-80722615.862096,0.000,758.859,42.7,3714.860,
10b19e2b,
43,8,20375687.399,0.253,-108919708.904476,0.012,-2781.090,39.1,10629.934,
18119e84,
43,8,20375689.555,0.177,-84715349.232514,0.000,-2163.074,42.2,10619.916,
10b19e8b*fd2d3125
```

Consider the case where you have a computer to record data at a fixed location, and another laptop in the field also recording data as you travel. Can you take the difference between the recorded location and the known location of the fixed point and use that as an error correction for the recorded data in the field?

The simple answer is yes. You can take the difference between recorded position and known location and apply this as a position correction to your field data. Then, what is the difference between pseudorange and position differencing?

The correct and more standard way of computing this correction is to compute the range error to each GNSS satellite being tracked at your fixed location and to apply these range corrections to the observations at your mobile station.

The position corrections method is seldom used in industry. The drawback of this method is that computed corrections vary depending on the location of the fixed station. The geometry is not accounted for between the fixed station and the tracked satellites. Also, position corrections at the fixed site are computed with a certain group of satellites while the field station is tracking a different group of satellites. In general, when the position correction method is used, the farther the fixed and field stations are apart, the less accurate the solution.

The range corrections method is more commonly used in industry. The advantage of using this method is that it provides consistent range corrections and hence field positions regardless of the location of your fixed station. You are only able to obtain a "good" differential position if both the fixed and field stations are tracking the same four satellites at a minimum.

DGPS refers to using 1 base receiver at a known location and 1 or more rover receivers at unknown locations. As the position of the base is accurately known, we can determine the error that is present in GNSS at any given instant by either of the two methods previously described. We counter the bias effects present in GNSS including: ionospheric, tropospheric, ephemeris, receiver and satellite clock errors. You could choose either method depending on your application and the accuracy required.

Table 84: Tracking State

State	Description	State	Description
0	Idle	7	Frequency-lock loop
2	Wide frequency band pull-in	9	Channel alignment
3	Narrow frequency band pull-in	10	Code search
4	Phase lock loop	11	Aided phase lock loop

Table 85: Correlator Type

State	Description
0	N/A
1	Standard correlator: spacing = 1 chip
2	Narrow Correlator®: spacing < 1 chip
3	Reserved
4	Pulse Aperture Correlator (PAC)
5-6	Reserved

Table 86: Channel Tracking Example

	N7				N6				N5				N4				N3				N2				N1				N0			
0x	0				8				1				0				9				C				0				4			
Bit #	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Binary[a]	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0
Data	Chan. Assignment	Reserved (R)			Primary L1	R			Signal Type			Grouping	R	Satellite System			Correlator Spacing			Code locked flag	Parity flag	Phase lock flag		Channel Number				Tracking State			
Value	Automatic				Primary				L1 C/A			Grouped		GPS			PAC			Locked	Known	Locked		Channel 0				L1 Phase Lock Loop			

a. For a complete list of hexadecimal and binary equivalents please refer to the Unit Conversions page on our website at www.novatel.com through *Support* | *Knowledge and Learning*.

Table 87: Channel Tracking Status

Nibble #	Bit #	Mask	Description	Range Value
N0	0	0x00000001	Tracking state	0-11, see *Table 84, Tracking State* on *page 469*
	1	0x00000002		
	2	0x00000004		
	3	0x00000008		
N1	4	0x00000010		
	5	0x00000020	SV channel number	0-n (0 = first, n = last) n depends on the receiver
	6	0x00000040		
	7	0x00000080		
	8	0x00000100		
	9	0x00000200		
	10	0x00000400	Phase lock flag	0 = Not locked, 1 = Locked
	11	0x00000800	Parity known flag	0 = Not known, 1 = Known

Continued on next page

Nibble #	Bit #	Mask	Description	Range Value
N3	12	0x00001000	Code locked flag	0 = Not locked, 1 = Locked
	13	0x00002000	Correlator type	0-7, see *Table 85, Correlator Type* on *page 470*
	14	0x00004000		
	15	0x00008000		
N4	16	0x00010000	Satellite system	0 = GPS 1= GLONASS 2 = SBAS 3 = Galileo 4-6 = Reserved 7 = Other
	17	0x00020000		
	18	0x00040000		
	19	0x00080000	Reserved	
N5	20	0x00100000	Grouping	0 = Not grouped, 1 = Grouped
	21	0x00200000	Signal type	Dependent on satellite system above: GPS: 0 = L1 C/A 2 = L5 Q 5 = L2 P 9 = L2 P codeless 14= L5 Q 17 = L2 C Galileo: 2 = E1 C 12 = E5a Q 14 = L5 Q 17 = E5b Q 20 = AltBOC Q GLONASS: 0 = L1 C/A 1 = L2 C/A 5 = L2 P SBAS: 0 = L1 C/A Other: 19 = OmniSTAR
	22	0x00400000		
	23	0x00800000		
N6	24	0x01000000		
	25	0x02000000		
	26	0x04000000	Forward Error Correction	0 = Not FEC, 1 = FEC
	27	0x08000000	Primary L1 channel	0 = Not primary, 1 = Primary
N7	28	0x10000000	Carrier phase measurement [a]	0 = Half Cycle Not Added, 1 = Half Cycle Added
	29	Reserved		
	30	0x40000000	PRN lock flag [b]	0 = PRN Not Locked Out,
	31	0x80000000	Channel assignment	0 = Automatic, 1 = Forced

a. This bit is zero until the parity is known and the parity known flag (bit 11) is set to 1.

b. A PRN can be locked out using the LOCKOUT command, see also *page 156*.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RANGE header	Log header		H	0
2	# obs	Number of observations with information to follow [a]	Long	4	H
3	PRN/ slot	Satellite PRN number of range measurement (GPS: 1 to 32, SBAS: 120 to 138, GLONASS: 38 to 61, and Galileo: 1 to 36, see *Section 1.3* on *page 31*)	UShort	2	H+4
4	glofreq	(GLONASS Frequency + 7), see *Section 1.3* on *page 31*.	UShort	2	H+6
5	psr	Pseudorange measurement (m)	Double	8	H+8
6	psr std	Pseudorange measurement standard deviation (m)	Float	4	H+16
7	adr	Carrier phase, in cycles (accumulated Doppler range)	Double	8	H+20
8	adr std	Estimated carrier phase standard deviation (cycles)	Float	4	H+28
9	dopp	Instantaneous carrier Doppler frequency (Hz)	Float	4	H+32
10	C/No	Carrier to noise density ratio C/No = $10[\log_{10}(S/N_0)]$ (dB-Hz)	Float	4	H+36
11	locktime	# of seconds of continuous tracking (no cycle slipping)	Float	4	H+40
12	ch-tr-status	Tracking status (see *87, Channel Tracking Status* on *page 470* and the example in *Table 86*)	ULong	4	H+44
13...	Next PRN offset = H + 4 + (#obs x 44)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#obs x 44)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. Satellite PRNs may have two lines of observations, one for the L1 frequency and the other for L2.

3.3.91 RANGECMP Compressed Version of the RANGE Log

This log contains the RANGE data in a compressed format.

Message ID: **140**
Log Type: **Synch**

Recommended Input:

log rangecmpa ontime 10

Example:

```
#RANGECMPA,COM1,0,63.5,FINESTEERING,1429,226780.000,00000000,9691,2748;
26,
049c10081857f2df1f4a130ba2888eb9600603a709030000,
0b9c3001225bf58f334a130bb1e2bed473062fa609020000,
449c1008340400e0aaa9a109a7535bac2015cf71c6030000,
4b9c300145030010a6a9a10959c2f09120151f7166030000,
...
0b9d301113c8ffefc284000c6ea051dbf3089da1a0010000,
249d1018c6b7f67fa228820af2e5e39830180ae1a8030000,
2b9d301165c4f8ffb228820a500a089f31185fe0a8020000,
449d1018be18f41f2aacad0a1a934efc40074ecf88030000,
4b9d301182b9f69f38acad0a3e3ac28841079fcb88020000,
849d101817a1f95f16d7af0a69fbe1fa401d3fd064030000,
8b9d30112909fb2f20d7af0a9f24a687521ddece64020000,
249e1118af4e0470f66d4309a0a631cd642cf5b821320000,
2b9eb110a55903502f6e4309ee28d1ad032c7cb7e1320000,
849e1118b878f54f4ed2aa098c35558a532bde1765220000,
8b9eb110abcff71f5ed2aa09cb6ad0f9032b9d16c5220000*0eeead18
```

Consider the case where commercial vehicles are leaving a control center. The control center's coordinates are known but the vehicles are on the move. Using the control center's position as a reference, the vehicles are able to report where they are at any time. Post-processed information gives more accurate comparisons.

Post-processing can provide post-mission position and velocity using raw GNSS collected from the vehicles. The logs necessary for post-processing include:

RANGECMPB ONTIME 1

RAWEPHEMB ONNEW

This is an example of data collection for post-processing. OEM6-based output is compatible with post-processing software from the Waypoint Products Group, NovAtel Inc. Refer to our website at www.novatel.com for more details.

Table 88: Range Record Format (RANGECMP only)

Data	Bit(s) first to last	Length (bits)	Scale Factor	Units
Channel Tracking Status	0-31	32	see *Table 87* on *page 470*	-
Doppler Frequency	32-59	28	1/256	Hz
Pseudorange (PSR)	60-95	36	1/128	m
ADR [a]	96-127	32	1/256	cycles
StdDev-PSR	128-131	4	see note b	m
StdDev-ADR	132-135	4	(n + 1)/512	cycles
PRN/Slot [c]	136-143	8	1	-
Lock Time [d]	144-164	21	1/32	s
C/No [e]	165-169	5	(20 + n)	dB-Hz
Reserved	170-191	22		

a. ADR (Accumulated Doppler Range) is calculated as follows:

ADR_ROLLS = (RANGECMP_PSR / WAVELENGTH + RANGECMP_ADR) / MAX_VALUE
Round to the closest integer
IF (ADR_ROLLS ≤ 0)
    ADR_ROLLS = ADR_ROLLS - 0.5
ELSE
    ADR_ROLLS = ADR_ROLLS + 0.5
At this point integerise ADR_ROLLS
CORRECTED_ADR = RANGECMP_ADR - (MAX_VALUE*ADR_ROLLS)
where
ADR has units of cycles
WAVELENGTH = 0.1902936727984 for GPS L1
WAVELENGTH = 0.2442102134246 for GPS L2
MAX_VALUE = 8388608

Note: *GLONASS satellites emit L1 and L2 carrier waves at a satellite-specific frequency, refer to the GNSS Reference Book for more on GLONASS frequencies.*

b.

Code	StdDev-PSR (m)
0	0.050
1	0.075
2	0.113
3	0.169
4	0.253
5	0.380
6	0.570
7	0.854
8	1.281
9	2.375
10	4.750
11	9.500
12	19.000
13	38.000
14	76.000
15	152.000

c. GPS: 1 to 32, SBAS: 120 to 138, and GLONASS: 38 to 61, see *Section 1.3* on *page 31*.

d. The *Lock Time* field of the RANGECMP log is constrained to a maximum value of 2,097,151 which represents a lock time of 65535.96875 s (2097151 ÷ 32).

e. C/No is constrained to a value between 20-51 dB-Hz. Thus, if it is reported that C/No = 20 dB-Hz, the actual value could be less. Likewise, if it is reported that C/No = 51, the true value could be greater.

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	RANGECMP header	Log header		H	0
2	#obs	Number of satellite observations with information to follow.	Long	4	H
3	1st range record	Compressed range log in format of *Table 88* on *page 474*	Hex	24	H+4
4	Next rangecmp offset = H + 4 + (#obs x 24)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 4 + (#obs x 24)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.92 RANGEGPSL1 L1 Version of the RANGE Log

This log is identical to the RANGE log, see *page 468*, except that it only includes L1 GPS observations.

Message ID: **631**
Log Type: **Synch**

Recommended Input:

log rangegpsl1a ontime 30

ASCII Example:

```
#RANGEGPSL1A,COM1,0,57.0,FINESTEERING,1337,404766.000,00000000,5862,1984;
10,
14,0,21773427.400,0.037,-114420590.433332,0.006,-2408.171,49.9,14963.280,
18109c04,
22,0,24822942.668,0.045,-130445851.055756,0.009,-3440.031,48.0,22312.971,
08109c24,
25,0,20831000.299,0.033,-109468139.214586,0.006,1096.876,50.7,7887.840,
08109c44,
1,0,20401022.863,0.032,-107208568.887106,0.006,-429.690,51.1,10791.500,
18109c64,
24,0,23988223.932,0.074,-126058964.619453,0.013,2519.418,43.8,493.550,
18109c84,
11,0,22154466.593,0.043,-116423014.826717,0.007,-1661.273,48.4,11020.952,
08109ca4,
5,0,24322401.516,0.067,-127815012.260616,0.012,-1363.596,44.6,6360.282,
18109cc4,
20,0,22294469.347,0.043,-117158267.467388,0.008,2896.813,48.5,4635.968,
08109ce4,
30,0,23267589.649,0.051,-122271969.418761,0.009,822.194,47.0,4542.270,
08109d04,
23,0,24975654.673,0.058,-131247903.805678,0.009,3395.097,45.9,406.762,
18109d24*be4b7d70
```

Since the RANGEGPSL1 log includes only L1 GPS observations, it it smaller in size than the RANGE log which contain entries for both L1 and L2. Use the RANGEGPSL1 log when data throughput is limited and you are only interested in GPS L1 range data. For L1 only models, RANGE and RANGEGPSL1 logs are identical.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RANGEGPSL1 header	Log header		H	0
2	# obs	Number of L1 observations with information to follow	Long	4	H
3	PRN	Satellite PRN number of range measurement (GPS: 1 to 32)	UShort	2	H+4
4	Reserved		UShort	2	H+6
5	psr	Pseudorange measurement (m)	Double	8	H+8
6	psr std	Pseudorange measurement standard deviation (m)	Float	4	H+16
7	adr	Carrier phase, in cycles (accumulated Doppler range)	Double	8	H+20
8	adr std	Estimated carrier phase standard deviation (cycles)	Float	4	H+28
9	dopp	Instantaneous carrier Doppler frequency (Hz)	Float	4	H+32
10	C/No	Carrier to noise density ratio C/No = $10[\log_{10}(S/N_0)]$ (dB-Hz)	Float	4	H+36
11	locktime	Number of seconds of continuous tracking (no cycle slipping)	Float	4	H+40
12	ch-tr-status	Tracking status (see *87, Channel Tracking Status* on *page 470*)	ULong	4	H+44
13...	Next PRN offset = H + 4 + (#obs x 44)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#obs x 44)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.93 RAWALM Raw Almanac Data

This log contains the undecoded almanac subframes as received from the satellite. For more information about Almanac data, refer to the *Introduction to GNSS* book, available through our website at www.novatel.com through *Support | Knowledge and Learning > Learn About GNSS > GNSS Book.*

Message ID: **74**
Log Type: **Asynch**

Recommended Input:

log rawalma onchanged

ASCII Example:

```
#RAWALMA,COM1,0,56.0,SATTIME,1337,405078.000,00000000,cc1b,1984;
1337,589824.000,43,
3,8b04e4839f35433a5590f5aefd3900a10c9aaa6f40187925e50b9f03003f,
27,8b04e483a1325b9cde9007f2fd5300a10da5562da3adc0966488dd01001a,
4,8b04e483a1b44439979006e2fd4f00a10d15d96b3b021e6c6c5f23feff3c,
28,8b04e483a3b05c5509900b7cfd5800a10cc483e2bfa1d2613003bd050017,
5,8b04e483a43745351c90fcb0fd4500a10d8a800f0328067e5df8b6100031,
57,8b04e483a6337964e036d74017509f38e13112df8dd92d040605eeaaaaaa,
6,8b04e483a6b54633e390fa8bfd3f00a10d4facbc80b322528f62146800ba,
29,8b04e483a8b05d47f7901b20fd5700a10ce02d570ed40a0a2216412400cb,
7,8b04e483a935476dee90fb94fd4300a10d93aba327b7794ae853c02700ba,
.
.
.
1,8b04e483d8b641305a901b9dfd5a00a10ce92f48f1ba0a5dcccb7500003b,
25,8b04e483dab25962259004fcfd4c00a10dc154eee5c555d7a2a5010d000d,
2,8b04e483db37424aa6900720fd4f00a10c5ad89baa4dc1460790b6fc000f,
26,8b04e483dd305a878c901d32fd5b00a10c902eb7f51db6b6ce95c701fff4*83cae97a
```

The OEM6 family of receivers automatically saves almanacs in their non-volatile memory (NVM), therefore creating an almanac boot file is not necessary.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWALM header	Log header		H	0
2	ref week	Almanac reference week number	Ulong	4	H
3	ref secs	Almanac reference time (s)	GPSec	4	H+4
4	subframes	Number of subframes to follow	Ulong	4	H+8
5	svid	SV ID (satellite vehicle ID) [a]	UShort	2	H+12
6	data	Subframe page data	Hex	30	H+14
7...	Next subframe offset = H + 12 + (subframe x 32)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H + 12 + (32 x subframes)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. A value between 1 and 32 for the SV ID indicates the PRN of the satellite. Any other values indicate the page ID. See section 20.3.3.5.1.1, *Data ID and SV ID*, of ICD-GPS-200C for more details. To obtain copies of ICD-GPS-200, see ARINC in the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/.

3.3.94 RAWCNAVFRAME Raw L2C frame data

This log provides raw L2C frame data.

Message ID: **1066**
Log Type: **Asynch**

Recommended Input:

log rawcnavframe onnew

ASCII Example:

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWCNAVFRAME header	Log header		H	0
2	sigchannum	Signal cannel providing the bits	Ulong	4	H
3	PRN	Satellite PRN number	Ulong	4	H+4
4	frameId	frame ID	Ulong	4	H+8
5	data	Raw frame data	Hex[38]	38	H+12
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.95 RAWEPHEM Raw Ephemeris

This log contains the raw binary information for subframes one, two and three from the satellite with the parity information removed. Each subframe is 240 bits long (10 words - 24 bits each) and the log contains a total 720 bits (90 bytes) of information (240 bits x 3 subframes). This information is preceded by the PRN number of the satellite from which it originated. This message is not generated unless all 10 words from all 3 frames have passed parity.

Ephemeris data whose TOE (Time Of Ephemeris) is older than six hours is not shown.

Message ID: 41
Log Type: Asynch

Recommended Input:

log rawephema onnew

ASCII Example:

```
#RAWEPHEMA,COM1,15,60.5,FINESTEERING,1337,405297.175,00000000,97b7,1984;
3,1337,403184,8b04e4818da44e50007b0d9c05ee664ffbfe695df763626f00001b03c6b3,
8b04e4818e2b63060536608fd8cdaa051803a41261157ea10d2610626f3d,
8b04e4818ead0006aa7f7ef8ffda25c1a69a14881879b9c6ffa79863f9f2*0bb16ac3
.
.
.
#RAWEPHEMA,COM1,0,60.5,SATTIME,1337,405390.000,00000000,97b7,1984;
1,1337,410400,8b04e483f7244e50011d7a6105ee664ffbfe695df9e1643200001200aa92,
8b04e483f7a9e1faab2b16a27c7d41fb5c0304794811f7a10d40b564327e,
8b04e483f82c00252f57a782001b282027a31c0fba0fc525ffac84e10a06*c5834a5b
```

A way to use only one receiver and achieve better than 1 metre accuracy is to use precise orbit and clock files. Three types of GPS ephemeris, clock and earth orientation solutions are compiled by an elaborate network of GNSS receivers around the world all monitoring the satellite characteristics. IGS rapid orbit data is processed to produce files that correct the satellite clock and orbit parameters. Since there is extensive processing involved, these files are available on a delayed schedule from the US National Geodetic Survey at: www.ngs.noaa.gov/orbits

Precise ephemeris files are available today to correct GPS data which was collected a few days ago. All you need is one GNSS receiver and a computer to process on. Replace the ephemeris data with the precise ephemeris data and post-process to correct range values.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWEPHEM header	Log header		H	0
2	prn	Satellite PRN number	Ulong	4	H
3	ref week	Ephemeris reference week number	Ulong	4	H+4
4	ref secs	Ephemeris reference time (s)	Ulong	4	H+8
5	subframe1	Subframe 1 data	Hex	30	H+12
6	subframe2	Subframe 2 data	Hex	30	H+42
7	subframe3	Subframe 3 data	Hex	30	H+72
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+102
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.96 RAWGPSSUBFRAME Raw Subframe Data

This log contains the raw GPS subframe data.

A raw GPS subframe is 300 bits in total. This includes the parity bits which are interspersed with the raw data ten times in six bit chunks, for a total of 60 parity bits. Note that in Field #5, the 'data' field below, we have stripped out these 60 parity bits, and only the raw subframe data remains, for a total of 240 bits. There are two bytes added onto the end of this 30 byte packed binary array to pad out the entire data structure to 32 bytes in order to maintain 4 byte alignment.

Message ID: **25**
Log Type: **Asynch**

Recommended Input:

```
log rawgpssubframea onnew
```

ASCII Example:

```
#RAWGPSSUBFRAMEA,COM1,59,62.5,SATTIME,1337,405348.000,00000000,f690,1984;2,22
,4,8b04e483f3b17ee037a3732fe0fc8ccf074303ebdf2f6505f5aaaaaaaaa9,2*41e768e4
...
#RAWGPSSUBFRAMEA,COM1,35,62.5,SATTIME,1337,405576.000,00000000,f690,1984;4,25
,2,8b04e48406a8b9fe8b364d786ee827ff2f062258840ea4a10e20b964327e,4*52d460a7
...
#RAWGPSSUBFRAMEA,COM1,0,62.5,SATTIME,1337,400632.000,00000000,f690,1984;20,9,
3,8b04e4826aadff3557257871000a26fc34a31d7a300bede5ffa3de7e06af,20*55d16a4a
```

The RAWGPSSUBFRAME log can be used to receive the data bits with the parity bits stripped out. Alternately, you can use the RAWGPSWORD log to receive the parity bits in addition to the data bits.

Field#	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWGPSSUBFRAME header	Log header		H	0
2	decode #	Frame decoder number	Ulong	4	H
3	PRN	Satellite PRN number	Ulong	4	H+4
4	subfr id	Subframe ID	Ulong	4	H+8
5	data	Raw subframe data	Hex[30]	32[a]	H+12
6	chan	Signal channel number that the frame was decoded on.	Ulong	4	H+44
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

3.3.97 RAWGPSWORD Raw Navigation Word

This message contains the framed raw navigation words. Each log contains a new 30 bit navigation word (in the least significant 30 bits), plus the last 2 bits of the previous word (in the most significant 2 bits). The 30 bit navigation word contains 24 bits of data plus 6 bits of parity. The GPS reference time stamp in the log header is the time that the first bit of the 30 bit navigation word was received. Only navigation data that has passed parity checking appears in this log. One log appears for each PRN being tracked every 0.6 seconds if logged ONNEW or ONCHANGED.

Message ID: **407**
Log Type: **Asynch**

Recommended Input:

log rawgpsworda onnew

ASCII Example:

```
#RAWGPSWORDA,COM1,0,58.5,FINESTEERING,1337,405704.473,00000000,9b16,1984;
14,7ff9f5dc*8e7b8721
...
#RAWGPSWORDA,COM1,0,57.0,FINESTEERING,1337,405783.068,00000000,9b16,1984;
1,93feff8a*6dd62c81
...
#RAWGPSWORDA,COM1,0,55.5,FINESTEERING,1337,405784.882,00000000,9b16,1984;
5,fffff8ce*a948b4de
```

The RAWGPSWORD log can be used to receive the parity bits in addition to the data bits. Alternately, you can use the RAWGPSSUBFRAME log which already has the parity bits stripped out

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWGPSWORD header	Log header		H	0
2	PRN	Satellite PRN number	Ulong	4	H
3	nav word	Raw navigation word	Ulong	4	H+4
4	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+8
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.98 RAWLBANDFRAME Raw L-band Frame Data

This log contains the raw L-band frame data. The RAWLBANDPACKET is output for OmniSTAR tracking.

1. In addition to a NovAtel receiver with L-band capability, use of a DGPS service is required. Contact NovAtel for details. Contact NovAtel for details, through our website at www.novatel.com through *Support*, or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.
2. Please use the RAWLBANDPACKET log for raw OmniSTAR frame data, see *page 487*.

Message ID: **732**
Log Type: **Asynch**

Recommended Input:

log rawlbandframea onnew

ASCII Example:

```
#RAWLBANDFRAMEA,COM2,0,73.5,FINESTEERING,1295,152802.068,00000040,4f80,34461;
9,1a1e,600,f6,00,62,35,c8,cd,34,e7,6a,a1,37,44,8f,a8,24,71,90,d0,5f,94,2d,94,
3c,74,9c,f0,12,a3,4c,a7,30,aa,b6,2e,27,dd,dc,24,ba,d3,76,8d,76,d9,e7,83,1a,c8
,81,b0,62,1c,69,88,23,70,2a,06,c0,fc,f8,80,2c,72,f1,2e,6b,c2,5b,ec,03,70,d3,f
3,fe,ef,37,3d,17,37,1b,cf,be,af,d1,02,15,96,d1,f6,58,56,ac,bd,a3,11,12,d0,3d,
11,27,8a,87,28,0c,0f,52,70,b3,2f,0c,0c,62,2d,b8,69,6c,52,10,df,7d,bb,08,d6,ca
,a9,5e,77,66,96,c2,a0,63,3b,98,34,bc,d5,47,64,e0,00,37,10,4a,f7,c1,b6,83,8f,0
6,94,21,ff,b4,27,15,b0,60,40,02,b4,af,9c,9d,c2,d4,ea,95,68,86,0f,0a,9d,2d,36,
52,68,65,b8,a2,0b,00,21,80,64,8a,72,ff,59,b7,79,b9,49,fd,f5,3c,48,1c,2f,77,f1
,b2,9e,58,0a,81,05,1f,00,7b,00,1e,68,c9,a3,12,56,b8,2a,32,df,d9,ea,03,9b,16,c
6,17,2f,33,b3,5f,c4,f9,d2,97,75,64,06,52,a1,b2,3a,4b,69,e7,eb,0f,97,d3,e6,bf,
de,af,37,c6,10,13,9b,dc,c9,e3,22,80,78,3f,78,90,d5,9f,d3,5f,af,1f,7a,75,ef,77
,8e,de,ac,00,32,2e,79,fb,3f,65,f3,4f,28,77,b4,6d,f2,6f,31,24,b2,40,76,37,27,b
c,95,33,15,01,76,d5,f1,c4,75,16,e6,c6,ab,f2,fe,34,d9,c3,55,85,61,49,e6,a4,4e,
8b,2a,60,57,8a,e5,77,02,fc,9c,7d,d4,40,4c,1d,11,3c,9b,8e,c3,73,d3,3c,0d,ff,18
.
.
.
,7a,21,05,cb,12,f6,dd,c3,df,69,62,f5,70*3791693b
```

The data signal is structured to perform well in difficult, or foliated conditions, so the service is available more consistently and has a higher degree of service reliability.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWLBANDFRAME header	Log header		H	0
2	frame#	Frame number (maximum = 9)	Ushort	2	H+2
3	channelcode	10-bit channel code word	Ushort	2	H+4
4	data	Raw L-band frame data	Uchar[1200]	1200	H+6
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+1206
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.99 RAWLBANDPACKET Raw L-band Data Packet

This log contains the raw L-band packet data. The RAWLBANDPACKET log is only output for OmniSTAR tracking.

In addition to a NovAtel receiver with L-band capability, a subscription to the OmniSTAR service is required. Contact NovAtel for details. Contact NovAtel for details, through our website at www.novatel.com through *Support*, or the *Customer Support* section in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **733**

Log Type: **Asynch**

Recommended Input:

log rawlbandpacketa onnew

ASCII Example:

```
#RAWLBANDPACKETA,COM2,0,77.0,FINESTEERING,1295,238642.610,01000040,c5b1,34461
;9,07,de,3a,f9,df,30,7b,0d,cb*7e5205a8
```

OmniSTAR currently has several high-powered satellites in use around the world. They provide coverage for most of the Earth's land areas. Subscriptions are sold by geographic area. Any regional OmniSTAR service center can sell and activate subscriptions for any area. They may be arranged prior to travelling to a new area, or after arrival. Contact OmniSTAR at www.omnistar.com for further details.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWLBANDPACKET header	Log header		H	0
2	#recs	Number of records to follow	Ulong	4	H
3	data	Raw L-band data packet.	Uchar[128]	128	H +4
4	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+128
5	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.100 RAWSBASFRAME Raw SBAS Frame Data

This log contains the raw SBAS frame data of 226 bits (8-bit preamble, 6-bit message type and 212 bits of data but without a 24-bit CRC). Only frame data with a valid preamble and CRC are reported.

Message ID: **287**
Log Type: **Asynch**

Recommended Input:

log rawsbasframea onnew

ASCII Example:

```
#RAWSBASFRAMEA,COM1,0,91.0,SATTIME,1610,341534.000,00000000,58e4,38637;32,
133,4,c6115ffc00000c009ffc07004c089ffdffdffdffdfff957bbb6bfffc0,32*5afc5f95
#RAWSBASFRAMEA,COM1,0,91.0,SATTIME,1610,341535.000,00000000,58e4,38637;32,133,2,
53084007ff9fffffc03002c0000f0009ffc004005ffd6b961e39b9fb80,32*db5dfa62
#RAWSBASFRAMEA,COM1,0,91.0,SATTIME,1610,341535.000,00000000,58e4,38637;35,135,2,
53084007ff9fffffc03002c0000f0009ffc004005ffd6b961e39b9fb80,35*b72ff2a0
...
#RAWSBASFRAMEA,COM1,0,90.0,SATTIME,1610,341539.000,00000000,58e4,38637;34,138,3
,9a0c4000009ffc009ffdffc007fb9ffdffc0000040315b9bb96fb95680,34*cb050361
```

The RAWWAASFRAME log output contains all the raw data required for an application to compute its own SBAS correction parameters.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RAWSBASFRAME header	Log header		H	0
2	decode #	Frame decoder number	Ulong	4	H
3	PRN	SBAS satellite PRN number	Ulong	4	H+4
4	WAASmsg id	SBAS frame ID	Ulong	4	H+8
5	data	Raw SBAS frame data. There are 226 bits of data and 6 bits of padding.	Uchar[29]	32[a]	H+12
6	chan	Signal channel number that the frame was decoded on	Ulong	4	H+44
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

3.3.101 REFSTATION Base station position and health

This log contains the ECEF Cartesian position of the base station as received through the RTCM, RTCMV3, RTCA, or CMR message. It also features a time tag, the health status of the base station, and the station ID. This information is set at the base station using the FIX POSITION command and the DGPSTXID command. See *Figure 10, page 315* for a definition of the ECEF coordinates.

The base station health, Field #6, may be one of 8 values (0 to 7). Values 0 through 5 indicate the scale factor that multiply satellite UDRE one-sigma differential error values. Below are values 0 to 5 and their corresponding UDRE scale factors:

0: 1 (Health OK) 1: 0.75 2: 0.5 3: 0.3 4: 0.2 5: 0.1

The base station health field only applies to RTCM base stations. A value of 6 means that the base station transmission is not monitored and a value of 7 means that the base station is not working.

Message ID: **175**

Log Type: **Asynch**

Recommended Input:

log refstationa onchanged

ASCII Example:

```
#REFSTATIONA,COM1,0,66.5,FINESTEERING,1364,490401.124,80000000,4e46,2310;
00000000,-1634532.443,-3664608.907,4942482.713,0,RTCA,"AAAA"*1e2a0508
```

Table 89: Base Station Status

Bit #	Mask	Description	Bit = 0	Bit = 1
0	0x00000001	Validity of the base station.	Valid	Invalid

Table 90: Station Type

Base Station Type (Binary)	(ASCII)	Description
0	NONE	Base station is not used
1	RTCM	Base station is RTCM
2	RTCA	Base station is RTCA
3	CMR	Base station is CMR
4	RTCMV3	Base station is RTCMV3

The REFSTATION log can be used for checking the operational status of a remotely located base station. You can verify that the base station is operating properly without travelling to it. This is especially useful for RTK work on long baselines

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	REFSTATION header	Log header		H	0
2	status	Status of the base station information (see *Table 89* below)	ULong	4	H
3	x	ECEF X value	Double	8	H+4
4	y	ECEF Y value	Double	8	H+12
5	z	ECEF Z value	Double	8	H+20
6	health	Base station health, see the 2nd paragraph on the previous page	Ulong	4	H+28
7	stn type	Station type (see *Table 90, Station Type* on *page 489*)	Enum	4	H+32
8	stn ID	Base station ID	Char[5]	8[a]	H+36
9	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
10	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

3.3.102 REFSTATIONINFO Base Station Position Information

This is extended version of REFSTATION log with Latitude, Longitude and Ellipsoidal Height of the base station in WGS84. In addition to the base station position, ARP height, Antenna model name and Antenna serial number are available if provided by the base station only through RTCMV3.

Message ID: **1325**
Log Type: **Asynch**

Recommended Input:

log refstationinfoa onchanged

**ARP, Antenna model and Antenna serial number are set at the base station using BASEANTENNAMODEL command.

For example: baseantennamodel 702GG NVH05410007 1 user 0 0 1234

ASCII Example:

#REFSTATIONINFOA,USB1,0,89.5,EX-ACT,0,0.000,00000040,d38f,6782;51.116375174,-114.038254922,1048.502830628,WGS84,1.234,0,RTCMV3,"0","702GG","NVH05410007"*bedf8ece

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	REFSTATIONINFO header	Log header	H	0	
2	latitude	Latitude	Double	8	H
3	longitude	Longitude	Double	8	H+8
4	height	Ellipsoidal Height	Double	8	H+16
5	datum	Datum ID number (WGS84)	Enum	4	H+24
6	ARP height	Base Antenna ARP	FLOAT	4	H+28
7	health	Base Station Health, see REFSTATION	Ulong	4	H+32
8	Ref Stn Type	Base Station Type, see REFSTATION	Enum	4	H+36
9	stn ID	Base Station ID	Char[5]	8[a]	H+40
10	Ant Model	Base Antenna Model Namel	Char[32]	32	H+48
11	Ant Serial	Base Antenna Serial Number	Char[32]	32	H+80
12	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

3.3.103 ROVERPOS Position using ALIGN

ALIGN generates distance and bearing information between a “Master” and “Rover” receiver. This log outputs the position information of the rover when using the ALIGN feature. This log can only be output from a Y ALIGN model and can be output at both Master and Rover ends.

1. ALIGN is useful for obtaining the relative directional heading of a vessel/body, separation heading between two vessels/bodies, or heading information with moving base and pointing applications.
2. You must have an ALIGN -capable receiver to use this log, see *Table 118* on *page 682*.
3. The log can be output at both Y model Rover only if it is receiving the RTCAREFEXT message from the Master. The log can be output at any Master if Master is receiving HEADINGEXTB from the Rover
4. ROVERPOS is dependent on the output frequency of the RTCAREFEXT message from the master to the rover.

Message ID: **1052**
Log Type: **ASynch**

Recommended Input:

log roverposa onchanged

Example 1:

```
#ROVERPOSA,COM1,0,21.5,FINESTEERING,1544,340322.000,00000008,7453,4655;
SOL_COMPUTED,NARROW_INT,51.11605565964,-114.03854655975,1055.8559,-
16.9000,WGS84,0.0130,0.0122,0.0206,"RRRR",0.0,0.0,13,12,12,11,0,0,0,0*635b3a1
c
```

Asynchronous logs, such as ROVERPOS, should only be logged ONCHANGED or ONNEW. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

Field #	Field Type	Field Description	Binary Format	Binary Bytes	Binary Offset
1	ROVERPOS header	Log Header		H	0
2	sol stat	Solution Status, see *Table 56* on *page 302*	Enum	4	H
3	pos type	Position Type see *Table 55* on *page 301*	Enum	4	H+4
4	lat	Rover WGS84 Latitude in degrees	Double	8	H+8
5	long	Rover WGS84 Longitude in degrees	Double	8	H+16
6	hgt	Rover MSL Height in metres	Double	8	H+24
7	undulation	Undulation in metres	Float	4	H+32
8	datum id#	WGS84 (default)	Enum	4	H+36
9	lat σ	Latitude Std in metres	Float	4	H+40
10	long σ	Longitude Std in metres	Float	4	H+44
11	hgt σ	Height Std in metres	Float	4	H+48
12	stn id	Receieve ID (currently, “RRRR”)	Char[4]	4	H+52
13	Reserved		Float	4	H+56
14			Float	4	H+60
15	#SVs	Number of satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65
17	#obs	Number of satellites above elevation mask angle	Uchar	1	H+66
18	#multi	Number of satellites above the mask angle with L2	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20			Uchar	1	H+69
21			Uchar	1	H+70
22			Uchar	1	H+71
23	xxxx		HEX	1	H+72
24	[CR][LF]	Sentence Terminator (ASCII only)	-	-	-

3.3.104 RTCA Standard Logs

RTCA1 DIFFERENTIAL GPS CORRECTIONS
Message ID: 10
RTCAEPHEM EPHEMERIS AND TIME INFORMATION
Message ID: 347
RTCAOBS BASE STATION OBSERVATIONS*2*
Message ID: 6
RTCAOBS2 BASE STATION OBSERVATIONS
Message ID: 805
RTCAREF BASE STATION PARAMETERS
Message ID: 11
RTCAREFEXT EXTENDED BASE STATION PARAMETERS FOR ALIGN
MESSAGE ID: 1049
RTCAOBS3 BASE STATION OBSERVATION FOR ALIGN
MESSAGE ID: 1340

1. The above messages can be logged with an A or B suffix for an ASCII or Binary output with a NovAtel header followed by Hex or Binary raw data respectively.
2. When you plan to send both RTCAOBS2 and RTCAOBS messages, ensure you send the RTCAOBS2 message first, before RTCAOBS.
3. RTCADATA logs output the details of the above logs if they have been sent.

The RTCA (Radio Technical Commission for Aviation Services) Standard is being designed to support Differential Global Navigation Satellite System (DGNSS) Special Category I (SCAT-I) precision instrument approaches. The RTCA Standard is in a preliminary state. Described below is NovAtel's current support for this standard. It is based on "Minimum Aviation System Performance Standards DGNSS Instrument Approach System: Special Category I (SCAT-I)".[1]

NovAtel has defined six proprietary RTCA Standard Type 7 binary-format messages, RTCAOBS, RTCAOBS2, RTCAREF, RTCAEPHEM, RTCAREFEXT and RTCAOBS3 for base station transmissions. RTCAOBS3 and RTCAREFEXT are defined specifically for use in ALIGN. These can be used with either single or dual-frequency NovAtel receivers. The RTCA message format outperforms the RTCM format in the following ways, among others:

- a more efficient data structure (lower overhead)
- better error detection
- allowance for a longer message, if necessary

RTCAREF and RTCAOBS, respectively, correspond to the RTCM Type 3 and Type 59 logs used in single-frequency-only measurements. Both are NovAtel-proprietary RTCA Standard Type 7 messages with an 'N' primary sub-label.

1.For further information about RTCA Standard messages, you may wish to refer to: *Minimum Aviation System Performance Standards - DGNSS Instrument Approach System: Special Category I (SCAT-I)*, Document No. RTCA/DO-217 (April 19,1995); Appx A, Pg 21

Refer to the *Receiving and Transmitting Corrections* section in the *OEM6 Installation and Operation Manual* for more information about using these message formats for differential operation.

Input Example

```
interfacemode com2 none RTCA
fix position 51.1136 -114.0435 1059.4
log com2 rtcaobs2 ontime 1
log com2 rtcaobs ontime 1
log com2 rtcaref ontime 10
log com2 rtca1 ontime 5
log com2 rtcaephem ontime 10 1
log com2 rtcarefext ontime 1
log com2 rtcaobs3 ontime 1
```

3.3.105 RTCADATA1 Differential GPS Corrections

See *Section 3.3.104* starting on *page 494* for information about RTCA standard logs.

Message ID: **392**
Log Type: **Synch**

Recommended Input:

log rtcadata1a ontime 10 3

ASCII Example:

```
#RTCADATA1A,COM1,0,60.0,FINESTEERING,1364,493614.000,00100000,606b,2310;
414.000000000,0,9,
30,-6.295701472,111,-0.019231669,1.000000000,
2,-4.720861644,60,-0.021460577,1.000000000,
6,-11.464165041,182,-0.015610195,1.000000000,
4,-6.436236222,7,-0.021744921,1.000000000,
5,-5.556760025,39,0.003675566,1.000000000,
10,-14.024430156,181,-0.013904139,1.000000000,
7,-5.871886130,48,-0.016165427,1.000000000,
25,-22.473942049,59,-0.003024942,1.000000000,
9,-28.422760762,130,-0.048257797,1.000000000*56d5182f
```

RTCA1

This log enables transmission of RTCA Standard format Type 1 messages from the receiver when operating as a base station. Before this message can be transmitted, the receiver FIX POSITION command must be set, see *page 120*. If the receiver is configured as a mov ing base station, refer to *Section 2.5.57* on *page 169* for further information. The RTCA log is accepted by a receiver operating as a rover station over a COM port after an INTERFACEMODE *port* RTCA command is issued, see *page 147*.

The RTCA Standard for SCAT-I stipulates that the maximum age of differential correction (Type 1) messages accepted by the rover station cannot be greater than 22 seconds. See the DGPSTIMEOUT command on *page 101* for information regarding DGPS delay settings.

The RTCA Standard also stipulates that a base station shall wait five minutes after receiving a new ephemeris before transmitting differential corrections. Refer to the DGPSEPHEMDELAY command on *page 101* for information regarding ephemeris delay settings.

The basic SCAT-I Type 1 differential correction message is as follows:

Format: Message length = 11 + (6*obs)

Field Type	Data	Scaling	Bits	Bytes
SCAT-I header	– Message block identifier	-	8	6
	– Base station ID	-	24	
	– Message type	-	8	
	– Message length	-	8	
Type 1 header	– Modified z-count	0.2 s	13	2
	– Acceleration error bound	-	3	
Type 1 data	– Satellite ID	-	6	6 * obs
	– Pseudorange correction[a]	0.02 m	16	
	– Issue of data	-	8	
	– Range rate correction[a]	0.002 m/s	12	
	– UDRE	0.2 m	6	
CRC	Cyclic redundancy check	-		3

a. The pseudorange correction and range rate correction fields have a range of ±655.34 metres and ±4.049 m/s respectively. Any satellite which exceeds these limits are not included.

At the base station it is possible to log out the contents of the standard corrections in a form that is easier to read or process. These larger variants have the correction fields broken out into standard types within the log, rather than compressed into bit fields. This can be useful if you wish to modify the format of the corrections for a non-standard application, or if you wish to look at the corrections for system debugging purposes. These variants have "DATA" as part of their names (for example, RTCADATA1).

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCADATA1 header	Log header	-	H	0
2	z-count	Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris.	Double	8	H
3	AEB	Acceleration Error Bound	Uchar	4 [a]	H+8
4	#prn	Number of satellite corrections with information to follow	Ulong	4	H+12
5	PRN/slot	Satellite PRN number of range measurement (GPS: 1-32 and SBAS: 120 to 138.)	Ulong	4	H+16
6	range	Pseudorange correction (m)	Double	8	H+20
7	IODE	Issue of ephemeris data	Uchar	4 [a]	H+28
8	range rate	Pseudorange rate correction (m/s)	Double	8	H+32
9	UDRE	User differential range error	Float	4	H+40
10...	Next prn offset = H+16 + (#prns x 28)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

3.3.106 RTCADATAEPHEM Ephemeris and Time Information

See *Section 3.3.104* starting on *page 494* for information about RTCA standard logs.

RTCAEPHEM Type 7

An RTCAEPHEM (RTCA Satellite Ephemeris Information) message contains raw satellite ephemeris information. It can be used to provide a rover receiver with a set of GPS ephemerides. Each message contains a complete ephemeris for one satellite and the GPS reference time of transmission from the base. The message is 102 bytes (816 bits) long. This message should be sent once every 5-10 seconds (The faster this message is sent, the quicker the rover station receives a complete set of ephemerides). Also, the rover receiver automatically sets an approximate system time from this message if time is still unknown. Therefore, this message can be used in conjunction with an approximate position to improve time to first fix (TTFF).

Message ID: **393**

Log Type: **Synch**

Recommended Input:

```
log rtcadataephema ontime 10 7
```

ASCII Example:

```
#RTCADATAEPHEMA,COM1,0,49.0,FINESTEERING,1364,494422.391,00100000,d869,2310;
78,2,340,494422,4,0,
8b0550a0f0a455100175e6a09382232523a9dc04f307794a00006415c8a98b0550a0f12a070b1
2394e4f991f8d09e903cd1e4b0825a10e669c794a7e8b0550a0f1acffe54f81e9c0004826b947
d725ae063beb05ffa17c07067d*c9dc4f88
```

A hot position is when the receiver has a saved almanac, saved recent ephemeris data and an approximate position.

A hot position aids the time to first fix (TTFF). The TTFF is the actual time required by a GNSS receiver to achieve a position solution.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCADATAEPHEM header	Log header	-	H	0
2	des	NovAtel designator	Uchar	1	H
3	subtype	RTCA message subtype	Uchar	3[a]	H+1
4	week	GPS reference week number (weeks)	Ulong	4	H+4
5	sec	Seconds into the week (seconds)	Ulong	4	H+8
6	prn	PRN number	Ulong	4	H+12
7	Reserved		Uchar	4[b]	H+16
8	raw data	Raw ephemeris data	Hex[90]	92[a]	H+20
9	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
10	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case an additional 2 bytes of padding are added to maintain 4 byte alignment

b. In the binary log case an additional 3 bytes of padding are added to maintain 4 byte alignment

3.3.107 RTCADATAOBS Base Station Observations

See *Section 3.3.104* starting on *page 494* for information about RTCA standard logs.

RTCAOBS Type 7

An RTCAOBS (RTCA Base-Station Satellite Observations) message contains base station satellite observation information. It is used to provide range observations to the rover receiver, and should be sent every 1 or 2 seconds.

Do not log RTCADATAOBS or RTCA2DATAOBS with an offset. A period of 1 or 2 seconds, as stated above, is acceptable. See also the LOG command starting on *page 158*.

This log is made up of variable-length messages up to 255 bytes long. The maximum number of bits in this message is [140 + (92 x *N*)], where *N* is the maximum number of satellite record entries transmitted. Using the RTKSVENTRIES command, see *page 202*, you can define *N* to be anywhere from 4 to 12; the default value is 12.

Message ID: **394**
Log Type: **Synch**

Recommended Input:

```
log rtcadataobsa ontime 2
```

ASCII Example:

```
#RTCADATAOBSA,COM1,0,47.0,FINESTEERING,1364,494469.000,00100000,9025,2310;
78,
1,2.027098600000000e+07,69.000000000,0,8,2,
3,3,4.000000000,-3.500000000,0.241999999,0.207000002,TRUE,180,
5,3,3,569234.000000000,-1.750000000,0.717999995,1.340999961,TRUE,180,
7,3,3,756774.600000000,-1.250000000,0.054000001,-0.119999997,TRUE,180,
30,3,3,445544.200000000,-1.250000000,0.140000001,0.344999999,TRUE,180,
4,3,3,1897221.200000000,-0.750000000,0.361999989,1.179000020,TRUE,180,
6,3,3,2883369.000000000,-0.500000000,-0.751999974,-1.922999978,TRUE,180,
10,3,3,2860119.800000000,-0.250000000,-0.546000004,-1.944000006,TRUE,
180,25,3,3,4734110.200000000,-0.750000000,0.474000007,2.013000011,
TRUE,180*dd9699f5
```

Transmission of the base station observations is necessary for the highest precision applications. The base station observations are used by the rover for carrier phase ambiguity resolution.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCADATAOBS header	Log header	-	H	0
2	des	NovAtel designator	Uchar	1	H
3	subtype	RTCA message subtype	Uchar	3 [a]	H+1
4	min psr	Minimum pseudorange	Double	8	H+4
5	sec	Seconds into the GPS reference week	Float	4	H+12
6	Reserved		Long	4	H+16
7	#ids	Number of Transmitter IDs with information to follow	Ulong	4	H+20
8	trans ID	Transmitter ID	Uchar	1	H+24
9	L1 lock	L1 lock flag	Uchar	1	H+25
10	L2 lock	L2 lock flag	Uchar	2 [b]	H+26
11	L1 psr	L1 pseudorange offset (2/10 m)	Double	8	H+28
12	L2 psr	L2 pseudorange offset (1/4 m)	Double	8	H+36
13	L1 ADR	L1 carrier phase offset, accumulated Doppler range (2/1000 m)	Float	4	H+44
14	L2 ADR	L2 carrier phase offset, accumulated Doppler range (3/1000 m)	Float	4	H+48
15	L2 encrypt	L2 not encrypted? 0 = FALSE 1 = TRUE	Enum	4	H+52
16	Reserved		Long	4	H+56
17...	Next id offset = H+24 + (#ids x 36)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

b. In the binary log case, an additional 1 byte of padding is added to maintain 4-byte alignment

3.3.108 RTCADATA2OBS Base Station Observations 2

See *Section 3.3.104* starting on *page 494* for information about RTCA standard logs.

RTCAOBS2 Type 7

An RTCAOBS2 (RTCA Base-Station Satellite Observations subtype 2) message supports GPS, GLONASS and L1/L2 RTK differential operation. It contains base station satellite observation information. It is used to provide range observations to the rover receiver, and should be sent every 1 or 2 seconds. See also the RTCADATAOBS notebox on *page 501*.

This log is made up of variable-length messages up to 255 bytes long. The maximum number of bits in this message is [128 + (108 x *N*)], where *N* is the maximum number of satellite record entries transmitted.

The RTCAOBS2 message is the same as the RTCAOBS message except for the determination of the L1 pseudorange offset for each transmitter. The L1 ADR, L2 PSR and L2 ADR are all calculated the same as RTCAOBS. Instead of determining the minimum pseudorange, as in RTCAOBS, RTCAOBS2 relies on a constellation specific nominal offset and the receiver GPS reference time bias. The nominal offset values for some different satellite types are shown in *Table 91* below.

Table 91: RTCAOBS2 Satellite Type Offsets

Satellite Type	Nominal Offset
GPS	23,000 km
GLONASS	22,000 km
Pseudolite	0 km

Message ID: **808**

Log Type: **Synch**

Recommended Input:

log rtcadata2obsa ontime 2

ASCII Example:

```
#RTCADATA2OBSA,COM1,0,63.5,FINESTEERING,1416,508872.000,00140008,e0c5,2690;
78,3,0.000000000,72.000000000,0,13,
44,135,0,-2809276.000000000,-0.102000000,5.877472455e-39,0.000000000,TRUE,43,
21,131,0,-2763150.200000000,-0.016000000,5.877472455e-39,0.000000000,TRUE,19,
18,227,0,-2284827.400000000,0.090000000,5.877472455e-39,0.000000000,TRUE,84,
60,118,0,-1049837.400000000,0.074000000,5.877472455e-39,0.000000000,TRUE,201,
26,30,0,-1406884.400000000,0.062000000,5.877472455e-39,0.000000000,TRUE,184,
43,30,0,-984645.600000000,0.040000000,5.877472455e-39,0.000000000,TRUE,184,
22,217,0,-651966.600000000,-0.002000000,5.877472455e-39,0.000000000,TRUE,23,
24,0,0,-205779.800000000,0.070000000,5.877472455e-39,0.000000000,TRUE,0,
3,223,0,-407386.400000000,-0.048000000,5.877472455e-39,0.000000000,FALSE,60,
45,114,0,-53743.200000000,-0.088000000,5.877472455e-39,0.000000000,TRUE,176,
7,126,0,263919.200000000,-0.020000000,5.877472455e-39,0.000000000,TRUE,
250,6,34,0,1336444.200000000,-0.102000000,5.877472455e-39,0.000000000,
TRUE,209,
19,206,0,1943816.400000000,-0.048000000,5.877472455e-39,0.000000000,TRUE,217
*afe9ae2e
```

Transmission of the base station observations is necessary for the highest precision applications. The base station observations are used by the rover for carrier phase ambiguity resolution.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCADATA2-OBS header	Log header	-	H	0
2	des	NovAtel designator	Uchar	1	H
3	subtype	RTCA message subtype	Uchar	3 [a]	H+1
4	GPStimebias	Receiver GPS reference time bias	Double	8	H+4
5	sec	Seconds into the GPS reference week	Float	4	H+12
6	Reserved		Long	4	H+16
7	#ids	Number of Transmitter IDs with information to follow	Ulong	4	H+20
8	trans ID	Transmitter ID	Uchar	1	H+24
9	L1 lock	L1 lock flag	Uchar	1	H+25
10	L2 lock	L2 lock flag	Uchar	2 [b]	H+26
11	L1 psr	L1 pseudorange offset (2/10 m)	Double	8	H+28
12	L2 psr	L2 pseudorange offset (1/4 m)	Double	8	H+36
13	L1 ADR	L1 carrier phase offset, accumulated Doppler range (2/1000 m)	Float	4	H+44
14	L2 ADR	L2 carrier phase offset, accumulated Doppler range (3/1000 m)	Float	4	H+48
15	L2 encrypt	L2 not encrypted? 0 = FALSE 1 = TRUE	Enum	4	H+52
16	Reserved		Long	4	H+56
17...	Next id offset = H+24 + (#ids x 36)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

b. In the binary log case, an additional 1 byte of padding is added to maintain 4-byte alignment

3.3.109 RTCADATAREF Base Station parameters

See *Section 3.3.104* starting on *page 494* for information about RTCA standard logs.

RTCAREF Type 7

An RTCAREF (RTCA Base Station Position Information) message contains base station position information, and should be sent once every 10 seconds. Each message is 24 bytes (192 bits) long.

If RTCA-format messaging is being used, the optional *station id* field that is entered using the DGPSTXID command, see *page 103*, can be any 4-character string combining numbers and upper-case letters, and enclosed in double quotation marks (for example, “RW34”). The station ID is reported at the rover receiver, in its position log.

Message ID: **395**

Log Type: **Synch**

Recommended Input:

log rtcadatarefa ontime 10

ASCII Example:

```
#RTCADATAREFA,COM1,0,47.5,FINESTEERING,1364,494600.601,00100000,44de,2310;
78,0,-1634531.401490912,-3664616.874355976,4942495.215668959,0*646a495c
```

The rover receiver automatically sets an approximate position from the RTCADATAREF message if it does not already have a position. Therefore this message can be used in conjunction with an approximate time to improve TTFF. Refer to NovAtel’s *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/ for more information about TTFF.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCADATAREF header	Log header	-	H	0
2	des	NovAtel designator.	Uchar	1	H
3	subtype	RTCA message subtype	Uchar	3[a]	H+1
4	X pos	Base station X coordinate position (mm)	Double	8	H+4
5	Y pos	Base station Y coordinate position (mm)	Double	8	H+12
6	Z pos	Base station Z coordinate position (mm)	Double	8	H+20
7	Reserved		Uchar	4[b]	H+28
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+32
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case an additional 2 bytes of padding are added to maintain 4 byte alignment
b. In the binary log case an additional 3 bytes of padding are added to maintain 4 byte alignment

3.3.110 RTCAOBS3 Message for ALIGN

RTCAOBS3 is a NovAtel proprietary message that carries dual-frequency GPS and GLO measurements and is used in ALIGN. This message also carries SBAS measurements if the Master receiver is single-frequency (L1-only) receiver to enable SBAS-ALIGN at the L1-only ALIGN Rover.

Message ID: **1340**
Log Type: **Synch**

Recommended Input:

log com2 rtcaobs3 ontime 0.1

Field Type	Data	Scaling	Bits	Bytes
RTCA header	Message Block Identifier	-	8	6
	Reference Station ID	-	24	
	Message Type	-	8	
	Message Length (#)	-	8	
Message Block	-	-	-	(#)

3.3.111 RTCM Standard Logs

RTCM1 DIFFERENTIAL GPS CORRECTIONS
Message ID: 107

RTCM3 BASE STATION PARAMETERS
Message ID: 117

RTCM9 PARTIAL DIFFERENTIAL GPS CORRECTIONS
MESSAGE ID: 275

RTCM15 IONOSPHERIC CORRECTIONS
Message ID: 307

RTCM16 SPECIAL MESSAGE
Message ID: 129

RTCM16T SPECIAL TEXT MESSAGE, see also *page 227*
Message ID: 131

RTCM1819 RAW MEASUREMENTS
Message ID: 260

RTCM2021 MEASUREMENT CORRECTIONS
Message ID: 374

RTCM22 EXTENDED BASE STATION
Message ID: 118

RTCM23 ANTENNA TYPE DEFINITION
Message ID: 665

RTCM24 ANTENNA REFERENCE POINT (ARP)
Message ID: 667

RTCM31 DIFFERENTIAL GLONASS
Message ID: 864

RTCM32 GLONASS BASE PARAMETERS
Message ID: 873

RTCM36 SPECIAL EXTENDED MESSAGE
Message ID: 875

RTCM36T SPECIAL EXTENDED MESSAGE, see also *page 227*
Message ID: 877

RTCM59 TYPE 59N-0 PROPRIETARY DIFFERENTIAL
Message ID: 116

RTCM59GLO PROPRIETARY GLONASS DIFFERENTIAL
Message ID: 903

RTCMOMNI1 RTCM1 FROM OMNISTAR VBS
Message ID: 957

1. The RTCM messages can be logged with an A or B suffix for an ASCII or Binary output with a NovAtel header followed by Hex or Binary raw data respectively.
2. Combinations of integer offsets and fractional offsets are not supported for RTCM logs. See also the LOG command starting on *page 158* for more details on offsets.
3. RTCMDATA logs output the details of the above logs if they have been sent.

The Radio Technical Commission for Maritime Services (RTCM) was established to facilitate the establishment of various radio navigation standards, which includes recommended GNSS differential standard formats. Refer to the *Receiving and Transmitting Corrections* section in the *OEM6 Installation and Operation Manual* for more information about using these message formats for differential operation.

The standards recommended by the Radio Technical Commission for Maritime Services Special Committee 104, Differential GPS Service (RTCM SC-104,Washington, D.C.), have been adopted by NovAtel for implementation into the receiver. Because the receiver is capable of utilizing RTCM formats, it can easily be integrated into positioning systems around the globe.

As it is beyond the scope of this manual to provide in-depth descriptions of the RTCM data formats, it is recommended that anyone requiring explicit descriptions of such, should obtain a copy of the published RTCM specifications. Refer to NovAtel's *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/ for information.

RTCM SC-104[1] Type 3 & 59 messages can be used for base station transmissions in differential systems. However, since these messages do not include information about the L2 component of the GPS signal, they cannot be used with RT-2 positioning. Regardless of whether single or dual-frequency receivers are used, the RT-20 positioning algorithm is used. This is for a system in which both the base and rover stations utilize NovAtel receivers.

Note that the error-detection capability of an RTCM-format message is less than that of an RTCA-format message. The communications equipment that you use may have an error-detection capability of its own to supplement that of the RTCM message, although at a penalty of a higher overhead. Consult the radio vendor's documentation for further information.

If RTCM-format messaging is being used, the optional *station id* field that is entered using the DGPSTXID command can be any number within the range of 0 - 1023 (for example, 119). The representation in the log message is identical to what was entered.

The NovAtel logs which implement the RTCM Standard Format for Type 1, 3, 9, 16, 18, 19, 22, 23, 24, 31, 32 and 36 messages are known as the RTCM1, RTCM3, RTCM9, RTCM16, RTCM1819,

1. For further information about RTCM SC-104 messages, you may wish to refer to:

   RTCM Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 2.3 at http://www.rtcm.org/overview.php.

RTCM22, RTCM23, RTCM24, RTCM31, RTCM32 and RTCM36 logs, respectively, while Type 59N-0 messages are listed in the RTCM59 log.

All receiver RTCM standard format logs adhere to the structure recommended by RTCM SC-104. Thus, all RTCM message are composed of 30 bit words. Each word contains 24 data bits and 6 parity bits. All RTCM messages contain a 2-word header followed by 0 to 31 data words for a maximum of 33 words (990 bits) per message.

Message Frame Header	Data		Bits
Word 1	–	Message frame preamble for synchronization	8
	–	Frame/message type ID	6
	–	Base station ID	10
	–	Parity	6
Word 2	–	Modified z-count (time tag)	13
	–	Sequence number	3
	–	Length of message frame	5
	–	Base health	3
	–	Parity	6

Version 3.0, also developed by the RTCM SC-104, consists primarily of messages designed to support real-time kinematic (RTK) operations. It provides messages that support GPS and GLONASS RTK operations, including code and carrier phase observables, antenna parameters, and ancillary system parameters. Version 3.1 adds RTCM messages containing transformation data and information about Coordinate Reference Systems.[1]

The remainder of this section provides further information concerning receiver commands and logs that utilize the RTCM data formats.

Example Input:

```
interfacemode com2 none RTCM
fix position 51.1136 -114.0435 1059.4
log com2 rtcm3 ontime 10
log com2 rtcm22 ontime 10 1
log com2 rtcm1819 ontime 1
log com2 rtcm31 ontime 2
log com2 rtcm32 ontime 2
log com2 rtcm1 ontime 5
```

1. For further information about RTCM SC-104 messages, you may wish to refer to:

   RTCM Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3.0 and Version 3.1 at http://www.rtcm.org/overview.php.

OmniSTAR Local Wide Area Corrections

RTCM Type 1 messages are generated from OmniSTAR VBS corrections.

The positioning performance using OmniSTAR local wide area corrections meets the standard OmniSTAR VBS code differential performance specifications.

Unless otherwise noted, values in the RTCM Type 1 messages are unchanged from what is provided by the VBS library (for example, RRC, UDRE, station ID) apart from necessary unit scaling. An RTCM1 message is generated and output each time the VBS library provides updated corrections (about every 6 s). The receiver no longer outputs corrections when the L-band signal is lost and the VBS library stops generating corrections. The output is for the same set of satellites provided by the VBS library (above 5° elevation at the current position).

Enable the output of OmniSTAR VBS corrections in RTCM messages by using the following commands:

INTERFACEMODE COM2 NOVATEL RTCM OFF

ASSIGNLBAND OMNISTAR <frequency> <bps> or ASSIGNLBAND OMNISTARAUTO

PSRDIFFSOURCE OMNISTAR

LOG COM2 RTCMOMNI1 ONCHANGED

The RTCMOMNI1 log is asynchronous.

The OmniSTAR RTCM model outputs RTCM corrections at a rate of up to 0.2 Hz. This new model does not include position or raw measurement output.

3.3.112 RTCMDATA1 Differential GPS Corrections

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **396**
Log Type: **Synch**

Recommended Input:

log rtcmdata1a ontime 10 3

ASCII Example:

```
#RTCMDATA1A,COM1,0,68.5,FINESTEERING,1420,506618.000,00180020,d18a,1899;
1,0,4363,0,0,6,
9,
0,0,26,22569,-2,231,
0,0,19,-3885,-36,134,
0,0,3,-14036,-23,124,
0,0,24,1853,-36,11,
0,0,18,5632,15,6,
0,0,21,538,-26,179,
0,0,9,12466,3,4,
0,0,14,-21046,17,27,
0,0,22,-7312,16,238*35296338
```

RTCM1

This is the primary RTCM log used for pseudorange differential corrections. This log follows the RTCM Standard Format for a Type 1 message. It contains the pseudorange differential correction data computed by the base station generating this Type 1 log. The log is of variable length depending on the number of satellites visible and pseudoranges corrected by the base station. Satellite specific data begins at word 3 of the message.

Structure:

Type 1 messages contain the following information for each satellite in view at the base station:

- Satellite ID
- Pseudorange correction
- Range-rate correction
- Issue of Data (IOD)

When operating as a base station, the receiver must be in FIX POSITIONor Moving Base Station modes and have the INTERFACEMODE command set before the data can be correctly logged. When operating as a rover station, the receiver COM port receiving the RTCM data must have its INTERFACEMODE command set. Refer to the *Receiving and Transmitting Corrections* section in the *OEM6 Installation and Operation Manual* for more information about using these commands and RTCM message formats.

REMEMBER: Upon a change in ephemeris, base stations transmit Type 1 messages based on the old ephemeris for a period of time defined by the DGPSEPHEMDELAY command, see *page 101*. After the time out, the base station begins to transmit the Type 1 messages based on the new ephemeris.

RTCMDATA logs provide you with the ability to monitor the RTCM messages, being used by the NovAtel receiver, in an easier to read format than the RTCM standard format. You can also use the RTCMDATA logs as a diagnostic tool to identify when the receivers are operating in the required modes.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	#prn	Number of PRNs with information to follow	Ulong	4	H+24
9	scale	Scale where 0 = 0.02 m and 0.002 m/s 1 = 0.32 m and 0.032 m/s	Ulong	4	H+28
10	UDRE	User differential range error	Ulong	4	H+32
11	PRN/slot	Satellite PRN number of range measurement (GPS: 1-32 and SBAS: 120 to 138.)	Ulong	4	H+36
12	psr corr	Scaled pseudorange correction (metres)	Long	4	H+40
13	rate corr	Scaled range rate correction	Long	4	H+44
14	IOD	Issue of data	Long	4	H+48
15...	Next PRN offset = H+28 + (#prns x 24)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.113 RTCMDATA3 Base Station parameters

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **402**
Log Type: **Synch**

Recommended Input:

log rtcmdata3a ontime 10

ASCII Example:

```
#RTCMDATA3A,COM1,0,72.0,FINESTEERING,1420,506793.276,00180020,61e6,1899;
3,0,4655,0,0,6,-163496421.7426230311393738,-366468552.3169214129447937,
494229879.5281358957290649*0f343499
```

Use this log to see what base station information is being received by your rover receivers.

RTCM3 Base Station parameters (RTK)

This log contains the GPS position of the base station expressed in rectangular ECEF coordinates based on the center of the WGS-84 ellipsoid. It follows the RTCM SC-104 Standard for a Type 3 message. This log uses four RTCM data words following the two-word header, for a total frame length of six 30-bit words (180 bits maximum). This message must be sent at least once every 30 seconds, although it is recommended that it is sent once every 10 seconds.

Also, the rover receiver automatically sets an approximate position from this message if it does not already have a position. Therefore, this message can be used in conjunction with an approximate time to improve TTFF, refer to NovAtel's *An Introduction to GNSS* book, available on our website at http://www.novatel.com/support/knowledge-and-learning/ for information..

Structure:

Type 3 messages contain the following information:

- Scale factor
- ECEF X-coordinate
- ECEF Y-coordinate
- ECEF Z-coordinate

The receiver only transmits the RTCM Type 3 when the position is fixed by the FIX command, see *page 120*. If the receiver is configured as a mov ing base station, refer to *Section 2.5.57* on *page 169* for further information.

This log is intended for use when operating in RTK mode.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA3 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris.	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	ECEF-X	Base station ECEF X-coordinate (1/100 m)	Double	8	H+24
9	ECEF-Y	Base station ECEF Y-coordinate (1/100 m)	Double	8	H+32
10	ECEF-Z	Base station ECEF Z-coordinate (1/100 m)	Double	8	H+40
11	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
12	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.114 RTCMDATA9 Partial Differential GPS Corrections

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs. This log is the same as the RTCMDATA1 log but there are only corrections for a maximum of 3 satellites.

Message ID: **404**
Log Type: **Synch**

Recommended Input:

```
log rtcmdata9a ontime 1
```

ASCII Example:

```
#RTCMDATA9A,COM1,0,68.5,FINESTEERING,1420,506833.000,00180020,37f9,1899;
9,0,4721,0,0,6,
3,
0,0,26,22639,11,231,
0,0,19,-4387,-22,134,
0,0,3,-14572,-27,124*6016236c
```

RTCM9 Partial Satellite Set Differential Corrections

RTCM Type 9 messages follow the same format as Type 1 messages. However, unlike a Type 1 message, Type 9 does not require a complete satellite set. This allows for much faster differential correction data updates to the rover stations, thus improving performance and reducing latency.

Type 9 messages should give better performance with slow or noisy data links.

The base station transmitting Type 9 corrections must be operating with a high-stability clock to prevent degradation of navigation accuracy due to the unmodeled clock drift that can occur between Type 9 messages. All OEM6 family receivers can accept Type 9 messages.

NovAtel recommends a high-stability clock whose 2-sample (Allan) variance meets the following stability requirements:

3.24×10^{-24} s^2/s^2 between 0.5 - 2.0 seconds, and

1.69×10^{-22} T s^2/s^2 between 2.0 - 100.0 seconds

An external clock, such as an OCXO, requires approximately 10 minutes to warm up and become fully stabilized after power is applied. Do not broadcast RTCM Type 9 corrections during this warm-up period.

Structure:

Type 9 messages contain the following information for a group of three satellites in view at the base station:

- Scale factor
- Satellite ID
- Range-rate correction
- User Differential Range Error
- Pseudorange correction
- Issue of Data (IOD)

3.3.115RTCMDATA15 Ionospheric Corrections

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **397**
Log Type: **Synch**

Recommended Input:

log rtcmdata15a ontime 10

ASCII Example:

```
#RTCMDATA15A,COM1,0,74.5,FINESTEERING,1117,160783.000,00100020,9601,399;
15,0,3971,7799968,5163500,6,
10,
0,0,3,1631,445,
0,0,15,1423,-222,
0,0,18,1275,-334,
0,0,21,1763,-334,
0,0,17,1454,-556,
0,0,6,2063,0,
0,0,26,1579,222,
0,0,23,1423,-111,
0,0,28,1874,445,
0,0,22,2146,-445*19ed193f
```

This data message provides data to continually enable you to remove ionospheric components from received pseudorange corrections. The *ion rate* and *ion delay* fields can be added just like Type 1 corrections to provide “iono-free” data collection.

RTCM15 Ionospheric Corrections

RTCM Type 15 messages support the broadcast of ionospheric delay and rate of change measurements for each satellite as determined by the base station receiver. They are used to improve the ionospheric de-correlation that would otherwise be experienced by a rover at a long distance from the base. This log works in conjunction with Type 1 messages using dual frequency receivers. Type 15 messages are broadcast every 5-10 minutes and follow the RTCM standard for Type 15 messages.

Type 15 messages enable the rover to continuously remove the ionospheric component from received pseudorange corrections. The delay and rate terms are added like Type 1 corrections to provide the total ionospheric delay at a given time, which is then subtracted from the pseudorange corrections. The resulting corrections are then "iono-free". The rover subtracts its measurements (or estimates) of ionospheric delay from its own pseudorange measurements and applies the iono-free corrections.

Structure:

Type 15 messages contain the following information for each satellite in view at the base station:

- Satellite ID
- Ionospheric delay
- Iono rate of change

When operating as a base station, the receiver must be in FIX POSITION mode and have the INTERFACEMODE command set before the data can be correctly logged. You must also log the RTCM Type 1 corrections. See *pages 120* and *147* respectively. If configured as a mov ing base station, refer to *Section 2.5.57* on *page 169* for further information.

When operating as a rover station, the receiver COM port receiving the RTCM data must have its INTERFACEMODE command set.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA15 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris.	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	#prn	Number of PRNs with information to follow	Ulong	4	H+24
9	Reserved		Ulong	4	H+28
10	sat type	Satellite type where 0 = GPS 1 = GLONASS	Ulong	4	H+32
11	PRN/slot	Satellite PRN number of range measurement (GPS: 1 to 32,SBAS: 120 to 138 and for GLONASS, see *page 31*.)	Ulong	4	H+36
12	ion delay	Ionospheric delay (cm)	Ulong	4	H+40
13	ion rate	Ionospheric rate (0.05 cm / min.)	Long	4	H+44
14...	Next PRN offset = H+28 + (#prns x 20)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.116 RTCMDATA16 Special Message

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **398**
Log Type: **Synch**

Recommended Input:

log rtcmdata16a once

ASCII Example:

```
#RTCMDATA16A,COM1,0,65.0,FINESTEERING,1420,507147.000,00180020,2922,1899;
16,0,5245,0,0,6,37,"base station will shut down in 1 hour"*ac5ee822
```

RTCM16 Special Message

This log contains a special ASCII message that can be displayed on a printer or cathode ray tube. The base station wishing to log this message out to rover stations that are logged onto a computer, must use the SETRTCM16T command to set the required ASCII text message. Once set, the message can then be issued at the required intervals with the "LOG *port* RTCM16 *interval*" command. The Special Message setting can be verified in the RXCONFIGA log, see *page 605*. The received ASCII text can be displayed at the rover by logging RTCM16T ONNEW.

The RTCM16 data log follows the RTCM Standard Format. Words 1 and 2 contain RTCM header information followed by words 3 to *n* (where *n* is variable from 3 to 32) which contain the special message ASCII text. Up to 90 ASCII characters can be sent with each RTCM Type 16 message frame.

Message Type 16 is a special ASCII message capable of being displayed on a printer or CRT. The message can be up to 90 characters long.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA16 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	#chars	Number of characters to follow	Ulong	4	H+24
9	character	Character	Char	4[a]	H+28
10...	Next char offset = H+28 + (#chars x 4)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

3.3.117 RTCMDATA1819 Raw Measurements

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **399**
Log Type: **Synch**

Recommended Input:

log rtcmdata1819a ontime 2

ASCII Example:

```
#RTCMDATA1819A,COM1,1,80.0,FINESTEERING,1415,317696.000,00140040,f337,2616;
18,1000,1493,0,0,6,
2,0,200000,5,
1,1,0,2,0,1,7017922,
1,1,0,30,0,1,12485535,
1,1,0,4,0,1,-8421345,
1,1,0,5,0,1,4072787,
1,1,0,12,0,1,3227209,
19,1000,1493,0,0,6,
2,0,200000,5,
1,1,0,2,2,3,1025891090,
1,1,0,30,2,3,1098334724,
1,1,0,4,2,3,1051480779,
1,1,0,5,2,3,1028271427,
1,1,0,12,2,3,1029484966*dce6f781
```

RTCM18 and RTCM19 Raw Measurements (RTK)

RTCM18 provides uncorrected carrier phase measurements and RTCM19 provides uncorrected pseudorange measurements. The measurements are not corrected by the ephemerides contained in the satellite message.

The messages have similar formats. Word 3, the first data word after the header, contains a GPS reference time OF MEASUREMENT field which is used to increase the resolution of the MODIFIED Z-COUNT in the header. Word 3 is followed by pairs of words containing the data for each satellite observed. Appropriate flags are provided to indicate L1 C/A or P-code **or** L2 cross correlated or P-code measurements. The carrier smoothing interval for pseudoranges and pseudorange corrections is also furnished, for a total frame length of six 30 bit words (180 bits maximum).

RTCM18 and RTCM19 messages follow the RTCM SC-104 Standard for Type 18 and Type 19 messages.

For RTK, you may periodically transmit a set of RTCM Type 18 and RTCM Type 19 together with an RTCM Type 3 message and an RTCM Type 22 message.

RTCMDATA1819 and RTCM2021 logs contain data useful for surveying and highly accurate positioning and/or navigation.

This data provides support for RTK applications using real-time interferometric techniques to resolve integer ambiguities. (An interferometre is, in aerospace for example, an instrument that utilizes the interference of waves for precise determinations.)

RTCM Message Type 18 provides carrier phase measurements, while RTCM Message Type 19 provides pseudorange measurements.

RTCM Message Types 20 and 21 contain the same data as Types 18 and 19 except that the values of Types 20 and 21 are corrected by the ephemerides contained in the satellite message.

Table 92: RTCM1819 Data Quality Indicator

Code	Pseudorange Error
0	≤ 0.020 m
1	≤ 0.030 m
2	≤ 0.045 m
3	≤ 0.066 m
4	≤ 0.099 m
5	≤ 0.148 m
6	≤ 0.220 m
7	≤ 0.329 m
8	≤ 0.491 m
9	≤ 0.732 m
10	≤ 1.092 m
11	≤ 1.629 m
12	≤ 2.430 m
13	≤ 3.625 m
14	≤ 5.409 m
15	> 5.409 m

Table 93: RTCM1819 Smoothing Interval

Code	Smoothing Interval (Minutes)
0	0 to 1
1	1 to 5
2	5 to 15
3	Undefined smoothing interval

Table 94: RTCM1819 Multipath Indicator

Code	Multipath Error
0	≤ 0.100 m
1	≤ 0.149 m
2	≤ 0.223 m
3	≤ 0.332 m
4	≤ 0.495 m
5	≤ 0.739 m
6	≤ 1.102 m
7	≤ 1.644 m
8	≤ 2.453 m
9	≤ 3.660 m
10	≤ 5.460 m
11	≤ 8.145 m
12	≤ 12.151 m
13	≤ 18.127 m
14	> 18.127 m
15	Undetermined multipath

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA-1819 header	Log header	-	H	0
2	RTCM header (for RTCM18)	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	freq	Frequency indicator where 0 = L1 2 = L2 (1 is reserved for future use)	Ulong	4	H+24
9	Reserved		Ulong	4	H+28
10	GNSS time	Global Navigation Satellite System (GNSS) time of measurement (microseconds)	Long	4	H+32
11	#obs	Number of observations with information to follow	Long	4	H+36
12	multi bit	Multiple message indicator	Ulong	4	H+40
13	code	Is code P Code? 0 = FALSE 1 = TRUE	Ulong	4	H+44
14	sat type	Satellite type 0 = GPS 1 = GLONASS	Ulong	4	H+48
15	PRN/slot	PRN number for GPS satellites (satellite number 32 is indicated by 0); slot number for GLONASS satellites, see also *Section 1.3* on *page 31*.	Ulong	4	H+52
16	quality	Data quality indicator, see *Table 92, RTCM1819 Data Quality Indicator* on *page 523*	Ulong	4	H+56
17	continuity	Cumulative loss of continuity indicator with a loss of lock counter	Ulong	4	H+60
18	phase	Carrier phase (1/256 cycles)	Long	4	H+64
19...	Next RTCM18 observation offset = H+40 + (#obs x 28)				

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
variable	RTCM header (for RTCM19)	RTCM message type	Ulong	4	variable
		Base station ID	Ulong	4	
		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	
		Sequence number	Ulong	4	
		Length of frame	Ulong	4	
		Base station health, see *REFSTATION* on *page 489*	Ulong	4	
variable	freq	Frequency indicator where 0 = L1 2 = L2 (1 is reserved for future use)	Ulong	4	variable
	smooth	Smoothing interval, see *Table 93, RTCM1819 Smoothing Interval* on *page 523*	Ulong	4	
	GNSS time	GNSS time of measurement (μs)	Long	4	
	#obs	Number of observations with information to follow	Ulong	4	
variable	multi bit	Multiple message indicator	Ulong	4	variable
	code	Is code P Code? 0 = FALSE 1 = TRUE	Ulong	4	
	sat type	Satellite type 0 = GPS 1 = GLONASS	Ulong	4	
	prn	Satellite PRN/slot number	Ulong	4	
	quality	Data quality indicator, see *Table 92, RTCM1819 Data Quality Indicator* on *page 523*	Ulong	4	
	multipath	Multipath indicator, see *Table 94, RTCM1819 Multipath Indicator* on *page 524*	Ulong	4	
	range	Pseudorange (2/100 m)	Ulong	4	
variable...	Next RTCM19 observation offset = variable				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.118 RTCMDATA2021 Measurement Corrections

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **400**
Log Type: **Synch**

Recommended Input:

log rtcmdata2021a ontime 10

ASCII Example:

```
#RTCMDATA2021A,COM1,1,84.0,FINESTEERING,1415,317796.000,00140040,ade1,2616;
20,1000,1660,0,0,6,
0,0,0,6,
0,0,0,2,0,1,2,221,
0,0,0,4,0,1,129,244,
0,0,0,5,0,1,208,108,
0,0,0,30,0,1,227,196,
0,0,0,12,0,1,73,269,
0,0,0,24,0,1,13,130,
21,1000,1660,0,0,6,
0,0,0,6,
0,0,0,2,0,0,0,3,2,136,
0,0,0,0,4,0,0,0,3,129,
226,-1,0,0,0,5,0,0,0,3,
208,-195,1,0,0,0,30,0,0,0,
3,227,-55,1,0,0,0,12,0,0,
0,3,73,1,1,0,0,0,24,0,0,0,3,13,-1309,8*e1b9072c
```

RTCM20 and RTCM21 Measurement Corrections (RTK)

RTCM20 provides carrier phase corrections and RTCM21 provides pseudorange corrections. Types 20 and 21 are corrected by the ephemerides contained in the satellite message and are therefore referred to as ‘corrections’.

Message Type 21 is very similar to the standard Type 1 message, but has additional measurement quality information, and can be used to support cross-correlation receivers. Message Type 21 is also useful in non-kinematic applications requiring high accuracy and integrity.

See the section above for the message format of the Type 18 and 19 messages that are similar to the Type 20 and 21 messages.

RTCM Message Types 20 and 21 contain the same data as Types 18 and 19 except that the values of Types 20 and 21 are corrected by the ephemerides contained in the satellite message. See also the usage box for Types 18 and 19 on *page 522*.

Table 95: RTCM2021 Data Quality Indicator

Code	Pseudorange Error
0	≤ 0.1 m
1	≤ 0.25 m
2	≤ 0.5 m
3	≤ 1.0 m
4	≤ 2.0 m
5	≤ 3.5 m
6	≤ 5 m
7	> 5

Table 96: RTCM2021 Multipath Indicator

Code	Multipath Error
0	≤ 0.1 m
1	≤ 0.25 m
2	≤ 0.5 m
3	≤ 1.0 m
4	≤ 2.5 m
5	≤ 5 m
6	> 5 m
7	Undetermined multipath

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA-2021 header	Log header	-	H	0
2	RTCM header (for RTCM20)	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION, page 489*	Ulong	4	H+20
8	freq	Frequency indicator 0 = L1 2 = L2	Ulong	4	H+24
9	Reserved		Ulong	4	H+28
10	GNSS time	Global Navigation Satellite System (GNSS) time of measurement (μs)	Long	4	H+32
11	#obs	Number of observation with information to follow	Long	4	H+36
12	multi bit	Multiple message indicator	Ulong	4	H+40
13	code	Is code P Code? 0 = FALSE 1 = TRUE	Ulong	4	H+44
14	sat type	Satellite type 0 = GPS 1 = GLONASS	Ulong	4	H+48
15	PRN/slot	PRN number for GPS satellites (satellite number 32 is indicated by 0); slot number for GLONASS satellites, see also *Section 1.3* on *page 31*.	Ulong	4	H+52
16	quality	Data quality indicator, see *Table 95, RTCM2021 Data Quality Indicator* on *page 528*	Ulong	4	H+56
17	continuity	Cumulative loss of continuity indicator with a loss of lock counter	Ulong	4	H+60
18	IODE	Issue of ephemeris data	Ulong	4	H+64
19	phase	Carrier phase correction (1/256 cycles)	Long	4	H+68
20...	Next RTMC20 observation offset = H+40 + (#obs x 32)				
variable	RTCM header (for RTCM21)	RTCM message type	Ulong	4	vari-able
		Base station ID	Ulong	4	
		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris.	Ulong	4	
		Sequence number	Ulong	4	
		Length of frame	Ulong	4	
		Base station health, see *REFSTATION, page 489*	Ulong	4	

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
variable	freq	Frequency indicator	Ulong	4	vari-able
	Reserved		Ulong	4	
	GNSS time	GNSS time of measurement	Long	4	
	#obs	Number of observations to follow	Ulong	4	
variable	multi bit	Multiple message indicator			var-iable
	code	Is code P Code? 0 = FALSE 1 = TRUE	Ulong	4	
	sat type	Satellite type 0 = GPS 1 = GLONASS	Ulong	4	
	prn	Satellite PRN/slot number	Ulong	4	
	corr scale	Pseudorange correction scale factor 0 = 0.02 1 = 0.32	Ulong	4	
	rate scale	Pseudorange rate correction scale factor 0 = 0.002 1 = 0.032	Ulong	4	
	quality	Data quality indicator, see *Table 95, Page 528*	Ulong	4	
	multipath	Multipath indicator, see *Table 96, Page 528*	Ulong	4	
	IODE	Issue of ephemeris data	Ulong	4	
	range corr	Pseudorange correction (scaled)	Long	4	
	range rate	Pseudorange range correction rate (scaled)	Long	4	
variable	Next RTCM21 observation offset = variable				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.119 RTCMDATA22 Extended Base Station

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

This message accommodates Network RTK. However, it is not specific to Network RTK and may be used in other applications. For more details, refer to the Network RTK application note available from our website as APN-041 at http://www.novatel.com/support/applicationnotes.htm.

Message ID: **401**
Log Type: **Synch**

Recommended Input:

```
log rtcmdata22a ontime 10
```

ASCII Example:

```
#RTCMDATA22A,COM1,0,68.5,FINESTEERING,1450,231012.566,00100000,28b0,35794;
22,0,1020,0,0,6,-24,-122,82,1,0,0,0,0,TRUE,174762,1,0,0,0*2846ab0c
```

Only use the RTCMDATA22 log with GPS-only receiver models.

RTCM22 RTCM Extended Base Station parameters (RTK)

Message Type 22 provides firstly, a means of achieving sub-millimetre precision for base station coordinates, and secondly, base station antenna height above a base, which enables mobile units to reference measured position to the base directly in real time.

The first data word of message Type 22 provides the corrections to be added to each ECEF coordinate. Note that the corrections may be positive or negative.

The second data word, which may not be transmitted, provides the antenna L1 phase center height expressed in integer and fractional centimetres, and is always positive. It has the same resolutions as the corrections. The range is about 10 metres. The spare bits can be used if more height range is required.

RTCM Message Type 22 can be used to achieve sub-millimetre precision for base station coordinates .

Further, if a base station antenna is for example, above a monument, it can be used to provide height. This enables mobile units (rovers) to reference measured positions to the monument directly in real time.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA22 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489.*	Ulong	4	H+20
8	L1 ECEF-X	L1 ECEF ΔX correction (1/256 cm)	Long	4	H+24
9	L1 ECEF-Y	L1 ECEF ΔY correction (1/256 cm)	Long	4	H+28
10	L1 ECEF-Z	L1 ECEF ΔZ correction (1/256 cm)	Long	4	H+32
11	#L1 recs	Number of GPS L1 records to follow	Ulong	4	H+36
12	spare	Spare bits	Ulong	4	H+40
13	height stat	No height flag where 0 = FALSE 1 = TRUE	Enum	4	H+44
14	phase center	Antenna L1 phase center height (1/256 cm)	Ulong	4	H+48
variable	#L2 recs	Number of GPS L2 records to follow	Ulong	4	variable
variable	L2 ECEF-X	L2 ECEF ΔX correction (1/256 cm)	Long	4	variable
variable	L2 ECEF-Y	L2 ECEF ΔY correction (1/256 cm)	Long	4	variable
variable	L2 ECEF-Z	L2 ECEF ΔZ correction (1/256 cm)	Long	4	variable
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.120 RTCMDATA22GG Extended Base Station for GLONASS

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs. See also RTCMDATA22 for GPS-only receivers starting on *page 531*.

This message accommodates Network RTK. However, it is not specific to Network RTK and may be used in other applications. For more details, refer to the Network RTK application note available from our website as APN-041 at http://www.novatel.com/support/applicationnotes.htm.

Message ID: **964**
Log Type: **Synch**

Recommended Input:

log rtcmdata22gga ontime 10

ASCII Example:

```
#RTCMDATA22GGA,COM1,0,68.5,FINESTEERING,1450,231012.566,00100000,28b0,35794;
22,0,1020,0,0,6,-24,-122,82,1,0,0,0,0,TRUE,174762,1,0,0,0*2846ab0c
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA-22GG header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health	Ulong	4	H+20
8	L1 ECEF-X	L1 ECEF ΔX correction (1/256 cm)	Long	4	H+24
9	L1 ECEF-Y	L1 ECEF ΔY correction (1/256 cm)	Long	4	H+28
10	L1 ECEF-Z	L1 ECEF ΔZ correction (1/256 cm)	Long	4	H+32
11	#L1recs	Number of GPS/GLONASS L1 records to follow	Ulong	4	H+36
12	spare	Spare bits	Ulong	4	H+40
13	constellation	Constellation	Ulong	4	
14	ant type	Antenna type	Ulong	4	
15	ant ref pt	Antenna reference point	Ulong	4	
16	height stat	No height flag where 0 = FALSE 1 = TRUE	Enum	4	H+44
17	phase center	Antenna L1 phase center height (1/256 cm)	Ulong	4	H+48
variable	#L2recs	Number of GPS/GLONASS L2 records to follow	Ulong	4	variable
variable	L2 ECEF-X	L2 ECEF ΔX correction (1/256 cm)	Long	4	variable
variable	L2 ECEF-Y	L2 ECEF ΔY correction (1/256 cm)	Long	4	variable
variable	L2 ECEF-Z	L2 ECEF ΔZ correction (1/256 cm)	Long	4	variable
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.121 RTCMDATA23 Antenna Type Definition

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **663**
Log Type: **Synch**

Recommended Input:

log rtcmdata23a ontime 5

ASCII Example:

```
#RTCMDATA23A,COM1,0,80.5,COARSESTEERING,1399,253488.880,005c0002,3188,35143;
23,0,2481,0,0,6,0,0,1,9,"arbitrary",1,0,6,"values"*f84ed3a0
```

RTCM23 RTCM Antenna Type Definition Record (RTK)

Message Type 23 provides information about the antenna type used at the base station. The RTCM commission uses an equipment-naming downloadable table from the International GPS Service Central Bureau (IGS CB): ftp://igscb.jpl.nasa.gov/igscb/station/general/rcvr_ant.tab. This table provides a unique antenna descriptor for antennas used for high-precision surveying type applications.

The service provider uses the *setup ID* parameter to indicate the particular base station-antenna combination. "0" for this value means that the values of a standard model type calibration should be used. A non-zero value specifies a particular setup, or calibration, table for the specific antenna in use at the base station. Increase the number whenever a change occurs at the station that affects the antenna phase center variations. Depending on the change of the phase center variations due to a setup change, a change in the *setup ID* would mean that you should check with the service provider to see if the antenna phase center variation in use is still valid. The provider must make appropriate information available to users.

The *ant ser#* field is the individual antenna serial number as issued by the manufacturer of the antenna. A possible duplication of the antenna serial number is not possible, because together with the antenna descriptor, only one antenna with the particular number is available. In order to avoid confusion, the antenna serial number should be omitted when the record is used together with reverse reduction to model type calibration values, because it cannot be allocated to a real physical antenna.

In order to produce RTCM23 or RTCM24 messages from a base receiver, the receiver must have a fixed position (or be properly set to operate as a moving base station). The receiver must also have a BASEANTENNAMODEL command sent to it, see *page 80*. Provided these conditions are met, you can log RTCM23 and RTCM24 from the base station. If an RTCM24 log, or request for an RTCM24 log, is detected at the base, the rover station ARP parameter is set to 1. Otherwise it is set to 0.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA23 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	Reserved		Ulong	4	H+24
9	ARP	Antenna Reference Point	Ulong	4	H+28
10	ser flag	Serial flag	Ulong	4	H+32
11	#chars	Length of antenna descriptor (number of characters)	Ulong	4	H+36
12	ant descrp	Antenna descriptor	Uchar [31]	32 [a]	H+40
13	setup ID	Setup ID	Ulong	4	H+72
14	Reserved		Ulong	4	H+76
15	#chars2	Length of antenna serial number (characters)	Ulong	4	H+80
16	ant ser#	Antenna serial number	Uchar [31]	31	H+84
17	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
18	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, additional bytes of padding may be added to maintain 4-byte alignment.

3.3.122 RTCMDATA24 Antenna Reference Point (ARP)

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

This message accommodates Network RTK. However, it is not specific to Network RTK and may be used in other applications. For more details, refer to the Network RTK application note available from our website as APN-041 at http://www.novatel.com/support/applicationnotes.htm.

Message ID: **664**
Log Type: **Synch**

Recommended Input:

```
log rtcmdata24a ontime 5
```

ASCII Example:

```
#RTCMDATA24A,COM1,0,71.0,FINESTEERING,1450,237173.950,00100000,0625,35794;
24,0,5289,0,0,6,-1.634526570929836e+10,0,-3.664616764707576e+10,
0,4.942495013223856e+10,0,1,1,0,0*530c8b71
```

In the example, log RTCM24 from the base before you log RTCMDATA24 at a rover:

`interfacemode com2 none rtcm` *(Set the COM2 interface mode to RTCM)*

`log com2 RTCM24 ontime 5.0` *(Output RTCM24 messages from COM2 every 5 s)*

RTCM24 RTCM Antenna Reference Point parameter (RTK)

Message 24 replaced messages 3 and 22 for RTK operation. The L1 phase center is not a point in space that can be used as a standard reference but rather, depends on the antenna setup and calibration. The location of the L1 phase center may vary between different calibration tables for the same antenna model. Message Type 24 solves this using ARP, used throughout the International GPS Service (IGS).

Message 24 contains the coordinates of the installed antenna's ARP in the GNSS coordinate system Earth-Center-Earth-Fixed (ECEF) coordinates. Local datums are not supported. The coordinates refer to a physical point on the antenna (typically the bottom of the antenna mounting surface).

BASEANTENNAMODEL and ANTENNAMODEL commands set the data, see *pages 80* and *63* respectively. ECEF coordinates correspond to the currently calculated base station coordinates with the L1 phase center offsets applied and will soon reflect the ARP, calculated from the base and rover sets of user antenna model parameters.

Reserved fields are set to 0, the *sys ind* field defaults to GPS, and the *ant ht* field is set to 0 by default. This follows current implementation of RTCM22 messages.

RTCM24 data can be viewed at the base by requesting the RTCMDATA24 log.

If a rover receives RTCM24, RTCM1005, or RTCM1006 data, containing antenna offset information but does not have the same antenna type as the base station, the position is offset. Provided the two receivers have matching antenna models, the output rover positions reflect the position of the ARP.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA24 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	ECEF_X	ECEF ΔX correction (1/256 cm)	Double	8	H+24
9	Reserved		Ulong	4	H+32
10	ECEF_Y	ECEF ΔY correction (1/256 cm)	Double	8	H+36
11	Reserved		Ulong	4	H+44
12	ECEF_Z	ECEF ΔZ correction (1/256 cm)	Double	8	H+48
13	sys ind	System indicator	Ulong	4	H+56
14	ant ht flag	Antenna height flag	Ulong	4	H+60
15	#recs	Number of antenna records to follow	Ulong	4	H+64
16	ant ht	Antenna height	Ulong	4	H+68
16	Reserved		Ulong	4	H+72
17	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+76
18	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.123 RTCMDATA31 GLONASS Differential Corrections

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **868**
Log Type: **Synch**

Recommended Input:

log rtcmdata31a ontime 2

ASCII Example:

```
#RTCMDATA31A,COM1,0,59.5,FINESTEERING,1417,171572.000,00140000,77c0,2698;
31,1000,3953,0,0,6,4,0,0,4,-506,-6,1,77,0,0,2,-280,-9,1,77,0,0,18,-645,
-4,1,77,0,0,19,-660,-6,1,77*29664bf3
```

RTCM31 Differential GLONASS Corrections (RTK)

Message Type 31 provides differential GLONASS corrections.

The Type 31 format complies with the tentative RTCM 2.3 standard but is subject to change as the RTCM specifications change. It currently matches the Type 59GLO format, but unlike Type 31 which may change, Type 59GLO will say in the same format.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA31 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	#recs	Number of records to follow	Ulong	4	H+24
9	scale	Scale factor	Long	4	H+28
10	udre	User differential range error	Ulong	4	H+32
11	prn	Satellite ID	Ulong	4	H+36
12	cor	Correction	Int	4	H+40
13	cor rate	Correction rate	Int	4	H+44
14	change	Change bit	Ulong	4	H+48
15	τ_K	Time of day	Ulong	4	H+52
16	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	vari-able
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.124 RTCMDATA32 GLONASS Base Station parameters

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **878**
Log Type: **Synch**

Recommended Input:

log rtcmdata32a ontime 2

ASCII Example:

```
#RTCMDATA32A,COM1,0,41.0,FINESTEERING,1417,159021.845,00140000,4231,2698;
32,1000,1036,0,0,6,-109917613.9246512502431870,
-164379942.4939256608486176,247124922.7021482884883881*3d24c470
```

RTCM32 GLONASS Base Station parameters (RTK)

Message Type 32 provides GLONASS base station parameters in ECEF coordinates.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA32 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	ECEF-X	ECEF ΔX correction (1/100 m)	Double	8	H+24
9	ECEF-Y	ECEF ΔY correction (1/100 m)	Double	8	H+32
10	ECEF-Z	ECEF ΔZ correction (1/100 m)	Double	8	H+40
17	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
18	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.125 RTCMDATA36 Special Message

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **879**

Log Type: **Synch**

Recommended Input:

log rtcmdata36a once

ASCII Example:

```
#RTCMDATA36A,COM1,0,64.5,FINESTEERING,1399,237113.869,00500000,
f9f5,35359;36,0,5189,0,0,6,11,"QUICK\d166\d146\d174\d144\d140"
*8bdeae71
```

RTCM36 Special Message Including Russian Characters

This log contains a special ASCII message that can be displayed on a printer or terminal. The base station wishing to log this message out to rover stations that are logged onto a computer, must use the SETRTCM36T command to set the required ASCII text message. Once set, the message can then be issued at the required intervals with the “LOG *port* RTCM36 *interval*” command. The Special Message setting can be verified in the RXCONFIGA log, see *page 605*. The received ASCII text can be displayed at the rover by logging RTCM36T ONNEW.

The RTCM36 data log follows the RTCM Standard Format. Words 1 and 2 contain RTCM header information followed by words 3 to *n* (where *n* is variable from 3 to 32) which contain the special message ASCII text. Up to 90 ASCII characters, including an extended ASCII set as shown in *Table 42* on *page 228*, can be sent with each RTCM Type 36 message frame.

The ASCII extended character set includes Cyrillic characters to provide, for example, Russian language messages.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA36 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	#chars	Number of characters to follow	Ulong	4	H+24
9	character	Character	Char	4[a]	H+28
10...	Next char offset = H+28 + (#chars x 4)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

3.3.126 RTCMDATA59 Type 59N-0 NovAtel RT20

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **403**

Log Type: **Synch**

Recommended Input:

log rtcmdata59a ontime 10

ASCII Example:

```
#RTCMDATA59A,COM1,0,71.0,FINESTEERING,1420,506996.000,00180020,7dc7,1899;
59,0,4993,0,0,6,78,20506229,2,0,8,26,3,39864503,-167,19,3,20437804,-40,
3,3,16170184,-41,18,3,1213739,-123,21,3,13601473,-50,9,3,23627155,-171,
14,3,26086086,-151,22,3,5,-182*9c414d63
```

RTCM59 Type 59N-0 NovAtel Proprietary Message (RTK)

RTCM Type 59 messages are reserved for proprietary use by RTCM base station operators.

Each message is variable in length, limited only by the RTCM maximum of 990 data bits (33 words maximum). The first eight bits in the third word (the word immediately following the header) serve as the message identification code, in the event that the base station operator wishes to have multiple Type 59 messages.

NovAtel has defined only a Type 59N-0 message to date; it is used for operation in receivers capable of operating in RT-20 Carrier Phase Differential Positioning Mode. This log is primarily used by a base station to broadcast its RT-20 observation data (delta pseudorange and accumulated Doppler range) to rover RT-20 – capable receivers. Type 59N messages should be sent once every 1 or 2 seconds.

1. The PORTSTATS log, see *page 445*, is very useful for monitoring the serial data link, as well as differential data decode success.
2. This log is intended for use when operating in RT-20 mode.

RTCM Message Type 59 is a message type reserved for private use by operators who communicate proprietary information.

NovAtel receivers make use of this Message Type 59 for RT20 differential positioning. The RTCMDATA59 log can be used to observe data being used by a rover that is performing RT-20 level positioning and RTCM corrections.

For example, the German SAPOS (Satellitenpositionierungsdienst der Deutschen Landesvermessung) and ASCOS (Satelliten-Referenzdienst der E.ON Ruhrgas AG) correction networks send their FKP RTK correction parameters (using their own message format) through RTCM message Type 59. FKP is an acronym for Flachen Korrectur parameter (Plane Correction parameter).

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA -59 header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris.	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION, page 489*	Ulong	4	H+20
8	subtype	Message subtype	Char	4[a]	H+24
9	min psr	Minimum pseudorange (m)	Long	4	H+28
10	time offset	Time difference between the Z-count time and the measurement time where Z-count time from subframe 1 of the ephemeris (0.1 s / lsb)	Long	4	H+32
10	Reserved		Ulong	4	H+36
11	#prn	Number of PRNs with information to follow	Ulong	4	H+40
12	PRN/slot	Satellite PRN number of range measurement (GPS: 1-32 and SBAS: 120 to 138. For GLONASS, see *Section 1.3* on *page 31*.)	Ulong	4	H+44
13	lock	Lock time: 0 = <20 seconds 1 = 20-40 seconds 2 = 40-80 seconds 3 = >80 seconds	Ulong	4	H+48
14	psr	Pseudorange correction (1/10 m)	Ulong	4	H+52
15	adr	Accumulated Doppler (ADR) correction (1/1000 m)	Long	4	H+56
16...	Next PRN offset = H+44 + (#prns x 16)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

3.3.127 RTCMDATA59GLO NovAtel Proprietary GLONASS Differential Corrections

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs.

Message ID: **905**
Log Type: **Synch**

Recommended Input:

log rtcmdata59gloa ontime 2

ASCII Example:

```
#RTCMDATA59GLOA,COM1,0,71.5,FINESTEERING,1420,509339.000,00100008,e896,2733;
59,10,2898,0,0,6,110,2,0,0,19,-459,-9,0,56,0,0,4,570,-7,1,56*00dee641
```

The Type 31 format, see *page 539*, currently matches the Type 59GLO format, but unlike Type 31 which may change, Type 59GLO will stay in the same format. The Type 31 format complies with the tentative RTCM 2.3 standard but is subject to change as the RTCM specifications change.

RTCM59GLO Differential GLONASS Corrections (DGPS)

Message Type 59GLO provides differential GLONASS corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA-59GLO header	Log header	-	H	0
2	RTCM header	RTCM message type	Ulong	4	H
3		Base station ID	Ulong	4	H+4
4		Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5		Sequence number	Ulong	4	H+12
6		Length of frame	Ulong	4	H+16
7		Base station health, see *REFSTATION* on *page 489*	Ulong	4	H+20
8	subtype	Message subtype	Uchar	4 [a]	H+24
9	#recs	Number of records to follow	Ulong	4	H+28
10	scale	Scale factor	Long	4	H+32
11	udre	User differential range error	Ulong	4	H+36
12	prn	Satellite ID	Ulong	4	H+40
13	cor	Correction	Int	4	H+44
14	cor rate	Correction rate	Int	4	H+48
15	change	Change bit	Ulong	4	H+52
16	τ_K	Time of day	Ulong	4	H+56
17	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	vari-able
18	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment.

3.3.128 RTCMDATAOMNI1 RTCM1 from OmniSTAR VBS

See *Section 3.3.110* starting on *page 507* for information about RTCM standard logs. See also *OmniSTAR Local Wide Area Corrections* on *page 511*.

Message ID: **960**

Log Type: **Asynch**

Recommended Input:

log rtcmdataomni1a onchanged

ASCII Example:

```
#RTCMDATAOMNI1A,COM1,0,74.0,FINESTEERING,1464,424276.151,00000000,405e,35912;
1,100,5119,0,0,0,0,12,
0,0,6,-313,0,2,0,0,3,-570,0,73,0,0,10,-1116,0,77,0,0,15,-339,0,0,
0,0,16,-527,0,5,0,0,18,-29,0,9,0,0,21,-306,0,64,0,0,22,-586,0,48,
0,0,24,-362,0,81,0,0,26,-394,0,59,0,0,29,-487,0,37,0,0,8,-1242,0,63*f128cbd2
```

RTCMOMNI1 RTCM from OmniSTAR

The RTCMOMNI1 message is an RTCM Type 1 message that the receiver generates from OmniSTAR VBS corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA-OMNI1 header	Log header	-	H	0
2	type	RTCM message type	Ulong	4	H
3	baseID	Base station ID	Ulong	4	H+4
4	Z	Modified Z count where the Z count week number is the week number from subframe 1 of the ephemeris	Ulong	4	H+8
5	seq#	Sequence number	Ulong	4	H+12
6	frame length	Length of frame	Ulong	4	H+16
7	health	Base station health	Ulong	4	H+20
8	Mhealth	Message health	Ulong	4	H+24
9	#recs	Number of records to follow	Ulong	4	H+28
10	scale	Scaling for the correction and correction rate	Ulong	4	H+32
11	UDRE	User differential range error	Ulong	4	H+36
12	prn	Satellite PRN (1-32)	Ulong	4	H+40
13	corr	Correction	Int	4	H+44
14	corr rate	Correction rate	Int	4	H+48
15	IODE	Issue of ephemeris data	Ulong	4	H+52
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.129 RTCMV3 RTCMV3 Standard Logs

RTCM1001 L1-ONLY GPS RTK OBSERVABLES
Message ID: 772

RTCM1002 EXTENDED L1-ONLY GPS RTK OBSERVABLES
Message ID: 774

RTCM1003 L1 AND L2 GPS RTK OBSERVABLES
Message ID: 776

RTCM1004 EXTENDED L1 AND L2 GPS RTK OBSERVABLES
Message ID: 770

RTCM1005 STATIONARY RTK BASE STATION ANTENNA REFERENCE POINT (ARP)
Message ID: 765

RTCM1006 STATIONARY RTK BASE STATION ARP WITH ANTENNA HEIGHT
Message ID: 768

RTCM1007 EXTENDED ANTENNA DESCRIPTOR AND SETUP INFORMATION

Message ID: 852

RTCM1008 EXTENDED ANTENNA REFERENCE STATION DESCRIPTION AND SERIAL NUMBER
Message ID: 854

RTCM1009 GLONASS L1-ONLY RTK
Message ID: 885

RTCM1010 EXTENDED GLONASS L1-ONLY RTK
Message ID: 887

RTCM1011 GLONASS L1/L2 RTK
Message ID: 889

RTCM1012 EXTENDED GLONASS L1/L2 RTK
Message ID: 891

RTCM1019 GPS EPHEMERIDES
Message ID: 893

RTCM1020 GLONASS EPHEMERIDES
Message ID: 895

RTCM1033 RECEIVER AND ANTENNA DESCRIPTORS

Message ID: 1097

1. At the base station, choose to send either an RTCM1005 or RTCM1006 message to the rover station. Then select one of the observable messages (RTCM1001, RTCM1002, RTCM1003 or RTCM1004) to send from the base.
2. RTCM1007 and RTCM1008 data is set using the BASEANTENNAMODEL command, see *page 80*. If you have set a base station ID, it is detected and set. Other values are also taken from a previously entered BASEANTENNA-MODEL command.
3. In order to set up logging of RTCM1007 or RTCM1008 data, it is recommended to first use the INTERFACEMODE command to set the interface mode of the port transmitting RTCMV3 messages to RTCMV3, see *page 147*. Providing the base has a fixed position, see FIX on *page 120*, or is configured as a mov ing base station (refer to *Section 2.5.57* on *page 169*), and its BASEANTENNA-MODEL command set, you can log out RTCM1007 messages.
4. The RTCM messages can be logged with an A or B suffix for an ASCII or Binary output with a NovAtel header followed by Hex or Binary raw data respectively.
5. RTCMDATA logs output the details of the above logs if they have been sent.

RTCM SC-104 is a more efficient alternative to the documents entitled "RTCM Recommended Standards for Differential NAVSTAR GPS Service, Version 2.x". Version 3.0, consists primarily of messages designed to support real-time kinematic (RTK) operations. The reason for this emphasis is that RTK operation involves broadcasting a lot of information, and thus benefits the most from a more efficient data format.

The RTCM SC-104 standards have been adopted by NovAtel for implementation into the receiver. The receiver can easily be integrated into positioning systems around the globe because it is capable of utilizing RTCM Version 3.0 formats.

The initial Version 3.0 document describes messages and techniques for supporting GPS. However, the format accommodates modifications to these systems (for example, new signals), and to new satellite systems that are under development. In addition, augmentation systems that utilize geostationary satellites with transponders operating in the same frequency bands are now in the implementation stages. Generically they are called Satellite-Based Augmentation Systems (SBAS), and they have been designed to be interoperable (for example WAAS, EGNOS, MSAS).

Message types contained in the current Version 3.0 standard have been structured in different groups. Transmit at least one message type from each of Groups 1 to 3:

Group 1 - Observations:

RTCM1001	L1-Only GPS RTK
RTCM1002	Extended L1-Only GPS RTK
RTCM1003	L1 And L2 GPS RTK
RTCM1004	Extended L1and L2 GPS RTK
RTCM1009	L1-Only GLONASS RTK
RTCM1010	Extended L1-Only GLONASS RTK

RTCM1011	L1/L2 GLONASS RTK
RTCM1012	Extended L1/L2 GLONASS RTK

Group 2 - Base Station Coordinates:

RTCM1005	RTK Base Antenna Reference Point (ARP)
RTCM1006	RTK Base ARP with Antenna Height

Group 3 - Antenna Description:

RTCM1007	Extended Antenna Descriptor and Setup Information
RTCM1008	Extended Antenna Reference Station Description and Serial Number

Group 4 - Auxiliary Operation Information:

RTCM1019	GPS Ephemerides
RTCM1020	GLONASS Ephemerides
RTCM1033	Receiver and Antenna Descriptors

Example Input:

```
interfacemode com2 none RTCMV3
fix position 51.1136 -114.0435 1059.4
baseantennamodel 702 NVH05410007 1 user
log com2 rtcm1005 ontime 3
log com2 rtcm1002 ontime 5
log com2 rtcm1006 ontime 1
log com2 rtcm1007 ontime 10
log com2 rtcm1008 ontime 10
```

RTCM1001-RTCM1004GPS RTK Observables

RTCM1001, RTCM1002, RTCM1003 and RTCM1004 are GPS real-time kinematic (RTK) messages, which are based on raw data. From these data, valid RINEX files can be obtained. As a result, this set of messages offers a high level of interoperability and compatibility with standard surveying practices. Refer also to the *PC Software and Firmware* section of the *OEM6 Installation and Operation Manual* for details on the logs that Convert4 converts to RINEX.

The Type 1001 Message supports single-frequency RTK operation. It does not include an indication of the satellite carrier-to-noise ratio as measured by the base station.

The Type 1002 Message supports single-frequency RTK operation, and includes an indication of the satellite carrier-to-noise (C/No) as measured by the base station. Since the C/No does not usually change from measurement to measurement, this message type can be mixed with the Type 1001, and used primarily when a satellite C/No changes, thus saving broadcast link throughput.

The Type 1003 Message supports dual-frequency RTK operation, but does not include an indication of the satellite carrier-to-noise (C/No) as measured by the base station.

The Type 1004 Message supports dual-frequency RTK operation, and includes an indication of the satellite carrier-to-noise (C/No) as measured by the base station. Since the C/No does not usually change from measurement to measurement, this message type can be mixed with the Type 1003, and used only when a satellite C/No changes, thus saving broadcast link throughput.

RTCM1005 & RTCM1006 RTK Base Antenna Reference Point (ARP)

Message Type 1005 provides the earth-centered, earth-fixed (ECEF) coordinates of the antenna reference point (ARP) for a stationary base station. No antenna height is provided.

Message Type 1006 provides all the same information as Message Type 1005, but additionally provides the height of the ARP.

These messages are designed for GPS operation, but are equally applicable to future satellite systems, and system identification bits are reserved for them.

Message Types 1005 and 1006 avoid any phase center problems by utilizing the ARP, which is used throughout the International GPS Service (IGS). They contain the coordinates of the installed antenna's ARP in Earth-Center-Earth-Fixed (ECEF) coordinates - datum definitions are not yet supported. The coordinates always refer to a physical point on the antenna, typically the bottom of the antenna mounting surface.

RTCM1007 & RTCM1008 Extended Antenna Descriptions

Message Type 1007 provides an ASCII descriptor of the base station antenna. The International GPS Service (IGS) Central Bureau convention is used most of the time, since it is universally accessible.

Message Type 1008 provides the same information, plus the antenna serial number, which removes any ambiguity about the model number or production run.

IGS limits the number of characters to 20 at this time. The antenna setup ID is a parameter for use by the service provider to indicate the particular base station-antenna combination. "0" for this value means that the values of a standard model type calibration should be used. The antenna serial number is the individual antenna serial number as issued by the manufacturer of the antenna.

RTCM1009-RTCM1012 GLONASS RTK Observables

Message Types 1009 through 1012 provide the contents of the GLONASS RTK messages, which are based on raw data. You can obtain complete RINEX files from this data. This set of messages offers a high level of interoperability and compatibility with standard surveying practices. When using these messages, you should also use an ARP message (Type 1005 or 1006) and an Antenna Descriptor message (Type 1007 or 1008). If the time tags of the GPS and GLONASS RTK data are synchronized, the Synchronized GNSS flag can be used to connect the entire RTK data block.

RTCM1019-RTCM1020 GPS and GLONASS Ephemerides

Message Type 1019 contains GPS satellite ephemeris information. Message Type 1020 contains GLONASS ephemeris information. These messages can be broadcast in the event that an anomaly in ephemeris data is detected, requiring the base station to use corrections from previously good satellite ephemeris data. This allows user equipment just entering the differential system to use corrections being broadcast from that ephemeris. Broadcast this message (Type 1019 or 1020) every 2 minutes until the satellite broadcast is corrected, or until the satellite drops below the coverage area of the base station.

These messages can also be used to assist receivers to quickly acquire satellites. For example, if you access a wireless service with this message, it can utilize the ephemeris information immediately rather than waiting for a satellite to be acquired and its almanac data processed.

3.3.130 RTCMDATA1001 L1-Only GPS RTK Observables

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

Message ID: **784**
Log Type: **Synch**

Recommended Input:

log rtcmdata1001a ontime 10 3

ASCII Example:

```
#RTCMDATA1001A,COM1,0,82.0,FINESTEERING,1317,239228.000,00180040,c279,1855;
0,0,239228000,0,8,0,0,8,21,0,14513926,8707,127,2,0,3705361,5040,127,16,0,
7573721,3555,124,29,0,5573605,-11078,127,26,0,2996771,-17399,99,6,0,9341652,
-329,127,10,0,13274623,2408,127,30,0,3355111,18860,127*ec698c2a
```

Message Type 1001 contains the shortest version of a message for GPS observations, namely L1-only observables. Message Type 1002 contains additional information that enhances performance. If throughput is not limited and the additional information is available, it is recommended to use the longer version of messages.

Table 97: SBAS PRN Codes

SBAS Code	GPS/GLONASS Satellite ID	SBAS Code	GPS/GLONASS Satellite ID
120	40	130	50
121	41	131	51
122	42	132	52
123	43	133	53
124	44	134	54
125	45	135	55
126	46	136	56
127	47	137	57
128	48	138	58
129	49		

Table 98: Carrier Smoothing Interval of Code Phase

Indicator		Smoothing Interval
ASCII	Binary	
0	000	No smoothing
1	001	< 30 s
2	010	30-60 s
3	011	1-2 min.
4	100	2-4 min.
5	101	4-8 min.
6	110	>8 min.
7	111	Unlimited smoothing interval

Table 99: Lock Time Indicator

Indicator (i) [a]	Minimum Lock Time (s)	Range of Indicated Lock Times
0-23	i	$0 \leq$ lock time < 24
24-47	i · 2 - 24	$24 \leq$ lock time < 72
48-71	i · 4 - 120	$72 \leq$ lock time < 168
72-95	i · 8 - 408	$168 \leq$ lock time < 360
96-119	i · 16 - 1176	$360 \leq$ lock time < 744
120-126	i · 32 - 3096	$744 \leq$ lock time < 937
127	---	lock time ≥ 937

a. Determining Loss of Lock: In normal operation, a cycle slip is evident when the Minimum Lock Time (s) has decreased in value. For long time gaps between messages, such as from a radio outage, extra steps should be taken on the rover to safeguard against missed cycle slips.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1001 header	Log header	-	H	0
2	RTCMV3 observations header	Message number	Ushort	2	H
3		Base station ID	Ushort	2	H+2
4		GPS epoch time in ms from the beginning of the GPS reference week, which begins at midnight GMT on Saturday night/Sunday morning, measured in GPS reference time (as opposed to UTC)	Ulong	4	H+4
5		GNSS message flag: 0 = No further GNSS observables referenced to the same epoch time. The receiver begins to process data immediately after decoding the message. 1 = The next message contains observables from another GNSS source referenced to the same epoch time	Uchar	1	H+8
6		Number of GPS satellite signals processed (the number of satellites in the message and not necessarily equal to the number of satellites visible to the base station)	Uchar	1	H+9
7		Smoothing indicator 0 = Divergence-free smoothing not used 1 = Divergence-free smoothing used	Uchar	1	H+10
8		Smoothing interval, see *Table 98* on *page 555*. This is the integration period over which base station pseudorange code phase measurements are averaged using carrier phase information. Divergence-free smoothing may be continuous over the entire period that the satellite is visible.	Uchar	1	H+11
9	#prns	Number of PRNs with information to follow	Ulong	4	H+12
10	PRN	PRN #, for SBAS see *Table 97, page 554*	Uchar	1	H+16
11	code-ind	GPS L1 code indicator 0 = C/A code 1 = P(Y) code direct	Uchar	1	H+17
12	psr	GPS L1 pseudorange (m) in 0.02 m units	Ulong	4	H+18
13	phase-pseudo	GPS L1 (phaserange - pseudorange) in 0.0005 m units Range: ±262.1435 m	Long	4	H+22

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
14	locktime-ind	GPS L1 continuos tracking lock time indicator, see *Table 99* on *page 555*	Uchar	2 [a]	H+26
15...	Next PRN offset = H+16 + (#prns x 12)				
vari-able	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
vari-able	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, a variable number of additional bytes of padding are added, depending on the number of satellites, to maintain 4-byte alignment.

3.3.131 RTCMDATA1002 Extended L1-Only GPS RTK Observables

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

Message ID: **785**
Log Type: **Synch**

Recommended Input:

log rtcmdata1002a ontime 7

ASCII Example:

```
#RTCMDATA1002A,COM1,0,79.0,FINESTEERING,1317,239318.000,00180040,adb2,1855;
0,0,239318000,0,9,0,0,9,21,0,12261319,-9236,127,0,202,
2,0,6623657,4517,127,0,171,16,0,5632627,1876,127,0,179,
29,0,3064427,-10154,127,0,177,26,0,14721908,-21776,105,0,164,
6,0,9384778,1113,127,0,205,18,0,9594701,-1176,27,0,184,
10,0,14876991,8629,127,0,202,30,0,6417059,20243,127,0,195*e7d3c54d
```

Message Type 1002 contains additional information to Message Type 1001, see *page 554*, that enhances performance. If throughput is not limited and the additional information is available, it is recommended to use the longer version of messages.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1002 header	Log header	-	H	0
2	RTCMV3 observations header, see the RTCM-DATA1001 log on *page 554* for details	Message number	Ushort	2	H
3		Base station ID	Ushort	2	H+2
4		GPS epoch time (ms)	Ulong	4	H+4
5		GNSS message flag	Uchar	1	H+8
6		Number of GPS satellite signals processed (0-31)	Uchar	1	H+9
7		Smoothing indicator	Uchar	1	H+10
8		Smoothing interval, see *Table 98* on *page 555*.	Uchar	1	H+11
9	#prns	Number of PRNs with information to follow	Ulong	4	H+12
10	prn#	PRN #, for SBAS see *Table 97, page 554*	Uchar	1	H+16
11	code-ind	GPS L1 code indicator 0 = C/A code 1 = P(Y) code direct	Uchar	1	H+17
12	psr	GPS L1 pseudorange (m) in 0.02 m units	Ulong	4	H+18
13	phase-pseudo	GPS L1 (phaserange - pseudorange) in 0.0005 m units Range: ±262.1435 m	Long	4	H+22
14	locktime-ind	GPS L1 continuous tracking lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+26
15	amb	GPS L1 PSR modulus ambiguity (m). The integer number of full pseudorange modulus divisions (299,792.458 m) of the raw L1 pseudorange measurement.	Uchar	1	H+27
16	C/No	GPS L1 carrier-to-noise ratio (dBHz). The base station's estimate of the satellite's signal. A value of 0 indicates that the C/No measurement is not computed.	Uchar	4[a]	H+28
17...	Next PRN offset = H+16 + (#prns x 16)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, a variable number of additional bytes of padding are added, depending on the number of satellites, to maintain 4-byte alignment.

3.3.132 RTCMDATA1003 L1/L2 GPS RTK Observables

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

Message ID: **786**
Log Type: **Synch**

Recommended Input:

log rtcmdata1003a ontime 7

ASCII Example:

```
#RTCMDATA1003A,COM1,0,79.0,FINESTEERING,1317,239386.000,00180040,a38c,1855;
0,0,239386000,0,9,0,0,9,
21,0,10569576,-8901,127,0,-176,-7752,127,
2,0,8831714,3717,127,0,-163,7068,127,
16,0,4189573,-1118,127,0,-108,-1273,127,
29,0,1181151,-10116,127,0,-61,-11354,127,
26,0,12256552,-15107,109,0,24,-18232,109,
6,0,9442835,1961,127,0,-116,2536,127,
18,0,7145333,-3326,54,0,-17,-304,54,
10,0,1125215,13933,127,0,-148,12353,127,
30,0,8737848,20418,127,0,-48,19592,127*2286a5ab
```

Message Type 1003 provides minimum data for L1/L2 operation, while Message Type 1004 provides the full data content. The longer observation messages do not change very often, and can be sent less often.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1003 header	Log header	-	H	0
2	RTCMV3 observations header, see the RTCM-DATA1001 log on *page 554* for details	Message number	Ushort	2	H
3		Base station ID	Ushort	2	H+2
4		GPS epoch time (ms)	Ulong	4	H+4
5		GNSS message flag	Uchar	1	H+8
6		Number of GPS satellite signals	Uchar	1	H+9
7		Smoothing indicator	Uchar	1	H+10
8		Smoothing interval: *Table 98* on *page*	Uchar	1	H+11
9	#prns	Number of PRNs with information to	Ulong	4	H+12
10	prn#	PRN #, for SBAS see *Table 97, page*	Uchar	1	H+16
11	L1code-ind	GPS L1 code indicator 0 = C/A code 1 = P(Y) code direct	Uchar	1	H+17
12	L1psr	GPS L1 pseudorange (m) in 0.02 m	Ulong	4	H+18
13	L1 phase-pseudo	GPS L1 (phaserange - pseudorange) in 0.0005 m units Range: ±262.1435 m	Long	4	H+22
14	L1locktime-ind	GPS L1 lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+26
15	L2code-ind	GPS L2 code indicator 0 = C/A or L2C code 1= P(Y) code direct 2= P(Y) code cross-correlated 3= Correlated P/Y	Uchar	1	H+27
16	L1L2psrdiff	GPS L2-L1 pseudorange difference (m) in 0.02 m units Range: ±163.82 m	Short	2	H+28
17	L2phase-L1pseudo	GPS L2 phaserange - L1 pseudorange in 0.005 m units Range: ±262.1435 m	Long	4	H+30
18	L1L2 locktime-ind	GPS L2 continuous tracking lock time indicator, see *Table 99* on *page 555*	Uchar	2 [a]	H+34
19...	Next PRN offset = H+16 + (#prns x 20)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, a variable number of additional bytes of padding are added, depending on the number of satellites, to maintain 4-byte alignment.

3.3.133 RTCMDATA1004 Expanded L1/L2 GPS RTK Observables

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

Message ID: **787**
Log Type: **Synch**

Recommended Input:

log rtcmdata1004a ontime 7

ASCII Example:

```
#RTCMDATA1004A,COM1,0,83.5,FINESTEERING,1317,238497.000,00180040,5500,1855;
0,0,238497000,0,7,0,0,7,
21,0,3492634,1536,98,0,202,0,-169,1904,96,175,
2,0,10314064,-3500,99,0,195,0,-192,-1385,96,165,
16,0,9713480,7187,65,0,164,0,-80,6159,65,148,
29,0,11686252,1601,95,0,163,0,-24,932,94,164,
6,0,10511647,3261,99,0,206,0,-115,3375,96,188,
10,0,1964375,2688,99,0,200,0,-120,2779,96,178,
30,0,9085068,4078,98,0,190,0,-50,2990,96,167*f91c8c6d
```

Message Type 1004 provides fuller data content than Message Type 1003, see *page 560*. The longer observation messages do not change very often, and can be sent less often.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1004 header	Log header	-	H	0
2	RTCMV3 observations header, see the RTCM-DATA1001 log on *page 554* for details	Message number	Ushort	2	H
3		Base station ID	Ushort	2	H+2
4		GPS epoch time (ms)	Ulong	4	H+4
5		GNSS message flag	Uchar	1	H+8
6		Number of GPS satellite signals processed (0-31)	Uchar	1	H+9
7		Smoothing indicator	Uchar	1	H+10
8		Smoothing interval, see *Table 98* on *page 555*	Uchar	1	H+11
9	#prns	Number of PRNs with information to follow	Ulong	4	H+12
10	prn#	PRN #, for SBAS see *Table 97, page 554*	Uchar	1	H+16
11	L1code-ind	GPS L1 code indicator 0 = C/A code 1 = P(Y) code	Uchar	1	H+17
12	L1psr	GPS L1 pseudorange (m) in 0.02 m units	Ulong	4	H+18
13	L1 phase-pseudo	GPS L1 (phaserange - pseudorange) in 0.0005 m units Range: ±262.1435 m	Long	4	H+22
14	L1lcktm-ind	GPS L1 lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+26
15	L1amb	GPS L1 PSR modulus ambiguity (m). The integer number of full pseudorange modulus divisions (299,792.458 m) of the raw L1 pseudorange.	Uchar	1	H+27
16	L1C/No	GPS L1 carrier-to-noise ratio (dBHz). The base station's estimate of the satellite's signal. A value of 0 indicates that the C/No measurement is not computed.	Uchar	1	H+28
17	L2code-ind	GPS L2 code indicator: 0 = C/A or L2C code 1 = P(Y) code direct 2 = P(Y) code cross-correlated 3 = Correlated P(Y)	Uchar	1	H+29
18	L1L2psrdiff	GPS L2-L1 pseudorange difference (m) in 0.02 m units; Range: ±163.82 m	Short	4 [a]	H+30

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
19	L2phase-L1pseudo	GPS L2 phaserange - L1 pseudorange in 0.0005 m units Range: ±262.1435 m	Long	4	H+34
20	L2lcktm-ind	GPS L2 lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+38
21	L2 C/No	GPS L2 carrier-to-noise ratio (dBHz). The base station's estimate of the satellite's signal. A value of 0 indicates that the C/No measurement is not computed.	Uchar	1	H+39
22...	Next PRN offset = H+16 + (#prns x 24)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, a variable number of additional bytes of padding are added, depending on the number of satellites, to maintain 4-byte alignment

3.3.134 RTCMDATA1005 Base Station Antenna Reference Point (ARP)

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

In order to produce RTCM1005 or RTCM1006 messages from a base receiver, it must have a fixed position (or be properly set to operate as a moving base station). However, the RTCM1005 or RTCM1006 message only incorporate antenna offsets if a BASEANTENNAMODEL command has been sent to the receiver. Once a BASEANTENNAMODEL command has been set, the ARP values are reflected in the RTCM1005 and RTCM1006 logs.

See also the BASEANTENNAMODEL command on *page 80* and the MOVINGBASESTATION command on *page 169*.

If a rover receives RTCM24, RTCM1005, or RTCM1006 data, containing antenna offset information but does not have the same antenna type as the base station, the position is offset. Provided the two receivers have matching antenna models, the output rover positions reflect position of the ARP.

Message ID: **788**
Log Type: **Synch**

Recommended Input:

```
log rtcmdata1005a ontime 3
```

ASCII Example:

```
#RTCMDATA1005A,COM1,0,84.5,FINESTEERING,1317,238322.885,00180040,0961,1855;
0,0,0,1,0,0,0,-16349783637,0,-36646792121,0,49422987955*7dbd6160
```

Message Types 1005 and 1006 are designed for GPS operation, but are equally applicable to GLONASS and the future Galileo.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1005 header	Log header	-	H	0
2	msg#	Message number	Ushort	2	H
3	ID	Base station ID	Ushort	2	H+2
4	Reserved		Uchar	1	H+4
5	GPSind	GPS indicator 0 = No GPS service supported 1 = GPS service supported	Uchar	1	H+5
6	GLOind	GLONASS indicator 0 = No GLONASS service supported 1 = GLONASS service supported	Uchar	1	H+6
7	GALind	Galileo indicator 0 = No Galileo service supported 1 = Galileo service supported	Uchar	1	H+7
8	Reserved		Uchar	1	H+8
9	ECEF-X	Base station ECEF X-coordinate (1/10000 m)	Double	8	H+9
10	Reserved		Uchar	1	H+17
11	ECEF-Y	Base station ECEF Y-coordinate (1/10000 m)	Double	8	H+18
12	Reserved		Uchar	2 [a]	H+26
13	ECEF-Z	Base station ECEF Z-coordinate (1/10000 m)	Double	8	H+28
14	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+36
15	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional byte of padding is added to maintain 4-byte alignment

3.3.135 RTCMDATA1006 Base Station ARP with Antenna Height

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

In order to produce RTCM1005 or RTCM1006 messages from a base receiver, it must have a fixed position (or be properly set to operate as a moving base station). However, the RTCM1005 or RTCM1006 message only incorporate antenna offsets if a BASEANTENNAMODEL command has been sent to the receiver. Once a BASEANTENNAMODEL command has been set, the ARP values are reflected in the RTCM1005 and RTCM1006 logs.

See also the BASEANTENNAMODEL command on *page 80* and the MOVINGBASESTATION command on *page 169*.

If a rover receives RTCM24, RTCM1005, or RTCM1006 data, containing antenna offset information but does not have the same antenna type as the base station, the position is offset. Provided the two receivers have matching antenna models, the output rover positions reflect position of the ARP.

Message ID: **789**

Log Type: **Synch**

Recommended Input:

```
log rtcmdata1006a ontime 3
```

ASCII Example:

```
#RTCMDATA1006A,COM1,0,80.5,FINESTEERING,1317,239459.744,00180040,7583,1855
;0,0,0,1,0,0,0,-16349783637,0,-36646792121,0,49422987955,0*5a466fb5
```

Message Types 1005 and 1006 are designed for GPS operation, but are equally applicable to GLONASS and the future Galileo.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1006 header	Log header	-	H	0
2	msg#	Message number	Ushort	2	H
3	ID	Base station ID	Ushort	2	H+2
4	Reserved		Uchar	1	H+4
5	GPSind	GPS indicator 0 = No GPS service supported 1 = GPS service supported	Uchar	1	H+5
6	GLOind	GLONASS indicator 0 = No GLONASS service supported 1 = GLONASS service supported	Uchar	1	H+6
7	GALind	Galileo indicator 0 = No Galileo service supported 1 = Galileo service supported	Uchar	1	H+7
8	Reserved		Uchar	1	H+8
9	ECEF-X	Base station ECEF X-coordinate (1/10000 m)	Double	8	H+9
10	Reserved		Uchar	1	H+17
11	ECEF-Y	Base station ECEF Y-coordinate (1/10000 m)	Double	8	H+18
12	Reserved		Uchar	2 [a]	H+26
13	ECEF-Z	Base station ECEF Z-coordinate (1/10000 m)	Double	8	H+28
14	anthgt	Antenna height	Ushort	4 [b]	H+36
15	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+40
16	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional byte of padding is added to maintain 4-byte alignment

b. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

3.3.136 RTCMDATA1007 Extended Antenna Descriptor and Setup Information

RTCM1007 information is set using the BASEANTENNAMODEL command, see *page 80*. If you have set a base station ID, it is detected and set. Other values are also taken from a previously entered BASEANTENNAMODEL command.

Message Type 1007 provides information about the antenna type used at the base station. The RTCM commission uses an equipment-naming downloadable table from the International GPS Service Central Bureau (IGS CB): ftp://igscb.jpl.nasa.gov/igscb/station/general/rcvr_ant.tab. This table provides a unique antenna descriptor for antennas used for high-precision surveying type applications.

The service provider uses the *setup ID* parameter to indicate the particular base station-antenna combination. "0" for this value means that the values of a standard model type calibration should be used. A non-zero value specifies a particular setup, or calibration, table for the specific antenna in use at the base station. Increase the number whenever a change occurs at the station that affects the antenna phase center variations. Depending on the change of the phase center variations due to a setup change, a change in the *setup ID* would mean that you should check with the service provider to see if the antenna phase center variation in use is still valid. The provider must make appropriate information available to users.

In order to set up logging of RTCM1007 data, it is recommended to first use the INTERFACEMODE command to set the interface mode of the port transmitting RTCMV3 messages to RTCMV3, see *page 147*. Providing the base has a fixed position, see FIX on *page 120*, or is configured as a mov ing base station (refer to *Section 2.5.57* on *page 169*), and its BASEANTENNAMODEL command is set, you can log out RTCM1008 messages.

Message ID: **856**

Log Type: **Synch**

Recommended Input:

```
log rtcmdata1007a ontime 10
```

ASCII Example:

```
#RTCMDATA1007A,COM1,0,73.5,FINESTEERING,1423,309496.883,00180000,1d56,2748;
0,0,3,"702",1*c6f5de3d
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1007 header	Log header	-	H	0
2	msg#	Message number	Ushort	2	H
3	base ID	Base station ID	Ushort	2	H+2
4	#chars	Length of antenna descriptor (number of characters)	Ulong	4	H+4
5	ant descrp	Antenna descriptor	Char[31]	31 [a]	H+8
6	setupID	Setup identification	Uchar	1	H+39
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+40
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. Additional bytes of padding may be added to maintain 4-byte alignment

3.3.137 RTCMDATA1008 Extended Antenna Descriptor and Setup Information

RTCM1008 information is set using the BASEANTENNAMODEL command, see *page 80*. If you have set a base station ID, it is detected and set. Other values are also taken from a previously entered BASEANTENNAMODEL command.

Message Type 1008 provides information about the antenna type used at the base station. The RTCM commission uses an equipment-naming downloadable table from the International GPS Service Central Bureau (IGS CB): ftp://igscb.jpl.nasa.gov/igscb/station/general/rcvr_ant.tab. This table provides a unique antenna descriptor for antennas used for high-precision surveying type applications.

The service provider uses the *setup ID* parameter to indicate the particular base station-antenna combination. "0" for this value means that the values of a standard model type calibration should be used. A non-zero value specifies a particular setup, or calibration, table for the specific antenna in use at the base station. Increase the number whenever a change occurs at the station that affects the antenna phase center variations. Depending on the change of the phase center variations due to a setup change, a change in the *setup ID* would mean that you should check with the service provider to see if the antenna phase center variation in use is still valid. The provider must make appropriate information available to users.

In order to set up logging of RTCM1008 data, it is recommended to first use the INTERFACEMODE command to set the interface mode of the port transmitting RTCMV3 messages to RTCMV3, see *page 147*. Providing the base has a fixed position, see FIX on *page 124*, or is configured as a mov ing base station (refer to *Section 2.5.57* on *page 169*), and its BASEANTENNAMODEL command is set, you can log out RTCM1007 messages.

Message ID: **857**

Log Type: **Synch**

Recommended Input:

```
log rtcmdata1008a ontime 10
```

ASCII Example:

```
#RTCMDATA1008A,COM1,0,69.0,FINESTEERING,1423,309565.095,00180000,d8c6,2748;
0,0,3,"702",1,11,"NVH05410007"*e89f1a17
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1008 header	Log header	-	H	0
2	msg#	Message number	Ushort	2	H
3	base ID	Base station ID number	Ushort	2	H+2
4	#chars	Length of antenna descriptor (number of characters)	Ulong	4	H+4
5	ant descrp	Antenna descriptor	Char[31]	32[a]	H+8
6	setupID	Setup identification	Uchar	1	H+40
7	#chars2	Length of antenna serial number (characters)	Ulong	4	H+41
8	ant ser#	Antenna serial number	Char [31]	31	H+45
9	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+76
10	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. Additional bytes of padding may be added to maintain 4-byte alignment

3.3.138 RTCMDATA1009 GLONASS L1-Only RTK

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

Message ID: **897**
Log Type: **Synch**

Recommended Input:

log rtcmdata1009a ontime 3

ASCII Example:

```
#RTCMDATA1009A,COM1,0,68.5,FINESTEERING,1432,313977.000,00100000,58cf,35602;
0,0,65563000,0,4,0,0,
4,
7,0,12,3853223,295,96,
21,0,15,22579496,-8,95,
6,0,8,28671345,-9,97,
14,0,11,10195220,-403,96*4ea61d07
```

RTCM1009 supports single-frequency RTK operation, but does not include an indication of the satellite carrier-to-noise (C/No) as indicated by the base station.

Table 100: GLONASS L1 and L2 Frequencies

Frequency Indicator	Channel #	L1 Frequency, MHz	L2 Frequency, MHz
0	-07	1598.0625	1242.9375
1	-06	1598.6250	1243.3750
2	-05	1599.1875	1243.8125
3	-04	1599.7500	1244.2500
4	-03	1600.3125	1244.6875
5	-02	1600.8750	1245.1250
6	-01	1601.4375	1245.5625
7	00	1602.0	1246.0
8	01	1602.5625	1246.4375
9	02	1603.125	1246.875
10	03	1603.6875	1247.3125
11	04	1604.25	1247.75
12	05	1604.8125	1248.1875
13	06	1605.375	1248.625
14	07	1605.9375	1249.0625
15	08	1606.5	1249.5
16	09	1607.0625	1249.9375
17	10	1607.625	1250.375
18	11	1608.1875	1250.8125
19	12	1608.75	1251.25
20	13	1609.3125	1251.6875

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1009 header	Log header	-	H	0
2	RTCMV3 observations header, see the RTCM-DATA1001 log on *page 554* for details	Message number	Ushort	2	H
3		Base station ID	Ushort	2	H+2
4		GPS epoch time (ms)	Ulong	4	H+4
5		GNSS message flag	Uchar	1	H+8
6		Number of GLONASS satellite signals processed	Uchar	1	H+9
7		Smoothing indicator	Uchar	1	H+10
8		Smoothing interval, see *Table 98* on *page 555*.	Uchar	1	H+11
9	#rec	Number of records with information to follow	Ulong	4	H+12
10	satID	GLONASS sateliite ID (slot# 1-24)	Uchar	1	H+16
11	GLOcode	GLONASS code indicator 0 = L1 C/A code 1 = L2 P code	Uchar	1	H+17
12	GLOfreq	GLONASS frequency indicator (0-20), see *Table 100* on *page 574*	Uchar	1	H+18
13	GLOpsr	GLONASS L1 pseudorange in 0.02 m units Range: 0 to +599584.92 m	Ulong	4	H+19
14	phase-pseudo	GLONASS L1 phaserange - L1 pseudorange in 0.0005 m units Range: ±262.1435 m	Long	4	H+23
15	locktime-ind	GLONASS L1 continuous tracking lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+27
16...	Next record offset = H+16 + (#recs x 12)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.139 RTCMDATA1010 Extended L1-Only GLONASS RTK

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

Message ID: **898**
Log Type: **Synch**

Recommended Input:

log rtcmdata1010a ontime 3

ASCII Example:

```
#RTCMDATA1010A,COM1,0,63.5,FINESTEERING,1432,313982.000,00100000,3b2a,35602;
0,0,65568000,0,4,0,0,
4,
7,0,12,3689203,306,96,39,175,
21,0,15,22641632,35,96,33,192,
6,0,8,28599532,9,97,32,194,
14,0,11,10250494,-433,96,37,179*b9747504
```

Message Type 1010 supports single-frequency RTK operation, and includes an indication of the satellite C/No measured by the base. Since C/No does not usually change from measurement to measurement, this message type can be mixed with Type 1009 and used only when a satellite C/No changes, saving broadcast link throughput.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1010 header	Log header	-	H	0
2	RTCMV3 observations header, see the RTCM-DATA1001 log on *page 554* for details	Message number	Ushort	2	H
3		Base station ID	Ushort	2	H+2
4		GPS epoch time (ms)	Ulong	4	H+4
5		GNSS message flag	Uchar	1	H+8
6		Number of GLONASS satellite signals	Uchar	1	H+9
7		Smoothing indicator	Uchar	1	H+10
8		Smoothing interval, see *Table 98*, *page 555*	Uchar	1	H+11
9	#recs	Number of GLONASS records to follow	Ulong	4	H+12
10	satID	GLONASS sateliite ID (slot# 1-24)	Uchar	1	H+16
11	GLOcode	GLONASS code indicator 0 = L1 C/A code 1 = L2 P code	Uchar	1	H+17
12	GLOfreq	GLONASS frequency indicator (0-20), see *Table 100* on *page 574*	Ulong	4	H+18
13	GLOpsr	GLONASS L1 pseudorange in 0.02 m units Range: 0 to +599584.92 m	Long	4	H+22
14	phase-pseudo	GLONASS L1 phaserange - L1 pseudorange in 0.0005 m units; Range: ±262.1435	Long	4	H+26
15	locktime-ind	GLONASS L1 continuous tracking lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+30
16	amb	GLONASS L1 PSR modulus ambiguity. The full pseudorange modulus divisions integer (599584.916 m) of the raw L1 pseudorange measurement. Range: 0 to +76147284.332	Uchar	1	H+31
17	C\No	GLONASS L1 carrier-to-noise ratio. The base station's estimate of the satellite's signal. A value of 0 indicates that the C/No measurement is not computed. Range: 0 to +63.75 dB-Hz	Uchar	4[a]	H+32
17...	Next record offset = H+16 + (#recs x 20)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, a variable number of additional bytes of padding are added, depending on the number of satellites, to maintain 4-byte alignment

3.3.140 RTCMDATA1011 GLONASS L1/L2 RTK

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

Message ID: **899**
Log Type: **Synch**

Recommended Input:

log rtcmdata1011a ontime 3

ASCII Example:

```
#RTCMDATA1011A,COM1,0,70.5,FINESTEERING,1432,313985.000,00100000,35bd,35602;
0,0,65571000,0,4,0,0,
4,
7,0,12,3590806,357,96,0,-2,361,94,
21,0,15,22679016,35,96,0,74,154,94,
6,0,8,28556501,-9,97,0,-185,-126,94,
14,0,11,10283759,-463,97,0,171,-824,95*5e265573
```

The RTCM Type 1011 Message supports dual-frequency RTK operation but does not include an indication of the satellite C/No measured by the base station.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1011 header	Log header	-	H	0
2	RTCMV3 observations header, see the RTCM-DATA1001 log on *page 554* for details	Message number	Ushort	2	H
3		Base station ID	Ushort	2	H+2
4		GPS epoch time (ms)	Ulong	4	H+4
5		GNSS message flag	Uchar	1	H+8
6		Number of GLONASS satellite signals (0-31)	Uchar	1	H+9
7		Smoothing indicator	Uchar	1	H+10
8		Smoothing interval, see *Table 98*, *page 555*	Uchar	1	H+11
9	#rec	Number of records with information to follow	Ulong	4	H+12
10	satID	GLONASS satellite ID (slot# 1-24)	Uchar	1	H+16
11	GLOcode	GLONASS code indicator 0 = L1 C/A code 1 = L2 P code	Uchar	1	H+17
12	GLOfreq	GLONASS frequency indicator (0-20), see *Table 100* on *page 574*	Ulong	4	H+18
13	GLOpsr	GLONASS L1 pseudorange in 0.02 m units Range: 0 to +599584.92 m	Long	4	H+22
14	phase-pseudo	GLONASS L1 phaserange - L1 pseudorange in 0.0005 m units Range: ±262.1435 m	Uchar	1	H+26
15	locktime-ind	GLONASS L1 continuous tracking lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+27
16	GLOcodeL2	GLONASS L2 code indicator 0 = C/A code 1 = P code	Uchar	1	H+28
17	L1L2psrdiff	GLONASS L2-L1 pseudorange difference in 0.02 m units; Range: ±163.82 m	Short	2	H+29
18	L2phase-L1pseudo	GLONASS L2 phaserange - L1 pseudorange in 0.0005 m units; Range: ±262.1435 m	Long	4	H+31
19	L2locktime-ind	GLONASS L2 continuous tracking lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+35
20...	Next record offset = H+16 + (#recs x 20)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.141 RTCMDATA1012 Extended GLONASS L1/L2 RTK

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

Message ID: **900**
Log Type: **Synch**

Recommended Input:

log rtcmdata1012a ontime 3

ASCII Example:

```
#RTCMDATA1012A,COM1,0,52.5,FINESTEERING,1432,407880.000,00000000,ee92,35602;
0,0,73066000,0,5,0,0,
5,
7,0,12,421564,185,108,34,193,0,-35,33,108,176,0,
8,0,13,22564562,69,108,32,193,0,150,-100,108,188,0,
1,0,14,5214900,271,107,38,135,0,189,886,106,161,0,
24,0,9,21406829,160,109,36,187,0,139,84,108,159,0,
10,0,11,18616094,202,109,35,186,0,215,329,108,181,0*4b04eecb
```

Message Type 1012 supports dual-frequency RTK operation, and includes an indication of the satellite C/No as measured by the base station.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA1012 header	Log header	-	H	0
2	RTCMV3 observations header, see the RTCM-DATA1001 log on *page 554* for details	Message number	Ushort	2	H
3		Base station ID	Ushort	2	H+2
4		GPS epoch time (ms)	Ulong	4	H+4
5		GNSS message flag	Uchar	1	H+8
6		Number of GLONASS satellite signals processed	Uchar	1	H+9
7		Smoothing indicator	Uchar	1	H+10
8		Smoothing interval, see *Table 98* on *page 555*.	Uchar	1	H+11
9	#recs	Number of records with information to follow	Ulong	4	H+12
10	satID	GLONASS satellite ID (slot# 1-24)	Uchar	1	H+16
11	GLOcode	GLONASS code indicator 0 = L1 C/A code 1 = L2 P code	Uchar	1	H+17
12	GLOfreq	GLONASS frequency indicator (0-20), see *Table 100* on *page 574*	Uchar	2 [a]	H+18
13	GLOpsr	GLONASS L1 pseudorange Range: 0 to +599584.92 m	ULong	4	H+20
14	phase-pseudo	GLONASS L1 phaserange - L1 pseudorange Range: ±262.1435 m	Long	4	H+24
15	locktime-ind	GLONASS L1 continuous tracking lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+28
16	amb	GLONASS L1 PSR modulus ambiguity. The full pseudorange modulus divisions integer (599584.916 m) of the raw L1 pseudorange measurement. Range: 0 to +76147284.332	Uchar	1	H+29
17	C\No	GLONASS L1 carrier-to-noise ratio. The base station's estimate of the satellite's signal. A value of 0 indicates that the C/No measurement is not computed. Range: 0 to +63.75 dB-Hz	Uchar	1	H+30
18	GLOcodeL2	GLONASS L2 code indicator 0 = C/A code 1 = P code	Uchar	1	H+31

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
19	L1L2psrdiff	GLONASS L2-L1 pseudorange difference in 0.02 m units; Range: ±163.82 m	Short	4 [b]	H+32
20	L2phase-L1pseudo	GLONASS L2 phaserange - L1 pseudorange in 0.0005 m units; Range: ±262.1435 m	Long	4	H+36
21	L2locktime-ind	GLONASS L2 continuous tracking lock time indicator, see *Table 99* on *page 555*	Uchar	1	H+40
22	GLO L2 C\No	GLONASS L2 carrier-to-noise ratio. The base station's estimate of the satellite's signal. A value of 0 indicates that the C/No measurement is not computed. Range: 0 to +63.75 dB-Hz	Uchar	1	H+41
23	Reserved		UShort	2	H+42
24...	Next record offset = H+16 + (#recs x 28)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional byte of padding is added to maintain 4-byte alignment

b. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

3.3.142 RTCMDATA1019 GPS Ephemeris

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

All data fields have the same number of bits, scale factors and units as defined in the GPS SPS Signal Specification, Sections 2.4.3 and 2.4.4.

Message ID: **901**
Log Type: **Synch**

Recommended Input:

log rtcmdata1019a ontime 3

ASCII Example:

```
#RTCMDATA1019A,COM1,0,70.5,FINESTEERING,1432,313994.864,00100000,f837,3560
2;
1019,3,408,0,1,775,112,19800,0,48,161191,112,516,14603,1364270492,428,
80926891,4761,2702050848,19800,-109,-991856009,-60,632629735,6099,
504327378,-23427,-9,0,0,0*dba8a7f4
```

Message Type 1019 contains only GPS ephemeris information, see Message Type 1020 starting on *page 586* for GLONASS ephemeris information.

Table 101: SV Accuracy

Index Value (m)	Standard Deviations (m)	Index Value (m)	Standard Deviations (m)
0	2.0	8	64.0
1	2.8	9	128.0
2	4.0	10	256.0
3	5.7	11	512.0
4	8	12	1024.0
5	11.3	13	2048.0
6	16.0	14	4096.0
7	32.0	15	8192.0

Field #	Field type	Data Description	Scale Factor	Format	Binary Bytes	Binary Offset
1	RTCMDATA-1019 header	Log header	-	-	H	0
2	message#	Message number Range: 0 to 4095	-	Ushort	2	H
3	PRN#	Satellite PRN#, for SBAS see *Table 97, page 554* Range: 1 to 63	-	Uchar	2 [a]	H+2
4	week	GPS reference week number Range: 0 to 1023	1 week	Ushort	2	H+4
5	SV accur index	SV Accuracy (m), see *Table 101* on *page 583*	-	Uchar	1	H+6
6	GPSCodeOnL2	GPS code on L2 0 = Reserved 1 = P code 2 = C/A code 3 = L2C	1	Uchar	1	H+7
7	IDOT	Rate of inclination angle, semi-circles/second	2^{-43}	Short	2	H+8
8	IODE	Issue of ephemeris data Range: 0-255 (unitless)	1	Uchar	2 [a]	H+10
9	TOC	SV clock correction term Maximum: 604784 s	2^{4}	Ushort	2	H+12
10	AF2	Clock aging parameter, s/s^2	2^{-55}	Char	2 [a]	H+14
11	AF1	Clock aging parameter, s/s	2^{-43}	Short	4 [b]	H+16
12	AF0	Clock aging parameter, seconds	2^{-31}	Long	4	H+20
13	IODC	Issue of data, clock Range: 0-1023 (unitless)	1	Ushort	2	H+24
14	Crs	Orbit radius (amplitude of sine, metres)	2^{-5}	Short	2	H+26
15	ΔN	Mean motion difference, semi-circles/second	2^{-43}	Short	4 [b]	H+28
16	M_0	Mean anomaly of reference time, semi-circles	2^{-31}	Long	4	H+32
17	Cuc	Argument of latitude (amplitude of cosine, radians)	2^{-29}	Short	4 [b]	H+36
18	ecc	Eccentricity, dimensionless - quantity defined for a conic section where e = 0 is a circle, e = 1 is a parabola, 0<e<1 is an ellipse and e>1 is a hyperbola. (unitless)	2^{-33}	Ulong	4	H+40
19	Cus	Argument of latitude (amplitude of sine, radians)	2^{-29}	Short	4 [b]	H+44
20	$(A)^{1/2}$	Square root of the semi-major axis	2^{-19}	Ulong	4	H+48

Continued on next page

Field #	Field type	Data Description	Scale Factor	Format	Binary Bytes	Binary Offset
21	toe	Reference time for ephemeris, seconds	2^{4}	Ushort	2	H+52
22	Cic	Inclination (amplitude of cosine, radians)	2^{-29}	Short	2	H+54
23	ω_0	Right ascension, radians	2^{-31}	Long	4	H+56
24	Cis	Inclination (amplitude of sine, radians)	2^{-29}	Short	4 [b]	H+60
25	I_0	Inclination angle at reference time, radians	2^{-31}	Long	4	H+64
26	Crc	Orbit radius (amplitude of cosine, metres)	2^{-5}	Short	4 [b]	H+68
27	ω	Argument of perigee, radians - measurement along the orbital path from the ascending node to the point where the SV is closest to the Earth, in the direction of the SV's motion.	2^{-31}	Long	4	H+72
28	$\dot{\omega}$	Rate of right ascension, radians/second	2^{-43}	Long	4	H+76
29	tgd	Estimated group delay difference, seconds	2^{-31}	Char	1	H+80
30	SV health	The six-bit health indication given by bits 17 through 22 of word three refers to the transmitting satellite. The MSB indicates a summary of the health of the navigation data, where: 0 = all navigation data is OK 1 = some or all navigation data is not OK	1	Uchar	1	H+81
31	L2Pflag	GPS L2 P flag, subframe 1, word 4, bit 1: 0 = L2 P-code NAV data ON 1 = L2 P-code NAV data OFF	1	Uchar	1	H+82
32	fit interval	GPS fit interval, subframe 2, word 10, bit 17: 0 = Curve-fit interval is 4 hours 1 = Curve-fit is greater than 4 hours	1	Uchar	1	H+83
variable	xxxx	32-bit CRC (ASCII and Binary only)	-	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

a. In the binary log case, an additional byte of padding is added to maintain 4-byte alignment

b. In the binary log case, two additional bytes of padding are added to maintain 4-byte alignment

3.3.143 RTCMDATA1020 GLONASS Ephemeris

This log is available at the base station. See *Section 3.3.129* starting on *page 550* for information about RTCM Version 3.0 standard logs.

All data fields have the same number of bits, scale factors and units defined in the 5th edition of the GLONASS ICD, which contains the most recent information about GLONASS-M navigation data.

Message ID: **902**
Log Type: **Synch**

Recommended Input:

```
log rtcmdata1020a ontime 3
```

ASCII Example:

```
#RTCMDATA1020A,COM1,0,71.0,FINESTEERING,1432,313998.350,00100000,48c9,35602;
1020,6,8,0,0,0,2329,0,1,73,2911974,-27323203,0,-379009,-15756135,0,1761261,
41395090,-2,1,-2,3,0,227246,-15,0,1,15,1267,1,1,1267,-2958,3,-1032,0,0
*cfbf1816
```

Message Type 1020 contains only GLONASS ephemeris information, see Message Type 1019 starting on *page 583* for GPS ephemeris information.

Table 102: GLONASS Ephemeris Word P1

Word P1	Time Interval [a]
00	0
01	30
10	45
11	60

a. Time interval between adjacent values of tb in minutes

Table 103: M-Satellite User Range AccuracyC

F_T	Accuracy σ (m)	F_T	Accuracy σ (m)	F_T	Accuracy σ (m)
0	1	6	10	12	128
1	2	7	12	13	256
2	2.5	8	14	14	512
3	4	9	16	15	Reserved
4	5	10	32		
5	7	11	64		

Field #	Field type	Data Description	Scale Factor	Format	Binary Bytes	Binary Offset
1	RTCMDATA-1020 header	Log header		-	H	0
2	message#	Message number Range: 0 to 4095	-	Ushort	2	H
3	satID	GLONASS satellite ID (slot# 1-24)	-	Uchar	1	H+2
4	GLOfreq	GLONASS frequency indicator (0-20), see *Table 100* on *page 574*	1	Uchar	1	H+3
5	alm health	GLONASS almanac health: 0 = non-operability of satellite. 1 = operability of satellite	-	Uchar	1	H+4
6	alm health ind	Almanac health availability indicator (depends on whether an almanac has been received yet or not): 0 = Almanac health is not available 1 = Almanac health is available	-	Uchar	1	H+5
7	P1	Word P1 is a data updating flag. It indicates a time interval between two adjacent values of the *tb* parameter (in minutes) in both current and previous frames as indicated in *Table 102* on *page 586*.	-	Uchar	2 [a]	H+6
8	Tk	Time of frame start (since start of GLONASS day). The number of hours elapsed occupies the 5 MSB, the minutes occupies the next 6 bits and the number of thirty-second intervals occupies the LSB: Bits 11 to 17: 0 - 23 (hours) Bits 6 to 1 : 0 - 59 (minutes) Bit 0 : 0 - 1 (30-second intervals)	-	Ushort	2	H+8
9	Bn MSB	Word Bn is the health flag: 0 = GOOD 1 = BAD Both the second and third bits of this word are not used.	-	Uchar	1	H+10
10	P2	Word P2 is a flag of oddness (1) or evenness (0) of the value of *tb* (for intervals of 30 or 60 minutes)	-	Uchar	1	H+11
11	tb	Time to which GLONASS navigation data are referenced. Range: 1 - 95 (minutes)	15 mins.	Uchar	4 [b]	H+12
12	Xn(tb)1	GLONASS ECEF-X component of satellite velocity vector in PZ-90 datum Range: ±4.3 km/s	$\pm 2^{-20}$ km/s	Long	4	H+16
13	Xn(tb)	GLONASS ECEF-X component of satellite coordinates in PZ-90 datum Range: ±27000 km	$\pm 2^{-11}$ km	Long	4	H+20

Field #	Field type	Data Description	Scale Factor	Format	Binary Bytes	Binary Offset
14	Xn(tb)2	GLONASS ECEF-X component of satellite acceleration in PZ-90 datum Range: $\pm 6.2 \times 10^{-9}$ km/s	$\pm 2^{-30}$ km/s^2	Char	4 [b]	H+24
15	Yn(tb)1	GLONASS ECEF-Y component of satellite velocity vector in PZ-90 datum Range: ±4.3 km/s	$\pm 2^{-20}$ km/s	Long	4	H+28
16	Yn(tb)	GLONASS ECEF-Y component of satellite coordinates in PZ-90 datum Range: ±27000 km	$\pm 2^{-11}$ km	Long	4	H+32
17	Yn(tb)2	GLONASS ECEF-Y component of satellite acceleration in PZ-90 datum Range: $\pm 6.2 \times 10^{-9}$ km/s	$\pm 2^{-30}$ km/s^2	Char	4 [b]	H+36
18	Zn(tb)1	GLONASS ECEF-Z component of satellite velocity vector in PZ-90 datum Range: ±4.3 km/s	$\pm 2^{-20}$ km/s	Long	4	H+40
19	Zn(tb)	GLONASS ECEF-Z component of satellite coordinates in PZ-90 datum Range: ±27000 km	$\pm 2^{-11}$ km	Long	4	H+44
20	Zn(tb)2	GLONASS ECEF-Z component of satellite acceleration in PZ-90 datum Range: $\pm 6.2 \times 10^{-9}$ km/s	$\pm 2^{-30}$ km/s^2	Char	1	H+48
21	P3	The Word P3 flag indicates the number of satellites the almanac is transmitting within the given frame: 1 = five satellites 0 = four satellites	-	Uchar	1	H+49
22	γ(tb)	GLONASS relative deviation of predicted satellite carrier frequency from the nominal value. Range: $\pm 2^{-}$	2^{-40}	Short	2	H+50

Continued on next page

Field #	Field type	Data Description	Scale Factor	Format	Binary Bytes	Binary Offset
23	M P	Word P for the GLONASS-M satellite is a technological parameter that indicates the satellite operation mode in respect of time parameters[c]: 0 = τ_C parameter relayed from control segment, τ_{GPS} parameter relayed from control segment 1 = τ_C parameter relayed from control segment, τ_{GPS} parameter calculated on-board the GLONASS-M satellite 2 = τ_C parameter calculated on-board the GLONASS-M satellite, τ_{GPS} parameter relayed from control segment 3 = τ_C parameter calculated on-board the GLONASS-M satellite, τ_{GPS} parameter calculated on-board the GLONASS-M satellite	-	Uchar	1	H+52
24	M I_n 3rd	GLONASS-M 3rd string Word I_n: 0 = the nth satellite is healthy 1 = the nth satellite is not healthy	-	Uchar	3 [d]	H+53
25	τ_{tb}	GLONASS correction time relative to GLONASS system time. Range: $\pm 2^{-9}$ s	2^{-30}	Long	4	H+56
26	M $\Delta\tau$	GLONASS time difference between the navigation RF signal transmitted in L2 sub-band and navigation RF signal transmitted in L1 sub-band. Range: $\pm 13.97 \times 10^{-9}$ s	2^{-30}	Char	1	H+60
27	E	The age of GLONASS navigation data. Range: 0 to 31 days	1 day	Uchar	1	H+61
28	M P4	Word P4 for the GLONASS-M satellite is a flag to show that ephemeris parameters are present. 1 = Updated ephemeris or frequency/time parameters have been uploaded by the control segment 0 = No parameters have been uploaded by the control segment	-	Uchar	1	H+62
29	M F_T	GLONASS-M predicted satellite user range at time t_b. Range: 0 to 15, see *Table 103* on *page 586*	-	Uchar	1	H+63

Continued on next page

Field #	Field type	Data Description	Scale Factor	Format	Binary Bytes	Binary Offset
30	M Nt	GLONASS-M current data number Range: 1 to 1461 days	1 day	Ushort	2	H+64
31	M type?	Type of GLONASS satellite 1 = Valid GLONASS-M data 0 = Not valid GLONASS-M data and may contain arbitrary values	-	Uchar	1	H+66
32	GLOavail	This flag determines the availability of additional GLONASS data fields 132-136: 1 = Available 0 = Unavailable	-	Uchar	1	H+67
33	N^A	GLONASS calendar day within a four-year period to which τ_C is referenced Range: 1 to 1461	1 day	Ushort	4 [d]	H+68
34	τ_C	τ_C is the difference between GLONASS time and UTC time. This parameter is referenced to the beginning of the day N^A. Range: $\pm$1 s	2^{-31}	Long	4	H+72
35	M N4	GLONASS four-year interval number starting from 1996 Range: 1 to 31	4-year interval	Uchar	4 [b]	H+76
36	M τ_{GPS}	GLONASS-M τ_{GPS} is the correction to GPS reference time relative to GLONASS time. Range: $\pm 1.9 \times 10^{-3}$ s	2^{-31}	Long	4	H+80
37	M I_n 5th	GLONASS-M 5th string Word I_n: 0 = the nth satellite is healthy 1 = the nth satellite is not healthy	-	Uchar	1	H+84
38	Reserved		-	Char	1	H+85
variable	xxxx	32-bit CRC (ASCII and Binary only)	-	Hex	4	variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

a. In the binary log case, an additional byte of padding is added to maintain 4-byte alignment

b. In the binary log case, an additional 3 bytes of padding are added to maintain 4-byte alignment

c. τ_C is the GLONASS time scale correction to UTC(SU) time. τ_{GPS} is the correction to GPS reference time relative to GLONASS time: $T_{GPS} - T_{GLO} = \Delta T + \tau_{GPS}$ where ΔT is the integer part, and τ_{GPS} is the fractional part of the difference between the system time scales expressed in seconds.

d. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

3.3.144 RTCMDATA1033 Receiver and antenna descriptors

Message ID: 1099
Log Type: Synch

Recommended Input:

log rtcmdata1033 ontime 3

ASCII Example:

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTCMDATA-1033 header	Log header	-	-	H
2	message#	Message number Range: 0 to 4095	Ushort	2	0
3	ReferenceStationID	Base Station ID	Ushort	2	H+2
4	DescriptorCounter	Antenna Descriptor Length	Uchar	1	H+4
5	#chars	Length of antenna descriptor (number of characters)	Ulong	4	H+8
6	ant descrp	Antenna descriptor	Char[31]	31 [a]	H+12
7	setupID	Setup identification	Uchar	1	H+43
8	SerialNumberCounter		Uchar	1	H+44
9	SerialNumberLength	Number of Records to Follow	ULONG	4	H+48
10	AntennaSerialNumber		Char[31]	31[a]	H+52
11	ReceiverTypeDescriptorCounter		Uchar	1	H+83
12	ReceiverTypeDescriptorLength	Number of Records to Follow	ULONG	4	H+84
13	ReceiverTypeDescriptor		Char[31]	31[a]	H+88
14	ReceiverFirmwareVersionCounter		Uchar	1	H+119
15	ReceiverFirmwareVersionLength	Number of Records to Follow	ULONG	4	H+120
16	ReceiverFirmwareVersion		Char[31]	31[a]	H+124
17	ReceiverSerialNumberCounter		Uchar	1	H+155
18	ReceiverSerialNumberLength	Number of Records to Follow	ULONG	4	H+156
19	ReceiverSerialNumber		Char[31]	31[a]	H+160

a. Additional bytes of padding may be added to maintain 4-byte alignment

3.3.145 RTKDATA RTK Solution parameters

This is the “RTK output” log, and it contains miscellaneous information regarding the RTK solution. It is based on the matched update. Note that the length of the log messages vary depending on the number of common satellites (on both rover and base stations) in the solution, a quantity represented by #sv in the field numbers.

See also the BESTPOS log (the best available position computed by one receiver) and the MATCHEDPOS log (positions that have been computed from time matched base and rover observations), on *pages 299* and *413* respectively.

See *Figure 10, page 315* for a definition of the ECEF coordinates

Message ID: **215**

Log Type: **Asynch**

Recommended Input:

log rtkdataa onchanged

Asynchronous logs should only be logged ONCHANGED. Otherwise, the most current data is not output when it is available. This is especially true of the ONTIME trigger, which may cause inaccurate time tags to result.

ASCII Example:

```
#RTKDATAA,COM1,0,61.0,FINESTEERING,1419,340038.000,00000040,d307,2724;
SOL_COMPUTED,NARROW_INT,00000103,12,12,12,12,0,01,0,33,HNAV,0,
6.3126e-05,5.3089e-05,-4.4002e-05,
5.3089e-05,2.5408e-04,-4.2023e-05,
-4.4002e-05,-4.2023e-05,2.3526e-04,
0.0000,0.0000,0.0000,0.0000,0.0000,0.0000,
22,12,

1,NARROW_INT,-0.000102415,
3,NARROW_INT,0.000007917,
9,NARROW_INT,0.000485239,
11,NARROW_FLOAT,-0.001025980,
14,NARROW_INT,0.000196952,
18,NARROW_INT,0.000621116,
19,NARROW_INT,-0.000129004,
21,NARROW_INT,0.002786725,
39,NARROW_FLOAT,-0.003358357,
56,NARROW_FLOAT,-0.002554488,
22,REFERENCE,0.000000000,
41,REFERENCE,0.000000000*6fe4101f
```

Consider the appropriate observation times when using dual frequency receivers. One primary advantage of dual frequency equipment is the ability to observe baselines using much shorter occupation times. It is difficult to state exactly what this occupation time should be since every observation session is different. Keep the following factors in mind when determining how long a station should be occupied (occupation time refers to the simultaneous observation time at both base and rover):

- The distance between rover and base station. As the distance between the base and rover receivers increases, the occupation times should also increase.
- Sky visibility at each of the base and rover receiver. The accuracy and reliability of differential GPS is proportional to the number of common satellites that are visible at the base and rover. Therefore, if the sky visibility at either station is poor, you might consider increasing the occupation times. This condition is best measured by monitoring the number of visible satellites during data collection along with the PDOP value (a value less than 3 is ideal). See also the SATVIS log on *page 619*.
- Time of day. The location and number of satellites in the sky is constantly changing. As a result, some periods in the day are slightly better for GPS data collection than others. Use the SATVIS log to monitor the satellite constellation at a particular place and time.
- Station environment. It is good practice to observe the site conditions surrounding the station to be occupied. Water bodies, buildings, trees, and nearby vehicles can generate noise in the GPS data. Any of these conditions may warrant an increased occupation time.

Table 104: Searcher Type

Searcher Type (binary)	Searcher Type (ASCII)	Description
0-4	Reserved	
5	ARTK	AdVance RTK Engine

Table 105: Ambiguity Type

Ambiguity Type (binary)	Ambiguity Type (ASCII)	Description
0	UNDEFINED	Undefined ambiguity
1	L1_FLOAT	Floating L1 ambiguity
2	IONOFREE_FLOAT	Floating ionospheric-free ambiguity
3	NARROW_FLOAT	Floating narrow-lane ambiguity
4	NLF_FROM_WL1	Floating narrow-lane ambiguity derived from integer wide-lane ambiguity
5	L1_INT	Integer L1 ambiguity
6	WIDE_INT	Integer wide-lane ambiguity
7	NARROW_INT	Integer narrow-lane ambiguity
8	IONOFREE_DISCRETE	Discrete ionospheric-free ambiguity
9-10	Reserved	
11	REFERENCE	Double-difference reference satellite (There are two references if GLONASS is being used. The residuals of the references are always 0.0.)

Table 106: RTK Information

Bit #	Mask	Description	Bit = 0	Bit = 1
0	0x00000001	RTK dynamics	Static	Dynamic
1	0x00000002	RTK dynamics mode	Auto	Forced
2	0x00000004	Severe differential ionosphere detected	No	Yes
8	0x00000100	Verification flag for AdVance RTK, see also the note box below	Not verified	Verified
3-31	0xFFFFFF8	Reserved		

The verification flag is shown in the 8th bit of Field #4 where a 1 means the AdVance RTK narrow-lane ambiguity is verified and a 0 means it has not yet been verified.

To achieve the best reliability, particularly when operating in difficult environments such as high foliage, longer baselines or unstable atmospheric conditions, the user should wait for the verified status. The verification flag provides an extra level of assurance that the ambiguity resolutions are correct.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKDATA header	Log header		H	0
2	sol status	Solution status (see *Table 56, Solution Status* on *page 302*)	Enum	4	H
3	pos type	Position type (see *Table 55, Position or Velocity Type* on *page 301*)	Enum	4	H+4
4	rtk info	RTK information (see *Table 106, RTK Information* on *page 594*)	Ulong	4	H+8
5	#SVs	Number of satellite vehicles tracked	Uchar	1	H+12
6	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+13
7	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+14
8	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+15
9	Reserved		Uchar	1	H+16
10	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+17
11	Reserved		Hex	1	H+18
12	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+19
13	search stat	Searcher status, normally ANAV (see *Table 104, Searcher Type* on *page 594*)	Enum	4	H+20
14	Reserved		Ulong	4	H+24
15-23	[C]	The C_{xx},C_{xy},C_{xz},C_{yx},C_{yy},C_{yz},C_{zx},C_{zy} and C_{zz} components in $(metres)^2$, of the ECEF position covariance matrix (3x3).	Float	36	H+28
24	Reserved		Double	8	H+64
25			Double	8	H+72
26			Double	8	H+80
27			Float	4	H+88
28			Float	4	H+92
29			Float	4	H+96
30	ref PRN	Base PRN	Ulong	4	H+100

Continued on page 595.

31	# SV	Number of SVs to follow	Long	4	H+104
32	PRN	Satellite PRN number of range measurement	Ulong	4	H+108
33	amb	Ambiguity type (see *Table 105, Ambiguity Type* on *page 594*)	Enum	4	H+112
34	res	Residual (m)	Float	4	H+116
35...	Next SV offset = H + 108 + (obs x 12)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+108+ (12xobs)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.146 RTKDOP DOP Values from the RTK Fast Filter

This log contains the DOP values calculated by the RTK fast filter.

The RTKDOP log contains single-point DOPs, calculated using only the satellites used in the fast RTK solution, that is, those used for the RTKPOS position. Calculation of the RTK DOPs are limited to once a second.

The calculation of the RTK DOP is different than that for the pseudorange DOP. In the pseudorange filter, new DOPs are calculated every 60s, or when the satellites used in the solution change. The RTK DOP is calculated at the rate requested, and regardless of a change in satellites. However, the DOP is only calculated when the RTKDOP log is requested.

Message ID: **952**
Log Type: **Synch**

Recommended Input:

```
log rtkdopa ontime 10
```

ASCII Example:

```
#RTKDOPA,COM1,0,60.0,FINESTEERING,1449,446982.000,00000008,b42b,3044;2.3386,
1.9856,0.9407,1.5528,1.2355,10.0,11,21,58,6,7,10,16,18,24,26,29,41*85f8338b
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKDOP header	Log header		H	0
2	GDOP	Geometric DOP	Float	4	H
3	PDOP	Position DOP	Float	4	H+4
4	HDOP	Horizontal DOP	Float	4	H+8
5	HTDOP	Horizontal and Time DOP	Float	4	H+12
6	TDOP	Time DOP	Float	4	H+16
7	elev mask	Elevation mask angle	Float	4	H+20
8	#sats	Number of satellites to follow	Ulong	4	H+24
9	sats	Satellites in use at time of calculation	Ulong[#sats]	4x(#sats)	H+28
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.147 RTKDOP2 DOP Values from the RTK Fast Filter

Message ID: **1172**
Log Type: **Synch**

Recommended Input:

log rtkdop2a ontime 10

ASCII Example:

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKDOP2 header	Log header		H	0
2	GDOP	Geometric DOP	Float	4	H
3	PDOP	Position DOP	Float	4	H+4
4	HDOP	Horizontal DOP	Float	4	H+8
5	VDOP	Vertical DOP	Float	4	H+12
6	TDOP	Time dilution of precision - assumes 3-D position is known and only the receiver clock offset is unknown.	ULong	4	H+16
6	system	See *Table 29* on *page 157*	Enum	4	H+20
8	dop	Dilution of precision	Long	4	H+24
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	variable
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.148 RTKPOS RTK Low Latency Position Data

This log contains the low latency RTK position computed by the receiver, along with two status flags. In addition, it reports other status indicators, including differential age, which is useful in predicting anomalous behavior brought about by outages in differential corrections. This log is recommended for kinematic operation. Better accuracy can be obtained in static operation with the MATCHEDPOS log.

With the system operating in an RTK mode, this log reflects if the solution is a good RTK low latency solution (from extrapolated base station measurements) or invalid. A valid RTK low latency solution is computed for up to 60 seconds after reception of the last base station observation. The degradation in accuracy, due to differential age, is reflected in the standard deviation fields, and is summarized in the Standards and Reference page available on our website at http://www.novatel.com/support/knowledge-and-learning/. See also the DGPSTIMEOUT command on *page 102*.

Message ID: **141**

Log Type: **Synch**

Recommended Input:

log rtkposa ontime 1

ASCII Example:

```
#RTKPOSA,COM1,0,54.5,FINESTEERING,1419,340040.000,00000040,176e,2724;
SOL_COMPUTED,NARROW_INT,51.11635911294,-114.03833103654,1063.8336,-16.2712,
WGS84,0.0179,0.0096,0.0174,"AAAA",1.000,0.000,12,11,11,11,0,01,0,33*0adb3e47
```

Consider the case of a racing car on a closed circuit requiring RTK operation. In this situation, you would have to send live data to the pits using a radio link.

RTK operation enables live cm-level position accuracy. When answers are required right in the field, the base station must transmit its information to the rover in real-time. For RTK operation, extra equipment such as radios are required to be able to transmit and receive this information. The base station has a corresponding base radio and the rover station has a corresponding rover radio.

Post-processing can provide post-mission position and velocity data using raw GNSS data collected from the car. The logs necessary for post-processing include:

RANGECMPB ONTIME 1
RAWEPHEMB ONNEW

These are examples of data collection for post-processing, and real-time operation. OEM6-based output is compatible with post-processing software from the Waypoint Products Group, NovAtel Inc. Refer to our website at www.novatel.com.. for more details.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKPOS header	Log header		H	0
2	sol status	Solution status (see *Table 56* on *page 302*)	Enum	4	H
3	pos type	Position type (see *Table 55* on *page 301*)	Enum	4	H+4
4	lat	Latitude	Double	8	H+8
5	lon	Longitude	Double	8	H+16
6	hgt	Height above mean sea level	Double	8	H+24
7	undulation	Undulation - the relationship between the geoid and the WGS84 ellipsoid (m) [a]	Float	4	H+32
8	datum id#	Datum ID number (see *Table 16, Reference Ellipsoid Constants* on *page 95*)	Enum	4	H+36
9	lat σ	Latitude standard deviation	Float	4	H+40
10	lon σ	Longitude standard deviation	Float	4	H+44
11	hgt σ	Height standard deviation	Float	4	H+48
12	stn id	Base station ID	Char[4]	4	H+52
13	diff_age	Differential age in seconds	Float	4	H+56
14	sol_age	Solution age in seconds	Float	4	H+60
15	#SVs	Number of satellite vehicles tracked	Uchar	1	H+64
16	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+65
17	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+66
18	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+67
19	Reserved		Uchar	1	H+68
20	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+69
21	Reserved		Hex	1	H+70
22	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+71
23	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+72
24	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. When using a datum other than WGS84, the undulation value also includes the vertical shift due to differences between the datum in use and WGS84

3.3.149 RTKSATS Satellites used in RTKPOS solution

This log lists the used and unused satellites for the corresponding RTKPOS solution. It also describes the signals of the used satellites and reasons for exclusions.

Message ID: **1174**
Log Type: **Synch**

Recommended Input:

log rtksatsa ontime 1

ASCII Example:

```
#RTKSATSA,COM1,0,78.0,FINESTEERING,1594,335430.000,00000008,95e7,5945;16,GPS,
26,GOOD,00000003,GPS,15,GOOD,00000003,GPS,19,GOOD,00000003,GPS,17,GOOD,000000
03,GPS,7,GOOD,00000003,GPS,8,GOOD,00000003,GPS,28,GOOD,00000003,GPS,24,GOOD,0
0000003,GPS,11,GOOD,00000003,GLONASS,14-7,GOOD,00000003,GLONASS,13-
2,GOOD,00000003,GLONASS,15,GOOD,00000003,GLONASS,5+1,GOOD,00000003,GLONASS,24
+2,GOOD,00000003,GLONASS,23+3,GOOD,00000003,GLONASS,17+4,GOOD,00000003*8e1891
b6
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKSATS header	Log header		H	0
2	#entries	Number of records to follow	Ulong	4	H
3	system	See *Table 29* on *page 157*.	Enum	4	H+4
4	Satellite ID	Satellite identifiers. See *page 307*	Simple	4	H+8
5	Status	Satellite status. See *Table 59*	Enum	4	H+16
6	Status mask	See *Table 60* on *page 307*	Hex	4	H+16
7	xxxx	32-bit CRC (ASCII and Binary only)	Hex	1	H+17
8	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.150 RTKVEL RTK Velocity

This log contains the RTK velocity information computed by the receiver. In addition, it reports a velocity status indicator, which is useful in indicating whether or not the corresponding data is valid and differential age, which is useful in predicting anomalous behavior brought about by outages in differential corrections. The velocity measurements sometimes have a latency associated with them. The time of validity is the time tag in the log minus the latency value. See also the table footnote for velocity logs on page 264.

Velocities from the RTK filter are calculated from the delta-position. In RTKVEL, the velocity type is the same as the position type.

With the system operating in an RTK mode, this log reflects if the solution is a good RTK Low Latency solution (from extrapolated base station measurements) or invalid. A valid RTK Low Latency solution is computed for up to 60 seconds after reception of the last base station observation.

The velocity is computed from consecutive RTK low latency updates. As such, it is an average velocity based on the time difference between successive position computations and not an instantaneous velocity at the RTKVEL time tag. The velocity latency to be subtracted from the time tag is normally 1/2 the time between filter updates. Under default operation, the RTK low latency filter is updated at a rate of 2 Hz. This translates into a velocity latency of 0.25 seconds. The latency can be reduced by increasing the update rate of the RTK low latency filter by requesting the BESTVEL, RTKVEL, BESTPOS or RTKPOS messages at a rate higher than 2 Hz. For example, a logging rate of 10 Hz would reduce the velocity latency to 0.05 seconds. For integration purposes, the velocity latency should be applied to the record time tag.

Message ID: **216**
Log Type: **Synch**

Recommended Input:

log rtkvela ontime 1

ASCII Example:

```
#RTKVELA,COM1,0,43.5,FINESTEERING,1364,496137.000,00100000,71e2,2310;
SOL_COMPUTED,NARROW_INT,0.250,1.000,0.0027,207.645811,0.0104,0.0*f551cc42
```

Consider the case of an unmanned aircraft. A differential base station must send data to the remote aircraft. In this type of application, the aircraft's radio may pass differential data, for example RTKVEL, to the positioning system so it can process it and generate precise position information for the flight controls.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKVEL header	Log header		H	0
2	sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	vel type	Velocity type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results.	Float	4	H+8
5	age	Differential age in seconds	Float	4	H+12
6	hor spd	Horizontal speed over ground, in metres per second	Double	8	H+16
7	trk gnd	Actual direction of motion over ground (track over ground) with respect to True North, in degrees	Double	8	H+24
8	vert spd	Vertical speed, in metres per second, where positive values indicate increasing altitude (up) and negative values indicate decreasing altitude (down)	Double	8	H+32
9	Reserved		Float	4	H+40
10	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
11	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.151 RTKXYZ RTK Cartesian Position and Velocity

This log contains the receiver's low latency position and velocity in ECEF coordinates. The position and velocity status fields indicate whether or not the corresponding data is valid. See Figure 10, page 315 for a definition of the ECEF coordinates.

The velocity measurements have a latency associated with them. The time of validity is the time tag in the log minus the latency value.

With the system operating in an RTK mode, this log reflects if the solution is a good RTK Low Latency solution (from extrapolated base station measurements) or invalid. A valid RTK Low Latency solution is computed for up to 60 seconds after reception of the last base station observation. The degradation in accuracy due to differential age is reflected in the standard deviation fields, and is summarized in the Satndarda and Reference page on our website at http://www.novatel.com/support/knowledge-and-learning/. See also the DGPSTIMEOUT command on *page 102*.

The velocity is computed from consecutive RTK low latency updates. As such, it is an average velocity based on the time difference between successive position computations and not an instantaneous velocity at the RTKVEL time tag. The velocity latency to be subtracted from the time tag is normally 1/2 the time between filter updates. Under default operation, the RTK low latency filter is updated at a rate of 2 Hz. This translates into a velocity latency of 0.25 seconds. The latency can be reduced by increasing the update rate of the RTK low latency filter by requesting the BESTXYZ message at a rate higher than 2 Hz. For example, a logging rate of 10 Hz would reduce the velocity latency to 0.05 seconds. For integration purposes, the velocity latency should be applied to the record time tag.

See also the BESTXYZ and MATCHEDXYZ logs, on *pages 313* and *422* respectively.

Message ID: **244**
Log Type: **Synch**

Recommended Input:

```
log rtkxyza ontime 1
```

ASCII Example:

```
#RTKXYZA,COM1,0,56.0,FINESTEERING,1419,340041.000,00000040,3d88,2724;
SOL_COMPUTED,NARROW_INT,-1634531.5666,-3664618.0291,4942496.3230,0.0099,
0.0219,0.0115,SOL_COMPUTED,NARROW_INT,0.0030,0.0003,-0.0016,0.0198,0.0438,
0.0230,"AAAA",0.250,1.000,0.000,12,11,11,11,0,01,0,33*0497d146
```

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RTKXYZ header	Log header		H	0
2	P-sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H
3	pos type	Position type, see *Table 55, Position or Velocity Type* on *page 301*	Enum	4	H+4
4	P-X	Position X-coordinate (m)	Double	8	H+8
5	P-Y	Position Y-coordinate (m)	Double	8	H+16
6	P-Z	Position Z-coordinate (m)	Double	8	H+24
7	P-X σ	Standard deviation of P-X (m)	Float	4	H+32
8	P-Y σ	Standard deviation of P-Y (m)	Float	4	H+36
9	P-Z σ	Standard deviation of P-Z (m)	Float	4	H+40
10	V-sol status	Solution status, see *Table 56, Solution Status* on *page 302*	Enum	4	H+44
11	vel type	Velocity type, see *Table 55* on *page 301*	Enum	4	H+48
12	V-X	Velocity vector along X-axis (m)	Double	8	H+52
13	V-Y	Velocity vector along Y-axis (m)	Double	8	H+60
14	V-Z	Velocity vector along Z-axis (m)	Double	8	H+68
15	V-X σ	Standard deviation of V-X (m)	Float	4	H+76
16	V-Y σ	Standard deviation of V-Y (m)	Float	4	H+80
17	V-Z σ	Standard deviation of V-Z (m)	Float	4	H+84
18	stn ID	Base station identification	Char[4]	4	H+88
19	V-latency	A measure of the latency in the velocity time tag in seconds. It should be subtracted from the time to give improved results.	Float	4	H+92
20	diff_age	Differential age in seconds	Float	4	H+96
21	sol_age	Solution age in seconds	Float	4	H+100
22	#SVs	Number of satellite vehicles tracked	Uchar	1	H+104
23	#solnSVs	Number of satellite vehicles used in solution	Uchar	1	H+105
24	#ggL1	Number of GPS plus GLONASS L1 used in solution	Uchar	1	H+106
25	#ggL1L2	Number of GPS plus GLONASS L1 and L2 used in solution	Uchar	1	H+107
26	Reserved		Char	1	H+108
27	ext sol stat	Extended solution status (see *Table 58, Extended Solution Status* on *page 303*)	Hex	1	H+109
28	Reserved		Hex	1	H+110
29	sig mask	Signals used mask - if 0, signals used in solution are unknown (see *Table 57* on *page 303*)	Hex	1	H+111
30	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+112
31	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.152 RXCONFIG Receiver Configuration

This log is used to output a list of all current command settings. When requested, an RXCONFIG log is output for each setting. See also the LOGLIST log on *page 410* for a list of currently active logs.

Message ID: **128**
Log Type: **Polled**

Recommended Input:

log rxconfiga once

ASCII Example[1]:

```
#RXCONFIGA,COM1,71,47.5,APPROXIMATE,1337,333963.260,00000000,f702,1984;
#ADJUST1PPSA,COM1,71,47.5,APPROXIMATE,1337,333963.260,00000000,f702,1984;
OFF,ONCE,0*ba85a20b*91f89b07
#RXCONFIGA,COM1,70,47.5,APPROXIMATE,1337,333963.398,00000000,f702,1984;
#ANTENNAPOWERA,COM1,70,47.5,APPROXIMATE,1337,333963.398,00000000,f702,1984;
ON*d12f6135*8f8741be
#RXCONFIGA,COM1,69,47.5,APPROXIMATE,1337,333963.455,00000000,f702,1984;
#CLOCKADJUSTA,COM1,69,47.5,APPROXIMATE,1337,333963.455,00000000,f702,1984;
ENABLE*0af36d92*b13280f2
...
#RXCONFIGA,COM1,7,47.5,APPROXIMATE,1337,333966.781,00000000,f702,1984;
#STATUSCONFIGA,COM1,7,47.5,APPROXIMATE,1337,333966.781,00000000,f702,1984;
CLEAR,AUX2,0*a6141e28*d0bba9f2
#RXCONFIGA,COM1,2,47.5,APPROXIMATE,1337,333967.002,00000000,f702,1984;
#SBASECUTOFFA,COM1,2,47.5,APPROXIMATE,1337,333967.002,00000000,f702,1984;
-5.000000000*b9b11096*2e8b77cf
#RXCONFIGA,COM1,1,47.5,FINESTEERING,1337,398382.787,00000000,f702,1984;
#LOGA,COM1,1,47.5,FINESTEERING,1337,398382.787,00000000,f702,1984;
COM1,MARKPOSA,ONNEW,0.000000,0.000000,NOHOLD*a739272d*6692c084
#RXCONFIGA,COM1,0,47.5,FINESTEERING,1337,400416.370,00000000,f702,1984;
#LOGA,COM1,0,47.5,FINESTEERING,1337,400416.370,00000000,f702,1984;
COM2,PASSCOM2A,ONCHANGED,0.000000,0.000000,NOHOLD*55fc0c62*17086d18
```

Do not use undocumented commands or logs! Doing so may produce errors and void your warranty.

1. The embedded CRCs are flipped to make the embedded messages recognizable to the receiver. For example, consider the first embedded message above.

   91f89b07: 10010001111110001001101100000111

   11100000110110010001111110001001:e0d91f89

   Its CRC is really e0d91f89.

The RXCONFIG log can be used to ensure that your receiver is set up correctly for your application.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RXCONFIG header	Log header	-	H	0
2	e header	Embedded header	-	h	H
3	e msg	Embedded message	Varied	a	H + h
4	e xxxx	Embedded (inverted) 32-bit CRC (ASCII and Binary only). The embedded CRC is inverted so that the receiver does not recognize the embedded messages as messages to be output but continues with the RXCONFIG message. If you wish to use the messages output from the RXCONFIG log, simply flip the embedded CRC around for individual messages.	Long	4	H+ h + a
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+ h + a + 4
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.153 RXHWLEVELS Receiver Hardware Levels

This log contains the receiver environmental and voltage parameters. *Table 107* provides some of the minimum, maximum and typical OEM6 parameters .

Message ID: **195**
Log Type: **Polled**

Recommended Input:

log rxhwlevelsa ontime 60

ASCII Example:

```
#RXHWLEVELSA,COM1,0,82.5,FINESTEERING,1364,490216.808,00000008,863c,2310;
31.563,0.000,1.352,11.763,4.996,0.000,0.000,0.000,0.000,0.000*76927cb1
```

Refer also to the Technical Specifications section of the *OEM6 Family Installation and Operation User Manual* .

Table 107: Receiver Hardware parameters

	Temp. (°C)	Antenna Current	Core Voltage [a]	Supply Voltage	RF Voltage	Internal LNA Voltage	GPAI	LNA Voltage
Min	-40	0	1.30	4.5	4.55	4.55	0	0
Max	100 [b]	0.10	1.65	18	5.25	5.25	2.5	30
Typical	40	0.04	1.37	12	5	5	0	5

a. The shown voltage levels are for OEM628 cards.

b. The board temperature is about 15°C higher than the ambient temperature. Bit 1, in *Table* , . on *page 610*, turns on as a warning when the board temperature is above 100°C and a hazardous temperature error message is generated at 110°C.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RXHWLEVELS header	Log header		H	0
2	temp	Board temperature (degrees celsius)	Float	4	H

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
3	ant current	Approximate internal antenna current (A)	Float	4	H+4
4	core volt	CPU core voltage (V)	Float	4	H+8
5	supply volt	Receiver supply voltage (V)	Float	4	H+12
6	rf volt	5V RF supply voltage (V)	Float	4	H+16
7	int lna volt	Internal LNA voltage level (V)	Float	4	H+20
8	GPAI	General purpose analog input (V)	Float	4	H+24
9	Reserved		Float	4	H+28
10			Float	4	H+32
11	lna volt	LNA voltage (V) at OEM card output	Float	4	H+36
12	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+40
13	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.154 RXSTATUS Receiver Status

This log conveys various status parameters of the GNSS receiver system. These include the Receiver Status and Error words which contain several flags specifying status and error conditions. If an error occurs (shown in the Receiver Error word) the receiver idles all channels, turns off the antenna, and disables the RF hardware as these conditions are considered to be fatal errors. The log contains a variable number of status words to allow for maximum flexibility and future expansion.

The receiver gives the user the ability to determine the importance of the status bits. In the case of the Receiver Status, setting a bit in the priority mask causes the condition to trigger an error. This causes the receiver to idle all channels, turn off the antenna, and disable the RF hardware, the same as if a bit in the Receiver Error word is set. Setting a bit in an Auxiliary Status priority mask causes that condition to set the bit in the Receiver Status word corresponding to that Auxiliary Status. See also the STATUSCONFIG command on *page 238*.

1. Field #4, the receiver status word as represented in *Table 109*, is also in Field #8 of the header. See the *ASCII Example* below and *Table 109* on *page 611* for clarification.
2. Refer also to the chapter on *Built-In Status Tests* in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **93**
Log Type: **Asynch**

Recommended Input:

```
log rxstatusa onchanged
```

ASCII Example:

```
#RXSTATUSA,COM1,0,43.5,FINESTEERING,1337,407250.846,00000000,643c,1984;
00000000,4,00000000,00000000,00000000,00000000,00000083,00000008,00000000,
00000000,00000000,00000000,00000000,00000000,00000000,00000000,00000000,
00000000*ba27dfae
```

Receiver errors automatically generate event messages. These event messages are output in RXSTATUSEVENT logs. It is also possible to have status conditions trigger event messages to be generated by the receiver. This is done by setting/clearing the appropriate bits in the event set/clear masks. The set mask tells the receiver to generate an event message when the bit becomes set. Likewise, the clear mask causes messages to be generated when a bit is cleared. See the STATUSCONFIG command on *page 238* for details.

If you wish to disable all these messages without changing the bits, simply UNLOG the RXSTATUSEVENT logs on the appropriate ports. See also the UNLOG command on *page 250*.

.

Table 108: Receiver Error

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Dynamic Random Access Memory (DRAM) status [a]	OK	Error
	1	0x00000002	Invalid firmware	OK	Error
	2	0x00000004	ROM status	OK	Error
	3	0x00000008	Reserved		
N1	4	0x00000010	Electronic Serial Number (ESN) access status	OK	Error
	5	0x00000020	Authorization code status	OK	Error
	6	0x00000040	Reserved		
	7	0x00000080	Supply voltage status	OK	Error
N2	8	0x00000100	Reserved		
	9	0x00000200	Temperature status (as compared against acceptable limits)	OK	Error
	10	0x00000400	MINOS status	OK	Error
	11	0x00000800	PLL RF1 hardware status - L1	OK	Error
N3	12	0x00001000	PLL RF2 hardware status - L2	OK	Error
	13	0x00002000	Reserved		
	14	0x00004000	Reserved		
	15	0x00008000	NVM status	OK	Error
N4	16	0x00010000	Software resource limit	OK	Error
	17	0x00020000	Model not valid for this receiver	OK	Error
	18	0x00040000	Reserved		
	19	0x00080000			

Continued on next page.

Table 108: Receiver Error

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N5	20	0x00100000	Remote loading has begun	No	Yes
	21	0x00200000	Export restriction	OK	Error
	22	0x00400000	Safe Mode	OK	Error
	23	0x00800000	Reserved		
N6	24	0x01000000			
	25	0x02000000			
	26	0x04000000			
	27	0x08000000			
N7	28	0x10000000			
	29	0x20000000			
	30	0x40000000			
	31	0x80000000	Component hardware failure	OK	Error

a. RAM failure on an OEM6 card may also be indicated by a flashing red LED.

Table 109: Receiver Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Error flag, see *Table 108, Receiver Error* on *page 610*	No error	Error
	1	0x00000002	Temperature status	Within specifications	Warning
	2	0x00000004	Voltage supply status	OK	Warning
	3	0x00000008	Antenna power status See *ANTENNAPOWER* on *Page 65*	Powered	Not powered
N1	4	0x00000010	LNA Failure		
	5	0x00000020	Antenna open flag [a]	OK	Open
	6	0x00000040	Antenna shorted flag [a]	OK	Shorted
	7	0x00000080	CPU overload flag [a]	No overload	Overload

Continued on next page

Table 109: Receiver Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N2	8	0x00000100	COM1 buffer overrun flag	No overrun	Overrun
	9	0x00000200	COM2 buffer overrun flag	No overrun	Overrun
	10	0x00000400	COM3 buffer overrun flag	No overrun	Overrun
	11	0x00000800	Link overrun flag [b]	No overrun	Overrun
N3	12	0x00001000	Reserved		
	13	0x00002000	Aux transmit overrun flag	No overrun	Overrun
	14	0x00004000	AGC out of range		
	15	0x00008000	Reserved		
N4	16	0x00010000	Reserved		
	17	0x00020000	Reserved		
	18	0x00040000	Almanac flag/UTC known	Valid	Invalid
	19	0x00080000	Position solution flag	Valid	Invalid
N5	20	0x00100000	Position fixed flag, see *FIX* on *page 120*	Not fixed	Fixed
	21	0x00200000	Clock steering status	Enabled	Disabled
	22	0x00400000	Clock model flag	Valid	Invalid
	23	0x00800000	External oscillator locked flag	Unlocked	Locked
N6	24	0x01000000	Software resource	OK	Warning
	25	0x02000000	Reserved		
	26	0x04000000			
	27	0x08000000			
N7	28	0x10000000			
	29	0x20000000	Auxiliary 3 status event flag	No event	Event
	30	0x40000000	Auxiliary 2 status event flag	No event	Event
	31	0x80000000	Auxiliary 1 status event flag	No event	Event

a. This flag is only available on certain products.

b. This flag indicates if any of the three USB ports (USB1, USB2, or USB3) are overrun. See the auxiliary status word for the specific port for which the buffer is overrun.

Table 110: Auxiliary 1 Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x00000001	Reserved		
	1	0x00000002			
	2	0x00000004			
	3	0x00000008	Position averaging	Off	On
N1	4	0x00000010	Reserved		
	5	0x00000020			
	6	0x00000040			
	7	0x00000080	USB connection status	Connected	Not connected
N2	8	0x00000100	USB1 buffer overrun flag	No overrun	Overrun
	9	0x00000200	USB2 buffer overrun flag	No overrun	Overrun
	10	0x00000400	USB3 buffer overrun flag	No overrun	Overrun
	11	0x00000800	Reserved		
N3	12	0x00001000	Reserved		
	13	0x00002000	Reserved		
	14	0x00004000	RF1 AGC out of range		
	15	0x00008000	RF2 AGC out of range		
N4	16	0x00010000	RF3 AGC out of range		
	17	0x00020000	Reserved		
	18	0x000040000	Ethernet not connected		
	19	0x000080000	ICOM1 buffer overrun flag		

Continued on next page

Table 110: Auxiliary 1 Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N5	20	0x00100000	ICOM2 buffer overrun flag		
	21	0x00200000	ICOM3 buffer overrun flag		
	22	0x00400000	NCOM1 buffer overrun flag		
	23	0x00800000	NCOM2 buffer overrun flag		
N6	24	0x01000000	NCOM3 buffer overrun flag		
	25	0x02000000	XCOM1 buffer overrun flag		
	26	0x04000000	XCOM2 buffer overrun flag		
	27	0x08000000	XCOM3 buffer overrun flag		
N7	28	0x10000000	Reserved		
	29	0x20000000	Reserved		
	30	0x40000000	Reserved		
	31	0x80000000	Reserved		

Table 111: Auxiliary 2 Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x0000001	Reserved		

Table 112: Auxiliary 3 Status

Nibble #	Bit #	Mask	Description	Bit = 0	Bit = 1
N0	0	0x0000001	Reserved		

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RXSTATUS header	Log header		H	0
2	error	Receiver error (see *Table 108, Receiver Error* on *page 610*). A value of zero indicates no errors.	ULong	4	H
3	# stats	Number of status codes (including Receiver Status)	ULong	4	H+4
4	rxstat	Receiver status word (see *Table 109, Receiver Status* on *page 611*)	ULong	4	H+8
5	rxstat pri	Receiver status priority mask, which can be set using the STATUSCONFIG command (*page 238)*	ULong	4	H+12
6	rxstat set	Receiver status event set mask, which can be set using the STATUSCONFIG command (*page 238)*	ULong	4	H+16
7	rxstat clear	Receiver status event clear mask, which can be set using the STATUSCONFIG command (*page 238)*	ULong	4	H+20
8	aux1stat	Auxiliary 1 status word (see *Table 110, Auxiliary 1 Status* on *page 613*)	ULong	4	H+24
9	aux1stat pri	Auxiliary 1 status priority mask, which can be set using the STATUSCONFIG command (*page 238)*	ULong	4	H+28
10	aux1stat set	Auxiliary 1 status event set mask, which can be set using the STATUSCONFIG command (*page 238)*	ULong	4	H+32
11	aux1stat clear	Auxiliary 1 status event clear mask, which can be set using the STATUSCONFIG command (*page 238)*	ULong	4	H+36
12	aux2stat	Auxiliary 2 status word (see *Table 111, Auxiliary 2 Status* on *page 614*)	ULong	4	H+40
13	aux2stat pri	Auxiliary 2 status priority mask, which can be set using the STATUSCONFIG command (*page 238)*	ULong	4	H+44
14	aux2stat set	Auxiliary 2 status event set mask, which can be set using the STATUSCONFIG command	ULong	4	H+48
15	aux2stat clear	Auxiliary 2 status event clear mask, which can be set using the STATUSCONFIG command	ULong	4	H+52
16	aux3stat	Auxiliary 3 status word (see *Table 112, Auxiliary 3 Status* on *page 614*)	ULong	4	H+56
17	aux3stat pri	Auxiliary 3 status priority mask, which can be set using the STATUSCONFIG command (see *page 238)*	ULong	4	H+60

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
18	aux3stat set	Auxiliary 3 status event set mask, which can be set using the STATUSCONFIG command	ULong	4	H+64
19	aux3stat clear	Auxiliary 3 status event clear mask, which can be set using the STATUSCONFIG command	ULong	4	H+68
20...	Next status code offset = H + 8 + (# stats x 16)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+8+(#stats x 64)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.155 RXSTATUSEVENT Status Event Indicator

This log is used to output event messages as indicated in the RXSTATUS log. An event message is automatically generated for all receiver errors, which are indicated in the receiver error word. In addition, event messages can be generated when other conditions, which are indicated in the receiver status and auxiliary status words, are met. Whether or not an event message is generated under these conditions is specified using the STATUSCONFIG command, which is detailed starting on *page 238*.

On start-up, the receiver is set to log the RXSTATUSEVENTA log ONNEW on all ports. You can remove this message by using the UNLOG command, see *page 250*.

See also the chapter on *Built-In Status Tests* in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **94**
Log Type: **Asynch**

Recommended Input:

```
log rxstatuseventa onchanged
```

ASCII Example 1:

```
#RXSTATUSEVENTA,COM1,0,17.0,FREEWHEELING,1337,408334.510,00480000,b967,1984;
STATUS,19,SET,"No Valid Position Calculated"*6de945ad
```

ASCII Example 2:

```
#RXSTATUSEVENTA,COM1,0,41.0,FINESTEERING,1337,408832.031,01000400,b967,1984;
STATUS,10,SET,"COM3 Transmit Buffer Overrun"*5b5682a9
```

When a fatal event occurs (for example, in the event of a receiver hardware failure), a bit is set in the receiver error word, part of the RXSTATUS log on *page 607*, to indicate the cause of the problem. Bit 0 is set in the receiver status word to show that an error occurred, the error strobe is driven high, and the LED flashes red and yellow showing an error code. An RXSTATUSEVENT log is generated on all ports to show the cause of the error. Receiver tracking is disabled at this point but command and log processing continues to allow you to diagnose the error. Even if the source of the error is corrected at this point, the receiver must be reset to resume normal operation.

Table 113: Status Word

Word (binary)	Word (ASCII)	Description
0	ERROR	Receiver Error word, see *Table 108* on *page 610*
1	STATUS	Receiver Status word, see *Table 109* on *page 611*
2	AUX1	Auxiliary 1 Status word, see *Table* on *page 610*
3	AUX2	Auxiliary 2 Status word see *Table 111* on *page 614*
4	AUX3	Auxiliary 3 Status word see *Table 112* on *page 614*

Table 114: Event Type

Event (binary)	Event (ASCII)	Description
0	CLEAR	Bit was cleared
1	SET	Bit was set

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	RXSTATUSEVENT header	Log header		H	0
2	word	The status word that generated the event message (see *Table 113,* above)	Enum	4	H
3	bit position	Location of the bit in the status word (see*Table 109, Receiver Status* on *page 611* or the *Auxiliary Status* tables on *page 610*)	Ulong	4	H+4
4	event	Event type (see *Table 114* above)	Enum	4	H+8
3	description	This is a text description of the event or error	Char[32]	32	H+12
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.156 SATVIS Satellite Visibility

Satellite visibility log with additional satellite information.

1. The SATVIS log is meant to provide a brief overview. The satellite positions and velocities used in the computation of this log are based on Almanac orbital parameters, not the higher precision Ephemeris parameters.
2. In the SATVIS log output there may be double satellite number entries. These are GLONASS antipodal satellites that are in the same orbit plane separated by 180 degrees latitude. For further information on GLONASS refer to *An Introduction to GNSS*, available through our website at www.novatel.com through *Support | Knowledge and Learning > Learn About GNSS > GNSS Book*.

Message ID: **48**
Log Type: **Synch**

Recommended Input:

log satvisa ontime 60

ASCII Example:

```
#SATVISA,COM1,0,46.5,FINESTEERING,1363,238448.000,00000000,0947,2277;
TRUE,TRUE,61,
7,0,0,86.1,77.4,-69.495,-69.230,
2,0,0,66.3,70.7,-1215.777,-1215.512,
58,7,1,64.7,324.5,1282.673,1282.939,
58,12,0,64.7,324.5,1283.808,1284.074,
30,0,0,60.8,267.7,299.433,299.699,
5,0,0,58.1,205.5,-1783.823,-1783.557,
42,7,1,53.0,79.0,17.034,17.300,
42,9,1,53.0,79.0,20.108,20.373,
...
19,0,0,-86.8,219.3,88.108,88.373*a0b7cc0b
```

Consider sky visibility at each of the base and rover receivers in a differential setup. The accuracy and reliability of differential messages is proportional to the number of common satellites that are visible at the base and rover. Therefore, if the sky visibility at either station is poor, you might consider increasing the occupation times. This condition is best measured by monitoring the number of visible satellites during data collection along with the PDOP value (a value less than 3 is ideal). Also, the location and number of satellites in the sky is constantly changing. As a result, some periods in the day are slightly better for data collection than others. Use the SATVIS log to monitor satellite visibility. The PSRDOP log, see *page 447*, can be used to monitor the PDOP values.

Site conditions surrounding the station that may affect satellite visibility and can generate noise in the data are water bodies, buildings, trees and nearby vehicles.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SATVIS header	Log header		H	0
2	sat vis	Is satellite visibility valid? 0 = FALSE 1 = TRUE	Enum	4	H
3	comp alm	Was complete GPS almanac used? 0 = FALSE 1 = TRUE	Enum	4	H+4
4	#sat	Number of satellites with data to follow	Ulong	4	H+8
5	PRN/slot	Satellite PRN number of range measurement (GPS: 1-32 and SBAS: 120 to 138. For GLONASS, see *Section 1.3* on *page 31*)	Short	2	H+12
6	glofreq	(GLONASS Frequency + 7), see *Section 1.3* on *page 31*	Short	2	H+14
7	health	Satellite health [a]	Ulong	4	H+16
8	elev	Elevation (degrees)	Double	8	H+20
9	az	Azimuth (degrees)	Double	8	H+28
10	true dop	Theoretical Doppler of satellite - the expected Doppler frequency based on a satellite's motion relative to the receiver. It is computed using the satellite's coordinates and velocity, and the receiver's coordinates and velocity. (Hz)	Double	8	H+36
11	app dop	Apparent Doppler for this receiver - the same as Theoretical Doppler above but with clock drift correction added. (Hz)	Double	8	H+44
12	Next satellite offset = H + 12 + (#sat x 40)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12+ (#sat x 40)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. Satellite health values may be found in ICD-GPS-200. To obtain copies of ICD-GPS-200, refer to ARINC in the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/.

3.3.157 SATVIS2 Satellite Visibility

Satellite visibility log with additional satellite and satellite system information.

1. The SATVIS2 log is meant to provide a brief overview. The satellite positions and velocities used in the computation of this log are based on Almanac orbital parameters, not the higher precision Ephemeris parameters.
2. In the SATVIS2 log output there may be double satellite number entries. These are GLONASS antipodal satellites that are in the same orbit plane separated by 180 degrees latitude. Refer also to the *GLONASS* chapter of the *An Introduction to GNSS Book*, available on our website at http://www.novatel.com/support/knowledge-and-learning/.

Message ID: **1043**

Log Type: **Asynch**

Recommended Input:

log satvis2a ontime 60

ASCII Example:

```
#SATVIS2A,COM2,3,90.5,FINESTEERING,1610,244590.000,00000000,a867,6293;GPS,
TRUE,TRUE,31,2,0,70.2,76.8,-815.364,-815.747,12,0,61.3,192.3,-1708.957,-
1709.339,25,0,57.8,282.3,984.112,983.729,10,0,42.4,99.7,957.491,957.108,4,0,3
3.6,60.3,-3112.510,-3112.892,29,0,29.6,282.7,2874.294,2873.912,5,0,
28.2,154.7,3305.821,3305.439,30,0,23.2,312.7,3227.645,3227.262,31,0,14.4,325.
4,1177.840,1177.457,23,0,4.8,26.3,570.313,569.930,13,0,2.8,54.4,2118.874,2118
.492,9,0,-3.3,204.6,-3695.150,-3695.532,17,0,-10.1,99.7,-3286.706,-
3287.089,21,0,-10.2,233.4,3183.252,3182.869,27,0,-11.7,194.3,-2856.249,-
2856.632,14,0,-19.0,280.9,-2767.366,-2767.749,20,0,-19.1,11.3,-3534.725,-
3535.108,26,0,-24.7,154.6,2016.654,2016.271,15,0,-
27.7,184.5,757.297,756.914,32,0,-30.3,353.9,-3096.307,-3096.689,16,0,-
31.3,330.6,3336.083,3335.701,18,0,-38.7,217.8,1888.025,1887.643,28,0,-
41.7,134.6,-2764.977,-2765.360,7,0,-44.5,72.9,1911.461,1911.078,8,0,-
49.2,107.9,346.080,345.697,11,0,-53.9,60.8,-2100.073,-2100.455,22,0,-
54.8,250.0,424.266,423.883,6,0,-55.7,281.7,1899.454,1899.072,3,0,-
67.4,285.8,1549.628,1549.246,24,0,-71.1,35.5,-1105.593,-1105.976,19,0,-
86.8,213.2,206.102,205.720*4c9815ef
```

Consider sky visibility at each of the base and rover receivers in a differential setup. The accuracy and reliability of differential messages is proportional to the number of common satellites that are visible at the base and rover. Therefore, if the sky visibility at either station is poor, you might consider increasing the occupation times. This condition is best measured by monitoring the number of visible satellites during data collection along with the PDOP value (a value less than 3 is ideal). Also, the location and number of satellites in the sky is constantly changing. As a result, some periods in the day are slightly better for data collection than others. Use the SATVIS2 log to monitor satellite visibility. The PSRDOP log, see *page 447*, can be used to monitor the PDOP values.

Site conditions surrounding the station that may affect satellite visibility and can generate noise in the data are water bodies, buildings, trees and nearby vehicles.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SATVIS2 header	Log header		H	0
2	Satellite System	GNSS satellite system identifier. See *Table 29* on *page 157*	Enum	4	H
3	sat vis	Is satellite visibility valid? 0 = FALSE 1 = TRUE	Enum	4	H+4
4	comp alm	Was complete GNSS almanac used? 0 = FALSE 1 = TRUE	Enum	4	H+8
5	#sat	Number of satellites with data to follow	Ulong	4	H+12
6	Satellite ID	In binary logs, the satellite ID field is 4 bytes. The 2 lowest-order bytes, interpreted as a USHORT, are the system identifier: for instance, the PRN for GPS, or the slot for GLONASS. The 2 highest-order bytes are the frequency channel for GLONASS, interpreted as a SHORT, and zero for all other systems. In ASCII and abbreviated ASCII logs, the satellite ID field is the system identifier. If the system is GLONASS and the frequency channel is not zero, then the signed channel is appended to the system identifier. For example, slot 13, frequency channel -2 is output as 13-2.	Simple	4	H+16
7	health	Satellite health [a]	Ulong	4	H+20
8	elev	Elevation (degrees)	Double	8	H+24
9	az	Azimuth (degrees)	Double	8	H+32
10	true dop	Theoretical Doppler of satellite - the expected Doppler frequency based on a satellite's motion relative to the receiver. It is computed using the satellite's coordinates and velocity, and the receiver's coordinates and velocity (Hz)	Double	8	H+40
11	app dop	Apparent Doppler for this receiver - the same as Theoretical Doppler above but with clock drift correction added. (Hz)	Double	8	H+48
12	Next satellite offset = H + 16 + (#sat x 40)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+16+ (#sat x 40)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. Satellite health values may be found in ICD-GPS-200. To obtain copies of ICD-GPS-200, refer to ARINC in the *Standards and References* section of our website at http://www.novatel.com/support/knowledge-and-learning/.

3.3.158 SATXYZ Satellite Positions in ECEF Cartesian Coordinates

When combined with a RANGE log, this data set contains the decoded satellite information necessary to compute the solution: satellite coordinates (ECEF WGS84), satellite clock correction, ionospheric corrections and tropospheric corrections. See the calculation examples in the usage box below. Only those satellites used in the corresponding PSRPOS solution are reported here. See also *Figure 10* on *page 315*.

Message ID: **270**
Log Type: **Synch**

Recommended Input:

log satxyz ontime 1

ASCII Example:

```
#SATXYZA,COM1,0,45.5,FINESTEERING,1337,409729.000,00000000,6f3c,1984;0.0,11,
1,8291339.5258,-17434409.5059,18408253.4923,1527.199,2.608578998,
3.200779818,0.000000000,0.000000000,
...
14,18951320.4329,-16297117.6697,8978403.7764,-8190.088,4.139015349,
10.937283220,0.000000000,0.000000000*8a943244
```

The OEM6 family use positive numbers for ionospheric and tropospheric corrections. A positive clock offset indicates that the clock is running ahead of the reference time. Positive ionospheric and tropospheric corrections are added to the geometric ranges or subtracted from the measured pseudoranges. For example:

P = p + pd + c(dT - dt) + d(ion) + d(trop) + Ep

is equivalent to

P - c(dT - dt) - d(ion) - d(trop) = p + pd + Ep

where

P = measured pseudorange

p = geometric range

pd = orbit error

dt = satellite clock offset

dT = receiver clock offset

d (ion) = ionospheric delay

d (trop) = tropospheric delay

c = speed of light

Ep = noise and multipath

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SATXYZ header	Log header		H	0
2	Reserved		Double	8	H
3	#sat	Number of satellites with Cartesian information to follow	Ulong	4	H+8
4	PRN/slot	Satellite PRN number of range measurement (GPS: 1-32 and SBAS: 120 to 138. For GLONASS, see *Section 1.3* on *page 31*	Ulong	4	H+12
5	x	Satellite X coordinates (ECEF, m)	Double	8	H+16
6	y	Satellite Y coordinates (ECEF, m)	Double	8	H+24
7	z	Satellite Z coordinates (ECEF, m)	Double	8	H+32
8	clk corr	Satellite clock correction (m)	Double	8	H+40
9	ion corr	Ionospheric correction (m)	Double	8	H+48
10	trop corr	Tropospheric correction (m)	Double	8	H+56
11	Reserved		Double	8	H+64
12			Double	8	H+72
13	Next satellite offset = H + 12 + (#sat x 68)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12+ (#sat x 68)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.159 SBAS0 Do Not Use for Safety Applications

This message tells you, that the GEO transmitting SBAS corrections is operating in test mode, and should not be used for safety applications for a period of time outlined in the SBAS signal specification.

The GEO transmitting SBAS corrections is operating in test mode, and should not be used for safety-of-life applications.

See how the SBAS0 message relates to the SBAS testing modes in the SBASCONTROL command on *page 205*.

Message ID: **976**
Log Type: **Asynch**

Recommended Input:

log SBAS0a onchanged

ASCII Example:

```
#SBAS0A,COM1,0,68.5,SATTIME,1093,161299.000,00040020,7d6a,209;122*e9a5ab08
```

Although the SBAS was designed for aviation users, it now supports a wide variety of non-aviation uses including agriculture, surveying, recreation, and surface transportation.

.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS0 header	Log header		H	0
2	prn	Source PRN message - also PRN not to use	Ulong	4	H
3	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4
4	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.160 SBAS1 PRN Mask Assignments

The PRN mask is given in SBAS1. The transition of the PRN mask to a new one (which will be infrequent) is controlled with the 2-bit IODP, which sequences to a number between 0 and 3. The same IODP appears in the applicable SBAS2, SBAS3, SBAS4, SBAS5, SBAS7, SBAS24 and SBAS25 messages (SBAS32, SBAS33, SBAS34, SBAS35 and SBAS45). This transition would probably only occur when a new satellite is launched or when a satellite fails and is taken out of service permanently. A degraded satellite may be flagged as a don't use satellite temporarily.

Message ID: 977
Log Type: Asynch

Recommended Input:

log SBAS1a onchanged

ASCII Example:

```
#SBAS1A,COM1,0,24.5,SATTIME,1337,415802.000,00000000,5955,1984;
134,ffeffffe00000000000000000000004004000000000000000000,2*3633cf7b
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS1 message can be logged to view the data breakdown of SBAS frame 1 which contains information about the PRN mask assignment.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	mask	PRN bit mask	Uchar[27]	28 [a]	H+4
4	iodp	Issue of PRN mask data	Ulong	4	H+32
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+36
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 1 byte of padding is added to maintain 4-byte alignment

3.3.161 SBAS2 Fast Correction Slots 0-12

SBAS2 are fast corrections for slots 0-12 in the mask of SBAS1. This message may or may not come when SBAS is in testing mode (see the SBASCONTROL command on *page 205* for details).

Message ID: **982**
Log Type: **Asynch**

Recommended Input:

log SBAS2a onchanged

ASCII Example:

```
#SBAS2A,COM1,0,29.0,SATTIME,1337,415925.000,00000000,e194,1984;
134,2,2,3,-3,5,1,2047,-2,2047,2047,2047,2047,2047,-3,2,5,11,7,
8,14,8,14,14,14,14,14,6,12*8d8d2e1c
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS2 message can be logged to view the data breakdown of SBAS frame 2 which contains information about fast correction slots 0-12.

Table 115: Evaluation of UDREI

UDREI [a]	UDRE metres	$\sigma^2_{i.udre}$ metres^2
0	0.75	0.0520
1	1.0	0.0924
2	1.25	0.1444
3	1.75	0.2830
4	2.25	0.4678
5	3.0	0.8315
6	3.75	1.2992
7	4.5	1.8709
8	5.25	2.5465
9	6.0	3.3260
10	7.5	5.1968
11	15.0	20.7870
12	50.0	230.9661
13	150.0	2078.695
14	Not Monitored	Not Monitored
15	Do Not Use	Do Not Use

a. The σ^2UDRE broadcast in SBAS2, SBAS3, SBAS4, SBAS5, SBAS6 and SBAS24 applies at a time prior to or at the time of applicability of the associated corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS2 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf	Issue of fast corrections data	Ulong	4	H+4	-
4	iodp	Issue of PRN mask data	Ulong	4	H+8	-
5	prc0	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 0-12)	Long	4	H+12	-
6	prc1		Long	4	H+16	-
7	prc2		Long	4	H+20	-
8	prc3		Long	4	H+24	-
9	prc4		Long	4	H+28	-
10	prc5		Long	4	H+32	-
11	prc6		Long	4	H+36	-
12	prc7		Long	4	H+40	-
13	prc8		Long	4	H+44	-
14	prc9		Long	4	H+48	-
15	prc10		Long	4	H+52	-
16	prc11		Long	4	H+56	-
17	prc12		Long	4	H+60	-
18	udre0	udre(i): User differential range error indicator for the prn in slot i (i = 0-12)	Ulong	4	H+64	See *Table 115, Evaluation of UDREI* on *page 628*
19	udre1		Ulong	4	H+68	
20	udre2		Ulong	4	H+72	
21	udre3		Ulong	4	H+76	
22	udre4		Ulong	4	H+80	
23	udre5		Ulong	4	H+84	
24	udre6		Ulong	4	H+88	
25	udre7		Ulong	4	H+92	
26	udre8		Ulong	4	H+96	
27	udre9		Ulong	4	H+100	
28	udre10		Ulong	4	H+104	
29	udre11		Ulong	4	H+108	
30	udre12		Ulong	4	H+112	
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+116	-
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.162 SBAS3 Fast Corrections Slots 13-25

SBAS3 are fast corrections for slots 13-25 in the mask of SBAS1. Only applies to SBAS2.

Message ID: **987**
Log Type: **Asynch**

Recommended Input:

log SBAS3a onchanged

ASCII Example:

```
#SBAS3A,COM1,0,17.0,SATTIME,1337,415990.000,00000000,bff5,1984;
134,1,2,2047,0,2047,2047,-21,-4,2047,2047,-1,0,2,2047,6,14,5,
14,14,11,5,14,14,5,7,5,14,8*a25aebc5
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS3 message can be logged to view the data breakdown of SBAS frame 3 which contains information about fast correction slots 13-25.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS3 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf	Issue of fast corrections data	Ulong	4	H+4	-
4	iodp	Issue of PRN mask data	Ulong	4	H+8	-
5	prc13	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 13-25)	Long	4	H+12	-
6	prc14		Long	4	H+16	-
7	prc15		Long	4	H+20	-
8	prc16		Long	4	H+24	-
9	prc17		Long	4	H+28	-
10	prc18		Long	4	H+32	-
11	prc19		Long	4	H+36	-
12	prc20		Long	4	H+40	-
13	prc21		Long	4	H+44	-
14	prc22		Long	4	H+48	-
15	prc23		Long	4	H+52	-
16	prc24		Long	4	H+56	-
17	prc25		Long	4	H+60	-
18	udre13	udre(i): User differential range error indicator for the prn in slot i (i = 13-25)	Ulong	4	H+64	See *Table 115, Evaluation of UDREI* on *page 628*
19	udre14		Ulong	4	H+68	
20	udre15		Ulong	4	H+72	
21	udre16		Ulong	4	H+76	
22	udre17		Ulong	4	H+80	
23	udre18		Ulong	4	H+84	
24	udre19		Ulong	4	H+88	
25	udre20		Ulong	4	H+92	
26	udre21		Ulong	4	H+96	
27	udre22		Ulong	4	H+100	
28	udre23		Ulong	4	H+104	
29	udre24		Ulong	4	H+108	
30	udre25		Ulong	4	H+112	
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+116	-
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.163 SBAS4 Fast Correction Slots 26-38

SBAS4 are fast corrections for slots 26-38 in the mask of SBAS1. Only applies to SBAS2.

Message ID: **992**
Log Type: **Asynch**

Recommended Input:

log SBAS4a onchanged

ASCII Example:

```
#SBAS4A,COM1,0,58.0,SATTIME,1093,163399.000,00000020,b4b0,209;
122,0,3,2047,3,-1,2047,2047,2047,-3,-1,5,3,3,
2047,2,14,3,3,14,14,14,6,3,4,5,4,14,3*2e0894b1
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS4 message can be logged to view the data breakdown of SBAS frame 4 which contains information about fast correction slots 26-38.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS4 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf	Issue of fast corrections data	Ulong	4	H+4	-
4	iodp	Issue of PRN mask data	Ulong	4	H+8	-
5	prc26	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 26-38)	Long	4	H+12	-
6	prc27		Long	4	H+16	-
7	prc28		Long	4	H+20	-
8	prc29		Long	4	H+24	-
9	prc30		Long	4	H+28	-
10	prc31		Long	4	H+32	-
11	prc32		Long	4	H+36	-
12	prc33		Long	4	H+40	-
13	prc34		Long	4	H+44	-
14	prc35		Long	4	H+48	-
15	prc36		Long	4	H+52	-
16	prc37		Long	4	H+56	-
17	prc38		Long	4	H+60	-
18	udre26	udre(i): User differential range error indicator for the prn in slot i (i = 26-38)	Ulong	4	H+64	See *Table 115, Evaluation of UDREI* on *page 628*
19	udre27		Ulong	4	H+68	
20	udre28		Ulong	4	H+72	
21	udre29		Ulong	4	H+76	
22	udre30		Ulong	4	H+80	
23	udre31		Ulong	4	H+84	
24	udre32		Ulong	4	H+88	
25	udre33		Ulong	4	H+92	
26	udre34		Ulong	4	H+96	
27	udre35		Ulong	4	H+100	
28	udre36		Ulong	4	H+104	
29	udre37		Ulong	4	H+108	
30	udre38		Ulong	4	H+112	
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+116	-
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.164 SBAS5 Fast Correction Slots 39-50

SBAS5 are fast corrections for slots 39-50 in the mask of SBAS1. Only applies to SBAS 2.

Message ID: **994**
Log Type: **Asynch**

Recommended Input:

log SBAS5a onchanged

ASCII Example:

```
#SBAS5A,COM1,0,72.5,SATTIME,1093,161480.000,00040020,31d4,209;122,1,3,
-7,2047,2047,2047,-4,2047,2047,2047,9,2047,2047,-3,-2,11,14,14,14,4,14,14,14,
5,14,14,4,2*2bf0109b
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS5 message can be logged to view the data breakdown of SBAS frame 5 which contains information about fast correction slots 39-50.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS5 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf	Issue of fast corrections data	Ulong	4	H+4	-
4	iodp	Issue of PRN mask data	Ulong	4	H+8	-
5	prc39	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 39-50)	Long	4	H+12	-
6	prc40		Long	4	H+16	-
7	prc41		Long	4	H+20	-
8	prc42		Long	4	H+24	-
9	prc43		Long	4	H+28	-
10	prc44		Long	4	H+32	-
11	prc45		Long	4	H+36	-
12	prc46		Long	4	H+40	-
13	prc47		Long	4	H+44	-
14	prc48		Long	4	H+48	-
15	prc49		Long	4	H+52	-
16	prc50		Long	4	H+56	-
17	prc51 (Invalid, do not use)		Long	4	H+60	-
18	udre39	udre(i): User differential range error indicator for the prn in slot i (i = 39-50)	Ulong	4	H+64	See *Table 115, Evaluation of UDREI* on *page 628*
19	udre40		Ulong	4	H+68	
20	udre41		Ulong	4	H+72	
21	udre42		Ulong	4	H+76	
22	udre43		Ulong	4	H+80	
23	udre44		Ulong	4	H+84	
24	udre45		Ulong	4	H+88	
25	udre46		Ulong	4	H+92	
26	udre47		Ulong	4	H+96	
27	udre48		Ulong	4	H+100	
28	udre49		Ulong	4	H+104	
29	udre50		Ulong	4	H+108	
30	udre51 (Invalid, do not use)		Ulong	4	H+112	
31	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+116	-
32	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.165 SBAS6 Integrity Message

SBAS6 is the integrity information message. Each message includes an IODF for each fast corrections message. The σ^2_{UDRE} information for each block of satellites applies to the fast corrections with the corresponding IODF.

Message ID: **995**
Log Type: **Asynch**

Recommended Input:

log SBAS6a onchanged

ASCII Example:

```
#SBAS6A,COM1,0,57.5,SATTIME,1093,273317.000,00000020,526a,209;
122,3,3,3,3,9,14,14,2,3,10,2,14,14,3,14,14,5,14,14,7,14,14,14,14,14,14,3,3,
14,14,14,14,3,15,11,11,15,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*925a2a9b
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS6 message can be logged to view the data breakdown of SBAS frame 6 which contains information about the integrity message.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS6 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	iodf2	Issue of fast corrections data	Ulong	4	H+4	-
4	iodf3	Issue of fast corrections data	Ulong	4	H+8	-
5	iodf4	Issue of fast corrections data	Ulong	4	H+12	-
6	iodf5	Issue of fast corrections data	Ulong	4	H+16	-
7	udre0	udre(i): User differential range error indicator for the prn in slot i (i = 0-50)	Ulong	4	H+20	See *Table 115, Evaluation of UDREI* on *page 628*
8	udre1		Ulong	4	H+24	
9	udre2		Ulong	4	H+28	
10	udre3		Ulong	4	H+32	
11	udre4		Ulong	4	H+36	
12	udre5		Ulong	4	H+40	
13	udre6		Ulong	4	H+44	
14	udre7		Ulong	4	H+48	
15	udre8		Ulong	4	H+52	
16	udre9		Ulong	4	H+56	
17	udre10		Ulong	4	H+60	
18	udre11		Ulong	4	H+64	
19	udre12		Ulong	4	H+68	
20	udre13		Ulong	4	H+72	
21	udre14		Ulong	4	H+76	
22	udre15		Ulong	4	H+80	
23	udre16		Ulong	4	H+84	
24	udre17		Ulong	4	H+88	
25	udre18	udre(i): User differential range error indicator for the prn in slot i (i = 0-50)	Ulong	4	H+92	See *Table 115, Evaluation of UDREI* on *page 628*
26	udre19		Ulong	4	H+96	
27	udre20		Ulong	4	H+100	
28	udre21		Ulong	4	H+104	
29	udre22		Ulong	4	H+108	
30	udre23		Ulong	4	H+112	
31	udre24		Ulong	4	H+116	

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
32	udre25		Ulong	4	H+120	
33	udre26		Ulong	4	H+124	
34	udre27		Ulong	4	H+128	
35	udre28		Ulong	4	H+132	
36	udre29		Ulong	4	H+136	
37	udre30		Ulong	4	H+140	
38	udre31		Ulong	4	H+144	
39	udre32		Ulong	4	H+148	
40	udre33		Ulong	4	H+152	
41	udre34		Ulong	4	H+156	
42	udre35		Ulong	4	H+160	
43	udre36		Ulong	4	H+164	
44	udre37		Ulong	4	H+168	
45	udre38		Ulong	4	H+172	
46	udre39		Ulong	4	H+176	
47	udre40		Ulong	4	H+180	
48	udre41		Ulong	4	H+184	
49	udre42		Ulong	4	H+188	
50	udre43		Ulong	4	H+192	
51	udre44		Ulong	4	H+196	
52	udre45		Ulong	4	H+200	
53	udre46	udre(i): User differential range error indicator for the prn in slot i (i = 0-50)	Ulong	4	H+204	See *Table 115, Evaluation of UDREI* on *page 628*
54	udre47		Ulong	4	H+208	
55	udre48		Ulong	4	H+212	
56	udre49		Ulong	4	H+216	
58	udre50		Ulong	4	H+220	
58	udre51 (Invalid, do not use)		Ulong	4	H+224	
59	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+228	-
60	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.166 SBAS7 Fast Correction Degradation

The SBAS7 message specifies the applicable IODP, system latency time and fast degradation factor indicator for computing the degradation of fast and long-term corrections.

Message ID: **996**
Log Type: **Asynch**

Recommended Input:

log SBAS7a onchanged

ASCII Example:

```
#SBAS7A,COM1,0,36.5,SATTIME,1337,416367.000,00000000,12e3,1984;
122,1,2,0,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,15,
15,15,15,15,15,15,15,15,15,15,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*827a7364
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS7 message can be logged to view the data breakdown of SBAS frame 7 which contains information about fast correction degradation.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS7 header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	latency	System latency	Ulong	4	H+4
4	iodp	Issue of PRN mask data	Ulong	4	H+8
5	spare bits	Unused spare bits	Ulong	4	H+12
6	al(0)	al(i): Degradation factor indicator for the prn in slot i (i = 0-50)	Ulong	4	H+16
7	al(1)		Ulong	4	H+20
8	al(2)		Ulong	4	H+24
9	al(3)		Ulong	4	H+28
10	al(4)		Ulong	4	H+32
11	al(5)		Ulong	4	H+36
12	al(6)		Ulong	4	H+40
13	al(7)		Ulong	4	H+44
14	al(8)		Ulong	4	H+48
15	al(9)		Ulong	4	H+52
16	al(10)		Ulong	4	H+56
17	al(11)		Ulong	4	H+60
18	al(12)		Ulong	4	H+64
19	al(13)		Ulong	4	H+68
20	al(14)		Ulong	4	H+72
21	al(15)		Ulong	4	H+76
22	al(16)		Ulong	4	H+80
23	al(17)		Ulong	4	H+84
24	al(18)		Ulong	4	H+88
25	al(19)		Ulong	4	H+92
26	al(20)		Ulong	4	H+96
27	al(21)	al(i): Degradation factor indicator for the prn in slot i (i = 0-50)	Ulong	4	H+100
28	al(22)		Ulong	4	H+104
29	al(23)		Ulong	4	H+108
30	al(24)		Ulong	4	H+112
31	al(25)		Ulong	4	H+116
32	al(26)		Ulong	4	H+120
33	al(27)		Ulong	4	H+124
34	al(28)		Ulong	4	H+128

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
35	al(29)		Ulong	4	H+132
36	al(30)		Ulong	4	H+136
37	al(31)		Ulong	4	H+140
38	al(32)		Ulong	4	H+144
39	al(33)		Ulong	4	H+148
40	al(34)		Ulong	4	H+152
41	al(35)		Ulong	4	H+156
42	al(36)		Ulong	4	H+160
43	al(37)		Ulong	4	H+164
44	al(38)		Ulong	4	H+168
45	al(39)		Ulong	4	H+172
46	al(40)		Ulong	4	H+176
47	al(41)		Ulong	4	H+180
48	al(42)		Ulong	4	H+184
49	al(43)		Ulong	4	H+188
50	al(44)		Ulong	4	H+192
51	al(45)		Ulong	4	H+196
52	al(46)		Ulong	4	H+200
53	al(47)		Ulong	4	H+204
54	al(48)		Ulong	4	H+208
55	al(49)	al(i):	Ulong	4	H+212
56	al(50)	Degradation factor indicator for the prn in slot i (i = 0-50)	Ulong	4	H+216
57	al(51) (Invalid, do not use)		Ulong	4	H+220
58	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+224
59	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.167 SBAS9 GEO Navigation Message

SBAS9 provides the GEO navigation message representing the position, velocity and acceleration of the geostationary satellite, in ECEF coordinates and its apparent clock time and frequency offsets.

Also included is the time of applicability, an issue of data (IOD) and an accuracy exponent (URA) representing the estimated accuracy of the message. The time offset and time drift are with respect to SBAS Network Time. Their combined effect is added to the estimate of the satellite's transmit time.

Message ID: **997**
Log Type: **Asynch**

Recommended Input:

log SBAS9a onchanged

ASCII Example:

```
#SBAS9A,COM1,0,38.0,SATTIME,1337,416426.000,00000000,b580,1984;
122,175,70848,2,24802064.1600,-34087313.9200,-33823.2000,
1.591250000,0.107500000,0.6080000,-0.0000750,-0.0001125,
0.000187500,-2.235174179e-08,9.094947018e-12*636051d2
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS9 message can be logged to view the data breakdown of SBAS frame 9 which contains the GEO navigation message.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS9 header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	iodn	Issue of GEO navigation data	Ulong	4	H+4
4	t_0	Time of applicability	Ulong	4	H+8
5	ura	URA value	Ulong	4	H+12
6	x	ECEF x coordinate	Double	8	H+16
7	y	ECEF y coordinate	Double	8	H+24
8	z	ECEF z coordinate	Double	8	H+32
9	xvel	X rate of change	Double	8	H+40
10	yvel	Y rate of change	Double	8	H+48
11	zvel	Z rate of change	Double	8	H+56
12	xaccel	X rate of rate change	Double	8	H+64
13	yaccel	Y rate of rate change	Double	8	H+72
14	zaccel	Z rate of rate change	Double	8	H+80
15	a_{f0}	Time offset	Double	8	H+88
16	a_{f1}	Time drift	Double	8	H+96
17	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+104
18	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.168 SBAS10 Degradation Factor

The fast corrections, long-term corrections and ionospheric corrections are all provided in the SBAS10 message.

Message ID: **978**
Log Type: **Asynch**

Recommended Input:

log SBAS10a onchanged

ASCII Example:

```
#SBAS10A,COM1,0,35.5,SATTIME,1337,416469.000,00000000,c305,1984;
122,54,38,76,256,152,100,311,83,256,6,0,300,292,0,1,
00000000000000000000*8884d248
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS10 message can be logged to view the data breakdown of SBAS frame 10 which contains information about degradation factors.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS10 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	b_{rcc}	Estimated noise and round off error parameter	Ulong	4	H+4	0.002
4	c_{ltc_lsb}	Maximum round off due to the least significant bit (lsb) of the orbital clock	Ulong	4	H+8	0.002
5	c_{ltc_vl}	Velocity error bound	Ulong	4	H+12	0.00005
6	i_{ltc_vl}	Update interval for v=1 long term	Ulong	4	H+16	-
7	c_{ltc_v0}	Bound on update delta	Ulong	4	H+20	0.002
8	i_{ltc_v1}	Minimum update interval v = 0	Ulong	4	H+24	-
9	c_{geo_lsb}	Maximum round off due to the lsb of the orbital clock	Ulong	4	H+28	0.0005
10	c_{geo_v}	Velocity error bound	Ulong	4	H+32	0.00005
11	i_{geo}	Update interval for GEO navigation message	Ulong	4	H+36	-
12	c_{er}	Degradation parameter	Ulong	4	H+40	0.5
13	c_{iono_step}	Bound on ionospheric grid delay difference	Ulong	4	H+44	0.001
14	i_{iono}	Minimum ionospheric update interval	Ulong	4	H+48	-
15	c_{iono_ramp}	Rate of ionospheric corrections change	Ulong	4	H+52	0.000005
16	rss_{udre}	User differential range error flag	Ulong	4	H+56	-
17	rss_{iono}	Root sum square flag	Ulong	4	H+60	-
18	spare bits	Spare 88 bits, possibly GLONASS	Ulong	4	H+64	-
19	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+68	-
20	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.169 SBAS12 SBAS Network Time and UTC

SBAS12 contains information bits for the UTC parameters and UTC time standard from which an offset is determined. The UTC parameters correlate UTC time with the SBAS network time rather than with GPS reference time.

Message ID: **979**
Log Type: **Asynch**

Recommended Input:

log SBAS12a onchanged

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS12 message can be logged to view the data breakdown of SBAS frame 12 which contains information about time parameters.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS12 header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	A_1	Time drift (s/s)	Double	8	H+4
4	A_0	Time offset (s)	Double	8	H+12
5	seconds	Seconds into the week (s)	Ulong	4	H+20
6	week	Week number	Ushort	4	H+24
7	dt_{ls}	Delta time due to leap seconds	Short	2	H+28
8	wn_{lsf}	Week number, leap second future	Ushort	2	H+30
9	dn	Day of the week (the range is 1 to 7 where Sunday = 1 and Saturday = 7)	Ushort	2	H+32
10	dt_{lsf}	Delta time, leap second future	Short	2	H+34
11	utc id	UTC type identifier	Ushort	2	H+36
12	gpstow	GPS reference time of the week	Ulong	2	H+38
13	gpswn	GPS de-modulo week number	Ulong	2	H+40
14	glo indicator	Is GLONASS information present? 0 = FALSE 1 = TRUE	Enum	4	H+42
15	Reserved array of hexabytes for GLONASS		Char[10]	12[a]	H+46
16	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+58
17	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

3.3.170 SBAS17 GEO Almanac Message

Almanacs for all GEOs are broadcast periodically to alert you of their existence, location, the general service provided, status, and health.

Unused almanacs have a PRN number of 0 and should be ignored, see *ASCII Example* below.

Message ID: **980**
Log Type: **Asynch**

Recommended Input:

log SBAS17a onchanged

ASCII Example:

```
#SBAS17A,COM1,0,84.5,SATTIME,1610,514149.000,00000000,896c,39061;135,3,
0,135,0,-11536200,-40536600,-260000,0,0,0,0,138,0,-12521600,-40258400,
0,0,0,0,0,133,0,-5551000,-41774200,-1248000,0,0,120,
82112*2be5146f
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS17 message can be logged to view the data breakdown of SBAS frame 17 which contains GEO almanacs.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS17 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	#ents	Number of almanac entries with information to follow	Ulong	4	H+4	-
4	data id	Data ID type	Ushort	2	H+8	-
5	entry prn	PRN for this entry	Ushort	2	H+10	-
6	health	Health bits	Ushort	4[a]	H+12	-
7	x	ECEF x coordinate	Long	4	H+16	-
8	y	ECEF y coordinate	Long	4	H+20	-
9	z	ECEF z coordinate	Long	4	H+24	-
10	x vel	X rate of change	Long	4	H+28	-
11	y vel	Y rate of change	Long	4	H+32	-
12	z vel	Z rate of change	Long	4	H+36	-
13...	Next entry = H+8 + (#ents x 32)					-
variable	t0	Time of day in seconds (0 to 86336)	Ulong	4	H+8+ (#ents x 32)	64
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12+ (#ents x 32)	-
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

a. In the binary log case, an additional 2 bytes of padding is added to maintain 4-byte alignment

3.3.171 SBAS18 IGP Mask

The ionospheric delay corrections are broadcast as vertical delay estimates at specified ionospheric grid points (IGPs), applicable to a signal on L1. The predefined IGPs are contained in 11 bands (numbered 0 to 10). Bands 0-8 are vertical bands on a Mercator projection map, and bands 9-10 are horizontal bands on a Mercator projection map. Since it is impossible to broadcast IGP delays for all possible locations, a mask is broadcast to define the IGP locations providing the most efficient model of the ionosphere at the time.

Message ID: **981**
Log Type: **Asynch**

Recommended Input:

log SBAS18a onchanged

ASCII Example:

```
#SBAS18A,COM1,0,33.0,SATTIME,1337,417074.000,00000000,f2c0,1984;
122,4,2,2,0000ffc0007fc0003ff0000ff80007fe0007fe0003ff0000ff80,0*b1ed353e
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS18 message can be logged to view the data breakdown of SBAS frame 18 which contains information about ionospheric grid points.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBAS18 header	Log header		H	0
2	prn	Source PRN of message	Ulong	4	H
3	#bands	Number of bands broadcast	Ulong	4	H+4
4	band num	Specific band number that identifies which of the 11 IGP bands the data belongs to	Ulong	4	H+8
5	iodi	Issue of ionospheric data	Ulong	4	H+12
6	igp mask	IGP mask	Uchar[26]	28[a]	H+16
7	spare bit	One spare bit	Ulong	4	H+44
8	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+48
9	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, an additional 2 bytes of padding are added to maintain 4-byte alignment

3.3.172 SBAS24 Mixed Fast/Slow Corrections

If there are 6 or fewer satellites in a block, they may be placed in this mixed correction message. There is a fast data set for each satellite and a UDRE indicator. Each message also contains an IODP indicating the associated PRN mask.

The fast correction (PRC) has a valid range of -2048 to +2047. If the range is exceeded a don't use indication is inserted into the user differential range error indicator (UDREI) field, see *Table 115* on *page 628*. You should ignore extra data sets not represented in the PRN mask.

The time of applicability (T0) of the PRC is the start of the epoch of the WNT second that is coincident with the transmission at the GEO satellite of the first bit of the message block.

Message ID: **983**
Log Type: **Asynch**

Recommended Input:

log SBAS24a onchanged

ASCII Example:

```
#SBAS24A,COM1,0,34.0,SATTIME,1337,417108.000,00000000,0a33,1984;
134,2047,2047,2047,2047,-1,-2,14,14,14,14,11,14,2,2,0,0,1,0,0,0,
0,0,0,0,0,0,0,0,0,0,0,0*76ff954b
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS24 message can be logged to view the data breakdown of SBAS frame 24 which contains mixed fast/slow corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS24 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	prc0	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 0-5)	Long	4	H+4	-
4	prc1		Long	4	H+8	-
5	prc2		Long	4	H+12	-
6	prc3		Long	4	H+16	-
7	prc4		Long	4	H+20	-
8	prc5		Long	4	H+24	-
9	udre0	udre(i): User differential range error indicator for the prn in slot i (i = 0-5)	Ulong	4	H+28	See *Table 115* on *page 628*
10	udre1		Ulong	4	H+.32	
11	udre2		Ulong	4	H+36	
12	udre3		Ulong	4	H+40	
13	udre4		Ulong	4	H+44	
14	udre5		Ulong	4	H+48	
15	iodp	Issue of PRN mask data	Ulong	4	H+52	-
16	block id	Associated message type	Ulong	4	H+56	
17	iodf	Issue of fast corrections data	Ulong	4	H+60	-
18	spare	Spare value	Ulong	4	H+64	-
19	vel	Velocity code flag	Ulong	4	H+68	-
20	mask1	Index into PRN mask (Type 1)	Ulong	4	H+72	-
21	iode1	Issue of ephemeris data	Ulong	4	H+76	-
22	dx1	Delta x (ECEF)	Long	4	H+80	0.125
23	dy1	Delta y (ECEF)	Long	4	H+84	0.125
24	dz1	Delta z (ECEF)	Long	4	H+88	0.125
25	da^{f0}	Delta a^{f0} clock offset	Long	4	H+92	2^{-31}
26	mask2	Second index into PRN mask (Type 1)	Ulong	4	H+96	-
27	iode2	Second issue of ephemeris data	Ulong	4	H+100	-
28	ddx	Delta delta x (ECEF)	Long	4	H+104	2^{-11}
29	ddy	Delta delta y (ECEF)	Long	4	H+108	2^{-11}
30	ddz	Delta delta z (ECEF)	Long	4	H+112	2^{-11}
31	da^{f1}	Delta a^{f1} clock offset	Long	4	H+116	2^{-39}
32	t_0	Applicable time of day	Ulong	4	H+120	16
33	iodp	Issue of PRN mask data	Ulong	4	H+124	-
34	corr spare	Spare value when velocity code is equal to 0	Ulong	4	H+128	-
35	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+132	-
36	[CR][LF]	Sentence terminator (ASCII only)	-	-	H+136	-

3.3.173 SBAS25 Long-Term Slow Satellite Corrections

SBAS25 provides error estimates for slow varying satellite ephemeris and clock errors with respect to WGS-84 ECEF coordinates.

Message ID: **984**
Log Type: **Asynch**

Recommended Input:

log SBAS25a onchanged

ASCII Example:

```
#SBAS25A,COM1,0,37.5,SATTIME,1337,417193.000,00000000,b8ff,1984;
134,1,19,25,-1,-3,0,-15,0,0,0,1,-1,-2,4465,2,0,1,0,0,0,0,0,0,0,
0,0,0,0,0,0,0*81685317
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS25 message can be logged to view the data breakdown of SBAS frame 25 which contains long-term slow satellite corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS25 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	1st half vel	Velocity code flag (0 or 1)	Ulong	4	H+4	-
4	1st half mask1	Index into PRN mask (Type 1)	Ulong	4	H+8	-
5	1st half iode1	Issue of ephemeris data	Ulong	4	H+12	-
6	1st half dx1	Delta x (ECEF)	Long	4	H+16	0.125
7	1st half dy1	Delta y (ECEF)	Long	4	H+20	0.125
8	1st half dz1	Delta z (ECEF)	Long	4	H+24	0.125
9	1st half a^{f0}	Delta a^{f0} clock offset	Long	4	H+28	2^{-31}
10	1st half mask2	Second index into PRN mask (Type 1) Dummy value when velocity code = 1	Ulong	4	H+32	-
11	1st half iode2	Second issue of ephemeris data Dummy value when velocity code = 1	Ulong	4	H+36	-
12	1st half ddx	Delta delta x (ECEF) when velocity code = 1 Delta x (dx) when velocity code = 0	Long	4	H+40	2^{-11}
13	1st half ddy	Delta delta y (ECEF) when velocity code = 1 Delta y (dy) when velocity code = 0	Long	4	H+44	2^{-11}
14	1st half ddz	Delta delta z (ECEF) when velocity code = 1 Delta z (dz) when velocity code = 0	Long	4	H+48	2^{-11}
15	1st half a^{f1}	Delta a^{f1} clock offset when velocity code = 1 Delta a^{f0} clock offset when velocity code = 0	Long	4	H+52	2^{-39}
16	1st half t_0	Applicable time of day Dummy value when velocity code = 0	Ulong	4	H+56	16
17	1st half iodp	Issue of PRN mask data	Ulong	4	H+60	-
18	1st half corr spare	Spare value when velocity code = 0 Dummy value when velocity code = 1	Ulong	4	H+64	-
19	2nd half vel	Velocity code flag (0 or 1)	Ulong	4	H+68	-
20	2nd half mask1	Index into PRN mask (Type 1)	Ulong	4	H+72	-
21	2nd half iode1	Issue of ephemeris data	Ulong	4	H+76	-
22	2nd half dx1	Delta x (ECEF)	Long	4	H+80	0.125

Continued on next page

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
23	2nd half dy1	Delta y (ECEF)	Long	4	H+84	0.125
24	2nd half dz1	Delta z (ECEF)	Long	4	H+88	0.125
25	2nd half a^{f0}	Delta a^{f0} clock offset	Long	4	H+92	2^{-31}
26	2nd half mask2	Second index into PRN mask (Type 1) Dummy value when velocity code = 1	Ulong	4	H+96	-
27	2nd half iode2	Second issue of ephemeris data Dummy value when velocity code = 1	Ulong	4	H+100	-
28	2nd half ddx	Delta delta x (ECEF) when velocity code = 1 Delta x (dx) when velocity code = 0	Long	4	H+104	2^{-11}
29	2nd half ddy	Delta delta y (ECEF) when velocity code = 1 Delta y (dy) when velocity code = 0	Long	4	H+108	2^{-11}
30	2nd half ddz	Delta delta z (ECEF) when velocity code = 1 Delta z (dz) when velocity code = 0	Long	4	H+112	2^{-11}
31	2nd half a^{f1}	Delta a^{f1} clock offset when velocity code = 1 Delta a^{f0} clock offset when velocity code = 0	Long	4	H+116	2^{-39}
32	2nd half t_0	Applicable time of day Dummy value when velocity code = 0	Ulong	4	H+120	16
33	2nd half iodp	Issue of PRN mask data	Ulong	4	H+124	-
34	2nd half corr spare	Spare value when velocity code = 0 Dummy value when velocity code = 1	Ulong	4	H+128	-
35	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+132	-
36	[CR][LF]	Sentence terminator (ASCII only)	-	-	H+136	-

3.3.174 SBAS26 Ionospheric Delay Corrections

SBAS26 provides vertical delays (relative to an L1 signal) and their accuracy at geographically defined IGPs identified by the BAND NUMBER and IGP number. Each message contains a band number and a block ID, which indicates the location of the IGPs in the respective band mask.

Message ID: 985
Log Type: Asynch

Recommended Input:

log SBAS26a onchanged

ASCII Example:

```
#SBAS26A,COM1,0,38.0,SATTIME,1337,417243.000,00000000,ec70,1984;
134,1,2,15,27,11,25,11,23,11,19,11,16,11,16,12,15,13,16,13,29,14,
30,13,27,11,27,11,24,11,19,11,16,12,2,0*3b6d6806
```

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS26 message can be logged to view the data breakdown of SBAS frame 26 which contains ionospheric delay corrections

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS26 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	band num	Band number	Ulong	4	H+4	-
4	block id	Block ID	Ulong	4	H+8	-
5	#pts	Number of grid points with information to follow	Ulong	4	H+12	-
6	igp_{vde}	IGP vertical delay estimates	Ulong	4	H+16	0.125
7	givei	Grid ionospheric vertical error indicator	Ulong	4	H+20	-
8...	Next #pts entry = H + 16 + (#pts x 8)					
variable	iodi	Issue of data - ionosphere	Ulong	4	H+16+ (#pts x 8)	
variable	spare	7 spare bits	Ulong	4	H+20+ (#pts x 8)	-
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+24+ (#pts x 8)	-
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.175 SBAS27 SBAS Service Message

SBAS27 messages apply only to the service provider transmitting the message. The number of service messages indicates the total number of unique SBAS27 messages for the current IODS. Each unique message for that IODS includes a sequential message number. The IODS is incremented in all messages, each time that any parameter in any SBAS27 message is changed.

Message ID: **986**

Log Type: **Asynch**

Recommended Input:

log SBAS27a onchanged.

Each raw SBAS frame gives data for a specific frame decoder number. The SBAS27 message can be logged to view the data breakdown of SBAS frame 27 which contains information about SBAS service messages.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS27 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	iods	Issue of slow corrections data	Ulong	4	H+4	-
4	#messages	Low-by-one count of messages	Ulong	4	H+8	-
5	message num	Low-by-one message number	Ulong	4	H+12	-
6	priority code	Priority code	Ulong	4	H+16	-
7	dudre inside	Delta user differential range error - inside	Ulong	4	H+20	-
8	dudre outside	Delta user differential range error -outside	Ulong	4	H+24	-
9...	#reg	Number of regions with information to follow	Ulong	4	H+28	-
variable	lat1	Coordinate 1 latitude	Long	4	H+32	-
variable	lon1	Coordinate 1 longitude	Long	4	H+36	-
variable	lat2	Coordinate 2 latitude	Long	4	H+40	-
variable	lon2	Coordinate 2 longitude	Long	4	H+44	-
variable	shape	Shape where: 0 = triangle 1 = square	Ulong	4	H+48	-
variable	Next #reg entry = H + 32 + (#reg x 20)					
variable	t_0	Time of applicability	Ulong	4	H+32+ (#reg x 20)	16
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+36+ (#reg x 20)	-
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.176 SBAS32 Fast Correction Slots 0-10

SBAS32 are fast corrections for slots 0-10 in the mask of SBAS1, see *page 626*.

Message ID: **988**
Log Type: **Asynch**

Recommended Input:

log SBAS32a onchanged

ASCII Example:

```
#SBAS32A,COM2,0,70.5,FINE,1295,153284.000,00000240,18e9,34461;209,0,0,
-8097,0,0,0,0,-947,0,-2128,0,2570,14,0,14,14,14,14,0,14,0,14,0*58778ae5
```

Table 116: Evaluation of UDREI

UDREI	UDRE metres
0	0.01
1	0.02
2	0.03
3	0.05
4	0.10
5	0.15
6	0.20
7	0.25
8	0.30
9	0.35
10	0.40
11	0.45
12	0.50
13	0.60
14	Not Monitored
15	Do Not Use

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS32 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodp	Issue of PRN mask data	Ulong	4	H+4	-
4	prc0	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 0-10)	Long	4	H+8	-
5	prc1		Long	4	H+12	-
6	prc2		Long	4	H+16	-
7	prc3		Long	4	H+20	-
8	prc4		Long	4	H+24	-
9	prc5		Long	4	H+28	-
10	prc6		Long	4	H+32	-
11	prc7		Long	4	H+36	-
12	prc8		Long	4	H+40	-
13	prc9		Long	4	H+44	-
14	prc10		Long	4	H+48	-
15	udre0	udre(i): User differential range error indicator for the prn in slot i (i = 0-10)	Ulong	4	H+52	See *Table 116, Evaluation of UDREI* on *page 657*
16	udre1		Ulong	4	H+56	
17	udre2		Ulong	4	H+60	
18	udre3		Ulong	4	H+64	
19	udre4		Ulong	4	H+68	
20	udre5		Ulong	4	H+72	
21	udre6		Ulong	4	H+76	
22	udre7		Ulong	4	H+80	
23	udre8		Ulong	4	H+84	
24	udre9		Ulong	4	H+88	
25	udre10		Ulong	4	H+92	
26	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+96	-
27	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.177 SBAS33 Fast Correction Slots 11-21

SBAS33 are fast corrections for slots 11-21.

Message ID: **989**

Log Type: **Asynch**

Recommended Input:

log SBAS33a onchanged

ASCII Example:

```
#SBAS33A,COM2,0,47.5,FINE,1295,158666.000,01000240,b23e,34461;209,0,0,
-3343,0,0,0,-533,0,0,0,0,0,14,0,14,14,14,0,14,14,14,14,14*6d890f5f
```

Each raw mask frame gives data for a specific frame decoder number. The SBAS33 message can be logged to view the data breakdown of SBAS frame 33 which contains information about correction slots 11-21

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS33 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodp	Issue of PRN mask data	Ulong	4	H+4	-
4	prc11	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 11-21)	Long	4	H+8	-
5	prc12		Long	4	H+12	-
6	prc13		Long	4	H+16	-
7	prc14		Long	4	H+20	-
8	prc15		Long	4	H+24	-
9	prc16		Long	4	H+28	-
10	prc17		Long	4	H+32	-
11	prc18		Long	4	H+36	-
12	prc19		Long	4	H+40	-
13	prc20		Long	4	H+44	-
14	prc21		Long	4	H+48	-
15	udre11	udre(i): User differential range error indicator for the prn in slot i (i = 11-21)	Ulong	4	H+52	See *Table 116, Evaluation of UDREI* on *page 657*
16	udre12		Ulong	4	H+56	
17	udre13		Ulong	4	H+60	
18	udre14		Ulong	4	H+64	
19	udre15		Ulong	4	H+68	
20	udre16		Ulong	4	H+72	
21	udre17		Ulong	4	H+76	
22	udre18		Ulong	4	H+80	
23	udre19		Ulong	4	H+84	
24	udre20		Ulong	4	H+88	
25	udre21		Ulong	4	H+92	
26	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+96	-
27	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.178 SBAS34 Fast Correction Slots 22-32

SBAS34 are fast corrections for slots 22-32 in the mask of SBAS1, see *page 626*.

Message ID: **990**
Log Type: **Asynch**

Recommended Input:

log SBAS34a onchanged

ASCII Example:

```
#SBAS34A,COM2,0,73.0,FINE,1295,226542.000,00000040,1be8,34461;209,0,5879,0,0,
0,0,2687,0,10922,10922,10922,10922,0,14,14,14,14,0,14,15,15,15,15*3aeb74be
```

Each raw mask frame gives data for a specific frame decoder number. The SBAS34 message can be logged to view the data breakdown of SBAS frame 34 which contains information about fast correction slots 22-32.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS34 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodp	Issue of PRN mask data	Ulong	4	H+4	-
4	prc22	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 22-32)	Long	4	H+8	-
5	prc23		Long	4	H+12	-
6	prc24		Long	4	H+16	-
7	prc25		Long	4	H+20	-
8	prc26		Long	4	H+24	-
9	prc27		Long	4	H+28	-
10	prc28		Long	4	H+32	-
11	prc29		Long	4	H+36	-
12	prc30		Long	4	H+40	-
13	prc31		Long	4	H+44	-
14	prc32		Long	4	H+48	-
15	udre22	udre(i): User differential range error indicator for the prn in slot i (i = 22-32)	Ulong	4	H+52	See *Table 116, Evaluation of UDREI* on *page 657*
16	udre23		Ulong	4	H+56	
17	udre24		Ulong	4	H+60	
18	udre25		Ulong	4	H+64	
19	udre26		Ulong	4	H+68	
20	udre27		Ulong	4	H+72	
21	udre28		Ulong	4	H+76	
22	udre29		Ulong	4	H+80	
23	udre30		Ulong	4	H+84	
24	udre31		Ulong	4	H+88	
25	udre32		Ulong	4	H+92	
26	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+96	-
27	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.179 SBAS35 Fast Correction Slots 33-43

SBAS35 are fast corrections for slots 33-43 in the mask of SBAS1, see *page 626*.

Message ID: **991**
Log Type: **Asynch**

Recommended Input:

log SBAS35a onchanged

ASCII Example:

Each raw mask frame gives data for a specific frame decoder number. The SBAS35 message can be logged to view the data breakdown of SBAS frame 35 which contains information about fast correction slots 33-43.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS35 header	Log header		H	0	
2	prn	Source PRN of message	Ulong	4	H	-
3	iodp	Issue of PRN mask data	Ulong	4	H+4	-
4	prc33	prc(i): Fast corrections (-2048 to +2047) for the prn in slot i (i = 33-43)	Long	4	H+8	-
5	prc34		Long	4	H+12	-
6	prc35		Long	4	H+16	-
7	prc36		Long	4	H+20	-
8	prc37		Long	4	H+24	-
9	prc38		Long	4	H+28	-
10	prc39		Long	4	H+32	-
11	prc40		Long	4	H+36	-
12	prc41		Long	4	H+40	-
13	prc42		Long	4	H+44	-
14	prc43		Long	4	H+48	-
15	udre33	udre(i): User differential range error indicator for the prn in slot i (i = 33-43)	Ulong	4	H+52	See *Table 116, Evaluation of UDREI* on *page 657*
16	udre34		Ulong	4	H+56	
17	udre35		Ulong	4	H+60	
18	udre36		Ulong	4	H+64	
19	udre37		Ulong	4	H+68	
20	udre38		Ulong	4	H+72	
21	udre39		Ulong	4	H+76	
22	udre40		Ulong	4	H+80	
23	udre41		Ulong	4	H+84	
24	udre42		Ulong	4	H+88	
25	udre43		Ulong	4	H+92	
26	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+96	-
27	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.180 SBAS45 Slow Corrections

Each SBAS45 message contains a 2-bit IODP indicating the associated PRN mask.

The time of applicability (T0) of the PRC is the start of the epoch of the WNT second that is coincident with the transmission at the satellite of the first bit of the message block.

Message ID: **993**
Log Type: **Asynch**

Recommended Input:

log SBAS45a onchanged

ASCII Example:

```
#SBAS45A,COM2,0,73.0,FINE,1295,228498.000,00000040,c730,34461;209,23,32,197,
-116,206,-1,-6,-3,-5546,3488,25,148,262,-312,867,4,3,0,2513,3488,0*02d6e0d5
```

Each raw mask frame gives data for a specific frame decoder number. The SBAS45 message can be logged to view the data breakdown of SBAS frame 45 which contains information about slow corrections.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset	Scaling
1	SBAS45 header	Log header		H	0	-
2	prn	Source PRN of message	Ulong	4	H	-
3	mask1	Index into PRN mask (Type 1)	Ulong	4	H+4	-
4	iode1	Issue of ephemeris data	Ulong	4	H+8	-
5	dx1	Delta x (ECEF)	Long	4	H+12	0.125
6	dy1	Delta y (ECEF)	Long	4	H+16	0.125
7	dz1	Delta z (ECEF)	Long	4	H+20	0.125
8	ddx	Delta delta x (ECEF)	Long	4	H+24	2^{-11}
9	ddy	Delta delta y (ECEF)	Long	4	H+28	2^{-11}
10	ddz	Delta delta z (ECEF)	Long	4	H+32	2^{-11}
11	$da^{f0}1$	Delta a^{f0} clock offset	Long	4	H+36	2^{-31}
12	$t_0 1$	Applicable time of day	Ulong	4	H+40	16
13	mask2	Second index into PRN mask (Type 1)	Ulong	4	H+44	-
14	iode2	Second issue of ephemeris data	Ulong	4	H+48	-
15	dx1	Delta x (ECEF)	Long	4	H+52	0.125
16	dy1	Delta y (ECEF)	Long	4	H+56	0.125
17	dz1	Delta z (ECEF)	Long	4	H+60	0.125
18	ddx	Delta delta x (ECEF)	Long	4	H+64	2^{-11}
19	ddy	Delta delta y (ECEF)	Long	4	H+68	2^{-11}
20	ddz	Delta delta z (ECEF)	Long	4	H+72	2^{-11}
21	$da^{f0}2$	Delta a^{f0} clock offset	Long	4	H+76	2^{-31}
22	$t_0 2$	Applicable time of day	Ulong	4	H+80	16
23	iodp	Issue of PRN mask data	Ulong	4	H+84	-
24	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+88	-
25	[CR][LF]	Sentence terminator (ASCII only)	-	-	-	-

3.3.181 SBASCORR SBAS Range Corrections Used

The information is updated with each pseudorange position calculation. It has an entry for each tracked satellite. Satellites that are not included in an SBAS corrected solution have 0.0 in both the correction and ‘corr stdv’ fields.

The correction is the combined fast and slow corrections and is to be added to the pseudorange. Ionospheric and tropospheric corrections are not included and should be applied separately.

Message ID: **998**
Log Type: **Synch**

Recommended Input:

log SBAScorra ontime 1

ASCII Example:

```
#SBASCORRA,COM1,0,40.5,FINESTEERING,1337,417485.000,01000000,3b3b,1984;
20,
3,101,0.0000,0.0000,3,0,0.0000,0.0000,
2,133,0.0000,0.0000,2,0,0.0000,0.0000,
23,48,0.0000,0.0000,23,0,0.0000,0.0000,
4,55,0.0000,0.0000,4,0,0.0000,0.0000,
16,197,0.0000,0.0000,16,0,0.0000,0.0000,
20,25,0.0000,0.0000,20,0,0.0000,0.0000,
27,26,0.0000,0.0000,27,0,0.0000,0.0000,
25,186,0.0000,0.0000,25,0,0.0000,0.0000,
13,85,0.0000,0.0000,13,0,0.0000,0.0000,
122,0,0.0000,0.0000,134,0,0.0000,0.0000*0af4c14d
```

The SBAS pseudorange corrections can be added to the raw pseudorange for a more accurate solution in applications that compute their own solutions.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	SBASCORR header	Log header		H	0
2	#sat	Number of satellites with information to follow	Ulong	4	H
3	prn	Satellite PRN	Ulong	4	H+4
4	iode	Issue of ephemeris data for which the corrections apply	Ulong	4	H+8
5	corr	SBAS pseudorange correction (m)	Float	4	H+12
6	corr stdv	Standard deviation of pseudorange correction (m)	Float	4	H+16
7...	Next sat entry = H+4 + (#sat x 16)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#sat x 16)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.182 SOFTLOADSTATUS Status of the soft load process

Message ID: 1235
Log Type: Asynch

Recommended Input:

log softloadstatusa once

ASCII Example:

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	SOFTLOADSTATUS Header	Log header	-	H	0
2	status	Status of the soft load process see the following table	Enum	4	H
	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	
	[CR][LF]	Sentence terminator (ASCII only)			

Value	Name	Description
1	NOT_STARTED	SoftLoad process has not begun
2	READY_FOR_SETUP	Softload process is ready to receive setup information in the form of SOFTLOADSETUP commands or SOFTLOADSREC commands with S0 records.
3	READY_FOR_DATA	Softload process is ready to receive data in the form of SOFTLOADDATA commands or SOFTLOADSREC commands with S3 records. Once all data has been sent, send the SOFTLOADCOMMIT command.
4	DATA_VERIFIED	SoftLoad data has passed CRC. This status occurs after a SOFTLOADCOMMIT command.
5	WRITING_FLASH	SoftLoad data is being writting to flash. This status occurs after a SOFTLOADCOMMIT command. During a firmware upload, the receiver may remain in this state for 45 seconds or longer.
6	WROTE_FLASH	SoftLoad data has been written to flash
7	WROTE_AUTHCODE	The embedded AuthCode was successfully written
8	COMPLETE	Softload process has completed. The next step is to send the RESET command to reset the receiver.

Continued on next page

Value	Name	Description
9	VERIFYING_DATA	SoftLoad is verifying the downloaded image
17	RESET_ERROR	Error reseting SoftLoad
18	BAD_SRECORD	A bad S Record was received
19	BAD_PLATFORM	This data cannot be loaded onto this platform.
20	BAD_MODULE	This module cannot be loaded with SoftLoad.
21	BAD_AUTHCODE	Bad AuthCode received for this PSN
22	NOT_READY_FOR_SETUP	A SOFTLOADSETUP command was entered before a SOFTLOADRESET or after a SOFTLOADDATA command
23	NO_MODULE	No data module was entered before a SOFTLOADDATA command was received
24	NO_PLATFORM	No platform was entered before a SOFTLOADDATA command was received
25	NOT_READY_FOR_DATA	A SOFTLOADDATA command was received, but the receiver was not ready for it.
26	MODULE_MISMATCH	The SoftLoad data module was changed in the middle of loading
27	OUT_OF_MEMORY	SoftLoad has run out of RAM to store the incoming data
28	DATA_OVERLAP	SoftLoad data has overlapped
29	BAD_IMAGE_CRC	CRC of the downloaded image has failed.
30	IMAGE_OVERSIZE	The downloaded image is too big for the intended data module.
31	AUTHCODE_WRITE_ERROR	An error occured when writting the embedded AuthCode to flash
32	BAD_FLASH_ERASE	Erasing of the flash failed.
33	BAD_FLASH_WRITE	Writing to the flash failed.

3.3.183 SOURCETABLE NTRIP Sourcetable Entries

This log outputs the NTRIP sourcetable entries from the NTRIPCASTER set by the NTRIPSOURCETABLE command.

Message ID: **1344**
Log Type: **Synch**

Recommended Input:

log sourcetablea once

ASCII Example:

#SOURCETABLEA,ICOM1,7,70.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","HTTP/1.1 200 OK;Ntrip-Version: Ntrip/2.0;Ntrip-Flags: st_filter,st_auth,st_match,st_strict,rtsp,plain_rtp;Server: NTRIP Caster/2.0.15;Date: Mon, 27 Jun 2011 17:47:23 GMT;Connection: close;Content-Type: gnss/sourcetable;Content-Length: 671"*6d385807

#SOURCETABLEA,ICOM1,6,70.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","CAS;hera.novatel.ca;80,2101;NovAtel;NovAtel;0;CAN;51;-115;http://www.novatel.com"*d5dcf61b

#SOURCETABLEA,ICOM1,5,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","NET;GREF;NovAtel;B;N;http://novatel.com;none;novatel.com;none"*e1abe7ef

#SOURCETABLEA,ICOM1,4,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","STR;novatel_rtcmv3;novatel rtcmv3;RTCM 3.0;1004(1),1006(1),1012(1),1033(1);2;GPS+GLO;NovAtel;CAN;51;-15;0;1;NovAtel OEM628;none;B;N;9600;Test"*59cd860f

#SOURCETABLEA,ICOM1,3,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","STR;novatel_rtcm;novatel rtcm;RTCM;1(1),3(10),31(1),32(10);2;GPS+GLO;NovAtel;CAN;51;-15;0;1;NovAtel OEM628;none;B;N;9600;Test"*3a8dc2ff

#SOURCETABLEA,ICOM1,2,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","STR;novatel_rtcaobs2;novatel rtcaobs2;RTCA; rtcaref(10), rtcaobs2(1);2;GPS+GLO;NovAtel;CAN;51;-15;0;1;NovAtel OEM628;none;B;N;9600;Test"*7078fa36

#SOURCETABLEA,ICOM1,1,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","STR;ipg;ipg test;unknown;unknown;2;unknown;NovAtel;CAN;51;-115;0;1;NovAtel OEM628;none;B;N;1200;Test"*e0f2cf39

#SOURCETABLEA,ICOM1,0,72.0,FINESTEERING,1642,150600.299,00000020,275d,6883;"198.161.64.11:80","ENDSOURCETABLE"*2c5015c9

Field #	Field Type	Data Description	Binary Format	Binary Bytes	Binary Offset
1	SOURCETABLE	Log header		H	0
2	endpoint	NTRIPCASTER Endpoint	String	80	H
3	Reserved1	reserved	ULONG	4	H+80
4	Reserved2	reserved	ULONG	4	H+84
5	Entry data 0	Source table entry data 0	String	512	H+88
6	Entry data 1	Source table entry data 1	String	512	H+88+512
	…				
N+5	Entry data N	Source table entry data N	String	512	N+88+512+*(N-1)
N+6	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+88+512*N
N+7	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.184 TIME Time Data

This log provides several time related pieces of information including receiver clock offset and UTC time and offset. It can also be used to determine any offset in the PPS signal relative to GPS reference time.

To find any offset in the PPS signal, log the TIME log 'ontime' at the same rate as the PPS output. For example, if the PPS output is configured to output at a rate of 0.5 seconds, see the PPSCONTROL command on *page 182*, log the TIME log 'ontime 0.5' as follows:

```
log time ontime 0.5
```

The TIME log offset field can then be used to determine any offset in PPS output relative to GPS reference time.

Message ID: **101**

Log Type: **Synch**

Recommended Input:

log timea ontime 1

ASCII Example:

```
#TIMEA,COM1,0,50.5,FINESTEERING,1337,410010.000,00000000,9924,1984;
VALID,1.953377165e-09,7.481712815e-08,-12.99999999492,2005,8,25,17,
53,17000,VALID*e2fc088c
```

1. Consider the case where you used the ADJUST1PPS command, see *page 56*, to synchronize two receivers in a primary/secondary relationship to a common external clock. You can use the TIME log after the clock model has stabilized at state 0, to monitor the time difference between the Primary and Secondary receivers.

2. The header of the TIME log gives you the GPS reference time (the week number since January 5th, 1980) and the seconds into that week. The TIME log outputs the UTC offset (offset of GPS reference time from UTC time) and the receiver clock offset from GPS reference time.

   If you want the UTC time in weeks and seconds, take the week number from the header. Then take the seconds into that week, also from the header, and add the correction to the seconds using the 2 offsets. Ensure you take care of going negative or rollover (going over the total number of seconds, 604800, in a week. In the case of rollover, add a week and the left over seconds become the seconds into this new week. If negative, subtract a week and the remainder from the seconds of that week.

   For example:

   TIME COM1 0 73.5 FINESTEERING 1432 235661.000 00000000 9924 2616

   `VALID` -0.000000351 0.000000214 -14.00000000106 2007 6 19 17 27 27000 `VALID`

   From the time information above:

   GPS reference time = 1432 (GPS reference week), 235661.000 (GPS seconds) from the header.

   From the UTC offset row in the TIME log description on *page 675*:

   UTC time = GPS reference time + offset + UTC offset

   UTC time

   = week 1432, 235661.000 s - 0.000000351 (offset) - 14.00000000106 (UTC offset)
   = week 1432, seconds 235646.99999964794

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	TIME header	Log header		H	0
2	clock status	Clock model status (not including current measurement data), see *Table 64* on *page 320*	Enum	4	H
3	offset	Receiver clock offset, in seconds from GPS reference time. A positive offset implies that the receiver clock is ahead of GPS reference time. To derive GPS reference time, use the following formula: GPS reference time = receiver time - offset	Double	8	H+4
4	offset std	Receiver clock offset standard deviation.	Double	8	H+12
5	utc offset	The offset of GPS reference time from UTC time, computed using almanac parameters. UTC time is GPS reference time plus the current UTC offset plus the receiver clock offset: UTC time = GPS reference time + offset + UTC offset	Double	8	H+20
6	utc year	UTC year	Ulong	4	H+28
7	utc month	UTC month (0-12) [a]	Uchar	1	H+32
8	utc day	UTC day (0-31) [a]	Uchar	1	H+33
9	utc hour	UTC hour (0-23)	Uchar	1	H+34
10	utc min	UTC minute (0-59)	Uchar	1	H+35
11	utc ms	UTC millisecond (0-60999) [b]	Ulong	4	H+36
12	utc status	UTC status 0 = Invalid 1 = Valid 2 = Warning[c]	Enum	4	H+40
13	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+44
14	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. If UTC time is unknown, the values for month and day are 0.

b. Maximum of 60999 when leap second is applied.

c. Indicates that the leap seconds value is used as a default due to the lack of an almanac.

3.3.185 TIMESYNC Synchronize Time Between GNSS receivers

The TIMESYNC log is used in conjunction with the ADJUST1PPS command, see *page 56*, to synchronize the time between GNSS receivers.

Refer also to the *Transfer Time Between Receivers* section in the *OEM6 Family Installation and Operation User Manual*.

Message ID: **492**
Log Type: **Synch**

Recommended Input:

log timesynca ontime 1

ASCII Example:

```
#TIMESYNCA,COM1,0,46.0,FINESTEERING,1337,410095.000,00000000,bd3f,1984;
1337,410095000,FINESTEERING*aa2025db
```

The time data embedded in this log represents the time of the most recent 1PPS signal. The receiver will issue this log from a communications port within 200 ms of the last 1PPS event. The 200 ms value is a "worst case scenario." See *Figure 1, 1PPS Alignment* on *page 57* for an illustration.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	TIMESYNC header	Log header		H	0
2	week	GPS reference week number	Ulong	4	H
3	ms	Number of milliseconds into the GPS reference week	Ulong	4	H+4
4	time status	GPS reference time Status, see *Table 8, GPS Reference Time Status* on *page 32*	Enum	4	H+8
5	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+12
6	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.186 TRACKSTAT Tracking Status

This log provides channel tracking status information for each of the receiver parallel channels.

If both the L1 and L2 signals are being tracked for a given PRN, two entries with the same PRN appear in the tracking status log. As shown in *Table 87, Channel Tracking Status* on *page 470* these entries can be differentiated by bit 20, which is set if there are multiple observables for a given PRN, and bits 21-22, which denote whether the observation is for L1 or L2. This is to aid in parsing the data.

Message ID: **83**
Log Type: **Synch**

Recommended Input:

log trackstata ontime 1

ASCII Example:

```
#TRACKSTATA,COM1,0,49.5,FINESTEERING,1337,410139.000,00000000,457c,1984;
SOL_COMPUTED,PSRDIFF,5.0,30,
1,0,18109c04,21836080.582,-2241.711,50.087,1158.652,0.722,GOOD,0.973,
1,0,11309c0b,21836083.168,-1746.788,42.616,1141.780,0.000,OBSL2,0.000,
30,0,18109c24,24248449.644,-2588.133,45.237,939.380,-0.493,GOOD,0.519,
30,0,11309c2b,24248452.842,-2016.730,38.934,939.370,0.000,OBSL2,0.000,
...
14,0,18109da4,24747286.206,-3236.906,46.650,1121.760,-0.609,GOOD,0.514,
14,0,11309dab,24747288.764,-2522.270,35.557,1116.380,0.000,OBSL2,0.000,
0,0,0c0221c0,0.000,0.000,0.047,0.000,0.000,NA,0.000,
0,0,0c0221e0,0.000,0.000,0.047,0.000,0.000,NA,0.000*255a732e
```

L-band and HP/XP requires the following minimum number of satellites for the following operations:

- single point = 4 GPS satellites
- RTK, including HP/XP = 5 GPS satellites

Extra satellites provide additional redundancy, which is good to have. Note that the default cut-off angle is 5 degrees, and single point positioning utilizes all available GPS satellites in the position solution.

RTK solutions, including HP/XP, only use GPS satellites that are above the RTK elevation angle, (usually 12.5 degrees). So, although there could be more than 5 GPS satellites in view, if there are not at least 5 GPS satellites above 12.5 degrees then an RTK solution may not be possible.

Table 117: Range Reject Code

Reject Code (binary)	Reject Code (ASCII)	Description
0	GOOD	Observation is good
1	BADHEALTH	Bad satellite health is indicated by ephemeris data
2	OLDEPHEMERIS	Old ephemeris due not being updated during the last 3 hours
3	ECCENTRICANOMALY	Eccentric anomaly error during computation of the satellite's position
4	TRUEANOMALY	True anomaly error during computation of the satellite's position
5	SATCOORDINATE-ERROR	Satellite coordinate error during computation of the satellite's position
6	ELEVATIONERROR	Elevation error due to the satellite being below the cut-off angle
7	MISCLOSURE	Misclosure too large due to excessive gap between estimated and actual positions
8	NODIFFCORR	No compatible differential correction is available for this particular satellite
9	NOEPHEMERIS	Ephemeris data for this satellite has not yet been received
10	INVALIDIODE	Invalid IODE (Issue Of Data Ephemeris) due to mismatch between differential stations
11	LOCKEDOUT	Locked out: satellite is excluded by the user (LOCKOUT command)
12	LOWPOWER	Low power: satellite is rejected due to low carrier/noise ratio
13	OBSL2	L2 observation is ignored and not used in the pseudorange solution
16	NOIONOCORR	No compatible ionospheric correction is available for this particular satellite
17	NOTUSED	Observation is ignored and not used in the solution
99	NA	No observation (a reject code is not applicable)
100	BAD_INTEGRITY	The integrity of the pseudorange is bad

Field #	Field Type	Data Description	Format	Binary Bytes	Binary Offset
1	TRACKSTAT header	Log header		H	0
2	sol status	Solution status (see *Table 56, Solution Status* on *page 302*)	Enum	4	H
3	pos type	Position type (see *Table 55, Position or Velocity Type* on *page 301*)	Enum	4	H+4
4	cutoff	Tracking elevation cut-off angle	Float	4	H+8
5	# chans	Number of hardware channels with information to follow	Long	4	H+12
6	PRN/slot	Satellite PRN number of range measurement (GPS: 1 to 32, SBAS: 120 to 138 and Galileo: 1 to 36. For GLONASS, see *Section 1.3* on *page 31*)	Short	2	H+16
7	glofreq	(GLONASS Frequency + 7), see *Section 1.3* on *page 31*	Short	2	H+18
8	ch-tr-status	Channel tracking status (see *Table 87, Channel Tracking Status* on *page 470*)	ULong	4	H+20
9	psr	Pseudorange (m) - if this field is zero but the channel tracking status in the previous field indicates that the card is phase locked and code locked, the pseudorange has not been calculated yet.	Double	8	H+24
10	Doppler	Doppler frequency (Hz)	Float	4	H+32
11	C/No	Carrier to noise density ratio (dB-Hz)	Float	4	H+36
12	locktime	Number of seconds of continuous tracking (no cycle slips)	Float	4	H+40
13	psr res	Pseudorange residual from pseudorange filter (m)	Float	4	H+44
14	reject	Range reject code from pseudorange filter (see *Table 117, Range Reject Code* on *page 678*)	Enum	4	H+48
15	psr weight	Pseudorange filter weighting	Float	4	H+52
16...	Next PRN offset = H + 16 + (#chans x 40)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+16+ (#chans x 40)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

3.3.187 VALIDMODELS Valid Model Information

This log gives a list of valid authorized models available and expiry date information.

If a model has no expiry date it reports the year, month and day fields as 0, 0 and 0 respectively.

Message ID: **206**
Log Type: **Polled**

Recommended Input:

log validmodelsa once

ASCII Example:

```
#VALIDMODELSA,COM1,0,92.0,FINESTEERING,1610,499139.682,00000000,342f,6293;1,"
D2LR0RCCR",0,0,0*d0580c1b
```

Use the VALIDMODELS log to output a list of available models for the receiver. You can use the AUTH command, see *page 78*, to add a model and the MODEL command, see *page 168*, to change the currently active model. See the VERSION log on *page 681* for the currently active model

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	VALIDMODELS header	Log header		H	0
2	#mod	Number of models with information to follow	Ulong	4	H
3	model	Model name	String [max. 16]	Variable[a]	Variable
4	expyear	Expiry year	Ulong	4	Variable Max:H+20
5	expmonth	Expiry month	Ulong	4	Variable Max: H+24
6	expday	Expiry day	Ulong	4	Variable: Max: H+28
7...	Next model offset = H + 4 + (#mods x variable [max:28])				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	Variable
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

a. In the binary log case, additional bytes of padding are added to maintain 4-byte alignment

3.3.188 VERSION Version Information

This log contains the version information for all components of a system. When using a standard receiver, there is only one component in the log.

A component may be hardware (for example, a receiver or data collector) or firmware in the form of applications or data (for example, data blocks for height models or user applications). See *Table 119, VERSION Log: Field Formats* on *page 682* for details on the format of key fields.

See also the VALIDMODELS log on *page 680*.

Message ID: **37**
Log Type: **Polled**

Recommended Input:

log versiona once

ASCII Example:

```
#VERSIONA,COM1,0,89.0,FINESTEERING,1610,504872.194,00000000,3681,6293;1,GPSCA
RD,"D2LR0RCCR","BFN10260022","OEM628-.00","OEM060000RN0000",
"OEM060000SB0002","2010/Nov/05","16:11:18"*
```

1. There is no need for an extra OmniSTAR Interface Board (I-Board) on L-band capable OEM6 receivers. If you have an OmniSTAR subscription and the receiver is tracking an OmniSTAR satellite, the OmniSTAR serial number can be found in the LBANDINFO log, see *page 400*.
2. The VERSION log is a useful log as a first communication with your receiver. Once connected, using Connect or HyperTerminal, log VERSION and check that the output makes sense. Also, ensure that you have the receiver components you expected.

Table 118: Component Types

Binary	ASCII	Description
0	UNKNOWN	Unknown component
1	GPSCARD	OEM6 family component
2	CONTROLLER	Data collector
3	ENCLOSURE	OEM card enclosure
4-7	Reserved OmniSTAR CAN[a] interface board	
981073920 (0x3A7A0000)	DB_HEIGHTMODEL	Height/track model data
981073921 (0x3A7A0001)	DB_USERAPP	User application firmware
981073925 (0x3A7A0005)	DB_USERAPPAUTO	Auto-starting user application firmware

a. Please refer to the Acronyms page on our website at http://www.novatel.com/support/knowledge-and-learning/.

Table 119: VERSION Log: Field Formats

Field Type	Field Format (ASCII)	Description
hw version	P-RS-CCC	P = hardware platform (for example, OEM628) R = hardware revision (for example, 6.00) S = processor revision (for example, A) [a] CCC = COM port configuration (for example, 22T) [b]
sw version, boot version		
comp date	YYYY/MM/DD	YYYY = year MM = month DD = day (1 - 31)
comp time	HH:MM:SS	HH = hour MM = minutes SS = seconds

a. This field may be empty if the revision is not stamped onto the processor

b. One character for each of the COM ports 1, 2, and 3. Characters are: 2 for RS-232, 4 for RS-422, T for LV-TTL, and X for user-selectable (valid for COM1 of certain products). Therefore, the example is for a receiver that uses RS-232 for COM 1 and COM 2 and LV-TTL for COM 3.

Field #	Field type	Data Description	Format	Binary Bytes	Binary Offset
1	VERSION header	Log header		H	0
2	# comp	Number of components (cards, and so on)	Long	4	H
3	type	Component type (see *Table 118, Component Types* on *page 682*)	Enum	4	H+4
4	model	This needs to be redone.	Char[16]	16	H+8
5	psn	Product serial number	Char[16]	16	H+24
6	hw version	Hardware version, see *Table 119, VERSION Log: Field Formats* on *page 682*	Char[16]	16	H+40
7	sw version	Firmware software version, see *Table 119*	Char[16]	16	H+56
8	boot version	Boot code version, see *Table 119*	Char[16]	16	H+72
9	comp date	Firmware compile date, see *Table 119*	Char[12]	12	H+88
10	comp time	Firmware compile time, see *Table 119*	Char[12]	12	H+100
11...	Next component offset = H + 4 + (#comp x 108)				
variable	xxxx	32-bit CRC (ASCII and Binary only)	Hex	4	H+4+ (#comp x 108)
variable	[CR][LF]	Sentence terminator (ASCII only)	-	-	-

Chapter 4 Response

The receiver is capable of outputting several responses for various conditions. Most responses are error messages to indicate when something is not correct.

The output format of the messages is dependent on the format of the input command. If the command is input as abbreviated ASCII, the output will be abbreviated ASCII. The same rule applies for both ASCII and binary formats.

Table 120: Response Messages

ASCII Message	Binary Message ID	Meaning
OK	1	Command was received correctly
REQUESTED LOG DOES NOT EXIST	2	The log requested does not exist
NOT ENOUGH RESOURCES IN SYSTEM	3	The request has exceeded a limit (for example, the maximum number of logs are being generated)
DATA PACKET DOESN'T VERIFY	4	Data packet is not verified
COMMAND FAILED ON RECEIVER	5	Command did not succeed in accomplishing requested task
INVALID MESSAGE ID	6	The input message ID is not valid
INVALID MESSAGE. FIELD = *X*	7	Field *x* of the input message is not correct
INVALID CHECKSUM	8	The checksum of the input message is not correct. Only applies to ASCII and binary format messages.
MESSAGE MISSING FIELD	9	A field is missing from the input message
ARRAY SIZE FOR FIELD *X* EXCEEDS MAX	10	Field *x* contains more array elements than allowed
PARAMETER *X* IS OUT OF RANGE	11	Field *x* of the input message is outside the acceptable limits
TRIGGER *X* NOT VALID FOR THIS LOG	14	Trigger type *x* is not valid for this type of log
AUTHCODE TABLE FULL - RELOAD SOFTWARE	15	Too many authcodes are stored in the receiver. The receiver firmware must be reloaded.
INVALID DATE FORMAT	16	This error is related to the inputting of authcodes. Indicates the date attached to the code is not valid.
INVALID AUTHCODE ENTERED	17	The authcode entered is not valid

Table 120: Response Messages

NO MATCHING MODEL TO REMOVE	18	The model requested for removal does not exist
NOT VALID AUTH CODE FOR THAT MODEL	19	The model attached to the authcode is not valid
CHANNEL IS INVALID	20	The selected channel is invalid
REQUESTED RATE IS INVALID	21	The requested rate is invalid
WORD HAS NO MASK FOR THIS TYPE	22	The word has no mask for this type of log
CHANNELS LOCKED DUE TO ERROR	23	Channels are locked due to error
INJECTED TIME INVALID	24	Injected time is invalid
COM PORT NOT SUPPORTED	25	The COM or USB port is not supported
MESSAGE IS INCORRECT	26	The message is invalid
INVALID PRN	27	The PRN is invalid
PRN NOT LOCKED OUT	28	The PRN is not locked out
PRN LOCKOUT LIST IS FULL	29	PRN lockout list is full
PRN ALREADY LOCKED OUT	30	The PRN is already locked out
MESSAGE TIMED OUT	31	Message timed out
UNKNOWN COM PORT REQUESTED	33	Unknown COM or USB port requested
HEX STRING NOT FORMATTED CORRECTLY	34	Hex string not formatted correctly
INVALID BAUD RATE	35	The baud rate is invalid
MESSAGE IS INVALID FOR THIS MODEL	36	Message is invalid for this model of receiver
COMMAND ONLY VALID IF IN NVM FAIL MODE	40	Command is only valid if NVM is in fail mode
INVALID OFFSET	41	The offset is invalid
MAXIMUM NUMBER OF USER MESSAGES REACHED	78	Maximum number of user messages has been reached
GPS PRECISE TIME IS ALREADY KNOWN	84	GPS precise time is already known

Index

1PPS, *see* one pulse per second
2-D 122, 373
3-D 122, 373, 448-449
50 Hz 682

A

abbreviated ascii 19, 23
accumulated doppler range (ADR) 468, 544
accuracy
  correction 120
  degradation 299
  limit 180
  navigation 516
  position 120
  RTK solution 264
  time 33
acquisition 67, 120, 243
ADJUST1PPS command 56
adjustable PPS 182
ADR, *see* accumulated doppler range
age
  differential
    RTK 264, 598, 601
    velocity 312, 314, 455, 457, 604
    xyz coordinates 314, 457, 604
  solution
    at mark input 414
    ECEF coordinates 314, 457, 604
    OmniSTAR HP/XP 430
    position 304, 451
    RTK 599
    UTM coordinates 309
agriculture 200, 429, 625
aircraft 110, 311, 601
ALIGNBSLNENU LOG 288
ALIGNBSLNXYZ log 290
almanac
  complete 620, 622
  data 217, 360
  GEO 647
  GLONASS 344, 346
  log 266, 269, 293
  lost 176
  raw data 478
  reset 130
  stored 131
  time status 32
ALMANAC log 293
along track 424, 426
ambiguity
  half cycle 468
  type 595
anomaly 294, 678
antenna
  active 65
  altitude 113, 132, 138, 363, 365, 367
  base station 80
  delay 88
  high altitude 207
  motion 69, 71, 194
  phase center 122, 534
  position 413
  receiver status 609
  reference point 534
  reference point (ARP) 552-553, 565
  rover station 63
  speed 426
  type 534
ANTENNAMODEL command 63
ANTENNAPOWER command 65
anti-spoofing (AS) 294
APPLICATION command 66
APPLICATIONSTATUS log 295
ascii
  display 519, 542
  message 21
  overview 21
  printable data 209
  redirect 434
  response 29
  send 209
  text message 226-227
  transfer 226
assign
  cancel 243

channel 67
cut-off angle 113, 132, 138, 207
ASSIGN command 66-67
ASSIGNALL command 70
ASSIGNLBAND command 73
ASSIGNLBAND2 command 76
asterisk 21
asynchronous log 260
atmospheric
delay 468
noise 114
refraction 113, 132, 138, 207
authorization 78-79
AUX port
break condition 91
identifier 26, 28
interface mode 150
pass-through log 281, 434
AVEPOS log 297
averaging, position 180, 297
azimuth 376, 620, 622

B

bandwidth 202
base station
aiding 217
antenna model 80
common to rover 436, 447
ephemeris 101
health 534, 549
height 531
ID 534, 549
log 269-270
moving 169
network RTK 196
observations 197
parameter 514
parameters 531
position 505-506
radio 601
satellite visibility 619, 621
send data 209, 601
standard corrections 497
status 489
unique messages 422
virtual 197
BASEANTENNAMODEL command 80
baseline
dual frequency 593
RTK 266, 271, 489
basline
heading 390
battery 330
bearing 163-164, 380, 424, 426
BESTPOS log 299
BESTUTM log 308
BESTVEL log 308
BESTXYZ log 313
bias 82
bi-directional communication 434
binary
overview 23
raw ephemeris 481
redirect 434
response 29
Bluetooth 241
bps 176
break 91, 150, 212, 446
bridge 178
broadcast
almanac 360
correction 516
observation data 544
BSLNXYZ log 316
buffer 158
Built-In Status Test (BIT) 609
Bursa-Wolf transformation 94
byte 21, 24, 30

C

C/No, *see* carrier to noise density ratio
cable
delay 88
external device 166, 413
integrity 130
null modem 58
serial 437
CAN
name fields 220
car 598
carrier phase ??-477
jump 82
RTK 326, 502, 504, 522, 544
carrier to noise density ratio (C/No) 89, 377, 409, 472-477, 679
caster 173

CDGPS
fast corrections 657-664
network 657
status 405
CDGPSTIMEOUT command 82
celestial pole 165
CHANCONFIGLIST log 318
channel 351
assign 67, 69
control 266, 268-269
range measurement 468
raw subframe data 483, 488
tracking 351
tracking status 470, 474, 677
unassign 243
chatter 437
checksum 21, 23
clock
adjust 82, 468
age 294
bias 82
calibrate 84
dither 116, 320
drift 82, 321
error 69, 71, 82, 320
external 58, 516
internal 33
model 320, 322
offset 113, 132, 138, 266, 416, 448-449
parameter 116
phase 56
precise 481
receiver 675
set 468
shift 56, 60
status 266, 320, 416
steer 82, 84
validity 320
CLOCKADJUST command 82
CLOCKCALIBRATE command 84
CLOCKMODEL log 316
CLOCKOFFSET command 88
CLOCKSTEERING log 323
CMR
analogous to RTCA 334, 337
bandwidth 339
base station 489
dgps type 186
interface mode 149
log 326
CMR messages 327, 332-333
CMR Type 2 328
CMRDATADESC log 329
CMRDATAGLOOBS log 331
CMRDATAOBS log 334
CMRDATAREF log 337
CMRPLUS log 339
CNOUPDATE command 89
Coast Guard 401, 450
COM command 90
COM port 159, 209, 445
COMCONFIG log 334
COMCONTROL command 91
command response messages 684
communication 544
compass 425
configuration
non-volatile memory 130
port 212
receiver 190, 262, 605, 609
reset 55, 190
RXCONFIG log 519, 542
save 204
status mask 238
Connect 681
constellation 322, 447
constraint 468
control
automatic 243
centre 454, 473
filtering 263
receiver 262
Control and Display Unit (CDU) 55, 159, 241
Convert4 397
coordinate geometry (COGO) 329
coordinated universal time (UTC)
log 263, 266, 388
offset 416
position 363, 365, 367, 375
status 675
copyright 2
correction
accuracy 120
bias 122
magnetic 164

magnitude of 165
mean motion 294
RTCA 149
RTK 197, 202
CPU 158, 445, 608
CRC, *see* cyclic redundancy check
cross track 311, 424, 426
CSMOOTH command 94
Customer Service 130, 168, 410
cut-off angle
command 114, 132
DOP 448
GLONASS 138
negative 207
range reject code 678
SBAS 207
cyclic redundancy check (CRC) 21, 23-24, 30, 35
Cyrillic characters 227

D

data link 209
datum 96-100
best position 304
command 122
current 223
customized 253
expanded 255
fix position 124
mark position 414
matched position 420
OmniSTAR HP 430
pseudorange position 451
RTK 599
transformation parameters 96-100
UTM 309
declination 165
default
factory 55, 94, 101, 190
delay, antenna 88
destination 223, 426
device, user point 166, 182, 415
de-weighting 447
DGPS command 101-103, 147, 375
DGPSTIMEOUT command 102, 203
DGPSTXID command 103
DIFFCODEBIASCONTROL command 104
DIFFCODEBIASES log 342
differential correction
accept 147
age 312, 314
DGPS 102
OmniSTAR HP/XP 430
position 299, 304, 414
pseudorange 450, 455
pseudorange position 457
RTK 264, 598-599, 602, 604
UTM 309
DGPS 401
error reduction 450
fix position 120, 122
method 184
none available 678
outage 200, 299, 450, 598, 601
positioning 101
satellite visibility 619, 621
send 180, 209
set 516
station 122, 184, 200, 269-270, 678
transmit RTCA 101
differential GPS (DGPS) 154
dilution of precision (DOP) 363-367, 596
NMEA 372
position averaging 298
pseudorange 447
volume 372
direction
accuracy 311
bearing 426
communication 197
over ground 454
referenced to True North 163
report 454
static position 311
tunnel 241
dispatcher 202
distance
exceeded 302
straight line 426
track offset 223
dither 320
DLLTIMECONST 105
DL-V3 241
DNSCONFIG command 109
DOP, *see* dilution of precision

Doppler 472
accumulated 468, 474-477, 502, 504, 544-545
assign 67, 69-70
instantaneous 456, 472, 477
jump 82
offsets 293
range record 474
satellite visibility 620, 622
tracking status 679
drift 82
dual frequency 300, 593
dynamic 110, 181, 194-195
dynamics 179
DYNAMICS command 110

E

earth-centered earth-fixed (ECEF) 313, 489, 514
earth-centred-earth-fixed (ECEF) 534
eccentricity 294, 385, 584
ECEF, *see* earth-centered earth-fixed
ECHO command 112
ECUTOFF command 113
EGNOS 205
EGNOS (European SBAS) 205
elevation 596
cut-off 113-114, 132, 207, 448
error 678
GLONASS 138
highest 202
satellite visibility 376, 620, 622
tracking status 679
ellipsoid 514
constants 95
customized 253
navigation 223
parameter 94, 96-100, 255
surface 223
undulation 245
e-mail 16
environmental parameter 607
ephemeris
change in 513
collect 217
decoded 266
delay 101, 496
GLONASS 350
health 678
log 267
raw data 266, 481, 500
RTK 499
time status 32-33
error
averaged position 180
clock 82, 116, 320
extrapolation 419, 422
fatal 617
flag 609
framing 445
in fixed coordinates 122
messages 609
multipath 468
non-volatile memory 176
parity 445-446
range reject code 678
response message 684
statistics 298, 374
status 238
text description 618
tracking 468
escape, tunnel 241-242
ETHCONFIG 115
Ethernet
configuration 115, 145
ETHSTATUS LOG 343
event
fatal 617
message 238, 609, 618
text description 618
type 618
expiry date 680
external
oscillator 116
reference frequency 56
EXTERNALCLOCK command 116
extrapolation error 419, 422

F

factory default
datum 94
ephemeris delay 101
modify 204
reset 55, 190
setting 55, 212
fallback to SBAS 200

field type 19
field upgrade 78
filter 178-179, 440, 596
  pseudorange 679
  RTK 193
  solution log 263
  update 603
fine time 33
fix
  command 120
  data 362, 364, 366
  position 368
  save setting 204
  solution 193
FIX command 120
FIXPOSDATUM command 124
flag
  antenna 65
  error 609
  parity 468
  status 450, 609
flattening 256
fleet 202
flight controls 601
float solution 193
foliage 485
FORCEGLOL2CODE command 125
FORCEGPSL2CODE command 126
format 21, 23, 35, 38, 427
frame decoder number, WAAS 626
framing error 445
frequency 127, 494
FREQUENCYOUT command 127
FRESET command 130

G

GALECOUTOFF command 132
Galileo 132
  tracking 132
Galileo and RTCM Version 3.0 565, 567
gaps 178
GENERATEDIFFCORRECTIONS command 134
GENERATERTKCORRECTIONS command 135
generic data formats 149, 397
geodetic datum, *see* datum
geoid 245, 297
geometric bias 298
GGAQUALITY command 136
GLMLA log 344
GLOALMANAC 346
GLOALMANAC log 344
GLOCLOCK log 348
GLOCSMOOTH command 138
GLODECODEKSAT command 138
GLOECUTOFF command 138
GLOEPHEMERIS log 350
GLONASS 327
  almanac 344, 346
  base station 541
  elevation cut-off 138
  logs 344-359
  OmniStar 177
  RTCM 227, 530, 539, 541, 546
  RTCM V3 529, 565-568
  SBAS 645-646
GLORAWALM log 354
GLORAWEPHEM log 356
GLORAWFRAME log 358
GLORAWSTRING log 359
GPALM log 360
GPGGA log 364
GPGGALONG log 364
GPGGARTK log 362
GPGLL log 368
GPGRS log 370
GPGSA log 372
GPGST log 374
GPGSV log 376
GPHDT log 378
GPRMB log 379
GPRMC log 381
GPRMCDATA log 383, 400
GPS overview 33-34
GPSEPHEM log 383
GPVTG log 387
GPZDA log 388
graphical display 425
great circle line 223-224, 426

H

handshaking 91
hardware
  parameter 607
  reset 190

version 262, 683
HDOP, *see* dilution of precision
HDTOUTTHRESHOLD command 139
header
ascii 21-22, 29
binary 19
convention 18
log 468
Heading
offset value 140
heading
and velocity 265, 311
information 389, 391
magnetic variation 164
NMEA 139, 378
HEADING log 389
HEADING2 log 391
HEADINGOFFSET 140
HEADINGSATS log 393
health
almanac 361
base station 270, 284, 489
satellite 294, 620, 622, 678
status 385
height 534
approximate 216
base antenna 531
calculate 122, 245
fix 120, 122
limit 302
position 304, 451
mark 414
match 420
OmniSTAR HP/XP 143, 430
RTK 599
Helmert transformation 94
hexadecimal 18, 20-21, 24, 30, 211, 239
hibernate mode, PC 159
hiking 311
hold 158, 161-162, 411-412
horizon 114, 132, 138, 207
Horizontal Alert Limit (HAL) 188
hot position 499
HP/XP seed 142, 144
HP/XP, OmniSTAR 429, 677
expiration date 402
position or velocity type 301
status 407, 409
tracking state 405
HPSEED command 141
HPSTATICINIT command 144
http
//www.novatel.com/support/knowledge-and-learning/ 505, 509, 514
HWMONITOR 394
hydrographic survey 170

I

ICOMCONFIG 145
identifier
ascii message 21
serial port 26, 134-135, 151, 446
iMAX mode 197
inclination angle 294
instantaneous Doppler 456
integer ambiguities 522
interface 151
INTERFACEMODE command 147-148
interferometric techniques 522
interrupt 446
IONOCONDITION command 152
ionosphere 106, 152, 197
carrier smoothing 106
delay 655
grid points 649
log 397
positive integers 623
remove 517
IONUTC log 397
IP addresses 109
IPCONFIG command 153
IPSTATUS 399
island 255

K

kinematic 196, 531
known site 196
Kp 349

L

L1-only observables 554
laptop 159, 436, 469
latched time 413
latency

data link 419, 422
position 264, 299, 603
reduction 516
velocity 314, 457, 603-604
latitude/longitude
approximate 216
fix data 363, 365, 367
GPS specific 382
position 304, 451
mark 414
match 420
NMEA 368
OmniSTAR HP/XP 143, 430
RTK 599
set navigation waypoint 224
LB2_0E_MEASUREMENTDOPMMPHR log 400
L-band 184, 400, 404
assign 73, 76
LBANDINFO log 400
LBANDSTAT log 404
LBANDTRACKSTAT log 410
Leap seconds 349
LED 617
library, OmniSTAR 511
link 209, 445
local horizon 113, 132, 138
localized wide area corrections 154
LOCALIZEDCORRECTIONDATUM command 154
lock
command 156-157
out 447, 678
reinstate 247, 249
time 679
LOCKOUT command 156
LOCKOUTSYSTEM command 157
locktime
current 472, 477
L-band 409
reset to zero 105
RTK 557, 559, 561, 575, 577, 579, 581
log
list 410
response messages 684
RTCA 494
RTCM 494, 509-510
trigger 260
type 260
LOG command 158
LOGLIST log 410
loss of lock 217
low noise amplifier (LNA) 65, 608
LSB 21

M

machine guidance 429
magnetic variation 163-164, 382, 426
MAGVAR command 163
map 170, 257, 649
mark
event 60, 167, 264
input pulse 413, 415
MARKCONTROL command 166
MARKPOS log 413
MARKTIME log 415
mask
event 609
priority 615
SBAS PRN 626
MASTERPOS log 417
matched update 592
MATCHEDPOS log 417, 419, 492
MATCHEDSATS 421
MATCHEDXYZ log 422
matrix 320
mean sea level
fix 122, 363, 365, 367
position 304, 309, 451
mark 414
match 420
OmniSTAR HP/XP 143, 430
RTK 599
memory 330
buffer space 158
non-volatile
erase 55, 130
restore 176
save
almanac 293
configuration 204
meridian, UTM 257
message
almanac 293
ascii 21

base station 489
format 19, 23, 35
ID 411-412
length 226-227
navigation 223
response 29, 684
send 209
time stamp 34
trigger 160-161
mode
2-D 373
3-D 373
dynamic 194
interface 148, 151
operating 372
RTK 299
static 194
model
active 680
authorization 78-79, 168
card 168
clock 320, 322, 416
expiry date 262, 680
ionospheric 397
log 263
lost 176
switch 168
valid 680
version 680
MODEL command 168
modem 434
month 675, 682
monument height 531
MOPS 188
motion
detector 194
island 255
mean 294, 386
Mountpoint 173
moving base stations 170
MOVINGBASESTATION command 169
MRTCA 150
MSAS (Japanese SBAS) 205
MSB 21
multipath
carrier smoothing 105
example 106, 450
indicator 524, 528
NMEA 372
RTK 526, 530

N

National Topographic Series (NTS) 257
NAVIGATE log 424
navigation
accuracy 516
data 372, 381
information 378-379
log 424-425
magnetic compass 163
path 223
satellite system 494
standard 509
status 380, 426
waypoint 223, 265
word 484
network RTK 196, 537
NGS, *see* US National Geodetic Survey
NMEA
fix data 367
generic format 149
log list 427
position 369
pseudorange measurement noise statistics 374
satellite range residuals 370-371
satellite type 171
standards 362
NMEA log 427
NMEATALKER command 171
node 361
noise
oscillator 116
statistic 374
thermal 468
time of 322
non-printable character 211
non-volatile memory (NVM) 55
automatic 478
reset 130
restore 176
save
almanac 293
configuration 204
north pole 165
note

antenna motion 194
authorization code 78
clock adjustment 82
differential correction 101-102
elevation cut-off angle 113, 132
ephemeris delay 101
factory default 176
logging 158
navigation 424
range residual 370
reset 130
satellite 447
status 617
WGS84 297
NovAtel Inc. 2
NTRIP
configuration status 399
NTRIPCONFIG command 173
NTRIPSOURCETABLE LOG 429
NTS, *see* National Topographic Series
NVMRESTORE 176
NVMRESTORE command 176

O

observation
base station 330
observations 593
ocean 170
offset
clock 416
Doppler 67
ECUTOFF effect 113, 132, 138
oscillator clock 116
receiver clock 448, 597, 675
track 223, 426
OMNIHPPOS log 429
OMNIHPSATS log 431
OmniSTAR 147, 154, 400, 511, 548
OmniSTAR subscription 487
OMNIUSEGLONASS command 177
OMNIVIS log 432
one pulse per second (1PPS)
adjust 56
control 182
delay 88
frequency 127
obtain 57
offset 82
time 82, 676
on-foot 311, 425
operating mode 372
optionality 18
orbit 481
origin 223
oscillator
clock drift 82, 321
error 320
external 116, 323
outages 178
output pulse 127
overload 158

P

parity
errors 445
flag 468
port 327, 446
receive 484
removed 481, 483
RTCM word 510
PASSAUX log 434
PASSCOMx logs 434
pass-through log 434, 436, 438
PASSUSBx logs 434
PC 159
PC or laptop 159, 436, 469
PDOP, *see* dilution of precision
PDPFILTER command 178
PDPMODE command 179
PDPPOS log 439-440
PDPSATS 441
PDPVEL log 442
PDPXYZ log 443-444
perigee 294
period 158, 160, 162, 411-412
perpendicular distance 223, 426
persistence, UTM 257
phase lock loop (PLL) 469-470, 610
Pitch 140
offset value 140
PLL, *see* phase lock loop
polled log 260
Port
echo command 112
port
ascii header 22

communication 23, 496
configuration 134-135, 204, 212
identifier 27
interrupt 446
log request 159
output 160-161, 411-412
parameters 241
pass-through 434
RS232 91
RTCM 512
send data 209
serial 134-135, 147, 149, 151, 445
status 445, 617
unlog 252
PORTSTATS log 445
POSAVE command 180
position 440
3-D 448-449
accuracy 120
approximate 217, 293, 505
at time of mark 414
averaging 180, 297
base station 270, 284, 489, 506
best 299, 308, 313, 592
calculation 181
current 424, 426
datum 94
fix 122
four unknowns 298, 447, 469
hot 499
log 263, 265
matched 419, 422
precision 366, 501, 504
pseudorange 270, 450
solution 113, 132, 138, 447
static 311
time out 181
type 414
xyz coordinates 314, 423, 456-457, 604
POSTIMEOUT command 181
post-process
application example 473, 598
carrier smoothing 106
elevation angle 114
ephemeris data 481
generic software 149
Waypoint, a NovAtel Precise Positioning Company 473
power 65, 678
PPSCONTROL command 182
prerequisite 18
pressure 182
PRN 205
Probability of False Alert (Pfa) 188
Probability of Falso Alert (Pfa) 188
processing 22, 25, 266, 468
proprietary information 544
Pseudorange
least squares DOP 449
pseudorange 667
correction 122, 512, 516
error estimate 468
jump 82, 468
measurement 374, 472, 474, 477, 522
noise statistic 374
position 265, 270
raw 667
solution 122, 299
tracking status 679
velocity 270, 454
Pseudorange Differential 205
pseudorange/delta-phase (PDP) 178-179, 440, 442
PSRDIFFSOURCE command 184
PSRDOP log 447
PSRDOP2 449
PSRPOS log 450
PSRSATS log 452
PSRTIME log 453
PSRVEL log 454
PSRVELOCITYTYPE command 188
PSRXYZ log 456
pulse 127, 413, 415

Q

quality
NMEA 136, 367, 374
quotation mark 21, 209, 226-227
QZSSALMANAC log 458
QZSSECUTOFF command 187, 460
QZSSIONUTC log 463
QZSSRAWALMANAC log 464
QZSSRAWEPHEM log 464-465

R
radio 202, 339, 450, 598, 601
RAIM
  Horizontal Alert Limit (HAL) 188
  Integrity Status 467
  PL Status 467
  Vertical Alert Limit (VAL) 188
RAIM command 188
RAIMSTATUS 466
range
  bias 33, 322
  compressed 475
  corrections 469
  measurement 82, 468, 476
  reject code 679
  residual 370
RANGE log 468
RANGECMP log 473-474
RANGEGPSL1 log 476
rate of right ascension 294
raw almanac 360
RAWALM log 476, 478
RAWCNAVFRAME log 480
RAWEPHEM log 481
RAWGPSSUBFRAME log 483
RAWGPSWORD log 484
RAWLBANDFRAME log 485
RAWLBANDPACKET log 487
RAWWAASFRAME log 488
reacquisition 67, 70
receiver
  character 446
  clock offset 298
  components 681
  dual frequency 300
  errors 609
  independent exchange (RINEX) 397
  interface 147
  set up 606
  status 158, 609-611
  time 60
recent satellite information 181
reference station, *see* base station
REFSTATION log 489
REFSTATIONINFO log 491
reinstate satellite 247, 249
relative pseudorange/delta phase 179
remote station, *see* rover station
reset 241
  after error 617
  average positions after 180
  complete 193
  hardware 130, 190
RESET command 190
residual 370, 595, 679
resolution 193
response 29, 147, 151, 684
RF delay 88
RINEX, *see* receiver independent exchange
root mean square (RMS) 375
route 425
rover station
  antenna model 63
  carrier phase ambiguity resolution 501, 504
  common to base 447
  data age 102, 203
  data from base 514
  faster data update to 516
  format messages 509
  satellite visibility 619, 621
  to base scenario 436
ROVERPOS 264
RS-422 92
RTCA
  age 102, 496
  base station 503
  base station type 489
  DGPS type 186
  ephemeris delay 101
  interface mode 147, 149
  log list 494
  station ID 505
RTCADATA1 log 496
RTCADATA2OBS log 503
RTCADATAEPHEM log 499
RTCADATAOBS log 501, 503
RTCADATAREF log 505
RTCM
  and L-band 511
  base station 489, 514
  DGPS type 186
  ephemeris delay 101
  example 510
  header 529

interface mode 149
log list 507
measurement corrections 527
messages 534, 548-549
multipath indicator 524, 528
P Code 526
proprietary message 544
quality indicator 523
RTCA comparison 494
RTCM 2.2 229
RTCM 2.3 229-230
RTCMDATA log 513
RTCMDATA1 log 512
RTCMDATA1001 log 554
RTCMDATA1002 log 558
RTCMDATA1003 log 560
RTCMDATA1004 log 562
RTCMDATA1005 log 565
RTCMDATA1006 log 567
RTCMDATA1009 log 573
RTCMDATA1010 log 576
RTCMDATA1011 log 578
RTCMDATA1012 log 580
RTCMDATA1019 log 583
RTCMDATA1020 log 586
RTCMDATA1033 591
RTCMDATA15 log 517
RTCMDATA16 log 519
RTCMDATA1819 log 521
RTCMDATA2021 log 527
RTCMDATA22 log 531
RTCMDATA22GG log 533
RTCMDATA23 log 535
RTCMDATA24 log 537
RTCMDATA3 log 514
RTCMDATA31 log 539
RTCMDATA32 log 541
RTCMDATA36 log 542
RTCMDATA59 log 544
RTCMDATA59GLO log 546
RTCMDATA9 log 516
RTCMDATACDGPS9 log 547
RTCMDATAOMNI1 log 548
RTCMV3
antenna setup 569, 571
base station 489-586
DGPS type 186
ephemeris 583, 586
example input 552
GLONASS 573, 576, 578, 580
interface mode 150
locktime 555
RTK
baseline 266
correction 202
data 271, 592
DOP 596
dynamic mode 194
elevation mask 195
filter 193
low latency position 264, 271, 598
mode 299, 603
network 196
position 264, 299, 419, 422, 598
satellite count 266
solution 592
transfer 326
velocity 601
RTK corrections 135
RTKANTENNA command 191
RTKCOMMAND command 193
RTKDOP log 596
RTKDYNAMICS command 193-194
RTKELEVMASK command 195
RTKNETWORK command 195-196
RTKPOS log 598
RTKQUALITYLEVEL command 199
RTKSOURCE command 200
RTKSVENTRIES command 202
RTKTIMEOUT command 203
RTKVEL log 601
RTKXYZ log 603
Russian characters 227
RXCONFIG log 605
RXHWLEVELS log 607
RXSTATUS log 607
RXSTATUSEVENT log 617

S

SATCUTOFF command 204
satellite
acquisition 67, 217, 293
active 372
almanac 293
availability 122, 376
clock dither 116

common 592
count 266, 271
coverage 178
DGNSS 494
elevation 113, 132, 207, 293
error 678
geometry 447
GLONASS 138
group 447
ID 512, 516
in view 376
lock 156-157, 447
low 106, 114
motion 456
number of 448, 475, 596
range 370
raw 478, 480-481, 483-484
recent 181
record, number of 501
redundancy 677
reinstate 248
RTK 202, 592, 596
SBAS 207
tracking 266, 268-269, 468
unassign 243
unlock 247, 249
visibility 217, 268, 619, 621
SATVIS log 619
SATXYZ log 623
SAVECONFIG command 204
SBAS
control 205
degradation factor 641
differential 184
fallback 200
fast correction slots 627
integrity message 636-638
mixed fast/slow corrections 650
PRN 69, 71
range corrections used 667
raw frame data 488
service message 656
system type 206
SBAS0 log 625
SBAS1 log 626
SBAS10 log 644
SBAS12 log 646
SBAS17 log 647
SBAS18 log 649
SBAS2 log 627
SBAS24 log 650
SBAS25 log 652
SBAS26 log 655
SBAS27 log 656
SBAS3 log 630
SBAS32 log 657
SBAS33 log 659
SBAS34 log 661
SBAS35 log 663
SBAS4 log 632
SBAS45 log 665
SBAS5 log 634
SBAS6 log 636
SBAS7 log 639
SBAS9 log 642
SBASCONTROL 205
SBASCONTROL command 209
SBASCORR log 667
SBASECUTOFF command 207
scaling
almanac 293
factor 474
scope 17
SELECTCHANCONFIG command 208
self-test 158
semi-major axis 256, 294
send 209, 211
SEND command 209
SENDHEX command 211
serial port 134-135, 149, 151, 446
SETAPPROXPOS command 216
SETAPPROXTIME command 217
SETBESTPOSCRITERIA command 219
SETCANNAME 220
SETCANNAME command 220
SETDIFFCODEBIASES command 221
SETIONOTYPE command 222
SETNAV command 216, 223
SETRTCM16 225
SETRTCM36 command 227
SETRTCMRXVERSION command 229
SETTIMEBASE command 231
setting, command 38
SETUTCLEAPSECONDS command 232
shipping lanes 170
Sift load

configure the process 236
signal
1PPS 182
control 93
DC 129
elevation cut-off 113, 132, 138
error 106, 184
external 56
mark 167
oscillator 58
path 88, 114
period 129
search 120
structure 485
timing 91
sky 619, 621
smooth 178
smoothing
carrier phase 105-106
indicator 556
interval 523, 526, 555
pseudorange 521
Soft load
commit 233
configure 237
restart 235
upload data 232, 234
SOFTLOADCOMMIT command 233
SOFTLOADDATA command 234
SOFTLOADRESET command 235
SOFTLOADSETUP command 236
SOFTLOADSREC command 237
SOFTLOADSTATUS 669
software version 262
solar cars 111
solution
status 414
type 136
speed
current 426
data 264, 381
over ground 312, 382, 387, 455, 602
standard positioning service (SPS) 293
standby mode, PC 159
static mode 144, 179, 194, 330, 422
station ID 103, 489, 509
stationary 144
statistics 298, 374, 401
status
arrival 380
base station health 489
channel tracking 470, 472, 474, 477, 677
clock model 416
COM port 445
data 368
event 617
flag 450, 609
indicator 299, 310, 313, 456, 603
mask 238
receiver 22, 158, 262, 609-611
self-test 262
solution 414
time 22
trigger 609
velocity 313, 601
word 618
STATUSCONFIG 233
STATUSCONFIG command 229-230
steer
clock 82, 84
time 32-33, 82
subframe 268, 293, 478-479, 481
support 16
survey
base station 180
control ship 170
datum 124, 253, 255
grade receivers 149
HP/XP seed 142
hydrographic 170
navigate 223
WAAS 625
synchronize 56, 58, 674
synchronous log 260

T

tag external event 438
Technical Specifications 413, 415
temperature 182
text, transfer 226
throughput 554
time
1PPS 57, 676
acquisition 120
almanac reference 479

anomaly 294
approximate 293, 505
clock adjustment 82
coarse/fine 32
CPU 158
delay 101
difference 58, 674
dilution of precision 448
embedded 676
ephemeris 101, 481
event 415
fine 33
GPS 320, 438, 675
interval 160-161
latched 413
limit 180
log 266
matched position 270, 422
observation 593
occupation 619, 621
of mark in event 416
of position fix 368
out 102, 203
precision 32
receiver clock offset 298
stamp 34, 422
status 22, 32-33
steering 32, 82
tag 435, 489, 603
to first fix (TTFF) 217, 293, 499, 505
transfer 56
UTC 363, 365, 367, 388
validity 32
TIME log 623
TIMESYNC log 676
track
made good 381, 387
over ground 312, 455, 602
tracking
assign 67
automatic 244
channel 468, 677
continuous 409, 472, 477, 679
cut-off angle 113, 132
disabled 617
fix position 122
GLONASS 138
loop 468
satellite 266, 268-269, 447
status 677
undesirable 156-157
TRACKSTAT log 677
transfer
ASCII text 226
RTK 326
time 56
transformation parameter 94
transit 202
transmit 147, 446
travel 469
trigger
error 609
event message 238
log 158, 260, 411-412, 419-420
option 159
troposphere 623
true north
direction of motion 312, 455
magnetic variation 163-164
pseudorange error orientation 375
to waypoint 426
track over ground 602
TTFF, *see* time to first fix
tunnel escape sequence 241-242
tunnel, serial port 150
TUNNELESCAPE 241
TUNNELESCAPE command 238
type, field 19

U

UNASSIGN command 243
UNASSIGNALL command 243-244
undulation
best position 304, 309, 430
command 245
illustration 245
position 297, 414, 420, 451, 599
type 143
UNDULATION command 245
United States Geological Survey (USGS) 165, 257
universal time coordinated (UTC) 327
unknown network 198
UNLOCKOUT command 247
UNLOCKOUTALL command 247-249
UNLOCKOUTSYSTEM command 249

UNLOG command 250
UNLOGALL command 252
upgrade 78, 168
US National Geodetic Survey (NGS) 481
user point device 166, 182, 415
USERDATUM command 253
USEREXPDATUM command 255
USGS, *see* United States Geological Survey
UTM coordinates 308
UTMZONE 257
UTMZONE command 257

V

validity
  base station 489, 603
  clock model 320
  receiver model 680-681
  time tag 603
VALIDMODELS log 680
VBS, OmniSTAR
  HP/XP 142
  position or velocity type 301
  subscription 402
VCTCXO, *see* oscillator
VDOP, *see* dilution of precision
vehicle 598
  application example 170, 202, 311, 473
  dynamics 110
  moving base station 170
  velocity 311
velocity 442
  accuracy 311
  average 603
  best 310, 313
  closing 380
  island 255
  latency 603-604
  limit 302
  log 265
  offset 255
  pseudorange 270
  report 454
  RTK 601
  vector 311
  via radio 598
  xyz coordinates 256, 314, 456-457, 604
version 2, 78, 262, 681
VERSION log 681
Vertical Alert Limit (VAL) 188
video camera device 166
virtual address 22
virtual base station (VBS) 197, 511
visibility, satellite 268, 619, 621
voltage 608
VRS (Virtual Reference Station) 197

W

WAAS 205
WAAS (North American SBAS) 205
WAASTIMEOUT 259
warning 78, 410, 605
warranty 17
waypoint
  destination 379, 426
  navigation 223, 265, 424-425
  setting 223
  track offset 223-224
Waypoint Products Group 473, 598
Web site 16
week
  decoding 34
  future 398
  GPS 385, 426
  reference 482
weighting, pseudorange filter 679
WGS84
  base station 514
  default datum 94, 253
  differential corrections 122, 313
  waypoint navigation 223
word
  error 176
  raw ephemeris 481
  status 609, 618
  week number 361

X

xyz coordinates 313, 456, 489

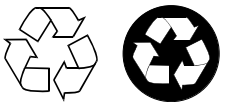
Y

year 675, 682

Z

Z count 327, 534, 549
zone number, UTM 257

Recyclable



Printed in Canada on recycled paper