applied satellite
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User Manual

Osprey T.M.C. / Bay

Version 1.1 October 2014

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Contacts

For additional information about this Product warranty,
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Introduction

Overview

The T.M.C. uses the Iridium Satellite Communications network to remotely provide GPS and sensor tracking data to users. In addition to GPS and internal accelerometer, the T.M.C. is capable of monitoring up to two digital input signals and one analog input signal. It can also be used to control various external device with either of the two digital outputs.

The T.M.C. contains a built-in rechargeable battery (optional).

Because the T.M.C. uses the Short Burst Data (SBD) protocol over the Iridium Constellation, the device will work anywhere on earth and provides exceptionally low latency times of less than 30 seconds.

The T.M.C. can be configured and controlled remotely over the satellite network for all values and settings.

Life Cycle

The life cycle of the T.M.C. is as follows:

A) Define the T.M.C. Feature Implementation

The T.M.C. is a highly versatile device that can provide GPS and sensor based tracking reports (including position, heading, speed, sensor inputs, and diagnostic information) at configured intervals, up to four pre-assigned times each day, and/or upon a sensor defined event. (See Section: Tracking, Monitor, Control features)

B) Select the T.M.C. Tracking Service (when the device is used for tracking)

The T.M.C. reporting delivery can be to one or all of the options below:

- Delivered to your email address
- Delivered to your Enterprise Server (see packet encoding in Appendix: Packet Encoding)
- Delivered to Applied Satellite Data Server and available to you via web services including SOAP/XML (see Appendix: Wireless innovation Data Server)
- Delivered to 3rd Party Mapping Services (see Appendix: Mapping Service)

C) Determine the best T.M.C. installation

The T.M.C. installation includes:

- Locating the T.M.C. (or T.M.C. Bay antennas) for 360 line-of-sight of antenna to horizon (internal antenna for T.M.C., external for Bay - this is a critical consideration, see Appendix: Antenna Location)

D) Evaluating and Validating the T.M.C.

The T.M.C. can be configured over the Iridium Satellite Network or via USB port:

- Via the USB port using a terminal emulation program, such as Hyperterm or TerraTerm (USB drivers provided by ASE)
- Over the air using configuration menus per your selected tracking or enterprise service
- Over the air using image built from a Applied Satellite Engineering configuration utility and sent via your email account

F) Put the T.M.C. into service

- Activate the T.M.C. with the Iridium Satellite Network
- Activate the selected Data Service (optional)
- Charge the battery
- Configure the reporting (Track), sensors (Monitor) and control
- Validate the configuration

G) Track, Monitor, and Control your asset (as needed)

Track, monitor, and control your asset using the selected Tracking/Data Service

H) Service the T.M.C.

Periodic maintenance is recommended for optimal performance

- Replace the lithium-ion battery every 2 years

Tracking, Monitoring, and Control Features

Overview

The T.M.C. can provide GPS and sensor based tracking reports (including position, heading, speed, sensor inputs, and diagnostic information) at up to four pre-assigned times each day. These reports may also be set to be sent at specific time intervals. In addition, the T.M.C. can monitor and detect event based conditions that trigger a more rapid reporting rate or provide local control.

For example, to track, monitor, and control a remote asset, the T.M.C. could be configured for 6 periodic reports per day (4 hour intervals) for standard reporting but can also be configured to report at 15 minute intervals if a sensor (GPS Geofence or analog sensor) critical value has been breached. Also, upon this breach, a local alarm can also be activated by the T.M.C.

Tracking

The T.M.C. can track your assets by sending a periodic or event driven position report via the Iridium Satellite Network. This report can be configured to be transmitted on a time based interval between 5 minutes to 1 day. Alternatively, the T.M.C. can be configured to send the periodic report daily at up to 4 preset times of the day. In addition, a Geofence monitor and an Analog sensor monitor can be configured to send reports at an accelerated reporting rate based on critical sensor data that requires more urgent attention.

Monitoring

The T.M.C. can monitor sensor data to generate event driven reports, change reporting rate, and/or drive a control output. In addition, the sensor data will be included in all tracking reports.

Possible monitors that can be enabled include:

- GPS/Geofence monitor
- Analog Inputs monitor
- Digital Inputs monitor (2)
- Vibration monitor
- Battery Level monitor

Tracking, Monitoring, and Control Features
(continued)

Possible events that can be enabled to generate a report include:

- GPS (Enter Geofence or Exit Geofence)
- Analog sensor (Enter alert window or Exit alert window)
- Digital Input (Set detected, Clear detected, or Toggle detected)
- Vibration (Time match detected, or Event count match detected)
- Battery (Low battery detected)

Geofence Monitor

Tracking reports may be configured to change reporting frequency based on a Geofence of either 500m or 1km radius. A Geofence is an artificial boundary that can be defined at any location with satellite coverage. It can be utilized to trigger standard or accelerated reporting once a tracked signal crosses the boundary.

For example, a ship exiting a dock may trigger a report "Leaving Depot" notification. If this movement is unauthorized, such a report may indicate theft.

The Geofence Monitor will monitor the current GPS location and compute the distance from the Geofence Center. This monitor can execute ENTER GEOFENCE and EXIT GEOFENCE events, change the reporting rate and/or drive a control output.

Theft Mode and Depot Mode are special Geofence Monitor modes:

- Theft Mode: In Theft Mode, the T.M.C. starts accelerated reporting once the Geofence is breached and continues reporting at this interval until commanded remotely to stop or when the T.M.C. returns to within the Geofence boundary

- Depot Mode: In Depot Mode, the behavior is similar but reporting stops and the Geofence resets if the T.M.C. has remained stationary for two report cycles.

The center of the Geofence is established in the following ways:

- Power up: The device can be programmed to establish a Geofence based on its initial position when powered on.
- Depot: When set to this mode, the device establishes the Geofence's center when two GPS position reports are identical for two interval reports.
- Manual: At any time, a user may send the device a signal to establish a Geofence center at its current location.

Tracking, Monitoring, and Control Features
(continued)

Analog Input Monitor

The T.M.C. can monitor a 0 to a 30V analog input. (If you are connecting to a sensor with 0-200mA, please contact us for assistance).

The Analog Monitor will monitor the current Analog Sensor value and compare against the configured critical sensor window. This monitor can execute ENTER ANALOG CRITICAL WINDOW or EXIT ANALOG CRITICAL WINDOW events, change the reporting rate and/or drive a control output.

Digital Inputs Monitor

The T.M.C. can monitor two digital inputs. These inputs can be utilized to monitor a door opening, an ignition "on" or "off", etc. Each digital input can be configured for a "change in input", "change HI-LO", or "change LO-HI".

In addition, the user can configure the digital input to wait a certain number of seconds before accepting the change as valid. The user can also configure the digital input to accept a valid change within a certain window to avoid unnecessary reporting. This is particularly useful for an input that is known to rapidly vacillate from HI to LO.

These digital inputs can be programmed to internally trigger a report and/or drive a control output without accessing the satellite network.

Digital Input as a Pulse Counter

One of the T.M.C.'s digital inputs can also be utilized as a pulse counter. This is useful to interface with devices which emit outputs as digital pulses. For this type of configuration, a user must define the "Begin Count" and "End Count" timing intervals on the pulse counter.

Vibration Monitor

The T.M.C. has an accelerometer that can monitor vibration. This is often used to detect movement, as well as for other actions that produce vibration, such as an engine starting.

Tracking, Monitoring, and Control Features
(continued)

Control

The T.M.C. has two digital outputs for the control of external devices, e.g. relays. These control outputs can be controlled remotely. Alternatively, the T.M.C. control outputs can be configured to be controlled by a local sensor event – having an output to react to an analog value, digital value or Geofence breach.

An example would include setting one of the digital outputs to open a relay that opens a gate when a water level is reached. In this case, the water level is the analog value.

Possible events that can be enabled to generate a report or output response include:

- GPS (Enter Geofence or Exit Geofence)
- Analog Sensor (Enter Alert Window or Exit Alert Window)
- Digital Input (Set Detected, Clear Detected, or Toggle Detected)
- Vibration (Time Match Detected or Event Count Match Detected)
- Battery (Low Battery Detected).

Possible control options include:

- Control Output 1 (Set, Clear or Toggle)
- Control Output 2 (Set, Clear or Toggle)

Reports

Overview

The T.M.C. generates reports that contain the following information:

- GPS Position
- Digital Input and Output Status
- Analog Input Value
- Vibration Indication
- Speed and Heading
- Diagnostic Information and Battery Status

Reporting Modes

The T.M.C. can send reports according to the following modes:

- Time-of-Day Reporting
- Interval Reporting
- Device outside of Geofence reporting
- Device outside of Geofence accelerated reporting
- Change in Digital Input alarm
- Analog value (window) reached alarm
- Vibration-initiated alarm
- Vibration accumulator reached
- Digital Pulse Counter value reached

Report Frequency

The T.M.C. may be configured to send reports at any of the following frequencies:

Regular Time-of-Day Presets Reporting

Regular Time-of-Day presets are pseudo rather than exact in order to preserve the Iridium network. Since it would be impossible for all devices to send reports at a common time such as 12:00, the T.M.C. operates on its user-defined schedule plus an offset based on the device's serial number. So, if the device is set to report at 8:00, 12:00, 18:00, and 00:00, it does so slightly after each chosen time. For more general features of the T.M.C.'s Event-Triggered Reporting, please consult the next section.

Regular Time Interval Reporting

Following powering on the device, it can be configured to send reports at a certain time interval, Although a common interval is every 4 hours, the interval may be as short as 1 minute or as long as two weeks.

Event-Triggered Interval Reporting

The device can be configured to begin reporting at regular intervals, such as in "Outside of Geofence" Mode or "Unauthorized Movement (Theft)" Mode.

A real-world example of this would be configuring a device to report when it is moved outside of a depot, and it continues to report every two hours while in motion. Once the asset reaches the next depot and the GPS positioning is the same for two intervals, the device then establishes the new GPS position as the new depot and ceases to report. However, it would report again once it moved beyond the new Geofence.

Event Triggered Reporting

Cost Saving Reports

With Cost Saving reports, the T.M.C. only generates a report upon some events occurring, such as:

- Device has left the Geofence (DEPOT OR UNAUTHORIZED MOVEMENT SETTING)
- Digital input value(s) have changed (ANTI-FLAP REPORT SETTING)
- Analog value reached
- Detection of vibration of a certain value
- Certain vibration accumulator setting reached
- Pulse input counter value reached

Reports

Accelerated or Additional Reports

The Accelerated or Additional Reports settings can be configured by the user for the above conditions in the following ways:

- Device has left the Geofence - reports for every user-defined number of hours until the new Depot reached (same GPS position for two reports), or until the asset has been recovered (unauthorized access).
- Reports when analog value returns to "within" window.
- Reports when vibration ceases.
- Accelerated or additional reporting is optional.

Performance and Maintenance

Diagnostic Reporting

The T.M.C. can be configured to generate a report at a given time or on a configured interval. This can be useful when paired with Cost Saving Reports for the following examples:

- Sending a report every 14 days to verify that the device is still functioning.
- Transmitting a report once per week to find out the vibration accumulation time (to determine the engine usage for a piece of heavy equipment for example).
- Sending a weekly report to monitor battery level and charging performance.

Battery Low Reporting

The T.M.C. will send a report when the battery is low.

Remote Query

Standard Report

The T.M.C. allows its users to remotely query the device for its status. A single remote query is sent to the device and a single report is returned. The standard report contains the following:

- GPS Positioning with Heading and Speed
- Digital I/O Settings
- Analog Value
- Vibration Counters
- Diagnostic Information

Application Examples

Asset Tracking with Theft Mode Detection

Example: Portable Power Generator Tracking for Location and Theft

The T.M.C. can be utilized to track an asset by reporting on a specific frequency, such as once-every 72 hours, and then programmed to report position every 30 minutes, if the asset is moved from a GeoFence. Assets such as power generators can be transported to a site where it might remain for several weeks. The T.M.C. can report every three days to ensure that the device and utilize the vibration counter to report how often the generator was put into use. This can be extremely useful for time-based maintenance. If the asset were to be stolen, the T.M.C. would report position every 30 minutes until either the battery was exhausted, or the asset was found.

Configuration:
- Reporting: 72 Hours
- Theft Mode
- Geofence 1km.
- Vibration Monitor On

Sensor Tracking with accelerated reporting for Alert Conditions

Example: Work Boat needs to report position AND Over temperature of Engine

Monitoring the position and critical analog values can be crucial to reduce maintenance costs. An example would be to track the position of a Work Boat and monitor the engine temperature. Work Boat Crews have the added tasks of moving their vessel to various locations, as well as putting their crew to rigorous tasks which can distract them from important ship alerts, such as engine temperature.

Example: Work Vessel

Vessel Tracking every four hours when moving (Depot Mode which stops reporting when position is the same for two reports, thus saving costs.)

Engine Temperature Alert Condition when Analog Value corresponds to 250 Degrees.

- Configuration:
- Depot Mode
- GeoFence 1kM
- Send Alert when Analog Value = 250 Degrees

Application Examples
(continued)

External Input Event Reporting

Example: Moving Vehicle with a removable asset

Specialized Vehicles that are in remote locations often carry specialized assets. The T.M.C. can track the vehicle and also report if one ore more assets are physically removed using the Digital Inputs.

Configuration:
- Depot Mode
- Report Every 4 Hours
- Digital Input Change HIGH-LOW

Check Out and Quick Start

Quick Check Out

Charge Internal Backup Battery for 5 Hours for full charge

- Charge LED will be RED while charging and GREEN once fully charged
- Or OFF when in low power modes 15 minutes after power has been applied

Monitoring the LED behavior

Signal LED (Green)
- Continuous blinking indicates no Iridium or GPS signal has been detected.
- Blinking twice with a pause indicates the T.M.C. is searching for an Iridium signal.
- Blinking three times with a pause indicates the T.M.C. is searching for a GPS signal.
- Solid green indicates solid signal for both.

Report/Alert - MSG LED (Red/Green/Amber)
- Blinking Red indicates an ERROR.
    - Every 2 seconds indicates POWER TOO LOW
    - 5 Hz (5 blinks per sec) indicates DAILY LIMIT reached
    - Blink at the end of transmission means transmit failed
- Solid Green indicates a REPORT message is being sent.
- Solid Amber indicates a message is being received.

Charge LED (Red/Green)
- Red indicates battery is charging.
- Green indicates charging is complete.
- Blinking amber & blinking signal indicates MESSAGE in queue.

Quick Start Bench Checkout Procedure

The Bench Test allows check-out and verification of the T.M.C. operation. Local configuration and control is very helpful for bench top checkout.

NOTE: Line-of-Site visibility to the Iridium Satellite and GPS Satellites is fundamental for proper operation of this checkout. When using the bench top procedure indoors, be sure the T.M.C. is located in a window and also understand the Iridium and GPS signal strength might be inadequate for complete execution of this procedure and your results might vary from this example.

This procedure uses the USB Local Command Interface (see Appendix). USB Drivers are provided by Applied Satellite.

1. Hardware Hookup

1. Connect the antenna RF connectors to GPS and Iridium antennas located outdoors and with 360 view of the horizon.
2. Connect the power supply
3. Connect the USB to PC
4. Install Drivers if requested
5. Start a Terminal Emulation client

Quick Start Bench Checkout Procedure
(continued)

2. Using Local Applied Satellite Command Server for system checkout
    1. Hit ENTER to see the command server prompt ("#>)"
    2. Use the VER command to verify fw versions, model numbers and
       IMEI information
    3. Use the RPT command to verify report setup
       i. Verify RPT.ENABLE = T
       ii. Verify RPT.REPEAT = 15 (for 15 minute report interval)
    4. Use the CFG command to verify system configuration setup
       i. Verify CFG.PROTOCOL=1
       ii. Verify CFG.PMODE=5 (for full power profile)
       iii. Verify CFG.KEEPAWAKE=15 (for 15min power-up keep awake)
    5. Repeatedly use the STAT command to check instantaneous system status
       i. The system MUST capture GPS UTC time and Iridium Time Sync after
         power up for the reporting features to be enabled.
       ii. On power up, the system will be in the Full Power mode for the KEEP
         AWAKE TIME parameter before entering the configured power profile.
       iii. Continue checking until system has connected to satellite networks.
         It should take about 30 -60 seconds to capture time sync,
         Iridium Fix and GPS Fix after power up.
    6. Use the RPT.TEST command to queue a report and immediately start the
      transmission attempt. This command also enables the
      VERBOSE DEBUG STREAMING Command

This is very helpful for monitoring the behavior of the communication channel.

Quick Start Bench Checkout Procedure
(continued)

The information captured below represents a typical SBD transmission sequence using an efficient antenna installation.

```
.modem wakeup initiated
.done
.searching for network
.onnet.ttf:1.netavail:T.bars:0
.online
.starting time sync
.signal strength:5
.time sync:8a0163ba
.done
.starting SBD send sequence
.signal strength:5
.mo status:0, mt queue:0
.done
.modem powered down into sleep mode
```

It is recommended that the system is left in this mode and monitored for as many hours as feasible for checkout.

Configuration

The T.M.C. can be configured locally via the USB port or remotely over the Iridium Satellite Network:

- Via the USB port using a terminal emulation program such as Hyperterm or TerraTerm (USB Drivers provided by Appled Satellite).
- Over the air using configuration menus per your selected tracking service
- Over the air using image built from Appled Satellite Configuration Utility and sent via your email account.

Setting Parameters

Reporting Configuration Parameters

- Reporting Interval: Set this parameter in minutes.
- Special Case: If set to 0, then the TOD reporting values will be used
- Accelerated Interval: Set this parameter in minutes. This will be the reporting rate for accelerated reporting of the Geofence or Analog Monitors

Time of Day 1: Set this parameter as minutes since 0:00GMT
                (only used if Reporting Interval is 0).
Time of Day 2: Set this parameter as minutes since 0:00GMT
                (only used if Reporting Interval is 0).
Time of Day 3: Set this parameter as minutes since 0:00GMT
                (only used if Reporting Interval is 0).
Time of Day 4: Set this parameter as minutes since 0:00GMT
                (only used if Reporting Interval is 0).

Position Monitor Parameters

- Enable: Set to True or False. (If False, Geofence features will be OFF and GPS data will NOT be included in reports).
- Accel Enable: Enable accelerated reporting for Geofence breach.
- Geofence Event: Set on Exit Geofence or Enter Geofence or Disable.

Analog Monitor Parameters

- Enable: Set to True or False. If False, Analog features will be OFF.
- Accel Enable: Accelerated reporting can be Enabled or Disabled when analog sensor is inside window or analog sensor is outside window.
- Analog Event: Set on Enter Window and/or Exit Window.
- Min Value: Sensor critical window minimum value set in volts (0.00 to max value).
- Max Value: Sensor critical window maximum value set in volts (min value to 30,0).
- Hysteresis: Sensor critical window hysteresis when entering window set in volts.

Digital Input Monitor Parameters

- Enable D1: Set to True or False
- Event On: Set an event based on NONE, HI_TO_LOW, LOW_TO_HI, ANY CHANGE, or PULSE MATCH
- Enable D2: Set to True or False
- Event On: Set an event based on NONE, HI_TO_LOW, LOW_TO_HI, ANY CHANGE

Vibration Monitor Parameters

- Enable Monitor: Set to True or False
- Mode: Time or Count
- Event on Match: Set an event based on match
- Match Value: Set value for Time or Count match

Output Control Parameters

- Enable DO1: Set to DISABLE, SET, OR CLEAR.
- DO1 Event: 0:12 Events
- Enable DO2: Set to DISABLE, SET, OR CLEAR.
- DO2 Event: 0:12 Events

Backup Battery and Low Power Operation

The T.M.C. includes an internal battery to extend operation when the external power source has been removed. The configuration and operation can be modified to extend the battery life. Battery life is a function of the power profile in use and the configured frequency of report/alert messages. The configuration options have been grouped into a parameter called Power Profiles.

Configuration options to extending battery life do impact the system responsiveness per the following table:

Configuration Options				
Battery Life (estimate)	Power Profile	Receive Message	Check GPS	Check Sensors
14 Hours	5	5-30 secs	2-5 secs	2-4 secs
7.2 Days	3	5-10 mins	5 mins	1 min
16 Days	2	15-30 mins	15 mins	5 mins
400 Days	1	24 hours	24 hours	5 mins

*Note: The reporting transmission rate will also impact battery life. This table has assumed a report every 6 hours, except for Power Profile 1 which is every 24 hours.

External IO Pin Out

The PANEL DB9 Connector is as follows:

1. VDC IN+
2. DIGITAL OUT 1
3. DIGITAL IN 1
4. DIGITAL GROUND
5. ANALOG GROUND
6. VDC IN GROUND
7. DIGITAL OUT 2
8. DIGITAL IN 2
9. ANALOG IN
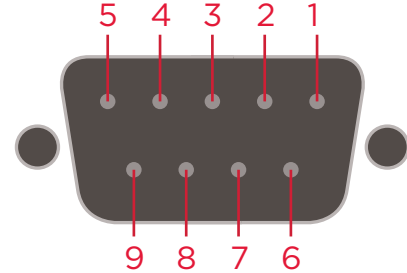
Configuration Options

DB-9 Pin	Colour	Type	Function	Specs
1	RED	POWER (VIN+)	Input Voltage	10-28VDC, 12W 20 AWG
2	TAN	DIGITAL OUT 1	DIGITAL OUT	Open Collector, 30V pull-up max, 100ma sink max
3	ORANGE	DIGITAL IN 1	DIGITAL IN	Input impedance: 1M, 30VDC max, <800mv=low,>2.5 = high
4	GREY common	DIGITAL REF	DIGITAL GND REF	Common GND for Digital I/O
5	GREY common	ANALOG REF	ANALOG GND REF	Common AGND for Analog In
6	BLACK	POWER (VIN-)	Input Voltage Return	20 AWG
7	VIOLET	DIGITAL OUT 2	DIGITAL OUT	Open Collector, 30V pull-up max, 100ma sink max
8	YELLOW	DIGITAL IN 2	DIGITAL IN	Input impedance: 1M, 30VDC max, <800mv=low,>2.5 = high
9	PINK	ANALOG IN	ANALOG IN	Input impedance: 1M, 30VDC max, internally scaled 10:1

Appendix: Applied Satellite Configuration Utility

Configuring the T.M.C.

The T.M.C. Configuration Utility is found at ase-corp.configure.com
Here is a description of how to use the Utility.

Standard Based Reporting: Time Based or Time of Day

If Standard Reporting is utilized, enable by ticking/checking the Box.

Repeat Rate is in minutes. This will send a report XX minutes after the device is powered on.

Time of Day reporting is enabled by entering a "O" into Repeat Rate.

You can also select 4 Time of Day Reports. The format is Minutes since 00:00GMT.

Appendix: Applied Satellite Configuration Utility
(continued)

Position Monitor - Geofencing Depot or Theft Mode

If the position monitor is enabled, you can set the alert to be on geofence entry, or Geofence exit. You can also set to DEPOT Mode which stops reporting after two identical Geoposition reports and also resets the center of the Geofence. It will begin reporting when the device moves outside the newest geofence. THEFT Mode will report "forever" after it leaves the geofence. The Position fence radius is set in meters.

Analog Reporting Enabled

Enable the Analog reporting by ticking or checking the box shown below. You can configure an alert on exit of the window, entry to the window and decide if you want an accelerated report based upon the alert as well. The levels are 100 counts = 1 Volt. The Range is 0 to 3000 (0 to 30VDC). To prevent oscillation, choose an appropriate hysteresis for the analog values.

Appendix: Applied Satellite Configuration Utility
(continued)

Digital Monitor 1 and 2

See the figure below. You can enable Digital inputs 1 and 2 and configure how the conditions for how they are set; alerts, disabled, etcetera. Digital Input 1 can also be configured as a pulse counter if needed. If this is enabled, then set the pulse match count to send an alert when this count has been reached. The timer then resets to "0".

Digital Monitor

D1 Enabled	☑	← Enable Digital 1 Input
D1 Alert On-Digital	On Set	← Off, Set, Clear, Change, and Match
D2 Enabled	☑	← Enable Digital 2 Input
D2 Alert On-Digital	On Set	←
Pulse Match Count	32767	Enable Digital 1 Pulse Count
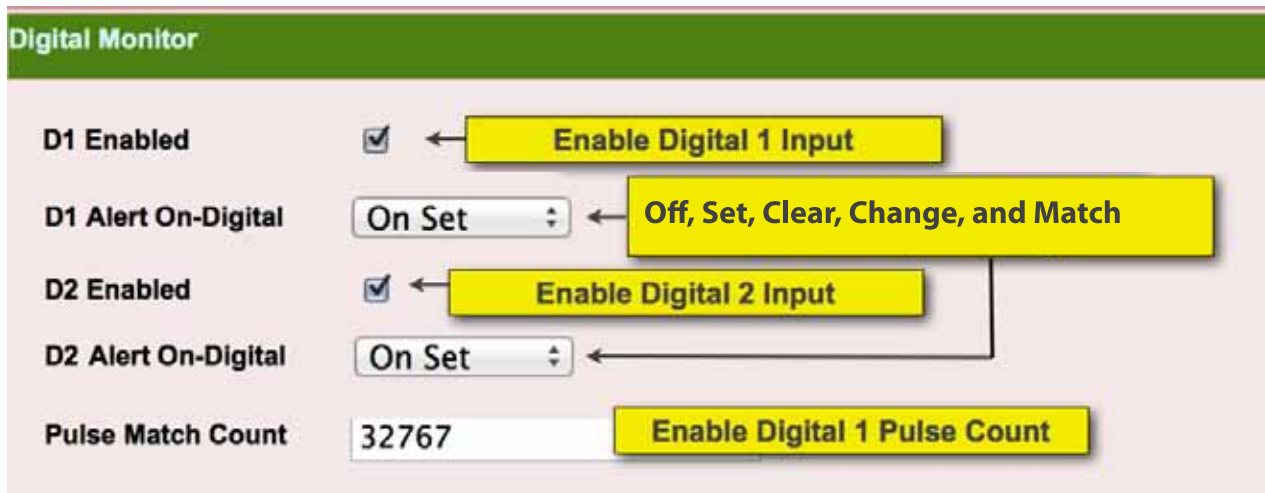
Diagnostic Reporting

Select additional diagnostic reporting by selecting the check boxes shown below. Note the last check box will increase message size by six bytes.

Diagnostic Reporting

Alert on low battery	☑	← Alert when Low Battery
Alert on bad GPS	☑	← Alert on Bad GPS
Rpt ext diag	☑	← Enable Additional Diagnostic info in Standard Report, 6 Bytes includes degC, Ext V, additional alerts
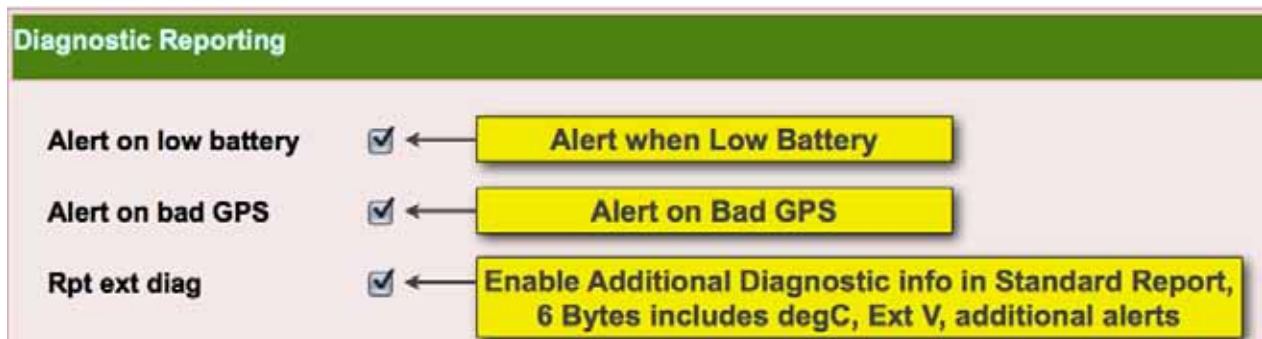
Appendix: Applied Satellite Configuration Utility
(continued)

Vibration Monitoring and Reports.

The powerful features of the vibration monitor are selected below.
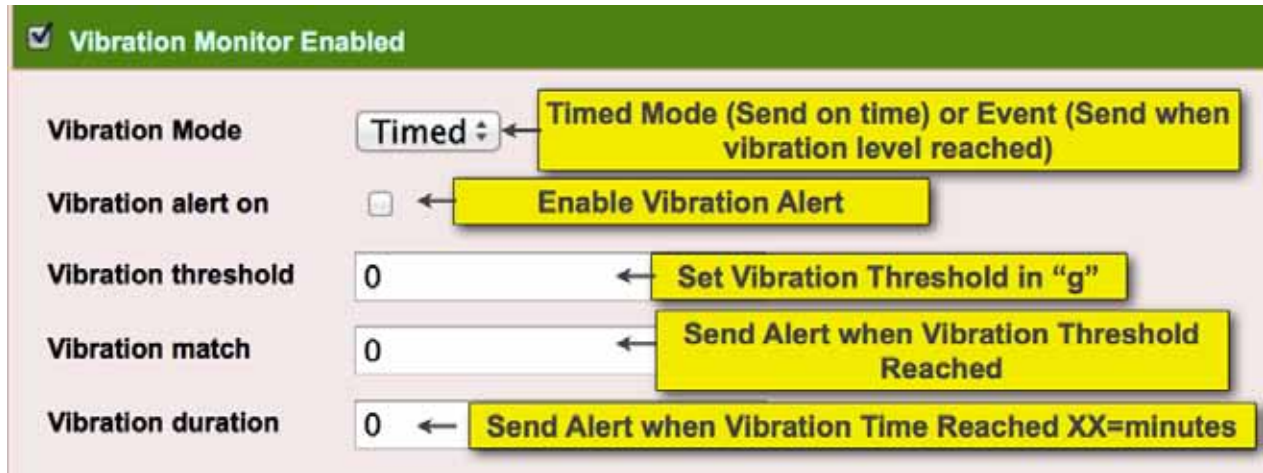
Diagnostic Outputs

The Digital Outputs 1 and 2 are configured with the menu below.
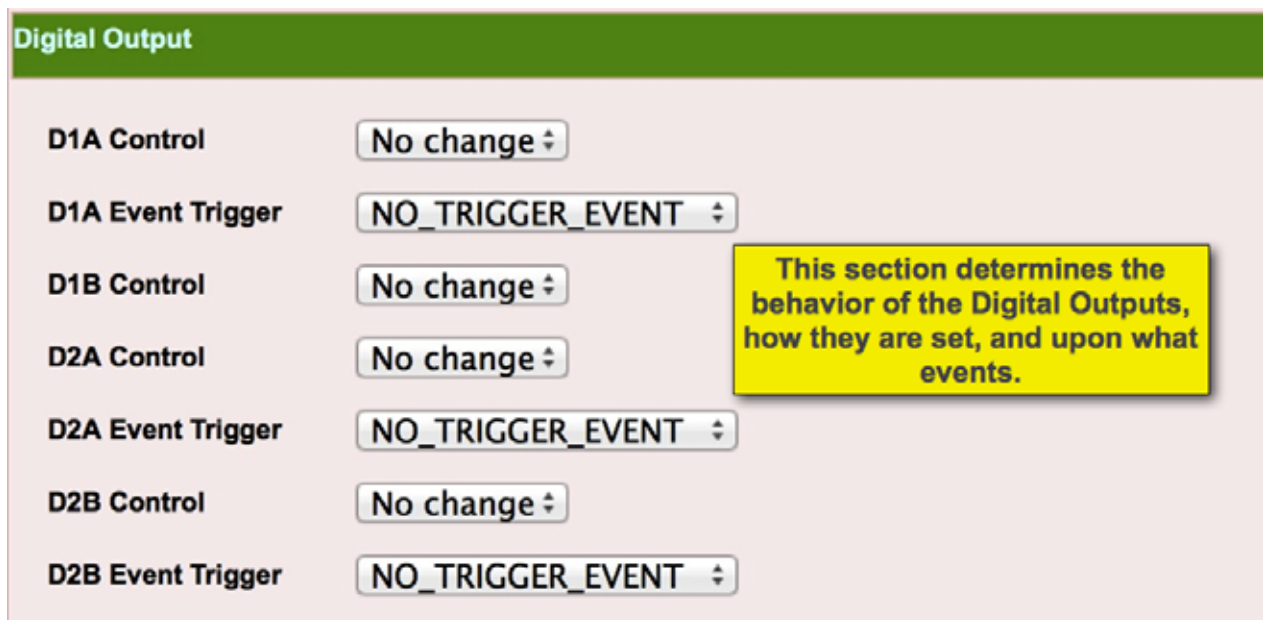
Appendix: Applied Satellite Configuration Utility
(continued)

Power Mode and Tracking Service Protocol

Finalizing Configuration

Once all menus have been selected, select "Create Config" Button at the end. The configuration file will automatically be downloaded to your computer.

This file can now be emailed to the T.M.C directly via email, or uploaded via the appropriate tracking service.

It is recommended that the T.M.C be queried for its configuration and tested.

Appendix: Applied Satellite Configuration Utility
(continued)

Configuration via Email Attachment

Queries, commands and configuration can be performed over the SBD network by simply sending it an email message with a file attachment that contains your specific command, query or configuration information. The email message format is shown below and must be sent to the address shown with your unit's IMEI number in the subject line. Also, the attached file must have a .sbd extension and be 270 bytes or less in size - or it will be rejected by Iridium's SBD service. Additionally, your service provider must configure your T.M.C. airtime account with the "Automatic Notification" feature enabled.

To: data@sbd.iridium.com
From: <your_email_address@your_domain.com>
Subject: 304050607080903
<Message Attached = your_config.sbd>

Messages must follow Iridium's SBD service formatting rules outlined below:

- Messages to the T.M.C. are sent to the email address: data@sbd.iridium.com
- Placing at least one, and up to a total of four, IMEI(s) into the subject line of the email identifies the destination T.M.C. If there are more than one destination IMEIs, then list the additional IMEIs on the subject line separated with a single space between each IMEI.
- The message must contain a properly formatted sender ("From:" address), otherwise the message will be dropped by Iridium's SBD service.
- The configuration script sent to the T.M.C. must be carried as an attachment to the email:
    - The attachment name must have a '.sbd'file name extension: E.g. 'configdata.sbd'
    - File names must be 80 characters or less. (Including the .sbd extension.)
    - File names are not case sensitive.

IMPORTANT NOTE: Command and configuration messages sent via email are processed by the T.M.C. immediately upon receipt except when the unit is operating in a Power Saving mode. Under Power Saving conditions, updates occur upon the next scheduled data transmission or scheduled mailbox check.

Appendix: Local/USB Configuration

The T.M.C. Series can be configured locally using a terminal emulation client connected via USB

Available Commands

STAT - Get Status
VER - Get Version
CFG - Setup Configuration
RPT - Setup Standard Reporting
DO - Setup for DO Control
POS - Setup Position Monitor
ANA - Setup Analog Monitor
DI - Setup Digital Monitor
VIB - Setup Vibration Monitor
DIAG - Setup Diagnostic Monitor

The command syntax supports GET parameters, SET parameter and HELP as follows:
#>cmd
        - returns the values for all parameters of that command
#>cmd.parameter=####
        - sets the parameter to that value
#>cmd
        - returns information about parameters and parameter ranges

Version Command

#>>ver

The VER command provides model number, fw version, modem IMEI, modem fw version, and Bootloader version.

.model:OSP.TMC1.id:00000000-B.ver:01.00.4
.imei:300234010309800.ver:TA10003
.boot:16X.01.6

Status Command

#>>stat

The STAT command provides instantaneous system information

Appendix: Local/USB Configuration
(continued)

System Time

.curr time:09/13/13, 22:25 GMT
.next rprt:09/13/13, 22:40 GMT

Modem

.stat:ON NET.bars:5.xmitPending:0.iTTF:2

GPS

.pos:33.63541,-111.88155.hdop:0.9.num satellites:9

Configuration Command

The CFG command provides local configuration and validation of the power mode and protocol.

#>cfg=?

.RESET
        - reset to factory defaults
.PMODE
        -set mAmp consumption user case - 1-5
.PROTOCOL
        -set server protocol - 0:ASE, 1:GAP
.KEEPAWAKE
        -set the power-up keep awake minutes - 2-15

Use the VER command to verify fw versions, model numbers and IMEI information.
Use the STAT command to check instantaneous system status.

Appendix: Local/USB Configuration
(continued)

Report Command

The RPT command provides local configuration and validation of the reporting times and rates.

#>rpt=?

.ENABLE
      - enable feature   T|F
.REPEAT
      - repeat rate of report (mins)   0-10800
.TOD1
      - send report (mins since 0:00 GMT) 0-1440
.TOD2
      - send report (mins since 0:00 GMT) 0-1440
.TOD3
      - send report (mins since 0:00 GMT) 0-1440
.TOD4
      - send report (mins since 0:00 GMT) 0-1440
.ACCEL
      - repeat rate when accelerated(mins) 0-10800
.TEST
      - send test report now

The RPT.TEST command is a unique command that initiates an immediate standard position report and also enables the VERBOSE DEBUG STREAMING to monitor SBD communication status. This DEBUG STREAMING is disabled upon power cycle.

Appendix: Local/USB Configuration
(continued)

Position Command

The POS command provides local configuration and validation of the GPS Position related parameters and features.

#>pos=?

.ENABLE
- enable feature   T|F
.ENTRYALERT
- alert when inside region   T|F
.EXITALERT
- alert when outside region   T|F
.MODE
- T-Depot Mode; F-Theft Mode   T|F
.FENCE
- geofence radius (kmeters)   0.0-1.0
.ACCEL
- off, on   T|F
.GCENTER
- geofence center   lat,lon
.NOW
- change current position lat,lon   (engineering debug only)
.MOVE
- set move degrees per update. lat,lon   (engineering debug only)
.GP
- show raw NMEA sentences

Appendix: Local/USB Configuration
(continued)

Analog Sensor Command

The ANA command provides local configuration and validation of the Analog Sensor related parameters and features.

#>ana=?

.ENABLE		
	- enable feature	T|F
.ENTRYALERT		
	- alert when inside window	T|F
.EXITALERT		
	- alert when outside window	T|F
.MIN		
	- window lower limit	0.0-30.0
.MAX		
	- window lower limit	0.0-30.0
.HYS		
	- window limit hysteresis.	0.1-2.5
.ACCEL		
	- off, on.	T|F

Digital Inputs (Dry Contact Closures) Command

The DI command provides local configuration and validation of the Digital Inputs/Relay Closure related parameters and features.

#>di=?

.1ENABLE		
	- enable feature	T|F
.2ENABLE		
	- enable feature	T|F
.1ALERT		
	- off, on set, on clear, on toggle, or on match	0-3
.2ALERT		
	- off, on set, on clear, on toggle, or on match	0-3
.1MATCH		0-32000

Appendix: Local/USB Configuration
(continued)

Diagnostic Command

The DIAG command provides local configuration and validation of the Diagnostic related parameters and features.

#>diag=?

.BATTALERT
  - alert when battery is low   T|F
.GPSALERT
  - alert when gps health is bad   T|F

Vibration Command

The VIB command provides local configuration and validation of the Vibration related parameters and features.

#>vib=?

.ENABLE
  - enable feature   T|F
.ALERTTOGGLE
  - enable alert for selected mode   T|F
.MODE
  - T for event mode, F for timed mode   T|F
.THRESHOLD
  - set accelerometer threshold. 127 stages   0-127
.MATCH
  -set accumulator match point for vibration mode (min)   0-500
.DURATION
  - set time delay before device 's 'vibrat'ng' (mS)   0-500
.TIMEOUT
  - set time-out for occurence detection (sec)   0-240

Digital Output Command

The DO command provides local configuration, control and validation of the Digital Outputs and Event Triggering.

#>do=?

.1PIN
    - do nothing, set clear or toggle   0:3
.2PIN
    - do nothing, set clear or toggle   0:3
.1AENABLE
    - enable control, or set, clear or toggle   0:3
.2AENABLE
    - enable control, or set, clear or toggle   0:3
.1AEVENT
    - set trigger event   0:12
.2AEVENT
    - set trigger event   0:12
.1BENABLE
    - enable control, or set, clear or toggle   0:3
.2BENABLE
    - enable control, or set, clear or toggle   0:3
.1BEVENT
    - set trigger event   0:12
.2BEVENT
    - set trigger event   0:12

Appendix: Important Installation Considerations

Iridium Satellite Network

The Iridium satellite constellation is comprised of 66 low-earth orbit (LEO) satellites that traverse the sky every 8 to 10 minutes. At any given time, there may be from 1 to 3 satellites in view with varying locations in the sky, at times as low as the horizon.

The most critical factor related to a successful LEO installation is locating the Iridium antenna where there is a complete clear view of the sky in all directions. For optimal performance, Iridium specifies visibility of the sky in all directions down to 8 degrees above the horizon. Any obstacles (buildings, mountains, terrain, etc) that violate this requirement may result in periodic outages when/if a satellite's visibility is blocked. Some applications can tolerate a temporary outage, others cannot.

The T.M.C. must be mounted with the antennas facing skyward and the top horizontal with the sky.

Unobstructed sky view for optimal performance

8^0
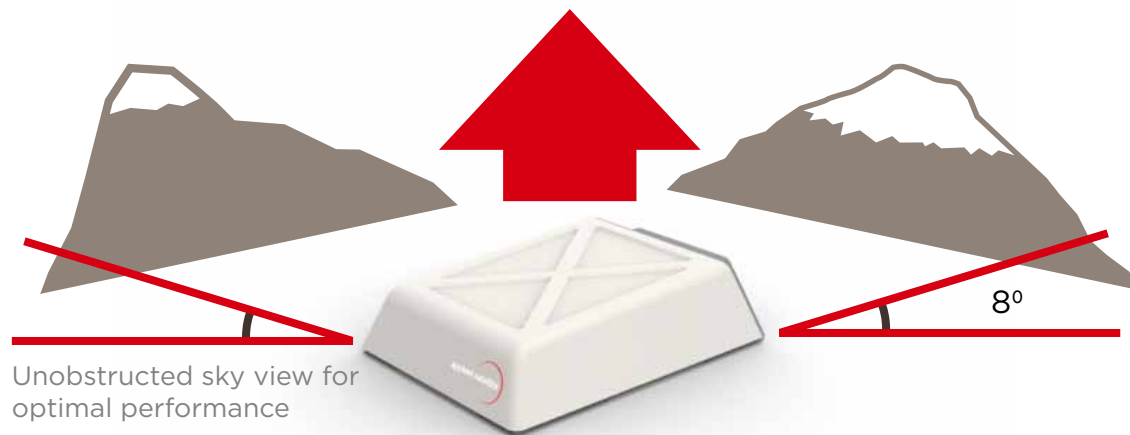
The T.M.C. must be located in a dry, protected environment. The external, cabled antennas must be installed in a location with a clear view of the sky
 - with no obstructions.

For external antennas the cable impedance and attenuation is a critical parameter. Applied Satellite approved antennas and cables must be used.

Appendix: Important Installation Considerations
(continued)

Recommended External Antennas for T.M.C.

Iridium

P/N: AT1621-142W-TNCF-000-00-00-NM
Manuf: Aero Antenna
Cable Type/Length: See table*
*requires TNC female to SMA male transition cable

GPS

P/N: AT575-68W-TNCF-000-RG-NM
Manuf: Aero Antenna
Cable Type/Length: See table*
*requires TNC female to SMA male transition cable

Dual Iridium/GPS

P/N: A10AA1971A
Manuf: MultiBand
Cable Length: 10 feet (3 meters)
Connectors: SMA male

LMR Cable (TNC male connector at each end)	dB loss/foot	Connector insertion loss (2x combined)	Max Length (feet)	Max Length (meters)
240	0.103	0.72	22.1	6.7
400	0.05355	0.72	42.6	13.0
600	0.0347	0.72	65.7	20.0

Stable Power

The satellite communication sources high current for short durations. The internal backup battery helps buffer the power surge, but it is also important that the external power supply meets the electrical specifications (10-28VDC, 12W).

In addition, keep cable lengths as short as possible to minimize voltage drops.

Appendix: Mounting T.M.C. Bay

Appendix: Mounting T.M.C.

Multiple Mounting Configurations

Countersunk for .25" machine screw

Reserved for TMC

2.50

.20

8.50
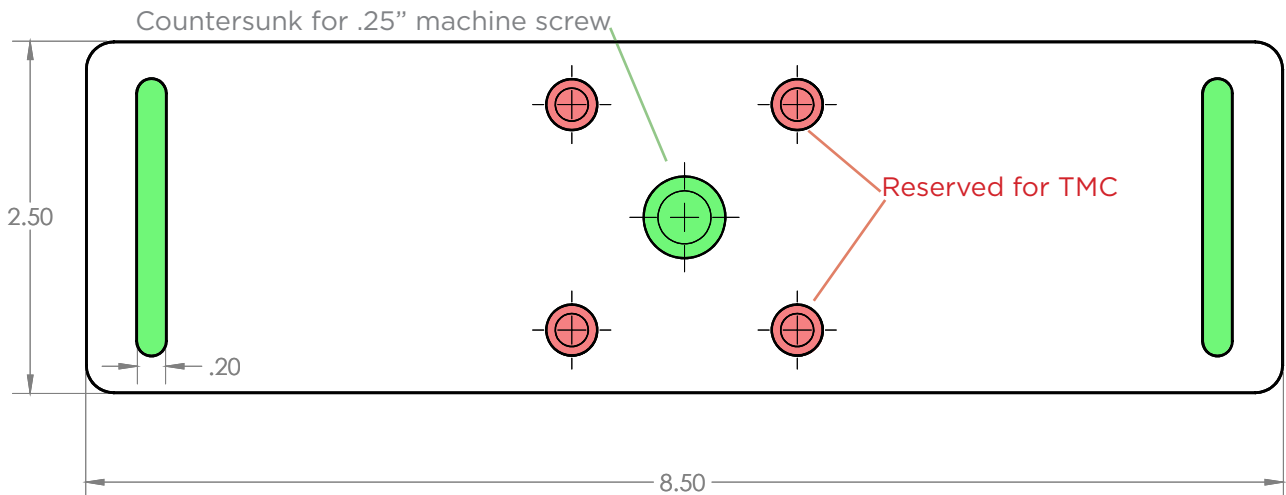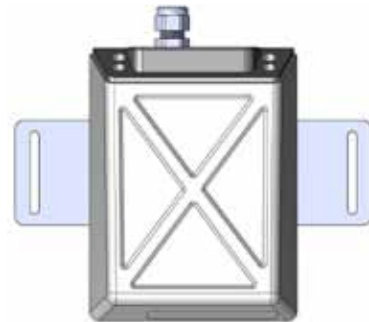
Appendix: Mounting T.M.C.
(continued)

Right Angle Mount

Horizontal Mount

Appendix: T.M.C. Specifications

1. Electrical Specifications

Input Voltage: 6-28VDC operating voltage

Internal Battery: 7.4V, 2200mah Li-on

Power Consumption: Standard power profile

Peak: 12W (during transmit phase)

Avg Transmit: 2W

Avg Idle: 1W

Avg Idle + Charging: 5W

Low power profiles

Sleeping: 1.2mW

DC Inputs: Input Impedance: 1M ohm (DC Input 1)
Absolute Max: 40VDC
Operating Range: 0-30VDC, up to 1KHz

DC Outputs: Open Collector (requires 10K external pull-ups)
Absolute Max: 35VDC
Operating Range: 0-30VDC

Analog Inputs: Input impedance: 1M ohm
Absolute Max: 40VDC
Operating Range: 0-30VDC
Resolution: 12-bit

Appendix: T.M.C. Specifications
(continued)

2. Antenna Specifications

a. TMC (internal patch antennas)

The T.M.C. utilizes internal patch antennas. If multiple units are in use, separation between units should be 3.3 feet (1 meter) or greater.

b. TMC Bay

c. Iridium antenna requirements (Iridium Approved);

Frequency:	1616 – 1626.5 MHz
Impedance:	50 ohm
Return loss (min):	9.5dB (< 2:1 VSWR)
Gain (weighted average min):	0.0 dBic
Polarization:	RHCP
Operating temperature:	-40 to +85°C

3. GPS Antenna Specifications

Active GPS antenna bias:	3V
Bias current:	35ma max
Frequency:	1575 ±2 MHz
Impedance:	50 ohm
Nominal gain	26 – 28dB (+/- 3dB)
Polarization:	RHCP
Operating temperature:	-40 to +85°C

4. Mechanical Specifications

Enclosure:	TMC
Material:	UV/FR ABS plastic
Dimensions:	127 x 146 x 38.1mm
Approximate Weight:	0.45kg

Enclosure:	TMC Bay
Material:	Extruded aluminium
Dimensions:	100 x 120 x 30.5mm
Approximate Weight:	0.36kg

Appendix: T.M.C. Specifications
(continued)

5. Environmental Specifications

Temperature:

Operating:	-20°C to +60°C
Charging:	0°C to +45°C
Storage:	-5°C to +35°C (within 1 month)
	0°C to +35°C (within 6 months)
Humidity:	≤ 75% RH
Exposure:	TMC Outdoor: IP66 rated

Appendix: Packet Encoding and Decoding

The T.M.C. has a variable report length set by the user's configuration to optimize messaging costs. A standard report is 22 bytes in length and always contains the status of the device, the digital and analog I/O, and the GPS position, as well as the battery status.

Optional configurations can include:

- pulse input information (+4 bytes)
- and/or vibrational information (+4 bytes)
- and/or (for non-tracking applications)
- or remove GPS position (-11 bytes)

Table 1: Report Binary Image

Byte Number	Variable	Bits	Description
0	report type	8	Report Type 0x01
1	periodic	1	bit7 is 1 if this is a periodic report (repeat or TOD)
1	start of repeat	1	bit6 is 1 if this is a start of the periodic repeat
1	data included	6	bit3: include diag, bit2:include vibration, bit1: include position, bit0:include pulse,
2	monitor in alert5		bit5: vibration, bit4: position, bit3:analog, bit2:digital, bit1:pulse, bit0:diagnostics
3	IO, Digital4		bit15 DI2, bit14 DI2, bit13, DO2, bit12 DO1
3,4	IO, Analog	12	bit11:0 analog volts x 100 (0 to 3000 = 0.0 to 30.00)
5	battery level	8	Battery Level * 10 (0.0 - 25.0)
6	GPS time to fix	4	Bits7:4: gpsTTF secs div 5 (i.e. value 2 = 10 secs)
6	Iridium time to fix	4	Bits3:0: iriTTF secs div 5 (i.e. value 2 = 10 secs)
7, 8, 9, 10	time	32	Seconds since UTC EPOCH time if no position

Appendix: Packet Encoding and Decoding
(continued)

Byte Number	Variable	Bits	Description
If position data is included			
bytes 11:13	Long	24	bit23 = N/S (+/-) bitfield[22:0] represents 180deg Longitude bit22 MSb, bit0 LSb
bytes 14:16	Lat	24	bit23 = E/W (+/-) bitfield[22:0] represents 180deg Latitude bit22 MSb bit0 LSb
byte 17	hdop quality	2	bitfield [7:6], 0 = hdop 10.0+, 1= 2.0-5.0 (good), 2=hdop 1.0-2.0 (excellent), 3=hdop<1.0 (ideal)
byte 17	num satellites4		bit 5: vibration, bit 4: position, bit3:analog, bit2:digital, bit1:pulse, bit0:diagnostics
bytes 18:19	Speed1	6	Speed * 10
bytes 20:21	Heading1	6	Heading * 10
If pulse data is enabled			
byte n+1: n+4	pulse accum3	2	pulse accumulation
If vibration data is enabled			
byte n+1: n+4	vibration accum3	2	vibration accumulation
If diagnostic data is enabled			
byte n+1: n+2	degC x 10	16	Degrees C * 10
byte n+3: n+4	Ext Vin1	6	External Power Voltage (Vin) * 10
byte n+5: n+6	Alert Bit Fields	16	bit0: not used, bit1: GPS in fence, bit2: GPS out of fence, bit3: analog in window, bit4: analog out of window, bit5: vibration match, bit6: DI1 is set, bit7: DI1 is clear, bit8: DI1 is changed (toggle) bit9: DI1 pulse match, bit10: DI2 is set, bit11: DI2 is clear, bit12: DI2 is changed (toggle), bit13: low battery, bit14: bad GPS

Appendix: Packet Encoding and Decoding
(continued)

The T.M.C. can be queried, configured and controlled using a binary command structure per the following:

NOTES:

- The command is the Mobile Terminated ("MT->") byte string received by the device
- The reply is the Mobile Originated ("MO<-") byte string sent by the device
- The REPLY ID is the associated CMD ID so the data server can track responses to commands
- A reply of ACK (0x06) indicates the command was successful
- A reply of NACK (0x15) indicates an error in the execution of the command

Direction	Command/Reply	ID	Payload
MT->	0x80	CMD ID	<PAYLOAD, CONFIGURATION IMAGE)
MO<-	0x06/0x15	REPLY ID	<PAYLOAD, CONFIGURATION IMAGE)
Set to Default Configuration (has no parameters)			
MT->	0x80	CMD ID	0x01
MO<-	0x06/0x15	REPLY ID	<PAYLOAD, CONFIGURATION IMAGE)
Get Configuration Command (has no parameters)			
MT->	0x80	CMD ID	0xFF
MO<-	0x06/0x15	REPLY ID	<PAYLOAD, CONFIGURATION IMAGE)

Appendix: Packet Encoding and Decoding
(continued)

Direction	Command/Reply	ID	Payload
Set to Default Configuration (has no parameters)			
MT->	0x82	CMD ID	0xFF
MO<-	0x06/0x15	REPLY ID	<PAYLOAD, CONFIGURATION IMAGE)
Get Diagnostics Report (Type 2) Now Command (has no parameters)			
MT->	0x80	CMD ID	0x01
MO<-	0x06/0x15	REPLY ID	<PAYLOAD, DIAG IMAGE)
Set Digital Outputs Command (includes parameter DO1 and DO2)			
MT->	0x82	0X00	DO2
		For Latitude	bit23 = E/W (+/-) bits22:0 represents 180deg Latitude bit22:17 MSB, bit16:8, bit7:0 LSB
		For Longitude	bit23 = N/S (+/-) bits22:0 represents 180deg Longitude bit22:17 MSB, bit16:8, bit7:0 LSB
MO<-	0x06/0x15	REPLY ID	<PAYLOAD, DIAG IMAGE)

Appendix: Packet Encoding and Decoding
(continued)

Table 2: Configuration Binary Image

Byte Number	Variable	Bits	Description
Command/ Reply Header			
-2	Command or ack/ nack	8	Command or Reply (Ack (0x06) or Nak (0x15))
-1	reply ID	8	command ID or reply ID
Payload Image starts at Byte 0			
0	Type = Configuration	8	Always 0x00
1	Revision	8	configuration revision
Reporting Configuration starts at Byte 2			
2	std report enabled	1	bit7:enabled
2	pos accel report enabled	1	bit6:enabled
2	anna accel report enabled	1	
3,4	repeat minutes	16	Repeat rate in minutes (0 = disabled) (0 to 30days in minutes)
5,6	Time of Day 1	16	Time of Day in minutes since 0:00GMT (0 = disabled) (0 to 23:59hrs in mins)
7,8	Time of Day 2	16	Time of Day in minutes since 0:00GMT (0 = disabled) (tod1 to 23:59hrs in mins)
9,10	Time of Day 3	16	Time of Day in minutes since 0:00GMT (0 = disabled) (tod2 to 23:59hrs in mins)
11,12	Time of Day 4	16	Time of Day in minutes since 0:00GMT (0 = disabled) (tod3 to 23:59hrs in mins)
13,14	accel repeat minutes	16	Repeat rate in minutes (0 = disabled) (0 to 30days in minutes)

Appendix: Packet Encoding and Decoding
(continued)

Byte Number	Variable	Bits	Description
Position Monitor Configuration starts at Byte 15			
15	enabled	1	bit7:enabled
15	alert on exit of Geofence	1	bit6:alert on exit enabled
15	alert on entry to Geofence	1	bit5:alert on entry enabled
15	theft/depot mode	1	bit4:theft=0;depot=1
15	enabled accelerated	1	bit3:accelerated disabled=0; accelerated enabled = 1
16,17	fence radius	16	Fence radius in km * 100 (0.50-2.00)
Analog Monitor Configuration starts at Byte 18			
18	enabled	1	bit7:enabled
18	alert on exit of window	1	bit6:alert on exit enabled
18	alert on entry of window	1	bit5:alert on entry enabled
18	accel outside of window	1	bit3:accelerated mode when inside of
19,20	min level for window	16	min voltage to define window * 100 (0.00-30.00)
21,22	max level for window	16	max voltage to define window * 100 (0.00-30.00)
23	Hysteresis	8	hys voltage for window level crossing * 100 (0.00-2.50)
Digital Monitor Configuration Starts at Byte 24			
24	D1 enabled	1	bit7:dig1 enabled
24	D1 Pulse Mode	1	bit6:D1 in pulse mode
24	D1 alert on _____	2	bit5:4 none, set, clear or change, (or pulse match = set)

Appendix: Packet Encoding and Decoding
(continued)

Byte Number	Variable	Bits	Description
24	D2 enabled	1	bit2:dig2 enabled
24	D2 alert on _____	2	bit1:0 none, set, clear or change
25,26	pulse match count	16	pulse match count (0-65000)
Vibration Monitor Configuration starts at Byte 27			
27	enabled	1	bit7:enabled
27	Mode	1	bit6:mode (VIB TIME, VIB EVENTS)
27	alert on match	1	bit5:alert enabled
28,29	Threshold	16	vibration threshold
30,31,32,33	Match	32	match value for event
34,35	Duration	16	vibration duration for vib event
Diagnostic Monitor Configuration starts at Byte 36			
36	alert on low battery	1	bit7:alert on low battery
36	alert on bad gps	1	bit6:alert on bad GPS
Digital Out Control Configuration starts at Byte 37			
37	D1A control	2	bit 7:6 off, Set, Clear, Toggle
37	D1A event trigger	6	bit 5:0 trigger number
38	D1B control	2	bit 7:6 off, Set, Clear, Toggle
38	D1B event trigger	6	bit 5:0 trigger number

Appendix: Packet Encoding and Decoding
(continued)

Byte Number	Variable	Bits	Description
39	D2A control	2	bit 7:6 off, Set, Clear, Toggle
39	D2A event trigger	6	bit 5:0 trigger number
40	D2B control	2	bit 7:6 off, Set, Clear, Toggle
40	D2B event trigger	6	bit 5:0 trigger number
Power Management Configuration starts at Byte 41			
41	Power mode	3	bits 0:2
42	Protocol	3	bits 4:6 - 0-ASE, 1-GAP, 2-BSN

Appendix: Packet Encoding and Decoding
(continued)

Table 3: Diagnostics Binary Image

Byte Number	Variable	Bits	Description
0	report type	8	Report Type 0x02
1	rev	2	bitfield[7:6] Report Revision (bit 6 =include position data)
1	gps health	6	bitfield[5:0] gps health
2	monitor in alert	5	bit 4: position, bit3:analog, bit2:digital, bit1:pulse, bit0:diagnostics
3	IO, Digital	4	bit 15 DI2, bit 14 DI2, bit13, DO2, bit 12 DO1
3,4	IO, Analog	12	bit 11:0 analog volts x 100 (0 to 3000 = 0.0 to 30.00)
5	battery level	8	Battery Level * 10 (0.0 - 25.0)
6	star8 bars	1	bitfield[7:4] Star8 diagnostic, num bars
6	star8 blockage	4	bitfield[0:3] Star8 diagnostic, blockage
7	good attempts	3	bitfield[6:4] number of success attempts (of up to last 7)
7	total attempts	3	bitfield[6:4] number of success attempts (of up to last 7)
8,9,10,11	time	32	Seconds since EPOCH time
12,13	degC x 10	16	Degress C * 10
14,15	Ext Vin	16	External Power Voltage (Vin) * 10
16,17	Alert Bit Fields	16	bit0: not used, bit1: GPS in fence, bit2: GPS out of fence, bit3: analog in window, bit4: analog out of window, bit5: vibration match, bit6: DI1 is set, bit7: DI1 is clear, bit8: DI1 is changed (toggle), bit9: DI1 pulse match, bit10: DI2 is set, bit11: DI2 is clear, bit12: DI2 is changed (toggle), bit13: low battery, bit14: bad GPS

Appendix: Packet Encoding and Decoding
(continued)

Byte Number	Variable	Bits	Description
If position monitor is enabled include by			
bytes 18:20	gfence center lon	24	bit23 = N/S (+/-) bits 22:0 represents 180deg Longitude bit22:17 MSB, bit 16:8, bit7:0 LSB
bytes 21:23	gfence center lat		bit23 = E/W (+/-) bits 22:0 represents 180deg Latitude bit22:17 MSB, bit 16:8, bit7:0 LSB
Always append firmware version			
byte n+1	Firmware Version	8	Major Revision Number
byte n+2	theft/depot mode	1	Minor Revision Number
byte n+3	enabled accelerated	1	Sub-Minor Revision Number

Appendix: Declaration of Conformity (DOC)

Declaration of Conformity

Application of Council Directive: 2004/108/EC

Standards To Which
Conformity Is Declared:

IEC60945: 2002
Conducted Emissions	Clause 9.2
Radiated Emissions	Clause 9.3
Conducted RF Disturbance	Clause 10.3
Radiated RF Immunity	Clause 10.4
Electrical Fast Transients	Clause 10.5
Electrostatic Discharge	Clause 10.9
Compass Safe Distance	Clause 11.2

Manufacturer's Name: Applied Satellite Engineering, Inc.

Manufacturer's Address: 16559 N 92nd St., Ste 101
Scottsdale, AZ 85260
480-443-1424

Equipment Description: Asset Tracker

Equipment Class: Maritime Navigation and Radio
Communication Equipment and Systems

Model Numbers: **ASE-OSPREY TMC** (Inclusive of ASE-OSPREY TMC BAY)

I the undersigned, hereby declare that the equipment specified above, conforms to the above Directive(s) and Standard(s).

Place: Scottsdale, AZ USA

Signature: *Bill Reddy*

Full Name: Bill Reddy

Position: CTO/Dir. Eng

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www.ase-corp.com

Appendix: Additional Certifications
(continued)

FCC ID: Q639602

IC: 4629A-9602

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