QUICK START GUIDE

MOTOROLA Oncore™ GT
GPS Module for Embedded OEM

A rugged and reliable eight-channel receiver, the **Oncore™ GT** provides position and velocity data anywhere on Earth, at any time of day, in any weather. It also provides accurate time. A one-pulse-per-second signal output is synchronized to UTC within a nominal accuracy of five hundred nanoseconds—ideal for multi-site synchronization and time-distribution applications.

Features

• 8-channel parallel receiver, 8 simultaneous satellite vehicles, L1 1575.42 MHz
• Code plus carrier tracking (carrier-aided tracking)
• Velocity: 1000 knots (515 m/s); > 1000 knots at altitudes < 60,000 ft.
• Position filtering
• Antenna current sense circuit
• Operates from +5 Vdc regulated power
• TTL interface to host equipment
• 3-dimensional positioning within 25 meters, SEP (without Selective Availability [SA])
• Latitude, longitude, height, velocity, heading, time, and satellite status information output either continuously (once per second) or polled
• Differential GPS with Motorola binary corrections
• RTCM SC-104 differential GPS correction input on second comm port
• Motorola binary protocol at 9600 baud
• NMEA 0183 output at 4800 baud: GGA, GLL, GSA, GSV, RMC, VTG, ZDA sentences
• Velocity filtering
• 1PPS output (+/- 500 ns accuracy)

Time To First Fix (TTFF)

- < 15 s typical TTFF-hot (with current almanac, position, time and ephemeris)
- < 45 s typical TTFF-warm (with current almanac, position and time)
- < 90 s typical TTFF-cold

Oncore™ Operation Voltage and Current Ranges

5VDC Main power
Voltage: 4.75 V to 5.25 V
50 mV peak-to-peak ripple
Current: < 0.9 W at 5 V at 25°C with active antenna drawing 20 mA

BATTERY (Externally applied backup power)
Voltage: 2.5 V to 5.25 V
Current: 5 µA typical @ 2.5 V
100 µA typical @ 5.0 V

ONCORE™ USER'S GUIDE

The complete Oncore™ User's Guide is available in Acrobat .pdf file format at the Motorola GPS products website: http://www.motorola.com/ies/GPS/products/manual.html

ELECTRICAL CONNECTIONS

The Oncore™ receives electrical power and receives/transmits I/O signals through a 10-pin power & data connector mounted on the Oncore™. Refer to Figure 1 for pin numbering.

The following table lists the assigned signal connections of the Oncore™ receiver's power and data connector.

Pin #	Name	Description
1	BATTERY	Externally applied backup power (+2.5V to + 5V)
2	+5V PWR	+5 VDC regulated
3	GROUND	Ground (receiver)
4	VPP	Flash memory programming voltage
5	RTCM	IN RTCM input
6	1PPS	One pulse per second signal
7	1PPS RTN	One pulse per second return
8	TTL TXD	Transmit Data 5V logic
9	TTL RXD	Receive Data 5V logic
10	TTL RTN	Transmit/receive return

Table 1 – 10-pin Header Receiver and RS-232 Interface Signals.

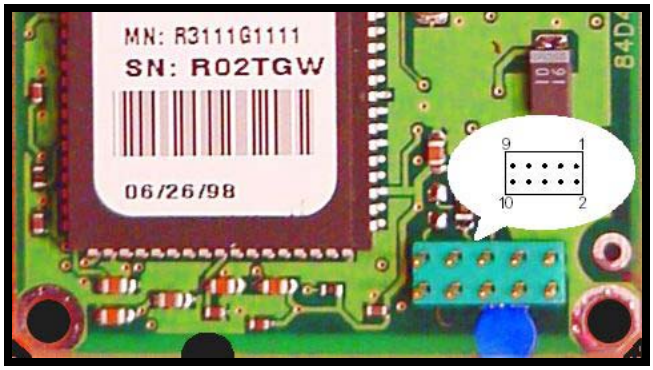

Figure 1 - Oncore™ GPS 10 Pin Connector Pinout

ADAPTING THE OSX ANTENNA CONNECTOR

The OSX antenna connector used on the Oncore™ GPS board will normally need to be adapted to an SMB or BNC connector to match connectors commonly found on GPS antennas. An adapter can easily be made using a short piece of RG-174 coaxial cable with the desired antenna connector.

Refer to Figure 2 for the following instructions.

1. Attach the desired antenna connector (typically SMB or BNC female) to one end of the RG-174.
2. On the end of the cable that will connect to the Oncore™ GPS receiver, remove the outside jacket to approximately 0.75" (2 cm) from the end. Carefully separate the braid of the RG-174 to one side.
3. Remove 1/16" (1.5mm) of the insulator from the center conductor and tin with solder.
4. Twist the braid strands together and cover with shrink tubing, leaving 1/16" (1.5mm) exposed at the end. Tin the exposed end with solder.
5. Solder the center conductor to the center conductor of the OSX connector as shown in the illustration.
6. Solder the shield of the RG-174 to one of the four shield connections of the OSX connector.

Note: The Oncore™ GPS RF Connector is a M/A-COM #5864-5002-10 (OSX) sub-miniature snap-on.

Figure 2 - Antenna Adapter Connection

1PPS SIGNAL

If you are really serious about time, a very accurate clock synchronization option is provided by the constellation of Global Positioning System (GPS) satellites. Each Block II/IIA satellite contains two cesium (Cs) and two rubidium (Rb) atomic clocks. Each Block IIR satellite contains three Rb atomic clocks. In addition to helping people on the ground get their navigational fixes, the satellites transmit precise time pulses synchronized to the on-board atomic clocks.

A one-pulse-per-second signal output by the Oncore™ GPS receiver is synchronized to UTC within a nominal accuracy of five-hundred nanoseconds—ideal for multi-site synchronization and time-distribution applications. The accompanying suggested interface schematic includes optional circuitry to interface the 1PPS pulse to a PC for highly accurate time synchronization of the PC clock.

1PPS Pulse Characteristics:

- 0 to 5 V TTL level pulse
- 1 PPS time mark is synchronous with the mid point of the rising edge of the pulse rising from 0-5 V.
- Rise time is approximately 20 to 30 ns
- 5 V pulse width is approximately 200 ms ± 1 ms
- The falling edge will occur approximately 200 ms after the rising edge
- Accurate to < 500 ns (1 sigma) in stand alone mode (with SA on)

ANTENNA

Inexpensive GPS antennas are often available at www.ebay.com for a cost $10.00-$30.00 Like all things on Ebay, your mileage may vary. **Be certain the antenna is ACTIVE (versus passive) and designed to be powered by 5 volts DC**.

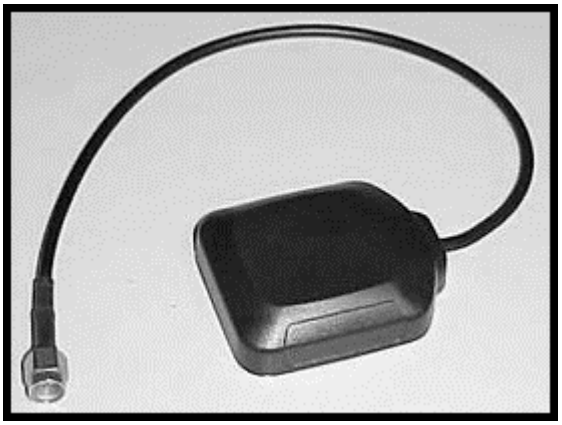

Figure 3 - Active Antenna Obtained from EBAY

GETTING STARTED - SUGGESTED ONCORE™ RS232 INTERFACE

The schematic provided with this guide presents a simple RS-232 interface for use with the Oncore™ GT GPS receiver and a PC or Laptop. This circuit is intended to be a starting point for your design needs. Additional components and design work may be required for your application and construction methods. Refer to the Motorola ***Oncore™ User's Guide*** as the authoritative source for Oncore™ receiver information.

1. Build the RS-232 interface. This interface allows the unit to communicate via RS-232 to a computer. Be certain and provide an adequate heatsink for IC2 if using an LM7805 voltage regulator. Consider using the PT5101 switching regulator for mobile applications to improve regulator efficiency, remove the need for the regulator heatsink and greatly lessen the generation of unwanted heat.

2. Before inserting U2 or U3 into their IC sockets, verify the integrity of the +5VDC supply and ground connections to U2 and U3.

	+5 VDC	Ground
74HC132	14	7
MAX233	7	6,9

Table 2 – Power and Ground Distribution.

3. Verify the RS232 section's integrity by temporarily shorting pins 8 & 9 of the 10-pin header (pin 8 connects to TTL TXD and pin 9 to TTL RXD of the receiver). Attach a PC or laptop to the interface and use a terminal program such as Hyperlink or Procomm to test the interface (the terminal program must be set so it does not automatically echo characters). With the pins shorted, any characters typed should be echoed to the screen if the RS-232 section of the interface is functioning properly. Correct any problems before proceeding.

4. **Verify voltage levels on all pins of the 10-pin connector prior to connecting the Oncore™ to the RS-232 interface! See figure 1 for pin orientation.**

5. Remove power and connect the RS-232 interface to the Oncore™ receiver. Connect an appropriate preamplified GPS antenna to the receiver.

IMPORTANT NOTE: Avoid placing the GPS antenna in close proximity to a laptop or PC. This can cause interference with proper signal reception!

6. Apply power to the interface and use VisualGPS software (*see Software Resources section*) to initialize the Oncore™ receiver to NEMA mode and verify proper operation.

7. Use NMEATime or similar software to verify clock synchronization. **The receiver must first be initialized and changed to NEMA message output in order for NMEATime to work!**

Diagnose further operational problems by verifying connections and signals with a voltmeter and oscilloscope if required.

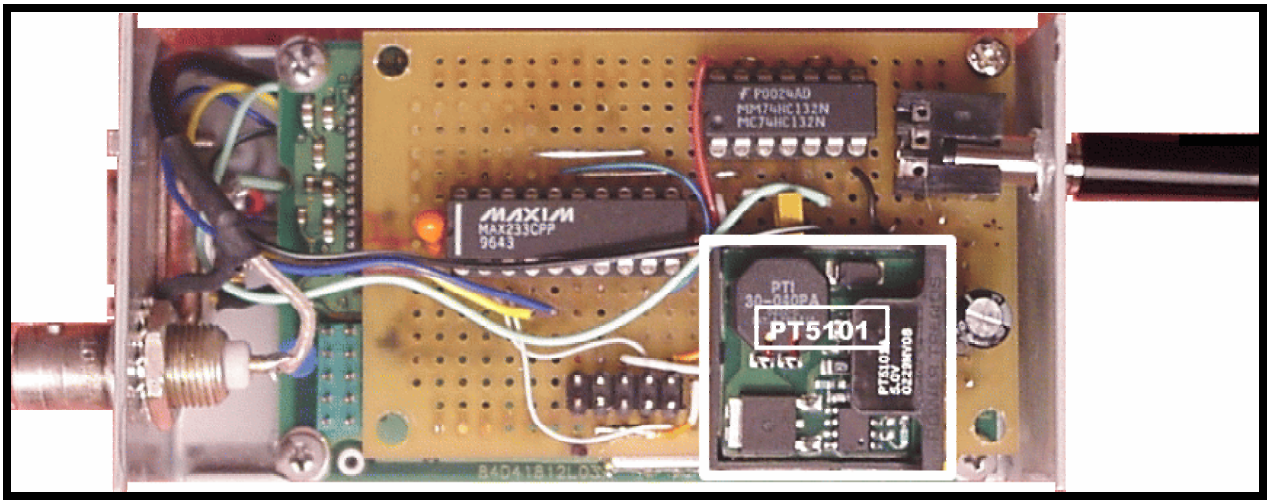

Figure 4 - Prototype RS232 & Clock PC Interface. Shown with optional switching regulator.

SOFTWARE RESOURCES

Many GPS applications found on the Internet utilize "NEMA" communications output protocol between the GPS receiver and PC software. The ability to use this common protocol provides for a large number of existing programs that can be utilized by this receiver**. We recommend you start your functional verification and initial operations with VisualGPS.**

VisualGPS (Freeware) – http://www.apollocom.com/VisualGPS/default.htm
This free program can be used to initialize the Oncore™ receiver to NEMA mode and verify operational parameters. Includes:

- NMEA Command Monitor - View NMEA sentences as they are received
- Signal Quality/SNR Window - Satellite signal to noise ratios for all satellites are displayed graphically.
- Survey - Displays latitude, longitude and altitude graphically. Performs running statistical analysis of location mean and least squares method with standard deviations.
- Navigation - Monitor latitude, longitude and altitude.

NMEATime (Shareware) - http://www.apollocom.com/NMEATime/
NMEA Time sets the PC clock to the time from the GPS receiver. The software uses GPGGA, GPRMC or GPZDA NEMA sentences to obtain time. Time can be set with additional accuracy by using the 1PPS signal from the GPS receiver and optional interface circuitry.

GPSS (FREE/Freeware) - http://www.gpss.co.uk/
Tracking and Mapping Software provided free to individuals to promote business contacts for the vendor. Displayed map resolutions are available down to 1000 feet. Carefully read the documentation on the web site.

Moving Map Software – Any GPS mapping software program that supports NMEA sentences can be utilized for travel and outdoors navigation.

WinOncore12 Software for GPS Receivers (Free)
http://www.motorola.com/ies/GPS/products/winOncore™12.html
WinOncore12 is distributed with Motorola's Oncore™ evaluation kits and is designed for evaluation and testing of Oncore™ GPS receivers. This utility aids the user in initializing and operating the Oncore™ receiver. The software includes diagnostics, satellite signal strength readouts, satellite positions, navigational information, plotting and printing data from the receiver; and recording and replaying data files.

NOTE: You should first initialize the receiver using the Setup Receiver button:
No response will be available unless this is done first!

INFORMATION LINKS

ONCORE™ MANUAL ONLINE (.pdf)
http://www.motorola.com/ies/GPS/products/manual.html

ONCORE™ TECHNICAL APPLICATION NOTE - Oncore™ NMEA Output
http://www.motorola.com/ies/GPS/pdfs/nmea.pdf

TAPR
www.tapr.org - TAPR - TAPR was founded in 1982 as an international organization with interests in the areas of packet and digital communications. It supports some interesting uses for the Oncore receiver, often utilized by amateur radio operators as well as commercial interests. Visit the website for more information.

Synergy Systems, LLC
http://www.synergy-gps.com/ - Stocks popular models of Motorola's Oncore™ GPS cards, antennas, cables and accessories for further development needs, Motorola's User's Guides, manuals, and WinOncore12 software.

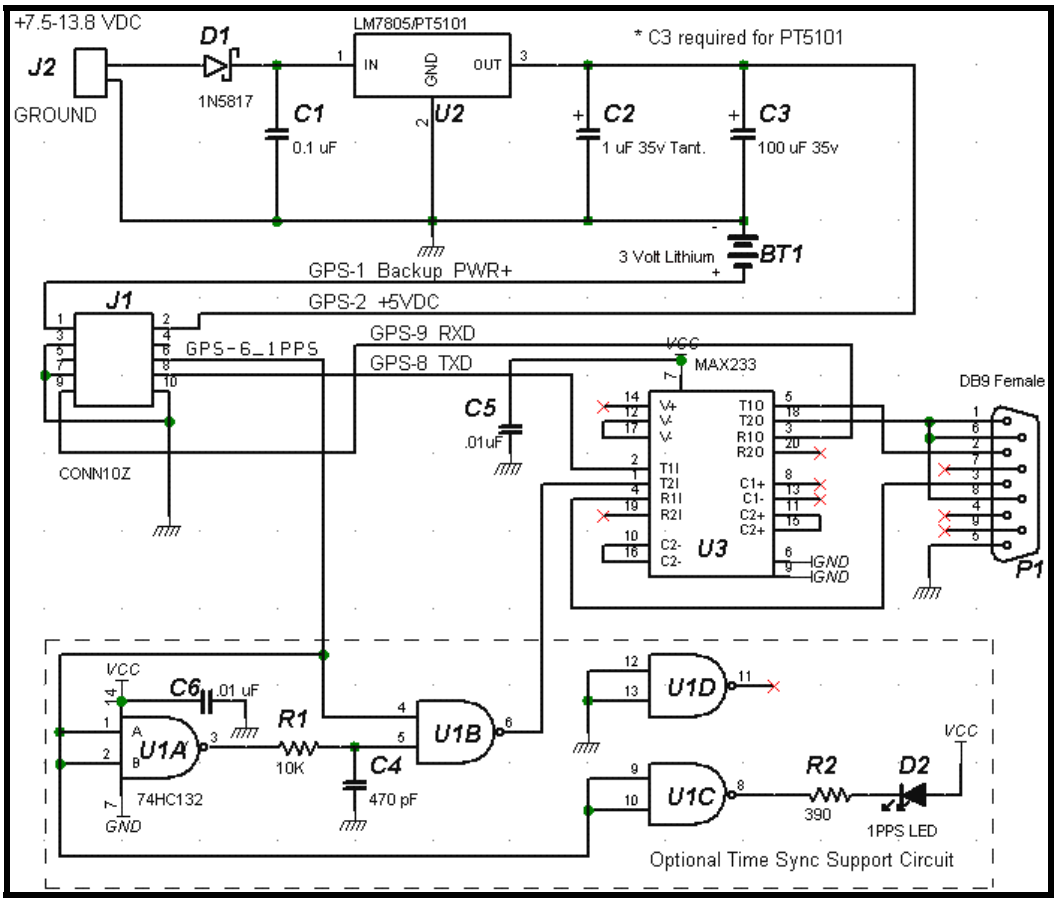

Figure 5 - Suggested RS-232 GPS Receiver to Computer and Time Sync Interface

Bill of Materials			
Item	Qty	Ref	Value
1-3	1	C1, C5, C6	0.1 uF bypass capacitors
4	1	C2	1 uF 35v Tantalum.
5	1	C3	100 uF 35v electrolytic
6	1	C4	470 pF
7	1	R1	10 kΩ
8	1	R2	390Ω
8	1	D1	IN5817 Schottky Diode or similar
9	1	BT1	3 volt Lithium Battery (and holder)
10	1	U1	MAX233
11	1	U2	74HC132
12	1	U3	LM7805 or PT5101 5 volt regulator
13	1	LED	
14	1	P1	DB9 Female connector
15	1	J1	10 pin male PCB header connector
16	1	J2	Coaxial power connector, female PCB mount
17	1	Cable	10 pin ribbon cable with female 10 pin female header each end
18	1	sockets	14 pin & 20 pin IC sockets
19	1	Holder	Coin cell lithium battery holder
20	1	misc.	0.1’ prototype PCB, RG-174 with BNC or SMB Female connector
21	1	Case	Appropriate project case

Table 3 - Parts List