MOTOROLA

Position and Navigation Systems Business

XT ONCORE
Engineering Notes

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Motorola. Inc.
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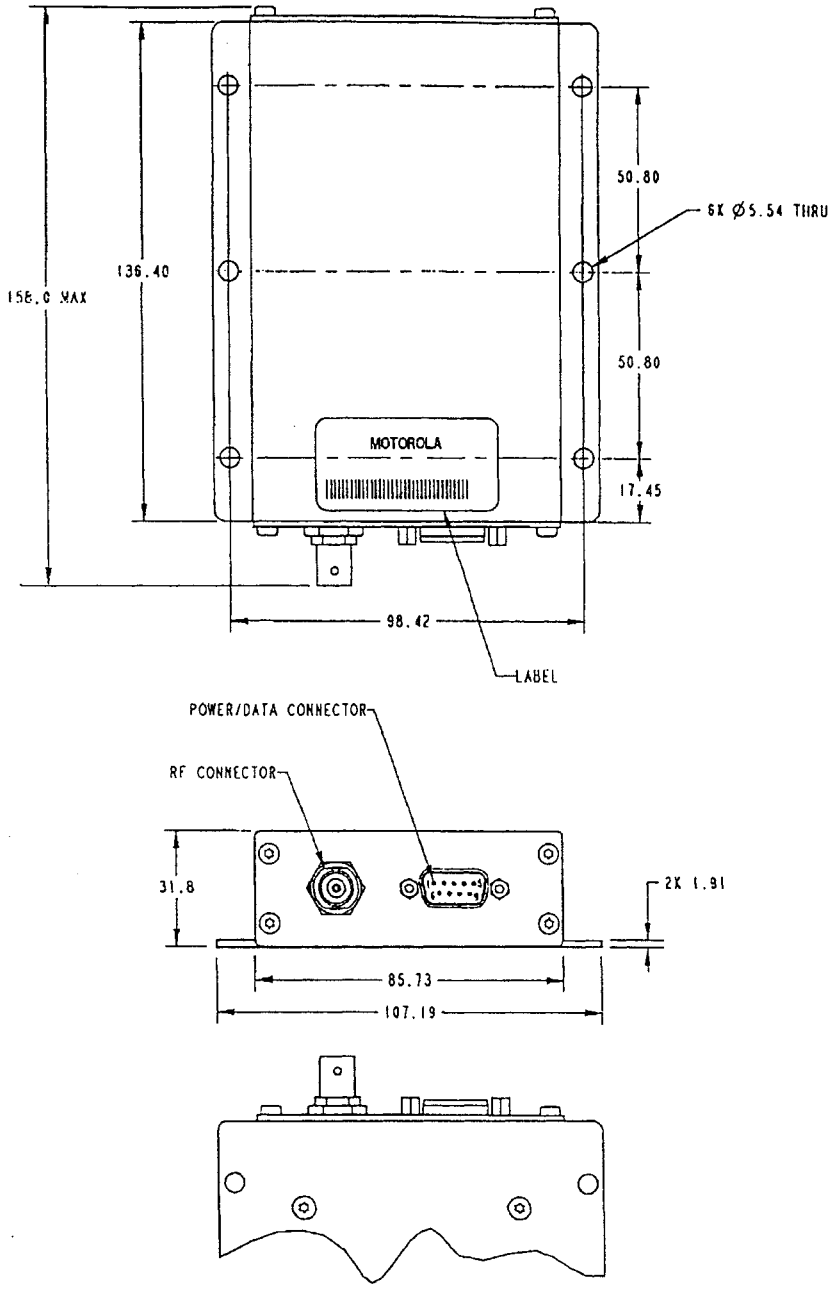
1. Product Specifications

Receiver Architecture	• 6 channel • L1 – 1575.42 MHz • C/A code (1.023 MHz chip rate) • Code plus carrier tracking (carrier aided tracking)
Tracking Capability	• 6 simultaneous satellite vehicles
Dynamics	• Velocity: 1000 knots (515 m/s) >1000 knots at altitudes < 60,000 ft • Acceleration: 4g • Jerk: 5 m/s^3
Acquisition Time (Time to First Fix (TTFF)	• 18 sec. typical TTFF (with current almanac, position, time, and ephemeris • 45 sec. typical TTFF (with current almanac, position, and time) • 2.5 sec. typical reacquire
Positioning Accuracy	• Less than 25 meters, SEP (without SA) • Less than 100 meters, SEP (with SA) • DGPS accuracy: 1-5 meters typical
Timing Accuracy (1 Pulse Per Second, 1PPS)	• 130 ns observed (1σ) with SA on • In Position-Hold mode, <50 ns observed (1σ) with SA on
Antenna	• Active micro-strip patch antenna module • Powered by receiver module (25 mA @ 5V)
Datums	• 49 std datums, 2 user defined, default WGS-84
Output Messages	• Latitude, longitude, height, velocity, heading, time, satellite tracking status (Motorola Binary protocol) • NMEA-0183 v2.00 (selected formats) available • Software selectable output rate (continuous or poll) • Broad list of command/control messages • RS-232C interface
Power Requirements	• 9 to 16 Vdc
"Keep Alive" BATT Power	• 4.75 - 16 Vdc; 0.3 mA (max) or • 3V onboard battery; 15 uA typ., 60 uA max.
Power Consumption	• 1.8W @ 12 Vdc
Dimensions	• Receiver: 5.5 x 4.2 x 1.25 in. (140x107x32 mm) • Active antenna: 4.01d x 0.89 in. high (102x22.6 mm)
Weight	• Receiver in metal housing: 13.9 oz (393 g) • Active antenna module: 4.8 oz (136 g)
Connectors	• Data/Power: DB-9 • RF: BNC
Antenna to Receiver Interconnection	• Single coaxial cable (6 dB max loss at L1; 1574.42 MHz)
Operating Temperature	• Receiver module -30°C to + 85°C • Active antenna -40°C to + 100°C
Humidity	• 95% non-condensing, +30°C to + 60°C
Altitude	• 60,000 ft (18 km) • > 60,000 ft (18 km) for velocities < 1000 knots
Optional Features	• 1PPS Timing Output • Raw measurement data • Onboard rechargeable lithium battery
DGPS	• Differential GPS – standard software feature • RTCM-104 format (remote input) • Motorola Custom Format

2. Mechanical Dimensions

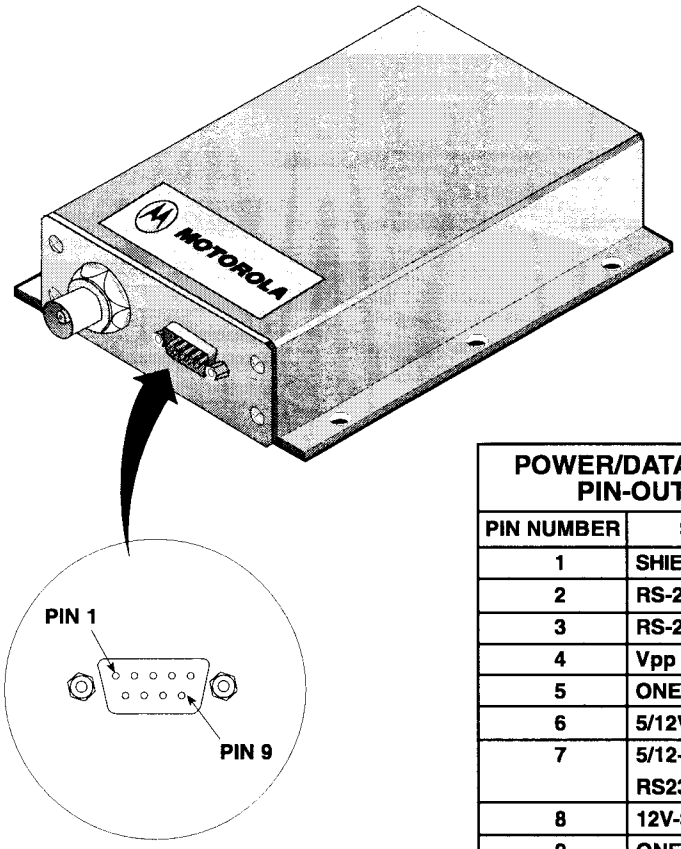


NOTES:

1. Materials.
   1.1. Housing: Black Anodized Aluminum
2. Mating connectors:
   2.1. RF - 50 Ohm BNC connector
   2.2 Power/Data Standard Subminiature D connector

All Dimensions are reference only
All Dimensions are in Millimeters

3. Pin Out Designations



POWER/DATA CONNECTOR PIN-OUT DETAILS	
PIN NUMBER	SIGNAL NAME
1	SHIELD TO CASE/EMI GND
2	RS-232-RXD
3	RS-232-TXD
4	Vpp
5	ONEPPS-RTN
6	5/12V-BAT
7	5/12-RTN AND RS232-RTN
8	12V-SW
9	ONEPPS

4. Operating Voltage and Current Ranges

12 Vdc PWR (Main power)

- Voltage
  9 Vdc to 16 Vdc
- Power
  1.8 W @ 12 Vdc over temperature range
- Current with Active Antenna
  158 mA typical @ 12V at 25°C
  172 mA max @ 12V over temperature range

BATTERY

External Applied Back-up Power

- Voltage
  4.75V to 1 6V
- Current
  0.140 mA typical; 0.3 mA max over temperature range

OR

Lithium Battery Option

- Voltage 3V
- Current
  Typical 5 μA @ 25°C
  10 μA max @ 25°C
  60 μA max @ 60°C
- Battery life
  90 mAh life between charges
  at 10 uA load a fully charged battery will last 3 months without recharging.
  Full component life: 5+ years
- Recharge
  Automatically recharged by 12V main power
  Recommended first time charge: 24 hours

Lithium Battery Option Users

CAUTION

Production Units

No electrical connection exists between the Lithium battery and the external applied back-up power. This opening was designed intentionally and it is recommended that this pin be left open and unused.

Recharge

Recharging of the Lithium Battery is accomplished automatically while the receiver is powered on. A one time, overnight recharge is recommended prior to usage to ensure the battery is charged and ready.

5. Active Antenna Information

- Active Antenna
- 24 dB Amplification
- 25 mA @ 5 Volts (max 50 mA)

MOTOROLA ONCORE
GPS RECEIVER/ACTIVE ANTENNA RF INTERFACE SPECIFICATIONS
V1.5

Amplification	24 dB
Power of Receiver Module	25 mA @ 5 Vdc (max 50 mA)
Input Impedance	50 Ω
VSWR	2:1 maximum @ 1575.42 MHz (+/- 1 MHz)
Connector type	BNC Jack, panel mount
Preamplifier power	+5V, 25 mA available at connector

Recommended Antenna Design Guidelines

Operating frequency	1575.42 MHz
Bandwidth	30 MHz typical
Polarization	Right hand circular
Pattern	Essentially hemispherical
Gain Characteristics	• +3 dBic minimum at 90° above the horizon (zenith) • 0 dBic minimum at 30° above the horizon • -6 dBic minimum at 0° (horizon)
VSWR	2:1 maximum at 1575.42 MHz, +/- 1 MHz into a 50 Ω system
Preamplifier Gain	18 dB minimum (including 6 dB cable loss)
Noise Figure	2.5 dB maximum

6. EMC (Electro-Magnetic Compatibility) Considerations

- *RF Interference:* When designing the XT Oncore near and around RF sources such as radios, it is recommended that the XT Oncore be tested and tried in the target environment to identify potential interference issues prior to final design.
- *Note:* Because the GPS Oncore receiver contains a very sensitive RF receiver you must observe certain precautions to prevent possible interference from the host system. Because the electromagnetic environment will vary for each OEM application, it is not possible to define exact guidelines to assure electromagnetic compatibility.

7. RTC (Real Time Clock)

The RTC is a feature of the XT Oncore. The user has three options regarding time initialization:

1) Set time manually in idle mode, OR,
2) Set time in fix mode BEFORE receiver acquires any satellites, OR,
3) Receiver will automatically set time in fix mode AFTER the receiver acquires satellites.

- *Note:* Time cannot be set in fix mode while the receiver is tracking satellites.

With the Real-time clock and no Lithium battery option, the receiver will start up but will have an incorrect time unless it was previously set and maintained by an external battery. To ensure a faster time to first fix, the time, date and GMT offset should be re-set if both the main power and battery backup power have been disconnected.

With the RTC and the Lithium battery option on-board, the receiver clock is set to UTC time prior to shipping and maintained by the on-board Lithium battery automatically.

8. 1 PPS Signal Definition

- 0 to 5V level pulse
- 1PPS time mark is synchronous with rising edge of pulse - rising from 0V to 5V. Rise Time is approx. 20 to 30 nanoseconds
- 5V pulse width is approx. 200 milliseconds (+/- 1 millisecond), i.e. the falling edge will occur approximately 200 milliseconds after.rising edge
- Accuracy: 130 nanoseconds observed (1σ) with SA on. In position hold mode, <50 nanoseconds observed with SA on.

9. RF Application Note

Active Antenna System

Both the gain and the noise of the overall system affect the performance of the A/D convertor in a GPS receiver. The illustration below illustrates typical values for the Oncore family of GPS receivers when used with the Motorola antenna and standard RG-58 cable. The thresholds and ranges listed should be considered with a tolerance of 2 to 3 dB.

System constraints:

1. The gain in decibels is cumulative through all stages (i.e. G = G1+ G2 + G3...). The optimal gain of the antenna, cabling and any in-line amplifiers and splitters is 18 dB +/- 8 dB. The Oncore receiver may operate outside of the optimal gain range but performance will degrade. Therefore, Motorola does not recommend operating outside of the optimal gain range as indicated above. For the system below, the gain is 18 dB in front of the receiver.

2) System noise (F) is not to exceed 4 dB. The cascaded system noise figure

   is F = F1 + (F2-1/G1) + (F3-1/(G1*G2)) + …., (= 2.7 dB for the system below)

   where F1 is the noise figure for stage one and G1 is the gain for stage one. Note that all of these values are absolute. Recall the formula for converting absolute values to decibels:

   F(dB) = 10 * log(F)