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Introduction

General Overview

Congratulations on your purchase of the Magellan S@tellite Modem Board and/or S@tellite Modem Development Kit. The S@tellite Modem Development Kit allows system integrators to immediately evaluate, interface and develop hardware and software solutions using the S@tellite Modem. It includes all components necessary to make development into existing applications quick and easy.

With your S@tellite Modem, you can send and receive messages to any email address in the world. Unlike traditional modems connected to telephone lines, the S@tellite Modem communicates directly with the ORBCOMM constellation of 28 Low Earth Orbit (LEO) satellites via VHF link. Each modem has its own email address, which can send & receive email via satellite from anywhere to anywhere.

Your Magellan S@tellite Modem has built-in functions to automatically send GPS positions at pre-programmed intervals, when polled, or when crossing user-defined boundaries. Your modem will also send a message when the state of digital inputs change or when they reach a target value. For the programming/uploading of these features we have included S@tellite PC software in this kit.

The following items come standard with your new S@tellite Modem Development Kit: S@tellite Modem, Controller Interface Board, combined ORBCOMM + GPS external antenna, wide range power supply, interface cable, S@tellite PC Software, Evaluate Software and technical manuals/documentation.

For purposes of this manual, we will be addressing setup for the development kit operation first, then board-only application information will follow. To help you get started with your development kit, turn to the section titled "**Getting Started**". This section is designed to summarize how to: interface with the S@tellite Modem, obtain GPS fixes, send and receive messages using the S@tellite software provided with this development kit. If you ordered a S@tellite Modem board only, you will need to develop application software to interface with the board to perform the above functions.

Message Activation

Prior to use, your S@tellite Modem must be activated with ORBCOMM Customer Service. A set of Activation Instructions has been included with this development kit to guide you through the activation process. Included in this packet are instructions, registration forms, and a list of contacts.

Contacting Magellan

If you need to contact Magellan Corporation regarding your S@tellite Modem Development Kit, please refer to the following information:

Magellan Corporation/Wireless Communications
471 El Camino Real
Santa Clara, CA 95050-4300
Sales Number: (408) 615-5100 or (800) 922-2401; Fax Number: (408) 615-5200
Technical Support Number: (800) 229-2400
Website: www.magellangps.com
Email: wireless.support@magellangps.com

2

S@tellite Modem Development Kit

This section describes the operation of your S@tellite Modem as part of the development kit, including an overview, descriptions of hardware and software, as well as steps for interfacing, sending/receiving messages and obtaining GPS position fixes. For information on the S@tellite Modem board, see ”S@tellite Modem Board” on page 3..

Overview

Your Magellan S@tellite Modem Development kit provides the tools necessary for developing an application using the ORBCOMM Satellite System. The ORBCOMM system uses low-Earth orbit satellites to provide cost-effective monitoring, tracking, and messaging capabilities. The system, similar to two-way paging or email, is capable of sending and receiving two-way alphanumeric "packets" of data. These economical messages increase the productivity and efficiency of your remote operations by making location coordinates and other critical information readily available-often from areas that are beyond the geographic and economic reach of traditional systems.

These applications can be classified into three major categories:

- **Fixed Asset Monitoring** - These applications provide the end user with a means to monitor fixed asset sites in many locations without the need for travel and personal inspection. Examples of these applications are meter reading, pipeline monitoring, and marine buoy monitoring. Magellan's S@tellite Communicators are power-efficient, so you don't need to deploy expensive infrastructure at each communicator location.
- **Mobile Asset Tracking** - These applications involve reporting of asset locations, usually at periodic intervals. Position determination is usually performed by the use of GPS circuitry in conjunction with the S@tellite Communicator. Examples of these applications include auto/truck fleet tracking, trailer tracking, and tracking of railcars. By attaching a small Magellan S@tellite Communicator, you can know where your asset is, if it's moving, or even how long it hasn't been moving. Knowing the location and availability of your property-and being able to respond immediately when problems do occur-will help you maximize revenue and decrease costs.
- **Personal Messaging** - These applications involving sending and receiving Internet email over the ORBCOMM satellite system. Messaging can be commercial, such as ordering a part or personal such as checking on your family from any location - all without worrying about terrestrial service coverage limitations.

Contents of the Development Kit

This section describes the contents of the S@tellite Modem Development Kit including hardware and software. Inspect all parts for signs of physical damage. Contact Magellan for a replacement of any missing or damaged parts.

S@tellite Modem Board

The S@tellite Modem Board (Figure 2.1) allows you to establish a low-cost-two-way communication channel between your equipment and the ORBCOMM satellite system. It is available with embedded

GPS, configurable digital I/O, built-in functions which you configure and the standard ORBCOMM serial interface protocol.

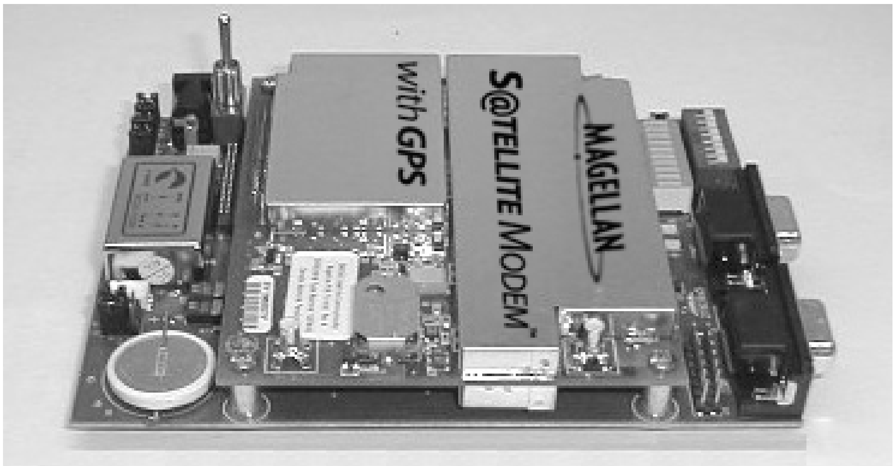


Figure 2.1. S@tellite Modem Board

Controller Interface Board

Included in the S@tellite Modem Development Kit is a controller interface board (Figure 2.2) that the S@tellite Modem plugs into. This provides the following functions: DTR/DSR toggle switch, breakout connector providing access to all of the pins on the board, power regulator which supplies the modems required +12VDC and +5VDC, reset buttons to return the modem to the factory default parameters, eight toggle switches which exercise each corresponding digital input, output, and ORBCOMM & GPS serial ports.

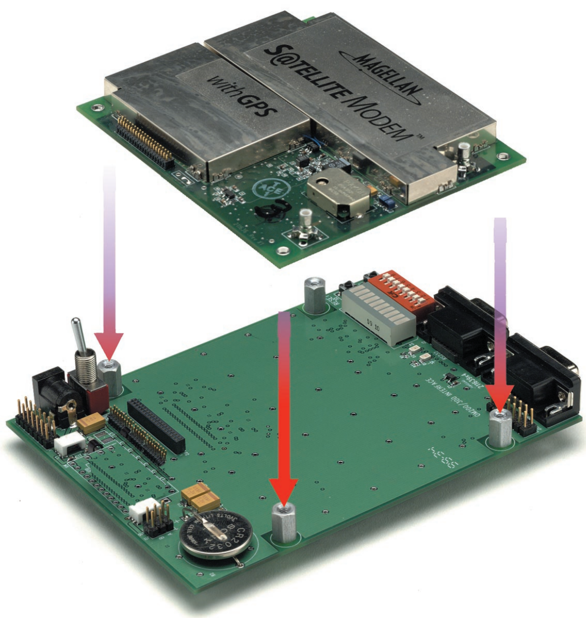


Figure 2.2. Controller Interface Board

Combined ORBCOMM and GPS Antenna

The S@tellite Modem Development Kit comes standard with a combined ORBCOMM and GPS vehicle mount antenna from Magellan. This dual antenna is in a single integrated device with a separate feed line for each band. A 3.5 dB microstrip patch antenna with 25 dB gain LNA serves the GPS function. A rugged, low profile, encapsulated 15.5" Flex Mast antenna rounds out the VHF element. Several mounting configurations are available: rooftop, for permanent installation; magnetic, for temporary usage (i.e. for vehicle mounting); and trunk lid, for semipermanent installation.

A fixed-mount, high-gain VHF antenna is available for installations where a longer cable is needed (for example, mounting on a roof). Do NOT add to or extend the cable length of the vehicle mount antenna. Doing so will cause the S@tellite Modem to not work correctly.

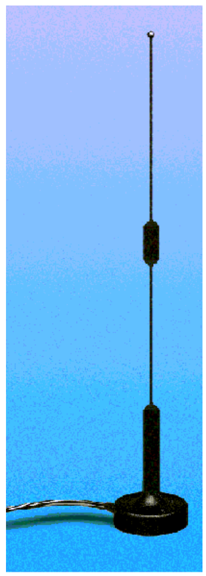


Figure 2.3. ORBCOMM/GPS Antenna

S@tellite PC Software

This software is a tool for controlling and testing both the ORBCOMM and GPS functions of your S@tellite Modem. It provides menus for all of the packet types defined in the ORBCOMM Serial Interface Specifications as well as allows sending and receiving email.

Evaluate 5.0 Software

Magellan’s Evaluate software provides system integrators and end users with a quick and simple way to interface with the GPS functions of your S@tellite Modem to gauge performance and develop an integrated system.

Installing the Antenna

The combined ORBCOMM/GPS (VHF) antenna included in the development kit is a single integrated device with a separate feed line for each band. A 3.5 dB microstrip patch antenna with 25 dB gain LNA serves the GPS function and terminated in a red labeled SMB connector. A rugged, low-profile, encapsulated flex mast antenna rounds out the VHF element (which terminates in a SMB connector).

Connect the red labeled SMB antenna connector to the S@tellite Modem's GPS connector. Next connect the SMB connector (no label) to the ORBCOMM connector. The antenna should have an unobstructed view of the sky for optimal tracking and communication results.

CAUTION
The standard antenna included with your development kit is a magnetic mount. Place the antenna on a metallic surface such as a ca. The metallic surface serves as a ground plane, and without it, you may encounter performance problems.

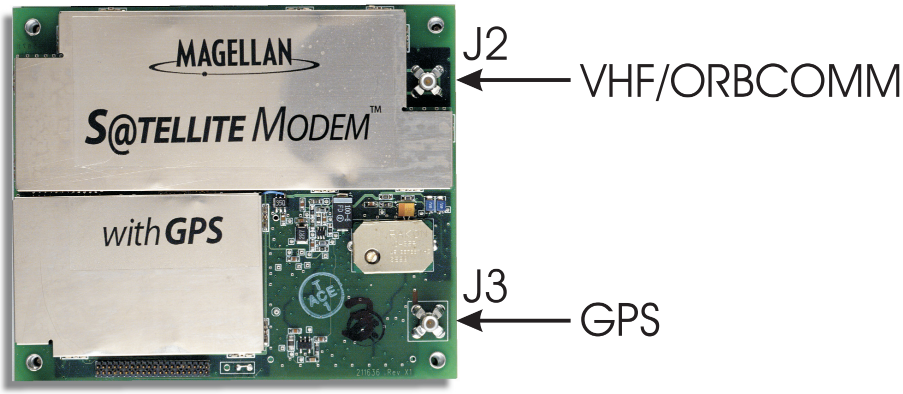


Figure 2.4. Antenna Connections

Connecting the Interface Board to the S@tellite Modem

This section guides you through the setup of your S@tellite Modem using the development kit and the procedures necessary to obtain GPS position fixes, send and receive email messages and poll for position.

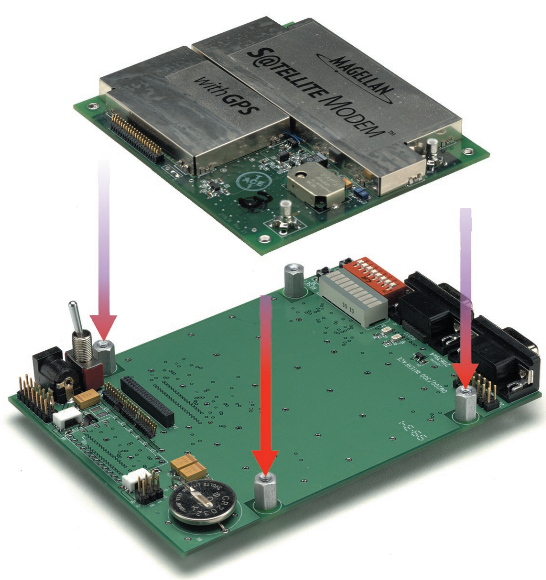


Figure 2.5. S@tellite Modem with Interface Board

Before initiating satellite communications with the S@tellite Modem (see Activating Instructions) contact ORBCOMM to provision the S@tellite Modem. If the S@tellite Modem was purchased separately (without the contents of the development kit), contact Magellan Corporation.

Initializing the S@tellite Modem

Before testing the S@tellite Modem with the ORBCOMM system, it is recommended that you configure your parameters using S@tellite PC. It is not necessary to have the ORBCOMM/GPS antenna connected at this time

- Verify the S@tellite Modem is connected to the Controller Interface Board provided with the Development Kit.
- If the antenna is installed, connect the antenna cable to the S@tellite Modem's SMB jack.
- Power the unit by connecting the cable on the +12V power supply provided with the developer kit to the round power port (refer to figure 2.2) on the Controller Interface board. The +12V power supply then plugs into any standard AC outlet (US type).
- The LED light labeled "AWAKE" on the controller interface board will come on in green which indicates that the board is running.
- Connect the provided DB9 cable to the ORBCOMM serial port on the S@tellite Modem and on the DB9 port on your computer.
- Run S@tellite PC by clicking on the S@tellite PC icon on the computer desktop (see the S@tellite PC manual for installation instructions).
- Verify connection to the S@tellite Modem (see S@tellite PC manual).
- Configure your S@tellite Modem (see S@tellite PC manual for step-by-step instructions).
- If any problems occur, contact Magellan.
- Disconnect the power cable from the S@tellite Modem to turn off power to the unit. When the power cable is reconnected, the unit will function as last configured.

Obtaining a GPS Fix

When you switch on the S@tellite Modem for the very first time it has to initialize its GPS receiver, and internal clock. Thanks to the built-in Magellan G10 GPS Receiver, you do not have to provide any input for this initialization, the process is entirely automatic.

Make sure that:

1. the S@tellite Modem board is correctly and securely connected to the interface board,
2. both antenna connectors are securely connected,
3. the antenna is placed somewhere with a clear view of the sky.

Apply power to the Interface Board, and switch the DTR (power) switch on. Now go and have a cup of coffee, and the S@tellite Modem will initialize itself in 5 to 15 minutes. This process is known as a "cold start".

Once the unit computes a GPS position, the position is updated every 5 minutes by default. This period can be changed using the timeout command built into the Satellite PC software. To change the period using Satellite PC, click on "Configuration" in the top menu and select "New". Now select "Timeouts" from the drop down menu and change the Torb setting to a new value. This setting defines the time period for which the unit will be in Orbcomm mode. So if you want GPS position to be updated every 10 minutes, you will have to set the Torb to 10 minutes. Refer to Satellite PC User's Guide for more information.

To see the position status all you have to do is click "View" from the top menu and select "Modem Status". This will open a window that shows the Modem Status, which also indicates the present GPS position (Latitude and Longitude).

During a "cold start" the S@tellite Modem dedicates almost all of its resources to finding GPS satellites. Response to serial port commands may be very slow during this time, and you are advised not to send any serial port commands during the cold start.

As long as the S@tellite Modem remains connected to the memory backup battery (and you do not push the "Reset" button on the interface board), then the internal clock will maintain correct time and the GPS satellite data will be maintained in memory; future power-ups will be "warm starts" which take less than one minute (again, with no user input required).

On any power-up the default behavior of the S@tellite Modem is first to go into GPS mode, then, after getting a position fix, to go into ORBCOMM mode. This is described in Figure 4.1. You can see the status of the S@tellite Modem (whether in GPS or ORBCOMM mode) by using the "Status" window provided in the S@tellite PC software.

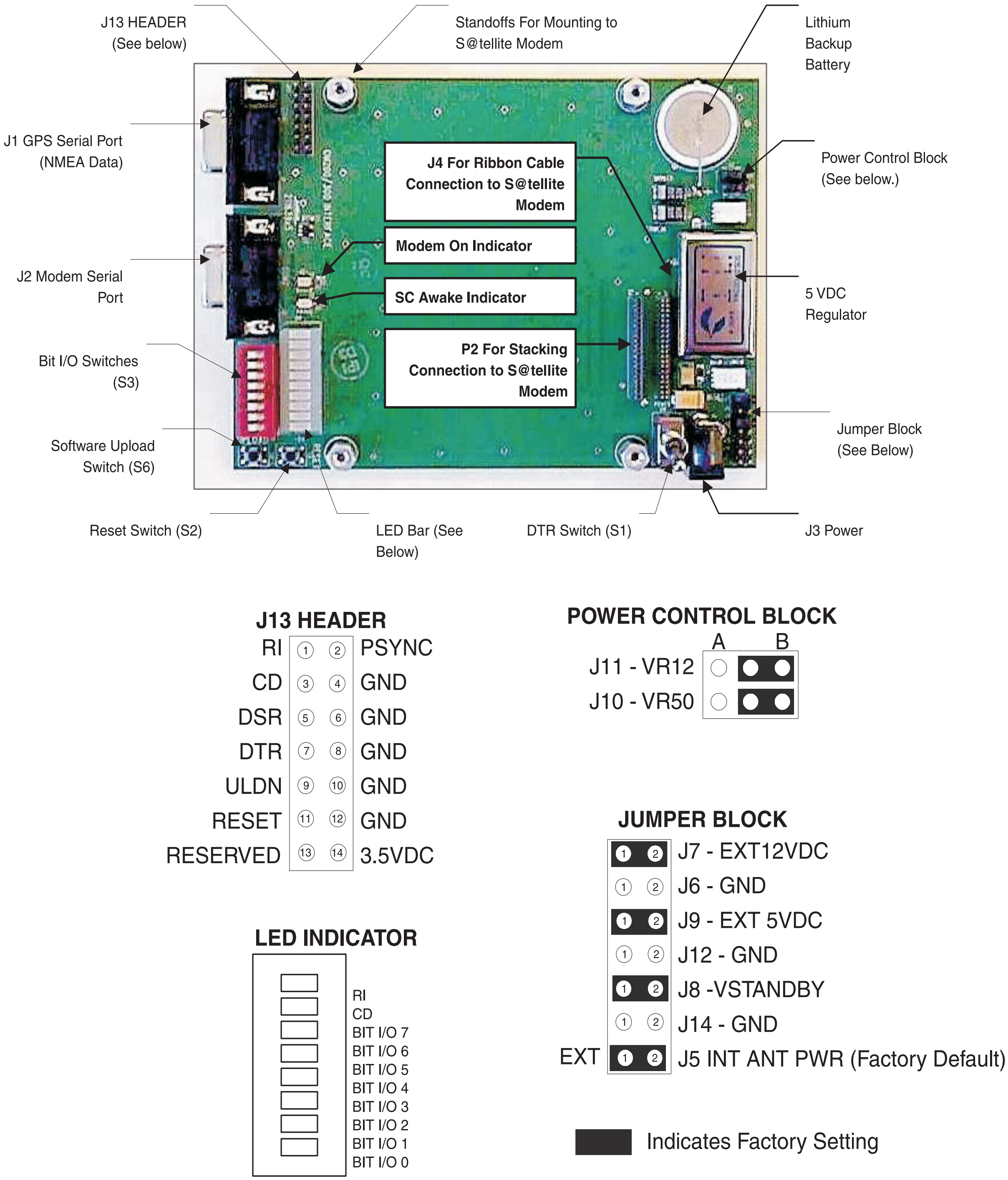


Figure 2.6. Controller Interface Board

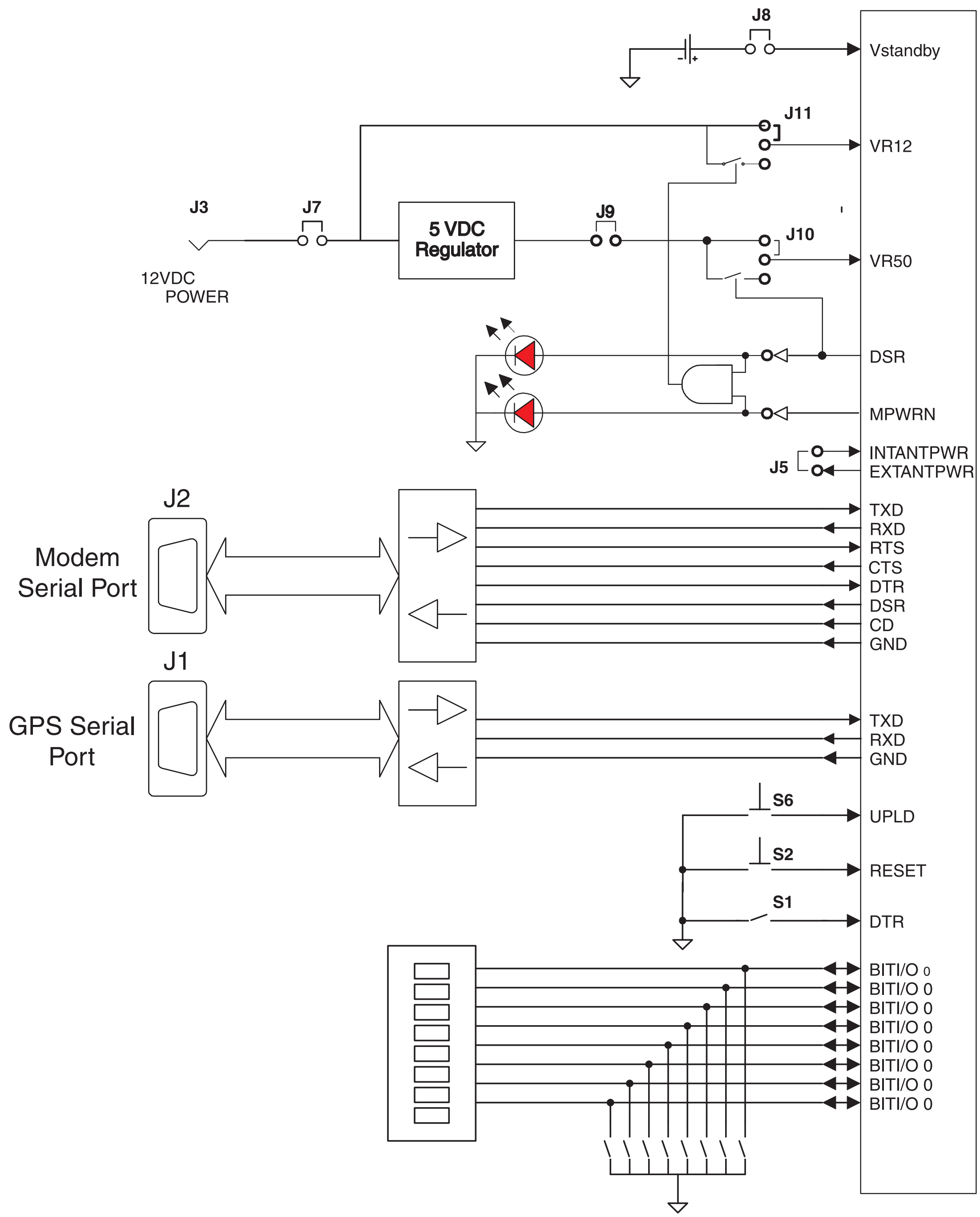


Figure 2.7. Controller Interface Board Block Diagram

The Development Kit interface board leaves the factory with six (6) jumpers in place. The factory location of these jumpers is J5, J7,J8, J9, J10, and L11; as shown in the figures below. The labels J5, etc. are printed on the interface board. If the jumpers are removed, you should replace them in their default positions. The functions of these jumpers are described in Figure 2.2.

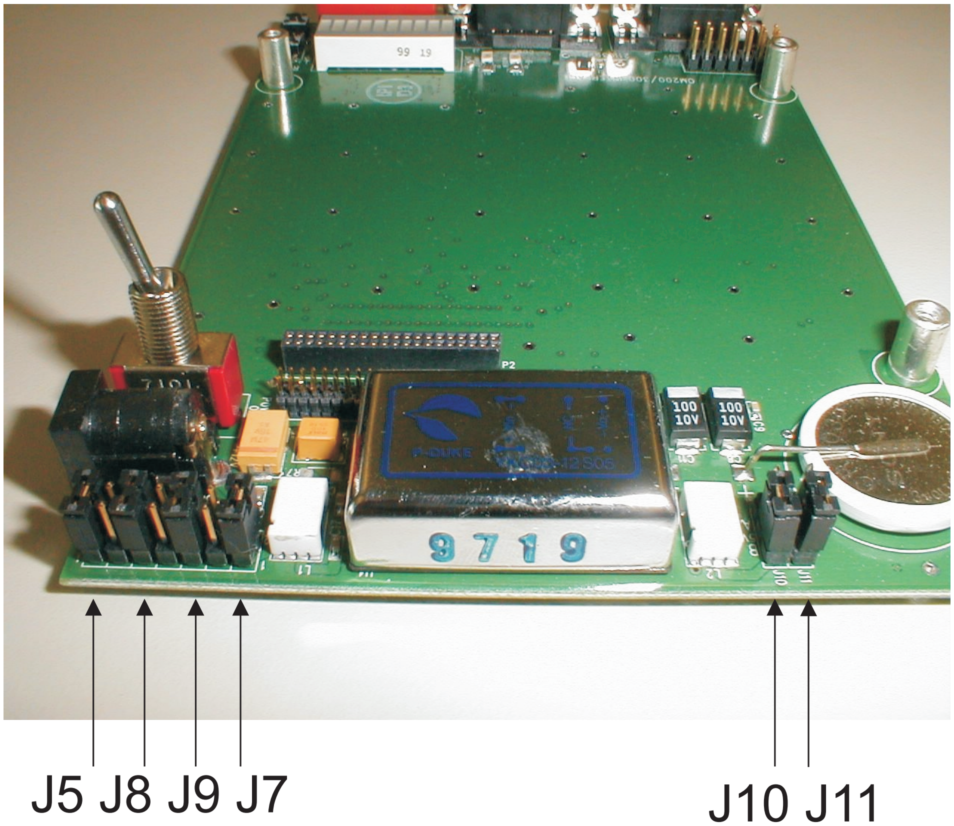


Figure 2.8. Location of Jumpers J5, J7, J8, J9, J10, and J11

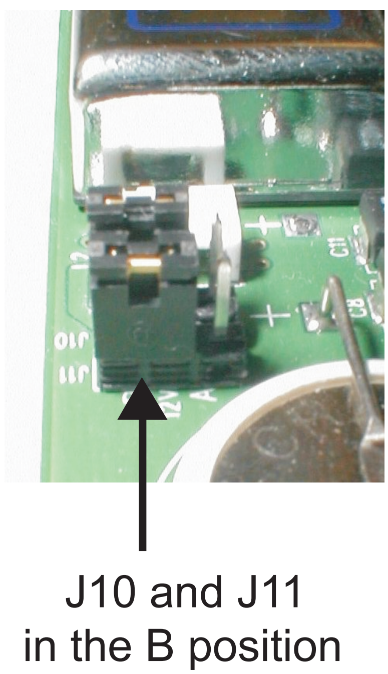


Figure 2.9. Jumpers J10 and J11 in the B Position

Sending Messages

The following messages, called "packets" by the S@tellite PC program, are available to send to the S@tellite Modem.

Commands:

- Communications Command
- Configuration Command
- Position Determination Command

Messages:

- SC-Originated Message
- SC-Originated Default Message

Reports:

- SC-Originated Report
- SC-Originated Default Report

Globalgrams:

- SC-Originated Globalgram

Get/Set Parameter:

- Get Parameter
- Set Parameter

Refer to the ORBCOMM Serial Interface Specification for detailed tables describing how to use these messages.

Refer to the S@tellite PC Manual Section 3.8 ("Terminal Window") for an explanation of how you can use S@tellite PC to send these messages through the S@tellite Modem.

The "SC-Originated Message" allows you to send an email through the S@tellite Modem to another email address. Again, using the Satellite PC program, you can do this through either the **Terminal** Window or the **Mailbox** Window. Refer to the S@tellite PC Manual Sections 3.8 ("Terminal Window") and 3.10 ("Mailbox Window") for details.

Also, you are able to view the number of messages sent that are currently in Modem Memory by viewing the **S@tellite Modem Status** Window in the S@tellite PC program (in the field called "Number of SC-Originated Messages in memory"). Refer to the S@tellite PC Manual Sections 3.9 ("S@tellite Modem Status Window") for details.

Receiving Messages

You may receive messages from the S@tellite Modem. These messages will be as an email. You can view these e-mails using the Mailbox Window in the S@tellite PC program. Refer to the S@tellite PC Manual Section 3.10 ("Mailbox Window") for details.

Also, you are able to view the number of messages received that are currently in Modem Memory by viewing the S@tellite Modem Status Window in the S@tellite PC program (in the field called "Number of SC-Terminated Messages in memory"). Refer to the S@tellite PC Manual Sections 3.9 ("S@tellite Modem Status Window") for details.

Installation Notes

In the event that the S@tellite Modem does not operate properly after installation, contact Magellan immediately. The S@tellite Modem is not field repairable. It must be shipped to the factory or to an authorized maintenance facility for repair.

The power cable on the Controller Interface board serves as the ON/OFF switch for the S@tellite Modem. The power supply cable must be connected for the unit to operate. When the power cable is disconnected, the unit shuts down and all data stored in volatile memory (messages and counter values) is lost. To retain messages and counter values, keep the power cable attached.

3

Introduction

This section outlines the requirements needed to use your S@tellite Modem Board as well as necessary commands when developing an application to interface with this board. Lists of hardware and software requirements will aid you when you are integrating this board into your operations.

General

The Magellan Satellite Modem Board is an OEM board implementation of an ORBCOMM Satellite Communicator with GPS.

The S@tellite Modem has been designed to provide maximum flexibility to the OEM developer. This compact design includes:

- A complete VHF ORBCOMM transmitter and receiver,
- A multi-channel Magellan GPS,
- Modem Serial Port
- GPS NMEA Serial Port
- On-board timer/alarm function
- Eight configurable digital I/O lines for sensing external events
- Configurable on-board firmware for setting schedules and timers for autonomous operation.

The S@tellite Modem is fully compliant with ORBCOMM specifications for Subscriber Communicators, including the Modem Serial port implementation and the satellite air interface.

Technical Description

Physical Description

As shown in Figure 3.1, the S@tellite Modem is a single circuit card measuring 3.3 x 3.9 inches. Four mounting holes are provided in a rectangular pattern for simple mechanical mounting.

Maximum component height, including shields but excluding mating connectors, is 0.260 inches for the both sides of the board. Board thickness is 0.062 inches. Thus, the total assembly height is 0.582 inches maximum. Clearance around mounting holes is 0.325 inches diameter.

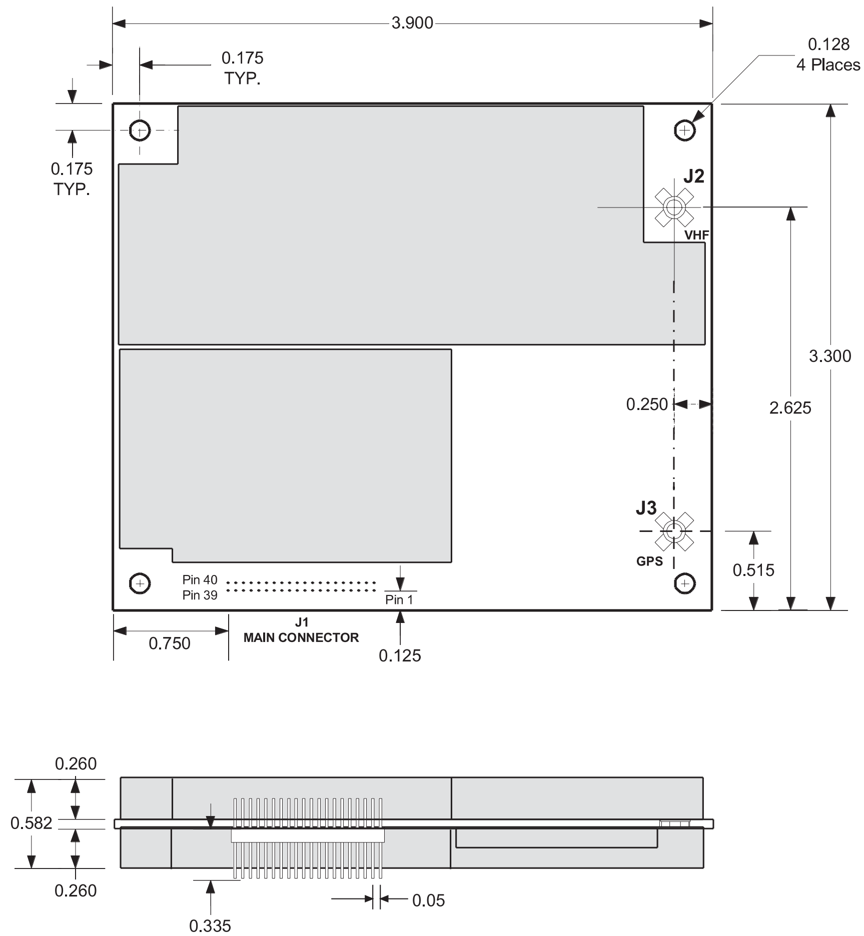


Figure 3.1. Mechanical Interface Diagram

External Connectors

Electrical interface with the S@tellite Modem is accomplished through only three connectors:

J1 - Main Interface Connector This 40-pin connector carries all interfacing signals except the VHF and GPS antennas.

J2 - VHF Antenna Port SMB connector for connection to a VHF antenna. Impedance is 50 ohms.

J3 - GPS Antenna Port SMB connector for connection to both passive and active GPS antennas. Impedance is 50 ohms.

Communication Specifications

VHF Data Communications

The S@tellite Modem operators on the VHF in the following frequency assignments and characteristics:

- VHF Transmit. . . . . . 8.000 to 150.050 MHz
- VHF Receiver . . . . . 137.000 to 138.00 MHz
- Transmit Power . . . . 5 watts
- Data Rate (Uplink) . . 2400 bps
- Data Rate (Downlink) 4800 bps

GPS

The S@tellite Modem contains a DGPS-capable multi-channel Magellan GPS. DGPS accuracy to 1 meter CEP. Cold start time-to-first fix (TTFF) is nominally 2 minutes or less with hot start TTFF less than 30 seconds.

Environmental Specifications

The S@tellite Modem meets the following environmental specifications:

- Operating Temperature: -40ºC to +85ºC
- Shock and Vibration: meets SAE J1455

Power

The S@tellite Modem included with your Development Kit has five modes of operation that involving system function and power consumption. These modes are based in the hardware design and these are described below. Supply voltages current requirements for are described in Table 3.1.

Table 3.1. Power Requirements of the S@tellite Modem

Mode	+3VDC Vstandby	+5V	+12V	Notes
Sleep	<15µA typical at 25ºC (250 µa max)	OFF	OFF	Vstandby at 3.0 V typically from 3V alkaline cells
Standby	0	<500µA	20µA typical at 25ºC if +12V is on	+5V applied +12V optionally applied
VHF Receive	0	I=180mA	I=10mA	
VHF Transmit	0	I=200mA	I=2A (during transmit burst)	
GPS	0	I-145mA	<20µA (if applied)	Does not include antenna. LNA current. (+12V does not have to be on in GPS mode.)

Sleep Mode

When the unit is in Sleep mode, it is inactive and powered off except for the standby voltage. No power is applied to the +5V and 12V inputs during Sleep Mode. The 3V standby voltage keeps power on the program memory and system timer, but the S@tellite Modem does not recieve information. Power consumption in Sleep mode is thereby minimal. The unit is placed in Sleep mode by internal software, in reaction to the one of the following three events, followed by the removal of +5V and +12V power.

1. Receiving a **go to sleep** command (via the air or serial interface)
2. DTR line going inactive.
3. Removing the power source.

The unit may be powered-up from Sleep Mode by applying +5V and +12V power and activating the units DTR line. This sequence may be initialized by the S@tellite Modem's internal alarm timer by asserting the S@tellite Modem DSR function (open drain) at alarm time. The host application must then apply +5V and +12V power within 50ms then activate the DTR signal.

Standby Mode

In Standby Mode, +5V and +12V (optional) are still present after the unit has powered off. If the option to not apply +12V power is used, then it must be applied before the unit attempts to transmit.

Transmit Mode

Transmit mode is the length of time power is internally applied to the S@tellite Modem's VHF transmitter.

VHF Receive

Only the unit's VHF receiver is activated in this mode. The unit is actively listening for ORBCOMM satellites.

GPS

In this mode, power is only applied to the GPS RF section. The VHF RF section is powered off.

Using the S@tellite Modem

Mechanical Mounting & Connection

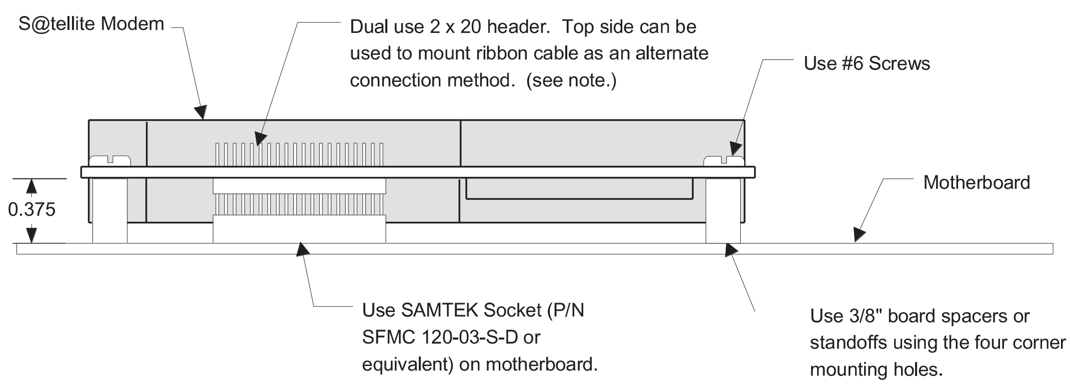


Figure 3.2. S@atellite Modem Mechanical Mounting

Interface Signal Descriptions

Signal names and functions are shown in Table 3.2. Table 3.2 also provides pin assignments oriented as they appear on J1 (as seen from the top of the board). The sections below provide functional description of each signal.

The hardware interface to the S@tellite Modem is accomplished through J1 (except for antenna connections). The various signals assigned to J1 have been organized into six groups as listed below.

- Power Group
- Modem Serial Port Group
- User I/O Group
- Board Control Group
- GPS Group
- Miscellaneous Signals Group

Power Group

The S@tellite Modem operates from these power supply voltages: +5VDC (VR5), +12VDC (VR12) and +3VDC (Vstandby). See Table 3.1 for exact voltage specifications and current demand.

VR5 - VR5 (+5VDC) supplies the main logic power to operate the S@tellite Modem board, including the GPS section.

VR12 - VR12 (+12VDC) provides power for the VHF RF section of the S@tellite Modem. Transmit power is provided by VR12.

Vstandby - Vstandby is nominally 3V and provides power for memory retention and processor real-time clock operation during sleep mode. If Vstandby is lost and there is no other power source, the S@tellite Modem loses its GPS almanac, current configuration settings, and function of the internal alarm timer.

Modem Serial Port Group

The following eight signals are implemented on the Modem Serial Port. No RS-232 level translators are implemented on the S@tellite Modem. The implementation of this serial port is in accordance with the ORBCOMM Serial Interface Specification.

CTS - (Clear-To-Send) Is provided for full duplex operation. Use of this signal is optional.

RTS - (Request-To-Send) Is provided for full duplex operation. Use of this signal is optional.

DTR - External input to the S@tellite Modem to initiate a power up sequence. Holding DTR activated will keep the S@tellite Modem board powered up. Deactivation will allow the board to power down, after processing of current tasks is completed. DTR and DSR are used to implement external power control and for standby/sleep mode control. See section on Power Control.

CD - (Carrier Detect) The S@tellite Modem activates the Carrier Detect out put whenever it is locked onto the ORBCOMM satellite downlink and is receiving Gateway Information, Downlink Channel Information and Uplink Channel information packets.

DSR - (Data Set Ready) The Data Set Ready signal is an active low output from the S@tellite Modem indicating that the S@tellite Modem is powered up and active. DSR is used in conjunction with DTR to implement external power control and for standby/sleep mode control. See section on Power Control.

RXD2 - Received serial data line for the modem serial port. Implemented at TTL levels.

TXD2 - Transmitted serial data line for the modem serial port. Implemented at TTL levels.

SGND - (Signal Ground) Common ground reference between the S@tellite Modem and its host.

Table 3.2. Interface Pin Descriptions

Pin No.X	SignalX	TypeX	Function
POWER GROUP			
1,2,3,40	VR120	Power	+12V power input.
5,6,7,80	GNDRTN0	Ground	Power ground returns.
9,10	VR5	Power	+5.0V power input.
11	VSTANDBY	Power	Standby voltage input.
12	GNDRTN	Power	Power ground returns.
MODEM SERIAL PORT GROUP			
13	CTS	TTL Output	Clear-To-Send hardware handshake.
14	RTS	TTL Input	Request-To-Send hardware handshake.
15	DTR	TTL Input	Data Terminal Ready - modem power on/off control.
16	UNUSED		Unused
17	CD	TTL Output	Carrier Detect - indicates comm. Link established.
18	DSR	OC Output	Data Set Ready - modem powered up indicator.
19	TXD2	TTL Output	Modem port serial data output (TTL levels). (Input if we are not the DTE.)
20	RXD2	TTL Input	Modem port serial data input (TTL levels). (Assuming we are not the DTE.)
21	SGND	Ground	Signal ground.
USER I/O GROUP			
22	SGND	Ground	Signal ground.
23	BITIO1	TTL I/O	User programmable I/O line.
24	BITIO	TTL I/O	User programmable I/O line.
25	BITIO3	TTL I/O	User programmable I/O line.
26	BITIO2	TTL I/O	User programmable I/O line.
27	BITIO5	TTL I/O	User programmable I/O line.
28	BITIO4	TTL I/O	User programmable I/O line.
29	BITIO7	TTL I/O	User programmable I/O line.
30	BITIO6	TTL I/O	User programmable I/O line.
BOARD CONTROL GROUP			
31	RESETN	TTL Input	Externally supplied reset.
32	UDLN	TTL Input	Flash upload control.
GPS GROUP			
33	RXD1	TTL Input	Serial differential data input (TTL levels).
34	TXD1	NMEA Output	NMEA data serial output
35	INTANTPWR	Power	Current limited GPS antenna power.
36	SGND	Ground	Signal ground.
37	EXTANTPWR	Power	Externally supplied GPS antenna power.
MISCELLANEOUS PINS GROUP			
38	RESERVED		Reserved by manufacturer. Make no connection to this pin.

Table 3.2. Interface Pin Descriptions (continued)

Pin No.X	SignalX	TypeX	Function
39	CA	TTL Compatible (3.5V)	Reserved for future use.
40	MPWRN	TTL Compatible (3.5V)	Active low logic signal indicating that power is applied to the modem circuitry only (excludes GPS circuitry).

User I/O Group

BITIO0 - BITIO7 - These eight digital I/O lines are provided for monitoring of external events. These lines are TTL compatible. Four of these lines (BITIO0 - BITIO3) are pulled up internally while the remaining four (BITIO4 - BITIO7) are pulled down internally. These lines can be configured as either inputs or outputs by software (see Software section). When the S@tellite Modem is powered off, these lines are undefined at high impedance. **The host should not attempt to drive these lines while the S@tellite Modem is not powered.**

SGND - Reference ground return for the BITIO0 - BITIO7.

Board Control Group

RESETN - The RESETN input is an active low input that will cause the S@tellite Modem processor to restart. This signal is connected to an internal RC network and is pulled up to +3VDC through a 10K resistor.

UDLN - S@tellite Modem processor firmware may be loaded by activating this active low input. The firmware is loaded via the Modem Serial Port. A PC based software utility (PC_UPLD) is available to assist with loading S@tellite Modem firmware.

GPS Group

RXD1 - This is the serial line in to the GPS receiver portion of the S@tellite Modem. It is a TTL compatible input. Please see NMEA specifications for interface details.

TXD1 - This is the serial output from the GPS receiver and is typically used to provide an NMEA output data stream. It is TTL level compatible. Please see NMEA specifications for interface details.

INTANTPWR - The output is provided to supply power to an active external GPS antenna.

EXTANTPWR - An external power source may be used for an active GPS antenna by connection to this input.

SGND - Signal ground return for the GPS signal group.

Miscellaneous Group

CA0 - Reserved for future use.

RESERVED - Pin 38 is reserved by the manufacturer. No connection should be made to this pin.

MPWRN - (Modem Power Not) This active-low logic signal indicate when power is applied to the S@tellite Modem. This signal may be used to control the application of the external +12VDC supply.

Power Supply Requirements

The operating power characteristics of the S@tellite Modem are provided in Table 3.1. Table 3.3 summarizes the recommended characteristics for any external power supply to be used with this OEM board.

Care should be taken when designing a power supply for the S@tellite Modem to minimize power supply noise from being conducted in to the S@tellite Modem. The use of common mode chokes and ample capacitive filtering on all power supply lines is necessary to ensure proper performance of the communicator application. Any common mode chokes must have a low DC resistance to prevent any voltage rise on the return side. The parts used in the reference circuit have a DC resistance of 0.135Ω maximum (Delta THM08S01).

Table 3.3. External Power Supply Characteristics

Item	Recommendation
+5VDC supply regulation	+5 VDC ±5%
+5VDC supply current	200 mA maximum
+12VDC supply regulation	+12 VDC +10% -0%
+12VDC supply current	2 A maximum
Ripple (+5VDC & +12VDC)	50mV
Standby voltage	+2.9 VDC to +3.3 VDC
Standby current	50 µA minimum

Modes Of Operation

In contrast to the power modes described earlier, the operational modes are implemented by software and are user-selectable via the air or serial interfaces. The following are brief descriptions of each operational mode. For most ORBCOMM applications, especially those that involve tracking, you should use the AUTO ORBCOMM mode.

GPS

As the name implies, the unit will only perform the GPS function in this mode. All ORBCOMM functions are disabled.

ORBCOMM Mode

When in the ORBCOMM mode, your receiver will continuously listen for ORBCOMM satellites. In this mode, the unit will never update its GPS position. Therefore, ORBCOMM mode should only be used when location data (i.e. GPS position) is not required. While in ORBCOMM mode, position information and satellite schedule are based on the last calculated satellite fix. The ORBCOMM mode is appropriate when the S@tellite Modem is stationery and communication is the only required function.

ORBCOMM AUTO Mode

In the ORBCOMM AUTO mode, the unit will normally operate in ORBCOMM mode ("listening") except when an update of GPS position is required. The need to update the GPS position can be caused by a poll command received over the air or serial interfaces. In addition, the unit will automatically switch to GPS at 5-minute intervals to maintain a current position fix. (The 5-minute interval is configurable by the user, however 5 minutes is the default.) Once the position information has been obtained, your unit will then switch back into ORBCOMM mode. ORBCOMM AUTO is the most useful mode to the ORBCOMM application developer.

Power Management

Power (on-off) control of the S@tellite Modem is implemented by the DTR input for external events or the internal clock timer.

Internal Clock Timer - The S@tellite Modem contains an internal clock timer for the purpose of providing a means for the S@tellite Modem to automatically perform events such as send reports, update GPS position etc. according to a predefined schedules. These schedules are more fully described in the Software section. When the time for a scheduled event is reached, an internal timer alarm signal causes the S@tellite Modem processor to initiate a power up sequence. The S@tellite Modem will perform the scheduled task and return to sleep mode.

DTR - The DTR input is used to externally activate the S@tellite Modem. DTR is an active-low input; i.e. the S@tellite Modem will start up when this line is brought low. DTR must be activated to start the S@tellite Modem - simple application of power will not initiate a start-up sequence. It is important to note that the DTR signal will override the internal clock timer. If the DTR signal remains activated (held low), then the internal clock timer will not function. The operation is analogous to a common clock-radio. If the radio is manually turned on, then the clock radio alarm is overridden.

DSR - DSR is an active low open-collector output from the S@tellite Modem that indicates that the board is powered and running. Power (VR5 and VR12) must be applied to the S@tellite Modem no later than 50 milliseconds after assertion of DSR. A schematic of the Magellan Interface Board is provided in Appendix F. This shows how to use DSR to control 5V and 12V power so that in sleep mode the S@tellite Modem will not draw any current from the 5V and 12V supplies.

Figure 3.3 to Figure 3.6 provide the timing diagrams for power sequencing the S@tellite Modem.

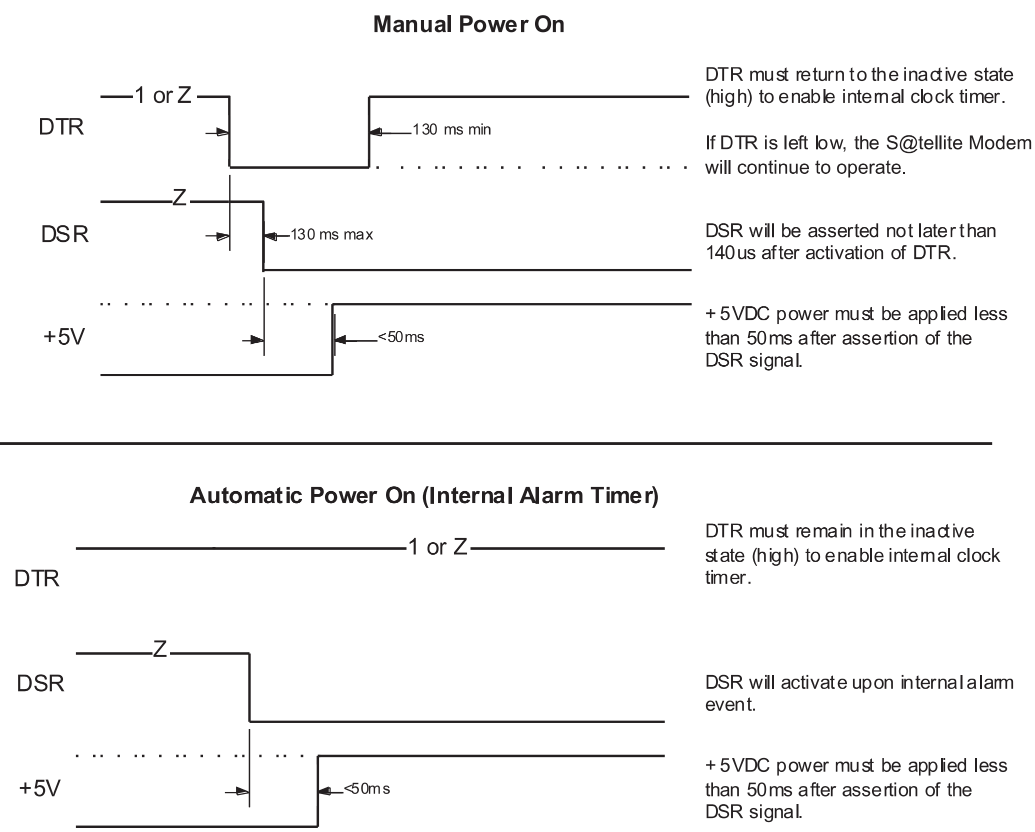


Figure 3.3. Power-On Sequence

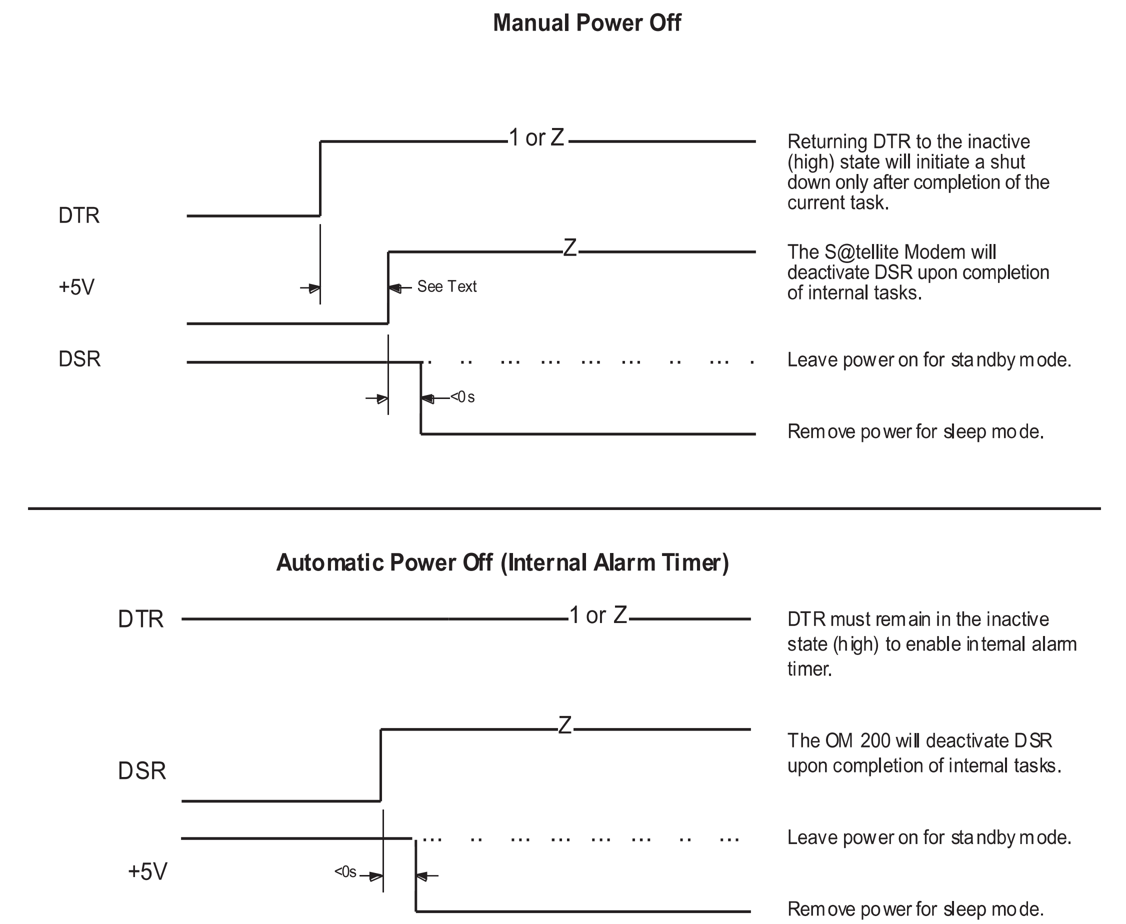


Figure 3.4. Power-Off Sequence

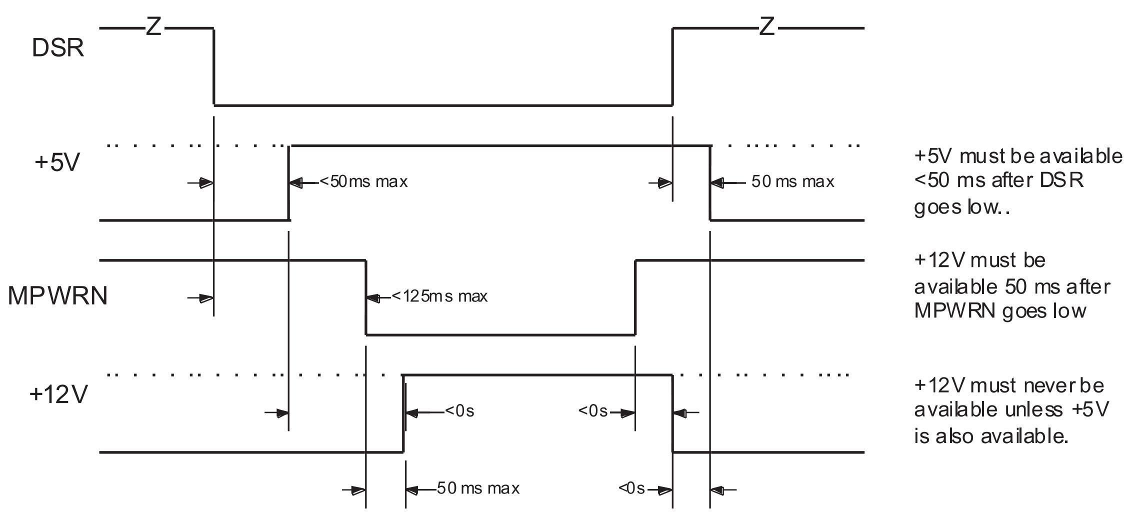


Figure 3.5. Transmit Power Sequencing

DTR Start Up

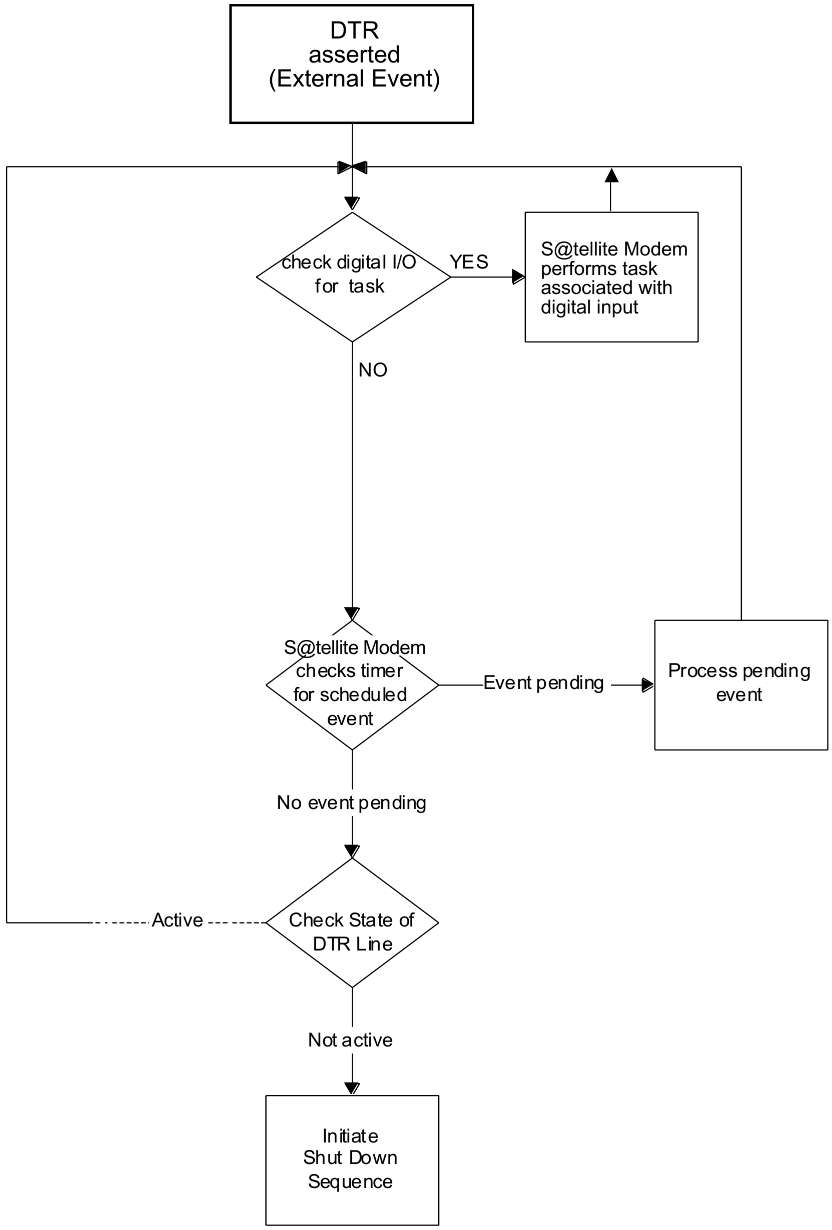


Figure 3.6. Power-On Processing

Certifications

ORBCOMM Type Approval

Satellite Communicators using original equipment manufacturer (OEM) cards produced for VARs and System Integrators must receive an ORBCOMM Type Approval number before operating on the ORBCOMM System. This Type Approval is granted by ORBCOMM after the unit has passed a set of prescribed tests for RF compatibility and adherence to the required communication protocols. Additional tests for power and environmental characteristics are also necessary. The Magellan Satellite Communicator has been granted type approval by ORBCOMM as an OEM board intended for use in OEM equipment.

ORBCOMM has been authorized by the Federal Communications Commission (FCC) to grant type approvals for equipment used on their network in lieu of direct approvals from the FCC. In other words, once your unit has been granted type approval from ORBCOMM, no further testing for the FCC is required.

However, additional testing must be performed on the final solution in which any OEM board or Subscriber Communicator has been integrated. This additional testing is required to ensure that the basic Radio Frequency (RF) characteristics of the OEM Card/SC have not been altered in any way. These tests include but are not limited to:

- Bit Error Rate (BER) Testing
- Interference, Fading & Intermodulation (IFI) Testing
- Transmitter Operational Output Power Level Testing
- Out-of-Band and In-Band Emissions Testing
- Environmental (vibration, shock, and humidity)

You should contact ORBCOMM directly for further questions on type approval for your unit.

European (ETSI) Approval

Communicator units intended for use in Europe must show compliance to certain standards established by the European Test Standards Institute (ETSI). This testing standard is used as a basis for type approvals in most European nations and is recognized as an established standard in other parts of the world. Compliance must be demonstrated to these standards:

- ETS 300 721 for spurious emissions
- ETS 300 722 for remote disable
- ETS 300 832 for electromagnetic compatibility (EMC)

The Magellan S@tellite Modem has been successfully tested to these standards, however, ORBCOMM SC Manufacturers are required to ensure that their unit is ETSI compliant. (ETSI Certification will not be possible for the OEM product, as testing requires a complete system for certification.) It will be the responsibility of the VAR Integrator to gain ETSI Certification under the above standards for their final product.

Magellan will assist users of the S@tellite Modem in obtaining ETSI certification by providing copies of the ETSI test report on OEM board and by providing useful information and guidance on completing the process. ORBCOMM can also provide up to date information on test standards and requirements.

While each country has their own requirements and regulatory issues for operating devices such as the ORBCOMM SCs within their borders, an SC with that has been granted an ORBCOMM Type Approval., FCC Equipment Authorization and ETSI Certification should have few problems gaining acceptance due to RF issues.

The requirements for European type approval are emerging and subject to frequent change. Testing procedures and requirements are constantly changing as the European community moves toward harmonization of these standards. OEM manufacturers wishing to obtain European type approvals are strongly advised to consult ORBCOMM for current requirements.

4

Embedded Software

The Satellite Modem contains embedded software that implements built-in, user configured, functions; and supports a serial interface as described in the ORBCOMM Serial Interface Specification.

The built-in functions are for monitoring and/or controlling the state of the digital i/o lines, GPS position, movement, and communications from the Satellite Modem. These functions allow the board to work independently of any external controller. The built-in functions include several, independently configured, sleep schedulers that allow you to maximize battery life. These functions may be configured over the serial port, or over-the-air by sending the appropriate commands through the ORBCOMM network. To assist you in configuring the Modem, Magellan provides S@tellite PC, which is part of the S@tellite Modem development kit, and also available on the Magellan website.

The serial interface allows an external controller to generate messages which the Satellite Modem will transmit, and to extract messages that the Satellite Modem has received from the satellites.

The ORBCOMM serial interface is fully described in the document E80050015, available to all Magellan customers in pdf format on the same CD that contains this Satellite Modem manual.

The built-in functions, and user commands necessary to configure them are described below.

User Commands

User Commands, to be sent through the air, or into serial port. For defining Regularly Scheduled Transmissions, GPS, Digital I/O, and other functions.

Commands Through the Air

Commands are all 5 bytes, binary.

Commands Through the Serial Port

The commands through the serial port shall be AT-Style commands.

Here's some things that the Orbcomm Language Serial Interface Specification has to say about this Command Mode.

- < > denotes an ASCII text element
- [ ] denotes optional text
- Not case sensitive
- Structure of an SC command line is: AT[<Command>][<Data>]<CR>
- ATSR means "Set Register"
- S-Registers 200 and above are set aside for manufacturer definition.

The User Commands defined in this MRD shall all be implemented using the <SR> Command (Set Register), and using S-register 200. NOTE: These Magellan-defined commands don't really set a register, the "ATSR200" string is just interpreted by the S@tellite Modem as a header that prefixes all Magellan commands. This is what the ORBCOMM Serial Spec requires, and it fits easily into the Magellan board logic.

The form of all commands shall be:

ATSR200 = ≤<Data>≤

Other Details

Command Mode or Protocol Mode

Because the latest ORBCOMM spec defines the AT-style commands the way it does, there is no need to have the user do anything special to switch from a Command mode to a Protocol mode.

The OM board shall not have separate Command and Protocol modes. If the board received a serial message with the prefix ATSR200, it will automatically interpret it as a Magellan command, and act on that command. If the board receives a Protocol mode packet, it will interpret it correctly and act on it. So a user shall be able to intersperse protocol mode packets and ATSR200 commands, and the S@tellite Modem board shall automatically handle them correctly.

Acknowledgment

The OM board shall acknowledge a valid ATSR200 command by echoing the command back to the DTE, followed by OK. If a command is invalid then the S@tellite Modem board shall echo the command back to the DTE, followed by ERR.

Checksums

There shall be no checksums at the end of the ATSR200 command.

Fixed Length Fields

The user manual shall warn all system integrators not to rely on fixed length fields as a means to create/parse ATSR200 messages. The ATSR200 command are all comma delimited, and the user (and the S@tellite Modem firmware) must use the commas to parse the messages. This is because there will be a need, sooner or later, to change the length and/or resolution of some of the fields in these commands.

Leading Zeros

The S@tellite Modem shall be insensitive to leading zeros. That is, it shall make no difference whether the DTE uses them or not.

Double Quotes

The ATSR200 command has the data inside double quotes: "<Data>". The manual shall clearly specify the ASCII character for double quotes (ASCII 34), so it is not mistakenly typed as a single quote (ASCII 39) or as two single quotes.

Store Configuration in Non-Volatile Memory (Permanent)

The user configuration must be stored in non-volatile memory on the OM board. NOTE: non-volatile memory means Flash or EEPROM or other that does NOT need a battery backup.

Power-Cycle Behavior

The state of the output lines shall be remembered and restored following a power-cycle.

Reset from Pin 31.

When pin 31 is exercised, the board state shall return to factory defaults.

AutoModes, GPS and ORBCOMM Time-Outs

The default mode for the S@tellite Modem is Auto-ORBCOMM mode, which means the unit is in ORBCOMM mode, until it needs to get a GPS position, in which case it switches to GPS mode, gets the position and switches back to ORBCOMM mode. The complete list of events that make the unit try to get a GPS position:

1. Command from DTE to get a GPS position
2. GPS Schedule, see Section 4.1.8.
3. ORBCOMM timeout: after Torb, the unit automatically switches to GPS mode to update its position, before returning to ORBCOMM mode.
4. The unit has been polled, and the most recent GPS position in memory is older than max_gps_age.

If the unit has a queued message waiting to transmit, then it stays in ORBCOMM mode until the message has been transmitted, or until back_to_sleep_timout puts the unit to sleep. See “AutoModes, GPS and ORBCOMM Time-Outs” on page 26 for more information.

There will be times when the unit does not have a clear view of the sky (i.e., in a tunnel or parked in a garage), and cannot get a GPS fix, or cannot send an ORBCOMM message. In these cases the unit shall time-out what it is trying to do, and try again later. The following timing diagrams show how the time-outs work:

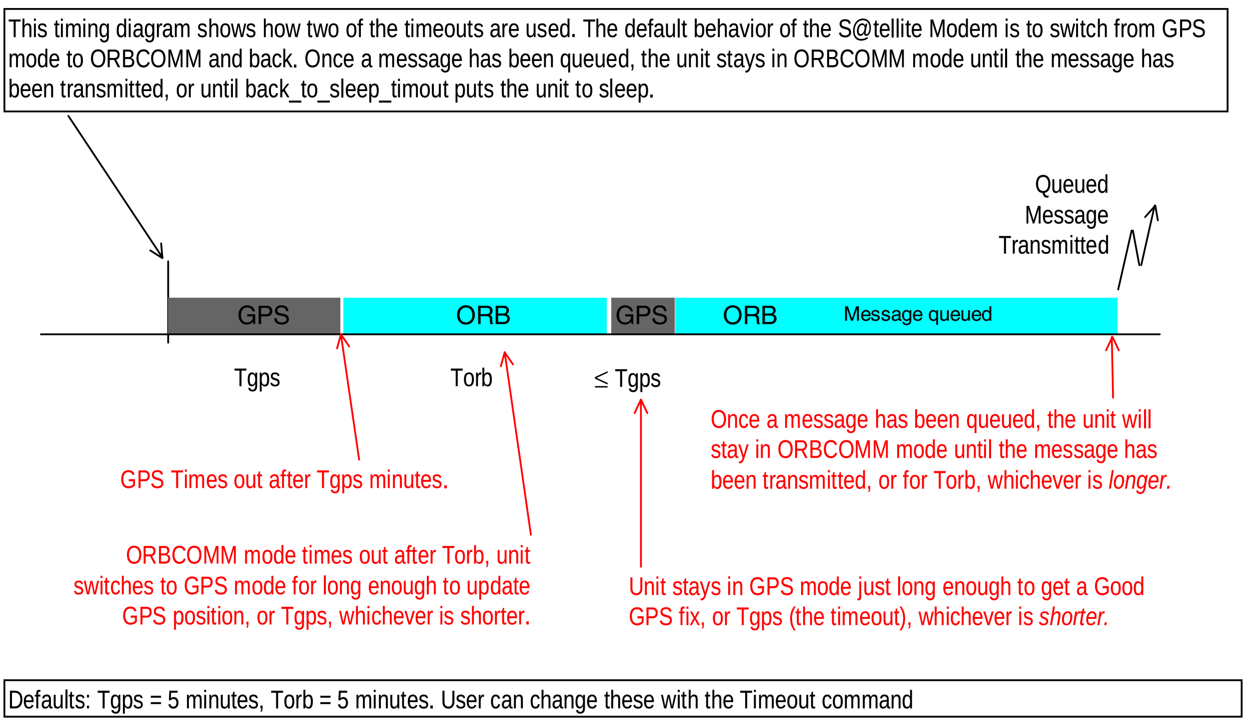


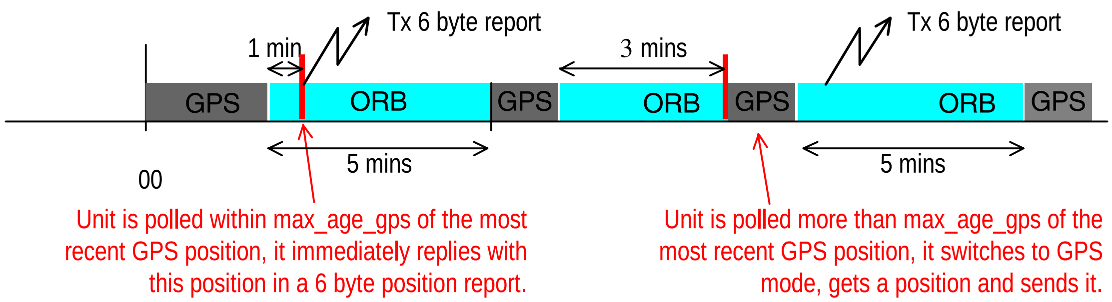
Figure 4.1. Auto-ORBCOMM Mode Timing Diagram

If messages are queued to the S@tellite Modem, the default to switch to GPS Mode and acquire a position fix will be disregarded. After the message is sent, the unit will then resume its automatic signal acquisition and computing the current position.

```
When the unit is polled for position:
If
     the most recent GPS position in memory is less than max_age_gps,
then
     the unit immediately replies with this GPS position;
else       {
     it goes to GPS mode, and tries to get a position
     if it gets a position within Tgps
             it sends a 6 byte position report;
     else
             if it has a gps position in memory
                          it sends a time-tagged ASCII position report
             else
                          it sends a time-tagged NO POSITION Report
             }

NOTE: When the "Listen" function is active, max_age_gps is overridden.
```

Timing diagram shows example: Tgps = 5 minutes, Torb = 5 minutes, max_age_gps = 2 minutes



Defaults: Tgps = 5 minutes, Torb = 5 minutes, max_gps_age = 10 minutes.
User can change these with the Timeout command

Figure 4.2. How max_gps_age Works

If the unit has been programmed to perform scheduled functions (including being placed in sleep mode), then the behavior is determined by the function which has been activated. There are four type of functions:

Table 4.1. Scheduled Functions

Function	Wake Up Behavior
Previously queued messages that have not yet been transmitted	If unit was asleep, it first wakes up, then: Unit begins by trying to transmit these messages. If they are successfully transmitted, the unit then reverts to the beginning of the timeline in Figure 4.1. If back-to-sleep timeout occurs before the queue is cleared, then the unit goes back to sleep, and tries again the next time it wakes up.
Regularly scheduled transmission	If the modem was asleep, it first wakes up, then: The behavior depends on what messages need to be sent. If one of them contains GPS position, or course or speed; then the wake-up behavior is the same as in Figure 4.1. If no messages require GPS position, course or speed; then the modem does not try to get GPS position when it wakes up. If the unit was not asleep, it sends the required message on schedule.
Digital I/O Functions	Same as above

Table 4.1. Scheduled Functions (continued)

Function	Wake Up Behavior
GPS Functions	If unit was asleep when it wakes up, then: Behavior is the same as Figure 4.1. If the unit was not asleep, it performs the required function on schedule.
Listen Function	If unit was asleep when it wakes up, then it goes into ORBCOMM mode only for the period specified by the “Listen” function, then goes back to sleep. If the unit was awake, it switches to ORBCOMM mode for the period specified by the “Listen” function, then goes back to default behavior (Figure 4.1).

The sleep modes have been designed to maximize battery life. When the unit has been placed in sleep mode, it wakes up because of schedulers that have been set. We must guard against the times that the unit is totally out of sight of satellites (example: in an underground parking garage), and could run the battery dead trying in vain to send a transmission or get a GPS fix. To protect from this, there is a back_to_sleep_timeout. Once the unit wakes up, if it hasn’t managed to do what it was trying to do within the back_to_sleep_timeout time, it gives up and goes back to sleep.

When the S@tellite Modem gets a GPS Fix, it will typically not use the very first fix it gets. This is because any GPS receiver often has only 3 or 4 satellites in view when it gets the first fix, and the fix may consequently have fairly large errors. A few seconds later, the unit will typically lock onto more satellites and get a much better fix.

The "Good Fix" algorithm used in the S@tellite Modem is shown below.

The algorithm can be summarized as:

> the S@tellite Modem will wait for a predefined time after the first fix, however, if 3D HDOP gets low enough during this waiting period, then we know that the fix is good, and the process is stopped

Here is the same algorithm in more detail:

Time	Action
T0	Unit switches to GPS mode
T1	First fix obtained

if HDOP < HDOPmax and Fix is 3D then the fix is considered good, and the S@tellite Modem will use this fix.

if elapsed time since T1 exceeds Delta_ttff then the last fix taken is considered good, and the S@tellite Modem will use this fix.

The default values are:

HDOPmax = 3 (default)

Delta_ttff = 30 seconds (default)

These may be changed using Timeout Command 2. See “Timeout Commands” on page 39 for more information.

Command Overview

There are four categories: Regularly Scheduled, GPS, Digital i/o and Listening.

Commands through the serial ports are all ASCII. Serial commands are fully described in the following sections. Commands over the air are binary. Over-the-air commands are a binary representation of the corresponding serial command, packed into 5 bytes. The binary commands are described in “Binary (over-the-air) commands” on page 44.

Command names are just numbers, as shown in the table below.

Table 4.2. User Commands

Command Name (Decimal)	Description
48	Schedule for Regularly Scheduled Messages
49	Message Types to be sent on the above schedule
50	Message Types to be sent immediately
51	ASCII messages to be sent over serial port immediately
65	Schedule for GPS functions
66	Time & Distance Movement function (report if modem moves
67	Time & Distance Stop function (report if modem doesn't move)
68	Latitude function #1 (report the first time this latitude is crossed)
69	Latitude function #2 (report the first time this latitude is crossed)
70	Longitude function #1 (report the first time this longitude is crossed)
71	Longitude function #2 (report the first time this longitude is crossed)
97	Schedule for Digital I/O functions
98	Send message/s if state of digital I/O changes
99	Send message/s if digital I/O achieves a target value
100	Define inputs and outputs
101	Set all outputs with a single command
102	Set up to two specified outputs on/off immediately
103	Set one specified output on/off at a specified time
36	Schedule for Listening
37	Listen duration
38	Timeout command 1
39	Timeout command 2
63	Report modem ID or ID+Configuration
122	Sleep command

Indexing

The approach taken in defining the commands is:

For ASCII (serial port) commands, the command parameters will be set explicitly.

For binary (over-the-air) commands, the command parameters are indexed when necessary so that fewer bits can be used to carry more information.

Schedules

Each function category has one schedule associated with it; i.e. four schedules can be defined, one for Regularly Scheduled reports, one for GPS functions, one for Digital I/O functions, and one for the Listen function.

Table 4.3. Schedule Functions

Function Category	Function
48	Regularly scheduled message
65	GPS schedule
97	Digital I/O schedule
36	Listen schedule

Schedules are defined as: Time schedules (more frequently than once per day) or Day Schedules (once-per-day-or-less frequently).

Time Schedules

Schedule defined over a 24 hour day by a start time, period, and end time. Start times and end times are always UTC. Rollover past midnight UTC is allowed. For example: to define a schedule of one message per hour, from 8am to 5pm Pacific Standard Time (where Pacific Standard Time = UTC -8 hrs):

start time = 16:00, period = 01:00, end time = 01:00

Day Schedules

Schedule defined by a start date and time, and a period in days. There is no end time defined.

Schedules will be adhered to whether the Modem is awake or asleep. If the modem is awake, the defined functions are performed on schedule. If the modem is asleep, it will wake up on schedule, and then perform the functions.

Set schedule for each function category command

ATSR200 = XX,hh,mm,hh,mm,hh,mm,yyyy,mm,dd,hh,mm,ddd

Table 4.4. Function Category Command

Field	Description	Range
XX	Function category	48,65,97,36
hh	Start time: Hours	00 — 23
mm	Start time: Minutes	00 — 59
hh	Period: Hours	00 — 15
mm	Period: Minutes	00 — 59
hh	End time: Hours	00 — 23
mm	End time: Minutes	00 — 59
yyyy	Start: Year	1999 — 9999
mm	Start: Month	01 — 12
dd	Start: Day	01 — 31
hh	Start: Hour	00 — 23
mm	Start: Minute	00 — 59
ddd	Period: Days	000 — 255

The way the command is defined, the user enters either a Time Schedule, or a Day Schedule, but not both. The unused fields are left null.

A period of zero cancels the schedule.

The OM must be robust to omitted null fields at the end of a command. That is, example 1 and example 2 below must produce the same result:

Example 1: start time = 08:00 UTC, period = 1 hour, end time = 16:00 UTC

ATSR200 = "48,08,00,01,00,16,00,,,,,,"

Example 2: start time = 08:00 UTC, period = 1 hour, end time = 16:00 UTC

ATSR200 = "48,08,00,01,00,16,00"

Example 3: start date = 1999/06/30 00:00 UTC, period = 1 week

ATSR200 = "48,,,,,,,1999,06,30,00,00,7"

Indexing: Parameters are not indexed, parameters are written literally, as shown in the examples above.

Messages

When any function is activated (except Listen), the user can choose one or more messages to transmit.

In the Orbcomm language, message - with a lowercase m means either a Report (6 bytes) or a Message (N bytes).

Table 4.5. Messages Identifiers

Message Type	Decimal Identifier
Position Message (6 bytes)	48
Position, time and date binary Message (2 × 6 bytes)	49
Position, time and dateASCII Message	50
Digital i/o status, date and time Message (6 bytes)	51
Digital i/o status, time and date, ASCII Message	52
Time, course and speed Message (6 bytes)	53
Time, course and speed, ASCII Message	54

The definition for each message is in Appendix B, **Message and Report Definition**. The messages are transmitted over the air by the Modem. They are not sent through the serial port. To get GPS position and other satellite status out of the serial port, use standard ORBCOMM serial commands (see ORBCOMM Serial Interface Spec).

Regularly Scheduled Transmissions

This function causes up to four messages to be sent according to the schedule defined by command ATSR200 = "48,…".

Regularly Scheduled Transmission.

Transmit the following messages on the schedule defined by ATSR200 = "48,…":

ATSR200 = 49,x1,x2,x3,x4

Table 4.6. Regularly Scheduled Message Command

Field	Description	Range
49	Regularly scheduled message command	
x1	Message 1	48, 49, or 0
x2	Message 2	48, 49, or 0
x3	Message 3	48, 49, or 0
x4	Message 4	48, 49, or 0

To cancel this function, send the command with all zeros:

$ATSR200 = "49,0,0,0,0"

Immediate Transmission

This function causes up to four messages to be transmitted immediately.

ATSR200 = 50,x1,x2,x3,x4

Table 4.7. Immediate Message Command

Field	Description	Range
50	Immediate message command	
x1	Message 1	48, 49, or 0
x2	Message 2	48, 49, or 0
x3	Message 3	48, 49, or 0
x4	Message 4	48, 49, or 0

All the indicated messages (up to four total) will be transmitted immediately (i.e. as soon as the S@tellite Modem can get a link to the satellite and successfully transmit the data to the satellite).

GPS Functions

All actions generated by these functions are executed according to the schedule defined by serial command ATSR200 = "65,…".

If the modem is put to sleep, then on schedule the modem wakes up, takes a GPS fix, executes the functions, transmits the defined messages (if necessary) and goes back to sleep.

If the modem is not put to sleep, then the functionality is the same, and the S@tellite Modem takes a GPS fix on schedule. The only difference from sleep mode is that the modem does not have to wake up before taking a fix.

If a schedule has not been defined, and the modem is put to sleep, then it is SOL. A schedule MUST be defined before the modem wakes up and perform the functions.

The movement functions give the user the capability to define a circle, 2 lines of latitude, and 2 lines of longitude. This allows the user to define a closed region, and receive a message when the OM200 leaves (or enters) the region.

CAUTION

All the following GPS functions are defined in terms of the most recent GPS position, and in some cases, current time. For these functions to make sense, the S@tellite Modem board must have previously calculated a GPS position, and the 5V or 3V power must have remained connected to the board to keep the memory and real-time clock active. If you have reset the memory, or disconnected all power (including the 3V backup battery), or you are using the board for the first time, then complete the following steps before sending a GPS command:

1. **Connect the GPS antenna,**
2. **Apply power to the board,**
3. **Verify that the board has calculated a GPS position in the Status window of S@tellite PC.**

The S@tellite Modem calculates a first GPS position within 5 to 15 minutes of power-up after a cold start (i.e. a first-time start), with no user intervention required. Subsequent starts (warm starts) require less than a minute to get a GPS fix following power up, provided the 3V backup battery remains connected when the board is turned off.

If you do not follow the above procedure, and attempt to set a GPS Function before the S@tellite Modem has calculated any GPS fix, then the S@tellite Modem will not accept the command (it responds with an echo of the command, followed by ERR).

GPS: Movement Function

This function detects whether the modem is moving or not. Movement is defined as leaving a circle of specified radius in a specified amount of time.

The circle is defined with its center at the position of the modem at the time the command is received.

Time begins at zero when the command is received.

If the modem leaves the circle, the defined messages are sent; and the center of the circle is redefined at the current position, and the time is reset to zero. The function then repeats, automatically, until cancelled.

The radius can is defined in 100m increments: [100:100:819,200].

ATSR200 = 66,x1,x2,x3,x4,hh,mm,rrr

Table 4.8. Time and Distance Movement Command

Field	Description	Range
66	Indicates time & distance function	66
x1	Message 1	48, 49, or 0
x2	Message 2	48, 49, or 0
x3	Message 3	48, 49, or 0
x4	Message 4	48, 49, or 0
hh	Time: Hours	00 — 31
mm	Time: Minutes	00 — 59
rrr	Radius	100 — 819, 100 (100 meter increments)

The time arguments are optional. If they are not defined, then this function sends a message whenever the unit leaves the radius. To leave time undefined, set time to zero.

Indexing: Parameters are not indexed, parameters are written literally, as shown in the following example.

Example: Set the S@tellite Modem to send message 48 if position changes by 1000 meters or more within 1 hour.

ATSR200 = "66,48,0,0,0,01,00,1000

1000 meters is written out, as 1000.

The resolution of the radius is 100m, if the command is sent with a radius of something other than a multiple of 100, the S@tellite Modem automatically rounds up to the nearest 100m. The S@tellite Modem echoes the exact command, as received, but internally the S@tellite Modem rounds up the radius value to the nearest 100.

Radius of zero is interpreted as a cancellation of the command.

To cancel this function, send the command name, and all zeros:

GPS: Stop Function

Command name ATSR200 = "67,…"

The opposite of the Movement function. When this command is sent, the timer starts counting. If, at the end of the specified time, the modem is still inside the circle, the defined messages are sent. Function resets after the specified time has elapsed.

To cancel this function, send the command name with all zeros.

This command has the same format as Time & Distance Movement function, but with a different command name. Time is not optional.

GPS: Boundary Function, Latitude 1

This function sends the specified messages when line of latitude # 1 is crossed for the first time. After transmission the function is cancelled. To cancel the function yourself, send the command with all reports set to zero. The S@tellite Modem responds with an echo of the command, and OK, which acknowledges that the command has been cancelled.

ATSR200 = 68,x1,x2,x3,x4,dd,mm.mmm,N/S

Table 4.9. Latitude Crossing Function

Field	Description	Range
68	Latitude crossing function	68
x1	Message 1	48, 49, or 0
x2	Message 2	48, 49, or 0
x3	Message 3	48, 49, or 0
x4	Message 4	48, 49, or 0
dd	Degrees	0 — 89 (1 degree increments)
mm.mmm	Time: Minutes	0 — 59.999
N/S	Hemisphere	N/S

GPS: Boundary Function, Latitude 2

This function sends the specified messages when a line of latitude # 2 is crossed for the first time. After transmission the function is cancelled. To cancel the function yourself, send the command with all reports set to zero. The S@tellite Modem responds with an echo of the command, and OK, which acknowledges that the command has been cancelled.

ATSR200 = 69,x1,x2,x3,x4,dd,mm.mmm,N/S

Table 4.10. Latitude #2 Crossing Function

Field	Description	Range
69	Latitude #2 crossing function	69
x1	Message 1	48, 49, 50, 51, or 0
x2	Message 2	48, 49, 50, 51, or 0
x3	Message 3	48, 49, 50, 51, or 0
x4	Message 4	48, 49, 50, 51, or 0
dd	Degrees	0 — 89 (1 degree increments)
mm.mmm	Time: Minutes	0 — 59.999
N/S	Hemisphere	N/S

GPS: Boundary Function, Longitude

Same as Latitude crossing functions, but defined for longitude #1 and longitude #2, with a different command names (70 and 71 instead of 68 and 69), Degrees range from 0 to180, and the Hemisphere is E/W instead of N/S.

Digital I/O

All actions generated by these functions are executed according to the schedule defined by serial command ATSR200 = "97,...".

If the modem is put to sleep, then on schedule the modem wakes up, checks its digital inputs, transmits the defined messages (if the digital inputs have changed since the last time they were checked) and goes back to sleep.

If the modem does not have to transmit anything (i.e. if the inputs have not changed), then the modem should only be awake for 1 second maximum.

If the modem is not put to sleep, then the modem checks its digital inputs once per second, and transmits the defined messages whenever the inputs change.

If a schedule has not been defined, and the modem is put to sleep, then it is SOL. A schedule MUST be defined before the modem will wake up and perform the functions.I/O: Transmit message if digital inputs change.

All the indicated messages (up to four total) are transmitted if the digital inputs change.

Change in outputs are ignored by this function, and change in Don't Care inputs are ignored by this function. See ”Don't Care Inputs in Use” on page 38 for more on Don't Care inputs, including how to define an input as Don't Care.

Send the following messages if the Care digital input lines change:

ATSR200 = 98,x1,x2,x3,x4

Table 4.11. Change in Digital Input Command

Field	Description	Range
98	Change in digital input command	98
x1	Message 1	48, 49, or 0
x2	Message 2	48, 49, or 0

Table 4.11. Change in Digital Input Command (continued)

Field	Description	Range
x3	Message 3	48, 49, or 0
x4	Message 4	48, 49, or 0

To cancel the command, send command with all zeros:

ATSR200 = "98,0,0,0,0"

I/O: Transmit Message if Digital Inputs Achieve Target Value

All the indicated messages (up to three total) are transmitted if the digital i/o lines achieve a target value. After transmission the function is cancelled.

Output pins are ignored when the unit assesses whether the target has been achieved or not. Don't Care inputs are ignored when the unit assesses whether the target has been achieved or not. See Section \n 1.9.3 for more on Don't Care inputs, including how to define an input as Don't Care.

Command, send the following messages the first time the digital i/o achieve the target byte:

ATSR200 = 99,xxxxxxxx,x1,x2,x3

Table 4.12. Digital I/O Target Command

Field	Description	Range
99	Digital i/o target command	99
xxxxxxxx	Target byte	0 or 1
x1	Message 1	48, 49, or 0
x2	Message 2	48, 49, or 0
x3	Message 3	48, 49, or 0

If some of the i/o lines have been defined as outputs or Don't Care inputs, then the corresponding bit in the Target byte is irrelevant, since this function ignores the value of outputs and Don't Care inputs.

To cancel the command, send command with all zeros:

ATSR200 = "99,00000000,0,0,0"

This command only allows you to select up to 3 messages for transmission, although some other commands allow up to 4 messages. This difference is because the commands have been designed to fit into 5 bytes, for transmission over the air, and command 99 uses one byte for the target value of the inputs. See "Binary (over-the-air) commands" on page 44 and "Generating Command Bytes From a Standard Keyboard" on page 51 for more information.

I/O: Define I/O

Define 8 I/O lines as inputs or outputs; and define inputs as Care inputs or Don't Care inputs. A Don't Care input is an input that is reported, but that does not itself activate a transmission when it changes, or hits a defined target value. See the following example for why customers need "Don't Care inputs.

ATSR200 = 100,xxxxxxxx

Table 4.13. Define Digital I/O Command

Field	Description	Range
100	Define digital i/o command	100
xxxxxxxx	Define mask	I,X or O (I = Care Input, X = Don't care input, O = Output)

The left most character corresponds to DIP PIN #29 and the right most character corresponds to DIP PIN #24.

Don't Care Inputs in Use

An application may monitor 8 digital inputs, but just one of the 8 is a critical input. If this input changes, then the application wants to get a report of all the inputs. The inputs are thus defined as 1 Care and 7 Don't Care, and the Transmit on change command is activated:

ATSR200 = "100,XXXXXXXI"

ATSR200 = "98,51"

I/O: Set All Outputs with a Single Command

Set outputs on or off, with a single command.

ATSR200 = 101,xxxxxxxx

Table 4.14. Set All Digital Outputs Command

Field	Description	Range
101	Set all digital outputs command	101
xxxxxxxx	Definition byte	00000000 – 11111111

1 sets the output to active, 0 sets the output to inactive.

If one of the lines was previously defined as an input, then the corresponding digit has no meaning (i.e. the OM200 ignores the digit).

I/O: Set Up to Two Specified Outputs On/Off

This command is defined only as an over-the air command. It has been created to support Keyboard generated binary (see "Sleep Command" on page 54). There is no need for a serial command, since the serial command 101 already supports this function.

When an i/o line is defined as an output, the default state of that output is 0, and stays at 0 unless it is set to 1 by command 101, or by the equivalent over-the-air commands.

Listen

The S@tellite Modem listens to the ORBCOMM satellites for T minutes, according to the schedule specified by serial command ATSR200 = "36,…".

If the modem is put to sleep, then on schedule the modem wakes up, and listens for T minutes.

When the Listen function is active the S@tellite Modem is placed in ORBCOMM-mode only. It does not switch back and forth from ORBCOMM to GPS mode during the Listen period.

If the Modem is polled for position during a Listen period:

- max_gps_age is overridden during Listen periods.
- the S@tellite Modem responds with the most recent GPS fix.

If the S@tellite Modem is not put into the sleep mode, then this function does not apply.

The purpose of a listen function is to ensure that the back office always has a window during which they can talk to the modem (over the air), and change its configuration, if necessary.

The modem shall have a default listen function of 30 minutes, once per week, from midnight UTC until 00:30 UTC, on Sunday morning. This time has been chosen since it is the lowest traffic time, so that there is the greatest chance of being able to contact the S@tellite Modem.

On the schedule defined by ATSR200 = "36,…", listen for T minutes:

ATSR200 = 37,mmm

Table 4.15. Listen Command

Field	Description	Range
37	Listen command	37
mmm	Time: Minutes	0 – 999

Timeout Commands

ORBCOMM Auto-Mode Timeouts

Table 4.16. Timeout Parameters

Parameter	Default
Tgps	5 minutes
Torb	5 minutes
max_gps_age	10 minutes
back_to_sleep_timeout	10 minutes

These parameters are also described in "AutoModes, GPS and ORBCOMM Time-Outs" on page 26.

To change the settings, use the command:

ATSR200 = 38,mmm,mmm,mmm,mmm

Table 4.17. ORBCOMM Auto-Mode Timeouts

Field	Description	Range
38	ORBCOMM Auto-Mode Timeouts	38
Tgps	GPS timeout (Minutes)	0 – 127
Torb	Orb timeout (minutes)	0 – 127
mmm	Max_pgs_age timeout (minutes)	5:5 – 160
mmm	Back_to_sleep_timeout (minutes)	5:5 – 160

Indexing: Parameters are not indexed, parameters are written literally, as shown in the following example.

Example: set ORBCOMM Auto-mode timeouts to: Tgps=5 minutes; Torb=5 minutes; max_gps_age = 10 minutes; back_to_sleep_timeout = 20 minutes

ATSR200 = "38,5,5,10,20

Tgps

0 is allowed. If Tgps=0, and Torb>0, then the S@tellite Modem never goes into GPS mode, not even if the unit is polled for position.

CAUTION
If Tgps = 0, you cannot poll the unit for position or command a position report from a DTE.

Torb

0 is allowed. If Torb=0, and Tgps>0, then the S@tellite Modem stays in GPS mode always, except for the period that the Listen function is active, when the unit goes into ORBCOMM mode.

Torb=0 and Tgps=0 is not allowed and results in an ERR response, and the command is not accepted.

max_gps_age

The resolution of max_gps_age is 5 minutes, if the command is sent with something other than a multiple of 5, the S@tellite Modem automatically rounds up to the nearest 5.

max_gps_age of zero is not allowed and results in an ERR response, and the command is not accepted.

back_to_sleep_timeout

The resolution of back_to_sleep_timeout is 5 minutes, if the command is sent with something other than a multiple of 5, the S@tellite Modem automatically round up to the nearest 5. back_to_sleep_timeout of zero is not allowed and results in an ERR response, and the command is not accepted.

If the S@tellite Modem has to round a number up to the nearest 5, it echoes the exact command as received, but internally rounds the values to the nearest 5.

Good GPS Fix Parameters

Timeout Command 2 allows the user to customize two parameters that control when a GPS fix is considered good.

To change the settings, use the command:

ATSR200 = 39,H,sss

Table 4.18. Good GPS Fix Parameters

Field	Description	Range
39	Good GPS fix parameters	39
H	HDOP_max	0 – 7
sss	Delta_ttff (seconds)	0 – 127 Default = 30

Defaults:

HDOP_max default = 3

Delta_ttff default = 30 seconds

HDOP_max

0 is allowed. The actual HDOP is never zero, therefore, setting HDOP_max = 0 has the effect of always constraining the algorithm to remain in GPS mode for Delta_ttff seconds following the first fix before considering the fix Good.

delta_ttff

0 is allowed. The effect of Delta_ttff=0 is that the first fix is always be used as the reported GPS position and used in GPS functions. This is not advisable, the recommended value of Delta_ttff is the default of 30 seconds.

Send S@tellite Modem ID or ID+Configuration

Command 63 causes the S@tellite Modem to send its ID or ID+Configuration. The command 63 requires two arguments to specify whether the configuration must be transmitted through the air or through the port, and to specify whether the full configuration is required, or just the Modem ID.

Send configuration over the air or through the serial port:

ATSR200 = 63,I/M/C,A/S

Table 4.19. Message Configuration Command

Field	Description	Range
63	Message configuration command	63
I/M/C	I = ID only, C = Complete configuration, M = Mode	
A/S	A = Transmit through the Air, S = Through Serial port	

Response to ATSR200 = "63,I,S"

If the modem gets and understands the valid command, it responds with an echo of the command, followed by the ID of the Modem:

ATSR200 = "63,I,S"

S@tellite Modem, Serial #: XXXXXXXX, SW: V1.01, HW: S@tellite Modem

Serial # is an 8 character alphanumeric string.

Response to ATSR200 = "63,M,S"

This command sends the current mode of the S@tellite Modem over the serial port: GPS mode or ORBCOMM mode. Figure 4.1 shows how the S@tellite Modem automatically switched from GPS to ORBCOMM mode and back. This command returns the current state of the S@tellite Modem at the time that it receives the command.

The S@tellite Modem responds with an echo of the command, followed by:

MODE: XXX

XXX = GPS or ORB.

Response to ATSR200 = "63,C,S"

If the S@tellite Modem receives and understands the valid command ATSR200="63,CS", it responds with an echo of the command, followed by the ID of the modem, followed by a comma delimited ASCII representation of the configuration as defined below. The format shown below has been designed to match the format of the commands used to set these parameters in the first place; but with the important distinction that the format below is meant to be human-readable as well as machine-readable. The command names, which are numbers in the commands themselves, have been replaced with their English names, and time fields (hours and minutes) are represented with a colon (hh:mm) to make them easier to read.

Table 4.20. Response from S@tellite Modem

Format (Example)	Notes
ATSR200 = "63,C,S" ATSR200="63,C,S" S@tellite Modem, Serial #: XXXXXXXX, SW: Vx.xx, HW: xxxxx S@tellite Modem, Serial #:OMX00020, SW:V1.01, HW:OM200	The same as the response to ATSR200 = "63,I,S" (ID only)
SCHEDULED TX,hh:mm,hh:mm,hh:mm,yyyy,mm,dd,hh:mm,ddd SCHEDULED TX,,,,1999,6,1,00:00,1	The schedule is either greater-than-once-per-day (Time), or once-per-day-or-less (Day). You cannot have both types of schedule set, it is either one (Time) or the other (Day). If the schedule is a Day schedule then the format is as shown in the example above. If the schedule is a Time schedule, then trailing commas are suppressed.
messages,xx,xx,xx,xx messages,50,52,54	The messages that have been selected are shown. Up to 4 messages can be selected, trailing commas are suppressed (in this example, only three messages have been selected).
GPS,hh:mm,hh:mm,hh:mm,yyyy,mm,dd,hh:mm,ddd GPS,16:00,00:30,01:00	The GPS schedule is shown, followed by the GPS functions. If the schedule is greater-than-once-per-day, as in the example, then trailing commas are suppressed (see example above). If the schedule is once-per-day-or-less then the schedule format is: GPS,,,,YYYY,MM,DD,hh:mm,ddd, example: GPS,,,,1999,6,1,00:00,7
stop,xx,xx,xx,xx,hh:mm,rrr stop, 50,52,54,,04:00,1000	If a GPS function has been set (like the stop function in this example), the function parameters are shown, these are the same parameters, in the same order as the command that sets this function. Up to 4 messages can be selected, null fields are used if fewer than 4 are selected. In this example 3 messages are shown, and 1 null field. The radius of the stop function is shown in the actual units, not by an index, that is: 1000 means "one-thousand meters; similarly for other values.
movexx,xx,xx,xx,hh:mm,rrr move	When a function has been set, then the parameters are reported as shown. When a function has not been set, then there are no parameters reported (like "move" in the above example).
lat1,xx,xx,xx,xx,ddmm.mmmH lat1,50,54,,,2500.00N lat2,xx,xx,xx,xx,ddmm.mmmH lat2,50,54,,,4900.000N lon1,xx,xx,xx,xx,ddmm.mmmH lon1,50,54,,,6500.000W lon2,xx,xx,xx,xx,ddmm.mmmH lon2,50,54,,,12500.000W	The function parameters are shown, these are the same parameters, in the same order as the command that sets this function. The messages that have been selected are shown, up to 4 messages can be selected, null fields are used if fewer than 4 are selected. In this example 2 messages are shown, and 2 null fields. In general the different boundaries could have different messages selected, but typically they would have the same, as shown in the example. The resolution on lat and lon is 3 digits of minutes (approximately 2 meters).
IO,hh:mm,hh:mm,hh:mm,yyyy,mm,dd,hh:mm,ddd IO,00,00:10,23:59	The Digital IO schedule is shown, followed by the IO functions. The schedule is reported in a similar way to the SCHEDULED TX, and GPS schedules.
change,xx,xx,xx,xx change	
target,xxxxxxxx,xx,xx,xx target,00000001,52	If an IO function has been set (like the target function in this example), The function parameters are shown, these are the same parameters, in the same order as the command that sets this function. Trailing commas are suppressed.
define,xxxxxxxx define,XIIIIIIO	The definition of the outputs is shown. O=Output, I=Input, X=Don't Care Input. To query the state of an IO line, you must use the commands 50 or 51.

Table 4.20. Response from S@tellite Modem

Format (Example)	Notes
LISTEN,hh:mm,hh:mm,hh:mm,yyyy,mm,dd,hh:mm,ddd LISTEN,,,,1999,6,1,00:00,7	The schedule is reported in a similar way to the SCHEDULED TX, GPS, and IO schedules.
alert,mm 11 alert,30	The alert time is the time (in minutes) that the s@TELLITE Modem has been commanded to listen (See command ATSR200= "37, …").
AUTO TIMEOUTS,mm,mm,mm,mm AUTOTIMEOUTS,5,5,10,10	
GPS PARAMETERS,h,mm GPS PARAMETERS,3,30	

Save Current Configuration to Flash

Command 63 can also be used to command the unit to save the current configuration to Flash memory (this ensures that the configuration is saved even if the backup battery becomes disconnected.

Write Current Configuration to Flash:

Syntax: ATSR200="63,F,W"

Binary Syntax (for over-the-air command): 0x3F, 0x46, 0x57, 0x0, 0x0

Function: Save all ATSR configuration into flash and reset the S@tellite Modem modem.

This configuration will be used in case of loss of power or hard reset (cold start).

Reprogram of the Gateway ID resets the configuration back to factory default settings.

Restore Configuration to Factory Default

Restore ATSR Configuration to Factory Default Setting

Syntax: ATSR200="63,F,R"

Binary Syntax (for over-the-air command): 0x3F, 0x46, 0x52, 0x0, 0x0

Function: Restore the ATSR configuration to factory default setting and reset the S@tellite Modem.

S@tellite PC

The S@tellite PC software uses ATSR200 = "63,I,S" to determine what kind of product it is connected to (similar to how Evaluate uses $PASHQ,RID).

Sleep command

After you have set up the schedule configuration, you can then put the unit to sleep. To put the unit to sleep send the command:

ATSR200 = "122,1"

Once the S@tellite Modem receives the sleep command it echoes the command back, as an acknowledgments, and then goes into sleep mode. It wakes up according to the schedule, or when DTR is activated. If a schedule wakes up the unit, then after the unit has done what it was scheduled to do, it automatically returns to sleep mode, unless the sleep mode is cancelled. To cancel the sleep mode, send the following command while the unit is awake:

ATSR200 = "122,0"

Example 1:

Scenario: Digital i/o schedule, transmit message on change. No change in inputs.

Behavior: Unit wakes up, checks the state of the digital inputs, compares state to the previous state (i.e. the state observed the last time the unit was awake). Nothing has changed, unit goes back to sleep.

Example 2:

Scenario: GPS schedule, transmit message if Latitude 37º21.09' crossed. Latitude not crossed.

Behavior: Unit wakes up, gets a GPS fix, checks whether Latitude was crossed since the previous GPS fix. It wasn't. Unit goes back to sleep.

Example 3:

Scenario: GPS schedule, transmit message if Latitude 37º21.09' crossed. Latitude is crossed while unit was sleeping.

Behavior: Unit wakes up, gets a GPS fix, checks whether Latitude was crossed since the previous GPS fix. It was. Unit transmits the messages that it was programmed to transmit by the GPS function. Unit goes back to sleep.

The unit can be awoken and put to sleep by the DTR levels:

Deactivated DTR if modem goes to sleep

Activated DTR if modem wakes up

Binary (over-the-air) commands

Over-the-air commands are a binary representation of the corresponding serial command, packed into 5 bytes. This section describes how each command is packed into five bytes. The description of what the command actually does is given along with the serial (ASCII) command definitions above.

Schedule Commands

Corresponding Serial commands: 48, 65, 97 and 36.

The first byte of the schedule command contains the schedule flag and function category, the next four bytes define the schedule that is being set.

The schedule flag = 0 for once-per-day-or-more-frequently schedules

The schedule flag = 1 for once-per-day-or-less-frequently schedules

Table 4.21. Schedule Flags

Schedule Flag	Meaning
0	once-per-day-or-more-frequently
1	once-per-day-or-less-frequently

Table 4.22. Function Categories

Function Category	Function
0x30	Regularly scheduled messages
0x41	GPS schedule
0x61	Digital I/O schedule
0x24	Listen schedule

Time Schedule

The schedule times and period are packed into 4 bytes as follows:

Table 4.23. Bytes for Schedule Times and Periods

start time hours	[00,23]	start time minutes	[00,59]
period hours	[00,15]	period minutes	[00,59]
end time hours	[00,23]	end time minutes	[00,59]

<table>
<tr><td>byte</td><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
<tr><td>0</td><td>1</td><td colspan="7">Function category (0x30, 0x41, 0x61, 0x24) implemented using 7 bits</td></tr>
<tr><td>1</td><td colspan="4">start year [0:9]</td><td colspan="4">start month [1:12]
1 is encoded as 1</td></tr>
<tr><td>2</td><td colspan="5">start day [1:31]
1 is encoded as 1</td><td colspan="3">start hour …</td></tr>
<tr><td>3</td><td colspan="2">… [00:23]</td><td colspan="6">start minute [00:59]</td></tr>
<tr><td>4</td><td colspan="8">period (days) [000:255]</td></tr>
</table>

Day Schedule

The schedule start date, time and period are packed into 4 bytes as follows:

Table 4.24. Bytes for Schedule Start Date, Time, and Period

start year (encode just the least significant digit)	[0:9] 4 bits
start month	[1:12] 4 bits
start day	[1:31] 5 bits
start hour	[00:23] 5 bits
start minute	[00:59] 6 bits
period (days)	[000:255] 8 bits

<table>
<tr><td>byte</td><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
<tr><td>0</td><td>0</td><td colspan="7">Function category (0x30, 0x41, 0x61, 0x24) implemented using 7 bits</td></tr>
<tr><td>1</td><td colspan="5">start time hours [00:23]</td><td colspan="3">start time …</td></tr>
<tr><td>2</td><td colspan="3">… minutes [00:59]</td><td colspan="4">period hours [00:15]</td><td>period …</td></tr>
<tr><td>3</td><td colspan="5">… minutes [00:59]</td><td colspan="3">end time …</td></tr>
<tr><td>4</td><td colspan="2">… hours [00:23]</td><td colspan="6">end time minutes [00:59]</td></tr>
</table>

The encoding of the start year is just the last decimal digit of the year, example: 1999 = 9, 2000 = 0. After 10 years the logic must handle this digit in the same way, so that, come 2009, the code shall interpret 9 as meaning 2009. Thus, if a S@tellite Modem is programmed today, it should continue working correctly forever.

A period of zero (zero days) cancels the schedule.

Regularly Scheduled Transmissions

Corresponding Serial commands: 49

Over-the-air command 0x31.

Send the following messages on the schedule defined by 0x30:

byte	MSB							LSB
0	Command name 0x31							
1	Hex identifier for desired message							
2	Hex identifier for desired message (zeros, if no more messages needed)							
3	Hex identifier for desired message (zeros, if no more messages needed)							
4	Hex identifier for desired message (zeros, if no more messages needed)							

To cancel this function, send the command name (0x31), and all zeros following.

Immediate Transmission

Corresponding Serial commands: 50

Over-the-air command 0x32.

Send the following messages immediately:

byte	MSB							LSB
0	Command name 0x32							
1	Hex identifier for desired message							
2	Hex identifier for desired message (zeros, if no more messages needed)							
3	Hex identifier for desired message (zeros, if no more messages needed)							
4	Hex identifier for desired message (zeros, if no more messages needed)							

GPS: Movement Function

Corresponding Serial commands: 66

Over-the-air command 0x42.

Perform the time & distance movement function:

byte	MSB							LSB
0	Command name 0x42							
1	this byte defines which messages are sent. Each bit corresponds to one of the messages defined in Section **Error! Reference source not found.**. LSB=6 byte position report.							
2	time, hours [0:31]					time, …		
3	minutes [0:59]			radius (5 MSBs)				
4	radius (8 LSBs) [0:100:819,100] 0 is encoded as 0, 100 is encoded as 1, … 819100 is encoded as 8191							

The time arguments are optional, but if they are not defined, then this function sends a message whenever the S@tellite Modem leaves the radius. To leave time undefined, set time to zero.

To cancel this function, send the command name with all zeros.

GPS: Stop Function

Corresponding Serial commands: 67

Over-the-air command 0x43.

Same format as GPS Movement Function, but time is not optional.

GPS: Boundary Function, Latitude 1

Corresponding Serial commands: 68

Over-the-air command 0x44

Send the indicated messages when the specified line of latitude is crossed for the first time.

Byte	MSB							LSB
0	Command name 0x44							
1	this byte defines which messages are sent. Each bit corresponds to one of the messages defined in Section **Error! Reference source not found.**. LSB=6 byte position report.							
2	latitude (8 MSBs)							
3	latitude							
4	latitude (8 LSBs)							

Encoding of latitude, same as in 6 byte position message, see the ORBCOMM Serial Interface Specification for more information.

GPS: Boundary Function, Latitude 2

Corresponding Serial command: 69

Over-the-air command 0x45

Send the indicated messages when the specified line of latitude is crossed for the first time.

Byte	MSB							LSB
0	Command name 0x45							
1	this byte defines which messages are sent. Each bit corresponds to one of the messages defined in Section **Error! Reference source not found.**. LSB=6 byte position report.							
2	latitude (8 MSBs)							
3	latitude							
4	latitude (8 LSBs)							

Encoding of latitude, same as in 6 byte position message, see ORBCOMM serial interface spec.

GPS: Boundary Function, Longitude

Same as Latitude crossing functions, but defined for longitude #1 and longitude #2, and with a different command names (0x46 & 0x47 instead of 0x44 and 0x45).

Encoding of longitude, same as in 6 byte position message, see ORBCOMM serial interface spec.

I/O: Send Message if Digital Inputs Change

Corresponding Serial command: 98

Over-the-air command 0x62

Send the following messages if the digital inputs change.

Byte	MSB							LSB
0	Command name 0x62							
1	Hex identifier for desired message							
2	Hex identifier for desired message (zeros, if no more messages needed)							
3	Hex identifier for desired message (zeros, if no more messages needed)							
4	Hex identifier for desired message (zeros, if no more messages needed)							

To cancel this function, send the command name (0x62) with all zeros.

I/O: Send Message if Digital Inputs Achieve Target Value

Corresponding Serial command: 99

Over-the-air command 0x63

Send the following messages the first time the digital i/o achieve the target value indicated in Byte 1.

Byte	MSB							LSB
0	Command name 0x63							
1	target byte. LSB corresponds to DIP PIN #24 BIT00 MSB corresponds to DIP PIN #29 BIT07							
2	Hex identifier for desired message							
3	Hex identifier for desired message (zeros, if no more messages needed)							
4	Hex identifier for desired message (zeros, if no more messages needed)							

I/O: Define I/O

Corresponding Serial command: 100

Over-the-air command 0x64

Byte	MSB							LSB
0	Command name 0x64							
1	Definition byte. LSB corresponds to DIP PIN #24 BIT00 MSB corresponds to DIP PIN #29 BIT07 1 defines the line as an input, 0 defines the line as an output							
2	Care/Don’t Care Mask Bits correspond to the same lines as in the Definition byte, above. 0 defines the line as a “Care” line, 1 defines the line as a “Don’t Care” line.							
3								
4								

The Care/Don’t Care mask affects the two functions:

I/O: Send message if digital inputs change

I/O: Send message if digital inputs achieve target value

The Care/Don’t Care mask has been defined so that 0 = Care, thus, by default, there are no Don’t Care lines. The user has to actively set a line to Don’t Care.

I/O: Set All Outputs with a Single Command

Corresponding Serial command: 101

Over-the-air command 0x65

Byte	MSB							LSB
0	Command name 0x65							
1	Definition byte. LSB corresponds to DIP PIN #24 BIT00 MSB corresponds to DIP PIN #29 BIT07 1 sets the output active, 0 sets the output inactive If one of the lines was previously defined as an input, then the corresponding bit has no meaning (i.e. the OM just ignores that bit)							
2								
3								
4								

I/O: Set Up to Two Specified Outputs On/Off

Corresponding Serial command: None

Over-the-air command 0x66

This command is defined only as an over-the air command. It has been created to support ASCII Keyboard generated binary (see "Sleep Command" on page 50).

Byte	MSB							LSB
0	Command name 0x66							
1	[0x31:0x38] ASCII representation of output pin (1 through 8) 1 corresponds to PIN #24 8 corresponds to PIN#29							
2	0x31 (ASCII 1) sets the output active, 0x30 (ASCII 0) sets the output inactive							
3	[0x31:0x38] ASCII representation of output pin (1 through 8) 1 corresponds to PIN #24 8 corresponds to PIN#29							
4	0x31 (ASCII 1) sets the output active, 0x30 (ASCII 0) sets the output inactive							

Listen

Corresponding Serial command: 37

Over-the-air command 0x25

Byte	MSB							LSB
0	Command name 0x25							
1	most significant digit of T							
2	second digit of T							
3	least significant digit of T							
4								

The digits of T are carried by ASCII characters 0 thru 9. Example: to set listen time to 123 minutes:

Byte	MSB							LSB
0	Command name 0x25							
1	0x31 (ASCII 1)							
2	0x32 (ASCII 2)							
3	0x33 (ASCII 3)							
4								

ORBCOMM Auto-Mode Timeout

Corresponding Serial command: 38

Over-the-air command 0x26

Change the timeouts to the following settings:

Byte	MSB							LSB
0	Command name 0x26							
1	Tgps (mins) [0:127] 0 encoded as 0, 1 encoded as 1, …							Torb…
2	Torb (mins) [0:127] 0 encoded as 0, 1 encoded as 1, …						max_…	
3	max_gps_age (mins) [5:5:160] 5 encoded as 0, 10 encoded as 1, …, 160 encoded as 31			back_to_sleep_timeout (mins) [5:5:160] 5 encoded as 0, 10 encoded as 1, …, 160 encoded as 31				
4	spare (for future use)							

Good GPS Fix Parameters

Corresponding Serial command: 39

Over-the-air command 0x27

Change the timeouts to the following settings:

Byte	MSB							LSB
0	Command name 0x27							
	HDOPmax [0:7] 0 encoded as 0, 1 encoded as 1, …			Delta_ttff [0:127] MSBs 0 encoded as 0, 1 encoded as 1, …				
2	Delta_ttff [0:127] LSBs							
3	spare (for future use)							
4	spare (for future use)							

Send OM ID or ID+Configuration

Corresponding Serial command: 63

Over-the-air command 0x3F

Send configuration, over the air, or through the serial port:

Byte	MSB							LSB
0	Command name 0x3F							
1	0x49 or 0x43 (ASCII I or ASCII C)							
2	0x41 or 0x53 (ASCII A or ASCII S)							
3								
4								

Sleep Command

Corresponding Serial command: 122

Over-the-air command 0x7A

Byte	MSB							LSB
0	Command name 0x7A							
1	0x30 (cancel sleep mode) or 0x31 (go to sleep)							
2								
3								
4								

Generating Command Bytes From a Standard Keyboard

The commands sent through the air are all five bytes (binary). Some of these commands have been defined by us to have parameters who's numerical value happens to correspond to ASCII characters on a standard keyboard (See Appendix A, **ASCII Table**). Thus these commands can be generated by typing the following in the Subject line and Body of the E-mail:

Subject line: [COMMAND:ACK]

Body: the five characters (or fewer than five)

See the Orbcomm Gateway Interface Specification for more details on sending commands.

Table 4.25 describes the commands:

Table 4.25. Generating Command Bytes from a Standard Keyboard

Command Name (Hex)	ASCII Character which generates the correct byte	Description
0x30	0	Schedule for Regularly Scheduled Messages
0x31	1	Message types to be sent on the above schedule
0x32	2	Message types to be sent immediately
0x41	A	Schedule for GPS functions
0x42	B	Time and Distance Movement function (report if S@tellite Modem moves)
0x43	C	Time and Distance Stop function (report if S@tellite Modem doesn't move)
0x44	D	Latitude function #1 (report the first time this latitude is crossed)
0x45	E	Latitude function #2 (report the first time this latitude is crossed)
0x46	F	Longitude function #1 (report the first time this longitude is crossed)
0x47	G	Longitude function #2 (report the first time this longitude is crossed)
0x61	a	Schedule for Digital I/O functions
0x62	b	Send message(s) if state of Digital I/O changes
0x63	c	Send message(s) if Digital I/O achieves a target value
0x64	d	Define inputs and outputs
0x65	e	Set all outputs with a single command
0x66	f	Set up to two specified outputs ON/OFF
0x67	g	Set one specified output ON/OFF at a specified time
0x24	$	Schedule for Listening
0x25	%	Period to Listen
0x26	&	Timeout Command
0x3F	?	Report S@tellite Modem ID or ID+ Configuration

As shown in the above table, all the commands have hex names that can be generated from standard keyboard characters. The following commands have hex arguments that correspond to standard characters:

Schedules

Schedules are defined bit-wise, and are not designed to be generated using standard keyboard characters - except perhaps for a few special case schedules that happen to correspond to hex values that can be generated from a keyboard.

Messages

The message identifiers have been chosen to correspond to keyboard characters 0 through 7.

Regularly Scheduled Transmissions

The over the air five byte command can be generated using the keyboard characters shown:

Table 4.26. Bytes for Regularly Schedule Transmissions

Byte	Hex	Keyboard
0	Command name 0x31	1
1	Hex identifier for desired message.	Keyboard character identifying desired message (from 0 through 7)
2	Hex identifier for desired message (zeros, if no more messages needed)	Keyboard character identifying desired message. Do not use if no more messages are needed.
3	Hex identifier for desired message (zeros, if no more messages needed)	Keyboard character identifying desired message. Do not use if no more messages are needed.
4	Hex identifier for desired message (zeros, if no more messages needed)	Keyboard character identifying desired message. Do not use if no more messages are needed.

Keyboard 0 generates Hex 0x30. Do not use keyboard 0 to try to generate Hex 0x00, just end the text after selecting the desired messages.

Immediate Transmission

Similar to above.

GPS Functions

Movement is defined bit-wise and is not designed to be generated using standard keyboard characters, with the exception of a few special cases that happen to correspond to hex values that can be generated from a keyboard.

I/O: Send Message if Digital Inputs Change

The over the air five byte command can be generated using the keyboard characters are listed in Table 4.26.

Table 4.27. Bytes Flagging Change in Digital Inputs

Byte	Hex	Keyboard
0	Command name 0x62	b
1	Hex identifier for desired message.	Keyboard character identifying desired message (from 0 through 7)
2	Hex identifier for desired message (zeros, if no more messages needed)	Keyboard character identifying desired message. Do not use if no more messages are needed.
3	Hex identifier for desired message (zeros, if no more messages needed)	Keyboard character identifying desired message. Do not use if no more messages are needed.
4	Hex identifier for desired message (zeros, if no more messages needed)	Keyboard character identifying desired message. Do not use if no more messages are needed.

Keyboard 0 generates Hex 0x30. Do not use keyboard 0 to try to generate Hex 0x00; end the text after selecting the desired messages.

I/O: Send Message if Digital Inputs Achieve Target Value

Defined bit-wise, not designed to be generated using standard keyboard characters.

I/O: Define I/O

Defined bit-wise, not designed to be generated using standard keyboard characters.

I/O: Set All Outputs With a Single Command

Defined bit-wise, but can be used, using ASCII, to turn off all outputs by sending the command name (0x65, ASCII e) followed by nothing. This gets interpreted as Hex zeros and switches off all outputs.

The following command (0x66) allows you to set any output on and off using keyboard generated binary.

I/O: Set Up to Two Specified Outputs On/Off

The over the air five byte command can be generated using the keyboard characters are listed in Table 4.27.

Table 4.28. Bytes Used to Specify TG10 Outputs

Byte	Hex	Keyboard
0	Command name 0x66	f
1	[0x31:0x38]	1 through 8 1 corresponds to PIN #24 8 corresponds to PIN #29
2	0x31 = active 0x30 = inactive	1 = active 0 = inactive
3	[0x31:0x38]	ASCII representation of output pin (1 through 8) 1 corresponds to PIN #24 8 corresponds to PIN #29
4	0x31 = active 0x30 = inactive	1 = active 0 = inactive

Keyboard 0 generates Hex 0x30. Do not use keyboard 0 to try to generate Hex 0x00; end the text after selecting the desired messages.

Listen

The over the air five byte command can be generated using the keyboard characters are listed in Table 4.29.

Table 4.29. Bytes used to Specify Listen

Byte	Hex	Keyboard
0	Command name 0x25	%
1	[0x30:0x39]	0 through 9
2	[0x30:0x39]	0 through 9
3	[0x30:0x39]	0 through 9
4		

Keyboard 0 generates Hex 0x30. Do not use keyboard 0 to try to generate Hex 0x00, just end the text after selecting the desired messages.

Timeout Commands

These commands are not designed for keyboard characters.

Send S@tellite Modem Configuration

The over the air five byte command can be generated using the keyboard characters are listed in Table 4.30.

Table 4.30. Bytes Used to Specify Send

Byte	Hex	Keyboard
0	Command name 0x25	?
1	0x49 or 0x43	1 or C
2	0x41 or 0x53	A or S
3		
4		

Keyboard 0 generates Hex 0x30. Do not use keyboard 0 to try to generate Hex 0x00; end the text after selecting the desired messages.

Sleep Command

The over the air five byte command can be generated using the z key, followed by a one (go to sleep) or a zero (cancel sleep mode):

Table 4.31. Bytes Used to Specify Sleep

Byte	Hex	Keyboard
0	Command name 0x7A	z (lower case)
1	0x30 or 0x31	0 or 1
2		
3		
4		

Keyboard 0 generates Hex 0x30. Do not use keyboard 0 to try to generate Hex 0x00; end the text after selecting the desired messages.

A

ASCII Table

User commands are defined as five bytes, sent in an email to ORBCOMM. In the S@tellite Modem we have some commands where the five bytes are defined to correspond to ASCII characters. This is so these special commands can be originated from standard email, actually typed from a keyboard (PC or GSC 100).

Table A.1 shows the ASCII characters that can be generated from a GSC 100. The light gray rows are the symbols that need “ALT, SYM”; avoid using them. The dark gray rows are symbols that are not on the GSC 100 at all, or are easily confused (example, underscore and dash), and so we do not use them to define commands.

Table A.1. ASCII Table

Unassigned Decimal	Hex	ASCII	Notes		Unassigned Decimal	Hex	ASCII	Notes
32	20		(space)		80	50	P	
33	21	!			81	51	Q	
34	22	“	double quote		82	52	R	
35	23	#	#		83	53	S	
36	24	$			84	54	T	
37	25	%			85	55	U	
38	26	&			86	56	V	
39	27	‘	single quote		87	57	W	
40	28	(			88	58	X	
41	29	)			89	59	Y	
42	2A	*			90	5A	Z	
43	2B	+			91	5B	[	
44	2C	,	comma		92	5C	\	
45	2D	-	dash		93	5D	]	
46	2E	.	period		94	5E	^	caret
47	2F	/			95	5F	_	underscore
48	30	0			96	60	‘	reverse quote
49	31	1			97	61	a	
50	32	2			98	62	b	
51	33	3			99	63	c	
52	34	4			100	64	d	
53	35	5			101	65	e	
54	36	6			102	66	f	
55	37	7			103	67	g	
56	38	8			104	68	h	
57	39	9			105	69	i	
58	3A	:			106	6A	j	
59	3B	;			107	6B	k	
60	3C	<			108	6C	l	
61	3D	=			109	6D	m	
62	3E	>			110	6E	n	
63	3F	?			111	6F	o	

Table A.1. ASCII Table

Unassigned Decimal	Hex	ASCII	Notes		Unassigned Decimal	Hex	ASCII	Notes
64	40	@			112	70	p	
65	41	A			113	71	q	
66	42	B			114	72	r	
67	43	C			115	73	s	
68	44	D			116	74	t	
69	45	E			117	75	u	
70	46	F			118	76	v	
71	47	G			119	77	w	
72	48	H			120	78	x	
73	49	I			121	79	y	
74	4A	J			122	7A	z	
75	4B	K			123	7B	{	
76	4C	L			124	7C	|	
77	4D	M			125	7D	}	
78	4E	N			126	7E	~	
79	4F	O						

B

Message and Report Definition

Table B.1. S@tellite Modem Messages

Message Types	Decimal ID	Hex Character	Keyboard Character
Position Report (6 bytes) delivered to customer as ASCII by ORBCOMM	48	30	0
Position time and date binary Message (12 bytes)	49	31	1
Position time and date, ASCII Message (32 bytes)	50	32	2
Digital I/O status, date and time Report (6 bytes)	51	33	3
Digital I/O status, time and date, ASCII Message (20 bytes)	52	34	4
Time, course and speed Report (6 bytes)	53	35	5
Time, course aaand speed, ASCII Message (21 bytes)	54	36	6

The ASCII messages are delivered in the subject field.

The binary reports are delivered the way ORBCOMM delivers them; Position Report in the subject field, other binary reports as MIME attachments.

Position Report

The six byte Position Report is a special report, in that it goes through the air as binary, then gets translated to ASCII at the ORBCOMM switch, and delivered as ASCII.

Definition

[POSITION-REPORT:LAT=XX.XXXXXX,LON=YYY.YYYYYY]

Example

[POSITION-REPORT:LAT=37.350563,LON=-121.924448]

The southern and western hemispheres are denoted by negative latitude.

Resolution is shown to 6 decimals of degrees, this is approximately 10 cm or better. However, resolution of the binary message through the air is approximately 1m, so the last digit of latitude and longitude actually carries no useful information.

Position Date and Time

ASCII Message

Definition

XX.XXXXXH,YYY.YYYYYH,MM/DD,HH:MM

X = latitude

Y = longitude

H = hemisphere (N/S and E/W)

Example (same position as shown in the 6 byte report above)

37.35056N,121.92445W,06/27,08:00

The resolution is shown to 5 decimals of degrees, this is approximately 1m or better.

The hemisphere is shown by letters, no negative signs.

The date and time have leading zeros where necessary (example: June shows as 06).

No Position

If the S@tellite Modem is polled, and cannot compute a GPS position, and it has no position in memory, then it sends the following message:

NO POSITION,MM/DD,HH:MM

The time tag is the time at which the message was sent.

This is considered to be a very unlikely event.

Binary Report

A Report is six bytes, by definition. The position, date and time are carried in two successive reports as shown.

Latitude:

<table>
<tr><td>Byte</td><td>MSB</td><td></td><td></td><td></td><td></td><td></td><td></td><td>LSB</td></tr>
<tr><td>0</td><td colspan="4">Report ID 0001</td><td colspan="4">month (1 to 12) [0:15]
(January is coded as 0x01)</td></tr>
<tr><td>1</td><td colspan="5">day (1 to 31) [0:31]
(day 1 is coded as 0x01)</td><td colspan="3">hour [0:23]
(hour 0 is coded as 0x00)</td></tr>
<tr><td>2</td><td colspan="2">…hour</td><td colspan="6">minute [0:63]
(minute 0 is coded as 0x00)</td></tr>
<tr><td>0</td><td colspan="8">latitude (8 MSBs)</td></tr>
<tr><td>1</td><td colspan="8">latitude</td></tr>
<tr><td>2</td><td colspan="8">latitude (8 LSBs)</td></tr>
</table>

Longitude: encoded similarly, Report ID = 0010, with the same time tag.

The lat and lon coding is same as for ORBCOMM air interface, 6 byte report.

The resolution is 1.2m for latitude, 2.4m or better for longitude.

The user can use time tags to put together the latitude with the corresponding longitude.

The dateate is month and day. A year is not sent.

Digital I/O Date and Time

ASCII Message

Definition

XXXXXXXX,MM/DD,HH:MM:SS

X = zeros and ones

Example (same position as shown in the 6 byte report above)

01000100,06/27,08:00:00

Binary Report

The digital I/O status, date and time is carried in a 6 byte report as shown.

Latitude:

Byte	MSB							LSB
0	Report ID 0011				state of digital input encoded directly …			
1	to binary 0=TTL low, 1=TTL high				month (1 to 12) [0:15] (January is coded as 0x01)			
2	hour [0:23] (hour 0 is coded as 0x00)					minutes …		
3	minutes [0:59] (minute 0 is coded as 0x00)			seconds [0:59] (second 0 is coded as 0x00)				
4	seconds LSB	0	0	0	0	0	0	0
5								

Course, Speed, Date, and Time

ASCII Message

Definition

XXX,mmm.m,YYYY,MM/DD,HH:MM

X = Course, in degrees, clockwise from true North.

m= speed in meters/second (1 m/s = 1.942 knots = 3.596 km/h = 2.235 mph)

Example (same position as shown in the 6 byte report above)

090,10.2,1999,06/27,08:00

Binary Report

The Course, Speed, date and time is carried in one six byte report as shown.

Latitude:

Byte	MSB							LSB
0	Report ID 0100				month (1 to 12) [0:15] (January is coded as 0x01)			
1	day (1 to 31) [0:31] (day 1 is coded as 0x01)					hour [0:23] (hour 0 is coded as 0x00)		
2	…hour		minute [0:63] (minute 0 is coded as 0x00)					
0	Course [0:359] (0 is encoded as 0x00)							
1	course LSB	Speed (m/s times 10) [0:32,767] (0 m/s encoded as 0x00, 0.1 m/s encoded as 0x01)						
2	speed							

The date is month and day. A year is not sent.

C

The ORBCOMM System

The three main components of the ORBCOMM System are;

- the **space segment** - the constellation of 28 satellites;
- the **ground segment** - gateways which include the Gateway Control Centers (GCCs) and Gateway Earth Stations (GESs), and the Network Control Center (NCC) located in the United States; and
- **subscriber communicators** (SCs) - hand-held or installed devices for personal messaging and reporting, as well as fixed and mobile units for remote monitoring and tracking applications.

A message or report sent from an SC unit in the US — either stationary or mobile — is received at the satellite and relayed down to one of four US GESs that connects the ORBCOMM ground system with the satellites. The GES then relays the message via satellite link or dedicated terrestrial line to the NCC. The NCC routes the message to the final addressee via email, dedicated telephone line or facsimile. Messages originated outside the US are routed through GCCs in the same manner.

Messages and data sent to an SC can be initiated from any computer using common email systems including the Internet, cc:Mail, or Microsoft Mail. The NCC or GCC then transmits the information using ORBCOMM's global telecommunications network. The ORBCOMM System support four basic types of communication, as described below. **For further information, refer to the ORBCOMM documentation that was provided with this Development Kit.**

Data Reports

A Data Report is a short data message that typically contains important information on equipment being tracked or monitored. The most common example of a Data Report is a GPS position report. Applications typically use the Data Report to transmit the status of data items monitored by the SC equipment, such as door closures, temperature, pressure, and meter readings. A Data Report may be generated as needed (based on events) or on a periodic basis, by setting timers within the SC. A Data Report also may be sent on request, i.e. polled by the ORBCOMM System at the request of the end user. The ORBCOMM standard format for a Data Report includes six bytes of user data. **For further information, refer to the ORBCOMM Gateway Customer Access Interface Specification that was provided with this kit.**

Messages

A Message is a longer transmission of data than a Data Report. Messages are typically used for satellite/internet email but can be used for specially designed data reports. Message lengths are typically less than 100 bytes, although the ORBCOMM System can handle messages of greater length. To ensure reliable Message transfer, Messages are transferred via short packets over the Satellite reservation channels, with all packets acknowledged or retransmitted. Messages are then accepted/delivered via public or private data networks. Messages from SCs can be originated at the request of the subscriber (random access), or at the request of the network (polled).

Store and Forward Message

A Store & Forward Message is a special form of a Message for worldwide communication. In many places around the world, ORBCOMM satellites are not in contact with Ground Earth Stations (GES) as they pass overhead. Messaging in these situations is accomplished by storing the message on the satellite for later delivery to an ORBCOMM GES. The message is constrained to be a single, self-contained data packet. For an SC-Terminated GlobalGram, the relaying Satellite stores the data packet in memory and transmits it upon request from the destination SC.

Commands

A Command is a short message consisting of one packet which is transmitted to an SC instructing it to perform a specific function. Commands could be signals to initiate action by devices attached to the SC. Acknowledgments may or may not be required.

Commands and Polling

The ORBCOMM system supports an extensive command and polling capability. By sending an email to a S@tellite Modem, you can command it to perform certain actions, such as “Position Polling” which is a secured command providing position reports from a remote unit. Security is guaranteed in two ways:

- Commands are only be forwarded to the S@tellite Modem from email addresses previously registered with ORBCOMM.
- The S@tellite Modem only sends a response to an email address programmed into its list of “speed dials”.

When a command or poll is sent;

The ORBCOMM control center sends the command to all satellites in the vicinity of the last known position of the S@tellite Modem, and the satellites initiate contact with the Modem to deliver the command.

If no response has been received after three minutes, this process is repeated up to 20 times. If the command has not been successfully delivered, the originator of the command is informed. If the command is successfully delivered, an acknowledgment is sent to the originator (if the originator has requested an acknowledgment).

How does the control center know where the S@tellite Modem is?

When the S@tellite Modem sends a position report, its last known position is automatically updated in the control center database. If no position reports have been sent for 4 days, then any messages sent from the S@tellite Modem will cause the control center to update the last known position by assigning the position directly below the satellite that received the last message from the Modem.

Table C.1. ORBCOMM Serial Interface Specification

Packet Name	Description
Link Level Acknowledgement	Response packet used to indicate the receipt of a command or data packet across the serial interface.
Configuration Command	Command packet used to set various parameters in an SC that control the communication between the SC, satellite and the ORBCOMM system. These parameters can be either read-only or read-write. Descriptions of these parameters can be found in the Appendix of the ORBCOMM Serial Interface Specification.
Communications Command	Command packet to specify a requested action or request information from the ORBCOMM system. These commands are originated by the DTE and are relayed to the ORBCOMM system by the SC.

Table C.1. ORBCOMM Serial Interface Specification (continued)

Packet Name	Description
System Announcement	Message sent to the DTE requesting data needed to comply with a communication request.
Status	Packet containing status information about the communication link to the satellite system. This information includes the number of satellites in view, current satellite, number of messages in the SC's memory, and diagnostic data.
SC-Originated Message	Packet containing a Subscriber Communicator originated message with user-defined parameters.
SC-Originated Default Message	Packet containing a Subscriber Communicator originated message with SC-defined default parameters.
SC-Originated Report	Packet containing a Subscriber Communicator originated report with user-defined parameters.
SC-Originated Default Report	Packet containing a Subscriber Communicator originated report with user-defined parameters.
SC-Originated GlobalGram	Packet containing a Subscriber Communicator originated "store and forward" message. These messages are received from SC's while the satellite is not in contact with a Ground Earth Station (GES).
System Response	Message sent to the DTE providing status of the SC's response to an ORBCOMM system request.
SC-Terminated Message	Packet containing a Subscriber Communicator terminated message.
SC-Terminated User Command	A command to the user's application (SC) where user data is defined by the developer.
SC-Terminated GlobalGram	Packet containing a Subscriber Communicator originated "store and forward" message. These messages are received from SC's while the satellite is not in contact with a Ground Earth Station (GES).
Position Determination Command	Used to initiate a position determination using the ORBCOMM doppler method. (GPS is normally used in preference to this method.)
Position Status	Used to determine position using the ORBCOMM doppler method. (GPS is normally used in preference to this method.)
SC-Originated Position Report	This command, when sent to SC, causes a position report to be sent via ORBCOMM network.
SC-Originated Enhanced GlobalGram	Not supported by ORBCOMM.
SC-Terminated Enhanced GlobalGram	Not supported by ORBCOMM.

D

Hayes AT Commands

All Hayes AT commands are preceded with a prefix command, and are terminated with a carriage return. All of the Hayes AT commands must follow this protocol.

Syntax Rules

- A command string should start with "AT" or "at", except for the commands "A/" and "+++". "At" or "aT" are invalid.
- The commands can be given in upper or lower case.
- A command string should contain less than 40 characters.

E

Glossary

This glossary contains terms that you will see when using your Development Kit. For a more extensive list, refer to the GSC 100 User Guide.

Address	The logical or Internet address is used to facilitate moving data between physical networks. Identifier assigned to networks, stations and other devices so that each device can be separately designated to receive and reply to messages. Each host computer on the Internet has a unique address.
Bit	Binary Digit. The smallest unit of information into which digital data can be subdivided and which a computer can hold. Each bit has only two values, one or zero.
Channel	Either a single frequency or a pair of radio frequencies used as a communication path.
Data Rate	The maximum number of bits of information which can be transmitted per second, as in a data transmission link; typically expressed as megabits per second (Mb/s).
Differential GPS	DGPS. A procedure of correction global positioning system (GPS) solutions to achieve improved position accuracy. Differential GPS provides 2 to 5 meter position accuracy.
E-mail	Electronic Mail. A method of file transfer and message sending among workstations.
Frequency	The number of vibrations per second of an audio or radio signal. Measured in hertz (Hz), kilohertz (kHz) or megahertz (MHz).
Gateway	1) Provides message processing and subscriber management for the defined service area. 2) A hardware/software package that runs on the open system interconnection (OSI) application layer and allows incompatible protocols to communicate; includes X.25 gateways. 3) A relay at any layer above the network layer.
Gateway Control Center (GCC)	The GCC acts as the Operations Center for all Gateway activities. All communications must pass through an ORBCOMM GCC.
Gateway Data System	Interacts with the Network Management System and Network Data Server to exchange network status and system performance information.
Gateway Downlink Channels	Used by the satellites to send traffic, telemetry and network management packets to the NCCs.
Gateway Earth Station (GES)	The GES provides interconnection between the OMS and the satellite constellation. The GES consists of medium gain tracking antennas, RF and modem equipment, and communications hardware to send and receive ORBCOMM data packets. A single GES can communicate with multiple satellites within its main beam.

Gateway Management System (GMS)	The GMS provide management functions, including; supervision of the health and status of various systems and equipment in the Gateway; monitoring physical facilities that house the Gateway elements; monitoring message processing flow and throughput; monitoring status of interconnecting links that connect the GES to GSS; providing the interface between the Gateway and ORBCOMM NCC.
Gateway Uplink Channels	Used by the NCCs to send traffic and commands to the satellites.
Globalgram	A single, self-contained packet sent or received by a subscriber communicator. Standard and Store & Fwd messages are considered globalgrams.
HDOP	Horizontal Dilution of Precision. A term used to describe the error introduced into horizontal position information.
Internet	A concatenation of many individual TCP/IP networks into one single logical network all sharing a common addressing scheme.
Latitude	The angular distance north or south of the equator measured by lines encircling the earth parallel to the equator in degrees from 0º to 90º.
LAT/LON	Coordinate system using latitude and longitude coordinates to define a position on the earth.
Longitude	The angular distance east or west of the prime meridian (Greenwich meridian) as measured by lines perpendicular to the parallels and converging at the poles from 0º to 180º.
Modem	A modulator/demodulator that converts digital data into analog (waveform) signals for transmission along media that carry analog signals and converts received analog signals back into digital data for use by the computer.
NCO	Numerically Controlled Oscillator.
Network Control Center (NCC)	The NCC houses the computer systems and personnel (Gateway Operators) responsible for managing the Satellites and the US ORBCOMM Gateway and for supporting Licensee's ORBCOMM Gateways.
Network	1) A system that sends and receives data and messages, typically over a cable. A network enables a group of computers to with each other, share peripherals (such as hard disks and printers), and access remote hosts or other networks. 2) A series of points interconnected by communication channels. The switched telephone network consists of public telephone lines normally used for dialed telephone calls; a private network is a configuration of communication channels reserved for the use of a sole customer. A series of nodes connected by communications channels.
ORBCOMM	The ORBCOMM mobile, wireless satellite communications system is a wide are, packet switched, two-way data system. Communications to and from a mobile ORBCOMM subscriber to the Gateway is accomplished by use of a constellation of low Earth orbit satellites.
Pin Code	The OMS maintains a 4-digit number Personal Identification Number (PIN) code for each SC.
PDOP	Position Dilution of Precision. A GPS term for the errors introduced into the GPS calculations.
Serial Port	A port in which each bit of information is brought in/out on a single channel. Serial ports are designated for devices that receive data one bit at a time.
SV	Space Vehicle. A vehicle used in space.

Store & Fwd Store & Fwd messages are up to 229 user bytes per packet to be sent by the SC and 182 user bytes per packet to be received.

TDOP Time Dilution of Precision. A term used to describe the error introduced by variances in the calculated time.

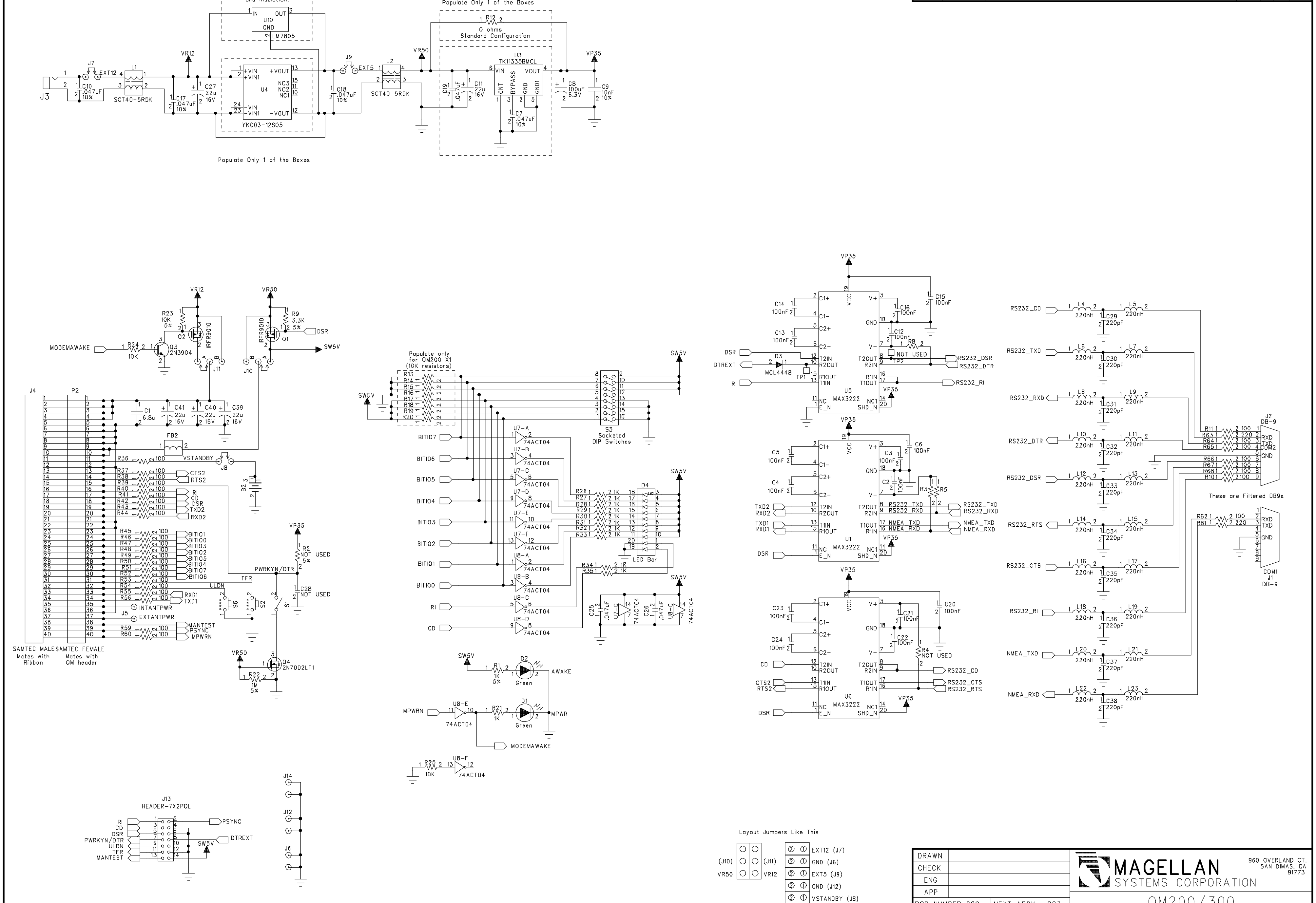
UTC Universal Coordinated Time.

VDOP Vertical Dilution of Precision. A term used to describe the error introduced into vertical position information.

F

Interface Board Schematic

REV	EDM #	DESCRIPTION	APP	DATE
A	51998	PRODUCTION RELEASE		1/10/00
B	52098	PCB UPDATE		1/31/00



DRAWN	
CHECK	
ENG	
APP	
PCB NUMBER 020-	NEXT ASSY. 023-
XXXXX-XXX	XXXXX-XXX

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MAGELLAN SYSTEMS CORPORATION

960 OVERLAND CT.
SAN DIMAS, CA
91773

OM200/300
Interface Board

C s711639 B

PATH:

SHEET 1 OF 1

All Magellan GPS receivers are navigational aids, and are not intended to replace other methods of navigation. The purchaser is advised to perform careful position charting and use good judgement. Read the User Guide carefully before using this product.

MAGELLAN CORPORATION WARRANTY

Magellan Corporation warrants their GPS receivers, communicators and accessories to be free of defects in material and workmanship for a period of one year from the date of original purchase. **This warranty applies only to the original purchaser of this product.**

In the event of a defect, Magellan Corporation will, at its option, repair or replace the product with no charge to the purchaser for parts or labor. The repaired or replaced product will be warranted for ninety (90) days from the date of return shipment, or for the balance of the original warranty, whichever is longer.

PURCHASER S REMEDY

Purchaser s Exclusive Remedy under this written warranty or any implied warranty shall be limited to the repair or replacement, at Magellan Corporation s option, of any defective part of the receiver or accessories which are covered by this warranty. Repairs under this warranty shall only be made at a **Magellan Authorized Service Center.**

PURCHASER S DUTIES

To obtain warranty service, the purchaser must return the receiver or accessories postpaid, with proof of the date of original purchase and purchaser s return address to Magellan Authorized Service Centers. Prior to returning your receiver the purchaser must first contact Magellan for return authorization and the location of the nearest Service Center.

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Except as set forth in item 1 above, all other expressed or implied warranties, including those of fitness for any particular purpose and merchantability, are hereby disclaimed.

Some states do not allow limitations on warranties, so the above limitation may not apply to you.

EXCLUSIONS

This warranty does not cover the following:

- Installation
- Battery Pack, excluding workmanship
- Finishes
- Defects resulting from installation
- Any damage due to accident, resulting from inaccurate satellite transmissions. Inaccurate transmissions can occur due to changes in the position, health or geometry of a satellite.
- Any damage due to shipping, misuse, negligence or tampering or improper use.
- Servicing performed or attempted by anyone other than an authorized Magellan Service Center representative.
- Modifications to the receiver which may be required due to any change in the Global Positioning System (GPS).
- Damage resulting from improper external connections.

All Magellan GPS receivers use GPS to obtain position, velocity and time information. GPS is operated by the U.S. Government, which is solely responsible for its accuracy and maintenance. Certain conditions can cause inaccuracies which could require modifications to the receiver. Examples of such conditions include but are not limited to changes in the GPS transmission. Such modifications are not covered by this warranty.

Opening of this product by anyone other than an Authorized Magellan Service Center representative will void this warranty.

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For further information concerning this limited warranty please call or write:

Magellan Corporation

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Santa Clara, California 95050-4300

Phone: (408)615-5100

FAX: (408)615-5200

e-mail: wireless@magellangps.com

OBTAINING LICENSING FOR ORBCOMM COMMUNICATORS

Use of the ORBCOMM System outside the United States has only been authorized by a limited number of foreign Governmental Authorities. Use of the ORBCOMM System outside the United States is permissible only when all necessary permits, approvals and authorizations have been received from the applicable foreign Governmental Authorities.

In addition, use of the S@tellite Modem outside the United States is only permissible if it has been type approved for use in that country or territory. Both the ORBCOMM System and the S@tellite Modem may need to be approved prior to use in a foreign country or territory. For information on those countries or territories in which use of the ORBCOMM System and the S@tellite Modem is authorized, please contact ORBCOMM or your local service provider.

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