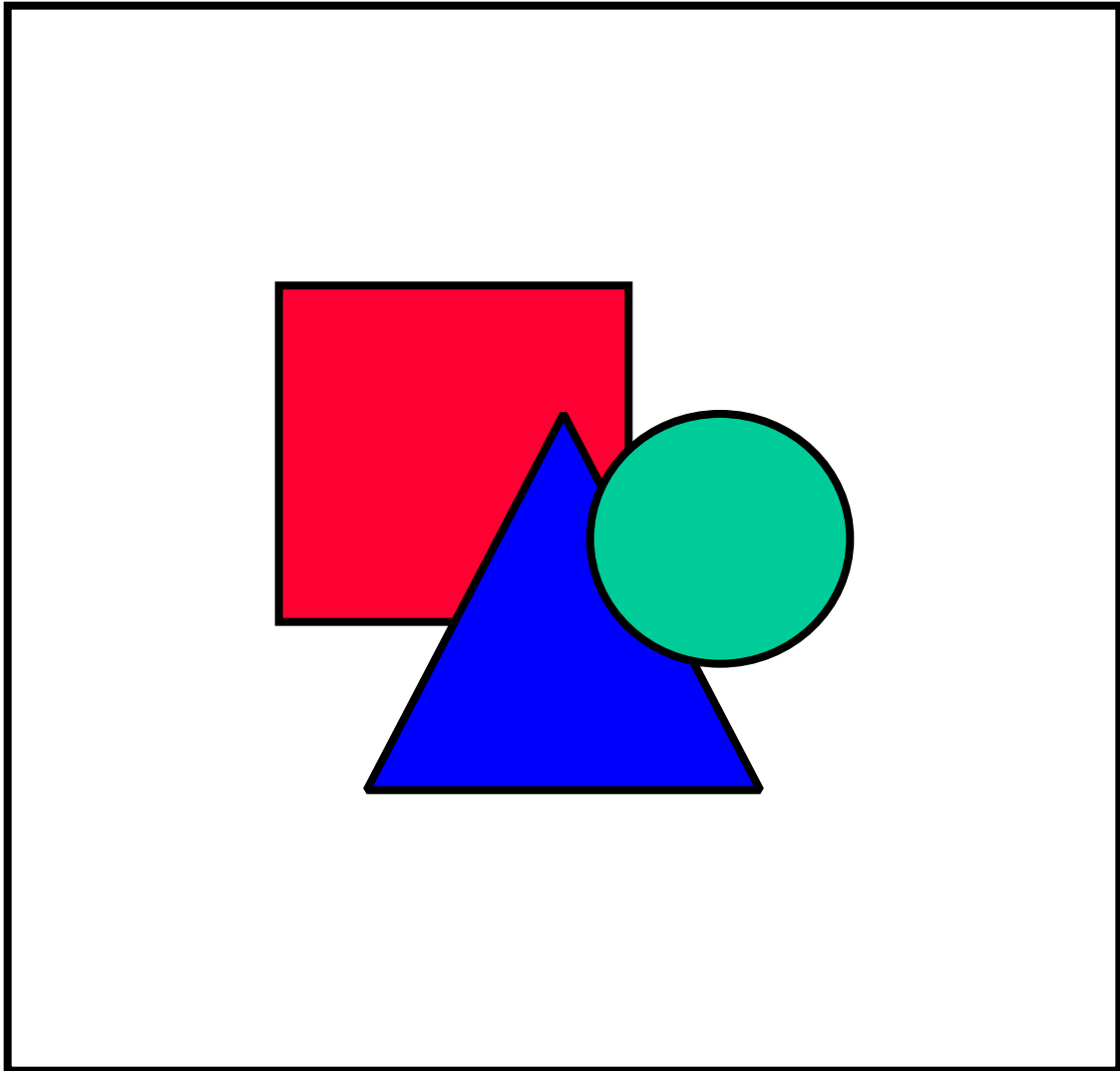# Qualcomm GSP 1620

Globalstar Satellite Packet Data Modem

Product Specification

1. Globalstar Overview

Globalstar is a voice and data telecommunications system utilizing a constellation of 48 Low Earth Orbiting (LEO) satellites, providing near world wide coverage (70N to 70S latitudes).

GlobalstarLP (GLP), the owner / operator of the LEO constellation, is a strategic partnership comprised of many of the world's leading telecommunications providers:

- Globalstar USA, Canada, and Mexico (formerly known as Vodaphone / Airtouch)

- Alenia Marconi

- China Telecom

- DACOM

- Daimler-Chrysler Aerospace

- Elsacom

- Hyundia

- TESAM (joint venture between France Telecom and ALCATEL)

- Space Systems / Loral

- Qualcomm, Inc

- Vodaphone

The Globalstar system is comprised of a Space Segment, and a Ground or Earth Segment.

1.1.1 Space Segment

The Space Segment is comprised of 48 LEO Satellites (and 8 additional in orbit spares) built by Loral Space Systems and operated by Globalstar LP in San Jose, CA.

The advantages of a LEO satellite over MEO / GEO's is the minimal delay, multi satellite handoff, extremely small antenna, lower power consumption, very small delay (~250 ms or comparable to terrestrial digital cellular), and the cheaper cost to the user.

1.1.2 Ground Segment

The Ground Segment is comprised of Earth Stations, called Gateways that provide service in specific geographical areas. The Gateways are deployed worldwide and communicate via C Band frequencies to / from the LEO Satellites which serve as "bent pipe" transponders.

The User Terminal (Phones and Modem Modules) communicate to / from the Gateway ground station using L and S band Frequencies, via the LEO satellites.

1.1.3 Coverage
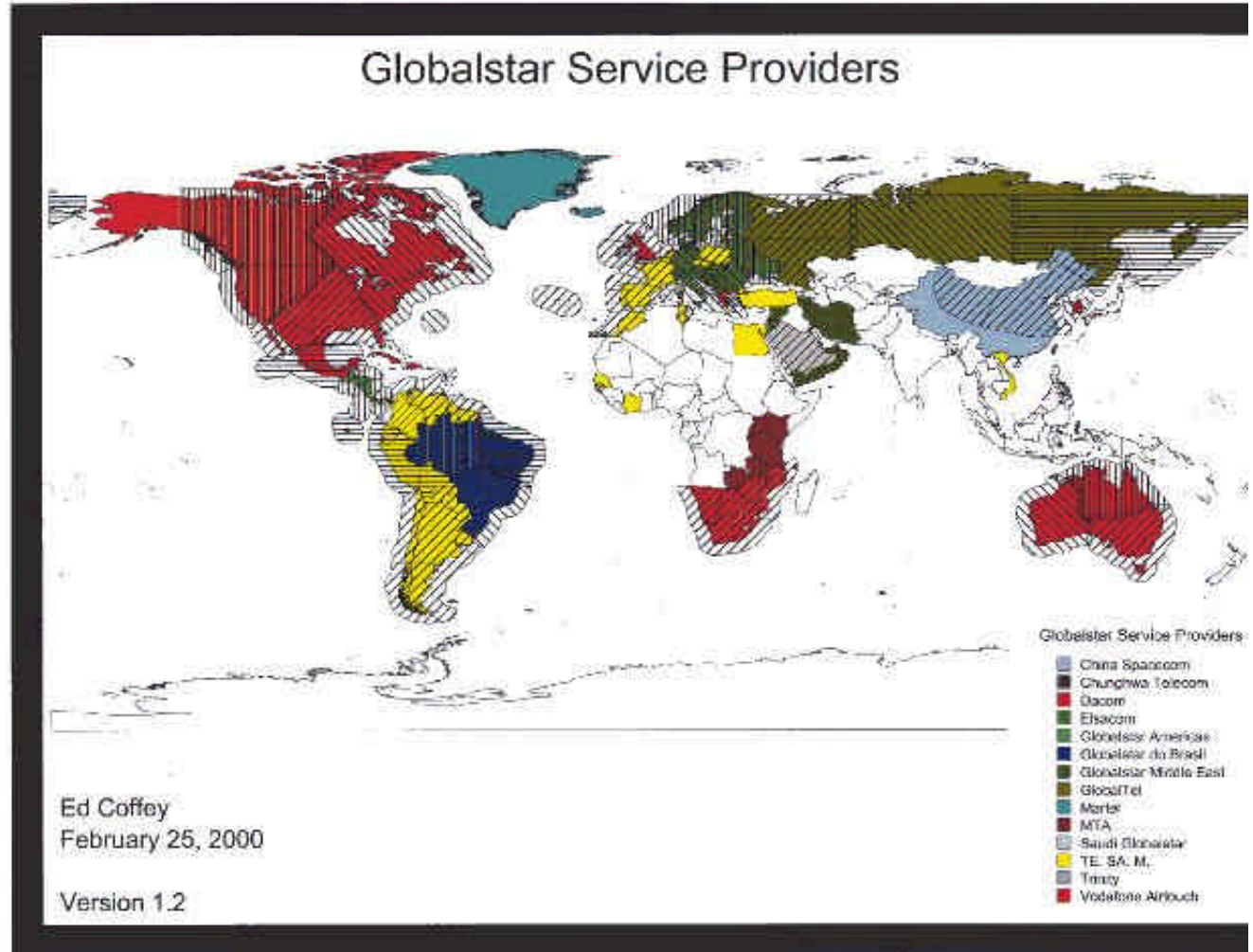
1.1.4 Carriers

Each coverage territory, typically aligned with country boundaries, has one or more Service Providers, which provide the user service, similar to a "cellular" model. The Service Provider or Carrier is licensed by Globalstar to offer service in a part of the world wide coverage area (one or more countries). The Service Provider offers "airtime" to the OEM or end user, as well as providing a customer care center, and billing records for the satellite air time used and the packet data traffic sent and received.

As Service Providers vary by region around the world, it is best to refer to the Globalstar Web Page to identify the correct service provider in your area of interest. http://globalstar.com.

1.1.5 Distributors and OEMs:

For the regular Globalstar Tri Mode Phone, cellular and satellite distributorships provide customers retail sales conduits to purchase, provision, and repair Tri Mode Phones throughout the world.

For the GSP 1620 Packet Data Modem OEM's and VARs directly integrate the module into a market specific product which is then resold to a business / industrial customer. The OEM/VAR may be able to buy bulk airtime from a Gateway Service Provider, and bulk modules (in units of 50) direct from Qualcomm. The OEM then integrates the Modem into their product line.

<Venkat Rangan has the original drawing>
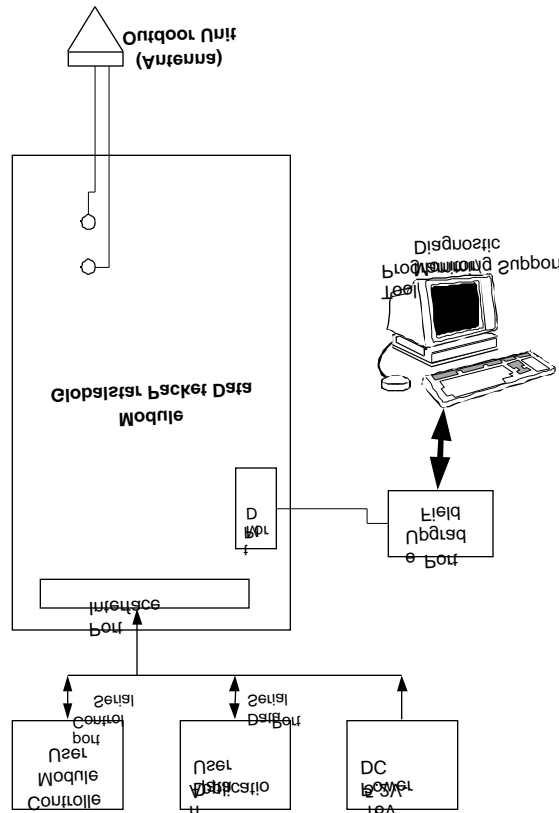
The GSP 1620 Packet Data Modem is a bare board "sandwich" stack of CCAs (Circuit Card Assemblies) comprised of a Globalstar RF board, and a Globalstar Digital board. The digital board contains all the digital electronics required by the modem and some of the power management electronics. The RF board contains the baseband converters, receiver, RF power amp, upconverters and downconverters, TCXO, synthesizers, and the remaining power electronics.

The module is offered without a mechanical enclosure as it is anticipated that the OEM VAR will be integrating and packaging the module with the end users application.

The Packet Data Modem operates in the "Globalstar (or satellite) packet data mode only", as opposed to the Tri Mode Phone Product which has the additional Terrestrial Cellular (Analog and Digital) and Voice Capabilities.
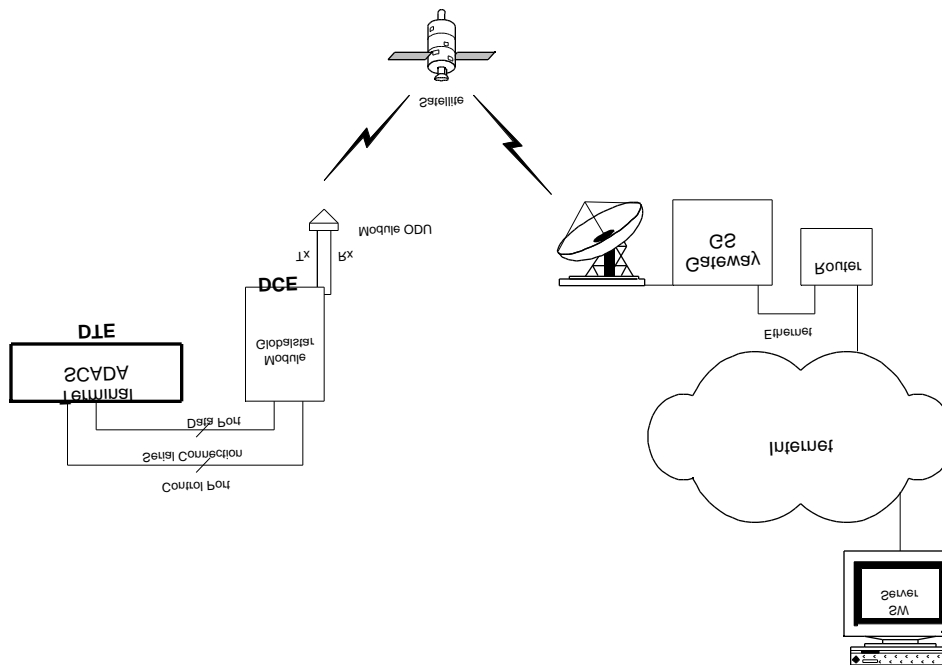
The module is powered by an external voltage source provided by the user and is intended for use in Supervisory Control and Data Acquisition (SCADA), remote telemetry / monitoring, asset tracking and monitoring and other vertical market applications.

A weather proof Dielectric Resonator Antenna (DRA), sometimes referred to as an Outdoor Unit (ODU) with SMA bulkhead connectors is included. The required mating cable (SMA to MCX connectors) will be provided by the OEM / VAR in order to meet customer antenna length options.

A single DB-25 (Male) connector is used for the User Interface Port. The DB-25 carries DC Power, as well as the Data and Control RS 232 signals to / from the application (DTE) to the module (DCE).

A Qualcomm Diagnostic Monitor (DM) Port is provided for Software Configuration, Network Provisioning, Software Upgrades, performance data collection, and operational diagnostics.

The diagram labels (as shown, partly rotated in the original):

- Satellite
- Module ODU
- Tx / Rx
- DCE
- Globalstar Module
- DTE
- SCADA Terminal
- Data Port
- Serial Connection
- Control Port
- GS Gateway
- Router
- Ethernet
- Internet
- Server SW

A typical use of the GSP 1620 is depicted above showing a SCADA application.

As shown the GSP 1620 can be thought of as a 9.6Kbps Full Duplex Satellite Modem. The modem uses typical Hayes AT commands (see Chapter 4). Standard RS232 interfaces facilitate ease of use and OEM / VAR application integration.

The OEM VAR provides the custom Data Terminal Equipment or DTE which manages the field processing of data, and reports process exceptions, performance reports, alarm conditions, in short any data needed from the remote site by the users host application.

The GSP 1620 can be thought of as a "node" on the Internet and with its Fixed or Dynamically assigned IP address can be addressed in Real Time, as often as necessary to maintain application control over the remote devices.

3.1 Typical GSP 1620 Module Applications

• Electric Utility Industry	• Remote Security Systems Monitoring
• Oil and Gas Wells, Tanks, Pipelines, Offshore Platforms	• Energy Management
• Water Treatment Plants	• Retail Point of Sale (POS) Transactions
• Remote Inventory Management	• Remote Banking
• Electronic Billboards	• Aircraft Weather / Messaging for Commercial and General Aviation
• Highway Traffic Monitoring	

In remote settings or difficult to access sites, acquiring and responding to process control and alarm data can be a challenging and costly task. The QUALCOMM Globalstar GSP 1620 Satellite Packet Data Modem provides both system integrators, VARs, and OEMs with reliable, real-time low cost,

bi-directional data comunication solutions applications in remote locations for fixed or mobile use.

With the GSP 1620 Satellite Packet Data Modem, you can cost-effectively retrieve data automatically from remote power substations, telecommunication concentration nodes, oil and gas wells, pipes, and offshore facilities. Unmanned sensors connected to the GSP 1620 Satellite Packet Data Modem can monitor remote operations and initiate alert notifications.

The GSP 1620 Satellite Packet Data Modem is a cost-effective way to collect basic environmental and industrial data, and turn remote locations into real-time business data centers.

3.1.1 Electric Utility Industry

•   Remotely turn on a pump, close a switch, open a gate, or request a new meter reading.

•   Capture polled, scheduled, and event-driven data cost-effectively.

•   Line voltage monitoring

•   Reporting on power outages, under/over voltage status

•   Transfer switch monitor/remote control

•   Standby or portable generator monitor/remote control

•   Remote substation monitor/remote control

•   Capacitor bank monitor/remote control

•   Voltage regulator monitor/remote control

•   Controlled pole-top RTU

•   Load management

3.1.2 Oil and Gas, Pipelines

- Monitor pipeline Cathodic Protection rectifiers to ensure operability.

- Remotely test the pipeline electrical discharges and be alerted to electrical current buildup without having an inspector driving from one 40-mile checkpoint to another, manually checking each location.

- Reduce costs, maximize use of personnel for repairs and maintenance, and receive real-time notification of a problem before a line ruptures.

- Monitor production well heads. Track mud flow in real-time to maximize profitability in the market.

- Utilize the GSP 1620 Satellite Packet Data Modem with a monitoring device on a remote "nodding donkey" rig so you monitor energy and velocity amounts. Temporarily suspend, slow or stop the flow of oil when it drops below a profitable level, or shut down the rig if there are mechanical problems.

- Monitor pressure reduction equipment. Remotely control the converter volume and transmit data to a central system. Keep service interventions to a minimum.

3.1.3 Utility: Water, Treatment Plants

- Monitor water flow along pipelines and achieve better regulation of water pressure, thereby reducing unnecessary consumption and eliminating water losses.

- Reduce maintenance costs by detecting lift station failures.

- Monitor waterways and canals.

- Transmit the status of snowpack gauges, flow rates, and spillway conditions back to the control center to help regulate water flow in dam operations.

- Send back images taken by a remote camera of the river or spillway conditions to help provide visual input along with the flow rate data.

- Set up automatic control systems on pumping stations, water towers, storage tanks and lift stations.

- Keep operations going smoothly in chemical tank monitoring. Don't pay for unnecessary inventory chemicals.

- Monitor tanks above and below ground for process variables such as pressure, temperature, and pH.

3.1.4 Inventory Management

- Receive remote inventory information that can be reviewed in real time by procurement, logistics, production, transportation, sales and suppliers.

- Streamline inventory management with remotely monitored information delivered in real time.

- Eliminate stock-outs, shortages, and stockpiling.

- Provide faster response time so you can negotiate more effectively with customers and suppliers.

3.1.5 Security Systems

- Transmit alarm messages wirelessly and securely.

- Remotely control video surveillance.

3.1.6 Energy Management

- Control energy usage in buildings, stores, and supermarkets by remotely tracking levels.

- Monitor temperatures, lighting, motors, heating, ventilation and air conditioning (HVAC), and adjust levels as needed according to opening and closing times, realizing utility bill savings.

3.1.7 Banking and Retail Transactions

• Set up banking ATMs in remote areas with reliable and cost effective Globalstar communications, without dependency on unreliable or expensive terrestrial communication lines.

• Transmit credit card verification and remote retail authorization transactions.

• Monitor performance and inventory of vending machines.

• Provide redundancy for unreliable terrestrial or cellular communication systems.

3.1.8 Agriculture

• Monitor the harvest rate and determine if the yield is sufficient, adding additional chemicals to boost production levels.

• Relay the information to a host application which directs farm equipment to release the right amount of chemicals, when processing crops in the field.

3.1.9 Aviation

• Transmit weather to the cockpit as well as transmit, receive and amend flight plans in the air.

• Track aircraft position location and display in a monitoring center.

4. GSP 1620 Features:

4.1 Globalstar Satellite Service:

The GSP 1620 offers Full Duplex (FDX) transmit and receive capabilities, at 9.6 Kbps, via the Globalstar satellite constellation, and utilizes Qualcomm's CDMA Digital technology, for signal clarity and reliability.

The Globalstar Air Interface (GAI) is based on a modified (proprietary) IS-95A standard adapted for Mobile Satellite System (MSS) operations.

- Forward Link (Module Receive):   2484.39 to 2499.15 Mhz

- Reverse Link (Module Transmit):   1610.73 to 1625.49 Mhz

4.2 Packet Data:

Globalstar and the GSP 1620 Satellite Modem offers direct internet connectivity by bridging the last "thousand" miles air gap using LEO satellites. The following section describes in detail the capabilities offered by the GSP 1620 for user connectivity, and data transmission.

4.2.1 Mobile Originated and Mobile Terminated Packet Data:

Allows the Application Device (DTE) connected to the module to originate or receive, via standard AT commands (see Chapter 4) a "packet data call" and establish a PPP session, connecting to the Internet, and then establishing a session with a host application at the far end.

4.2.2 Data Rate: 9.6 Kbps

- Discounting packet data overhead bits, the measured effective "user" throughput (i.e. customer bearer data) has been measured and averages 7.4Kbps.

4.2.3 TCP/IP with PPP Connectivity

4.2.3.1 Networking Software:

The modem can be controlled using standard AT commands, (listed in Chapter 4) as well as Standard Networking Software which will establish, manage, and teardown the PPP

session. The module has been operability tested with the following standard operating systems:
- **Windows 95/98/2000**
- **Windows NT**
- **Mac OS**
- **Palm OS**
- **Unix / LINUX**

4.2.3.2 Dormant Mode Service :

The Globalstar system has the ability to keep the IP session "up" at the application layer (host and terminal end) while dropping the air link / traffic channel, to conserve Globalstar resources, and to decrease billing time to the end user. The traffic channel is automatically reestablished upon receipt of PPP traffic at the host or terminal end. The Globalstar system then completes the transmission, with no loss of user data. Dormant Mode can be commanded at the Terminal End via AT commands, or it can be automatically entered by the channel remaining inactive for a user specified time.
- Dormant mode default values is currently =0 or none. The user can specify a time between 20 secs and 120 seconds for the dormant mode time to time out and tear down the traffic channel.
- Dormant mode can also be entered by issuing a specific AT command to the module, versus using the ATH (Hang Up command), which would drop the traffic channel and the session.

During Dormant Mode operations each use of the traffic channel to send and receive PPP data will produce one billing record (called a Call Detail Record or CDR).

4.2.3.3   GSP 1620 Terminal (IP) Addressing

The OEM or Service Provider must choose one of two addressing schemes depending on the intended use of the modem. If the module is expected to be mobile and roam between gateway service areas then Dynamic Addressing should be used, where each GW assigns a IP address whenever the modem and terminal equipment set up a session. Otherwise if the unit is "fixed" in its position and no mobility is involved then a fixed IP addressing scheme should be used.

The difference is that in a "fixed" addressing scheme it is possible to initiate remotely "module" terminated IP packet data calls, since the IP address is always known. In the "dynamic" scheme the Terminal / Modem will have to initiate a call / IP session so the host or DNS server knows what the IP address is, upon the session being established.

4.2.3.4 Dynamic IP Addressing:

The Gateway uses a Private IP addressing scheme, to assign IP addresses to all GSP 1620 modems as well as the GSP 1600 Tri-Mode Phone. With a dynamically assigned IP address, you can ROAM to another Gateway and re-establish Packet Data service, by

having the system automatically assign a new dynamic IP address. Only Mobile Originated Calls may be made with Dynamic IP addresses.

4.2.3.5 Fixed IP Addressing

Fixed IP addresses may be assigned "instead" of dynamic IP addresses.   With a "fixed" IP address assigned the GSP 1620 can make Mobile Originated and receive incoming or Mobile Terminated Calls. Private IP addresses are "decoded" from the Module's IMSI (International Mobile Subcriber Identity) so that precludes ROAMING between Gateways. Fixed IP addressing, as opposed to Dynamic, is assumed to be assigned to "fixed" GSP 1620 terminals that do not roam.

4.2.3.6 Virtual Private Network Service:

In either case, fixed or dynamic IP addressing schemes, the OEM or user will need to establish a VPN between their host and the gateway, to support the private IP addressing scheme used. This can be done by establishing a Point of Presence private line into the GW and hooking directly to the router, or by establishing a SW VPN service on the Public Internet, directly to the GW.

4.3 IS 637 Mobile Terminated Short Messaging Service (SMS):

And additional service option allows the integrator to utilize the Short Messaging Service on the GSP 1620. This a separate "service option" from Packet Data, and may be billed differently by the service provider. Using Mobile Terminated SMS can allow the host application to "send" numeric or alphanumeric messages to the module. These messages are passed transparently out the data or control RS 232 ports to the application. No attempt is made to construct ASCII character data by the module, so that if "control" data is sent to the module via the SMS service option, it will be passed along transparently to the application.

The SMS service option is fully functional even if the GSP 1620 is "up" on a packet data call. Therefore the host application can send command and control information to the unit, while it is in a PPP session, or idle (not in a call).

4.3.1 SMS Alerts

SMS "alerts" are asynchronous messages sent out the data or control port to the application upon receipt of the SMS message (see single data port operations later for more detailed explanation).

4.3.2 SMS Message Field Information:
- Length of SMS

- Read status (new / read)
- Call back number (if available)
- Type (alpha, numeric, voice mail – These are carrier specific fields)
- Priority (urgent, normal)
- Time received
- Message content (alpha characters)

4.3.3 SMS AT Commands

- Navigate through SMS messages
- Delete SMS messages
- Print/display current SMS message
- Lock or unlock SMS messages
- Turn on/off SMS alerting
- Get information on SMS messages stored in memory.

4.4 Globalstar Service Alerts

Service alerts are sent or queued (if only the data port is in use) whenever a service parameter changes:

- Fades: gateway / satellite coverage is lost for any reason.
- Acquisition: gateway / satellite coverage is acquired.
- Roaming status: when the module "roams" onto a gateway outside the home service area (see your service provider for the scope of these areas)

4.5 Service Status Message

The Service Status Message can be thought of as a message detailing the readout of former "display" on the phone product. Items included in the Service Status Message are:

- Gateway coverage "seen" (acquired) or not (lost)
- Signal strength (Bars on the phone display)
- Registration status ("I" indicator on the phone)
- Current call status (in call / idle)
- Roaming

4.6 Position Location Determination: The module has a "get position" AT command (AT$QCPLS). This command has a parameter to select between getting the current position (via making a new request) or

returning the last stored position. If you select the current position and you are NOT in a call, the module will return "ERROR".   If you select the stored position and there IS no stored position (you haven't done a position request EVER), you'll get an error.

4.7 Roaming: The module is capable of "fixed" operation in one location

(building, tank, pipeline, and well monitoring and control) or "Roaming" type applications such as (trucks, rail cars, aircraft, shipping containers etc.).

- Roaming within a Gateway service will keep the PPP session up the entire time utilizing Dormant Mode.
- Roaming between Gateway Service Areas is supported. However there is no hard hand off capability between separate gateways and the PPP session will be dropped, and will have to be reestablished by the Terminal.
- Once on a new Gateway automatic re-registration will be performed and a new dynamic IP address will be assigned to the terminal.
- A Service ALERT message is sent out the Data / Control Port when the modem changes from Roaming to HOME service area and vice versa.

5. AT Commands

The AT Commands recognized in the Tri Mode Portable Phone Software Release R5.1 are listed below in Table (1) as well as those specifically developed for the Packet Data Module Table (3):

Commands that are recognized, but not supported on the module (such as the speaker volumes) are listed in Table (2). For example, the module does not return an ERROR if someone tries to set a modem speaker volume, but we don't do anything with it either.

5.1 Operational Tri Mode AT Commands:

AT Command	AT Command Description	Supported Tri Mode AT Commands
E	Set Command Echo ON|OFF	Y
Q	Result Code Suppression	Y
V	DCE Response Format	Y
Z	Reset Default Configuration	Y
&C	Set DCE RLSD (DCD) Behavior	Y
&D	Set DCE Behavior with DTR Changes	Y
&F	Set to Factor Default Configuration	Y
A/	Repeat Last Command	Y
D	Dial: • #777 for Packet Data • #MARKOV • #LOOPBACK	Y
H	Hook Control	Y
O	Return to Online State	Y
S3	Command Line Termination Character	Y
S4	Response Termination Character	Y
S5	Command Edit Character	Y
S777	Silent Retry Timeout	Y
+IFC	Local Flow Control Settings	Y
+IPR	Rm Interface Baud Rate Setting	Y
+CTA	Dormant Mode Timeout Setting	Y
$QCMODE	Set UT Mode; Auto, Globalstar, Digital	Y

Table 1.

5.2 Non Operational Tri Mode AT Commands:

AT Command	AT Command Description	Non Supported Tri Mode AT Commands
L	DCE Monitor Speaker Loudness	N
M	DCE Monitor Speaker Mode	N
P	Select Pulse Dialing	N
T	Select Tone Dialing	N
S0	Auto Answer Ring Count (0 disables)	N
S7	Connection Completion Timeout	N
+ICF	Character Framing Settings	N
+CRM	Rm Interface Protocol Setting	N

Table (2) NO OP Commands

5.3 New GSP 1620 Module AT Commands:

AT Command	AT Command Description
$QCSERR	Retrieve Error Log
$QCCLR	Clear Error Log
$QCSSA	Service alert control (on/off)
$QCSTATUS	Retrieve module service status
$QCTOD	Retrieve time of day
$QCPLS	Position Location Service
$QCMSTATS	Retrieve Markov Statistics
$QCSMSP	Print SMS message
$QCSMSM	Navigate through SMS list
$QCSMSL	Lock SMS message
$QCSMSA	SMS alerting control
$QCSMSI	Retrieve SMS message information

Table 2

6. Hardware Description

6.1 Module Mechanical Description

The Globalstar GSP 1620 Globalstar Satellite Packet Data Modem is a sandwich made of two circuit card assemblies (CCAs) which are open and unprotected. As a result, the GSP1620 must be shielded from direct impacts, precipitation, and particulates. I/O is obtained through four connectors. Power, data, and control functions are accessed via a 25 pin "D" style connector. The Qualcomm Diagnostic Monitor (offered separately) interface is a 9 pin "D" style connector. Globalstar RF transmit and receive signals are each ported out MCX style coax connectors.

6.1.1 Depiction

The following technical drawings are included in this chapter:

GSP 1620 Modem Board Layout, Figure 6-1 (Top View)

GSP 1620 Modem Board Layout, Figure 6-2 (Side and Bottom View)

6.1.1.1 Drawing Reference Notes:

Dimensions are shown as millimeter [inch].

Millimeters are the controlling dimensions on these drawings. Inch dimensions are for reference only.
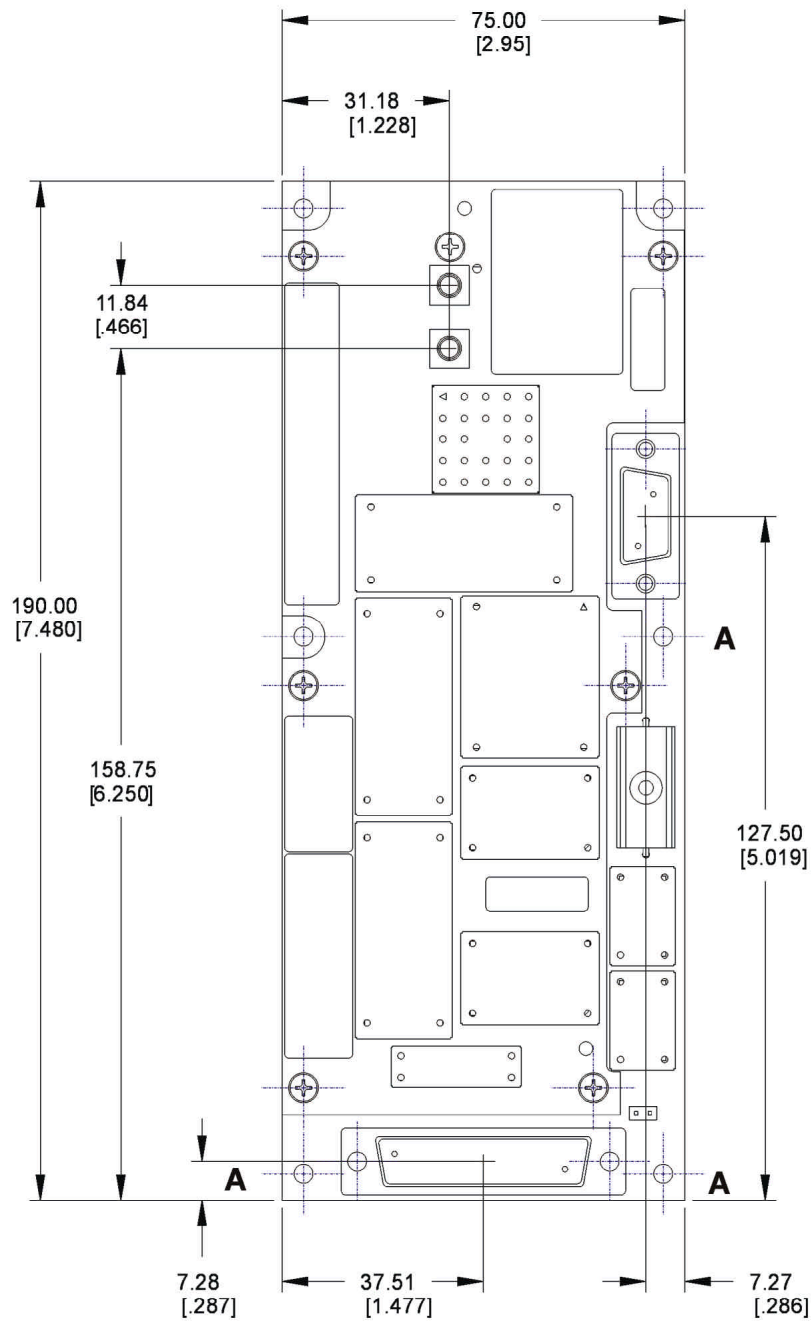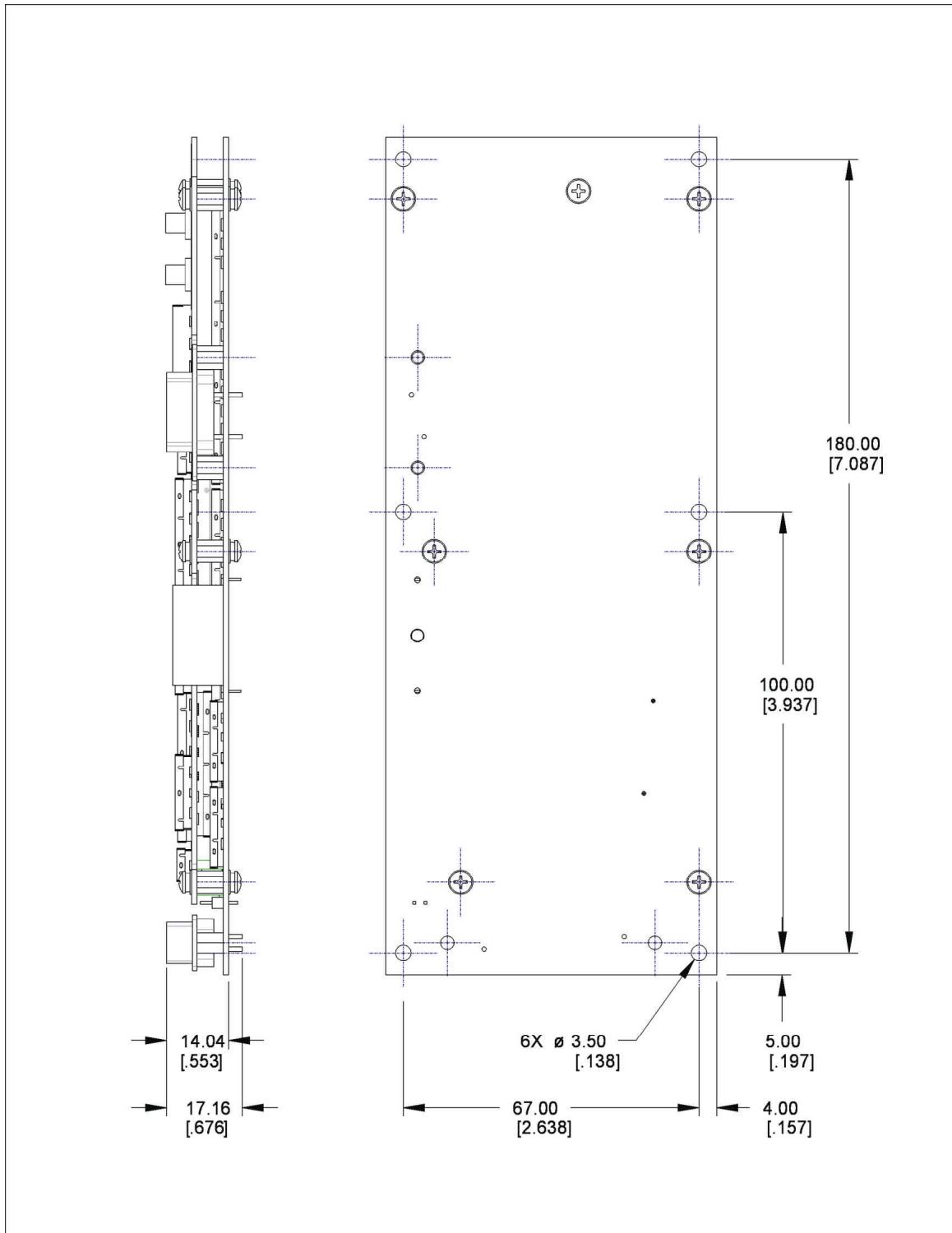
75.00
[2.95]

31.18
[1.228]

11.84
[.466]

190.00
[7.480]

158.75
[6.250]

127.50
[5.019]

A

A

A

A

7.28
[.287]

37.51
[1.477]

7.27
[.286]

Holes marked "A" connect to ground.

Figure 6-1

Figure 6-2

6.1.2 Overall Dimensions Summary:

- Module dimensions are 190 x 75 x 17 mm (7.48 x 2.95 x .68 inches)

6.1.3 Module Weight:

• Module weight is less than 180 grams (7 ounces)

6.1.4 OEM Installation of the Modem

The GSP1620 has holes for six mounting screws which are sized for M3 or #4 screws. All six mounting locations must be fastened to a rigid structure to meet the specified vibration and shock requirements. The hole size and locations, connector locations, and overall envelope dimensions are specified in paragraph 6.1.1, Depiction.

The installer of the modem shall exercise care during the installation process. The installer should adhere to the following recommendations:

Observe handling precautions necessary to avoid damage by ESD.

Fasten the module to a planar surface of sufficient flatness and rigidity to not cause flexing of the module.

Do not use fasteners that will damage the grounding areas around the through holes.

Do not fasten the module using tools with speed and/or torque that will cause damage to the printed circuit board.

Do not fasten the module with enough clamping force to damage the printed circuit board.

Exercise caution and do not damage components on the module during handling.

6.2 DRA Module Antenna Specifications

The Packet Data Modem is to be used with a Dielectric Resonator Antenna (DRA). The module DRA has a passive transmit and an active receive section. Sketches of the DRA are shown in Figure 6-3 and Figure 6-4.

6.2.1 Size

• DRA dimensions are 103 mm (4.1 inches) dia by 63 mm (2.5 inches) tall

6.2.2 Weight

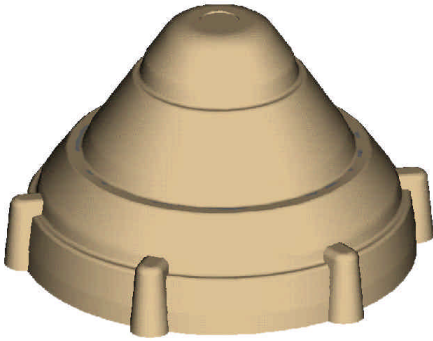- The estimated weight for the DRA is less than 250 grams (8.8 ounces)
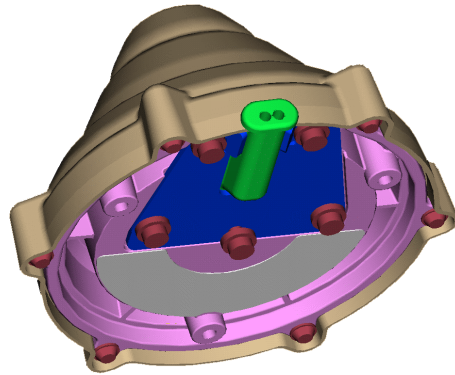

Figure 6-3 DRA View 1

Figure 6-4 DRA View 2

6.2.3 DRA Depiction

The following technical drawings are included in this chapter:

GSP 1620 DRA Antenna, Figure 6-5 DRA Top and Side Views

GSP 1620 DRA Antenna, Figure 6-6 DRA Bottom View

6.2.3.1 Drawing Reference Notes:

Dimensions are shown as millimeter [inch].

Millimeters are the controlling dimensions on these drawings.   Inch dimensions are for reference only.
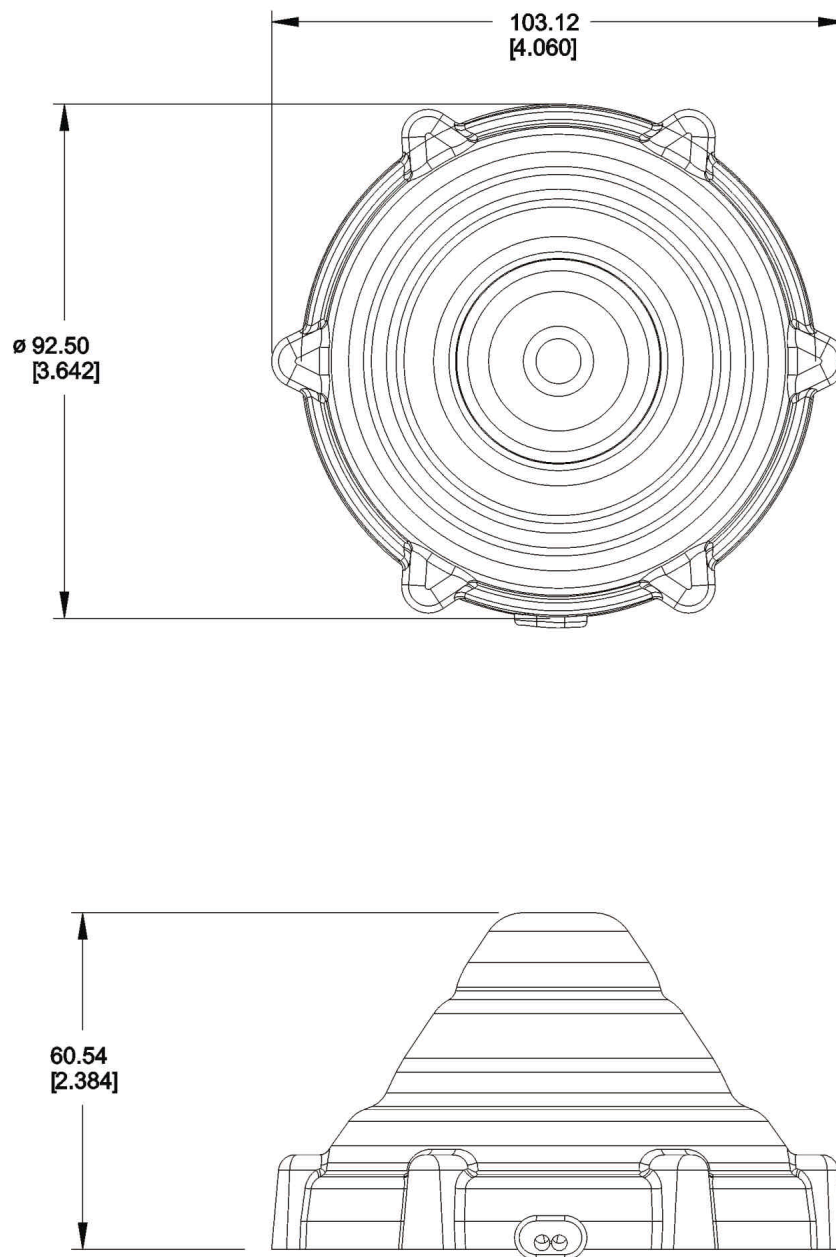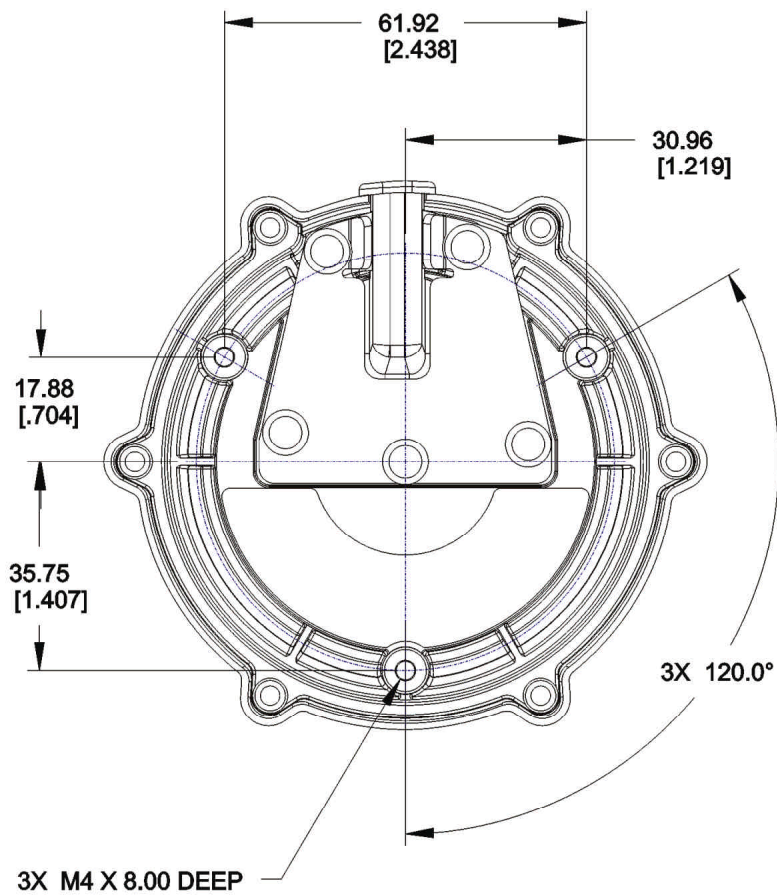
Figure 6-5 DRA Top and Side Views

61.92
[2.438]

30.96
[1.219]

17.88
[.704]

35.75
[1.407]

3X 120.0°

3X M4 X 8.00 DEEP

Figure 6-6 DRA Bottom View and Mounting Hole Locations

6.2.4 Antenna Cable Specifications:

- (2) Cables are required; one for transmit and one for receive.
- The required connectors are male SMA (DRA bulkhead) to Male MCX (Modem)
- Maximum 0.6 dB insertion loss @ 1618 MHz is required for the cable.

6.3 Module User Interfaces

6.3.1 Antenna Connectors

The module has (2) MCX snap-in connectors for the Transmit and Receive antenna leads, connecting the DRA to the module.

6.3.2 Data and Control User Ports

- The Data and Control Ports are combined into a single DB-25 male upright connector, as the primary user interface and functionally contains (2) 9 pin serial ports and DC power, and reset leads.

- Line Speed for the Data Port and Control Ports are 9.6 K bps

- Signalling uses 8 bits, No Parity and 1 Stop Bit (8,N,1)

- All ports are ESD and short circuit protected.

> **Note:**
>
> The module signal naming convention assumes that the module is the DCE and that the user application is the DTE.

6.3.2.1 DTR / DSR signal and Power On / Off

An active DTR on <u>any of the three serial ports</u> (Data, Control or Diagnostic) <u>is used to turn the module on</u> (if DC power is applied first). The module then boots up from the shut-down state and will assert DSR to indicate that it is booted up and ready to communicate.

The module starts its power-down sequence only after the DTR lines on all three serial ports connected to the module are de-asserted. Just before the module powers off, it will de-assert DSR to let the application know that it is OK to remove DC power to the module without risk of losing volatile data.

This mode of operation is useful in cases where power to the module as well as the rest of the system might be turned off periodically to conserve battery power.

In case the module "hangs up" and the watchdog circuit doesn't reset the module, the user has the option of resetting the module by pulling the MODULE_RESET_N low. Pulling the line low has the effect of a power on reset and not just a watchdog reset.

6.3.2.2 Control Port Signals

The Control Port (CP) is an RS-232 level asynchronous interface operating at 9.6 Kbps using Transmit Data (TXD), Receive Data (RXD) Data Terminal Ready (DTR),Data Set Ready (DSR) and Signal Common (GND).

RXD, TXD, CTS, RTS perform the data transfer and handshaking while DTR is used to turn on the module and to let it know that there is an application waiting to talk to it.

The Control Port specifically allows dedicated usage of the Data Port by the Application and allows all AT commands and Module Alerting and SMS messages to be sent simultaneously via a separate "control" port to / from the Modem.   This separation of functionality is especially useful in "Dormant" Mode, when the application and host sessions are active, thus the Data Port appears active / in use, although a Globalstar traffic channel is not up (no In Call Status Message).

The control port is "enabled" by asserting DTR on both the Control Port for AT Commands and Alert Status messages, and the Data port, for the simultaneous PPP session.

6.3.2.3 Data Port Signals

The Data Port (DP) is an hardware flow controlled, RS-232 level, asynchronous serial interface.

- The Data Port uses the following RS232 leads for operations: Transmit Data (TXD), Receive Data (RXD), Clear To Send (CTS), Data Terminal Ready (DTR), Ready to Send(RTS), Data Carrier Detect (DCD), Ring Indicator (RI) and Signal Common (GND).

- The format for data on the Data Port is 8 bits, No parity and 1 stop bit.

- The baud rate is user configurable from between 300 and 115.2Kbps. The baud rate is adjustable in software.

- In case of a reboot (due to fatal errors or any other reason), the DCD line will be set inactive so that the user application can detect a reset condition and take the necessary action.

- Functionally the Data Port integrates AT Commands and Alert Messages as well as Application Packet Data PPP traffic.

- The Data Port provides limited deconfliction of PPP vs. AT Commands and Alerts by queuing alerts to the user, if control port is not in use. The User Application is required to deconflict AT commands sent to the module if no control port is used.

6.3.3 DB 25 Data and Control Port Pinouts:

Table 1 Interface Connector Pinout

Pin number	Signal Name	Signal level	Direction User <-> Module	Description
1	Chassis Ground	-	Chassis Ground	Isolated chassis ground
2	DP_TXD	RS-232	DTE -> DCE	Data port TXD
3	DP_RXD	RS-232	DTE <- DCE	Data port RXD
4	DP_RTS	RS-232	DTE -> DCE	Data port RTS
5	DP_CTS	RS-232	DTE <- DCE	Data port CTS
6	DSR	RS-232	DTE <- DCE	Module DSR
7	Ground	Ground	Ground return	Ground return
8	DP_DCD	RS-232	DTE <- DCE	Data port DCD
9	DC_POWER	5.2V-11V		Module Power
10	DC_POWER	5.2V-11V		Module Power
11	Ground	Ground	Ground return	Ground return
12	DP_DTR	RS-232	DTE -> DCE	Control port DTR
13	Reserved	Reserved	Reserved	Control port CTS,

				not used
14	CP_TXD	RS-232	DTE -> DCE	Control port TXD
15	Reserved	Reserved	Reserved	Reserved
16	CP_RXD	RS-232	DTE <- DCE	Control port RXD
17	MIC_P	Analog	Input to module	Analog Microphone Input (Reserved for Future Use)
18	MIC_N	Analog	Input to module	Analog Microphone Input (Reserved for Future Use)
19	Reserved	Reserved	Reserved	Control port RTS, not used
20	CP_DTR	RS-232	DTE -> DCE	Control port DTR
21	Ground	Ground	Ground return	Ground return
22	DP_RI	RS-232	DTE <- DCE	Data Port RI
23	SPKR_P	Analog	Output from Module	Analog speaker output (Reserved for Future Use)
24	SPKR_N	Analog	Output from Module	Analog speaker output (Reserved for Future Use)
25	MODULE_RESET_N	TTL	Input to Module	Hard reset of the module, inverted logic

6.3.4 DC Power

The module requires Input DC Power ranging from 5.2V to 16 V, with 1 Amp (maximum).

It is the responsibility of the Value Added Reseller to make sure that the input voltage specification will never be exceeded. Minimal input transient

protection is provided but it is not intended to protect the module in case of a sustained over-voltage / lightning condition.

6.3.4.1 Power consumption

Power consumption depends on a variety of factors such as transmit power, input voltage and data rate. The table below summarizes the power consumption of the module at an input voltage of +12 V DC.   All currents are in mA, and include the DC power consumption of the DRA antenna receive section.

The receive current consumption is with the receiver on all the time. These numbers will be a much lower number when slotted mode paging is activated, in the Fall of 2000.

Table 6-1 Module DC Power Consumption estimates at 12V DC Input:

Mode	Minimum	Typical	Maximum
Shutdown	1.2mW	2.4mW	3.6mW
Standby(Receive only)	1.2 W	1.8 W	2.4 W
Transmit (minimum)	3.6 W	4.8 W	5.4 W

6.3.4.2 Power On

Power on is controlled via OR'ed DTR signals from any Port (Data, Control or Diagnostic). Upon successful Power Up, the Module asserts the DSR line to let user know that it has booted up successfully and is ready to accept commands etc.

6.3.4.3 Power Off

Power off is controlled by the module processor being completed with all software tasking, and AND all DTRs being inactive. The module will de-assert DSR when all DTR's are seen as inactive, and all SW processing has concluded, informing the application it is safe to shutdown power.

Note DSR/DCD will also go inactive in case of a fatal failure during re-boot.

6.3.4.4 Hard Power Reset

Provisions are included to "hard reset" a "stuck-up" module under user control: equivalent to power cycling (see Pin 25)

6.3.5 Diagnostic Monitor Port

The Diagnostic Monitor Port consists of a single DB-9 male upright connector, located on the right side of the module drawing Figure XX.

6.3.5.1 DM Port Functionality:

- Allows OEM VAR to perform debugging and field SW upgrades / data collection using DM tool or PST (available from Qualcomm separately)

- Uses TTL levels, un-translated

- TXD, RXD, RTS, CTS, DTR, POWER, PROGRAM, GND

- TXD, RXD, RTS and CTS for hardware flow control

- DTR to turn on the module from DM

- POWER for an active translator DM cable

- PROGRAM is used to unlock the boot block with >13V applied

- Flash unlock through a 2 pin jumper header on the board

6.4 Grounding

In order to keep the "clean" and "dirty" grounds isolated, the chassis ground of the interface connector as well as that of the DM connector will be isolated from the ground return of the module.

The chassis ground is the ground that is connected to the DB 25 User Interface and DM connector shields. The module ground is the same as the serial port ground return. Depending on the application, these may be independent or connected together.

Both the chassis grounds of the DM and Interface connector are taken to mounting holes where the solder mask is exposed on both sides of the board in order that the <u>mounting hole may serve as a chassis ground</u>. The two mounting holes will provide for independent grounding of the two connectors. <u>It is left to the user to ground the two connectors per the application</u>. Provision is made, on the board using a DNI resistor, that allows the user to connect the two grounds as well as the module ground easily in case the application does require the interconnection of the two grounds.

The power and signal ground for the other signals / power is on a few pins of the DB 25 User Interface connector as well as the DM connector.

<u>*The RF connector ground is the same as the signal and power ground*</u>. The user should be aware of this fact so that ground loops can be avoided in the final installation.

7. Environmental Specifications

The environmental requirements specified herein are under development and subject to change.

7.1 GSP 1620 Module Environments

7.1.1 Operational Temperature / Humidity.

The GSP1620 shall operate as specified during exposure to the operational temperature / humidity envelope shown in Figure 7-1. Condensation on the module is <u>not</u> permissible.

7.1.2 Non-Operational Temperature / Humidity.

The Packet Data Modem shall operate as specified after exposure to the operational and non-operational temperature / humidity envelopes shown in Figure 7-1.
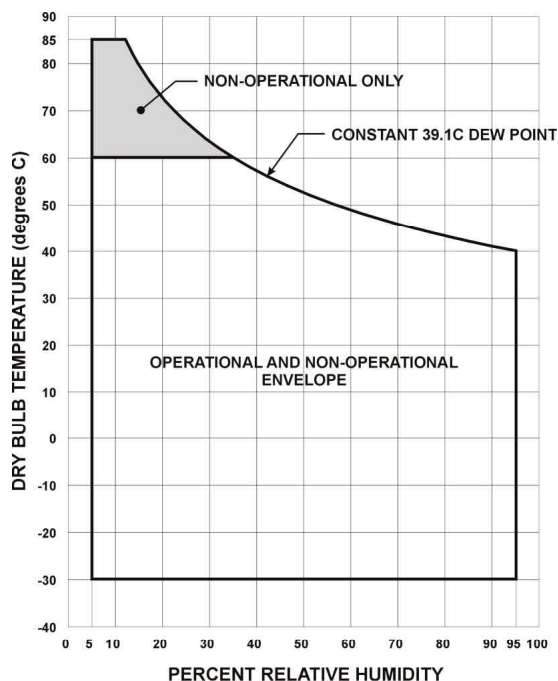

Figure 7-1 GSP1620 Temperature / Humidity Envelope

7.1.3 Thermal Radiation.

The temperature profile shown in Figure 7-1 includes temperature rise due to thermal radiation, solar radiation, and other heat loads.

7.1.4 Operational Altitude.

The GSP1620 shall operate at standard atmospheric pressure altitudes between 0 and 15,000 meters (50,000 ft).

7.1.5 Non-operational Altitude.

The Packet Data Modem shall operate as specified after storage at pressure altitudes ranging from 0 to 15,000 meters (50,000 ft).

7.1.6 Operational Vibration.

7.1.6.1 Random Vibration.

The Packet Data Modem shall operate as specified during exposure to the random vibration spectrum defined in Figure 7-2.

7.1.6.2 Sinusoidal Vibration.

The Packet Data Modem shall operate as specified during exposure to the swept sinusoidal vibration environment defined in Table 7-1.

7.1.7 Non-Operational Vibration.

7.1.7.1 Random Vibration.

The Packet Data Modem shall operate as specified after exposure to the random vibration spectrum defined in Figure 7-2.

7.1.7.2 Sinusoidal Vibration.

The Packet Data Modem shall operate as specified after exposure to the swept sinusoidal vibration environment defined in Table 7-1.
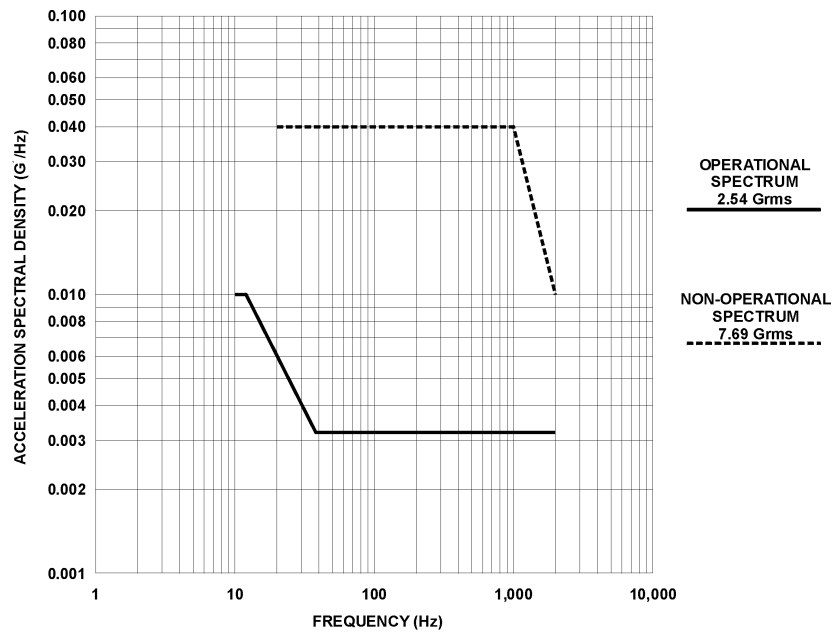
Figure 7-2 GSP1620 Random Vibration Spectra

	Double Amplitude Displacement (inch)	Acceleration (Gs)	Frequency Range (Hz)
Operational	0.28		2 to 9
		1.02	9 to 200
		1.53	200 to 500
Non-Operational	0.59		2 to 8
		2.04	8 to 200
		4.08	200 to 500

Table 7-1 Swept Sine Vibration Definition

7.1.8 Operational Mechanical Shock.

The Packet Data Modem shall operate as specified while being subjected to a half sine pulsed acceleration wave form of six milliseconds in duration, 10 G's peak.

7.1.9 Non-Operational Mechanical Shock.

The Packet Data Modem shall operate as specified after being subjected to a half sine pulsed acceleration wave form of six milliseconds in duration, 30 G's peak.

7.1.10 Digital Data Connector Durability.

7.1.10.1 Applied Forces.

The digital data connector shall meet all performance requirements after application of a 24.5 Nt force on the mating connector. The force shall be applied in six directions; two opposite directions along each of three mutually perpendicular axes.

7.1.10.2 Mating cycles.

The digital data connector shall meet all performance requirements after a minimum of 3,000 connect / disconnect cycles.

7.1.11 RF Connector Durability

The GSP1620 RF connectors shall meet all performance requirements after 500 connect / disconnect cycles at a maximum rate of 12 cycles per minute.

7.1.12 Materials.

The Packet Data Modem shall be manufactured of non-nutrient materials with respect to fungal growth.

7.1.13 Shipping.

The Packet Data Modem as packaged for shipment shall meet the pre-shipment test procedures specified in the National Safe Transit Association, Project 1A.

7.2 Dielectric Resonator Antenna (DRA) Environments

7.2.1 *Operational Temperature / Humidity*

The DRA shall operate as specified during exposure to the operational temperature / humidity envelope shown in Figure 7-3.

7.2.2 *Non-Operational Temperature / Humidity*

The DRA shall operate as specified after exposure to the operational and non-operational temperature / humidity envelopes shown in Figure 7-3.

7.2.3 *Thermal Radiation.*

The temperature profile shown in Figure 7-3 includes temperature rise due to thermal radiation, solar radiation, and other heat loads. . The module dissipates heat that is dependent on the mode and the transmit power. The dissipated heat is the difference of the DC input power and the RF transmitted power.
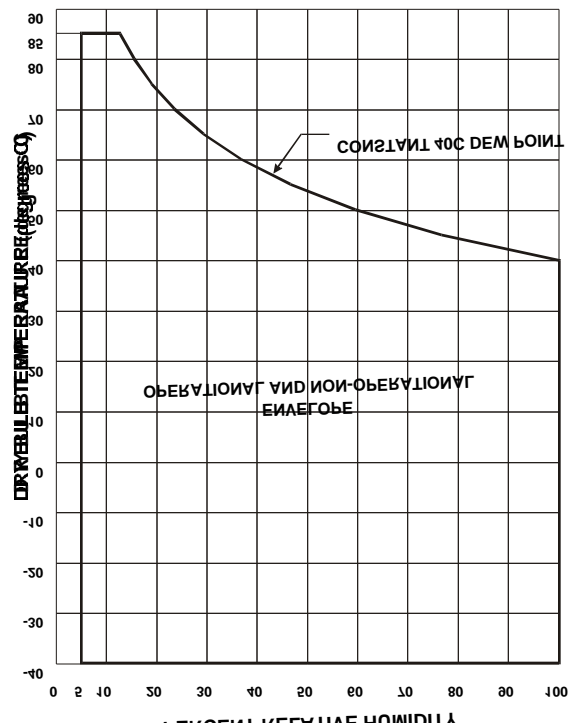

Figure 7-3 DRA Temperature / Humidity Envelope

7.2.4 *Operational Altitude.*

The DRA shall operate at standard atmospheric pressure altitudes between 0 and 15,000 meters (50,000 ft).

7.2.5 Non-operational Altitude.

The DRA shall operate as specified after storage at pressure altitudes ranging from 0 to 15,000 meters (50,000 ft).

7.2.6 Operational Vibration.

7.2.6.1 Random Vibration.

The DRA shall operate as specified during exposure to the random vibration spectrum defined in Figure 7-4.

7.2.7 Non-Operational Vibration.

7.2.7.1 Random Vibration.

The DRA shall operate as specified after exposure to the random vibration spectrum defined in Figure 7-4.
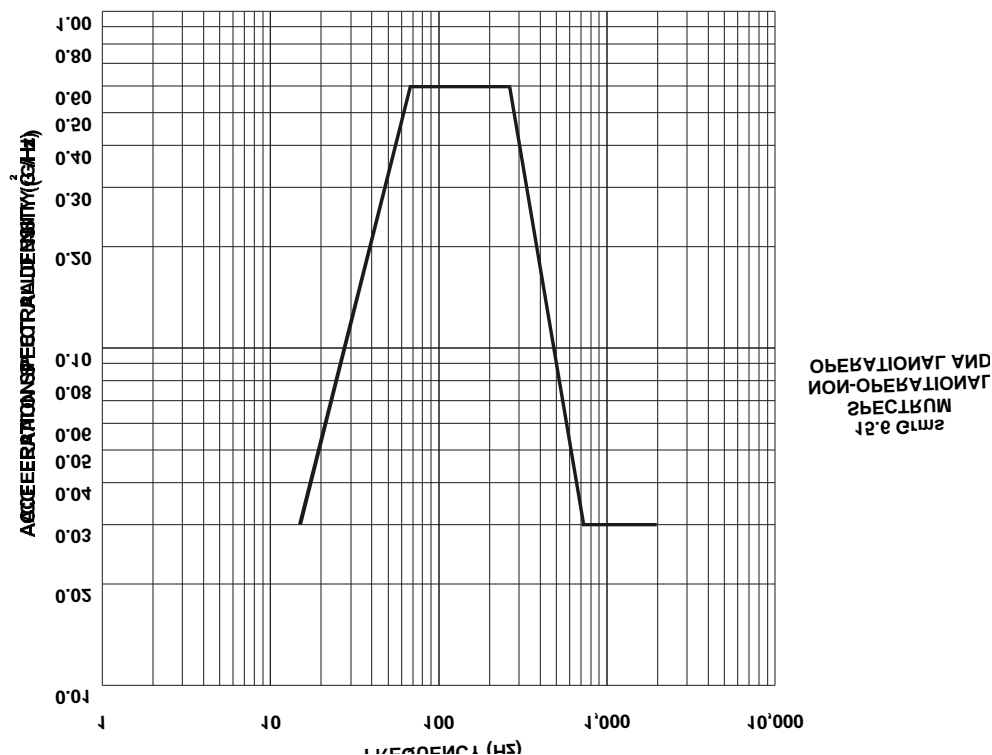

Figure 7-4 DRA Random Vibration Spectrum

7.2.8 Operational Mechanical Shock

The DRA shall operate as specified while being subjected to a half sine pulsed acceleration wave form of six milliseconds in duration, 30 G's peak.

7.2.9 Non-Operational Mechanical Shock.

The DRA shall operate as specified after being subjected to a half sine pulsed acceleration wave form of six milliseconds in duration, 100 G's peak.

7.2.10 RF Connector Durability

The DRA RF connectors shall meet all performance requirements after 500 connect / disconnect cycles at a maximum rate of 12 cycles per minute.

7.2.11 Materials.

The DRA shall be manufactured of non-nutrient materials with respect to fungal growth.

7.2.12 Shipping.

The DRA as packaged for shipment shall meet the pre-shipment test procedures specified in the National Safe Transit Association.

8. RF Certification / Restrictions

8.1.1 Certification

The packet data modem, Antenna and cabling as supplied by Qualcomm Inc. shall be compliant with the following International standards when configured in accordance with the Qualcomm recommendations. Any deviation from the guidelines or modifications to the product performed without the permission of Qualcomm Inc. will invalidate all regulatory approvals.

Compliance to the technical requirements shall be demonstrated with the product installed in a non metallic enclosure which provides no additional shielding or RF protection. An OEM supplied enclosure is required to protect the product from the effects of electrostatic discharge (ESD) and environmental conditions that result in the product operating outwith its specified range.

Compliance to the technical requirements shall be demonstrated with the product powered by a supply which is compliant with the rules and regulations of the FCC and the European Community. The OEM manufacturer is required to provide a power supply that ensures that the product continues to meet the applicable regulatory requirements for the specific application.

Qualcomm Inc. does not accept any responsibility for regulatory compliance of the OEM product and it is the responsibility of the OEM manufacturer to ensure that all regulatory requirements have been met for the specific application.

8.1.1.1 Federal Communications Commission (FCC)

The packet data modem configured with the Qualcomm Inc. supplied Antenna and RF cabling shall be compliant and approved in accordance with the FCC Code Of Federal Rules (CFR) 47 parts:

Part 1 Para 1.1310 Radio Frequency Radiation Exposure limits

Part 15 Radio Frequency Devices

Part 25 Satellite Communications

8.1.1.1.1 European Directive 1999/5/EC On Radio Equipment & Telecommunications Terminal Equipment (R&TTE Directive)

The packet data modem configured with the Qualcomm Inc. supplied Antenna and RF cabling shall be compliant and approved in accordance with the essential requirements of the European Community. The supporting technical standards used to demonstrate compliance are:

EN 300 831 Electromagnetic Compatibility

EN 301 441 (TBR 041) Essential Terminal Requirements

8.1.2 RF Restrictions

The packet modem must be used with the Qualcomm Inc. provided antenna and no modification to the RF transmit or receive path is permitted in the form of amplifiers.

Qualcomm Inc. must be consulted before any changes can be made in the RF path, including cable length deviations from the Qualcomm Inc. provided or recommended cabling. Failure to do so may result in non compliance with the Globalstar communications network and Government Radio Regulations.

8.1.2.1 Radio Astronomy Zones

The OEM manufacturer must consult with the Globalstar service provider to ensure that the location/locations of the installed OEM product do not fall within local Radio Astronomy exclusion zones.

8.1.2.2 GPS Interference Elimination

The modem antenna must be installed a minimum distance of 30" from a GPS antenna to ensure compatibility between the two satellite systems.

9. Module Testing and Integration

This chapter outlines the testing performed at Qualcomm and the suggested testing by the OEM Customer. This test flow will be part of the warranty / product support plan that Qualcomm will use for module returns.

## 9.1 Qualcomm Module Production Testing

The module is assembled by using standard Surface Mount Technology (SMT) and fully tested to verify functional performance of the module before it leaves the factory.

The module will be packaged separately from the antenna, and will not be supplied with an antenna cable. The second paragraph to this section needs to be changed

The module is then static wrapped, and packaged in groups of 50 to a box. 50 antennas will be packaged separately and will ship as "one" kit when ordered by the OEM Customer.

It is anticipated that once the module has received at the OEM Customer location an incoming QA test at the OEM plant will be able to determine that the module is functional.

9.2 OEM VAR Module Testing
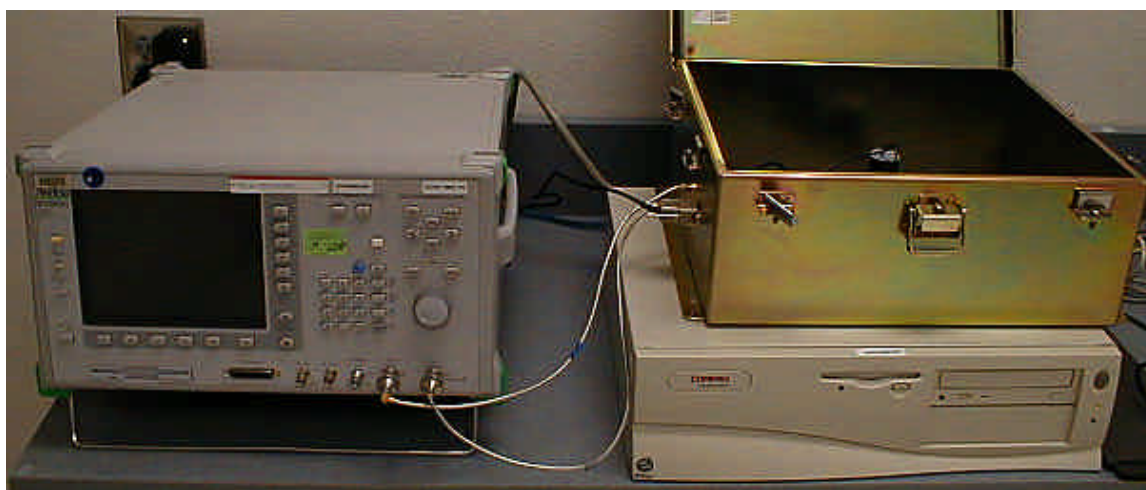
9.2.1 Module Test Equipment

- Lease or purchase an Anritsu MT8803G
- GQUAT, available from QUALCOMM Incorporated.
- A PC running a windows-based program that controls the Anritsu MT8803G to permit measurement of:
  - Access probe power
  - Maximum transmit power
  - Waveform quality
  - Forward-link sensitivity.

10. Module Development Kit

The Module Development Kit (MDK) is used to assist the OEM VAR in rapid development of user applications for GSP 1620 Satellite Data Modems.

The Module Development Kit consists of:
- (1) GSP1620 Modem
- (1) Dialectric Resonating Antenna (DRA)
- (1) Pair of Antenna Cables w/ Connectors
- (1) Custom DB25 cable bridle, which splits out the DE9 Data Port, the DE9 Control Port, and has a connected DC power supply for powering the module.
- (1) Diagnostic Monitor Cable.
- (1) GSP1620 Globalstar Satellite Data Modem Developer's Reference Manual.
- (1) CD ROM with a "soft copy" of the reference manual, and sample Software scripts to quickly set up the Module and get it operating over the air.

10.1 Recommended Products

The following products are available for developmental use in configuring, testing and debugging the GSP 1620 Globalstar Satellite Packet Data Modem.

10.1.1 Globalstar Diagnostic Monitor

The Globalstar User Terminal Diagnostic Monitor (UTDM) is a Windows NT application that allows you to run user-selected diagnostics on the Globalstar User Terminal (UT). The UTDM collects the feedback in real-time and displays this feedback on screen.

The UTDM collects the following types of information:

- Log packet data

- Markov status data

- Searcher status data

- Finger status data

- Physical Layer status data

- Symbol Error Rate status data

- Traffic Channel Frame Error Rate Status data

- Call Processing status data

- Vocoder Rate status data

- Satellite status data

In addition, the UTDM has a test mode feature that puts the UT in special test-oriented modes of operation. The UTDM is intended to be used as a troubleshooting and system level testing tool. The data collected can be used to diagnose and fix phone or switch software, to diagnose and reconfigure a faulty network, or to diagnose and fix a faulty UT. Further, the data collected from the UT can be combined with information from the gateway to provide overall system diagnostics.

11. Warranty

The Globalstar GSP 1620 Packet Data Modem from Qualcomm, Inc. will arrive having been tested as described in the Module Testing and Integration Chapter. Testing should be duplicated at the integrator's facility. Qualcomm can provide advice as to he type of test equipment needed.

This module testing should be a separate test mechanism from the testing to be performed on the end product, with the module integrated into it.

11.1 Warranty

Qualcomm, Inc. offers a warranty for the GSP 1620 module, from the date of delivery from Qualcomm's facility. This warranty provides for the return of any defective module within the warranty period and subject to all warranty provisions.

Qualcomm, Inc. requests that the integrator retain several modules as backups / spares in the case of failure. It is assumed that you will maintain a first level of returned module testing in your QA department prior to returning the module to Qualcomm, Inc. This will alleviate the questions of whether the failure is in the module or the end product.

An excessive number of "no trouble found" occurrences on modules returned to Qualcomm will result in extra fees. Qualcomm, Inc. reserves the right, at its own discretion to repair or replace any defective module.

Warranty repair excludes warranty claims on products that have been subject to misuse, neglect, improper storage or installation, or that have been repaired, modified, or altered by a facility other than a Qualcomm, Inc. authorized service center or a Qualcomm, Inc. certified repair center.

In all cases final testing of the Qualcomm line will be the sole determination of the module performance.

12. Product Support

This chapter provides support information for users who encounter any issues with the GSP 1620 Packet Data Modem hardware and software. The chapter contains contact information for QUALCOMM Globalstar Customer Service, and a description of the support you can receive from the Order Fulfillment and Technical Support teams.

12.1 QUALCOMM Globalstar Customer Service

QUALCOMM Globalstar Customer Service provides skilled staff to support you with order fulfillment (purchase order requests and Return Material Authorizations, or RMAs) and technical support.

*   Contact QUALCOMM Customer Service at: (U.S.) +1 858 651-4911

*   Send QUALCOMM Customer Service a fax at:
    Fax (U.S.) +1 858 651-7329

12.1.1 Order Fulfillment

To repair, replace, or upgrade parts, you must request an RMA (Return Material Authorization) from QUALCOMM. The Technical Support team must approve all RMA requests before the Order Fulfillment team processes the RMA. See Section 12.2for information about how to submit RMA requests. For details on the RMA process, consult the following references:

*   The QUALCOMM Globalstar Customer Service Website
    (http://www.gstechsupport.qualcomm.com) under the RMA tab

*   Call QUALCOMM Customer Service at +1 858 651-4911

Order Fulfillment support is available 8:00 a.m. to 5:00 p.m. Pacific Time (PT) Monday through Friday.

Note: Pacific Time (PT) is Pacific Daylight Time (PDT) when Daylight Saving Time is in effect, and is Pacific Standard Time (PST) during the remainder of the year. Daylight Saving Time begins the first Sunday in April and ends the last Sunday in October. International customers, note that PST is Universal Time (UTC) minus 8 hours, and PDT is UTC minus 7 hours. (UTC stands for Universal Time Co-ordinated, and is also written UCT for Universal Coordinated Time. UTC/UCT replaces the older terminology, GMT, for Greenwich Mean Time.)

To contact the Order Fulfillment team:

1. Call (U.S.) +1 858 651-4911

2. Choose: Option 1 for Globalstar Gateway Products (including encryption router support)

3. Choose: Option 2 to request an RMA to return equipment

You will be connected to a Customer Service Sales Representative who will assist you with your sales order or RMA.

12.1.2 Technical Support

The Technical Support team provides troubleshooting assistance for all QUALCOMM-provided Globalstar products.

To get the support you need, be sure to follow the QUALCOMM Technical Support process and procedures, which you can find at the QUALCOMM Globalstar Customer Service Website (http://www.gstechsupport.qualcomm.com) under the Gateway tab, under Troubleshooting.

QUALCOMM Customer Service provides Technical Support 24 hours a day, every day.

To contact Technical Support:

1. Call (U.S.) +1 858 651-4911

2. Choose: Option 1 for Globalstar Gateway Products (including encryption router support)

3. Choose: Option 1 for Troubleshooting Assistance

You will be connected to a Technical Support Specialist (TSS), who will create a case and assist you with resolving your problem or request.

12.2 Website and email support

You must be a registered user to use the QUALCOMM Customer Service website and email addresses. For details on how to register in order to gain access to the website, refer to the following:

• The QUALCOMM Globalstar Customer Service Website (http://www.gstechsupport.qualcomm.com) — on the home page, click "Website Registration" and follow the directions

Website support is available to registered users at the following URL:

> http://www.gstechsupport.qualcomm.com

The website contains Gateway Technical Support Request forms and RMA Request forms that you can use to submit cases electronically. If you do not have access to the Internet, you can do the following:

- Submit an RMA (Return Material Authorization) on a problem by sending email to the following address: gstechsupport@qualcomm.com. Be sure to provide your name, company, location, telephone number, description of the problem, part information, and details about the error messages and/or log information.

- To obtain information on the status of a case, send email with the case number to the following address: status.techsupport@qualcomm.com

- To obtain information on the status of an RMA, send email with the RMA number to the following address: status.rma@qualcomm.com

- Other questions of a product informational nature can be referred to Qualcomm, Inc. at Gs.modules.info@qualcomm.com

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13. Acronym List

This chapter contains definitions of the Globalstar-related acronyms used in this release notes document.

BVI   Bridged Virtual Interface

CD   Compact Disc

CD-ROM   Compact Disc Read-Only Memory

CDMA   Code Division Multiple Access

CPU   Central Processing Unit

EXE   Executable

FAX   Facsimile

GMS   Gateway Management Subsystem

GMT   Greenwich Mean Time

GOCC   Ground Operations Control Center

GW   Gateway

HW   Hardware

IOS   Internetwork Operating System

IP   Internet Protocol

ISDN   Integrated Services Digital Network

MCN   Material Control Number

N/A   Not Applicable

O/S   Operating System

PDF   Portable Document Format

PDT   Pacific Daylight Time

PST   Pacific Standard Time

PT   Pacific Time

RF   Radio Frequency

RMA   Return Material Authorization

SP	Service Provider
SPCC	Service Provider Control Center
SW	Software
TSS	Technical Support Specialist
UCT	Universal Coordinated Time
URL	Uniform Resource Locator
UTC	Universal Time Co-ordinated