8 INTEGRATING GSP-1720 MODULES INTO PRODUCTS

Integrators can buy QUALCOMM Globalstar GSP-1720 Satellite Data/Voice Modules in bulk direct from QUALCOMM to incorporate them into market-specific products.

As an integrator, you provide custom module and antenna cables as appropriate to your specific products. You must also mount the module boards in protective enclosures, which field technicians can then install on-site, connected to antennas.

This chapter is intended for:

- Integrators who incorporate GSP-1720 hardware into products (for example, oil pipeline monitors)
- Field technicians who install those products on site

It is assumed that integrators and field technicians can work directly from the technical specifications. This chapter contains the following information:

- Integrating modules into products
  - Hardware description of the module, including mechanical descriptions; specifications; Data and Control port signaling and pinouts; DC power; and grounding information
  - Guidelines for mounting modules in enclosures
- Mounting antennas on-site
  - Antenna cable specifications and lengths

  - Positioning antennas for Globalstar service, and mounting and sealing antennas
- Environmental specifications for the GSP-1720 and antenna

Caution For your safety and to avoid potential damage to the equipment, observe the *Cautions and Warnings* on page xxiv.

Caution When integrating the GSP-1720 and its antenna into products, be sure to abide by all RF restrictions as described in Appendix A.

Integrating Modules into Products

This section describes the QUALCOMM Globalstar GSP-1720 Satellite Data/Voice Module hardware, including mechanical descriptions of the module, its Data and Control port signals and pinouts, DC power, and grounding.

Using this information for your specific products, you can create custom cables, which connect a module (the DCE) to:

- A terminal or processor (the DTE) running custom application software for your product — using the Data port only, or both Data and Control ports
- An appropriate DC power source
- Antenna — for information about installing antennas and calculating cable lengths, see *Mounting Antennas at the Field Site* on page 8-17.

Note The Diagnostic port uses a standard USB cable.

Module Mechanical Description

The GSP-1720 is a single circuit card assembly (CCA) that is open and unprotected. As a result, the GSP-1720 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 22-pin connector (labeled J4 on the board).
- Globalstar RF transmit signals are routed to an SMA-style coaxial connector (labeled J2 on the board).
- Globalstar RF receive signals are routed to an SMA-style coaxial connector (labeled J1 on the board).
- The Diagnostic port uses a standard USB cable (labeled J3 on the board).

Module Board Layout

This section includes the following technical drawings depicting the module:

- GSP-1720 Module Board Layout (Top View), Figure 8-1
- GSP-1720 Module Board Layout (Side and Bottom View), Figure 8-2

Note In Figure 8-1 and Figure 8-2, dimensions are shown as: millimeters [inches]. Millimeters are the controlling dimensions on these drawings. Inch dimensions are for reference only.

Figure 8-1. GSP-1720 Module Board Layout (Top View)

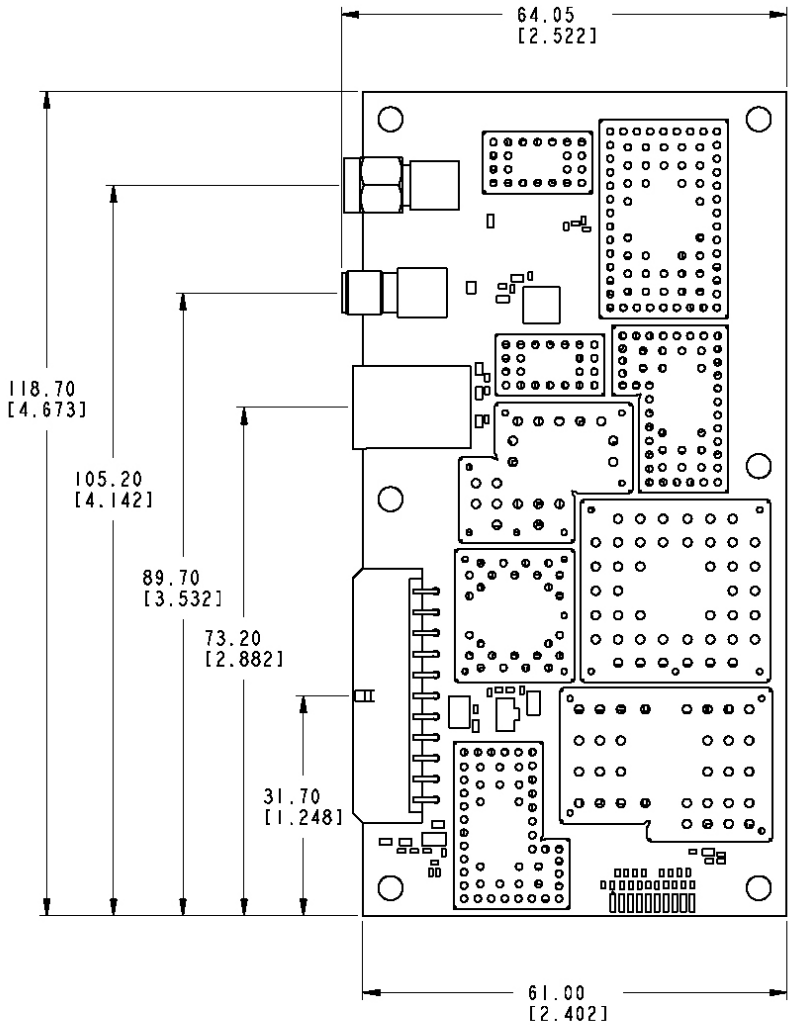
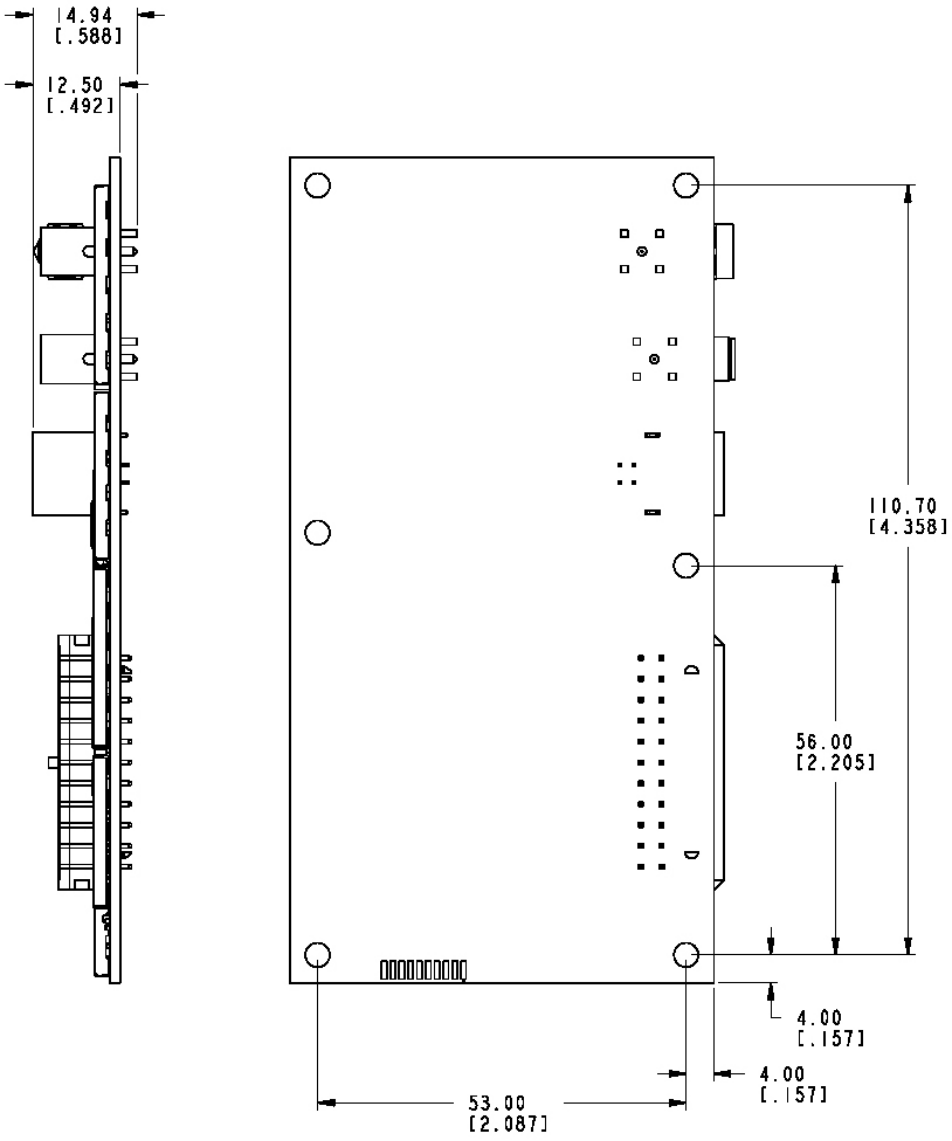


Figure 8-2. GSP-1720 Module Board Layout (Side/ Bottom Views)



Module Dimensions and Weight

Module dimensions are 119 x 65x 14 millimeters (4.69 x 2.56 x 0.55 inches).

Module weight is less than 60 grams (2.15 ounces).

Module Antenna Connectors

The GSP-1720 has two (2) sma screw-on connectors for the antenna leads, connecting the antenna to the module:

- Transmit (Tx) lead is labeled **J2**.
- Receive (Rx) lead is labeled **J1**.

Caution The SMA connectors are secured only by a solder joint and are not designed to withstand excessive force. When cables are connected to these connectors, care must be taken to ensure adequate strain relief is provided.

Data and Control Ports

The Data and Control ports are combined into a single 22-pin Molex serial connector, which provides the primary user interface:

- The connector contains two (2) 9-pin serial ports, DC power leads, and a reset lead.
- Line speed for the Data port is variable between 300 bps and 38400 bps. (This is different from the over-the-air effective throughput, which is 9600 bps.)
- Line speed for the Control port is fixed at 9600 bps.
- Signaling uses 8 bits, no parity and 1 stop bit (8,N,1).
- All ports are ESD and short-circuit protected.

Note The Data port can be set to either USB or serial. Refer to Chapter 5 for setting port configurations.

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

Note Pin 13 in the 22-pin Molex connector is used for power on/off. Pull the pin low to power on the module. By floating or pulling the pin high (4.7 V), the module will power down.

Control Port Signals

The Control port (CP) is an RS-232-level asynchronous interface operating at 9600 bps using Transmit Data (TxD), Receive Data (RxD), Data Terminal Ready (DTR), Data Set Ready (DSR), and Signal Common (GND).

RxD and TxD perform 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. It allows all AT commands, module alerting, and SMS messages to be sent simultaneously via a separate “control” port to/from the module. This separation of functionality is especially useful in dormant mode, when the application and host sessions are active, and 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 the Control port.

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

Data Port Signals

The Data port (DP) is a hardware-flow controlled, RS-232 level, asynchronous serial interface:

- The Data port uses the following RS-232 leads for operations: Transmit Data (TxD), Receive Data (RxD), Clear To Send (CTS), Data Terminal Ready (DTR), Data Set Ready (DSR), 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 to selected rates from 300 bps to 38400 bps. The baud rate is adjustable in software.
- In case of a reboot (due to fatal errors or any other reason), the DCD and DSR lines 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 data traffic.

22-Pin Data and Control Port Pinouts

Table 8-1 provides detailed information about the Interface connector pinouts.

Table 8-1. Interface Connector Pinouts

Pin Number	Signal Name	Termination	Pin
1	Audio Out		n/a
2	Audio In		n/a
3	Audio GND		n/a
4	Data Port TX	P2-Data port	3
5	Data Port RX	P2-Data port	2
6	Data Port DTR	P2-Data port	4
7	Data Port RTS	P2-Data port	7
8	Data Port CTS	P2-Data port	8
9	Data Port DCD	P2-Data port	1
10	Data Port RI	P2-Data port	9
11	Data Port DSR	P2-Data port	6
12	GND	P2-Data port	5
13	POWER_ENABLE_N		n/a
14	GND		n/a

Table 8-1. Interface Connector Pinouts (continued)

Pin Number	Signal Name	Termination	Pin
15	DC In		n/a
16	Control Port TX	P3-Control Port	3
17	Control Port DTR	P3-Control Port	4
18	Control Port RX	P3-Control Port	2
19	GND		
20	GND	P3-Control Port	5
21	Control Port DSR	P3-Control Port	6
22	VDD_ODU		n/a

Diagnostic Port

The Diagnostic port can be connected to a standard USB cable. By connecting a USB cable to the Diagnostic port, you can:

- Service-program a module or upgrade its software, using the Globalstar User Terminal Program Support Tool (UTPST).

Note

For more information about the UTPST, see *UTPST Overview* on page 3-2.

Caution

The USB connector is secured only by a solder joint and is not designed to withstand excessive force. When a cable is connected to this connector, care must be taken to ensure adequate strain relief is provided.

DC Power

The GSP-1720 requires input DC power ranging from 4.7 V to 5.1 V, with 1 Amp (maximum) (pin 15). The module DC input power must be clean (maximum of 50 mV peak-peak ripple and noise) and must be within the absolute maximum voltage

range of 4.7 V to 5.1 V under all conditions. For typical DC power consumption limits, see *Power Consumption* on page 8-11.

The approximate minimum input impedance of the module is given by $R = V^2/P_{max}$ where V is the operating voltage of the module and P_{max} is the maximum power consumed by the module. For example, the minimum input impedance of the module at 5 V would be approximately 5*5/5.0 = 5.0 Ohms. Any DC power supply capable of supplying the peak demand of 5.4W at 12V would have this output impedance. Additional design margin of at least 20% is recommended beyond this minimum value.

Care should be taken that if additional EMI filtering is added (see *EMI Filtering* on page 8-11), the impedance as seen by the module's input power supply does not exceed this value.

Warning

Do not unplug the power cables while the module is powered up. This can cause ESD damage to the module and also presents a danger of electrical shock.

Caution

You must ensure that the output impedance of the power supply sourcing DC power to the module is always less than that of the input impedance of the module. Otherwise, a potential exists for oscillations on the DC power line and the GSP-1720 will not operate as designed.

Surge Protection

As an integrator, you are responsible for ensuring that the input voltage specification will never be exceeded.

Minimal transient protection is provided on the GSP-1720 board but this is intended only for low energy/duration events (total transient power less than 1 kW). It is not intended to protect the module in case of a sustained over-voltage/lightning condition.

The use of a fuse is strongly recommended in the power supply connecting to the GSP-1720. The input surge current requirements of the GSP-1720 are such that a fuse with a minimum melting I^2t rating of 0.02 A^2 seconds will be sufficient.

EMI Filtering

Adequate conducted EMI filtering has already been provided in the GSP-1720 to pass FCC and ETSI limits. Additional filtering should not be necessary to meet these requirements.

Caution

Should additional filtering be necessary, you must take precautions to ensure that the above criteria are not violated. Please contact QUALCOMM Incorporated for further details in such a case.

Power Consumption

Power consumption depends on a variety of factors such as transmit power, input voltage, and data rate. Table 8-2 summarizes the power consumption of the GSP-1720 at an input voltage of 4.7 V to 5.1 V DC. All power estimates include the DC power consumption of the ODU antenna's receive section.

Table 8-2. Module DC Power Consumption Estimates at 5.0 V DC Input

Mode	Minimum	Typical	Maximum
Shutdown	0 mW	0.65 mW	1 mW
Standby	0.5 W	0.5 W	1.1 W
Transmit	2.2 W	3.65 W	5 W

The power modes in Table 8-2 are as follows:

- **Shutdown** — The module is not operational in this state when POWER_ENABLE_N is high.
- **Standby** — The receiver section in the module is active during this time and the module is ready to transmit/receive data.
- **Transmit** — The module's transmitter is active in this state and may be in the process of transmitting/receiving data.

Power-On

Power-on is controlled by the presence of DC In and POWER_ENABLED_N being low.

Power-Off

Power-off is also controlled by the removal of DC In or raising POWER_ENABLED_N.

Hard Power Reset

Provisions equivalent to power cycling (see Pin 25 in Table 8-1) are included to "hard reset" a GSP-1720 under user control. This pin is pulled high for a minimum of five seconds to reset the module. The line is normally left grounded.

Grounding

The GSP-1720 has been designed to provide flexibility in the area of grounding, with options to make connections between digital ground and the integrator-provided chassis ground (metallic enclosures). These grounding options are also independently available for the 22-pin Molex connector.

The GSP-1720 has been certified in accordance with the technical and regulatory requirements of the FCC and the European Union. The module was tested in a configuration that did not include, or require, an enclosure or specially shielded cable configuration in order to demonstrate compliance with the requirements.

Your application may need different grounding configurations. To do accomplish this, a chassis ground connection to the module may be established using conductive support posts/ screws between the module mounting holes, where the solder mask is exposed on both sides of the board, and the integrator-provided chassis (metallic enclosure or base).

Caution

The RF connector ground is the same as the signal and power ground. As an integrator, you should understand this when designing an integrated product for use in environments where surge protection may

be required. You should also be aware of this fact to avoid ground loops in the final installation.

Voice Call Specifications

The SDVM audio system is designed to function in a near field application such as a headset or a handset. Audio levels at the 22-pin connector.

Table 8-3. Audio OUT

Output impedance	10 ohms, intended to drive a 16 ohms load
Freq response	300 Hz-3300 Hz
Output power	8 mW into 16 ohm full scale out with VDD 2.5 V-2.7 V
Power Supply rejection ratio	45 dB

Table 8-4. Audio IN

Input Impedance	35 Kohms
Freq response	300 Hz-3300 Hz
Max Input Voltage	64.5 Vrms

Table 8-5. 3.626 V ADC Reference Voltage

Gain	Vin (SE)	Digital Output
-2	2.5	-5.22976 dBFS
6	1.817305	0 dBFS
8	1.443537	0 dBFS
16	0.574682	0 dBFS

Module Mounting Guidelines

QUALCOMM offers the GSP-1720 without a mechanical enclosure, anticipating that integrators will incorporate and package the module into an enclosure or cabinet appropriate to the end-user's application. The enclosure must shield the GSP-1720 from direct impacts, precipitation, vibration, acoustic noise, and particulates.

The GSP-1720 has six mounting holes sized for M3 screws. All six mounting locations of the module must be fastened to a rigid structure to meet the vibration and shock requirements specified in *Integrating Modules into Products* on page 8-2.

For hole size and locations, connector locations, and overall envelope dimensions, see Figure 8-1 on page 8-4 and Figure 8-2 on page 8-5.

Caution

When you mount the GSP-1720 into an enclosure or onto a surface, you must exercise care during the process. 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 prevent flexing of the module.
- Use shock mounts when the environment includes vibration in excess of that shown in Figure 8-5 on page 8-22.
- Use acoustic dampening material when the environment includes acoustic noise in excess of 110 dB OSPL (Overall Sound Pressure Level).
- 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.

QUALCOMM Mark on Integrator Enclosures

Each GSP-1720 based product and its packaging shall bear the "CDMA by QUALCOMM" mark and such other mark(s) of QUALCOMM, or those which QUALCOMM has the right to use and permit the use of, as QUALCOMM may designate from time to time upon notice to the buyer. The product markings shall appear in a size and location reasonably agreed to by both parties.

Figure 8-3 shows the QUALCOMM marking suitable for integrator enclosures.

Figure 8-3. QUALCOMM Mark for Integrator Enclosures

Integrated Product Regulatory Labeling

The GSP-1720 as delivered by QUALCOMM Incorporated is approved and labeled in accordance with the requirements for the FCC, the European Union, and Industry Canada (see Appendix A, *RF Certification / Restrictions*).

If the regulatory labeling is not visible when the module is integrated into the final product, then the labels must be applied to the product enclosure clearly showing the FCC and Industry Canada numbers with the same style and font size as the label on the circuit board. QUALCOMM Incorporated authorizes the duplication and use of these regulatory approvals on the integrated product provided that the module has not been modified or altered to the extent that the electromagnetic performance has been degraded (see *Module Mounting Guidelines* on page 8-14 and Appendix A, *RF Certification / Restrictions*).

The integrator is responsible for obtaining all required regulatory approvals and certifications for the Integrated

Product and for ensuring that the Integrated Product complies with all requirements for its target market and is labeled accordingly.

The label must be located on the product in an area that can be easily viewed and the type size must be large enough to be legible without the aid of magnification. The integrator labeling may be worded as follows:

> "This Product Contains a Globalstar Radio Transceiver FCC ID: J9CGSSDVM; CE0168"

Antenna Cable Specifications

The antenna requires two (2) cables, one for transmit and one for receive:

- The required connectors are male SMA to male SMA (module Tx) and female SMA to female SMA (module Rx).
- Transmit cable maximum 1.0 dB insertion loss @ 1618 MHz is required for the cable.
- Receive cable maximum 3.0 dB insertion loss @ 2492 MHz is required for the cable.

QUALCOMM does not provide cables for integrator bulk applications since cables of different lengths may be needed for particular applications. Table 8-6 lists potential suppliers of RF and microwave connectors and cable assemblies.

Table 8-6. Suggested RF Cable and Connector Suppliers

Volex Inc.:
Address: Volex Inc. 1 Batterymarch Park, Quincy, MA 02169 USA Web: http://www.volex.com/

Table 8-6. Suggested RF Cable and Connector Suppliers (continued)

Times Microwave Systems:
Address: Times Microwave Systems 358 Hall Avenue P.O. Box 5039 Wallingford, CT 06492-5039 Web: http://www.timesmicrowave.com

Calculating Antenna Cable Length

The maximum loss for an antenna cable of any length is 1.0 dB at 1.6 GHz for module transmit and 3 dB at 2.5 GHz for module receive.

You must take these losses into account when calculating antenna lengths for a GSP-1720 installation.

Mounting Antennas at the Field Site

When mounting an antenna on-site, you must position it properly to obtain Globalstar satellite signals. You can mount the antenna on a flat surface or on a pole. In either case, you should seal the antenna connectors against dirt and moisture.

Caution The ODU antenna must be installed in a configuration that ensures a minimum line-of-sight separation distance of 25 centimeters (10 inches) is maintained at all times between the ODU antenna and any personnel.

Finding a Good Antenna Location

When installed in the field, the antenna of a GSP-1720 product must have a direct line of sight to the Globalstar satellites. Keep in mind that Globalstar satellites follow different paths across the sky, and you cannot predict where they will be.

Position the antenna outdoors where it has a clear view of the sky, unimpeded by tall obstacles such as buildings and trees.

Signal fading associated with trees, buildings, and other obstacles that prevent a clear line-of-sight to the satellite can cause degraded operation in a mobile environment.

Note Globalstar frequencies are attenuated by wet snow. When mounting the antenna in a snowy location, you must make provisions to prevent snow buildup on the antenna. Wet ice/snow must be restricted to a maximum thickness of 20 centimeters (8 inches) by suitably mounting the antenna.

Securing Antenna Cables

When connecting the antenna cables, the recommended torque for the SMA connectors is 0.79 to 1.13 N·m (7 to 10 in·lb).

Environmental Specifications

This section describes environmental specifications for both the QUALCOMM Globalstar GSP-1720 Satellite Data/Voice Module and its antenna.

The environmental requirements specified herein are under development and are subject to change without notice.

Note This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

GSP-1720 Module Environments

Environments affecting the GSP-1720 include temperature/humidity, thermal radiation, altitude, vibration, mechanical shock, and acoustic noise. This section also discusses connector durability, materials, and shipping.

Temperature/Humidity

Operational

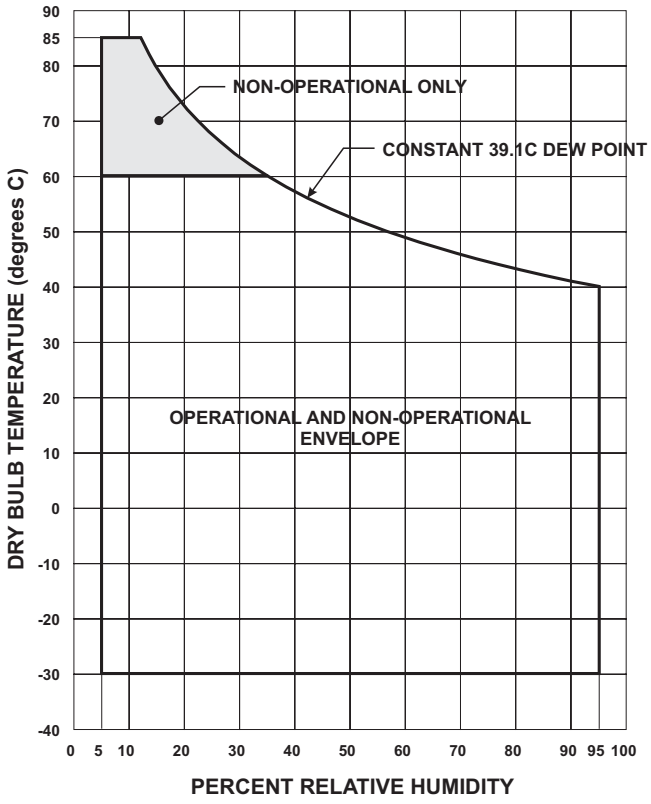
The GSP-1720 operates as specified during exposure to the operational temperature/humidity envelope shown in Figure 8-4.

Caution Condensation on the GSP-1720 is not permissible.

Non-Operational

The GSP-1720 operates as specified after exposure to the operational and non-operational temperature/humidity envelopes shown in Figure 8-4.

Figure 8-4. GSP-1720 Module Temperature/Humidity Envelope



Thermal Radiation

The temperature profile shown in Figure 8-4 includes temperature rise due to thermal radiation, solar radiation, and other heat loads. The GSP-1720 dissipates heat that is dependent on the mode and the transmit power. The dissipated heat is the difference between the DC input power and the RF transmitted power.

Altitude

Operational

The GSP-1720 operates at standard atmospheric pressure altitudes between 0 and 15,000 meters (50,000 feet).

Non-operational

The GSP-1720 operates as specified after storage at pressure altitudes ranging from 0 to 15,000 meters (50,000 feet).

Vibration

Operational - Random

The GSP-1720 operates as specified during exposure to the random vibration spectrum defined in Figure 8-5.

Non-Operational - Random

The GSP-1720 operates as specified after exposure to the random vibration spectrum defined in Figure 8-5.

Operational - Sinusoidal

The GSP-1720 operates as specified after exposure to the swept sinusoidal vibration environment defined in Table 8-7 when E-A-R damping feet (MF-100-UC04-H, black) are used as shock mounts.

Non-Operational - Sinusoidal

The GSP-1720 operates as specified after exposure to the swept sinusoidal vibration environment defined in Table 8-7.

Figure 8-5. GSP-1720 Module Random Vibration Spectra

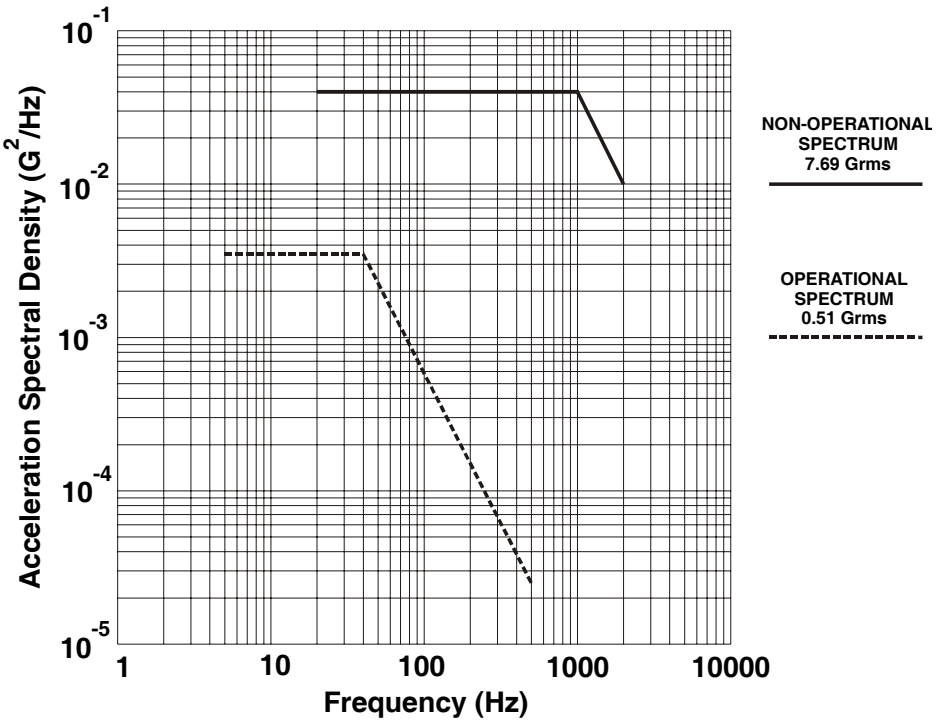


Table 8-7. Swept Sine Vibration Definition

	Double Amplitude Displacement (inch)	Acceleration (Gs)	Frequency Range (Hz)
Operational	0.28		2 to 6
		0.5	6 to 500*
Non-Operational	0.59		2 to 8
		2.04	8 to 200
		4.08	200 to 500

* E-A-R damping feet (MF-100-UC04-H, black) used as shock mounts

Mechanical Shock

Operational

The GSP-1720 operates as specified while being subjected to a half sine pulsed acceleration wave form of 11 milliseconds in duration, 2 Gs peak.

Non-Operational

The GSP-1720 operates as specified after being subjected to a half sine pulsed acceleration wave form of 6 milliseconds in duration, 30 Gs peak.

Acoustic Noise

The GSP-1720 is sensitive to very high ambient noise levels. Exceeding specified levels will cause degraded performance. Steps must be taken to ensure that the noise level at the module does not exceed 110 dB OSPL (Overall Sound Pressure Level).

22-Pin and USB Connector Durability

Applied Forces

The 22-pin data connector meets all performance requirements after application of a 25 newton force on the mating connector, applied in six directions—two opposite directions along each of three mutually perpendicular axes.

The USB connector meets all performance requirements after application of a 15 newton force on the mating connector, applied in six directions—two opposite directions along each of three mutually perpendicular axes.

Strain relieving of all cables is advised to minimize load placed upon connectors.

Mating cycles

The 22-pin data and USB connectors meet all performance requirements after a minimum of 3,000 connect/disconnect cycles.

RF Connector Durability

The GSP-1720 RF connectors meet all performance requirements after 500 connect/disconnect cycles at a maximum rate of 12 cycles per minute.

Materials

The GSP-1720 is manufactured of non-nutrient materials with respect to fungal growth.

Shipping

The GSP-1720 as packaged for shipment meets the pre-shipment test procedures specified in the National Safe Transit Association, Project 1A.

Antenna Environments

Since the GSP-1720 antenna communicates with Globalstar satellites, it must be positioned outdoors where it has a clear view of the sky.

As a result, environments affecting the antenna include temperature/humidity, thermal radiation, icing/freezing rain/snow, altitude, vibration, and mechanical shock. This section also discusses RF connector durability, materials, and shipping.

Temperature/Humidity

Operational

The antenna operates as specified during exposure to the operational temperature/humidity envelope shown in Figure 8-6.

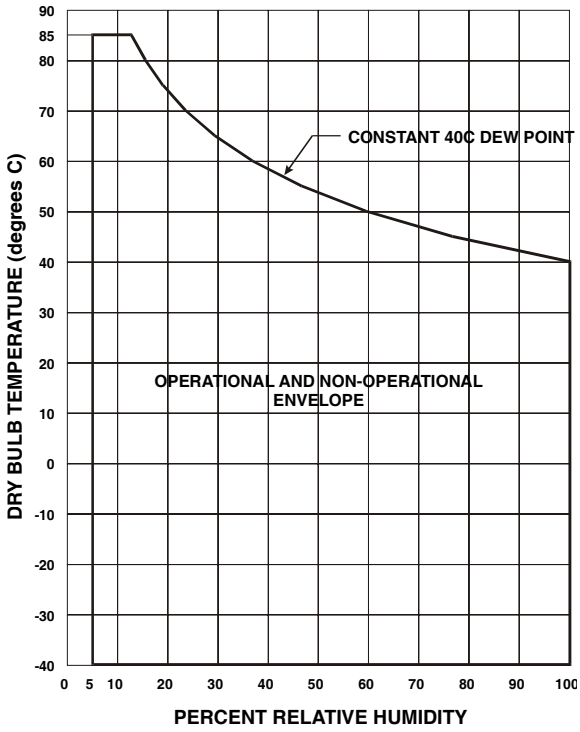
Non-Operational

The antenna operates as specified after exposure to the operational and non-operational temperature/humidity envelopes shown in Figure 8-6.

Thermal Radiation

The temperature profile shown in Figure 8-6 includes temperature rise due to thermal radiation, solar radiation, and other heat loads.

Figure 8-6. Anetnna Temperature/Humidity Envelope



Icing/Freezing Rain/Snow

Any ice or freezing rain on the radome of the ODU will cause degraded performance. Steps must be taken to ensure that ice formation is kept to a minimum on the ODU.

Globalstar frequencies are attenuated by wet ice and snow and integrators must make provisions (such as installing the antenna on a pole) to prevent snow buildup on the antenna. Wet ice/snow must be restricted to a maximum thickness of 20 centimeters (8 inches) by suitably mounting the antenna (see *Mounting Antennas at the Field Site* on page 8-17).

Altitude

Operational

The antenna operates at standard atmospheric pressure altitudes between 0 and 15,000 meters (50,000 feet).

Non-Operational

The antenna operates as specified after storage at pressure altitudes ranging from 0 to 15,000 meters (50,000 feet).

Vibration

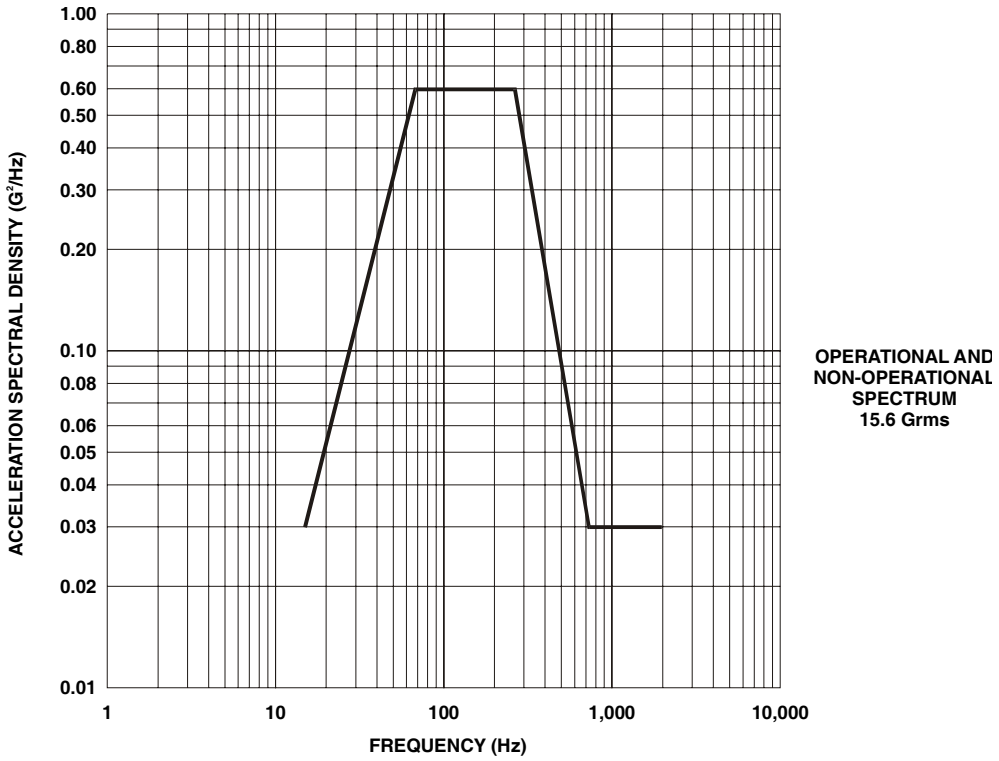
Operational - Random

The antenna operates as specified during exposure to the random vibration spectrum defined in Figure 8-6.

Non-Operational - Random

The antenna operates as specified after exposure to the random vibration spectrum defined in Figure 8-7.

Figure 8-7. Antenna Random Vibration Spectrum



Mechanical Shock

Operational

The antenna operates as specified while being subjected to a half sine pulsed acceleration waveform of 6 milliseconds in duration, 30 Gs peak.

Non-Operational

The antenna operates as specified after being subjected to a half sine pulsed acceleration waveform of 6 milliseconds in duration, 100 Gs peak.

RF Connector Durability

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

Materials

The antenna is manufactured of non-nutrient materials with respect to fungal growth.

Shipping

The antenna as packaged for shipment meets the pre-shipment test procedures specified in the National Safe Transit Association, Project 1A.