



OGi Modem

User Manual

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Preface


Purpose

This document provides an overview of the hardware characteristics and specifications for the OGi modem.

Notation

An OEM Integrator is an ORBCOMM customer who purchases an OGi modem for integration into their own enclosure. To become an OEM Integrator certain commercial criteria must be met. Contact your Account Executive for further details.

Hardware components and hardware labels in this document might not be exactly as shown and are subject to change without notice.

CAUTION  *This safety symbol warns of possible hazards to personnel, equipment, or both. It includes hazards that will or can cause personal injury, property damage, or death if the hazard is not avoided.*

Note: *A note indicates information with no potential hazard. A note indicates points of interest or provides supplementary information about a feature or task.*

Numbered lists indicate a series of steps required to complete a task or function.

Bulleted lists highlight information where order or sequence is not crucial.

Reference

The content of the following documents might be useful in conjunction with this guide. These documents are available from the downloads section at support.skywave.com or from the OG Toolkit, which is also available from the website.

[T402] OG Interface Developer Guide

[T403] AT Interface Developer Guide

Safety Disclaimer

ORBCOMM makes no warranties, representations or guarantees that the products and network services are suitable for any use in any hazardous environments requiring fail

safe performance (including without limitation marine safety and distress systems, operation of nuclear facilities, aircraft navigation or communications systems, weapons systems, air traffic control and life support services) or any other application in which the failure of the products or network services could result in death or personal injury.

Purchasers assume all liability associated with selling any products and network services for any such applications, and the Purchaser will defend, indemnify, and hold ORBCOMM harmless against any claims against ORBCOMM for loss, damage, liability, or expense (including lawyers' fees) arising out of or related to the sale by Purchasers or any Reseller, or the use by any end user, of any product or network service.

Please read all cautions and warnings throughout this document.

Environmental Protection

The Purchaser's enclosure must provide environmental protection for the OG ISAT modem.

Safety Precautions

The terminal must comply with all safety precautions relating to the operation, usage, service and repair of the terminal. ORBCOMM assumes no liability for the customer's failure to comply with any of these precautions.

Caution warnings appear throughout this document.

Limited Liability

ORBCOMM's liability is limited to the cost of repair or replacement of any of ORBCOMM's products during the warranty period. To the maximum extent permitted by applicable law, ORBCOMM's total liability for damages of any kind, whether based on breach of contract, tort (including negligence), product liability, incidental, special, consequential, indirect or similar damages with product application and usages will be limited to an amount equal to the product's original price paid by the Purchaser to ORBCOMM and this limitation of liability is reasonable given the price of ORBCOMM's products. In no event will ORBCOMM be liable to the Purchaser, any resellers of the Purchaser or any end user for any lost profits or savings, lost business, loss of data, any telecommunications breakdown, unavailability, downtime, interruption or delay, any suspension of service by any third party service provider including Inmarsat or any incidental, special, indirect, or consequential damages, whether based on breach of contract, tort (including negligence), product liability, incidental, special, consequential, indirect or similar damages and whether or not ORBCOMM has been advised of the possibility of such occurrence or damage. The parties agree that the foregoing represents a fair allocation of risk hereunder.

Certification

The Purchasers is responsible for ensuring that the Purchaser's integrated product complies with all local electrical and safety codes. The Purchaser is also responsible for certifying all of their integrated products.

Warranty

ORBCOMM provides a manufacturer's warranty to the original purchaser (Purchaser) that its products and services will perform in accordance with ORBCOMM's specifications and will be free from defects in material and workmanship for a limited period of time. This warranty is limited to the repair and/or replacement of any defective components experienced under normal specified operating use and storage conditions, at ORBCOMM's discretion. It does not cover any damages caused or associated with the product's misuse. Please check your agreement for warranty details and conditions. The end-user's only remedy or recourse is against the Purchaser, and any experience with defective products should be communicated to the authorized distributor from whom they have been purchased. Shipping of defective product, back to the authorized distributor will be in accordance with the authorized distributor's instructions and should be accompanied with a fault report. ORBCOMM is not responsible for corrosion damage caused by inadequate enclosure or cable assembly or installation. **Warranty is void if unit is opened.**

A fault report is required for each unit returned under warranty. Please contact your authorized distributor's customer support for additional information.

1 Overview

The OGi modem is an L-Band mobile device and provides either an AT interface or an OG interface for command and control. Hardware using an AT interface operates on the IsatData Pro gateway while hardware using an OG interface operates on the ORBCOMM gateway. ORBCOMM's turn-key OEM solutions are intended for early integration into M2M applications.

An OGi modem contains a satellite transceiver and a GNSS receiver, and requires a specific passive antenna. The modem accepts commands and returns responses via a serial interface.

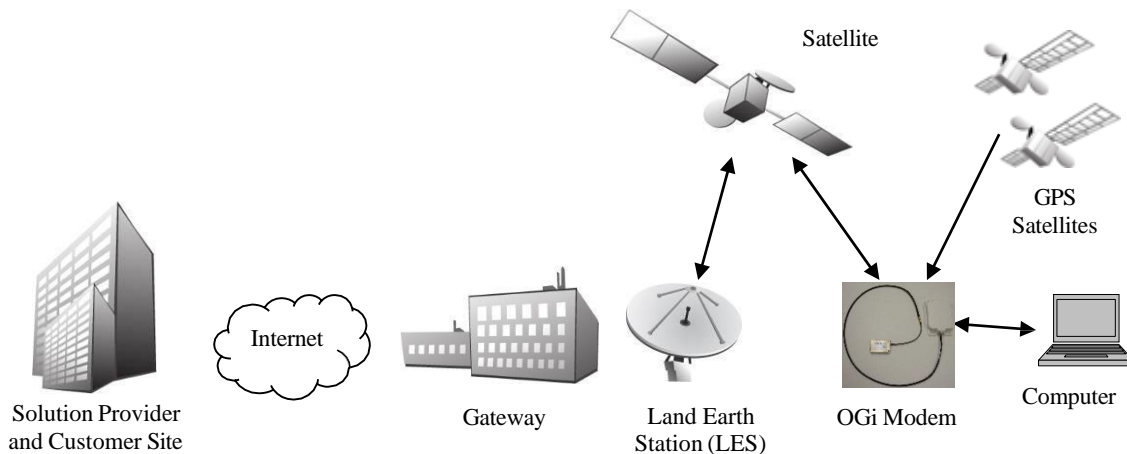
The modem is suitable for both industrial and fixed applications such as:

- Transportation and Distribution
- Fleet management and security
- Asset tracking, monitoring and control

1.1 Overview of the Messaging System

The IsatData Pro service allows OEM Integrators to offer particular applications and/or services to their clients. As shown in Figure 1, the OEM Integrator communicates with the modem through a centralized gateway. The gateway is the communications hub of the system, controlling access to the modem and routing traffic to the modem, regardless of where it is deployed in the world.

Figure 1 Messaging Gateway



Configuration and data retrieval from the modem can be easily accomplished through Internet-based application services provided by OEM Integrators or by integrating existing customer enterprise software to receive information from the Gateway.

IsatData Pro provides the following key features and benefits:

- Two-way communication
- Messaging to a host connected to the modem

- Broadcast messages
- Low latency messaging
- Up to 6,400 bytes from-mobile messages for the AT Interface; up to 6,000 bytes from-mobile messages for the OG Interface
- Up to 10,000 bytes to-mobile messages for the AT Interface; to-mobile messages for the OG Interface are truncated
- Acknowledged messages
- Global service

1.2 OGi Modem

The OGi modem provides easy integration and the highest level of EMI/EMC shielding that reduces integration risk when the modem is co-located with other electronics.

Figure 2 OGi Modem



1.3 Approved Antenna

Two passive antenna types are available: a standard patch antenna (Figure 3) and a low elevation helix antenna (Figure 3). The OEM Integrator is responsible for providing a specific RF cable to connect the antenna to the modem.

Both the standard and low elevation antennas are:

- Available with a side or bottom connector
- Sealed for operating in outdoor environments
- Provide four mounting tabs for installation
- Available with an SMA connector
- Available packaged or unpackaged

1.3.1 Antenna Specification

Approved Antenna Types:

- 1). Patch Antenna: unpacked or packed.
- 2). Helix Antenna: unpacked or packed

Note: a packed antenna is built with an unpacked antenna within a plastic enclosure.

Max Gain:

- 1). Patch antenna: 4.5dBi maximum
- 2). Helix antenna: 2.5dBi maximum.

Impedance: 50 Ohm

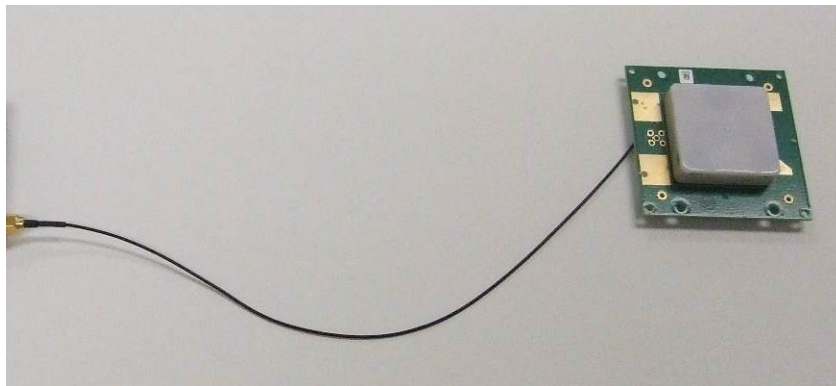
Radiation Pattern: Omni-Directional

Input Power: 2 W Max

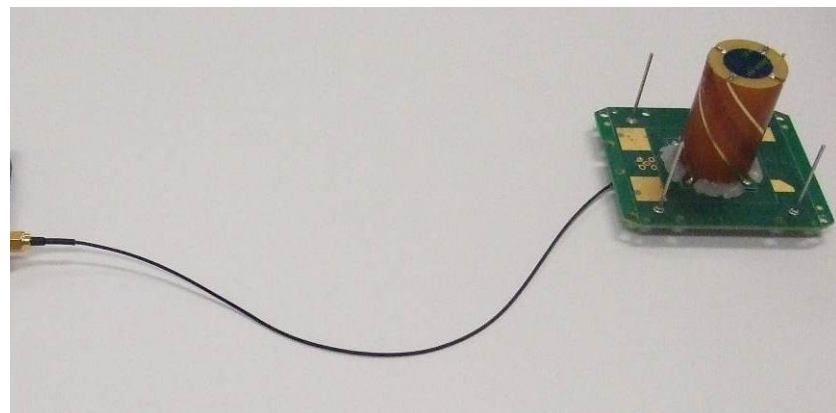
Polarization: RHCP

1.3.2 Unpacked Antenna

Unpacked patch antenna (**Figure 3**)



Unpacked Quadrifiler Helix antenna (**Figure 4**)



1.3.3 Packed Antenna

Figure 5 Packed Antennas



Figure 6 Antenna Bottom Mount (standard antenna shown)



1.4 Key Features and Benefits

The OGi modem offers the following key features and benefits:

- Designed to be incorporated into an OEM Integrator's solution
- Built-in GNSS receiver to provide position, speed and heading information
- Broad operational temperature range
- IsatData Pro message payload and latency capabilities

1.5 Operating Modes

1.5.1 Satellite Modem

For the most part, the modem operates independently from the host application. The modem operating modes are described in Table 1.

Table 1 Satellite Modem Operating Modes

Operating Mode	Description
Transmit Mode	In transmit mode the modem is transmitting a signal to the gateway.
Receive Mode	In receive mode the modem is attempting or actively listening to the satellite (listening on the bulletin board channel or on a traffic channel).

1.5.2 GNSS Receiver

The GNSS receiver is a module peripheral that is either on or off.

2 Compliance

At this time, all certifications listed in this section are pending for the OGi modems.

Once approved, these certifications and test results will be available to OEM Integrators for use as a baseline for the certification approval of their enclosure.

However, the OEM Integrator is responsible for ensuring that their final enclosure complies with all local regulatory requirements, and electrical and safety codes wherever the enclosures are sold or used. As the OEM Integrator's enclosure contains the OEM Integrator's power supply and possibly other circuitry that affects the modem, the OEM Integrator most likely needs to perform additional testing or repeat some of the tests listed below.

Inmarsat Type Approval

ISED Canada

- RSS-170, Issue 3

FCC

- CFR Title 47: Telecommunication, Part 25 - Satellite Communications

CE Mark

- EN 301 426

RoHS

- Restriction of Hazardous Substances (RoHS)

ISED non-interference disclaimer

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference.
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

- (1) L'appareil ne doit pas produire de brouillage;
- (2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RSS-Gen Transmit antenna statement

This radio transmitter [11881A-OGI200] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio [11881A-OGI200] a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

Under Innovation, Science and Economic Development regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by ISED. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Approved Antenna Types:

- Max Gain: Patch Antenna 4.5 dBi, & Quadrifilar Helix Antenna 2.5 dBi
- Impedance: 50 Ohm
- Radiation Pattern: Omni-Directional
- Input Power 2 W

RF Exposure statement

This equipment complies with ISED RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm (7.6 inches) between the radiator and any part of your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Pour se conformer aux exigences de conformité ISED RSS-102 RF exposition, une distance de séparation d'au moins 20 cm doit être maintenue entre l'antenne de cet appareil et toutes les personnes. Lanceurs ou ne peuvent pas coexister cette antenne ou capteurs avec d'autres.

FCC Compliance Statement

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 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.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation. Please note that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

RF Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, this equipment should be installed and operated with minimum distance 20 cm (7.8 inches) between the antenna and your body during normal operation. Users must follow the specific operating instructions for satisfying RF exposure compliance.

3 Specifications

3.1 Connector

The table below describes the mating connector.

Parameter	Value
Connector	Mini PCI express,

3.1.1 Pin Descriptions

Table 2 contains the modem pin assignments.

Table 2 Modem Electrical Pin Assignment

Pin	Name	I/O	Voltage	Description
1	Reserved	-	-	Do not connect
2	MAIN_POWER	I	5.0 – 15.0 VDC	-
3	Reserved	-	-	Do not connect
4	GND	-	-	Ground
5	MASTER_RX	I	-	3.3 V logic levels
6	Reserved	-	-	Do not connect
7	MASTER_TX	O	-	3.3 V logic levels
8	Reserved	-	-	Do not connect
9	GND	-	-	Ground
10	Reserved	-	-	Do not connect
11	DEBUG_RX	I	-	3.3 V logic levels
12	Reserved	-	-	Do not connect
13	DEBUG_TX	O	-	3.3 V logic levels
14	Reserved	-	-	Do not connect
15	MASTER_RESET	I	-	High impedance, active low internal 10 kΩ pull-up, pull- down with field effect transistor.
16	Reserved	-	-	Do not connect
17	Reserved	-	-	Do not connect
18	GND	-	-	Ground
19, 20	Reserved	-	-	Do not connect
21	GND	-	-	Ground
22, 23	Reserved	-	-	Do not connect
24	MAIN_POWER	I	5.0 – 15.0 VDC	Input voltage
25	Reserved	-	-	Do not connect
26	GND	-	-	Ground

Pin	Name	I/O	Voltage	Description
27	GND	-	-	Ground
28	Reserved	-	-	Do not connect
29	GND	-	-	Ground
30	1PPS	O	3.3 V logic level	Output
31...33	Reserved	-	-	Do not connect
34	GND	-	-	Ground
35	GND	-	-	Ground
36...39	Reserved	-	-	Do not connect
40	GND	-	-	Ground
41...49	Reserved	-	-	Do not connect
50	GND	-	-	Ground
51	Reserved	-	-	Do not connect
52	MAIN_POWER	I	5.0 – 15.0 VDC	Input voltage

3.2 RF Connector

Parameter	Value
Modem RF Connector	MMCX, female (jack) connector
Unpackaged Antenna RF Connector	IPEX (U.FI) SMT receptacle

Parameter	Value
Packed/Remote Antenna RF Connector	SMA female

3.3 RF Connection Specifications

The table below lists the specification for the RF present on the RF connector.

Parameter	Minimum	Typical	Maximum	Units
RF Output	30.5	31.5	32.5	dBm

3.4 Power

The modem has various power pins as shown in Table 2. Power input must always be present on all power pins.

Parameter	Minimum	Maximum	Units
MAIN_POWER	5	15	VDC

3.4.1 Typical Power Consumption

When the modem is on, its default and steady state is satellite communications receive current, unless it is transmitting or acquiring a GPS fix.

Table 3 shows power averages, at room temperature (22°C), taken from startup to registration, for three MAIN_POWER voltage.

Table 3 Typical Power Consumption (current)

Parameter	I (mA) max.
GPS Fix	150 mA
Satellite communications receive	200 mA
Satellite transmit	2000 mA

3.5 Serial Interface

The serial defaults to the following settings: 9600 bit/s (8 data, no parity, 1 stop bit) with debug default of 115,200 bit/s (8 data, no parity, 1 stop bit).

The master and debug ports are configurable. Voltages for these ports are 3.3 VDC CMOS logic levels.

3.6 Frequency

The table below lists the modem's operating frequencies.

Parameter	Value
Receive frequency band (to-mobile)	Subband 1: 1525 to 1559 MHz, channel bandwidth 5 kHz Subband 2*: 1518 to 1525 MHz, channel bandwidth 5 kHz
Transmit frequency band (from-mobile)	Subband 1: 1626.5 to 1660.5 MHz, channel bandwidth 2 kHz Subband 2*: 1668 to 1675 MHz, channel bandwidth 2 kHz
GNSS Band	GPS L1; GLONASS L1; BeiDou B1

- Note, Subband 2 is for non-America region

3.7 Multi-GNSS

Table 4 Multi-GNSS Typical Specifications

Parameter	Typical value
Time to First Fix²	
Cold Start	30 s
Hot Start	1 s
Sensitivity	
Tracking	-163 dBm
Hot Start	-156 dBm
Cold Start	-147 dBm
Accuracy	
Horizontal Position (CEP) ³	2.5/2.0 m

3.8 Mechanical Properties

3.8.1 OGi Modem

Parameter	Value
Mass	20 g

3.8.2 Packaged Antenna – Standard

Parameter	Value
Mass (excludes cable, side entry version)	360 g

3.8.3 Packaged Antenna – Low Elevation

Parameter	Value
Mass (excludes cable, side entry version)	370 g

3.8.4 Unpackaged Antenna – Standard

Parameter	Value
Mass	90 g

3.8.5 Unpackaged Antenna – Low Elevation

Parameter	Value
Mass	70 g

3.9 Physical Dimensions

All dimensions are shown in millimeters (mm).

3.9.1 OGi Modem

Figure 7 Top View Dimensions (mm)

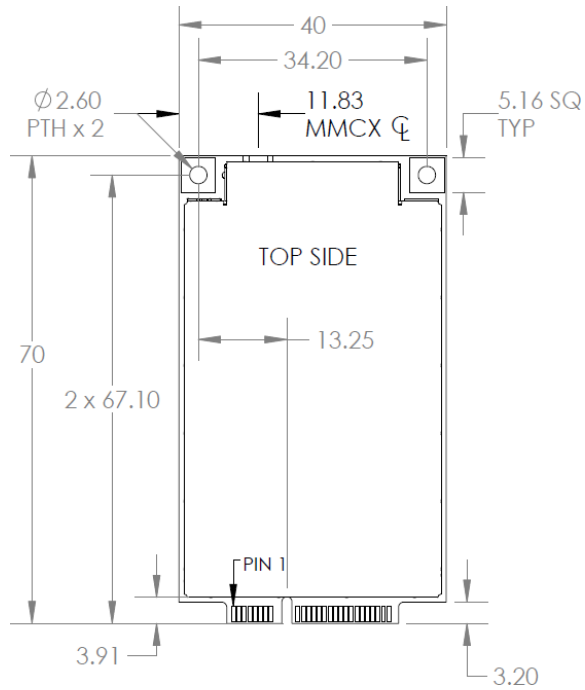


Figure 8 Side Views (mm)



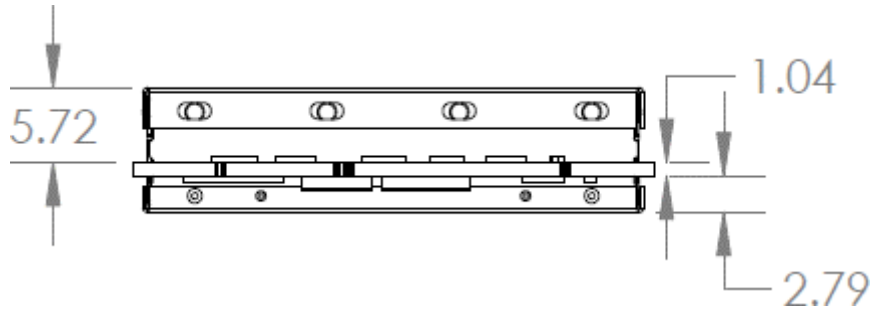
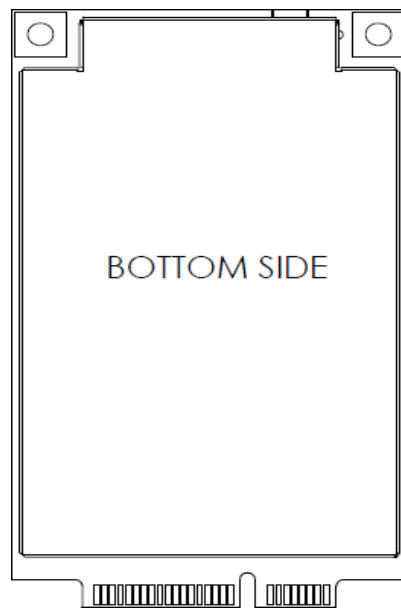


Figure 9 Bottom View



3.9.2 Packaged Antenna - Standard

Figure 10 Packaged Antenna (Standard and Low Elevation) - Bottom View

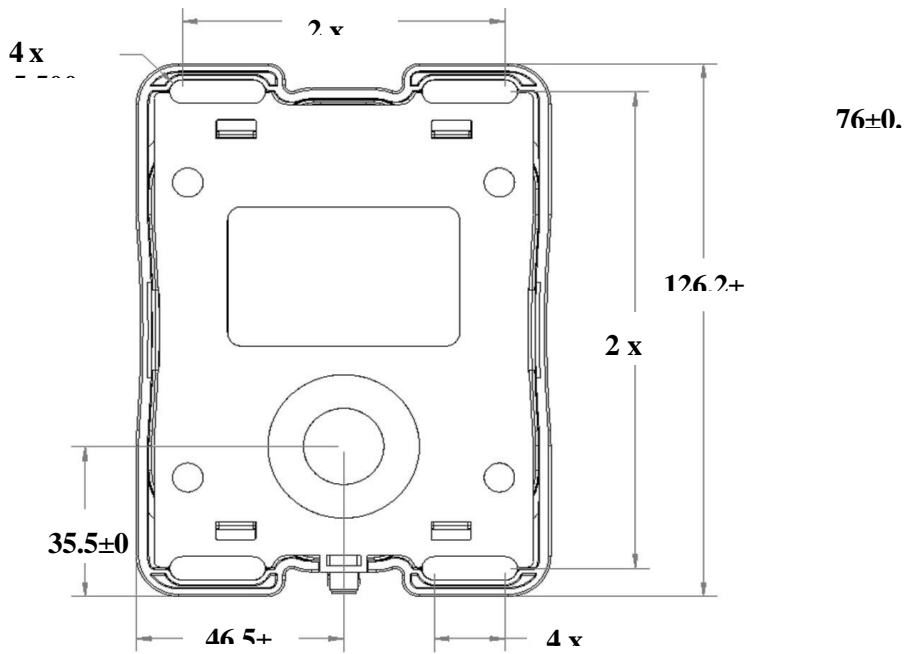


Figure 11 Packaged Standard Antenna Height Dimensions (mm)

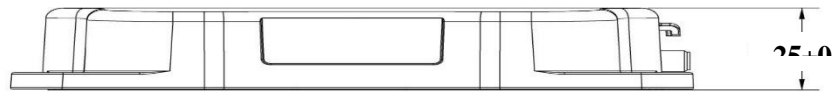


Figure 12 Packaged Low Elevation Antenna Height Dimensions (mm)

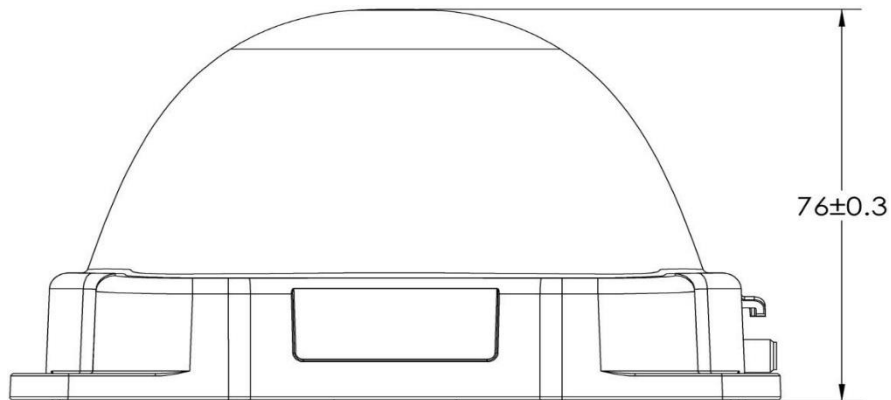
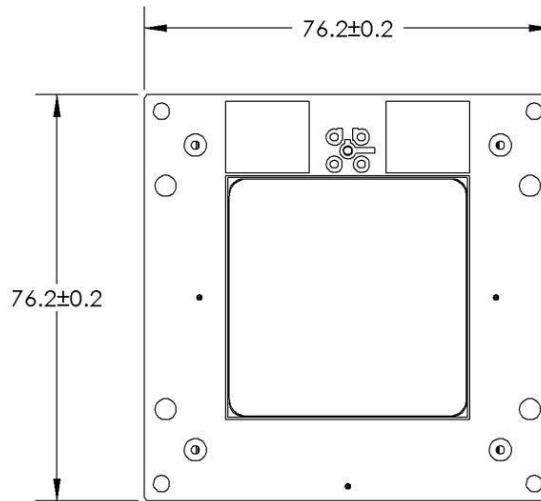


Figure 13 Standard Unpackaged Antenna – Top View (mm)



3.10 Environmental⁴

Temperature

Parameter	Value
Operating temperature range	-40 °C to +85 °C
Storage temperature	-40 °C to +85 °C

Unpackaged Antenna

The unpackaged antenna met the following specifications when mounted to a rigid structure. Note that the rigidity and strength of the mounting structure must be considered to maintain or comply with these specifications.

Parameter	Description
Vibration	The unpackaged antenna meets all its specifications during exposure to random vehicular vibration levels per SAE J1455, section 4.9.4.2 and MIL-STD-810G, section 514.6, fig 514.6C-1.
Mechanical Shock	The unpackaged antenna meets all its specifications after exposure to positive and negative saw tooth shock pulses with peaks of 20G and durations of 11 ms as specified in MIL-STD-810G, section 516.6, Procedure I, section 2.3.2c, 3/axis/(positive and negative direction).
Altitude	The unpackaged antenna meets all of its specifications after a non-operating 12.2 km altitude test as detailed in SAE J1455, section 4.9.3, except with an ambient temperature of -40°C.
Thermal Shock	The unpackaged antenna meets all of its specifications after a thermal shock test as detailed in SAE J1455, section 4.1.3.2.

4 Integration Guidelines

This section contains a number of guidelines to assist the OEM Integrator in building their enclosure. It must be recognized that this section provides guidelines only and each OEM Integrator must use their own discretion to finish the integration approach that works for them.

4.1 Regulatory Guidelines

The OEM Integrator must recognize the importance of regulatory requirements for their integrated design. These requirements can have a major impact on the product design functioning and schedule. Further, as the regulatory requirements can be quite complex, ORBCOMM recommends that OEM Integrators always seek the advice of a regulatory expert prior to starting integration. This advice allows the OEM Integrator to properly plan and schedule design and test requirements.

When the regulatory tests are defined, it is also important to identify authorized test labs that are qualified to perform the required tests. Prior to a design, critical tests should be identified. It is recommended that the OEM Integrator pretest any high risk critical specifications early in the design stage.

4.2 Compliance

Refer to section 2 for compliance information.

4.2.1 Reference Power Supply

The internal power supply operates between 5.0 and 15.0 VDC. A full RF output requires an input voltage above the minimum operating voltage.

4.2.2 Review Process

The OGi modem integration can be challenging as the modem is a sensitive receiver that has stringent emission specifications.

To help minimize integration risk, ORBCOMM recommends that the OEM Integrator consult with ORBCOMM and review the mechanical integration prior to starting a detailed design.

4.3 EMI/EMC Guidelines

The modem and antenna form a highly sensitive receiver that can receive very weak satellite or GNSS signals. The highly sensitive receiver can also pick up noise or other interference. Components such as processors and support circuitry should be shielded with good quality shielding. It is also recommended that RF coupling/bypass capacitors be added to the power supply rail, as close as possible to the modem's power pin. Digital interface devices should be shielded, and care must be taken to ensure the digital interface cable does not run close to the antenna.

4.4 Modem Mounting Guidelines

As shown in Figure 22 the modem has a hole in each corner of the enclosure sized for M2.5 hardware to secure the modem to an application card or other environmental enclosure surface.

Figure 14 Modem Mounting Holes



4.5 Unpackaged Antenna Mounting Guidelines

As shown in Figure 17 the unpackaged antenna has a set of four holes sized for M3.5 hardware to secure the antenna to an environmental enclosure surface. A second set of holes at the corner of the card can be used for mounting with #4 hardware, but the holes are tight fitting and tolerances need to be considered, so SkyWave recommends the larger hole set for mounting.

5 Antenna Installation

The following section contains ORBCOMM's recommended installation guidelines for installing the antenna. It is recommended that the OEM Integrator include these in the installation guidelines for end users.

5.1 Antenna Mounting Guidelines

CAUTION *Mount the antenna at least 20 cm away from humans.*



5.2 Mount a Remote Antenna

Two mounting options are available for the remote packaged satellite antennas: screw mount or silicone mount. OEM Integrators, who have included an unpackaged antenna within their product, should apply any packaged antenna restrictions mentioned in this section, to the mounting of their own products.