ORBCOMM®

WHERE DATA DRIVES DECISIONS

CT 360x
Hardware Guide

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Trademark Notice

TABLE OF CONTENTS

PREFACE

Purpose

This guide is as an overview of the hardware characteristics and specifications for the CT 3600 and CT 3601 (hereafter referred to as "CT 360x").

Unless noted otherwise, all hardware features and functionality mentioned in this guide apply to both products.

Notation

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.

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

Battery Safety Warnings

CAUTION: DO NOT short circuit or expose the battery to temperatures above the maximum rated temperature.

CAUTION: Always follow local disposal guidelines to properly dispose of the Lithium-ion battery and the device.

CAUTION: Store in a cool, well-ventilated area. Elevated temperatures will result in shortened battery life.

CAUTION: DO NOT throw the internal battery or the device into fire.

CAUTION: DO NOT replace the battery. Changing the battery without ORBCOMM's permission could violate regulatory conformity.

CAUTION: If Shipping the device, contact your local shipping carrier for safe shipping guidelines.

1 PRODUCT OVERVIEW

The CT 360x (model numbers CT3600 and CT3601) is a low-cost device capable of tracking, monitoring, and controlling refrigerated containers (reefers) both on land and at sea for total intermodal asset visibility. It pairs information read from the reefer controller with data from onboard sensors such as location and temperature and sends messages over cellular networks.

The CT 360x (part numbers CT3600-2100-H and CT3601-2100-H) utilizes a rugged enclosure that houses all electronics and power control. External interfaces for power, communication, and antenna are available through rugged external connectors. It is designed to be mounted inside the reefer controller cabinet with cabled antenna mounted to the cabinet exterior.

The device can be powered externally through the main connector or through the internal rechargeable battery. The batteries are charged when power is available from the external connector.

Figure 1: CT 360x

The CT 360x includes the following features and functionality:

- RS-232 Reefer Communications Port
- Motion detection accelerometer
- Advanced accelerometer for shock, rollover detection, etc.
- Tri-color LED to indicate overall health
- Internal rechargeable battery
- Global cellular module with factory installed SIM card
- GNSS with support for GPS, GLONASS, BeiDou, Galileo, and QZSS
- Connectors for direct integration with reefer controllers
- Magnet switch
- Bluetooth Low Energy (BLE)
- Temperature sensor to measure internal temperature

The CT 3601 also includes the following:

- A secondary BLE for communication to BLE vessel systems
- Different LTE bands than the CT 3600 (refer to appropriate section for details)

2 SPECIFICATIONS

2.1 Temperature

Parameter	Value
Operating temperature range	-40°C to +85°C (-40°F to +185°F) Temperatures below -20°C (-4°F) or above +60°C (140°F) result in a limited functionality.
Recommended storage temperature range	-40°C to +85°C (-40°F to +185°F) Storage for extended periods of time outside of -20°C to + 60°C (-4°F to +140°F) can result in non-recoverable battery capacity loss.

2.2 Internal Battery Temperature

Parameter	Value
Internal battery operating temperature range	-40°C to +70°C (-40°F to +185°F)
Internal battery charging temperature range	-20°C to +60°C (-4°F to +158°F)

2.3 Electrical Specifications

The main power source for the CT 360x is external power provided by the refrigerated container. While operating on external power, the input power also charges the device's internal back up battery. When external power is removed the device operates using its internal battery at a somewhat reduced feature set.

2.3.1 Input Range

The CT 360x is designed to operate on 24 VAC power commonly provided by reefer containers.

Parameter	Value
Power supply voltage (DC) range	9 V to 32 VDC (specifically designed to operate on 12 V or 24 VDC systems)
Power supply voltage (AC) range	15 V to 36 V, 50 Hz to 60 Hz
Over-voltage protection	-40 V to 200 V (but does not operate outside of the 9 to 32 V range)

2.3.2 Power Consumption

Mode	Power
Cellular transmit (pulsed)	7.2 W
Battery charge	800 mW
Cellular transmit plus battery charge	8 W

2.4 Connectors

2.4.1 Power Connector

The CT 360x use a 3-pin, right-angle, block style connector.

2.4.2 Reefer Serial Connector

The reefer serial connector is for communication with the reefer micro-controller. It is a 7-pin, block style connector.

2.4.3 RF Antenna Connector

The RF FAKRA (Bordeaux) connector interfaces with the antenna. It has a frequency range of 700 to 2700 MHz. This range is suitable for LTE and GNSS.

CAUTION: Take note of the ground position location (pin 1) and match the device accordingly. As a precaution, ORBCOMM strongly recommends you verify the ground pin signal position on the reefer's 3-pin and 7-pin harness connectors prior to connecting them to the device (the ORBCOMM name is horizontal as shown). Refer to the CT 360x Installation Guide for more details.

Figure 2: Ground Position

Signal	# of Circuits	Pin Position
VIN (24 VAC)	1	3
		2
Ground	1	1

Signal	# of Circuits	Pin Position
		7
Reefer RS-232 Tx	1	6
Reefer RS-232 Rx	1	5
		4
24 VAC	1	3
RMM Ground	1	2
Ground	1	1

2.5 Serial Interface

2.5.1 RS-232

The device includes a standard 2-wire RS-232 serial interface, with no flow control, for communication with the reefer container microcontroller.

Parameter	Min.	Typical	Max.	Units
Rx input lower threshold for DTE connected	-	-	-2.7	V
Rx input upper threshold for DTE connected	2.7	-	-	V
Rx input threshold for DTE disconnected	-0.3	-	0.3	V

Parameter	Min.	Typical	Max.	Units
Serial Rx input low threshold	0.6	-	-	V
Serial Rx input high threshold	-	-	2.4	V
Serial Tx low output (3 kΩ load)	-	5.4	-	V
Serial Tx high output (3 kΩ load)	-	5.4	-	V
Over-voltage protection	-50	-	50	V

2.6 Battery

2.6.1 Battery Voltage Measurement

The device can measure the input voltage over the range 2.5 V to 4.2 V.

2.6.2 Internal Battery

The device includes a long life, rechargable internal battery capable of operating the device when reefer power is disconnected. The battery is charged when external power is available. When external power is removed, the device automatically switches to battery power, and goes back to operating on external power when external power is restored.

The electrical specifications for the battery are below.

Parameter	Min.	Typical	Max.	Units
Capacity	2800	-	-	mAh
Voltage (nominal)	-	3.6	-	V
Current output	2	-	-	A
Discharge temperature	-40 / -40	-	85 / 185	°C / °F
Charge temperature	-20 / -4	-	60 / 140	°C / °F
Charge current (limited to 0°C to 60°C/32°F to 140°F)	360	400	440	mA

2.6.3 Battery Life Expectancy

During normal operation, the device is expected to last 6 months while reporting twice per day on a single charge.

2.7 RF Specs

2.7.1 External Antenna

The antenna (part number ST101651-001) is in a rugged enclosure with a bottom side RF FAKRA (Bordeaux) cable. It supports LTE and GNSS in a single RF feed.

Parameter	Value
Frequency	698 to 2690 MHz
Impedance	50 Ω
GNSS VSWR (1561MHz – 1602MHz)	Minimum 3:1

Parameter	Value
Peak gain	698 to 960 MHz: 2.8 dBi 1710 to 2170 MHz: 3.7 dBi 2300 to 2690 MHz: 1.3 dBi
IP rating (enclosure)	IP54

Antenna cable specifications:

Parameter	Value
Cable length	1.2 m / 4 ft.
IP rating	IP54

2.7.2 Integrated BLE Antenna

Parameter	Value
Frequency	2400 to 2480 MHz
Impedance	50 Ω
VSWR	≤2.2
Gain (realized gain)	3.6 dBi maximum 2400 MHz 3.7 dBi maximum 2440 MHz 3.7 dBi maximum 2480 MHz
Efficiency	88%

2.8 Cellular

2.8.1 CT 3600

The CT 3600 includes a cellular module cable of global cellular communication. The table shows the specifications.

Parameter	Value
LTE category	Cat 1
LTE bands	1, 2, 3, 4, 5, 7, 8, 12, 13, 18, 19, 20, 25, 26, 28, 38, 39, 40, 41
UMTS/HSPA+ Bands	1, 2, 4, 5, 6, 8, 19
GSM Bands	2, 3, 5, 8

2.8.2 CT 3601

The CT 3601 includes a cellular module cable of global cellular communication. The table shows the specifications.

Parameter	Value
LTE category	Cat 1
LTE bands	1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 39
UMTS/HSPA+ Bands	1, 2, 4, 5, 6, 8, 19
GSM Bands	2, 3, 5, 8

2.8.3 CT 360x

Maximum RF Output Power:

Parameter	Max RF Output Power
LTE	23 dBm ±2 dB
GSM	33 dBm ±2 dB
WCDMA	23 dBm ±2 dB

2.9 GNSS

A fully integrated GNSS solution that supports GPS, GLONASS, BeiDou, Galileo, and QZSS.

The manufacturer's specifications are shown in the table that follows.

Figure 3: Multi-GNSS Specifications

Parameter	Typical
Time to First Fix	
Cold Start	35 s
Assisted	15 s
Warn Start	28 s
Assisted	3 s
Hot Start	2 s
Sensitivity	
Tracking	-157 dBm
Hot Start	-156 dBm
Cold Start	-146 dBm
Accuracy	
Horizontal Position	<2.5 m

2.10 Sensors

2.11 Temperature Sensor

Measures an internal temperature over the range of -40 to +85°C (-40° to +185°F), with a typical accuracy of ±2°C and an accuracy of ±3°C over the full range.

2.11.1 Accelerometer

The CT 360x has two accelerometers to allow for dedicated functions that may require different settings. The first provides motion detections, and the second is for advanced functions such as shock and rollover detection.

The following table shows the specifications for both accelerometers.

Parameter	Condition	Min.	Typical	Max.	Units
Acceleration Range	software selectable	-	±2	-	g
		-	±4	-	g
		-	±8	-	g
		-	±16	-	g
Bandwidth Filtering	Selectable via digital interface	40	-	400	Hz
Sensitivity	2 g	-	256	-	LSB/g
	4 g	-	128	-	LSB/g
	8 g	-	64	-	LSB/g
	16 g	-	32	-	LSB/g

2.12 Magnet Switch

The CT 360x includes a magnetic switch, on the connector face, to allow local interaction. The switch can wake the device from shipping mode and perform other software defined actions. Refer to APPENDIX A for more details.

2.13 Primary Bluetooth Low Energy (BLE) (CT 3600 and CT 3601)

The primary BLE allows the CT 360x to communicate as a peripheral with a mobile phone or other BLE enabled host for configuration and some debug logging. Additionally, it allows the device to communicate as a host to wireless sensors.

The primary BLE includes an internal BLE antenna.

The characteristics for the primary BLE are:

Parameter	Min.	Typical	Max.	Units
Frequency	2360	-	2500	MHz
Bluetooth version compliance	-	5.3	-	-
Receive sensitivity	95	-	-	dBm
TX power	-	-	+8	dBm
BLE External Memory	The device includes 16 Mbit of nonvolatile onboard flash storage. The flash is capable of 1000,000 write cycles.			

2.13.1 BLE External Memory

The CT 360x includes 16 Mbit of nonvolatile onboard flash storage for data for use with the BLE subsystem. The flash is capable of 100,000 write-erase cycles over its operating life.

2.14 Secondary Bluetooth Low Energy (BLE) (CT 3601 only)

The secondary BLE allows the CT 3601 to communicate with other devices using the external antenna. This allows the broadcasting of reefer information to external mobile devices.

The secondary BLE uses the external Cell/GNSS antenna.

The characteristics for the secondary BLE are:

Parameter	Min.	Typical	Max.	Units
Frequency	2360	-	2500	MHz
Bluetooth version compliance	-	5.4	-	-
Receive sensitivity	-96	-	-	dBm
TX power	-	-	+6	dBm

2.15 NVM Storage

Parameter	Value
Nonvolatile onboard flash storage	128 MB
Write-erase cycles (per operating life)	100,000

2.16 LED

The CT 360x has a single tri-color LED. The LED indicates general device health indicator during initial power on and is dark (OFF) otherwise.

2.17 Mechanical Details

Parameter	Value
Weight CT 3600 CT 3601	 175 g (6 oz) 180 g (6 oz)
Bracket (only) weight	105 g (4 oz)
CT 360x enclosure	Rugged, impact, and chemical resistant plastic material

Units are shown in [millimeters] and inches.

Figure 4: CT 360x Dimensions

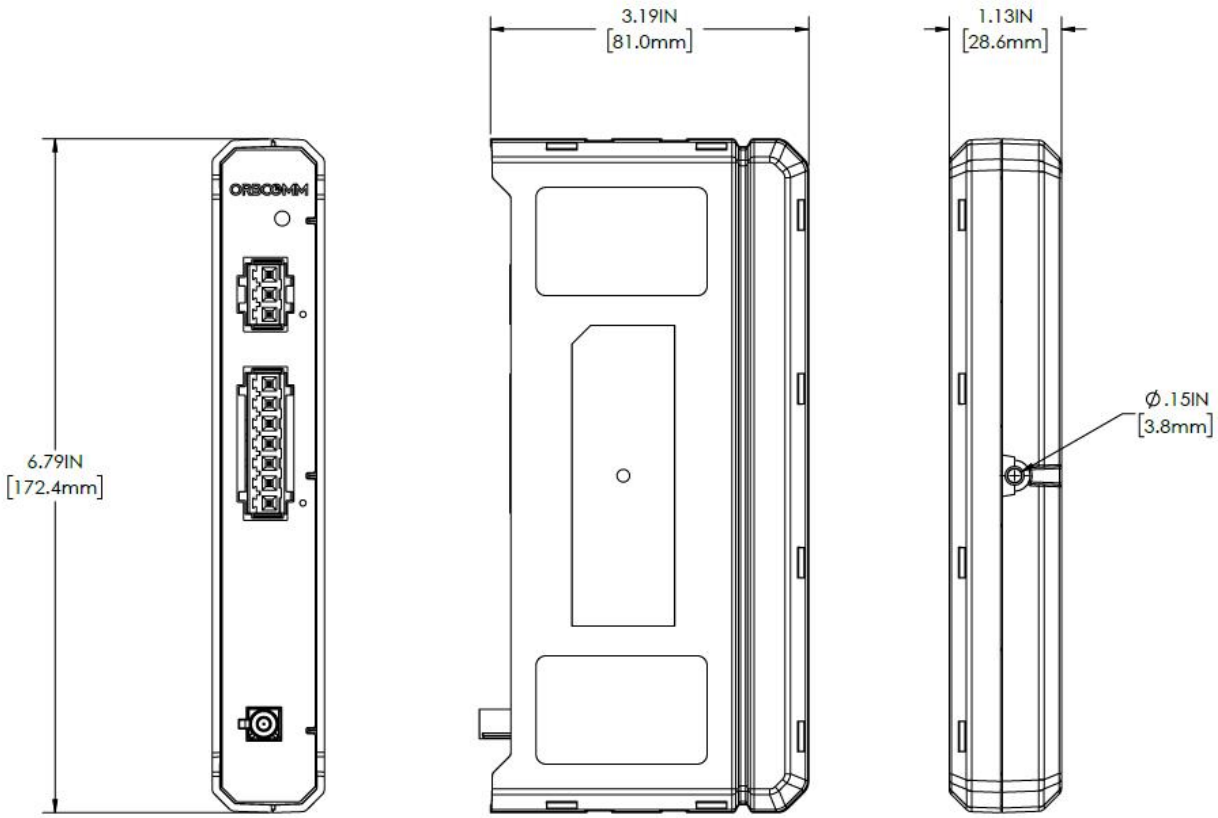
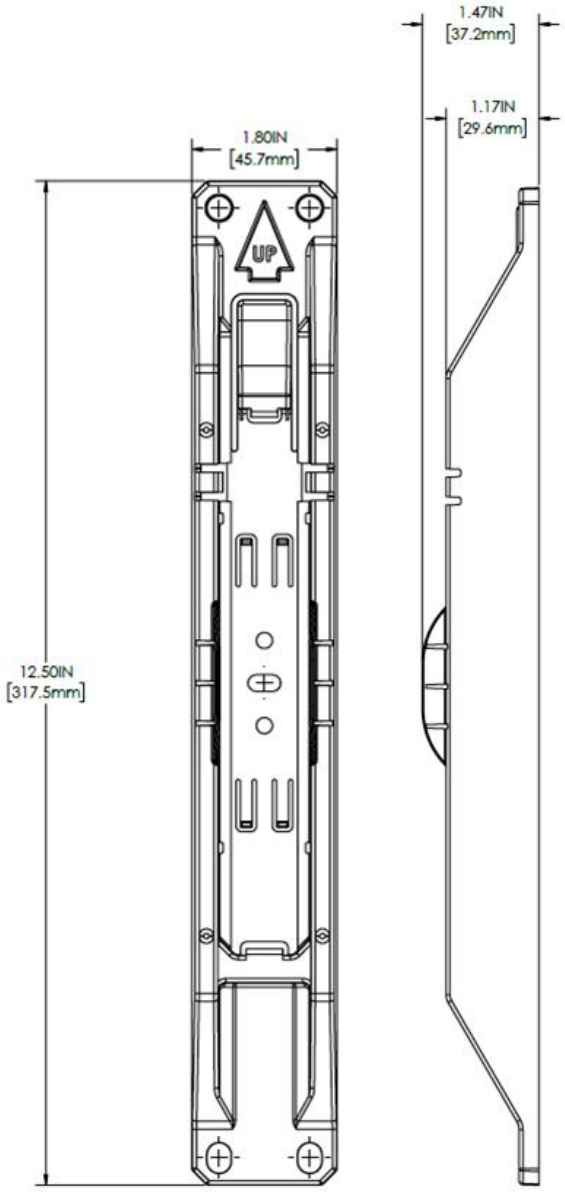
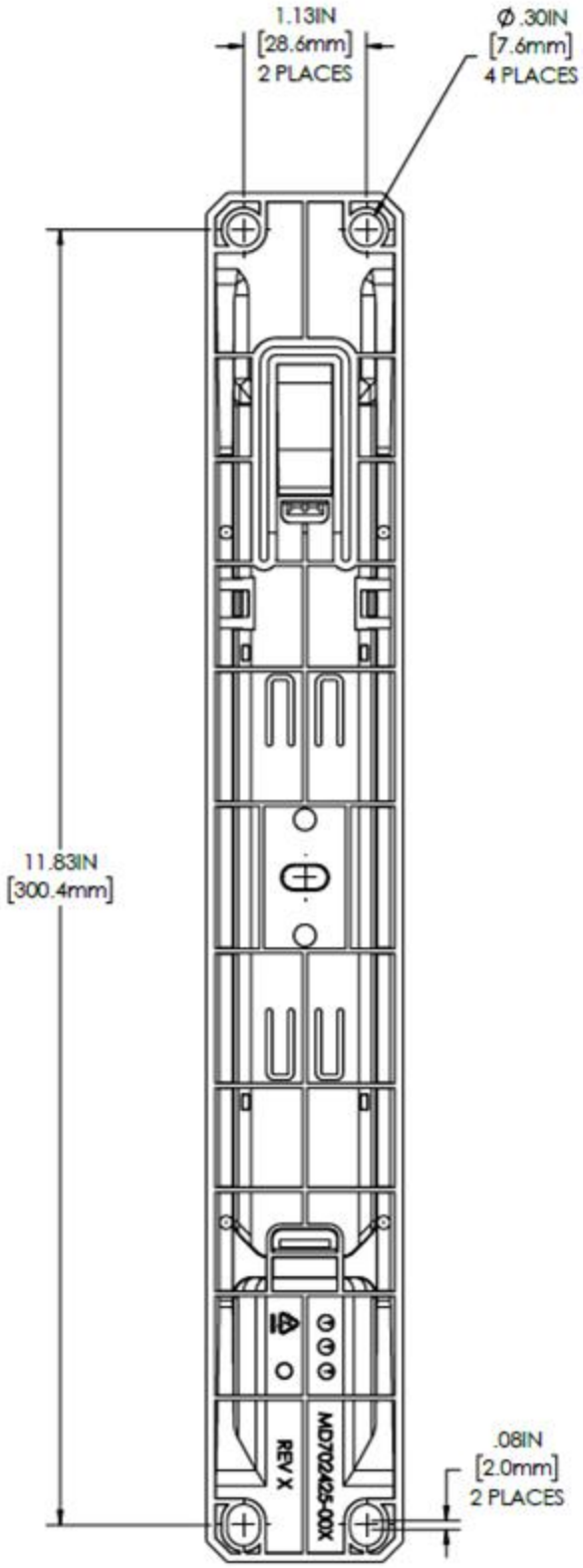


Figure 5: Locking Bracket Dimensions

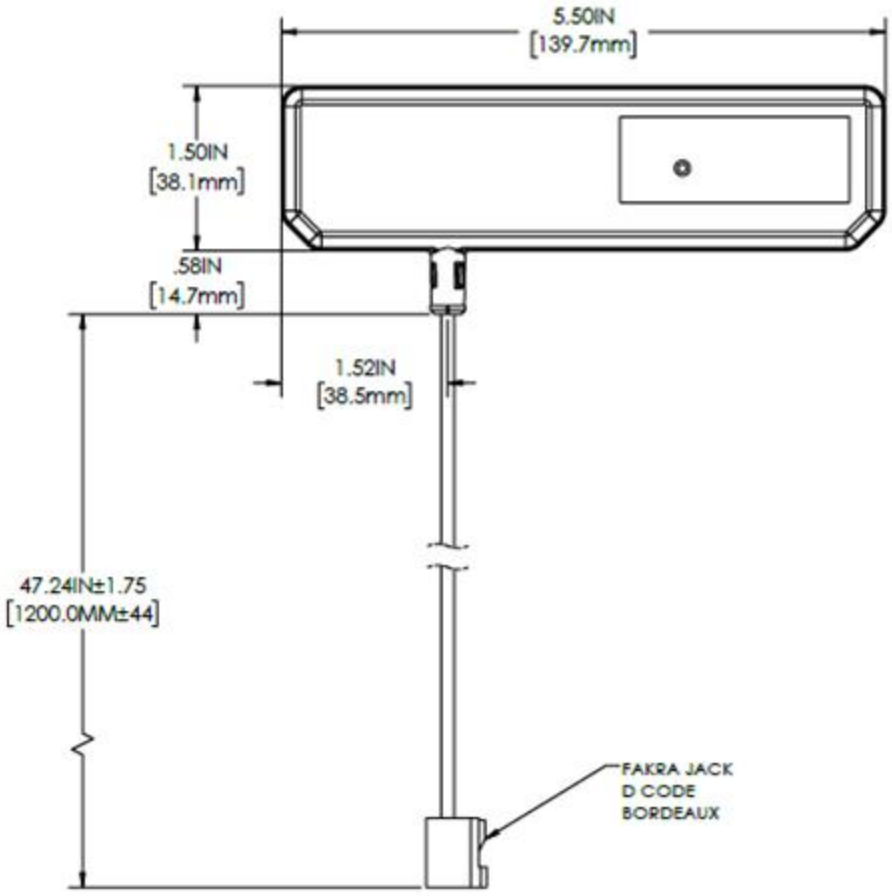


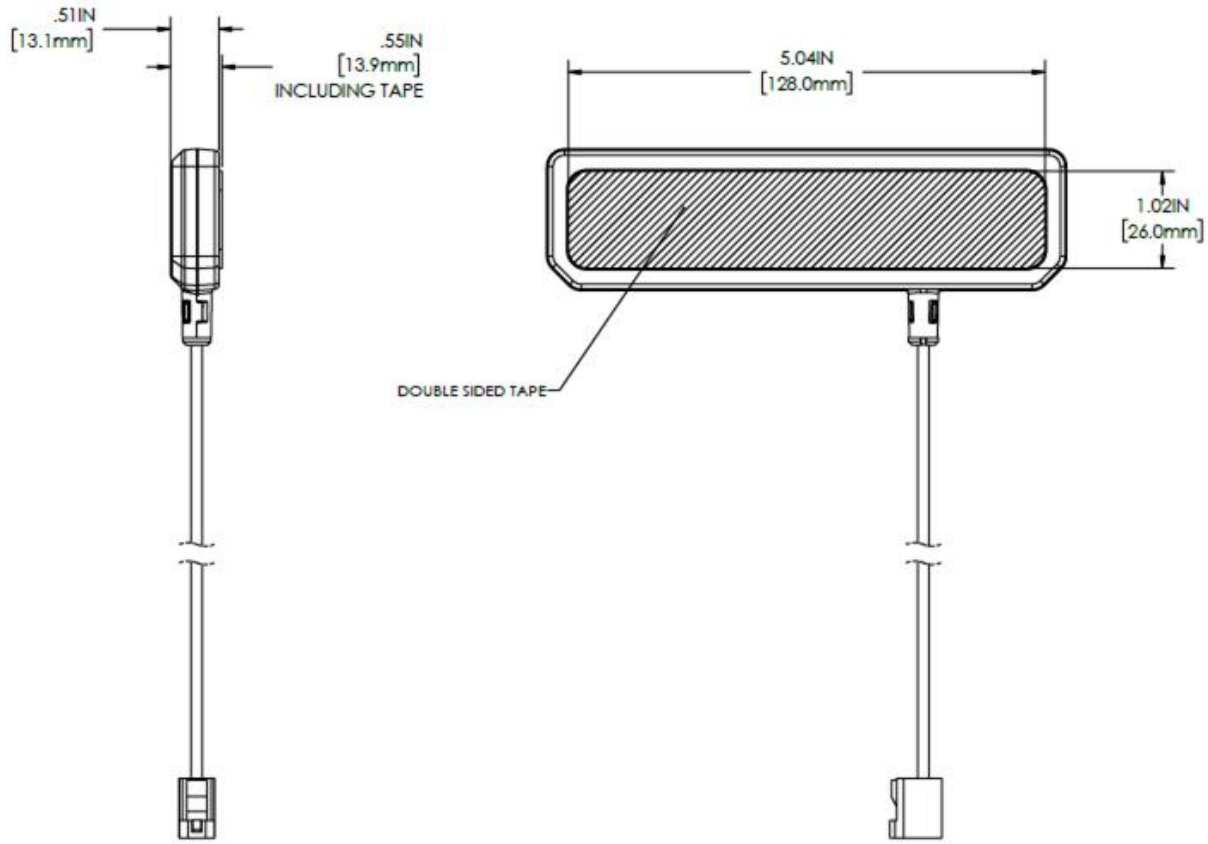


External Antenna

Parameter	Value
Antenna weight	70 g (2.5 oz)
Antenna enclosure rating	IP54.

Figure 6: External Antenna Dimensions





2.18 Environmental

Parameter	Description
Vibration	The device meets all its specifications during exposure to random vehicular vibration levels per AAR-S-9401, section 3.2.4.2.
Humidity	The device meets all its specifications during exposure to 90% relative humidity at +85°C (185°F), per the test methodology of SAE J1455, section 4.2.3 (8-hour humidity cycle per figure 4a)
Mechanical Shock	The device meets all its specifications after exposure to positive and negative saw tooth shock pulses with peaks of 40 G and durations of 11 ms as specified in MIL-STD-810H, section 516.8, Procedure I, section 2.3.1.
Thermal Shock	The device meets all of its specifications after a thermal shock test as detailed in SAE J1455, section 4.1.3.2
Handling Drop	The device meets all its specifications after a handling drop test as specified in SAE J1455, section 4.11.3.1.
Ingress - Solid Foreign Objects	The enclosure provides protection against ingress of solid foreign objects of IP5X as specified in IEC-60529, section 13.5, Category 2.
Ingress - Water	The enclosure provides protection against ingress of water of IPX4 as specified in IEC-60529, section 14.2.4. The CT 3600 and antenna PCAs are conformally coated to provide additional protection against water.
Salt Spray Atmosphere	The device meets all of its specifications after a salt spray test as detailed in SAE J1455, section 4.3.3.1.
Exposure to Chemicals and Oils	The device meets all of its specifications after a light to moderate splash test as detailed in SAE J1455 section 4.4.3.2, for the following chemicals: Window Washer Solvent Gasoline Diesel Fuel Fuel Additives Alcohol Antifreeze Water Mixture Degreasers Soap and Detergents Steam Waxes Kerosene Freon Spray Paint Paint Strippers Ether Dust Control Agents (magnesium chloride) Moisture Control Agents (calcium chloride) Ammonia Aluminum brightener (acid wash)
ESD	The device meets all its specifications after exposure of the enclosure to 8 kV ESD air discharge per IEC61000--4-2, level 3.

3 COMPLIANCE

ISED (Canada)

- IC: 11881A-CT3600 (for CT 3600)
- IC: 11881A-CT3601 (for CT 3601)
- CONTAINS IC ID: 10224A-202212EG21GL
- ICES-003
- RSS-170, Issue 2, Spectrum Management and Telecommunications Policy, Radio Standard
- RSS-102, radiation safety per Safety Code 6 (compliance shown by computation)
- IC compliance statement

  This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

  Le present appareil est conforme aux CNR d'Industrie Canada applicable aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, meme si le brouillage est susceptible d'en compromettre le fonctionnement.

FCC (USA)

- FCC ID: XGS-CT3600 (for CT 3600)
- FCC ID: XGS-CT3601 (for CT 3601)
- CONTAINS FCC ID: XMR202212EG21GL
- CFR 47 Part 25
- CFR 47 Part 15
- FCC compliance statement

  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. “

CE MARK (Europe)

- RED 2014/53/EU
- EU Declaration of Conformity

  Hereby, ORBCOMM Inc. declares that the radio equipment types listed in this document comply with Directive 2014/53/EU.

  The full text of the EU declaration of conformity is available from http://www2.orbcomm.com/eudoc.

RoHS

- Restriction of Hazardous Substances (RoHS) [1]

[1] European Union's (EU) Directive 2002/95/EEC "Restriction of Hazardous Substances" (RoHS) in Electronic and Electrical Equipment.

REACH

WARNING:

- The minimum 20 cm (8 in.) separation distance from the device is required for RF exposure safety for all persons.
- Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
- 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.

Ingress Protection

- CT 360x: IP54
- Antenna: IP54

APPENDIX A MAGNET SWITCH

The CT 360x supports a magnet reset and other functions using a magnet.

To enable the magnet switch options:

1. Place the magnet to the right of the LED, near the ORBCOMM logo, for the time indicated in the Time Asserted column.

2. Hold the magnet over this location for at least the duration indicated in the Hold Time column for the desired action and then remove it.

Action	Hold Time	Description
Generate Message	3 to 7 seconds	The device generates a *Wake Up Button* message. If the device requires a new GPS fix, then it can take up to 4 minutes for the message to reach the ORBCOMM Maritime platform. This action is disabled while the device is either in shipping or inventory mode and guest mode has not been enabled. This action exists shipping mode and triggers reefer communication if the device has guest mode enabled.
Enter / Exit Shipping Mode	13 to 17 seconds	The device exits shipping and inventory modes if currently in one of those modes. The device enters shipping mode if it is not already in shipping or inventory mode.
Reset Device	23 to 27 seconds	The device performs a software reset.