

The ORBCOMM logo is displayed in white, bold, sans-serif capital letters on a red rectangular background. The 'O' and 'C' in 'ORBCOMM' contain a small white satellite icon.

ORBCOMM®

CONNECTING THE
WORLD'S ASSETS



ST 81xx

User Guide

T417-ECert, Version 1.1
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CONTACT AND LEGAL INFORMATION

Visit ORBCOMM Online

Website: www.ORBCOMM.com

Office: 395 W Passaic Street, Suite 325, Rochelle Park, NJ 07662 USA

Contact Support

Website: <https://www.orbcomm.com/en/support>

Email: customer.care@orbcomm.com OR FMSupport@orbcomm.com (Fleet Management support needs)

Phone: (North America Toll-Free) 1.800.ORBCOMM (United Kingdom Toll-Free) +44 800 538.5909
(USA/ International Toll) +1.804.404.8681 (United Kingdom Toll) +44 20 3855.6153
(Australia Toll) +61 (8) 6186 9633 (Austria, Germany, Switzerland Toll) +49 89.208045522
(New Zealand Toll) +64 (9) 884 1439 (Ireland Toll) +353 1.582.4013

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PREFACE

Purpose

This guide contains product information about the ST 8100 (Standard and Advanced variant). The information in this guide refers to both variants unless noted otherwise.

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.

Note: Figures of assets shown in this document are for reference only. Due to variations in asset makes and models, your asset may not be exactly as shown in the figures.

Cautions and Warnings

IMPORTANT

READ ALL INSTRUCTIONS CAREFULLY BEFORE INSTALLING. FAILURE TO DO SO MAY CAUSE PERSONAL INJURY OR DAMAGE TO PRODUCT AND/OR PROPERTY.

- Review the product package and contents prior to beginning the installation. Take care when opening the packaging and removing items. If a return is needed, you will want to return the product in its original packaging if possible.
- This instruction guide is provided as a GENERAL installation guide; some assets vary dimensionally and may require additional steps.
- ORBCOMM has a policy of continuous development and improvements. Therefore, products, guides, and technical information are subject to change without prior notice.
- The manufacturer and/ or distributors do not accept responsibility for third-party charges, labor, and/ or third-party replacement modifications that are not ORBCOMM approved. Some modifications may void the factory warranty.
- ORBCOMM does not accept any responsibility for installations performed by installers/ third parties not approved and / or authorized by ORBCOMM. Some installations may void the factory warranty.
- Exercise due diligence when installing this product. ORBCOMM does not accept any responsibility for asset damage or personal injury resulting from the installation of this product. Careless installation and operation can result in serious injury or equipment damage.
- All liability for installation and use rests with the owner/ operator.
- Always make sure you have a clean, dry, and well-lit work area.
- Always ensure products are secure during disassembly and installation.
- Always take steps to protect yourself when drilling, cutting, and grinding because this may create flying particles that can cause injury.
- Thoroughly inspect the area to be drilled, on both sides of material, prior to modification, and relocate any objects that may become damaged.
- Always route electrical cables carefully. Avoid moving parts, parts that may become hot and rough, or sharp edges.
- Make sure to fully understand the product, its intended use, and operation prior to use.

CAUTION: While ORBCOMM provides mounting hardware to assist with installations, it is the responsibility of the installer to select the proper mounting hardware for the asset's surface material where an ORBCOMM device or accessory will be mounted.



Device and Battery Safety Warnings

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 replace the battery. Changing the battery without ORBCOMM's permission could violate regulatory conformity.

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

CAUTION: This device is designed to operate with an ORBCOMM specified antenna. Changing the antenna could violate regulations, therefore a recertification process may be required for the device. As such, ORBCOMM does not recommend you use a different antenna other than the ones specified in this guide. Should the customer require a different antenna, please contact ORBCOMM's Hardware Integrity & Certification group.

WEEE Statement

Disposal of this device should be handled according to all national laws and regulations.

The mark shown to the right is in compliance with Waste Electrical and Electronic Equipment Directive 2012/19/EU (WEEE). The mark indicates the requirement NOT to dispose the equipment as unsorted municipal waste but use the return and collection systems according to local law.



1 PRODUCT OVERVIEW

The ST 8100 (model number ST8100) dual-mode satellite-cellular terminal supports cost-effective IoT solutions that track and monitor mobile and fixed assets in industries such as maritime, transportation, oil and gas, agriculture, water management and more. It is ideal for applications without external power, such as tracking small vessels or monitoring fixed assets in remote locations, thanks to its solar-powered battery.

The ST 8100 has two variants

- Standard - no external connector and basic functionality (part number ST8100-0100-H)



- Advanced - a 16-pin external connector and open lid detection (part number ST8100-1100-H)

2 COMPLIANCE

FCC (United States of America) CFR47 Part 25 & Part 15

- FCC ID: XGS-ST8100
- CONTAINS FCC ID: XPYUBX20VA01
- 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.

ISED (Canada) RSS-170 & ICES-003

- IC: 11881A-ST8100
- CONTAINS IC: 8595A-UBX20VA01
- 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 présent appareil est conforme aux CNR d'Industrie 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, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RF Exposure & Non-modification Warning

RF Exposure statement This equipment complies with FCC and ISED RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 25 cm (9.8 inches) between the radiator and any part of the human body.

Cet équipement est conforme aux limites d'exposition aux radiations établies par la FCC et ISED RSS-102 pour un environnement non contrôlé. Cet équipement doit être installé et utilisé à une distance minimale de 25 cm (9,8 pouces) entre le radiateur et toute partie du corps humain.

Non-modification Warning statement Equipment changes or modifications not expressly approved by the party responsible for FCC compliance, could void the user's authority to operate the equipment and could create a hazardous condition.

CE Mark (Europe) RED 2014/53/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 <https://www2.orbcomm.com/eudoc>.

Viasat Type Approval

IEC60945

- International Standard that certifies navigation and radio communication equipment and systems for use in maritime application.

FFA

PTCRB

Class I Division 2 (CID2)

HERO

- Hazard of Electromagnetic Radiation to Ordnance

RCM

ICASA

Anatel

IFT

Country Approval

- Japan

FFA

Environmental

Parameter	Description
Humidity	The device meets all its specifications during exposure to 90% relative humidity at +85°C (185°F), per the test methodology of SAE JI 455, section 4.2.3 (8-hour humidity cycle per figure 4a).
Vibration	The device meets all its specifications during exposure to random vehicular vibration levels per SAE JI 455, section 4.10.
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-81 OH, section 516.8, Procedure I, section 2.3.2.3.1.
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 JI 455, section 4.11.3.1
Ingress Protection	Solid Foreign Objects: The enclosure provides protection against ingress of solid foreign objects of IP6X as specified in IEC-60529, section 13.5, Category 2. Water: The enclosure provides protection against ingress of water of IPX7 and IPX9k as specified in IEC-60529.
Salt Spray Atmosphere	The device meets all of its specifications after a salt spray test as detailed in SAE JI 455, section 4.3.3.1.
Fungus	The device meets all of its specifications after a fungus test as detailed in SAE J1455, section 4.6.3.
Transit Drop	The device meets all its specifications after transit drop test as specified in SAE JI 455, section 4.11.3.2.
ESD	(Enclosure) The device meets all its specifications after exposure of the enclosure to 6 kV ESD contact discharge per IEC 61000-4-2, level 3.

Parameter	Description
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 Anti-Freeze 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)

3 SPECIFICATIONS

3.1 Temperature

Parameter	Value
ST 8100 Operating Temperature Range	-40° to +10°C (-40° F to +158° F)
ST 8100 Storage Temperature Range	-40° to +85°C (-40° F to +185° F)
Internal Battery Operating Temperature Range	-35°C to +10°C (-31° F to +158° F)
Internal Battery Charging Temperature Range (Standard)	-20°C to +75°C (-4° F to +167° F)
Internal Battery Charging Temperature Range (Advanced)	-35°C to +75°C (-31° F to +167° F)

3.2 Power

The ST 87 00 is powered through the internal battery that is recharged using an integrated solar panel.

3.3 Battery

The battery is a Li-ion rechargeable battery.

3.3.1 Battery Voltage Measurement

ORBCOMM License Corp. ("the applicant") certifies that, as of the date of the filing of the application, the applicant is not identified on the Covered List as an entity producing "covered" equipment.

3.3.1 Battery Electrical

The device includes a long life, rechargeable battery capable of recharging from the integrated solar panel.

The electrical specifications for the battery are:

Parameter	Min.	Typical	Max.	Units
Capacity	1000	-	-	mAh
Voltage (nominal)	-	3.6	-	V
Current Output	2.0	-	-	A
Charge Current	1	-	200	mA

3.4 RF Specifications

The device includes two-way satellite communication to interface with both the OGx and IsatData Pro networks.

3.4.1 OGx and IsatData Pro

Parameter	loGx	IsatData Pro
Receive		
Frequency Band	1525 to 1559 MHz	1525 to 1559 MHz



Parameter	OGx	IsatData Pro
Modulation	OQPSK	OQPSK
Symbol Rate	2000, 8000, 16000 symbols / second	3000 symbols / second
Polarization	RHCP	RHCP
Transmit		
Frequency Band	1626.5 to 1660.5 MHz	1626.5 to 1660.5 MHz
Modulation	OQPSK	OQPSK
Symbol Rate	800, 1600, 3200, 6400, 12800 symbols/ second	900 symbols/ second (maximum)
Polarization	RHCP	RHCP

3.5 GNSS

The major constellations include GPS, GLONASS, Galileo, BeiDou and BeiDou B1I.

Parameter	GPS	GLONASS	BeiDou B1I	Galileo	BeiDou
Time to First Fix					
Cold Start	29 s	27 s	30 s	41 s	56 s
Hot Start	1 s	1 s	1 s	1 s	1 s
Aided Start	1 s	1 s	1 s	5s	N/A
Sensitivity					
Tracking and Navigation	-167dBm	-166 dBm	-160 dBm	-161 dBm	-163 dBm
Cold Start	-148 dBm	-147 dBm	-146 dBm	-141 dBm	-136 dBm
Hot Start	-159 dBm	-159 dBm	-159 dBm	-155 dBm	-157dBm
Accuracy					
Horizontal Position	1.5 m CEP	4.0 m CEP	2.0 m CEP	3.0 m CEP	2.0 m CEP
Velocity	0.05 <i>mis</i>				
Heading	0.3 degrees				

3.6 Satellite Antenna

Parameter	Value
Antenna Type	Patch
Frequency Band	1525 to 1660.5 MHz
Impedance	SQQ
VSWR (with matching network)	<2
Polarization	RHCP
Antenna Gain	4.2 dBi typical, 5 dBi maximum

3.7 Cellular Antenna

Parameter	Value
Frequency Range	698 to 960 / 1710 to 2690 MHz
Impedance	50 Ω
VSWR	s7.3 for 698 to 960 MHz and s2.3 for 1710 to 2690 MHz
Gain (total realized)	3.0 dBi maximum for 698 to 960 MHz 3.0 dBi maximum for 1710 to 2000 MHz 3.4 dBi maximum for 2000 to 2170 MHz 4.0 dBi maximum for 2300 to 2690 MHz
Polarization	Linear

3.8 BLE Antenna

Parameter	Value
Antenna Type	Inverted F
Frequency Range	2400 to 2.480 GHz
Impedance	50 Ω
VSWR	s1 9:1
Gain (realized gain)	3.1 dBi max
Polarization	Linear

3.9 Cellular Radio

The device is capable of global cellular communications over LTE and 2G networks.

The cellular radio specifications are:

Parameter	Minimum Specification
LTE Category	Category M1 and NB2
LTE Bands	1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28, 66, 85, and 2G 4-band
GSM Bands	GSM850/EGSM900/DCS1800/PCS1900

3.10 BLE

The characteristics for the BLE are:

Parameter	Min.	Typical	Max.	Units
Frequency	2402		2480	MHz
Bluetooth version compliance		5		
Receive sensitivity	-95			dBm
TX power			+7.2	dBm
Available RAM	256			kBytes

Parameter	Min.	Typical	Max.	Units
Available flash				MBytes
Peripherals available			4	

3.11 Memory

3.11.1 Non-Volatile Flash Storage

The device includes 128 Mbit of non-volatile on-board flash storage. The flash is capable of 100,000 write-erase cycles over its operating life. The external flash memory also has small block sizes of 4 KB or less.

3.11.2 External Memory

The device has 64 Mbit of PSRAM external memory.

3.12 LED

The device has an LED to indicate general health.

3.13 Accelerometer

The device includes an accelerometer to detect motion.

3.14 Temperature Sensor

Parameter	Value
Range	-40 to +85°C (-40 to +185°F)
Accuracy (typical)	±2°C (±3.6°F)

3.15 Magnet Switch

The device has a magnet switch to detect if the device has been removed from its mounting position.

3.16 Advanced Variant Features

3.16.1 External Connector

The advanced variant has a 16-pin connector. The connector allows various peripherals such as RS-232/RS-485, configurable I/O, high voltage analog inputs, and analog current inputs.

3.16.2 Open Cover Detect

The advanced variant includes a magnetic switch dedicated to detecting if the cover of the device has been removed.

3.16.3 Configurable I/O

The advanced variant supports two configurable I/Os:

- Digital input with weak (7 MO) pull-down
- Digital input with 30 to 50 K pull-down
- Digital input with 30 to 50 K pull-up
- Analog input with 0 to 3.3 V range
- Digital output - push-pull
- Digital output - open drain switch-to-ground
- Disabled

3.16.4 RS-232 Serial Interface

The advanced variant supports an RS-232 interface.

3.16.5 RS-485 Serial Interface

The advanced variant supports an RS-485 interface.

3.16.6 24 V Output

The advanced variant includes two optional 24 V output pins with 30 mA each of output current. The intended use for the 24 V output is to provide power to two external 4 to 20 mA sensors.

3.16.7 High Voltage Analog Input

The advanced variant includes two optional analog voltage inputs. Each input has an accurate input voltage range between 0 and 15.3 V.

3.16.8 Analog Current Input

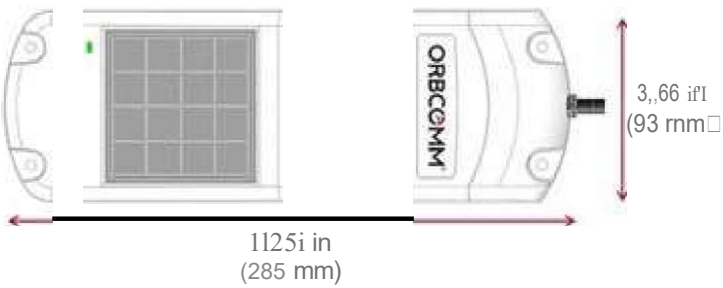
The advanced variant includes two optional analog current inputs. Each input can support 4 to 20 mA.

3.16.9 1-Wire Expansion

The advanced variant supports a 1-Wire interface for 1-Wire devices connected on a bus or to a single 1-Wire button adapter.

3.17 Mechanical

Parameter	Value
ST 8100 Weight	
Standard (no connector)	485 g (17 oz)
Advanced (with connector)	500 g (17.6 oz)



4 INSTALLATION

CAUTION: The installer is responsible for following all safety guidelines during product installation. Refer to the [Preface](#) section for details.

4.1 Wake Up the Terminal

The terminal ships in a non-transmitting mode. Prior to installation on an asset, you **must** wake up the device by exposing it to bright light.

Note: Expose the terminal to bright light at the beginning of the day to ensure it has time to wake up and transmit critical information before you install it.

1. Remove the terminal from the shipping packaging, and then wake up the device in one of two ways:
 - Bring the terminal outside during daylight, with the solar panel facing the sky, for a minimum of 5 minutes.
 - OR
 - Use another bright light source to wake up the device. Use a light meter or a mobile phone app to find a light source with a minimum 600 Lux light intensity, the higher the Lux value, the better. Position the terminal solar panel directly facing the light source for at least one minute.

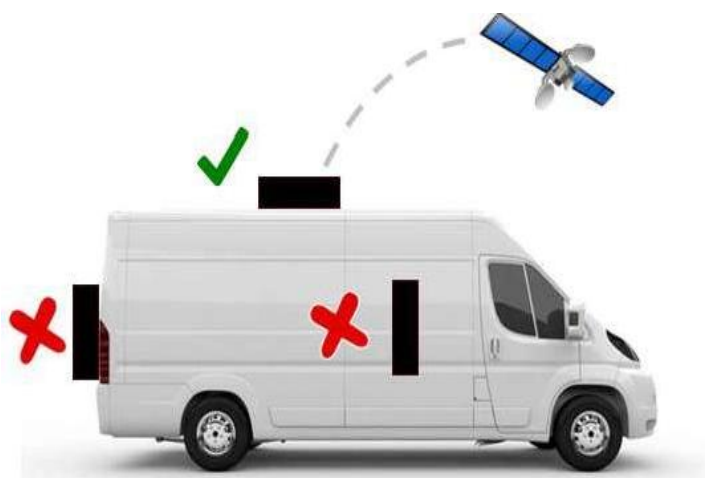
CAUTION: When using a hot light source (for example, halogen or incandescent), ensure that the solar panel does not become hot to the touch.

Note: The terminal solar panel does not charge with typical indoor office lighting.

4.2 Prepare the Mounting Surface

1. Determine the mounting location for the ST 81xx following the guidelines below:
 - Mount the device where it has a clear view of the sky/ satellite. For a mobile installation, this means that it is preferable to install at the highest point on the asset where it has a clear view of the sky in all directions.
 - Select an outdoor location where the top of the ST 81xx (the side with the solar panel) has direct exposure to sunlight and the sky.
 - Mount the device so that the device's line-of-sight with the sky is clear of obstructions.
 - Mount the device on the roof of the asset where it has a clear line of sight with the satellite.





- Mount the device on a flat horizontal surface for mobile installations such that the elevation angle does not change with rotation.
- When deployed on roads (especially trailers), check that the installation meets the maximum vehicle height permitted in the country where the device operates. Maximum vehicle height examples (subject to change and the installer's responsibility to verify these values) Europe: 4 to 6 m, United States of America: 13 ft 6 in. to 14 ft., Canada: 4.15 m, and Kenya and South Africa: 4.3 m.
- Fasten the device securely so that it is not loose and does not move easily.
- Mount the device on a solid, stable surface. If necessary, use a mounting bracket (not supplied) or other suitable support.
- Ensure that any paint above the device is non-metallic and non-metallic flake if the installation is under fiberglass or composite wind fairings.
- Mount the device on the driver's side of the vehicle, if possible, when there is a possibility of strikes by overhanging tree branches.
- Mount the device on a surface that does not get hotter than the maximum operating temperature (70°C/158°F). If the surface may get hotter, mount the device with a thermal barrier between it and the mounting surface.
- **DO NOT** mount the device on stacked assets/ containers.
- **DO NOT** mount the device close to other electrical equipment due to possible radiated and/ or conducted electromagnetic interference.
- **DO NOT** mount the device on or next to any external sources of heating or cooling.
- **DO NOT** mount the device close to radar or other communications antennas. Use the following guidelines:
 - > 1 m from VHF/UHF antenna
 - > 3 m from loop antenna
 - > 4 m from MF/HF antenna
 - > 5 m from other satellite antennas
 - Not within a radar beam
- **DO NOT** mount the device where water may build-up or collect.

- **DO NOT** mount the device close to an exhaust pipe due to the excessive heat and the potential for the exhaust pipe causing satellite blockage.
 - **DO NOT** mount the device close to air horns or any tractor roof hardware (for example, emergency lights) that could interfere with satellite communications.
 - **DO NOT** install the device inside a truck under the roof liner.
2. Mark the location of the corners of the ST 87 xx on the asset. This is recommended for accurate prepping the asset surface.

4.3 Install the ST 81xx

You can install the ST 87 xx using rivets or self-drilling screws.

4.3.1 Gather the Required Tools and Materials

Ensure you have the following for this installation:

- ST 87 xx
- Permanent mount hardware (rivet method)
 - #8 self-drilling screws or 4 mm self-drilling screws (minimum 7/2" or 72 mm length)
 - 4.8 mm x 9.5 mm to 72.7 mm grip range (3/76" diameter x 3/8" to 7/2") aluminum rivets
- 5.0 mm (0.796") drill bit
- Cordless drill and cordless rivet gun
- Tape measure
- Isopropyl alcohol or equivalent
- Clean cloth
- Sealant (self-drilling holes method)

4.3.2 Prepare the Tamper Magnet

7. Clean the asset surface with isopropyl alcohol or an equivalent product that does not leave a residue.
2. Wait for the surface to dry completely.
3. Remove the liner from the anti-tamper magnet.

CAUTION: DO NOT touch the adhesive.



4. Place the ST 87 xx onto the asset.

5. Press firmly on the top surface of the ST 81xx (7 kg (7 5 pounds) for 60 seconds) to bond the double-sided tape to the asset.
6. Hold the ST 81xx in place without allowing it to move while fastening with either rivets or self-drilling screws.

If using rivets:

- a. Install a 5.0 mm (0.196") drill bit into the drill.

Note: Only use a 5.0 mm (0.196") drill bit.

- b. (Recommended) Assemble a drill stop, 10 mm to 20 mm (3/8" to 3/4") from the end of the drill bit.

- c. Use the ST 81xx as a guide and then drill through the four (4) mounting holes with a 5 mm (0.196") drill bit.



- d. Assemble four (4) rivets through the drilled holes and install them using a rivet gun.

Note: Installing the rivets seals the drilled holes, so no additional sealant is required. However, sealant over the head of the rivet can be used, if desired.

If using self-drilling screws:

- a. Use the ST 81xx as a guide and then drill the self-drilling screws through the four (4) mounting holes.



- b. Seal the four (4) holes with sealant.