commsignia

Hardware Description for the Commsignia ITS-RS4-M

Document Version: 4-0
Publication date January 12, 2023
Document ID: HW-002

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1. Overview of the ITS-RS4-M

This is an introduction and a general overview of the ITS-RS4-M product, created by Commsignia.

The fourth generation vehicular connectivity system, designed by Commsignia, offers superior performance with a fully compatible Vehicle to Everything (V2X) software stack. The unit provides low-cost and simple OEM / after market integration, offering a built-in tamper-proof Hardware Security Module, CAN, high range V2X radio and easy HMI integration. By combining the benefits of automotive grade design, high performance application CPU and dual channel V2X radio performance, the ITS-RS4-M offers a professional, complete and future proof solution.

The platform features a powerful application processor, various communication subsystems (such as V2X, Cellular, CAN, Wi-Fi) and utilities for positioning, hardware security module, supervisor and many more. The product is built for automotive use with easy instalment into the vehicle and protection against physical and other challenges.

The ITS-RS4-M comes with an integrated Linux based operating system, complete V2X protocol Stack and a feature rich web based User Interface.

The main features of the ITS-RS4-M product line are:

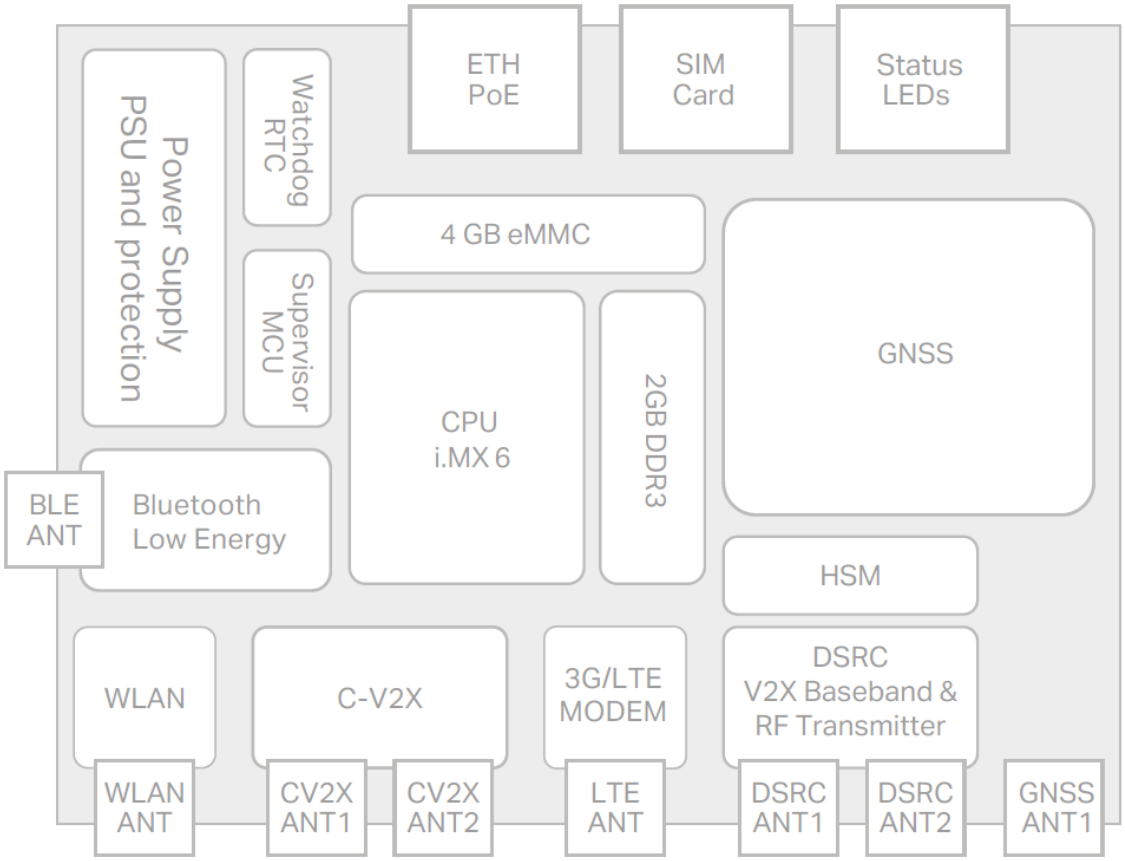
- **High performance application processor**: The platform is based on an i.MX 6 CPU, which delivers performance to host the main operating system, all cooperative ITS services and any additional custom applications as well.
- **Easy control and management**: Unit functions and state can be easily used, monitored and configured using the advanced web-based HMI.
- **V2X Software Stack**: All variants are delivered with the pre-integrated V2X Software Stack, which complies with both EU (ETSI G5) and US (IEEE Wave 1609.x) standard protocols. This lets applications running on the device to receive, process, and transmit V2X standard compliant messages.
- **V2X Security Stack:** The system includes a multi-function Security Software Stack for V2X authentication, verification, and signing V2X messages - including support for Hardware Acceleration and key storage using a Hardware Security Module.
- **V2X radio support**: Units are equipped with V2X radios - Autotalks Secton (for DSRC) / WNC MV-9150M (for C-V2X)
- **IPv4/v6 Network Layer Security**: The platform supports standard Linux network security functions to enable secure connectivity towards external entities over any of the supported interfaces.
- **Tamper-proof HSM**: The unit features a Hardware Security Module (HSM) for secure key storage to meet all security and privacy requirements.
- **Hardware Accelerated V2X signature and verification**: The platform utilizes HW acceleration by dedicated System on Chips (SoCs) to deliver exceptional secure message processing time.
- **Positioning and dead reckoning:** The high precision positioning unit includes Dead Reckoning (DR) support and fast time to fix.
- **Smart time and clock management**: The device manages its clock input sources and internal signals to provide the most reliable system time facility.
- **Gigabit Ethernet:** The device is equipped with a Gb Ethernet interface for network connectivity.
- **Commercial Short range network access**: The device has Wi-Fi and Bluetooth connectivity for maintenance and configuration or for connecting to IoT devices and sensor networks. [The availability of this feature depends on the product variant.]
- **Cellular:** Cellular connection is recommended for use cases where wireless access to Cloud services or the Road/Backbone Infrastructure network is required. [The availability of this feature depends on the product variant.]
- **Power failure protected:** The unit is equipped with a dedicated power input protection circuitry making it resistant against power disturbances and short power outages. During long power failures, the device uses internal backup power to perform a store and shut down sequence.

- **Watchdog**: The system provides hardware based watchdog services essential for high reliability services and applications.
- **Smart upgrade package management:** The system firmware or modular updates are simple, convenient and fail-safe.
- **Infrastructure applications :** Various infrastructure applications and message sets are available to use services such as Green Light Optimal Speed Advisory (GLOSA), Road Works Warning (RWW), Traveler Information Message (TIM), Road Side Alert (RSA) and other Day 1 safety applications.
- **Environment resistant enclosures:** The devices are shipped in industrial grade, vibration resistant and easy to mount enclosures, compliant with the IP67 standard.
- **Camera, Radar, LiDAR support** : Connect all vehicle sensor feeds for Advanced Driver Assistance System (ADAS) sensor fusion.

2. Architecture of the ITS-RS4-M product

The following figure depicts the major internal components of the ITS-RS4-M product, the module intercommunication connections, as well as the internal/external interfaces.

Figure 1. Architecture of the ITS-RS4-M product



3. Technical specifications of the ITS-RS4-M

Table 1. Technical specifications of the ITS-RS4-M product

Feature	Description	
CPU	NXP i.MX6 quadcore 1 GHz	
RAM	2 GB DDR3 SDRAM	
Flash	4 GB eMMC (minimum 2 GB free storage is available)	
Data interfaces	• Gb Ethernet (PoE) Compliant with the IEEE 802.3at POE+ standard. • Dual USB 2.0 (INTERNAL, restrictions apply) • 5 isolated inputs, 3 isolated MOSFET outputs	
Connectors	• Female N (802.11p, C-V2X, LTE, Wi-Fi) • Sealed RJ45 (Ethernet, PoE) • Female 4 pos. M12 (power) • Sealed SIM socket	
Power supply	8–32 VDC / PoE (surge and reverse polarity protected) Compliant with the IEEE 802.3at POE+ standard.	
Backup power	10s Store & Shutdown	
V2X interface	V2X transceiver #1 802.11p	Autotalks Secton
	Output power	Default setting: 20 dBm Maximum setting: 28 dBm
	Receiver sensitivity	< −90 dBm
	V2X transciever #2 C-V2X	Qualcomm MDM 9150
	Output power	Default setting: 20 dBm Maximum setting: 23 dBm
	Receiver sensitivity	< −103 dBm
V2X Security	• Hardware Security Module (HSM) SLI97 • ECDSA verification (> 2000 verifications), encryption (< 50 µs signing delay) • Brainpool verification, encryption • Secure, tamper proof private key and certificate storage • EAL6+ certified with up to 1 MB of secure SOLID FLASH • ARM TrustZone including the TZ architecture	
GNSS	Supported technology	GPS, GLONASS, Galileo, and QZSS
	Frequency bands	GPS (L1), GLONASS (L1, FDMA), GALILEO (E1)
	Sensitivity	Acquisition: −146 dBm Navigation −158 dBm Tracking: −162 dBm
	Time to First Fix (@ −130 dBm)	Hot Start: 1 s Cold Start: < 35 s
Wi-Fi interface (only in -W models)	Supported technology	IEEE 802.11 a/b/g/n
	Receive Sensitivity (Wi-Fi)	• 802.11a: 54M less than 68 dBm • 802.11b: 11M less than 78dBm • 802.11g: 54M less than 68 dBm • 802.11n 2.4G: HT20 MCS7 < 64 dBm, HT40 MCS7 < 61 dBm • 802.11n 5G: HT20 MCS7 < 64 dBm, HT40 MCS7 < 61 dBm
Cellular interface	Supported technology	GPRS/EDGE/WCDMA/HSPA+/LTE
	Data throughput	• GPRS: DL 85.6 kbps/UL 85.6 kbps • EDGE: DL 236.8 kbps/UL 236.8 kbps • WCDMA CS: DL 64 kbps/UL 64 kbps • WCDMA PS: DL 384 kbps/UL 384 kbps • HSPA+: DL 21.6 Mbps/UL 5.76 Mbps • DC-HSPA+: DL 43.2 Mbps/UL 5.76 Mbps • LTE FDD: DL 150 Mbps/UL 50 Mbps @20M BW CAT4

Feature	Description
Bluetooth (only in -BL5 models)	Bluetooth 5.0
Enclosure	NEMA4X - IP67, vibration proof, waterproof outdoor enclosure
Mounting	Pole and wall mountable
Certifications	• FCC in progress • CE in progress • SW in progress
Commsignia PN	F-W-C40x-BL5-S-SGLB (with European LTE channels) F-W-C42x-BL5-S-SGLB (with US LTE channels)

4. Electrical specifications of the ITS-RS4-M

The following table contains the electrical specifications of the device. Do not exceed any of the specified minimum or maximum values listed here as it may cause permanent damage to the device!

Table 2. Electrical specifications of the ITS-RS4-M

Parameter	Min	Operation	Max
Power Supply Voltage	36 V	48 V	57 V
Maximum Input Current			1.3 A @ 12 V
Maximum Peak Power Consumption			25 W
Storage temperature	−45 °C (−49 °F)	n/a	+85 °C (+185 °F)
Operating temperature	−40 °C (−40 °F)	n/a	+65 °C (+149 °F)
Operating humidity resistance	10%	n/a	95%
Storage humidity resistance		n/a	95%

NOTE
The listed PoE is compliant with the IEEE 802.3at POE+ standard.

5. External interfaces of the ITS-RS4-M

The following interfaces are available on the device on the front and back side of the aluminum enclosure box. This information is applicable for the ITS-RS4-M product (Commsignia Part number: F-W-C40x-BL5-S-SGLB (with European LTE channels) F-W-C42x-BL5-S-SGLB (with US LTE channels)).

Figure 2. Bottom and top sides of the ITS-RS4-M

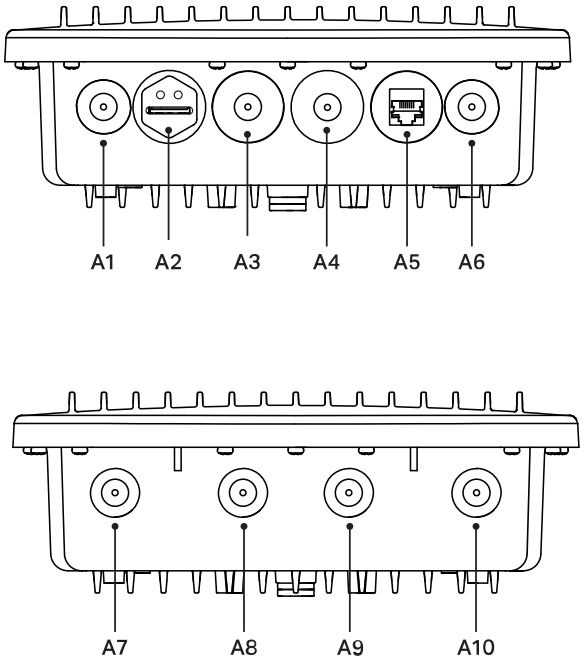


Table 3. ITS-RS4-M external interfaces

Label	Name	Type	Description
A1	Antenna connector	Female N-type connector	DSRC CH1
A2	SIM card slot	Standard SIM socket Push-Push	Supports standard SIM cards for the cellular modem
	Stat LED 1	RG LED	Status LED 1
	Stat LED 2	RG LED	Status LED 2
A3	Antenna connector	Female N-type connector	Wi-Fi
A4	Antenna connector	Female N-type connector	Bluetooth
A5	Ethernet socket	IP67 sealed Ethernet connector	Cat6 Ethernet cable connection with optional PoE. Compliant with the IEEE 802.3at POE+ standard.
A6	Antenna connector	Female N-type connector	DSRC CH2
A7	Antenna connector	Female N-type connector	C-V2X CH1
A8	Antenna connector	Female N-type connector	C-V2X GNSS antenna - accepts the provided dome GPS antenna
A9	Antenna connector	Female N-type connector	LTE main antenna
A10	Antenna connector	Female N-type connector	C-V2X CH2

6. LEDs

This chapter explains the different statuses of the two LEDs on the device.

Table 4. LED 1 Power supply status

Status	Color	Frequency	Duty cycle	Description
Normal	Green	1 Hz	100%	Power supply status of the main processing unit is normal.
Off	None	N/A	N/A	No power.

Table 5. LED 2 System status

Status	Color	Frequency	Duty cycle	Description
Off	None	N/A	N/A	No power
Device start-up	Green	1 Hz	50%	The device is starting up and the OS and the software stack are booting up.
Device operational	Green	1 Hz	100%	Normal operation.
Firmware update	Amber	1 Hz	100%	Firmware update is in progress.
Fault	Red	1 Hz	100%	System failure. The software stack is nonoperational. If this occurs during a firmware update, then it indicates firmware update failure.

7. Supported radio bands and antenna specifications

The device operates according to the regional technical standards regarding radio bands, antenna gain, and frequency.

7.1. Supported radio bands

- WLAN 2.4 GHz
- WLAN 5 GHz
- 4G / LTE / UMTS
- C-V2X / DSRC / ITS-G5 (depending on availability)

NOTE

Replacing the antennas of the device is not recommended! If the antennas are replaced then the following maximum gains of the antennas must not be exceeded.

Table 6. Maximum antenna gains

Antenna	Maximum gain
C-V2X / DSRC / ITS-G5 (depending on availability)	7.6 dBi
LTE	3.5 dBi
WLAN 2.4 / 5 GHz	3.4 dBi / 5.1 dBi

7.2. Tx Frequency usage

Table 7. Tx Frequency usage

Band	Frequency range	max. EIRP
C-V2X (ITS-G5B, ITS-G5A, ITS-G5D) (depending on availability)	5855-5925 MHz	33 dBm
WLAN 2.4	2412-2472 MHz	20 dBm
WLAN 5	5470-5725 MHz (except 5130- 5350 MHz)	23 dBm
WLAN 5	5725-5875 MHz	14 dBm
LTE-FDD(B1)	1920-1980 MHz	23 dBm
LTE-FDD(B2) – non EU	1850-1910MHz	23 dBm
LTE-FDD(B3)	1710-1785 MHz	23 dBm
LTE-FDD(B4) – non EU	1710-1755 MHz	23 dBm
LTE-FDD(B5) – non EU	824-849 MHz	23 dBm
LTE-FDD(B7)	2500-2570 MHz	23 dBm
LTE-FDD(B8)	880-915 MHz	23 dBm
LTE-FDD(B12) – non EU	699-716 MHz	23 dBm
LTE-FDD(B13) – non EU	777-787 MHz	23 dBm
LTE-FDD(B18) – non EU	815-830 MHz	23 dBm
LTE-FDD(B19) – non EU	830-845 MHz	23 dBm
LTE-FDD(B20)	832-862 MHz	23 dBm
LTE-FDD(B25) – non EU	1850-1915 MHz	23 dBm
LTE-FDD(B28) – non EU	703-748 MHz	23 dBm
LTE-FDD(B28)	703-748 MHz	23 dBm

Band	Frequency range	max. EIRP
LTE-TDD(B38)	2570-2620 MHz	23 dBm
LTE-TDD(B39) – non EU	1880-1920 MHz	23 dBm
LTE-TDD(B40)	2300-2400 MHz	23 dBm
LTE-TDD(B41) – non EU	2496-2690 MHz	23 dBm
WCDMA(B1)	1920-1980 MHz	24 dBm
WCDMA(B2) – non EU	1850-1910 MHz	24 dBm
WCDMA(B4) – non EU	1710-1755 MHz	24 dBm
WCDMA(B5) – non EU	824-849 MHz	24 dBm
WCDMA(B6) – non EU	830-840 MHz	24 dBm
WCDMA(B8)	880-915 MHz	24 dBm
WCDMA(B19) – non EU	830-845 MHz	24 dBm
GSM850	824-849 MHz	33 dBm
GSM900	880-915 MHz	33 dBm
GSM1800	1710-1785 MHz	30 dBm
GSM1900	1850-1910 MHz	30 dBm

8. Enclosure

This chapter describes the front and back side connector layout and product dimension information. For the antenna connections and other details related to the external interfaces of the product, refer to the External interfaces chapter.

8.1. Enclosure specifications for the ITS-RS4-M product line

8.1.1. Overview Image

8.1.2. Enclosure Dimensions (without antennas)

Height	90 mm / 3.54 inches
Width	257 mm / 10.12 inches
Depth	227 mm / 8.94 inches

8.1.3. Package Dimensions

Height	95 mm / 3.74 inches
Width	305 mm / 12.00 inches
Depth	240 mm / 9.44 inches

9. Mounting and device startup

Mounting the enclosure of the ITS-RS4

Figure 3. Contents of the mounting package

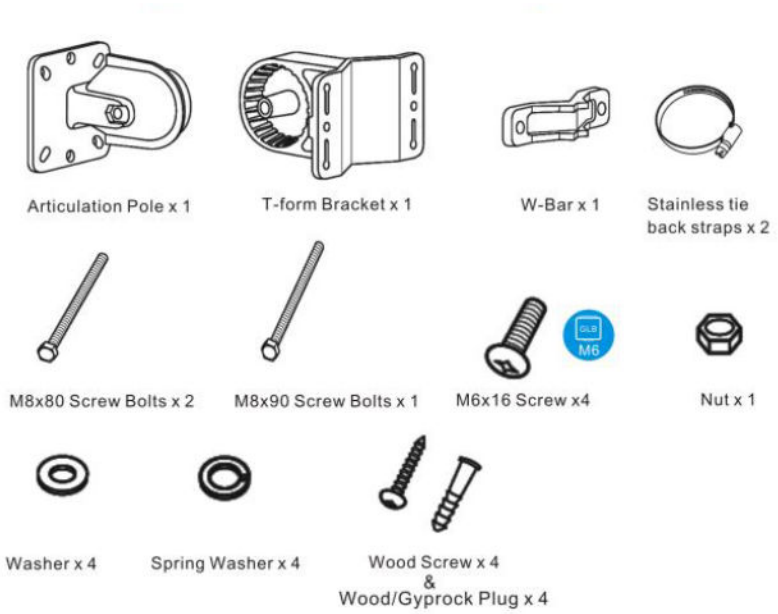


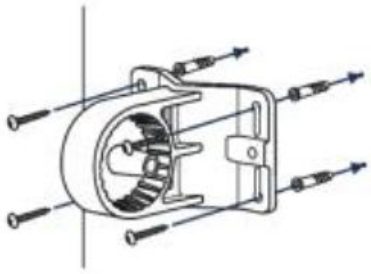
Table 8. Contents of the mounting package

Part name	Quantity in the package
Articulation pole	1
T-form bracket	1
W-bar	1
Stainless tie back straps	2
M8x80 screw bolts	2
M8x90 screw bolts	1
M6x16 screw	4
Nut	1
Washer	4
Spring washer	4
Wood screw	4
Wood/Gyprock plug	4

Roadside V2X units such as the ITS-RS4 are designed to be mounted to a fixed location and this guide offers instructions to mount your device to a location of your choice.

1. (Optional) Mount the enclosure to a wall using wood/gyprock screws

Figure 4. Mounting the enclosure on a wall bracket

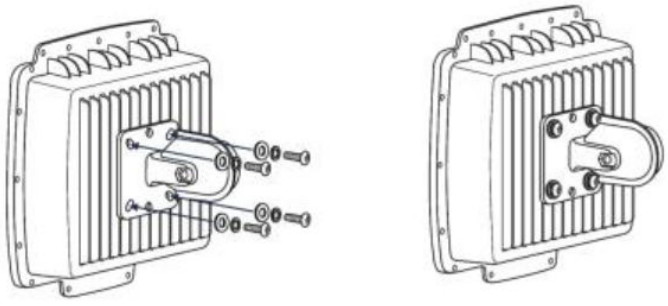


2. (Optional) Mount the enclosure on a pole by first attaching the base to the pole, then mounting the device on the base.
   a. Install the mount base on the pole using the W-bar and the M8x80 bolts with washer.

Figure 5. Installing the mount base on the pole

   b. Install the enclosure on the articulation pole using the M6x16 screws and washers.

Figure 6. Installing enclosure on the articulation pole



3. Install the enclosure on the articulation pole using the M6x16 screws and washers.

The ITS-RS4 enclosure is mounted to a fixed location and it is ready to be used.

9.1. Ensuring the IP67 weather-sealed operation of the ITS-RS4

Follow these guidelines to ensure the enclosure is properly weather sealed:

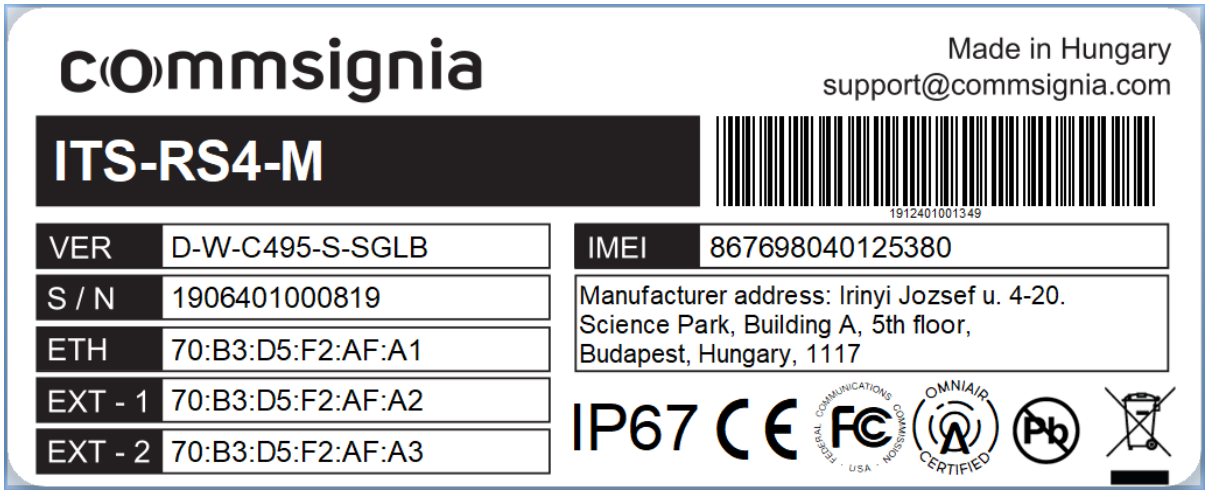
- All antennas (such as V2X radio or Wi-Fi) must be properly fastened to their connectors without any gaps.

- Do not remove antenna covers of any unused antenna connectors.
- Ensure that the plastic cover of any external interface (such as the SIM slot) is secured tightly.
- Use moderate force when connecting antennas or tightening screws while mounting the device. Exerting too much force can damage the enclosure or the mounting bracket.
- The weather-sealed connector of the Ethernet cable must always be used with a cable fitted inside. Leaving the cable connector on without a cable will leave a gap open and compromise IP67 standard weather resistance. If the ETH slot is not used, keep the plastic cover on the connector.

10. Labeling

General information about the labeling of the product.

The product is delivered labeled with the product type (marked in the green field) and the following information.



Example product label