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PCB number:	**SIS-LR-02, SIS-EXT-02**

Document History

Version	Date	Author	Change Description
1.0.0	Jul 10, 2020	A. Repich	Initial Release

Table of Contents

1   Overview

This document describes the hardware of the Smartico Industrial Sensor LoRaWAN. The sensor has a wide range of peripherals that can be used by the user in their own applications. The functionality of the device depends on the application that is integrated and launched in the device. This document does not describe the functionality of the device, but only contains a description of the technical parameters and capabilities.

For the functional part, see the document "App Description" for the required application.

The device can operate in the LoRaWAN 1.0.2 standard Class C or Class A.

2   Specifications

Table 1: Smartico Industrial Sensor LoRaWAN Specifications

Parameter	Description
Compliance with LoRaWAN	1.0.2 Class A,C
Frequency plan of LoRaWAN	EU868/US915
Power of transmitter, mW	25/100
Digital inputs	4
Analog inputs 4-20mA	2
Analog inputs 0-10V	2
Line control inputs	2
Serial interface	RS485/232, 1-WIRE
Outputs	2
Maximum output load current, mA	500
Connection of external antenna	Available
Magnetic sensor	Built-in
Accelerometer	Built-in
Archive of events and messages	100 000
External power supply, V	5-55
Built-in battery	Li-SOCl2 C
Battery capacity, mAh	9000
Ambient temperature, °C	-30 ...+75°C
Weight, g	250
Dimensions, WxDxH mm	100x100x40
Ingress protection	IP67

3   Hardware description

The device consists of two printed circuit boards located in one housing. The main board contains the LoRaWAN communication interface, the central processor (MCU) and the user interface. The second board is an extension board and contains a set of peripheral interfaces, a power supply and other elements. A detailed description of each board is described in the following sections.

3.1 Communication board

The sensor communication board is the main device and contains the microcontroller, wireless interface, and user interface. The main elements of the communication board are shown in the Figure 1.
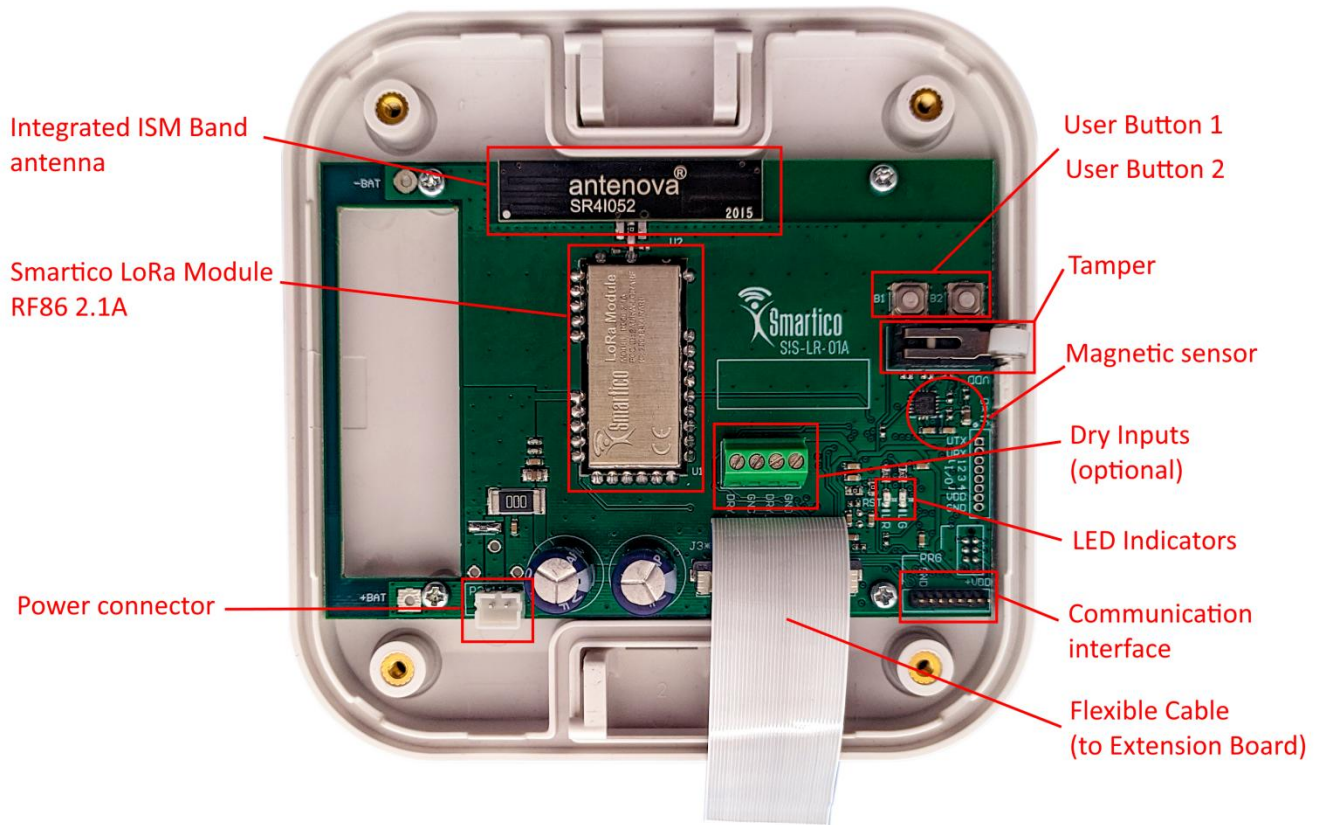

Figure 1: Communication board view

Table 2: Description of the Communication Board components

Component / Interface	Description
Integrated ISM Band antenna	A high performance antenna for the ISM bands 868/915MHZ
Smartico LoRa Module	Certified radio module of SMARTICO LLC own design. Based on the SX1276 Semtech chip.
Power connector	The connector is for powering the board. Working voltage 3.6V. Power from the Extension Board connects here.
User Button 1	When pressed once with a short, the device wakes up and is ready for communication via the serial interface. Other functions depend on the Application.
User Button 2	Application specific user button
LED Indicators	Two LED indicators (GREEN and RED). When the device is powered on or resets, the GREEN indicator will light up for 1 second if the self-test is successful. And 1 second RED flash - if there were any faults. Additional functionality of indicators depends on the application.
Communication interface	The Communication Interface is intended for connection with a device via a serial interface (UART TTL). It can be used to set the initial settings or update the Application (firmware). Factory programming is also done through this connector. The pinout for connecting the data cable is shown in the Table 5
Magnetic sensor	Built-in magnetic field sensor. Designed to activate the device, out-of-order data transmission. May be used for the purpose of the Application.
Dry Inputs (optional)	Two discrete dry contact inputs. May be absent and not used when connecting an expansion board. Application-defined. DRY_1, DRY_2 - Signal

	GND - Ground
Flexible Cable	This cable connects two boards: Communication and Extension Board

3.2   Extension board

The Extension Board contains a set of various I/O interfaces (digital inputs, analog inputs, serial interfaces). Also, this board can contain a power supply from an external source and a power manager. The power manager allows the device to automatically switch power to the internal battery when the external power is lost. The main elements of the communication board are shown in the Figure 2.
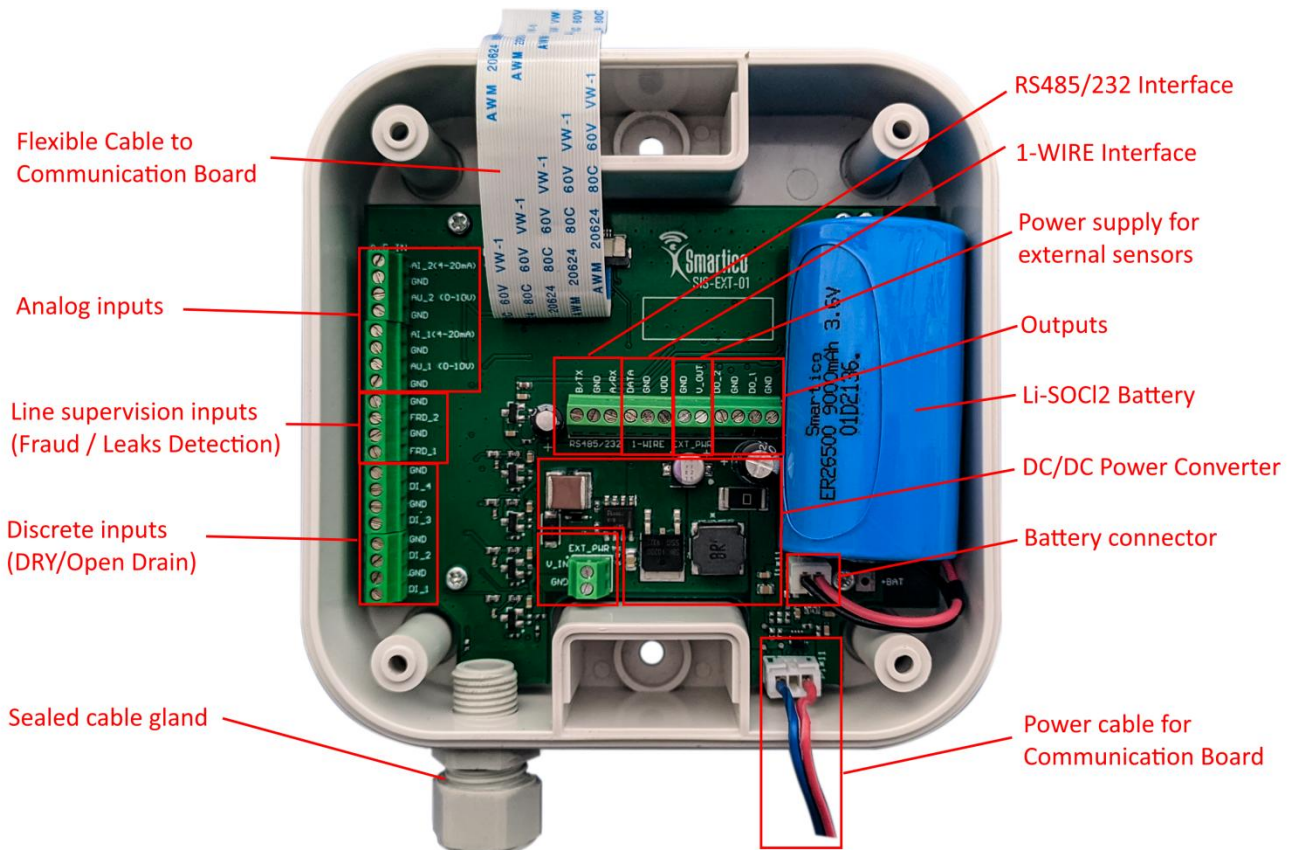

Figure 2: Extension Board view

The functionality of each component is described in the table below.

Table 3: Description of the Extension Board components

Component / Interface	Description
Discrete Inputs	The block of discrete inputs consists of 4xDI, which can be configured in two modes: DRY or Open Drain. The settings are made individually for each input. Depending on the Application, these inputs can be a pulse counter or a binary input or other.
Line Supervision inputs	These inputs are used for line monitoring (normal / short circuit / open line) or other functions such as a leaks detector. The functionality of these inputs is determined by the Application.
Analog Inputs	The device contains 4 analog inputs: 2x0-20mA and 2x0-10V

RS485/232 Serial Interface	The interface is intended for communication with external devices via the RS485/232 bus. This interface can be either RS485 or RS232, depending on the equipment ordering option.
1-WIRE Interface	Standard digital 1-WIRE interface is designed for communication with external devices (such as temperature sensors, i-Button, etc.)
Power Supply for Ext. sensors	This output is intended for supplying external sensors. The power supply is controlled by the Industrial Sensor. The output has built-in overcurrent protection. The output voltage is equal to the voltage of the external power supply. **Note**: In the modification of the Industrial Sensor without a built-in DC/DC converter, an option to power external sensors from an internal battery is possible (the option is ordered separately). In this case, the output voltage is equal to the battery voltage.
Outputs	The output block contains two digital outputs. When the output is activated, the signal is shorted to ground. In the passive state, the lines are open. Maximum current 2A.
Battery	The device has a built-in Li-SOCl2 Size C battery. The battery is powered when there is no external power supply. When operating on battery power, the device enters a low power mode (see Application description). **Note**: Do not disconnect the internal battery unnecessarily for a long time. This can lead to a reset of the RTC clock.
DC/DC Power Convertor (optional)	The built-in DC/DC Converter ensures the operation of the device from an external power source. Permissible range of external supply voltage 5-55V The DC/DC Converter may be absent depending on ordering options.
Battery Connector	The connector is only for connecting a 3.6V battery. **Caution:** keep the voltage polarity indicated near the connector.
Sealed cable gland	Sealed connector for wires to external sensors.
Power Cable for Communication Board	This cable powers the Communication Board.
Flexible Cable	This cable connects two boards: Communication and Extension Board

3.3   Terminals description

See the table below for a description of the terminal connectors and their electrical specifications.

Table 4: Terminals description

Terminal group	Name	Description
A/D_IN	DI_1	Discrete input 1 (DRY or Open Drain mode)
	GND	Ground
	DI_2	Discrete input 2 (DRY or Open Drain mode)
	GND	Ground
	DI_3	Discrete input 3 (DRY or Open Drain mode)
	GND	Ground
	DI_4	Discrete input 4 (DRY or Open Drain mode)
	GND	Ground
	FRD_1	Line Supervision input 1
	GND	Ground
	FRD_2	Line Supervision input 2
	GND	Ground
	GND	Ground
	AU_1	Analog Input 0-10V #1
	GND	Ground
	AI_1	Analog Input 0-20mA #1

	GND	Ground
	AU_2	Analog Input 0-10V #2
	GND	Ground
	AI_2	Analog Input 0-20mA #2
RS485/232	B/TX	B signal of RS485 bus or TX signal of COM Port (RS232)
	GND	Ground
	A/RX	A signal of RS485 bus or RX signal of COM Port (RS232)
1-WIRE	DATA	1-WIRE Data line
	GND	Ground
	VDD	1- WIRE Power line
EXT_PWR	GND	Ground
	V_OUT	Switchable power supply for external sensors with overload and short circuit protection. Maximum current load up to 500mA. The output voltage matches the V_IN input voltage.
EXT_OUT	DO_2	Discrete output 2, Open Drain to Ground up to 2A
	GND	Ground
	DO_1	Discrete output 1, Open Drain to Ground up to 2A
	GND	Ground
EXT_PWR	V_IN	Input for connecting an external power supply. Voltage range from 5 to 55V
	GND	Ground

3.4   User Interface

Smartico Industrial Sensor LoRaWAN has several user interface components:

- LED Indicators for signaling

- User Buttons for waking up the device and launching Application functions

- Magnetic Sensor: to be used as a switch for external user actions, without a need to open the housing.

- Internal Communication Interface: it contains the serial interface (UART) and is used to device configuration or update firmware.
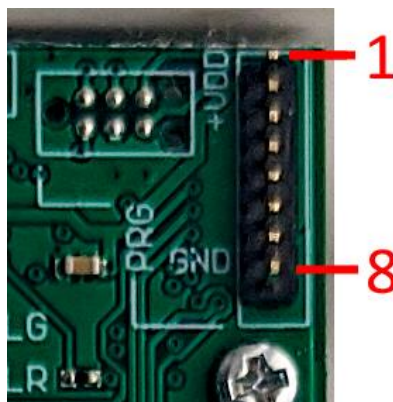

Figure 3: Internal Communication Interface

If there is no data cable supplied by the manufacturer, the customer can make the cable himself. To communicate with the sensor, it is enough to use any UART to USB converter and connect to three contacts (UART_RX, UART_TX and GND). The pinout of the connector is shown in the Table 5.

Table 5: Internal Communication Interface pinout

Pin	Name	Type	Description
1	VDD	VDD	V+ supply voltage
2	PRG_1	-	Factory programming pin 1
3	PRG_2	-	Factory programming pin 2
4	NRST	Input	MCU Reset
5	UART_TX	Output	UART transmit data output of the sensor
6	UART_RX	Input	UART receive data input of the sensor
7	GND	GND	Ground
8	DBG	Output	Factory debug pin

4 Initial Setup

4.1 Device activation

Smartico Industrial Sensor LoRaWAN may be in one of the following Device Operating Modes:

- SERVICE: in this mode, various service operations can be performed with the device. Service operations are performed by the manufacturer and are not described in this document.

- ON READY: the device is in normal mode, but no activity is taking place in the radio air. In other words, the radio part is disabled in this mode. Sensor can be switched to this mode before long-term storage.

- ON AIR: normal operating mode of the device, in which data is transmitted via the LPWAN network. The SENSOR can be switched to this mode by command or by the influence of a magnetic field in the when it ON READY mode. Also, the sensor is switched to this mode after 30 minutes of inactivity in the SERVICE mode.

If the device has all the preset settings, then it can be put into operation with a magnet, even without opening the housing. The place where you need to bring the magnet is shown in the Figure 4.

Note: Hold the magnet for at least 40 seconds.

Figure 4: Activating the device with a magnet

4.2 Data cable connection

To perform the initial settings of the device or to update the firmware, you must connect the data cable to the Communication Interface, as shown in the Figure 5. Make sure the marker on the data-cable is in the correct position.
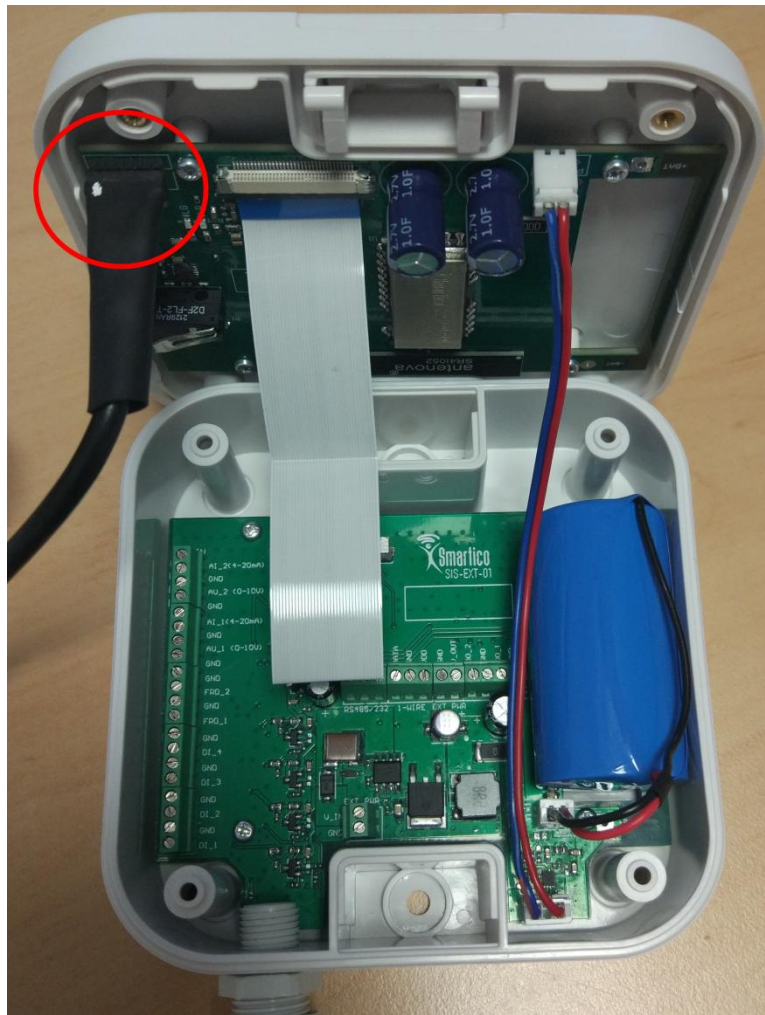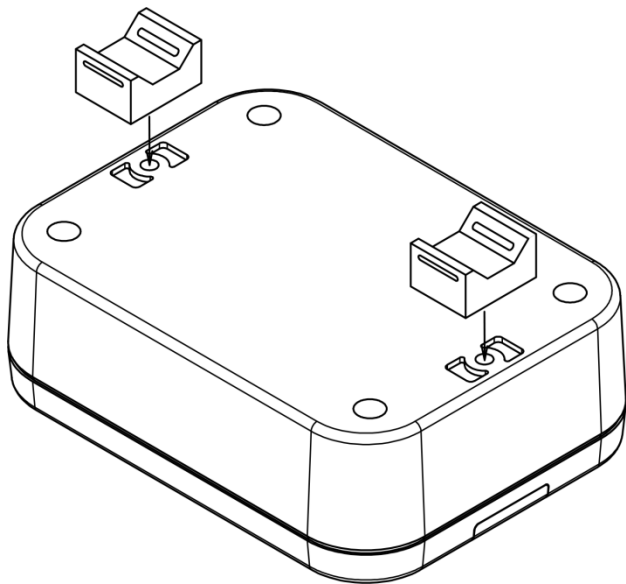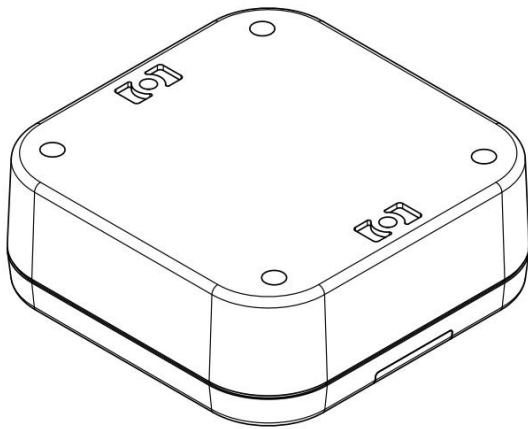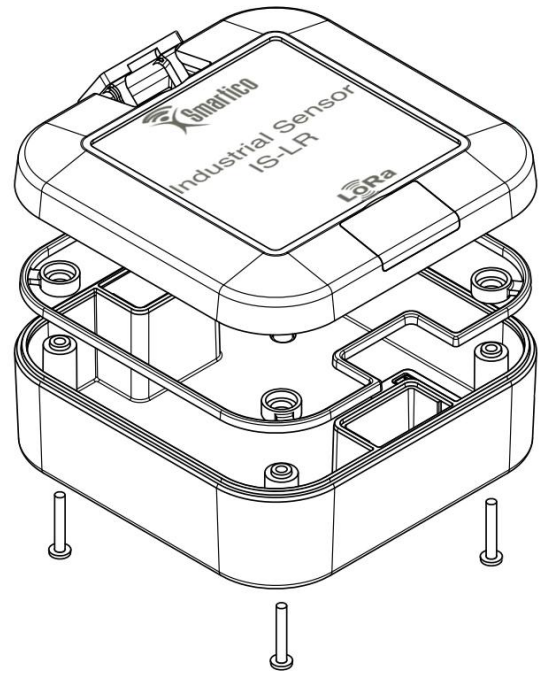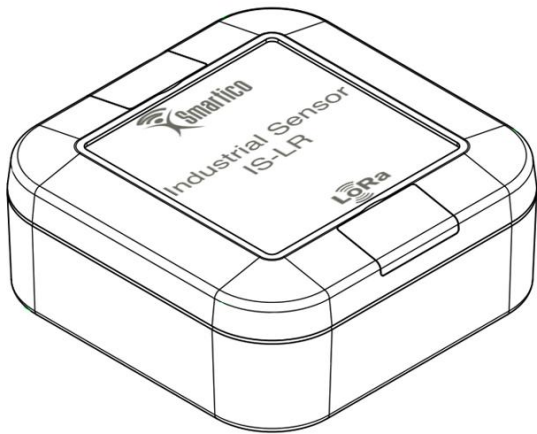
Figure 5: Data cable connection

After pressing the B1 button once, the sensor wakes up and is ready for via the date cable. For a detailed description of setting up the device, see the documents of AT Commands Description and App Description.

4.3   Installation

4.4   Firmware Upgrade

The device supports secure firmware updates. The firmware file is loaded encrypted and unpacked after being downloaded to the device. Only after checking the integrity and authenticity of the firmware, the update process begins. When updating via data cable, the firmware file is transferred to the SENSOR using the standard XMODEM file transfer protocol.

To complete the process of updating the firmware via the data cable, you must perform the following sequence of actions:

1. Connect the data cable as described in the section 4.2
2. Using a terminal program (for example, Tera Term), should be opened the serial COM port with the following settings: 115200/8-N-1

3. To wake up the SENSOR you must press once button B1.

4. To synchronize the SENSOR interface, you must send the AT <CR> command (where <CR> is a carriage return, code 0x0D). After one or more sent commands, the SENSOR should return an OK response

5. Check the current firmware version by running the command:

    AT+CGMR

    Possible answer: +CGMR: SW 1.13 HW 1.0

    where SW X.XX – software version. In this case 1.13

6. It is necessary to enter the access code (8-digit number):
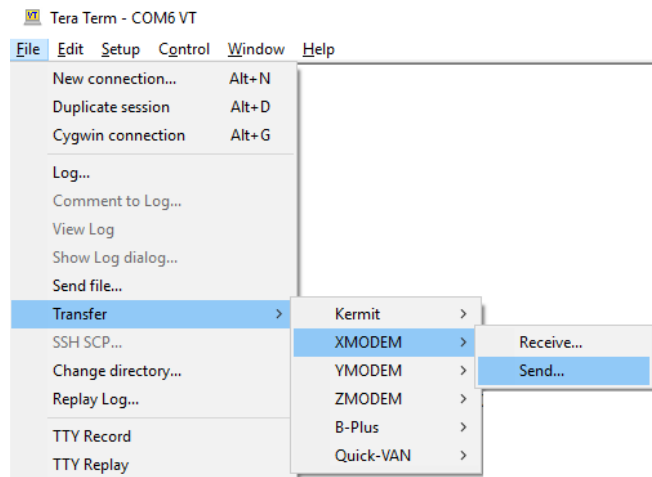
    Command: AT+PIN=XXXXXXXX

    Answer: OK

7. Initiate the procedure for loading the firmware file into the SENSOR using the command:
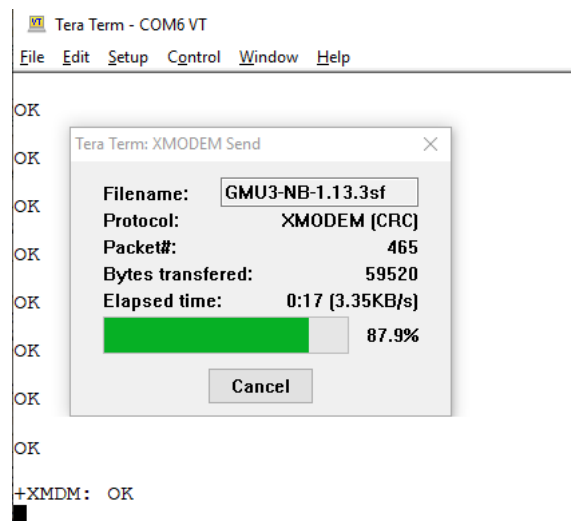
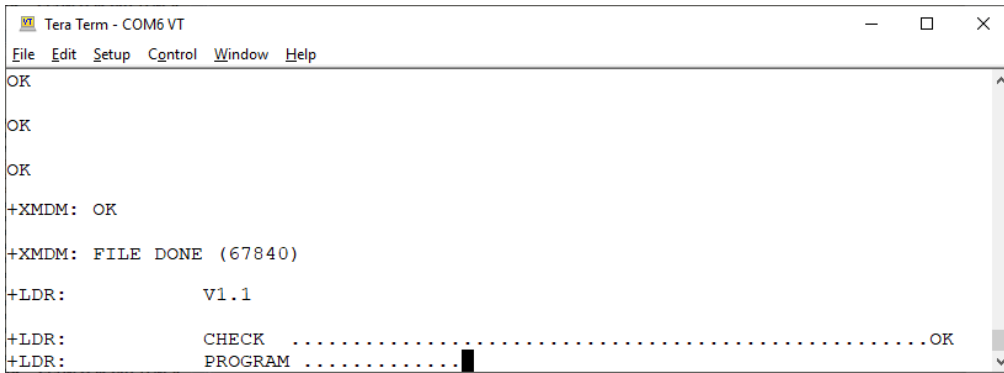   AT+XMDM

    Answer: +XMDM: OK

After executing the AT+XMDM command, the user has 30 seconds to start sending the firmware file via the XMODEM protocol. This can be done using the terminal program Tera Term:

After selecting the file, file transfer procedure will start as shown in the figure:

After the successful transfer of the firmware file, the firmware update procedure will begin:

```
VT  Tera Term - COM6 VT                                    —   □   ×
File  Edit  Setup  Control  Window  Help
OK

OK

OK

+XMDM:  OK

+XMDM:  FILE DONE (67840)

+LDR:           V1.1

+LDR:           CHECK   ....................................................OK
+LDR:           PROGRAM .............█
```

After completing the firmware update procedure, you need to check the current version by running the command:
AT+CGMR

FCC Statement

1. 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.

(2) This device must accept any interference received, including interference that may cause undesired operation.

2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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 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.

Radiation Exposure Statement

This equipment complies with RF 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.This equipment must be installed and operated wite a minimum distance of 20 cm between the radiator and user body.

IC WARNING:

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

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. End user must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation Exposure Statement

This equipment complies with RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-Iocated or operating in conjunction with any other antenna or.transmitter.This equipment must be installed and operated wite a minimum distance of 20 cm between the radiator and user body.

Ce dispositif est conforme aux normes autoriser-exemptes du Canada RSS d'industrie 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.Cet équipement est conforme avec l'exposition aux radiations IC définies pour un environnement non contrôlé. L'utilisateur final doit respecter les instructions de fonctionnement spécifiques pour satisfaire la conformité aux expositions RF. Cet émetteur ne doit pas être co-localisées ou opérant en conjonction avec une autre antenne ou transmetteur. This équipment complies with RF radiation éxposure limits set forth for an uncontrolled énvironment. This transmitter must not be co-Iocated or operating in conjunction with any other antenna or.transmitter.This équipement must be installed and operated wite a minimum distance of 20 cm between the radiator and user body.