SENSeOR AMS01 Switchgear Temperature And Partial Discharge Monitoring User Manual

Contents

SENSeOR AMS01 Switchgear Temperature And Partial Discharge Monitoring

Product Information

This user manual is for the 24/7 Asset Monitoring Solution (AMS01) by SENSeOR. The document revision is UM00403EN-AC, and the date of the manual is 2023-08.
The AMS01 is designed to provide continuous monitoring of assets. For any technical changes or modifications to the product, SENSeOR reserves the right to make them without prior notice. The product is warranted to be free from functional defects in material and workmanship at the time of manufacturing and to conform to the specifications set forth in the relevant instruction manuals or data sheets for a period of one year.
For warranty details and complete terms and conditions, please refer to SENSeOR's terms and conditions provided at the time of purchase.

Product Usage Instructions

Safety Instructions

Before installing or commissioning the SENSeOR Assets Monitoring System, it is important to read this manual.

The manual provides different safety instructions using specific conventions

- **DANGER:** Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. Failure to follow the instructions given can result in death or serious injury.
- **WARNING:** Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury. Failure to follow the given instructions can result in death or serious injury.
- **CAUTION:** Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. Failure to follow these instructions can result in personal injury.
- **NOTICE:** Provides guidance on damage unrelated to personal injury, such as those that can cause deteriorated property. Failure to follow these instructions can result in property damage.
- **IMPORTANT:** Indicates additional information about making effective use of the product.

Please adhere to these safety instructions to ensure the proper and safe use of the SENSeOR AMS01 Asset Monitoring Solution.

WARRANTY

These products are warranted to be free from functional defects in material and in workmanship at the time of the manufacturing and to conform at that time to the specifications set forth in the relevant instruction manuals or in the data sheets, for such products for a period of one year.
Reference SENSeOR terms and conditions provided at time of purchase for complete warranty details.

SENSeOR (head office)

- Bâtiment Natura 2
- 1198, avenue du Docteur Maurice Donat, 06250 Mougins
- France

SAFETY INSTRUCTIONS

IT IS IMPORTANT TO READ THIS MANUAL BEFORE INSTALLING OR COMMISSIONING SENSEOR ASSETS MONITORING SYSTEM.

CONVENTIONS

DANGER
DANGER INDICATES AN IMMINENTLY HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.
FAILURE TO FOLLOW THE INSTRUCTIONS GIVEN WILL RESULT IN DEATH OR SERIOUS INJURY.

WARNING
WARNING INDICATES A POTENTIALLY HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.
FAILURE TO FOLLOW THE GIVEN INSTRUCTIONS CAN RESULT IN DEATH OR IN SERIOUS INJURY.

CAUTION
CAUTION INDICATES A POTENTIALLY HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED, MAY RESULT IN MINOR OR MODERATE INJURY.
FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN PERSONAL INJURY.

NOTICE
NOTICE PROVIDES GUIDANCE ON DAMAGE UNRELATED TO PERSONAL INJURY, SUCH AS THOSE THAT CAN CAUSE DETERIORATED PROPERTY.
FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN PROPERTY DAMAGE.

IMPORTANT

IMPORTANT INDICATES ADDITIONAL INFORMATION ABOUT MAKING EFFECTIVE USE OF THIS PRODUCT.

SENSeOR AMS01 User Manual **www.senseor.com**

SAFETY INFORMATIONS

- Protect product from moisture and humidity.
- Protect product from too high or too low temperature.
- Protect product from fire.
- Do not paint the product.
- Do not modify or disassemble the product. Service must be carried out by SENSeOR.
- Store products in dry and dust-free place.

OVERVIEW

CAUTION
THIS READER IS DEDICATED TO SWITCHGEAR MONITORING WITH WIRELESS PASSIVE SAW TEMPERATURE SENSORS, ENVIRONMENTAL SENSOR AND UHF PARTIAL DISCHARGE DETECTION. IT IS DESIGNED FOR USE INSIDE METALLIC CAVITIES ONLY LIKE THE SWITCHGEAR CABINET AND TUNED TO BE COMPLIANT WITH IEC 62271 ENABLING A LICENSE-FREE USE IN SWITCHGEAR WORLDWIDE.

RELATED DOCUMENTS

- **UM00400-EN**: AMS01 Configuration Tool User Manual.
- **UM00417-EN**: AMS01 Modbus table.
- **UM00418-EN**: AMS01 Modbus table with HTR02 compatibility mode.
- **UM00419-EN**: AMS01 SD card file management.
- **SD00385-EN**: AMS01 readers Datasheet.

For additional related documentation and file downloads see support website at **senseor.com/downloads**.

AVAILABLE PRODUCTS
This manual covers the following products

- **AMS01-T**: Temperature monitoring only.
- **AMS01-P**: Partial discharge monitoring only.
- **AMS01-TP**: Temperature & partial discharge monitoring.

INSTRUCTIONS FOR USE
The AMS01 reader is dedicated to monitor electrical equipment like switchgears. The temperature of live conductors is measured by SAW sensors and prevent overheating and overload. Partial discharges are measured by antenna pairs and prevent equipment failure. Ambient temperature and humidity measurements are also available through an optional environmental sensor connected with wires to the reader.
The reader is intended to be installed in low voltage compartments of switchgear or in similar type of assets. It can also be installed in a weatherproof environmental enclosure.
The reader is intended for use at a maximum altitude of 5 km, typically between -20°C to +70°C (refer to reader specification for the complete specification) and between 10% to 95% non-condensing relative humidity.

WARNING

THE READER IS NOT INTENDED FOR INSTALLATION INTO MEDIUM OR HIGH VOLTAGE COMPARTMENT ASSETS. ONLY SAW TEMPERATURE SENSORS, ENVIRONMENTAL SENSOR AND RF ANTENNAS ARE INTENDED FOR INSTALLATION INTO MEDIUM VOLTAGE COMPARTMENTS.

READER OVERVIEW
Included in scope of delivery

- 1x AMS01 reader.
- 1x AMS01 system user manual.
- 1x µSD card.
- 1x 2-pin power connector.
- 1x 4-pin environmental sensor connector.
- 1x 2-pin relay connector.
- 1x 35 mm DIN rail mount with 2x M3x6 mm screws.

SERIALIZATION LABEL

Figure 1: Product serialization label

FRONT LABELS

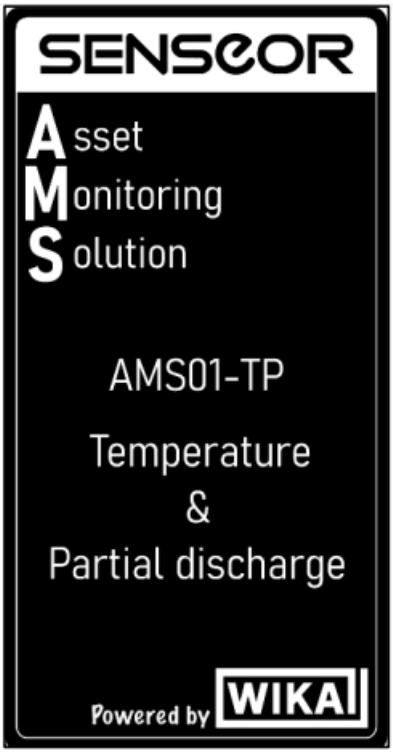


Figure 2: Example of front product labels

CONNECTORS & FUNCTIONS

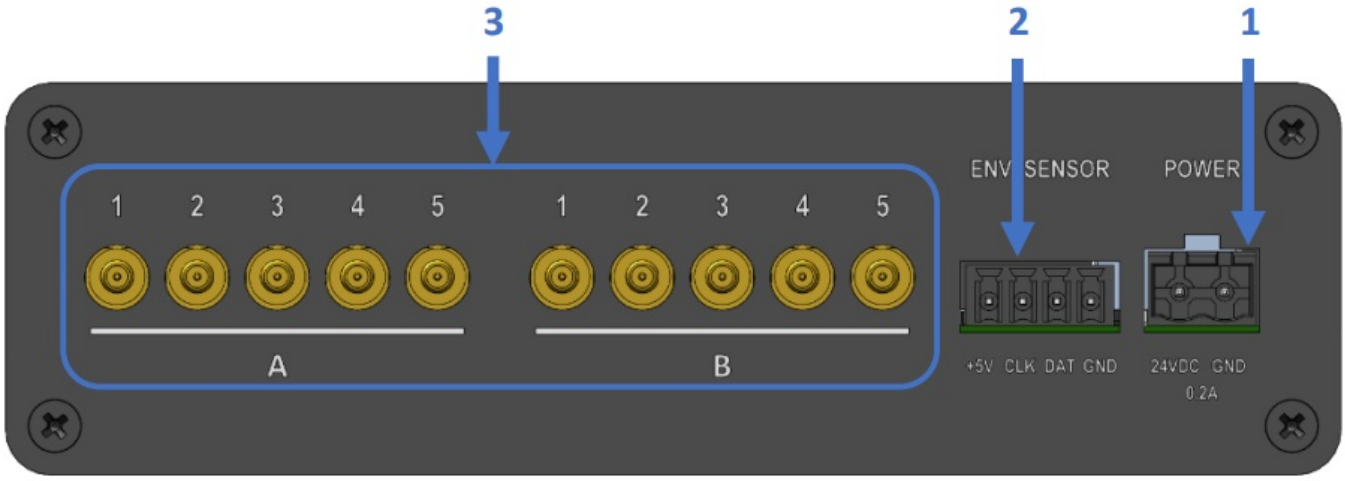


Figure 3: Rear connection view

INPUT POWER (1)

Pin	Type	Description
1 (left)	+24VDC	Main power supply input (24VDC 0.2A)
2 (right)	GND	Ground

CAUTION
DO NOT REVERSE THE POWER SUPPLY POLARITY, THIS MAY CAUSE ELECTRICAL DAMAGE.

ENVIRONMENTAL SENSOR (2)

Pin	Type	Description
1 (left)	+5VDC	Power supply of environmental sensor (5V out from reader)
2	CLK	Clock
3	DAT	Data
4 (right)	GND	Ground

RF ANTENNAS (3)

Connector	Type	Description
1A (left)		Antenna 1A
2A		Antenna 2A
3A		Antenna 3A
4A		Antenna 4A
5A	RF	Antenna 5A
1B		Antenna 1B
2B		Antenna 2B
3B		Antenna 3B
4B		Antenna 4B
5B (right)		Antenna 5B

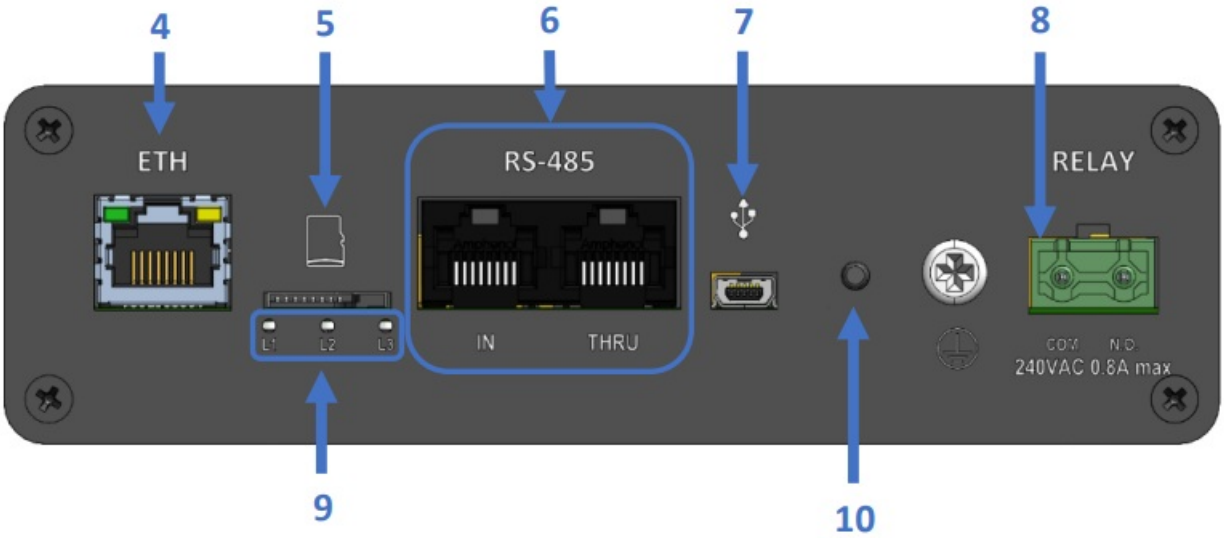


Figure 4: Front connection view

ETHERNET PORT (4)
Standard RJ45 socket for Modbus-TCP communication and reader configuration.

Pin	Type	Description
1	Tx +	Transmit data +
2	Tx -	Transmit data -
3	Rx +	Receive data +
4	-	*Not used*
5	-	*Not used*
6	Rx -	Receive data -
7	-	*Not used*
8	-	*Not used*

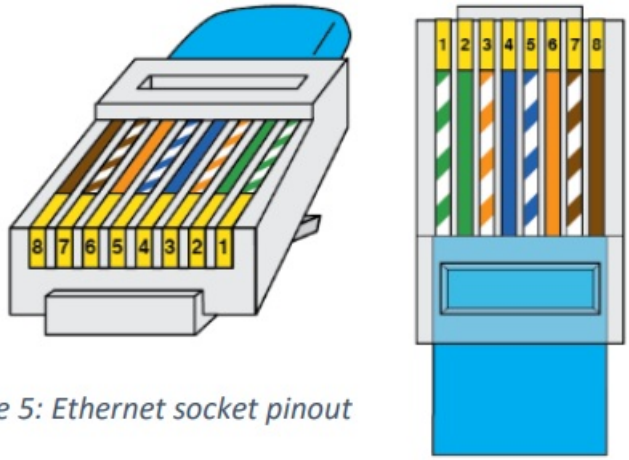


Figure 5: Ethernet socket pinout

SD CARD (5)
Memory card slot for µSD cards.

Specification	Form factor	File system	Bus interface	Speed class	Others
Version 3.0.1 (2010)	MicroSD HC	FAT32	UHS-I	Class 10	SD Smart

RS485 PORTS (6)
RJ45 ports for Modbus-RTU communication.

Pin	Type	Description
1 (left)	–	*Not used*
2	–	*Not used*
3	–	*Not used*
4	A	Data +
5	B	Data –
6	–	*Not used*
7	–	*Not used*
8 (right)	GND	Ground

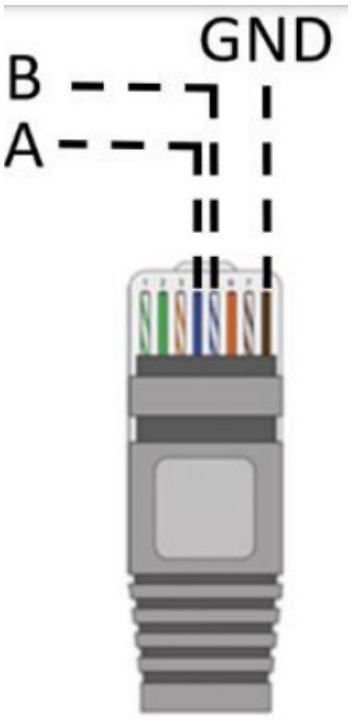


Figure 6: RS485 socket pinout

USB PORT (7)
Mini USB port reserved for future use.

RELAY OUTPUT (8)

Pin	Type	Description
1 (left)	COM	Common for relay
2 (right)	Normally Open (N.0.)	Alarm relay activation output (240VAC 0.8A max)

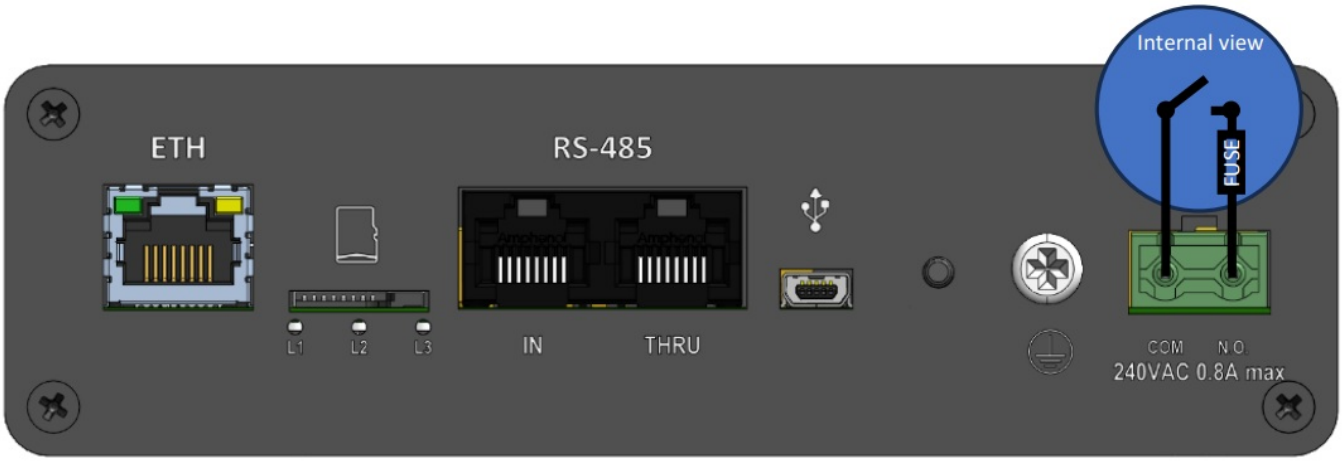


Figure 7: Relay output cabling

LEDS INTERFACE (9)
Status LEDs.

STATUS LEDS
Status LEDs are used to indicate the functional state of reader.

DFU MODE LEDS INDICATION (DEVICE FIRMWARE UPGRADE)
DFU is an AMS01 internal recovery/update program mode automatically called during firmware update process. Following table indicates reader status in this mode.

Description	LED1 status (L1)	LED2 status (L2)	LED3 status (L3)
No power *LEDs OFF*			
DFU mode *LEDs blinking* *Manually entered*			
DFU mode *LEDs blinking* *Corrupted firmware detected*			
Firmware update in progress *LEDs blinking*			

APPLICATIVE MODE LEDS INDICATION
LED 1 (L1) indication description

Description	Status
No power *LED OFF*	
System is working properly *LED ON*	
System warning *LED ON*	
System error *LED ON*	

LED 2 (L2) indication description

Description	Status
No notifier configured *LED OFF*	
At least one notifier configured *LED ON*	
At least one notifier in temperature warning or PD medium level state *LED ON*	
At least one notifier in temperature alarm or PD high level state *LED ON*	

LED 3 (L3) indication description
Reserved for future use.

INSTALLATION

IMPORTANT

THE INSTALLATION INSTRUCTIONS ARE ONLY FOR THE AMS01 READER.
IT IS ASSUMED THAT SAW TEMPERATURE SENSORS AND PARTIAL DISCHARGE PROBE ANTENNAS HAVE BEEN CONFIGURED AND INSTALLED.

WARNING

PROFESSIONAL INSTALLATION REQUIRED.
INSTALLATION AND CONFIGURATION SHOULD BE PERFORMED ONLY BY USERS WHO ARE TECHNICALLY COMPETENT AND AUTHORIZED TO DO SO.
LOCAL REGULATIONS REGARDING ELECTRICAL INSTALLATION AND SAFETY MUST BE OBSERVED.
FAILURE TO FOLLOW THE GIVEN INSTRUCTIONS CAN RESULT IN DEATH OR IN SERIOUS INJURY.

WARNING

THE USE OF THIS EQUIPMENT IN A MANNER NOT SPECIFIED IN THIS MANUAL OR BY THE MANUFACTURER MAY IMPAIR PROTECTION OF THE USER AND EQUIPMENT.

CAUTION

THIS EQUIPMENT IS DESIGNED FOR INSTALLATION IN AN ENCLOSURE THAT PROVIDES ADEQUATE PROTECTION AGAINST ELECTRICAL SHOCK.

UNPACKING

PHYSICAL DIMENSIONS

Unit in mm.

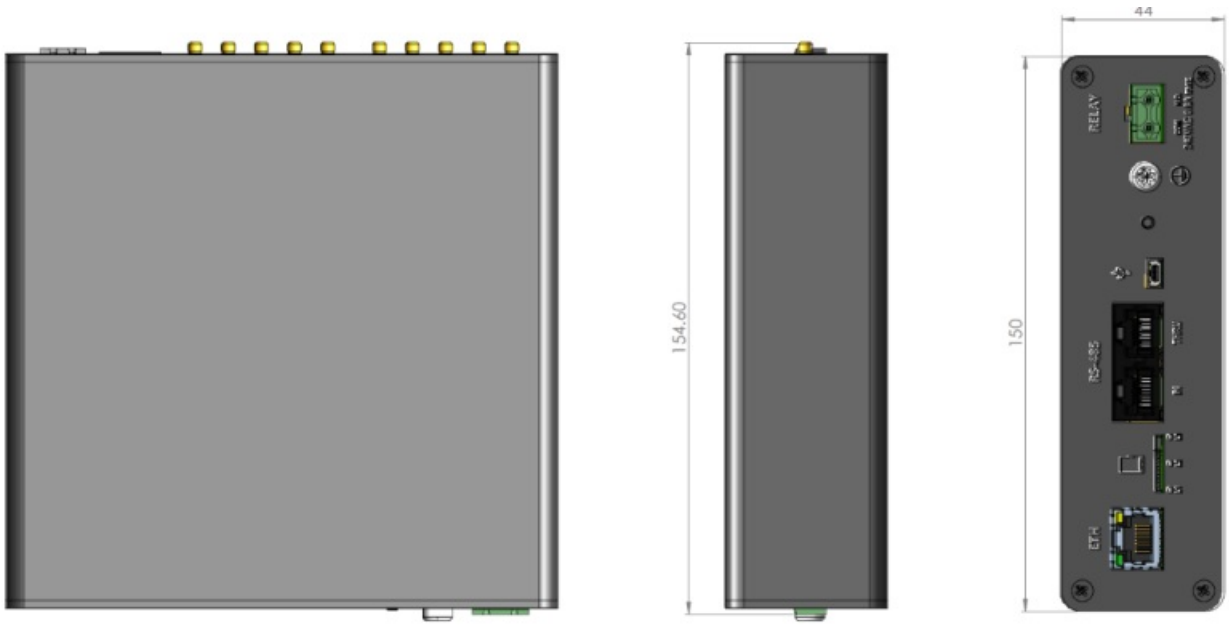


Figure 8: Reader dimensions views

DIN RAIL MOUNTING

CAUTION

ENSURE THAT THE LOW-LEVEL COMPARTMENT WHERE THE READER IS MOUNTED IS SUFFICIENTLY VENTILATED TO PREVENT OVERHEATING. THE DEVICE MUST BE ELECTRICALLY GROUNDED FOR EMC COMPLIANCE.

The reader is designed for installation on a grounded 35 mm DIN rail. It could be mounted in two different positions to facilitate integration.
Using the fixing clip and the two screws provided, screw it onto the box enclosure according to the preferred orientation.
SENSeOR recommends to mount the device vertically with antennas output to the top.

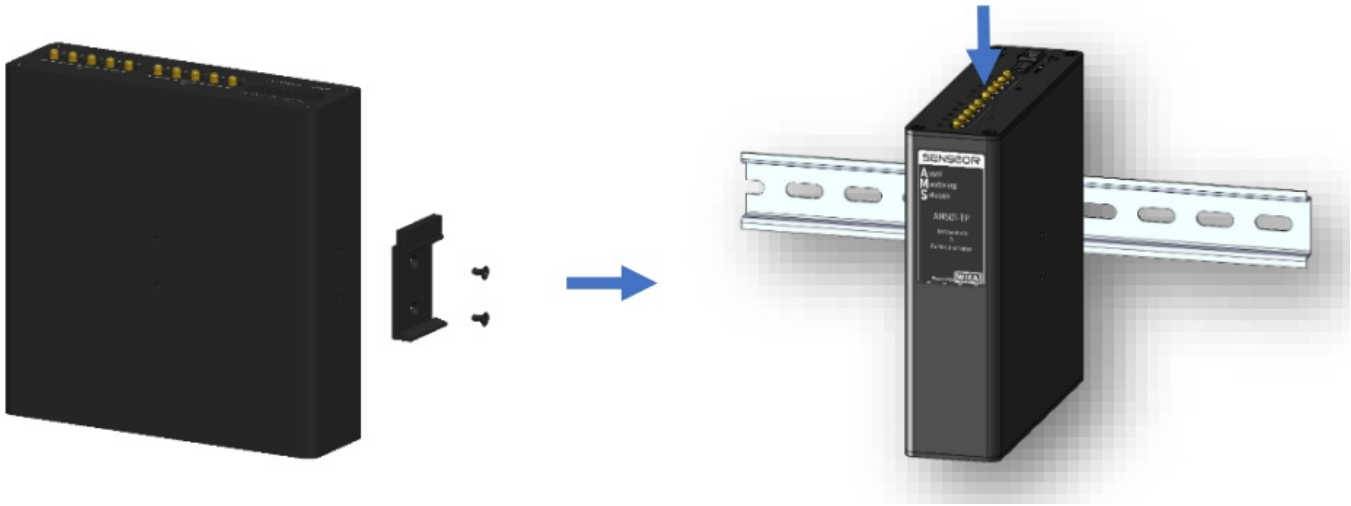


Figure 9: DIN rail fixation – Configuration 1

Figure 10: DIN rail fixation – Configuration 2

READER EMPLACEMENT
The reader is intended to be installed in the low voltage compartment of the switchgear. The other electrical assets are recommended to be weather protected in an enclosed location.

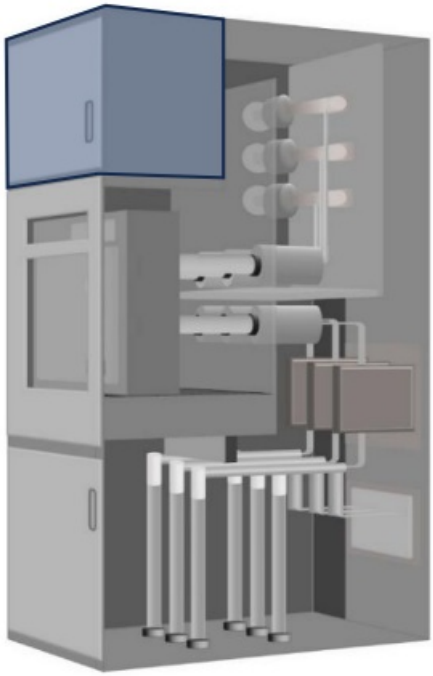
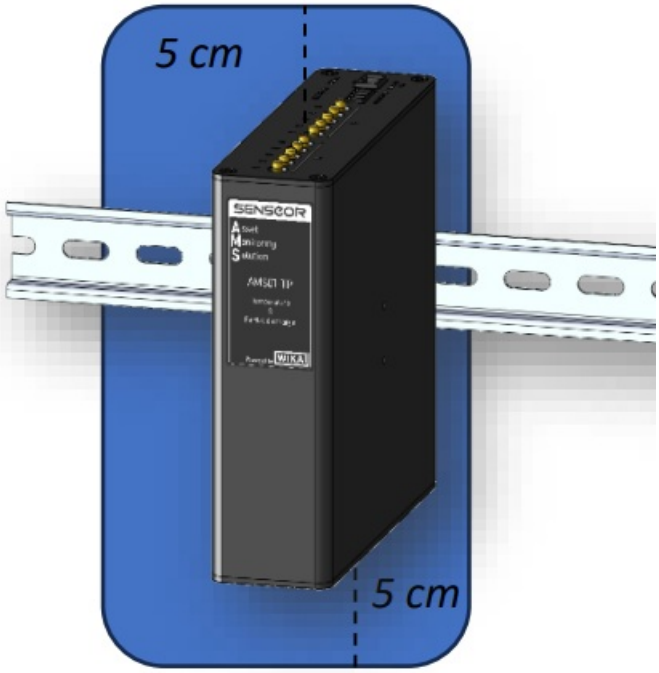


Figure 11: Reader emplacement in switchgear

The reader is required to be installed within a maximum distance of 10 meters from the antennas, corresponding to the maximum length of the antenna coaxial cable for SAW temperature sensors and partial discharge measurement.

RECOMMENDED SPACING
For connectors access, it is recommended to leave the minimum clearance for top and bottom panels of 5 cm (2 inches).



WIRING

POWER
The reader power connector is a 2-pin male connector. This screw connector supports from 16 to 26 AWG wires. For stranded conductor use connector ferrules on the termination.

Figure 13: Connector ferrule

INPUT POWER

The reader operates at 24VDC nominal with a total power consumption of 6 Watts maximum.
SENSeOR recommends the use of a DC power supply in the same low-voltage compartment as the reader. It is possible to run a DC power bus to power multiple readers from one DC power supply. However, this option requires a careful consideration of the wire diameter, AC/DC and circuit breaker capabilities.
Power connections are recommended to be at a minimum of 16 AWG.
If bussed power is being considered, the wire gauge must be selected to prevent excessive voltage drop between the DC power source and the reader that is electrically farthest from the source.
The following block diagram outlines the recommended power wiring for the reader with a 2-pole circuit breaker and an AC/DC power supply. Surge suppression devices can also be installed between the input line and the neutral only if higher safety rating is required.

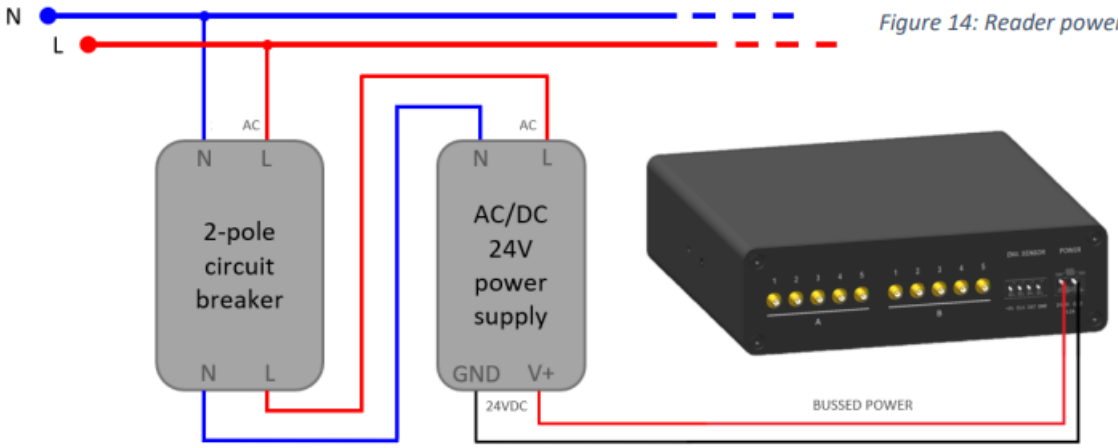


Figure 14: Reader power cabling

RELAY OUTPUT

Output relay connections are recommended to be at a minimum of 16 AWG.

INTERNAL BATTERY

SENSeOR reader has an internal 3VDC non rechargeable battery to keep the UTC date and the time in case of power down. Battery needs to be replaced if voltage value is under 2.1V.
It can be replaced only by authorized person using the following or an equivalent reference

Figure 15: 3V Lithium CR2032 battery

Battery replacement procedure

- Disconnect all the AMS01 reader connections (antennas, environmental sensor, relay and power supply).
- Using a PZ1 screwdriver, disconnect the ground lug and remove the screw.
- Extract the reader from its location on the DIN rail.

- Remove the 4 screws from the front panel.
- Remove the electronic card from the enclosure.
- Identify and replace the CR2032 battery by carefully respecting its polarity.
- Reinsert the electronic card in the enclosure.
- Screw the front panel on the enclosure.
- Reposition the reader on its location on the DIN rail.
- Reconnect the ground lug with the corresponding screw.
- Reconnect all the AMS01 reader connections (antennas, environmental sensor, relay and power supply).

WARNING
THERE IS A RISK OF EXPLOSION IF THE BATTERY IS REPLACED BY AN INCORRECT TYPE.
BE CAREFUL OF USED BATTERY IN ACCORDANCE WITH YOUR REGIONAL LEGAL INSTRUCTIONS.

COMMUNICATION CONNECTIONS

The components are used to connect Modbus devices, energy communication systems and industrial equipment with each other and to SCADA or cloud systems.
The reader could be connected to a network using RS485 Modbus-RTU or Ethernet Modbus-TCP.

CABLING FOR RS485 COMMUNICATION

SENSeOR recommends the use of shielded cable for the RS485 wiring, providing at least one twisted pair, one single line, and a drain wire. Although, a typical recommended cable has two twisted pair. The twisted pair provides DATA ± signals to each reader while the single line would be for D-COM, providing a low-impedance return for each reader.

Figure 16: RS485 daisy chaining

BUS RESISTIVE TERMINATION

The RS485 bus needs to be terminated at each end with a 120 Ohms resistor when long stretches of cable are used. This ensures that the bus has the correct impedance.
However, if the bus length is less than 2% of its maximum (20 meters at 9 600 bauds), the termination resistor may be omitted.
In general, RS485 adapters and master bus provide the source impedance internally and should be located at one end of the bus. If not, use this pinout to cable the resistor.

Pin	Type	Description
1 (left)	–	*Not used*
2	–	*Not used*
3	–	*Not used*
4	120 Ohms	Resistance pin 1
5	120 Ohms	Resistance pin 2
6	–	*Not used*
7	–	*Not used*
8 (right)	–	*Not used*

BUS DATA RATE
The RS485 bus data rate is dependent on the bus cable length and the number of readers on the bus. In industrial environments, slower data communication rates are generally more reliable.

BUS LENGTH
Bus cable length has an impact on the overall data rates that can be achieved. A conservative rule for RS485 follows this equation

- Baud rate x cable length (m) < 10 x 106
- A 9 600 bauds network would require a bus length less than (10 x 106 / 9 600) equals to 1 042 meters (about 3 400 feet). This is perfectly adequate for most substation installations.

NUMBER OF READERS
The more readers on the RS485 bus there are, the weaker the baud rate is. Baud rate must be adjusted to accommodate the electrical characteristics depending on the circuit.
The following table provides an example of recommended baud rate following the number of readers

Number of readers	Recommended baud rate
1	115 200
2	38 400
3	19 200
From 4 to 15	9 600

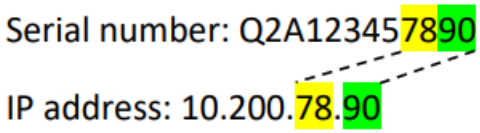
SENSeOR recommends to connect a maximum of 15 readers on a RS485 bus.

MODBUS-RTU DEFAULT CONFIGURATION
By default, the reader is configured with the following settings

- **Baud rate**: 19 200
- **Data bits**: 8
- **Parity:** None
- **Stop bits**: 1

CABLING FOR ETHERNET COMMUNICATION
SENSeOR recommends the use of shielded Cat 5e SFTP cable for the Ethernet wiring. Readers Ethernet network is provided by a fixed configuration more detailed below.

The IP address is defined by the last four digits of the product serial number printed on the side of the reader.



The connected computer must have an IP address in the range of '10.200.AA.BB' subnet and with '255.255.0.0' mask. To avoid any IP addresses conflict between the reader and the computer, 'AA' and 'BB' settings are recommended to be higher or to be equal to the value of '100'.

WARNING
IN CASE OF COMMUNICATION TROUBLES WITH THE 'AMS01 CONFIGURATION TOOL' APPLICATION, CHECK THAT THE FOLLOWING COMMUNICATION PORTS ARE OPENED ON THE COMPUTER: '6560', '5707', '5709' & '5710'.

ENVIRONMENTAL SENSOR CONNECTION
The SENSeOR environmental sensor provides humidity, ambient temperature and dew point measurements recommended to complement the partial discharges data. Connection of this environmental sensor must be done respecting cable colors and connector position.
Use 4-conductor 24 AWG shielded cable with 6-meter maximum length.

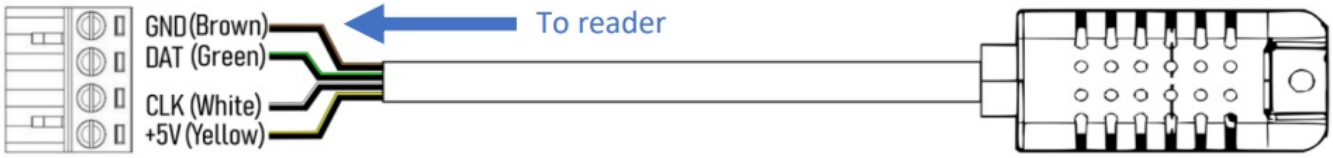


Figure 17: 'AMS01-ENV-SENS' environmental sensor cabling

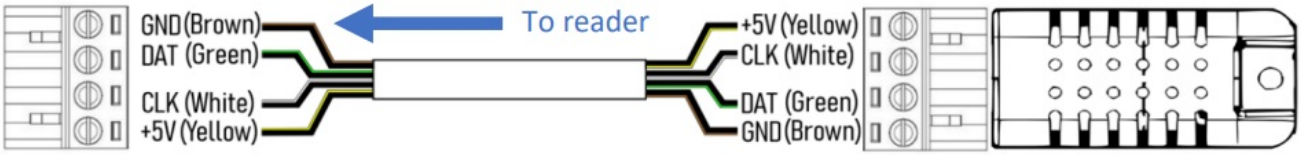


Figure 18: 'EXT-ENV-SENS' environmental sensor cabling

CONNECTING TO EARTH

Figure 19: Reader ground lug cabling

Earth connections must be done using ground lug with a minimum of 16 AWG with ring terminal.

CONNECTING RF ANTENNAS

Antenna installation should respect following pattern. Two antennas by compartment connected to the reader using A and B output connectors.

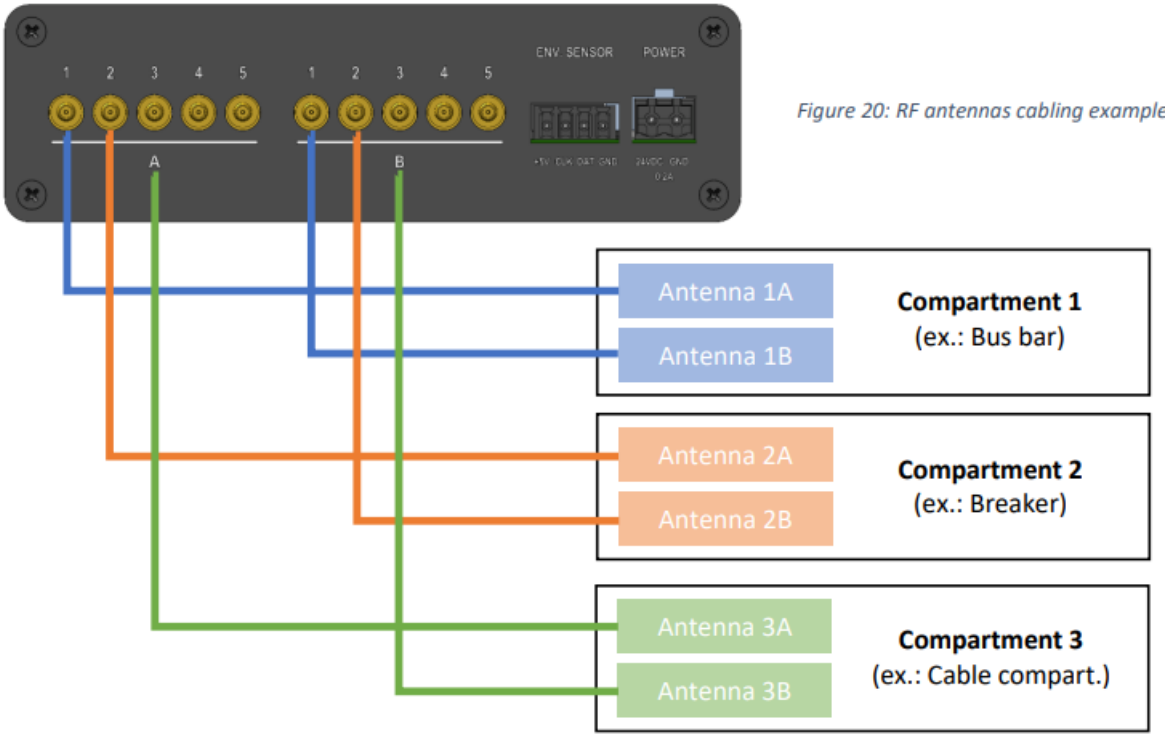


Figure 20: RF antennas cabling example

SYSTEM INSTALLATION AND CONFIGURATION

SAW TEMPERATURE SENSORS INSTALLATION

This manual does not cover all specific SAW temperature sensors installation.

SYSTEM CONFIGURATION

The reader requires a system configuration for the associated installed SAW temperature sensors, the ambient humidity and temperature sensors and the partial discharge probe antennas.
The configuration is performed through the Ethernet network interface and uses the ‘AMS01 Configuration Tool’ application.
For configuration details, see the ‘AMS01 Configuration Tool User Manual’ for detailed instructions.

DFU & NETWORK PARAMETERS RESET

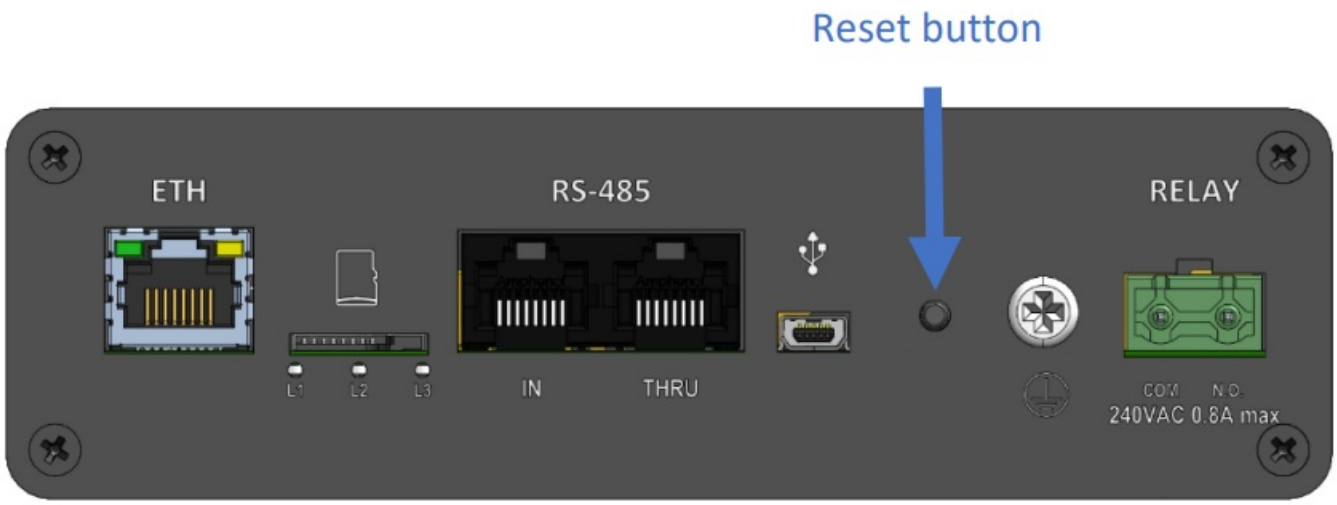


Figure 21: Reset button on front face

DFU MODE
In case of necessity, following procedure will switch the product in DFU mode

- Disconnect the device from power supply.
- Press and hold the Reset button.
- While holding the Reset button, connect the device to power supply.
- **Hold the Reset button until LEDs are flashing with following pattern:** ‘L1’ green and ‘L2’, ‘L3’ red. This can take up to 5 seconds.
- Release the Reset button.

SD CARD
A µSD HC memory card is inserted into the reader and will save all measurements locally.
Please refer to the document ‘UM00419EN-AA_AMS01 SD card file management’ for more information about the files and data format.
SENSeOR recommends to use a 8 Gb µSD card capacity to store a sufficient amount of data.

NETWORK PARAMETERS RESET

WARNING
ONLY ETHERNET SETTINGS ARE LOST (BACK TO DEFAULT VALUES) WHEN DEVICE IS RESET.

- Hold the Reset button until all LEDs are flashing green. This can take up to 15 seconds.
- Release the Reset button.
- Wait until the device is started up. Do not disconnect power supply before the device is started up.

CERTIFICATIONS

CERTIFICATIONS

- RoHS 2011/65/EU and 2015/863/EU
- **IEC 62271-1**: Switchgear, CISPR11
- IEC 61000-4-2, IEC 61000-4-4, IEC 61000-4-17
- IEC 61000-4-18, IEC 61000-4-29
- IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-6, IEC 60068-2-30 IEC 60068-2-6, IEC 60068-2-78
- IEC 60255-21-1, IEC 60255-21-3
- IEC 61010-1

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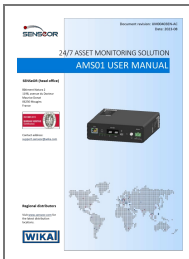
Documents / Resources

	SENSeOR AMS01 Switchgear Temperature And Partial Discharge Monitoring [pdf] User Manual AMS01 Switchgear Temperature And Partial Discharge Monitoring, AMS01, Switchgear Temperature And Partial Discharge Monitoring, Temperature And Partial Discharge Monitoring, Partial Discharge Monitoring, Discharge Monitoring, Monitoring

References

- Switchgear temperature and partial discharge monitoring solution – SENSeOR
- Downloads – Switchgear temperature and partial discharge monitoring solution
- Switchgear temperature and partial discharge monitoring solution – SENSeOR