User Manual

EE850

Duct Sensor for CO_2, Humidity and Temperature

YOUR PARTNER IN SENSOR TECHNOLOGY

E+E ELEKTRONIK® Ges.m.b.H.

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The document may contain technical inaccuracies and typographical errors. The content will be revised on a regular basis. These changes will be implemented in later versions. The described products can be improved and changed at any time without prior notice.

EMC note USA (FCC):

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

EMC note Canada (ICES-003):

CAN ICES-3 (A) / NMB-3 (A)

CONTENT

1 General

This user manual serves for ensuring proper handling and optimal functioning of the device. The user manual shall be read before commissioning the equipment and it shall be provided to all staff involved in transport, installation, operation, maintenance and repair. The user manual may not be used for the purposes of competition without the written consent of E+E Elektronik® and may not be forwarded to third parties. Copies may be made for internal purposes. All information, technical data and diagrams included in these instructions are based on the information available at the time of writing.

Disclaimer
The manufacturer or his authorized agent can be only be held liable in case of willful or gross negligence. In any case, the scope of liability is limited to the corresponding amount of the order issued to the manufacturer. The manufacturer assumes no liability for damages incurred due to failure to comply with the applicable regulations, operating instructions or the specified operating conditions. Consequential damages are excluded from the liability.

1.1 Explanation of Symbols

This symbol indicates safety instructions.
The safety instructions have to be carried out unconditionally. If disregarded, loss, injury, or damage may be inflicted to people or property. In any case E+E Elektronik® Ges.m.b.H. cannot be hold responsible.

This symbol indicates attention.
The note should be observed to achieve an optimum and safe operation of the equipment.

1.2 Safety Instructions

1.2.1 General Safety Instructions

- Avoid any unnecessary mechanical stress and inappropriate use.
- The device shall not be exposed to extreme thermal stress.
- Installation, electrical connection, maintenance and commissioning shall be performed by qualified personnel only.

Please note:
The EE850 is not appropriate for safety, emergency stop or other critical applications where device malfunction or failure could cause injury to humans and other living beings.

1.2.2 Intended Use

The EE850 is intended for CO_2, humidity (RH) and temperature (T) measurement in ducts. Its typical application is in demand controlled ventilation and building automation. Due to its wide measuring ranges and its insensitiveness to pollution, the EE850 can be employed in demanding climate and process control as well.

The sensor is available with two different probe lengths and analogue and digital outputs. The analogue outputs can be current or voltage outputs and provide the measured values as well as the calculated value for the dew point temperature (Td). The RS485 interface with Modbus RTU or BACnet MS/TP protocol also supplies other calculated parameters such as absolute humidity (dv), mixing ratio (r), water vapour partial pressure (e) or enthalpy (h).

The use of the EE850 in any other way than described in this manual bears a safety risk for people and the entire measurement installation and is therefore not allowed.
The manufacturer cannot be hold responsible for damages as a result of incorrect handling, installation, and maintenance of the equipment.

In order to avoid damage to the instrument or health hazards, the measuring equipment must never be manipulated with tools that are not specifically described in this manual.

The sensor may only be utilized in accordance with the conditions defined in the technical data. Otherwise, measurement inaccuracies will occur and equipment failures cannot be ruled out.

The steps recommended by the manufacturer for installation, inspections and maintenance work must be observed and carried out for the safety of the user and for the functionality of the equipment.

Unauthorized product modification leads to loss of all warranty claims. This may be accomplished only with an explicit permission of E+E Elektronik®!

1.2.3 Installation, Start-up and Operation

The EE850 duct sensor has been designed and produced under state of the art manufacturing conditions, has been thoroughly tested and has left the factory after fulfilling all safety criteria. The manufacturer has taken all actions to assure safe operation. The user has to make sure that the equipment is positioned and installed in such a way that safe operation is not impaired. The user is responsible for observing all applicable safety guidelines, local and international, with respect to safe installation and operation on the device.

This manual contains information and notes of caution, which have to be followed by the user to assure safe operation.

- Mounting, electrical installation, putting into operation and maintenance may be performed by qualified personnel only. Such staff must be authorized by the operator of the facility to carry out the mentioned activities.
- The qualified staff must have read and understood this manual and must follow the instructions contained within.
- All process and electrical connections shall be thoroughly checked by authorized staff before putting the device into operation.
- Do not put damaged products into operation and protect them from accidental commissioning. Mark the damaged product as defective.
- A faulty device may only be investigated and possibly repaired by qualified, trained and authorized staff. If the fault cannot be fixed, the device shall be removed from the process.
- Service operations other than described in this user manual may only be performed by the manufacturer.

1.3 Environmental Aspects

Products from E+E Elektronik® are developed and designed due to consideration of the importance of environmental protection. Therefore, disposal of the product also should not lead to pollution of the environment.

Single-variety components must be separated before the transmitter is disposed of. The electronic components must be collected and as electronic scrap properly disposed of.

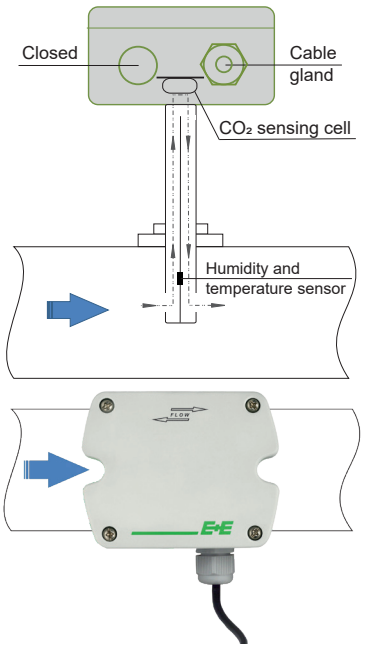
2 Scope of Supply

- EE850 sensor according ordering guide
- Cable gland
- Mounting flange + seal
- Mounting material
- Two self-adhesive labels for configuration changes (see user guide at www.epluse.com/relabeling)
- Test report according to DIN EN10204-2.2
- Quick user guide

3 Product Description

3.1 General

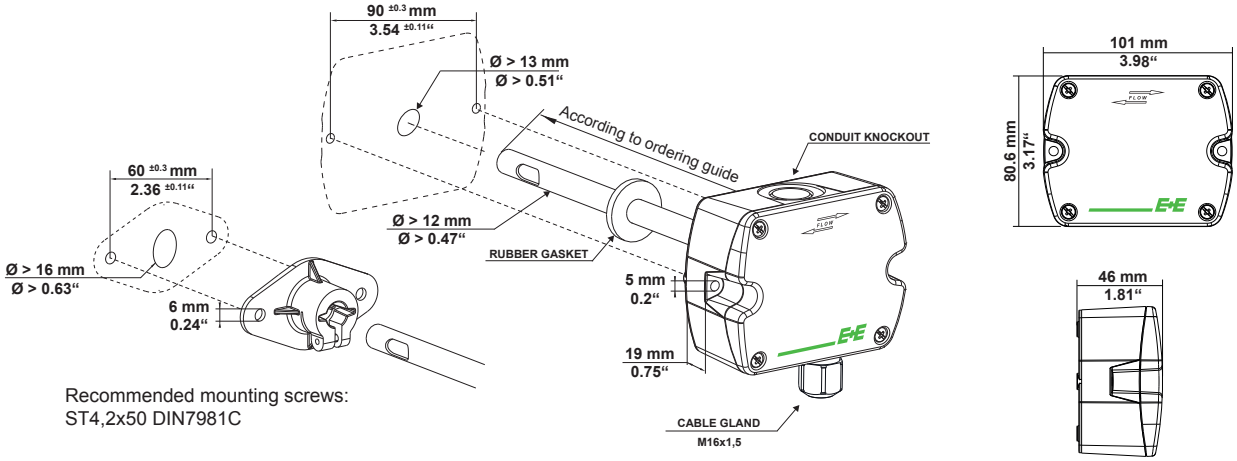
Installed into a duct, a small amount of air flows through the divided probe into the EE850 enclosure, where the CO_2 sensing cell is located, and back into the duct. The RH and T sensing elements are placed inside the probe.



Very important
For accurate measurement the cover of EE850 as well as the cable outlet – cable gland or conduit adapter – must be closed tightly. This is essential for avoiding ingress of air other than from the duct into the EE850 enclosure, which would falsify the measurement.

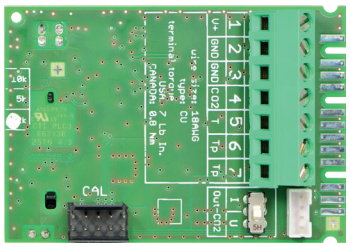
Please note: The direction of air flow in the duct shall correspond to the direction indicated with arrows on the EE850 cover. Depending on the EE850 version, the response time specified is only valid for direction marked with the blue arrow with respect to the cable gland position. Air flow in the opposite direction might lead to longer response time.

3.2 Installation



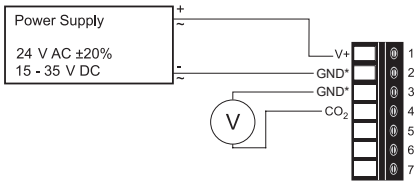
EE850 with conduit connection for the North American market: use a flat screwdriver to carefully break open the plastic knockout at the marked location, in order to avoid damaging the electronics inside the enclosure. The conduit adapter is not included in the scope of supply.

3.3 Electrical Connection

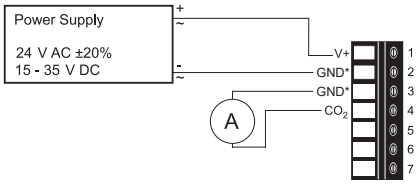


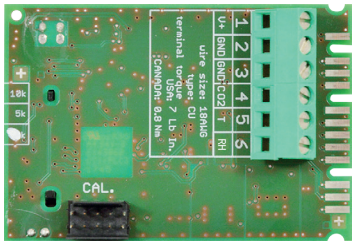
EE850-M10 and EE850-M11

EE850-M10 / voltage output



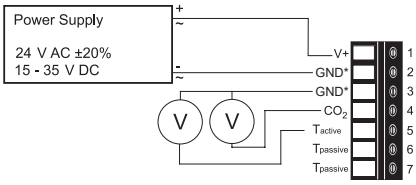
EE850-M10 / current output



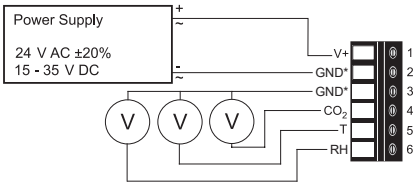


EE850-M12

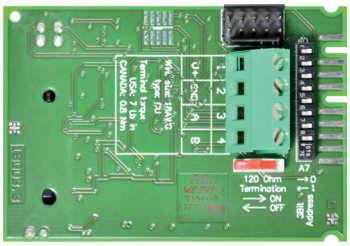
EE850-M11 / voltage output



EE850-M12 / voltage output

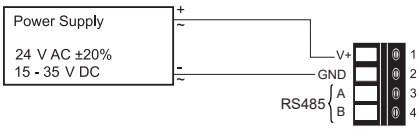


* **Very important:** For failure-free operation and performance according to the specs the supply GND and the measurement GND must be wired separately.



EE850-M1xJ3

EE850-M1xJ3 / digital output

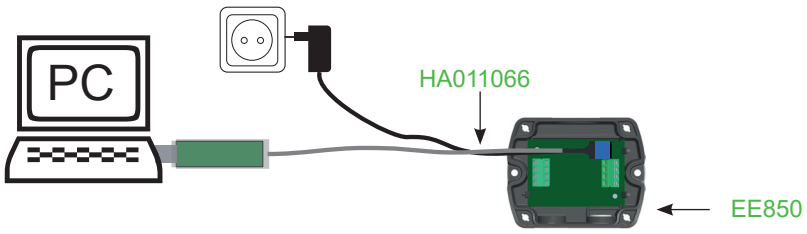


3.4 Setup and Adjustment

The EE850 is ready to use and does not require any configuration by the user. The factory setup of EE850 corresponds to the type number ordered. For ordering guide please see data sheet at www.epluse.com/EE850.

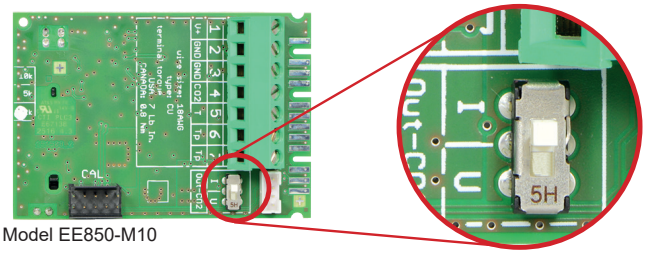
If needed, the user can change the factory setup by using the optional USB Configuration Adapter (HA011066) and the Product Configuration Software (EE-PCS). One can change the CO_2 output signal, the scaling of the outputs and perform CO_2, RH and T adjustment/calibration.

Please note: The EE850 may not be connected to any additional power supply when using the USB Configuration Adapter (HA011066).



MODEL EE850-M10:

Select the CO_2 output signal:
The output signal can be changed from voltage to current or vice-versa.
Set the output signal selection switch to I for current 4 - 20 mA output or to U for voltage 0 - 10 V output.
The original CO_2 output range does not change and the calibration data remains valid.



Model EE850-M10

Example:
Factory setup: voltage output (U), output scale: 0 - 10 V = 0...5000 ppm
User setup (after setting the output signal selection switch to I): current output (I), output scale: 4 - 20 mA = 0...5000 ppm.

MODELS EE850-M11 and EE850-M12:

Changing the CO_2 and T output scale:
The scaling of the output can be changed by using USB Configuration Adapter (HA011066) and Product Configuration Software (EE-PCS).

Example:

The initial scaling of the outputs is:		*The output scale after the change is:*	
CO_2:	*0 - 10 V = 0...5000 ppm*	*CO_2:*	*0 - 10 V = 400...4000 ppm*
T:	*0 - 10 V = 0...50 °C*	*T:*	*0 - 10 V = 40...100 °F*
RH:	*0 - 10 V = 0...100 % RH*	*Td:*	*0 - 10 V = -20...40 °C*

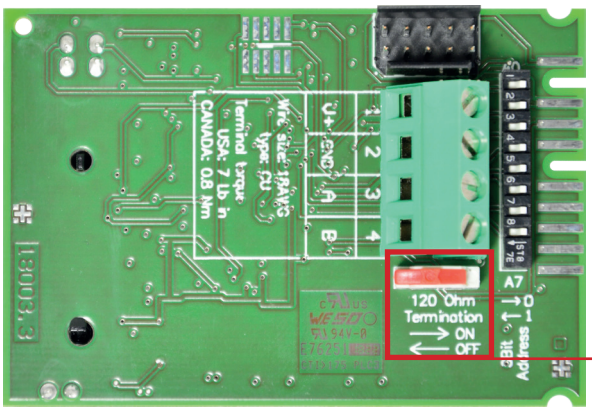
Please note:
- After changing the factory setup (output signal and/or output scale) the original type number on the EE850 identification label loses its validity; it does not match any longer the device setup.
- The return to factory setup function of EE-PCS restores the original adjustment/calibration of the device, but does not affect the user setup for output signal and output scale.

The Product Configuration Software (EE-PCS) is available for free download at
www.epluse.com/configurator.

3.5 Digital Settings

3.5.1 Bus Termination Resistor

Hardware:
The bus termination shall be realized with the 120 Ohm resistor (slide switch on the board).

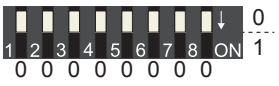


Bus termination resistor 120 Ω (ON-OFF slide switch)

Very important:
For proper function the power supply must be strong enough to ensure supply voltage within the specified range (see technical data) at any time and at all devices in the bus. This is particularly relevant when using long and thin cables which can cause high voltage drop. Please note that a single EE850 requires peak current of 350 mA.

3.5.2 Address Setting

Address Switch



Address setting via EE-PCS Product Configuration Software:
All DIP switches at position 0 → address has to be set via PCS
Modbus (Slave device): factory setting EE850: 67 (permitted values: 1…247).
BACnet (Master device): factory setting EE850: 67 (permitted values: 0…127).
Example: Slave address is set via configuration software.

Address Switch

Address setting via DIP switch:
Modbus (Slave device): Setting the DIP switches to any other address than 0, overrules the slave address set via configuration software
(permitted values: 1…247).
BACnet (Master device): Setting the DIP switches to any other address than 0, overrules the slave address set via configuration software.
BACnet Note: permitted values are 0…127.
The 8th bit of the DIP switches is ignored (ID 127 = 0111 111).
To set address 0 via DIP switches, the 8th bit shall be set to 1
(ID 0 = 1000 0000).
Example: Slave address set to 11 (= 0000 1011 binary).

3.5.3 BACnet Setup

Please see PICS (Product Implementation Conformance Statement) - available at
www.epluse.com/EE850

3.5.4 Modbus Setup

Item	Factory settings	Selectable values (via EE-PCS)
Baud rate	9 600	9 600, 19 200, 38 400, 57 600, 76 800, 115 200
Data bits	8	8
Parity	Even	None, odd, even
Stop bits	1	1, 2
Slave address	67	1...247

Tab. 1 Digital interface default settings

The recommended settings for multiple devices in a Modbus RTU network are 9600, 8, even, 1. The EE850 represents 1/10 unit load on an RS485 network.

Device address, baud rate, parity and stop bits can be set via:
1. EE-PCS Product Configuration Software and the Modbus configuration adapter HA011066. The EE-PCS can be downloaded free of charge from www.epluse.com/configurator
2. Modbus protocol in the register 60001 (0x00) and 60002 (0x01). See Modbus Application Note AN0103 (available on www.epluse.com/EE850)

The serial number as ASCII code is located in the register addresses 0x00...0x07 (16 bits per address). The firmware version is located in the register address 0x08 (bits 15...8 = major release; bits 7...0 = minor release). The beforementioned registers can be read out with function code 0x03 or 0x04.

The measured data is saved as 32 bit floating point values (data type FLOAT) and as 16 bit signed integer values (data type INTEGER).

FLOAT 32 bit			
Parameter	**Unit**	**Register number[1] [DEC]**	**Register address[2] [HEX]**
Read register: function code 0x03			
Temperature T	° C	1003	0x3EA
	° F	1005	0x3EC
Relative Humidity	%	1021	0x3FC
CO_2 (average)	ppm	1061	0x424
CO_2 (raw)	ppm	1063	0x426
Water vapour partial pressure	mbar	1101	0x44C
	psi	1103	0x44E
Dew point temperature	°C	1105	0x450
	°F	1107	0x452
Absolute humidity	g/m^3	1113	0x458
	gr/ft^3	1115	0x45A
Mixing ratio	g/kg	1121	0x460
	gr/lb	1123	0x462
Specific enthalpy	kJ/kg	1125	0x464
	ft lb/lb	1127	0x466
	BTU/lb	1129	0x468
Frost point temperature	°C	1131	0x46A
	°F	1133	0x46C

1) Register number starts from 1
2) Register address starts from 0

INTEGER 16 bit				
Parameter	**Unit**	**Scale[3)]**	**Register number[1)] [DEC]**	**Register address[2)] [HEX]**
Read register: function code 0x03				
Temperature T	° C	100	4002	0xFA1
	° F	50	4003	0xFA2
Relative Humidity	%	100	4011	0xFAA
CO_2 (average)	ppm	1	4031	0xFBE
CO_2 (raw)	ppm	1	4032	0xFBF
Water vapour partial pressure	mbar	10	4051	0xFD2
	psi	1000	4052	0xFD3
Dew point temperature	°C	100	4053	0xFD4
	°F	100	4054	0xFD5
Absolute humidity	g/m^3	10	4057	0xFD8
	gr/ft^3	10	4058	0xFD9
Mixing ratio	g/kg	10	4061	0xFDC
	gr/lb	10	4062	0xFDD
Specific enthalpy	kJ/kg	1	4063	0xFDE
	ft lb/lb	1	4064	0xFDF
	BTU/lb	1	4065	0xFE0
Frost point temperature	°C	100	4066	0xFE1
	°F	100	4067	0xFE2

1) Register number starts from 1
2) Register address starts from 0
3) Examples: For scale 100, the reading of 2550 means a value of 25.5. For scale 50, the reading of 2550 means a value of 51.

Communication settings (INTEGER 16 bit)		
Parameter	**Register number[1)] [DEC]**	**Protocol address[2)] [HEX]**
Write register: function code 0x06		
Slave ID (Modbus address)[3)]	1	0x00
Modbus protocol settings[4)]	2	0x01

1) Register number starts from 1.
2) Protocol address starts from 0.
3) If the ID is set via DIP switch the response will be NAK.
4) For Modbus protocol settings see Application Note Modbus AN0103 (available on www.epluse.com/EE850).

INFO (read register)		
Parameter	**Register number[1)] [DEC]**	**Protocol address[2)] [HEX]**
Read register: function code 0x03 / 0x04		
Serial number (as ASCII)	1	0x00
Firmware version	9	0x08

1) Register number starts from 1.
2) Protocol address starts from 0.

3.6 Modbus RTU Example

Example of MODBUS RTU command for reading the CO_2 (float value) CO_2 = 1288,34375 ppm from the register 0x424

Device EE850; slave ID 67 [0x43]
Reference document, chapter 6.3: http://www.modbus.org/docs/Modbus_Application_Protocol_V1_1b3.pdf

Request [Hex]: 43 03 04 24 00 02 8A 12

	Modbus ID address	Function code	Starting address Hi	Starting address Lo	No. of register Hi	No. of register Lo	CRC	
Request [Hex]:	43	03	04	24	00	02	8A	12

Response [Hex]: 43 03 04 0B 00 44 A1 68 AB

	Modbus ID address	Function code	Byte count	Register 1 value Hi	Register 1 value Lo	Register 2 value Hi	Register 2 value Lo	CRC	
Response [Hex]:	43	03	04	0B	00	44	A1	68	AB

Decoding of floating point values:

Floating point values are stored according IEEE 754 standard. The byte pairs 1, 2 and 3, 4 are inverted as follows:

MMMMMMMM	MMMMMMMM	SEEEEEEE	EMMMMMMM
Byte 3	Byte 4	Byte 1	Byte 2

Example:

Response [Hex]				Decimal value
Byte 1 (Register 2 - Hi)	Byte 2 (Register 2 - Lo)	Byte 3 (Register 1 - Hi)	Byte 4 (Register 1 - Lo)	
44	A1	0B	00	1288.34375

4 Technical Data

Measurands

CO_2

Measurement principle	Dual wavelength non-dispersive infrared technology (NDIR)	
Measuring range	0...2000 / 5000 / 10000 ppm	
Accuracy at 25 °C (77 °F) and 1013 mbar (14.7 psi)	0...2000 ppm:	< ± (50 ppm +2% of measured value)
	0...5000 ppm:	< ± (50 ppm +3% of measured value)
	0...10000 ppm:	< ± (100 ppm +5% of measured value)
Response time t_{63}	< 100 s at 3 m/s (590 ft/min) air speed in the duct	
Temperature dependency, typ.	± (1 + CO_2 concentration [ppm] / 1000) ppm/°C, for -20...45 °C (-4...113 °F)	
Calibration interval[1)]	> 5 years	
Measuring interval	Approx. 15 s	

Temperature

Working range	-20...60 °C (-4...140 °F)	
Accuracy at 20 °C (68 °F)	± 0.3 °C (± 0.54 °F)	
Response time t_{63}	< 50 s	

Relative Humidity

Working range	0...95 % RH	
Accuracy at 20 °C (68 °F)	± 3 % RH (20...80 % RH)	
Response time t_{63}	< 10 s	

Outputs

Analogue

CO_2: 0...2000 / 5000 / 10000 ppm	0 - 5 V / 0 - 10 V	-1 mA < I_L < 1 mA
	4 - 20 mA	R_L < 500 Ohm
T scale: according ordering guide **RH** scale: 0...100 % RH	0 - 5 V / 0 - 10 V	-1 mA < I_L < 1 mA
Digital Interface	RS485	EE850 = 1/10 unit load
Protocol	Modbus RTU or BACnet MS/TP	
Passive temperature, 2-wire	T sensor type according ordering guide	
Wire resistance (terminal - sensor), typ.	0.4 Ω	

General

Power supply class III ⧫	24 V AC/DC ± 20 % 15-35 V DC	
Current consumption average	Typ. 15 mA + output current	
peak	Max. 350 mA for 0.3 s	
Minimum air speed in the duct	1 m/s (196 ft/min)	
Enclosure material	Polycarbonate, UL94V-0 approved	
Protection class	Enclosure: IP65 / NEMA 4 Probe: IP20	CE
Cable gland	M16 x 1.5	
Electrical connection	Screw terminals max. 2.5 mm² (AWG 14)	
Electromagnetic compatibility	EN61326-1 EN61326-2-3 Industrial Environment FCC Part 15 ICES-003 ClassB	
Working and storage conditions	-20...60 °C (-4...140 °F) 0...95 % RH (non-condensing)	

1) under normal operating conditions

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