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# Datasheet EE360

## High-End Moisture in Oil Sensor



# EE360

## High-End Moisture in Oil Sensor

EE360 is dedicated for reliable monitoring of lubrication, hydraulic and insulation oils as well as diesel fuel. In addition to highly accurate measurement of water activity (aw) and temperature (T), EE360 calculates the absolute water content (x) in ppm.

### Measurement Performance

The EE360 employs high-end E+E humidity sensing elements manufactured in state-of-the-art thin film technology, which are the prerequisite for outstanding measurement accuracy.

### Process Connection

The sensing probe can be employed up to 180 °C (356 °F), 20 bar (290 psi) and is available with either ISO or NPT slide fitting, which allows for variable immersion depth. Using the optional ball valve, the probe can be mounted or removed even without process interruption.

### Enclosure

The EE360 features an IP65/NEMA 4X polycarbonate or stainless steel enclosure which facilitates installation and maintenance. The enclosure can accommodate a 100 - 240 V AC supply unit or various extension modules.

### Display and Outputs

The measured data is available on two analogue outputs, on the RS485 (Modbus RTU) or Ethernet-PoE (Modbus TCP) interface and on the alarm (relay) outputs.

The TFT colour display shows up to four measurands simultaneously and offers extensive setup and diagnosis features. The data logging function saves up to 20 000 measured values for each physical quantity. The logged data can be displayed graphically directly on the device or easily downloaded via the USB interface.

### Configurable and Adjustable

The configuration and adjustment of the EE360 can be performed either using the display and the push buttons or with the free E+E PCS10 Product Configuration Software via the USB interface.



EE360 with stainless steel enclosure



EE360 with polycarbonate enclosure

# Features

## 3.5" TFT colour display

- Shows up to 4 measurands simultaneously
- Layout and measurands freely selectable
- Data logger for 20 000 values per measurand
- Logged data shown graphically
- Diagnosis functions
- Intuitive device setup with push buttons

## Enclosure

- IP65/NEMA 4X protection rating
- Polycarbonate or stainless steel
- Easy mounting and service
- Screws secured in cover

## USB service interface

- Download logged data
- Perform configuration, adjustment and firmware update
- 4 status LEDs

## Outputs

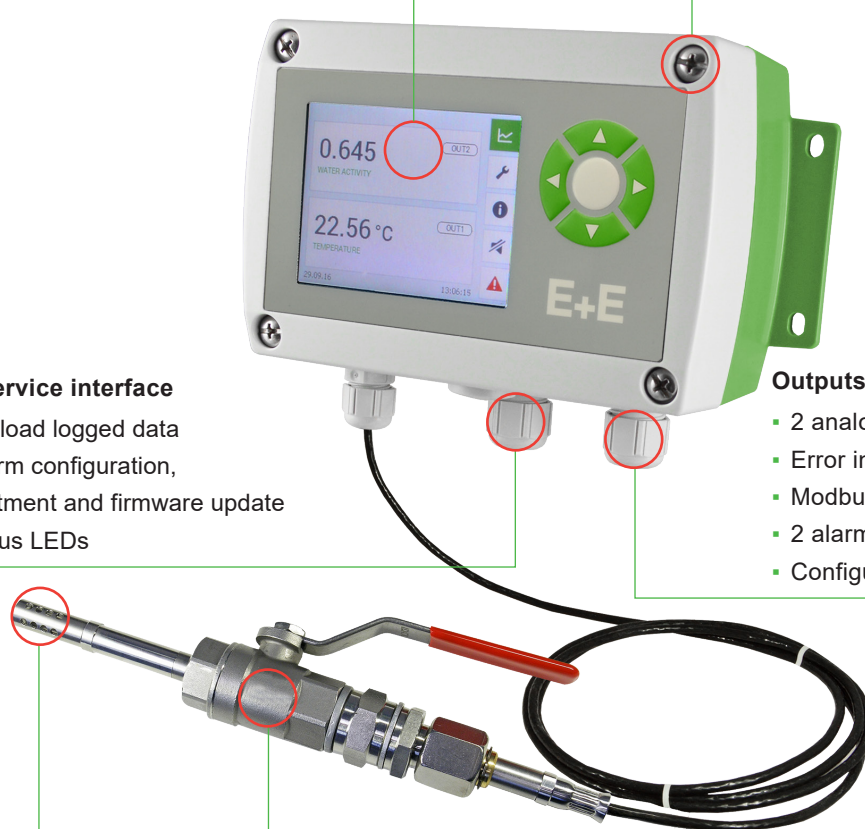
- 2 analogue outputs current/voltage
- Error indication according NAMUR
- Modbus RTU/Modbus TCP
- 2 alarm outputs
- Configurable via display or software

## Ball valve set

- Probe mounting and removal without process interruption

## Probe

- Oil temperature -40...+180 °C (-40...+356 °F)
- Pressure tight up to 20 bar (290 psi)
- ISO or NPT process connection
- Pluggable probe option



## Inspection certificate

According to DIN EN 10204-3.1

# Features

## Water activity $a_w$ / Water content $x$

The moisture in oil can be expressed in absolute or relative terms.

**Water activity  $a_w$**  is the relative measure for moisture in oil. It represents the ratio between the actual amount of dissolved water and the maximum possible amount of dissolved water in the oil at a certain temperature. Independently of the oil type, the water activity shows how close to saturation is the oil at any moment in time.

- $a_w = 0$  indicates completely dry oil
- $a_w = 1$  indicates fully saturated oil

EE360 measures directly the water activity.

**Water content  $x$**  is an absolute measure equal to the amount of water in the oil. The water content is measured in ppm (parts per million) and is independent from the oil temperature. For assessing how far is the oil from saturation,  $x$  must be regarded together with  $T$ .

EE360 calculates  $x$  out of the measured  $a_w$  and  $T$  values. The calculation is oil dependent and requires a set of oil specific parameters.

## Sensor Leads Protection

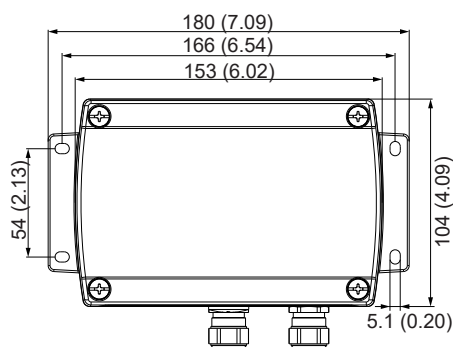
In certain applications, the oil can become corrosive over time, for example due to continuous contamination of lubricating oils by salt water in the maritime environment. In such demanding applications, the E+E proprietary protection of the sensing element leads can significantly extend the service life of the sensor.

# Dimensions

Values in mm (inch)

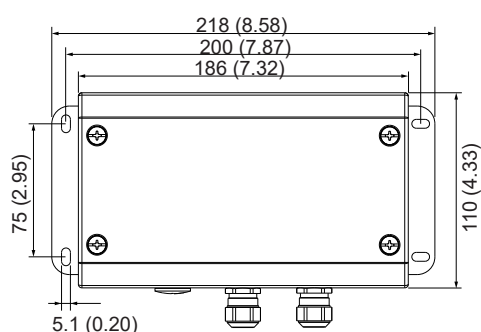
## Enclosure

Polycarbonate



## Enclosure

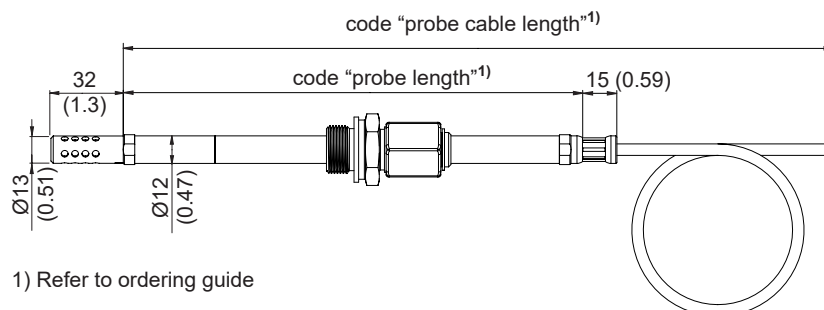
Stainless steel



# Dimensions

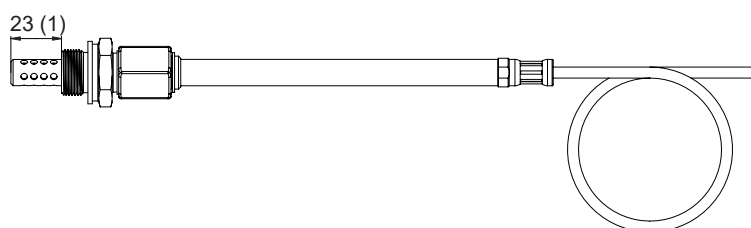
Values in mm (inch)

## Probe



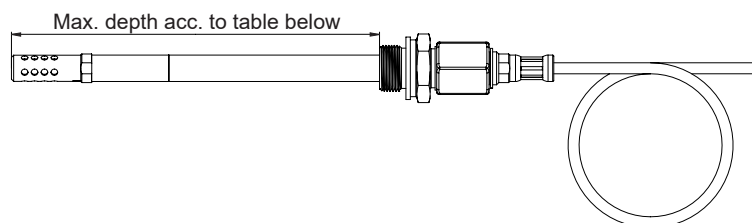
## Probe

Minimum insertion depth



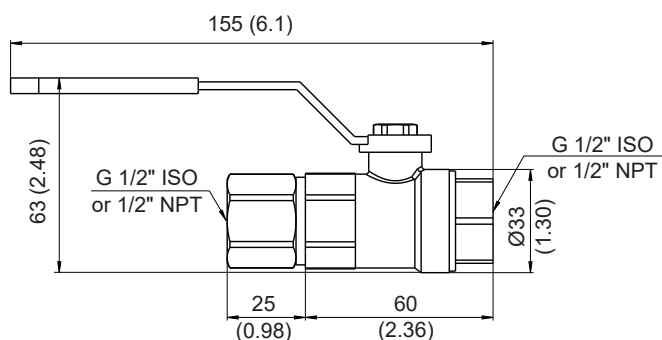
## Probe

Maximum insertion depth



## Ball valve set G 1/2" ISO or NPT

Probe length [mm (inch)]	Max. insertion depth [mm (inch)]
100 (2.5)	64 (3.9)
200 (6.5)	164 (7.9)
400 (14.3)	364 (15.8)
600 (22.2)	564 (23.6)
800 (30.1)	764 (31.59)
1000 (38.0)	964 (39.4)



# Technical Data

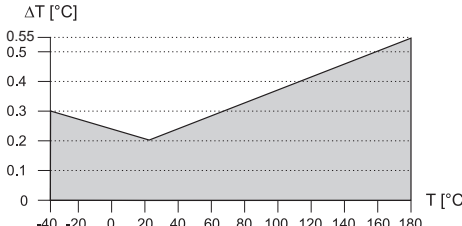
## Measurands

### Water Activity (aw) / Water Content (x)

Measuring range	0...1 aw 0...100000 ppm; actual range depends on the oil type, for non-mineral transformer oil, specific solubility parameters are needed (ppm output is valid in the range 0...100 °C (32...212 °F))		
Accuracy <sup>1)</sup> -15...+40 °C (5...+104 °F) -15...+40 °C (5...+104 °F) -25...+70 °C (-13...+158 °F) -40...+180 °C (-40...+356 °F)	(0...0.9 aw) (0.9...1 aw)	±(0.013 + 0.3%*mv) aw ±0.023 aw ±(0.014 + 1%*mv) aw ±(0.015 + 1.5%*mv) aw	mv = measured value
Temperature dependency of electronics, typ.	±0.0001 aw/°C (±5.6 * 10 <sup>-5</sup> aw/°F)		
Response time t <sub>90</sub> , typ. @ 20 °C (68 °F) in still oil	10 min.		

1) Including hysteresis, non-linearity and repeatability, traceable to intern. standards, administrated by NIST, PTB, BEV...  
The accuracy statement includes the uncertainty of the factory calibration with an enhancement factor k=2 (2-times standard deviation).  
The accuracy was calculated in accordance with EA-4/02 and with regard to GUM (Guide to the Expression of Uncertainty in Measurement).

### Temperature (T)

Probe measuring range	-40...+180 °C (-40...+356 °F)		
Accuracy <sup>1)</sup>			
Temperature dependency of electronics, typ.	±0.005 °C/°C (±0.016 °F/°F)		

1) Traceable to international standards, administrated by NIST, PTB, BEV...  
The accuracy statement includes the uncertainty of the factory calibration with an enhancement factor k=2 (2-times standard deviation).  
The accuracy was calculated in accordance with EA-4/02 and with regard to GUM (Guide to the Expression of Uncertainty in Measurement).

## Outputs

### Analogue




Two analogue outputs freely selectable and scalable	0 - 1 / 5 / 10 V 4 - 20 mA 3-wire 0 - 20 mA 3-wire	-1 mA < I <sub>L</sub> < 1 mA R <sub>L</sub> < 500 Ohm R <sub>L</sub> < 500 Ohm	I <sub>L</sub> = load current R <sub>L</sub> = load resistance
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### Digital

Digital interface	RS485 (EE360 = 1 unit load)		
Protocol Factory settings Supported Baud rates Measured data types	Option J3	Modbus RTU 9600 Baud, parity even, 1 stop bit, Modbus address 231 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 76800 FLOAT32 and INT16	
Protocol	Option J4	Ethernet-PoE Modbus TCP	

# Technical Data

## General

<b>Power supply</b> class III  USA & Canada: Class 2 supply necessary, max. voltage 30 V DC	8 - 35 V DC      12 - 30 V AC 100 - 240 V AC, 50/60 Hz with Option AM3 <sup>1)</sup>
<b>Current consumption</b> , typ. @ 24 V DC/AC  <b>for 2 voltage outputs</b> <b>for 2 current outputs</b> <b>additional for display</b> <b>additional for Ethernet</b>	15 mA and 40 mA <sub>rms</sub> 35 mA and 100 mA <sub>rms</sub> 50 mA and 150 mA <sub>rms</sub> 30 mA and 90 mA <sub>rms</sub>
<b>Electrical connection</b>	Screw terminals max. 1.5 mm <sup>2</sup> (AWG 16)
<b>Cable glands</b>  <b>for polycarbonate enclosure</b> <b>for metal enclosure</b>	M16x1.5, for cable Ø3 - 7 mm (0.12 - 0.28") M16x1.5, for cable Ø4.5 - 10 mm (0.18 - 0.39")
<b>Pressure working range with pressure-tight probe</b>	0.01...20 bar (0.15...300 psi)
<b>Temperature range</b>  <b>Operation</b> <b>Storage</b>	-40...+60 °C (-40...+140 °F) without display -20...+50 °C (-4...+122 °F) with display
<b>Material</b>  <b>Probe</b> <b>Enclosure</b>	Stainless steel 1.4404 (AISI 316L) PC (Polycarbonate), UL94-V0 approved Stainless steel 1.4404 (AISI 316L)
<b>Protection rating</b>	IP65 / NEMA 4X
<b>Electromagnetic compatibility</b>	EN 61326-1      EN 61326-2-3      Industrial environment FCC Part15 Class A      ICES-003 Class A
<b>Conformity</b>	 
<b>Two alarm outputs, with option AM2<sup>1)</sup></b>	Changeover contact 250 V AC / 6 A      28 V DC / 6 A
<b>Configuration software</b>	E+E PCS10 Product Configuration Software Free download from <a href="http://www.epluse.com/pcs10">www.epluse.com/pcs10</a>

1) Degree of pollution 2, overvoltage category II, altitude up to 3000 m (9843 ft).

# Ordering Guide

	Feature	Description	Code
Hardware Configuration			<b>EE360-</b>
	Enclosure material	PC (Polycarbonate)	No code
		Stainless steel	HS2
	Filter	Stainless steel, for flow <1 m/s (<3.3 ft/s)	No code
		Stainless steel, for flow >1 m/s (>3.3 ft/s)	F18
	Probe Cable Length (incl. probe length)	2 m (6.6 ft)	No code
		5 m (16.4 ft)	K5
		10 m (32.8 ft)	K10
		20 m (65.6 ft)	K20
	Probe length	100 mm (3.94")	L100
		200 mm (7.87")	No code
		400 mm (15.75")	L400
		600 mm (23.62")	L600
		800 mm (31.50")	L800
		1000 mm (39.37")	L1000
	Process connection	G 1/2" ISO - slide fitting, Ø13 mm (0.51")	No code
		1/2" NPT - slide fitting, Ø13 mm (0.51")	PA25
	Electrical connection	Cable glands	No code
		1 x plug for power supply and outputs	E4
		1 x cable gland and 1 plug for Modbus RTU (requires option J3)	E5
		2 x plugs for power supply + outputs and Modbus RTU (requires option J3)	E6
		3 x plugs for power supply + outputs and Modbus RTU (requires option J3) <sup>1)</sup>	E12
	Optional features	3.5" TFT display with integrated data logger	D2
		RS485 module - Modbus RTU	J3
		Ethernet module - Modbus TCP <sup>1)2)</sup>	J4
		Pluggable probe <sup>1)</sup>	PC4
		Sensing element protection (Sensor leads protection)	C2
		Alarm outputs (Relay module with cable glands) <sup>2)</sup>	AM2
		Integrated power supply (100 - 240 V AC, 50/60 Hz), with connector <sup>2)3)</sup>	AM3
Setup (Analogue) Outputs	Output 1 measurand	Water activity aw [1]	No code
		Water content x [ppm]	MA70
		Temperature T [°C]	MA1
		Temperature T [°F]	MA2
	Output signal 1 <sup>4)</sup>	0 - 1 V	GA1
		0 - 5 V	GA2
		0 - 10 V	GA3
		0 - 20 mA	GA5
		4 - 20 mA	GA6
	Output 1 scaling low	0	No code
		Value	SALValue
	Output 1 scaling high	1	No code
		Value	SAHValue
	Output 2 measurand	Temperature T [°C]	No code
		Temperature T [°F]	MB2
		Water activity aw [1]	MB67
		Water content x [ppm]	MB70
	Output signal 2 <sup>4)</sup>	0 - 1 V	GB1
		0 - 5 V	GB2
		0 - 10 V	GB3
		0 - 20 mA	GB5
		4 - 20 mA	GB6
	Output 2 scaling low	Value	SBLValue
	Output 2 scaling high	Value	SBHValue
	Oil parameterization for water content calculation	Mineral transformer oil	No code
		Customer specific oil	PPMxxx <sup>5)</sup>

1) Only with polycarbonate enclosure.

2) No combination of alarm output (AM2), Ethernet module (J4) and integrated power supply (AM3) is possible.

3) Integrated power supply includes 2 plugs for power supply and outputs, other plug options are not possible.

4) Both analogue outputs shall be either voltage or current.

5) Procedure for customer specific oil (see table below).



# Ordering Guide

## 5) Procedure for customer specific oil

Option	Description	Code
Oil number is known	Replace the <b>xxx</b> by the corresponding number	
Obtaining new oil parameters via oil analysis	Contact and provide E+E HQ the datasheet of the oil before sending us 2 litres of oil. After determination of the oil specific parameters, the corresponding oil number is available, insert this in place of the <b>xxx</b> .	<b>Oil-ppmcal</b>
Obtaining new oil parameters via saturation curve	Contact and provide E+E HQ the datasheet of the oil together with the saturation curve. After calculation of the oil specific parameters, the corresponding oil number is available, insert this in place of the <b>xxx</b> .	<b>Oil-calc</b>

# Order Example

## EE360-D2J3GA3GB3SBL-40SBH180

Feature	Code	Description
Enclosure material	<b>No code</b>	PC (Polycarbonate)
Filter	<b>No code</b>	Stainless steel, for flow <1 m/s (<3.3 ft/s)
Probe cable length	<b>No code</b>	2 m (6.6 ft)
Probe length	<b>No code</b>	200 mm (7.87")
Process connection	<b>No code</b>	G 1/2" ISO - slide fitting, Ø13 mm (0.51")
Electrical connection	<b>No code</b>	Cable glands
Optional features	<b>D2</b> <b>J3</b>	3.5" TFT display with integrated data logger RS485 module - Modbus RTU
Output 1 measurand	<b>No code</b>	Water activity aw [1]
Output 1 signal	<b>GA3</b>	0 - 10 V
Output 1 scaling low	<b>No code</b>	0
Output 1 scaling high	<b>No code</b>	1
Output 2 measurand	<b>No code</b>	Temperature T [°C]
Output 2 signal	<b>GB3</b>	0 - 10 V
Output 2 scaling low	<b>SBL-40</b>	-40
Output 2 scaling high	<b>SBH180</b>	180

## Oil-ppmcal

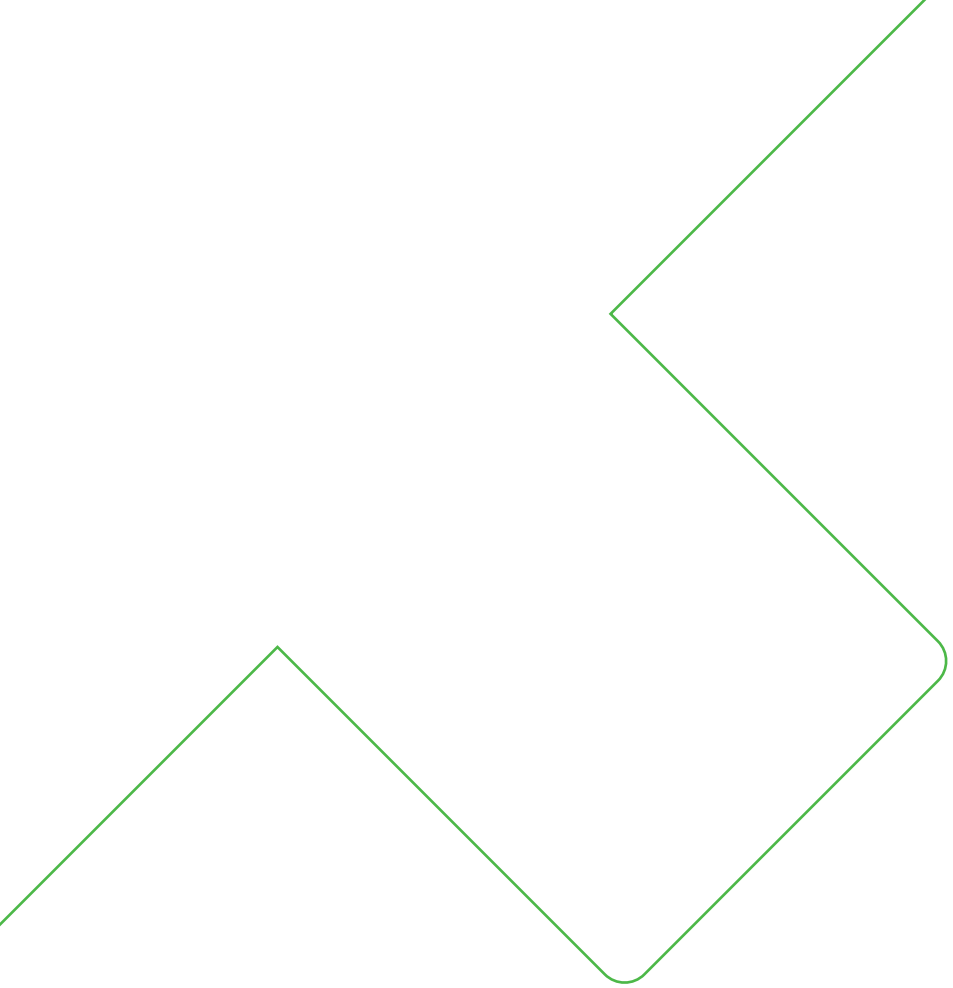
Contact and provide E+E HQ the datasheet of the oil before sending us 2 litres of oil.

# Accessories

For further information see datasheet [Accessories](#).

Description	Code
PCS10 Product Configuration Software (Free download: <a href="http://www.epluse.com/pcs10">www.epluse.com/pcs10</a> )	PCS10
USB-C to USB-A configuration cable	HA010327
Bracket for installation onto mounting rails <sup>1)</sup>	HA010203
Determination of oil specific parameters	ppm-cal
Humidity calibration kit	see data sheet <a href="#">Humidity calibration kit</a>
Ball valve set G 1/2" ISO	HA050101
Ball valve set 1/2" NPT	HA050104

1) For polycarbonate enclosure only. Two pieces are necessary for each EE360.



Company Headquarters &  
Production Site

**E+E Elektronik Ges.m.b.H.**  
Langwiesen 7  
4209 Engerwitzdorf | Austria  
T +43 7235 605-0  
F +43 7235 605-8  
info@epluse.com  
www.epluse.com

Subsidiaries

**E+E Sensor Technology (Shanghai) Co., Ltd.**  
T +86 21 6117 6129  
info@epluse.cn

**E+E Elektronik France SARL**  
T +33 4 74 72 35 82  
info.fr@epluse.com

**E+E Elektronik Deutschland GmbH**  
T +49 6171 69411-0  
info.de@epluse.com

**E+E Elektronik India Private Limited**  
T +91 990 440 5400  
info.in@epluse.com

**E+E Elektronik Italia S.r.l.**  
T +39 02 2707 86 36  
info.it@epluse.com

**E+E Elektronik Korea Ltd.**  
T +82 31 732 6050  
info.kr@epluse.com

**E+E Elektronik Corporation**  
T +1 847 490 0520  
info.us@epluse.com



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