MEDIUM VOLTAGE PRODUCT

KEVCD B

Indoor combined sensor; Indoor current sensor

01 Sensor characteristics

02 The Rogowski coil principle

Parameters for Application	Value
Rated primary current of application	1 250 up to 3 200 A
Rated primary voltage of application	6 up to 24 kV

Sensor Parameters	Value
Rated primary voltage, U_{pn}	11/√3; 15/√3; 22/√3 kV
Highest voltage for equipment, U_m	12; 17.5; 24 kV
Rated power frequency withstand voltage	28; 38; 50 kV
Rated lightning impulse withstand voltage	75; 95; 125 kV
Rated primary current, I_{pr}	1 600 A
Rated continuous thermal current, I_{cth}	3 200 A
Rated transformation ratio, K_{ra} for current measurement	1 600 A/ 150 mV at 50 Hz 180 mV at 60 Hz
Rated transformation ratio, K_n for voltage measurement	10 000 : 1
Current accuracy class	1
Voltage accuracy class	1 / 3P
Length of cable	5.0; 6.5; 7.5 m

Sensor principles

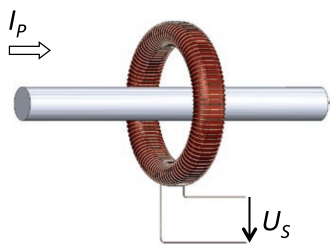
Electronic Instrument Transformers (Sensors) offer an alternative way of making the current and voltage measurements needed for the protection and monitoring of medium voltage power systems. Sensors based on alternative principles have been introduced as successors to conventional instrument transformers in order to significantly reduce size, increase safety, and to provide greater rating standardization and a wider functionality range. These well known principles can only be fully utilized in combination with versatile electronic relays.

Sensor characteristics

Construction of ABB's current and voltage sensors is done without the use of a ferromagnetic core.This fact results in several important benefits for the user and the application. The main benefit is that the behavior of the sensor is not influenced by non-linearity and width of hysteresis curve, which results in a highly accurate and linear response over a wide dynamic range of measured quantities.

Current sensor

Current measurement in KEVCD B sensors is based on the Rogowski coil principle. A Rogowski coil is a toroidal coil, without an iron core, placed around the primary conductor in the same way as the secondary winding in a current transformer. However, the output signal from a Rogowski coil is not a current, but a voltage:



$$u_s(t) = M \frac{di_p(t)}{dt}$$

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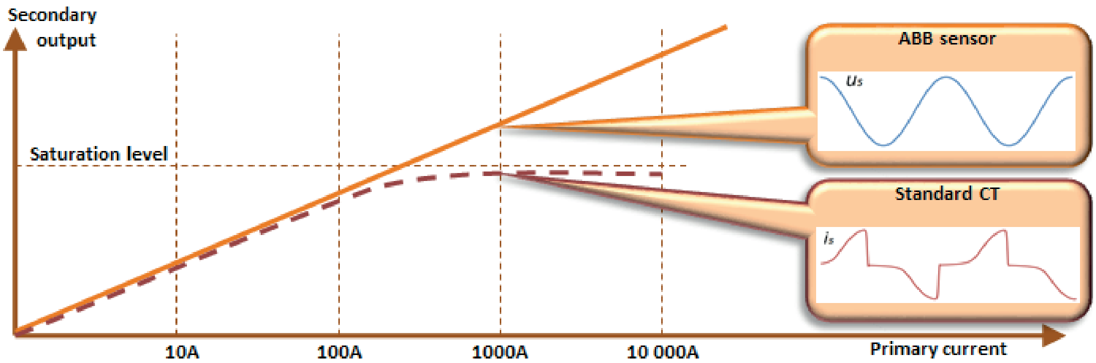
In all cases, a signal that represents the actual primary current waveform is easily obtained by integrating the transmitted output signal.

Voltage sensor

Voltage measurement in KEVCD B sensors is based on the resistive divider principle. The output voltage is directly proportional to the input voltage:



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03 Resistive divider principle
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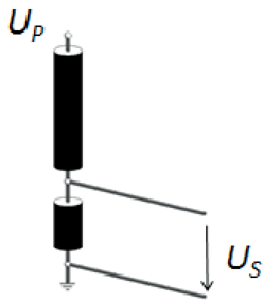
04 Example of IED



$$U_s = \frac{R_2}{R_1 + R_2} U_p$$

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In all cases, the transmitted output signal reproduces the actual waveform of the primary voltage signal.

Protection and control IEDs (Intelligent Electronic Devices)
Protection and control IEDs incorporate the functions of a traditional relay, as well as allow new additional functions. The information transmitted from the sensors to the IED is very accurate, providing the possibility of versatile relay functionality. However, the IED must be able to operate with sufficient accuracy at a sensor's low input signal level, and the signal from the Rogowski coil must be integrated. Modern IEDs (such as ABB's 615 series relays) are designed for such sensor use, and they are also equipped with built-in integrators for Rogowski coil sensor inputs. Modern digital apparatuses (microprocessor based relays) allow protection and measurement functions to be combined. They fully support current and voltage sensing realized by the single sensor with double the accuracy class designation (e.g.: voltage sensing with combined accuracy class 1/3P).

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Sensor design
KEVCD B is a block type sensor designed according to the DIN 42600 size requirements. Two versions could be selected: one providing current measurement together with voltage indication capability, or a second one, providing, in addition to these, also the possibility of voltage measurement.

Type designation	Functions included		
	Voltage sensor	Current sensor	Voltage indication
KEVCD 12 BE2	■	■	■
KEVCD 12 BG2		■	■
KEVCD 17.5 BE2	■	■	■
KEVCD 17.5 BG2		■	■
KEVCD 24 BE2	■	■	■
KEVCD 24 BG2		■	■

Tab. 1. Sensor variants

Differences between Sensors and Instrument Transformers
There are some noticeable differences between Sensors and conventional Instrument Transformers:

Linearity
Due to the absence of a ferromagnetic core the sensor has a linear response over a very wide primary current range, far exceeding the typical CT range. In addition, one standard sensor can be used for a broad range of rated currents and is also capable of precisely transferring signals containing frequencies different from rated ones.

Compactness
Since the sensing elements are particularly small, and the same elements are used for both measurement and protection, the current and voltage sensors can easily be combined in one device – the Combined Sensor, which is still smaller and far lighter than the conventional Instrument Transformer. The weight of the combined KEVCD B sensor designed for 24 kV is only 24 kg and designs for lower voltage levels are even lighter. This enables much easier handling without the need for special lifting devices.

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05 Example of combined sensors
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06 Example of sensor label
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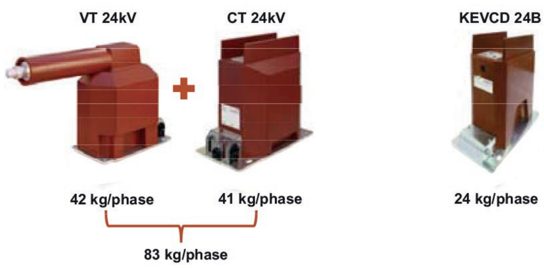
07 Connector RJ-45



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Rated parameters

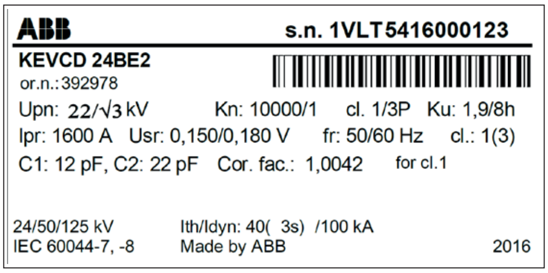
Because the sensors are highly linear within a very wide range of currents and voltages, the same single sensor can be used for the various rated currents and voltages associated with each specific application up to the specified maximum voltage for equipment. There is no need to specify other parameters such as burden, safety factor, etc. since they are standard over the defined range. To achieve the correct function of the protection and control IED, the selected rated current and voltage, as well as the rated transformation ratio, must be properly set into the IED.

Energy savings concept

As there is no iron core, no necessity for high burden values and thus a possibility for low current losses and only one secondary winding needed, KEVCD B sensors exhibit extremely low energy consumption that is just a fraction of that transferred to heat in conventional CTs/VTs. This fact contributes to huge energy savings during its entire operating life, supporting the world-wide effort to reduce energy consumption. Furthermore, the temperature rise caused by internal heating up due to current flowing through the sensor is very low and creates a further possibility of upgrading current ratings of the switchgear, or the other applications, and/or reduces the need for artificial ventilation.

Correction factors

The amplitude and phase error of a current and a voltage sensor is, in practice, constant and independent of the primary current and primary voltage. Due to this fact it is an inherent and constant property of each sensor and it is not considered as unpredictable and influenced error. Hence, it can be easily corrected in the IED by using appropriate correction factors, stated separately for every sensor. Values of the correction factors for the amplitude and phase error of a current and a voltage sensor are mentioned on the sensor label (for more information please refer to Instructions for installation, use and maintenance) and should be uploaded without any modification into the IED before the sensors are put into operation (please check available correction in the IED manual). To achieve required accuracy classes it is recommended to use all correction factors (Cfs): amplitude correction factor (aU) and phase error correction factor (pU) of a voltage sensor; amplitude correction factor (aI) and phase error correction factor (pI) of a current sensor.



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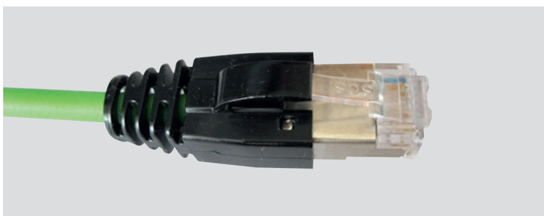
Secondary cables

The sensor is equipped with a cable for connection with the IED. The cable connector is type RJ-45. The sensor accuracy classes are verified up to the RJ-45 connector, i.e. considering also its secondary cable. These cables are intended to be connected directly to the IED, and subsequently neither burden calculation nor secondary wiring is needed. Every sensor is therefore accuracy tested when equipped with its own cable and connector. Standard cable lengths: 5.0; 6.5 and 7.5 m

Sensor type	Length		
	5 m	6.5 m	7.5 m
KEVCD_BE2	1VL5300801R0103	1VL5300801R0106	1VL5300801R0107
KEVCD_BG2	1VL5300802R0103	1VL5300802R0106	1VL5300802R0107

Tab. 2. Types of secondary cables



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08 Example of direct connection between the sensor and new IED family without the need for an adapter
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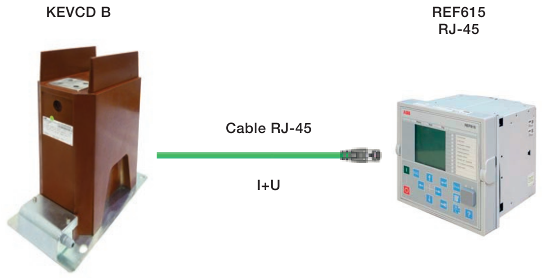
09 Example of connection of connectors between a sensor and IED which requires a connector adapter



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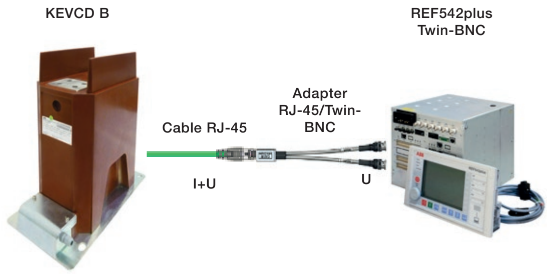
Connector adapters
To provide connectivity between a sensor with a RJ-45 cable connector and IEDs with Twin-BNC connectors a group of adapters were designed. The use of an adapter has no influence on the current and/or voltage signal and accuracy of the sensor with the cable.



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For more information about connector adapters refer to Doc. No. 1VLC000710 - Sensor accessories.

Coupling electrode for voltage detection system
Intended to be used in:

- Voltage detection system (VDS) according to IEC 61243-5;
- Voltage presence indication system (VPIS) according to IEC 62271-206

If there is no connection of the coupling electrode to the coupling system the electrode must be earthed. The sensor is delivered with an earthed coupling electrode.

Electrode	Sensor Highest voltage of equipment	
	12 and 17.5 kV	24 kV
C1	(23 – 40) pF	(10 – 48) pF
C2	≤25 pF	≤25 pF

Tab. 3. Capacitance values

Standards
Voltage sensors: IEC 60044-7 (1999-12)
Instrument transformers – Part 7: Electronic voltage transformers

Current sensors: IEC 60044-8 (2002-07)
Instrument transformers – Part 8: Electronic current transformers

Sensor name code

KEVCD 12 B E 2

Design number

Sensor function:
E = voltage and current sensors and coupling electrode

G = current sensor and coupling electrode

Use of sensors and current range:
B: I_{cth} = 3200 A

Highest voltage for equipment:
Voltage rating: 12kV, 17.5kV and 24kV

Cast resin insulated combisensor:
KE = sensors
V = voltage
C = current
D = block type sensor according to the DIN 42600 size requirements

Type	Highest voltage for equipment U_m	Rated power frequency test voltage	Rated lightning impulse test voltage
KEVCD 12_	12 kV	28 kV	75 kV
KEVCD 17.5_	17.5 kV	38 kV	95 kV
KEVCD 24_	24 kV	50 kV	125 kV

Tab. 4. Highest voltage for equipment and test voltages

Voltage sensor, rated values

Type	Rated primary voltage U_{pn} (kV)	Maximum rated primary voltage U_{pnmax} (kV)
KEVCD 12 _	11/√3	12/√3
KEVCD 17.5_	15/√3	17.5/√3
KEVCD 24_	22/√3	24/√3

Tab. 6. Rated primary voltage

- Rated frequency, f_n: 50/60 Hz
- Accuracy class: 1/3P
- Rated burden, R_{br}: 10 MΩ
- Rated transformation ratio, K_n: 10 000:1
- Rated voltage factor, k_u: 1.9/8 h

Current sensor, rated values
- Rated primary current, I_{pr}: 1 600 A
- Rated transformation ratio, K_{ra}:
  1 600 A/0.150 V at 50 Hz
  1 600 A/0.180 V at 60 Hz
- Rated secondary output, U_{sr}: 3 mV/Hz
  i.e. 150 mV at 50 Hz
  or 180 mV at 60 Hz
- Rated continuous thermal current, I_{cth}: 3 200 A
- Rated short-time thermal current, I_{th}:
  50 kA/3 s (KEVCD 12; KEVCD 17.5)
  40 kA/3 s (KEVCD 24)
- Rated dynamic current, I_{dyn}:
  125 kA (KEVCD 12; KEVCD 17.5)
  100 kA (KEVCD 24)
- Rated frequency, f_r: 50/60 Hz
- Rated extended primary current factor, K_{pcr}: 1.2
- Accuracy class: 1
- Rated burden, R_{br}: 10 MΩ

Temperature category
- Operation: -5°C/+40°C
- Transport and storage: -40°C/+70°C

Cables
- Length: 5.0; 6.5; 7.5 m
- Connector: RJ-45 (CAT-6)

Ordering data / specification of sensor
- Sensor name code
- Used IED
- Polarity
- Cable length
- Accessories (Connector adapter)

Dimensional Drawings

KEVCD B

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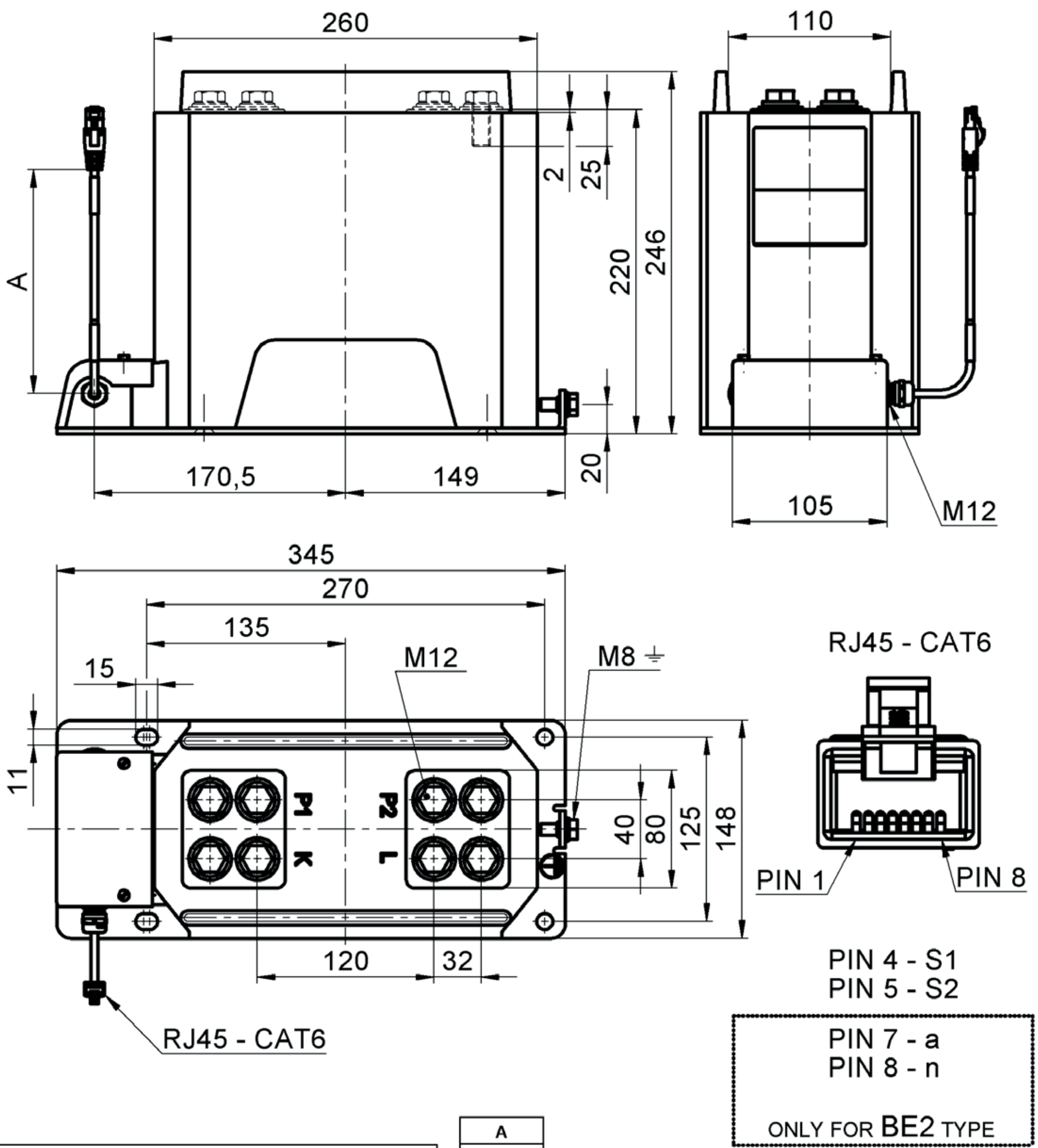
KEVCD 12_; KEVCD 17.5_

Outline drawing number: 1VL5300805R0101
Weight: 20 kg

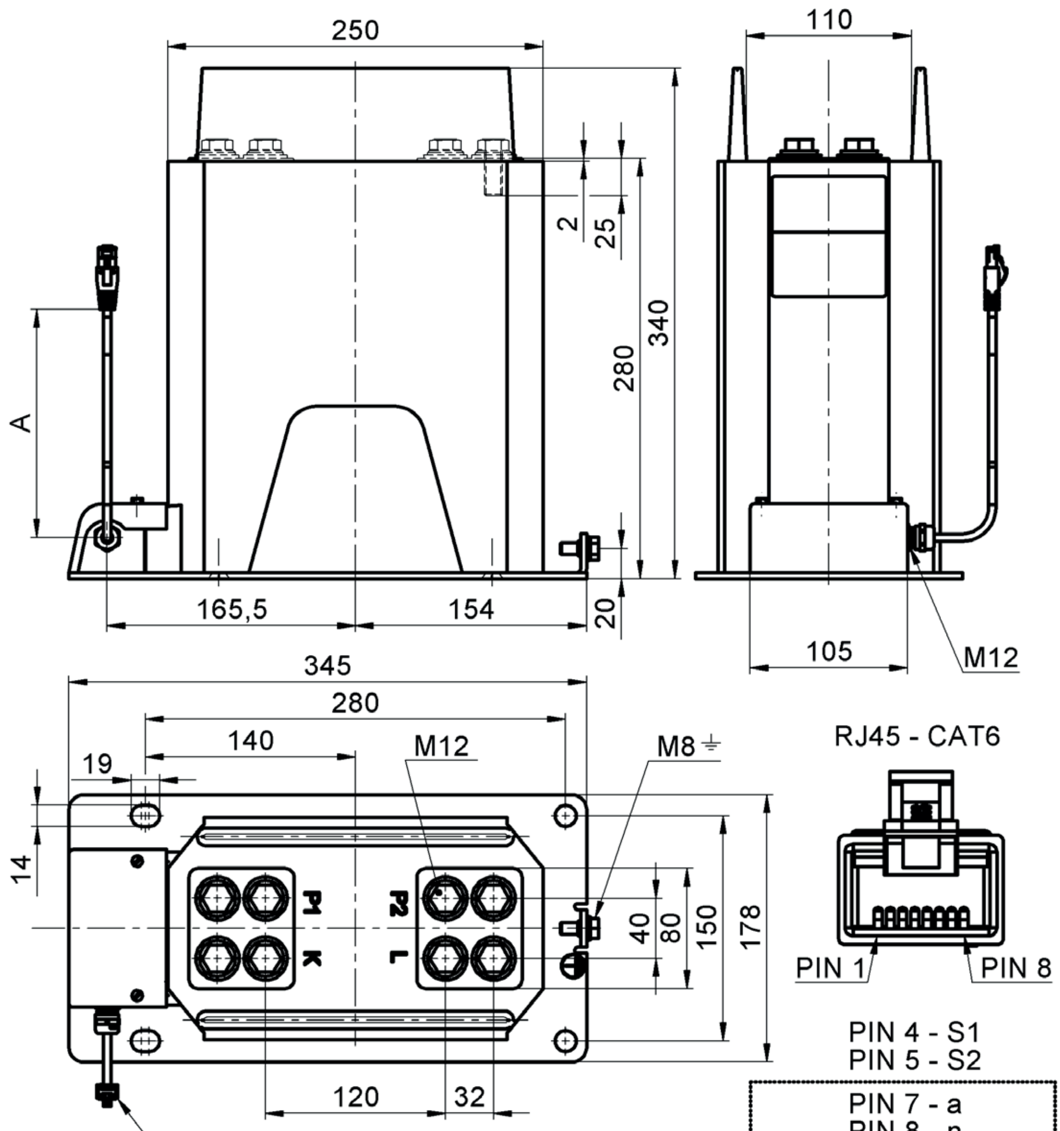


TYPE	
KEVCD 12 BE 2	KEVCD 17,5 BE 2
KEVCD 12 BG 2	KEVCD 17,5 BG 2

A
5000
6500
7500

KEVCD 24

Outline drawing number: 1VL5300804R0101
Weight: 24 kg



TYPE
KEVCD 24 BE 2
KEVCD 24 BG 2

A
5000
6500
7500

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