



Technical catalogue

# Current sensors Voltage sensors





# Current sensors Voltage sensors

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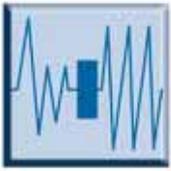


# Because you search for performance we make the difference.

In the industrial and railway sectors, where the tendency for all players is towards higher performance, ABB current and voltage sensors provide competitive and adapted solutions. To meet your requirements, they draw on all their qualities to give you the advantage.

Resulting from a totally electronic technology, they integrate the latest innovations. More compact, they allow for the optimum reduction in equipment dimensions.

Made from high technology material, ABB sensors offer exceptional thermal performance, a stronger mechanical robustness and generally excellent resistance to harsh external conditions. These products conform to ecological, security and strict quality standards.



# Three technologies for me

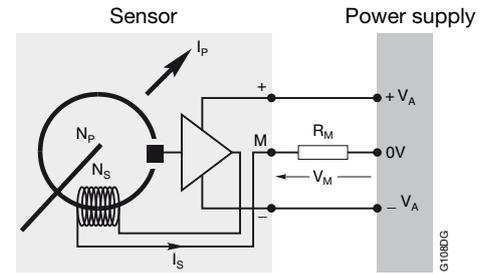
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## Closed loop Hall effect technology

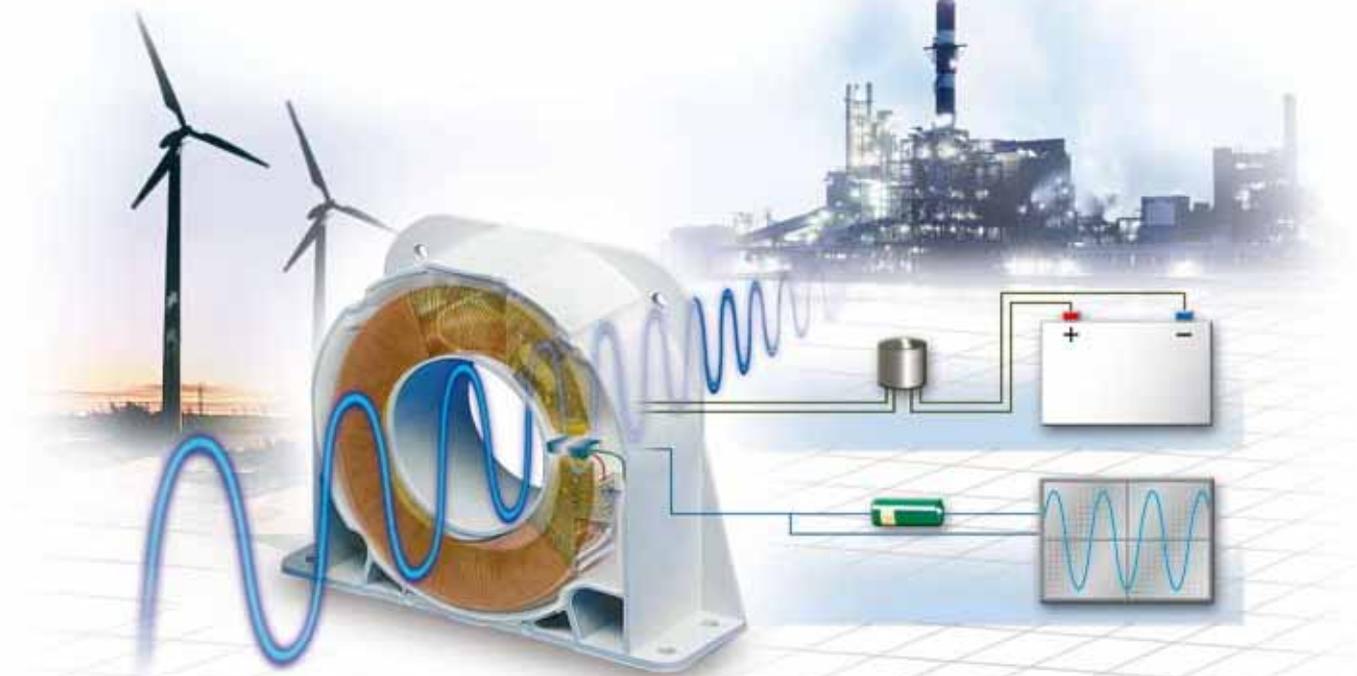


### Principle

ABB current sensors based on closed loop Hall effect technology are electronic transformers. They allow for the measurement of direct, alternating and impulse currents, with galvanic insulation between the primary and secondary circuits. The primary current  $I_p$  flowing across the sensor creates a primary magnetic flux. The magnetic circuit channels this magnetic flux. The Hall probe placed in the air gap of the magnetic circuit provides a voltage proportional to this flux. The electronic circuit amplifies this voltage and converts it into a secondary current  $I_s$ . This secondary current multiplied by the number of turns  $N_s$  of secondary winding cancels out the primary magnetic flux that created it (contra reaction). The formula  $N_p \times I_p = N_s \times I_s$  is true at any time. The current sensor measures instantaneous values.



The secondary output current  $I_s$  is therefore exactly proportional to the primary current at any moment. It is an exact replica of the primary current multiplied by the number of turns  $N_p/N_s$ . This secondary current  $I_s$  can be passed through a measuring resistance  $R_M$ . The measuring voltage  $V_M$  at the terminals of this measuring resistance  $R_M$  is therefore also exactly proportional to the primary current  $I_p$ .



### Advantages

The main advantages of this closed loop Hall effect technology are as follows:

- Galvanic insulation between the primary and secondary circuits.
- Measurement of all waveforms is possible: direct current, alternating current, impulse, etc.
- High accuracy over a large frequency range (from direct to more than 100kHz).
- High dynamic performance.
- High overload capacities.
- High reliability.

### Applications



#### Industry

Variable speed drives, Uninterruptible Power Suppliers (UPS), active harmonic filters, battery chargers, wind generators, robotics, conveyers, lifts, cranes, solar inverter, elevator, etc.



#### Traction

Main converters, auxiliary converters (lighting, air conditioning), battery chargers, choppers, substations, mining, etc.

# Measuring current

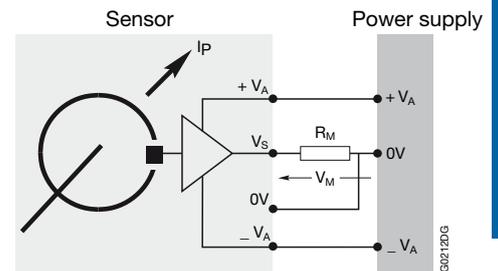
2

## Open loop Hall effect technology

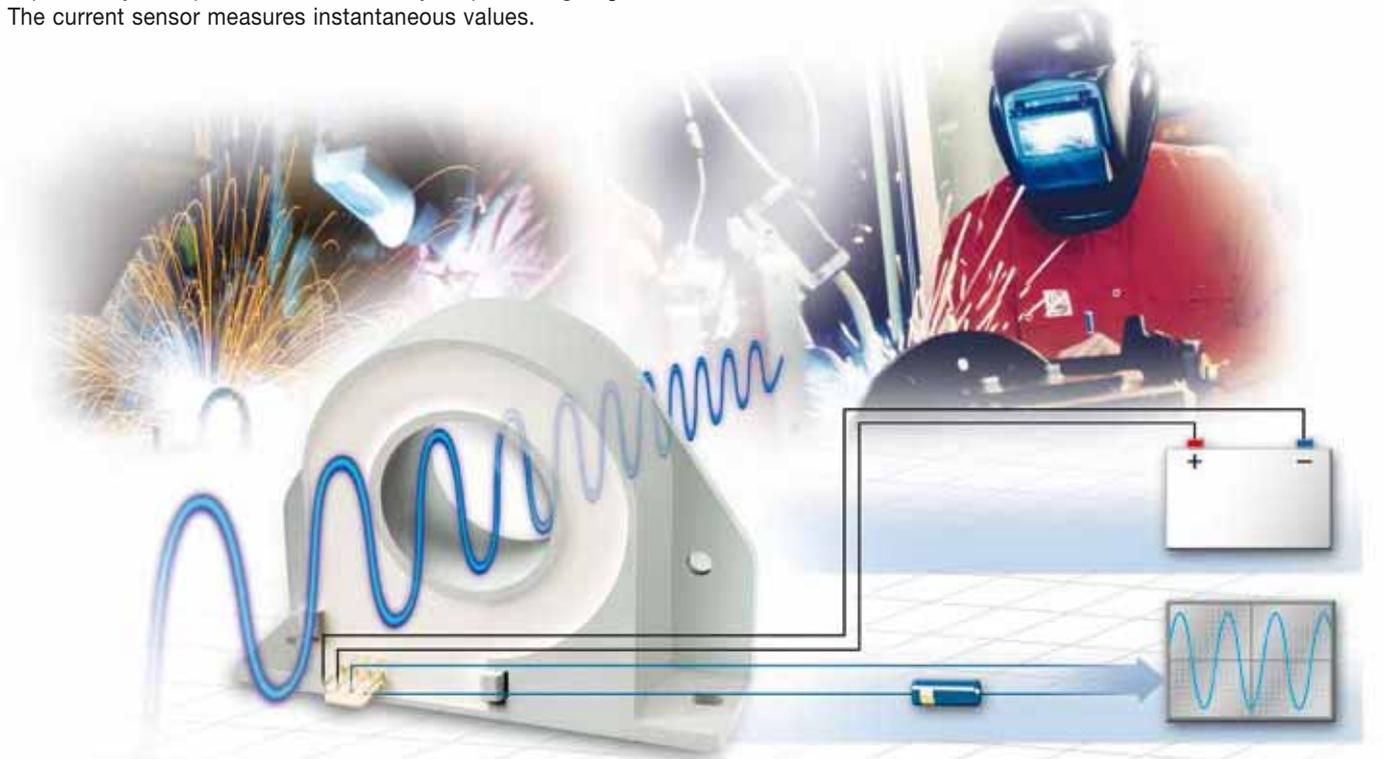


### Principle

ABB current sensors based on open loop Hall effect technology are also electronic transformers. They allow for the measurement of direct, alternating and impulse currents, with galvanic insulation between the primary and secondary circuits. The primary current  $I_P$  flowing across the sensor creates a primary magnetic flux. The magnetic circuit channels this magnetic flux. The Hall probe placed in the air gap of the magnetic circuit provides a voltage  $V_H$  proportional to this flux, which is itself proportional to the current  $I_P$  to be measured. The electronic circuit amplifies this Hall voltage ( $V_H$ ) allowing it to be directly exploited by the operator as a secondary output voltage  $V_S$ . The current sensor measures instantaneous values.



The secondary output voltage  $V_S$  is therefore directly proportional to the primary current. It is an exact replica of the primary current, generally with a value of 4V for a nominal current  $I_{PN}$ .



### Advantages

The main advantages of this open loop Hall effect technology are as follows:

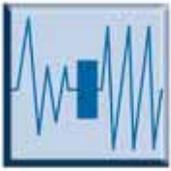
- Galvanic insulation between the primary and secondary circuits.
- Measurement of all waveforms is possible: direct current, alternating current, impulse, etc.
- Good accuracy over a medium frequency range (from direct to several tens of kHz).
- High reliability.
- Low power consumption.
- Reduced weight and volume.
- Excellent Performance/Cost ratio.

### Applications



Industry

Variable speed drives, backups ("UPS"), active harmonic filters, battery chargers, conveyers, lifts, cranes, solar inverter, etc.



# Three technologies for measuring current

3

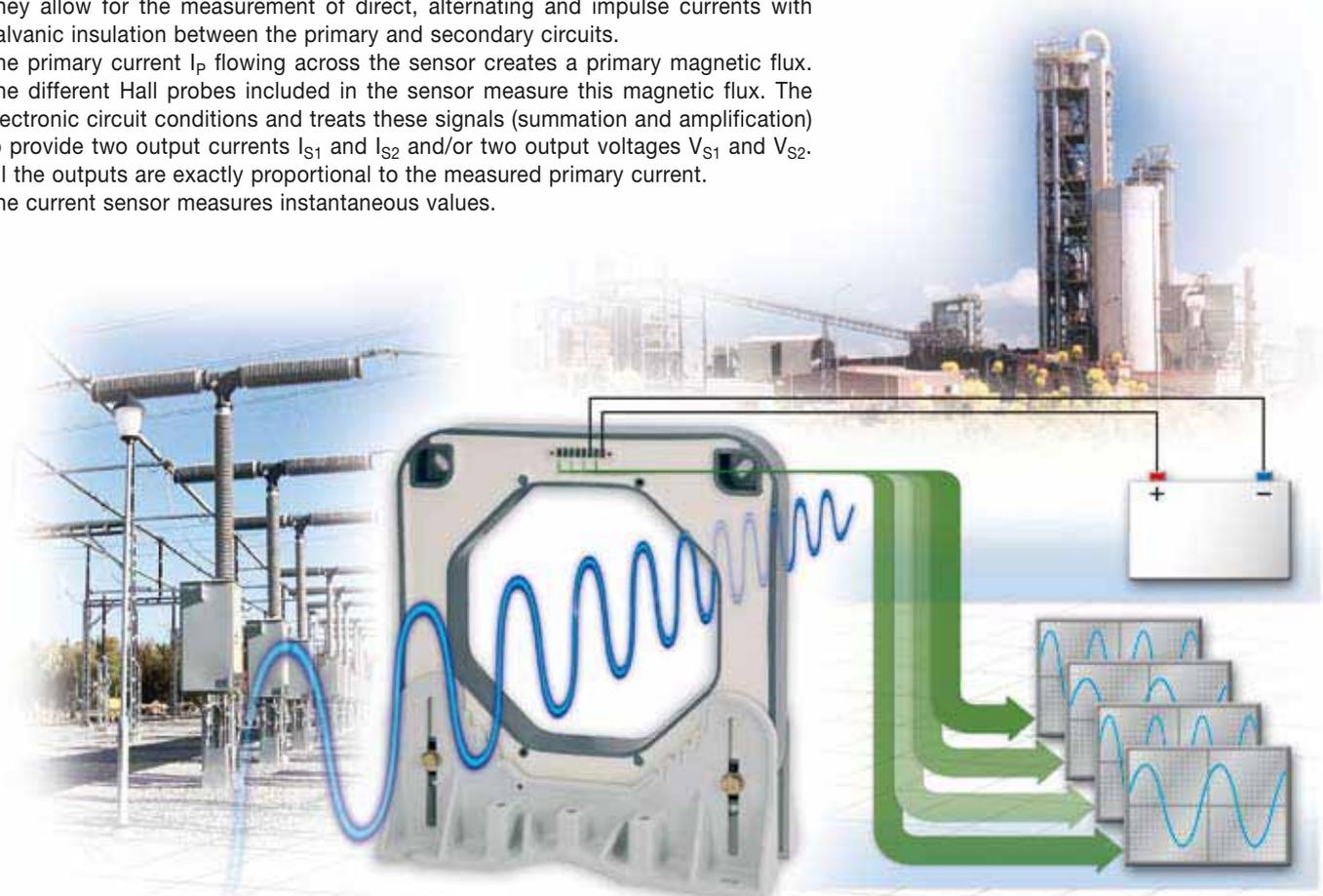
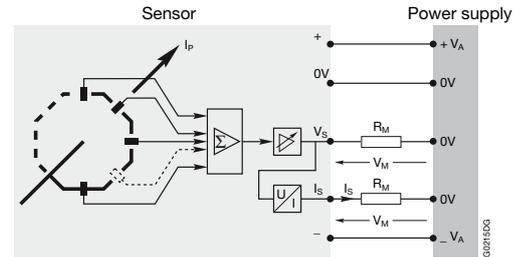
## Electronic technology



### Principle

ABB current sensors are based on entirely electronic technology. In contrast to closed or open loop Hall effect technology, no magnetic circuit is used in the sensor. They allow for the measurement of direct, alternating and impulse currents with galvanic insulation between the primary and secondary circuits.

The primary current  $I_p$  flowing across the sensor creates a primary magnetic flux. The different Hall probes included in the sensor measure this magnetic flux. The electronic circuit conditions and treats these signals (summation and amplification) to provide two output currents  $I_{S1}$  and  $I_{S2}$  and/or two output voltages  $V_{S1}$  and  $V_{S2}$ . All the outputs are exactly proportional to the measured primary current. The current sensor measures instantaneous values.



### Advantages

The main advantages of this electronic technology are as follows:

- Galvanic insulation between the primary and secondary circuits.
- Measurement of all waveforms is possible: direct current, alternating current, impulse, etc.
- Choice of output type (current or voltage,  $I_{PN}$  or  $I_{PMAX}$ ).
- Very large current measuring range (up to 40kA) without overheating the sensor.
- High dynamic performance.
- Low power consumption.
- Reduced weight and volume.
- Simplified mechanical fixing.

### Applications



Industry

Electrolysis, rectifiers, welding, etc.



Substation

Substations in continuous voltage.

# Product ranges for current measurement

## Industry applications



### Closed loop Hall effect technology

Range	Accuracy	Frequency	Consumption
ES	😊	😊	😊
ESM	😊	😊	😊
MP-EL	😊	😊	😊

100 A



2000 A

500 A



2000 A

5 A



100 A



### Open loop Hall effect technology

Range	Accuracy	Frequency	Consumption
HBO	😊	😊	😊

100 A



600 A



### Electronic technology

Range	Accuracy	Frequency	Consumption
NCS	😊	😊	😊

4 kA



40 kA

## Railway applications



### Closed loop Hall effect technology

Range	Accuracy	Frequency	Consumption
CS	😊	😊	😊

300 A



2000 A

## Substation applications



### Electronic technology

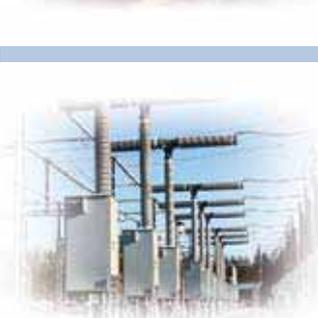
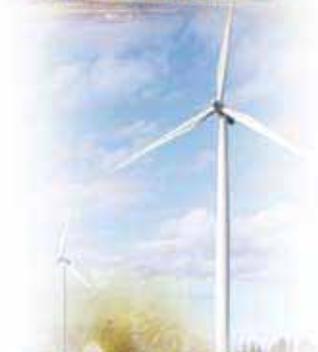
Fixed application  
only

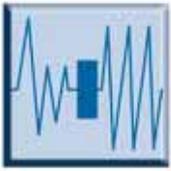
Range	Accuracy	Frequency	Consumption
NCS	😊	😊	😊

4 kA



40 kA





# Two technologies for meas

1

## Closed loop Hall effect technology



### Principle

ABB voltage sensors based on closed loop Hall effect technology are also electronic transformers. They allow for the measurement of direct, alternating and impulse voltages with galvanic insulation between the primary and secondary circuits.

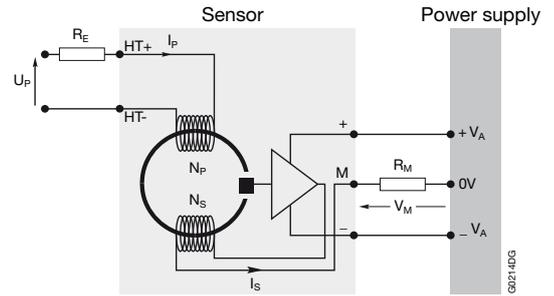
The primary voltage  $U_P$  to be measured is applied directly to the sensor terminals: HT+ (positive high voltage) and HT- (negative high voltage). An input resistance  $R_E$  must necessarily be placed in series with the resistance  $R_P$  of the primary winding to limit the current  $I_P$  and therefore the heat dissipated from the sensor. This resistance  $R_E$  may be either integrated during the manufacturing of the product (calibrated sensor) or added externally by the user to determine the voltage rating (not calibrated sensor).

The primary current  $I_P$  flowing across the primary winding via this resistance  $R_E$  generates a primary magnetic flux. The magnetic circuit channels this magnetic flux. The Hall probe placed in the air gap of the magnetic circuit provides a voltage  $V_H$  proportional to this flux.

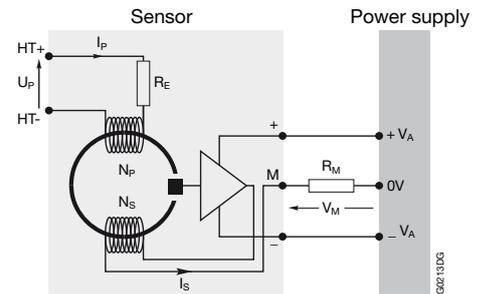
The electronic circuit amplifies this voltage and converts it into a secondary current  $I_S$ . This secondary current multiplied by the number of turns  $N_S$  of secondary winding cancels out the primary magnetic flux that created it (contra reaction). The formula  $N_P \times I_P = N_S \times I_S$  is true at any time.

The voltage sensor measures instantaneous values.

The secondary output current  $I_S$  is therefore exactly proportional to the primary voltage at any moment. It is an exact replica of the primary voltage. This secondary current  $I_S$  is passed through a measuring resistance  $R_M$ . The measuring voltage  $V_M$  at the terminals of this measuring resistance  $R_M$  is therefore also exactly proportional to the primary voltage  $U_P$ .



Principle diagram of a not calibrated EM010 sensor



Principle diagram of a calibrated EM010 sensor



### Advantages

The main advantages of this closed loop Hall effect technology are as follows:

- Galvanic insulation between the primary and secondary circuits.
- Measurement of all waveforms is possible: direct voltage, alternating voltage, impulse, etc.
- High accuracy.
- High reliability.

### Applications



#### Traction

Main converters, auxiliary converters (lighting, air conditioning), battery chargers, choppers, substations, mining, etc.

# uring voltage

2

## Electronic technology



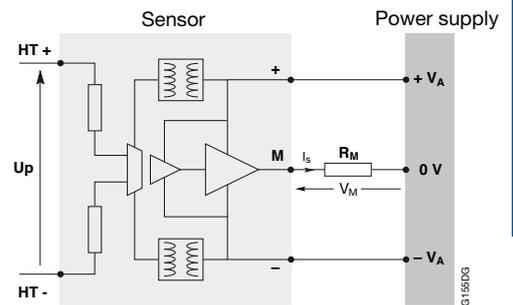
### Principle

ABB voltage sensors based on electronic technology only use electronic components. In contrast to closed or open loop Hall effect technology, no magnetic circuits or Hall effect probes are used in the sensor.

This allows for the measurement of direct or alternating voltages with electrical insulation between the primary and secondary circuits.

The primary voltage to be measured is applied directly to the sensor terminals: HT+ (positive high voltage) and HT- (negative high voltage or earth). This voltage is passed through an insulating amplifier and is then converted to a secondary output current  $I_s$ . This secondary current  $I_s$  is electrically insulated from the primary voltage to which it is exactly proportional.

The voltage sensor measures instantaneous values.



In the same way as for current sensors, this secondary current  $I_s$  can be then passed through a measuring resistance  $R_M$ . The measuring voltage  $V_M$  at the terminals of this measuring resistance  $R_M$  is therefore also exactly proportional to the primary voltage  $U_p$ . The electrical supply to the sensor is also insulated from the primary voltage.



### Advantages

The main advantages of this fully electronic technology are as follows:

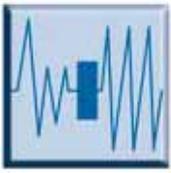
- Electrical insulation between the primary and secondary circuits.
- Measurement of all waveforms is possible: direct voltage, alternating voltage, impulse, etc.
- Excellent immunity to electromagnetic fields.
- Excellent accuracy.
- High dynamic performance.
- Excellent reliability.

### Applications



#### Traction

Main converters, auxiliary converters (lighting, air conditioning), battery chargers, choppers, substations, mining, etc.



# Voltage detection technology

1

## Electronic technology



### Principle

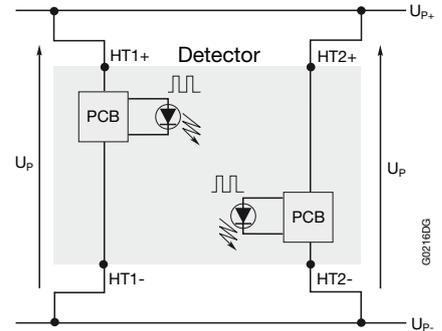
ABB voltage detector is based on entirely electronic technology. It allows the detection of the presence of direct or alternating voltage. For safety reasons this main function is duplicated within the detector to increase the product lifetime.

The voltage detector converts the primary voltage  $U_p$  applied to its terminals to visual information for the user. This function permits the user to carry out maintenance operations with the assurance that dangerous voltage is not present.

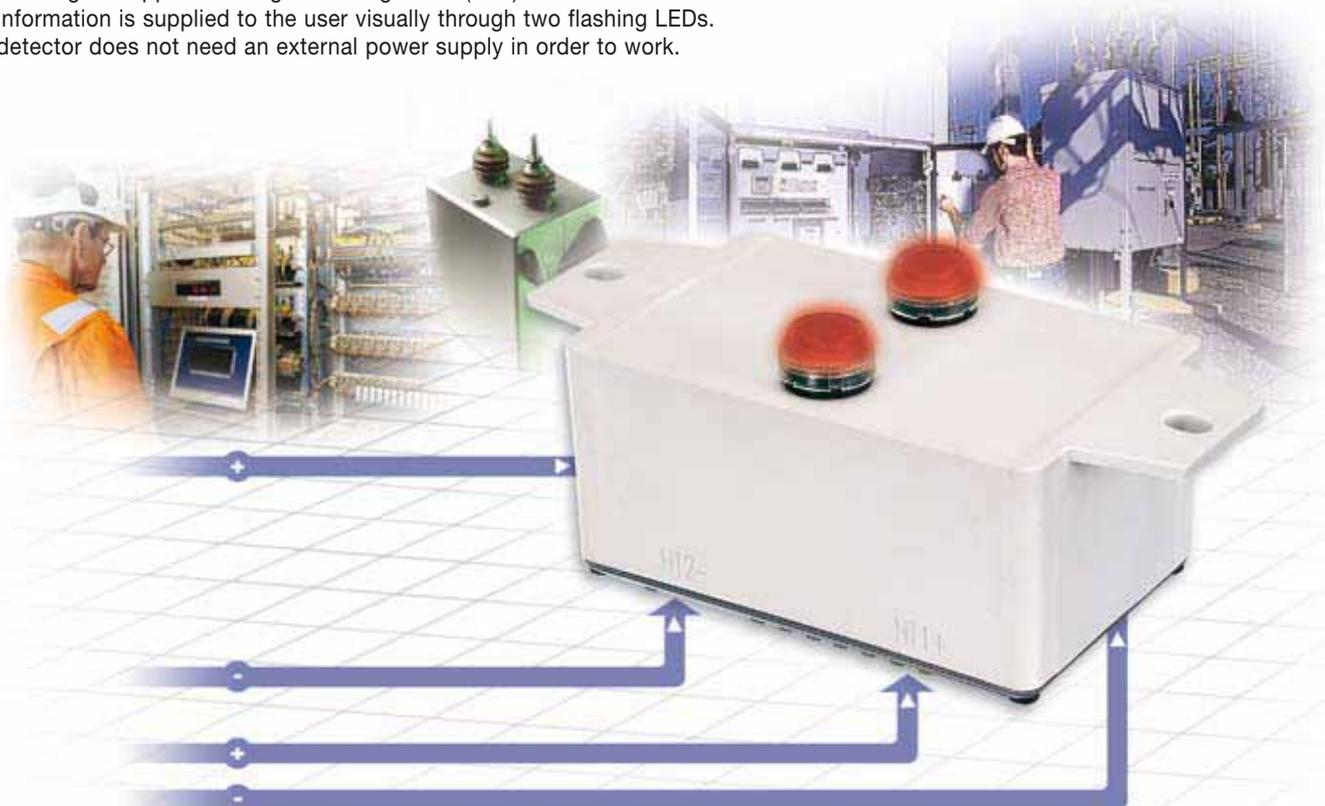
The primary voltage  $U_p$  to be measured is applied directly to the detector terminals: HT1+ and HT2+ (positive high voltage) and HT1- and HT2- (negative high voltage or 0V electric). The electronic circuit (PCB) converts the primary voltage  $U_p$  to an electrical signal supplied to a light emitting diode (LED).

The information is supplied to the user visually through two flashing LEDs.

The detector does not need an external power supply in order to work.



The voltage detector indicates the presence of a voltage higher than a limit (maximum 50V in compliance with standards) by the illumination of a LED. Inversely, the LED is extinguished when the voltage is below this limit.



### Advantages

The main advantages of this electronic technology are as follows:

- Detection of direct and alternating voltages.
- Very good visual indication.
- High overload capacities.
- Excellent reliability (functional redundancy in a single product).
- Excellent immunity to magnetic fields.
- Compact product.

### Applications



#### Traction

Main converters, auxiliary converters (lighting, air conditioning), electronic power devices integrating capacitors banks, battery chargers, choppers, substations, etc.

# Product ranges for voltage measurement

## *Railway applications*



### Closed loop Hall effect technology

Range	Accuracy	Frequency	Standards
EM010	😊	😐	😐

600 V



5000 V



### Electronic technology

Range	Accuracy	Frequency	Standards
VS	😊	😊	😊

50 V



4200 V



# Product ranges for voltage detection

## *Railway applications*



### Electronic technology

Range	Safety	Reliability
VD	😊	😊

50 V



1500 V



# Glossary

## Description of the main current and voltage sensor's characteristics

### Nominal primary current ( $I_{PN}$ ) and nominal primary voltage ( $U_{PN}$ )

This is the maximum current or voltage that the sensor can continuously withstand (i.e. without time limit).

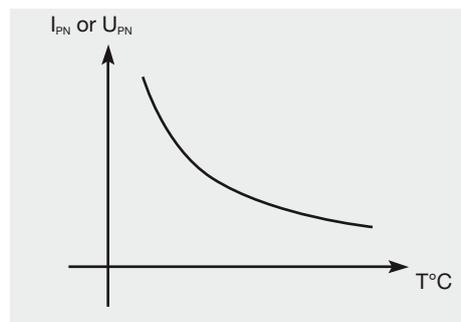
The sensor is thermally sized to continuously withstand this value.

For alternating currents, this is the r.m.s. value of the sinusoidal current.

The value given in the catalogue or in the technical data sheet is a nominal rating value. This figure can be higher if certain conditions (temperature, supply voltage...) are less restricting.

### Operating range ( $I_{PN}$ , $U_{PN}$ ) and temperature ( $^{\circ}\text{C}$ )

The sensor has been designed for a certain operating temperature. If this temperature is reduced, then it is possible to use the sensor with a higher thermal current or voltage.



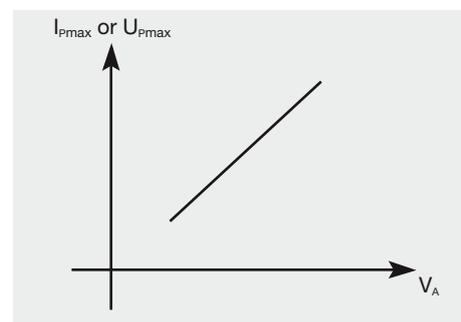
### Measuring range ( $I_{P\text{MAX}}$ and $U_{P\text{MAX}}$ )

This is the maximum current or voltage that the sensor can measure with the Hall effect. In general, mainly for thermal reasons, the sensor cannot continuously measure this value for direct currents and voltages.

This measuring range is given for specific operating conditions. This can vary depending mainly on the parameters below (see calculation examples p.114 and onwards):

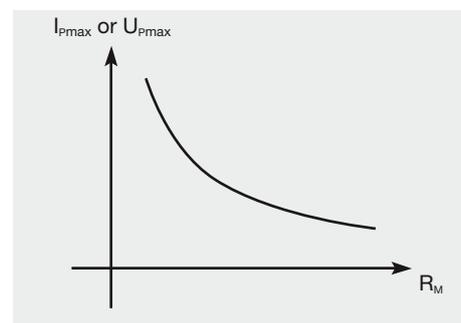
#### - Supply voltage:

The measuring range increases with the supply voltage.



#### - Measuring resistance:

The measuring range increases when the measuring resistance is reduced.



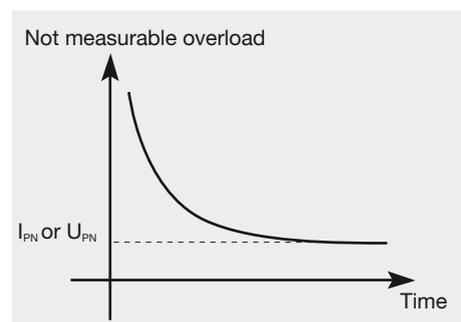
### Not measurable overload

This is the maximum instantaneous current or voltage that the sensor can withstand without being destroyed or damaged.

However the sensor is not able to measure this overload value.

This value must be limited in amplitude and duration in order to avoid magnetising the magnetic circuit, overheating or straining the electronic components.

A sensor can withstand a lower value overload for longer.



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## Glossary

### Description of the main current and voltage sensor's characteristics

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#### Secondary current $I_{SN}$ at $I_{PN}$ or at $U_{PN}$

This is the sensor's output current  $I_S$  when the input is equal to the nominal primary current  $I_{PN}$  or to the nominal primary voltage  $U_{PN}$ .

#### Measuring resistance $R_M$

This is the resistance connected in the secondary measuring circuit between terminal M of the current or voltage sensor and the 0 V of the supply. The measuring voltage  $V_M$  at the terminals of this resistance  $R_M$  is proportional to the sensor's secondary current  $I_S$ . It is therefore the image of the sensor's primary current  $I_P$  or primary voltage  $U_P$ .

For thermal reasons, a minimum value is sometimes required in certain operating conditions in order to limit overheating of the sensor.

The maximum value for this resistance is determined by the measuring range.  
(see calculation examples p.114 and onwards and the curve  $I_{P_{MAX}}$  or  $U_{P_{MAX}} = f(R_M)$  opposite).

#### Accuracy

This is the maximum error for the sensor output  $I_{SN}$  for the nominal input value (current or voltage). This takes into account the residual current, linearity and thermal drift.

#### a.c. accuracy

This is the maximum error for the sensor's output  $I_{SN}$  for an alternating sinusoidal primary current with a frequency of 50 Hz. The residual current is not taken into account. The linearity and thermal drift are always included.

#### No-load consumption current

This is the sensor's current consumption when the primary current (or primary voltage) is zero. The total current consumption of the sensor is therefore the no-load consumption current plus the secondary current.

*All given performance and data included in this catalogue could change.  
Dedicated data sheets are the only recognized reference documents  
for the given performances and data.  
To have the data-sheets, please contact your local distributor (see page 126-127).*

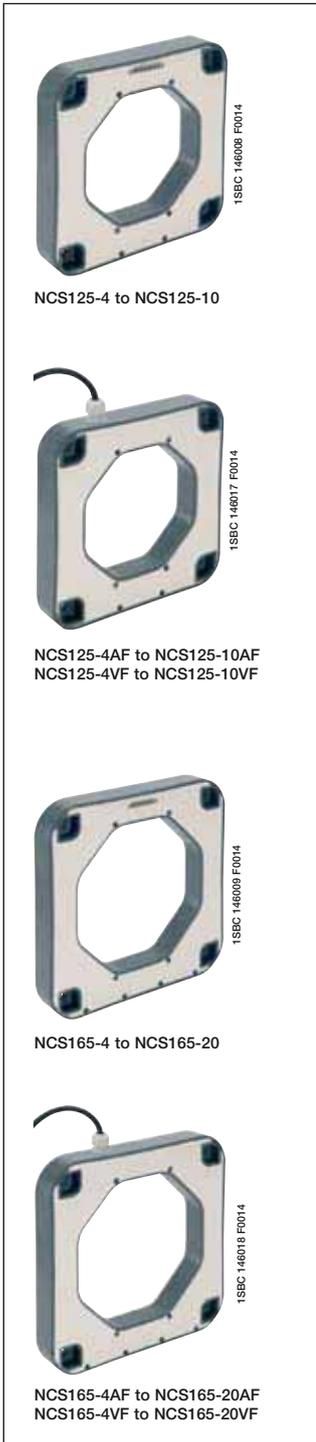


# Panorama of industry current sensors

## Frame mounting



These sensors are designed to be fixed by the case. They may be either vertically or horizontally mounted. The secondary connection is made with a connector or cable. For NCS sensors the primary conductor may be a cable, one or several bars.



Type	Nominal primary current (A peak)	Opening for the primary conductor (mm)	Secondary current $I_{S1}$ at $\pm I_{pn}$ (mA peak)	Secondary voltage $V_{S1}$ at $\pm I_{pn}$ (V peak)	Supply voltage (V d.c.)	Secondary connection	Order code
NCS125-4	4000	125	$\pm 20$	$\pm 10$	$\pm 15 \dots \pm 24$	Straight connector 8 pin	1SBT200204R0001
NCS125-4AF	4000	125	$\pm 20$	-	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200204R0002
NCS125-4VF	4000	125	-	$\pm 10$	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200204R0102
NCS165-4	4000	165	$\pm 20$	$\pm 10$	$\pm 15 \dots \pm 24$	Straight connector 8 pin	1SBT200604R0001
NCS165-4AF	4000	165	$\pm 20$	-	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200604R0002
NCS165-4VF	4000	165	-	$\pm 10$	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200604R0102
NCS125-6	6000	125	$\pm 20$	$\pm 10$	$\pm 15 \dots \pm 24$	Straight connector 8 pin	1SBT200206R0001
NCS125-6AF	6000	125	$\pm 20$	-	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200206R0002
NCS125-6VF	6000	125	-	$\pm 10$	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200206R0102
NCS165-6	6000	165	$\pm 20$	$\pm 10$	$\pm 15 \dots \pm 24$	Straight connector 8 pin	1SBT200606R0001
NCS165-6AF	6000	165	$\pm 20$	-	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200606R0002
NCS165-6VF	6000	165	-	$\pm 10$	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200606R0102
NCS125-10	10000	125	$\pm 20$	$\pm 10$	$\pm 15 \dots \pm 24$	Straight connector 8 pin	1SBT200210R0001
NCS125-10AF	10000	125	$\pm 20$	-	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200210R0002
NCS125-10VF	10000	125	-	$\pm 10$	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200210R0102
NCS165-10	10000	165	$\pm 20$	$\pm 10$	$\pm 15 \dots \pm 24$	Straight connector 8 pin	1SBT200610R0001
NCS165-10AF	10000	165	$\pm 20$	-	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200610R0002
NCS165-10VF	10000	165	-	$\pm 10$	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200610R0102
NCS165-20	20000	165	$\pm 20$	$\pm 10$	$\pm 15 \dots \pm 24$	Straight connector 8 pin	1SBT200620R0001
NCS165-20AF	20000	165	$\pm 20$	-	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200620R0002
NCS165-20VF	20000	165	-	$\pm 10$	$\pm 15 \dots \pm 24$	Shielded cable 6 wires (2m)	1SBT200620R0102

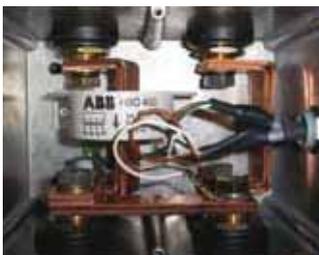


# Panorama of industry current sensors



Type	Nominal primary current (A peak)	Opening for the primary conductor (mm)	Secondary current $I_{S1}$ at $\pm I_{PN}$ (mA peak)	Secondary voltage $V_{S1}$ at $\pm I_{PN}$ (V peak)	Supply voltage (V d.c)	Secondary connection	Order code
NCS305-6	6	302	$\pm 20$	$\pm 10$	+15 ... +24 ( $\pm 2\%$ )	Straight connector 8 pin	1SBT200306R0001
NCS305-6AF	6	302	$\pm 20$	-	+15 ... +24 ( $\pm 2\%$ )	Shielded cable 6 wires (2m)	1SBT200306R0002
NCS305-6VF	6	302	-	$\pm 10$	+15 ... +24 ( $\pm 2\%$ )	Shielded cable 6 wires (2m)	1SBT200306R0102
NCS305-10	10	302	$\pm 20$	$\pm 10$	+15 ... +24 ( $\pm 2\%$ )	Straight connector 8 pin	1SBT200310R0001
NCS305-10AF	10	302	$\pm 20$	-	+15 ... +24 ( $\pm 2\%$ )	Shielded cable 6 wires (2m)	1SBT200310R0002
NCS305-10VF	10	302	-	$\pm 10$	+15 ... +24 ( $\pm 2\%$ )	Shielded cable 6 wires (2m)	1SBT200310R0102
NCS305-20	20	302	$\pm 20$	$\pm 10$	+15 ... +24 ( $\pm 2\%$ )	Straight connector 8 pin	1SBT200320R0001
NCS305-20AF	20	302	$\pm 20$	-	+15 ... +24 ( $\pm 2\%$ )	Shielded cable 6 wires (2m)	1SBT200320R0002
NCS305-20VF	20	302	-	$\pm 10$	+15 ... +24 ( $\pm 2\%$ )	Shielded cable 6 wires (2m)	1SBT200320R0102

## Frame mounting



These sensors are designed to be fixed by the case. They may be either vertically or horizontally mounted. The secondary connection is made with a connector. For HBO sensors the primary conductor may be a cable or a bar.

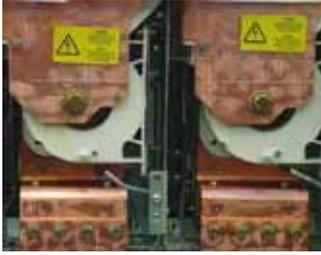


Type	Nominal primary current (A r.m.s.)	Secondary voltage at $I_{PN}$ (V)	Supply voltage (V d.c)	Secondary connection	Order code
HBO100	100	$\pm 4$	$\pm 12 \dots \pm 15$	Molex 4 pin	1SBT210100R0001
HBO200	200	$\pm 4$	$\pm 12 \dots \pm 15$	Molex 4 pin	1SBT210200R0001
HBO300	300	$\pm 4$	$\pm 12 \dots \pm 15$	Molex 4 pin	1SBT210300R0001
HBO400	400	$\pm 4$	$\pm 12 \dots \pm 15$	Molex 4 pin	1SBT210400R0001
HBO500	500	$\pm 4$	$\pm 12 \dots \pm 15$	Molex 4 pin	1SBT210500R0001
HBO600	600	$\pm 4$	$\pm 12 \dots \pm 15$	Molex 4 pin	1SBT210600R0001



# Panorama of industry current sensors

## Frame mounting



These sensors are designed to be fixed by the case. They may be either horizontally or vertically mounted. The secondary connection is made with a connector or cable. For ES and ESM sensors the primary conductor may be a cable or a bar.



Type	Nominal primary current (A r.m.s)	Secondary current at $I_{PN}$ (mA)	Supply voltage (V d.c.)	Secondary connection	Order code
ES100C	100	100	$\pm 12 \dots \pm 24$	Molex 3 pins HE 14	ES100C
ES100F	100	100	$\pm 12 \dots \pm 24$	3 wires 200 mm	ES100F
ES300C	300	150	$\pm 12 \dots \pm 24$	Molex 3 pins HE 14	ES300C
ES300S	300	150	$\pm 12 \dots \pm 24$	JST 3 pins	ES300S
ES300F	300	150	$\pm 12 \dots \pm 24$	3 wires 200 mm	ES300F
ES500C	500	100	$\pm 12 \dots \pm 24$	Molex 3 pins HE 14	ES500C
ES500S	500	100	$\pm 12 \dots \pm 24$	JST 3 pins	ES500S
ES500F	500	100	$\pm 12 \dots \pm 24$	3 wires 200 mm	ES500F
ES500-9672	500	125	$\pm 12 \dots \pm 24$	Molex 3 pins HE 14	ES500-9672
ES500-9673	500	125	$\pm 12 \dots \pm 24$	JST 3 pins	ES500-9673
ES500-9674	500	125	$\pm 12 \dots \pm 24$	3 wires 200 mm	ES500-9674
ES1000C	1000	200	$\pm 12 \dots \pm 24$	Molex 3 pins HE 14	ES1000C
ES1000S	1000	200	$\pm 12 \dots \pm 24$	JST 3 pins	ES1000S
ES1000F	1000	200	$\pm 12 \dots \pm 24$	3 wires 200 mm	ES1000F
ES1000-9678	1000	250	$\pm 12 \dots \pm 24$	Molex 3 pins HE 14	ES1000-9678
ES1000-9679	1000	250	$\pm 12 \dots \pm 24$	JST 3 pins	ES1000-9679
ES1000-9680	1000	250	$\pm 12 \dots \pm 24$	3 wires 200 mm	ES1000-9680
ESM1000C	1000	200	$\pm 15 \dots \pm 24$	Molex 3 pins HE 14	1SBT191000R0003
ESM1000S	1000	200	$\pm 15 \dots \pm 24$	JST 3 pins	1SBT191000R0002
ESM1000F	1000	200	$\pm 15 \dots \pm 24$	3 wires 200 mm	1SBT191000R0001
ESM1000-9888	1000	250	$\pm 15 \dots \pm 24$	Molex 3 pins HE 14	1SBT191000R9888
ESM1000-9887	1000	250	$\pm 15 \dots \pm 24$	JST 3 pins	1SBT191000R9887
ESM1000-9886	1000	250	$\pm 15 \dots \pm 24$	3 wires 200 mm	1SBT191000R9886
ES2000C	2000	400	$\pm 15 \dots \pm 24$	Molex 3 pins HE 14	1SBT152000R0003
ES2000S	2000	400	$\pm 15 \dots \pm 24$	JST 3 pins	1SBT152000R0002
ES2000F	2000	400	$\pm 15 \dots \pm 24$	3 wires 200 mm	1SBT152000R0001



# Panorama of industry current sensors

## PCB mounting



These sensors are designed for PCB mounting.

The sensor is mechanically fixed by soldering the secondary circuit pins to the PCB. The primary connection can also be integrated in the sensor (pins for MP sensors, integrated primary bar for EL...BB sensors).

The primary conductor for EL... sensors can also be a cable or a bar.

For MP sensors the primary pin combination determines the sensor's nominal rating (see table p.55).



Type	Nominal primary current (A r.m.s.)	Secondary current at $I_{PN}$ (mA)	Supply voltage (V d.c.)	Primary connection	Secondary connection	Order code
MP25P1	5 to 25*	24 or 25*	$\pm 12 \dots \pm 15$	Pins	3 pins	1SBT312500R0001

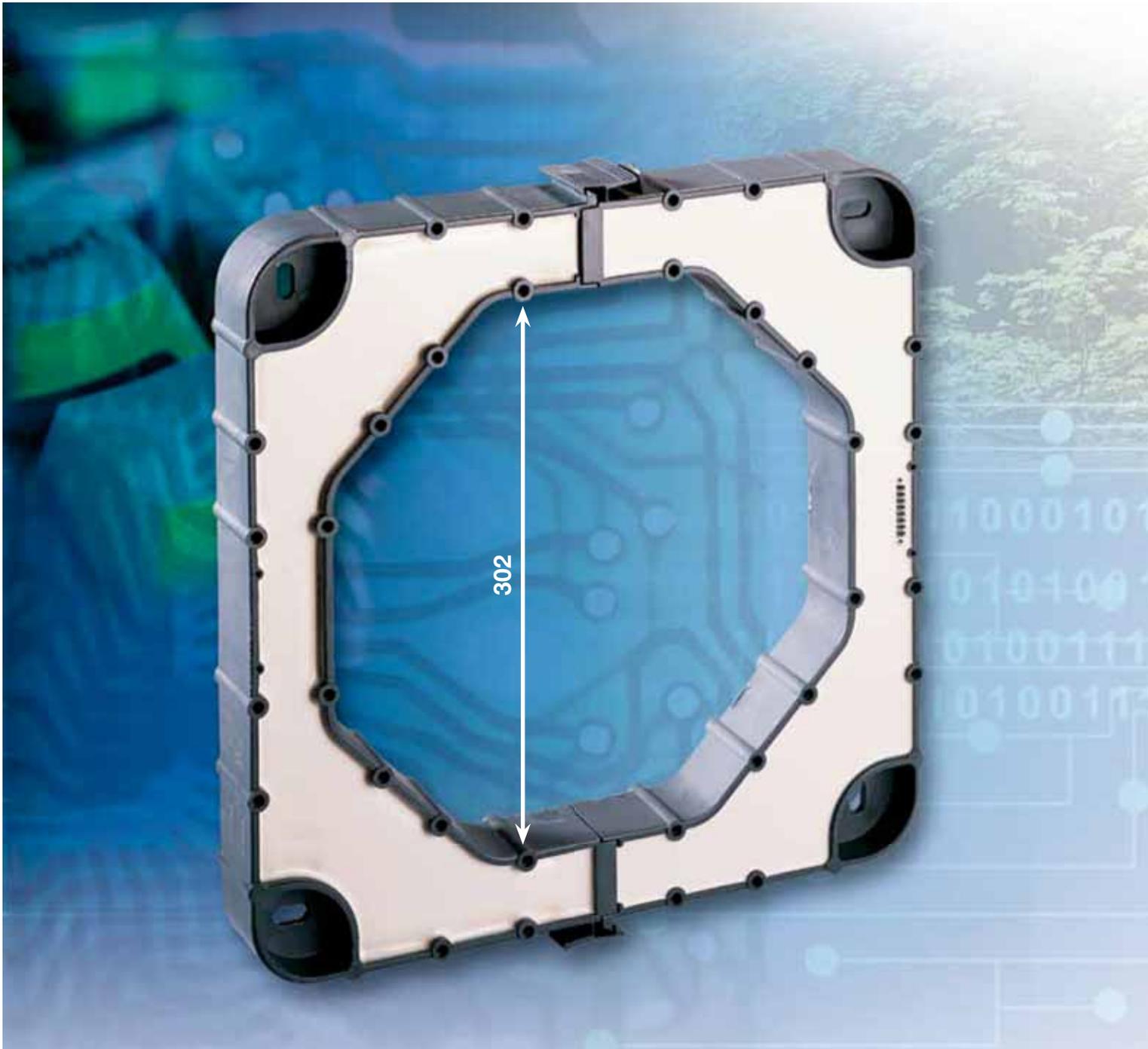
  

Type	Nominal primary current (A r.m.s.)	Secondary current at $I_{PN}$ (mA)	Supply voltage (V d.c.)	Primary connection	Secondary connection	Order code
EL25P1	25	25	$\pm 12 \dots \pm 15$	Hole $\varnothing 7.5$ mm	3 pins	1SBT132500R0001
EL25P1BB	25	25	$\pm 12 \dots \pm 15$	Bar	3 pins	1SBT132500R0002
EL50P1	50	50	$\pm 12 \dots \pm 15$	Hole $\varnothing 10$ mm	3 pins	1SBT135100R0001
EL50P1BB	50	50	$\pm 12 \dots \pm 15$	Bar	3 pins	1SBT135100R0003
EL55P2	50	25	$\pm 12 \dots \pm 15$	Hole $\varnothing 10$ mm	3 pins	1SBT135100R0002
EL55P2BB	50	25	$\pm 12 \dots \pm 15$	Bar	3 pins	1SBT135100R0004
EL100P2	100	50	$\pm 12 \dots \pm 15$	Hole $\varnothing 10$ mm	3 pins	1SBT130100R0001
EL100P2BB	100	50	$\pm 12 \dots \pm 15$	Bar	3 pins	1SBT130100R0002

\* see table p. 55 "MP25P1: arrangement of primary terminals and related characteristics".



# Industry Current Sensors NCS Range



## Designed to be integrated into every situation

The NCS125/165 sensor is entirely symmetrical. Its square shape and strategically positioned oblong holes make it easy to fasten in a choice of 2 positions.

As an accessory it comes with a side plate that can be fastened on either side of the sensor giving complete fitting flexibility. It meets the standard design of ABB current sensors. It can be fitted both horizontally and vertically.

This flexibility means that NCS125/165 sensor simplifies the work of integrators. Additionally the pair of side plate allows the NCS125/165 sensor to be fitted to one or several bars at the same time.

The NCS305 sensor has been designed to reduce installation costs for new and retrofit systems. Using our innovative and robust opening, the clip-on system allows the NCS305 to be easily adapted to existing bus bars.

Thanks to its core free, patented technology, the NCS is more cost effective and faster to install than traditional Hall Effect sensor.

The NCS is a "flyweight" with only 5.5 kg (for the NCS305), this sensor offer the best calibre/weight ratio.

## 100% electronic

The main advantage of the NCS range of sensors is that they are designed using a brand-new solution: 100% electronic technology. Unlike other currently available solutions such as shunts and CTs, this approach means that these sensors are very compact. Several patents were necessary to achieve this improvement.



## Considerable energy savings

NCS sensors offer considerable savings in energy. Indeed only a few watts are required to power the NCS sensor in contrast to traditional sensors that require several hundred watts. This reduction in wasted energy means there is no rise in temperature around the sensor.

## Quality that goes beyond standards

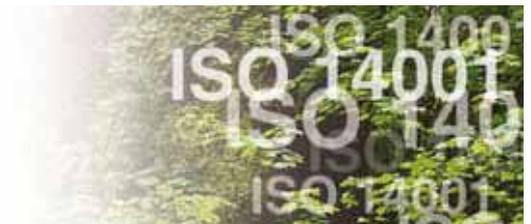
ABB have been ISO 9001 certified since 1993 and our standard NCS sensors bear the CE label in Europe. This ongoing striving after quality has always been the hallmark of a company where excellence and safety are part of the culture, from design right through to production. This culture is the result of continuous research to make technical progress and meet our customers' demands.

### QUALITY

The chief selling-point of NCS sensors is their quality. Compliance of their high-tech electronic design with standard EN 50178 is proof of their ability to comply with the most detailed constraint as well as major demands. The fact that each individual sensor is subjected to rigorous testing is proof of the importance ABB attribute to quality.

### ECOLOGY

ABB have long been concerned with the protection of the environment, as proved by the ISO 14001 certification they received in 1998. This environmental approach is particularly noticeable in the production of the NCS range in the reduction of the number of components, in the use of a low-energy manufacturing procedure and the use of recyclable packing. The products in use are also characterized by their reduced energy consumption.



# THE NCS MEETS ALL OF YOUR REQUIREMENTS

## Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

## Technical data

			ABB 8 pin connector		
			Output current shielded cable		
			Output voltage shielded cable		
			NCS125-4	- NCS125-4AF	- NCS125-4VF
Nominal primary current		<b>A peak</b>	4000	4000	4000
Measuring range		<b>A peak</b>	20000	20000	20000
Not measured overload	1s/h	<b>A peak</b>	80000	80000	80000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	$\pm 20$	$\pm 20$	-
Secondary current $I_{S2}$ at $I_{P_{MAX}}$		<b>mA peak</b>	$\pm 20$	$\pm 20$	-
Residual current $I_{S10}$	@ +25°C	<b><math>\mu A</math></b>	$\leq \pm 250$	$\leq \pm 250$	-
Residual current $I_{S20}$	@ +25°C	<b><math>\mu A</math></b>	$\leq \pm 180$	$\leq \pm 180$	-
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b><math>\mu A/^{\circ}C</math></b>	$\leq \pm 4$	$\leq \pm 4$	-
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b><math>\Omega</math></b>	0 ... 350	0 ... 350	-
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	$\pm 10$	-	$\pm 10$
Secondary voltage $V_{S2}$ at $I_{P_{MAX}}$		<b>V peak</b>	$\pm 10$	-	$\pm 10$
Residual voltage $V_{S10}$	@ +25°C	<b>mV</b>	$\leq \pm 100$	-	$\leq \pm 100$
Residual voltage $V_{S20}$	@ +25°C	<b>mV</b>	$\leq \pm 50$	-	$\leq \pm 50$
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/^{\circ}C</b>	$\leq \pm 2$	-	$\leq \pm 2$
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b><math>\Omega</math></b>	10000 ... $\infty$	-	10000 ... $\infty$
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	$\leq \pm 1$	$\leq \pm 1$	$\leq \pm 1$
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{P_{MAX}}$	@ +25°C	<b>%</b>	$\leq \pm 3$	$\leq \pm 3$	$\leq \pm 3$
Gain thermal drift	-25°C ... +85°C	<b>%/^{\circ}C</b>	$\leq 0.03$	$\leq 0.03$	$\leq 0.03$
Gain thermal drift	-40°C ... -25°C	<b>%/^{\circ}C</b>	$\leq 0.1$	$\leq 0.1$	$\leq 0.1$
Linearity (typical)		<b>%</b>	$\pm 0.5$	$\pm 0.5$	$\pm 0.5$
Delay time (typical)		<b><math>\mu s</math></b>	$\leq 3$	$\leq 3$	$\leq 3$
di/dt correctly followed		<b>A / <math>\mu s</math></b>	$\leq 100$	$\leq 100$	$\leq 100$
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	$\leq 180$	$\leq 180$	$\leq 180$
No load consumption current ( $I_{A0-}$ )		<b>mA</b>	$\leq 35$	$\leq 35$	$\leq 35$
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	5	5	5
Supply voltage	$\pm 2\%$	<b>V d.c.</b>	$\pm 15$ ... $\pm 24$	$\pm 15$ ... $\pm 24$	$\pm 15$ ... $\pm 24$
Mass		<b>Kg</b>	1	1	1
Operating temperature		<b>^{\circ}C</b>	-40 ... +85	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>^{\circ}C</b>	-50 ... +90	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.

## General data

- Plastic case and insulating resin are self-extinguishing.
- Two fixing modes:
  - Horizontal or vertical with fixing holes in the case moulding.
  - By bar using the intermediate side plate kit (Refer to accessories and options on the following page).
- Max tightening torque for M6 screws (side plate mounting): 2 N.m
- **Direction of the current:**
  - Output current ( $I_{S1}$  and  $I_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output current on terminals  $I_{S1}$  and  $I_{S2}$ .
  - Output voltage ( $V_{S1}$  and  $V_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output voltage on terminals  $V_{S1}$  and  $V_{S2}$ .

- Burn-in test in accordance with FPTC 404304 cycle.

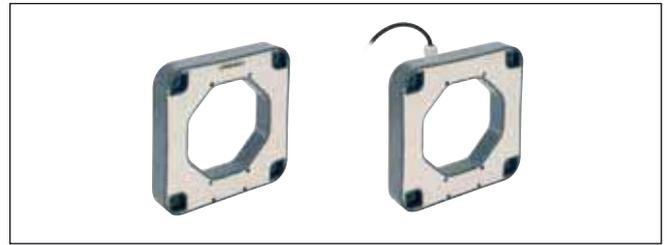
## Primary connection

Hole for primary conductor.  
The temperature of the primary conductor in contact with the case must not exceed 100°C.

## Secondary connection

- Male straight 8 pin connector (integrated in the sensor)  
A female straight 8 pin connector is provided as standard with each product.
- Shielded cable 6 x 2000 mm (cross section 0.5 mm<sup>2</sup>).

## NCS125 from 6000 to 10000 A



### Technical data

	ABB 8 pin connector		NCS125-6	-	-	NCS125-10	-	-
			-	NCS125-6AF	-	-	NCS125-10AF	-
			-	-	NCS125-6VF	-	-	NCS125-10VF
Nominal primary current		<b>A peak</b>	6000	6000	6000	10000	10000	10000
Measuring range		<b>A peak</b>	30000	30000	30000	30000	30000	30000
Not measured overload	1s/h	<b>A peak</b>	120000	120000	120000	200000	200000	200000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	±20	±20	-	±20	±20	-
Secondary current $I_{S2}$ at $I_{PMAX}$		<b>mA peak</b>	±20	±20	-	±20	±20	-
Residual current $I_{S10}$	@ +25°C	<b>µA</b>	≤±250	≤±250	-	≤±250	≤±250	-
Residual current $I_{S20}$	@ +25°C	<b>µA</b>	≤±180	≤±180	-	≤±180	≤±180	-
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b>µA/°C</b>	≤±4	≤±4	-	≤±4	≤±4	-
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b>Ω</b>	0 ... 350	0 ... 350	-	0 ... 350	0 ... 350	-
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	±10	-	±10	±10	-	±10
Secondary voltage $V_{S2}$ at $I_{PMAX}$		<b>V peak</b>	±10	-	±10	±10	-	±10
Residual voltage $V_{S10}$	@ +25°C	<b>mV</b>	≤±100	-	≤±100	≤±100	-	≤±100
Residual voltage $V_{S20}$	@ +25°C	<b>mV</b>	≤±50	-	≤±50	≤±50	-	≤±50
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/°C</b>	≤±2	-	≤±2	≤±2	-	≤±2
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b>Ω</b>	10000 ... ∞	-	10000 ... ∞	10000 ... ∞	-	10000 ... ∞
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	≤±1	≤±1	≤±1	≤±1	≤±1	≤±1
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PMAX}$	@ +25°C	<b>%</b>	≤±3	≤±3	≤±3	≤±3	≤±3	≤±3
Gain thermal drift	-25°C ... +85°C	<b>%/°C</b>	≤0.03	≤0.03	≤0.03	≤0.03	≤0.03	≤0.03
Gain thermal drift	-40°C ... -25°C	<b>%/°C</b>	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1
Linearity (typical)		<b>%</b>	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5
Delay time (typical)		<b>µs</b>	≤3	≤3	≤3	≤3	≤3	≤3
di/dt correctly followed		<b>A / µs</b>	≤100	≤100	≤100	≤100	≤100	≤100
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10	0 ... 10	0 ... 10	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	≤180	≤180	≤180	≤180	≤180	≤180
No load consumption current ( $I_{A0-}$ )		<b>mA</b>	≤35	≤35	≤35	≤35	≤35	≤35
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	5	5	5	5	5	5
Supply voltage	± 2%	<b>V d.c.</b>	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24
Mass		<b>Kg</b>	1	1	1	1	1	1
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.

### Accessories and options

#### ABB female straight 8 pin connector

- ABB order code: **1SBT200000R2003** including 10 lockable connectors

#### Side plates (or right angle brackets)

For installation of the side plates, please refer to the mounting instructions ref. **1SBC146005M1701** (NCS125) or the mounting instructions ref. **1SBC146004M1701** (NCS165)

- Side plate kit NCS125:

ABB order code: **1SBT200000R2002**

For other options please contact us.

### Conformity

EN50178

EN61000-6-2, EN61000-6-4



## Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

## Technical data

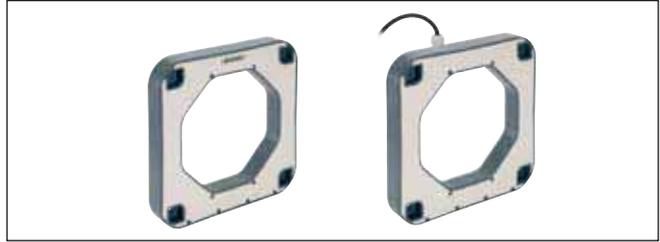
			ABB 8 pin connector Output current shielded cable Output voltage shielded cable					
			NCS165-4	- NCS165-4AF	- NCS165-4VF	NCS165-6	- NCS165-6AF	- NCS165-6VF
Nominal primary current		<b>A peak</b>	4000	4000	4000	6000	6000	6000
Measuring range		<b>A peak</b>	20000	20000	20000	30000	30000	30000
Not measured overload	1s/h	<b>A peak</b>	80000	80000	80000	120000	120000	120000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	±20	±20	-	±20	±20	-
Secondary current $I_{S2}$ at $I_{PMAX}$		<b>mA peak</b>	±20	±20	-	±20	±20	-
Residual current $I_{S1,0}$	@ +25°C	<b>µA</b>	≤±250	≤±250	-	≤±250	≤±250	-
Residual current $I_{S2,0}$	@ +25°C	<b>µA</b>	≤±180	≤±180	-	≤±180	≤±180	-
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b>µA/°C</b>	≤±4	≤±4	-	≤±4	≤±4	-
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b>Ω</b>	0 ... 350	0 ... 350	-	0 ... 350	0 ... 350	-
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	±10	-	±10	±10	-	±10
Secondary voltage $V_{S2}$ at $I_{PMAX}$		<b>V peak</b>	±10	-	±10	±10	-	±10
Residual voltage $V_{S1,0}$	@ +25°C	<b>mV</b>	≤±100	-	≤±100	≤±100	-	≤±100
Residual voltage $V_{S2,0}$	@ +25°C	<b>mV</b>	≤±50	-	≤±50	≤±50	-	≤±50
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/°C</b>	≤±2	-	≤±2	≤±2	-	≤±2
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b>Ω</b>	10000 ... ∞	-	10000 ... ∞	10000 ... ∞	-	10000 ... ∞
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	≤±1	≤±1	≤±1	≤±1	≤±1	≤±1
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PMAX}$	@ +25°C	<b>%</b>	≤±3	≤±3	≤±3	≤±3	≤±3	≤±3
Gain thermal drift	-25°C ... +85°C	<b>%/°C</b>	≤0.03	≤0.03	≤0.03	≤0.03	≤0.03	≤0.03
Gain thermal drift	-40°C ... -25°C	<b>%/°C</b>	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1
Linearity (typical)		<b>%</b>	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5
Delay time (typical)		<b>µs</b>	≤3	≤3	≤3	≤3	≤3	≤3
di/dt correctly followed		<b>A / µs</b>	≤100	≤100	≤100	≤100	≤100	≤100
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10	0 ... 10	0 ... 10	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	≤210	≤210	≤210	≤210	≤210	≤210
No load consumption current ( $I_{A0-}$ )		<b>mA</b>	≤35	≤35	≤35	≤35	≤35	≤35
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	5	5	5	5	5	5
Supply voltage	± 2%	<b>V d.c.</b>	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24
Mass		<b>Kg</b>	1.2	1.2	1.2	1.2	1.2	1.2
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.

## General data

- Plastic case and insulating resin are self-extinguishing.
- Two fixing modes:
  - Horizontal or vertical with fixing holes in the case moulding.
  - By bar using the intermediate side plate kit (Refer to Accessories and options on the following page).
- Max tightening torque for M6 screws (side plate mounting): 2 N.m
- **Direction of the current:**
  - Output current ( $I_{S1}$  and  $I_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output current on terminals  $I_{S1}$  and  $I_{S2}$ .
  - Output voltage ( $V_{S1}$  and  $V_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output voltage on terminals  $V_{S1}$  and  $V_{S2}$ .

## NCS165 from 4000 to 6000 A



- Burn-in test in accordance with FPTC 404304 cycle

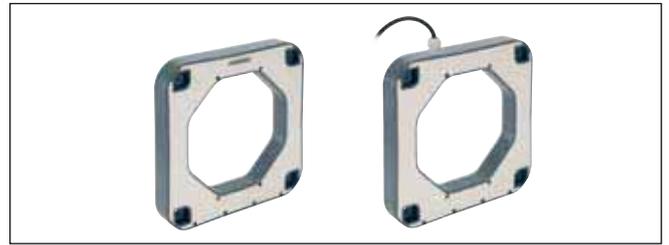
## Primary connection

Hole for primary conductor.  
The temperature of the primary conductor in contact with the case must not exceed 100°C.

## Secondary connection

- Male straight 8 pin connector (integrated in the sensor)  
A female straight 8 pin connector is provided as standard with each product.
- Shielded cable 6 x 2000 mm (cross section 0.5 mm<sup>2</sup>)

## NCS165 from 10000 to 20000 A



### Technical data

	ABB 8 pin connector		NCS165-10	-	-	NCS165-20	-	-
			-	NCS165-10AF	-	-	NCS165-20AF	-
			-	-	NCS165-10VF	-	-	NCS165-20VF
Nominal primary current		<b>A peak</b>	10000	10000	10000	20000	20000	20000
Measuring range		<b>A peak</b>	30000	30000	30000	40000	40000	40000
Not measured overload	1s/h	<b>A peak</b>	200000	200000	200000	200000	200000	200000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	±20	±20	-	±20	±20	-
Secondary current $I_{S2}$ at $I_{P_{MAX}}$		<b>mA peak</b>	±20	±20	-	±20	±20	-
Residual current $I_{S10}$	@ +25°C	<b>µA</b>	≤±250	≤±250	-	≤±250	≤±250	-
Residual current $I_{S20}$	@ +25°C	<b>µA</b>	≤±180	≤±180	-	≤±180	≤±180	-
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b>µA/°C</b>	≤±4	≤±4	-	≤±4	≤±4	-
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b>Ω</b>	0 ... 350	0 ... 350	-	0 ... 350	0 ... 350	-
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	±10	-	±10	±10	-	±10
Secondary voltage $V_{S2}$ at $I_{P_{MAX}}$		<b>V peak</b>	±10	-	±10	±10	-	±10
Residual voltage $V_{S10}$	@ +25°C	<b>mV</b>	≤±100	-	≤±100	≤±100	-	≤±100
Residual voltage $V_{S20}$	@ +25°C	<b>mV</b>	≤±50	-	≤±50	≤±50	-	≤±50
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/°C</b>	≤±2	-	≤±2	≤±2	-	≤±2
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b>Ω</b>	10000 ... ∞	-	10000 ... ∞	10000 ... ∞	-	10000 ... ∞
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	≤±1	≤±1	≤±1	≤±1	≤±1	≤±1
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{P_{MAX}}$	@ +25°C	<b>%</b>	≤±3	≤±3	≤±3	≤±3	≤±3	≤±3
Gain thermal drift	-25°C ... +85°C	<b>%/°C</b>	≤0.03	≤0.03	≤0.03	≤0.03	≤0.03	≤0.03
Gain thermal drift	-40°C ... -25°C	<b>%/°C</b>	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1
Linearity (typical)		<b>%</b>	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5
Delay time (typical)		<b>µs</b>	≤3	≤3	≤3	≤3	≤3	≤3
di/dt correctly followed		<b>A / µs</b>	≤100	≤100	≤100	≤100	≤100	≤100
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10	0 ... 10	0 ... 10	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	≤210	≤210	≤210	≤210	≤210	≤210
No load consumption current ( $I_{A0-}$ )		<b>mA</b>	≤35	≤35	≤35	≤35	≤35	≤35
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	5	5	5	5	5	5
Supply voltage	± 2%	<b>V d.c.</b>	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24
Mass		<b>Kg</b>	1.2	1.2	1.2	1.2	1.2	1.2
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.

### Accessories and options

#### ABB female straight 8 pin connector

- ABB order code : **1SBT200000R2003** includes 10 lockable connectors

#### Side plates (or right angle brackets)

For installation of the side plates, please refer to the mounting instructions ref. **1SBC146004M1701**

- Side plate kit NCS165:

ABB order code: **1SBT200000R2001**

For other options please contact us.

### Conformity

EN50178

EN61000-6-2, EN61000-6-4



## Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

## Technical data

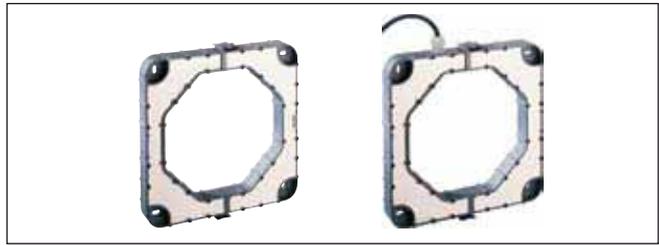
	ABB 8 pin connector		NCS305-6	NCS305-6AF	NCS305-6VF	NCS305-10
	Output current shielded cable	Output voltage shielded cable				
Nominal primary current		<b>A peak</b>	6000	6000	6000	10000
Measuring range		<b>A peak</b>	20000	20000	20000	30000
Not measured overload	1s/h	<b>A peak</b>	80000	80000	80000	120000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	±20	±20	-	±20
Secondary current $I_{S2}$ at $I_{P_{MAX}}$		<b>mA peak</b>	±20	±20	-	±20
Residual current $I_{S10}$	@ +25°C	<b>µA</b>	≤ ±250	≤ ±250	-	≤ ±250
Residual current $I_{S20}$	@ +25°C	<b>µA</b>	≤ ±180	≤ ±180	-	≤ ±180
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b>µA/°C</b>	≤ ±4	≤ ±4	-	≤ ±4
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b>Ω</b>	0 ... 350	0 ... 350	-	0 ... 350
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	±10	-	±10	±10
Secondary voltage $V_{S2}$ at $I_{P_{MAX}}$		<b>V peak</b>	±10	-	±10	±10
Residual voltage $V_{S10}$	@ +25°C	<b>mV</b>	≤ ±100	-	≤ ±100	≤ ±100
Residual voltage $V_{S20}$	@ +25°C	<b>mV</b>	≤ ±50	-	≤ ±50	≤ ±50
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/°C</b>	≤ ±2	-	≤ ±2	≤ ±2
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b>Ω</b>	10000 ... ∞	-	10000 ... ∞	10000 ... ∞
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	≤ ±1	≤ ±1	≤ ±1	≤ ±1
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{P_{MAX}}$	@ +25°C	<b>%</b>	≤ ±3	≤ ±3	≤ ±3	≤ ±3
Gain thermal drift	-20°C ... +85°C	<b>%/°C</b>	≤ ±0.01	≤ ±0.01	≤ ±0.01	≤ ±0.01
Gain thermal drift	-40°C ... -20°C	<b>%/°C</b>	≤ ±0.04	≤ ±0.04	≤ ±0.04	≤ ±0.04
Linearity (typical)		<b>%</b>	±0.5	±0.5	±0.5	±0.5
Delay time (typical)		<b>µs</b>	≤ 10	≤ 10	≤ 10	≤ 10
di/dt correctly followed		<b>A / µs</b>	≤ 100	≤ 100	≤ 100	≤ 100
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	≤ 300	≤ 300	≤ 300	≤ 300
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	5	5	5	5
Supply voltage	± 2%	<b>V d.c.</b>	+15 ... +24	+15 ... +24	+15 ... +24	+15 ... +24
Mass		<b>Kg</b>	5.5	5.5	5.5	5.5
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.

## General data

- Plastic case and insulating resin are self-extinguishing.
- **Clip on** mounting mode
- Two fixing modes:
  - Horizontal with fixing holes in the case moulding.
  - By bar using the intermediate side plate kit (Refer to accessories and options on the following page).
- Max tightening torque for M6.3 screws (side plate mounting): 4.5 N.m
- **Direction of the current:**
  - Output current ( $I_{S1}$  and  $I_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output current on terminals  $I_{S1}$  and  $I_{S2}$ .
  - Output voltage ( $V_{S1}$  and  $V_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output voltage on terminals  $V_{S1}$  and  $V_{S2}$ .
- Burn-in test in accordance with FPTC 404304 cycle.

## NCS305 from 6000 to 10000 A



## Primary connection

Hole for primary conductor.

The temperature of the primary conductor in contact with the case must not exceed 100°C.

## Secondary connection

- Male straight 8 pin connector (integrated in the sensor)  
A female straight 8 pin connector is provided as standard with each product.
- Shielded cable 6 x 2000 mm (cross section 0.5 mm<sup>2</sup>).

## NCS305 from 10000 to 20000 A



### Technical data

	ABB 8 pin connector		NCS305-10AF	NCS305-10VF	NCS305-20		NCS305-20AF	NCS305-20VF
	Output current shielded cable	Output voltage shielded cable						
Nominal primary current		<b>A peak</b>	10000	10000	20000	20000	20000	20000
Measuring range		<b>A peak</b>	30000	30000	40000	40000	40000	40000
Not measured overload	1s/h	<b>A peak</b>	120000	120000	200000	200000	200000	200000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	±20	-	±20	±20	-	-
Secondary current $I_{S2}$ at $I_{P_{MAX}}$		<b>mA peak</b>	±20	-	±20	±20	-	-
Residual current $I_{S10}$	@ +25°C	<b>µA</b>	≤ ±250	-	≤ ±250	≤ ±250	-	-
Residual current $I_{S20}$	@ +25°C	<b>µA</b>	≤ ±180	-	≤ ±180	≤ ±180	-	-
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b>µA/°C</b>	≤ ±4	-	≤ ±4	≤ ±4	-	-
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b>Ω</b>	0 ... 350	-	0 ... 350	0 ... 350	-	-
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	-	±10	±10	-	±10	±10
Secondary voltage $V_{S2}$ at $I_{P_{MAX}}$		<b>V peak</b>	-	±10	±10	-	±10	±10
Residual voltage $V_{S10}$	@ +25°C	<b>mV</b>	-	≤ ±100	≤ ±100	-	≤ ±100	≤ ±100
Residual voltage $V_{S20}$	@ +25°C	<b>mV</b>	-	≤ ±50	≤ ±50	-	≤ ±50	≤ ±50
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/°C</b>	-	≤ ±2	≤ ±2	-	≤ ±2	≤ ±2
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b>Ω</b>	-	10000 ... ∞	10000 ... ∞	-	10000 ... ∞	10000 ... ∞
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	≤ ±1	≤ ±1	≤ ±1	≤ ±1	≤ ±1	≤ ±1
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{P_{MAX}}$	@ +25°C	<b>%</b>	≤ ±3	≤ ±3	≤ ±3	≤ ±3	≤ ±3	≤ ±3
Gain thermal drift	-20°C ... +85°C	<b>%/°C</b>	≤ ±0.01	≤ ±0.01	≤ ±0.01	≤ ±0.01	≤ ±0.01	≤ ±0.01
Gain thermal drift	-40°C ... -20°C	<b>%/°C</b>	≤ ±0.04	≤ ±0.04	≤ ±0.04	≤ ±0.04	≤ ±0.04	≤ ±0.04
Linearity (typical)		<b>%</b>	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5
Delay time (typical)		<b>µs</b>	≤ 10	≤ 10	≤ 10	≤ 10	≤ 10	≤ 10
di/dt correctly followed		<b>A / µs</b>	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10	0 ... 10	0 ... 10	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	≤ 300	≤ 300	≤ 300	≤ 300	≤ 300	≤ 300
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	5	5	5	5	5	5
Supply voltage	± 2%	<b>V d.c.</b>	+15 ... +24	+15 ... +24	+15 ... +24	+15 ... +24	+15 ... +24	+15 ... +24
Mass		<b>Kg</b>	5.5	5.5	5.5	5.5	5.5	5.5
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.

### Accessories and options

#### ABB female straight 8 pin connector

- ABB order code: **1SBT200000R2003** including 10 lockable connectors

#### Side plates

For installation of the side plates, please refer to the mounting instructions ref. **1SBC146010M1701**

- Side plate kit NCS305:

ABB order code: **1SBT200000R2005**

For other options please contact us.

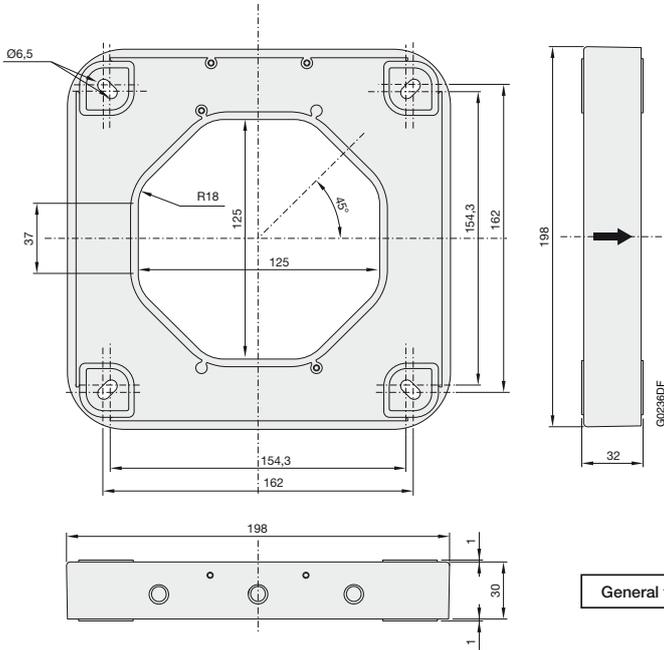
### Conformity

EN50178

EN61000-6-2, EN61000-6-4

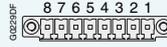


## Dimensions (mm)



General tolerance :  $\pm 1$  mm

### Standard NCS125-4...NCS125-10 sensors secondary connections



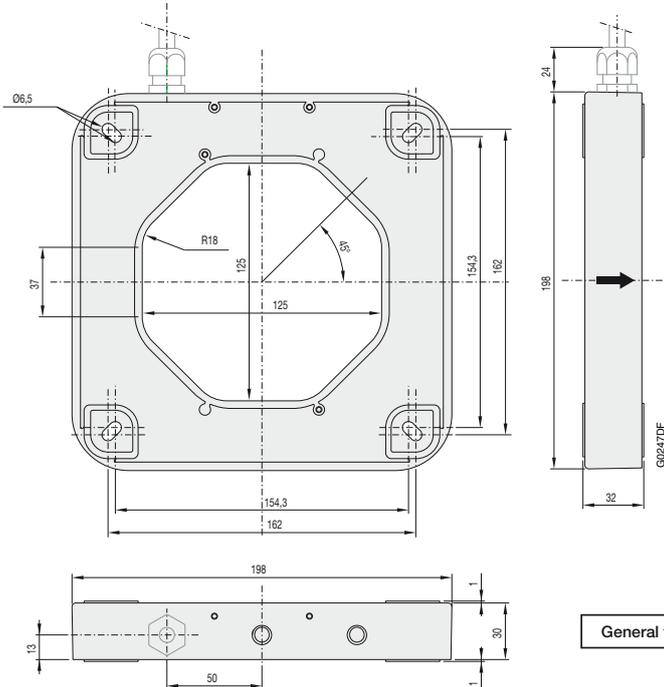
Straight connector base (with 3.81 mm pitch)  
Maximum tightening torque: 0.3 N.m

#### Terminal identification

- 1 :  $+V_A$  (+15 ... +24V d.c.)
- 2 : 0V
- 3 :  $-V_A$  (-15 ... -24V d.c.)
- 4 :  $V_{S1}$  ( $\pm 10V$  @  $I_{PN}$ )
- 5 :  $V_{S2}$  ( $\pm 10V$  @  $I_{P_{MAX}}$ )
- 6 :  $I_{S1}$  ( $\pm 20mA$  @  $I_{PN}$ )
- 7 :  $I_{S2}$  ( $\pm 20mA$  @  $I_{P_{MAX}}$ )
- 8 : 0V

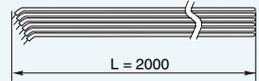
Shielding: see page 102

## NCS125-4 ... NCS125-10VF



General tolerance :  $\pm 1$  mm

### Standard NCS125-4AF...NCS125-10AF and NCS125-4VF...NCS125-10VF sensors secondary connections



Shielded cable 6 wires  
with braided earth:  
Cross section:  $0.5mm^2$   
Length:  $2m \pm 0.1$

#### AF range wire identification:

- 1 : Red:  $+V_A$  (+15 ... +24V d.c.)
- 2 : Black: 0V
- 3 : Blue:  $-V_A$  (-15 ... -24V d.c.)
- 4 : NC:
- 5 : NC:
- 6 : Green:  $I_{S1}$  ( $\pm 20mA$  @  $I_{PN}$ )
- 7 : White:  $I_{S2}$  ( $\pm 20mA$  @  $I_{P_{MAX}}$ )
- 8 : Brown: 0V

Shielding: see page 102

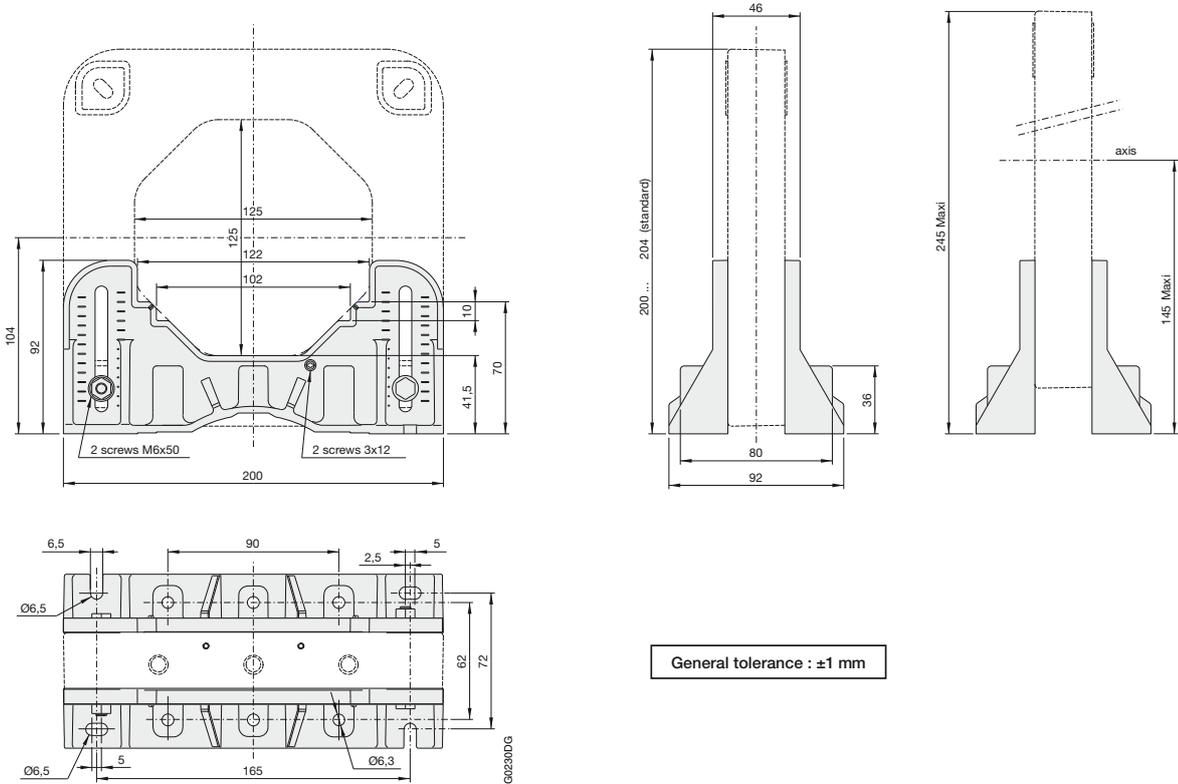
#### VF range wire identification:

- 1 : Red:  $+V_A$  (+15 ... +24V d.c.)
- 2 : Black: 0V
- 3 : Blue:  $-V_A$  (-15 ... -24V d.c.)
- 4 : Green:  $V_{S1}$  ( $\pm 10V$  @  $I_{PN}$ )
- 5 : White:  $V_{S2}$  ( $\pm 10V$  @  $I_{P_{MAX}}$ )
- 6 : NC:
- 7 : NC:
- 8 : Brown: 0V

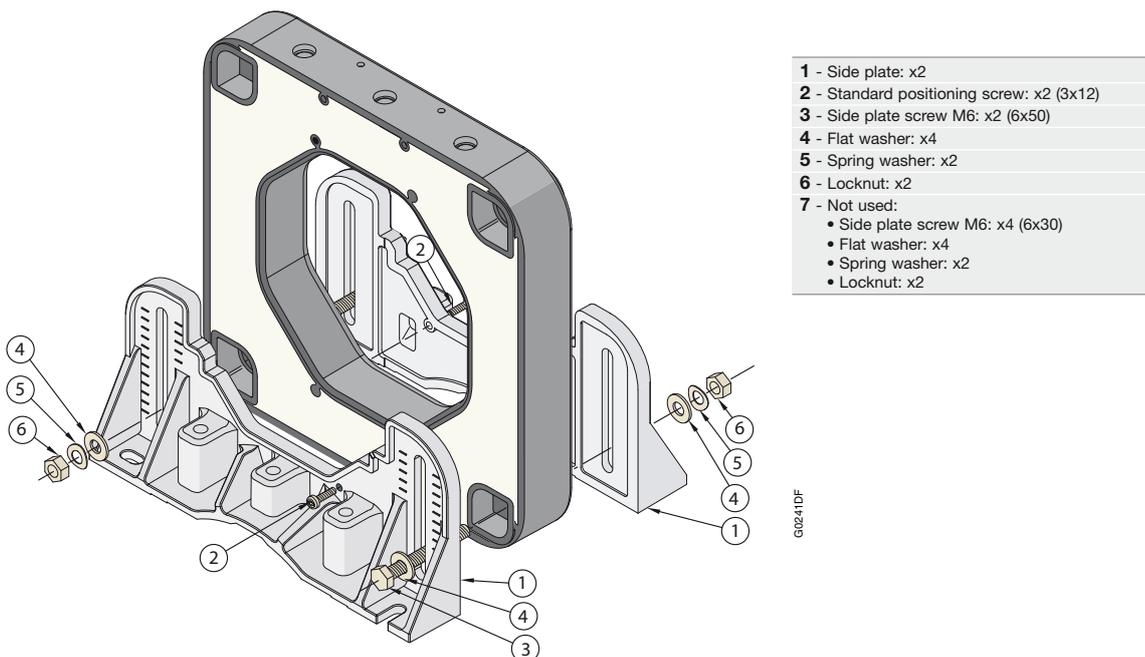
Shielding: see page 102

## NCS125-4AF...NCS125-10AF and NCS125-4VF...NCS125-10VF

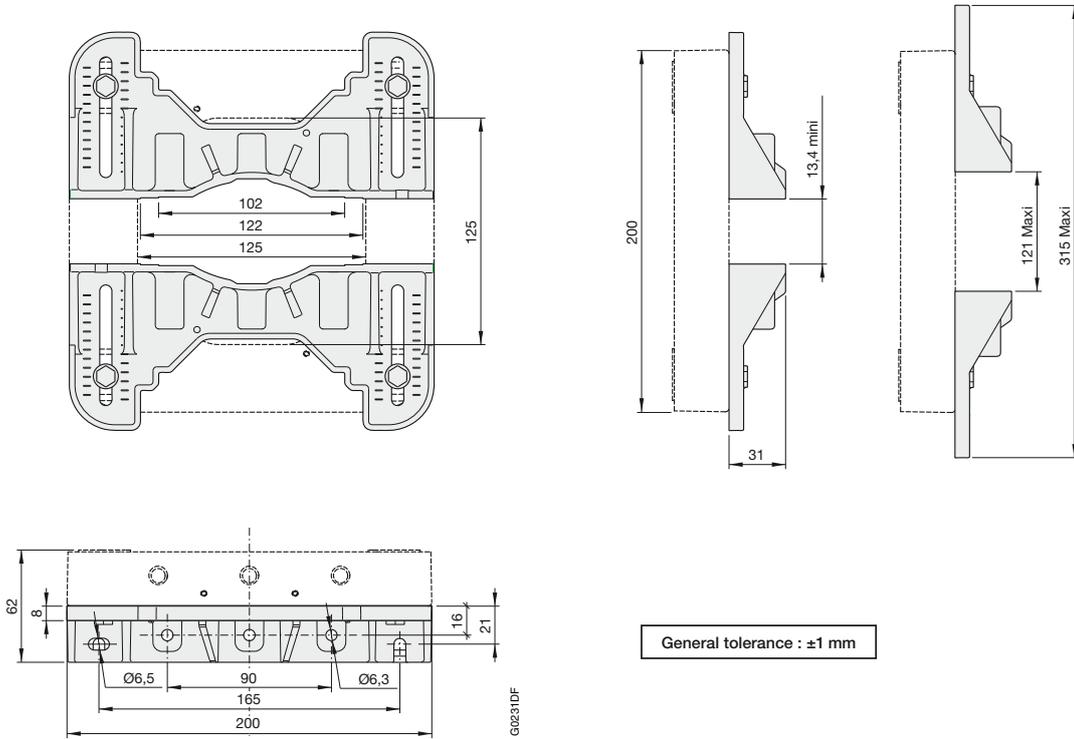
## Dimensions and arrangement of right angle brackets (mm)



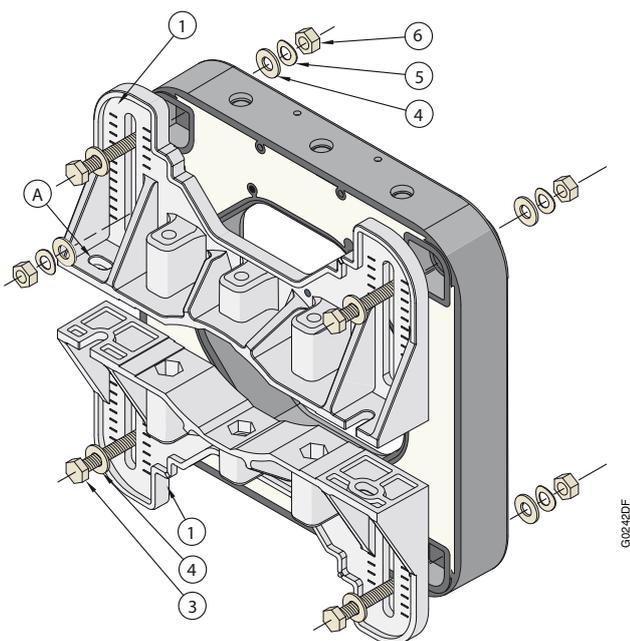
## Right angle brackets mounting on NCS125 sensors



## Dimensions and arrangement of right angle brackets (mm)



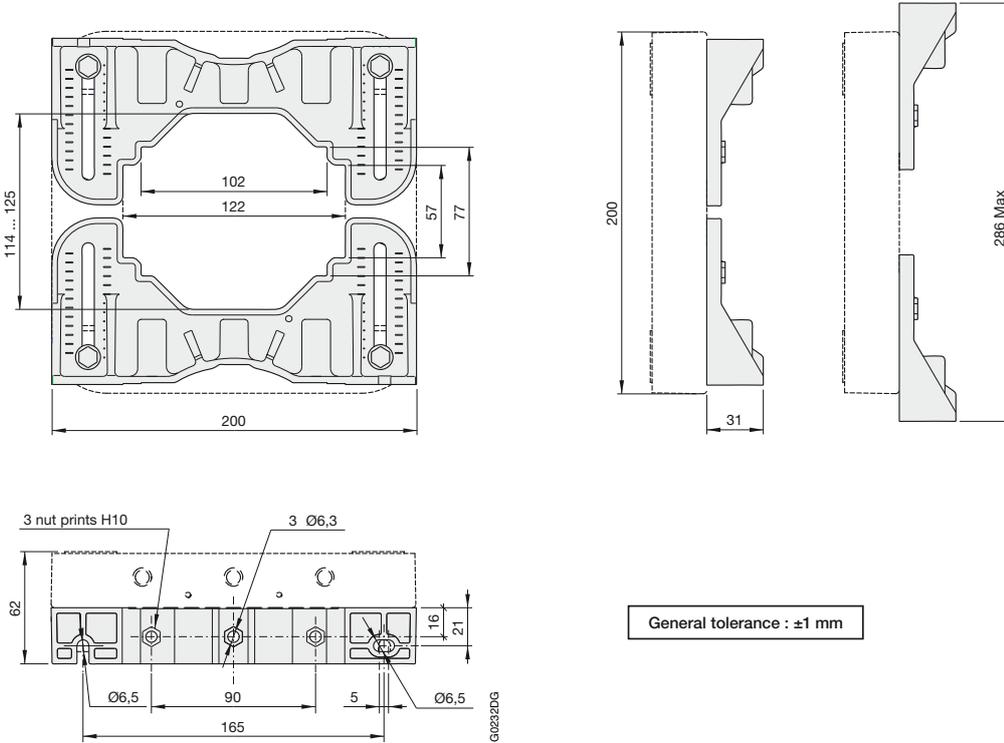
## Right angle brackets mounting on NCS125 sensors



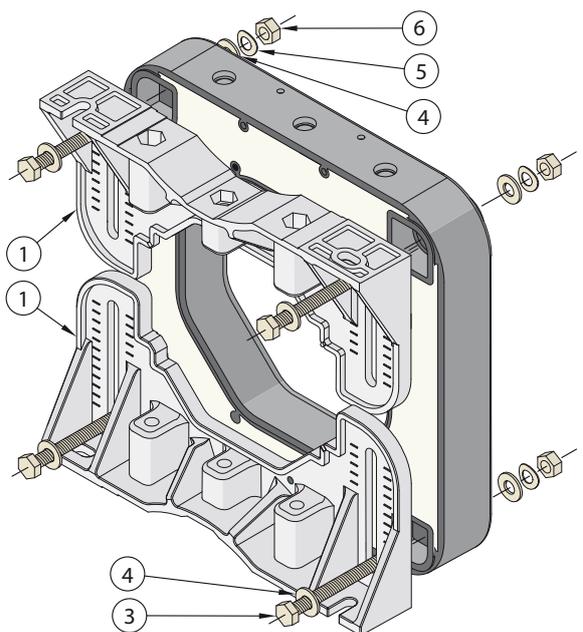
- |   |
|---|
| 1 - Side plate: x2                      |
| 3 - Side plate screw M6: x4 (6x30)      |
| 4 - Flat washer: x8                     |
| 5 - Spring washer: x4                   |
| 6 - Locknut: x4                         |
| 7 - Not used:                           |
| • Side plate screw M6: x2 (6x50)        |
| • Standard positioning screw: x2 (3x12) |

**A** - The screws for clamping the side plates to the bar (or cable) are not supplied

## Dimensions and arrangement of right angle brackets (mm)

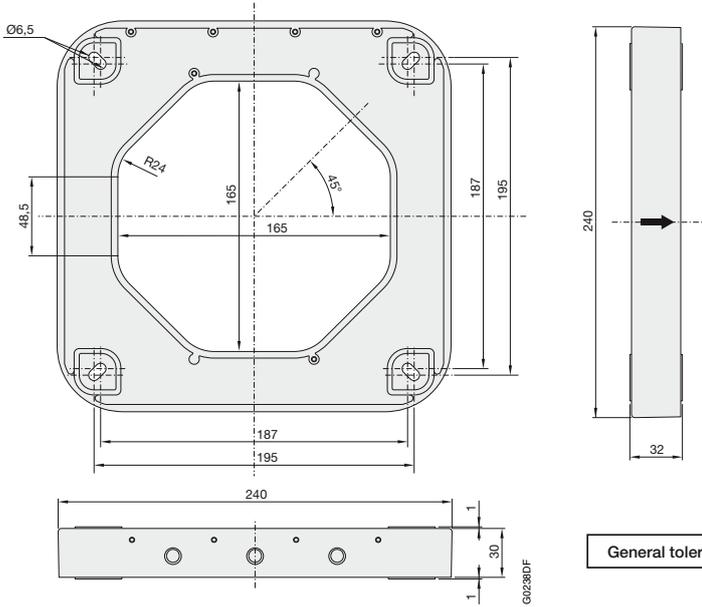


## Right angle brackets mounting on NCS125 sensors



- |   |   |
|---|---|
| 1 | - Side plate: x2                        |
| 3 | - Side plate screw M6: x4 (6x30)        |
| 4 | - Flat washer: x8                       |
| 5 | - Spring washer: x4                     |
| 6 | - Locknut: x4                           |
| 7 | - Not used:                             |
|   | • Side plate screw M6: x2 (6x50)        |
|   | • Standard positioning screw: x2 (3x12) |

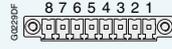
## Dimensions (mm)



General tolerance : ±1 mm

NCS165-4 ... NCS165-20

### Standard NCS165-4...NCS165-20 sensors secondary connections

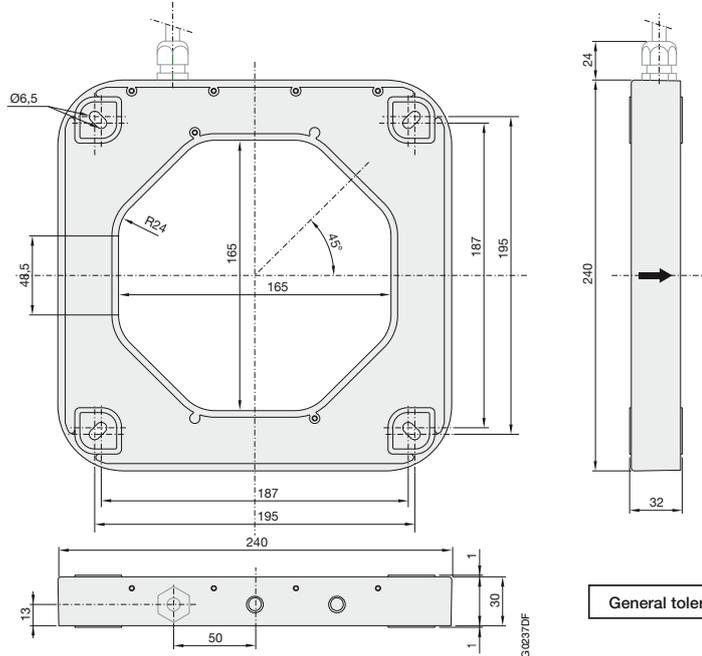


Straight connector base (with 3.81 mm pitch)  
Maximum tightening torque: 0.3 N.m

#### Terminal identification

- 1 : +V<sub>A</sub> (+15 ... +24V d.c.)
- 2 : 0V
- 3 : -V<sub>A</sub> (-15 ... -24V d.c.)
- 4 : V<sub>S1</sub> (±10V @ I<sub>PN</sub>)
- 5 : V<sub>S2</sub> (±10V @ I<sub>PMAX</sub>)
- 6 : I<sub>S1</sub> (±20mA @ I<sub>PN</sub>)
- 7 : I<sub>S2</sub> (±20mA @ I<sub>PMAX</sub>)
- 8 : 0V

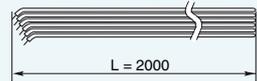
Shielding : see page 102



General tolerance : ±1 mm

NCS165-4AF...NCS165-20AF and  
NCS165-4VF...NCS165-20VF

### Standard NCS165-4AF...NCS165-20AF and NCS165-4VF...NCS165-20VF sensors secondary connections



Shielded cable 6 wires  
with braided earth:  
Cross section: 0.5mm<sup>2</sup>  
Length: 2m ±0.1

#### AF range wire identification:

- 1 : Red: +V<sub>A</sub> (+15 ... +24V d.c.)
- 2 : Black: 0V
- 3 : Blue: -V<sub>A</sub> (-15 ... -24V d.c.)
- 4 : NC:
- 5 : NC:
- 6 : Green: I<sub>S1</sub> (±20mA @ I<sub>PN</sub>)
- 7 : White: I<sub>S2</sub> (±20mA @ I<sub>PMAX</sub>)
- 8 : Brown: 0V

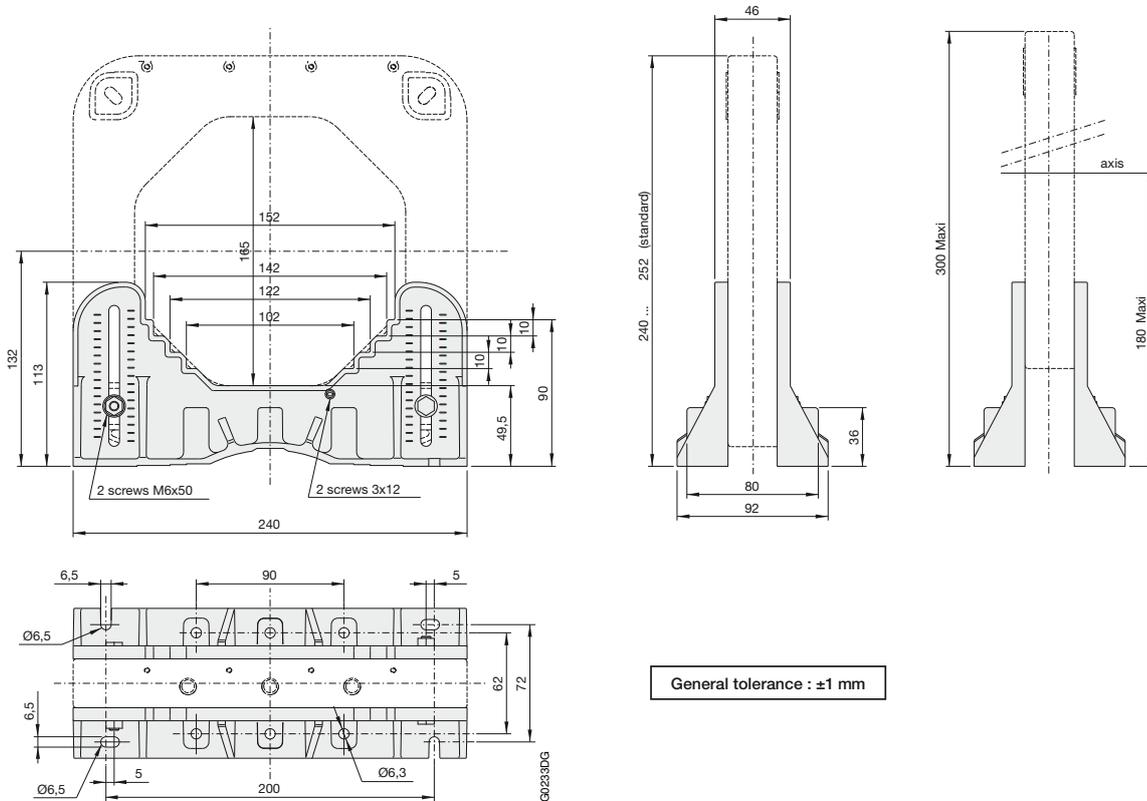
Shielding : see page 102

#### VF range wire identification:

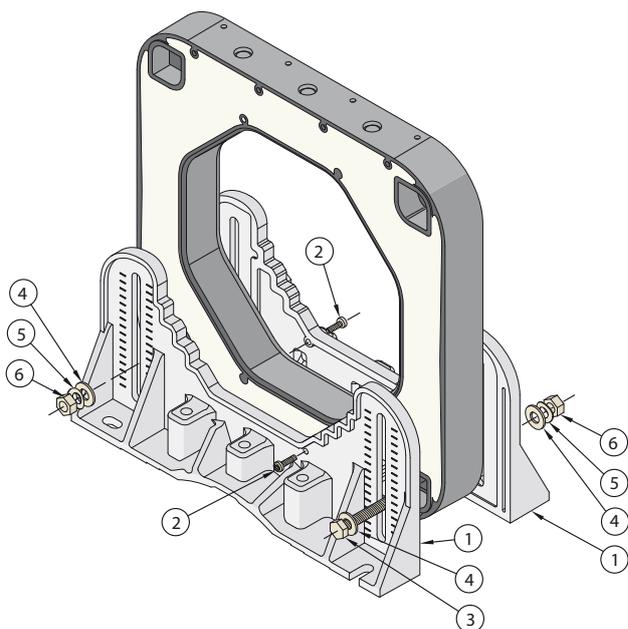
- 1 : Red: +V<sub>A</sub> (+15 ... +24V d.c.)
- 2 : Black: 0V
- 3 : Blue: -V<sub>A</sub> (-15 ... -24V d.c.)
- 4 : Green: V<sub>S1</sub> (±10V @ I<sub>PN</sub>)
- 5 : White: V<sub>S2</sub> (±10V @ I<sub>PMAX</sub>)
- 6 : NC:
- 7 : NC:
- 8 : Brown: 0V

Shielding : see page 102

## Dimensions and arrangement of right angle brackets (mm)



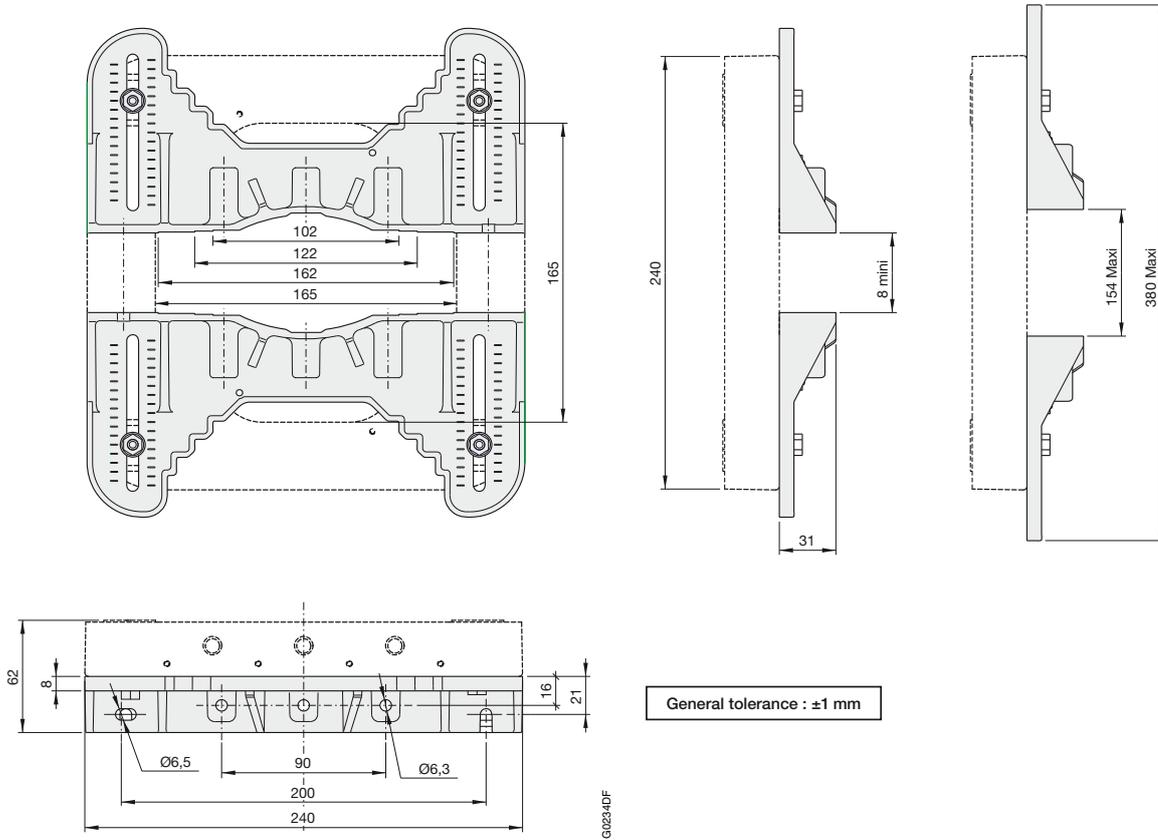
## Right angle brackets mounting on NCS165 sensors



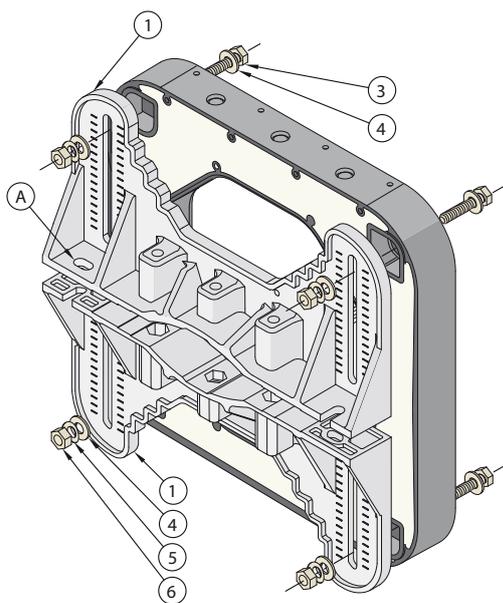
- |   |   |
|---|---|
| 1 | - Side plate: x2                        |
| 2 | - Standard positioning screw: x2 (3x12) |
| 3 | - Side plate screw M6: x2 (6x50)        |
| 4 | - Flat washer: x4                       |
| 5 | - Spring washer: x2                     |
| 6 | - Locknut: x2                           |
| 7 | - Not used:                             |
|   | • Side plate screw M6: x4 (6x30)        |
|   | • Flat washer: x4                       |
|   | • Spring washer: x2                     |
|   | • Locknut: x2                           |

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## Dimensions and arrangement of right angle brackets (mm)



## Right angle brackets mounting on NCS165 sensors

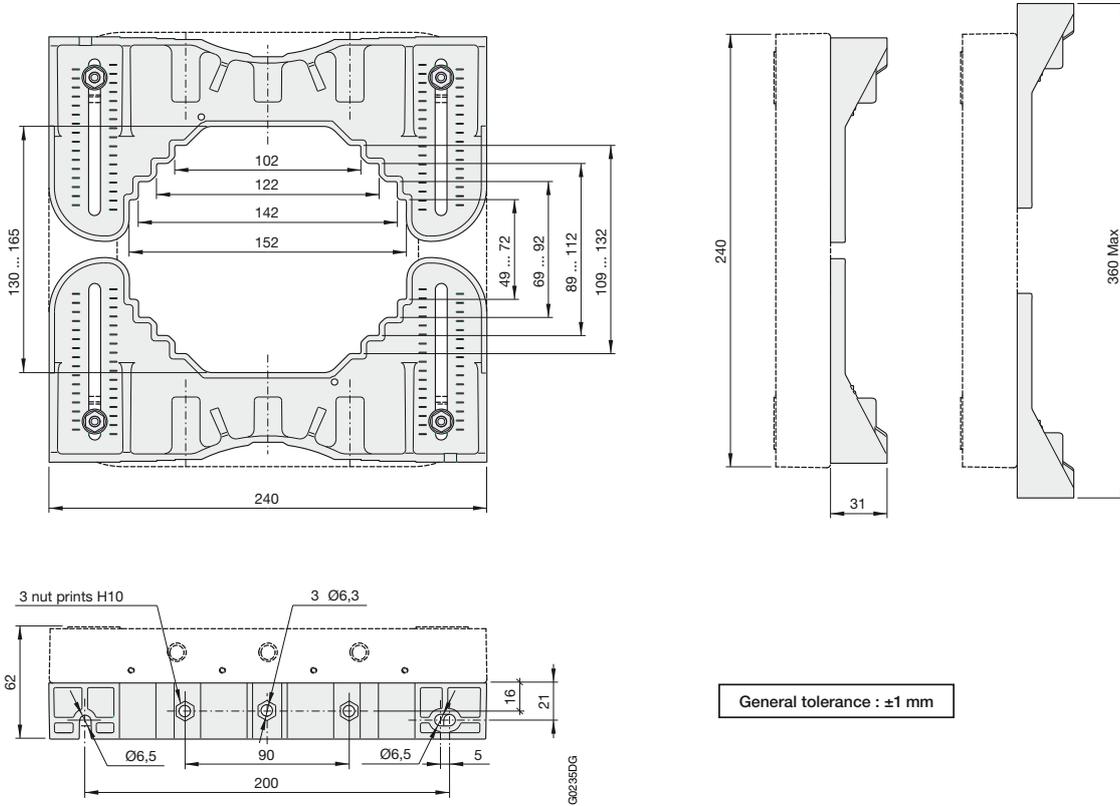


- |   |   |
|---|---|
| 1 | - Side plate: x2                        |
| 3 | - Side plate screw M6: x4 (6x30)        |
| 4 | - Flat washer: x8                       |
| 5 | - Spring washer: x4                     |
| 6 | - Locknut: x4                           |
| 7 | - Not used:                             |
|   | • Side plate screw M6: x2 (6x50)        |
|   | • Standard positioning screw: x2 (3x12) |

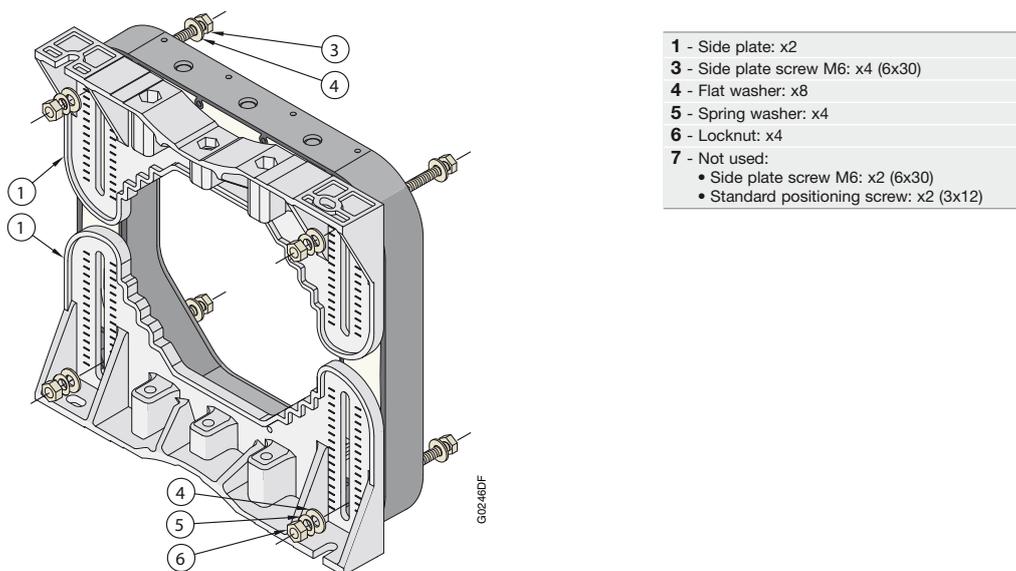
**A** - The screws for clamping the side plates to the bar (or cable) are not supplied

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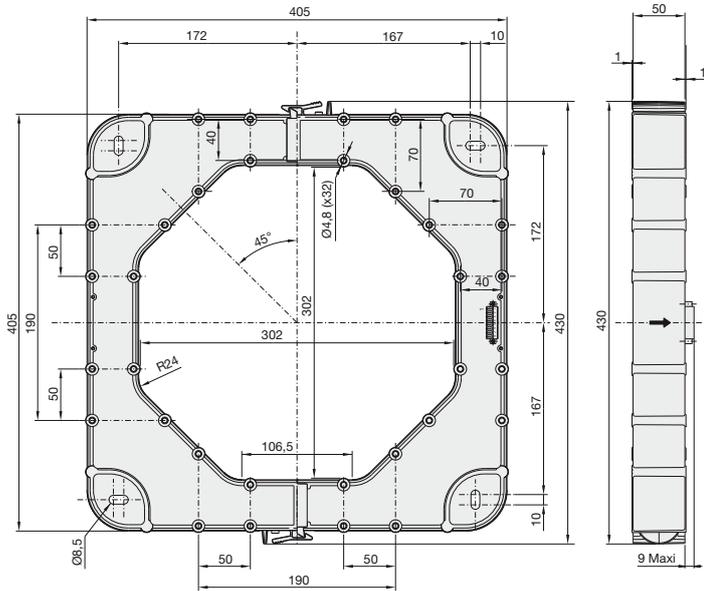
## Dimensions and arrangement of right angle brackets (mm)



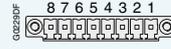
## Right angle brackets mounting on NCS165 sensors



## Dimensions (mm)



### Standard NCS305-6...NCS305-20 sensors secondary connections



Straight connector base (with 3.81 mm pitch)  
Maximum tightening torque: 0.3 N.m

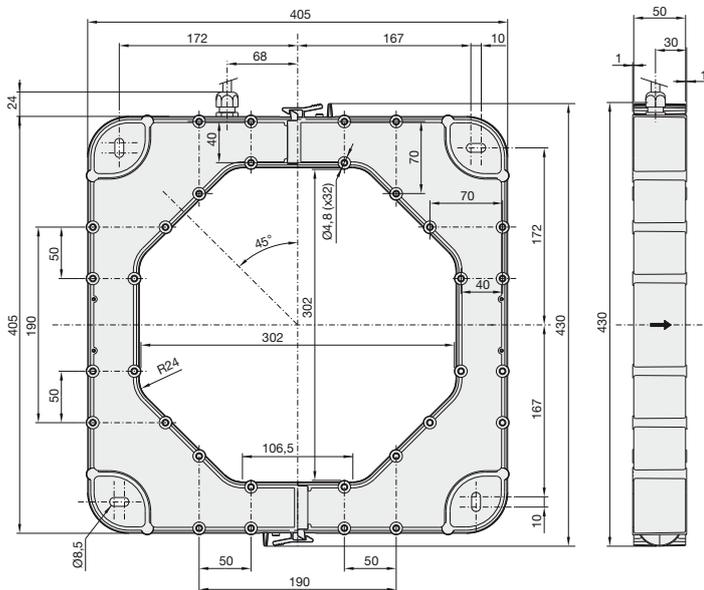
#### Terminal identification

- 1 : +V<sub>A</sub> (+15 ... +24V d.c.)
- 2 : 0V
- 3 : NC
- 4 : V<sub>S1</sub> (±10V @ I<sub>PN</sub>)
- 5 : V<sub>S2</sub> (±10V @ I<sub>PMAX</sub>)
- 6 : I<sub>S1</sub> (±20mA @ I<sub>PN</sub>)
- 7 : I<sub>S2</sub> (±20mA @ I<sub>PMAX</sub>)
- 8 : 0V

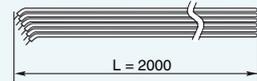
Shielding: see page 102

General tolerance : ±1 mm

## NCS305-6 ... NCS305-20



### Standard NCS305-6AF...NCS305-20AF and NCS305-6VF...NCS305-20VF sensors secondary connections



Shielded cable 6 wires  
with braided earth:  
Cross section: 0.5mm<sup>2</sup>  
Length: 2m ±0.1

#### AF range wire identification:

- 1 : Red: +V<sub>A</sub> (+15 ... +24V d.c.)
- 2 : Black: 0V
- 3 : Blue: NC
- 4 : NC:
- 5 : NC:
- 6 : Green: I<sub>S1</sub> (±20mA @ I<sub>PN</sub>)
- 7 : White: I<sub>S2</sub> (±20mA @ I<sub>PMAX</sub>)
- 8 : Brown: 0V

Shielding: see page 102

#### VF range wire identification:

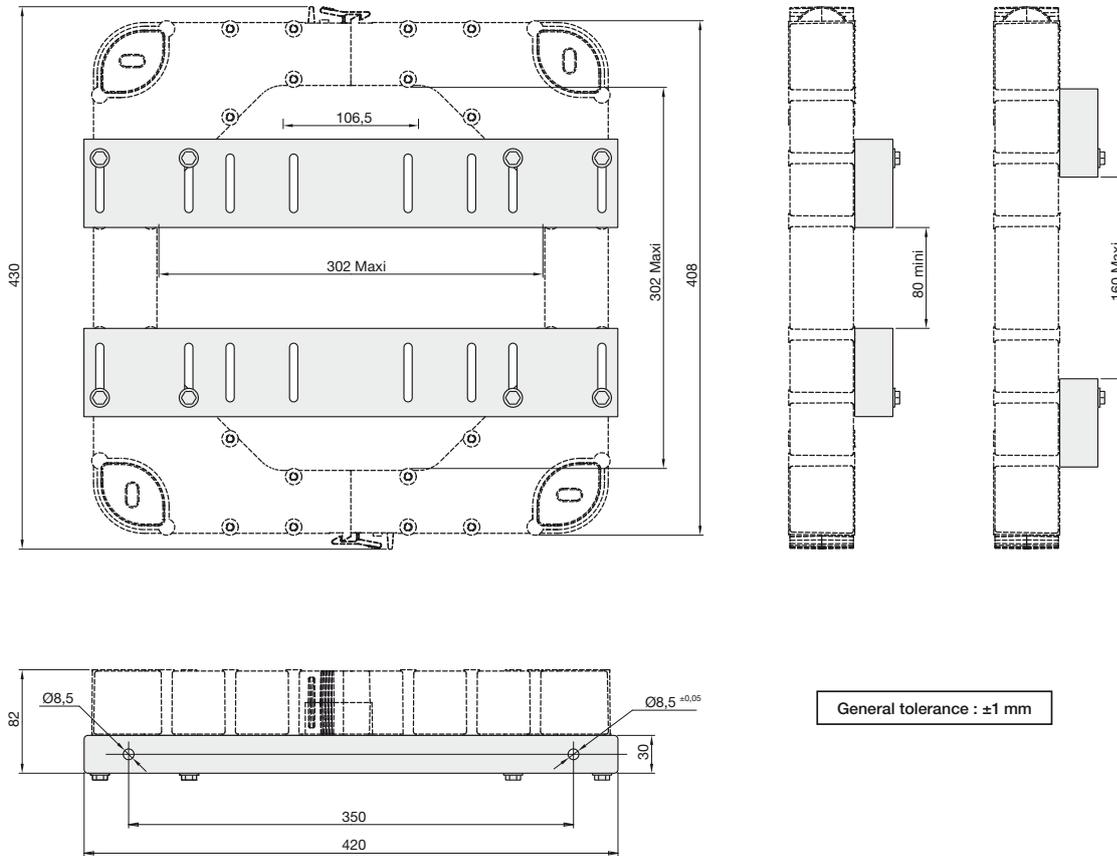
- 1 : Red: +V<sub>A</sub> (+15 ... +24V d.c.)
- 2 : Black: 0V
- 3 : Blue: NC
- 4 : Green: V<sub>S1</sub> (±10V @ I<sub>PN</sub>)
- 5 : White: V<sub>S2</sub> (±10V @ I<sub>PMAX</sub>)
- 6 : NC:
- 7 : NC:
- 8 : Brown: 0V

Shielding: see page 102

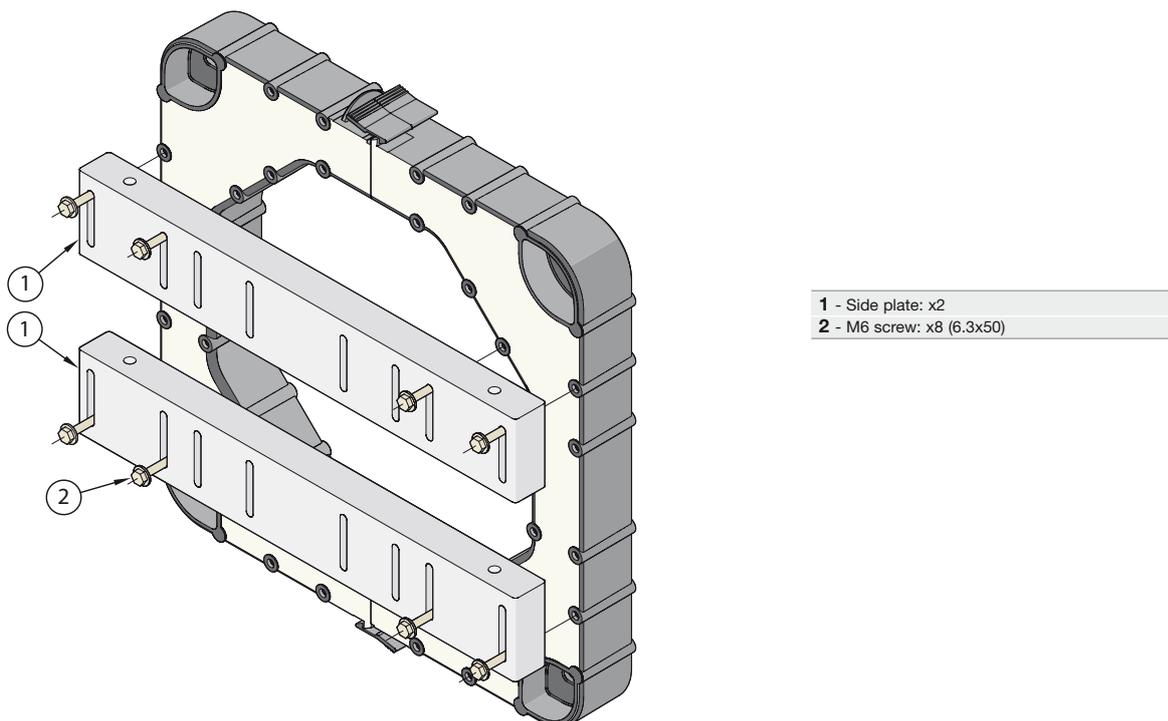
General tolerance : ±1 mm

## NCS305-6AF ... NCS305-20AF and NCS305-6VF ... NCS305-20VF

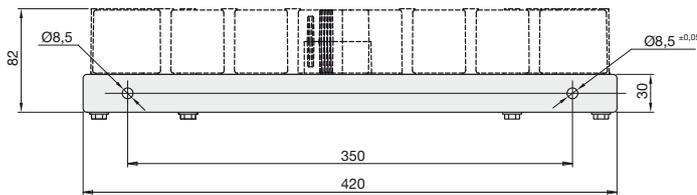
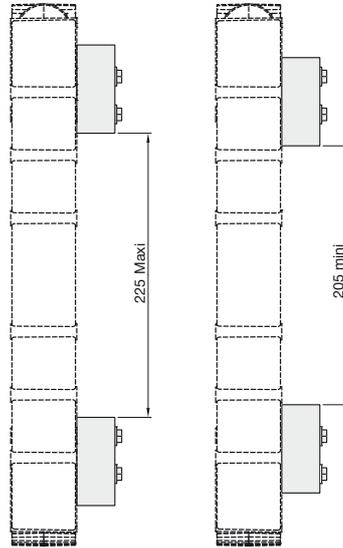
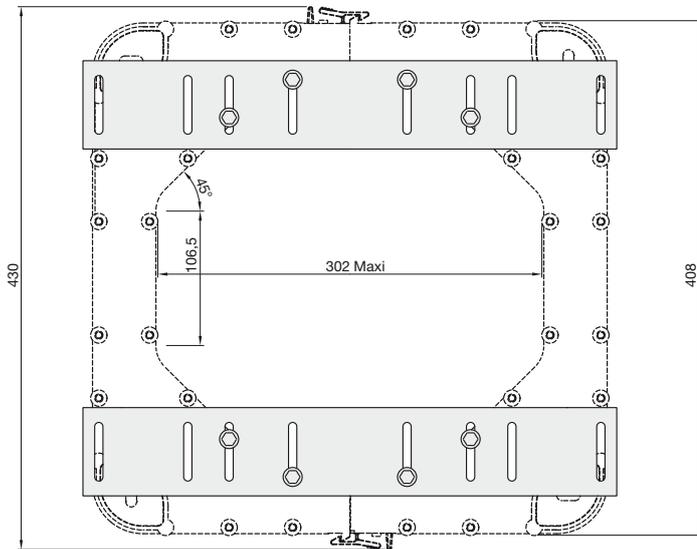
## Dimensions and arrangement of side plate (mm)



## Side plate mounting on NCS305 sensors

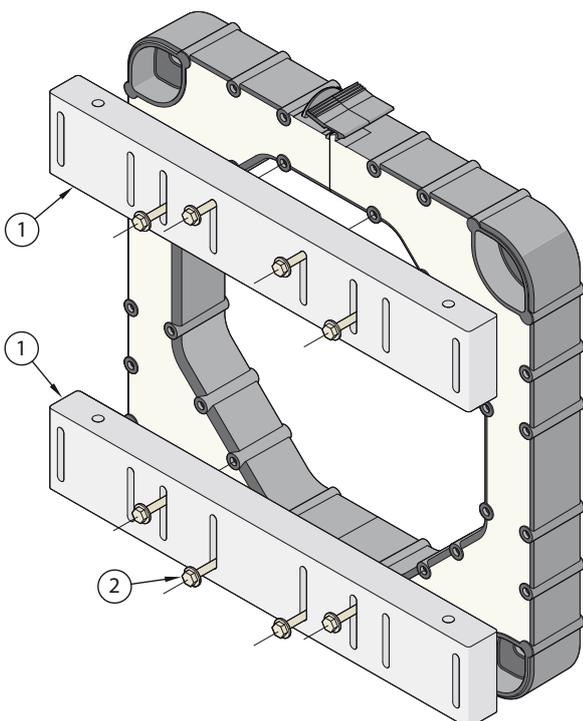


## Dimensions and arrangement of side plate (mm)



General tolerance :  $\pm 1$  mm

## Side plate mounting on NCS305 sensors



- 1 - Side plate: x2
- 2 - M6 screw: x8 (6.3x50)





# Industry Current Sensors HBO Range



## A single size for every rating

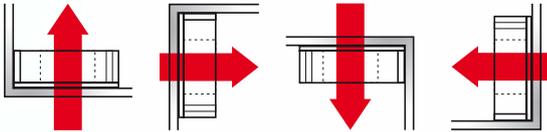
With a single size for every rating (from 100 A to 600 A), HBO current sensors give you the possibility of increasing equipment standardisation.

## A precise response to customer expectations

The HBO sensor has been designed using Open Loop Hall effect technology, thereby adding a whole new type to the various sensor technologies used by ABB. The HBO range enables ABB to offer an additional range of sensors that are suitable for less technically demanding applications and ensure best cost competitiveness. Customers are therefore free to choose the most suitable solution for their applications.

## Vertical or horizontal

Assemblers can choose 2 methods of fastening ABB sensors: horizontally or vertically.



## Quality that goes beyond standards

ABB have been ISO 9001 certified since 1993 and our standard HBO sensors bear the CE label in Europe.

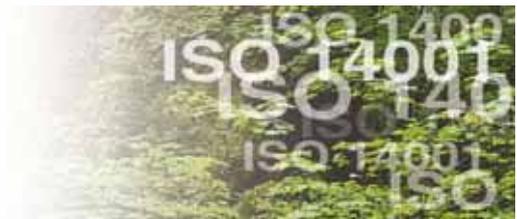
This ongoing striving after quality has always been the hallmark of a company where excellence and safety are part of the culture, from design right through to production.

This culture is the result of continuous research to make technical progress and meet our customers' demands.

**ECOLOGY** ABB have long been concerned with the protection of the environment, as proved by the ISO 14001 certification they received in 1998. This environmental approach is particularly noticeable in the production of the HBO range in the reduction of the number of components, in the use of a low-energy manufacturing procedure and the use of recyclable packing. The products in use are also characterized by their reduced energy consumption.

### QUALITY

The chief selling-point of HBO sensors is their quality. Compliance of their high-tech electronic design with standard EN 50178 is proof of their ability to comply with the most detailed constraint as well as major demands. The fact that each individual sensor is subjected to rigorous testing is proof of the importance ABB attribute to quality.



# LASER-TRIMMED SENSORS, AUTOMATED PRODUCTION

## Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

## HBO100 to HBO400



## Technical data

			HBO100	HBO200	HBO300	HBO400
Nominal primary current ( $I_{FN}$ )		<b>A r.m.s.</b>	100	200	300	400
Measuring range	@ $\pm 15V$ ( $\pm 5\%$ )	<b>A peak</b>	$\pm 300$	$\pm 600$	$\pm 900$	$\pm 1100$
Output voltage at $I_{FN}$		<b>V</b>	$\pm 4$	$\pm 4$	$\pm 4$	$\pm 4$
Supply voltage	$\pm 5\%$	<b>V d.c.</b>	$\pm 12 \dots \pm 15$			
Load resistance		<b>k<math>\Omega</math></b>	$> 1$	$> 1$	$> 1$	$> 1$
Internal output resistance	$\pm 5\%$	<b><math>\Omega</math></b>	12	12	12	12
Current consumption		<b>mA</b>	$\leq 25$	$\leq 25$	$\leq 25$	$\leq 25$
Rated voltage <sup>1</sup>		<b>V r.m.s.</b>	500	500	500	500
Insulation resistance	@ 500V d.c.	<b>M<math>\Omega</math></b>	$> 500$	$> 500$	$> 500$	$> 500$
Accuracy <sup>2</sup> a.c. at $I_{FN}$	@ $+25^\circ C$ , $R_L > 10k\Omega$ , $\pm 15V$ , 50Hz	<b>%</b>	$\leq \pm 1$	$\leq \pm 1$	$\leq \pm 1$	$\leq \pm 1$
Accuracy <sup>2</sup> a.c. at $I_{FN}$	@ $+25^\circ C$ , $R_L > 10k\Omega$ , $\pm 12V \dots \pm 15V$ , 50Hz	<b>%</b>	$\leq \pm 1.5$	$\leq \pm 1.5$	$\leq \pm 1.5$	$\leq \pm 1.5$
Output offset	@ $+25^\circ C$ , $I_p = 0$ , $\pm 15V$	<b>mV</b>	$\leq \pm 10$	$\leq \pm 10$	$\leq \pm 10$	$\leq \pm 10$
Output offset	@ $+25^\circ C$ , $I_p = 0$ , $\pm 12V \dots \pm 15V$	<b>mV</b>	$\leq \pm 15$	$\leq \pm 15$	$\leq \pm 15$	$\leq \pm 15$
Additional offset after an overload of $I_{FMAX}$	@ $+25^\circ C$ , $I_p = 0$ , $\pm 15V$	<b>mV</b>	$\leq \pm 10$	$\leq \pm 10$	$\leq \pm 10$	$\leq \pm 10$
Output offset thermal drift	$-25^\circ C \dots +85^\circ C$	<b>mV/<math>^\circ C</math></b>	$\leq \pm 1$	$\leq \pm 1$	$\leq \pm 1$	$\leq \pm 1$
Linearity <sup>2</sup>		<b>%</b>	$\leq 0.5$	$\leq 0.5$	$\leq 0.5$	$\leq 0.5$
Gain thermal drift	$-25^\circ C \dots +85^\circ C$ , @ $\pm 15V$ ( $\pm 5\%$ )	<b>%/<math>^\circ C</math></b>	$\leq 0.05$	$\leq 0.05$	$\leq 0.05$	$\leq 0.05$
Delay time		<b><math>\mu s</math></b>	$\leq 3$	$\leq 3$	$\leq 3$	$\leq 3$
di/dt correctly followed		<b>A / <math>\mu s</math></b>	$\leq 50$	$\leq 50$	$\leq 50$	$\leq 50$
Bandwidth	-3dB	<b>kHz</b>	0 ... 50	0 ... 50	0 ... 50	0 ... 50
Dielectric strength Primary/Secondary	50Hz, 1min	<b>kV r.m.s.</b>	3.5	3.5	3.5	3.5
Mass		<b>kg</b>	0.200	0.200	0.200	0.200
Operating temperature		<b><math>^\circ C</math></b>	$-25 \dots +85$	$-25 \dots +85$	$-25 \dots +85$	$-25 \dots +85$
Storage temperature		<b><math>^\circ C</math></b>	$-40 \dots +85$	$-40 \dots +85$	$-40 \dots +85$	$-40 \dots +85$

<sup>1</sup> Over voltage category: 3 (OV3), pollution level: 2 (PD2)

<sup>2</sup> Excluding the offset

## General data

- Plastic case and insulating resin are self-extinguishing.
- Fixing holes in the case moulding for two positions at right angles.
- Direction of the current: A primary current flowing in the direction of the arrow results in a positive secondary output voltage on terminal  $V_S$ .

## Secondary connection

- Molex HE14 4 pin connector (ref. 22-04-1041)

## Primary connection

Hole for primary conductor.

The temperature of the primary conductor in contact with the case must not exceed  $100^\circ C$ .



# HBO industry current sensors

## HBO500 to HBO600



### Technical data

			HBO500	HBO600
Nominal primary current ( $I_{pn}$ )		<b>A r.m.s.</b>	500	600
Measuring range	@ ±15V (±5%)	<b>A peak</b>	±1200	±1300
Output voltage at $I_{pn}$		<b>V</b>	±4	±4
Supply voltage	±5%	<b>V d.c.</b>	±12 ... ±15	±12 ... ±15
Load resistance		<b>kΩ</b>	>1	>1
Internal output resistance	±5%	<b>Ω</b>	12	12
Current consumption		<b>mA</b>	≤25	≤25
Rated voltage <sup>1</sup>		<b>V r.m.s.</b>	500	500
Insulation resistance	@ 500V d.c.	<b>MΩ</b>	>500	>500
Accuracy <sup>2</sup> a.c. at $I_{pn}$	@ +25°C, $R_L > 10kΩ$ , ±15V, 50Hz	<b>%</b>	≤±1	≤±1
Accuracy <sup>2</sup> a.c. at $I_{pn}$	@ +25°C, $R_L > 10kΩ$ , ±12V ... ±15V, 50Hz	<b>%</b>	≤±1.5	≤±1.5
Output offset	@ +25°C, $I_p = 0$ , ±15V	<b>mV</b>	≤±10	≤±10
Output offset	@ +25°C, $I_p = 0$ , ±12V ... ±15V	<b>mV</b>	≤±15	≤±15
Additional offset after an overload of $I_{pMAX}$	@ +25°C, $I_p = 0$ , ±15V	<b>mV</b>	≤±10	≤±10
Output offset thermal drift	-25°C... +85°C	<b>mV/°C</b>	≤±1	≤±1
Linearity <sup>2</sup>		<b>%</b>	≤0.5	≤0.5
Gain thermal drift	-25°C... +85°C, @ ±15V(±5%)	<b>%/°C</b>	≤0.05	≤0.05
Delay time		<b>μs</b>	≤3	≤3
di/dt correctly followed		<b>A / μs</b>	≤50	≤50
Bandwidth	-3dB	<b>kHz</b>	0 ... 50	0 ... 50
Dielectric strength Primary/Secondary	50Hz, 1min	<b>kV r.m.s.</b>	3.5	3.5
Mass		<b>kg</b>	0.200	0.200
Operating temperature		<b>°C</b>	-25 ... +85	-25 ... +85
Storage temperature		<b>°C</b>	-40 ... +85	-40 ... +85

<sup>1</sup> Over voltage category: 3 (OV3), pollution level: 2 (PD2)

<sup>2</sup> Excluding the offset

### Accessories and options

#### Female Molex connector

- ABB order code: **1SBT210000R2001** including 10 housings and 40 crimp socket contacts
- Molex order code: socket housing: 22-01-1044; crimp socket contacts: 08-70-0057

### Conformity

EN50178





# Notes



A series of horizontal lines for writing notes, starting below the pencil icon and extending to the bottom of the page.



# Industry Current Sensors ES Range



## The resin concept: a reference that has become a standard

Since obtaining ISO 14001 certification in 1998 ABB has integrated an essential concept into its ES current sensors : a determination to anticipate market requirements and genuine concern for the protection of the environment. This fundamental concern is the overwhelming culture that permeates the company. No wonder our competitors are jealous and find our approach an inspiration for their own efforts. With the introduction of recyclable resin, ABB were trailblazers of an innovation that has over the years become a touchstone. It was this concept that enabled ABB to obtain ISO 14001 certification for their concern for the environment. Optimized settings, waste control, minimization of losses, etc. are all factors that again ensure ABB pride of place in the field of current sensors.



## 46% smaller!

As components get smaller but more powerful, installing current sensors is becoming a real problem. But with ABB's ES range, the whole thing is child's play. By being the first in the field to offer these smaller current sensors that maintain your high-performance objectives, ABB have met the challenge of giving you the space you always needed.

## Horizontal or vertical mounting

Once again ABB lead the field by giving installers a chance to choose between two ways of fastening sensors: horizontally or vertically. This flexibility means that ES sensors can be installed in any position. This is a major breakthrough that greatly simplifies the task of systems integrators. The ES range is the ideal way of reducing the size of equipment.

## Unbeatable reliability

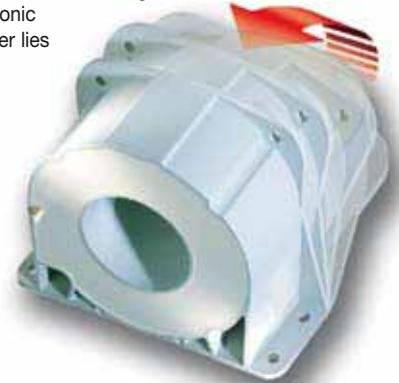
Designed using the 6 sigma approach, the ES range is a model of reliability. The choice and number of optimized components, traceability of subassemblies, individually production tests... nothing is left to chance to guarantee your peace of mind.

	Sigma	Defects (PPM)	Performance
Unacceptable	2 $\sigma$	308 537	69.2 %
Average	3 $\sigma$	66 807	93.3 %
Very good	4 $\sigma$	6 210	99.4 %
Outstanding	5 $\sigma$	233	99.98 %
	6 $\sigma$	3.4	99.9996 %



## A vast range of possibilities for every type of use

Because ABB are in constant touch with their customers so that they can respond and adapt to the demands of the different sectors, they hold pride of place in their customers' list of partners. ABB are totally at home in the world of power electronics, a world made up of target sectors that range from power converters and auxiliary converters, inverters, wind-power generators, welding, robotics and active harmonic suppressors. ABB's power lies in their ability to adapt.



Industry sensors

## Quality that goes beyond standards

ABB have been ISO 9001 certified since 1993 and our ES range of sensors bear the CE label in Europe and the UL or UR labels in the US.

This ongoing striving after quality has always been the hallmark of a company where excellence and safety are part of the culture, from design right through to production. This culture is the result of continuous research to make technical progress and meet our customers' demands.

### QUALITY

The chief selling-point of ES sensors is their quality. Compliance of their high-tech electronic design with standard EN 50178 is proof of their ability to comply with the most detailed constraint as well as major demands. The fact that each individual sensor is subjected to rigorous testing is proof of the importance ABB attribute to quality.

### ENVIRONMENT-FRIENDLY

ABB have long been concerned with the protection of the environment, as proved by the ISO 14001 certification they received in 1998. This environmental approach is particularly noticeable in production of the ES range in the reduction of the number of components, in the use of a low-energy manufacturing procedure and the use of recyclable packing. The products in use are also characterized by their reduced energy consumption.

**BECAUSE YOUR NEEDS ARE SPECIAL WE FIND YOU THE BEST SOLUTION**

## Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

## ES100 / ES300 / ES500



## Technical data

			ES100C - ES100F	ES300C ES300S ES300F	ES500C ES500S ES500F	ES500-9672 ES500-9673 ES500-9674
	Molex HE14 connector					
	JST connector					
	Cables					
Nominal primary current		<b>A r.m.s.</b>	100	300	500	500
Measuring range	@ ±15V (±5%)	<b>A peak</b>	±150	±500	±800	±800
Measuring range	@ ±24V (±5%)	<b>A peak</b>	±150	±500	±800	±800
Not measurable overload	10ms/hour	<b>A peak</b>	300 (1ms/hour)	3000	5000	5000
Max. measuring resistance	@ I <sub>PMAX</sub> & ±15V (±5%)	Ω	48	20	7	13
Max. measuring resistance	@ I <sub>PMAX</sub> & ±24V (±5%)	Ω	105	54	60	56
Min. measuring resistance	@ I <sub>PN</sub> & ±15V (±5%)	Ω	10	0	0	0
Min. measuring resistance	@ I <sub>PN</sub> & ±24V (±5%)	Ω	82	45	0	14
Turn number			1000	2000	5000	4000
Secondary current at I <sub>PN</sub>		<b>mA</b>	100	150	100	125
Accuracy at I <sub>PN</sub>	@ +25°C	%	≤±0.5	≤±0.5	≤±0.5	≤±0.5
Accuracy at I <sub>PN</sub>	-5 ... +70°C	%	≤±1	≤±1	≤±1	≤±1
Accuracy at I <sub>PN</sub>	-20 ... +70°C	%	≤±2.5	≤±1.5	≤±1	≤±1
Offset current	@ +25°C	<b>mA</b>	≤±0.4	≤±0.25	≤±0.25	≤±0.25
Linearity		%	≤0.1	≤0.1	≤0.1	≤0.1
Thermal drift coefficient	-5 ... +70°C	<b>µA/°C</b>	≤10	≤15	≤5	≤6.25
Thermal drift coefficient	-20 ... +70°C	<b>µA/°C</b>	≤80	≤40	≤16	≤20
Delay time		<b>µs</b>	≤1	≤1	≤1	≤1
di/dt correctly followed		<b>A / µs</b>	≤50	≤50	≤100	≤100
Bandwidth	-1dB	<b>kHz</b>	≤100	≤100	≤100	≤100
Max. no-load consumption current	@ ±24V (±5%)	<b>mA</b>	≤12	≤12	≤12	≤12
Secondary resistance	@ +70°C	Ω	≤30	≤33	≤76	≤53
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV</b>	3	3	3	3
Supply voltage	±5%	<b>V d.c.</b>	±12 ... ±24	±12 ... ±24	±12 ... ±24	±12 ... ±24
Voltage drop		<b>V</b>	≤2.5	≤1	≤1	≤1
Mass		<b>kg</b>	0.050	0.115	0.210	0.210
Operating temperature		<b>°C</b>	-20 ... +70	-20 ... +70	-20 ... +70	-20 ... +70
Storage temperature		<b>°C</b>	-25 ... +85	-25 ... +85	-25 ... +85	-25 ... +85

## General data

- Plastic case and insulating resin are self-extinguishing.
- Fixing holes in the case moulding for two positions at right angles.
- Direction of the current: A primary current flowing in the direction of the arrow results in a positive secondary output current from terminal M.

## Secondary connection

- Molex HE14 connector (ref.: 22-11-10 31)
- JST connector (ref.: B3P-VH)
- 3 x 200 mm cables (cross section 0.38 mm<sup>2</sup>)

## Primary connection

Hole for primary conductor.  
The temperature of the primary conductor in contact with the case must not exceed 100°C.



# ES industry current sensors

## ES1000 / ES2000



### Technical data

	Molex HE14 connector	JST connector	Cables	ES1000C ES1000S ES1000F	ES1000-9678 ES1000-9679 ES1000-9680	ES2000C ES2000S ES2000F
Nominal primary current			<b>A r.m.s.</b>	1000	1000	2000
Measuring range	@ ±15V (±5%)		<b>A peak</b>	±1500	±1500	-
Measuring range	@ ±24V (±5%)		<b>A peak</b>	±1500	±1500	±3000
Not measurable overload	10ms/hour		<b>A peak</b>	10000	10000	20000
Max. measuring resistance	@ I <sub>PMAX</sub> & ±15V (±5%)		Ω	4	7	-
Max. measuring resistance	@ I <sub>PMAX</sub> & ±24V (±5%)		Ω	33	30	11
Min. measuring resistance	@ I <sub>PN</sub> & ±15V (±5%)		Ω	0	0	0
Min. measuring resistance	@ I <sub>PN</sub> & ±24V (±5%)		Ω	0	0	0
Turn number				5000	4000	5000
Secondary current at I <sub>PN</sub>			<b>mA</b>	200	250	400
Accuracy at I <sub>PN</sub>	@ +25°C		%	≤±0.5	≤±0.5	≤±0.5
Accuracy at I <sub>PN</sub>	-5 ... +70°C		%	≤±1	≤±1	≤±1
Accuracy at I <sub>PN</sub>	-20 ... +70°C		%	≤±1	≤±1	≤±1
Offset current	@ +25°C		<b>mA</b>	≤±0.25	≤±0.25	≤±0.25
Linearity			%	≤0.1	≤0.1	≤0.1
Thermal drift coefficient	-5 ... +70°C		<b>µA/°C</b>	≤5	≤6.25	≤10
Thermal drift coefficient	-20 ... +70°C		<b>µA/°C</b>	≤20	≤20	≤10
Delay time			<b>µs</b>	≤1	≤1	≤1
di/dt correctly followed			<b>A / µs</b>	≤100	≤100	≤100
Bandwidth	-1dB		<b>kHz</b>	≤100	≤100	≤100
Max. no-load consumption current	@ ±24V (±5%)		<b>mA</b>	≤12	≤12	≤25
Secondary resistance	@ +70°C		Ω	≤40	≤28	≤25
Dielectric strength Primary/Secondary	50 Hz, 1 min		<b>kV</b>	3	3	4
Supply voltage	±5%		<b>V d.c.</b>	±12 ... ±24	±12 ... ±24	±15 ... ±24
Voltage drop			<b>V</b>	≤1	≤1	≤1
Mass			<b>kg</b>	0.460	0.460	1.5
Operating temperature			<b>°C</b>	-20 ... +70	-20 ... +70	-20 ... +70
Storage temperature			<b>°C</b>	-25 ... +85	-25 ... +85	-25 ... +85

### Accessories and options

#### Female Molex connector

- ABB order code: **FPTN 440 032 R0003** including 10 socket housings and 30 crimp socket contacts
- Molex order code: socket housing: 22-01-1034; crimp socket contacts: 08-70-0057.

#### Female JST connector

- ABB order code: **FPTN 440 032 R0002** including 10 socket housings and 30 crimp socket contacts
- JST order code: socket housing: VHR-3N; crimp socket contacts: SVH-21T-1.1.

For other options, please contact us.

### Conformity

**EN50178**

**EN61000-6-2, EN61000-6-4**

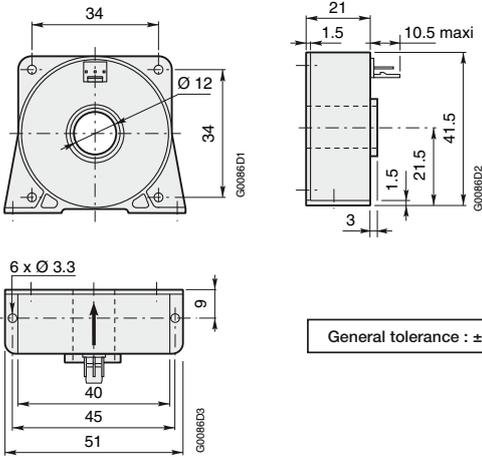


: ES sensors with cables.  
File number: E166814 Vol 1



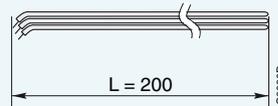
: ES sensors with connectors.  
File number: E166814 Vol 2

## Dimensions (mm)



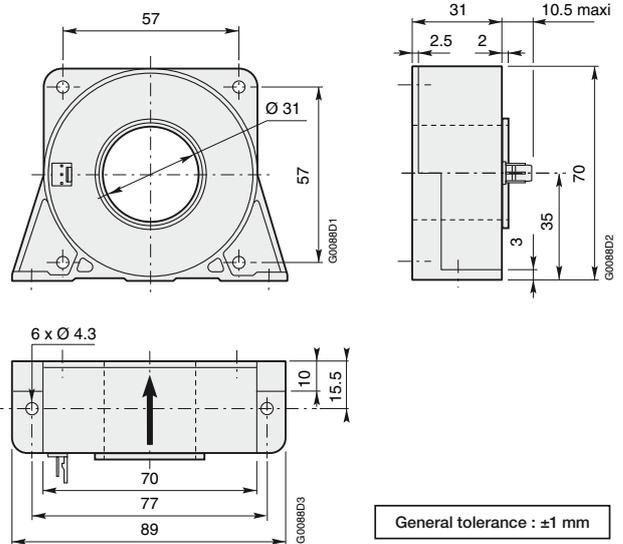
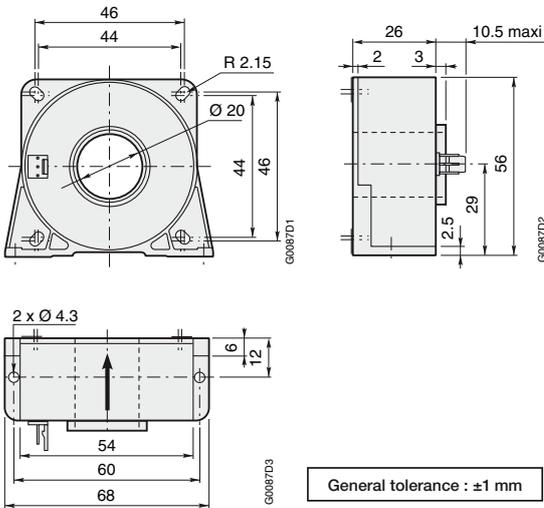
### Standard ES100... sensors secondary connection

G0082D M Molex connector (with 2.54 mm pitch)



Cable : - Red.....  $+V_A$   
 - Green ..... **M**  
 - Black .....  $-V_A$

## ES100C / ES100F



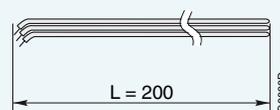
## ES300C / ES300S / ES300F

## ES500C / ES500S / ES500F ES500-9672 / ES500-9673 / ES500-9674

### Standard ES300... and ES500... sensors secondary connection

G0082D M Molex connector (with 2.54 mm pitch)

G0091D M JST connector (with 3.81 mm pitch)

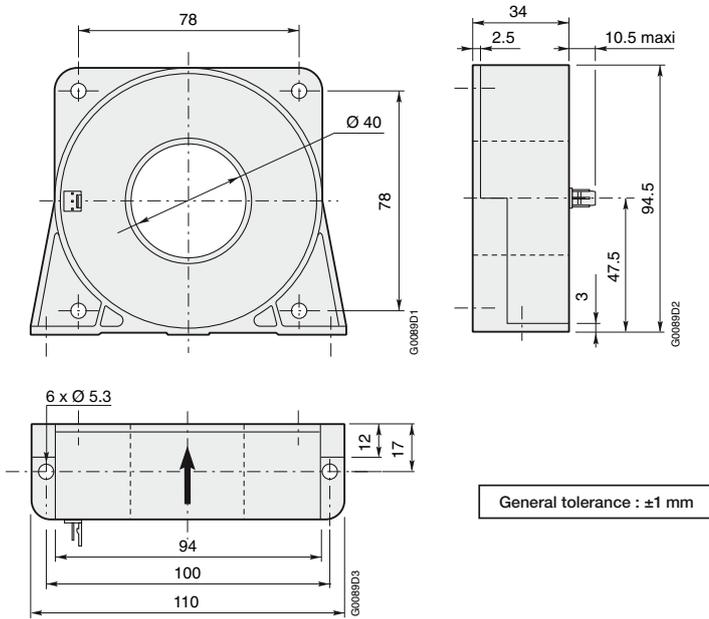


Cable : - Red.....  $+V_A$   
 - Green ..... **M**  
 - Black .....  $-V_A$



# ES industry current sensors

## Dimensions (mm)

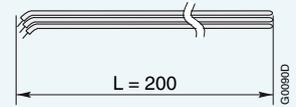


ES1000C / ES1000S / ES1000F  
 ES1000-9678 / ES1000-9679 / ES1000-9680

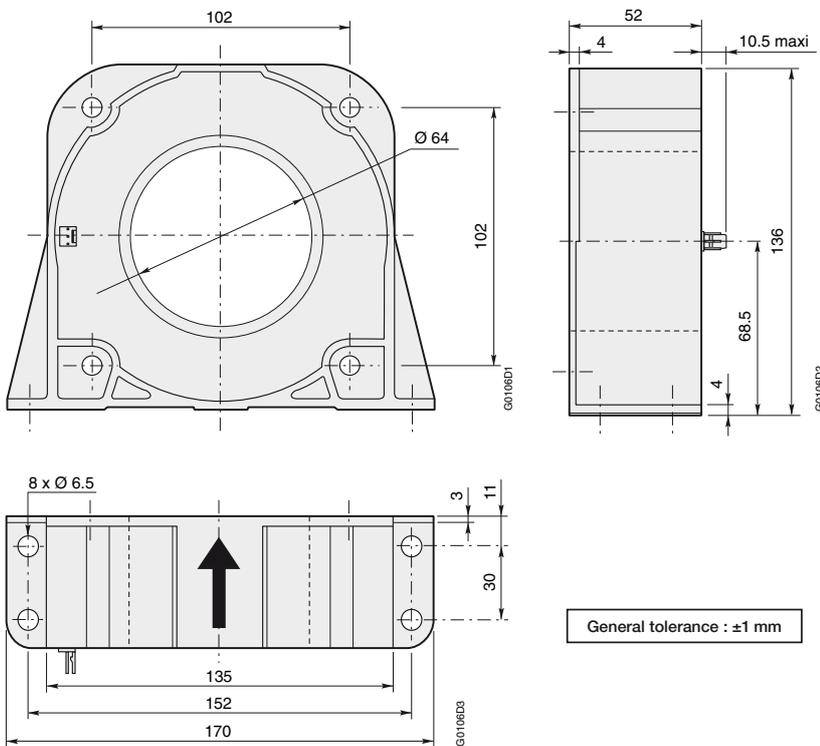
## Standard ES1000... and ES2000... sensors secondary connection

G0098D2 Molex connector (with 2.54 mm pitch)

G0098D1 JST connector (with 3.81 mm pitch)



Cable : - Red..... +V<sub>A</sub>  
 - Green ..... M  
 - Black ..... -V<sub>A</sub>



ES2000C / ES2000S / ES2000F



# Industry Current Sensors ESM Range

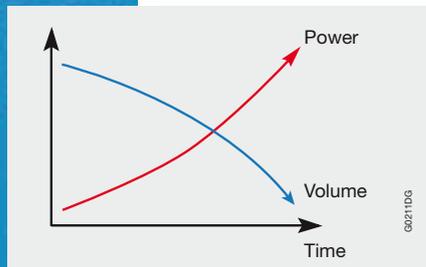


## High precision for all situations

With two mounting positions, the ABB sensor sets itself apart in the market. It is the first to offer a major innovation with the option of vertical or horizontal mounting. Other sensor manufacturers have been influenced by this arrangement. A way to considerably simplify the work of integrators! The ABB sensor also allows for reduced dimensions for the equipment into which it is being integrated, whilst meeting the requirements of the latest standards. So many essential advantages to better satisfy your aspirations. Between professionals, we understand each other.

## An incomparable immunity against magnetic fields

ESM sensors are thought out, designed and recognised for having an incomparable immunity against surrounding magnetic fields. Being constantly in the presence of strong currents can potentially disturb and produce measurement errors, but this is not the case. They have constant precision and are committed to measure a given current. Only this one ...and not another.



## An unavoidable requirement: reduce the volume and increase the power

The improvements in performance of the components used in electronic power systems and the requirement to reduce costs leads constructors to an irreversible tendency: produce smaller, more powerful and cheaper systems. The sensors, following this tendency, are subject to more and more magnetic interference. The ESM range replies well to this requirement by offering an improved immunity to this interference.



**BECAUSE YOU SEARCH FOR PERFORMANCE  
WE MAKE THE DIFFERENCE.**



# ESM industry current sensors

## Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

## Technical data

	Molex HE14 connector JST connector Cables	
Nominal primary current		<b>A r.m.s.</b>
Measuring range	@ ±15V (±5%)	<b>A peak</b>
Measuring range	@ ±24V (±5%)	<b>A peak</b>
Not measurable overload	10ms/hour	<b>A peak</b>
Max. measuring resistance	@ $I_{PMAX}$ & ±15V (±5%)	$\Omega$
Max. measuring resistance	@ $I_{PMAX}$ & ±24V (±5%)	$\Omega$
Min. measuring resistance	@ $I_{PN}$ & ±15V (±5%)	$\Omega$
Min. measuring resistance	@ $I_{PN}$ & ±24V (±5%)	$\Omega$
Turn number		
Secondary current at $I_{PN}$		<b>mA</b>
Accuracy at $I_{PN}$	@ +25°C	<b>%</b>
Accuracy at $I_{PN}$	-20 ... +70°C	<b>%</b>
Offset current	@ +25°C	<b>mA</b>
Linearity		<b>%</b>
Thermal drift coefficient	-20 ... +70°C	<b><math>\mu A/^{\circ}C</math></b>
Delay time		<b><math>\mu s</math></b>
di/dt correctly followed		<b>A / <math>\mu s</math></b>
Bandwidth	-1dB	<b>kHz</b>
Max. no-load consumption current	@ ±24V (±5%)	<b>mA</b>
Secondary resistance	@ +70°C	$\Omega$
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV</b>
Supply voltage	±5%	<b>V d.c.</b>
Voltage drop		<b>V</b>
Mass		<b>kg</b>
Operating temperature		<b>°C</b>
Storage temperature		<b>°C</b>

## ESM1000



	ESM1000C ESM1000S ESM1000F	ESM1000-9888 ESM1000-9887 ESM1000-9886
Nominal primary current	1000	1000
Measuring range	±1500	±1500
Measuring range	±1500	±1500
Not measurable overload	10000	10000
Max. measuring resistance	-	-
Max. measuring resistance	25	22
Min. measuring resistance	0	0
Min. measuring resistance	0	11
Turn number	5000	4000
Secondary current at $I_{PN}$	200	250
Accuracy at $I_{PN}$	≤±0.5	≤±0.5
Accuracy at $I_{PN}$	≤±1	≤±1
Offset current	≤±0.25	≤±0.25
Linearity	≤0.1	≤0.1
Thermal drift coefficient	≤10	≤12.5
Delay time	≤1	≤1
di/dt correctly followed	≤100	≤100
Bandwidth	≤100	≤100
Max. no-load consumption current	≤15	≤15
Secondary resistance	≤44	≤33
Dielectric strength Primary/Secondary	3	3
Supply voltage	±15 ... ±24	±15 ... ±24
Voltage drop	≤2	≤2
Mass	0.600	0.600
Operating temperature	-20 ... +70	-20 ... +70
Storage temperature	-40 ... +85	-40 ... +85

## General data

- Plastic case and insulating resin are self-extinguishing.
- Fixing holes in the case moulding for two positions at right angles.
- Direction of the current: a primary current flowing in the direction of the arrow results in a positive secondary output current from terminal M.

## Primary connection

Hole for primary conductor.  
The temperature of the primary conductor in contact with the case must not exceed 100°C.

## Secondary connection

- Molex HE14 connector (ref.: 22-11-10 31)
- JST connector (ref.: B3P-VH)
- 3 x 200 mm cables (cross section 0.38 mm<sup>2</sup>)

## Accessories and options

The same as the ES range (see page 47)

## Other ratings

- Other ratings (500A to 2000A) are available upon request.

## Conformity

EN50178, EN61000-6-2, EN61000-6-4



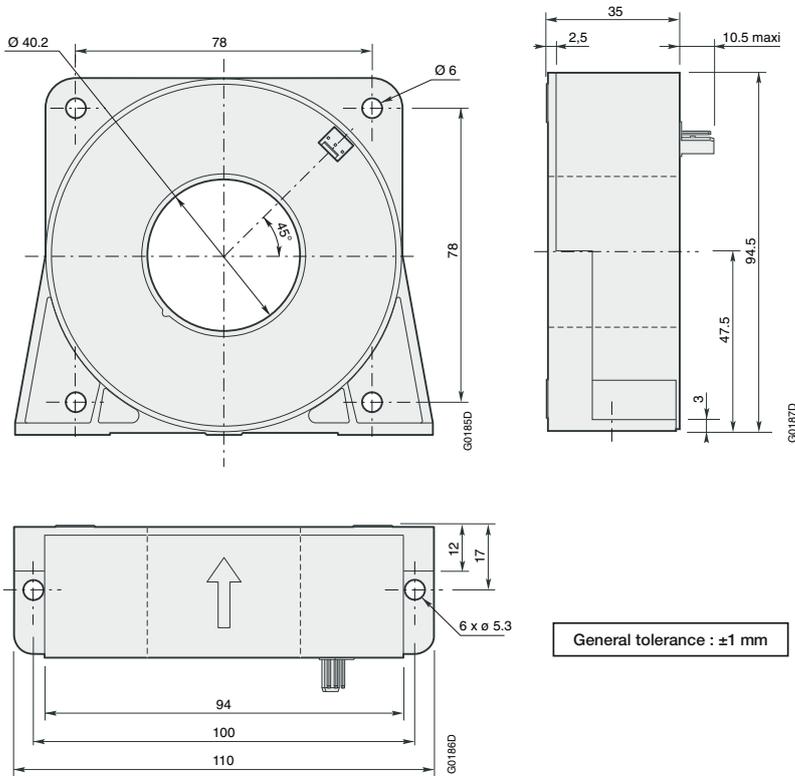
: ESM sensors with cables.  
File number: E166814 Vol 1

: ESM sensors with connectors.  
File number: E166814 Vol 2



# ESM industry current sensors

## Dimensions (mm)

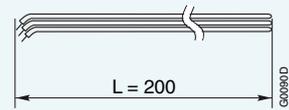


ESM1000C / ESM1000S / ESM1000F / ESM1000-9888  
 ESM1000-9887 / ESM1000-9886

### Standard ESM1000... sensors secondary connection

G0082D - M  
 + Molex connector  
 (with 2.54 mm pitch)

G0081D - M  
 + JST connector  
 (with 3.81 mm pitch)



Cable : - Red..... +VA  
 - Green ..... M  
 - Black ..... -VA





# MP and EL industry current sensors

## Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

**Type MP25P1:** the rating (from 5 to 25A) is determined via a combination of the primary connections (see table: "Arrangement of primary terminals and related characteristics").

## Technical data

	Without primary bus bar		-				
	With primary bus bar		MP25P1	EL25P1 EL25P1BB	EL50P1 EL50P1BB	EL55P2 EL55P2BB	EL100P2 EL100P2BB
Nominal primary current		<b>A r.m.s.</b>	See data page 55	25	50	50	100
Measuring range	@ ±15V (±5%)	<b>A peak</b>		±55	±80	±80	±145
Max. measuring resistance	@ I <sub>PMAX</sub> & ±15V (±5%)	Ω	216	142	78	93	29
Min. measuring resistance	@ I <sub>PN</sub> & ±15V (±5%) & 70°C	Ω	100	100	75	10	20
Min. measuring resistance	@ I <sub>PN</sub> & ±12V (±5%) & 70°C	Ω	0	0	15	0	0
Turn number			See data page 55	1000	1000	2000	2000
Secondary current at I <sub>PN</sub>		<b>mA</b>		25	50	25	50
Rms accuracy at I <sub>PN</sub>	-20 ... +70°C, sinus 50Hz	%	≤±0.5	≤±0.5	≤±0.5	≤±0.5	≤±0.5
Offset current	@ +25°C	<b>mA</b>	≤±0.1	≤±0.2	≤±0.2	≤±0.2	≤±0.2
Linearity		%	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1
Thermal drift coefficient	-20 ... +70°C	<b>µA/°C</b>	7	7	7	7	7
Delay time		<b>µs</b>	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1
di/dt correctly followed		<b>A / µs</b>	≤100	≤200	≤200	≤150	≤150
Bandwidth	-1dB	<b>kHz</b>	≤150	≤200	≤200	≤150	≤150
Max. no-load consumption current	@ ±15V (±5%)	<b>mA</b>	≤18	≤20	≤20	≤20	≤20
Secondary resistance	@ +70°C	Ω	≤96	≤63	≤63	≤188	≤126
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV</b>	2.5	3	3	3	3
Supply voltage	±5%	<b>V d.c.</b>	±12 ... ±15	±12 ... ±15	±12 ... ±15	±12 ... ±15	±12 ... ±15
Voltage drop		<b>V</b>	≤3	≤3	≤3	≤3	≤3
Mass (EL type)		<b>kg</b>	-	0.020	0.020	0.020	0.020
Mass (MP and EL...BB types)		<b>kg</b>	0.027	0.027	0.027	0.027	0.027
Operating temperature		<b>°C</b>	-20 ... +70	-20 ... +70	-20 ... +70	-20 ... +70	-20 ... +70
Storage temperature		<b>°C</b>	-25 ... +85	-25 ... +85	-25 ... +85	-25 ... +85	-25 ... +85

### MP25P1



### EL25P1 to EL100P2 / EL25P1BB to EL100P2BB



## General data

### Direction of the current:

- **MP25P1 Type:** A primary current flowing from pins 1- 5 to pins 6-10 results in a positive secondary output current from terminal M.
- **EL Type:** A primary current flowing in the direction of the arrow results in a positive secondary output current from terminal M.

## Fixing

By soldering pins on printed circuit board.

## Primary connection

- **MP25P1 Type:** By 10 soldering pins.
- **EL Type:** Hole for primary conductor (the temperature of the primary conductor in contact with the case must not exceed 100°C)
- **EL...BB type:** Primary bar included.

## Secondary connection

3 soldering pins.

## Unit packing

- **MP25P1 type:** 40 per pack.
- **EL type:** 50 per pack.
- **EL...BB type:** 25 per pack.

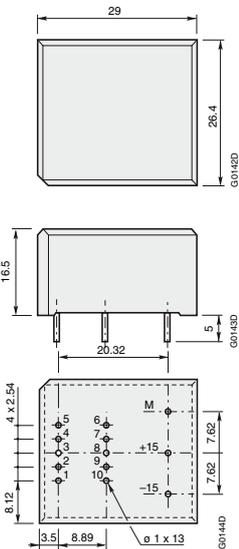


# MP and EL industry current sensors

## MP25P1 : Arrangement of primary terminals and related characteristics

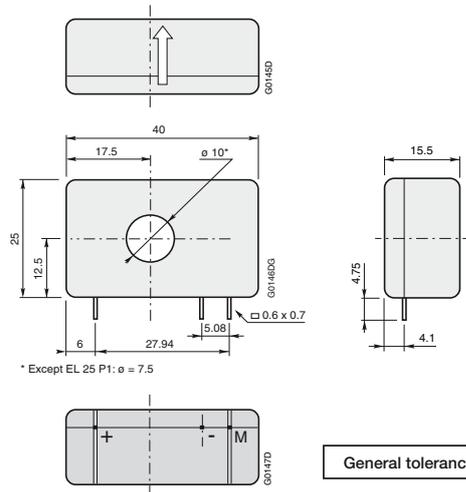
Nominal primary current (A r.m.s.)	Measuring range @ ±15V (±5%) (A peak)	Secondary current at I <sub>PN</sub> (mA)	Turn ratio (N <sub>P</sub> /N <sub>S</sub> )	Primary resistance (mΩ)	Primary pin connections
25	±36	25	1/1000	0.3	
12	±18	24	2/1000	1.1	
8	±12	24	3/1000	2.5	
6	±9	24	4/1000	4.4	
5	±7	25	5/1000	6.3	

### Dimensions (mm)



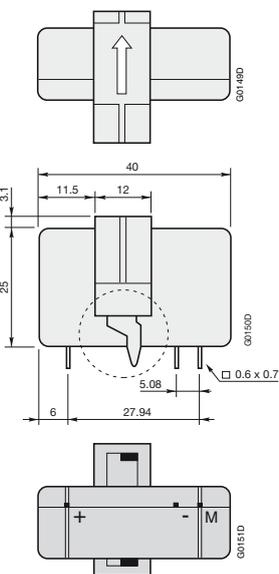
General tolerance : ±1 mm

MP current sensors

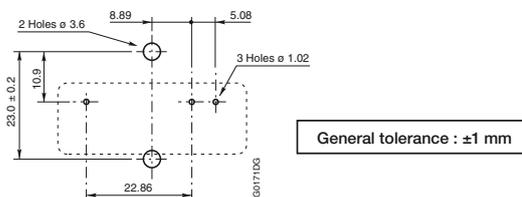


General tolerance : ±1 mm

EL current sensors



EL...BB current sensors



General tolerance : ±1 mm

EL...BB: PCB layout



# Traction current sensors

## Fixed installations only

### Frame mounting



These current sensors are specially designed and manufactured for Traction applications (NCS range for fixed railway applications and CS range for rolling stock). The requirements for these sensors are generally higher than those for Industry applications (larger operating temperature range, higher level of shocks and vibrations...).

These sensors can be fixed mechanically, by the case or by the primary bar, depending on the version or option.



Type	Nominal primary current (A peak)	Secondary current $I_{S1}$ at $\pm I_{PN}$ (mA peak)	Secondary voltage $V_{S1}$ at $\pm I_{PN}$ (V peak)	Supply voltage (V d.c.)	Secondary connection	Order code
NCS125T-4AF	4000	$\pm 20$	-	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209204R0001
NCS125T-4VF	4000	-	$\pm 10$	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209204R0101
NCS165T-4AF	4000	$\pm 20$	-	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209604R0001
NCS165T-4VF	4000	-	$\pm 10$	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209604R0101
NCS125T-6AF	6000	$\pm 20$	-	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209206R0001
NCS125T-6VF	6000	-	$\pm 10$	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209206R0101
NCS165T-6AF	6000	$\pm 20$	-	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209606R0001
NCS165T-6VF	6000	-	$\pm 10$	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209606R0101
NCS125T-10AF	10000	$\pm 20$	-	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209210R0001
NCS125T-10VF	10000	-	$\pm 10$	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209210R0101
NCS165T-10AF	10000	$\pm 20$	-	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209610R0001
NCS165T-10VF	10000	-	$\pm 10$	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209610R0101
NCS165T-20AF	20000	$\pm 20$	-	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209620R0001
NCS165T-20VF	20000	-	$\pm 10$	$\pm 24$	Shielded cable 6 wires (2m)	1SBT209620R0101



# Traction current sensors



Type	Nominal primary current (A peak)	Secondary current $I_{S1}$ at $\pm 1 I_N$ (mA peak)	Supply voltage (V d.c.)	Secondary connection	Order code
CS300BR	300	150	$\pm 15 \dots \pm 24$	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170300R0001
CS300BRV	300	150	$\pm 15 \dots \pm 24$	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170300R0002
CS300BRE	300	150	$\pm 15 \dots \pm 24$	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170300R0003
CS300BRVE	300	150	$\pm 15 \dots \pm 24$	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170300R0004
CS503BR	500	142.86	$\pm 15 \dots \pm 24$	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170503R0001
CS503BRE	500	142.86	$\pm 15 \dots \pm 24$	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170503R0003
CS500BR	500	100	$\pm 15 \dots \pm 24$	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170500R0001
CS500BRV	500	100	$\pm 15 \dots \pm 24$	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170500R0002
CS500BRE	500	100	$\pm 15 \dots \pm 24$	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170500R0003
CS500BRVE	500	100	$\pm 15 \dots \pm 24$	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170500R0004
CS1000BR	1000	200	$\pm 15 \dots \pm 24$	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT171000R0001
CS1000BRV	1000	200	$\pm 15 \dots \pm 24$	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT171000R0002
CS1000BRE	1000	200	$\pm 15 \dots \pm 24$	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT171000R0003
CS1000BRVE	1000	200	$\pm 15 \dots \pm 24$	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT171000R0004
CS1000-9940	1000	250	$\pm 15 \dots \pm 24$	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT171000R9940
CS1000-9941	1000	250	$\pm 15 \dots \pm 24$	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT171000R9941
CS1000-9942	1000	250	$\pm 15 \dots \pm 24$	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT171000R9942
CS1000-9943	1000	250	$\pm 15 \dots \pm 24$	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT171000R9943
CS2000BR	2000	400	$\pm 15 \dots \pm 24$	4 x M5 studs //	1SBT172000R0003
CS2000BRV	2000	400	$\pm 15 \dots \pm 24$	4 x M5 studs //	1SBT172000R0004
CS2000-9944	2000	500	$\pm 15 \dots \pm 24$	4 x M5 studs //	1SBT172000R9944
CS2000-9945	2000	500	$\pm 15 \dots \pm 24$	4 x M5 studs //	1SBT172000R9945



# Substation Current Sensors NCS Range



## Designed to be integrated into every situation

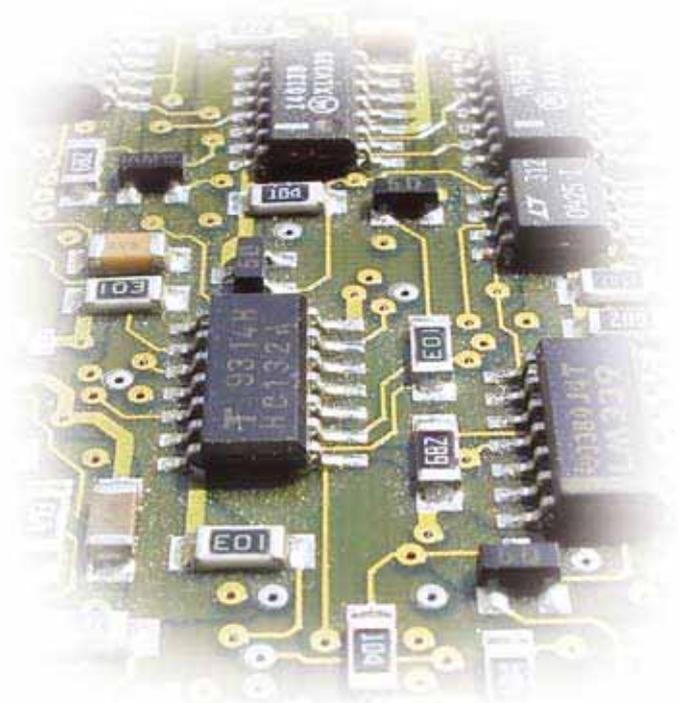
The NCS sensor is entirely symmetrical. Its square shape and strategically positioned oblong holes make it easy to fasten in a choice of 2 positions. As an accessory it comes with a side plate that can be fastened on either side of the sensor giving complete fitting flexibility. It meets the standard design of ABB current sensors. It can be fitted both horizontally and vertically. This flexibility means that NCS sensors can be fitted in any position and simplifies the work of integrators. Additionally the pair of right angle brackets allows the NCS sensor to be fitted to one or several bars at the same time.



# Fixed installations only

## 100% electronic

The main advantage of the NCS range of sensors is that they are designed using a brand-new solution: 100% electronic technology. Unlike other currently available solutions such as shunts and CTs, this approach means that these sensors are very compact. Several patents were necessary to achieve this improvement.



## Considerable energy savings

NCS sensors offer considerable savings in energy. Indeed only a few watts are required to power the NCS sensor in contrast to traditional sensors that require several hundred watts. This reduction in wasted energy means there is no rise in temperature around the sensor.

## Quality that goes beyond standards

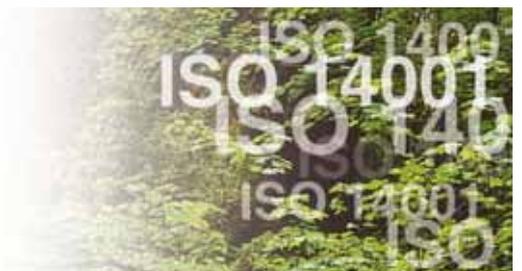
ABB have been ISO 9001 certified since 1993 and our standard NCS sensors bear the CE label in Europe. This ongoing striving after quality has always been the hallmark of a company where excellence and safety are part of the culture, from design right through to production. This culture is the result of continuous research to make technical progress and meet our customers' demands.

Substation sensors

**QUALITY** The chief selling-point of NCS sensors is their quality. Compliance of their high-tech electronic design with standard EN 50155 is proof of their ability to comply with the most detailed constraint as well as major demands. The fact that each individual sensor is subjected to rigorous testing is proof of the importance ABB attribute to quality.

**ECOLOGY** ABB have long been concerned with the protection of the environment, as proved by the ISO 14001 certification they received in 1998. This environmental approach is particularly noticeable in the production of the NCS range in the reduction of the number of components, in the use of a low-energy manufacturing procedure and the use of recyclable packing. The products in use are also characterized by their reduced energy consumption.

**SAFETY** NCS Substation sensors have been designed to meet the substation standards EN50123-1 and EN50121-5. NCS range sensors also meet the safety standard EN 50124-1.



# THE NCS MEETS ALL OF YOUR REQUIREMENTS



# NCS substation current sensors

## Fixed installations only

### Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

### Technical data

	Output current shielded cable Output voltage shielded cable		NCS125T-4AF	- NCS125T-4VF
			-	-
Nominal primary current		<b>A peak</b>	4000	4000
Measuring range		<b>A peak</b>	20000	20000
Not measured overload	1s/h	<b>A peak</b>	80000	80000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	±20	-
Secondary current $I_{S2}$ at $I_{P_{MAX}}$		<b>mA peak</b>	±20	-
Residual current $I_{S10}$	@ +25°C	<b>µA</b>	≤±250	-
Residual current $I_{S20}$	@ +25°C	<b>µA</b>	≤±180	-
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b>µA/°C</b>	≤±4	-
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b>Ω</b>	0 ... 350	-
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	-	±10
Secondary voltage $V_{S2}$ at $I_{P_{MAX}}$		<b>V peak</b>	-	±10
Residual voltage $V_{S10}$	@ +25°C	<b>mV</b>	-	≤±100
Residual voltage $V_{S20}$	@ +25°C	<b>mV</b>	-	≤±50
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/°C</b>	-	≤±2
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b>Ω</b>	-	10000 ... ∞
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	≤±1	≤±1
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{P_{MAX}}$	@ +25°C	<b>%</b>	≤±3	≤±3
Gain thermal drift	-25°C ... +85°C	<b>%/°C</b>	≤0.03	≤0.03
Gain thermal drift	-40°C ... -25°C	<b>%/°C</b>	≤0.1	≤0.1
Linearity (typical)		<b>%</b>	±0.5	±0.5
Delay time (typical)		<b>µs</b>	≤3	≤3
di/dt correctly followed		<b>A / µs</b>	≤100	≤100
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	≤180	≤180
No load consumption current ( $I_{A0-}$ )		<b>mA</b>	≤35	≤35
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	20	20
Supply voltage	± 25%	<b>V d.c.</b>	±24	±24
Mass		<b>Kg</b>	1	1
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>°C</b>	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.



### General data

- Plastic case and insulating resin are self-extinguishing.
- Two fixing modes:
  - Horizontal or vertical with fixing holes in the case moulding
  - By bar using the intermediate side plate kit (Refer to Accessories and options on the following page)
- Max tightening torque for M6 screws (side plate mounting): 2 N.m
- **Direction of the current:**
  - Output current ( $I_{S1}$  and  $I_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output current on terminals  $I_{S1}$  and  $I_{S2}$ .
  - Output voltage ( $V_{S1}$  and  $V_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output voltage on terminals  $V_{S1}$  and  $V_{S2}$ .

- Burn-in test in accordance with FPTC 404304 cycle

### Primary connection

Hole for primary conductor.  
The temperature of the primary conductor in contact with the case must not exceed 100°C.

### Secondary connection

- Shielded cable 6 x 2000 mm (cross section 0.5 mm<sup>2</sup>)

### NCS125T from 6000 to 10000 A



### Technical data

	Output current shielded cable		NCS125T-6AF	-	NCS125T-10AF	-
	Output voltage shielded cable		-	NCS125T-6VF	-	NCS125T-10VF
Nominal primary current		<b>A peak</b>	6000	6000	10000	10000
Measuring range		<b>A peak</b>	30000	30000	30000	30000
Not measured overload	1s/h	<b>A peak</b>	120000	120000	200000	200000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	±20	-	±20	-
Secondary current $I_{S2}$ at $I_{PMAX}$		<b>mA peak</b>	±20	-	±20	-
Residual current $I_{S10}$	@ +25°C	<b>µA</b>	≤±250	-	≤±250	-
Residual current $I_{S20}$	@ +25°C	<b>µA</b>	≤±180	-	≤±180	-
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b>µA/°C</b>	≤±4	-	≤±4	-
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b>Ω</b>	0 ... 350	-	0 ... 350	-
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	-	±10	-	±10
Secondary voltage $V_{S2}$ at $I_{PMAX}$		<b>V peak</b>	-	±10	-	±10
Residual voltage $V_{S10}$	@ +25°C	<b>mV</b>	-	≤±100	-	≤±100
Residual voltage $V_{S20}$	@ +25°C	<b>mV</b>	-	≤±50	-	≤±50
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/°C</b>	-	≤±2	-	≤±2
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b>Ω</b>	-	10000 ... ∞	-	10000 ... ∞
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	≤±1	≤±1	≤±1	≤±1
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PMAX}$	@ +25°C	<b>%</b>	≤±3	≤±3	≤±3	≤±3
Gain thermal drift	-25°C ... +85°C	<b>%/°C</b>	≤0.03	≤0.03	≤0.03	≤0.03
Gain thermal drift	-40°C ... -25°C	<b>%/°C</b>	≤0.1	≤0.1	≤0.1	≤0.1
Linearity (typical)		<b>%</b>	±0.5	±0.5	±0.5	±0.5
Delay time (typical)		<b>µs</b>	≤3	≤3	≤3	≤3
di/dt correctly followed		<b>A / µs</b>	≤100	≤100	≤100	≤100
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	≤180	≤180	≤180	≤180
No load consumption current ( $I_{A0-}$ )		<b>mA</b>	≤35	≤35	≤35	≤35
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	20	20	20	20
Supply voltage	± 25%	<b>V d.c.</b>	±24	±24	±24	±24
Mass		<b>Kg</b>	1	1	1	1
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.

### Accessories and options

#### Side plates (or right angle brackets)

For installation of the side plates, please refer to the mounting instructions ref. **1SBC146005M1701**

- Side plate kit NCS125T:

ABB order code: **1SBT200000R2002**

For other options please contact us.

### Conformity

EN50155

EN50121-5, EN50123-1, EN50124-1





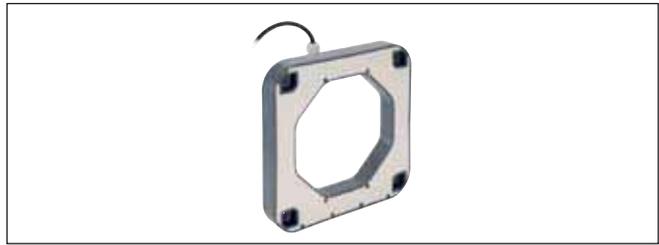
# NCS substation current sensors

## Fixed installations only

### Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

### NCS165T from 4000 to 6000 A



### Technical data

	Output current shielded cable		NCS165T-4AF	-	NCS165T-6AF	-
	Output voltage shielded cable		-	NCS165T-4VF	-	NCS165T-6VF
Nominal primary current		<b>A peak</b>	4000	4000	6000	6000
Measuring range		<b>A peak</b>	20000	20000	30000	30000
Not measured overload	1s/h	<b>A peak</b>	80000	80000	120000	120000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	±20	-	±20	-
Secondary current $I_{S2}$ at $I_{PMAX}$		<b>mA peak</b>	±20	-	±20	-
Residual current $I_{S10}$	@ +25°C	<b>µA</b>	≤±250	-	≤±250	-
Residual current $I_{S20}$	@ +25°C	<b>µA</b>	≤±180	-	≤±180	-
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b>µA/°C</b>	≤±4	-	≤±4	-
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b>Ω</b>	0 ... 350	-	0 ... 350	-
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	-	±10	-	±10
Secondary voltage $V_{S2}$ at $I_{PMAX}$		<b>V peak</b>	-	±10	-	±10
Residual voltage $V_{S10}$	@ +25°C	<b>mV</b>	-	≤±100	-	≤±100
Residual voltage $V_{S20}$	@ +25°C	<b>mV</b>	-	≤±50	-	≤±50
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/°C</b>	-	≤±2	-	≤±2
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b>Ω</b>	-	10000 ... ∞	-	10000 ... ∞
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	≤±1	≤±1	≤±1	≤±1
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PMAX}$	@ +25°C	<b>%</b>	≤±3	≤±3	≤±3	≤±3
Gain thermal drift	-25°C ... +85°C	<b>%/°C</b>	≤0.03	≤0.03	≤0.03	≤0.03
Gain thermal drift	-40°C ... -25°C	<b>%/°C</b>	≤0.1	≤0.1	≤0.1	≤0.1
Linearity (typical)		<b>%</b>	±0.5	±0.5	±0.5	±0.5
Delay time (typical)		<b>µs</b>	≤3	≤3	≤3	≤3
di/dt correctly followed		<b>A / µs</b>	≤100	≤100	≤100	≤100
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	≤210	≤210	≤210	≤210
No load consumption current ( $I_{A0-}$ )		<b>mA</b>	≤35	≤35	≤35	≤35
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	20	20	20	20
Supply voltage	± 25%	<b>V d.c.</b>	±24	±24	±24	±24
Mass		<b>Kg</b>	1.2	1.2	1.2	1.2
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.

### General data

- Plastic case and insulating resin are self-extinguishing.
- Two fixing modes:
  - Horizontal or vertical with fixing holes in the case moulding.
  - By bar using the intermediate side plate kit (Refer to accessories and options on the following page)
- Max tightening torque for M6 screws (side plate mounting): 2 N.m
- **Direction of the current:**
  - Output current ( $I_{S1}$  and  $I_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output current on terminals  $I_{S1}$  and  $I_{S2}$ .
  - Output voltage ( $V_{S1}$  and  $V_{S2}$ ): A primary current flowing in the direction of the arrow results in a positive secondary output voltage on terminals  $V_{S1}$  and  $V_{S2}$ .

- Burn-in test in accordance with FPTC 404304 cycle

### Primary connection

Hole for primary conductor.  
The temperature of the primary conductor in contact with the case must not exceed 100°C.

### Secondary connection

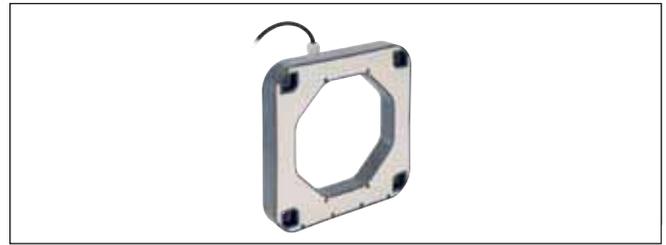
- Shielded cable 6 x 2000 mm (cross section 0.5 mm<sup>2</sup>)



# NCS substation current sensors

## Fixed installations only

### NCS165T from 10000 to 20000 A



### Technical data

	Output current shielded cable		NCS165T-10AF	-	NCS165T-20AF	-
	Output voltage shielded cable		-	NCS165T-10VF	-	NCS165T-20VF
Nominal primary current		<b>A peak</b>	10000	10000	20000	20000
Measuring range		<b>A peak</b>	30000	30000	40000	40000
Not measured overload	1s/h	<b>A peak</b>	200000	200000	200000	200000
Secondary current $I_{S1}$ at $I_{PN}$		<b>mA peak</b>	±20	-	±20	-
Secondary current $I_{S2}$ at $I_{PMAX}$		<b>mA peak</b>	±20	-	±20	-
Residual current $I_{S10}$	@ +25°C	<b>µA</b>	≤±250	-	≤±250	-
Residual current $I_{S20}$	@ +25°C	<b>µA</b>	≤±180	-	≤±180	-
Thermal drift coefficient (outputs $I_{S1}$ , $I_{S2}$ )		<b>µA/°C</b>	≤±4	-	≤±4	-
Measuring resistance (outputs $I_{S1}$ , $I_{S2}$ )		<b>Ω</b>	0 ... 350	-	0 ... 350	-
Secondary voltage $V_{S1}$ at $I_{PN}$		<b>V peak</b>	-	±10	-	±10
Secondary voltage $V_{S2}$ at $I_{PMAX}$		<b>V peak</b>	-	±10	-	±10
Residual voltage $V_{S10}$	@ +25°C	<b>mV</b>	-	≤±100	-	≤±100
Residual voltage $V_{S20}$	@ +25°C	<b>mV</b>	-	≤±50	-	≤±50
Thermal drift coefficient (outputs $V_{S1}$ , $V_{S2}$ )		<b>mV/°C</b>	-	≤±2	-	≤±2
Measuring resistance (outputs $V_{S1}$ , $V_{S2}$ )		<b>Ω</b>	-	10000 ... ∞	-	10000 ... ∞
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PN}$	@ +25°C	<b>%</b>	≤±1	≤±1	≤±1	≤±1
Rms accuracy 50Hz (without offset) <sup>1</sup> at $I_{PMAX}$	@ +25°C	<b>%</b>	≤±3	≤±3	≤±3	≤±3
Gain thermal drift	-25°C ... +85°C	<b>%/°C</b>	≤0.03	≤0.03	≤0.03	≤0.03
Gain thermal drift	-40°C ... -25°C	<b>%/°C</b>	≤0.1	≤0.1	≤0.1	≤0.1
Linearity (typical)		<b>%</b>	±0.5	±0.5	±0.5	±0.5
Delay time (typical)		<b>µs</b>	≤3	≤3	≤3	≤3
di/dt correctly followed		<b>A / µs</b>	≤100	≤100	≤100	≤100
Bandwidth	@ -1dB	<b>kHz</b>	0 ... 10	0 ... 10	0 ... 10	0 ... 10
No load consumption current ( $I_{A0+}$ )	@ -40°C	<b>mA</b>	≤210	≤210	≤210	≤210
No load consumption current ( $I_{A0-}$ )		<b>mA</b>	≤35	≤35	≤35	≤35
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV r.m.s.</b>	20	20	20	20
Supply voltage	± 25%	<b>V d.c.</b>	±24	±24	±24	±24
Mass		<b>Kg</b>	1.2	1.2	1.2	1.2
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage/startup temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90

<sup>1</sup>Maximum current  $I_{PN}$  generated: 5000A r.m.s.

### Accessories and options

#### Side plates (or right angle brackets)

For installation of the side plates, please refer to the mounting instructions ref. **1SBC146004M1701**

- Side plate kit NCS165T:

ABB order code: **1SBT200000R2001**

For other options please contact us.

### Conformity

EN50155

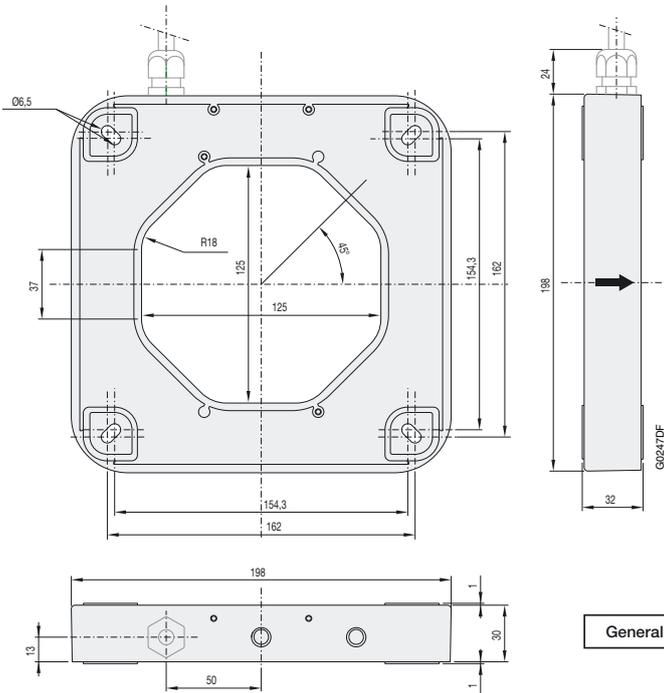
EN50121-5, EN50123-1, EN50124-1



# NCS substation current sensors

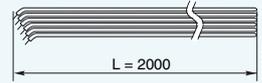
## Fixed installations only

### Dimensions (mm)



General tolerance:  $\pm 1$  mm

#### Standard NCS125T-AF sensors secondary connection



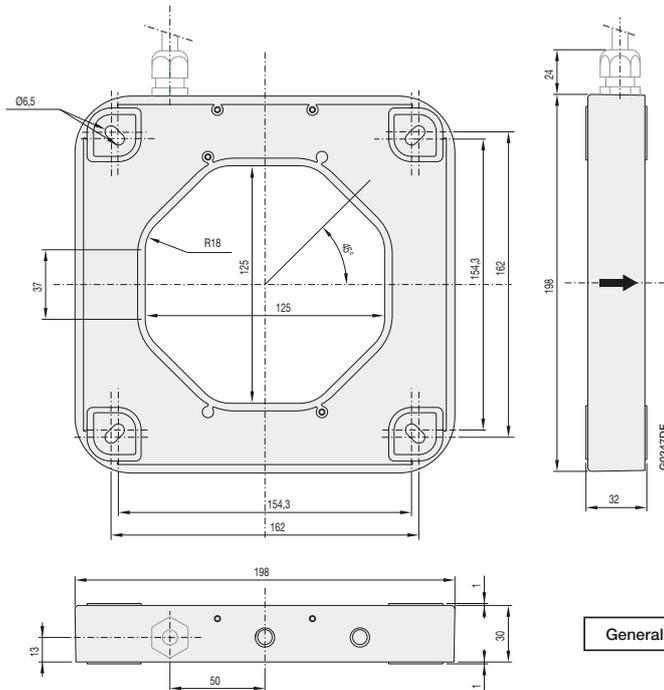
Shielded cable with braided earth:

#### AF range wires identification:

- 1 : Red:  $+V_A$  (+24V d.c.)
- 2 : Black: 0V
- 3 : Blue:  $-V_A$  (-24V d.c.)
- 4 : NC:
- 5 : NC:
- 6 : Green:  $I_{S1}$  ( $\pm 20$ mA @  $I_{PN}$ )
- 7 : White:  $I_{S2}$  ( $\pm 20$ mA @  $I_{P_{MAX}}$ )
- 8 : Brown: 0V

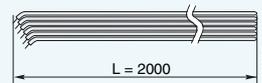
Shielding: see page 102

### NCS125T-AF



General tolerance:  $\pm 1$  mm

#### Standard NCS125T-VF sensors secondary connection



Shielded cable with braided earth:

#### VF range wires identification:

- 1 : Red:  $+V_A$  (+24V d.c.)
- 2 : Black: 0V
- 3 : Blue:  $-V_A$  (-24V d.c.)
- 4 : Green:  $V_{S1}$  ( $\pm 10$ V @  $I_{PN}$ )
- 5 : White:  $V_{S2}$  ( $\pm 10$ V @  $I_{P_{MAX}}$ )
- 6 : NC:
- 7 : NC:
- 8 : Brown: 0V

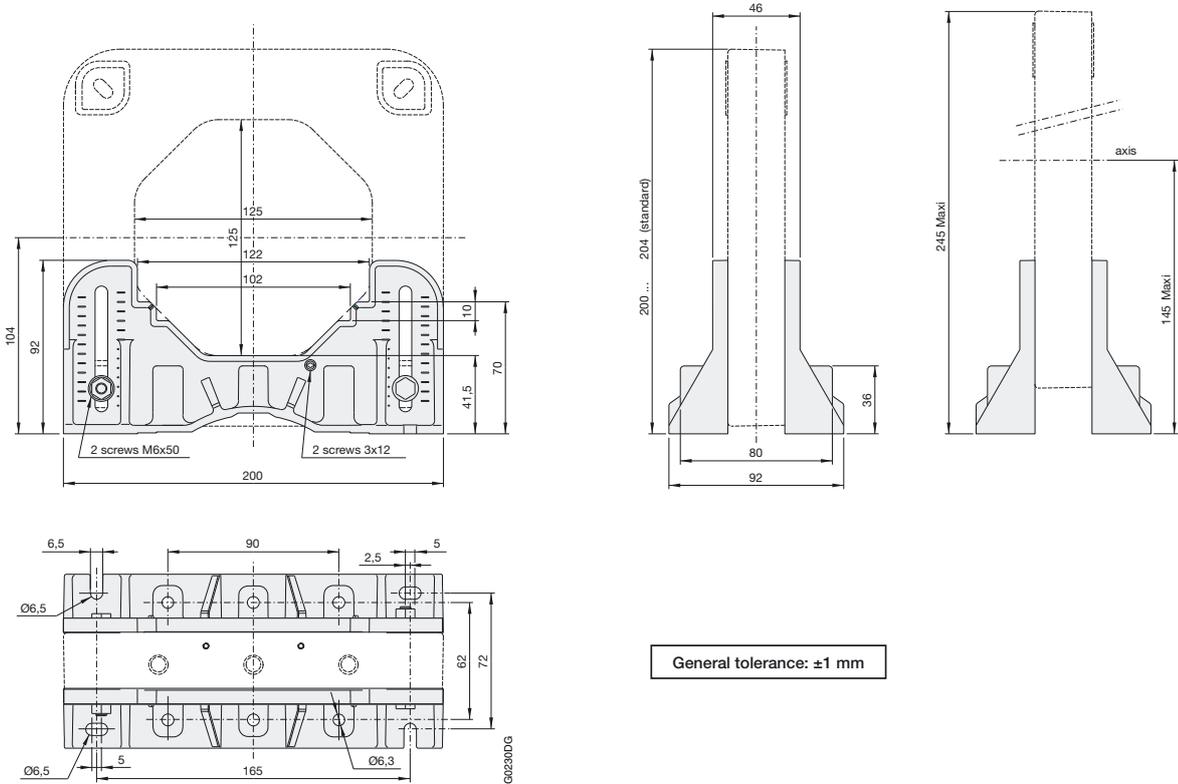
Shielding: see page 102

### NCS125T-VF

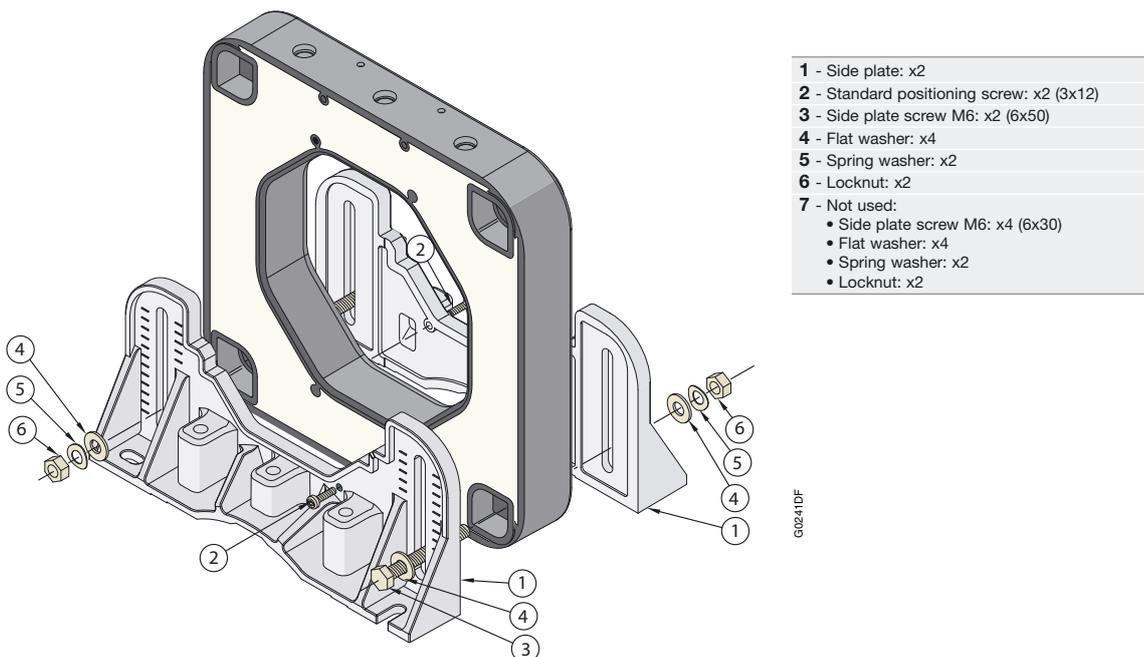
# NCS substation current sensors

## Fixed installations only

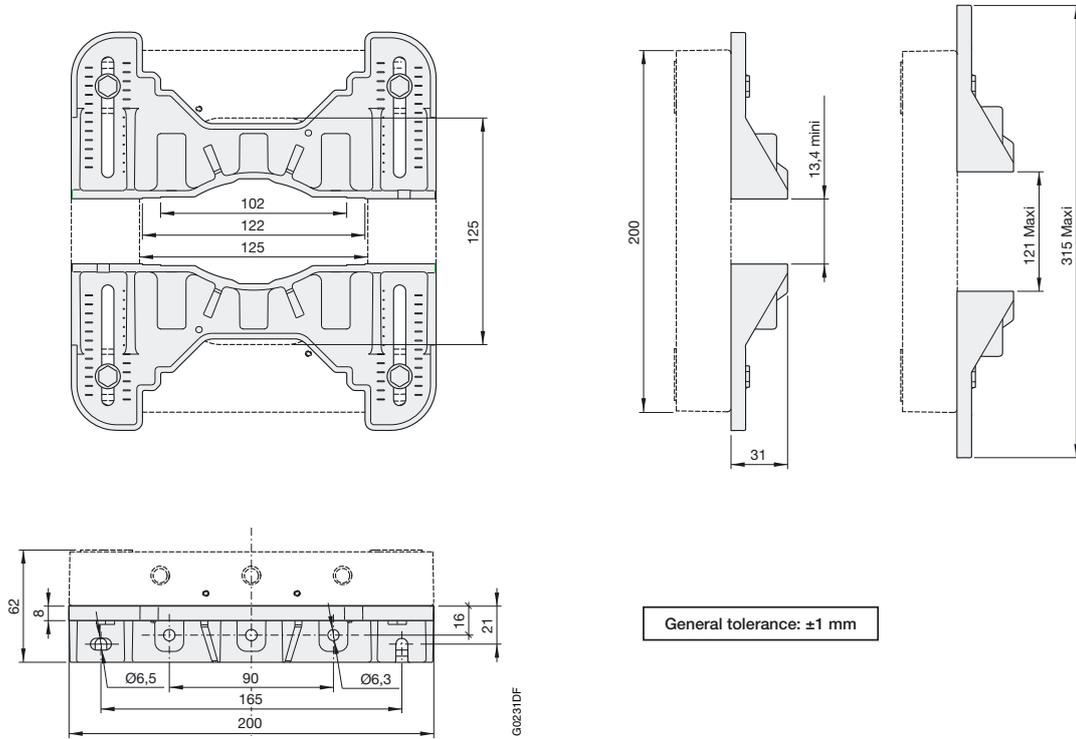
Dimensions and arrangement of right angle brackets (mm)



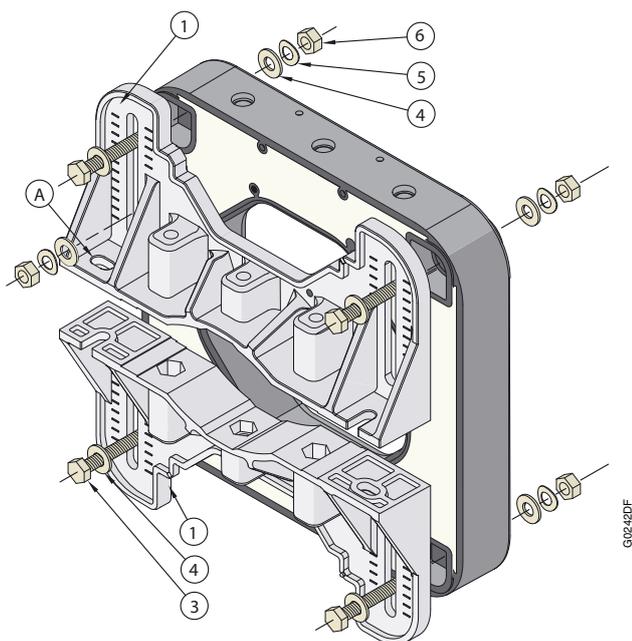
Right angle brackets mounting on NCS125T sensors



### Dimensions and arrangement of right angle brackets (mm)



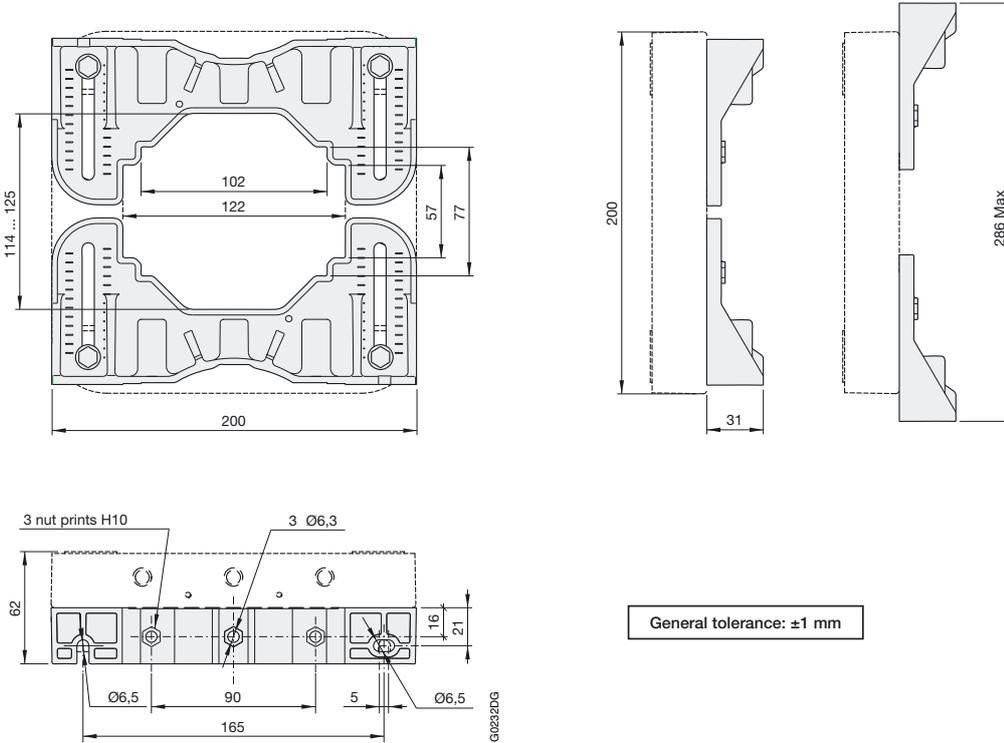
### Right angle brackets mounting on NCS125T sensors



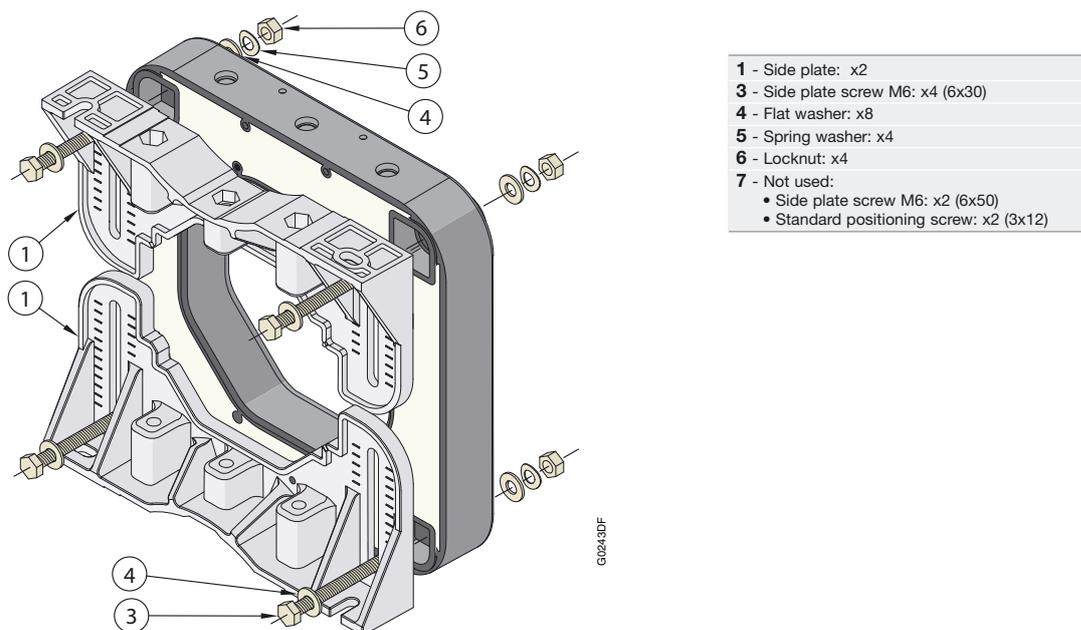
- |   |
|---|
| 1 - Side plate: x2                      |
| 3 - Side plate screw M6: x4 (6x30)      |
| 4 - Flat washer: x8                     |
| 5 - Spring washer: x4                   |
| 6 - Locknut: x4                         |
| 7 - Not used:                           |
| • Side plate screw M6: x4 (6x50)        |
| • Standard positioning screw: x2 (3x12) |

**A** - The screws for clamping the side plates to the bar (or cable) are not supplied

### Dimensions and arrangement of right angle brackets (mm)



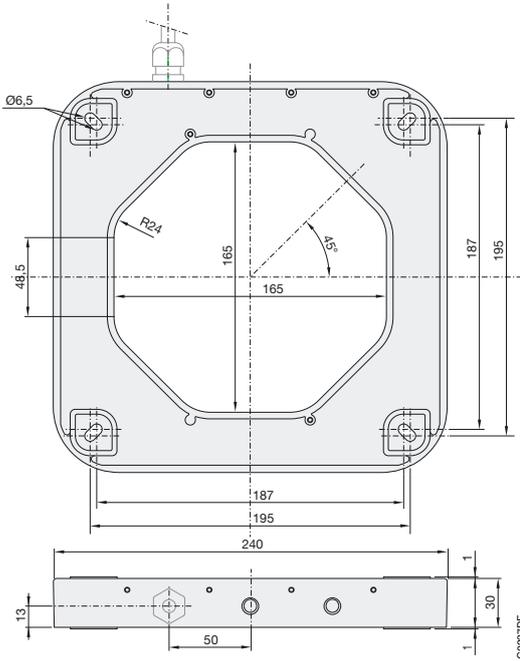
### Right angle brackets mounting on NCS125T sensors



# NCS substation current sensors

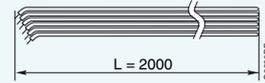
## Fixed installations only

### Dimensions (mm)



General tolerance:  $\pm 1$  mm

#### Standard NCS165T-AF sensors secondary connection



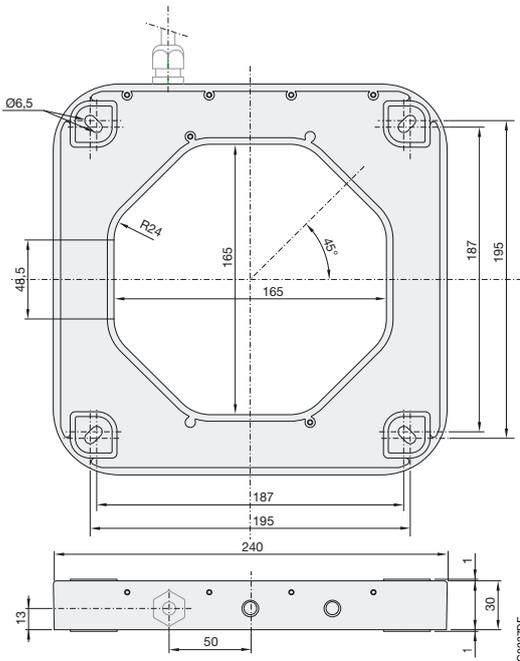
Shielded cable with braided earth:

#### AF range wires identification:

- 1 : Red:  $+V_A$  (+24V d.c.)
- 2 : Black: 0V
- 3 : Blue:  $-V_A$  (-24V d.c.)
- 4 : NC:
- 5 : NC:
- 6 : Green:  $I_{S1}$  ( $\pm 20$ mA @  $I_{PN}$ )
- 7 : White:  $I_{S2}$  ( $\pm 20$ mA @  $I_{P_{MAX}}$ )
- 8 : Brown: 0V

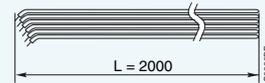
Shielding: see page 102

### NCS165T-AF



General tolerance:  $\pm 1$  mm

#### Standard NCS165T-VF sensors secondary connection



Shielded cable with braided earth:

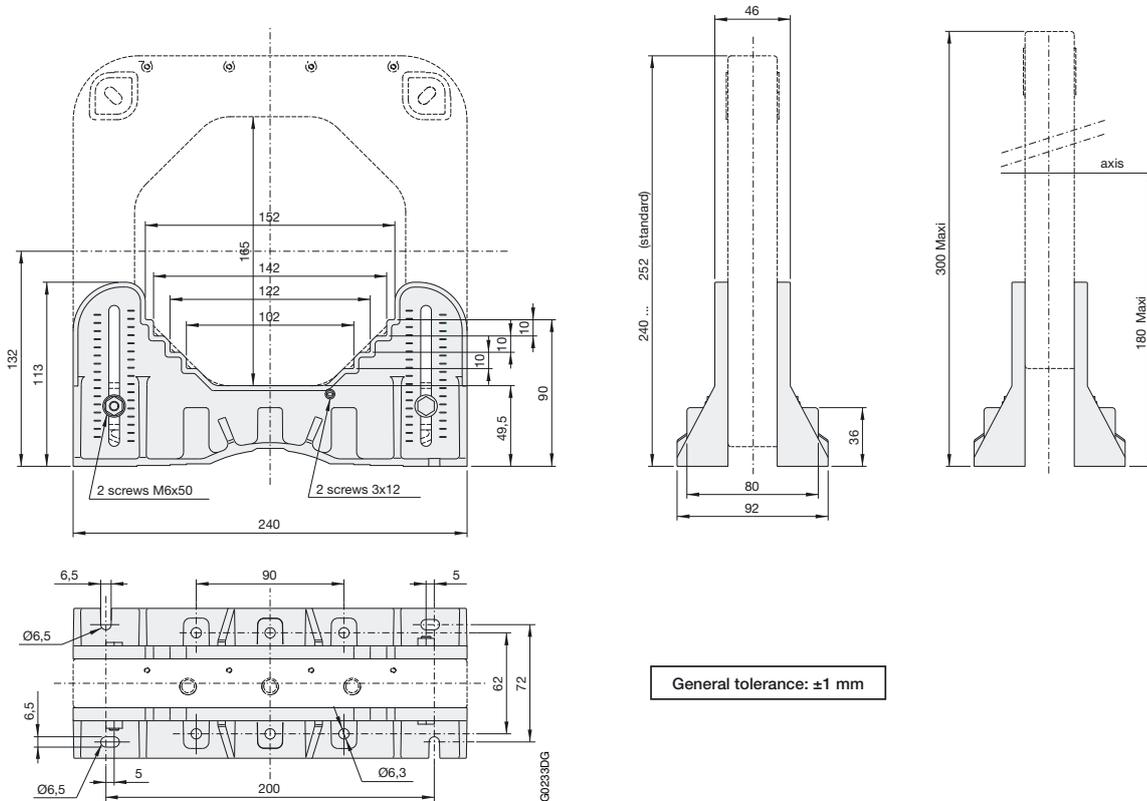
#### VF range wires identification:

- 1 : Red:  $+V_A$  (+24V d.c.)
- 2 : Black: 0V
- 3 : Blue:  $-V_A$  (-24V d.c.)
- 4 : Green:  $V_{S1}$  ( $\pm 10$ V @  $I_{PN}$ )
- 5 : White:  $V_{S2}$  ( $\pm 10$ V @  $I_{P_{MAX}}$ )
- 6 : NC:
- 7 : NC:
- 8 : Brown: 0V

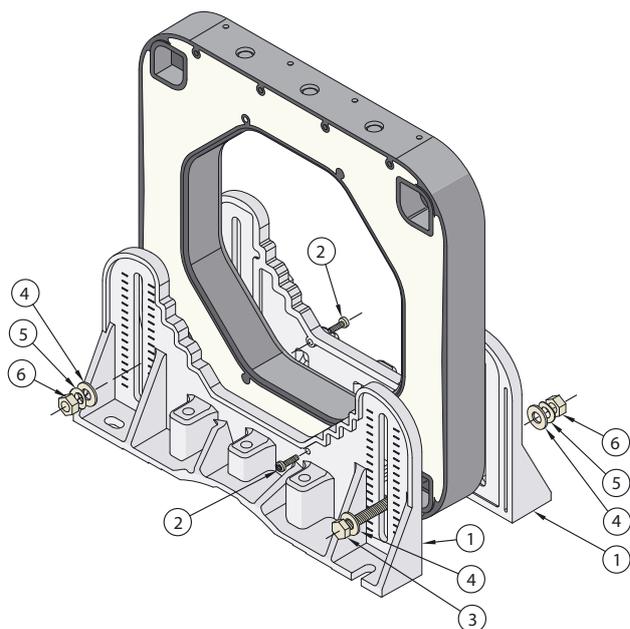
Shielding: see page 102

### NCS165T-VF

### Dimensions and arrangement of right angle brackets (mm)



### Right angle brackets mounting on NCS165T sensors

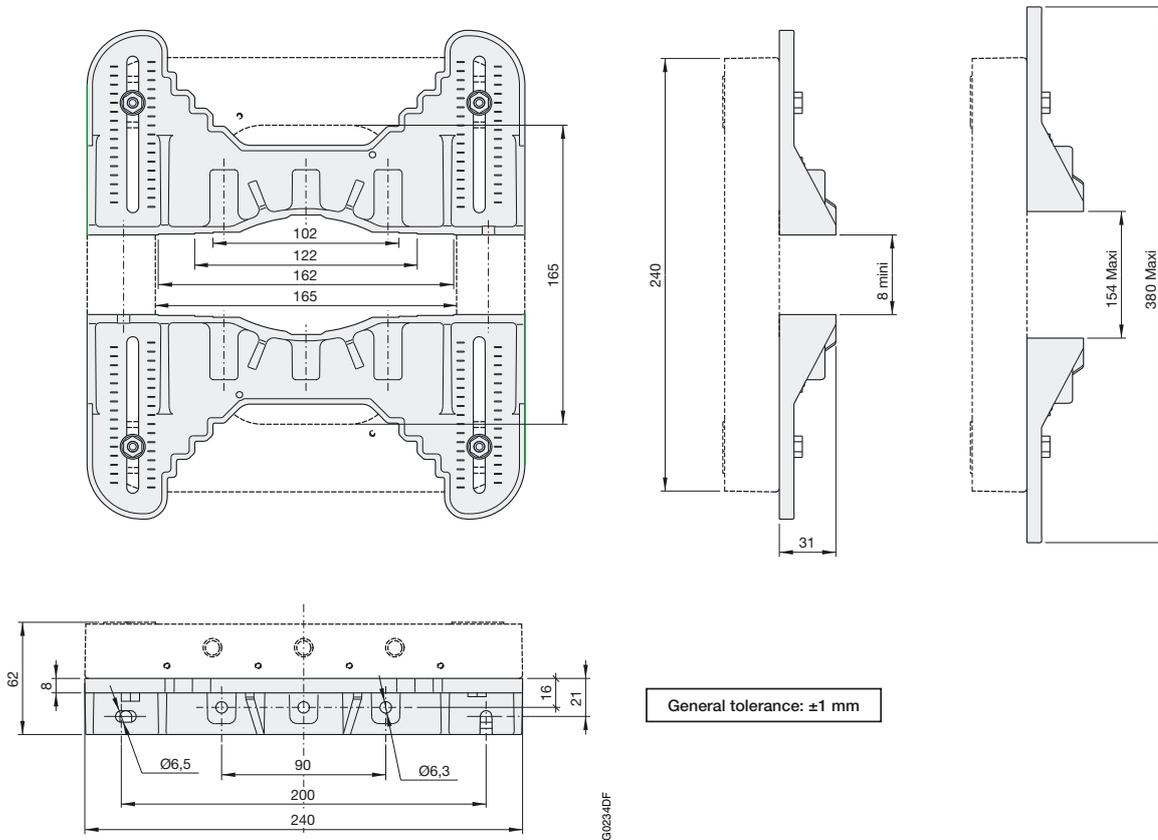


- |   |   |
|---|---|
| 1 | - Side plate: x2                        |
| 2 | - Standard positioning screw: x2 (3x12) |
| 3 | - Side plate screw M6: x2 (6x50)        |
| 4 | - Flat washer: x4                       |
| 5 | - Spring washer: x2                     |
| 6 | - Locknut: x2                           |
| 7 | - Not used:                             |
|   | • Side plate screw M6: x4 (6x30)        |
|   | • Flat washer: x4                       |
|   | • Spring washer: x2                     |
|   | • Locknut: x2                           |

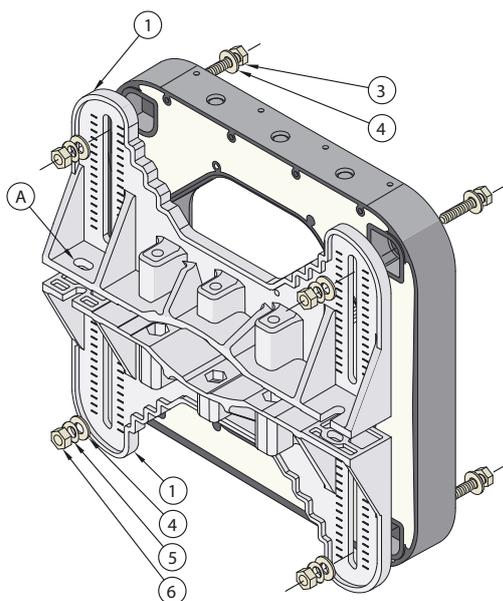
# NCS substation current sensors

## Fixed installations only

Dimensions and arrangement of right angle brackets (mm)



Right angle brackets mounting on NCS165T sensors

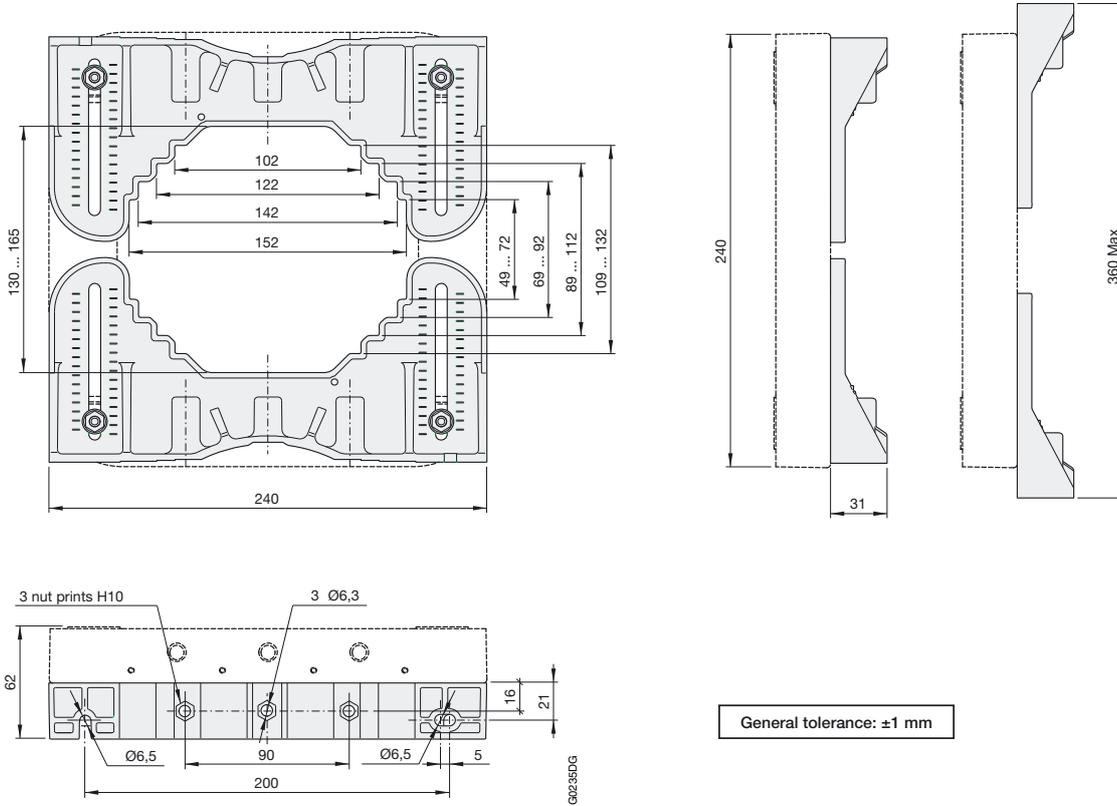


- |   |   |
|---|---|
| 1 | - Side plate: x2                        |
| 3 | - Side plate screw M6: x4 (6x30)        |
| 4 | - Flat washer: x8                       |
| 5 | - Spring washer: x4                     |
| 6 | - Locknut: x4                           |
| 7 | - Not used:                             |
|   | • Side plate screw M6: x2 (6x50)        |
|   | • Standard positioning screw: x2 (3x12) |

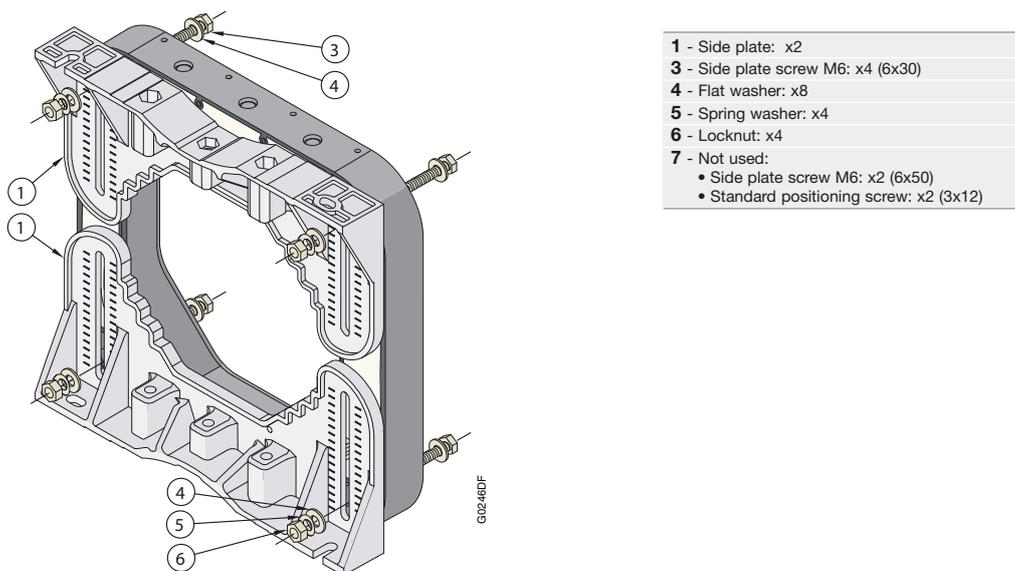
**A** - The screws for clamping the side plates to the bar (or cable) are not supplied

G0245DF

### Dimensions and arrangement of right angle brackets (mm)



### Right angle brackets mounting on NCS165T sensors





# Traction Current Sensors CS Range

## Incomparable modularity

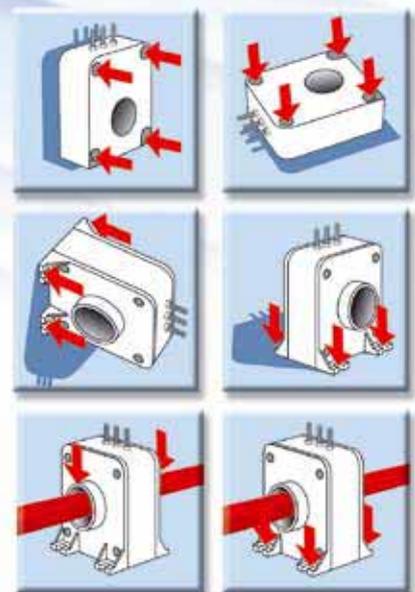
CS current sensors come with a complete range of options and accessories and a wealth of preset variants that have now become standard. As well as being renowned for their incomparable modularity, CS sensors give their users the edge because they are compact and easy to fit. They also offer a number of connection options, their simplicity and performance characteristics are unrivalled as are their magnetic immunity and mechanical resistance. They meet all the exacting demands of sectors as varied as railways, the mining industry and control in difficult environments such as ozone generators. CS current sensors and VS voltage sensors together constitute an offer the railway industry cannot afford to ignore.

## You simply can't get any smaller!

ABB current sensors contain everything needed to do the job – you don't need anything else. By integrating the philosophy of reduced size into its CS sensors, ABB have brought miniaturization to a point of perfection. This miniaturization also gives great flexibility of installation as well as the best size and performance for money on the market. Small really is beautiful.



**The best way up is the way you want**

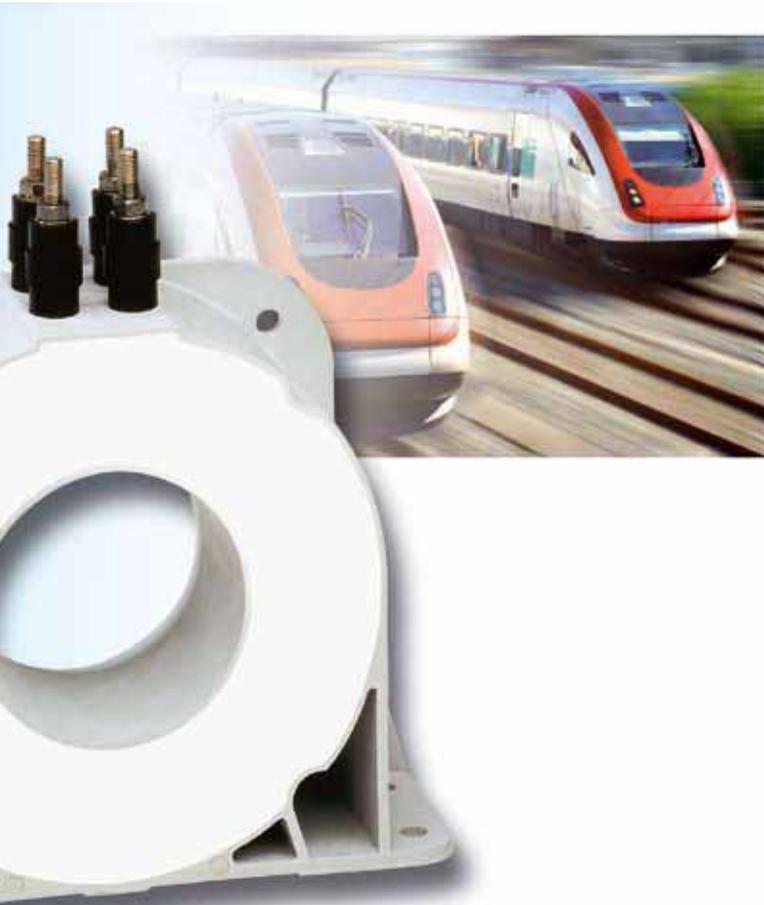


## The efficient way

Once again ABB have shown that they put all their know-how and talent for innovation into improving efficiency. Whether fitted horizontally or vertically, ABB sensors fit perfectly into your system configurations and the space available. Installation is no longer a problem; in fact inserting sensors is child's play. This choice of fittings is a first in the sensors market. This ability to stay a length ahead makes ABB stand out from their competitors.

## Unbeatable reliability

Designed using the 6 sigma approach, the CS range is a model of reliability. The choice and number of optimized components, traceability of subassemblies, individually production tests... nothing is left to chance to guarantee your peace of mind.



## Perfect efficiency in every environment

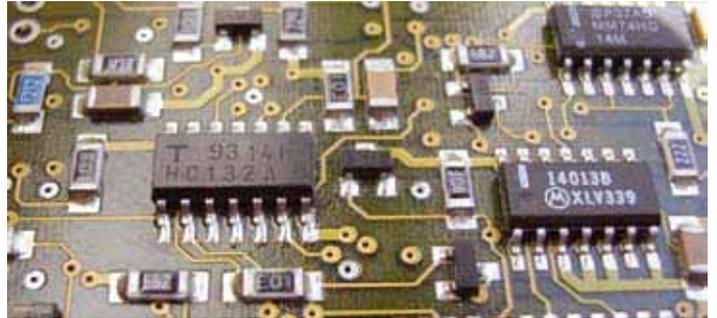
The CS range has been designed for applications in difficult environments such as on-board railway equipment (power converters, auxiliary converters for heating, ventilation and air conditioning) and the mining industry. Their robust design and excellent performances (e.g. operating range between  $-40^{\circ}$  and  $+85^{\circ}\text{C}$ ) make CS current sensors ideal for use in other very demanding applications (marine, wind-power, ozone generators, etc.)

## Incomparable protection against magnetic fields

CS sensors are conceived, designed and renowned for their unrivalled immunity to ambient magnetic fields. Although they are in continuous proximity of powerful currents capable of distorting their measurements, this does not, in fact, occur. Their accuracy is rock-solid and once set to measure a particular current, that is what they measure – that and nothing else.

## Quality that goes beyond standards

ABB have been ISO 9001 certified since 1993 and our sensors bear the CE label. This ongoing striving after quality has always been the hallmark of a company where excellence and safety are part of the culture, from design right through to production. This culture is the result of continuous research to make technical progress and meet our customers' demands.



**SAFETY** CS sensors meet the various safety standards in force such as EN 50124-1 for electrical insulation and NFF 16101-NFF 16102 for fire-smoke resistance.

**QUALITY** The chief selling-point of CS sensors is their quality. Compliance with EN 50121-X for electromagnetic disturbance and EN 50155 for their high-tech electronic design is proof of their ability to comply with the most detailed constraints as well as major demands. The fact that each individual sensor is subjected to rigorous testing such as sensor burn-in is proof of the importance ABB attribute to quality.

**ENVIRONMENT-FRIENDLY** ABB have long been concerned with the protection of the environment, as proved by the ISO 14001 certification they received in 1998. This environmental approach is particularly noticeable in production of the CS range in the reduction of the number of components, in the use of a low-energy manufacturing procedure and the use of recyclable packing. The products in use are also characterized by their reduced energy consumption.



**BECAUSE YOU WANT RELIABILITY,  
WE DESIGN FOR LONGEVITY**



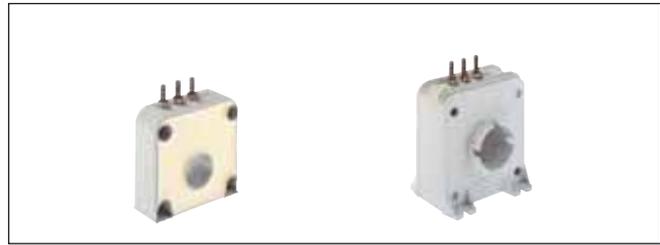
# CS traction current sensors

## Rolling stock and fixed installations

### Utilisation

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.

### CS300 / CS503 / CS500



### Technical data

	Horizontal mounting			CS300BR CS300BRV CS300BRE CS300BRVE		CS503BR CS503BRE		CS500BR CS500BRV CS500BRE CS500BRVE	
	Vertical mounting	horizontal + Screen		vertical + Screen					
Nominal primary current			<b>A r.m.s.</b>	300	500	500			
Measuring range	@ ±15V (±5%)		<b>A peak</b>	±600	-	-			
Measuring range	@ ±24V (±5%)		<b>A peak</b>	±600	±750	±1000			
Not measurable overload	10ms/hour		<b>A peak</b>	3000	5000	5000			
Max. measuring resistance	@ I <sub>PMAX</sub> & ±15V (±5%)		<b>Ω</b>	12	-	-			
Max. measuring resistance	@ I <sub>PMAX</sub> & ±24V (±5%)		<b>Ω</b>	40	6	37			
Min. measuring resistance	@ I <sub>PN</sub> & ±15V (±5%)		<b>Ω</b>	0	-	-			
Min. measuring resistance	@ I <sub>PN</sub> & ±24V (±5%)		<b>Ω</b>	35	0	0			
Turn number				2000	3500	5000			
Secondary current at I <sub>PN</sub>			<b>mA</b>	150	142.86	100			
Accuracy at I <sub>PN</sub>	@ +25°C		<b>%</b>	≤±0.5	≤±0.5	≤±0.5			
Accuracy at I <sub>PN</sub>	-40 ... +85°C		<b>%</b>	≤±1	≤±1	≤±1			
Offset current	@ +25°C & ±24V (±5%)		<b>mA</b>	≤±0.5	≤±0.3	≤±0.25			
Linearity			<b>%</b>	≤0.1	≤0.1	≤0.1			
Thermal drift coefficient	-40 ... +85°C		<b>µA/°C</b>	≤7.5	≤7	≤5			
Delay time			<b>µs</b>	≤1	≤1	≤1			
di/dt correctly followed			<b>A / µs</b>	≤100	≤100	≤100			
Bandwidth	-1dB		<b>kHz</b>	≤100	≤100	≤100			
Max. no-load consumption current	@ ±24V (±5%)		<b>mA</b>	≤15	≤15	≤15			
Secondary resistance	@ +85°C		<b>Ω</b>	≤27	≤88	≤64			
Dielectric strength Primary/Secondary (or Primary/(Secondary+Screen) if relevant)	50 Hz, 1 min		<b>kV</b>	6.5	6.5	12			
Dielectric strength Secondary/Screen (if relevant)	50 Hz, 1 min		<b>kV</b>	0.5	0.5	0.5			
Supply voltage	±5%		<b>V d.c.</b>	±15 ... ±24	±15 ... ±24	±15 ... ±24			
Voltage drop			<b>V</b>	≤2.5	≤2.5	≤2.5			
Mass			<b>kg</b>	0.36	0.36	0.78			
Mass with side plates			<b>kg</b>	0.45	0.45	0.95			
Operating temperature			<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85			
Storage temperature			<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90			

### General data

- Plastic case and insulating resin are self-extinguishing.
- Fixing holes in the case moulding for horizontal or vertical mounting, with side plates.
- Direction of the current: A primary current flowing in the direction of the arrow results in a positive secondary output current from terminal M.
- Internal electrostatic screen: All CS sensors have an electrostatic screen, this is connected to the screen terminal «E». Depending on the version, when this screen terminal «E» is not provided, the screen is connected to the (-) terminal of the sensor.

- Protections:
  - of the measuring circuit against short-circuits.
  - of the measuring circuit against opening.
  - of the power supply against polarity reversal.
- Burn-in test in accordance with FPTC 404304 cycle.

### Primary connection

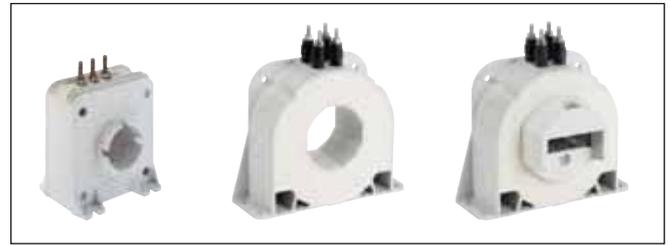
Hole for primary conductor. The temperature of the primary conductor in contact with the case must not exceed 100°C.



# CS traction current sensors

## Rolling stock and fixed installations

### CS1000 / CS2000



### Technical data

			Horizontal mounting	CS1000BR	CS1000-9940	CS2000BR*	CS2000-9944*
			Vertical mounting	CS1000BRV	CS1000-9941	CS2000BR*	CS2000-9944*
			Horizontal + Screen	CS1000BRE	CS1000-9942	CS2000BR*	CS2000-9944*
			Vertical + Screen	CS1000BRVE	CS1000-9943	CS2000BRV	CS2000-9945
Nominal primary current		<b>A r.m.s.</b>		1000	1000	2000	2000
Measuring range	@ ±15V (±5%)	<b>A peak</b>		-	-	-	-
Measuring range	@ ±24V (±5%)	<b>A peak</b>		±2000	±2000	±3000	±3000
Not measurable overload	10ms/hour	<b>A peak</b>		10000	10000	20000	20000
Max. measuring resistance	@ I <sub>P</sub> MAX & ±15V (±5%)	<b>Ω</b>		-	-	-	-
Max. measuring resistance	@ I <sub>P</sub> MAX & ±24V (±5%)	<b>Ω</b>		4	7	5	9
Min. measuring resistance	@ I <sub>P</sub> N & ±15V (±5%)	<b>Ω</b>		-	-	-	-
Min. measuring resistance	@ I <sub>P</sub> N & ±24V (±5%)	<b>Ω</b>		0	0	0	0
Turn number				5000	4000	5000	4000
Secondary current at I <sub>P</sub> N		<b>mA</b>		200	250	400	500
Accuracy at I <sub>P</sub> N	@ +25°C	<b>%</b>		≤±0.5	≤±0.5	≤±0.5	≤±0.5
Accuracy at I <sub>P</sub> N	-40 ... +85°C	<b>%</b>		≤±1	≤±1	≤±1	≤±1
Offset current	@ +25°C & ±24V (±5%)	<b>mA</b>		≤0.25	≤0.25	≤0.25	≤0.25
Linearity		<b>%</b>		≤0.1	≤0.1	≤0.1	≤0.1
Thermal drift coefficient	-40 ... +85°C	<b>µA/°C</b>		≤10	≤12.5	≤20	≤25
Delay time		<b>µs</b>		≤1	≤1	≤1	≤1
di/dt correctly followed		<b>A / µs</b>		≤100	≤100	≤100	≤100
Bandwidth	-1dB	<b>kHz</b>		≤100	≤100	≤100	≤100
Max. no-load consumption current	@ ±24V (±5%)	<b>mA</b>		≤15	≤15	≤25	≤25
Secondary resistance	@ +85°C	<b>Ω</b>		≤46	≤34	≤30	≤20
Dielectric strength Primary/Secondary (or Primary/(Secondary+Screen) if relevant)	50 Hz, 1 min	<b>kV</b>		12	12	12	12
Dielectric strength Secondary/Screen (if relevant)	50 Hz, 1 min	<b>kV</b>		0.5	0.5	1.5	1.5
Supply voltage	±5%	<b>V d.c.</b>		±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24
Voltage drop		<b>V</b>		≤2.5	≤2.5	≤1.5	≤1.5
Mass		<b>kg</b>		0.85	0.85	1.5	1.5
Mass with side plates		<b>kg</b>		1	1	1.66	1.66
Operating temperature		<b>°C</b>		-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage temperature		<b>°C</b>		-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90

\* Horizontal or vertical mounting is possible.

### Standard secondary connections

- M5 studs and Faston 6.35 x 0.8: see page 77 for details.

### Accessories

- Side plate kits (including the fixing screws): set of 2 plates allowing for:
  - Vertical or bar mounting for CS300 to CS1000
  - Bar mounting for CS2000 (vertical mounting is possible without side plate for CS2000)
- Mounting bar kits (including the fixing screws) for CS300 to CS2000. See the following page for details.

### Conformity

EN50155

EN50121-3-2

EN50124-1



# Accessories and options for CS sensors

## Rolling stock and fixed installations

### Accessories

#### Side plates:

Side plate kits include all the necessary screws for fixing the plates to the sensor.

Type	Sensor concerned	Technical description	Order code
Side plate kit CST0	CS300 & CS503	set of 2 plates	1SBT170000R2001
Side plate kit CST1	CS500 & CS1000	set of 2 plates	1SBT170000R2002
Side plate kit CST2	CS2000	set of 2 plates	1SBT170000R2007

#### Bar kits:

Bar kits include all the necessary screws for mounting the bar on the sensor (the sensor must already be fitted with side plates prior to mounting the bar).

Type	Sensor concerned	Technical description of the bar	Order code
Bar kit CST0	CS300 & CS503	6x25x155 mm <sup>2</sup> , 0.280 kg	1SBT170000R2003
Bar kit CST1-6	CS500 & CS1000	6x40x185 mm <sup>2</sup> , 0.510 kg	1SBT170000R2004
Bar kit CST1-10	CS500 & CS1000	10x40x185 mm <sup>2</sup> , 0.760 kg	1SBT170000R2005
Bar kit CST1 special	CS500 & CS1000	10x40x210 mm <sup>2</sup> , 0.8 kg (for compatibility with TA600, TA800 et EA1000 sensors)	1SBT170000R2010
Bar kit CST2	CS2000	20x60x240 mm <sup>2</sup> , 2.5 kg	1SBT170000R2008
Bar kit CST2 special	CS2000	20x60x370 mm <sup>2</sup> , 3.8 kg (for compatibility with EA2000 sensors)	1SBT170000R2012

For other bar dimensions: Please contact us for details.

### Options

The main available options are shown below.

Other options are possible: Please contact us for details.

#### Number of secondary turns Ns:

Sensor	CS300	CS503	CS500
Ns	1000 2500	4000 5000	3500

#### Secondary connection:

Sensor	CS300 & CS503	CS500 & CS1000	CS2000
Secondary connection	-	-	3 M5 studs
	3 M5 inserts	3 M5 inserts	3 M5 inserts
	4 M5 inserts	4 M5 inserts	4 M5 inserts
	3 pin Lemo connector	3 pin Lemo connector	3 pin Lemo connector
	4 pin Lemo connector	4 pin Lemo connector	4 pin Lemo connector
	Shielded cable (2 m)	Shielded cable (2 m)	Shielded cable (2 m)

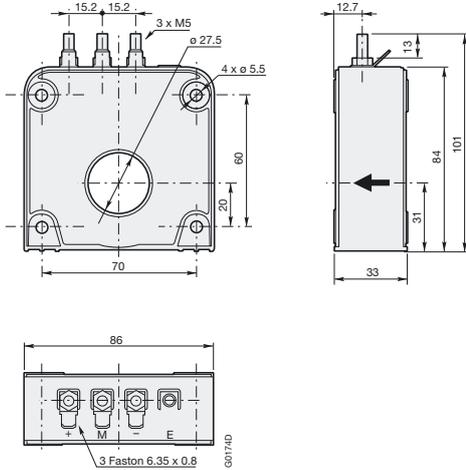


# CS traction current sensors

## Rolling stock and fixed installations

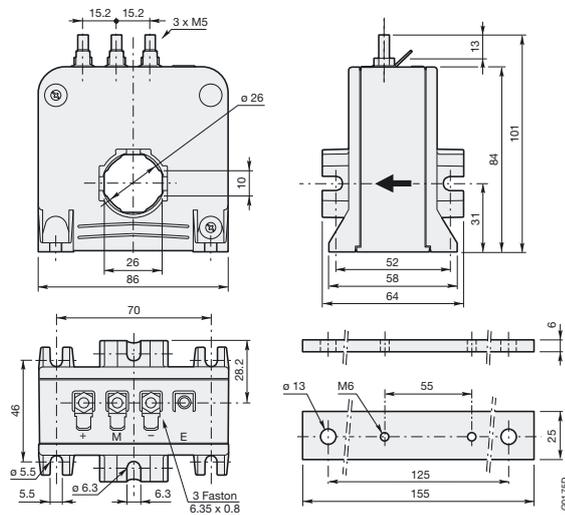
### Dimensions (mm)

#### Horizontal mounting



**Size 0 - CS300BR and CS503BR**

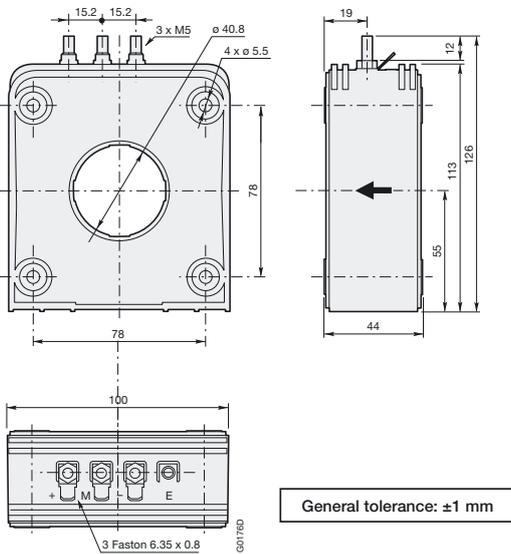
#### Vertical mounting



**Size 0 - CS300BRV**

**Bar CST0**

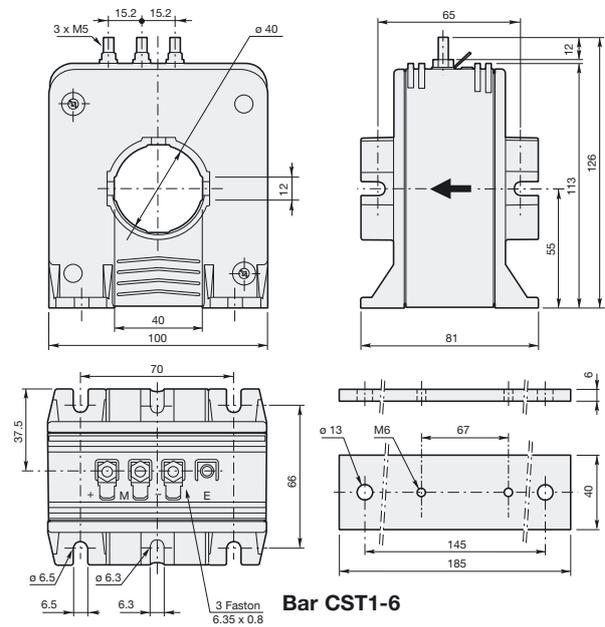
#### Horizontal mounting



**Size 1 - CS500BR and CS1000BR**

General tolerance: ±1 mm

#### Vertical mounting



**Size 1 - CS500BRV and CS1000BRV**

**Bar CST1-6**

**Bar CST1-10**

General tolerance: ±1 mm

The primary bar kit is only available with the vertical mounting versions.  
Tightening torque for M5 terminal studs (N.m) : 2

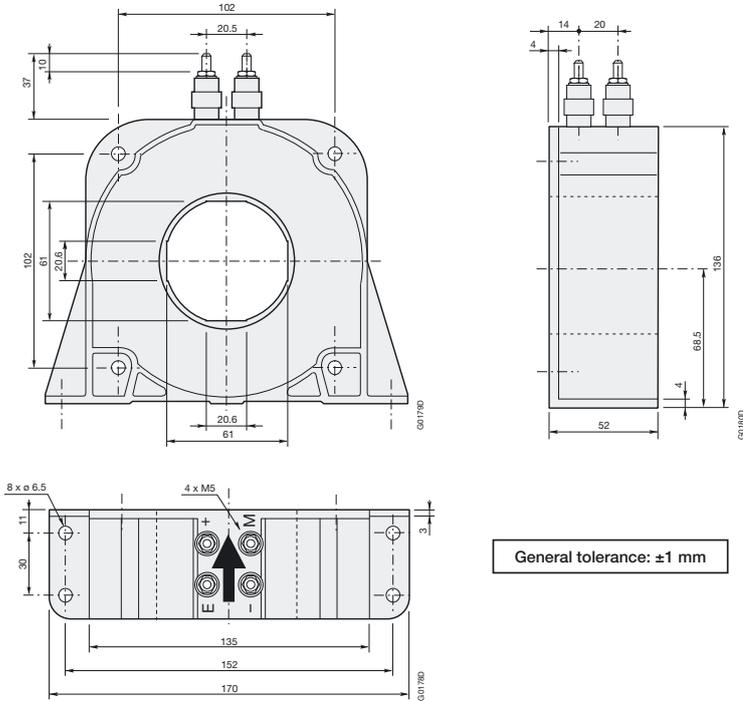


# CS traction current sensors

## Rolling stock and fixed installations

### Dimensions (mm)

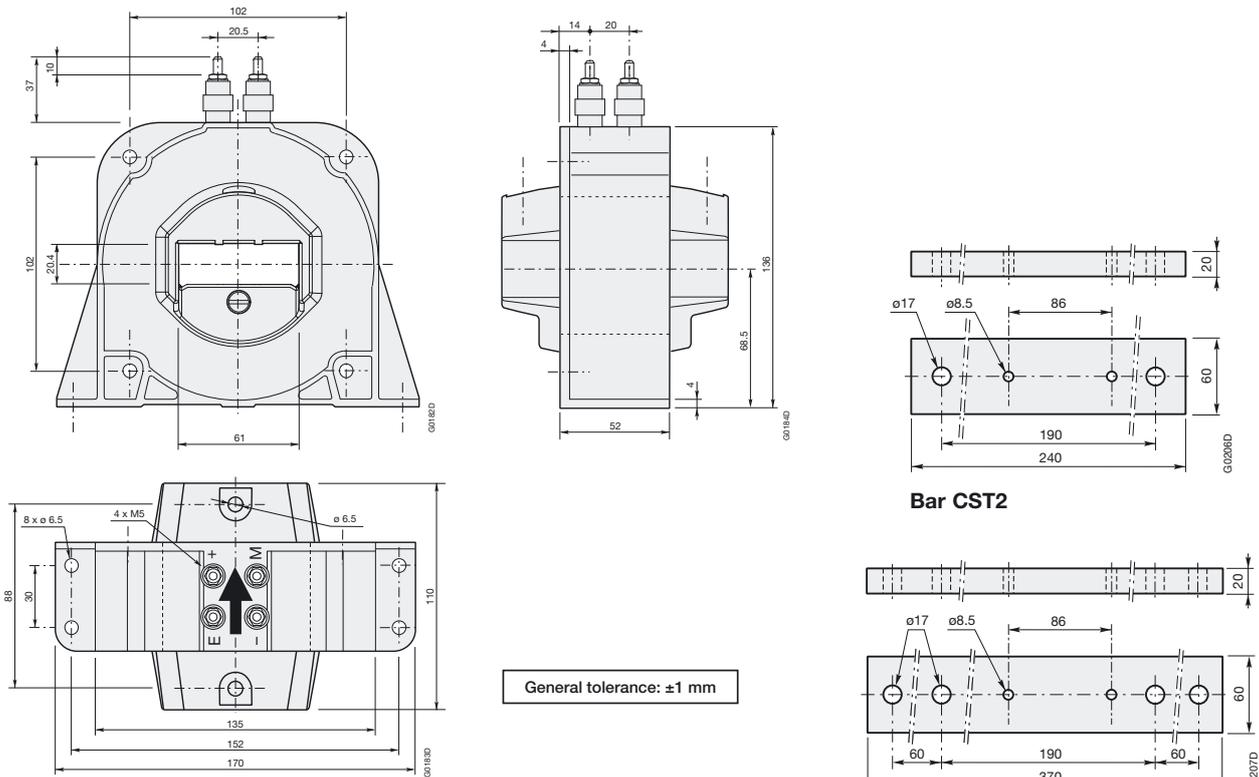
#### Horizontal and vertical mounting



General tolerance: ±1 mm

#### Size 2 - CS2000BR

#### Horizontal and vertical mounting



General tolerance: ±1 mm

#### Size 2 - CS2000BRV

#### Bar CST2 special

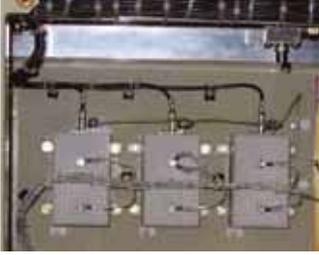
# Notes





# Traction voltage sensors

## Electronic technology



These voltage sensors use the new ABB 100% electronic technology (the magnetic circuit and Hall probe are no longer required). The voltage to be measured is applied directly to the primary terminals of the sensor. They are specially designed and manufactured to meet the latest Traction standards.



Type	Nominal primary voltage (V r.m.s.)	Secondary current at $U_{PN}$ (mA)	Supply voltage (V d.c.)	Secondary connection	Order code
VS50B	50	50	$\pm 12 \dots \pm 24$	4 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT160050R0001
VS125B	125	50	$\pm 12 \dots \pm 24$	4 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT160125R0001
VS250B	250	50	$\pm 12 \dots \pm 24$	4 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT160250R0001
VS500B	500	50	$\pm 12 \dots \pm 24$	4 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT160500R0001
VS750B	750	50	$\pm 12 \dots \pm 24$	4 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT160750R0001
VS1000B	1000	50	$\pm 12 \dots \pm 24$	4 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT161000R0001
VS1500B	1500	50	$\pm 12 \dots \pm 24$	4 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT161500R0001
VS2000B	2000	50	$\pm 12 \dots \pm 24$	3 x M5 studs	1SBT162000R0001
VS3000B	3000	50	$\pm 12 \dots \pm 24$	3 x M5 studs	1SBT163000R0001
VS4000B	4000	50	$\pm 12 \dots \pm 24$	3 x M5 studs	1SBT164000R0001
VS4200B	4200	50	$\pm 12 \dots \pm 24$	3 x M5 studs	1SBT164200R0001



# Traction voltage sensors

## Closed loop Hall effect technology



Closed loop Hall effect technology also allows for voltage measurement. For calibrated EM010 sensors, the voltage to be measured is applied directly to the primary terminals of the sensor. On the other hand, for not calibrated EM010 sensors, an external input resistor must be inserted in the primary before connecting the voltage to be measured.

### Calibrated EM010



EM010-9371

1SBC7 7204 3R0301

### Not calibrated EM010



EM010BBFHP1N

1SBC7 7512 4R0301



EM010TENHP1N

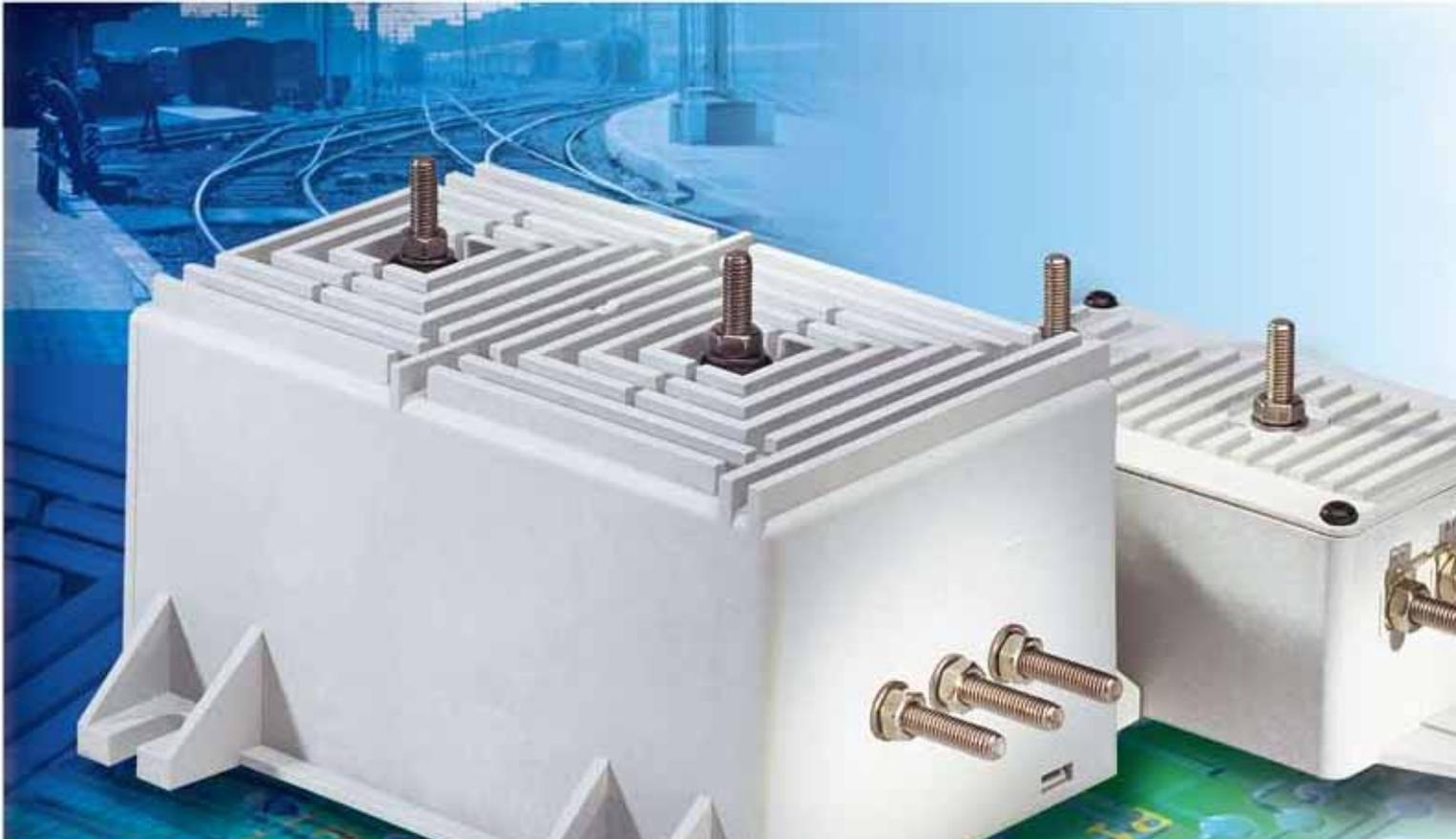
1SBC7 7201 3R0301

Type	Nominal primary voltage $U_{PN}$ (V r.m.s.)	Secondary current at $U_{PN}$ (mA)	Supply voltage (V d.c.)	Secondary connection	Order code
EM010-9239	600	50	$\pm 12 \dots \pm 24$	5 x M5 studs	EM010-9239
EM010-9240	750	50	$\pm 12 \dots \pm 24$	5 x M5 studs	EM010-9240
EM010-9371	1000	50	$\pm 12 \dots \pm 24$	5 x M5 studs	EM010-9371
EM010-9317	1500	50	$\pm 12 \dots \pm 24$	5 x M5 studs	EM010-9317
EM010-9318	2000	50	$\pm 12 \dots \pm 24$	5 x M5 studs	EM010-9318
EM010-9319	3000	50	$\pm 12 \dots \pm 24$	5 x M5 studs	EM010-9319
EM010-9394	4200	50	$\pm 12 \dots \pm 24$	5 x M5 studs	EM010-9394
EM010-9354	5000	50	$\pm 12 \dots \pm 24$	5 x M5 studs	EM010-9354

Type	Nominal primary current $I_{PN}$ (mA r.m.s.)	Secondary current at $I_{PN}$ (mA)	Supply voltage (V d.c.)	Secondary connection	Order code
EM010BBFHP1N	10	50	$\pm 12 \dots \pm 24$	3 x M5 studs	EM010BBFHP1N
EM010BEFHP1N	10	50	$\pm 12 \dots \pm 24$	3 x 6,35 x 0,8 Faston	EM010BEFHP1N
EM010TENHP1N	10	50	$\pm 12 \dots \pm 24$	3 x 6,35 x 0,8 Faston	EM010TENHP1N



# Traction Voltage Sensors VS Range



## 100% electronic a great leap forward

To push the performance barriers back ever further, VS sensors are made 100% electronic. Our sensors are the first ones on the market to incorporate this innovation. They prove themselves every day and give their users the edge in a broad range of applications. This guarantees you unbeatable dynamic performances that give optimal slaving of customer equipment while complying with the latest standards in force. VS sensors are perfect for use in sectors such as railways, mining and control in hazardous environments. VS voltage sensors and CS current sensors together constitute an offer the railway industry cannot afford to ignore.



## Incomparable protection against magnetic fields

VS sensors are conceived, designed and renowned for their unrivalled immunity to ambient magnetic fields. Although they are in continuous proximity of powerful currents capable of distorting their measurements, this does not, in fact, occur. Their accuracy is rock-solid and once set to measure a particular voltage, that is what they measure – that and nothing else.

## Perfect efficiency in every environment

The VS range has been designed for applications in difficult environments such as on-board railway equipment (power converters, auxiliary converters for heating, ventilation and air conditioning) and the mining industry. Their robust design and excellent performances (e.g. operating range between  $-40^{\circ}$  and  $+85^{\circ}\text{C}$ ) make VS voltage sensors ideal for use in other very demanding applications (marine, wind-power, ozone generators, etc.)

## Going beyond ordinary standards

ABB have been ISO 9001 certified since 1993 and our sensors bear the CE label. This ongoing striving after quality has always been the hallmark of a company where excellence and safety are part of the culture, from design right through to production. This culture is the result of continuous research to make technical progress and meet our customers' demands.

**SAFETY** VS sensors meet the various safety standards in force such as EN 50124-1 for electrical insulation and NFF 16101-NFF 16102 for fire-smoke resistance.

**QUALITY** The chief selling-point of VS sensors is their quality. Compliance with EN 50121-X for electromagnetic disturbance and EN 50155 for their high-tech electronic design is proof of their ability to comply with the most detailed constraints as well as major demands. The fact that each individual sensor is subjected to rigorous testing such as sensor burn-in is proof of the importance ABB attribute to quality.

**ENVIRONMENT-FRIENDLY** ABB have long been concerned with the protection of the environment, as proved by the ISO 14001 certification they received in 1998. This environmental approach is particularly noticeable in production of the VS range in the reduction of the number of components, in the use of a low-energy manufacturing procedure and the use of recyclable packing. The products in use are also characterized by their reduced energy consumption.

## Unrivalled compactness



ABB have applied the notion "Small is beautiful" to its products. By integrating the notion of reduced size into their VS sensors, ABB have brought miniaturization to a point of perfection. This miniaturization gives great flexibility of installation. The great breakthrough with VS sensors is that they are 100% electronic. This makes it possible to put cutting-edge technology into the smallest possible space. Everything is integrated; in other words everything is inside to leave as much room as possible outside.

## Optimized electronic performance

The electrical performances of VS sensors are genuinely customized to a variety of demands and meet the severest constraints. VS sensors give the best accuracy and performance for money on the market. And their performances really come up to your expectations.

## Flexibility of use



All our products have been conceived and designed so that installation and use are as simple as possible. Flexibility of installation and operation obtained using a range of connector variants mean that VS sensors are very easy to use. In fact, high-tech sensors have never been as easy to use.



# ABB – BECAUSE YOUR NEEDS DESERVE EXACT SCIENCE

## Utilisation

Electronic sensors to measure d.c., a.c. or pulsating voltages with insulation between primary and secondary circuits..

## Technical data

			VS50B	VS125B	VS250B	VS500B
Nominal primary voltage		<b>V r.m.s.</b>	50	125	250	500
Measuring range	@ ±12V (±5%) / 1 min/h	<b>V peak</b>	±75	±187.5	±375	±750
Measuring range	@ ±24V (±5%) / 1 min/h	<b>V peak</b>	±75	±187.5	±375	±750
Not measurable overload	1 sec/hour	<b>V peak</b>	150	375	750	1500
Max. measuring resistance	@ U <sub>PMAX</sub> & ±12V (±5%)	<b>Ω</b>	67	67	67	67
Max. measuring resistance	@ U <sub>PMAX</sub> & ±24V (±5%)	<b>Ω</b>	188	188	188	188
Min. measuring resistance	@ U <sub>PN</sub> & ±24V (±5%)	<b>Ω</b>	0	0	0	0
Secondary current at U <sub>PN</sub>		<b>mA</b>	50	50	50	50
Accuracy at U <sub>PN</sub>	@ +25°C	<b>%</b>	≤±0.9	≤±0.9	≤±0.9	≤±0.9
Accuracy at U <sub>PN</sub>	-25 ... +70°C	<b>%</b>	≤±1.5	≤±1.5	≤±1.5	≤±1.5
Accuracy at U <sub>PN</sub>	-40 ... +85°C	<b>%</b>	≤±1.7	≤±1.7	≤±1.7	≤±1.7
Offset current	@ +25°C & ±24V (±5%)	<b>mA</b>	≤±0.15	≤±0.15	≤±0.15	≤±0.15
Linearity	0.1U <sub>PN</sub> ... 1.5U <sub>PN</sub>	<b>%</b>	≤0.3	≤0.3	≤0.3	≤0.3
Delay time		<b>µs</b>	≤10	≤10	≤10	≤10
dv/dt correctly followed		<b>V / µs</b>	≤0.6	≤1.5	≤3	≤6
Bandwidth	-3 dB & R <sub>M</sub> = 50 Ω	<b>kHz</b>	≤13	≤13	≤13	≤13
Max. no-load consumption current	@ ±24V (±5%)	<b>mA</b>	≤50	≤50	≤50	≤50
Dielectric strength Primary/(Secondary+Screen)	50 Hz, 1 min	<b>kV</b>	3.3	3.3	3.3	3.3
Dielectric strength Secondary/Screen	50 Hz, 1 min	<b>kV</b>	0.5	0.5	0.5	0.5
Partial discharges : extinction voltage	@10pC, 50Hz	<b>kV</b>	≥1.1	≥1.1	≥1.1	≥1.1
Supply voltage	±5%	<b>V d.c.</b>	±12 ... ±24	±12 ... ±24	±12 ... ±24	±12 ... ±24
Mass		<b>kg</b>	0.450	0.450	0.450	0.450
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90



## Max. common mode voltage

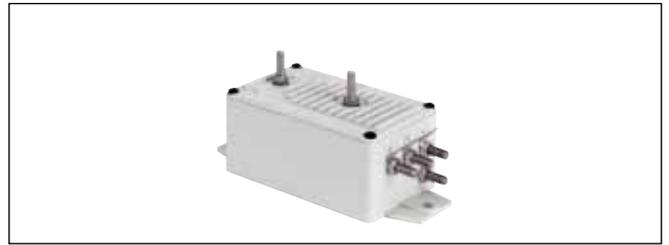
The following two conditions must be continuously and simultaneously respected:

- 1)  $U_{HT+} + U_{HT-} \leq 4.2 \text{ kV peak}$  and
- 2)  $|U_{HT+} - U_{HT-}| \leq U_{PMAX}$

## General data

- Coated electronic circuit.
- Plastic case and insulating resin are self-extinguishing.
- Direction of the current: A positive primary differential voltage ( $U_{HT+} - U_{HT-} > 0$ ) results in a positive secondary output current from terminal M.
- Protections:
  - of the measuring circuit against short-circuits.
  - of the measuring circuit against opening.
  - of the power supply against polarity reversal.
- Burn-in test in accordance with FPTC 404304 cycle.
- Tightening torque for M5 terminal studs (N.m): 2 N.m.

## VS750B to VS1500B



### Technical data

			VS750B	VS1000B	VS1500B
Nominal primary voltage		<b>V r.m.s.</b>	750	1000	1500
Measuring range	@ ±12V (±5%) / 1 min/h	<b>V peak</b>	±1125	±1500	±2250
Measuring range	@ ±24V (±5%) / 1 min/h	<b>V peak</b>	±1125	±1500	±2250
Not measurable overload	1 sec/hour	<b>V peak</b>	2250	3000	4500
Max. measuring resistance	@ U <sub>PMAX</sub> & ±12V (±5%)	<b>Ω</b>	67	67	67
Max. measuring resistance	@ U <sub>PMAX</sub> & ±24V (±5%)	<b>Ω</b>	188	188	188
Min. measuring resistance	@ U <sub>PN</sub> & ±24V (±5%)	<b>Ω</b>	0	0	0
Secondary current at U <sub>PN</sub>		<b>mA</b>	50	50	50
Accuracy at U <sub>PN</sub>	@ +25°C	<b>%</b>	≤±0.9	≤±0.9	≤±0.9
Accuracy at U <sub>PN</sub>	-25 ... +70°C	<b>%</b>	≤±1.5	≤±1.5	≤±1.5
Accuracy at U <sub>PN</sub>	-40 ... +85°C	<b>%</b>	≤±1.7	≤±1.7	≤±1.7
Offset current	@ +25°C & ±24V (±5%)	<b>mA</b>	≤±0.15	≤±0.15	≤±0.15
Linearity	0.1U <sub>PN</sub> ... 1.5U <sub>PN</sub>	<b>%</b>	≤0.3	≤0.3	≤0.3
Delay time		<b>μs</b>	≤10	≤10	≤10
dv/dt correctly followed		<b>V / μs</b>	≤9	≤12	≤18
Bandwidth	-3 dB & R <sub>M</sub> = 50 Ω	<b>kHz</b>	≤13	≤13	≤13
Max. no-load consumption current	@ ±24V (±5%)	<b>mA</b>	≤50	≤50	≤50
Dielectric strength Primary/(Secondary+Screen)	50 Hz, 1 min	<b>kV</b>	4.3	5.5	6.5
Dielectric strength Secondary/Screen	50 Hz, 1 min	<b>kV</b>	0.5	0.5	0.5
Partial discharges : extinction voltage	@10pC, 50Hz	<b>kV</b>	≥1.1	≥2.2	≥2.2
Supply voltage	±5%	<b>V d.c.</b>	±12 ... ±24	±12 ... ±24	±12 ... ±24
Mass		<b>kg</b>	0.450	0.450	0.450
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85
Storage temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90

### Primary connection

- 2 M5 studs

### Standard secondary connections

- 4 M5 studs and 3 Faston 6.35 x 0.8

### Options

- Primary connection: 2 separated High Voltage cables.
- Secondary connection: Shielded cable (2m), M5 inserts, Lemo connector.

For other options please contact us.

### Conformity

EN50155

EN50121-3-2

EN50124-1



## Utilisation

Electronic sensors to measure d.c., a.c. or pulsating voltages with insulation between primary and secondary circuits.

## Technical data

			VS2000B	VS3000B	VS4000B	VS4200B
Nominal primary voltage		<b>V r.m.s.</b>	2000	3000	4000	4200
Measuring range	@ ±12V (±5%) / 1 min/h	<b>V peak</b>	±3000	±4500	±6000	±6000
Measuring range	@ ±24V (±5%) / 1 min/h	<b>V peak</b>	±3000	±4500	±6000	±6000
Not measurable overload	1 sec/hour	<b>V peak</b>	6000	9000	12000	12000
Max. measuring resistance	@ U <sub>PMAX</sub> & ±12V (±5%)	Ω	61	61	61	61
Max. measuring resistance	@ U <sub>PMAX</sub> & ±24V (±5%)	Ω	183	183	183	183
Min. measuring resistance	@ U <sub>PN</sub> & ±24V (±5%)	Ω	0	0	0	0
Secondary current at U <sub>PN</sub>		<b>mA</b>	50	50	50	50
Accuracy at U <sub>PN</sub>	@ +25°C	%	≤±0.9	≤±0.9	≤±0.9	≤±0.9
Accuracy at U <sub>PN</sub>	-25 ... +70°C	%	≤±1.5	≤±1.5	≤±1.5	≤±1.5
Accuracy at U <sub>PN</sub>	-40 ... +85°C	%	≤±1.7	≤±1.7	≤±1.7	≤±1.7
Offset current	@ +25°C & ±24V (±5%)	<b>mA</b>	≤±0.15	≤±0.15	≤±0.15	≤±0.15
Linearity	0.1U <sub>PN</sub> ... 1.5U <sub>PN</sub>	%	≤0.3	≤0.3	≤0.3	≤0.3
Delay time		<b>µs</b>	≤10	≤10	≤10	≤10
dv/dt correctly followed		<b>V / µs</b>	≤24	≤36	≤48	≤50
Bandwidth	-3 dB & R <sub>M</sub> = 50 Ω	<b>kHz</b>	≤13	≤13	≤13	≤13
Max. no-load consumption current	@ ±24V (±5%)	<b>mA</b>	≤50	≤50	≤50	≤50
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV</b>	8	12	12	12
Partial discharges : extinction voltage	@10pC, 50Hz	<b>kV</b>	≥4.3	≥4.3	≥4.3	≥4.3
Supply voltage	±5%	<b>V d.c.</b>	±12 ... ±24	±12 ... ±24	±12 ... ±24	±12 ... ±24
Mass		<b>kg</b>	1.5	1.5	1.5	1.5
Operating temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	-40 ... +85
Storage temperature		<b>°C</b>	-50 ... +90	-50 ... +90	-50 ... +90	-50 ... +90



## Max. common mode voltage

The following two conditions must be continuously and simultaneously respected:

- 1)  $U_{HT+} + U_{HT-} \leq 10 \text{ kV peak}$   
and
- 2)  $|U_{HT+} - U_{HT-}| \leq U_{PMAX}$

## General data

- Coated electronic circuit.
- Plastic case and insulating resin are self-extinguishing.
- Direction of the current: A positive primary differential voltage ( $U_{HT+} - U_{HT-} > 0$ ) results in a positive secondary output current from terminal M.
- Protections :
  - of the measuring circuit against short-circuits.
  - of the measuring circuit against opening.
  - of the power supply against polarity reversal.
- Burn-in test in accordance with FPTC 404304 cycle.
- Tightening torque for M5 terminal studs (N.m): 2 N.m.

## Primary connection

- 2 M5 studs

## Standard secondary connection

- 3 M5 studs

## Options

- Primary connection: 2 separated High Voltage cables.
- Secondary connection: shielded cable (2 m), M5 inserts, Lemo connector.
- Nominal secondary current I<sub>SN</sub> :  
I<sub>SN</sub> (for U<sub>PN</sub>) = 20 mA or I<sub>SN</sub> (for U<sub>PN</sub>) = 80 mA.

For other options please contact us.

## Conformity

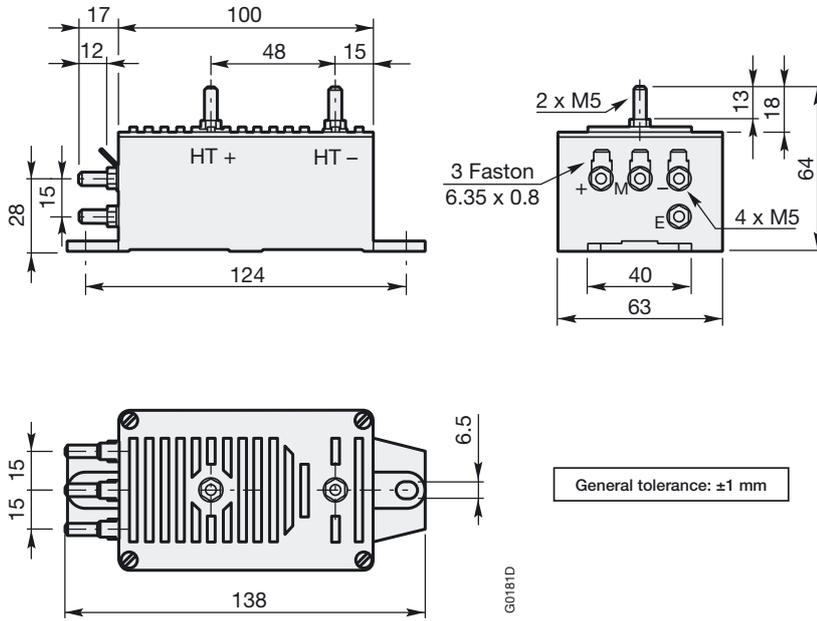
EN50155

EN50121-3-2

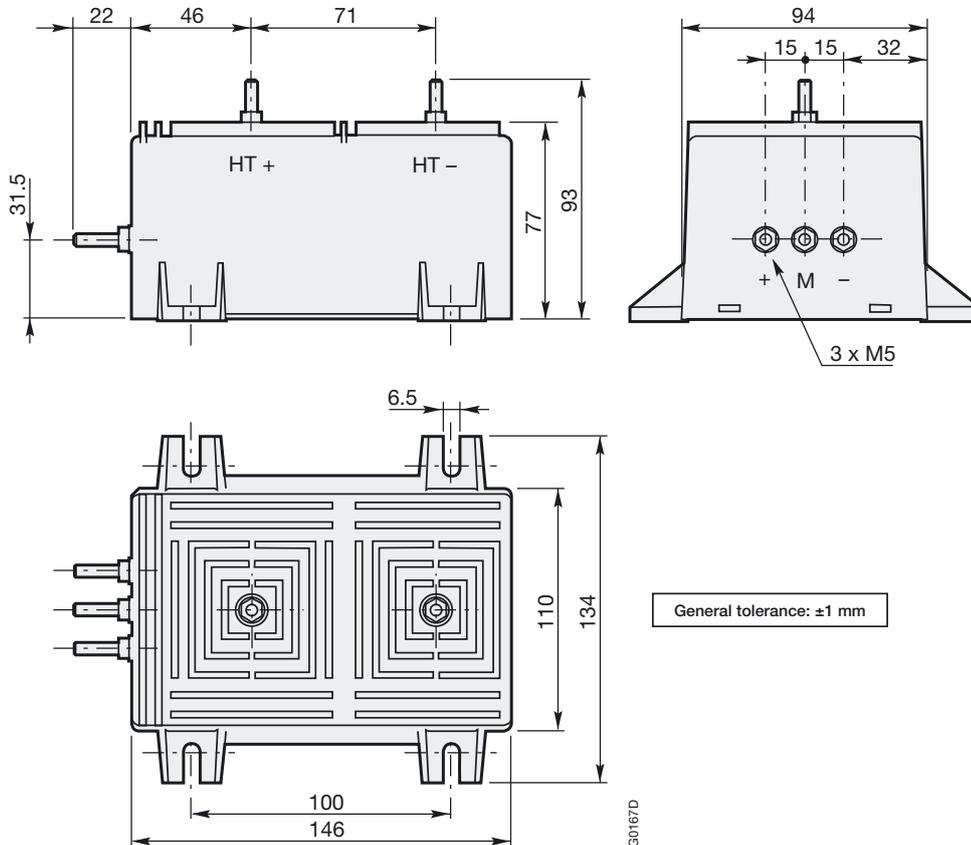
EN50124-1



## Dimensions (mm)



### Size 0 (VS50B to VS1500B)



### Size 1 (VS2000B to VS4200B)



# Calibrated EM010 traction voltage sensors

## Utilisation

Sensors to measure d.c. or a.c. voltages with a galvanic insulation between primary and secondary circuits. The input resistor  $R_E$  is included with calibrated EM010 sensors, the voltage to be measured  $U_P$  can be applied directly to the primary terminals marked «+HT» and «-HT» (see diagram below).

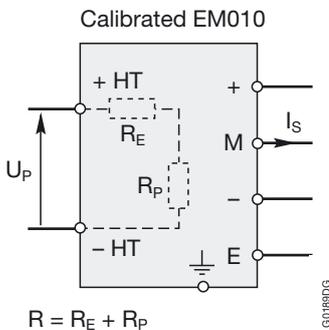
## EM010 from 600 to 1500 V



## Technical data

			EM010-9239	EM010-9240	EM010-9371	EM010-9317
Nominal primary voltage		<b>V r.m.s.</b>	600	750	1000	1500
Measuring range	50 s/h @ +70°C	<b>V peak</b>	±900	±1125	±1500	±2250
Min. measuring resistance	@ $U_{PN}$ & ±15V	$\Omega$	0	0	0	0
Primary turn number			10000	7500	15000	15000
Secondary turn number			2000	2000	2000	2000
Secondary current at $U_{PN}$		<b>mA</b>	50	50	50	50
Accuracy at $U_{PN}$	@ +25°C	<b>%</b>	≤±1	≤±1	≤±1	≤±1
Offset current	@ +25°C	<b>mA</b>	≤±0.3	≤±0.3	≤±0.3	≤±0.3
Linearity		<b>%</b>	≤±0.1	≤±0.1	≤±0.1	≤±0.1
Thermal drift coefficient	-25 ... +70°C	<b>µA/°C</b>	≤±5	≤±5	≤±5	≤±5
Delay time		<b>µs</b>	≤100	≤100	≤100	≤100
Max. no-load consumption current	@ ±24V	<b>mA</b>	≤25	≤25	≤25	≤25
Primary resistance	@ +25°C	<b>k Ω</b>	60	56	150	225
Secondary resistance	@ +70°C	<b>Ω</b>	60	60	60	60
Dielectric strength Primary/(Secondary+Screen+Ground)	50 Hz, 1 min	<b>kV</b>	6	6	12	12
Dielectric strength Secondary/(Screen+Ground)	50 Hz, 1 min	<b>kV</b>	1	1	1	1
Supply voltage	±10%	<b>V d.c.</b>	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24
Voltage drop		<b>V</b>	≤1.5	≤1.5	≤1.5	≤1.5
Mass		<b>kg</b>	0.650	0.650	0.650	0.650
Operating temperature		<b>°C</b>	-25 ... +70	-25 ... +70	-25 ... +70	-25 ... +70
Storage temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-40 ... +85	40 ... +85
Primary connections			2 x M5 studs			
Secondary connections			5 x M5 studs			

## Diagram



## General data

- Plastic case and insulating resin are self-extinguishing.
- Direction of the current: A positive primary differential voltage ( $U_{HT+} - U_{HT-} > 0$ ) results in a positive secondary output current from terminal M.
- The internal electrostatic screen between the primary and secondary is linked to the terminal «E».
- The heatsink for the integrated input resistance  $R_E$  is connected to the marked earth terminal  $\perp$  on the sensor.
- Protection of the power supply against polarity reversal.
- Burn-in test in accordance with FPTC 404304 cycle.
- Tightening torque for M5 terminal studs (N.m): 2.8 N.m.
- The primary resistance  $R$  is made up of the integrated input resistance  $R_E$  in series with the resistance  $R_P$  of the primary winding:  $R = R_E + R_P$



# Calibrated EM010 traction voltage sensors

## EM010 from 2000 to 5000 V



### Technical data

			EM010-9318	EM010-9319	EM010-9394	EM010-9354 <sup>1</sup>
Nominal primary voltage		<b>V r.m.s.</b>	2000	3000	4200	5000
Measuring range	50 s/h @ +70°C	<b>V peak</b>	±3000	±4500	±8000 (10s/2h)	±8000 (10s/2h)
Min. measuring resistance	@ U <sub>PN</sub> & ±15V	<b>Ω</b>	0	0	0	0
Primary turn number			20000	30000	30000	20000
Secondary turn number			2000	2000	1260	1000
Secondary current at U <sub>PN</sub>		<b>mA</b>	50	50	50	50
Accuracy at U <sub>PN</sub>	@ +25°C	<b>%</b>	≤±1	≤±1	≤±1	≤±1
Offset current	@ +25°C	<b>mA</b>	≤±0.3	≤±0.3	≤±0.3	≤±0.3
Linearity		<b>%</b>	≤±0.1	≤±0.1	≤±0.1	≤±0.1
Thermal drift coefficient	-25 ... +70°C	<b>μA/°C</b>	≤±5	≤±5	≤±5	≤±5
Delay time		<b>μs</b>	≤100	≤100	≤100	≤100
Max. no-load consumption current	@ ±24V	<b>mA</b>	≤25	≤25	≤25	≤25
Primary resistance	@ +25°C	<b>k Ω</b>	400	900	2000	2000
Secondary resistance	@ +70°C	<b>Ω</b>	60	60	60	60
Dielectric strength Primary/(Secondary+Screen+Ground)	50 Hz, 1 min	<b>kV</b>	12	12	12	12
Dielectric strength Secondary/(Screen+Ground)	50 Hz, 1 min	<b>kV</b>	1	1	1	1
Supply voltage	±10%	<b>V d.c.</b>	±15 ... ±24	±15 ... ±24	±15 ... ±24	±15 ... ±24
Voltage drop		<b>V</b>	≤1.5	≤1.5	≤1.5	≤1.5
Mass		<b>kg</b>	0.650	0.650	0.650	0.650
Operating temperature		<b>°C</b>	-40 ...+75	-40 ...+75	-25 ...+70	-25 ...+70
Storage temperature		<b>°C</b>	-40 ...+85	-40 ...+85	-45 ...+85	-40 ...+85
Primary connections			2 x M5 studs	2 x M5 studs	2 x M5 studs	2 x M5 studs
Secondary connections			5 x M5 studs	5 x M5 studs	5 x M5 studs	5 x M5 studs

<sup>1</sup> No burn-in test applied.

### Options

- Other connection types
- Other temperature operating ranges.

For other options please contact us.

### Conformity



## Utilisation

Sensors to measure d.c. or a.c. currents with a galvanic insulation between primary and secondary circuits.

**Warning:** The voltage  $U_p$  to be measured cannot be directly applied to the primary terminals marked «+» and «-» for not calibrated EM010 sensors.

In order to use these not calibrated EM010 sensors for voltage measurement, an input resistance  $R_E$  must be added to the primary (see diagram below).

The voltage rating is determined from the value of this resistance  $R_E$  (refer to calculation examples at the end of this catalogue).

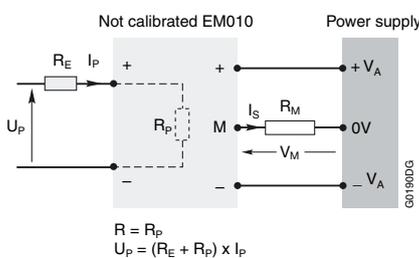
## Technical data

			EM010BBFHP1N	EM010BEFHP1N	EM010TENHP1N
Nominal primary current		<b>mA r.m.s.</b>	10	10	10
Measuring range	50 s/h @ +70°C	<b>mA Peak</b>	20	20	20
Overload	2 min/hour	<b>mA Peak</b>	20	20	20
Max. measuring resistance	@ $I_{PMAX}$ & $\pm 15V$	$\Omega$	60	60	60
Max. measuring resistance	@ $I_{PMAX}$ & $\pm 24V$	$\Omega$	160	160	160
Min. measuring resistance	@ $U_{PN}$ & $\pm 15V$	$\Omega$	0	0	0
Primary turn number			10000	10000	10000
Secondary turn number			2000	2000	2000
Secondary current at $I_{PN}$		<b>mA</b>	50	50	50
Accuracy at $I_{PN}$	@ +25°C	<b>%</b>	$\leq \pm 1$	$\leq \pm 1$	$\leq \pm 1$
Offset current	@ +25°C	<b>mA</b>	$\leq \pm 0.3$	$\leq \pm 0.3$	$\leq \pm 0.3$
Linearity		<b>%</b>	$\leq \pm 0.1$	$\leq \pm 0.1$	$\leq \pm 0.1$
Thermal drift coefficient	-25 ... +70°C	<b><math>\mu A / ^\circ C</math></b>	$\leq \pm 5$	$\leq \pm 5$	$\leq \pm 5$
Delay time		<b><math>\mu s</math></b>	$\leq 100$	$\leq 100$	$\leq 100$
Max. no-load consumption current	@ $\pm 24V$	<b>mA</b>	$\leq 25$	$\leq 25$	$\leq 25$
Primary resistance	@ +25°C	<b>k<math>\Omega</math></b>	1.5	1.5	1.5
Secondary resistance	@ +70°C	<b><math>\Omega</math></b>	60	60	60
Dielectric strength Primary/Secondary	50 Hz, 1 min	<b>kV</b>	6	6	6
Supply voltage	$\pm 10\%$	<b>V d.c.</b>	$\pm 15 \dots \pm 24$	$\pm 15 \dots \pm 24$	$\pm 15 \dots \pm 24$
Voltage drop		<b>V</b>	$\leq 1.5$	$\leq 1.5$	$\leq 1.5$
Mass		<b>kg</b>	0,350	0,350	0,350
Operating temperature		<b>°C</b>	-25 ... +70	-25 ... +70	0 ... +50
Storage temperature		<b>°C</b>	-40 ... +85	-40 ... +85	-25 ... +70
Primary connections			2 x M5 studs	2 x M5 studs	2 inserts M5
Secondary connections			3 x M5 studs	3 x 6,35 Faston	3 x 6,35 Faston

## EM010BBFHP1N / EM010TENHP1N



## Diagram



## General data

- Plastic case and insulating resin are self-extinguishing.
- Direction of the current: A primary current flowing from the primary terminal «+» to the primary terminal «-» results in a positive secondary output current from terminal M.

- The internal electrostatic screen between the primary and secondary is linked to the secondary terminal «-» (negative supply terminal).

- Protection of the power supply against polarity reversal.
- Tightening torque for M5 terminal studs (N.m): 2.8 N.m.
- The primary resistance  $R$  is made up of the primary winding resistance  $R_p$ :  $R = R_p$

## Options

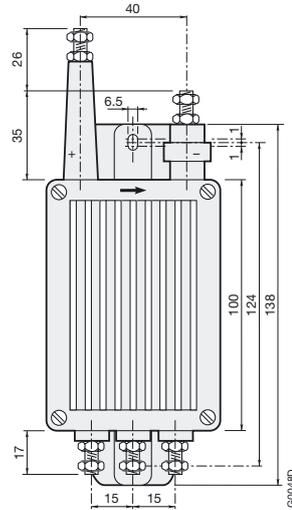
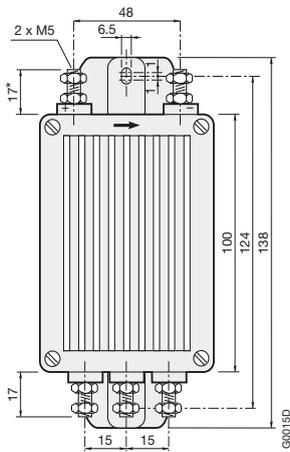
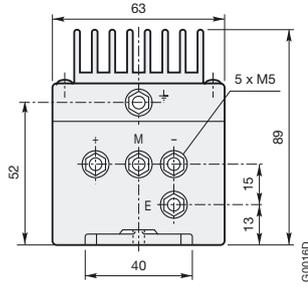
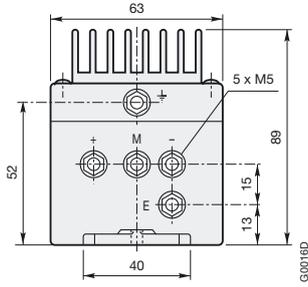
- Other connection types.
- Other temperature operating ranges.

For other options please contact us.

## Conformity



## Dimensions (mm)



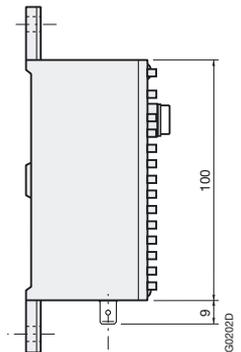
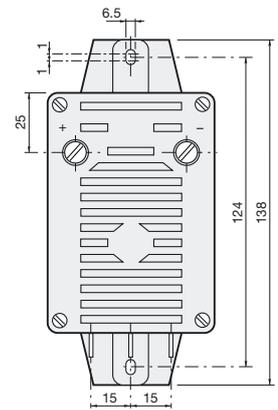
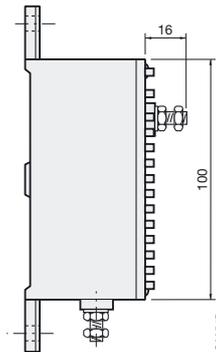
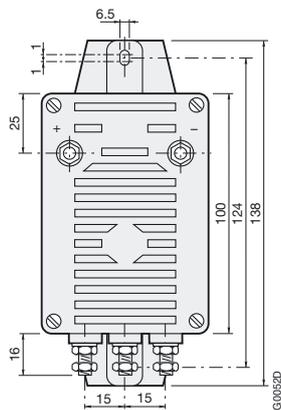
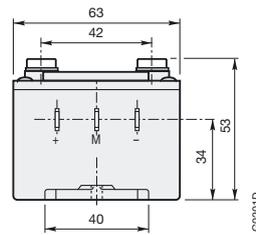
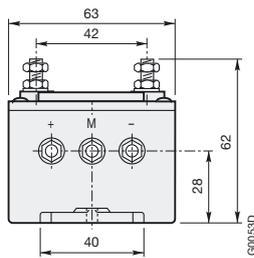
General tolerance: ±1 mm

### Calibrated EM010

600 V ≤ U<sub>N</sub> ≤ 2000 V  
 \* 35 mm for U<sub>N</sub> = 1500 and 2000 V

### Calibrated EM010

U<sub>N</sub> ≥ 3000 V



Not calibrated EM010BBFHP1N

General tolerance: ±1 mm

Not calibrated EM010TENHP1N

General tolerance: ±1 mm



# Traction Voltage Detectors VD Range



## Protection of maintenance personnel: an ABB innovation.

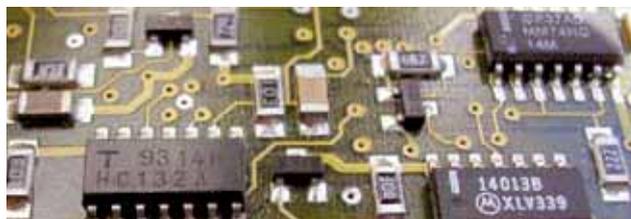
Faced with a current offering with insufficient reliability that doesn't meet the market standards, ABB has innovated with the VD Traction voltage detector. This 100% electronic product allows your maintenance operatives to detect the presence of a continuous, before carrying out operations on equipment. When the diode flashes, the voltage is greater than 50V and when it is extinguished, the voltage is below this limit. Provided with a double internal function and independent LEDs, the VD Traction voltage detector offers redundant safety and a lifetime of greater than 1 million hours. Guaranteed for 2 years, it allows reliable decisions to carry out operations to be made and warns personnel from dangerous high voltages.



## An answer adapted to market requirements

Guaranteeing optimum safety, the VD Traction voltage detector meets the requirements for difficult environments and is adaptable to the most demanding applications such as:

- rolling stock: main converters, auxiliary converters. Based on the SNCF CF60-100 specification, the whole French railway market imposes the presence of a voltage detector within built redundancy, to meet the drastic safety requirements of this sector.
- electronic power systems integrating capacitors banks: backups, wind generators, variable speed drives, electrolysis require voltage detectors of robust design and offer high reliability.



## A considered and measured integrated design

Thanks to a 100% electronic technology, ABB has reduced the size of the VD Traction voltage sensor to a minimum. The ultra-compact dimensions allow for simplified installation. Additionally, its self-sufficiency in energy means that it can work without an external power supply.



## Quality that goes beyond standards

The new product complies with the standard EN50155 (high technology electronic design and testing) and EMC EN50121-3-2 (electromagnetic compatibility: resistance to electromagnetic interference) and follows a very rigorous manufacturing process.

**QUALITY** Certified ISO 9001 and CE labeled, the VD Traction voltage detector complies with the most rigorous standards and requirements.

**SAFETY** The VD Traction voltage detector is the only product on the market that complies with rolling stock safety standards such as: EN50124-1 (electrical isolation), EN50163 (standardized voltage 1500 V d.c.).

## 100% electronic

At the forefront of technological innovation at ABB, the VD Traction voltage detector is 100% electronic. Other than the assurance of providing unbeatable performance, it has reduced dimensions: smaller and more compact, it offers greater installation flexibility.

Its 100% electronic technology also provides it with an excellent immunity to surrounding magnetic fields: a guarantee for accurate detection of a given voltage.

## Double reliability to avoid taking any risks

The VD Traction voltage detector is a voltage detection system with built in redundancy. It is equipped with two electronic circuits each connected to a light emitting diode (LED). These two parallel and independent systems guarantee a high level of safety and improve the reliability of the detector.

**ECOLOGY** Reduction of the number of components, low energy manufacturing processes, use of recyclable packing, reduced energy consumption... The VD Traction voltage detector complies with all the requirements of the ISO 14001 environmental standard, in place at ABB since 1998.



**BECAUSE YOUR SAFETY IS ESSENTIAL**



# VD traction voltage detectors

## Rolling stock and fixed installations

### Utilisation

Electronic detectors for direct voltages.  
This safety device signals the presence of dangerous voltages via the independent flashing of two LEDs (Light emitting diodes).  
A secondary supply voltage is not necessary.

### Technical data

Nominal voltage ( $U_N$ )		<b>V d.c.</b>
Maximum voltage permanent $U_{MAX1}$		<b>V d.c.</b>
Maximum voltage long duration $U_{MAX2}$	5 min	<b>V d.c.</b>
Maximum voltage overload $U_{MAX3}$	1 msec/h	<b>V d.c.</b>
Insulation voltage rating <sup>1</sup> ( $U_{NM}$ )	50 Hz, 10 sec	<b>kV</b>
Average current consumption (LED flashing)		<b>mA</b>
LED flashing frequency		<b>Hz</b>
Activating voltage $U_{ON}$		<b>V d.c.</b>
Activating voltage $U_{OFF}$		<b>V d.c.</b>
Mass		<b>Kg</b>
Operating temperature		<b>°C</b>
Operating and starting temperature		<b>°C</b>
Light Emitting Diode (LED) colour		
Light Emitting Diode (LED) angle of vision		

<sup>1</sup> Overload category: 3 (OV3), pollution degree: 2 (PD2)

### General data

- Plastic case and insulating resin are self-extinguishing.
- The casing temperature must not exceed 105°C.
- Fixing holes in the case moulding for horizontal mounting.
- Changing of the 2 LEDs is without tools.
- Product mounting according to the document: *VD1500 range Mounting Instructions* (ref. 1SBC140001M1702).
- Product Use and Maintenance instructions according to the document: *Use of the Voltage Detector - Preventive and Curative Maintenance VD1500 Range* (ref. 1SBD370058P0002).
- Tightening torque: 2Nm

### Safety

Only qualified and authorised personnel may carry out any operation on the detector; without voltage applied to the terminals of the voltage detector and with the equipment (power converter) electrically isolated.  
In order to maintain the high level of reliability, the 2 LEDs must always be replaced at the same time.

### Primary connection

- Insert M5x7 for terminals HT1+ and HT2+
- Insert M4x7 for terminals HT1- and HT2-

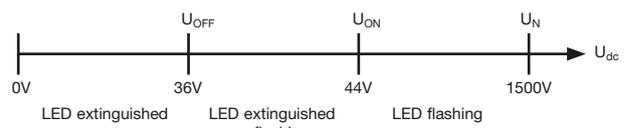
### VD1500



### VD1500-48

	<b>V d.c.</b>
	1500
	1800
	1950
	2300
	6.5
	≤1
	2
	> 44
	< 36
	≤0.5
	-25 ... +70
	-40 ... +85
	red
	≤15°

### General operation



$U_{OFF}$  : Low limit at which the LEDs extinguish when the equipment is electrically isolated.

$U_{ON}$  : High limit at which the LEDs illuminate (flashing frequency approximately 2 Hz) when the equipment power is switched on.

Between these two limits the LEDs maybe extinguished or flashing.

### Accessories

#### LED replacement kit

- ABB order code: 1SBT900000R2002 including 5 LEDs with plastic support.

#### Lens replacement kit (transparent cover)

- ABB order code: 1SBT900000R2001 including 10 lenses.

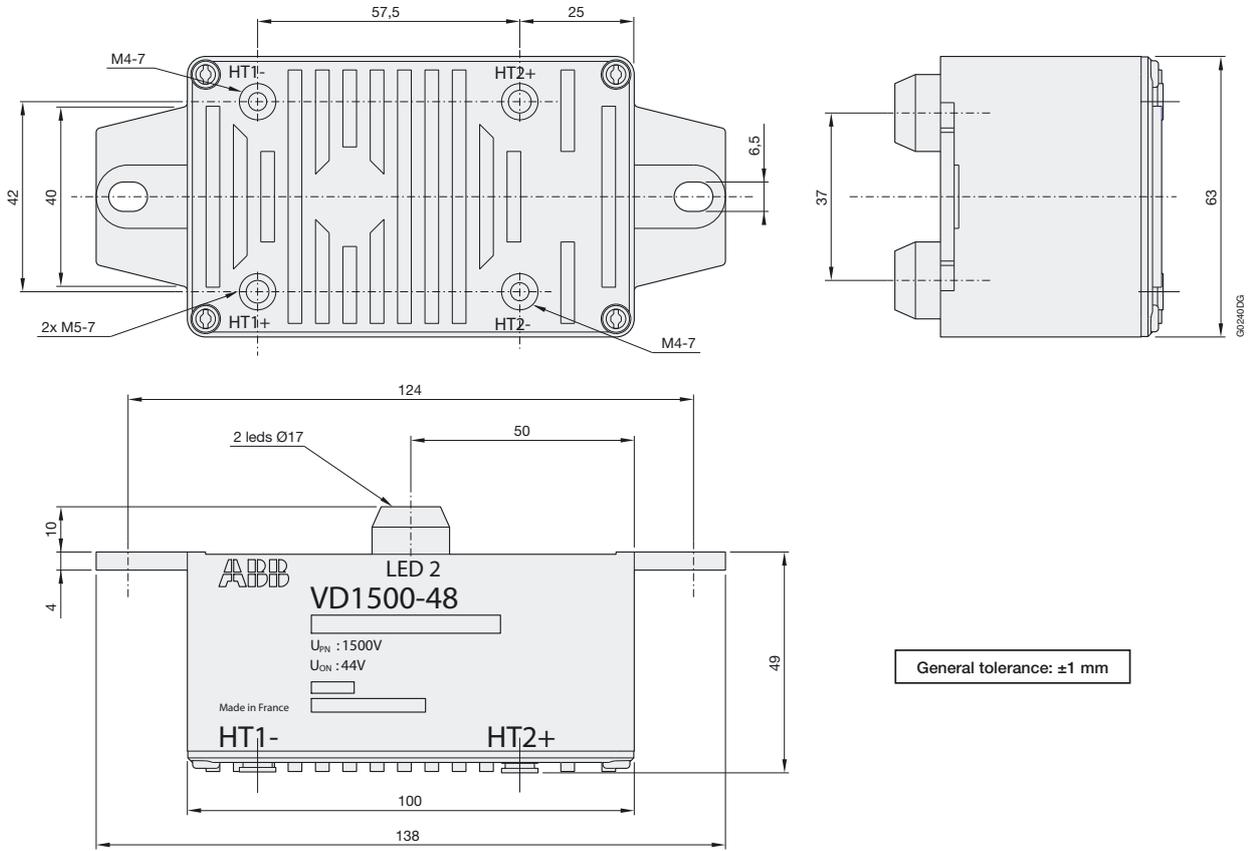
### Conformity

EN50155, EN50124-1, EN50121-3-2

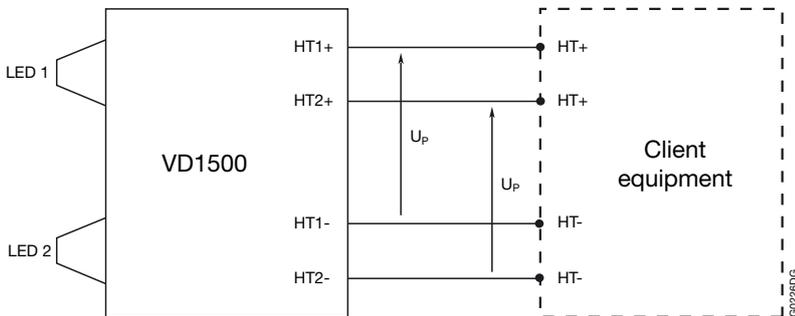
# VD traction voltage detectors

## Rolling stock and fixed installations

### Dimensions (mm)



### Wiring diagram



The two connections HT+ (client equipment side) must be made at different connection points.  
 The two connections HT - (client equipment side) must be made at different connection points.



## Other products



1SEIC7 7200 3F0301

EA101 to EA300



1SEIC7 7202 3F0301

EA1000



1SEIC7 7205 3F0301

NK...

### Traction current sensors

Technical data	EA101	EA200	EA300
Nominal primary current <b>A r.m.s.</b>	100	200	300
Turn number	1000	2000	2000
Supply voltage <b>V d.c.</b>	$\pm 12 \dots \pm 18$ ( $\pm 10\%$ )	$\pm 12 \dots \pm 18$ ( $\pm 10\%$ )	$\pm 12 \dots \pm 18$ ( $\pm 10\%$ )
Secondary connection	3 x 6.35 x 0.8 Faston	3 x 6.35 x 0.8 Faston	3 x 6.35 x 0.8 Faston
Operating temperature <b>°C</b>	-25...+70	-25...+70	-25...+70

Technical data	EA1000
Nominal primary current <b>A r.m.s.</b>	1000
Turn number	5000
Supply voltage <b>V d.c.</b>	$\pm 15 \dots \pm 24$ ( $\pm 10\%$ )
Secondary connection	3 x 6.35 x 0.8 Faston or 3 x M5 studs
Operating temperature <b>°C</b>	-25...+70

Technical data	NK400	NK500
Nominal primary current <b>A r.m.s.</b>	400	500
Turn number	4000	5000
Supply voltage <b>V d.c.</b>	$\pm 15 \dots \pm 28$	$\pm 15 \dots \pm 28$
Secondary connection	4 x 6.35 x 0.8 Faston or 4 x M4 studs	4 x 6.35 x 0.8 Faston or 4 x M4 studs
Operating temperature <b>°C</b>	-25...+70	-25...+70





# Closed loop Hall effect current sensors

## Instructions for mounting and wiring

### ES, ESM, MP, EL and CS sensors

## Introduction

These instructions are a non-exhaustive synthesis of the main recommendations for mounting closed loop Hall effect current sensors. Each application configuration is different, do not hesitate to contact us for advice adapted to your particular case. Please note that incorrect or non-judicious use of the sensor may lead to deterioration in the performance or operation of the sensor.

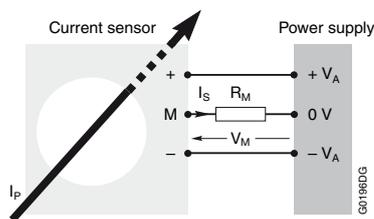
## 1 - Wiring diagram

- Direction of the current: A primary current  $I_P$  flowing in the direction of the arrow results in a positive secondary output current  $I_S$  from terminal M.
- Supply voltage: bipolar voltage  $-V_A \dots 0V \dots +V_A$

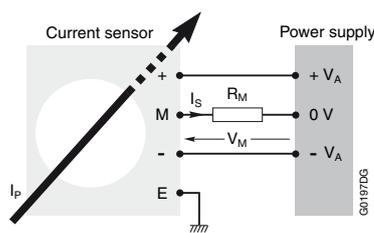
Closed loop Hall effect sensors can also operate with a unipolar supply voltage ( $-V_A \dots 0V$  or  $0V \dots +V_A$ ) under certain conditions.

Please contact your distributor for further details for this application.

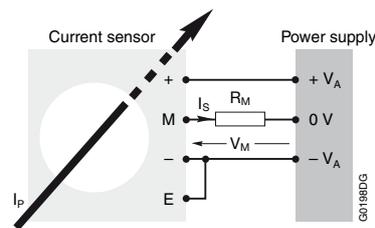
### 1.1 - Sensors without screen terminal



### 1.2 - Sensors with screen terminal



Recommended wiring



Alternative wiring

The screen terminal «E» can be connected to the secondary negative terminal (marked «-») on the sensor. However the best EMC performance is obtained by connecting the screen terminal «E» to ground by a copper braid strap as short as possible.

### 1.3 - Internal electrostatic screen

During very rapid variations in the primary conductor potential compared to the reference potential (high  $du/dt$ ), a capacitive coupling effect can be produced between the primary conductor and the secondary winding of the sensor. This coupling can lead to measurement errors. In order to eliminate this capacitive coupling, some current sensors have an internal copper electrostatic screen between the secondary winding and the hole for the primary conductor. This screen is linked internally either to an additional terminal marked «E», or to the sensor negative secondary terminal (marked «-»).

## 2 - Mechanical mounting

- All mounting positions are possible: horizontal, vertical, upside down etc.
- Recommended fixing: by screws and flat washers.
- Installation with a primary bar: in this case, the sensor must be mechanically fixed, either only by the bar, or only by the enclosure, but never by both at the same time (this type of fixing would lead to mechanical stresses that could lead to deterioration of the sensor casing).

## 3 - Precautions to be taken into account relative to the electromagnetic environment

Due to their operating principle (measure of magnetic field by the Hall effect probe), closed loop Hall effect current sensors can be sensitive to strong external magnetic fields. It is therefore strongly recommended to avoid positioning them too close to high current power cables. The use of a magnetic screen to protect the sensor may be advised for certain configurations with a strong magnetic influence.

The orientation of the sensor is also very important. Please contact your distributor for further information on this subject.

## 4 - Processing of the sensor's output signal

Standard codes of practice advise that, before the signal is processed, a low-pass filter adapted to the bandwidth of the sensor is used. Moreover, in the case of digital processing of the signal, it is also recommended that the sampling frequency is adapted to the bandwidth of both the signal to be measured and the sensor.

In the event of sensor failure, the processing of the output signal should take into account deterioration in performance (e.g. absence of signal or saturated signal) and rapidly and safely shut the system down.



# Open loop Hall effect current sensors

## Instructions for mounting and wiring

### HBO sensors

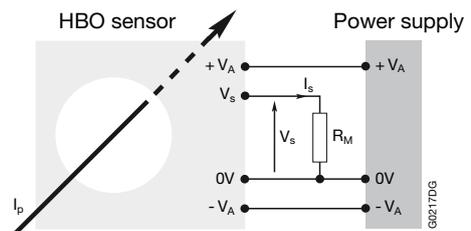
## Introduction

These instructions are a non-exhaustive synthesis of the main recommendations for mounting open loop Hall effect current sensors. Each application configuration is different, please do not hesitate to contact us for advice adapted to your particular case. Please note that incorrect or non-judicious use of the sensor may lead to deterioration in the performance or operation of the sensor.

## 1 - Wiring diagram

- Direction of the current: a primary current  $I_p$  flowing in the direction of the arrow results in a positive secondary output voltage from the terminal  $V_s$ .
- Supply voltage: bipolar voltage:  $-V_A \dots 0V \dots +V_A$

- Contrary to output current devices, HBO sensors do not need a load resistance but it is possible to use one if required.



## 2 - Mechanical mounting

- All mounting positions are possible: horizontal, vertical, upside down etc.
- Recommended fixing: by screws and flat washers.

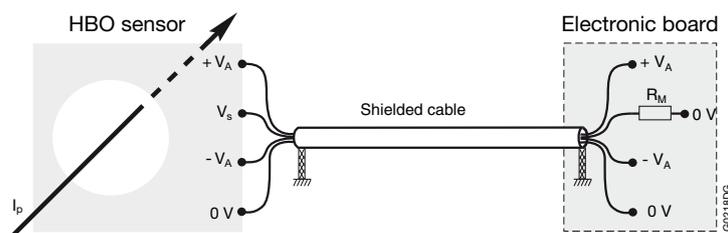
## 3 - Precautions to be taken into account relative to the electromagnetic environment

Due to their principle of operation (measure of magnetic field by the Hall effect probe), open loop Hall effect current sensors can be sensitive to strong external magnetic fields. It is therefore strongly recommended to avoid positioning them too close to high current power conductors. The sensor cables (shielded cable recommended) connecting to the equipment should be as short as possible.

These sensors emit almost no electromagnetic radiation but can be sensitive to the effects of external radiation. The sensor is not itself sensitive but the induced voltages, when long cables are used to link the sensor to the connector, can cause interference to the sensor.

In many applications the sensors are mounted in metal housings and have short cable lengths. In these applications, no special precautions are normally required.

In applications that require the sensor is used with long exposed cable lengths, shielded cable must be used, with both ends of the shielding connected to ground (see figure below).



## 4 - Processing of the sensor's output signal

Standard codes of practice advise that, before the signal is processed, a low-pass filter adapted to the bandwidth of the sensor is used. Moreover, in the case of digital processing of the signal, it is also recommended that the sampling frequency is adapted to the bandwidth of both the signal to be measured and the sensor.

In the event of sensor failure, the processing of the output signal should take into account this deterioration in performance (e.g. absence of signal or saturated signal) and rapidly and safely shut the system down.



# Electronic current sensors

## Instructions for mounting and wiring

### NCS Sensors

## Introduction

These instructions are a non-exhaustive synthesis of the main recommendations for mounting electronic current sensors. Each application configuration is different, please do not hesitate to contact us for advice adapted to your particular case. Please note that incorrect or non-judicious use of the sensor may lead to deterioration in the performance or operation of the sensor.

## 1 - Wiring diagram

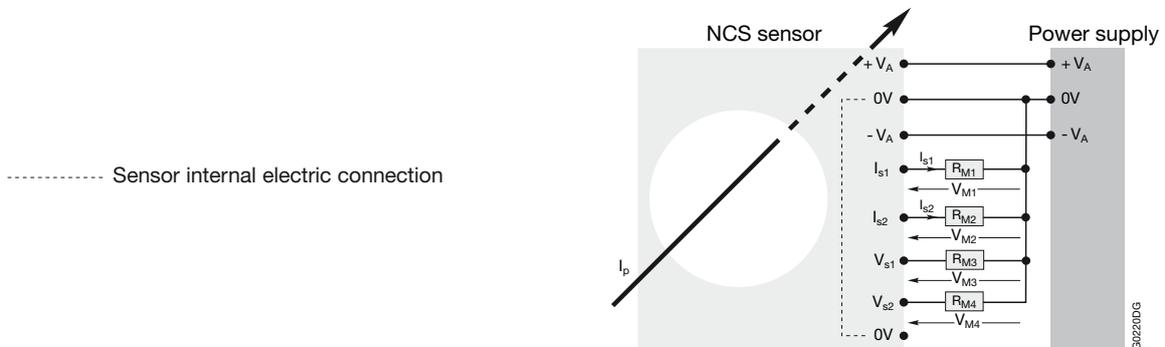
### ● Direction of the current:

- **Output current ( $I_{S1}$  and  $I_{S2}$ ):** A primary current flowing in the direction of the arrow results in a positive secondary output current on the terminals  $I_{S1}$  and  $I_{S2}$ .
- **Output voltage ( $V_{S1}$  and  $V_{S2}$ ):** A primary current flowing in the direction of the arrow results in a positive secondary output voltage on the terminals  $V_{S1}$  and  $V_{S2}$ .

- Supply voltage: bipolaire voltage  $-V_A \dots 0V \dots +V_A$  ( $0 \dots +V_A$  for the NCS305).

It is possible to design electronic current sensors, upon request, that can operate with a unipolar supply voltage ( $-V_A \dots 0V$  ou  $0V \dots +V_A$ ).

### 1.1 Sensors with connector output (current and voltage outputs)



### 1.2 Sensors with cable output (current outputs)

NCS sensors have two current outputs as standard:

- $I_{S1}$  that supplies  $\pm 20\text{mA}$  (peak) at  $\pm I_{PN}$  (peak)
- $I_{S2}$  that supplies  $\pm 20\text{mA}$  (peak) at  $\pm I_{P\text{MAX}}$  (peak)

Two measured gains are thus available.

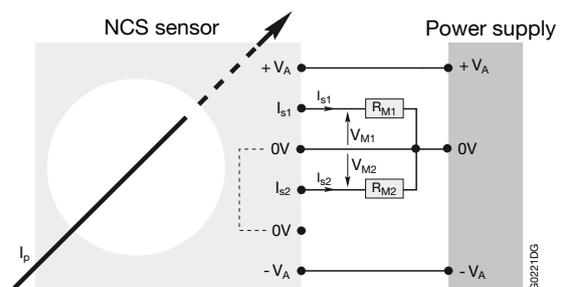
In the case of a current output,  $R_M$  is determined in the following manner:

$$R_M = V_M / I_S \quad \text{where } V_M = \text{to be obtained at the terminals of } R_M$$

$$I_S = I_{S1} \text{ or } I_{S2} \text{ (current output)}$$

Limitation:  $0\Omega < R_M < 350\Omega$  for  $I_S$  max (peak) of  $\pm 20\text{mA}$

The secondary cable passes through the white plastic enclosure (included) containing a ferrite core (NCS125 & NCS165), to reduce the interference that could affect the correct functioning of the sensor.



### 1.3 Sensors with cable output (voltage outputs)

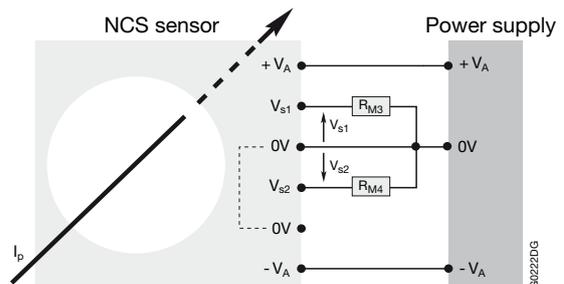
The sensors have two voltage outputs as standard:

- $V_{S1}$  that supplies  $\pm 10V$  (peak) at  $\pm I_{PN}$  (peak)
- $V_{S2}$  that supplies  $\pm 10V$  (peak) at  $\pm I_{P\text{MAX}}$  (peak)

Two measured gains are thus available.

In the case of a voltage output,  $R_M$  is either greater than or equal to  $10\text{k}\Omega$ .

The secondary cable passes through the white plastic enclosure (included) containing a ferrite core (NCS125 & NCS165), to reduce the interference that could affect the correct functioning of the sensor.





# Electronic current sensors

## Instructions for mounting and wiring

### NCS Sensors

## 2 - Mechanical mounting

- All mounting positions are possible: horizontal, vertical, upside down etc.
- Recommended fixing: by screws and flat washers. Oblong fixing holes in the enclosure moulding provide a large amount of mounting flexibility and allow for fully symmetrical positioning.
- Fixing by the use of side plate kits:
  - Fixing on one (or several) cable on one (or several) primary bar: in this case, the sensor should only be fixed to the primary conductor mechanically by the side plate kit. The sensor must not be mechanically fixed to the primary conductor by the enclosure and the side plate kit at the same time (this type of mounting would lead to mechanical stresses that may deteriorate the enclosure).
  - Fixing on a chassis or partition: in this case, the side plate kit offers a large amount of mounting flexibility.

See the particular mounting instructions.

### Recommendations for the passage of the primary conductor

- The primary conductor may be one (or several) cable or one (or several) bar.
- In order to obtain the best measuring performance, the primary conductor must be:
  - Centred as much as possible in the opening in the sensor
  - The biggest possible with respect to the opening in the sensor
  - Fixed at an angle close to 90° with respect to a plane formed by the sensor
  - As straight as possible at the sensor in order to minimise local increases in the magnetic field caused by bends in the primary conductor. These local increases may create a saturation of one of the sensor probes and induce measurement errors.

For further information, please refer to the «Dimensions» section of the NCS range in this catalogue (pages 26...36 or pages 64...71) or to the mounting instructions ref. **1SBC146000M1702** (NCS125 & NCS165) or ref. **1SBC146010M1701** (NCS305).



# Electronic current sensors

## Instructions for mounting and wiring

### NCS sensors

### 3 - Precautions to be taken into account relative to the electromagnetic environment

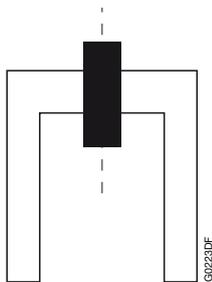
Due to the continuous reduction in equipment volume and the increase in their power, internal system components are subject to strong electromagnetic interference. NCS sensors, based on the measure of currents by magnetic fields, (see operating instructions **1SBD370024R1000**) must not be interfered by surrounding magnetic fields. They have therefore been designed in order to allow accurate measurement without interference. Different tests carried out on NCS sensors show the rejection of the sensors to this external magnetic interference in relation to the configuration of the predefined bar arrangement.

During type testing, the sensors were subject to 3 types of tests:

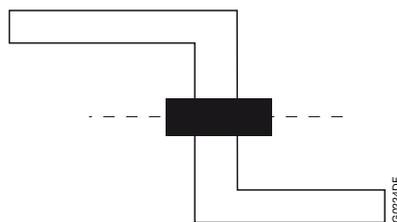
- magnetic field circuits: measure the influence of the magnetic fields generated by the primary conductor on the sensor
- interference by an external set of bars: measure the influence of the magnetic fields generated by the other conductors different from the primary conductor on the sensor
- coupling of primary bars: measure the influence of the mechanical mounting of the sensor on a primary conductor

During the different tests and in each configuration, the measured results (accuracy) are recorded whilst varying the following elements:

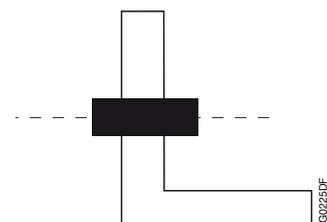
- distance between the sensor and the interfering current
- rotation of the interfering current around the sensor
- the magnitude of the interfering current
- the current form (DC or AC)
- inclination of the sensor on the primary conductor
- centricity of the sensor on the primary bar
- different primary bar configurations (rectangular simple or double, round and arrangements in «U», «S» or «L» configurations)



Primary bar in «U»



Primary bar in «S»



Primary bar in «L»

The tests were carried out with the primary bars in «U» configuration, the most restricting condition.

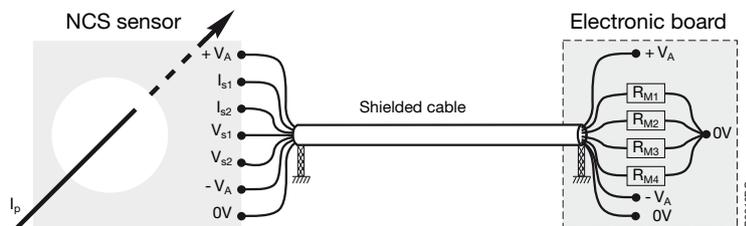
See mounting instructions ref. **1SBC146000M1702** (NCS125 & NCS165) or ref. **1SBC146010M1701** (NCS305) for further information.

#### 3.1 Mounting for improved EMC performance (shielding)

In applications that require the sensor to be used with long cables exposed to interference, it is imperative that shielded cables are used, with the shielding connected to ground at both ends (see figure below).

Standard NCS sensors with cable outputs are supplied in white plastic enclosures containing a ferrite core (NCS125 & NCS165). The secondary cable passes through this white plastic enclosure to reduce the interference caused that could affect the correct functioning of the sensor.

Please contact your distributor for further information on this subject.



### 4 - Processing of the sensor's output signal

Standard codes of practice advise that, before the signal is processed, a low-pass filter adapted to the bandwidth of the sensor is used.

Moreover, in the case of digital processing of the signal, it is also recommended that the sampling frequency is adapted to the bandwidth of both the signal to be measured and the sensor.

In the event of sensor failure, the processing of the output signal should take into account this deterioration in performance (e.g. absence of signal or saturated signal) and rapidly and safely shut the system down.



# Closed loop Hall effect voltage sensors

## Instructions for mounting and wiring

### EM010 sensors

## Introduction

These instructions are a non-exhaustive synthesis of the main recommendations for mounting EM010 voltage sensors. Each application configuration is different, do not hesitate to contact us for advice adapted to your particular case.

Please note that incorrect or non-judicious use of sensors may lead to deterioration in the performance or operation of the sensor.

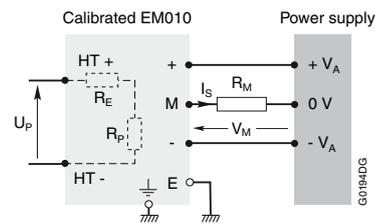
## 1 - Wiring diagram

- Supply voltage: bipolar voltage  $-V_A \dots 0V \dots +V_A$   
EM010 sensors can also operate with a unipolar supply voltage ( $-V_A \dots 0V$  or  $0V \dots +V_A$ ) under certain conditions.  
Please contact your distributor for further details for this application.

### 1.1 - Calibrated EM010 voltage sensors

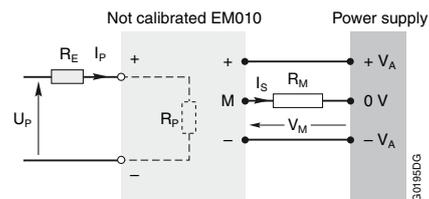
- Direction of the current: A positive primary differential voltage ( $U_P = U_{HT+} - U_{HT-} > 0$ ) results in a positive secondary output current  $I_S$  from terminal M.

The best EMC performance is obtained by connecting the screen terminal «E» to earth by a copper braid strap as short as possible. If the electromagnetic interference is weak the screen terminal «E» can be connected to the sensor negative secondary terminal (marked «-»).



### 1.2 - Not calibrated EM010 voltage sensors

- Direction of the current: A primary current flowing from the primary terminal «+» to the primary terminal «-» results in a positive secondary output current  $I_S$  from terminal M.



## 2 - Mechanical mounting

- Calibrated sensor: Heatsink on the top or on the side, with fins in vertical position.
- Not calibrated sensor: All mounting positions are possible: horizontal, vertical, upside down, on edge.
- Recommended fixing: 2 M6 screws with flat washers.

## 3 - Precautions to be taken into account relative to the electromagnetic environment

- Best performance is obtained in an environment with low electromagnetic interference.
- Electromagnetic interference is generated by the switching of strong currents (e.g.: switch relay), high voltage switchgear (e.g.: semi-conductor choppers), high intensity radio environment (e.g.: radio communication equipment).
- With the aim of minimising the effects of strong electromagnetic interference, please refer to standard rules (current working practice) and especially the following:
  - It is recommended that the sensor be fixed by its enclosure to a conducting plate that is connected to a stable potential (e.g.: earth ground plate).
  - It is recommended that the secondary be connected with a shielded cable (with the shielding connected to both cable ends and with a minimum length of wire as possible extending beyond the shielding).
  - It is recommended that the screen terminal « E » be connected to earth with a copper braid strap as short as possible (length not to exceed five times its width).
- It is recommended that the primary and secondary cables are separated.
- It is recommended that the two primary cables are fixed together (e.g. with cable clamps).
- It is strongly recommended that the primary and secondary cables connected to the sensors, are fixed to the earth ground plates or metal frame in order to minimise the interference induced in these cables.

## 4 - Processing of the sensor's output signal

Standard codes of practice advise that, before the signal is processed, a low-pass filter adapted to the bandwidth of the sensor is used. Moreover, in the case of digital processing of the signal, it is also recommended that the sampling frequency is adapted to the bandwidth of both the signal to be measured and the sensor.

In the event of sensor failure, the processing of the output signal should take into account deterioration in performance (e.g. absence of signal or saturated signal) and rapidly and safely shut the system down.



# Electronic voltage sensors

## Instructions for mounting and wiring

### VS sensors

## Introduction

These instructions are a non-exhaustive synthesis of the main recommendations for mounting VS voltage sensors. Each application configuration is different, do not hesitate to contact us for advice adapted to your particular case.

Please note that incorrect or non-judicious use of sensors may lead to deterioration in the performance or operation of the sensor.

## 1 - Wiring diagram

- Direction of the current: A positive primary differential voltage ( $U_P = U_{HT+} - U_{HT-} > 0$ ) results in a positive secondary output current  $I_S$  from terminal M.
- Supply voltage: bipolar voltage  $-V_A \dots 0V \dots +V_A$

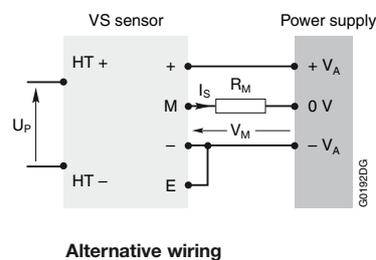
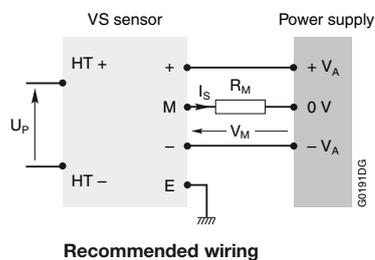
VS sensors can also operate with a unipolar supply voltage ( $-V_A \dots 0V$  ou  $0V \dots +V_A$ ) under certain conditions.

Please contact your distributor for further details for this application.

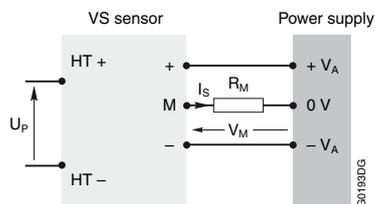
### 1.1 - VS voltage sensors with screen

The best EMC performance is obtained by connecting the screen terminal «E» to earth by a copper braid strap as short as possible.

If the electromagnetic interference is weak the screen terminal «E» can be connected to the sensor negative secondary terminal (marked «-»).



### 1.2 - VS voltage sensors without screen



## 2 - Mechanical mounting

All mounting positions are possible: horizontal, vertical, upside down, on edge.

Minimum distance between 2 sensors: 1 cm.

Recommended fixing: 2 M6 screws with flat washers.



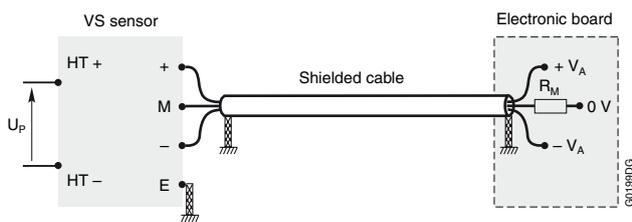
# Electronic voltage sensors

## Instructions for mounting and wiring

### VS sensors

### 3 - Precautions to be taken into account, relative to the electromagnetic environment

- Best performance is obtained in an environment with low electromagnetic interference.
- Electromagnetic interference is generated by the switching of strong currents (e.g.: switch relay), high voltage switchgear (e.g.: semi-conductor choppers), high intensity radio environment (e.g.: radio communication equipment).
- With the aim of minimising the effects of strong electromagnetic interference, please refer to standard rules (current working practice) and especially the following:
  - It is recommended that the sensor be fixed by its enclosure to a conducting plate that is connected to a stable potential (e.g.: earth ground plate).
  - It is recommended that the secondary be connected with a shielded cable (with the shielding connected to both cable ends and with a minimum length of wire as possible extending beyond the shielding).



- It is recommended that the screen terminal «E» be connected to earth with a copper braid strap as short as possible (length not to exceed five times its width).
- It is recommended that the primary and secondary cables are separated.
- It is recommended that the two primary cables are fixed together (e.g. with cable clamps).
- It is strongly recommended that the primary and secondary cables connected to the sensors, are fixed to the earth ground plates or metal frame in order to minimise the interference induced in these cables.

### 4 - Processing of the sensor's output signal

Standard codes of practice advise that, before the signal is processed, a low-pass filter adapted to the bandwidth of the sensor is used. Moreover, in the case of digital processing of the signal, it is also recommended that the sampling frequency is adapted to the bandwidth of both the signal to be measured and the sensor.

In the event of sensor failure, the processing of the output signal should take into account deterioration in performance (e.g. absence of signal or saturated signal) and rapidly and safely shut the system down.

Warning: The VS voltage sensor incorporates a switched mode power supply with a chopping frequency set at around 50kHz.



# Electronic voltage detectors

## Instructions for mounting and wiring

### VD detectors

## Introduction

These instructions are a non-exhaustive synthesis of the main recommendations for mounting VD voltage detectors. Each application configuration is different, please do not hesitate to contact us for advice adapted to your particular case. Please note that incorrect or non-judicious use of the sensor may lead to deterioration in the performance or operation of the sensor.

## 1 - Wiring diagram

The VD voltage detector is a safety product, consequently the wiring is an important point to take into account.

The following points must be respected:

- The VD voltage detector connection wires must be dedicated to High Voltage only,
- The screws used must respect the following specification:
  - M5x7 insert for terminals HT1+ and HT2+ : screw M5 with flat washer. Tightening torque: 2Nm.
  - M4x7 insert for terminals HT1- and HT2- : screw M4 with flat washer. Tightening torque: 1.5Nm.

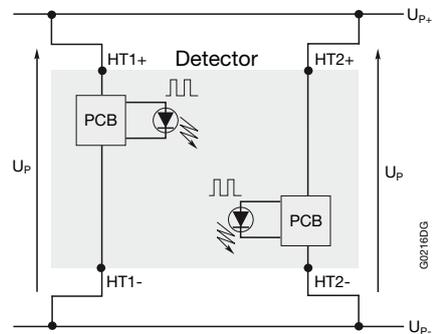
It is also recommended that the LED (Light Emitting Diode) lenses are only removed during maintenance operations by qualified personnel.

### 1.1 Redundancy function

In order to ensure that the detector works correctly and permanently (safety product), it includes two times the same function as explained opposite.

In order to operate accordingly, the VD detector must be connected using the 4 primary terminals:

- The first LED operates when the terminals HT1+ and HT1- are connected,
- The second LED operates when the terminals HT2+ and HT2- are connected.



### 1.2 High voltage connection

Before connecting the high voltage cable to the VD voltage detector, the operator must make sure that the identification of the terminals is clearly marked without the possibility of confusion.

The correct identification of the High Voltage terminals is shown opposite:

The detector operates correctly when the polarity of the terminals is respected as follows:

- The positive High Voltage is connected to HT1+ and HT2+ with 2 different cables coming from the 2 different connection points,
- The negative High Voltage is connected to HT1- and HT2- with 2 different cables coming from the 2 different connection points.



## 2 - Mechanical mounting

### 2.1 Fixing by the enclosure

From the safety point of view, it is very important that the VD voltage detector is fixed in the best mechanical conditions possible:

- The detector may be mounted in all positions (horizontal, vertical, upside down, on edge) but the two M6 screws must be checked that they are correctly tightened on the detector with a system to prevent nuts becoming loose.
- The use of flat washers under the nuts is generally recommended
- The surface where the detector is mounted, is sufficiently flat
- The location where the detector is mounted is not subject to high vibration levels
- The maintenance personnel have easy and quick access to the device
- The 2 LEDs are easily visible to the appropriate persons

### 2.2 Environment around the LEDs

Since preventive and curative maintenance is required for the VD voltage detector, it is important to leave sufficient space around the LED lenses in order to be able to unscrew them.

The recommended visual inspection distance for checking the LEDs should not exceed 2 metres between the operators eyes and the LED. The ambient light should not exceed 1000 lux. This distance may be increased if the voltage detector is placed in a location where the daylight has a small influence on the visual indication of the LED.

For normal and regular checking of the LEDs, the operators eyes should be within an angle of  $\pm 15^\circ$  from the LEDs axis. For further information, please do not hesitate to contact your distributor or refer to the document VD1500 range *Mounting Instructions* (ref. 1SBC140001M1702).



# Electronic voltage detectors

## Instructions for mounting and wiring

### VD detectors

### 3 - 1st switching on of the detector

After applying high voltage to the primary terminals of the VD voltage detector, pay attention to the following points:

- do not touch the HT terminals (high voltage) of the VD voltage detector
- do not try to remove the lenses of the LEDs

#### 3.1 Checking correct functioning

The VD voltage detector LEDs should flash about every 0.5 seconds as soon as the dangerous voltage  $U_{ON}$  is passed. The LEDs should remain extinguished below  $U_{OFF}$  (see the detailed characteristics of the VD1500 voltage detector). In the event that LEDs do not work when high voltage is applied:

- electrically isolate the system
- make sure that no residual voltage is present in the VD voltage detector (voltmeter or other means)
- check that the VD voltage detector wiring is correct (this may explain why the LEDs do not work)

If no faults are found in the installation, carry out a complete replacement of the voltage detector.

Please contact your distributor for further information on this subject or refer to the document *Voltage Detector usage - Preventive and Curative Maintenance* VD1500 Range (ref. 1SBD370058P0002).

### 4 - Preventive and curative maintenance of the detector

#### 4.1 Preventive maintenance

- Checking the correct operation of the LEDs

Please refer to the checklist in the annexe of the document *Voltage Detector usage - Preventive and Curative Maintenance* VD1500 Range (ref. 1SBD370058P0002) for the weekly preventive maintenance operations to be carried out in order to guarantee the correct operation of the VD voltage detector.

- Replacement of the LEDs

The VD voltage detector requires replacement of the LEDs, which increases the life of the sensor. This replacement also implies basic checks in order to assure, from the safety point of view, that VD voltage detector operates in good conditions.

**LED replacement kit:** kit including 5 LEDs mounted on plastic supports (ABB order code: 1SBT900000R2002).

##### o Periodicity of preventive actions

The maintenance operation must respect the main recommendations as follows:

Operator: maintenance personnel

Frequency: every 3 years

Checklist: annexe of the document *Voltage Detector usage - Preventive and Curative Maintenance* VD1500 Range (ref. 1SBD370058P0002)

Main actions: change the 2 LEDs.

##### o Updating of documentation

The documentation associated with preventive maintenance must be up to date at every inspection operation.

#### 4.2 Curative maintenance

During regular LEDs inspection or preventive maintenance visits, detector faults may be recorded. In such cases, the replacement of the defective part is imperative.

- Definition of the kits

2 repair kits are available for VD voltage detectors:

**LEDs replacement kit:** ABB order code: 1SBT900000R2002 including 5 LEDs mounted on plastic supports

**Lenses replacement kit:** ABB order code 1SBT900000R2001 including 10 transparent plastic lenses.

- Replacement of parts and checking

The maintenance operation must respect the main recommendations as follows:

##### o Curative maintenance :

Operator: maintenance personnel

Frequency: immediately after the detection of the fault

Checklist: annexe of the document *Voltage Detector usage - Preventive and Curative Maintenance* VD1500 Range (ref. 1SBD370058P0002)

Main actions: change the 2 LEDs or the 2 lenses or the detector.

##### o Updating of documentation

The documentation associated with preventive maintenance must be up to date at every inspection operation.

**In all cases, the maintenance operation must be carried out with maximum precaution for the safety of personnel and the system where the detector is mounted must be checked that there is no voltage present.**

- Complete replacement of a detector

In the case of complete replacement of a detector, follow the instructions in the documentation VD1500 range *Mounting Instructions* (ref. 1SBC140001M1702).

##### o Updating of documentation

The documentation associated with preventive maintenance must be up to date at every inspection operation.



LED on plastic support



# Questionnaire

## Current and voltage sensor selection guide

### General

The following questionnaires are used to select sensors according to the client's requirements.

The characteristics shown in the catalogue are given with respect to a defined environment (worst case conditions).

The technical requirements will not always reach these extreme limits, and it is possible, following confirmation by us, to propose higher maximum electrical or thermal values to those published, thanks to a knowledge and detailed analysis of the sensor operating environment.

A technical relationship between the client and ABB will allow the proposal of the best selection of sensors, equally from the viewpoint of performance and economy.

Two principal areas are considered in the selection of a sensor:

- the electrical aspect
- the thermal aspect

The sensor performance is based on a combination of electrical and thermal conditions; any values other than those indicated in this catalogue cannot be guaranteed unless validated by us.

The information below is only valid for sensors using closed loop Hall effect technology.

Contact your local supplier for other technologies.

### Electrical characteristics

The electrical characteristics values mentioned in this catalogue are given for a particular sensor operating point. These values may vary, according to the specific technical requirement, in the following way:

- The primary thermal current (voltage) ( $I_{PN}$  or  $U_{PN}$ ) may be increased if:
  - the maximum operating temperature is lower than the value shown in the technical data sheet
  - the sensor supply voltage ( $V_A$ ) is reduced
  - the load resistance value ( $R_M$ ) is increased
- The maximum current (voltage) measurable by the sensor may be increased if:
  - the maximum operating temperature is lower than the value shown in the technical data sheet
  - the sensor supply voltage ( $V_A$ ) is increased
  - the secondary winding resistance value ( $R_S$ ) is reduced (e.g. by using a lower transformation ratio)
  - the load resistance value ( $R_M$ ) is reduced

### Thermal characteristics

The operating temperature values mentioned in this catalogue are given for a particular sensor operating point. These values may vary, according to the specific technical requirement, in the following way:

- The maximum operating temperature may be increased if:
  - the primary thermal current (voltage) ( $I_{PN}$  or  $U_{PN}$ ) is reduced
  - the sensor supply voltage ( $V_A$ ) is reduced
  - the load resistance value ( $R_M$ ) is increased

PS: The minimum operating temperature cannot be lower than that shown in the technical data sheet as this is fixed by the lower temperature limit of the components used in the sensor.



# Questionnaire

## Industry current sensor selection

Company: .....

Name: .....

Address: .....

Tel: ..... Fax: .....

Email: .....

### Application

- Application :
  - Variable speed drive .....
  - UPS .....
  - Wind generator.....
  - Active harmonic filter.....
  - Welding machines.....
  - Solar.....
  - Other (description) .....
- Quantity per year: .....

### Mechanical characteristics

- Sensor fixing:
  - By soldering to the PCB.....
  - By the enclosure.....
  - By the primary conductor.....
- Primary conductor:
  - Cable diameter..... (mm)
  - Cable connection size ..... (mm)
  - Bar size ..... (mm)
- Secondary connection:
  - By connector .....
  - By cable without connector .....
  - Other .....

### Sensor environmental conditions

- Minimum operating temperature..... (°C)
- Maximum operating temperature..... (°C)
- Presence of strong electromagnetic fields.....
- Max. continuous primary conductor voltage ..... (V)
- Main reference standards .....

### Other requirements (description)

.....

.....

.....

.....

### Electrical characteristics

- Nominal current ( $I_{PN}$ )..... (A r.m.s.)
- Current type (if possible, show current profile on graph):
  - Direct.....
  - Alternating.....
- Bandwidth to be measured ..... (Hz)
- Current measuring range:
  - Minimum current ..... (A)
  - Maximum current ..... (A)
  - Duration (of max. current)..... (sec)
  - Repetition (of max. current).....
  - Measuring voltage (on  $R_M$ ) at max current ..... (V)
- Overload current (not measurable):
  - Not measurable overload current ..... (A)
  - Duration ..... (sec)
  - Repetition .....
- Sensor supply voltage:
  - Bipolar supply voltage ..... ( $\pm V$ )
  - Unipolar supply voltage..... (0 +V or 0 -V)
- Output current
  - Secondary current at nominal current  $I_{PN}$ ..... (mA)
- Current output (NCS range only)
  - Secondary current at maximum current  $I_{P_{MAX}}$  ..... (mA)
- Voltage output
  - Secondary voltage at nominal current  $I_{PN}$  ..... (V)
- Voltage output (NCS range only)
  - Secondary voltage at maximum current  $I_{P_{MAX}}$  ..... (V)

Common information

This document is used for selecting sensors according to the application and the clients requirements.



# Questionnaire

## Traction current sensor selection

<b>Company:</b> .....		<b>Name:</b> .....	
<b>Address:</b> .....			
<b>Tel:</b> .....	<b>Fax:</b> .....	<b>Email:</b> .....	

### Application

- Project name .....
- Application:
  - Rolling stock:
    - Power converter .....
    - Auxiliary converter.....
    - Other .....
  - Fixed installation (e.g. substation).....
- Quantity per year: .....
- Total quantity for the project.....

### Mechanical characteristics

- Sensor fixing:
  - By the enclosure .....
  - By the primary conductor.....
- Primary conductor:
  - Cable diameter ..... (mm)
  - Bar size ..... (mm)
- Secondary connection:
  - Screw or Faston .....
  - By connector .....
  - By shielded cable .....
  - Other .....

### Sensor environmental conditions

- Minimum operating temperature..... (°C)
- Maximum operating temperature..... (°C)
- Max. continuous primary conductor voltage ..... (V)
- Main reference standards .....

### Electrical characteristics

- Nominal current ( $I_{PN}$ )..... (A r.m.s.)
- Current type (if possible, show current profile on graph):
  - Direct .....
  - Alternating.....
- Bandwidth to be measured ..... (Hz)
- Current measuring range:
  - Minimum current ..... (A)
  - Maximum current ..... (A)
  - Duration (of max. current)..... (sec)
  - Repetition (of max. current).....
  - Measuring voltage (on  $R_M$ ) at max current ..... (V)
- Overload current (not measurable):
  - Not measurable overload current .....(A)
  - Duration..... (sec)
  - Repetition.....
- Sensor supply voltage:
  - Bipolar supply voltage ..... (±V)
  - Unipolar supply voltage..... (0 +V or 0 -V)
- Output current
  - Secondary current at nominal current  $I_{PN}$ ..... (mA)
- Current output (NCS125 & NCS165 only for fixed installations)
  - Secondary current at maximum current  $I_{PMAX}$  ..... (mA)
- Voltage output (NCS125 & NCS165 only for fixed installations)
  - Secondary voltage at nominal current  $I_{PN}$  ..... (V)
- Voltage output (NCS125 & NCS165 only for fixed installations)
  - Secondary voltage at maximum current  $I_{PMAX}$  ..... (V)

### Other requirements (description)

.....

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.....

.....

This document is used for selecting sensors according to the application and the clients requirements.



# Questionnaire

## Traction voltage sensor selection

Company: .....

Name: .....

Address: .....

Tel: ..... Fax: .....

Email: .....

### Application

- Project name .....
- Application:
  - Rolling stock:
    - Power converter .....
    - Auxiliary converter .....
    - Other .....
  - Fixed installation (e.g. substation) .....
- Quantity per year: .....
- Total quantity for the project.....

### Mechanical characteristics

- Primary connection:
  - By screw .....
  - Other .....
- Secondary connection:
  - Screw or Faston .....
  - By connector .....
  - Other .....

### Electrical characteristics

- Nominal voltage ( $U_{PN}$ )..... (V r.m.s.)
- Voltage type (if possible, show voltage profile on graph):
  - Direct .....
  - Alternating.....
- Bandwidth to be measured ..... (Hz)
- Voltage measuring range:
  - Minimum voltage..... (V)
  - Maximum voltage..... (V)
  - Duration (at max. voltage) ..... (sec)
  - Repetition (at max. voltage) .....
  - Measuring voltage (on  $R_M$ ) at max voltage..... (V)
- Overload voltage (not measurable):
  - Not measurable overload voltage..... (V)
  - Duration ..... (sec)
  - Repetition.....
- Sensor supply voltage:
  - Bipolar supply voltage..... ( $\pm V$ )
  - Unipolar supply voltage..... (0 +V or 0 -V)
- Output current
  - Secondary current at nominal voltage  $U_{PN}$  ..... (mA)

### Sensor environmental conditions

- Minimum operating temperature..... (°C)
- Maximum operating temperature..... (°C)
- Main reference standards .....

### Other requirements (description)

.....

.....

.....

.....

*This document is used for selecting sensors according to the application and the clients requirements.*



# Questionnaire

## Voltage detector selection

<b>Company:</b> .....		<b>Name:</b> .....	
<b>Address:</b> .....			
<b>Tel:</b> .....	<b>Fax:</b> .....	<b>Email:</b> .....	

### Application

- Project name .....
- Application:
  - Rolling stock:
    - Power converter .....
    - Auxiliary converter .....
    - Other .....
  - Fixed equipment (e.g. substation).....
- Quantity per year: .....
- Total quantity for the project .....

### Sensor environmental conditions

- Minimum operating temperature..... (°C)
- Maximum operating temperature..... (°C)
- Pollution degree .....
- Over voltage category .....
- Maximum ambient light level ..... (lux)
- Main reference standards .....

### Electrical characteristics

- Nominal voltage ( $U_{PN}$ ) ..... (V d.c.)
- Maximum voltage long duration: 5min ( $U_{MAX2}$ )..... (V d.c.)
- Maximum voltage overload: 20ms ( $U_{MAX3}$ )..... (V d.c.)
- Minimum voltage to be detected..... (V)

### Other requirements (description)

.....

.....

.....

.....

*This document is used for determining if the detector according to the application and the clients requirements.*



# Calculation guide

## Closed loop Hall effect current sensors

### ES, ESM, CS, MP and EL sensors



ES300C

1SE7 8982 4FC02

#### 1 - Reminder of the key elements (closed loop Hall effect)

##### Formulas:

$$N_P \times I_P = N_S \times I_S$$

$$V_A = e + V_S + V_M$$

$$V_S = R_S \times I_S$$

$$V_M = R_M \times I_S$$

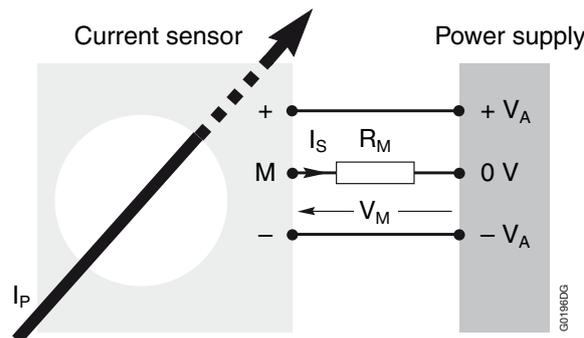
##### Abbreviations

$N_P$	: turn number of the primary winding
$I_P$	: primary current
$I_{PN}$	: nominal primary current
$N_S$	: turn number of the secondary winding
$I_S$	: output secondary current
$V_A$	: supply voltage
$e$	: voltage drop across output transistors (and in the protection diodes, if relevant)
$V_S$	: voltage drop across secondary winding
$V_M$	: measuring voltage
$R_S$	: resistance of the secondary winding
$R_M$	: measuring resistance

##### Values of "e" with a bipolar sensor supply

Sensor	ES100	ES300...ES2000	ESM1000	CS300...CS1000	CS2000	MP or EL
Voltage "e"	2,5 V	1 V	2 V	2,5 V	1,5 V	3 V

##### Reminder of the sensor electrical connection



#### 2 - Measurement circuit calculation (secondary part of the sensor)

##### Example with ES300C sensor

$N_P/N_S$	=	1/2000
$I_{PN}$	=	300A
$R_S$	=	33Ω (at +70°C)
$I_S$	=	0,15A (at $I_{PN}$ )
$e$	=	1V

##### 2.1 - What load resistance ( $R_M$ ) is required to obtain an 8V measuring signal ( $V_M = 8 V$ ) when the $I_P$ current = 520A peak?

$$I_S = (N_P / N_S) \times I_P = (1 / 2000) \times 520 = 0,26A \text{ peak}$$

$$R_M = V_M / I_S = 8 / 0,26 = 30,77\Omega$$

We must check that the sensor can measure these 520A peak, i.e.:

$$V_A \geq e + V_S + V_M$$

If  $V_A = \pm 15V (\pm 5\%)$ , then we must check that

$$15 \times 0,95 \geq 1 + (33 \times 0,26) + 8 \text{ which is false since } 14,25V < 17,58V$$

Therefore a supply greater than or equal to 17.58V must be selected. Select a  $\pm 24V (\pm 5\%)$  supply.

We verify that  $24 \times 0.95 \geq 17.58V$ .

##### Conclusion:

An ES300C sensor can measure a peak of 520A in the following conditions:

$$V_A = \pm 24V (\pm 5\%)$$

$$R_M = 30,77\Omega$$

to obtain an 8V signal at a peak of 520A

# Calculation guide

## Closed loop Hall effect current sensors

### ES, ESM, CS, MP and EL sensors



ES300C

1SIB7 8982 4F0302

#### 2.2 - What are the consequences, if the required signal is only 5V?

$$R_M = V_M / I_S = 5 / 0,26 = 19,23\Omega$$

We must check that the sensor can measure these 520A peak.

$$V_A \geq e + V_S + V_M$$

If  $V_A = \pm 15V$  ( $\pm 5\%$ ), then we must check that  $15 \times 0,95 \geq 1 + (33 \times 0,26) + 5$  which is false since  $14,25V < 14,58V$

Therefore a supply greater than or equal to 14.58V must be selected. Select a  $\pm 24V$  ( $\pm 5\%$ ) supply or a  $\pm 15V$  supply with a tighter tolerance, for example  $\pm 15V$  ( $\pm 2\%$ ). (since  $15V \times 0,98 \geq 14,58V$ )

#### Conclusion :

An ES300C sensor can measure a peak of 520A in the following conditions:

$$V_A = \pm 15V$$
 ( $\pm 2\%$ )

$$R_M = 19,23\Omega$$

to obtain a 5V signal at a peak of 520A.

In general, the larger the measuring signal required, the larger the load resistance and the higher the sensor supply voltage should be. The thermal aspect of the sensor should be considered.

#### 2.3 - What is the maximum current measurable by an ES300C in specific conditions?

For example, the conditions are:

$$V_A = \pm 15V$$
 ( $\pm 5\%$ )

$$R_M = 15\Omega$$

From the base formulas, we obtain the following formula:

$$I_{SMAX} = (V_{AMIN} - e) / (R_S + R_M) = [(15 \times 0,95) - 1] / (33 + 15) = 0,276A \text{ peak}$$

Now calculate the equivalent primary current:

$$I_P = (N_S / N_P) \times I_S = (2000 / 1) \times 0,276 = 552A \text{ peak}$$

#### Conclusion :

An ES300C sensor can measure a peak of 552A in the following conditions:

$$V_A = \pm 15V$$
 ( $\pm 5\%$ )

$$R_M = 15\Omega$$

Note: the 552A peak current must not be a continuous current. For specific requirements, contact your distributor.

#### 2.4 - What influence does the ambient temperature have on the sensor's performance?

Taking the conditions from point 2.3 (preceding example). The calculations were made using a maximum default operating temperature of  $+70^\circ C$ . If this maximum temperature is  $+50^\circ C$ , then the measuring range can be increased as follows:

$$R_S = 33\Omega \text{ at } +70^\circ C \quad \text{At } +50^\circ C, R_S = 30,5\Omega \quad \text{then,}$$

$$I_{SMAX} = (V_{AMIN} - e) / (R_S + R_M) = [(15 \times 0,95) - 1] / (30,5 + 15) = 0,291A \text{ peak}$$

Now calculate the equivalent primary current:

$$I_P = (N_S / N_P) \times I_S = (2000 / 1) \times 0,291 = 582A \text{ peak}$$

#### Conclusion :

An ES300C sensor can measure a peak of 582A in the following conditions:

$$V_A = \pm 15V$$
 ( $\pm 5\%$ )

$$R_M = 15\Omega$$

Max. operating temperature =  $+50^\circ C$

Note: the 582A peak current must not be a continuous current. For specific requirements, contact your distributor.

In general, the lower the ambient temperature, the more important the sensor measurable current. The thermal aspect of the sensor should be considered.

# Calculation guide

## Closed loop Hall effect current sensors

### ES, ESM, CS, MP and EL sensors



ES300C

1SB7 8982 4F0202

#### 2.5 - What influence does the turn ratio have on the sensor's performance?

Taking the conditions of point 2.3 again. The calculations were based on a turn ratio of 1/2000. If this ratio is 1/1500 (non standard ratio for a 300A sensor), then the elements are determined as follows:

$$I_S = (N_P / N_S) \times I_P = (1 / 1500) \times 552 = 0,368 \text{ peak} \quad (I_P = 522A \text{ from 2.3 above})$$

Now calculate the voltage obtained at the terminals of the measuring resistance:

- for a turn ratio of 1/2000:  
 $V_M = R_M \times I_S = 15 \times 0,276 = 4,14V$
- for a turn ratio of 1/1500:  
 $V_M = R_M \times I_S = 15 \times 0,368 = 5,52V$

#### Conclusion :

An ES300C sensor can measure a peak of 552A in the following conditions

$$V_A = \pm 15V (\pm 5\%)$$

$$R_M = 15\Omega$$

$$V_M = 4.14V \text{ with a turn ratio of } 1/2000$$

$$V_M = 5.52V \text{ with a turn ratio of } 1/1500$$

In general, the lower the turn ratio, the more important the output current and the higher the measuring voltage. The thermal aspect of the sensor should be considered.

#### 2.6 - What influence does the supply voltage have on the sensor's performance?

Taking the conditions in point 2.3 again. The calculations were based on a supply voltage of  $\pm 15V (\pm 5\%)$ . Reworking the calculations with a supply of  $\pm 24V (\pm 5\%)$ .

From the base formulas, we obtain the following formula:

$$I_{SMAX} = (V_{A \text{ MIN}} - e) / (R_S + R_M) = [(24 \times 0,95) - 1] / (33 + 15) = 0,454A \text{ peak}$$

Now calculate the equivalent primary current:

$$I_P = (N_S / N_P) \times I_S = (2000 / 1) \times 0,454 = 908A \text{ peak}$$

#### Conclusion :

An ES300C sensor can measure a peak of 908A in the following conditions:

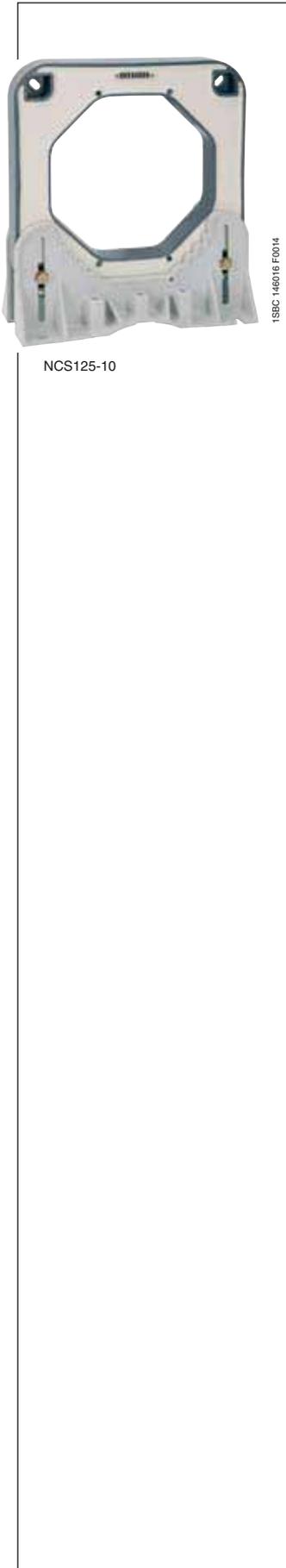
$$V_A = \pm 24V (\pm 5\%)$$

$$R_M = 15\Omega$$

Note: the 908A peak current must not be a continuous current.

In general, the higher the supply voltage, the more important the measuring current and the higher the measuring voltage. The thermal aspect of the sensor should be considered.

NB: for calculations with unipolar supply (e.g. 0...+24V), contact your distributor.



## 1 - Reminder of the key elements

### Formulas:

$$V_{M1} = R_{M1} \times I_{S1}$$

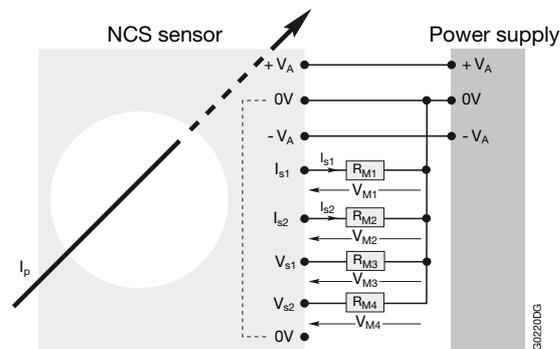
$$V_{M2} = R_{M2} \times I_{S2}$$

with  $0\Omega < R_{M1}$  or  $R_{M2} < 350\Omega$

### Abbreviations

$I_P$	: primary current
$I_{PN}$	: nominal primary current
$I_{P_{MAX}}$	: maximum primary current
$I_{S1}$	: secondary current at $I_{PN}$
$I_{S2}$	: secondary current at $I_{P_{MAX}}$
$V_{S1}$	: secondary voltage at $I_{PN}$
$V_{S2}$	: secondary voltage at $I_{P_{MAX}}$
$V_A$	: supply voltage
$V_M$	: measuring voltage
$R_M$	: measuring resistance
$R_{M_{MIN}}$	: minimum measuring resistance
$R_{M_{MAX}}$	: maximal measuring resistance

### Reminder of the sensor electrical connection



## 2 - Measurement circuit calculation (current output)

### Example with NCS125-4 sensor

$I_{PN}$	= 4 000A	$I_{S1} @ I_{PN}$	= $\pm 20$ mA
$I_{P_{MAX}}$	= 20 000A	$I_{S2} @ I_{P_{MAX}}$	= $\pm 20$ mA
$R_M$	= 0 - 350 $\Omega$ ( $I_{S1}$ & $I_{S2}$ )	$V_{S1} @ I_{PN}$	= $\pm 10$ V
$R_M$	$\geq 10$ k $\Omega$ ( $V_{S1}$ & $V_{S2}$ )	$V_{S2} @ I_{P_{MAX}}$	= $\pm 10$ V
$V_A$	= $\pm 15$ V ... $\pm 24$ V		

The design of the sensor requires that 2 operating points are respected on the outputs  $I_{S1}$  and  $I_{S2}$ :

- A maximum measuring voltage of 7V d.c. ( $V_{M_{MAX}} \leq R_{M_{MAX}} \times I_{S_{MAX}}$ )
- A maximum output current of  $\pm 20$ mA d.c..

The supply voltage does not have any influence on the output signals.

### 2.1 - What load resistance ( $R_M$ ) is required to obtain a 5V measuring ( $V_M = 5V$ ) when the current $I_P = 6000A$ peak?

The measured current is greater than  $I_{PN}$  (4000A for a NCS125-4),  $I_{S2}$  is therefore used as the measuring signal. Firstly the output current on  $I_{S2}$  must be calculated when  $I_{PN} = 6000$  A d.c.

$$I_{S2} = I_{PN} / I_{P_{MAX}} \times I_{S_{MAX}} = 6000 / 20000 \times 20 = 6 \text{ mA (correct because } I_{S2_{MAX}} = \pm 20 \text{ mA d.c.)}$$

Now determine the value of the resistance  $R_M$

$$R_M = V_M / I_{S2} = 5 / 0.006 = 833.33 \Omega$$

### Conclusion:

The NCS125-4 sensor can measure 6000A peak on the signal output  $I_{S2}$  with a resistance of 416.67  $\Omega$  (greater than 350  $\Omega$ ) because the output current is smaller than  $I_{S_{MAX}}$  i.e. 20mA d.c.

The product of  $R_M \times I_{S_{MAX}}$  must always be smaller than or equal to maximum output of 7V d.c.

## 3 - Measurement circuit calculation (voltage output)

No special calculation needs to be made. This NCS sensor range supplies a voltage directly proportional to the primary current  $I_P$  between  $-10V$  and  $+10V$ . A load resistance of a value greater than or equal to 10k adapts the impedance of the measured output ( $V_{S1}$  or  $V_{S2}$ ) to the acquisition system.

# Calculation guide

## Closed loop Hall effect voltage sensors

### EM010 sensors



EM010BBFHP1N

1SBC7 7512 4F0001

#### 1 - Reminder of the key elements (closed loop Hall effect)

Formulas :

$$N_P \times I_P = N_S \times I_S$$

$$V_A = e + V_S + V_M$$

$$V_S = R_S \times I_S$$

$$V_M = R_M \times I_S$$

$$R = R_E + R_P$$

$$R = U_P / I_P$$

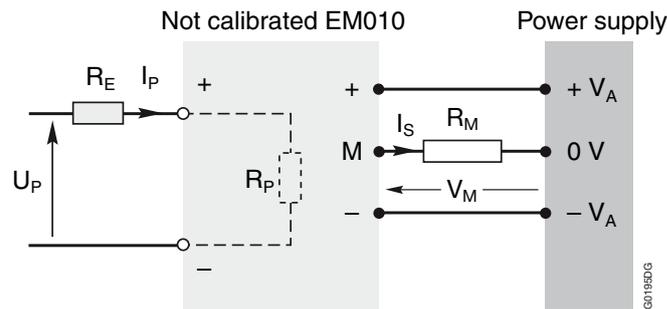
Abbreviations

$N_P$  : turn number of the primary winding  
 $U_P$  : primary voltage  
 $I_P$  : primary current  
 $I_{PN}$  : nominal primary current  
 $N_S$  : turn number of the secondary winding  
 $I_S$  : output secondary current  
 $V_A$  : supply voltage  
 $e$  : voltage drop across output transistors (and in the protection diodes, if relevant)  
 $V_S$  : voltage drop across secondary winding  
 $V_M$  : measuring voltage  
 $R_S$  : resistance of the secondary winding  
 $R_M$  : measuring resistance  
 $R_E$  : external resistance in series with the primary circuit of the voltage sensor  
 $R_P$  : internal resistance of the primary winding

Values of "e" with a bipolar sensor supply

Sensors	EM010
Voltage "e"	1,5 V

Reminder of the sensor electrical connection



#### 2 - Measurement circuit calculation (secondary part of the sensor)

Example with an EM010 sensor without primary resistance supplied with the sensor (EM010BBFHP1N)

$$\begin{aligned}
 N_P / N_S &= 10000 / 2000 \\
 I_{PN} &= 10 \text{ mA} \\
 R_P &= 1500 \Omega \text{ (at } +25^\circ\text{C)} \\
 R_S &= 60 \Omega \text{ (at } +70^\circ\text{C)} \\
 I_S &= 50 \text{ mA (at } I_{PN}) \\
 e &= 1,5 \text{ V}
 \end{aligned}$$

2.1 - What load resistance ( $R_M$ ) is required to obtain a 10V measuring signal ( $V_M = 10\text{V}$ ) when the  $I_P$  current = 12mA peak?

$$\begin{aligned}
 I_S &= (N_P / N_S) \times I_P = (10000 / 2000) \times 0,012 = 0,060 \text{ A peak} \\
 R_M &= V_M / I_S = 10 / 0,060 = 166,67 \Omega
 \end{aligned}$$

We must check that the sensor can measure this  $I_P = 12\text{mA}$  peak, i.e.:

$$V_A \geq e + V_S + V_M$$

If  $V_A = \pm 15\text{V}$  ( $\pm 5\%$ ), then we must check that

$$15 \times 0,95 \geq 1,5 + (60 \times 0,060) + 10 \text{ which is false since } 14,25\text{V} < 15,10\text{V}$$

Therefore a supply greater than or equal to 15.10V must be selected. Select a  $\pm 24\text{V}$  ( $\pm 5\%$ ) supply.

We verify that  $24 \times 0,95 \geq 15,10\text{V}$ .

Conclusion:

An EM010BBFHP1N sensor can measure a peak of 12mA in the following conditions:

$$V_A = \pm 24\text{V} (\pm 5\%)$$

$$R_M = 166,67 \Omega$$

to obtain a 10V signal at a peak of 12mA ( $V_M = 10\text{V}$  for  $I_P = 12\text{mA}$ )

Note: the 12mA peak current must not be a continuous current. For specific requirements, contact your distributor.

# Calculation guide

## Closed loop Hall effect voltage sensors

### EM010 sensors



EM010BBFHP1N

1SBC775124F0001

#### 2.2 - What are the consequences, if the required signal is only 5V ( $V_M = 5V$ )?

In the same way as for closed loop Hall effect current sensors (see page 114), if the required measuring voltage is reduced, carefully check that the  $\pm 15V$  ( $\pm 5\%$ ) supply used in this example is sufficient to obtain a 5V signal with the conditions used in the preceding point.

$$15 \times 0.95 \geq 1.5 + (60 \times 0.060) + 5 \text{ which is true since } 14.25V > 10.10V$$

#### 2.3 - What is the maximum measurable current by an EM010BBFHP1N in these specific conditions?

A closed loop Hall effect sensor is extremely sensitive to thermal aspects.

In general, a voltage sensor can withstand the following variations in primary current:

- Up to 110% of the nominal primary current: continuous overload possible
- Up to 125% of the nominal primary current: overload 3min/hr possible
- Up to 150% of the nominal primary current: overload 50sec/hr possible

In all these cases, we recommend that you contact your distributor in order to obtain detailed information on this subject.

#### 2.4 - What influence does the ambient temperature have on the sensor's performance?

In the same way as for closed loop Hall effect current sensors (see page 114), if the maximum operating temperature of the sensor is reduced, the measurable primary current (and therefore the primary voltage) of the voltage sensor increases. The thermal aspect of the sensor should be considered.

#### 2.5 - What influence does the turn ratio have on the sensor's performance?

For closed loop Hall effect voltage sensors, the turn ratio has a significant influence on the sensor's operation:

- Output current value
- Thermal capacity
- Maximum frequency of the measuring voltage

In general, the lower the turn ratio, the more important the output current and the higher the measuring voltage. The thermal aspect of the sensor should be considered.

#### 2.6 - What influence does the supply voltage have on the sensor's performance?

In general, the higher the supply voltage, the more important the measuring current and the higher the measuring voltage. The thermal aspect of the sensor should be considered.

NB: for calculations with unipolar supply (e.g. 0...+24V), contact your distributor.

## 3 - Sensor primary circuit calculation

Example with an EM010 sensor without primary resistance supplied with the sensor (EM010BBFHP1N)

$$\begin{aligned} N_P/N_S &= 10000/2000 \\ I_{PN} &= 10\text{mA} \\ R_P &= 1500\Omega \text{ (at } +25^\circ\text{C)} \\ R_S &= 60\Omega \text{ (at } +70^\circ\text{C)} \\ I_S &= 50\text{mA (at } I_{PN}) \\ e &= 1,5V \end{aligned}$$

#### 3.1 - What primary resistance $R_E$ is required in series with the sensor to obtain a primary current $I_p = 12\text{mA}$ when the primary voltage $U_p = 1500\text{V}$ ?

$$\begin{aligned} R &= R_E + R_P \text{ and } R = U_p / I_p && \text{therefore } R_E = (U_p / I_p) - R_P \\ R_E &= (1500 / 0,012) - 1500 && \text{i.e. } R_E = 123,50\text{k}\Omega \end{aligned}$$

#### 3.2 - What power is required for the primary resistance $R_E$ added in series with the sensor?

Taking the same conditions as point 3.1 above.

$P_{RE}$  is the power dissipated in the resistance  $R_E$ .

$$P_{RE} = R_E \times I_p^2 = 123\,500 \times 0,012^2 = 17,8\text{W}$$

For obvious reliability reasons, select a resistance with a nominal power of at least 5 times this calculated power, i.e. approx 90W.



## Calculation guide

### Closed loop Hall effect voltage sensors EM010 sensors



EM010BBFHP1N

15867 7512 4F0001

#### 3.3 - What influence does the temperature have on the determination of the primary resistance $R_E$ to be connected in series with the sensor?

Taking the same conditions as point 3.1 above.

The sensor's ambient temperature can vary the resistance of the primary winding, therefore if the sensor's operating temperature is 50°C, the difference will have to be treated as follows:

$R_p = 1500\Omega$  at +25°C gives a resistance of 1642Ω at +50°C.

By redoing the calculations with  $R_p = 1642\Omega$ , we obtain  $R_E = 123.36k\Omega$ , i.e. a difference of 0.1%.

The ambient temperature has only a very little influence on the calculation of primary resistance.



VS1000B

## 1 - Reminder of the key elements

### Formulas:

$$V_M = R_M \times I_S \text{ and } \frac{U_{PN}}{I_{SN}} = \frac{U_P}{I_S}$$

### VS50 ... VS1500:

- $R_M = [(0,8 \times V_{AMIN}) / I_S] - 55$
- $U_{HT+} + U_{HT-} \leq 4.2 \text{ kV peak}$  and
- $|U_{HT+} - U_{HT-}| \leq U_{PMAX}$

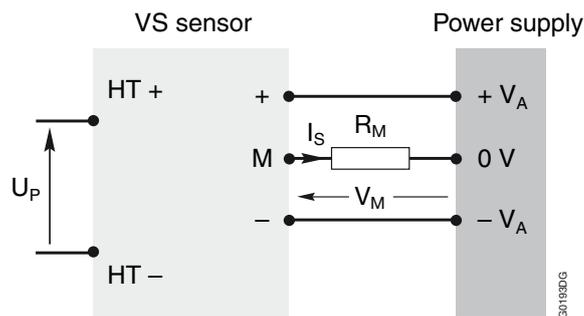
### VS2000 ... VS4200 :

- $R_M = [(0,8 \times V_{AMIN}) / I_S] - 60$
- $U_{HT+} + U_{HT-} \leq 10 \text{ kV peak}$  and
- $|U_{HT+} - U_{HT-}| \leq U_{PMAX}$

### Abbreviations

$U_P$	: primary voltage
$U_{PN}$	: nominal primary voltage
$I_S$	: secondary current
$I_{SN}$	: nominal secondary current
$V_A$	: supply voltage
$V_{AMIN}$	: $V_A$ less lowest supply tolerance
$V_M$	: measuring voltage
$R_M$	: measuring resistance

### Reminder of the sensor electrical connection



## 2 - Measurement circuit calculation (secondary part of the sensor)

### Example with VS1000B sensor

$U_{PN}$	= 1000V
$I_{SN}$	= 50mA
$V_A$	= $\pm 24V (\pm 5\%)$
$U_{PMAX}$	= 1500V

### 2.1 - What load resistance ( $R_M$ ) is required to obtain a 10V measuring signal ( $V_M = 10V$ ) when the voltage $U_{PMAX} = 1500V$ peak?

$$I_S = I_{SN} \times U_{PMAX} / U_{PN} = 0,050 \times 1500 / 1000 \quad \text{i.e. } I_S = 75\text{mA}$$

$$R_M = V_M / I_S = 10 / 0,075 \quad \text{i.e. } R_M = 133,33\Omega$$

We must check that the sensor can measure this 1500V with a  $\pm 24V (\pm 5\%)$  supply

$$V_{AMIN} = 24 \times 0,95 = 22,8V$$

$$R_M = [(0,8 \times V_{AMIN}) / I_S] - 55 = [(0,8 \times 22,8) / 0,075] - 55 \quad \text{i.e. } R_M = 188,2\Omega$$

We therefore verify that the sensor can measure this 1500V voltage since the measuring resistance with a  $\pm 24V (\pm 5\%)$  supply is  $188,2\Omega$  for  $133,33\Omega$  required.

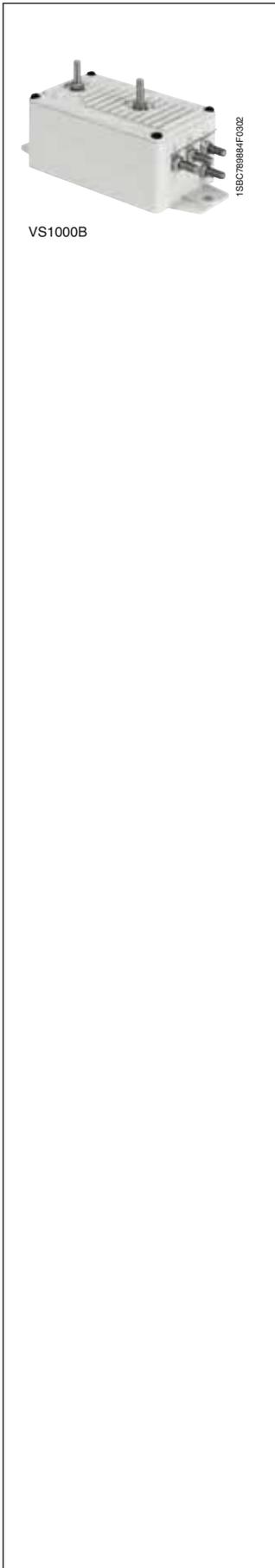
### Conclusion :

A VS1000B sensor can measure a peak of 1500V in the following conditions:

$$V_A = \pm 24V (\pm 5\%)$$

$$R_M = 133,33\Omega$$

to obtain a 10V signal at 1500V peak.



#### 2.2 - What are the consequences, if the required signal is only 5V ( $V_M = 5V$ )?

In the same way as for closed loop Hall effect current sensors (see page 114), if the required measuring voltage is reduced, carefully check that the  $\pm 15V$  ( $\pm 5\%$ ) supply used in this example is sufficient to obtain a 5V signal with the conditions used in the preceding point.

$$R_M = V_M / I_S = 5 / 0,075 \quad \text{i.e. } R_M = 66,67\Omega$$

$$R_M = [(0,8 \times V_{AMIN}) / I_S] - 55 = [(0,8 \times 14,25) / 0,075] - 55 \quad \text{i.e. } R_M = 97\Omega$$

We therefore verify that the sensor measures this 1500V voltage since the measuring resistance with a  $\pm 15V$  ( $\pm 5\%$ ) supply is  $97\Omega$  for  $66.67\Omega$  required.

#### 2.3 - What is the maximum measurable voltage by a VS1000B in specific conditions?

An electronic voltage sensor is also sensitive to the thermal aspect.

In general, a VS voltage sensor can withstand up to 150% of the nominal primary voltage, but only under certain conditions.

In all these cases, we recommend that you contact your distributor in order to obtain detailed information on this subject.

#### 2.4 - What influence does the ambient temperature have on the sensor's performance?

The electronic voltage sensor design means that the maximum operating temperature influences the sensor's performance, notably the measurement accuracy. However there is no correlation between a reduction in the ambient temperature and an increase in the voltage to be measured.

#### 2.5 - What influence does the supply voltage have on the sensor performance?

In general, the higher the supply voltage, the higher the measuring voltage. The thermal aspect of the sensor should be considered.

NB: for calculations with unipolar supply (e.g. 0...+24V), contact your distributor.

## 3 - Sensor primary circuit calculation

### Maximum common mode voltage:

Can the VS1000B sensor ( $U_{P_{MAX}} = 1500V$  peak) be used to measure a differential voltage

$$U_P = U_{HT+} - U_{HT-} \text{ with } U_{HT+} = 3500V \text{ d.c. and } U_{HT-} = 2600V \text{ d.c. ?}$$

$$3.1 - |U_{HT+} - U_{HT-}| = |3500 - 2600| = 900V \text{ d.c. } \leq 1500V \text{ peak :}$$

First condition  $|U_{HT+} - U_{HT-}| \leq U_{P_{MAX}}$  is therefore fulfilled.

$$3.2 - U_{HT+} + U_{HT-} = 3500 + 2600 = 6100V \text{ d.c. } > 4.2kV \text{ peak :}$$

Second condition  $U_{HT+} + U_{HT-} \leq 4.2kV$  peak is not therefore fulfilled.

### Conclusion :

The VS1000B sensor cannot therefore be used to measure this 900V d.c. primary differential voltage (even though this differential voltage is lower than the nominal primary voltage of the VS1000B sensor).

For this application the VS2000B sensor can be used since:

$$U_{HT+} + U_{HT-} = 6100V \text{ d.c. } \leq 10kV \text{ peak}$$

The condition  $U_{HT+} + U_{HT-} \leq 10kV$  peak is therefore fulfilled with the VS2000B.





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# Notes

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