Technical Catalogue

Current Sensors
Voltage Sensors

ABB

Current Sensors
Voltage Sensors

Table of contents

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: with two fixing positions, horizontal and vertical. 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.

Two technologies to m

Closed loop

Hall effect technology

Principle

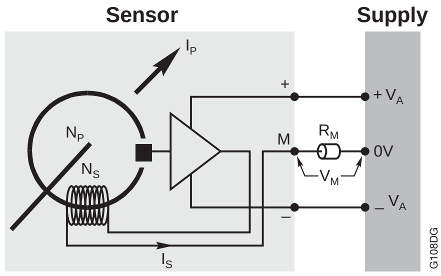
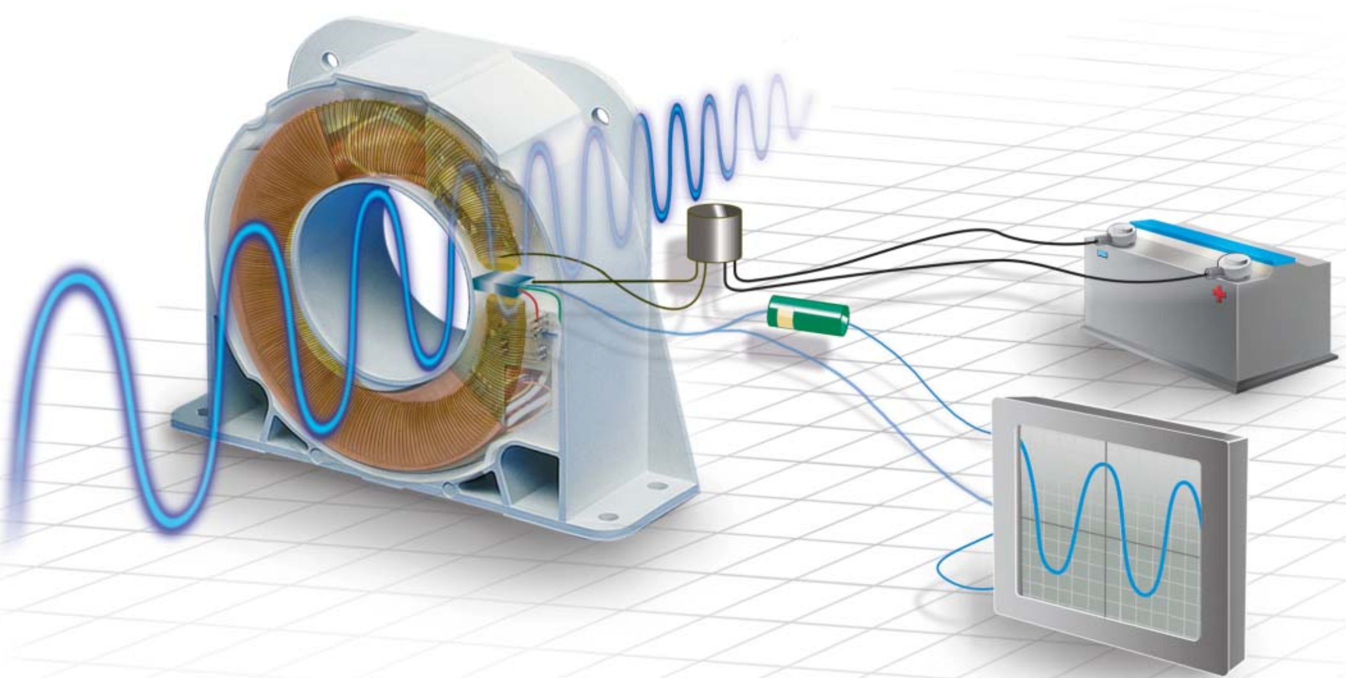


ABB current sensors are electronic transformers using closed loop Hall effect technology. This allows for the measurement of direct, alternating and impulse currents, with galvanic insulation between the primary and secondary circuits.
The primary current I_P flowing across the sensor creates a primary 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.
- Excellent accuracy
- High dynamic performance.
- High overload capacities.
- Excellent reliability.

Applications

Industry

Variable speed drives, Uninterruptible Power Suppliers (UPS), active harmonic filters, battery chargers, wind generators, robotics, conveyers, lifts, cranes, welding, electrolysis, surface treatment, laminators, telecommunications, marine, military, etc...

Traction

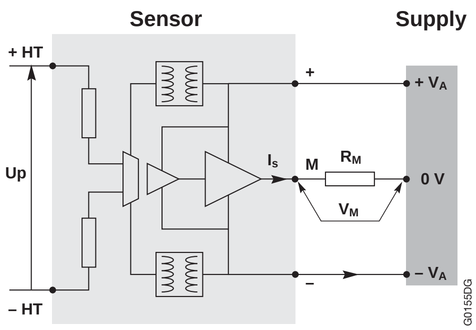
Main converters, auxiliary converters (lighting, air conditioning), battery chargers, choppers, sub-stations, mining, etc...

eet your requirements

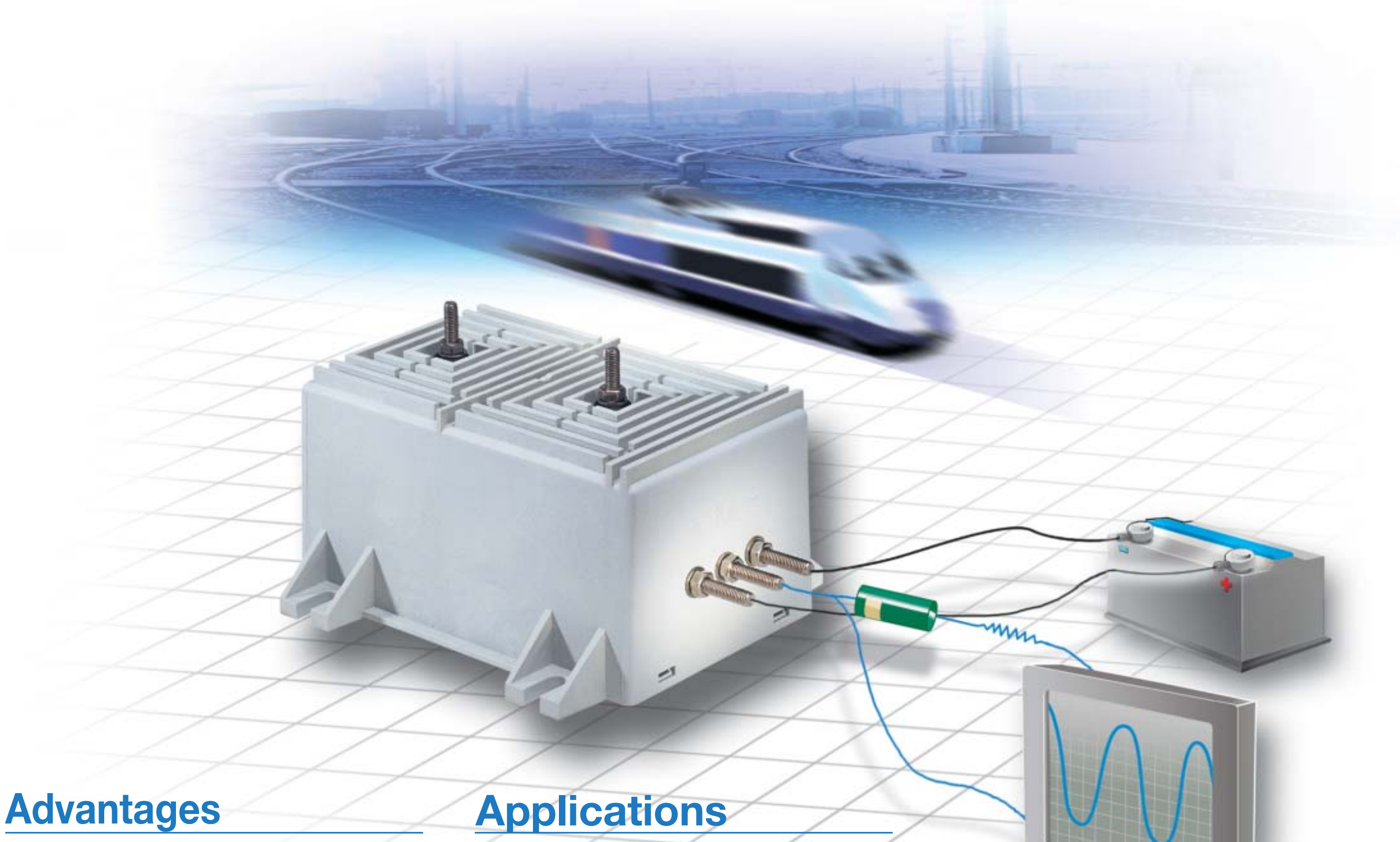
Electronic technology

Principle

The speciality of the VS voltage sensor range from ABB is that only electronic components are used. In contrast to closed loop Hall effect technology, this fully electronic technology does not use magnetic circuits or Hall probes.
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.
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 current, alternating current, 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, sub-stations, mining, etc...

Glossary

Description of the main current and voltage sensor's characteristics

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

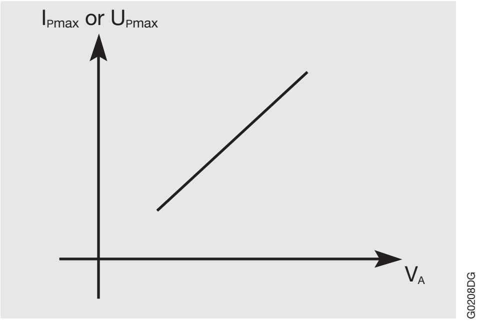
This is the maximum current or voltage that the sensor can continuously withstand (i.e. without time limit).
The sensor is thermally sized to continuously withstand this value.
For alternating currents, this is the r.m.s. value of the sinusoidal current.
The value given in the catalogue or in the technical data sheet is a nominal rating value. This figure can be higher if certain conditions (temperature, supply voltage…) are less restricting.

Measuring range (I_{PMAX} and U_{PMAX})

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.56 and onwards):

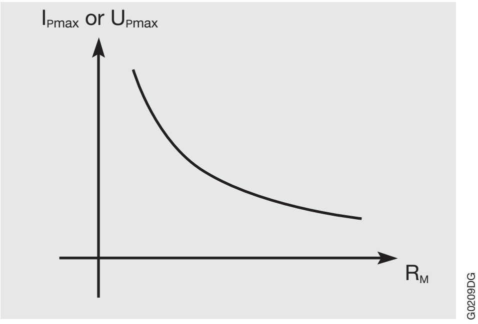
- Supply voltage:

The measuring range increases with the supply voltage.



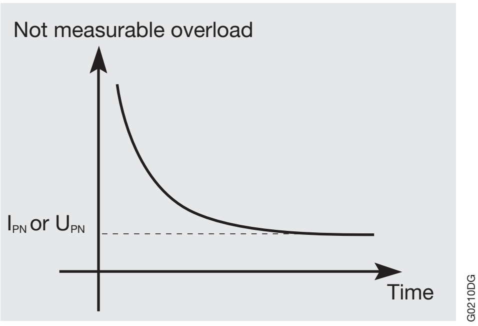
- Measuring resistance:

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.



Glossary

Description of the main current and voltage sensor's characteristics

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.56 and onwards and the curve I_{PMAX} or $U_{PMAX} = f(R_M)$ 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

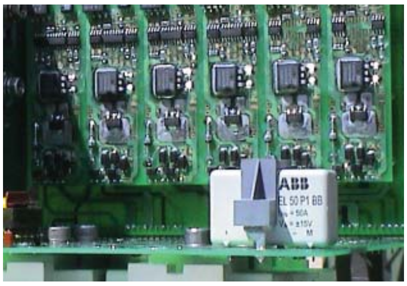
This is the maximum error for the sensor's output I_{SN} for an alternating sinusoidal primary current with a frequency of 50 Hz.
The residual current, linearity and thermal drift are not taken into account.

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.

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.11).

MP25P1

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*	±12 … ±15	Pins	3 pins	1SBT312500R0001

EL25P1 to 100P2

EL25P1BB to 100P2BB

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	±12 … ±15	Hole	3 pins	1SBT132500R0001
EL25P1BB	25	25	±12 … ±15	Bar	3 pins	1SBT132500R0002
EL50P1	50	50	±12 … ±15	Hole	3 pins	1SBT135100R0001
EL50P1BB	50	50	±12 … ±15	Bar	3 pins	1SBT135100R0003
EL55P2	50	25	±12 … ±15	Hole	3 pins	1SBT135100R0002
EL55P2BB	50	25	±12 … ±15	Bar	3 pins	1SBT135100R0004
EL100P2	100	50	±12 … ±15	Hole	3 pins	1SBT130100R0001
EL100P2BB	100	50	±12 … ±15	Bar	3 pins	1SBT130100R0002

* see table p. 11 “MP25P1: arrangement of primary terminals and related characteristics”.

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 sensors, the primary conductor may be a cable or a bar.

1SBC7 8979 4F0302

ES100C

1SBC7 8982 4F0302

ES300C

1SBC7 8983 4F0302

ES500C

1SBC7 8980 4F0302

ES1000C

1SBC7 8981 4F0302

ES2000C

1SBC7 898 44F0302

ESM1000-9935

Type	Nominal primary current (A r.m.s.)	Secondary current at I_{PN} (mA)	Supply voltage (V)	Secondary connection	Order code
ES100C	100	100	±12 … ±24	Molex 3 pins HE 14	ES100C
ES100F	100	100	±12 … ±24	3 wires 200 mm	ES100F
ES300C	300	150	±12 … ±24	Molex 3 pins HE 14	ES300C
ES300S	300	150	±12 … ±24	JST 3 pins	ES300S
ES300F	300	150	±12 … ±24	3 wires 200 mm	ES300F
ES500C	500	100	±12 … ±24	Molex 3 pins HE 14	ES500C
ES500S	500	100	±12 … ±24	JST 3 pins	ES500S
ES500F	500	100	±12 … ±24	3 wires 200 mm	ES500F
ES500-9672	500	125	±12 … ±24	Molex 3 pins HE 14	ES500-9672
ES500-9673	500	125	±12 … ±24	JST 3 pins	ES500-9673
ES500-9674	500	125	±12 … ±24	3 wires 200 mm	ES500-9674
ES1000C	1000	200	±12 … ±24	Molex 3 pins HE 14	ES1000C
ES1000S	1000	200	±12 … ±24	JST 3 pins	ES1000S
ES1000F	1000	200	±12 … ±24	3 wires 200 mm	ES1000F
ES1000-9678	1000	250	±12 … ±24	Molex 3 pins HE 14	ES1000-9678
ES1000-9679	1000	250	±12 … ±24	JST 3 pins	ES1000-9679
ES1000-9680	1000	250	±12 … ±24	3 wires 200 mm	ES1000-9680
ES2000C	2000	400	±15 … ±24	Molex 3 pins HE 14	1SBT152000R0003
ES2000S	2000	400	±15 … ±24	JST 3 pins	1SBT152000R0002
ES2000F	2000	400	±15 … ±24	3 wires 200 mm	1SBT152000R0001
ESM1000C	1000	200	±15 … ±24	Molex 3 pins HE 14	1SBT191000R0003
ESM1000S	1000	200	±15 … ±24	JST 3 pins	1SBT191000R0002
ESM1000F	1000	200	±15 … ±24	3 wires 200 mm	1SBT191000R0001
NEW ESM1000L	1000	200	±15 … ±24	Lockable connector	1SBT191000R0004
ESM1000-9888	1000	250	±15 … ±24	Molex 3 pins HE 14	1SBT191000R9888
ESM1000-9887	1000	250	±15 … ±24	JST 3 pins	1SBT191000R9887
ESM1000-9886	1000	250	±15 … ±24	3 wires 200 mm	1SBT191000R9886
NEW ESM1000-9935	1000	250	±15 … ±24	Lockable connector	1SBT191000R9935

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").

MP25P1 | **EL25P1 to 100P2 / EL25P1BB to 100P2BB**

Technical data

		Without primary bus bar	-	EL25P1	EL50P1	EL55P2	EL100P2
		With primary bus bar	**MP25P1**	**EL25P1BB**	**EL50P1BB**	**EL55P2BB**	**EL100P2BB**
Nominal primary current		**A r.m.s.**	See data page 11	25	50	50	100
Measuring range	@ ±15V (±5%)	**A peak**		±55	±80	±80	±145
Max. measuring resistance	@ I_p max & ±15V (±5%)	Ω	216	142	78	93	29
Min. measuring resistance	@ I_{PN} & ±15V (±5%) & 70°C	Ω	100	100	75	10	20
Min. measuring resistance	@ I_{PN} & ±12V (±5%) & 70°C	Ω	0	0	15	0	0
Turn number			See data page 11	1000	1000	2000	2000
Secondary current at I_{PN}		**mA**		25	50	25	50
Rms accuracy at I_{PN}	-20 … +70°C, sinus 50Hz	**%**	≤±0.5	≤±0.5	≤±0.5	≤±0.5	≤±0.5
Offset current	@ +25°C	**mA**	≤±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	**µA/°C**	7	7	7	7	7
Delay time		**µs**	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1
di/dt correctly followed		**A / µs**	≤100	≤200	≤200	≤150	≤150
Bandwidth	-1dB	**kHz**	≤150	≤200	≤200	≤150	≤150
Max. no-load consumption current	@ ±15V (±5%)	**mA**	≤18	≤20	≤20	≤20	≤20
Secondary resistance	@ +70°C	Ω	≤96	≤63	≤63	≤188	≤126
Dielectric strength Primary/Secondary	50 Hz, 1 min	**kV**	2.5	3	3	3	3
Supply voltage	±5%	**V dc**	±12 … ±15	±12 … ±15	±12 … ±15	±12 … ±15	±12 … ±15
Voltage drop		**V**	≤3	≤3	≤3	≤3	≤3
Mass (EL type)		**kg**	-	0.020	0.020	0.020	0.020
Mass (MP and EL…BB types)		**kg**	0.027	0.027	0.027	0.027	0.027
Operating temperature		**°C**	-20 …+70	-20 …+70	-20 …+70	-20 …+70	-20 …+70
Storage temperature		**°C**	-25 … +85	-25 … +85	-25 … +85	-25 … +85	-25 … +85

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 and connecting by soldering pins

(on PCB)

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:

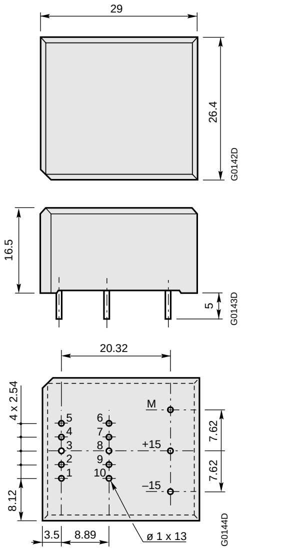
- **MP25P1 type**: 40 per pack.
- **EL type**: 50 per pack.
- **EL…BB type**: 25 per pack.

MP and EL Industry Current Sensors

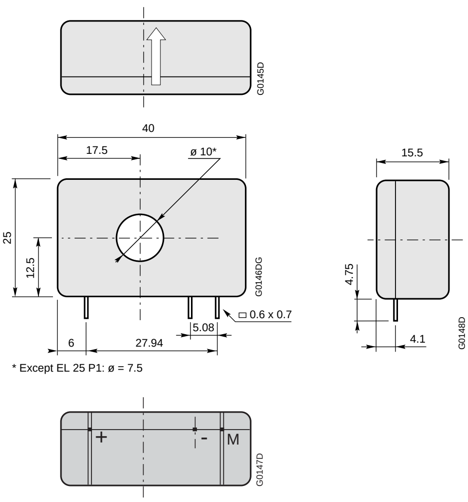
MP25P1 : Arrangement of primary terminals and related characteristics

Nominal primary current (A r.m.s.)	Measuring range @ ±15V (±5%) (A peak)	Secondary current at I_{PN} (mA)	Turn ratio (N_P/N_S)	Primary resistance (mΩ)	Primary pin connections
25	±36	25	1/1000	0.3	5 4 3 2 1 in / out 6 7 8 9 10
12	±18	24	2/1000	1.1	5 4 3 2 1 in / out 6 7 8 9 10
8	±12	24	3/1000	2.5	5 4 3 2 1 in / out 6 7 8 9 10
6	±9	24	4/1000	4.4	5 4 3 2 1 in / out 6 7 8 9 10
5	±7	25	5/1000	6.3	5 4 3 2 1 in / out 6 7 8 9 10

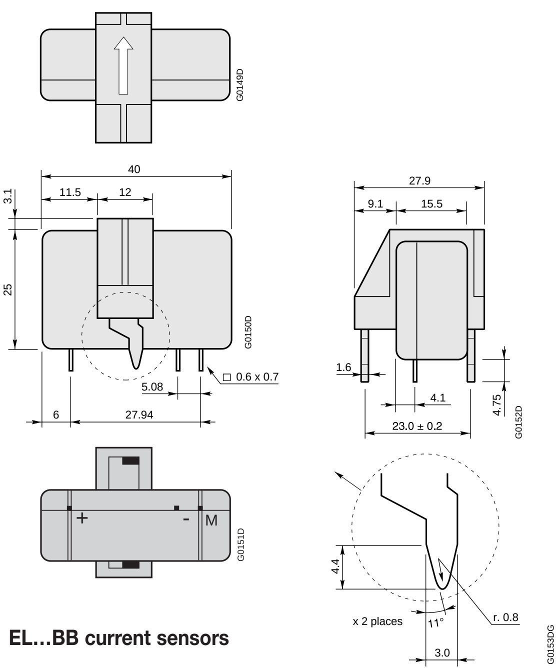
Dimensions (in mm)



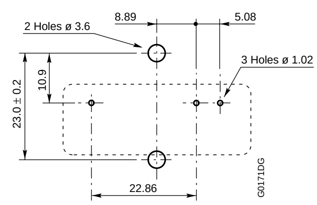
MP current sensors



EL current sensors



EL...BB current sensors



EL...BB: PCB layout

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.

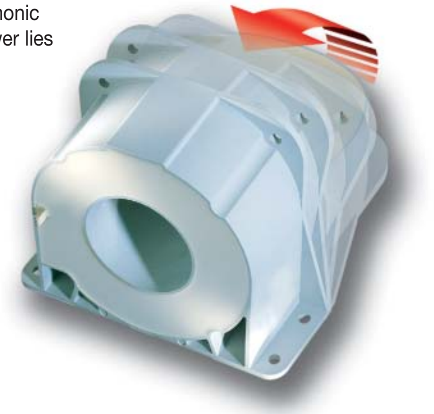
Unbeatable reliability

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 σ	308 537	69.2 %
Average	3 σ	66 807	93.3 %
Very good	4 σ	6 210	99.4 %
	5 σ	233	99.98 %
Outstanding	6 σ	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.



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

ES 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

			ES100	ES300	ES500	ES500
		Molex HE14 connector	**ES100C**	**ES300C**	**ES500C**	**ES500-9672**
		JST connector	**-**	**ES300S**	**ES500S**	**ES500-9673**
		Cables	**ES100F**	**ES300F**	**ES500F**	**ES500-9674**
Nominal primary current		**A r.m.s.**	100	300	500	500
Measuring range	@ ±15V (±5%)	**A peak**	±150	±500	±800	±800
Measuring range	@ ±24V (±5%)	**A peak**	±150	±500	±800	±800
Not measurable overload	10ms/hour	**A peak**	300 (1ms/hour)	3000	5000	5000
Max. measuring resistance	@ I_P max & ±15V (±5%)	Ω	48	20	7	13
Max. measuring resistance	@ I_P max & ±24V (±5%)	Ω	105	54	60	56
Min. measuring resistance	@ I_{PN} & ±15V (±5%)	Ω	10	0	0	0
Min. measuring resistance	@ I_{PN} & ±24V (±5%)	Ω	82	45	0	14
Turn number			1000	2000	5000	4000
Secondary current at I_{PN}		**mA**	100	150	100	125
Accuracy at I_{PN}	@ +25°C	**%**	≤±0.5	≤±0.5	≤±0.5	≤±0.5
Accuracy at I_{PN}	-5 … +70°C	**%**	≤±1	≤±1	≤±1	≤±1
Accuracy at I_{PN}	-20 … +70°C	**%**	≤±2.5	≤±1.5	≤±1	≤±1
Offset current	@ +25°C	**mA**	≤±0.4	≤±0.25	≤±0.25	≤±0.25
Linearity		**%**	≤0.1	≤0.1	≤0.1	≤0.1
Thermal drift coefficient	-5 … +70°C	**µA/°C**	≤10	≤15	≤5	≤6.25
Thermal drift coefficient	-20 … +70°C	**µA/°C**	≤80	≤40	≤16	≤20
Delay time		**µs**	≤1	≤1	≤1	≤1
di/dt correctly followed		**A / µs**	≤50	≤50	≤100	≤100
Bandwidth	-1dB	**kHz**	≤100	≤100	≤100	≤100
Max. no-load consumption current	@ ±24V (±5%)	**mA**	≤12	≤12	≤12	≤12
Secondary resistance	@ +70°C	Ω	≤30	≤33	≤76	≤53
Dielectric strength Primary/Secondary	50 Hz, 1 min	**kV**	3	3	3	3
Supply voltage	±5%	**V dc**	±12 … ±24	±12 … ±24	±12 … ±24	±12 … ±24
Voltage drop		**V**	≤2.5	≤1	≤1	≤1
Mass		**kg**	0.050	0.115	0.210	0.210
Operating temperature		**°C**	-20 …+70	-20 …+70	-20 …+70	-20 …+70
Storage temperature		**°C**	-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.

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 mm²)

ES Industry Current Sensors

ES1000	ES2000
	

Technical data

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

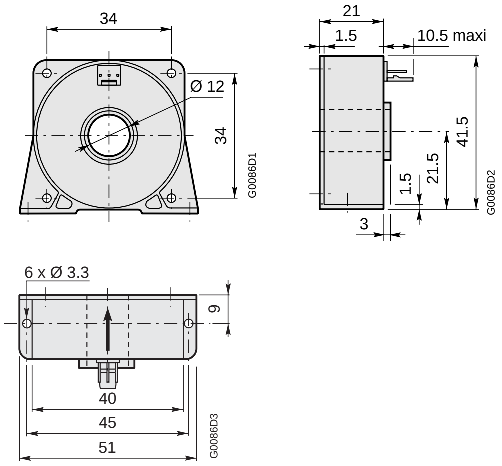
EN61000-6-2

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

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

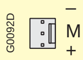
ES Industry Current Sensors

Dimensions (in mm)

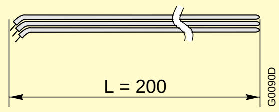


ES100C / ES100F

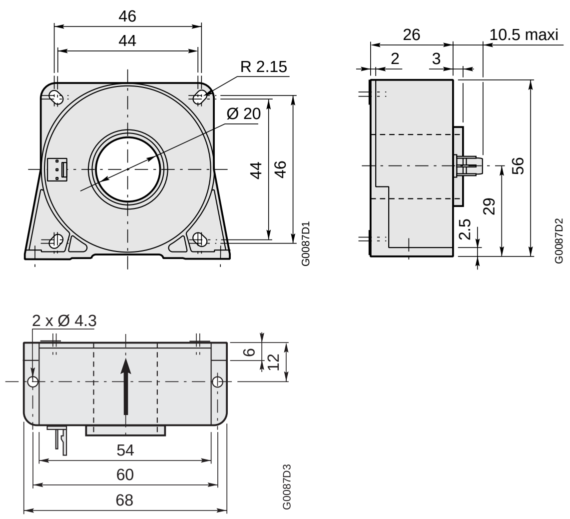
Standard ES100... sensor secondary connection



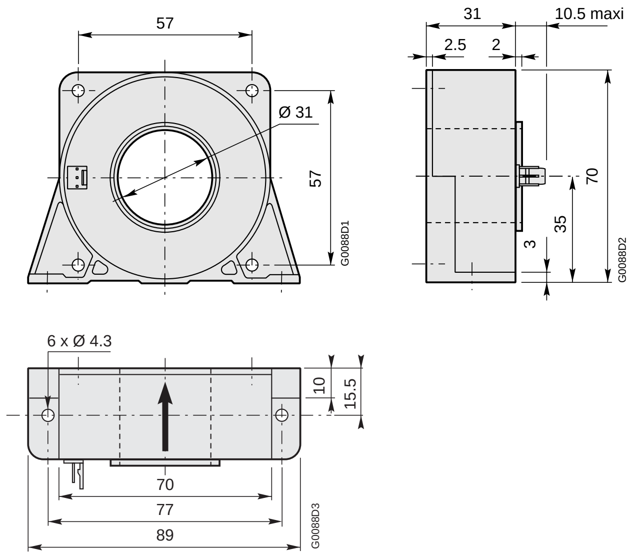
Molex connector
(with 2.54 mm pitch)



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

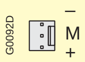


ES300C / ES300S / ES300F

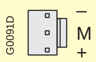


ES500C / ES500S / ES500F
ES500-9672 / ES500-9673 / ES500-9674

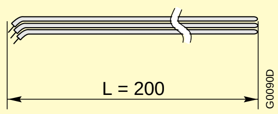
Standard ES300... and ES500... sensor secondary connection



Molex connector
(with 2.54 mm pitch)



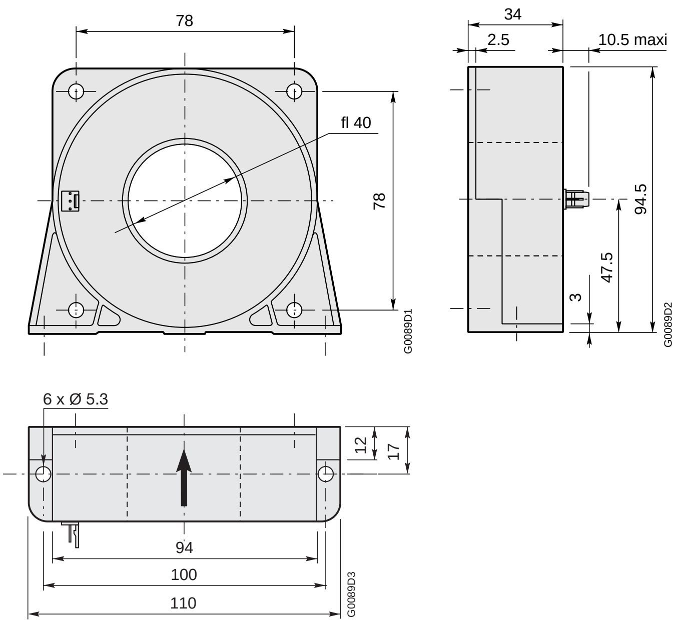
JST connector
(with 3.81 mm pitch)



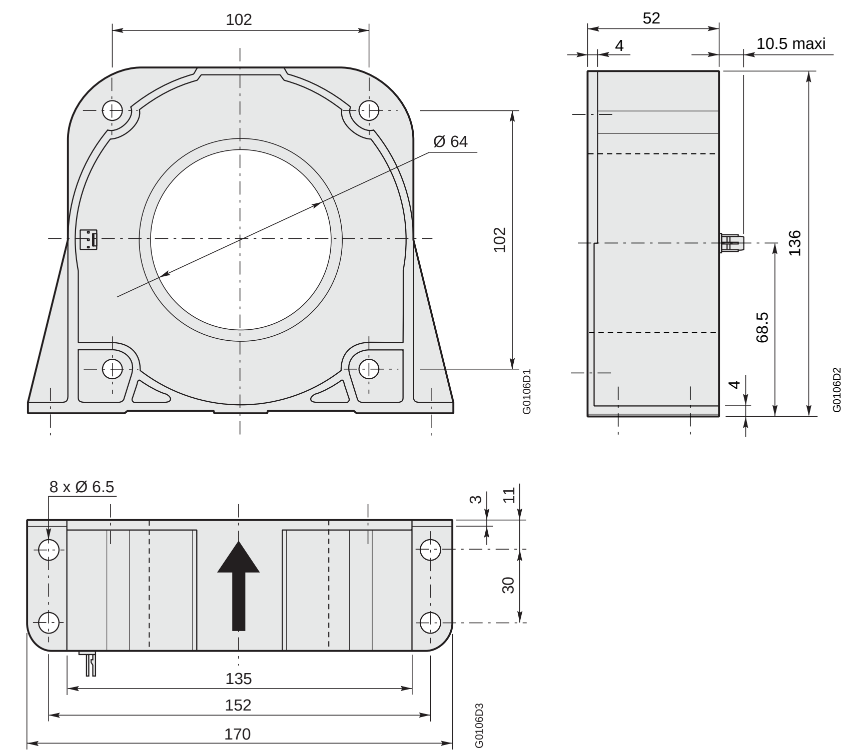
Cable : - Red .... $+V_A$
- Green .... **M**
- Black .... $-V_A$

ES Industry Current Sensors

Dimensions (in mm)

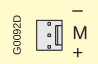


ES1000C / ES1000S / ES1000F
ES1000-9678 / ES1000-9679 / ES1000-9680

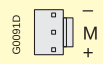


ES2000C / ES2000S / ES2000F

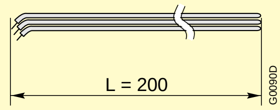
Standard ES1000... and ES2000... sensor secondary connection



Molex connector
(with 2.54 mm pitch)



JST connector
(with 3.81 mm pitch)



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

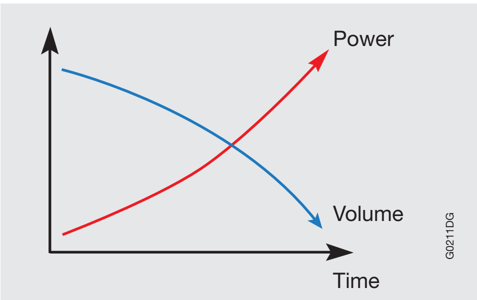
Industry Current Sensors ESM range

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.
Recently 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 Sensor

Utilisation

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

ESM1000

Technical data

Molex HE14 connector			**ESM1000C**	**ESM1000-9888**
JST connector			**ESM1000S**	**ESM1000-9887**
Cables			**ESM1000F**	**ESM1000-9886**
NEW **Lockable connector**			**ESM1000L**	**ESM1000-9935**
Nominal primary current		**A r.m.s.**	1000	1000
Measuring range	@ ±15V (±5%)	**A peak**	±1500	±1500
Measuring range	@ ±24V (±5%)	**A peak**	±1500	±1500
Not measurable overload	10ms/hour	**A peak**	10000	10000
Max. measuring resistance	@ I_P max & ±15V (±5%)	Ω	-	-
Max. measuring resistance	@ I_P max & ±24V (±5%)	Ω	25	22
Min. measuring resistance	@ I_{PN} & ±15V (±5%)	Ω	0	0
Min. measuring resistance	@ I_{PN} & ±24V (±5%)	Ω	0	11
Turn number			5000	4000
Secondary current at I_{PN}		**mA**	200	250
Accuracy at I_{PN}	@ +25°C	**%**	≤±0.5	≤±0.5
Accuracy at I_{PN}	-20 … +70°C	**%**	≤±1	≤±1
Offset current	@ +25°C	**mA**	≤±0.25	≤±0.25
Linearity		**%**	≤0.1	≤0.1
Thermal drift coefficient	-20 … +70°C	**µA/°C**	≤10	≤12.5
Delay time		**µs**	≤1	≤1
di/dt correctly followed		**A / µs**	≤100	≤100
Bandwidth	-1dB	**kHz**	≤100	≤100
Max. no-load consumption current	@ ±24V (±5%)	**mA**	≤15	≤15
Secondary resistance	@ +70°C	Ω	≤44	≤33
Dielectric strength Primary/Secondary	50 Hz, 1 min	**kV**	3	3
Supply voltage	±5%	**V dc**	±15 … ±24	±15 … ±24
Voltage drop		**V**	≤2	≤2
Mass		**kg**	0.600	0.600
Operating temperature		**°C**	-20 …+70	-20 …+70
Storage temperature		**°C**	-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 mm²)
- Lockable connector (ref. ABB Entrelec: L253 103 31 000)

Accessories and options

The same as the ES range (see page 15)

Conformity

EN50178

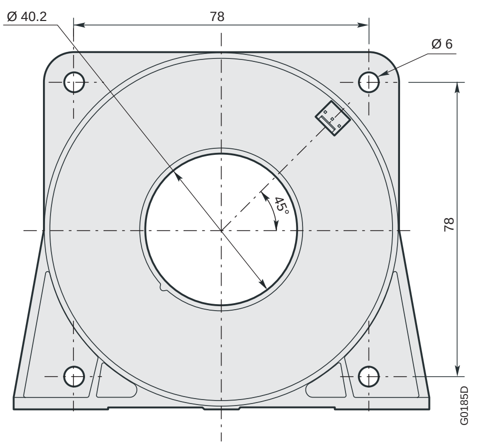
EN61000-6-2

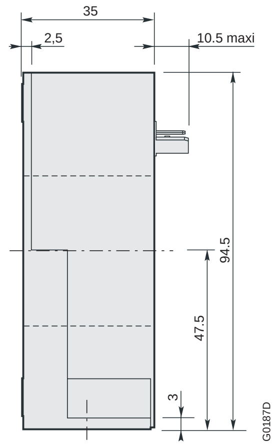
CE

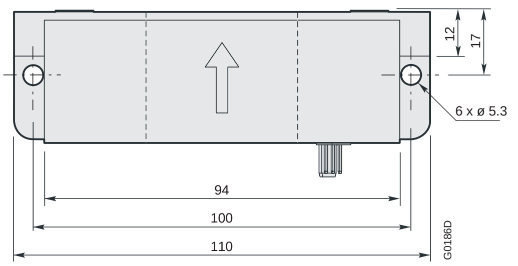
: ESM sensors with cables.
File number: E166814 Vol 1

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

Dimensions (in mm)

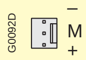




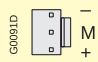


ESM1000C / ESM1000S / ESM1000F / ESM1000L / ESM1000-9888
ESM1000-9887 / ESM1000-9886 / ESM1000-9935

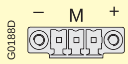
Standard ESM1000... sensor secondary connection



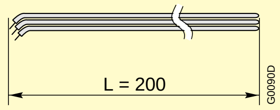
Molex connector
(with 2.54 mm pitch)



JST connector
(with 3.81 mm pitch)



Lockable connector
(with 3.81 mm pitch)



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

Notes

Traction Current Sensors


1SBC7 7914 2F0301

CS300BR


1SBC7 7917 2F0301

CS300BRV


1SBC7 7915 2F0301

CS1000BRV


1SBC7 8977 4F0302

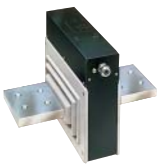
CS2000BR


1SBC7 8978 4F0302

CS2000BRV

Type	Nominal primary current (A r.m.s.)	Secondary current at I_{PN} (mA)	Supply voltage (V)	Secondary connection	Order code
CS300BR	300	150	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170300R0001
CS300BRV	300	150	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170300R0002
CS300BRE	300	150	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170300R0003
CS300BRVE	300	150	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170300R0004
CS503BR	500	142.86	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170503R0001
CS503BRV	500	142.86	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170503R0002
CS503BRE	500	142.86	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170503R0003
CS503BRVE	500	142.86	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170503R0004
CS500BR	500	100	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170500R0001
CS500BRV	500	100	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170500R0002
CS500BRE	500	100	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170500R0003
CS500BRVE	500	100	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170500R0004
CS500-9936	500	125	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170500R9936
CS500-9937	500	125	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT170500R9937
CS500-9938	500	125	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170500R9938
CS500-9939	500	125	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT170500R9939
CS1000BR	1000	200	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT171000R0001
CS1000BRV	1000	200	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT171000R0002
CS1000BRE	1000	200	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT171000R0003
CS1000BRVE	1000	200	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT171000R0004
CS1000-9940	1000	250	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT171000R9940
CS1000-9941	1000	250	±15 … ±24	3 x M5 studs // 3 x 6,35 x 0,8 Faston	1SBT171000R9941
CS1000-9942	1000	250	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT171000R9942
CS1000-9943	1000	250	±15 … ±24	4 x M5 studs // 4 x 6,35 x 0,8 Faston	1SBT171000R9943
CS2000BR	2000	400	±15 … ±24	4 x M5 studs	1SBT172000R0003
CS2000BRV	2000	400	±15 … ±24	4 x M5 studs	1SBT172000R0004
CS2000-9944	2000	500	±15 … ±24	4 x M5 studs	1SBT172000R9944
CS2000-9945	2000	500	±15 … ±24	4 x M5 studs	1SBT172000R9945

These current sensors are specially designed and manufactured for Traction applications (e.g.: fixed installations or rolling stock). The requirements for the sensors within these applications are generally higher than those for Industry applications (larger temperature operating 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.



1SBC7 7209 4F0301

TC030

1SBC7 7207 4F0301

TC050

1SBC7 7208 3F0301

TC060

Type	Nominal primary current	Secondary current at I_{PN} (mA)	Supply voltage (V)	Secondary connection	Order code
TC030XEFHN2N	3000 A r.m.s.	300	±15 … ±24	4 x 6,35 x 0,8 Faston and cable gland Pg 11	TC030XEFHN2N
TC050XEFHN2N	5000 A d.c.	1000	±15 … ±24	4 x 6,35 x 0,8 Faston and cable gland Pg 11	TC050XEFHN2N
TC060AEFHN2N	6000 A d.c.	1200	±15 … ±24	4 x 6,35 x 0,8 Faston and cable gland Pg 11	TC060AEFHN2N

Traction Current Sensors CS range

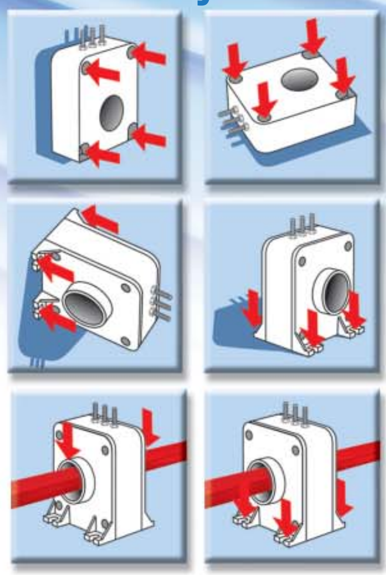
Incomparable modularity

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° and +85°C) make CS current sensors ideal for use in other very demanding applications (marine, wind-power, ozone generators, etc.)

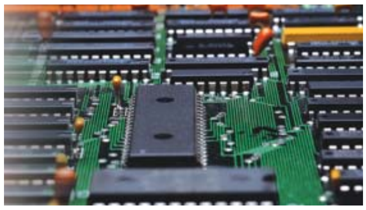
Incomparable protection against magnetic fields

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

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

			CS300BR	CS503BR	CS500BR	CS500-9936
Horizontal mounting			CS300BR	CS503BR	CS500BR	CS500-9936
Vertical mounting			CS300BRV	CS503BRV	CS500BRV	CS500-9937
Horizontal + Screen			CS300BRE	CS503BRE	CS500BRE	CS500-9938
Vertical + Screen			CS300BRVE	CS503BRVE	CS500BRVE	CS500-9939
Nominal primary current		**A r.m.s.**	300	500	500	500
Measuring range	@ ±15V (±5%)	**A peak**	±600	-	-	±1000
Measuring range	@ ±24V (±5%)	**A peak**	±600	±750	±1000	±1000
Not measurable overload	10ms/hour	**A peak**	3000	5000	5000	5000
Max. measuring resistance	@ I_P max & ±15V (±5%)	Ω	12	-	-	12
Max. measuring resistance	@ I_P max & ±24V (±5%)	Ω	40	6	37	46
Min. measuring resistance	@ I_{PN} & ±15V (±5%)	Ω	0	-	-	0
Min. measuring resistance	@ I_{PN} & ±24V (±5%)	Ω	32	0	0	0
Turn number			2000	3500	5000	4000
Secondary current at I_{PN}		**mA**	150	142.86	100	125
Accuracy at I_{PN}	@ +25°C	**%**	≤±0.5	≤±0.5	≤±0.5	≤±0.5
Accuracy at I_{PN}	-40 … +85°C	**%**	≤±1	≤±1	≤±1	≤±1
Offset current	@ +25°C & ±24V (±5%)	**mA**	≤±0.6	≤±0.3	≤±0.25	≤±0.3
Linearity		**%**	≤0.1	≤0.1	≤0.1	≤0.1
Thermal drift coefficient	-40 … +85°C	**µA/°C**	≤10	≤7	≤5	≤6
Delay time		**µs**	≤1	≤1	≤1	≤1
di/dt correctly followed		**A / µs**	≤100	≤100	≤100	≤100
Bandwidth	-1dB	**kHz**	≤100	≤100	≤100	≤100
Max. no-load consumption current	@ ±24V (±5%)	**mA**	≤10	≤15	≤15	≤15
Secondary resistance	@ +85°C	Ω	≤27	≤88	≤64	≤35
Dielectric strength Primary/Secondary (or Primary/(Secondary+Screen) if relevant)	50 Hz, 1 min	**kV**	6.5	6.5	12	12
Dielectric strength Secondary/Screen (if relevant)	50 Hz, 1 min	**kV**	0.5	0.5	0.5	0.5
Supply voltage	±5%	**V dc**	±15 … ±24	±15 … ±24	±15 … ±24	±15 … ±24
Voltage drop		**V**	≤2.5	≤2.5	≤2.5	≤2.5
Mass		**kg**	0.36	0.36	0.78	0.78
Mass with side plates		**kg**	0.45	0.45	0.95	0.95
Operating temperature		**°C**	-40 …+85	-40 …+85	-40 …+85	-40 …+85
Storage temperature		**°C**	-50 … +90	-50 … +90	-50 … +90	-50 … +90

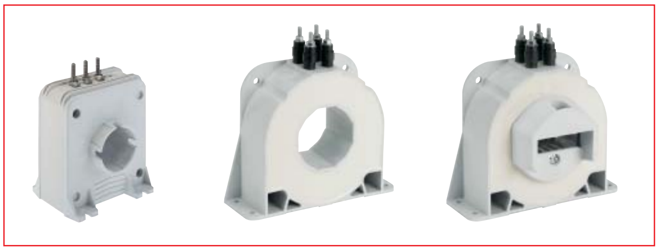
General data

- 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.

CS1000 / CS2000



Technical data

			CS1000		CS2000	
Horizontal mounting			CS1000BR	CS1000-9940	CS2000BR*	CS20009944*
Vertical mounting			CS1000BRV	CS1000-9941	CS2000BR*	CS20009944*
Horizontal + Screen			CS1000BRE	CS1000-9942	CS2000BR*	CS2000-9944*
Vertical + Screen			CS1000BRVE	CS1000-9943	CS2000BRV	CS2000-9945
Nominal primary current		A r.m.s.	1000	1000	2000	2000
Measuring range	@ ±15V (±5%)	A peak	-	-	-	-
Measuring range	@ ±24V (±5%)	A peak	±2000	±2000	±3000	±3000
Not measurable overload	10ms/hour	A peak	10000	10000	20000	20000
Max. measuring resistance	@ I_P max & ±15V (±5%)	Ω	-	-	-	-
Max. measuring resistance	@ I_P max & ±24V (±5%)	Ω	4	7	5	9
Min. measuring resistance	@ I_{PN} & ±15V (±5%)	Ω	-	-	-	-
Min. measuring resistance	@ I_{PN} & ±24V (±5%)	Ω	0	0	0	0
Turn number			5000	4000	5000	4000
Secondary current at I_{PN}		mA	200	250	400	500
Accuracy at I_{PN}	@ +25°C	%	≤±0.5	≤±0.5	≤±0.5	≤±0.5
Accuracy at I_{PN}	-40 … +85°C	%	≤±1	≤±1	≤±1	≤±1
Offset current	@ +25°C & ±24V (±5%)	mA	≤0.25	≤0.25	≤0.25	≤0.25
Linearity		%	≤0.1	≤0.1	≤0.1	≤0.1
Thermal drift coefficient	-40 … +85°C	µA/°C	≤10	≤12.5	≤20	≤25
Delay time		µs	≤1	≤1	≤1	≤1
di/dt correctly followed		A / µs	≤100	≤100	≤100	≤100
Bandwidth	-1dB	kHz	≤100	≤100	≤100	≤100
Max. no-load consumption current	@ ±24V (±5%)	mA	≤15	≤15	≤25	≤25
Secondary resistance	@ +85°C	Ω	≤46	≤34	≤30	≤20
Dielectric strength Primary/Secondary (or Primary/(Secondary+Screen) if relevant)	50 Hz, 1 min	kV	12	12	12	12
Dielectric strength Secondary/Screen (if relevant)	50 Hz, 1 min	kV	0.5	0.5	1.5	1.5
Supply voltage	±5%	V dc	±15 … ±24	±15 … ±24	±15 … ±24	±15 … ±24
Voltage drop		V	≤2.5	≤2.5	≤1.5	≤1.5
Mass		kg	0.85	0.85	1.5	1.5
Mass with side plates		kg	1	1	1.66	1.66
Operating temperature		°C	-40 …+85	-40 …+85	-40 …+85	-40 …+85
Storage temperature		°C	-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 22 for details.

Accessories

- Side plate kits (including 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 plates for CS2000)
- Mounting bar kits (including 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

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^3, 0.280 kg	1SBT170000R2003
Bar kit CST1-6	CS500 & CS1000	6x40x185 mm^3, 0.510 kg	1SBT170000R2004
Bar kit CST1-10	CS500 & CS1000	10x40x185 mm^3, 0.760 kg	1SBT170000R2005
Bar kit CST1 special	CS500 & CS1000	10x40x210 mm^3, 0.8 kg (for compatibility with TA600, TA800 and EA1000 sensors)	1SBT170000R2010
Bar kit CST2	CS2000	20x60x240 mm^3, 2.5 kg	1SBT170000R2011
Bar kit CST2 special	CS2000	20x60x370 mm^3, 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	4000	3500
	2500	5000	

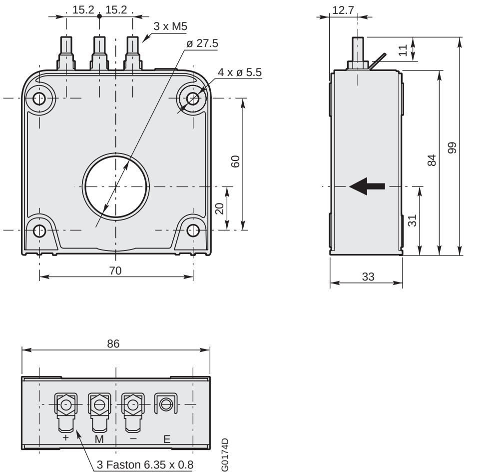
Secondary connection:

Sensor	CS300 & CS503	CS500 & CS1000	CS2000
Secondary connection	-	-	3 M5 studs
	3 M5 inserts	3 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	Shielded cable	Shielded cable

CS Traction Current Sensors

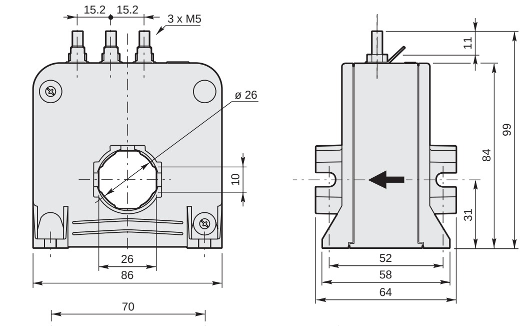
Dimensions (in mm)

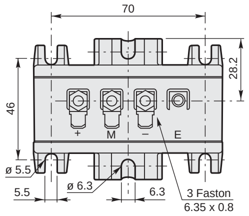
Horizontal mounting



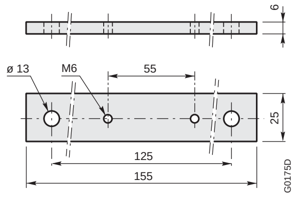
Size 0 - CS300BR and CS503BR

Vertical mounting



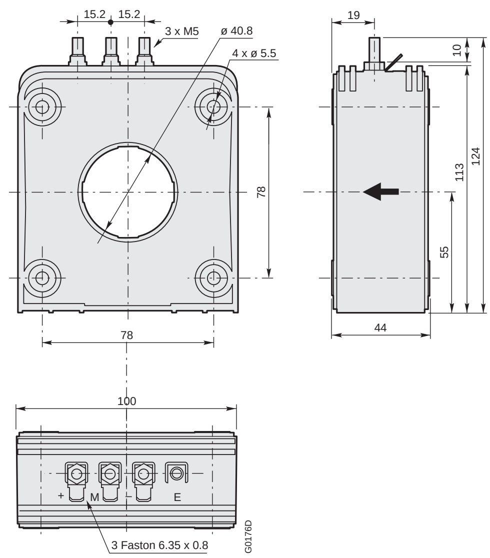


Size 0 - CS300BRV and CS503BRV



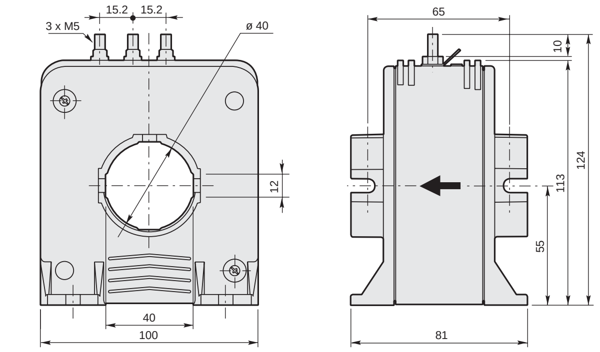
Bar CST0

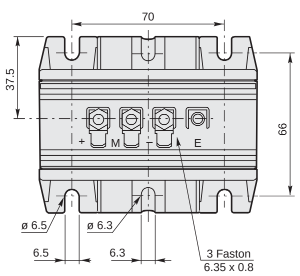
Horizontal mounting



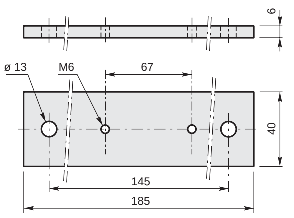
Size 1 - CS500BR and CS1000BR

Vertical mounting

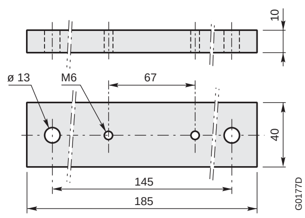




Size 1 - CS500BRV and CS1000BRV



Bar CST1-6



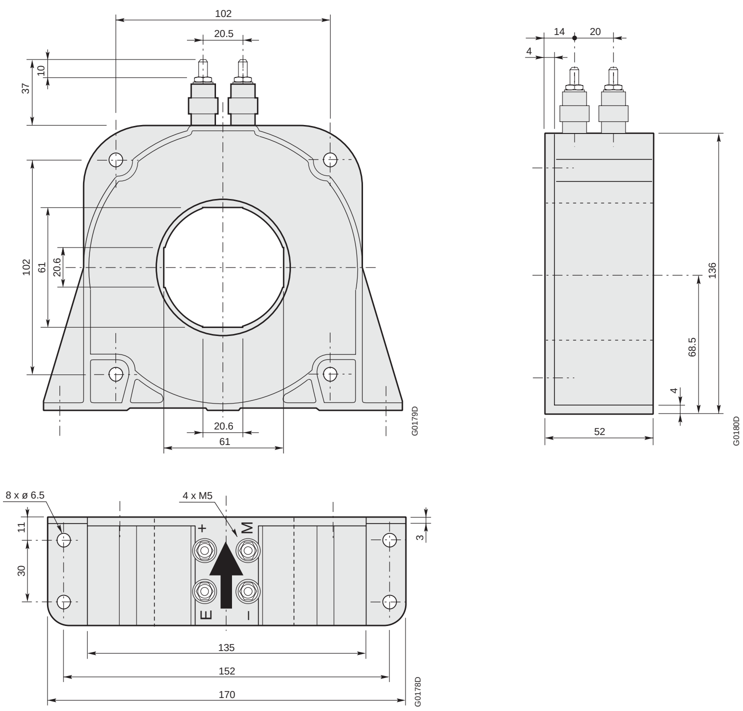
Bar CST1-10

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

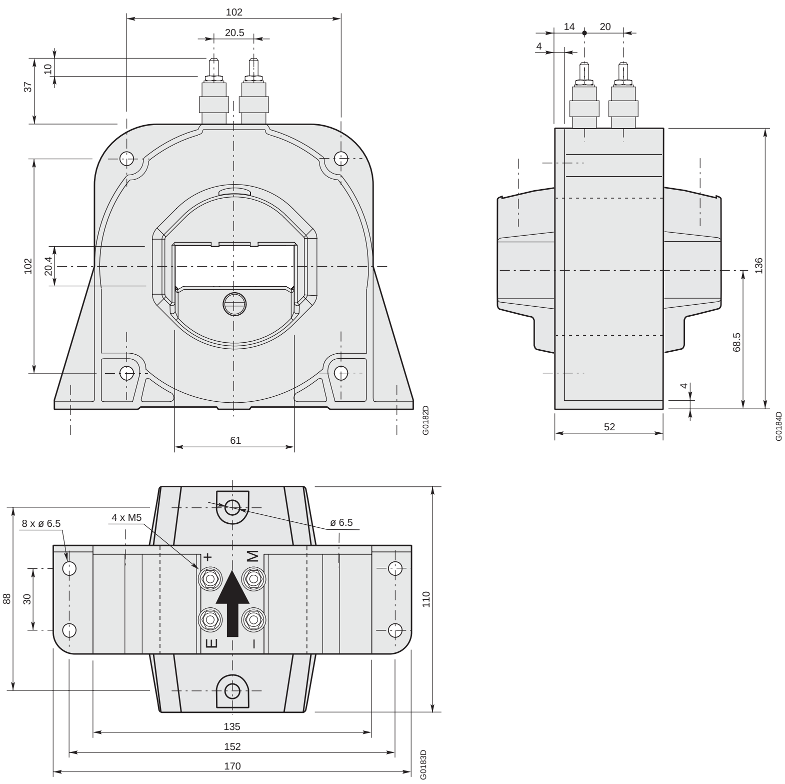
Dimensions (in mm)

Horizontal and vertical mounting

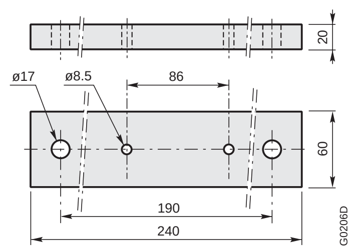


Size 2 - CS2000BR

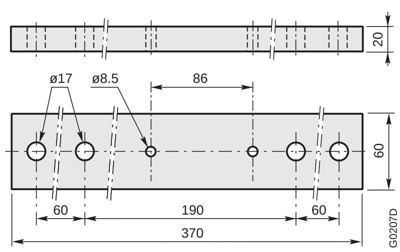
Horizontal and vertical mounting



Size 2 - CS2000BRV



Bar CST2



Bar CST2 special

1SBC140142C0201

Notes

TC Traction Current Sensors

Utilisation

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

TC030	TC050	TC060
		

Technical data

			TC030XEFHN2N	TC050XEFHN2N	TC060AEFHN2N
Nominal primary current		**A r.m.s.**	3000	-	-
Nominal primary current		**A dc**	-	5000	6000
Measuring range	@ ±24V	**A peak**	±5000	±8000	±12000
Not measurable overload	10ms/hour	**A peak**	6000	18000	18000
Max. measuring resistance	@ I_P max & ±24V	Ω	7	5	5
Min. measuring resistance	@ I_{PN} & ±15V	Ω	1	0	0
Min. measuring resistance	@ I_{PN} & ±24V	Ω	34	9	7
Turn number			10000	5000	5000
Secondary current at I_{PN}		**mA**	300	1000	1200
Accuracy at I_{PN}	-25 … +70°C	**%**	≤±1	≤±1	≤±1
Offset current	@ +25°C & ±24V (±5%)	**mA**	≤±0.25	≤±0.2	≤±0.2
Linearity		**%**	≤0.1	≤0.1	≤0.1
Thermal drift coefficient	-25 … +70°C	**µA/°C**	≤30	≤100	≤120
Delay time		**µs**	≤1	≤1	≤1
di/dt correctly followed		**A / µs**	≤50	≤50	≤100
Max. no-load consumption current	@ ±15V (±5%)	**mA**	≤50	≤50	≤50
Max. no-load consumption current	@ ±24V (±5%)	**mA**	≤60	≤60	≤60
Secondary resistance	@ +70°C	Ω	≤35	≤9	≤9
Dielectric strength Primary/(Secondary+Screen)	50 Hz, 1 min	**kV**	12	12	12
Dielectric strength Secondary/Screen	50 Hz, 1 min	**kV**	1	1	1
Supply voltage	±10%	**V dc**	±15 … ±24	±15 … ±24	±15 … ±24
Mass		**kg**	17	20	11.5
Operating temperature		**°C**	-25 …+70	-25 …+70	-25 …+70
Storage temperature		**°C**	-40 …+85	-40 …+85	-40 …+85

General data

- Plastic case and insulating resin are self-extinguishing.
- Bar mounting for TC030XEFHN2N and TC050XEFHN2N.
- Vertical Fixing by holes in the case for TC060AEFHN2N.
- 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 standard TC sensors have an electrostatic screen connected to the screen terminal «E».

Primary connection

- Primary bar for TC030XEFHN2N and TC050XEFHN2N.
- Hole for primary conductor for TC060AEFHN2N.

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

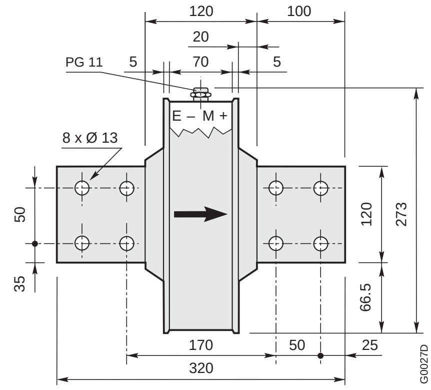
Standard secondary connection

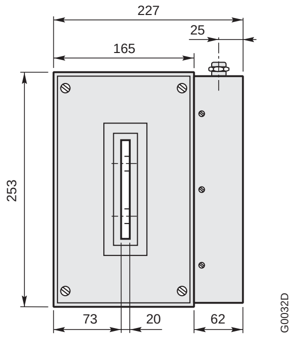
- Faston 6.35 x 0.8 and cable gland Pg 11.

Accessories and options

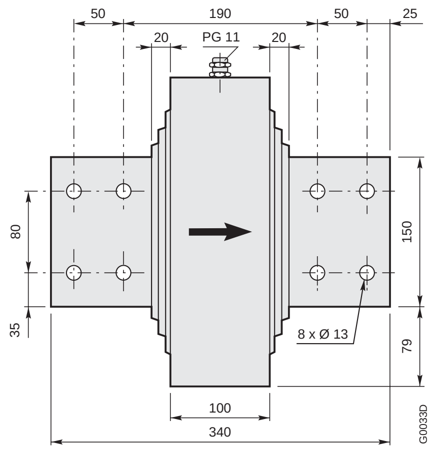
Please contact your distributor for specific requirements.

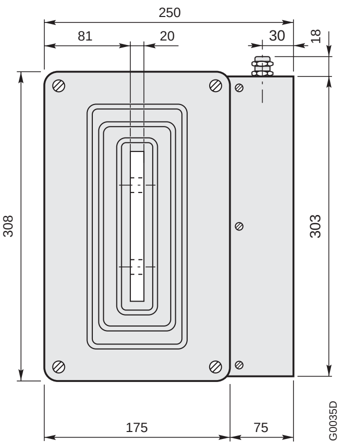
Dimensions (in mm)



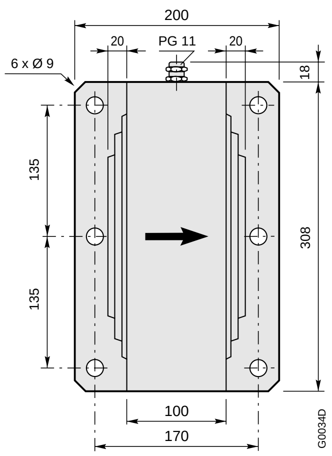


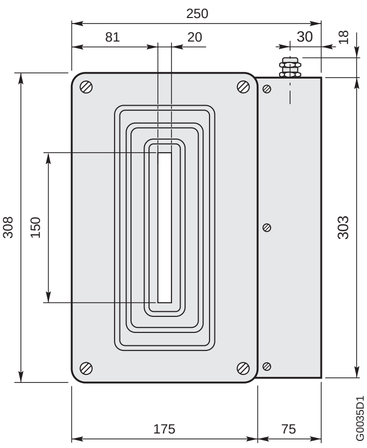
TC030





TC050





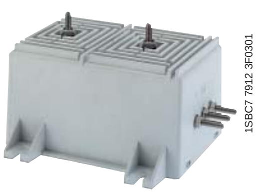
TC060

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.

VS50B to VS1500B



VS2000B to VS4200B

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

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

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

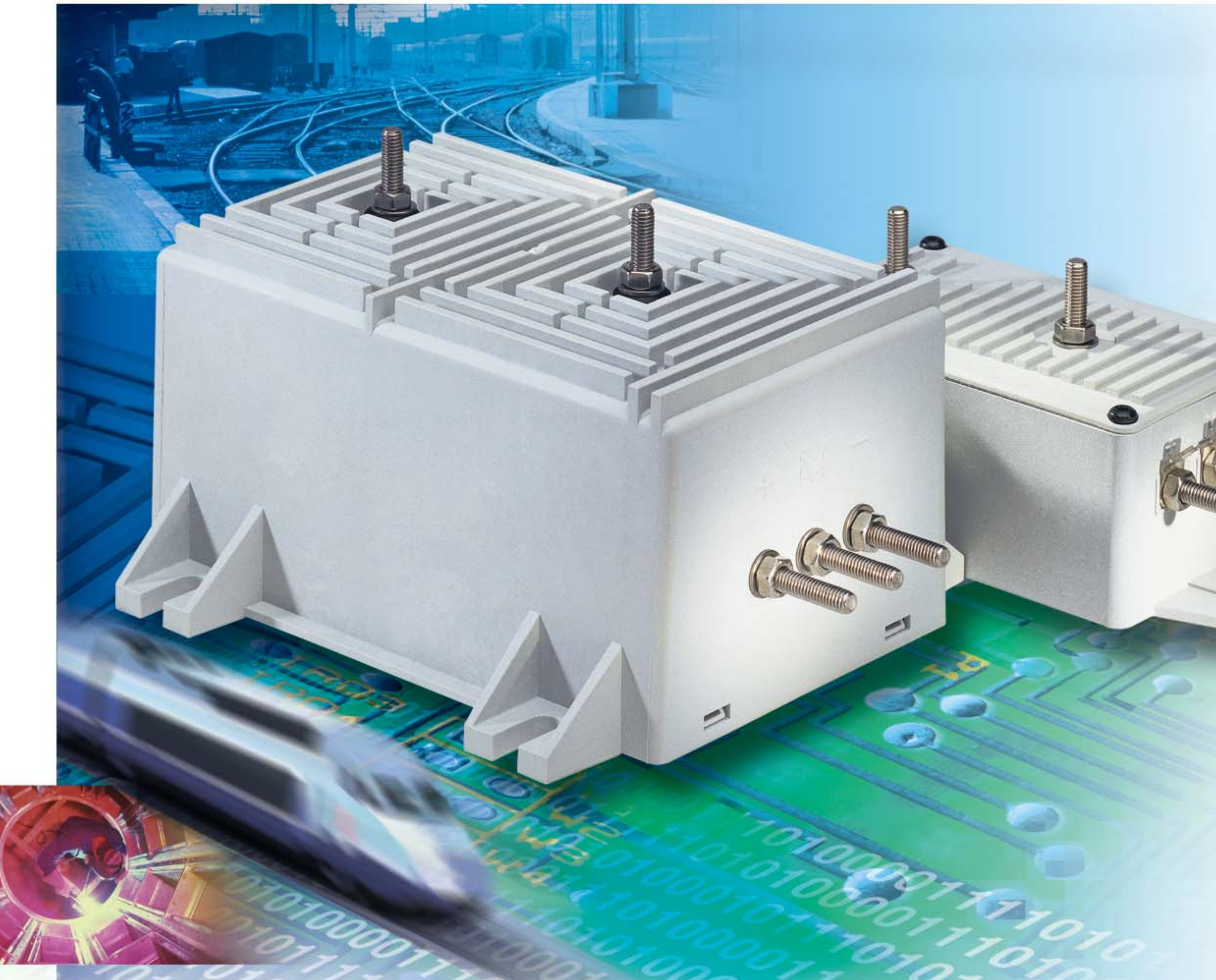
Not calibrated EM010

EM010BBFHP1N

EM010TENHP1N

Type	Nominal primary current I_{PN} (mA r.m.s.)	Secondary current at I_{PN} (mA)	Supply voltage (V)	Secondary connection	Order code
EM010BBFHP1N	10	50	±12 … ±24	3 x M5 studs	EM010BBFHP1N
EM010BEFHP1N	10	50	±12 … ±24	3 x 6,35 x 0,8 Faston	EM010BEFHP1N
EM010TENHP1N	10	50	±12 … ±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 only 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° and +85°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

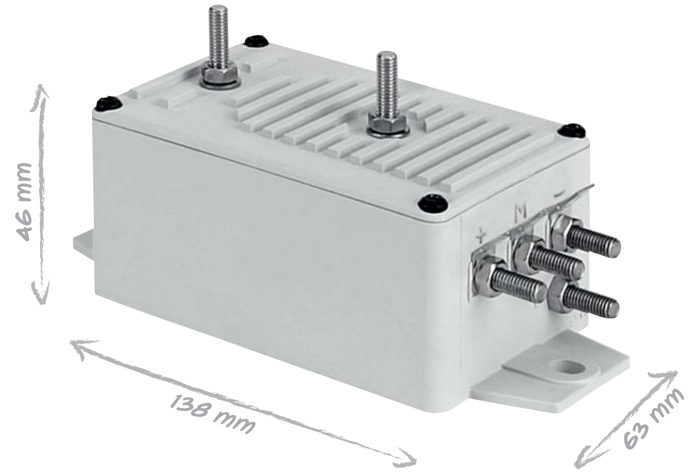


ABB have applied the notion "Small is beautiful" to its products.
By integrating the notion of reduced size into their VS sensors, ABB have brought miniaturization to a point of perfection.
This miniaturization gives great flexibility of installation. The great breakthrough with VS sensors is that they 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

VS Traction Voltage Sensors

Utilisation

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

VS50B to VS500B

Technical data

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

Max. common mode voltage

The following two conditions must be continuously and simultaneously respected:

1) $U_{HT+} + U_{HT-} \leq 4.2$ 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.

VS Traction Voltage Sensors

VS750B to VS1500B

Technical data

			VS750B	VS1000B	VS1500B
Nominal primary voltage		**V r.m.s.**	750	1000	1500
Measuring range	@ ±12V (±5%)	**V peak**	±1125	±1500	±2250
Measuring range	@ ±24V (±5%)	**V peak**	±1125	±1500	±2250
Not measurable overload	1s/hour	**V peak**	2250	3000	4500
Max. measuring resistance	@ U_P max & ±12V (±5%)	**Ω**	67	67	67
Max. measuring resistance	@ U_P max & ±24V (±5%)	**Ω**	188	188	188
Min. measuring resistance	@ U_{PN} & ±24V (±5%)	**Ω**	0	0	0
Secondary current at U_{PN}		**mA**	50	50	50
Accuracy at U_{PN}	@ +25°C	**%**	≤±0.9	≤±0.9	≤±0.9
Accuracy at U_{PN}	-25 … +70°C	**%**	≤±1.5	≤±1.5	≤±1.5
Accuracy at U_{PN}	-40 … +85°C	**%**	≤±1.7	≤±1.7	≤±1.7
Offset current	@ +25°C & ±24V (±5%)	**mA**	≤±0.15	≤±0.15	≤±0.15
Linearity	$0.1U_{PN}$ … $1.5U_{PN}$	**%**	≤0.3	≤0.3	≤0.3
Delay time		**µs**	≤10	≤10	≤10
dv/dt correctly followed		**V / µs**	≤9	≤12	≤18
Bandwidth	-3 dB & R_M = 50 Ω	**kHz**	≤13	≤13	≤13
Max. no-load consumption current	@ ±24V (±5%)	**mA**	≤50	≤50	≤50
Dielectric strength Primary/(Secondary+Screen)	50 Hz, 1 min	**kV**	4.3	5.5	6.5
Dielectric strength Secondary/Screen	50 Hz, 1 min	**kV**	0.5	0.5	0.5
Partial discharges : extinction voltage	@10pC, 50Hz	**kV**	≥1.1	≥2.2	≥2.2
Supply voltage	±5%	**V dc**	±12 … ±24	±12 … ±24	±12 … ±24
Mass		**kg**	0.450	0.450	0.450
Operating temperature		**°C**	-40 …+85	-40 …+85	-40 …+85
Storage temperature		**°C**	-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 cables.
- Secondary connection: Shielded cable, M5 inserts, Lemo connector.

For other options please contact us.

Conformity

EN50155

EN50121-3-2

EN50124-1

CE

VS Traction Voltage Sensors

Utilisation

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

VS2000B to VS4200B

Technical data

			VS2000B	VS3000B	VS4000B	VS4200B
Nominal primary voltage		V r.m.s.	2000	3000	4000	4200
Measuring range	@ ±12V (±5%)	V peak	±3000	±4500	±6000	±6000
Measuring range	@ ±24V (±5%)	V peak	±3000	±4500	±6000	±6000
Not measurable overload	1s/hour	V peak	6000	9000	12000	12000
Max. measuring resistance	@ U_P max & ±12V (±5%)	Ω	61	61	61	67
Max. measuring resistance	@ U_P max & ±24V (±5%)	Ω	183	183	183	195
Min. measuring resistance	@ U_{PN} & ±24V (±5%)	Ω	0	0	0	0
Secondary current at U_{PN}		mA	50	50	50	50
Accuracy at U_{PN}	@ +25°C	%	≤±0.9	≤±0.9	≤±0.9	≤±0.9
Accuracy at U_{PN}	-25 … +70°C	%	≤±1.5	≤±1.5	≤±1.5	≤±1.5
Accuracy at U_{PN}	-40 … +85°C	%	≤±1.7	≤±1.7	≤±1.7	≤±1.7
Offset current	@ +25°C & ±24V (±5%)	mA	≤±0.15	≤±0.15	≤±0.15	≤±0.15
Linearity	$0.1U_{PN}$ … $1.5U_{PN}$	%	≤0.3	≤0.3	≤0.3	≤0.3
Delay time		µs	≤10	≤10	≤10	≤10
dv/dt correctly followed		V / µs	≤24	≤36	≤48	≤50
Bandwidth	-3 dB & R_M = 50 Ω	kHz	≤13	≤13	≤13	≤13
Max. no-load consumption current	@ ±24V (±5%)	mA	≤50	≤50	≤50	≤50
Dielectric strength Primary/Secondary	50 Hz, 1 min	kV	8	12	12	12
Partial discharges : extinction voltage	@10pC, 50Hz	kV	≥4.3	≥4.3	≥4.3	≥4.3
Supply voltage	±5%	V dc	±12 … ±24	±12 … ±24	±12 … ±24	±12 … ±24
Mass		kg	1.5	1.5	1.5	1.5
Operating temperature		°C	-40 …+85	-40 …+85	-40 …+85	-40 …+85
Storage temperature		°C	-50 … +90	-50 … +90	-50 … +90	-50 … +90

Max. common mode voltage

The following two conditions must be continuously and simultaneously respected:

1) $U_{HT+} + U_{HT-} \leq 10$ 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 cables.
- Secondary connection: Shielded cable, M5 inserts, Lemo connector.
- Nominal secondary current I_{SN}:
  I_{SN} (for U_{PN})= 20 mA, I_{SN} (for U_{PN})= 80 mA.

For other options please contact us.

Conformity

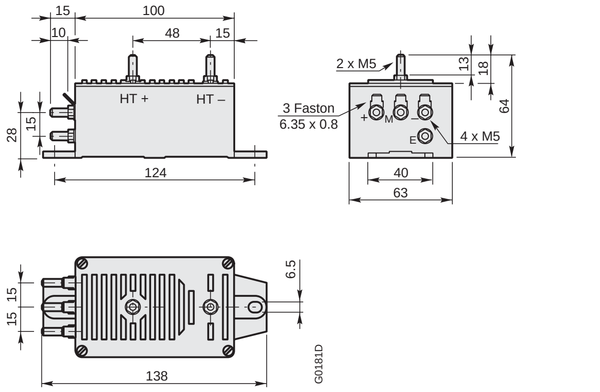
EN50155

EN50121-3-2

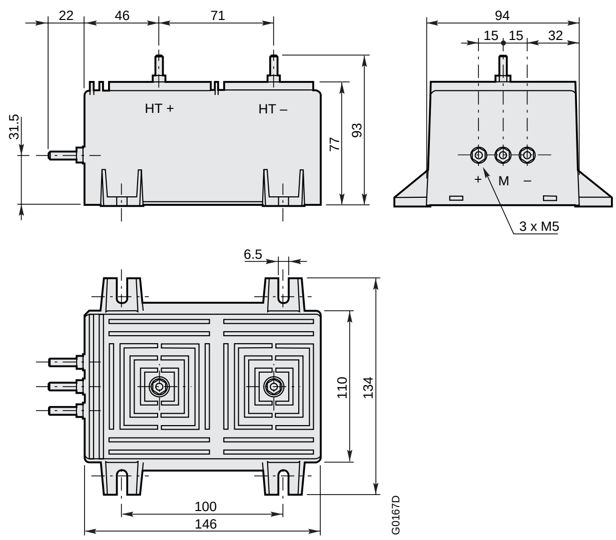
EN50124-1

CE

Dimensions (in 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» et «-HT» (see diagram below).
The primary resistance R is made up from the integrated input resistance R_E in series with the resistance R_P of the primary winding: $R = R_E + R_P$

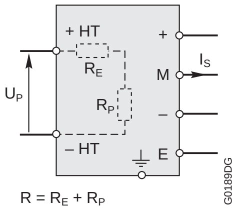
EM010 from 600 to 1500 V

Technical data

			EM010-9239	EM010-9240	EM010-9371	EM010-9317
Nominal primary voltage		V r.m.s.	600	750	1000	1500
Measuring range		V peak	±900	±1125	±1500	±2250
Min. measuring resistance	@ U_{PN} & ±15V	Ω	0	0	0	0
Primary turn number			10000	7500	15000	15000
Secondary turn number			2000	2000	2000	2000
Secondary current at U_{PN}		mA	50	50	50	50
Accuracy at U_{PN}	@ +25°C	%	≤±1	≤±1	≤±1	≤±1
Offset current	@ +25°C	mA	≤±0.3	≤±0.3	≤±0.3	≤±0.3
Linearity		%	≤±0.1	≤±0.1	≤±0.1	≤±0.1
Thermal drift coefficient	-25 … +70°C	µA/°C	≤±5	≤±5	≤±5	≤±5
Delay time		µs	≤100	≤100	≤100	≤100
Max. no-load consumption current	@ ±12V	mA	15	15	15	15
Max. no-load consumption current	@ ±24V	mA	25	25	25	25
Primary resistance	@ +25°C	k Ω	60	56	150	225
Secondary resistance	@ +70°C	Ω	60	60	60	60
Dielectric strength Primary/(Secondary+Screen+Ground)	50 Hz, 1 min	kV	6	6	12	12
Dielectric strength Secondary/(Screen+Ground)	50 Hz, 1 min	kV	1	1	1	1
Supply voltage	±10%	V dc	±12 … ±24	±12 … ±24	±12 … ±24	±12 … ±24
Voltage drop		V	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Mass		kg	0.550	0.550	0.550	0.550
Operating temperature		°C	-25 …+70	-25 …+70	-25 …+70	-25 …+70
Storage temperature		°C	-40 …+85	-40 …+85	-40 …+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

Diagram

Calibrated EM010



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 ⏚ 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
Nominal primary voltage		**V r.m.s.**	2000	3000	4200	5000
Measuring range		**V peak**	±3000	±4500	±8000	±8000
Min. measuring resistance	@ U_{PN} & ±15V	Ω	0	0	0	0
Primary turn number			20000	30000	30000	20000
Secondary turn number			2000	2000	1260	1000
Secondary current at U_{PN}		**mA**	50	50	50	50
Accuracy at U_{PN}	@ +25°C	**%**	≤±1	≤±1	≤±1	≤±1
Offset current	@ +25°C	**mA**	≤±0.3	≤±0.3	≤±0.3	≤±0.3
Linearity		**%**	≤±0.1	≤±0.1	≤±0.1	≤±0.1
Thermal drift coefficient	-25 … +70°C	**µA/°C**	≤±5	≤±5	≤±5	≤±5
Delay time		**µs**	≤100	≤100	≤100	≤100
Max. no-load consumption current	@ ±12V	**mA**	15	15	15	15
Max. no-load consumption current	@ ±24V	**mA**	25	25	25	25
Primary resistance	@ +25°C	**k Ω**	400	900	2000	2000
Secondary resistance	@ +70°C	Ω	60	60	25	20
Dielectric strength Primary/(Secondary+Screen+Ground)	50 Hz, 1 min	**kV**	12	12	12	12
Dielectric strength Secondary/(Screen+Ground)	50 Hz, 1 min	**kV**	1	1	1	1
Supply voltage	±10%	**V dc**	±12 … ±24	±12 … ±24	±12 … ±24	±12 … ±24
Voltage drop		**V**	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5
Mass		**kg**	0.550	0.550	0.550	0.550
Operating temperature		**°C**	-25 …+70	-25 …+70	-25 …+70	-25 …+70
Storage temperature		**°C**	-40 …+85	-40 …+85	-40 …+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

Options

- Other connection types
- Other temperature operating ranges.

For other options please contact us.

Conformity

CE

Not Calibrated EM010 Traction Voltage Sensors

Utilisation

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

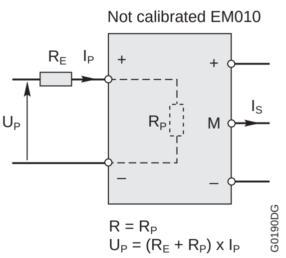
Warning: The voltage U_P to be measured cannot be directly applied to the primary terminals marked «+» and «-» for not calibrated EM010 sensors.
In order to use these not calibrated EM010 sensors for voltage measurement, an input resistance R_E must be added to the primary (see diagram below).
The voltage rating is determined from the value of this resistance R_E (refer to calculation examples at the end of this catalogue). The primary resistance R is made up of the primary winding resistance R_P: $R = R_P$

EM010BBFHP1N / EM010TENHP1N

Technical data

			EM010BBFHP1N	EM010BEFHP1N	EM010TENHP1N
Nominal primary current		mA r.m.s.	10	10	10
Measuring range		mA Peak	20	20	20
Overload	2s/hour	mA Peak	20	20	20
Max. measuring resistance	@ I_P max & ±12V	Ω	40	40	40
Max. measuring resistance	@ I_P max & ±24V	Ω	160	160	160
Min. measuring resistance	@ U_{PN} & ±15V	Ω	0	0	0
Primary turn number			10000	10000	10000
Secondary turn number			2000	2000	2000
Secondary current at I_{PN}		mA	50	50	50
Accuracy at I_{PN}	@ +25°C	%	≤±1	≤±1	≤±1
Offset current	@ +25°C	mA	≤±0.3	≤±0.3	≤±0.3
Linearity		%	≤±0.1	≤±0.1	≤±0.1
Thermal drift coefficient	-25 … +70°C	µA / °C	≤±5	≤±5	≤±5
Delay time		µs	≤100	≤100	≤100
Max. no-load consumption current	@ ±12V	mA	15	15	15
Max. no-load consumption current	@ ±24V	mA	25	25	25
Primary resistance	@ +25°C	kΩ	1.5	1.5	1.5
Secondary resistance	@ +70°C	Ω	60	60	60
Dielectric strength Primary/Secondary	50 Hz, 1 min	kV	6	6	6
Supply voltage	±10%	V dc	±12 … ±24	±12 … ±24	±12 … ±24
Voltage drop		V	≤ 1.5	≤ 1.5	≤ 1.5
Mass		kg	0.350	0.350	0.350
Operating temperature		°C	-25 …+70	-25 …+70	-25 …+70
Storage temperature		°C	-40 …+85	-40 …+85	-40 …+85
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

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.
- 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 primary winding resistance R_P: $R = R_P$

Options

- Other connection types.
- Other temperature operating ranges.

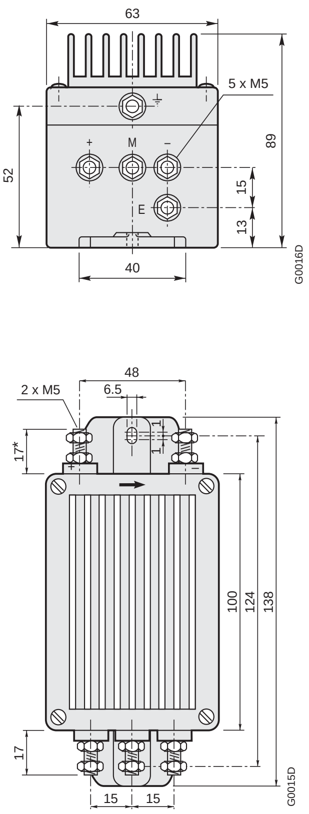
For other options please contact us.

Conformity

CE

EM010 Traction Voltage Sensors

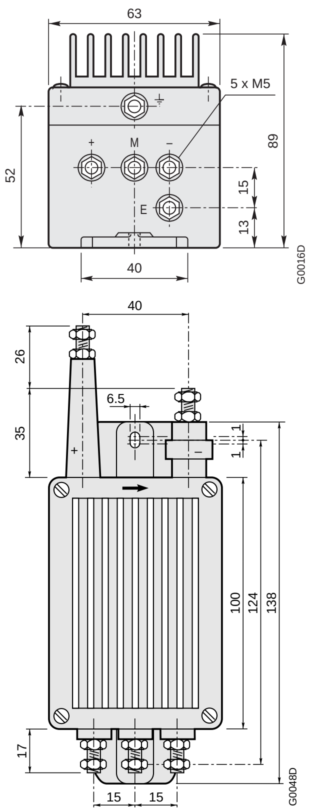
Dimensions (in mm)



Calibrated EM010

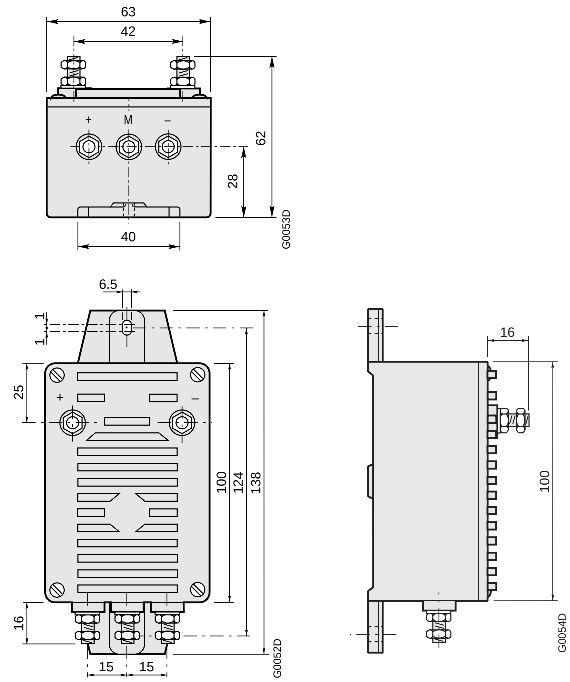
600 V ≤ U_N ≤ 2000 V

* 35 mm for U_N = 1500 and 2000 V

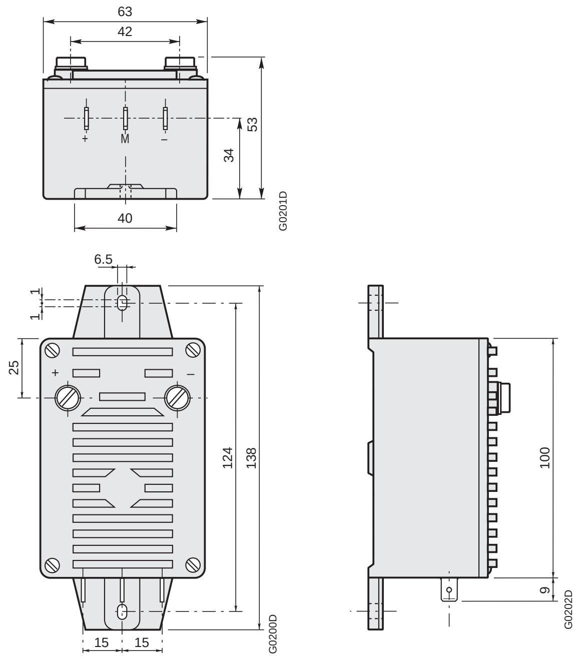


Calibrated EM010

U_N ≥ 3000 V



Not calibrated EM010BBFHP1N



Not calibrated EM010TENHP1N

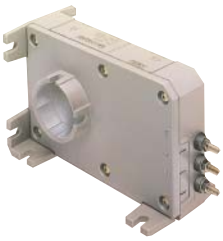
Other Products


5594

EA100


1SBC7 7200 3F0301

EA101 to EA400


1SBC7 7202 3F0301

EA1000


1SBC7 7203 3F0301

EA2000


1SBC7 7205 3F0301

NK...


1SBC7 6249 5F0301

TM020

Traction current sensors

Technical data		EA100	EA101
Nominal primary current	A r.m.s.	100	100
Turn number		1000	1000
Supply voltage	V d.c.	±12…±18 (±10%)	±12…±18 (±10%)
Secondary connection		3 x 6.35 x 0.8 Faston	3 x 6.35 x 0.8 Faston
Operating temperature	°C	-25…+70	-25…+70

Technical data		EA200	EA300	EA400
Nominal primary current	A r.m.s.	200	300	400
Turn number		2000	2000	2000
Supply voltage	V d.c.	±12…±18 (±10%)	±12…±18 (±10%)	±12…±18 (±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	°C	-25…+70	-25…+70	-25…+70

Technical data		EA1000	EA2000
Nominal primary current	A r.m.s.	1000	2000
Turn number		5000	5000
Supply voltage	V d.c.	±15…±24 (±10%)	±15…±24 (±10%)
Secondary connection		3 x 6.35 x 0.8 Faston or 3 x M5 studs	3 x 6.35 x 0.8 Faston or 3 x M5 studs
Operating temperature	°C	-25…+70	-25…+70

Technical data		NK050	NK100	NK200
Nominal primary current	A r.m.s.	50	100	200
Turn number		500	1000	2000
Supply voltage	V d.c.	±15…±28	±15…±28	±15…±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	4 x 6.35 x 0.8 Faston or 4 x M4 studs
Operating temperature	°C	-25…+70	-25…+70	-25…+70

Technical data		NK400	NK500	NK1000
Nominal primary current	A r.m.s.	400	500	1000
Turn number		4000	5000	5000
Supply voltage	V d.c.	±15…±28	±15…±28	±15…±24
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	4 x 6.35 x 0.8 Faston or 4 x M4 studs
Operating temperature	°C	-25…+70	-25…+70	-25…+70

Traction voltage sensors

Technical data		TM020
Nominal primary current	mA r.m.s.	20
Primary turn number		10000
Secondary turn number		2000
Supply voltage	V d.c.	±15…±24 (±10%)
Primary connection		2 x M5 studs
Secondary connection		4 x M5 studs
Operating temperature	°C	-25…+70

Notes

Closed loop Hall effect current sensors

Instructions for mounting and wiring

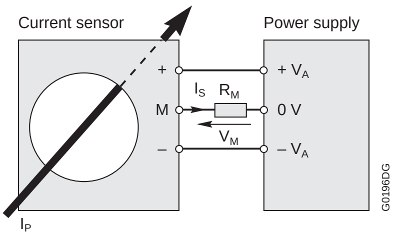
Introduction

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.
For further information, please do not hesitate to contact your distributor.

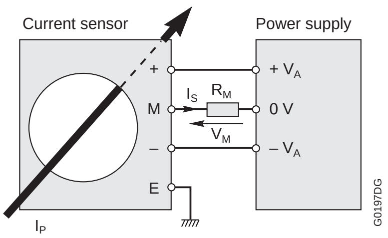
1 - Wiring diagram

- 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 $-V_A$ … 0V … $+V_A$
  Closed loop Hall effect sensors can also operate with a unipolar supply voltage ($-V_A$ … 0V or 0V … $+V_A$) under certain conditions.
  Please contact your distributor for further details for this application.

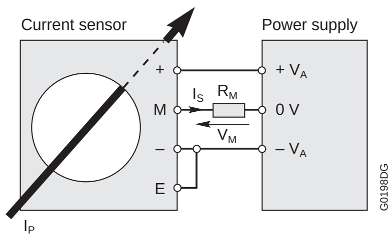
1.1 - Sensors without screen terminal



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 earth 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. 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 breaking of the sensor).

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), 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.

Closed loop Hall effect voltage sensors

Instructions for mounting and wiring

Introduction

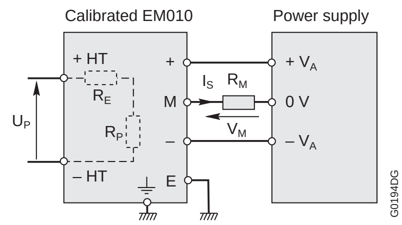
These instructions are a non-exhaustive synthesis of the main recommendations for mounting EM010 voltage sensors. Each application configuration is different, do not hesitate to contact us for advice adapted to your particular case.
Please note that incorrect or non-judicious use of sensors may lead to deterioration in the performance or operation of the sensor.
For further information, please do not hesitate to contact your distributor.

1 - Wiring diagram

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

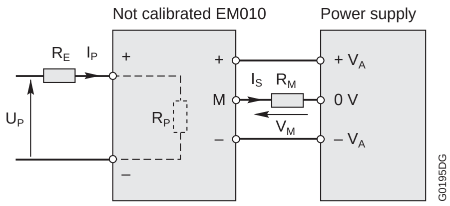
1.1 - Calibrated EM010 voltage sensors

- 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.

VS Voltage sensors

Instructions for mounting and wiring

Introduction

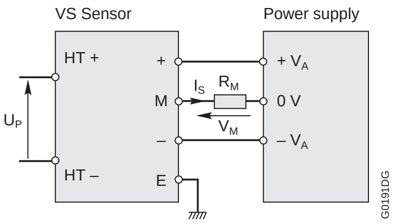
These instructions are a non-exhaustive synthesis of the main recommendations for mounting VS voltage sensors. Each application configuration is different, do not hesitate to contact us for advice adapted to your particular case.
Please note that incorrect or non-judicious use of sensors may lead to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

1 - Wiring diagram

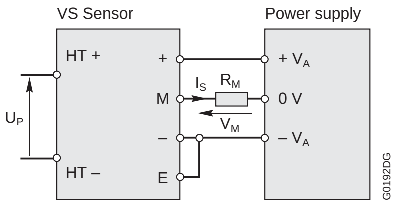
- Direction of the current: A positive primary differential voltage ($U_P = U_{HT+} - U_{HT-} > 0$) results in a positive secondary output current I_S from terminal M.
- Supply voltage: bipolar voltage $-V_A$ …0V …$+V_A$
  VS sensors can also operate with a unipolar supply voltage ($-V_A$ … 0V or 0V … $+V_A$) 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 «-»).

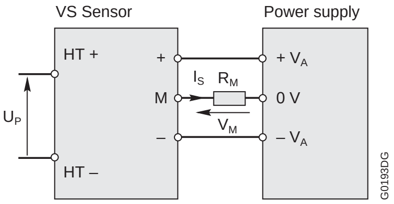


Recommended wiring



Alternative wiring

1.2 - VS voltage sensors without screen

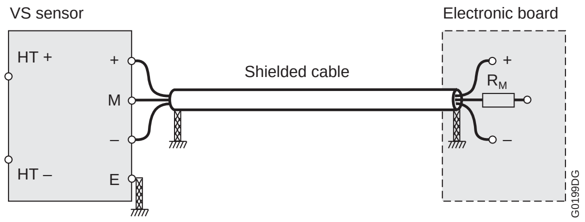


2 - Mechanical mounting

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.

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.

Common information

Questionnaire

Current and voltage sensor selection guide

General

The following questionnaires (1 page for industrial type sensors and 2 pages for traction or harsh environment type sensors) are used to select sensors according to the client's requirements.
The sensors 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.

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

NB: the indications above are valid for sensors using closed loop Hall effect technology. For voltage sensors using electronic technology, contact your distributor.

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

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

Mechanical charateristics

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

Electrical characteristics

1. Nominal current (I_{PN}).. (A r.m.s.)
2. Current type (if possible, show current profile on graph):
   - Direct .... ☐
   - Alternating .... ☐
3. Bandwidth to be measured .... (Hz)
4. 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)
5. Overload current (not measurable):
   - Not measurable overload current .... (A)
   - Duration.. (sec)
   - Repetition ....
6. Sensor supply voltage:
   - Bipolar supply voltage.. (±V)
   - Unipolar supply voltage .... (0 +V or 0 -V)
7. Output current
   - Secondary current at nominal current I_{PN} .... (mA)

Sensor environmental conditions

1. Minimum operating temperature.. (°C)
2. Maximum operating temperature .... (°C)
3. Presence of strong electromagnetic fields .... ☐
4. Max. continuous primary conductor voltage .... (V)
5. Main reference standards ....

Other requirements (description)

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

Questionnaire
Traction Current Sensor Selection

Company: . . . . **Name:** . . . .

Address: . . . .

Tel: . . . . **Fax:** . . . . **Email:** . . . .

Application

1. Project name ....
2. Application:
   Rolling stock:
   – Power converter .... ☐
   – Auxiliary converter .... ☐
   – Other .... ☐

Fixed installation (e.g. sub-station) .... ☐

3. Quantity per year: ....
4. Total quantity for the project ....

Electrical characteristics

1. Nominal current (I_{PN}).. (A r.m.s.)
2. Current type (if possible, show current profile on graph):
   – Direct .... ☐
   – Alternating .... ☐
3. Bandwidth to be measured .... (Hz)
4. 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)
5. Overload current (not measurable):
   – Not measurable overload current ....(A)
   – Duration .... (sec)
   – Repetition ....
6. Sensor supply voltage:
   – Bipolar supply voltage .... (±V)
   – Unipolar supply voltage .... (0 +V or 0 -V)
7. Output current
   – Secondary current at nominal current I_{PN} .... (mA)

Mechanical characteristics

1. Sensor fixing:
   – By the enclosure .... ☐
   – By the bar .... ☐
2. Primary conductor:
   – Cable diameter .... (mm)
   – Bar size .... (mm)
3. Secondary connection:
   – Screw or Faston .... ☐
   – By connector .... ☐
   – Other .... ☐

Sensor environmental conditions

1. Minimum operating temperature... (°C)
2. Maximum operating temperature .... (°C)
3. Max. continuous primary conductor voltage .... (V)
4. Main reference standards ....

Other requirements (description)

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

1. Project name ....
2. Application:
   Rolling stock:
   – Power converter .... ☐
   – Auxiliary converter. .... ☐
   – Other .... ☐
   Fixed installation (e.g. sub-station) .... ☐
3. Quantity per year: ....
4. Total quantity for the project..

Mechanical characteristics

1. Primary connection:
   – By screw .... ☐
   – Other .... ☐
2. Secondary connection:
   – Screw or Faston .... ☐
   – By connector... ☐
   – Other .... ☐

Electrical characteristics

1. Nominal voltage (U_{PN}).. (V r.m.s.)
2. Voltage type (if possible, show voltage profile on graph):
   – Direct .... ☐
   – Alternating .... ☐
3. Bandwidth to be measured .... (Hz)
4. 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)
5. Overload voltage (not measurable):
   – Not measurable overload voltage .... (V)
   – Duration .... (sec)
   – Repetition...
6. Sensor supply voltage:
   – Bipolar supply voltage .... (±V)
   – Unipolar supply voltage .... (0 +V or 0 -V)
7. Output current
   – Secondary current at nominal voltage U_{PN} .... (mA)

Sensor environmental conditions

1. Minimum operating temperature .... (°C)
2. Maximum operating temperature .... (°C)
3. Main reference standards ....

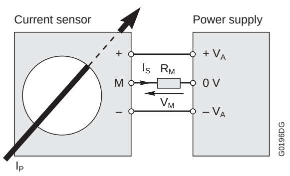
Other requirements (description)

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

Calculation guide

Closed loop Hall effect current sensors

ES300C



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

Formulas :

$N_P \times I_P = N_S \times I_S$

$V_A = e + V_S + V_M$

$V_S = R_S \times I_S$

$V_M = R_M \times I_S$

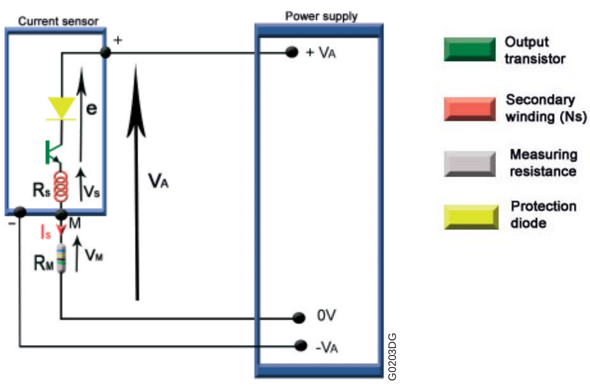
Abbreviations

- 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

Secondary circuit schematic diagram



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

<u>Example with ES300C sensor</u>

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) x 520 = 0,26A peak
$R_M = V_M / I_S$ = 8 / 0,26 = 30,77Ω

We must check that the sensor can measure these 520A peak, i.e.:
$V_A \geq e + V_S + V_M$

If V_A = ±15V (±5%), then we must check that

15 x 0.95 ≥ 1 + (33 x 0.26) + 8 which is false since 14.25V< 17.58V

Therefore a supply greater than or equal to 17.58V must be selected. Select a ±24V (±5%) supply.
We verify that 24 x 0.95 ≥ 17.58V.

<u>Conclusion</u> :
An ES300C sensor can measure a peak of 520A in the following conditions:
V_A = ±24V (±5%)
R_M = 30,77Ω
to obtain an 8V signal at a peak of 520A

ES300C

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

$\mathbf{R}_M = \mathbf{V}_M / \mathbf{I}_S$ = 5 / 0,26 = 19,23Ω

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

$\mathbf{V}_A \geq e + \mathbf{V}_S + \mathbf{V}_M$

If $\mathbf{V}_A$ = ±15V (±5%), then we must check that
15 x 0.95 ≥ 1 + (33 x 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 ±24V (±5%) supply or a ±15V supply with a tighter tolerance, for example ±15V (±2%).
(since 15V x 0.98 ≥ 14.58V)

Conclusion :
An ES300C sensor can measure a peak of 520A in the following conditions:
$\mathbf{V}_A$ = ±15V (±2%)
$\mathbf{R}_M$ = 19,23Ω
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:
$\mathbf{V}_A$ = ±15V (±5%)
$\mathbf{R}_M$ = 15Ω

From the base formulas, we obtain the following formula:
$\mathbf{I}_S$ max = ($\mathbf{V}_A$ min - e) / ($\mathbf{R}_S$ + $\mathbf{R}_M$) = [(15 x 0,95) – 1] / (33 + 15) = 0,276A peak

Now calculate the equivalent primary current:
$\mathbf{I}_P = (\mathbf{N}_S / \mathbf{N}_P) \times \mathbf{I}_S$ = (2000 / 1) x 0,276 = 552A peak

Conclusion :
An ES300C sensor can measure a peak of 552A in the following conditions:
$\mathbf{V}_A$ = ±15V (±5%)
$\mathbf{R}_M$ = 15Ω
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°C. If this maximum temperature is +50°C, then the measuring range can be increased as follows:

$\mathbf{R}_S$ = 33Ω at +70°C At +50°C, $\mathbf{R}_S$ = 30,5Ω then,
$\mathbf{I}_S$ max = ($\mathbf{V}_A$ min - e) / ($\mathbf{R}_S$ + $\mathbf{R}_M$) = [(15 x 0,95) – 1] / (30,5 + 15) = 0,291A peak

Now calculate the equivalent primary current:
$\mathbf{I}_P = (\mathbf{N}_S / \mathbf{N}_P) \times \mathbf{I}_S$ = (2000 / 1) x 0,291 = 582A peak

Conclusion :
An ES300C sensor can measure a peak of 582A in the following conditions:
$\mathbf{V}_A$ = ±15V (±5%)
$\mathbf{R}_M$ = 15Ω
Max. operating temperature = +50°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

1SB7 8982 4F0302

ES300C

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:

$\mathbf{I}_S = (\mathbf{N}_P / \mathbf{N}_S) \times \mathbf{I}_P$ = (1 / 1500) x 552 = 0,368 peak ($\mathbf{I}_P$ = 522A from 2.3 above)

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

- for a turn ratio of 1/2000:
  $\mathbf{V}_M = \mathbf{R}_M \times \mathbf{I}_S$ = 15 x 0,276 = 4,14V
- for a turn ratio of 1/1500:
  $\mathbf{V}_M = \mathbf{R}_M \times \mathbf{I}_S$ = 15 x 0,368 = 5,52V

Conclusion :

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

$\mathbf{V}_A$ = ±15V (±5%)

$\mathbf{R}_M$ = 15Ω

$\mathbf{V}_M$ = 4.14V with a turn ratio of 1/2000

$\mathbf{V}_M$ = 5.52V 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 ±15V (±5%). Reworking the calculations with a supply of ±24V (±5%).

From the base formulas, we obtain the following formula:

$\mathbf{I}_{S\ MAX} = (\mathbf{V}_{A\ MIN} - e) / (\mathbf{R}_S + \mathbf{R}_M)$ = [(24 x 0,95) – 1] / (33 + 15) = 0,454A peak

Now calculate the equivalent primary current:

$\mathbf{I}_P = (\mathbf{N}_S / \mathbf{N}_P) \times \mathbf{I}_S$ = (2000 / 1) x 0,454 = 908A peak

Conclusion :

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

$\mathbf{V}_A$ = ±24V (±5%)

$\mathbf{R}_M$ = 15Ω

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.

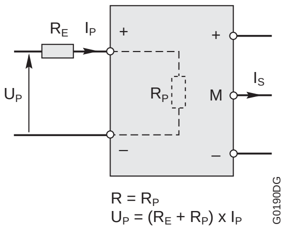
NB: for calculations with unipolar supply (e.g. 0…+24V), contact your distributor.

Calculation guide

Closed loop Hall effect voltage sensors

EM010BBFHP1N

Not calibrated EM010



$R = R_P$
$U_P = (R_E + R_P) \times I_P$

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

Formulas :

$\mathbf{N_P} \times \mathbf{I_P} = \mathbf{N_S} \times \mathbf{I_S}$

$\mathbf{V_A} = e + \mathbf{V_S} + \mathbf{V_M}$

$\mathbf{V_S} = \mathbf{R_S} \times \mathbf{I_S}$

$\mathbf{V_M} = \mathbf{R_M} \times \mathbf{I_S}$

$R = \mathbf{R_E} + \mathbf{R_P}$

$R = \mathbf{U_P} / \mathbf{I_P}$

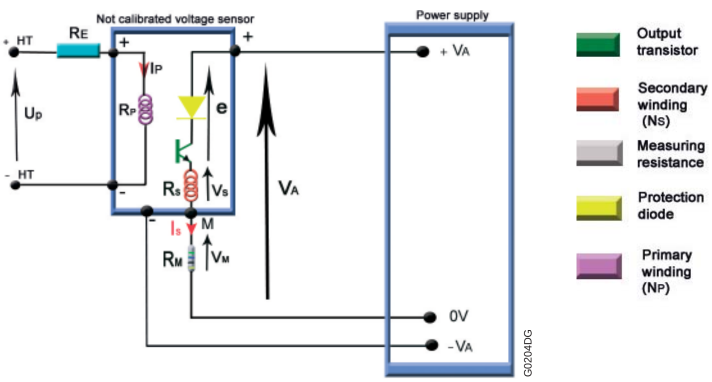
Abbreviations

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

Values of "e" with a bipolar sensor supply

Sensors	EM010
Voltage "e"	1,5 V

Secondary circuit schematic diagram



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

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

$\mathbf{N_P/N_S}$ = 10000/2000
$\mathbf{I_{PN}}$ = 10mA
$\mathbf{R_P}$ = 1500Ω (at +25°C)
$\mathbf{R_S}$ = 60Ω (at +70°C)
$\mathbf{I_S}$ = 50mA (at $\mathbf{I_{PN}}$)
e = 1,5V

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

$\mathbf{I_S} = (\mathbf{N_P} / \mathbf{N_S}) \times \mathbf{I_P}$ = (10000 / 2000) x 0,012 = 0,060A peak
$\mathbf{R_M} = \mathbf{V_M} / \mathbf{I_S}$ = 10 / 0,060 = 166,67Ω

We must check that the sensor can measure this I_P = 12mA peak, i.e.:
$\mathbf{V_A} \geq e + \mathbf{V_S} + \mathbf{V_M}$

If $\mathbf{V_A}$ = ±15V (±5%), then we must check that
15 x 0.95 ≥ 1.5 + (60 x 0.060) + 10 which is false since 14.25V < 15.10V

Therefore a supply greater than or equal to 15.10V must be selected. Select a ±24V (±5%) supply.
We verify that 24 x 0.95 ≥ 15.10V.

Conclusion :
An EM010BBFHP1N sensor can measure a peak of 12mA in the following conditions:
$\mathbf{V_A}$ = ±24V (±5%)
$\mathbf{R_M}$ = 166,67Ω
to obtain a 10V signal at a peak of 12mA (V_M = 10V for I_P = 12 mA)

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

1SBC7 7512 4F0301

EM010BBFHP1N

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 57), if the required measuring voltage is reduced, carefully check that the ±15V (±5%) supply used in this example is sufficient to obtain a 5V signal with the conditions used in the preceding point.

15 x 0.95 ≥ 1.5 + (60 x 0.060) + 5 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 57), if the maximum operating temperature of the sensor is reduced, the measurable primary current 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)

$\mathbf{N_P/N_S}$ = 10000/2000
$\mathbf{I_{PN}}$ = 10mA
$\mathbf{R_P}$ = 1500Ω (at +25°C)
$\mathbf{R_S}$ = 60Ω (at +70°C)
$\mathbf{I_S}$ = 50mA (at $\mathbf{I_{PN}}$)
e = 1,5V

3.1 - What primary resistance R_E is required in series with the sensor to obtain a primary current I_P = 12mA when the primary voltage U_P = 1500V?

R = $\mathbf{R_E}$ + $\mathbf{R_P}$ and R = $\mathbf{U_P}$ / $\mathbf{I_P}$ therefore $\mathbf{R_E}$ = ($\mathbf{U_P}$ / $\mathbf{I_P}$) - $\mathbf{R_P}$
$\mathbf{R_E}$ = (1500 / 0,012) – 1500 i.e. $\mathbf{R_E}$ = 123,50kΩ

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.

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

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

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

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EM010BBFHP1N

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:

$\mathbf{R_P}$ = 1500Ω at +25°C gives a resistance of 1642Ω at +50°C.

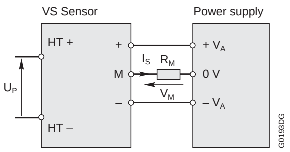
By redoing the calculations with $\mathbf{R_P}$ = 1642Ω, we obtain $\mathbf{R_E}$ = 123.36kΩ, i.e. a difference of 0.1%.

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

Calculation guide

Electronic technology voltage sensors

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 :

- $R_{M\ MAX} = [(0{,}8 \times V_{A\ MIN}) / I_S] - 55$
- $U_{HT+} + U_{HT-} \leq 4.2$ kV peak and $|U_{HT+} - U_{HT-}| \leq U_{P\ MAX}$

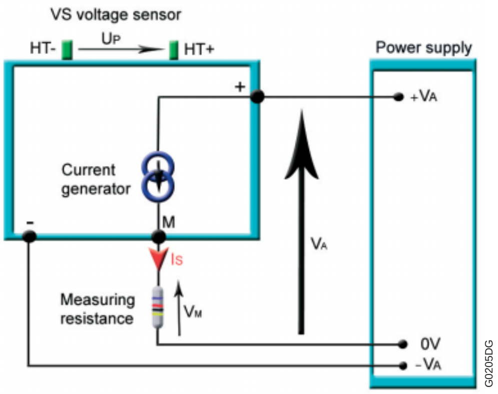
VS2000 ... VS4200 :

- $R_{M\ MAX} = [(0{,}8 \times V_{A\ MIN}) / I_S] - 60$
- $U_{HT+} + U_{HT-} \leq 10$ kV peak and $|U_{HT+} - U_{HT-}| \leq U_{P\ MAX}$

Abbreviations

U_P	: primary voltage
U_{PN}	: nominal primary voltage
I_S	: secondary current
I_{SN}	: nominal secondary current
V_A	: supply voltage
$V_{A\ MIN}$	: V_A less lowest supply tolerance
V_M	: measuring voltage
R_M	: measuring resistance
$R_{M\ MAX}$	: maximum measuring resistance

Electronic voltage sensor schematic diagram



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

Example with VS1000B sensor

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

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

$I_S = I_{SN} \times U_{P\ MAX} / U_{PN}$ = 0,050 x 1500 / 1000 i.e. I_S = 75mA
$R_M = V_M / I_S$ = 10 / 0,075 i.e. R_M = 133,33Ω

We must check that the sensor can measure this 1500V with a ±24V (±5%) supply
$V_{A\ MIN}$ = 24 x 0,95 = 22,8V
$R_{M\ MAX} = [(0{,}8 \times V_{A\ MIN}) / I_S] - 55$ = [(0,8 x 22,8) / 0,075] – 55 i.e. $R_{M\ MAX}$ = 188,2Ω

We therefore verify that the sensor can measure this 1500V voltage since the maximum measuring resistance with a ±24V (±5%) supply is 188.2Ω for 133.33Ω required.

Conclusion :
A VS1000B sensor can measure a peak of 1500V in the following conditions:
V_A = ±24V (±5%)
R_M = 133,33Ω
to obtain a 10V signal at 1500V peak.

VS1000B

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 57), if the required measuring voltage is reduced, carefully check that the ±15V (±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	i.e. R_M = 66,67Ω
$R_{M\ MAX}$ = [(0,8 x $V_{A\ MIN}$) / I_S] – 55	= [(0,8 x 14,25) / 0,075] – 55	i.e. $R_{M\ MAX}$ = 97Ω

We therefore verify that the sensor measures this 1500V voltage since the maximum measuring resistance with a ±15V (±5%) supply is 97Ω for 66.67Ω 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 continuously 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_{PMAX} = 1500V peak) be used to measure a differential voltage

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

3.1 - $|U_{HT+} - U_{HT-}| = |3500 - 2600|$ = 900V d.c. ≤ 1500V peak :
First condition $|U_{HT+} - U_{HT-}| \leq U_{P\ MAX}$ is therefore fulfilled.

3.2 - $U_{HT+} + U_{HT-}$ = 3500 + 2600 = 6100V d.c. > 4.2kV 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 d.c. ≤ 10kV peak

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

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