Technical Catalogue

Voltage Sensors
Current Sensors

1SBC 0011 99 R1001

ABB Control

TRANSTRONIC

Industrial Current Sensors

◆

Traction Current Sensors

◆

Traction Voltage Sensors

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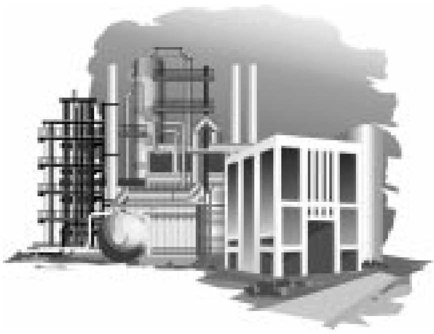

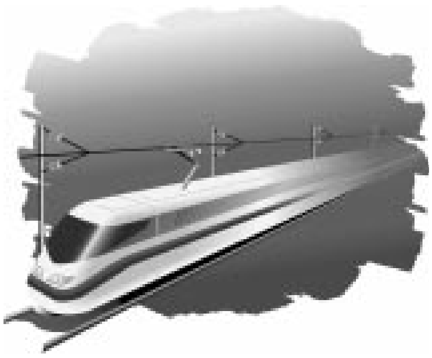

Summary

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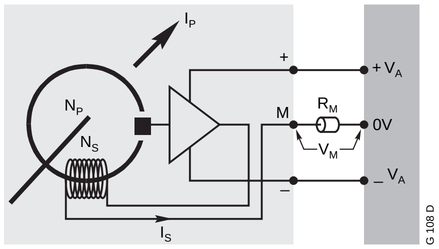
Hall Effect Technology

Principle

The ABB transducer is a transformer operating with a balanced magnetic flux principle to measure d.c. - a.c.- pulsating current, with galvanic insulation between primary and secondary circuits. The primary current produces a magnetic field, which is detected by a Hall effect device and, via an electronic amplifier, is immediately balanced by injecting a current into the secondary winding. The secondary current is an exact replica of the primary current multiplied by the turns ratio. This technology is called closed loop current sensing.



Applications:

Industry
- Drives
- UPS
- Robotics
- Welding machines
- etc ...

Traction
- Main convertors
- Auxiliaries
- Battery chargers
- Choppers
- Sub-Stations
- etc ...

Advantages:

- Galvanic insulation between primary and secondary circuits.
- For all wave forms : d.c., a.c., impulse.
- Accuracy, high dynamic performance.
- High overload capacities.
- High reliability.

Abbreviations:

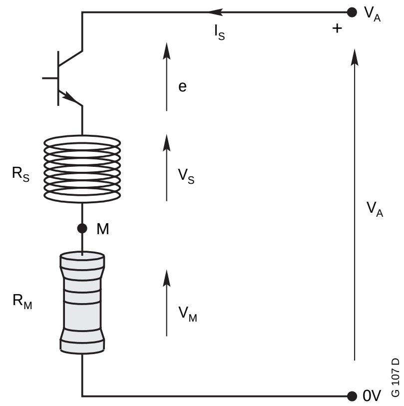
I_P : primary current
I_{PN} : nominal primary current
I_S : secondary current
I_{SN} : nominal secondary current
N_P : primary number of turns
N_S : secondary number of turns
R_S : secondary winding resistance
R_M : resistance to be added to the measuring circuit
V_A : sensor supply voltage
V_S : voltage drop in the secondary winding
V_M : voltage measurement
e : voltage drop in the output transistors
I_{AO} : current consumed by the sensor when $I_P = 0$

$N_P \times I_P = N_S \times I_S$

$V_A \geq e + V_S + V_M$

$V_S = R_S \times I_S$

$V_M = R_M \times I_S$



Consumption:

The total current consumed by the sensor at I_{PN} is : $I_{AO} + I_{SN}$
The no-load current I_{AO} flows from + V_A to - V_A

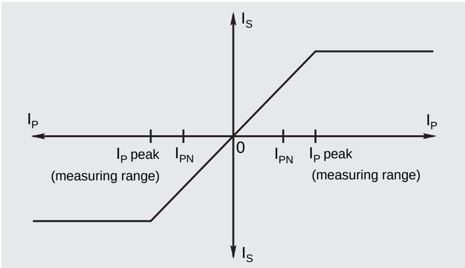
Key words

- Nominal current ($\mathbf{I_{PN}}$)

  This is the maximum r.m.s. current that the sensor can continuously measure. The sensor is thermaly sized to continuously withstand this current.

- Nominal voltage ($\mathbf{U_{PN}}$)

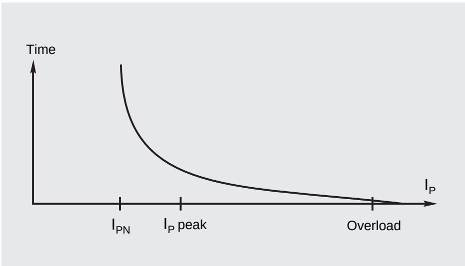
  This is the maximum r.m.s. voltage that the sensor can continuously measure. With the ABB Control closed loop technology, the EM 010 sensor can continuously measure up to 1.1 times the maximum r.m.s. voltage value given in the catalogue.



- Measuring range

  This is the maximum peak current or voltage that the sensor can measure.

  This peak current can last from tens of milliseconds to few minutes depending on the sensor type. The output current ($\mathbf{I_S}$) is directly proportional to the primary current or voltage from 0 to the measuring range.



- Overload

  This is the maximum value of instantaneous current or voltage not measurable by the sensor. This value must be limited in duration and in amplitude in order to avoid the magnetization of the core and the overheating of the sensor components. In the traction sensors, the protection against accidental inversion of the power supply limits the overload capability.

- Accuracy (%)

  This is the maximum error of measure given by the sensor. The accuracy (at nominal current) is given by the following formula :

$$\frac{\mathbf{k} \times \mathbf{I_{SN}} - \mathbf{I_{PN}}}{\mathbf{I_{PN}}} \times 100 \qquad \text{where } \mathbf{K} = \frac{\mathbf{N_S}}{\mathbf{N_P}} \qquad \text{and } \mathbf{I_{SN}}, \mathbf{I_{PN}} \text{ are measured values}$$

The sensor accuracy takes into account:

- the offset current $\mathbf{I_{SO}}$
- the linearity
- the thermal drift

When the nominal current to be measured is lower than the nominal rating of the sensor, the accuracy is improved with severals turns of the primary conductor through the sensor, up to the maximum of the Ampere-turns acceptable by the sensor. ($\mathbf{N_P} \times \mathbf{I_P} \leq$ nominal rating of sensor)

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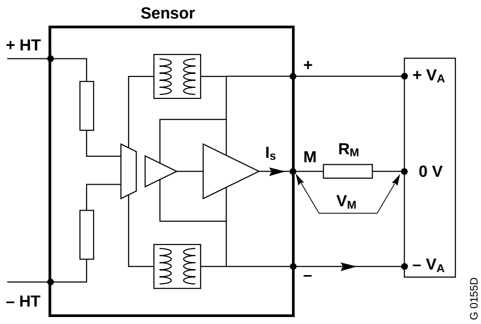
Static Technology

Principle

The VS range (Voltage Sensor) uses only electronic components. The voltage to be measured is directly applied to the sensor terminals: + HT (positive high voltage) and – HT (negative high voltage or ground). The primary voltage going through an insulated amplifier, is converted into the output current $\mathbf{I_S}$ proportionally to the input signal. The power supply of the primary section of this sensor is galvanicly insulated. This principle is called Static Voltage Sensing.



Advantages:

- Galvanic insulation between primary and secondary circuits.
- For all wave forms : d.c., a.c., impulse.
- Accuracy, high dynamic performance.
- High overload capacities.
- High reliability.

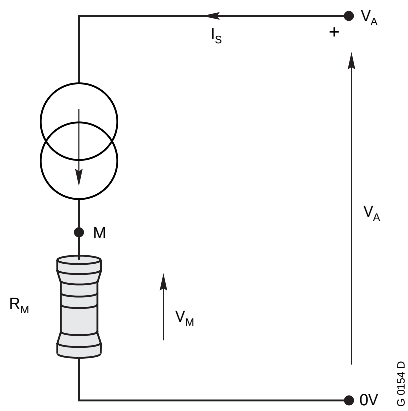
Applications:

Traction

- Main convertors
- Auxiliaries
- Battery chargers
- Choppers
- Sub-Stations
- etc ...

Abbreviations:

$\mathbf{U_P}$: primary voltage
$\mathbf{U_{PN}}$: nominal primary voltage
$\mathbf{I_S}$: secondary current
$\mathbf{I_{SN}}$: nominal secondary current
$\mathbf{R_M}$: resistance to be added to the measuring circuit
$\mathbf{V_A}$: sensor supply voltage
$\mathbf{V_M}$: voltage measurement
$\mathbf{I_{AO}}$: current consumed by the sensor when $\mathbf{U_P} = 0$



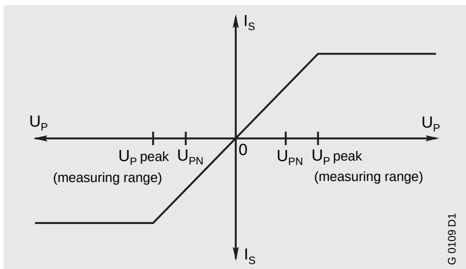
Consumption:

The total current consumed by the sensor at $\mathbf{U_{PN}}$ is : $\mathbf{I_{AO}} + \mathbf{I_{SN}}$
The no-load current flows from + $\mathbf{V_A}$ to - $\mathbf{V_A}$

Key words

- Nominal primary voltage ($\mathbf{U_{PN}}$)

This is the maximum continuous r.m.s. (or d.c.) voltage that the sensor can continuously measure.



- Measuring range

This is the maximum peak voltage that the sensor can measure. The sensor can continuously measure this peak which may vary upon different values of the burden resistor $\mathbf{R_M}$, the supply voltage $\mathbf{V_A}$ and the max. operating temperature.

- Overload

This is the maximum value of instantaneous voltage, not measurable by the sensor. This value must be limited in duration and in amplitude in order to avoid the destruction of the sensor. As a basis, for the VS range, the not measurable overload is 3 x $\mathbf{U_{PN}}$ during 1 sec per hour maximum.

- Accuracy (%)

This is the maximum error of measure given by the sensor. The accuracy (at nominal voltage) is given by the following formula:

$$\frac{\mathbf{I_S \text{ measured} - I_{SN}}}{\mathbf{I_{SN}}} \times 100$$

The sensor accuracy (within the temperature range) takes into account: the offset current $\mathbf{I_{so}}$, the linearity, the thermal drift.

Industrial Current Sensors

MP, EL, EH, ES types

Summary

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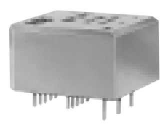
Panorama of Industrial Current Sensors

Current sensors : 5 to 100 A

MP 25 P1



SB7174

EL 25 P1 to 100 P2

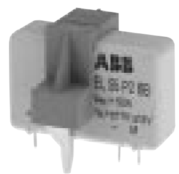
SB7140

MP 25 P1		EL 25 P1 to 100 P2
5, 6, 8, 12 and 25 A	Nominal primary current I_{PN}	25, 50 and 100 A
approx. 1.5 I_{PN}	Measuring range	approx. 1.5 I_{PN}
0 … +70 °C	Operating temperature	0 … +70 °C
±15 V	Power supply	±15 V
	For PCB mounting	

EH 050 and EH100

SB7199

NEW **EL 25 P1 BB to EL 100 P2 BB**



SB7916

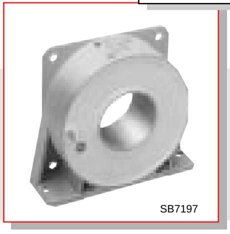
EH 050 and EH100		EL 25 P1 BB to EL 100 P2 BB
50 A and 100 A	Nominal primary current I_{PN}	25, 50 and 100 A
≤ 240 A	Measuring range	approx. 1.5 I_{PN}
0 … +70 °C	Operating temperature	0 … +70 °C
±12 V to ±18 V	Power supply	±15 V
	For PCB mounting	

Industrial sensor listing

Nominal current (A r.m.s.)	Page	Type	Nominal output current (mA)	Supply voltage (V)	Secondary connections	Primary connections	Order code
5 to 25	10	MP 25 P1	24 or 25	±15	3 pins	Pins	1SBT312500R0001
25	10	EL 25 P1	25	±15	3 pins	Hole	1SBT132500R0001
25	10	EL 25 P1 BB	25	±15	3 pins	Bar	1SBT132500R0002
50	10	EL 50 P1	50	±15	3 pins	Hole	1SBT135100R0001
50	10	EL 50 P1 BB	50	±15	3 pins	Bar	1SBT135100R0003
50	13	EH 050 AP	50	±12 to ±18	3 pins	Pins	EH 050 AP
50	11	EL 55 P2	25	±11 to ±15.7	3 pins	Hole	1SBT135100R0002
50	11	EL 55 P2 BB	25	±11 to ±15.7	3 pins	Bar	1SBT135100R0004
100	11	EL 100 P2	50	±15	3 pins	Hole	1SBT130100R0001
100	11	EL 100 P2 BB	50	±15	3 pins	Bar	1SBT130100R0002
100	13	EH 100 AP	100	±12 to ±18	3 pins	Pins	EH 100 AP

Current sensors : 100 to 2000 A

ES 100 to ES 2000



100 A to 2000 A	Nominal primary current I_{PN}
approx. 1.5 I_{PN}	Measuring range
– 5 … +70 °C	Operating temperature
±12 V to ±24 V *	Power supply
	Frame mounting

* Depends on rating

Industrial sensor listing (cont.)

Nominal current (A r.m.s.)	Page	Type	Nominal output current (mA)	Supply voltage (V)	Secondary connections	Order code
100	14	ES 100 C	100	±12 to ±20	Molex 3 pins HE 14	ES 100 C
100	14	ES 100 F	100	±12 to ±20	3 wires 200 mm	ES 100 F
300	14	ES 300 C	150	±12 to ±20	Molex 3 pins HE 14	ES 300 C
300	14	ES 300 F	150	±12 to ±20	3 wires 200 mm	ES 300 F
300	14	ES 300 S	150	±12 to ±20	JST 3 pins	ES 300 S
500	14	ES 500 C	100	±18 to ±24	Molex 3 pins HE 14	ES 500 C
500	14	ES 500 F	100	±18 to ±24	3 wires 200 mm	ES 500 F
500	14	ES 500 S	100	±18 to ±24	JST 3 pins	ES 500 S
500	14	ES 500 - 9672	125	±15	Molex 3 pins HE 14	ES 500 - 9672
500	14	ES 500 - 9673	125	±15	JST 3 pins	ES 500 - 9673
500	14	ES 500 - 9674	125	±15	3 wires 200 mm	ES 500 - 9674
1000	15	ES 1000 C	200	±18 to ±24	Molex 3 pins HE 14	ES 1000 C
1000	15	ES 1000 F	200	±18 to ±24	3 wires 200 mm	ES 1000 F
1000	15	ES 1000 S	200	±18 to ±24	JST 3 pins	ES 1000 S
1000	15	ES 1000 - 9675	200	±15	Molex 3 pins HE 14	ES 1000 - 9675
1000	15	ES 1000 - 9676	200	±15	JST 3 pins	ES 1000 - 9676
1000	15	ES 1000 - 9677	200	±15	3 wires 200 mm	ES 1000 - 9677
1000	15	ES 1000 - 9678	250	±15	Molex 3 pins HE 14	ES 1000 - 9678
1000	15	ES 1000 - 9679	250	±15	JST 3 pins	ES 1000 - 9679
1000	15	ES 1000 - 9680	250	±15	3 wires 200 mm	ES 1000 - 9680
2000	15	ES 2000 - 9725	400	±15 to ±24	Molex 3 pins HE 14	1SBT152000R9725
2000	15	ES 2000 F	400	±15 to ±24	3 wires 200 mm	1SBT152000R0001
2000	15	ES 2000 S	400	±15 to ±24	JST 3 pins	1SBT152000R0002

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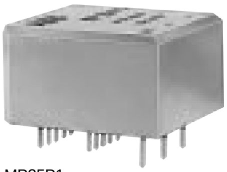
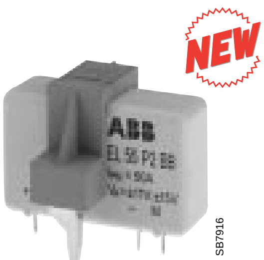
MP and EL Industrial Current Sensors



MP25P1

EL 25 P1 / EL 50 P1
EL 55 P2 / EL 100 P2



EL 25 P1 BB / EL 50 P1 BB
EL 55 P2 BB / EL 100 P2 BB

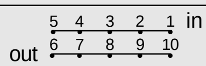
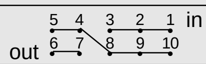
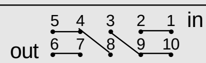
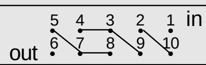
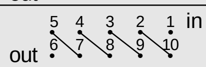
Utilization

Sensors to measure d.c., a.c. or pulsating currents with a galvanic insulation between primary and secondary circuits.
Type MP : the rating (from 5 to 25 A) is determined via a combination of the primary connections (see table below: "Arrangement of primary terminals and related characteristics").

Electrical characteristics

Type	MP 25 P1	EL 25 P1	EL 25 P1 BB	EL 50 P1	EL 50 P1 BB
Nominal primary current I_{PN} (A r.m.s.)	See table below	25	25	50	50
Measuring range at V_A min. (A d.c.)	**Arrangement of primary**	±55	±55	±80	±80
Turns ratio (N_P/N_S)	**terminals and related**	1/1000	1/1000	1/1000	1/1000
Secondary current I_{SN} at I_{PN} (mA)	**characteristics**	25	25	50	50
Accuracy max. at I_{PN} (0 … +70 °C) (%)	±1	±0.5	±0.5	±0.5	±0.5
Residual current I_{SO} (+25 °C) (mA)	< ±0.1	< ±0.2	< ±0.2	< ±0.2	< ±0.2
Linearity $/I_S$ better than	10^{-3}	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Thermal drift $/I_{SN}$ (/°C)	2×10^{-4}	2×10^{-4}	2×10^{-4}	1×10^{-4}	1×10^{-4}
Delay time (µs)	< 1	< 0.1	< 0.1	< 0.1	< 0.1
d_i/d_t correctly followed (A/µs)	50	> 100	> 100	> 100	> 100
Bandwidth (-1 dB) (kHz)	0 to 150	0 to 100	0 to 100	0 to 150	0 to 150
No-load current I_{AO} (V_A = ±15 V) (mA)	14	16	16	16	16
Internal secondary resistance (+70 °C) (Ω)	96	63	63	63	63
Dielectric strength P/S (kV r.m.s. 50Hz-1min)	2.5	3	3	3	3
Supply voltage V_A (V)	±15 (±5%)	±15 (±5%)	±15 (±5%)	±15 (±5%)	±15 (±5%)
Minimum measuring resistance (+70 °C and V_A max.) (Ω)	100	150	150	75	75
Primary connections	10 pins Ø 1 mm	Hole Ø 7.5 mm	Bar	Hole Ø 10 mm	Bar
Secondary connections	3 pins Ø 1 mm	3 pins 0.6 x 0.7	3 pins 0.6 x 0.7	3 pins 0.6 x 0.7	3 pins 0.6 x 0.7

MP 25 P1 : Arrangement of primary terminals and related characteristics

Primary current I_{PN} Nominal (A)	Primary current I_{PN} Measuring range (A)	Secondary current I_{SN} (N_p/N_s)	Turns ratio (mA)	Primary resistance (mΩ)	Primary pin connections
25	±36	25	1/1000	0.3	
12	±18	24	2/1000	1.1	
8	±12	24	3/1000	2.5	
6	±9	24	4/1000	4.4	
5	±7	25	5/1000	6.3	

Electrical characteristics (cont.)

Type		EL 55 P2	EL 55 P2 BB	EL 100 P2	EL 100 P2 BB
Nominal primary current I_{PN}	(A r.m.s.)	50	50	100	100
Measuring range at V_A min.	(A d.c.)	± 80	± 80	± 140	± 140
Turns ratio	(N_P/N_S)	1/2000	1/2000	1/2000	1/2000
Secondary current I_{SN} at I_{PN}	(mA)	25	25	50	50
Accuracy max. at I_{PN} (0 … + 70 °C)	(%)	± 0.5	± 0.5	± 0.5	± 0.5
Residual current I_{SO} (+25 °C)	(mA)	< ± 0.1	< ± 0.1	< ± 0.2	< ± 0.2
Linearity $/I_S$ better than		10^{-3}	10^{-3}	10^{-3}	10^{-3}
Thermal drift $/I_{SN}$	(/°C)	2 x 10^{-4}	2 x 10^{-4}	1 x 10^{-4}	1 x 10^{-4}
Delay time	(µs)	< 0.1	< 0.1	< 0.1	< 0.1
d_i/d_t correctly followed	(A/µs)	> 50	> 50	> 25	> 25
Bandwidth (-1 dB)	(kHz)	0 to 200	0 to 200	0 to 100	0 to 100
No-load current I_{AO} (V_A = ±15 V)	(mA)	16	16	16	16
Internal secondary resistance (+70 °C)	(Ω)	190	190	126	126
Dielectric strength P/S	(kV r.m.s. 50Hz-1min)	3	3	3	3
Supply voltage V_A	(V)	±11 to ±15.7	±11 to ±15.7	±15 (±5%)	±15 (±5%)
Minimum measuring resistance (+70 °C and V_A max.)	(Ω)	10	10	20	20
Primary connections		Hole Ø 10 mm	Bar	Hole Ø 10 mm	Bar
Secondary connections		3 pins 0.6 x 0.7	3 pins 0.6 x 0.7	3 pins 0.6 x 0.7	3 pins 0.6 x 0.7

General data

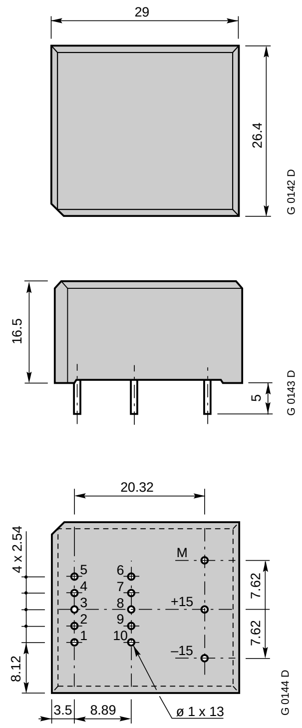
- Fixing and connecting by soldering pins.
- **MP type**: primary connection by 10 soldering pins.
- **EL type**: hole for primary conductor.
  The temperature of the primary conductor in touch with the case must not exceed 100 °C.
- **EL … BB type**: primary bar included.
- Operating temperature: (°C) 0 … + 70
- Storage temperature: (°C) – 25 … + 85
- Weight:
  - **MP** type: (kg) 0.027
  - **EL** type: (kg) 0.020
  - **EL … BB** type: (kg) 0.027
- Unit packing:
  - **MP** type: 40 per pack
  - **EL** type: 50 per pack
  - **EL … BB** type: 25 per pack

Direction of the current

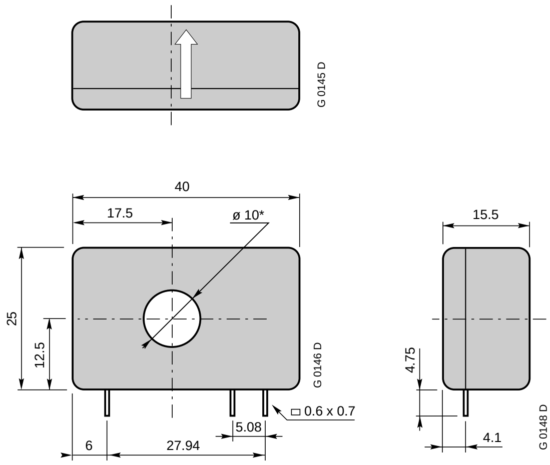
- **MP type**: a primary current flowing from pins 1-5 to pins 6-10 results in a positive output current on terminal **M**.
- **EL type**: a primary current in the direction of the arrow results in a positive output current on terminal **M**.

Dimensions in mm:

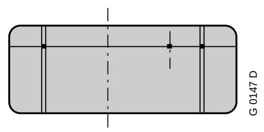
Current sensors MP



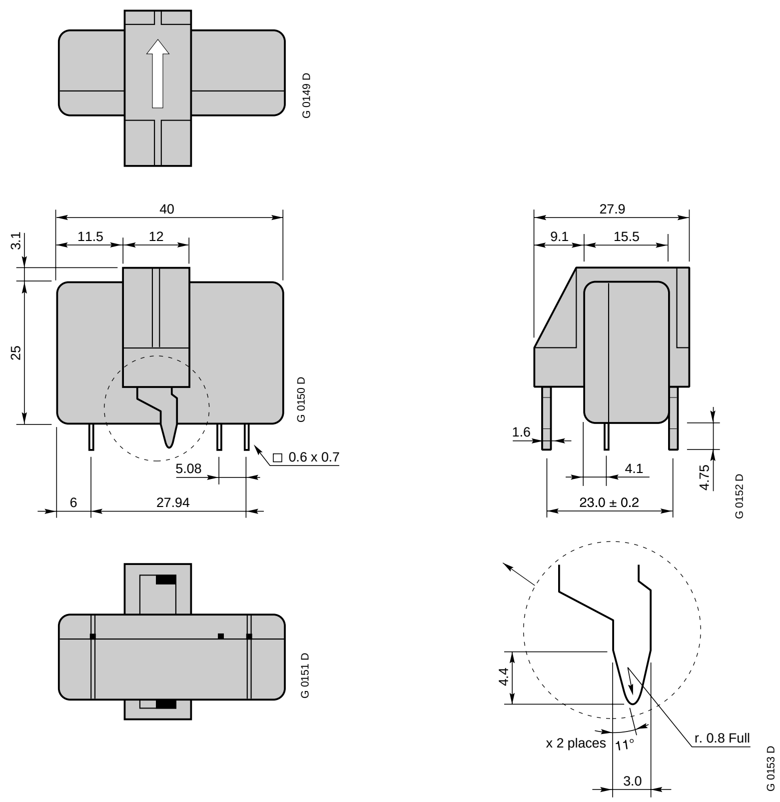
Current sensors EL



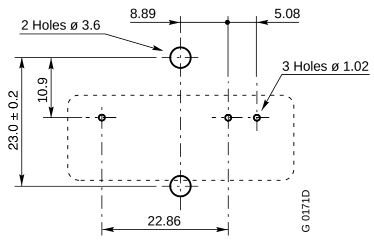
* Except EL 25 P1: ø = 7.5



Current sensors EL … BB



EL … BB: PCB layout



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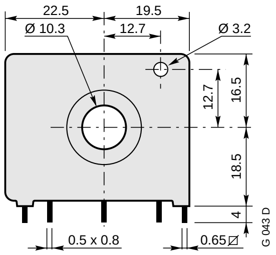
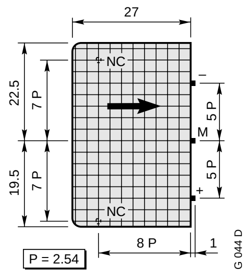
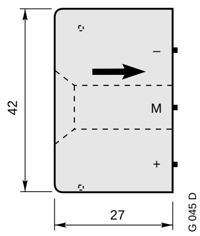
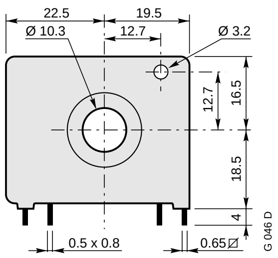
EH Industrial Current Sensors

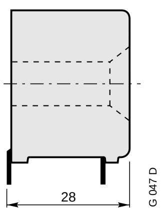
EH 050/100 AP











Dimensions in mm

Utilization

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

Electrical characteristics

Type	EH 050 AP	EH 100 AP
Nominal primary current I_{PN} (**A** r.m.s.)	50	100
Measuring range (**A** d.c.) with V_A & R_M max. with V_A & R_M max.	± 240 ± 12 V & 10 Ω ± 18 V & 30 Ω	± 240 ± 12 V & 10 Ω ± 18 V & 30 Ω
Overload (**Â**)	± 240 – 1 min/h	± 240 – 1 min/h
Turns ratio (**N_P/N_S**)	1/1000	1/1000
Secondary current I_{SN} at I_{PN} (**mA**)	50	100
Accuracy max. at I_{PN} (0 … +70 °C) (**%**) Residual current I_{SO} (+25 °C) (**mA**) Linearity /I_S better than Thermal drift /I_{SN} (**/°C**)	± 1 ± 0.25 10^{-3} < 10^{-4}	± 1 ± 0.4 10^{-3} < 10^{-4}
Delay time (**µs**)	< 1	< 1
d_i/d_t correctly followed (**A/µs**)	> 50	> 50
Bandwidth (-1 dB) (**kHz**)	100	100
No-load current I_{AO} (**mA**)	10 with V_A = ± 12 V	
(**mA**)	15 with V_A = ± 18 V	
Secondary resistance (+70 °C) (**Ω**)	30	30
Dielectric strength P/S (**kV** r.m.s. 50Hz-1min)	3	3
Supply voltage V_A (**V**)	± 12 to ± 18 (±5%)	
Minimum measuring resistance (+ 70 °C) (**Ω**) (**Ω**) – by unidirectional use (**Ω**)	0 with V_A = ±12 V 0 with V_A = ±18 V 0 with V_A = +24 V	0 with V_A = ±12 V 12 with V_A = ±18 V 62 with V_A = +24 V

General characteristics

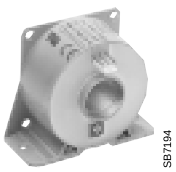
- Plastic case and insulating resin are self-extinguishing.
- Fixing and connecting by 5 soldering pins.
- Hole for primary conductor. The temperature of the primary conductor in touch with the case must not exceed 80 °C.
- Operating temperature: (°**C**) 0 … + 70
- Storage temperature: (°**C**) – 40 … + 85
- Weight: (**kg**) 0.070

Direction of the current

A primary current in the direction of arrow results in a positive output current on terminal M.

TRANSTRONIC

ES Industrial Current Sensors



ES 100 C

ES 300 C

ES 500 C

ES 1000 C

ES 2000 - 9725

Utilization

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

Electrical characteristics

Type – with connector Molex HE14 – with connector JST – with cables	**ES 100 C** **ES 100 F**	**ES 300 C** **ES 300 S** **ES 300 F**	**ES 500 C** **ES 500 S** **ES 500 F**	**ES 500 - 9672** **ES 500 - 9673** **ES 500 - 9674**
Nominal primary current I_{PN} (**A** r.m.s.)	100	300	500	500
Measuring range (**A** d.c.) with V_A & R_M max. with V_A & R_M max.	±150 ±12 V & 30 Ω ±20 V & 85 Ω	±500 ±12 V & 12 Ω ±20 V & 45 Ω	±800 ±18 V & 38 Ω ±24 V & 75 Ω	±800 ±14.25 V & 15 Ω –
Not measurable overload (**Â**)	300 – 1ms/h	3000 – 10ms/h	5000 – 10ms/h	5000 – 10ms/h
Turns ratio (N_P/N_S)	1/1000	1/2000	1/5000	1/4000
Secondary current I_{SN} at I_{PN} (**mA**)	100	150	100	125
Accuracy max. at I_{PN} (– 5 …+70 °C) (**%**) Residual current I_{SO} (+25 °C) (**mA**) Linearity /I_S better than Thermal drift /I_{SN} (**/°C**)	±1 ±0.4 10^{-3} < 10^{-4}	±1 ±0.25 10^{-3} < 10^{-4}	±1 ±0.25 10^{-3} < 0.5 x 10^{-4}	±1 ±0.25 10^{-3} < 0.5 x 10^{-4}
Delay time (**µs**)	< 1	< 1	< 1	< 1
d_i/d_t correctly followed (**A/µs**)	50	50	100	100
Bandwidth (-1 dB) (**kHz**)	0 to >100	0 to >100	0 to >100	0 to >100
No-load current I_{AO} (**mA**)	6 with V_A = ±12V	7.5 with V_A = ±12 V	12 with V_A = ±18V	12 with V_A = ±15V
(**mA**)	11 with V_A = ±20V		17 with V_A = ±24V	–
Secondary resistance (+70 °C) (**Ω**)	30	30	70	50
Dielectric strength P/S (**kV** r.m.s. 50Hz-1min)	3	3	3	3
Supply voltage V_A (**V**)	±12 to ±20 (±5%)		±18 to ±24 (±5%)	±15 (±5%)
Minimum measuring resistance (+ 70 °C) (**Ω**) (**Ω**) (**Ω**) – by unidirectional use (**Ω**)	0 with V_A = ±12V 10 with V_A = ±15V 40 with V_A = ±20V 70 with V_A = +24V	0 with V_A = ±12V 0 with V_A = ±15V 15 with V_A = ±20V 35 with V_A = +24V	0 with V_A = ±18V – 0 with V_A = ±24V on request	0 with V_A = ±15.75V – – 0 with V_A = +24V

General data

- Plastic case and insulating resin are self extinguishing.
- Fixing holes in the case moulding for two positions at right angle.
- Hole for primary conductor. The temperature of the primary conductor in touch with the case must not exceed 100 °C.
- Operating temperature: (°**C**) – 5 … + 70
- Storage temperature: (°**C**) – 25 … + 85
- Weight :
  - ES 100: (**kg**) 0.050
  - ES 300: (**kg**) 0.115
  - ES 500: (**kg**) 0.210
  - ES 1000: (**kg**) 0.460
  - ES 2000: (**kg**) 1.500
- Standard secondary connections:
  Connector Molex HE14 (ref.: 22-11-1031)
  ES 100 C ... ES 1000 C / ES 500-9672 / ES 1000-9675 / ES 1000-9678 / ES 2000 - 9725
- Secondary connections variants:
  Connector JST (ref.: B3P-VH)
  ES 300 S ... ES 1000 S / ES 500-9673 / ES 1000-9676 / ES 1000-9679 / ES 2000 S
  Cables 3 x 200 mm (cross-section 0.38 mm^2)
  ES 100 F ... ES 1000 F / ES 500-9674 / ES 1000-9677 / ES 1000-9680 / ES 2000 F

Electrical characteristics (cont.)

Type - with connector Molex HE14 - with connector JST - with cables	ES 1000 C ES 1000 S ES 1000 F	ES 1000 - 9675 ES 1000 - 9676 ES 1000 - 9677	ES 1000 - 9678 ES 1000 - 9679 ES 1000 - 9680	ES 2000 - 9725 ES 2000 S ES 2000 F
Nominal primary current I_{PN} (A r.m.s.)	1000	1000	1000	2000
Measuring range (A d.c.)	±1500	±1500	±1500	±3000
with V_A & R_M max.	±18 V & 15 Ω	±14.25 V & 5 Ω	±14.25 V & 8 Ω	–
with V_A & R_M max.	±24 V & 30 Ω	–	–	±22.8 V & 10 Ω
Not measurable overload (Â)	10000 – 10ms/h	10000 – 10ms/h	10000 – 10ms/h	20000 – 10ms/h
Turns ratio (N_P/N_S)	1/5000	1/5000	1/4000	1/5000
Secondary current I_{SN} at I_{PN} (mA)	200	200	250	400
Accuracy max. at I_{PN} (– 5 … +70 °C) (%)	±1	±1	±1	±1
Residual current I_{SO} (+25 °C) (mA)	±0.25	±0.25	±0.25	±0.25
Linearity /I_S better than	10^{-3}	10^{-3}	10^{-3}	10^{-3}
Thermal drift /I_{SN} (/°C)	$< 0.5 \times 10^{-4}$	$< 0.5 \times 10^{-4}$	$< 0.5 \times 10^{-4}$	$< 0.5 \times 10^{-4}$
Delay time (µs)	< 1	< 1	< 1	< 1
d_i/d_t correctly followed (A/µs)	100	100	100	100
Bandwidth (-1 dB) (kHz)	0 to >100	0 to >100	0 to >100	0 to >100
No-load current I_{AO} (mA)	12 with V_A = ±18V	15 with V_A = ±15V	15 with V_A = ±15V	20 with V_A = ±15V
(mA)	17 with V_A = ±24V	–	–	25 with V_A = ±24V
Secondary resistance (+70 °C) (Ω)	40	40	28	25
Dielectric strength P/S (kV r.m.s. 50Hz-1min)	3	3	3	4
Supply voltage V_A (V)	±18 to ±24 (±5%)	±15 (±5%)	±15 (±5%)	±15 to ±24 (±5%)
Minimum measuring resistance (+70 °C) (Ω)	0 with V_A = ±18V	0 with V_A = ±15.75V		0 with V_A = ±25.2V
(Ω)	–	–	–	–
(Ω)	0 with V_A = ±24V	–	–	–
– by unidirectional use (Ω)	on request	0 with V_A = +24V	0 with V_A = +24V	on request

Direction of the current

A primary current in the direction of the arrow results in a positive output current on terminal **M**.

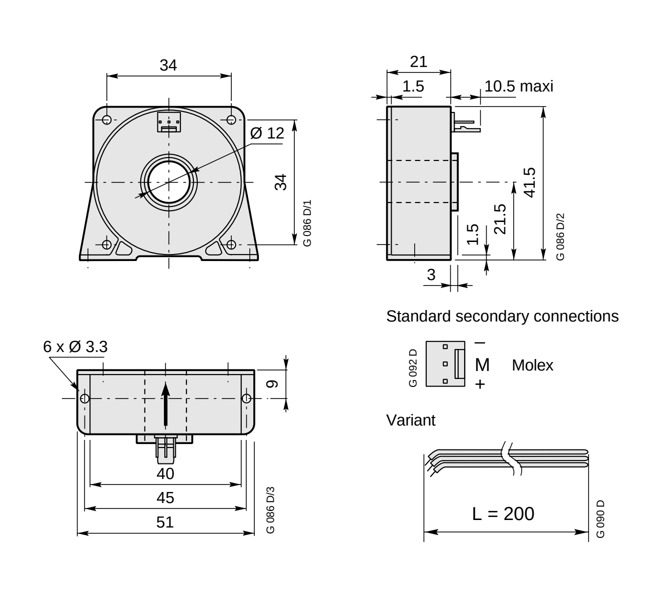
Accessories

- 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**.

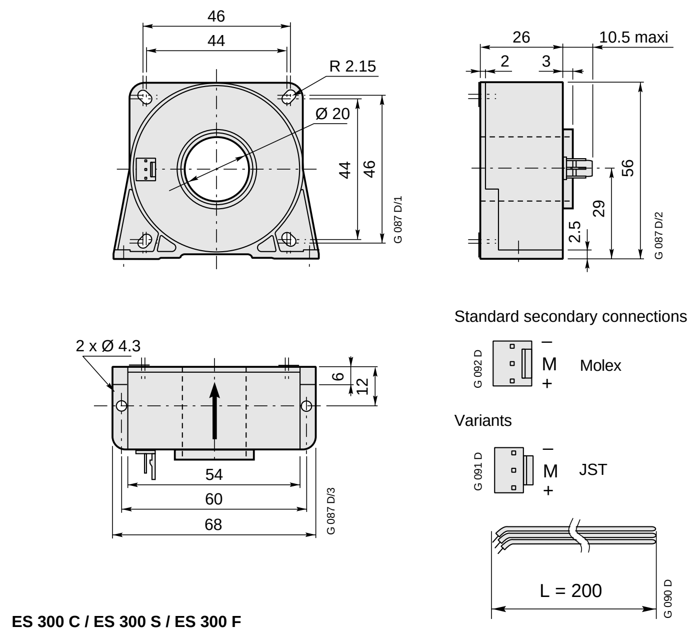
Conformity

- Insulation in accordance with **VDE 0160** with U_D = 1000 V r.m.s.
- UL: ES sensors (≤ 1000 A) with cables. File number: E 166814 Vol 1
- UR: ES sensors (≤ 1000 A) with Molex HE 14 or JST connectors. File number: E 166814 Vol 2

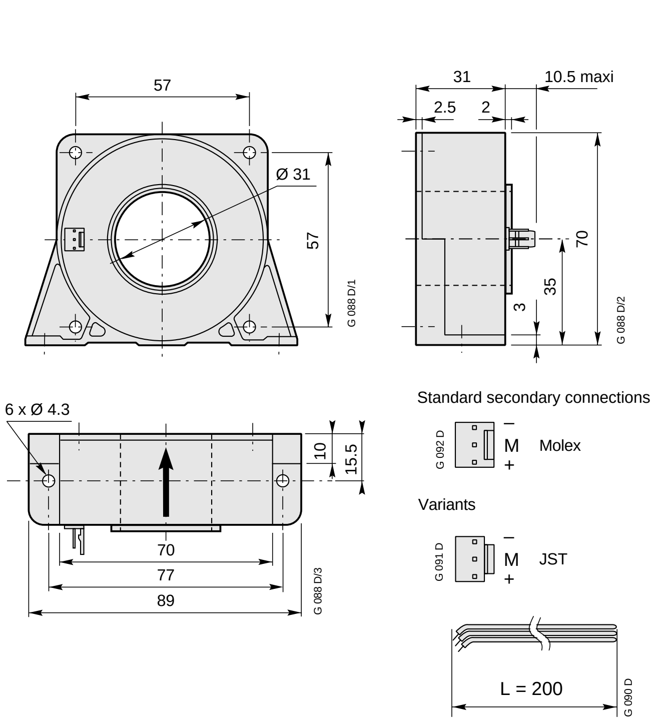
Dimensions in mm



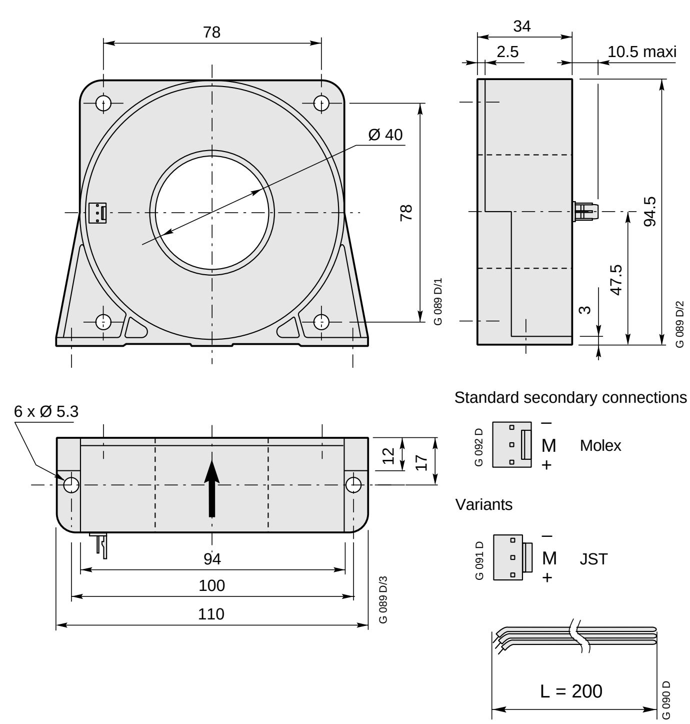
ES 100 C / ES 100 F



ES 300 C / ES 300 S / ES 300 F



ES 500 C / ES 500 S / ES 500 F
ES 500-9672 / ES 500-9673 / ES 500-9674

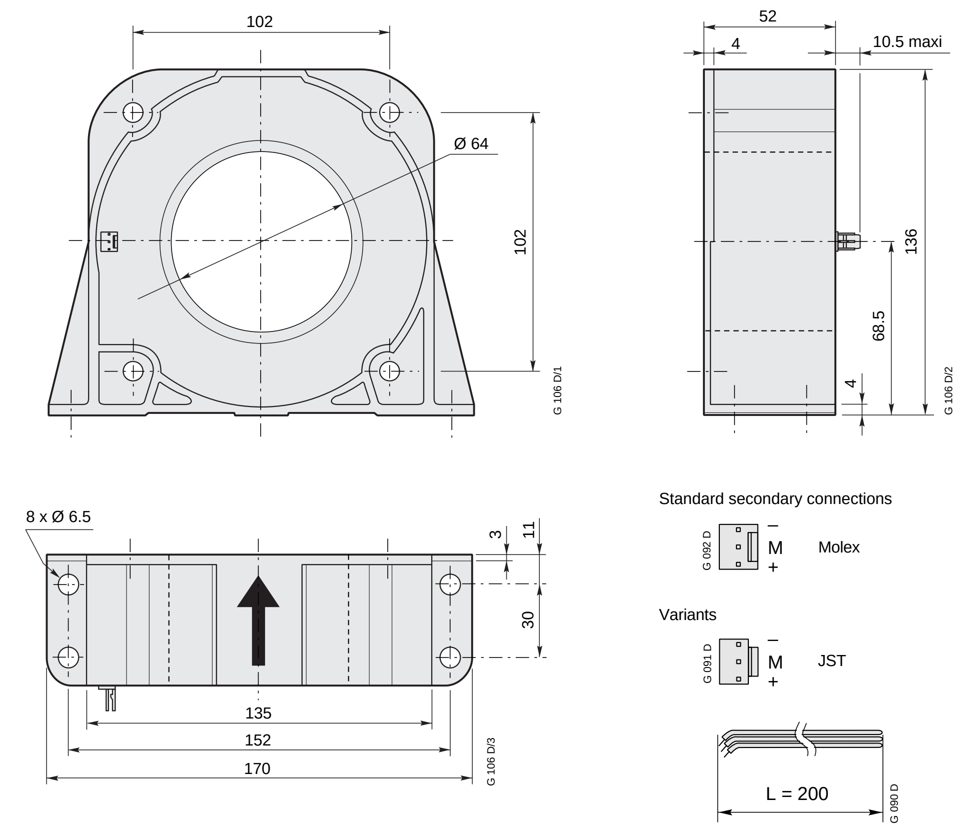


ES 1000 C / ES 1000 S / ES 1000 F
ES 1000-9675 ... 9680

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

Molex connector with a 2.54 mm pitch
JST connector with a 3.96 mm pitch

Dimensions in mm



ES 2000 - 9725 / ES 2000 S / ES 2000 F

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

Molex connector with a 2.54 mm pitch
JST connector with a 3.96 mm pitch

Questionnaire

Industrial Current Sensor Selection

Company:		Name:
Address:		Reference:
Tel.:	Fax.:	Date:

Application

1. Application:
- – Drive .... ☐
- – UPS .... ☐
- – Robotics .... ☐
- – Welding machines .... ☐
- – Other ....

2. Quantity / year ....

Electrical characteristics

1. Nominal current (**I_{PN}**) .... (**$I_{r.m.s.}$**)

2. Current:
- – d.c. .... ☐
- – a.c. .... ☐

3. Wave form

4. Frequency .... (**Hz**)

5. Measuring range:
- – **I** min. .... (**A**)
- – **I** max. measurable .... (**A**)
- – Duration .... (**s**)
- – Repetition ....

6. Overload (not measurable):
- – **I** .... (**A**)
- – Duration .... (**s**)
- – Repetition ....

7. Supply voltage : ± .... (**V**)
– Unidirectional : 0 + ... (**V**)
or : 0 – .... (**V**)

8. Measuring circuit :
- – **V_M** at **I_P** peak .... (**V**)

9. Max. continuous primary conductor voltage .... (**V**)

Mechanical characteristics

1. Fixing:
- – By the enclosure .... ☐
- – On PCB .... ☐

2. Secondary connections:
- – Molex connector .... ☐
- – JST connector .... ☐
- – Cable .... ☐
- – On PCB .... ☐
- – Other ....

Environmental conditions

1. Temperature min./max.:
- – Operating .... (°**C**)

2. Humidity - Dust ....
....

3. Vibrations ....
....

Approvals and other requirements

This document is used to choose a sensor and also to define its use and specification.

Traction Current Sensors

CS, EA, NK, TC types

Summary

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Panorama of Traction Current Sensors

Current sensors : 50 to 6000 A

CS 300 to CS 1000 (NEW)

CS 2000

CS 300 to CS 1000		CS 2000
300 A to 1000 A	Nominal primary current I_{PN}	2000 A
approx. 2 I_{PN}	Measuring range	3000 A
– 40 … +85 °C	Operating temperature	– 40 … +85 °C
±15 V to ±24 V	Power supply	±15 V to ±24 V
Primary bar supplied separately	Accessories	–

EA 101 to EA 400

EA 1000 and EA 2000

EA 101 to EA 400		EA 1000 and EA 2000
100 A to 400 A	Nominal primary current I_{PN}	1000 A & 2000 A
200 A to 600 A	Measuring range	1500 A & 3000 A
0 … +70 °C	Operating temperature	– 25 … +70 °C
±12 V to ±18 V ±12 V to ±24 V(EA400)	Power supply	±15 V to ±24 V
Primary bar supplied separately	Accessories	Primary bar supplied separately

NK 050 to NK 1000

TC 030 to TC 060

NK 050 to NK 1000		TC 030 to TC 060
50 A to 1000 A	Nominal primary current I_{PN}	3000 to 6000 A
≤ 2 I_{PN}	Measuring range	approx. 1.5 I_{PN}
– 25 … +70 °C	Operating temperature	– 25 … +70 °C
±15 V to ±28 V	Power supply	±15 V to ±24 V
Primary bar supplied separately	Accessories	Primary bar supplied as standard (except TC 060)

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Panorama of Traction Current Sensors

Traction current sensor listing

Nominal current (A r.m.s.)	Page	Type	Nominal output current (mA)	Supply voltage (V)	Secondary connections	Order code
50	30	NK 050 ADF VN 1L	100	±15 to ±28	4 x M4 studs	NK 050 ADF VN 1L
50	30	NK 050 AEF VN 1L	100	±15 to ±28	4 x 6.35 x 0.8 Faston	NK 050 AEF VN 1L
100	26	EA 101 AEN HN 1N	100	±12 to ±18	3 x 6.35 x 0.8 Faston	EA 101 AEN HN 1N
100	26	EA 101 AEN HP 1N	100	±12 to ±18	3 x 6.35 x 0.8 Faston	EA 101 AEN HP 1N
100	30	NK 100 ADF VN 1L	100	±15 to ±28	4 x M4 studs	NK 100 ADF VN 1L
100	30	NK 100 AEF VN 1L	100	±15 to ±28	4 x 6.35 x 0.8 Faston	NK 100 AEF VN 1L
200	26	EA 200 AEN HN 1N	100	±12 to ±18	3 x 6.35 x 0.8 Faston	EA 200 AEN HN 1N
200	26	EA 200 AEN HP 1N	100	±12 to ±18	3 x 6.35 x 0.8 Faston	EA 200 AEN HP 1N
200	30	NK 200 ADF VN 1L	100	±15 to ±28	4 x M4 studs	NK 200 ADF VN 1L
200	30	NK 200 AEF VN 1L	100	±15 to ±28	4 x 6.35 x 0.8 Faston	NK 200 AEF VN 1L
300	22	CS 300 BR	150	±15	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT 170300R0001
300	22	CS 300 BRV	150	±15	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT 170300R0002
300	26	EA 300 AEN HN 1N	150	±12 to ±18	3 x 6.35 x 0.8 Faston	EA 300 AEN HN 1N
300	26	EA 300 AEN HP 1N	150	±12 to ±18	3 x 6.35 x 0.8 Faston	EA 300 AEN HP 1N
300	26	EA 300 XEN HP 1N	150	±12 to ±18	3 x 6.35 x 0.8 Faston	EA 300 XEN HP 1N
400	27	EA 400 AEN HN 1N	133	±18 to ±24	3 x 6.35 x 0.8 Faston	EA 400 AEN HN 1N
400	27	EA 400 AEN HP 1N	133	±18 to ±24	3 x 6.35 x 0.8 Faston	EA 400 AEN HP 1N
400	31	NK 400 ADF VN 1L	100	±15 to ±28	4 x M4 studs	NK 400 ADF VN 1L
400	31	NK 400 AEF VN 1L	100	±15 to ±28	4 x 6.35 x 0.8 Faston	NK 400 AEF VN 1L
500	22	CS 503 BR	143	±15 to ±24	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT 170503R0001
500	22	CS 503 BRV	143	±15 to ±24	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT 170503R0002
500	22	CS 500 BR	100	±15 to ±24	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT 170500R0001
500	22	CS 500 BRV	100	±15 to ±24	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT 170500R0002
500	31	NK 500 ADF VN 1L	100	±15 to ±28	4 x M4 studs	NK 500 ADF VN 1L
500	31	NK 500 AEF VN 1L	100	±15 to ±28	4 x 6.35 x 0.8 Faston	NK 500 AEF VN 1L
1000	22	CS 1000 BR	200	±15 to ±24	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT 171000R0001
1000	22	CS 1000 BRV	200	±15 to ±24	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT 171000R0002
1000	27	EA 1000 ABF	200	±15 to ±24	3 x M5 studs	EA 1000 ABF
1000	27	EA 1000 AEF	200	±15 to ±24	3 x 6.35 x 0.8 Faston	EA 1000 AEF
1000	31	NK 1000 ADF VN 1L	200	±15 to ±28	4 x M4 studs	NK 1000 ADF VN 1L
1000	31	NK 1000 AEF VN 1L	200	±15 to ±28	4 x 6.35 x 0.8 Faston	NK 1000 AEF VN 1L
2000	23	CS 2000 BR	400	±15 to ±24	4 x M5 studs	1SBT 172000R0003
2000	27	EA 2000 ABF	400	±15 to ±24	3 x M5 studs	EA 2000 ABF
2000	27	EA 2000 AEF	400	±15 to ±24	3 x 6.35 x 0.8 Faston	EA 200 AEF
3000	34	TC 030 XEF HN 2N	300	±15 to ±24	4 x 6.35 x 0.8 Faston	TC 030 XEF HN 2N
5000 (d.c.)	34	TC 050 XEF HN 2N	1000	±15 to ±24	4 x 6.35 x 0.8 Faston	TC 050 XEF HN 2N
6000 (d.c.)	34	TC 060 AEF HN 2N	1200	±15 to ±24	4 x 6.35 x 0.8 Faston	TC 060 AEF HN 2N

TRANSTRONIC

CS Traction Current Sensors

NEW

CS 300 BR

CS 1000 BRV

CS 2000 BR

Utilization

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

Electrical characteristics

Type — Horizontal mounting / Vertical mouting		CS 300 BR CS 300 BRV	CS 503 BR CS 503 BRV	CS 500 BR CS 500 BRV	CS 1000 BR CS 1000 BRV
Nominal primary current I_{PN}	(A r.m.s.)	300	500	500	1000
Measuring range	(A d.c.)	±600	±750	±1000	±2000
with V_A & R_M max.		-	±22.8 V & 5 Ω	±22.8 V & 36 Ω	±22.8V & 4 Ω
with V_A & R_M max.		±14.25V & 11Ω	-	-	-
Not measurable overload	(Â)	3000 – 10ms/h	5000 – 10ms/h	5000 – 10ms/h	10000 – 10ms/h
Turns ratio	(N_P/N_S)	1/2000	1/3500	1/5000	1/5000
Secondary current I_{SN} at I_{PN}	(mA)	150	142.86	100	200
Accuracy max. at I_{PN} (– 40 … +85 °C)	(%)	±1	±1	±1	±1
Offset current I_{SO} (+25 °C)	(mA)	±0.5	±0.3	±0.25	±0.25
Linearity /I_S better than		10^{-3}	10^{-3}	10^{-3}	10^{-3}
Thermal drift /I_{SN}	(/°C)	0.5 x 10^{-4}	0.5 x 10^{-4}	0.5 x 10^{-4}	0.5 x 10^{-4}
Delay time	(µs)	< 1	< 1	< 1	< 1
d_i/d_t correctly followed	(A/µs)	> 100	> 100	> 100	> 100
Bandwidth (– 1 dB)	(kHz)	0 to > 100	0 to > 100	0 to > 100	0 to > 100
No-load current I_{AO} (consumption = I_{AO} + I_S)	(mA)	10	15	15	15
Secondary resistance (+85 °C)	(Ω)	27	88	64	46
Dielectric strength P/S + screen S/screen (E)	(kV r.m.s. 50Hz-1min)	6.5	6.5	12	12
Supply voltage V_A	(V)	±15 (±5%)	±15 to ±24 (±5%)	±15 to ±24 (±5%)	±15 to ±24 (±5%)
Minimum measuring resistance (+85 °C)	(Ω)	0 at V_A = ±15 V	0 at V_A = ±15 V	0 at V_A = ±15 V	0 at V_A = ±15 V
	(Ω)		0 at V_A = ±24 V	0 at V_A = ±24 V	0 at V_A = ±24 V
– by unidirectional use	(Ω)	on request	on request	on request	on request

General data

- Coated electronic circuit.
- Plastic case and insulating resin are self extinguishing.
- Fixing holes in the case moulding for horizontal or vertical mounting, with side plates.
- Hole for primary conductor.
- The temperature of the primary conductor in touch with the case must not exceed 100 °C.
- The CS 500 and CS 1000 types have an electrostatic screen connected to terminal (–) of the secondary circuit.
- Protections:

- Against short and open circuit of the output.
- Against accidental inversion of the power supply.
- Against overloads

- Operating temperature: (°C) – 40 … + 85
- Storage temperature: (°C) – 50 … + 90
- Burn in test in accordance with FPTC 404304 cycle
- Weight:

CS 300 BR	(kg)	0.36	CS 300 BRV	(kg)	0.45
CS 503 BR	(kg)	0.36	CS 503 BRV	(kg)	0.45
CS 500 BR	(kg)	0.78	CS 500 BRV	(kg)	0.91
CS 1000 BR	(kg)	0.85	CS 1000 BRV	(kg)	1.00
CS 2000 BR	(kg)	1.50			

Electrical characteristics (cont.)

Type	Horizontal mounting Vertical mouting	CS 2000 BR CS 2000 BR
Nominal primary current I_{PN}	(A r.m.s.)	2000
Measuring range with V_A & R_M max. with V_A & R_M max.	(A d.c.)	±3000 ±22.8 V & 5 Ω -
Overload not measurable	(Â)	20000 – 10 ms/h
Turns ratio	(N_P/N_S)	1/5000
Secondary current I_{SN} at I_{PN}	(mA)	400
Accuracy max. at I_{PN} (– 40 … +85 °C) Offset current I_{SO} (+25 °C) Linearity /I_S better than Thermal drift /I_{SN}	 (%) (mA) (/°C)	 ±1 ±0.25 10^{-3} 0.5×10^{-4}
Delay time	(µs)	< 1
d_i/d_t correctly followed	(A/µs)	> 100
Bandwidth (– 1 dB)	(kHz)	0 to > 100
No-load current I_{AO} (consumption = I_{AO} + I_S)	(mA)	20 at V_A = ±15 V 25 at V_A = ±24 V
Secondary resistance (+85 °C)	(Ω)	30
Dielectric strength P/S + screen S/screen (E)	(kV r.m.s. 50Hz-1min)	12 1.5
Supply voltage V_A	(V)	± 15 to ± 24 (±5%)
Minimum measuring resistance (+85 °C) – by unidirectional use	 (Ω) (Ω) (Ω)	 0 at V_A = ±15 V 0 at V_A = ±24 V on request

Direction of the current:

A primary current in the direction of the arrow results in a positive output current on terminal M.

Variants (on request):

- Secondary connection
- Turns ratio
- Supply voltage
- External connection for the screen (E)
- Primary bar (up to CS 1000)
- Side plates (vertical mounting up to CS 1000)

Accessories

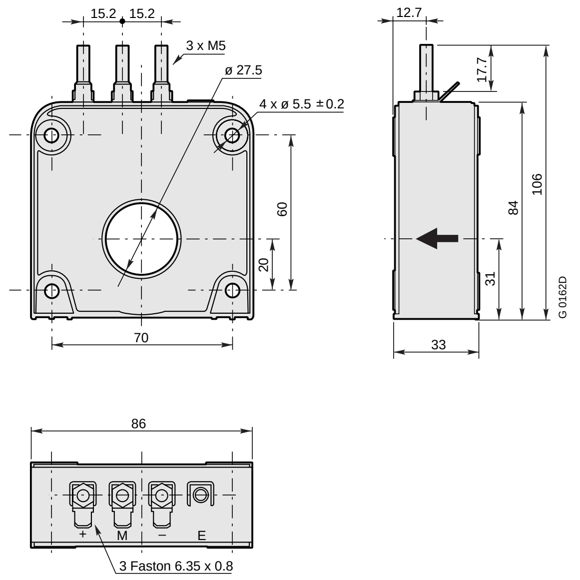
Mounting bar kits for:

CS 300 / CS 503 .... order code .... 1SBT170000R2003 .... weight (kg) 0.28 .... 6 mm thick bar
CS 500 / CS 1000 .... order code .... 1SBT170000R2004 .... weight (kg) 0.51 .... 6 mm thick bar
CS 500 / CS 1000 .... order code .... 1SBT170000R2005 .... weight (kg) 0.76 ..... 10 mm thick bar

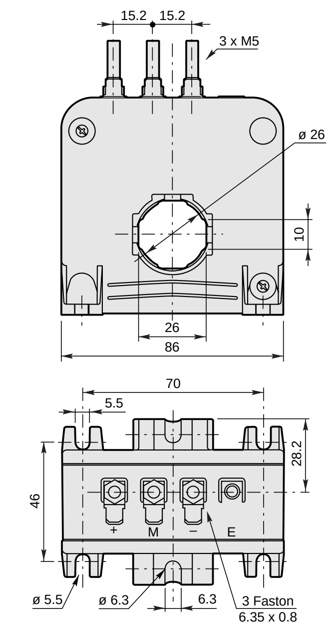
Side plate kits for:

CS 300 / CS 503 .... order code .... 1SBT170000R2001 .... weight (kg) 0.09
CS 500 / CS 1000 .... order code .... 1SBT170000R2002 .... weight (kg) 0.13

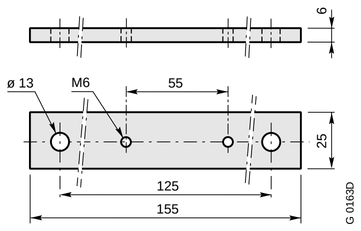
Dimensions in mm



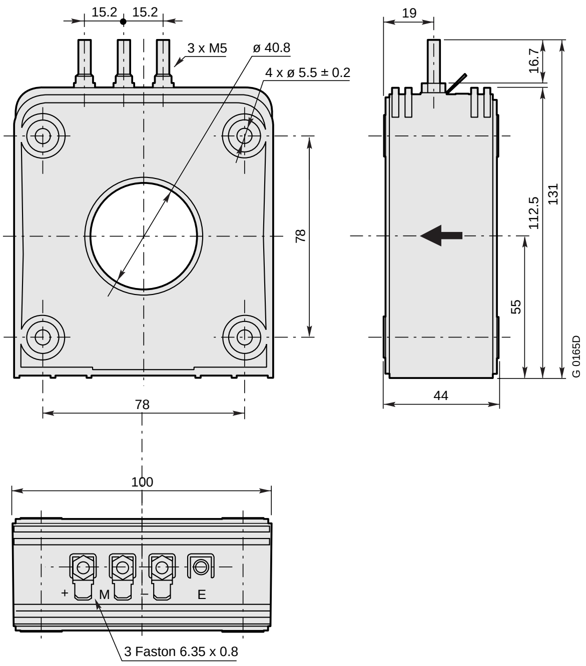
CS 300 BR and CS 503 BR



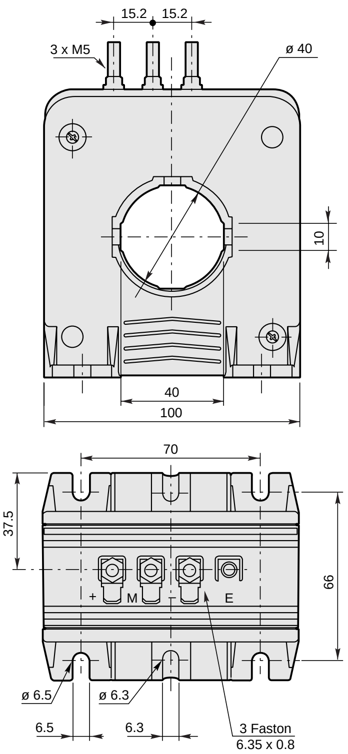
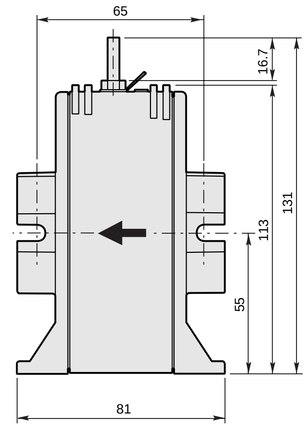
CS 300 BRV AND CS 503 BRV



Bar for CS 300 BRV and CS 503 BRV



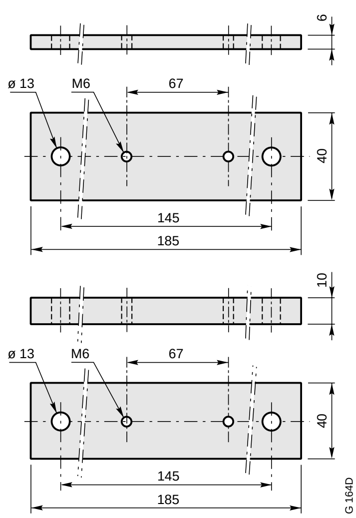
CS 500 BR and CS 1000 BR

CS 500 BRV AND CS 1000 BRV

* 6 mm: standard bar for CS 500 BRV and CS 1000 BRV

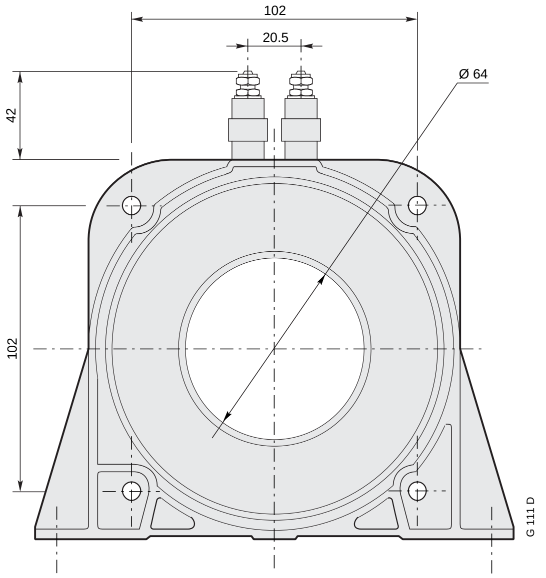
10 mm: variant bar for CS 500 BRV and CS 1000 BRV

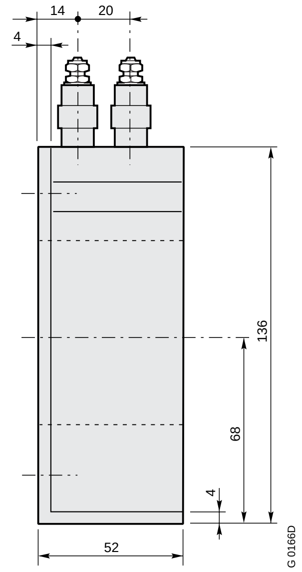


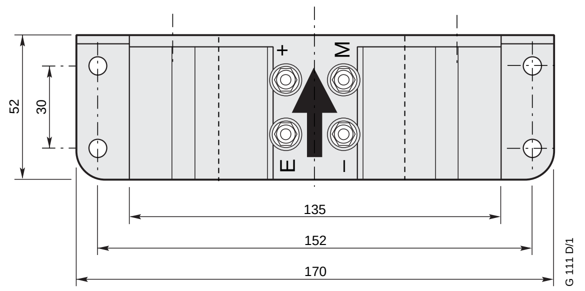
Bars* for CS 500 BRV and CS 1000 BRV

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

Dimensions in mm





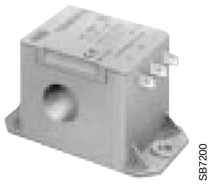


CS 2000 BR

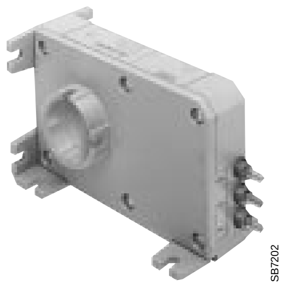
The primary bar kit is not available for the CS 2000 BR type
Tightening torque for M5 terminal studs (N.m): 2.8

TRANSTRONIC

EA Traction Current Sensors



EA 101 to EA 400



EA 1000

EA 2000

Utilization

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

Electrical characteristics

Type - with faston 6.35 x 0.8		**EA101AENH□1N***	**EA200AENH□1N***	**EA300AENH□1N***	**EA300XENHP1N**
Nominal primary current I_{PN}	(**A** r.m.s.)	100	200	300	300
Measuring range	(**A** d.c.)	±200	±400	±500	±500
with V_A & R_M max.		±12V & 30Ω	±12V & 15Ω	±12V & 5Ω	±12V & 5Ω
with V_A & R_M max.		±18V & 60Ω	±18V & 45Ω	±18V & 30Ω	±18V & 30Ω
Not measurable overload	(**Â**)	1000 – 3 s/h	2000 – 3 s/h	5000 – 3 s/h	5000 – 3 s/h
Turns ratio	(**N_P/N_S**)	1/1000	1/2000	1/2000	1/2000
Secondary current I_{SN} at I_{PN}	(**mA**)	100	100	150	150
Accuracy max. at I_{PN} (0 … +70 °C)	(**%**)	±1	±1	±0.5	±0.5
(– 25 … +70 °C)	(**%**)	-	-	-	-
Residual current I_{SO} (+25 °C)	(**mA**)	±0.4	±0.25	±0.25	±0.25
Linearity /I_S better than		10^{-3}	10^{-3}	10^{-3}	10^{-3}
Thermal drift /I_{SN}	(**/°C**)	< 10^{-4}	< 10^{-4}	< 10^{-4}	< 10^{-4}
Delay time	(**µs**)	< 1	< 1	< 1	< 1
d_i/d_t correctly followed	(**A/µs**)	> 50	> 50	> 50	> 50
No-load current I_{AO}	(**mA**)	20 with V_A = ±12V			
	(**mA**)	25 with V_A = ±18V			
Secondary resistance (+70 °C)	(**Ω**)	21	35	35	35
Dielectric strength P/S	(**kV** r.m.s. 50Hz-1min)	6	6	6	6
Supply voltage V_A	(**V**)	±12 to ±18 (±10%)	±12 to ±18 (±10%)	±12 to ±18 (±10%)	±12 to ±18 (±10%)
Minimum measuring resistance (+70 °C)	(**Ω**)	0 with V_A = ±12V	0 with V_A = ±12V	0 with V_A = ±12V	0 with V_A = ±12V
	(**Ω**)	0 with V_A = ±18V	0 with V_A = ±18V	0 with V_A = ±18V	0 with V_A = ±18V
– by unidirectional use	(**Ω**)	31 with V_A = +24V	17 with V_A = +24V	44 with V_A = +24V	44 with V_A = +24V
Primary bar		on request	on request	on request	yes

* □ : Complete the type reference with :
- N : no protection against accidental inversion of the power supply.
- P : protection against accidental inversion of the power supply.

General data

- Plastic case self extinguishing.
- Fixing holes in the case moulding.
- Hole for primary conductor.
- EA 1000 A... and EA 2000 A... have an electrostatic screen connected to the negative terminal of the secondary circuit.
- The electronic circuit is protected against short-circuit and open circuit of the output.
- Tightening torque for M5 studs: (**N.m**) 2.8 max.

● Operating temperature:	EA 101 AEN to EA 400 AEN	(°**C**)	0 … + 70
	EA 1000 A and EA 2000 A	(°**C**)	– 25 … + 70
● Storage temperature:	EA 101 AEN to EA 400 AEN	(°**C**)	– 25 … + 70
	EA 1000 A and EA 2000 A	(°**C**)	– 40 … + 85
● Weight:	EA 101 AE to EA 400 AE	(**kg**)	0.300
	EA 1000 A	(**kg**)	0.850
	EA 2000 A	(**kg**)	2.100

Electrical characteristics (cont.)

Type	EA400AENH□1N*	EA 1000 AEF	EA 2000 AEF
- with faston 6.35 x 0.8	EA400AENH□1N*	EA 1000 AEF	EA 2000 AEF
- with studs M5	-	EA 1000 ABF	EA 2000 ABF
Nominal primary current I_{PN} (A r.m.s.)	400	1000	2000
Measuring range (A d.c.)	±600	±1500	±3000
with V_A & R_M max.	±18V & 10Ω	±14.25V & 5Ω	–
with V_A & R_M max.	±24V & 40Ω	±22.8V & 30Ω	±22.8V & 10Ω
Not measurable overload (Â)	5000 – 3 s/h	10000 – 10 ms/h	20000 – 10 ms/h
Turns ratio (N_P/N_S)	1/3000	1/5000	1/5000
Secondary current I_{SN} at I_{PN} (mA)	133	200	400
Accuracy max. at I_{PN} (0 … +70 °C) (%)	±0.5	–	–
(– 25 … +70 °C) (%)	–	±0.5	±0.5
Residual current I_{SO} (+25 °C) (mA)	±0.2	±0.25	±0.25
Linearity /I_S better than	10^{-3}	10^{-3}	10^{-3}
Thermal drift /I_{SN} (/°C)	< 10^{-4}	< 10^{-4}	< 0.5 x 10^{-4}
Delay time (µs)	< 1	< 1	< 1
d_i/d_t correctly followed (A/µs)	> 50	> 50	> 50
No-load current I_{AO} (mA)	20 with V_A = ±18V	20 with V_A = ±15V	20 with V_A = ±15V
(mA)	25 with V_A = ±24V	25 with V_A = ±24V	25 with V_A = ±24V
Secondary resistance (+ 70 °C) (Ω)	70	40	25
Dielectric strength P/S (kV r.m.s. 50Hz-1min)	6	12	12
Supply voltage V_A (V)	±18 to ±24 (±10%)	±15 to ±24 (±10%)	±15 to ±24 (±10%)
Minimum measuring resistance (+ 70 °C) (Ω)	0 with V_A = ±18V	0 with V_A = ±15V	0 with V_A = ±15V
(Ω)	0 with V_A = ±24V	0 with V_A = ±24V	0 with V_A = ±24V
– by unidirectional use (Ω)	7 with V_A = +24V	0 with V_A = +24V	0 with V_A = +24V
Primary bar	on request	on request	on request

* □ : Complete the reference type with:
- N: no protection against accidental inversion of the power supply.
- P: protection against accidental inversion of the power supply.

Direction of the current

A primary current in the direction of the arrow results in a positive output current on terminal **M**.

Variants (on request):

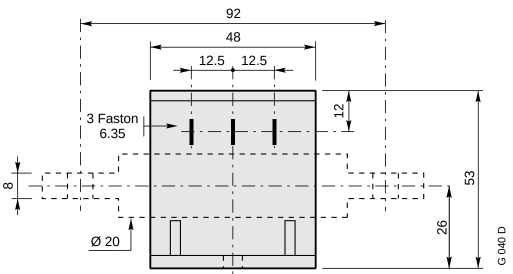
– Burn in test in accordance with FPTC 404 304 cycle
– Secondary connections
– Turns ratio
– Operating temperature
– Primary bar (mounted in our factory)
– External connection for the screen (E)
– Winding test (EA 1000 and EA 2000)

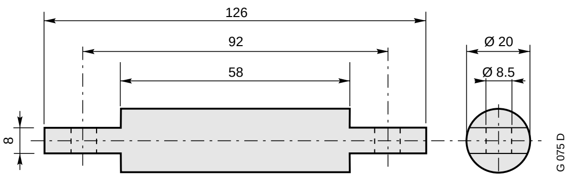
Accessories

Mounting bar kits for:

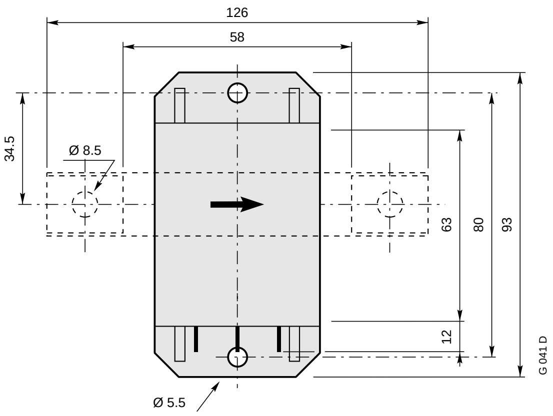
EA 101 AE to EA 400 AE .... order code .... FPTN404950R0001 .... weight (kg) 0.250
EA 1000 A .... order code .... FPTN 404993R0001 .... weight (kg) 0.790
EA 2000 A .... order code .... FPTN 404998R0001 .... weight (kg) 2.600

Dimensions in mm

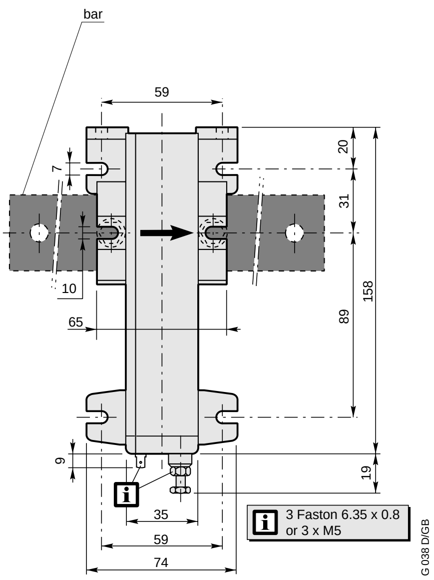


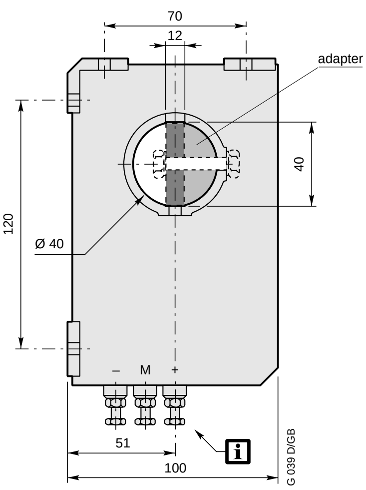


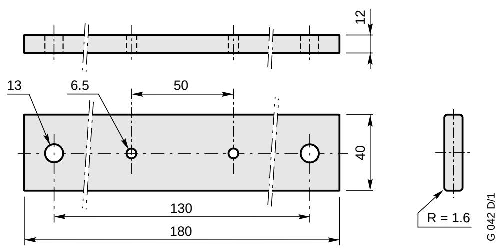
Bar for EA 101 to EA 400



EA 101 to EA 400



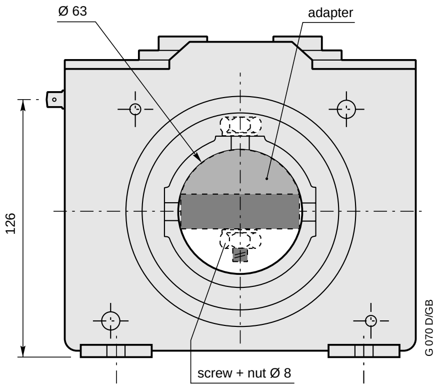


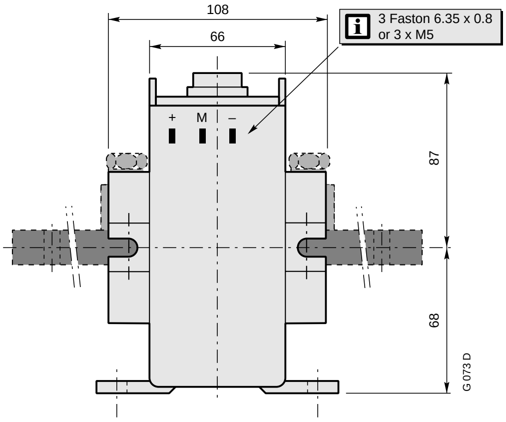


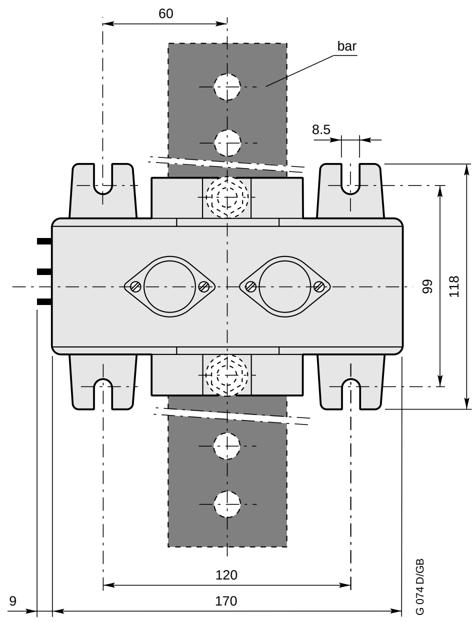
Bar for EA 1000

EA 1000 A ...

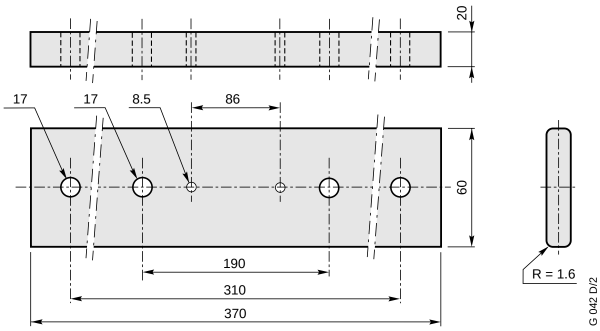
Dimensions in mm







EA 2000 A …



Bar for EA 2000

TRANSTRONIC

NK Traction Current Sensors

SB7206

NK 200 AD...

SB7205

NK 500 AE...

Utilization

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

Electrical characteristics

Type		NK050ADFVN1L	NK100ADFVN1L	NK200ADFVN1L
Type - with 4 studs M4		NK050ADFVN1L	NK100ADFVN1L	NK200ADFVN1L
- with 4 faston 6.35 x 0.8		NK050AEFVN1L	NK100AEFVN1L	NK200AEFVN1L
Nominal primary current I_{PN}	(**A** r.m.s.)	50	100	200
Measuring range	(**A** d.c.)	±100	±200	±400
with V_A & R_M max.		±15V & 50Ω	±15V & 50Ω	±15V & 45Ω
with V_A & R_M max.		±28V & 95Ω	±28V & 95Ω	±28V & 90Ω
Not measurable overload	(**Â**)	1000 – 3 s/h	2000 – 3 s/h	5000 – 3 s/h
Turns ratio	(N_P/N_S)	1/500	1/1000	1/2000
Secondary current I_{SN} at I_{PN}	(**mA**)	100	100	100
Accuracy max. at I_{PN} (– 25 … +70 °C)	(**%**)	±1	±1	±1
Residual current I_{SO} (+25 °C)	(**mA**)	±0.5	±0.4	±0.4
Linearity /I_S better than		10^{-3}	10^{-3}	10^{-3}
Thermal drift /I_{SN}	(**/°C**)	$< 10^{-4}$	$< 10^{-4}$	$< 10^{-4}$
Delay time	(**µs**)	< 1	< 1	< 1
d_i/d_t correctly followed	(**A/µs**)	> 50	> 50	> 50
No-load current I_{AO}	(**mA**)	25 with V_A = ±15 V		
	(**mA**)	30 with V_A = ±28 V		
Secondary resistance (+70 °C)	(**Ω**)	17	17	22
Dielectric strength	(**kV** r.m.s. 50Hz-1min)			
P/S + screen (E)		12	12	12
S/screen (E)		1	1	1
Supply voltage V_A	(**V**)	±15 (±5%) to ±28		
Minimum measuring resistance (+70 °C)	(**Ω**)	0 with V_A = ±15V	0 with V_A = ±15V	0 with V_A = ±15V
	(**Ω**)	115 with V_A = ±28V	113 with V_A = ±28V	108 with V_A = ±28V
– by unidirectional use	(**Ω**)	85 with V_A = +24V	85 with V_A = +24V	80 with V_A = +24V

General data

- Plastic case and insulating resin are self-extinguishing.
- Hole for primary conductor.
- Fixing holes in the case moulding.
- Tightening torque for M4 terminal studs: (**N.m**) 1.5 max.
- Operating temperature: (**°C**) – 25 … + 70
- Storage temperature: (**°C**) – 40 … + 85
- Weight :
  - NK 050 to NK 200 (**kg**) 0.600
  - NK 400 to NK 1000 (**kg**) 0.750

Electrical characteristics (cont.)

Type		NK400ADFVN1L	NK500ADFVN1L	NK1000ADFVN1L
	- with 4 studs M4 / - with 4 Faston 6.35 x 0.8	NK400AEFVN1L	NK500AEFVN1L	NK1000AEFVN1L
Nominal primary current I_{PN}	(A r.m.s.)	400	500	1000
Measuring range	(A d.c.)	±800	±1000	±2000
with V_A & R_M max.		±15V & 20Ω	±15V & 10Ω	–
with V_A & R_M max.		±28V & 65Ω	±28V & 55Ω	±28V & 20Ω
Not measurable overload	(Â)	10000 – 3 s/h	10000 – 3 s/h	10000 – 3 s/h
Turns ratio(N_P/N_S)		1/4000	1/5000	1/5000
Secondary current I_{SN} at I_{PN}	(mA)	100	100	200
Accuracy max. at I_{PN} (– 25 … +70 °C)	(%)	±0.5	±0.5	±0.5
Residual current I_{SO} (+25 °C)	(mA)	±0.25	±0.25	±0.25
Linearity /I_S better than		10^{-3}	10^{-3}	10^{-3}
Thermal drift /I_{SN}	(/°C)	< 10^{-4}	< 10^{-4}	< 10^{-4}
Delay time	(µs)	< 1	< 1	< 1
d_i/d_t correctly followed	(A/µs)	> 50	> 50	> 50
No-load current I_{AO}	(mA)	25 with V_A = ±15 V		
	(mA)	30 with V_A = ±28 V		
Secondary resistance (+70 °C)	(Ω)	45	55	55
Dielectric strength	(kV r.m.s. 50Hz-1min)			
P/S + screen (E)		12	12	12
S/screen (E)		1	1	1
Supply voltage V_A	(V)	±15 (±5%) to ±28		
Minimum measuring resistance (+70 °C)	(Ω)	0 with V_A = ±15V	0 with V_A = ±15V	0 with V_A = ±15V
	(Ω)	75 with V_A = ±28V	65 with V_A = ±28V	45 with V_A = ±28V
– by unidirectional use	(Ω)	47 with V_A = +24V	37 with V_A = +24V	31 with V_A = +24V

Direction of the current

A primary current in the direction of the arrow results in a positive output current on terminal **M**.

Variants (on request):

– Burn in test in accordance with FPTC 404 304 cycle.
– Secondary connections.
– Turns ratio.
– Operating temperature.
– Primary bar (mounted in our factory).
– Protection diodes to prevent accidental inversion of the power supply.

Accessories

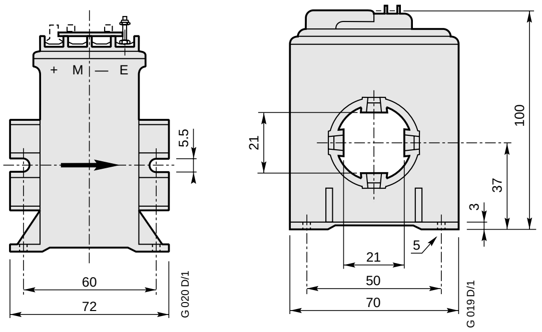
Mounting bar kits for:

NK 050 to NK 200 .... order code .... FPTN404742R0003 .... weight (kg) 0.160
NK 400 to NK 500 .... order code .... FPTN404743R0003 .... weight (kg) 0.490
NK 1000 .... order code .... FPTN 404901R0001 .... weight (kg) 1.600

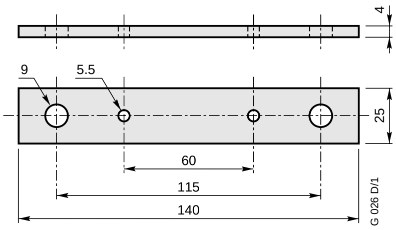
Dimensions in mm

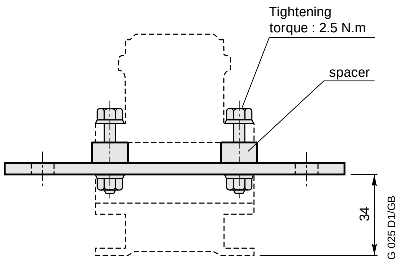
Size 0 (NK 050 to NK 200)

Standard device



Accessories





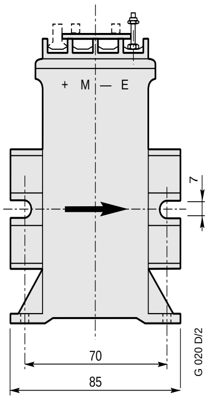
Bar for NK 050 to NK 200

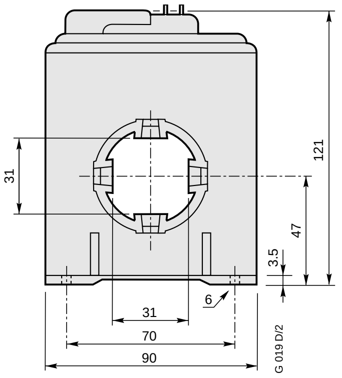
TRANSTRONIC

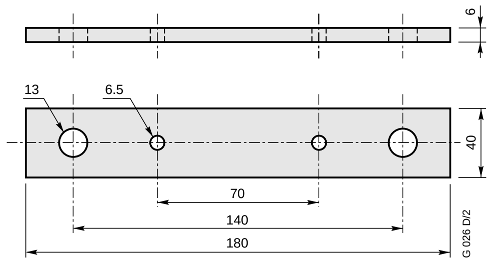
NK Traction Current Sensors

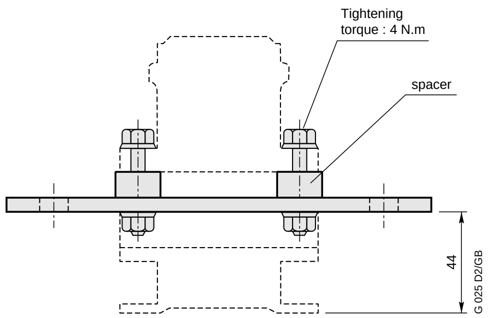
Dimensions in mm

Size 1 (NK 400 to NK 1000)

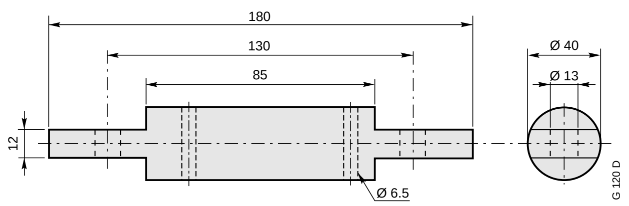








Bar for NK 400 to 500



Bar for NK 1000

TRANSTRONIC

TC Traction Current Sensors

TC 030

TC 050

TC 060

Utilization

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

Electrical characteristics

Type		TC030XEFHN2N	TC050XEFHN2N	TC060AEFHN2N
Nominal primary current I_{PN}		3000 A r.m.s.	5000 A d.c.	6000 A d.c.
Measuring range	(A d.c.)	±5000	±8000	±12000
with V_A & R_M max.		–	–	–
with V_A & R_M max.		±24V & 7Ω	±24V & 5Ω	±24V & 5Ω
Not measurable overload	(Â)	6000 – 15s/h	18000 – 10ms/h	18000 – 10ms/h
Turns ratio	(N_P/N_S)	1/10000	1/5000	1/5000
Secondary current I_{SN} at I_{PN}	(mA)	300	1000	1200
Accuracy max. at I_{PN} (– 25 … +70 °C)	(%)	±1	±1	±1
Residual current I_{SO} (+25 °C)	(mA)	±0.25	±0.2	±0.2
Linearity $/I_S$ better than		10^{-3}	10^{-3}	10^{-3}
Thermal drift $/I_{SN}$	(/°C)	< 10^{-4}	< 10^{-4}	< 10^{-4}
Delay time	(µs)	< 1	< 1	< 1
d_i/d_t correctly followed	(A/µs)	> 50	> 50	> 50
No-load current I_{AO}	(mA)	50 with V_A = ±15 V		
	(mA)	60 with V_A = ±24 V		
Secondary resistance (+70 °C)	(Ω)	35	9	9
Dielectric strength	(kV r.m.s. 50Hz-1min)			
P/S + screen (E)		12	12	12
S/screen (E)		1	1	1
Supply voltage V_A	(V)	±15 to ±24 (±10%)		
Minimum measuring resistance (+70 °C)	(Ω)	1 with V_A = ±15V	0 with V_A = ±15V	0 with V_A = ±15V
	(Ω)	34 with V_A = ±24V	9 with V_A = ±24V	7 with V_A = ±24V
– by unidirectional use	(Ω)	on request	on request	on request

General data

- Plastic case and insulating resin are self-extinguishing.
- Fixing by the primary bar.
- Secondary connections 4 Faston 6.35 x 0.8 and stuffing box PG 11.
- The sensors have a secondary screen (terminal marked E).
- Operating temperature: (°C) – 25 … + 70
- Storage temperature: (°C) – 40 … + 85
- Weight: TC 030 XE (kg) 17
  TC 050 XE (kg) 20
  TC 060 AE (kg) 11.5

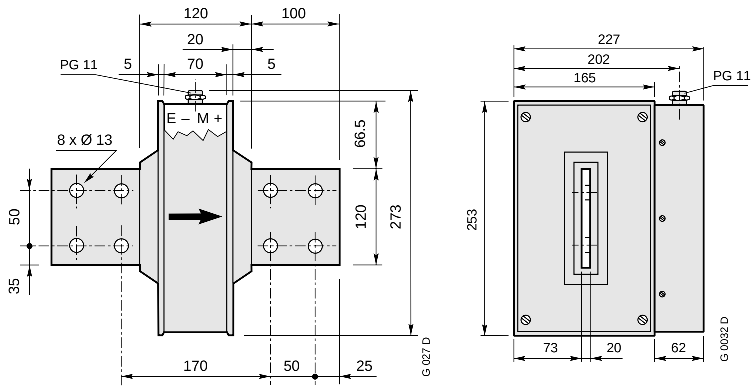
Direction of the current

A primary current in the direction of the arrow results in a positive current on terminal **M**.

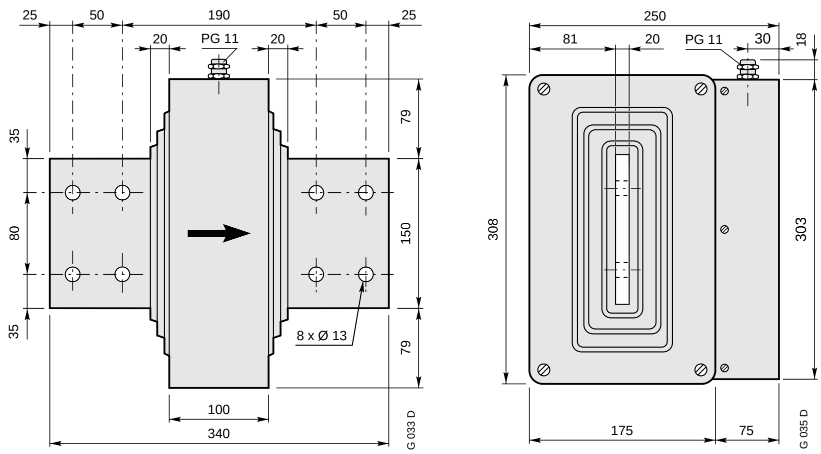
Variants

Please contact your local supplier for specific requirements.

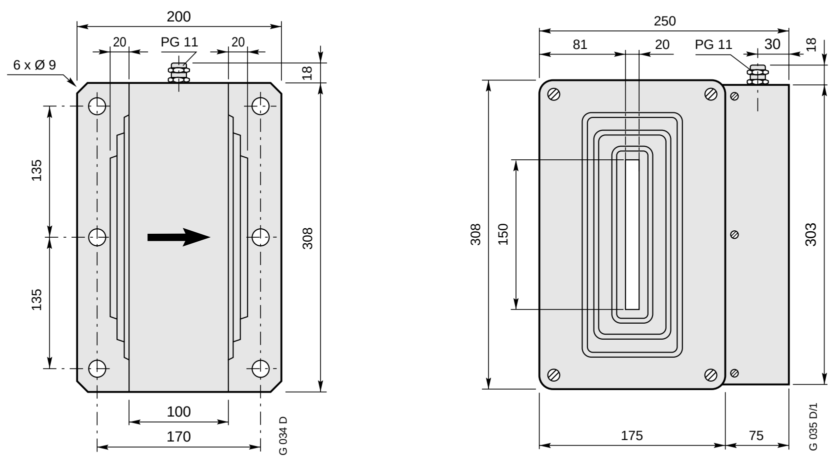
Dimensions in mm



TC 030 XE …



TC 050 XE …



TC 060 AE …

Notes

Traction Voltage Sensors

VS, EM 010 types

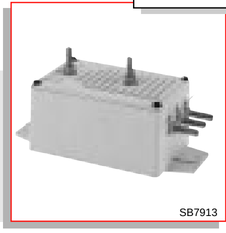
Summary

Voltage sensors : 50 to 5000 V

Static technology voltage sensors

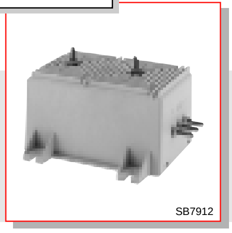
NEW

VS 50 B to VS 1500 B



NEW

VS 2000 B to VS 4200 B

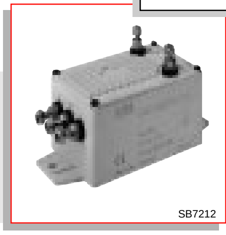


VS 50 B to VS 1500 B		VS 2000 B to VS 4200 B
50 to 1500 V	Nominal primary voltage $\mathbf{U}_{PN}$	2000 to 4200 V
±75 to ± 2250 V	Measuring range	±3000 to ± 6000 V
– 40 …+ 85 °C	Operating temperature	– 40 …+ 85 °C
±12 V to ± 24 V	Supply Voltage	±12 V to ± 24 V

Hall effect technology voltage sensors

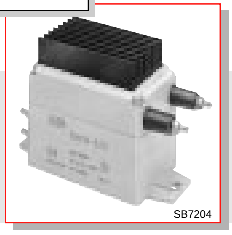
- Not calibrated : 10 mA
- Calibrated : 200 to 5000 V

EM 010 …



Not calibrated

EM 010- 9 …



Calibrated

EM 010 … (Not calibrated)		EM 010- 9 … (Calibrated)
10 mA	Nominal primary current $\mathbf{I}_{PN}$	-
-	Nominal primary voltage $\mathbf{U}_{PN}$	200 to 5000 V
(general use)	Measuring range	approx. 1.5 $\mathbf{U}_{PN}$
– 25 … + 70 °C	Operating temperature	– 25 … + 70 °C
± 12 V to ± 24 V	Supply voltage	± 12 V to ± 24 V

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Panorama of Traction Voltage Sensors

Static technology voltage sensors

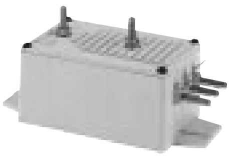
Nominal input voltage (V r.m.s.)	Page	Type	Nominal output current (mA)	Supply voltage (V)	Secondary connections	Order code
50	40	VS 50 B	50	±12 to ±24 V	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT160050R0001
125	40	VS 125 B	50	±12 to ±24 V	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT160125R0001
250	40	VS 250 B	50	±12 to ±24 V	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT160250R0001
500	40	VS 500 B	50	±12 to ±24 V	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT160500R0001
750	41	VS 750 B	50	±12 to ±24 V	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT160750R0001
1000	41	VS 1000 B	50	±12 to ±24 V	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT161000R0001
1500	41	VS 1500 B	50	±12 to ±24 V	3 x M5 studs // 3 x 6.35 x 0.8 Faston	1SBT161500R0001
2000	42	VS 2000 B	50	±12 to ±24 V	3 x M5 studs	1SBT162000R0001
3000	42	VS 3000 B	50	±12 to ±24 V	3 x M5 studs	1SBT163000R0001
4000	42	VS 4000 B	50	±12 to ±24 V	3 x M5 studs	1SBT164000R0001
4200	42	VS 4200 B	50	±12 to ±24 V	3 x M5 studs	1SBT164200R0001

Hall effect technology voltage sensors

Nominal input current (mA r.m.s.) voltage (V r.m.s.)	Page	Type	Nominal output current (mA)	Supply voltage (V)	Secondary connections	Order code
10 mA	44	EM010 BBF HP 1N	50	±12 to ±24 V	3 x M5 studs	EM 010 BBF HP 1N
10 mA	44	EM 010 BEF HP 1N	50	±12 to ±24 V	3 x 6.35 x 0.8 Faston	EM 010 BEF HP 1N
10 mA	44	EM 010 TEN HP 1N	50	±12 to ±24 V	3 x 6.35 x 0.8 Faston	EM 010 TEN HP 1N
200 V	45	EM 010-9237	50	±12 to ±24 V	5 x M5 studs	EM 010-9237
400 V	45	EM 010-9238	50	±12 to ±24 V	5 x M5 studs	EM 010-9238
500 V	45	EM 010-9320	50	±12 to ±24 V	5 x M5 studs	EM 010-9320
600 V	45	EM 010-9239	50	±12 to ±24 V	5 x M5 studs	EM 010-9239
750 V	45	EM 010-9240	50	±12 to ±24 V	5 x M5 studs	EM 010-9240
1000 V	45	EM 010-9371	50	±12 to ±24 V	5 x M5 studs	EM 010-9371
1200 V	45	EM 010-9241	50	±12 to ±24 V	5 x M5 studs	EM 010-9241
1500 V	45	EM 010-9317	50	±12 to ±24 V	5 x M5 studs	EM 010-9317
2000 V	45	EM 010-9318	50	±12 to ±24 V	5 x M5 studs	EM 010-9318
3000 V	45	EM 010-9319	50	±12 to ±24 V	5 x M5 studs	EM 010-9319
4200 V	45	EM 010-9394	50	±12 to ±24 V	5 x M5 studs	EM 010-9394
5000 V	45	EM 010-9354	50	±12 to ±24 V	5 x M5 studs	EM 010-9354

TRANSTRONIC

VS Traction Voltage Sensors



SB7913

VS 50 B ... VS 1500 B

Utilization

Electronic measuring sensor for d.c., a.c. and pulsating voltages with a galvanic insulation between primary and secondary circuits.

Electrical characteristics

Type		VS 50 B	VS 125 B	VS 250 B	VS 500 B
Nominal primary voltage $\mathbf{U_{PN}}$	(**V** r.m.s.)	50	125	250	500
Measuring range $\mathbf{U_{Pmax.}}$ continuously	(**V** d.c.)	± 75	± 187.5	± 375	± 750
with $\mathbf{V_A}$ & $\mathbf{R_M}$ max.		±22.8 V & 188 Ω			
with $\mathbf{V_A}$ & $\mathbf{R_M}$ max.		± 11.4 V & 66 Ω			
$\mathbf{R_M}$ min. at ± 24 V	(**Ω**)	0	0	0	0
Not measurable overload	(**V** d.c)	150 – 1s/h	375 – 1s/h	750 – 1s/h	1500 – 1s/h
Secondary current $\mathbf{I_{SN}}$ at $\mathbf{U_{PN}}$	(**mA**)	50	50	50	50
Accuracy max. at $\mathbf{U_{PN}}$ (– 40 … + 85 °C)	(**%**)	± 1.7	± 1.7	± 1.7	± 1.7
Accuracy max. at $\mathbf{U_{PN}}$ (– 25 … + 70 °C)	(**%**)	± 1.5	± 1.5	± 1.5	± 1.5
Accuracy max. at $\mathbf{U_{PN}}$ (+ 25 °C)	(**%**)	± 0.9	± 0.9	± 0.9	± 0.9
Offset current $\mathbf{I_{SO}}$ ($\mathbf{U_{PN}}$ = 0 and + 25 °C)	(**mA**)	± 0.15	± 0.15	± 0.15	± 0.15
Linearity better than (0.1 $\mathbf{U_{PN}}$ … 1.5 $\mathbf{U_{PN}}$)		$< 3x10^{-3}$	$< 3x10^{-3}$	$< 3x10^{-3}$	$< 3x10^{-3}$
Delay on voltage step	(**µs**)	< 10	< 10	< 10	< 10
$\mathbf{d_v}$ **/** $\mathbf{d_t}$ correctly followed	(**V/µs**)	0.012 U_{PN}			
Bandwidth (– 3 dB & $\mathbf{R_M}$ = 50 Ω)	(**kHz**)	0 to > 13	0 to > 13	0 to > 13	0 to > 13
No-Load current $\mathbf{I_{AO}}$	(**mA**)	< 50	< 50	< 50	< 50
Dielectric strength P/S	(**kV** r.m.s. 50Hz-1min)	3.3	3.3	3.3	3.3
Partial discharge (10 pC)	(**kV** r.m.s.)	1.1	1.1	1.1	1.1
Supply voltage	(**V** d.c.)	± 12 … ± 24 (± 5 %)			
Max. common mode voltage	(**V** r.m.s.)	1500 – U_{PN}/2	1500 – U_{PN}/2	1500 – U_{PN}/2	1500 – U_{PN}/2
Primary terminals		2 studs M5	2 studs M5	2 studs M5	2 studs M5
Secondary terminals		3 studs M5 // 3 Faston 6.35	3 studs M5 // 3 Faston 6.35	3 studs M5 // 3 Faston 6.35	3 studs M5 // 3 Faston 6.35

General data

- Coated electronic circuit
- Plastic case and insulating resin are self extinguishing.
- Protection against accidental inversion of the power supply.
- Protection against short and open circuit of the output.
- Protection against overloads
- Burn in test in accordance with FPTC 404 304 cycle.
- Tightening torque for M5 terminal studs: (**N.m**) 2
- Operating temperature: (°**C**) – 40 … + 85
- Storage and start-up temperature: (°**C**) – 50 … + 90
- Weight: (**kg**) 0.450

Utilization

Electronic measuring sensor for d.c., a.c. and pulsating voltages with a galvanic insulation between primary and secondary circuits.

Electrical characteristics (cont.)

Type		VS 750 B	VS 1000 B	VS 1500B
Nominal primary voltage U_{PN}	(V r.m.s.)	750	1000	1500
Measuring range U_{PMAX} continuously with V_A & R_M max. with V_A & R_M max.	(V d.c.)	± 1125	± 1500 ±22.8 V & 188 Ω ± 11.4 V & 66 Ω	± 2250
R_M min. at ± 24 V	(Ω)	0	0	0
Not measurable overload	(V d.c)	2250 – 1s/h	3000 – 1s/h	4500 – 1s/h
Secondary current I_{SN} at U_{PN}	(mA)	50	50	50
Accuracy max. at U_{PN} (– 40 … + 85 °C)	(%)	± 1.7	± 1.7	± 1.7
Accuracy max. at U_{PN} (– 25 … + 70 °C)	(%)	± 1.5	± 1.5	± 1.5
Accuracy max. at U_{PN} (+ 25 °C)	(%)	± 0.9	± 0.9	± 0.9
Offset current I_{SO} (U_{PN} = 0 and + 25 °C)	(mA)	± 0.15	± 0.15	± 0.15
Linearity better than (0.1 U_{PN} … 1.5 U_{PN})		< $3x10^{-3}$	< $3x10^{-3}$	< $3x10^{-3}$
Delay on voltage step	(µs)	< 10	< 10	< 10
d_v / d_t correctly followed	(V/µs)	0.012 U_{PN}		
Bandwidth (– 3 dB & R_M = 50 Ω)	(kHz)	0 to > 13	0 to > 13	0 to > 13
No-load current I_{AO}	(mA)	< 50	< 50	< 50
Dielectric strength P/S	(kV r.m.s. 50Hz-1min)	4.3	5.5	6.5
Partial discharge (10 pC)	(V r.m.s.)	1.1	2.2	2.2
Supply voltage	(V d.c.)	± 12 … ± 24 (± 5 %)		
Max. common mode voltage	(V r.m.s.)	1500 – U_{PN}/2	1500 – U_{PN}/2	1500 – U_{PN}/2
Primary terminals		2 studs M5	2 studs M5	2 studs M5
Secondary terminals		3 studs M5 // 3 Faston 6.35	3 studs M5 // 3 Faston 6.35	3 studs M5 // 3 Faston 6.35

Direction of the current

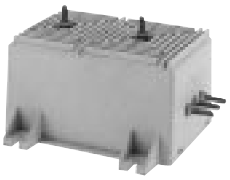
- A positive voltage applied to the primary terminal (+ HT) results in a positive current on terminal M.

Variants

- Primary and secondary terminals.

TRANSTRONIC

VS Traction Voltage Sensors



VS 2000 B ... VS 4200 B

Utilization

Electronic measuring sensor for d.c., a.c. and pulsating voltages with a galvanic insulation between primary and secondary circuits.

Electrical characteristics (cont.)

Type	VS 2000 B	VS 3000 B	VS 4000 B	VS 4200 B
Nominal primary voltage $\mathbf{U_{PN}}$ **(V** r.m.s.)	2000	3000	4000	4200
Measuring range $\mathbf{U_{PMAX}}$ continuously **(V** d.c.)	± 3000	± 4500	± 6000	± 6000
with $\mathbf{V_A}$ **&** $\mathbf{R_M}$ max.	±22.8 V & 183 Ω			
with $\mathbf{V_A}$ **&** $\mathbf{R_M}$ max.	± 11.4 V & 61 Ω			
$\mathbf{R_M}$ min. at ± 24 V (Ω)	0	0	0	0
Not measurable overload **(V** d.c)	6000 – 1s/h	9000 – 1s/h	12000 – 1s/h	12000 – 1s/h
Secondary current $\mathbf{I_{SN}}$ at $\mathbf{U_{PN}}$ **(mA)**	50	50	50	50
Accuracy max. at $\mathbf{U_{PN}}$ (– 40 … + 85 °C) **(%)**	± 1.7	± 1.7	± 1.7	± 1.7
Accuracy max. at $\mathbf{U_{PN}}$ (– 25 … + 70 °C) **(%)**	± 1.5	± 1.5	± 1.5	± 1.5
Accuracy max. at $\mathbf{U_{PN}}$ (+ 25 °C) **(%)**	± 0.9	± 0.9	± 0.9	± 0.9
Offset current $\mathbf{I_{SO}}$ ($\mathbf{U_{PN}}$ = 0 and + 25 °C) **(mA)**	± 0.15	± 0.15	± 0.15	± 0.15
Linearity better than (0.1 $\mathbf{U_{PN}}$ … 1.5 $\mathbf{U_{PN}}$)	< $3x10^{-3}$	< $3x10^{-3}$	< $3x10^{-3}$	< $3x10^{-3}$
Delay on voltage step **(µs)**	< 10	< 10	< 10	< 10
$\mathbf{d_v}$ **/** $\mathbf{d_t}$ correctly followed **(V/µs)**	0.012 $\mathbf{U_{PN}}$			
Bandwidth (– 3 dB 1 $\mathbf{R_M}$ = 50 Ω) **(kHz)**	0 to > 13	0 to > 13	0 to > 13	0 to > 13
No-load current $\mathbf{I_{AO}}$ **(mA)**	< 50	< 50	< 50	< 50
Dielectric strength P/S **(kV** r.m.s. 50Hz-1min)	8	12	12	12
Partial discharge (10 pC) **(kV** r.m.s.)	4.3	4.3	4.3	4.3
Supply voltage **(V** d.c.)	± 12 … ± 24 (± 5 %)			
Max. common mode voltage **(V** r.m.s.)	3500 – $\mathbf{U_{PN}}$/2	3500 – $\mathbf{U_{PN}}$/2	3500 – $\mathbf{U_{PN}}$/2	3500 – $\mathbf{U_{PN}}$/2
Primary terminals	2 studs M5	2 studs M5	2 studs M5	2 studs M5
Secondary terminals	3 studs M5	3 studs M5	3 studs M5	3 studs M5

General data

- Coated electronic circuit
- Plastic case and insulating resin are self extinguishing.
- Protection against accidental inversion of the power voltage.
- Protection against short and open circuit of the output.
- Protection against overloads
- Burn in test in accordance with FPTC 404 304 cycle.
- Tightening torque for M5 terminal studs: **(N.m)** 2
- Operating temperature: **(°C)** – 40 … + 85
- Storage and start-up temperature: **(°C)** – 50 … + 90
- Weight: **(kg)** 0.450

Direction of the current

- A positive voltage applied to the primary terminal (+ HT) results in a positive current on terminal M.

Variants

- Primary and secondary terminals.
- Output current (20 mA or 80 mA at $\mathbf{I_{SN}}$).

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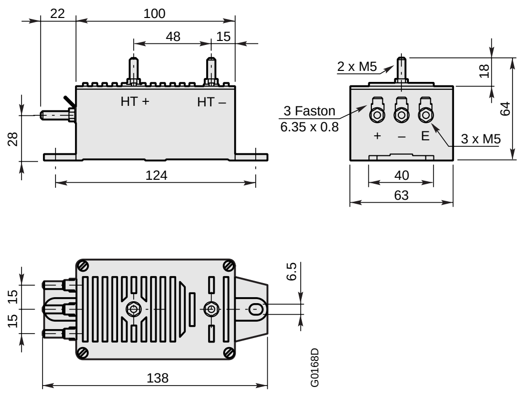
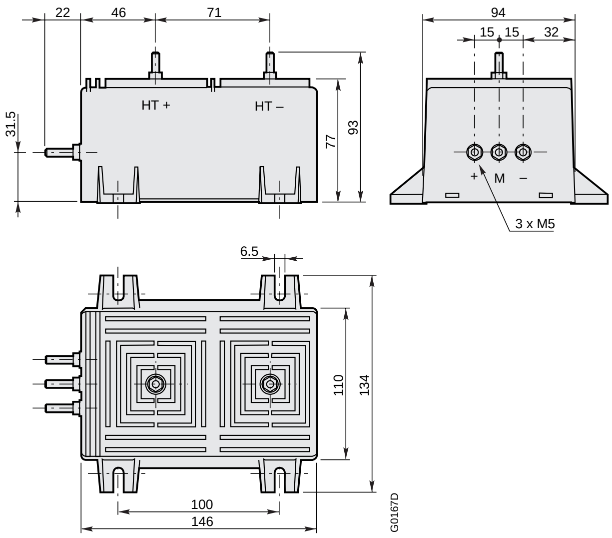
VS Traction Voltage Sensors

Dimensions in mm

Size 0 (VS 50 B to VS 1500 B)



Size 1 (VS 2000 B to VS 4200 B)



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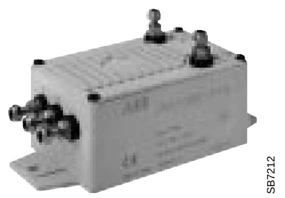
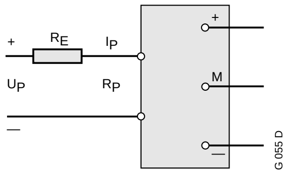
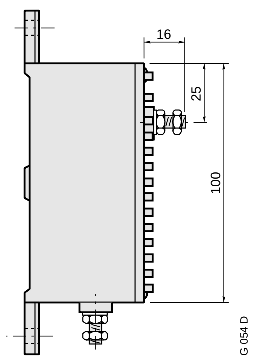
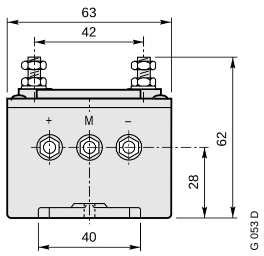
EM 010 Traction Voltage Sensors

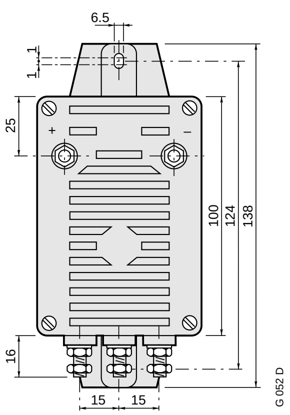


Not calibrated EM 010









Dimensions in mm

Utilization

Sensors to measure d.c., a.c. current (not calibrated sensors) or voltage (calibrated sensors) with a galvanic insulation between primary and secondary circuits.

Two options are available

Not calibrated sensors:

The customer adapts the transducer to the voltage to be measured by addition of a resistor, connected in series with the primary circuit. The value of this resistor is calculated from the formula below :

$U_P = (R_E + R_P)\, I_{PN}$ i.e.: $R_E = \frac{U_P}{I_{PN}} - R_P$ with $P_{RE} \geq U_P\, I_{PMAX.}$

Calibrated sensors:

The resistors connected in series with the transducer are included by the manufacturer. The nominal voltage to be measured is related to the number 9 … of the type code. e.g.: EM 010-9318 → 2000 V sensor.

Electrical characteristics (cont.)

Type	Not calibrated EM010BBFHP1N	EM010BEFHP1N	EM010TENHP1N	Calibrated See next page
Nominal primary current I_{PN} (mA r.m.s.)	10	10	10	–
Measuring range (mA d.c.) with V_A & R_M max. with V_A & R_M max.	20	20 ±12 V & 40 Ω ± 24 V & 160 Ω	20	See next page
Overload at + 70 °C (mÅ)	20 – 2 s/h	20 – 2 s/h	20 – 2 s/h	See next page
Turns ratio (N_P/N_S)	10000/2000	10000/2000	10000/2000	See next page
Secondary current I_{SN} at I_{PN} (or U_{PN}) (mA)	50	50	50	50
Accuracy max. at I_{PN} or U_{PN} (+ 25 °C) (%) Residual current I_{SO} (at + 25 °C) (mA) Linearity / I_S better than Thermal drift / I_{SN} (/°C)	± 1 ± 0.3 10^{-3} < 10^{-4}	± 1 ± 0.3 10^{-3} < 10^{-4}	± 1 ± 0.3 10^{-3} < 10^{-4}	± 1 ± 0.3 10^{-3} < 10^{-4}
Response time (µs)	20 to 100	20 to 100	20 to 100	20 to 100
No-load current I_{AO} (mA)	15 with V_A = ± 12 V			
(mA)	25 with V_A = ± 24 V			
Primary resistance (+ 25 °C) (Ω)	1500	1500	1500	See next page
Secondary resistance (+ 70 °C) (Ω)	60	60	60	See next page
Dielectric strength P/S (kV r.m.s. 50Hz-1min)	6	6	6	See next page
Supply voltage V_A (V)	± 12 … ± 24 (± 10 %)			
Minimum measuring resistance (+70 °C) (Ω) (Ω) – by unidirectional use (Ω)	0 with V_A = ± 12 V 0 with V_A = ± 24 V 0 with V_A = + 24 V			
Primary connections (1)	2 x M5 studs	2 x M5 studs	2 holes for M5 screws	2 x M5 studs
Secondary connections (1)	3 x M5 studs	3 x Faston 6.35	3 x Faston 6.35	5 x M5 studs (2)

(1) Max. tightening torque for M5 studs or screws : 2.8 N.m.
(2) Screen marked E and heat-sink for earth connecting.

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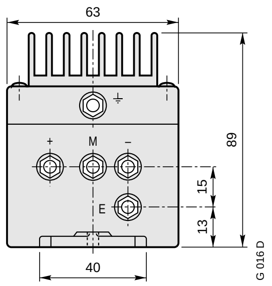
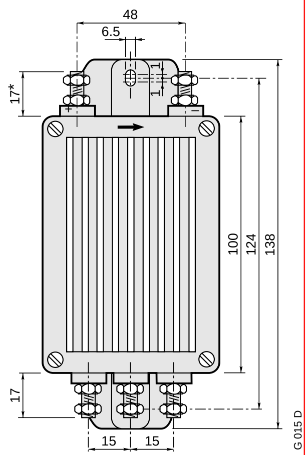
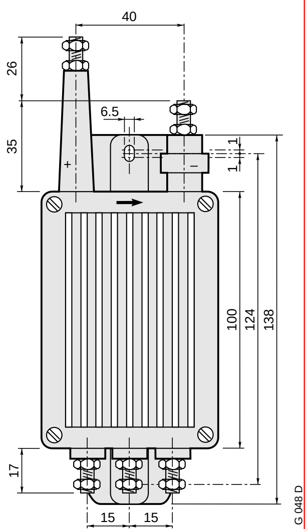
EM 010 Traction Voltage Sensors

Calibrated EM 010–9





EM 010 : 200 V ≤ $\mathbf{U_N}$ ≤ 2000 V
* 35 mm for $\mathbf{U_N}$ = 1500 and 2000 V



EM 010 : $\mathbf{U_N}$ ≥ 3000 V

Dimensions in mm

Electrical characteristics of calibrated EM 010 sensors

References	Dielectric strengh P/S **kV** r.m.s. 50 **Hz** 1 min		Primary nominal voltage	Measuring range (50 s/h)	N_P/N_S	R_P	R_S
	6	12	200 to 5000 V	300 to 8000 V		(kΩ)	(Ω)
EM010-9237	x		200	± 300	4000/2000	8	60
EM010-9238	x		400	± 600	4000/2000	16	60
EM010-9320	x		500	± 750	5000/2000	25	60
EM010-9239	x		600	± 900	10000/2000	60	60
EM010-9240	x		750	± 1125	7500/2000	56	60
EM010-9371		x	1000	± 1500	15000/2000	150	60
EM010-9241	x		1200	± 1800	12000/2000	144	60
EM010-9317		x	1500	± 2250	15000/2000	225	60
EM010-9318		x	2000	± 3000	20000/2000	400	60
EM010-9319		x	3000	± 4500	30000/2000	900	60
EM010-9394		x	4200	± 8000	30000/1250	2000	25
EM010-9354		x	5000	± 8000	20000/1000	2000	20

Max. tightening torque for M5 studs or screws: 2.8 N.m.

Common general data

- Plastic case and insulating resin are self extinguishing.
- The sensors with resistance included in the case have a terminal marked ⏚ to connect the cover heat sink to earth.
- Protection against accidental inversion of the power supply.
- Screen between primary and secondary circuits connected to:

– the negative terminal (–) on the not calibrated sensors.

– the terminal (E) on the calibrated sensors.

- Overload at 70 °C (basic conditions continuously) — 1.10 $\mathbf{U_N}$ continuously; 1.25 $\mathbf{U_N}$ 3 mn/h; 1.50 $\mathbf{U_N}$ 50 s/h
- Operating temperature — (°**C**) – 25 … + 70
- Storage temperature — (°**C**) – 40 … + 85
- Weight:

– not calibrated sensors — (**kg**) 0.350

– calibrated sensors — (**kg**) 0.550

Direction of the current

- A positive voltage applied to the primary terminal (+) results in a positive current on terminal M.

Variants (on request):

- burn-in test in accordance with FPTC 404 304 cycle.
- operating temperature.

Questionnaire for TRANSTRONIC Selection

Traction Sensor Selection

Company:		Name:
Address:		Reference:
Tel.:	Fax.:	Date:

Application

1. Project
2. Use :
   - – Installation .... ☐
   - – Rolling stock .... ☐
   - – Other ....
3. Function ....
4. Quantities / year ....
5. Total quantity of the project ....

Electrical characteristics

● **Voltage sensors**

1. Voltage to measure (U_N) .... (V)
2. Measuring range :
   - – $U_{min.}$ .... (V)
   - – $U_{max.}$ measurable .... (V)
   - – Duration .... (s)
   - – Repetition ....
3. Overload (not measurable) :
   - – **U** .... (V)
   - – Duration .... (s)
   - – Repetition ....

● **Current sensors**

4. Nominal current (I_{PN}) .... ($I_{r.m.s.}$)
5. Current :
   - – d.c. .... ☐
   - – a.c. .... ☐
6. Wave form
7. Frequency .... (Hz)
8. Measuring range :
   - – **I** min. .... (A)
   - – **I** max. measurable .... (A)
   - – Duration .... (s)
   - – Repetition ....
9. Overload (not measurable) :
   - – **I** .... (A)
   - – Duration .... (s)
   - – Repetition ....
10. d_i/d_t to measure .... (A/µs)

● **Common to voltage and current sensors**

11. Supply voltage :
    - – Bi-directional : ± .... (V)
    - – Unidirectional : 0 + ... (V)
    - or : 0 – .... (V)
12. Measuring circuit :
    - – V_M at I_P peak (or U_P peak) .... (V)
13. Dielectric strength .... (kV r.m.s. - 50 Hz - 1 min)
14. Protection against inversion of the power supply: yes .... ☐ no .... ☐
15. Burn-in test yes .... ☐ no .... ☐

Mechanical characteristics

1. Fixing :
   - – By bar .... ☐
   - – By the enclosure .... ☐
2. Primary circuit :
   - – Bar .... ☐
   - – Hole Ø .... ☐
3. Secondary connections :
   - – Faston 6.35 x 0.8 mm .... ☐
   - – Threaded studs M … .... ☐
   - – Other : ....

Environmental conditions

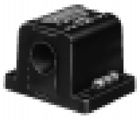
1. Temperature min./max. :
   - – Operating .... (°C)
   - – Storage .... (°C)
2. Humidity - Dust ....
   ....
3. Vibrations ....
   ....
4. Other ....
   ....

Approvals and other requirements

This document is used to choose a sensor and also to define its use and specification.

Traction current sensors

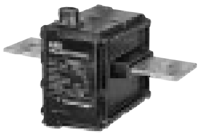
EA 100



5594

- EA 100

TA 600

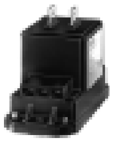


6353

- TA 600

Traction voltage sensors

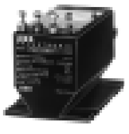
TM 010



6250

- TM 010

TM 020



6249

- TM 020

TM 020 DV

6253

- TM 020 DV

Contact your local supplier for technical details

TRANSTRONIC

Instructions for use and mounting

1 - Primary connections

To get a positive signal on secondary terminal **M**, the primary current must flow in the positive direction, as shown by an arrow on the enclosure.

To get a better thermal dissipation into the primary bar, we recommend that the bar is placed on its edge.

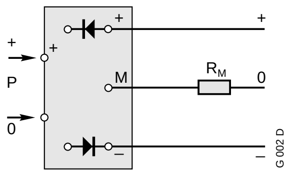
In order to get the best measure accuracy, it is recommended to center the primary conductor inside the hole.

The primary conductor mainly limits the value of the overload. We recommend not to exceed a temperature of 100 °C (or less according to the sensor type) on the primary conductor.

2 - Secondary connection of the supply voltage (V_A)

2-1 Standard supply (+ 0 –) :
Never invert the positive (+) and negative (–) leads of the supply .

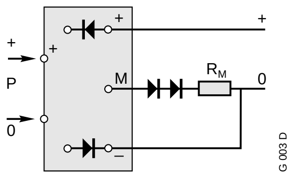
2-2 If the sensor is too far from the supply or from the measuring point (**R_M**), we recommend the use of a coaxial cable with earthed screen connected to zero Volt of the supply.

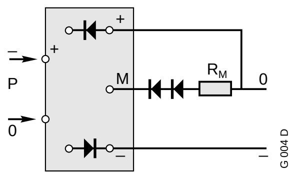


2-3 Unidirectional supply (0 +) and (0 –) :
We use this supply for a direct current or a.c. pulsating current with constant polarity (always positive, or always negative).

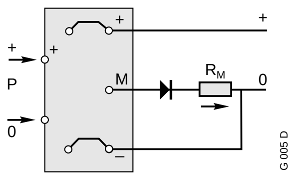
2-3-1 Hall effect technology

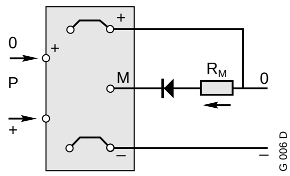
2-3-1-A If the sensor is fitted with diodes to protect against the inversion of the supply voltage:
We recommend that 2 diodes are put in series with the measuring resistance (**R_M**), to avoid the leakage currents which can influence the accuracy of the measurement.





2-3-1-B Sensor without protection diodes.

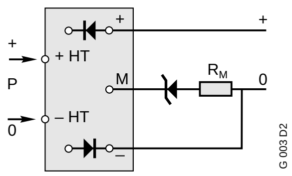


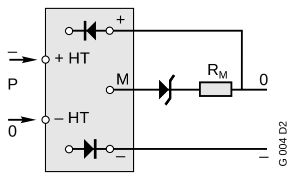


2-3-2 Static technology (VS range).

The zener diodes should respect the following characteristics:

- Zener voltage: 5.6 V
- Zener power: ≥ 5.6 x $\mathbf{I_s}$max.





2-4 If a sensor is fitted with a one-way connector, the diodes, to protect the sensor against inversion of the power supply, are not always mounted.

3 - Sensor with screen

The secondary screen earthes the charges induced by capacitive effect caused by large potential variation (high $\mathbf{d_u/d_t}$). Connect the screen terminal to the zero of the supply.

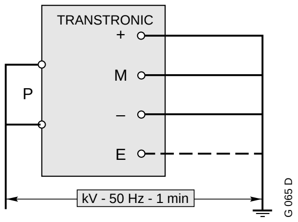


fig. 6

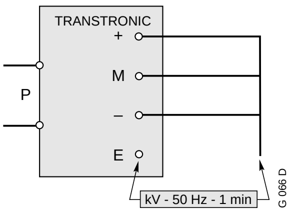


fig. 7

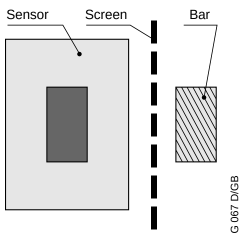


fig. 8

4 - Dielectric strength of the sensors

4-1 The test of dielectric strength generates stresses in the insulation (resin …). This test should only be repeated with precaution.

We recommend a minimum period of 24 hours between 2 tests.

4-2 These tests are carried out in accordance with IEC 77 publication.

- sensors alone:

the dielectric strength check is a sequence of tests carried out with the given voltage value $\mathbf{U_E}$

- sensors mounted on the equipment: the voltage must not exceed 0.85 $\mathbf{U_E}$

4-3 Two kinds of tests can be carried out:

- **P/S** + screen to earth (**kV r.m.s. - 50 Hz - 1 min**) - fig. 6
- **S**/screen (**kV r.m.s. - 50 Hz - 1 min**) - fig. 7

5 - Influence of the magnetic fields

If two sensors are side by side or if a sensor is mounted close to a bar carrying a high current, we recommend to place a magnetic screen between the sensor and the bar (fig. 8).

When mounting the sensor in the equipment, we also recommend that, as far as possible, it is orientated in order to minimize the influence of the electromagnetic field.

6 - Accidental magnetization

2 possibilities:

- primary supplied, secondary not supplied or measuring circuit open.
- primary current superior to the measurable current.

In this case, there is an accidental magnetization of the magnetic circuit (no compensation of the flux). The sensor is still functionning normally, but with a value of the offset ($\mathbf{I_{so}}$) higher than the normal value, leading to an additional error (small, however).

7 - Protection

Generally the sensors withstand without damage:

- high $\mathbf{d_i/d_t}$ thanks to the internal protection diodes.
- short circuits.
- opening of the measuring circuit.

8 - Others

For complete technical characteristics of sensor, please refer to the technical data sheet of the relevant sensor.

For general technical information on Hall effect closed loop technology, please refer to the document FPTC 404415.

● Secondary circuit for measuring current and voltage :

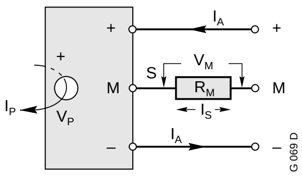
$V_A = e + V_S + V_M$ $V_S = R_S \times I_S$ $V_M = R_M \times I_S$ $N_P \times I_P = N_S \times I_S$

e = voltage drop inside diodes and output transistors.
The following table gives the different values of **e** according to the connecting of the sensor :

	Rating of sensor		
	≤ 100 A	> 100 A	> 100 A and diodes*
Power supply using $\pm V_A$	e = 2.5 V	e = 1 V	e = 1.5 V
Power supply following § 2-3-1-A page 48	Not applicable	Not applicable	e = 3 V
Power supply following § 2-3-1-A page 48	e = 3 V	e = 1.5 V	Not applicable

* Diodes to prevent accidental inversion of the power supply

For the CS range: e = 2.5 V for CS 300 to CS 1000



Example : ES 300 C

N_P/N_S = 1/2000 **I_{PN} = 300 A r.m.s.** **R_S = 30 Ω** **I_S = 0.150 A** **e = 1 V**

Calculation of V_M max. (and R_M max.):

if $V_A = \pm 15$ V $V_S = R_S \times I_S = 30 \times 0.15 = 4.5$ V

V_M max. = $V_A - (e + V_S) = 15 - (1 + 4.5) = 9.5$ V

Conclusion : **V_M max. = 9.5 V** **R_M max. = V_M max./I_S = 9.5/0.15 = 63.33 Ω**

Calculation of the max. measurable current:

if $V_A = \pm 15$ V and $R_M = 12$ Ω

$V_A - e = 15 - 1 = 14$ V $= V_M + V_S = (R_M + R_S) \times I_S$

$R_M + R_S = 12 + 30 = 42$ Ω I_S max. = $(V_A - e)/(R_M + R_S) = 14/42 = 0.333$ A

max. measurable $I_P = I_S$ max. x (N_S/N_P) = 0.333 x 2000 # 666 A

Conclusion : All peaks higher than 666 A cannot be measured under the above conditions.
However, peaks of higher value are without consequence on the sensor.

● Measurement of a peak of 750 A :

$I_S = I_P \times (N_P/N_S)$ = 750/2000 = 0.375 A **$V_S = R_S \times I_S$ = 30 x 0.375 = 11.25 V**

What value of R_M to use if $V_A = \pm 15$ V ?

$V_M = V_A - (e + V_S) = 15 - (1 + 11.25) = 2.75$ V

$R_M = V_M/I_S = 2.75/0.375$ # 7.33 Ω **R_M = 7.33 Ω**

What value of V_A to use if $R_M = 15$ Ω ?

$V_M = R_M \times I_S = 15 \times 0.375 = 5.625$ V

$V_A = e + V_S + V_M = 1 + 11.25 + 5.625 = 17.875$ **Choose $V_A = \pm 18$ V**

ES 300 C

Conclusion : It is possible to measure a peak of **750 A** with :

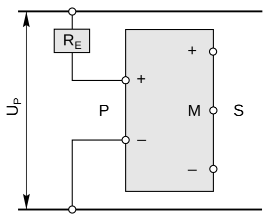
$V_A = \pm 15$ V and R_M = 7.33 Ω or: **$V_A = \pm 18$ V and R_M = 15 Ω**

● Maximum measurable current with V_A ± 20 V and R_M = 15 Ω

$V_A - e = 20 - 1 = 19$ V $R_S + R_M = 30 + 15 = 45$ Ω

I_S **max.** = $(V_A - e)/(R_S + R_M) = 19/45 = 0.422$ **A**

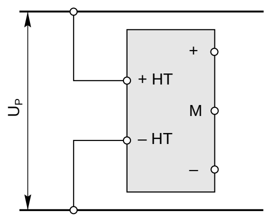
I_P max. = I_S max. x (N_S/N_P) = 0.422 x 2000 # 844 A



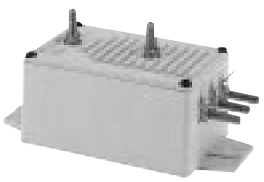
G 068 D


SB7212

EM 010 BBNHP1N



G 0172D


SB7913

VS 1000 B

- However with R_M = **15** Ω, it is possible to measure higher currents than this value ; to do so, use a uni-directionnal supply voltage (0 +) or (0 –) : refer **2.3** page **48**.

Example : Î = 1000 A and **V_A = 0 + 30 V (2 x 15 V)**

e = 1.5 V $I_S = I_P$ x **(N_P/N_S)** = 1000/2000 = 0.5 A

V_S = R_S x **I_S** = 30 x 0.5 = 15 V
V_M = R_M x **I_S** =15 x 0.5 = 7.5 V

We must check that: **e** + **V_S** + **V_M** < **V_A**
e + **V_S** + **V_M** =1.5 + 15 + 7.5 = 24 V < 30 V: OK.

Max. measurable peak current with V_A = 0 + 30 V and R_M= 15 Ω:

V_A – e = 30 – 1.5 = 28.5 **V** **R_S + R_M** = 30 + 15 = 45 Ω

$\hat{I}_S$ max. = (**V_A** – **e**)/(**R_S** + **R_M**) = 28.5/45 # 0.633 A

$\hat{I}_P$ max. = $\hat{I}_S$ max. x (N_S/N_P) # **0.633** x **2000** # **1267 A**

• Primary circuit for voltage measurement (Hall effect technology)

Calculation of the input resistance **R_E**:

R = **R_E** + **R_P** **R** = **U_P/I_{PN}** with **R_E** power ≥ **U_P** x **I_{PN}**

Example: EM 010 sensor

I_{PN} = 10 mA **R_P = 1500 Ω** **N_P/N_S = 10000/2000**

U_P = 1000 V
R = 1000/10.10^{-3} = 100 kΩ >>> **R_P** therefore take **R_E = 100 kΩ**
i.e. **R** = 100000 + 1500 = 101500 Ω ⇒ **I_P** = 1000/101500 = 9.85 mA
I_S = **N_P/N_S** x **I_P** = 10000/2000 x 9.85 = 49.25 mA
Conclusion : with **U_P** = 1000 V **I_S = 49.25 mA**

and : **R_E** power ≥ 1000 x 9.85 10^{-3} # **10 W**

• Secondary circuit for voltage measurement (Static technology)

Calculation of the burden resistor **R_M** :

For **VS 50 B** to **VS 1500 B:** $R_M = \dfrac{0.8 \times V_A \text{ min.}}{I_S \text{ max.}} - 55$

For **VS 2000 B** to **VS 4200 B:** $R_M = \dfrac{0.8 \times V_A \text{ min.}}{I_S \text{ max.}} - 60$

V_A min. = **V_A** minus low tolerance of the power supply
I_S max. = **I_{SN}** x (**U_P** max./**U_{PN}**)

Example : VS 1000 B sensor

U_{PN} = **1000 V** **I_{SN}** = **50 mA** **V_A** = ± **24 V** (± 5 %) **U_P max.** = **1800 V**

I_S max. = **I_{SN}** x (**U_P** max./**U_{PN}**) = 0.050 x 1800/1000 = 0.09 A
V_A min. = 24 V – 5 % = 24 x 0.95 = 22.8 V
R_M = [(0.8 x **V_A** min.)/**I_S** max.] – 55 = [(0.8 x 22.8)/0.09] – 55 # 148 Ω
V_M = **R_M** x **I_S** max. # 148 x 0.09 # 13.3 V

Conclusion: For **U_P** max. = **1800 V:** **R_M 148** Ω and **V_M = 13.3 V**

TRANSTRONIC
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