

Technical argumentation
Argumentation technique

CS Range

Gamme CS

1SBC146010C1701 Technical Presentation CS range 1.0 - Version 1.0

Hall effect closed-loop
current sensors

*Capteurs de courant
à effet Hall boucle-fermée*



ABB

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<p>Current and voltage sensors</p>	<p>CS range Technical Presentation</p>
	
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Technical presentation summary

- 1 The customer's needs
- 2 The aimed applications
- 3 The technology
- 4 The range
- 5 The main characteristics
- 6 The options and accessories
- 7 The electrical connections
- 8 The advantages
- 9 The used standards
- 10 The technical documentation

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1 The customers' needs



- Price



- High quality



- High performances



- Reliability



- Compactness



- Latest standards



- Reliable supplier

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2 The aimed applications

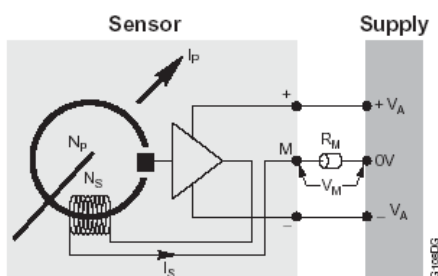
- Traction applications: ground mobile equipments
 - Power converters
 - Input DC current, Motor phase current, etc...
 - Auxiliary converters
 - Heating, air conditioning, lighting, battery charger, etc...

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3 The technology

- Functioning principle



The primary current I_p flowing across the sensor creates a 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 sensors 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 .

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3 The technology

- Technologies comparison for current sensing

	Shunt	Current Transformer	Open Loop	Closed Loop
Insulation P/S	NO	YES	YES	YES
Bandwidth	DC to few kHz	AC only	DC to few kHz	DC to 100 kHz
Measuring range	Low	Medium	Medium	High
Maximum overloads	Very Low	Low	Low	High
Power dissipation	High	Medium	Very Low	Low
Output signal	Voltage	Current	Voltage	Current
Supply voltage	No need	No need	$\pm V$	$\pm V$
Accuracy	0.5 to 2%	0.5 to 2%	2 to 4%	< 1%
Price	Low	Medium	Medium	High

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3 The technology

- Major advantages of the CS technology (closed loop Hall effect technology)
 - Galvanic isolation
 - High accuracy
 - Fast response time
 - Excellent linearity
 - Wide continuous measuring range
 - Low power dissipation (no heating)

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4 The range

■ General range presentation:

■ 300 A r.m.s. up to 2000A r.m.s.

- 300A r.m.s. => CS300
- 500A r.m.s. => CS500 / CS503
- 1000A r.m.s. => CS1000
- 2000A r.m.s. => CS2000



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4 The range

■ CS range:

- Technology: closed loop Hall effect
- Measuring range: up to $\pm 2 \times I_{PN}$ (few minutes/hour)
- Temperature: -40°C to $+85^{\circ}\text{C}$
- Supply voltage: $\pm 15\text{V} \dots \pm 24\text{V}$
- Bandwidth: 0 to $>100\text{kHz}$
- Global accuracy: $<\pm 1\%$ (-40°C to $+85^{\circ}\text{C}$)
- Dielectric strength: EN50124-1 (from 6.5kV up to 12kV)
- Options: turns ratio, secondary terminals, fixing mode, screen, primary bar

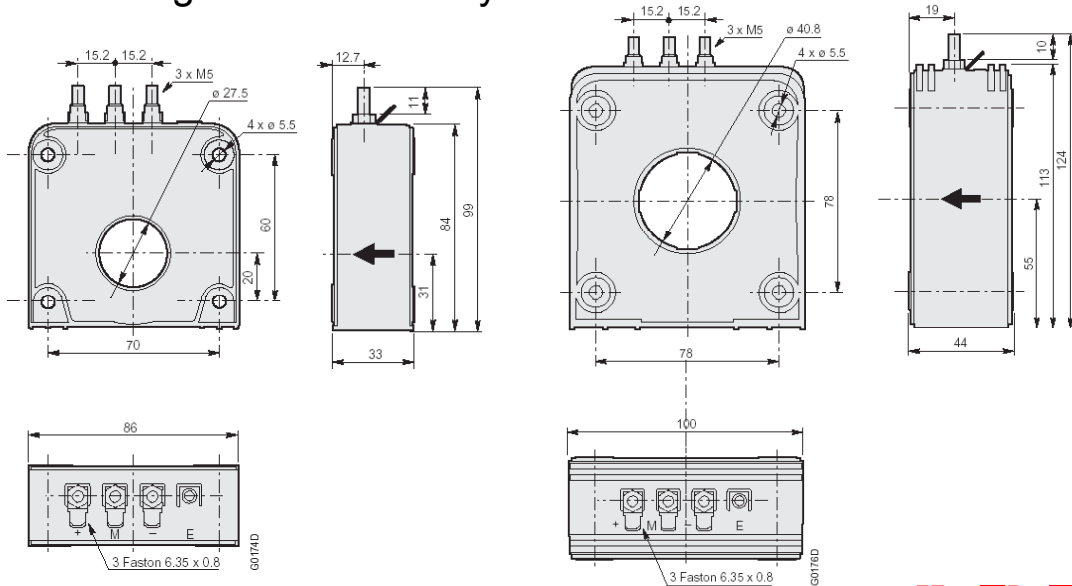
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4 The range

■ CS range mechanical layout

Horizontal mounting



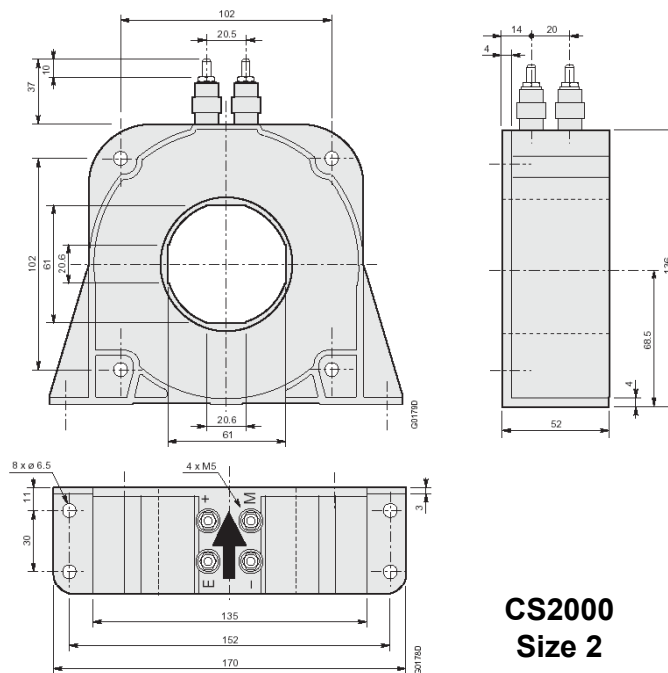
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4 The range

■ CS range mechanical layout

Horizontal mounting



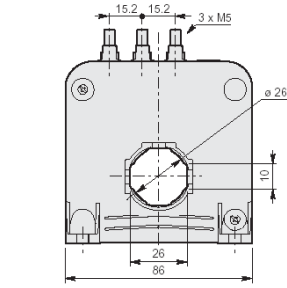
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4 The range

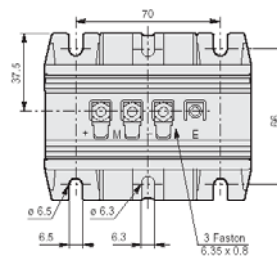
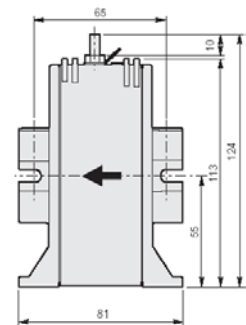
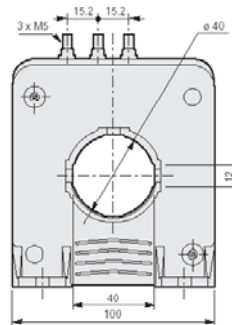
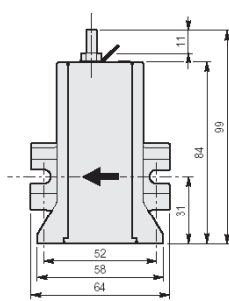
Vertical mounting

■ CS range mechanical layout



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CS300 / CS503
Size 0



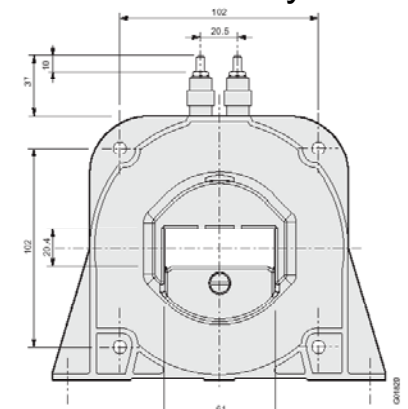
CS500 / CS1000
Size 1



4 The range

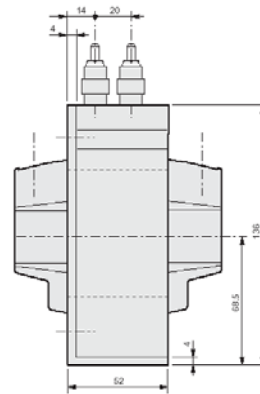
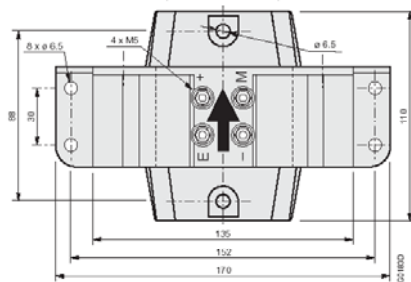
Vertical mounting

■ CS range mechanical layout



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CS2000
Size 2



5 The main characteristics

■ CS range main standard characteristics

				CS300	CS503	CS500	CS1000	CS2000
Nominal primary current	I_{PN}		A r.m.s.	300	500	500	1000	2000
Measuring range	$I_{P_{MAX}}$	@ $\pm 24V \pm 5\%$	A peak	± 600	± 750	± 1000	± 2000	± 3000
Turn number	N_S			2000	3500	5000 (1)	5000 (1)	5000 (1)
Secondary current at I_{PN}	I_S		mA	150	142.86	100 (1)	200 (1)	400 (1)
Accuracy at I_{PN}	$Err\%$	@ $+25^\circ C$	%	$\leq \pm 0.5$				
Linearity	Lin		%	≤ 0.1				
Delay time	dt		μs	≤ 1				
di/dt correctly followed	di/dt		A/ μs	≤ 100				
Bandwidth	BW	-1dB	kHz	< 100				
Max. no-load consumption current	I_{ao}	@ $\pm 24V \pm 5\%$	mA	≤ 10	≤ 15	≤ 15	≤ 15	≤ 25
Dielectric strength Primary/Secondary	$U_{d_p/s}$	50 Hz, 1 min	kV	6.5	6.5	12	12	12
Supply voltage	V_A	$\pm 5\%$	V d.c.	$\pm 15 \dots \pm 24$				
Operating temperature	T^{op}		$^\circ C$	$-40 \dots +85$				
Storage temperature	T^{st}		$^\circ C$	$-50 \dots +90$				

(1) Other standard values available

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6 The options and accessories

■ CS range : electrical options

- Special turns ratio: for 300A to 500A rated sensors
- Temperature range : $-40 \dots 85^\circ C$

■ CS range : terminals options

- Standard output connections:

3 x M5 studs
3 x 6.35 x 0.8 Faston



4 x M5 studs
4 x 6.35 x 0.8 Faston



4 x M5 studs



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6 The options and accessories

■ Optional output connections:

■ Shielded cable



■ 3 or 4 inserts



■ Others on request...

■ LEMO Connector:



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6 The options and accessories

■ Accessories:

■ Primary bars:

■ For CS300 and CS503

- Bar CST0: 155 x 25 x 6

■ For CS500

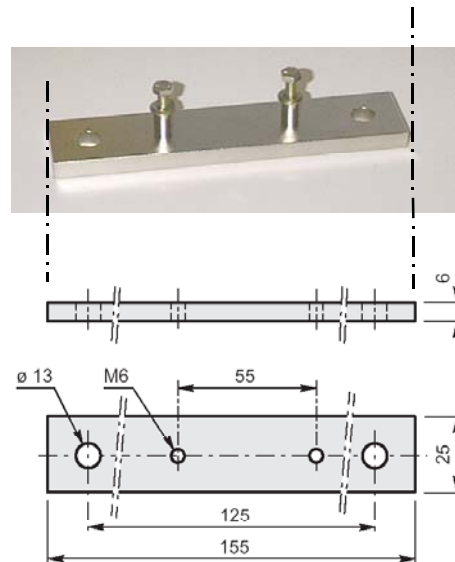
- Bar CST1-6: 185 x 40 x 6
- Bar CST1-10: 185 x 40 x 10
- Bar CST1 special: 210 x 40 x 10

■ For CS1000

- Bar CST1-6: 185 x 40 x 6
- Bar CST1-10: 185 x 40 x 10

■ For CS2000

- Bar CST2: 240 x 60 x 20
- Bar CST2 special: 370 x 60 x 20



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6 The options and accessories

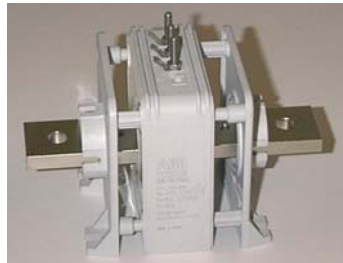
■ Accessories:

- Side Plates for vertical mounting and / or for primary bar:

- For CS300 and CS503 (size 0 – kit CST0)

- For CS500 and CS1000 (size 1 – kt CST1)

- For CS2000 (size 2 – kit CST2)

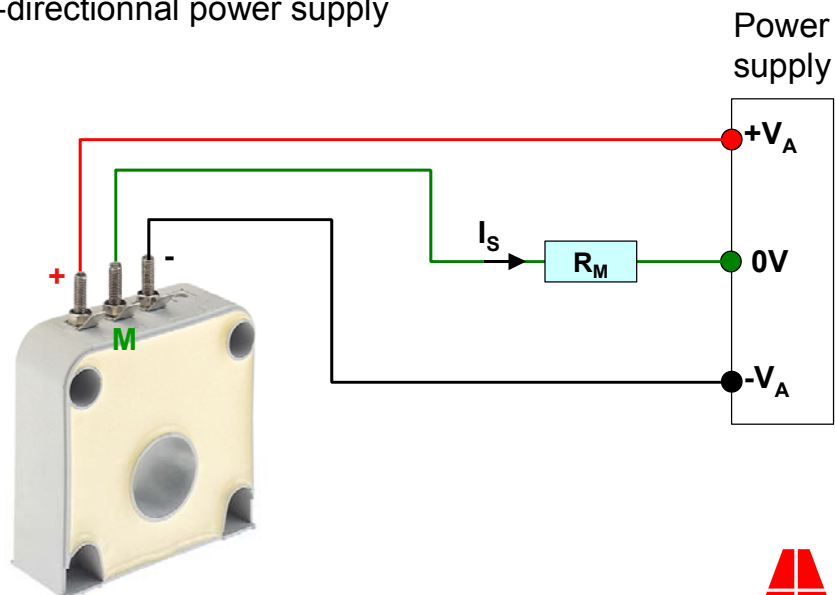


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7 The electrical connections

■ CS range: connection diagram

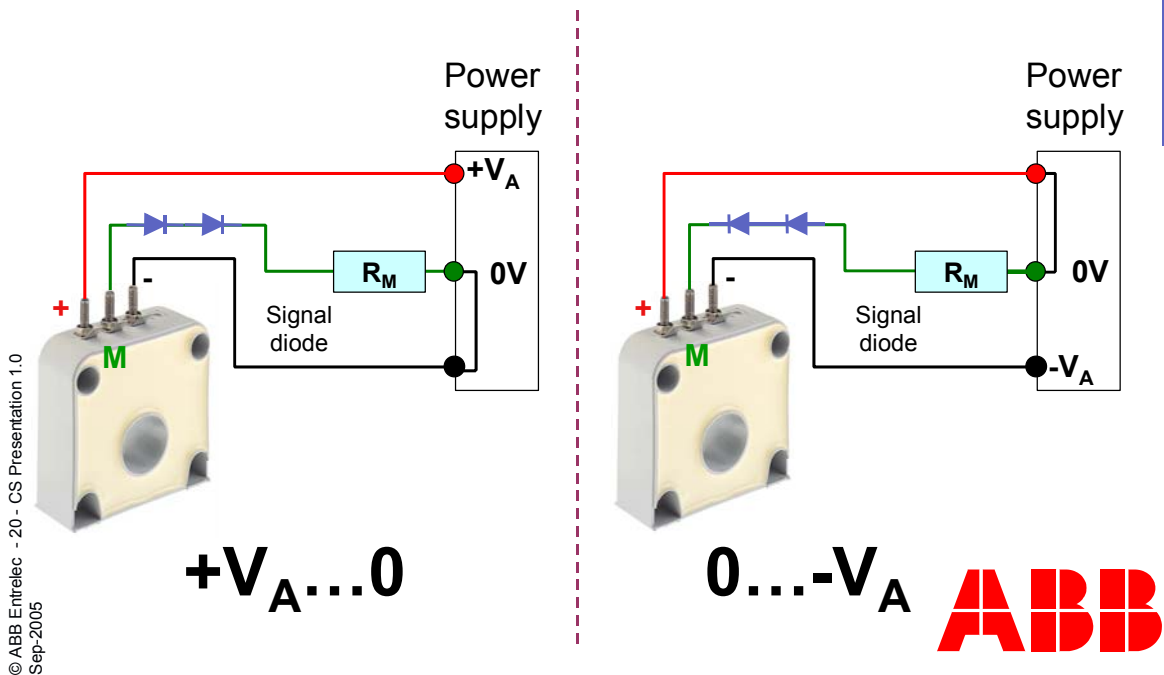
- Bi-directional power supply



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7 The electrical connections

■ Uni-directional power supply



8 The advantages

■ Construction

- The first and most compact product since 1997
- High performance
 - High external magnetic fields rejection
 - High measuring capabilities
- A traction current sensor 100% resin potted
 - Electronic board protected
 - Withstand high vibration constraints
 - High thermal capacities
- The best compromise: performance/volume/price
- Recyclable packaging

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8 The advantages

■ Set-up flexibility

- Accurate customer's needs optimise sensor selection knowing:
 - Max. permanent operating temperature
 - Max. measurable current with duration
 - Max. over current (not measurable) with duration
 - Max. voltage on burden resistance at I_{PMAX}
 - Min. supply voltage
- Mechanical flexibility: Terminals, Side plates, turns ratio, primary bars, ... due to modular sensor design

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9 The used standards: railways applications

■ EN50155

- Testing (see details in the concerned Type Test Report)
 - Functioning
 - : @ +25°C, @-40°C, @+85°C
 - : delay time
 - : di/dt
 - : bandwidth
 - : overload
 - : magnetic environment
 - : power supply over/under voltage
 - Other climatic tests
 - : salt mist
 - : humid heat cycling
 - : storage

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9 The used standards: railways applications

- IEC61373 (Jan 1999) for ground mobile equipments
 - Vibrations and shocks (see details in the concerned Type Test Report)
 - Tests
 - : random vibrations with functional sensor
 - : random vibrations without functional sensor
 - : shocks
 - Vibrations severity : class B

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9 The used standards: railways applications

- EN50124-1
 - Insulation coordination
 - Rated voltage : 3000Vdc
 - Pollution degree : PD3 (low conductivity and humidity with short term condensation)
 - Insulation distance : OV2 (same as OV1 with higher requirements on over voltages, reliability & dispoibility)
 - : 40 mm air distance (reinforced insulation)
 - : material group II ($400 \leq CTI < 600$)
 - Creepage distance : 118 mm (reinforced insulation) with grooves having minimum 1.5 mm
 - Partial discharges : up to 4.3kV (10pC) following sensor

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9 The used standards: railways applications

- EN50121-3-2 for ground mobile equipments
 - Electro-magnetic compatibility (see details in the concerned Type Test Report)
 - Emission : Conducted emission (tab 3)
 - : Radiated emission (tab 6)

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9 The used standards: railways applications

- EN50121-3-2 for ground mobile equipments
 - Electro-magnetic compatibility (see details in the concerned Type Test Report)
 - Immunity : Electrical fast transients burst
 - : Surge
 - : Electrostatic discharge
 - : Conducted perturbations
 - : Radiated electromagnetic fields
 - : Network magnetic fields

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10 The technical documentation

- Technical file
 - Technical presentation: this document
 - Functioning description
 - Mounting instructions
 - Technical data sheets
 - Type tests report synthesis
 - MTBF calculation
 - Fire/smoke certificate
 - Environmental certificate

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