

Technical argumentation  
*Argumentation technique*

# **NCS Range**

## **Gamme NCS**

1SBC146156D1701 Technical Argumentation NCS range 1.1 - Version 1.1

100% electronic  
current sensors

*Capteurs de courant  
100% électronique*



**ABB**

## SUMMARY

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Current and voltage sensors		NCS range Technical Presentation	
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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 used standards
- 9 The technical documentation

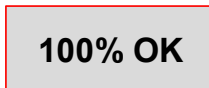
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## 1 The customers' needs



- Price



- High quality



- High performances



- Reliability



- Compactness



- Latest standards



- Reliable supplier

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## 2 The aimed applications

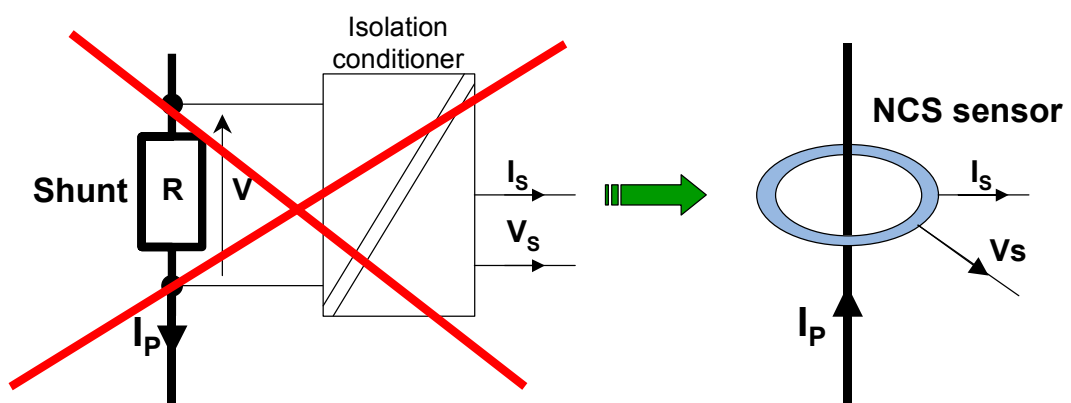
- Industrial applications
  - UPS, windmills, welding, electrolysis ...
- Traction applications
  - Sub-stations (mainly)...

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## 2 The aimed applications

- First typical technology of substitution:
  - To replace the entire function (shunt + isolation conditioner)



- Ratings targeted: 2 to 20 kA ( $I_p$ )
- Markets: Industry & Traction

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## 2 The aimed applications

- Other technologies to replace:
  - Depending on customer application, it is possible to use NCS instead of other current measurement technologies:
    - Closed loop Hall effect sensors
    - Open loop Hall effect sensors
    - Rogowski coils
    - Current transformers

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## 2 The aimed applications

- Specific applications:
  - Need of a large hole for a low nominal primary current:
    - Conductor in Aluminium (low current density)
    - Cable with thick insulation (medium voltage)
    - Several conductors through the hole
    - Specific bus bar dimensions

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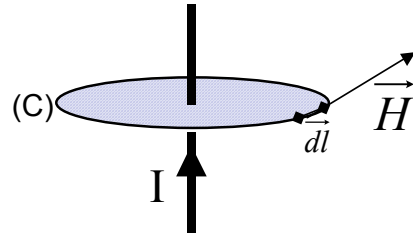
### 3 The technology

- Functioning principle

- Application of the Ampere's theorem:

The integration of the magnetic field vector  $\vec{H}$  on a closed contour (C) leads to the primary current I:

$$\oint_C \vec{H} \cdot d\vec{l} = I$$



In the air:  $\vec{B} = \mu_0 \cdot \vec{H}$

- Technology:

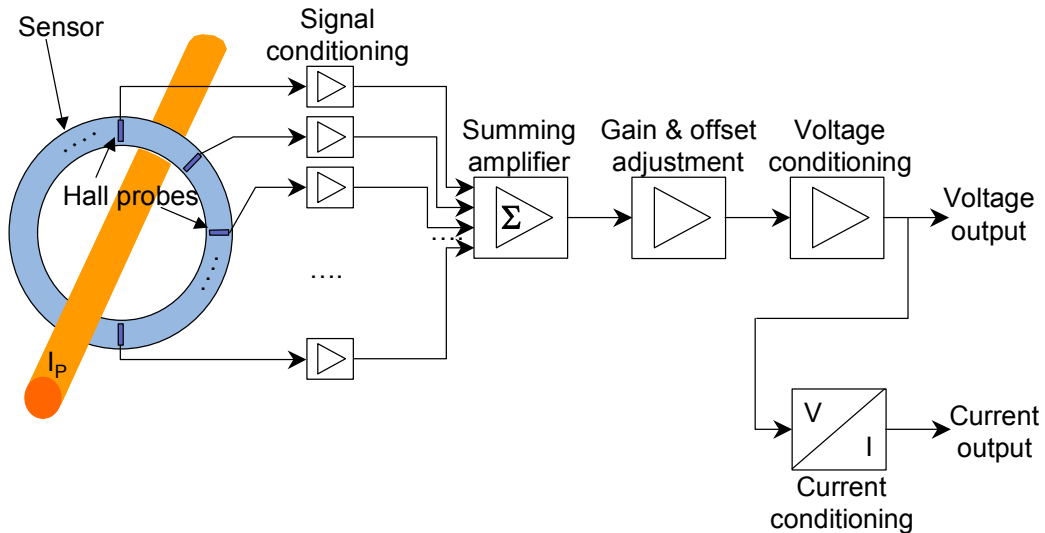
- Detection of the magnetic field with Hall effect probes
  - Full electronic concept (no magnetic core)

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### 3 The technology

- Functioning principle



- Major function

- To measure ac and dc high currents ( $\geq 2\text{kA}$ )

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### 3 The technology

- Technologies comparison for current sensing

	Shunt	Current Transformer	Open Loop	Closed Loop	Rogowski Coil	NCS Technology
<b>Insulation P/S</b>	NO	YES	YES	YES	YES	YES
<b>Bandwidth</b>	DC to few kHz	AC only	DC to few kHz	DC to 100 kHz	AC only	DC to few kHz
<b>Measuring range</b>	Low	Medium	Medium	High	Very High	Very High
<b>Maximum overloads</b>	Very Low	Low	Low	High	Very High	Very High
<b>Power dissipation</b>	High	Medium	Low	Medium	Low	Low
<b>Output signal</b>	Voltage	Current	Voltage	Current	Voltage	Voltage or current
<b>Supply voltage</b>	No need	No need	± V	± V	No need	± V or 0...+V
<b>Accuracy</b>	0.5 to 2%	0.5 to 2%	2 to 4%	< 1%	~1%	0.5 to 2%
<b>Price</b>	Low	Medium	Medium	High	Medium	medium
<b>Comments</b>	Need of conditioner	No DC	Low accuracy	High price	Need of conditioner	Very "flexible"

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### 3 The technology

- Major advantages of the NCS technology

- Galvanic isolation
- Wide continuous measuring range
- No power dissipation (no heating)

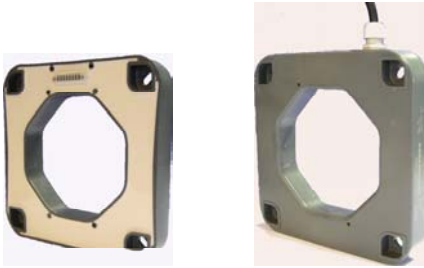
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## 4 The range

- General range presentation: markets & ratings

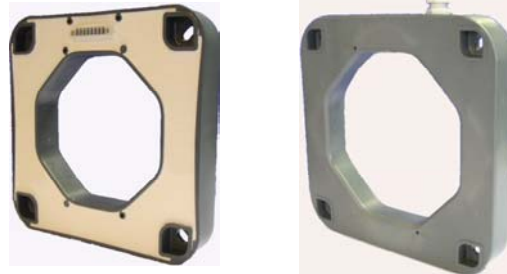
NCS125



**Traction  
Industry**

**2...10kA**

NCS165



**Traction  
Industry**

**4...20kA**



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## 4 The range

- NCS range: NCS125 and NCS165 (2 sizes)

**Current  
output**

- Internal hole: 125 mm and 165 mm

	Hole (mm)	I <sub>pn</sub> (kA peak)	I <sub>s1</sub> at I <sub>pn</sub> (mA peak)	I <sub>pmax</sub> (kA peak)	I <sub>s2</sub> at I <sub>pmax</sub> (mA peak)
NCS125-2	125	2	±20	10	±20
NCS125-4	125	4	±20	20	±20
NCS125-6	125	6	±20	30	±20
NCS125-10	125	10	±20	30	±20

NCS165-4	165	4	±20	20	±20
NCS165-6	165	6	±20	30	±20
NCS165-10	165	10	±20	30	±20
NCS165-20	165	20	±20	40	±20

- Important note: NCS sensors withstand I<sub>pmax</sub> **continuously**



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## 4 The range

- NCS range: NCS125 and NCS165 (2 sizes)
  - Internal hole: 125 mm and 165 mm

Voltage output

	Hole (mm)	$I_{pn}$ (kA peak)	$V_{s1}$ at $I_{pn}$ (V peak)	$I_{pmax}$ (kA peak)	$V_{s2}$ at $I_{pmax}$ (V peak)
NCS125-2	125	2	$\pm 10$	10	$\pm 10$
NCS125-4	125	4	$\pm 10$	20	$\pm 10$
NCS125-6	125	6	$\pm 10$	30	$\pm 10$
NCS125-10	125	10	$\pm 10$	30	$\pm 10$
NCS165-4	165	4	$\pm 10$	20	$\pm 10$
NCS165-6	165	6	$\pm 10$	30	$\pm 10$
NCS165-10	165	10	$\pm 10$	30	$\pm 10$
NCS165-20	165	20	$\pm 10$	40	$\pm 10$

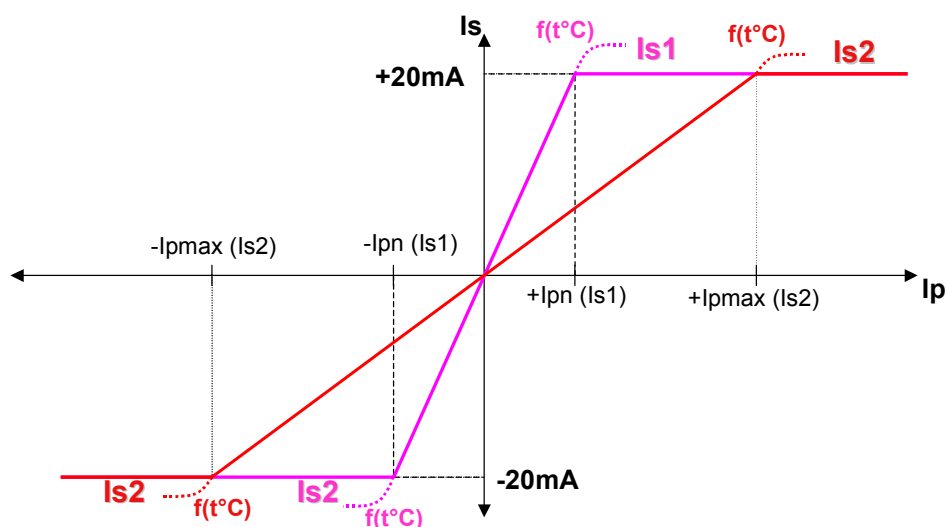
- Important note: NCS sensors withstand  $I_{pmax}$  **continuously**



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## 4 The range

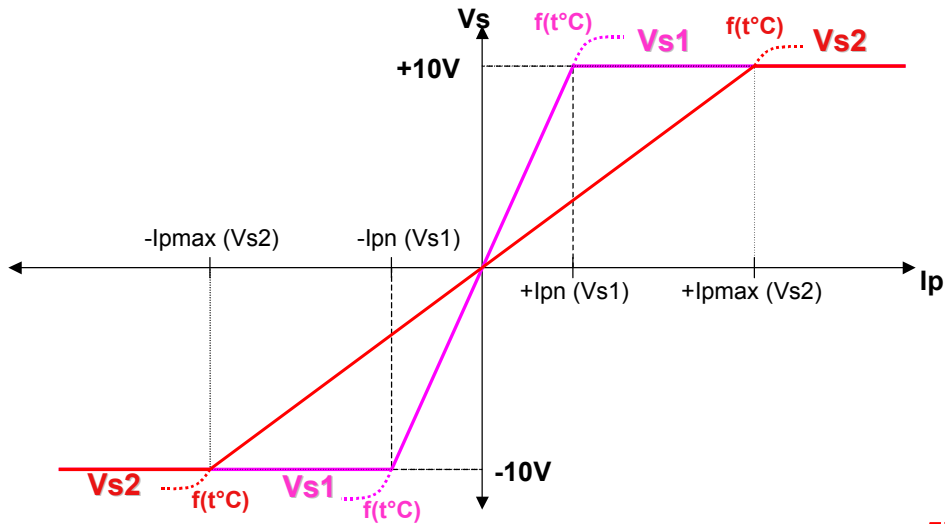
- NCS125 and NCS165 standard current outputs:



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## 4 The range

- NCS125 and NCS165 standard voltage outputs:



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## 4 The range

- NCS125 and NCS165 standard secondary outputs:

- Connector output ([industrial version only](#)):

- $I_{s1}$ :  $\pm 20\text{mA}$  @  $I_{pn}$  (peak value)
- $I_{s2}$ :  $\pm 20\text{mA}$  @  $I_{pmax}$  (peak value)
- $V_{s1}$ :  $\pm 10\text{V}$  @  $I_{pn}$  (peak value)
- $V_{s2}$ :  $\pm 10\text{V}$  @  $I_{pmax}$  (peak value)

- Cable output ([industrial and traction versions](#)):

- $I_{s1}$ :  $\pm 20\text{mA}$  @  $I_{pn}$  (peak value)
- $I_{s2}$ :  $\pm 20\text{mA}$  @  $I_{pmax}$  (peak value)

or

- $V_{s1}$ :  $\pm 10\text{V}$  @  $I_{pn}$  (peak value)
- $V_{s2}$ :  $\pm 10\text{V}$  @  $I_{pmax}$  (peak value)

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## 4 The range

### ■ Industrial and Traction main differences:

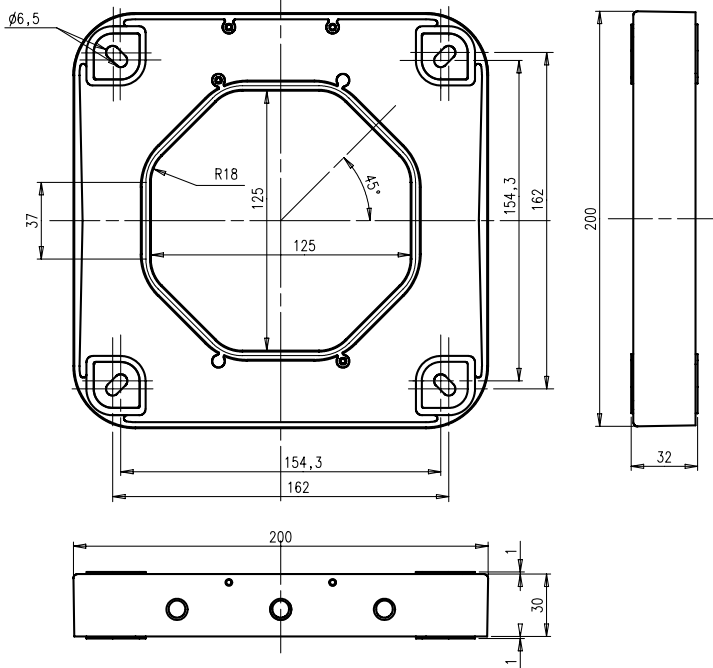
	Industry	Traction
Supply voltage	$\pm 15V$ to $\pm 24V$ ( $\pm 2\%$ )	$\pm 24V$ ( $\pm 25\%$ )
Test voltage	5kV	20kV
Partial discharges	1.25kV	4.3kV
Creepage distance	14mm	195mm
Clearance distance	14mm	76mm
EMC (refer to type test report)		

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## 4 The range

### ■ NCS125 mechanical layout

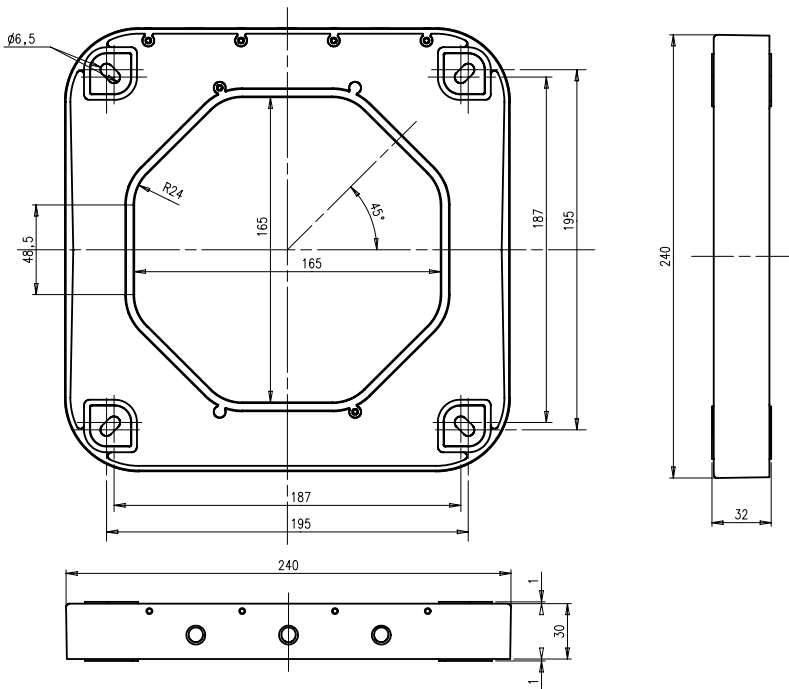


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## 4 The range

### ■ NCS165 mechanical layout

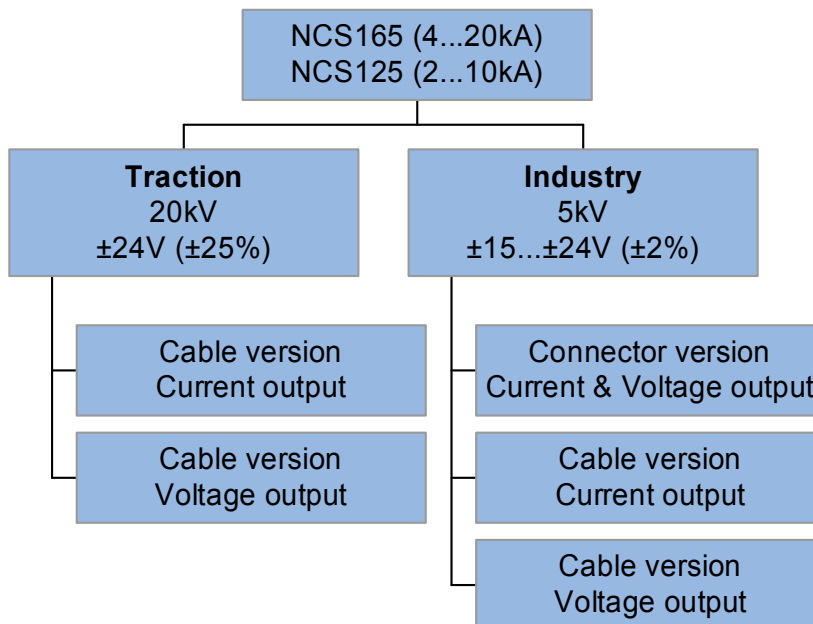


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## 4 The range

### ■ Standard NCS range synthesis



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## 5 The main characteristics

### ■ NCS125: main characteristics

Characteristics	Unit	NCS125-2	NCS125-4	NCS125-6	NCS125-10
Max. input current <b>I<sub>pn</sub></b> (continuously)	kA peak	2	4	6	10
Max. input current <b>I<sub>pmax</sub></b> (continuously)	kA peak	10	20	30	30
Max. not measurable overload	kA peak	40	80	120	200
Output current <b>I<sub>s1@I<sub>pn</sub></sub></b>	mA peak	±20			
Output current <b>I<sub>s2@I<sub>pmax</sub></sub></b>	mA peak	±20			
Output voltage <b>V<sub>s1@I<sub>pn</sub></sub></b>	V peak	±10			
Output voltage <b>V<sub>s2@I<sub>pmax</sub></sub></b>	V peak	±10			
Accuracy @ <b>I<sub>pn</sub></b> and @+25°C	%	±1			
Delay time (typical)	µS	3			
di/dt correctly followed	A/µS	< 100			
Bandwidth (@-1dB)	kHz	0...10			
Dielectric strength	kV; 50Hz; 1min	5			
Power supply	V	±15...±24			
Operating temperature	°C	-40...+85			
Storage temperature	°C	-50...+90			

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## 5 The main characteristics

### ■ NCS165: main characteristics

Characteristics	Unit	NCS165-4	NCS165-6	NCS165-10	NCS165-20
Max. input current <b>I<sub>pn</sub></b> (continuously)	kA peak	4	6	10	20
Max. input current <b>I<sub>pmax</sub></b> (continuously)	kA peak	20	30	30	40
Max. not measurable overload	kA peak	80	120	200	200
Output current <b>I<sub>s1@I<sub>pn</sub></sub></b>	mA peak	±20			
Output current <b>I<sub>s2@I<sub>pmax</sub></sub></b>	mA peak	±20			
Output voltage <b>V<sub>s1@I<sub>pn</sub></sub></b>	V peak	±10			
Output voltage <b>V<sub>s2@I<sub>pmax</sub></sub></b>	V peak	±10			
Accuracy @ <b>I<sub>pn</sub></b> and @+25°C	%	±1			
Delay time (typical)	µS	3			
di/dt correctly followed	A/µS	< 100			
Bandwidth (@-1dB)	kHz	0...10			
Dielectric strength	kV; 50Hz; 1min	5			
Power supply	V	±15...±24			
Operating temperature	°C	-40...+85			
Storage temperature	°C	-50...+90			

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## 6 The options and accessories

### ■ NCS125 & NCS165 : mechanical options

#### ■ Brackets

For horizontal mounting



For vertical mounting



For fixing on a bus bar



#### ■ Bus bars

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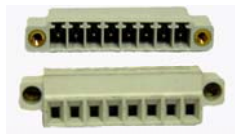


## 6 The options and accessories

### ■ NCS125 & NCS165 : terminals options

#### ■ Standard output connections:

- 6 wire shielded cable (2 m)
- 8 pin locable connector



#### ■ Optional output connections:

- Other to be defined upon request

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## 6 The options and accessories

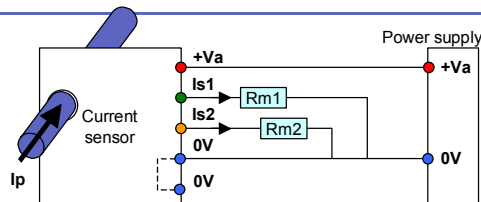
- NCS125 & NCS165 : electrical options
  - Specific gain for the output current  $I_s$
  - Specific gain for the output voltage  $V_s$
  - Multiple output voltage or current
  - Output current 4-20 mA: see next page  
(with unipolar supply voltage 0...+15 to +24 Vdc)

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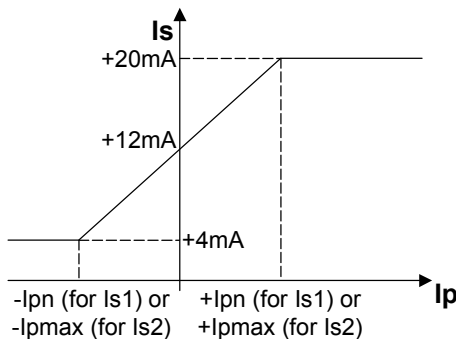


## 6 The options and accessories

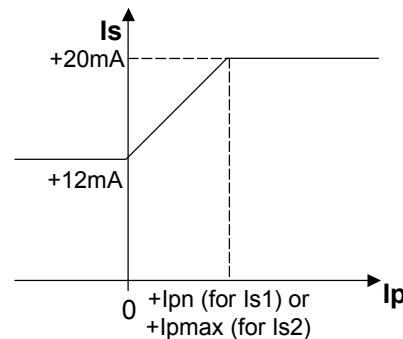
- NCS125 & NCS165
  - Optional output: current 4-20 mA



$I_{s1}$  or  $I_{s2}$  for **ac** primary current



$I_{s1}$  or  $I_{s2}$  for **dc** primary current



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## 6 The options and accessories

- NCS125 & NCS165 : the accessories

Side plates kit  
(without bar)



Female connector kit  
(set of 10 pieces)



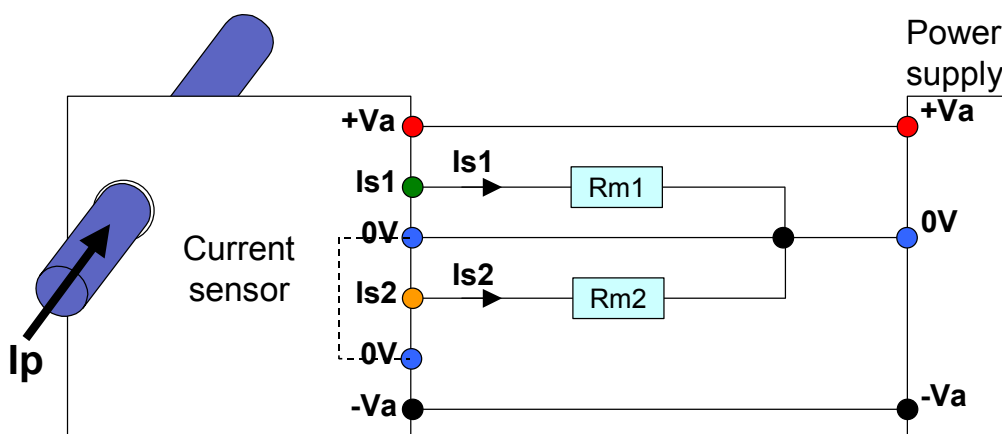
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## 7 The electrical connections

- NCS125 & NCS165: connection diagram

Current  
output



- $R_{m1}$  &  $R_{m2}$  with  $R_{min}$ :  $0\Omega$  and  $R_{max}$ :  $350\Omega$

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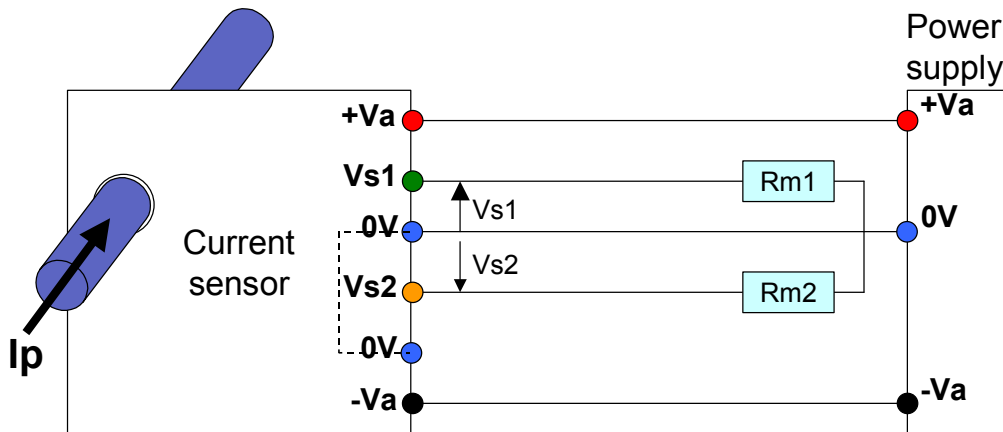




## 7 The electrical connections

- NCS125 & NCS165 : connection diagram

**Voltage output**



- $Rm1 \text{ \& } Rm2 \geq 10k\Omega$

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**ABB**

## 8 The used standards: Industrial applications

- EN50178 (Oct 1997)
  - Safety requirements
    - Rated voltage : 1000V rms or 1500Vdc
    - Pollution degree : PD2 (pollution normally conducting and random condensation)
    - Insulation distance : OV3 (fixed installations with requirements of reliability and disponibility)
      - : 14 mm air distance (reinforced insulation)
      - : material group II ( $400 \leq CTI < 600$ )
    - Creepage distance : 14.2mm (reinforced insulation) with grooves having minimum 2 mm
    - Partial discharges : 1.25kV (10pC)

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**ABB**

## 8 The used standards: Industrial applications

- EN50178 (Oct 1997)....
  - Environmental requirements
    - Climatic
      - : Tab 6, class 2K3
      - : -20...+70°C
      - : 95% relative humidity
      - : max 60gr of water / m<sup>3</sup>
      - : 70 à 106kPa
    - EMC
      - : design and tests in accordance with EN61000-6-2 and EN61000-6-4

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## 8 The used standards: Industrial applications

- EN50178 (Oct 1997)....
  - Testing (see details in the concerned Type Test Report)
    - Functioning
      - : @ +25°C, @-40°C, @+85°C
      - : delay time
      - : di/dt
      - : bandwidth
      - : overload
      - : magnetic environment
    - Other climatic tests
      - : salt mist
      - : humid heat
      - : storage

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## 8 The used standards: Industrial applications

- EN50178 (Oct 1997)....
  - Testing (see details in the concerned Type Test Report)
    - Dielectric : dielectric test  
: insulation resistance  
: dielectric overload  
: partial discharges
    - EMC (immunity) : burst  
**EN61000-6-2** : surges  
: electrostatic discharges  
: conducted perturbations  
: electromagnetic fields  
: network magnetic fields

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## 8 The used standards: Industrial applications

- EN50178 (Oct 1997)....
  - Testing (see details in the concerned Type Test Report)
    - EMC (emission) : conducted  
**EN61000-6-4** : radiated
    - Mechanical : vibrations  
: shocks

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## 8 The used standards: railways applications

- EN50155 (Dec 2002)
  - 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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## 8 The used standards: railways applications

- EN50123-1 (May 1995) for substations up to 3kVdc
  - Main requirements
    - Rated voltage ( $U_N$ ) : 3000Vdc
    - Max. repetitive Voltage ( $U_{NM}$ ) : 4800Vdc
    - Dielectric tests : 16.8kV (50Hz, 1min)
    - Air distance (outdoor) : 76mm
    - Over voltage category : 0V3
    - Pollution degree : PD3A

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## 8 The used standards: railways applications

- EN50163 (Nov 1995) for substations up to 3kVdc
  - Standard rated voltages

Rated voltage ( $U_N$ )	750Vdc	1500Vdc	3000Vdc
U <sub>max1</sub> (permanent)	900Vdc	1800Vdc	3600Vdc
U <sub>max2</sub> (max. 5 min)	950Vdc	1950Vdc	3900Vdc
U <sub>max3</sub> (20msec)	1269Vdc	2538Vdc	5075Vdc

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## 8 The used standards: railways applications

- EN50121-5 (Sep 2000) for substations up to 3kVdc
  - Electro-magnetic compatibility (see details in the concerned Type Test Report)
    - Immunity
      - : burst
      - : surges
      - : electrostatic discharges
      - : conducted perturbations
      - : electromagnetic fields
      - : network magnetic fields
    - Emission
      - : conducted
      - : radiated

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## 8 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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## 8 The used standards: railways applications

- EN50124-1 (Jan 1999)
  - Insulation coordination
    - Rated voltage : 3000Vdc
    - Pollution degree : PD3A (low conductivity and humidity with long term condensation)
    - Insulation distance : OV3 (same as OV4 with less requirements on over voltages, reliability & disponibility)  
: 76 mm air distance (reinforced insulation)  
: material group II ( $400 \leq CTI < 600$ )
    - Creepage distance : 195mm (reinforced insulation) with grooves having minimum 2.5 mm
    - Partial discharges : 4.3kV (10pC)

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## 8 The used standards: railways applications

- EN50121-3-2 (Sep 2000) for ground mobile equipments
  - Electro-magnetic compatibility (see details in the concerned Type Test Report)
    - Immunity & Emission : same as per EN50121-5 but with some higher levels during tests

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## 9 The technical documentation

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

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**ABB Entrelec  
Control Division**

10, rue Ampère Z.I. - B.P. 114  
F-69685 Chassieu cedex / France  
Telephone: +(33) (0) 4 7222 1722  
Fax: +(33) (0) 4 7222 1969

<http://www.abb.com/lowvoltage>  
E-mail : [sensors.sales@fr.abb.com](mailto:sensors.sales@fr.abb.com)

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