Current transducer LF 210-S

I_{PN} = 200 A

For the electronic measurement of current: DC, AC, pulsed..., with galvanic separation between the primary and the secondary circuit.

Features

- Bipolar and insulated current measurement up to 420A
- Current output
- Closed loop (compensated) current transducer
- Panel mounting.

Advantages

- High accuracy
- Very low offset drift over temperature.

Applications

- Windmill inverters
- Test and measurement
- Substations
- AC variable speed and servo motor drives
- Statics converters for DC motors drives
- Battery supplied applications
- Uninterruptible Power Supplies (UPS)
- Switched Mode Power Supplies (SMPS)
- Power supplies for welding applications.

Standards

- EN 50178: 1997
- UL 508: 2010.

Application Domain

- Industrial.

Absolute maximum ratings

Parameter	Symbol	Unit	Value
Maximum supply voltage (working) (-40 .. 85 °C)	$\pm U_C$	V	15.75
Primary conductor temperature	T_B	°C	100
Maximum steady state primary current (-40 .. 85 °C)	I_{PN}	A	200

Absolute maximum ratings apply at 25 °C unless otherwise noted.
Stresses above these ratings may cause permanent damage. Exposure to absolute maximum ratings for extended periods may degrade reliability.

UL 508: Ratings and assumptions of certification

File # E189713 Volume: 2 Section: 7

Standards

- USR indicated investigation to the Standard for Industrial Control Equipment UL 508.
- CNR Indicated investigation to the Canadian standard for Industrial Control Equipment CSA C22.2 No. 14-13

Conditions of acceptability

When installed in the end-use equipment, consideration shall be given to the following:

1 - These devices must be mounted in a suitable end-use enclosure.

2 - The terminals have not been evaluated for field wiring.

3 - Low voltage circuits are intended to be powered by a circuit derived from an isolating source (such as transformer, optical isolator, limiting impedance or electro-mechanical relay) and having no direct connection back to the primary circuit (other than through the grounding means).

Marking

Only those products bearing the UL or UR Mark should be considered to be Listed or Recognized and covered under UL's Follow-Up Service. Always look for the Mark on the product.

Insulation coordination

Parameter	Symbol	Unit	Value	Comment
Rms voltage for AC insulation test, 50 Hz, 1 min	U_d	kV	3.5	
Impulse withstand voltage 1.2/50 µs	$\hat{U}_W$	kV	8.8	
Insulation resistance	R_{IS}	MΩ	1000	measured at 3.5 kV AC
Partial discharge extinction rms voltage @ 10 pC	U_e	kV	2	with centered bar
Case material	-	-	V0 according to UL 94	
Comparative tracking index	*CTI*		600	
Application example			600 V CAT III, PD2	Reinforced insulation, non uniform field according to EN 50178, IEC 61010
Application example			1000 V CAT III, PD2	Basic insulation, non uniform field according to EN 50178, IEC 61010
Clearance and creepage	See dimensions drawing on page 7			

Environmental and mechanical characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Ambient operating temperature	T_A	°C	-40		85	
Ambient storage temperature	T_S	°C	-50		90	
Mass	*m*	g		75		

Electrical data

At T_A = 25 °C, $\pm U_C$ = ±15 V, R_M = 1 Ω, unless otherwise noted.
Lines with a * in the conditions column apply over the -40 .. 85 °C ambient temperature range.

Parameter	Symbol	Unit	Min	Typ	Max	Conditions	
Primary nominal rms current	I_{PN}	A			200	*	
Primary current, measuring range	I_{PM}	A	-420		420	*	
Measuring resistance	R_M	Ω	0			*	Max value of R_M is given in figure 1
Secondary nominal rms current	I_{SN}	A	-0.1		0.1	*	
Secondary current	I_S	A	-0.21		0.21	*	
Number of secondary turns	N_S			2000			
Supply voltage	$\pm U_C$	V	±11.4		±15.75	*	
Current consumption	I_C	mA		33 35			I_P = 0, $\pm U_C$ = ±12 V I_P = 0, $\pm U_C$ = ±15 V
Electrical Offset current, referred to primary	I_{OE}	mA			100		
Temperature coefficient of I_{OE} @ I_P = 0 A	TCI_{OE}	ppmA/K			1200	*	
Magnetic offset current, referred to primary	I_{OM}	A		0.12			After 3 × I_{PN}
Sensitivity error	ε_G	%	-0.1		0.1		
Temperature coefficient of G	TCG	ppm/K			12	*	
Linearity error	ε_L	% of I_{PN}	-0.05		0.05	*	$\pm I_{PN}$ range
Overall accuracy at I_{PN}	X_G	% of I_{PN}	-0.2		0.2	*	
Output rms current noise referred to primary	I_{no}	mA		20			1 Hz to 100 kHz (see figure 4)
Reaction time @ 10 % of I_{PN}	t_{ra}	µs		0.5			R_M = 10 Ω di/dt =100 A/µs
Step response time to 90 % of I_{PN}	t_r	µs		0.5			R_M = 10 Ω (see figure 2) di/dt =100 A/µs
Frequency bandwidth	BW	kHz		100			R_M = 50 Ω; -3dB

Definition of typical, minimum and maximum values

Minimum and maximum values for specified limiting and safety conditions have to be understood as such as well as values shown in “typical” graphs.
On the other hand, measured values are part of a statistical distribution that can be specified by an interval with upper and lower limits and a probability for measured values to lie within this interval.
Unless otherwise stated (e.g. “100 % tested”), the LEM definition for such intervals designated with “min” and “max” is that the probability for values of samples to lie in this interval is 99.73 %.
For a normal (Gaussian) distribution, this corresponds to an interval between -3 sigma and +3 sigma. If “typical” values are not obviously mean or average values, those values are defined to delimit intervals with a probability of 68.27 %, corresponding to an interval between -sigma and +sigma for a normal distribution.
Typical, maximal and minimal values are determined during the initial characterization of the product.

Typical performance characteristics

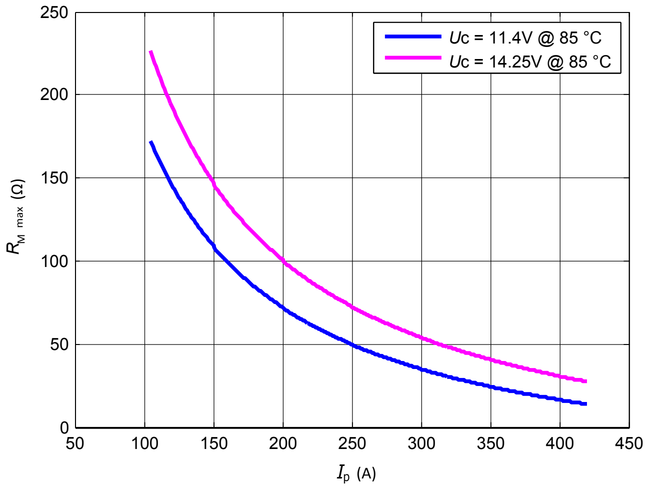


Figure 1: Maximum measuring resistance

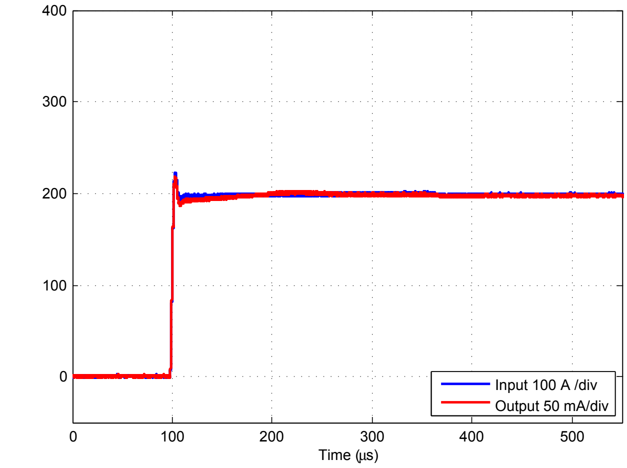


Figure 2: Typical step response

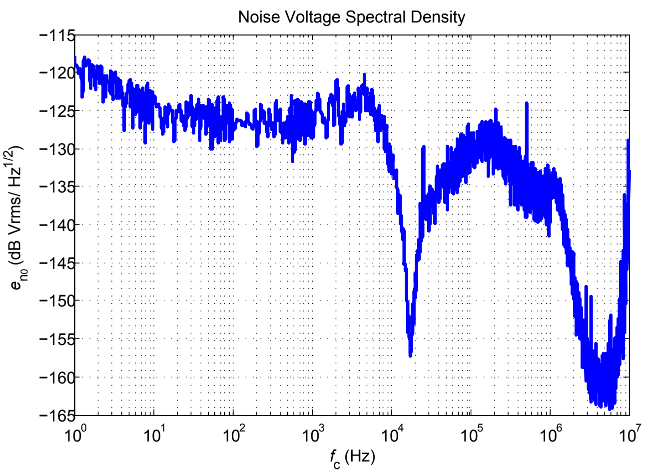


Figure 3: Typical noise voltage density e_{no} (R_M) with R_M = 10 Ω

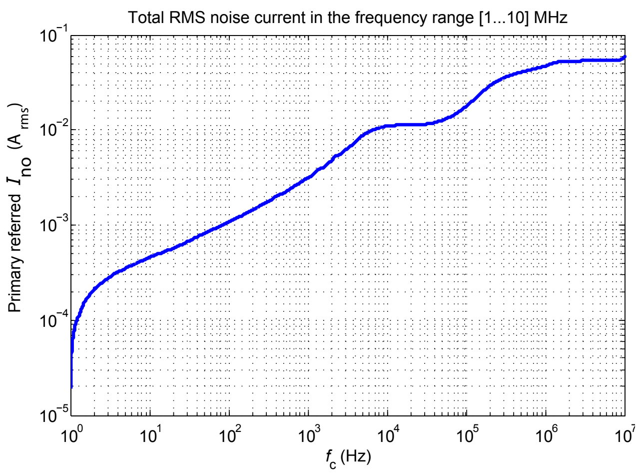


Figure 4: Typical total output current noise (primary referred, rms) with R_M = 10 Ω

Figure 3 (noise voltage density) shows if there are discrete frequencies in the output.

Figure 4 shows the cumulative output current noise referred to primary.
To calculate the noise in a frequency band f_1 to f_2, the formula is:

$$I_{no}(f_1 \text{ to } f_2) = \sqrt{I_{no}(f_2)^2 - I_{no}(f_1)^2}$$

with $I_{no}(f)$ read from figure 3 (typical, rms value).

Example:
What is the noise from 10^3 to 10^6 Hz?
Figure 4 gives $I_{no}(10^3$ Hz$)$ = 3.11 mA and $I_{no}(10^6$ Hz$)$ = 46.67 mA.
The output current noise (rms) is therefore.

$$\sqrt{(46.77\cdot10^{-3})^2 - (3.11\cdot10^{-3})^2} = 46.67 \text{ mA referred to primary}$$

Typical performance characteristics

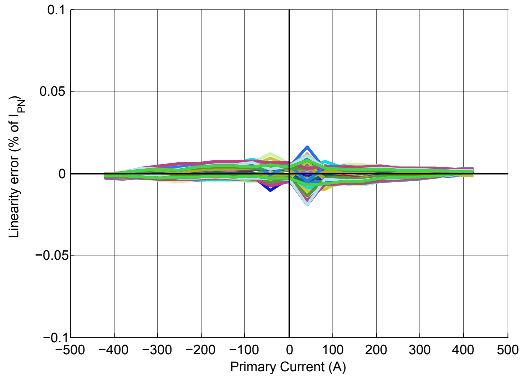


Figure 5: Maximum linearity error

Performance parameters definition

The schematic used to measure all electrical parameters are:

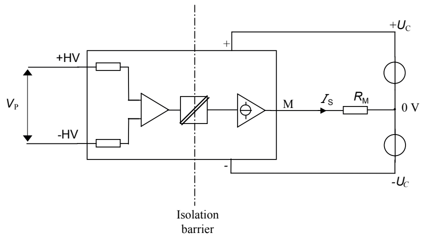


Figure 6: Standard characterization schematics for voltage output transducers (R_M = 50 Ω unless otherwise noted)

Transducer simplified model

The static model of the transducer at temperature T_A is:

$I_S = G \cdot I_P$ +error

In which

error = $I_{OE} + I_{OT}(T_A) + \varepsilon_G \cdot G \cdot I_P + \varepsilon_{GT}(T_A) \cdot G \cdot I_P + \varepsilon_L \cdot G \cdot I_{PM} + I_{OM}$

- I_S : secondary current (A)
- G : sensitivity of the transducer (A/A)
- I_P : primary current (A)
- I_{PM} : primary current, measuring range (A)
- T_A : ambient operating temperature (°C)
- I_{OE} : electrical offset current (A)
- I_{OM} : magnetic offset current (A)
- $I_{OT}(T_A)$: temperature variation of I_O at temperature T_A (A)
- ε_G : sensitivity error at 25 °C
- $\varepsilon_{GT}(T_A)$: thermal drift of sensitivity at temperature T_A
- ε_L : linearity error

This is the absolute maximum error. As all errors are independent, a more realistic way to calculate the error would be to use the following formula:

$$error = \sqrt{\sum (error \quad component)^2}$$

Sensitivity and linearity

To measure sensitivity and linearity, the primary current (DC) is cycled from 0 to I_{PM}, then to -I_{PM} and back to 0 (equally spaced I_{PM}/10 steps).

The sensitivity G is defined as the slope of the linear regression line for a cycle between ±I_{PM}.

The linearity error ε_L is the maximum positive or negative difference between the measured points and the linear regression line, expressed in % of the maximum measured value.

Magnetic offset

Due to its working principle, this type of transducer has no magnetic offset current I_{OM}.

Electrical offset

The electrical offset current I_{OE} is the residual output current when the input current is zero.

The temperature variation I_{OT} of the electrical offset current I_{OE} is the variation of the electrical offset from 25 °C to the considered temperature.

Overall accuracy

The overall accuracy X_G is the error at ±I_{PN}, relative to the rated value I_{PN}.

It includes all errors mentioned above.

Response and reaction times

The response time t_r and the reaction time t_{ra} are shown in the next figure.

Both slightly depend on the primary current d*i*/d*t*. They are measured at nominal current .

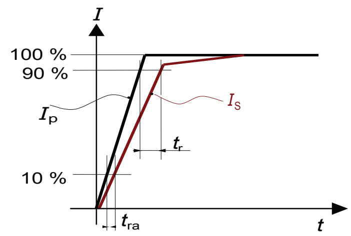
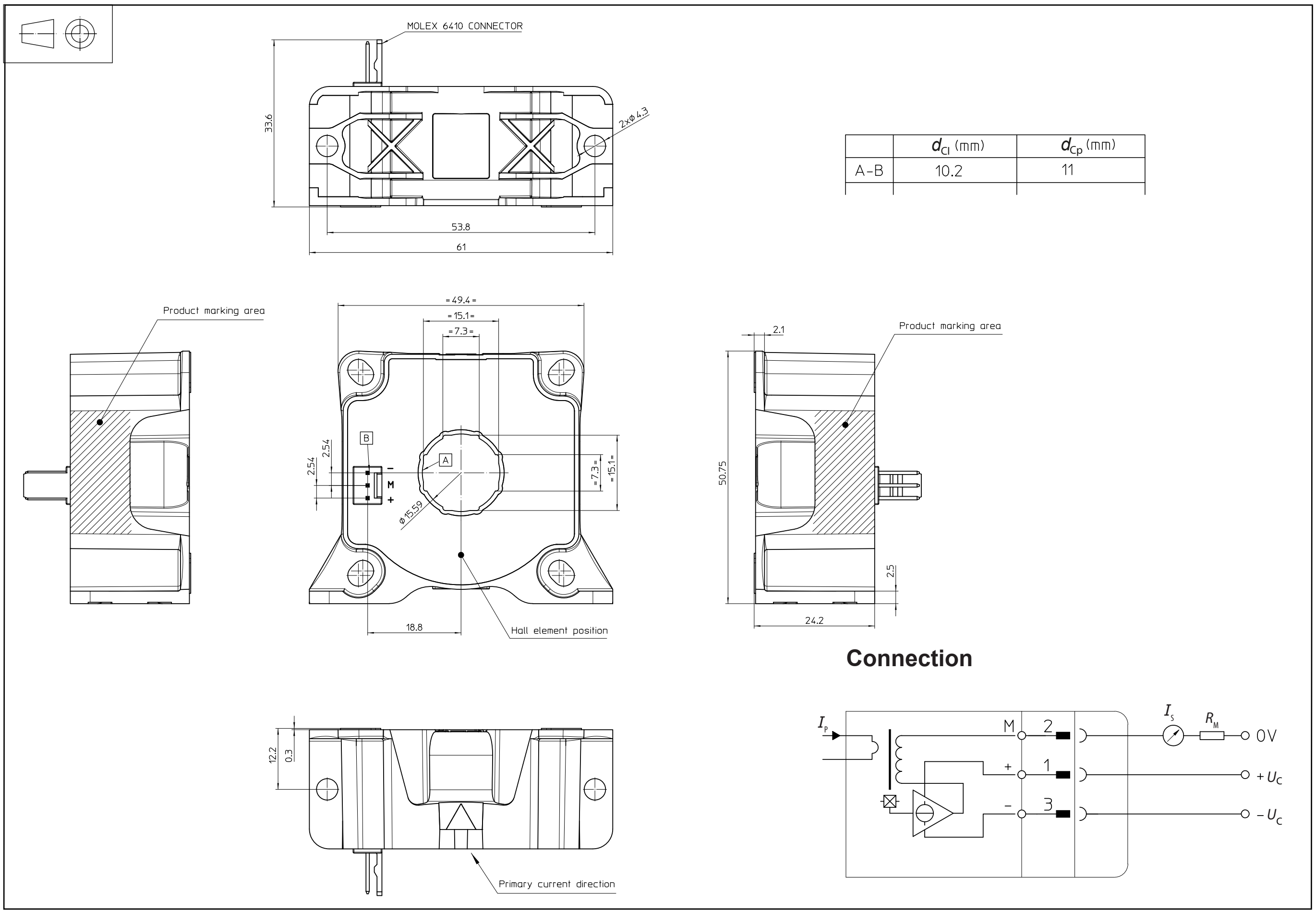


Figure 7: Response time t_r and reaction time t_{ra}

Dimensions (in mm)



	d_{Cl} (mm)	d_{Cp} (mm)
A-B	10.2	11

Mechanical characteristics

- General tolerance ±1 mm
- Transducer fastening
  Vertical position — 2 holes ⌀ 4.3 mm, 2 M4 steel screws
  Recommended fastening torque 2.1 N·m
- Transducer fastening
  Horizontal position — 4 holes ⌀ 4.3 mm, 4 M4 steel screws
  Recommended fastening torque 2.1 N·m
- Connection of secondary Molex 6410

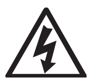
Remarks

- Installation of the transducer is to be done without primary current or secondary voltage present.
- This is a standard model. For different versions (supply voltages, turns ratios, unidirectional measurements...), please contact us
- Installation of the transducer must be done unless otherwise specified on the datasheet, according to LEM Transducer Generic Mounting Rules. Please refer to LEM document N°ANE120504 available on our Web site: **Products/Product Documentation.**

Safety

This transducer must be used in limited-energy secondary circuits according to IEC 61010-1.

This transducer must be used in electric/electronic equipment with respect to applicable standards and safety requirements in accordance with the manufacturer's operating instructions.



Caution, risk of electrical shock

When operating the transducer, certain parts of the module can carry hazardous voltage (eg. primary connection, power supply).
Ignoring this warning can lead to injury and/or cause serious damage.
This transducer is a build-in device, whose conducting parts must be inaccessible after installation.
A protective housing or additional shield could be used.
Main supply must be able to be disconnected.