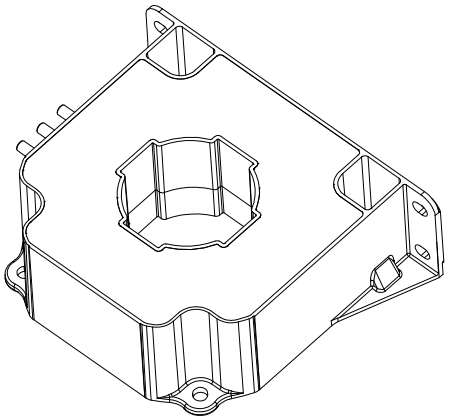
Current transducer LF 2010-S/SP6

I_{PN} = 2000 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 3.8 kA
- Current output
- Closed loop (compensated) current transducer
- Panel mounting.

Special features

- I_{PM} = 0 ... ±3800 A
- N_S = 4000
- U_C = ±15 ... ±24 (±10 %) V
- U_d = 10 kV
- Connection to secondary on M5 threaded studs.

Advantages

- High accuracy
- Very low offset drift over temperature.

Applications

- Single or three phase inverters
- Propulsion and braking choppers
- Propulsion converters
- High power drives
- Substations.

Standards

- EN 50155: 2007
- EN 50124-1: 2006
- EN 50121-3-2: 2006
- UL 508: 2010.

Application Domain

- Traction (fixed and onboard).

Absolute maximum ratings

Parameter	Symbol	Unit	Value
Maximum supply voltage (working) (−40 … 85 °C)	$\pm U_{C\,max}$	V	±26.4
Primary conductor temperature	$T_{B\,max}$	°C	100
Maximum primary nominal RMS current (−40 … 85 °C)	$I_{P\,N\,max}$	A	2000

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: 9

Standards

- USR indicates investigation to the Standard for Industrial Control Equipment UL 508.
- CNR indicates 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, with primary feedthrough potential involved of 600 V AC/DC, consideration shall be given to the following:

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

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

3 - Low voltage control circuit shall be supplied by an isolating source (such as transformer, optical isolator, limiting impedance or electro-mechanical relay).

4 - Based on the temperature test performed on all Series, the primary bar or conductor shall not exceed 100 °C in the end use application.

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	10	Between primary and secondary + shield
Impulse withstand voltage 1.2/50 µs	$\hat{U}_W$	kV	23	
Partial discharge extinction RMS voltage @ 10 pC	U_e	kV	4.2	Test carried out with a non insulated primary bar of 290 × 50 × 10 mm, centered in the through-hole
Insulation resistance	R_{INS}	MΩ	200	measured at 500 V DC
Comparative tracking index	CTI		600	
Application example		V	2000	Reinforced insulation, CAT III, PD 2, non uniform field according to EN 50178, IEC 61010
Application example		V	4000	Basic insulation, CAT III, PD 2, non uniform field according to EN 50178, IEC 61010
Clearance (pri. - sec.)	d_{Cl}		See dimensions drawing on page 7	Shortest distance through air
Creepage distance (pri. - sec.)	d_{Cp}		See dimensions drawing on page 7	Shortest path along device body
Case material	-	-	V0 according to UL 94	
Comparative tracking index	CTI		600	

Environmental and mechanical characteristics

Parameter	Symbol	Unit	Min	Typ	Max
Ambient operating temperature	T_A	°C	−40		85
Ambient storage temperature	T_S	°C	−50		90
Mass	m	g		1500	

Electrical data

At T_A = 25 °C, $\pm U_C$ = ±24 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 AC current DC current Primary nominal RMS AC current DC current	I_{PN}	A			2000 2000 2000 2000	* * *	$\pm U_C$ = ±24 V $\pm U_C$ = ±24 V, −40 … 70 °C $\pm U_C$ = ±15 V $\pm U_C$ = ±15 V
Primary current, measuring range	I_{PM}	A	−3800		3800	*	
Measuring resistance	R_M	Ω	0			*	Max value of R_M is given in figure 1
Secondary nominal RMS current	I_{SN}	A			0.5	*	
Resistance of secondary winding	R_S	Ω			13.3		$R_S(T_A) = R_S \times (1 + 0.004 \times (T_A + \Delta\text{temp} - 25))$ Estimated temperature increase @I_{PN} is Δtemp = 15 °C
Secondary current	I_S	A	−0.95		0.95	*	
Number of secondary turns	N_S			4000			
Theoretical sensitivity	G_{th}	mA/A		0.25			
Supply voltage	$\pm U_C$	V	±13.5		±26.4	*	
Current consumption	I_C	mA		42 + I_S 48 + I_S			$\pm U_C$ = ±15 V $\pm U_C$ = ±24 V
Offset current, referred to primary	I_O	A	−1		1		
Temperature variation of I_O referred to primary	I_{OT}	A	−1		1	*	
Magnetic offset current, referred to primary	I_{OM}	A		±1			After 3 × I_{PN}
Sensitivity error	ε_G	%	−0.15		0.15	*	
Linearity error	ε_L	% of I_{PN}	−0.1		0.1	*	
Overall accuracy	X_G	% of I_{PN}	−0.2 −0.3		0.2 0.3	 *	25 … 70 … 85 °C −40 … 85 °C
Output RMS noise current	I_{no}	mA		90			1 Hz to 20 kHz (see figure 4)
Reaction time @ 10 % of I_{PN}	t_{ra}	µs		< 0.5			0 to 1 kA, 200 A/µs
Step response time to 90 % of I_{PN}	t_r	µs		< 0.5			0 to 1 kA, 200 A/µs
Frequency bandwidth	BW	kHz		150			−3 dB, small signal bandwidth

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 a product.

Typical performance characteristics

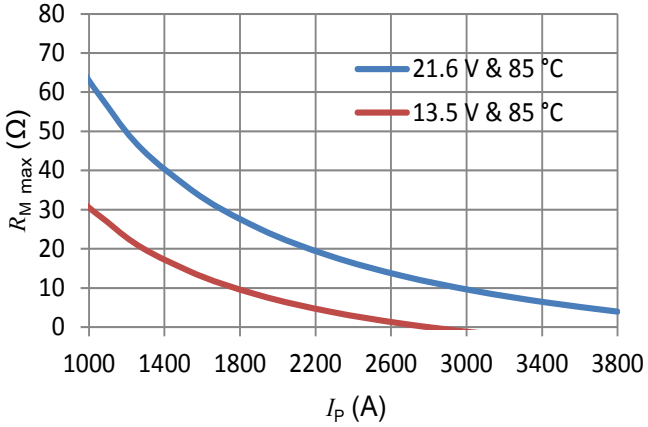


Figure 1: Maximum measuring resistance

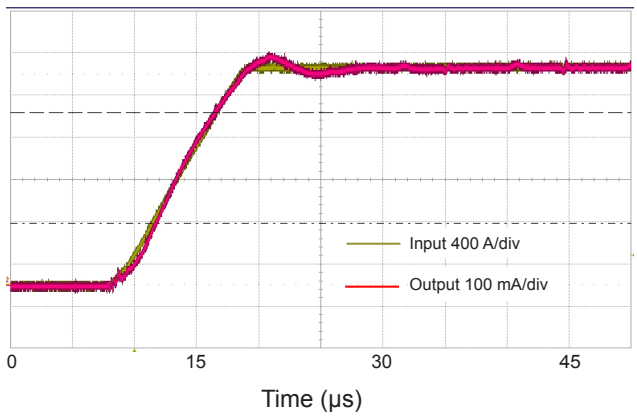


Figure 2: Typical step response (0 to 2 kA, 200 A/µs)

$$R_{M\ max} = N_S \times \frac{U_{C\ min} - 1.3\ V}{I_P} - R_{S\ max}\ \Omega$$

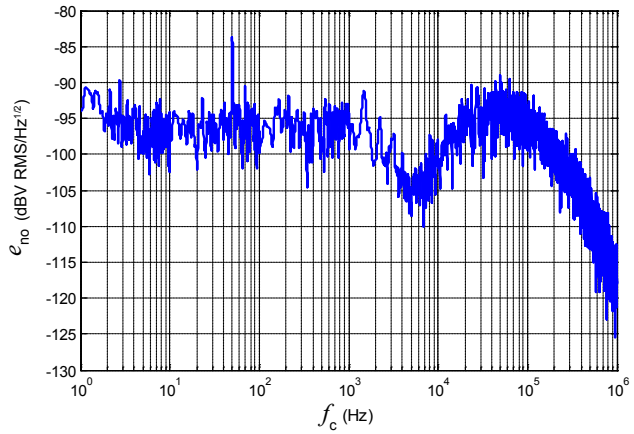


Figure 3: Typical output RMS noise voltage spectral density e_{no} with R_M = 100 Ω

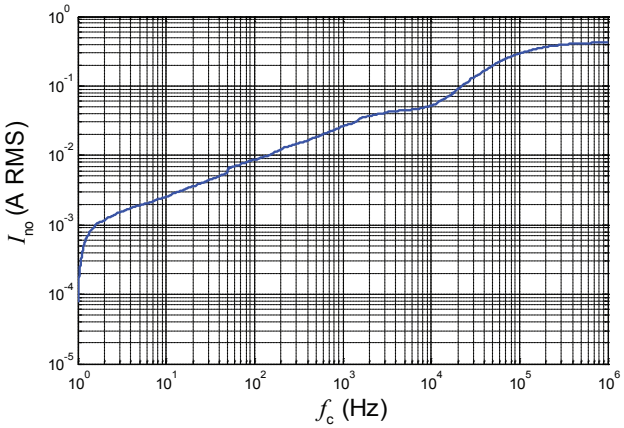


Figure 4: Typical total output RMS noise current with R_M = 100 Ω (primary referred)

To calculate the noise in a frequency band $f1$ to $f1$, the formula is:

$$I_{no}(f1 \text{ to } f2) = \sqrt{I_{no}(f2)^2 - I_{no}(f1)^2}$$

with $I_{no}(f)$ read from figure 4 (typical, RMS value).

Example:
What is the noise from 1 to 10^6 Hz?
Figure 4 gives I_{no} (1 Hz) = 0.2 mA and I_{no} (10^6 Hz) = 400 mA.
The output RMS noise current is therefore:

$\sqrt{(400 \times 10^{-3})^2 - (0.2 \times 10^{-3})^2}$ = 400 mA referred to primary

Typical performance characteristics continued

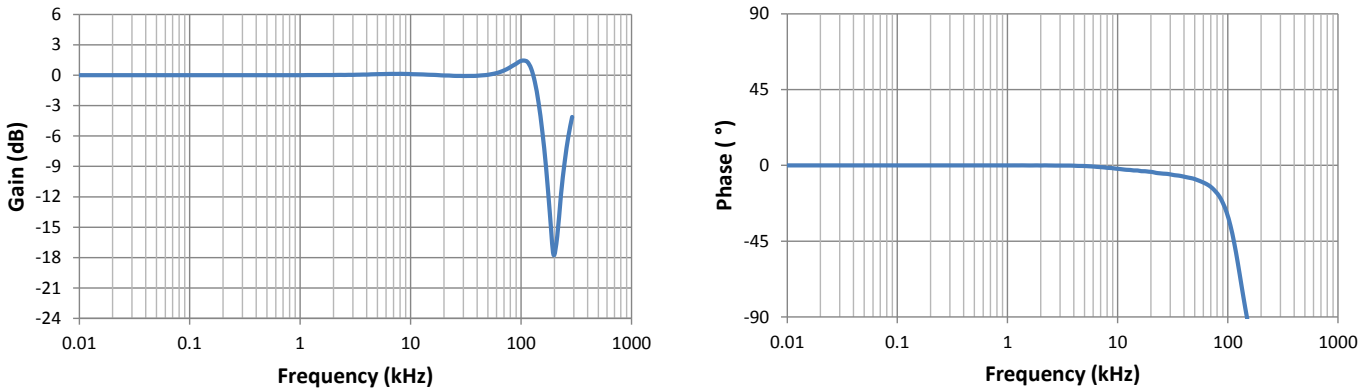


Figure 5: Typical frequency response, small signal bandwidth

Performance parameters definition

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 $\pm I_{PM}$.
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

The magnetic offset I_{OM} is the change of offset after a given current has been applied to the input. It is included in the linearity error as long as the transducer remains in its measuring range.

Electrical offset

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

Overall accuracy

The overall accuracy X_G is the error at $\pm I_{PN}$, 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 di/dt. They are measured at nominal current .

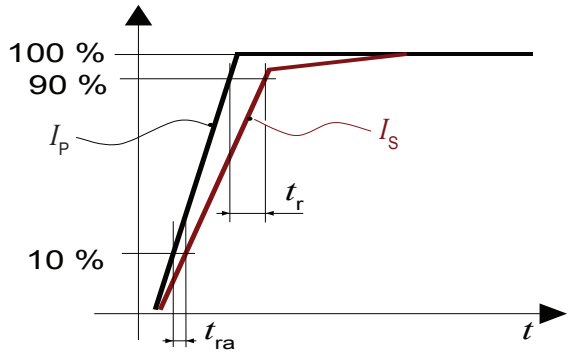
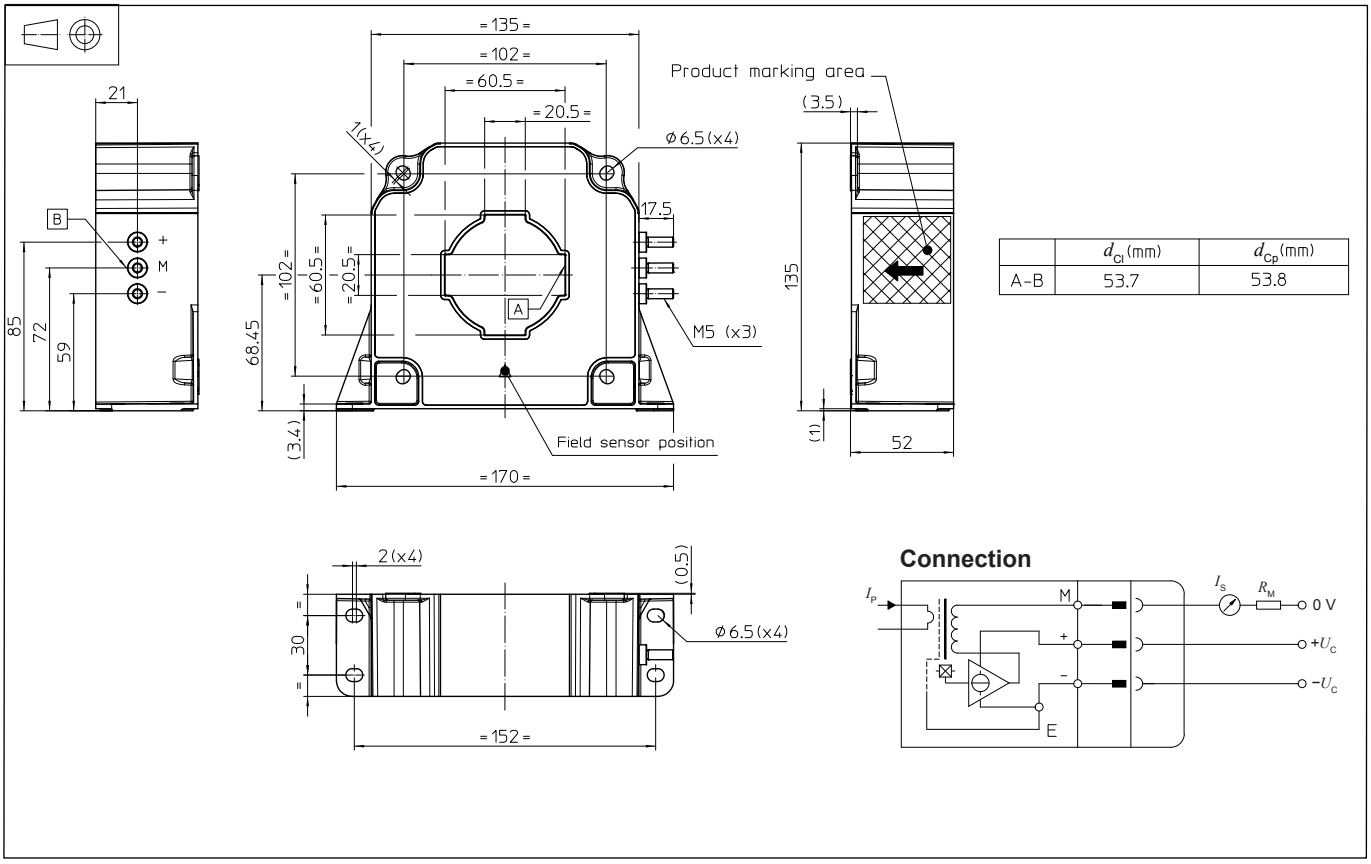


Figure 6: response time t_r and reaction time t_{ra}

Dimensions (in mm)



	d_{Cl} (mm)	d_{Cp} (mm)
A-B	53.7	53.8

Mechanical characteristics

- General tolerance ±0.5 mm
- Transducer fastening
  Vertical position 4 slotted holes ∅ 6.5 mm
  4 M6 steel screws
- Recommended fastening torque 5.5 N∅m (±10 %)
- Primary through-hole ∅ 57 mm
  Or 60 mm × 20 mm
- Transducer fastening
  Horizontal positions 4 slotted holes ∅ 6.5 mm
  4 M6 steel screws
  Recommended fastening torque 5.5 N∅m (±10 %)
- Connection of secondary M5 threaded studs

Remarks

- I_S is positive when I_P flows in the direction of arrow.
- The secondary cables also have to be routed together all the way.
- Installation of the transducer is to be done without primary or secondary voltage present.
- Maximum temperature of primary conductor: see page 2.
- 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.