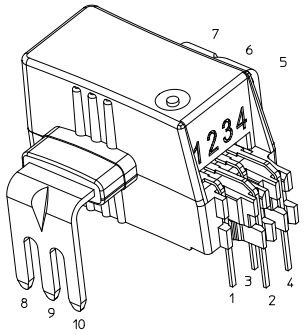
Current Transducer HLSR-P/SP39 series I_{PN} = 20 ... 60 A

Ref: HLSR 20-P/SP39, HLSR 32-P/SP39, HLSR 40-P/SP39, HLSR 50-P/SP39, HLSR 60-P/SP39

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



Features

- Open loop multi-range current transducer
- Voltage output
- Single supply +5 V
- Galvanic separation between primary and secondary
- Low power consumption
- Compact design for through-hole PCB mounting
- Factory calibrated
- High bandwidth, very low loss magnetic core.

Advantages

- Extremely low profile: h = 12 mm
- Low foot-print
- Low offset drift.

Applications

- AC variable speed and servo motor drives
- Static converters for DC motor drives
- Battery supplied applications
- Uninterruptible Power Supplies (UPS)
- Switched Mode Power Supplies (SMPS)
- Power supplies for welding applications
- Combiner box
- MPPT.

Standards

- EN 62477-1: 2023
- IEC 61010-1: 2010
- EN 61010: 2010+A1
- UL 508: 2010.

Application Domain

- Industrial.

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Safety

Caution

If the device is used in a way that is not specified by the manufacturer, the protection provided by the device may be compromised.
Always inspect the electronics unit and connecting cable before using this product and do not use it if damaged.
Mounting assembly shall guarantee the maximum primary conductor temperature, fulfill clearance and creepage distance, minimize electric and magnetic coupling, and unless otherwise specified can be mounted in any orientation.

Caution, risk of electrical shock

This transducer must be used in limited-energy secondary circuits SELV according to IEC 61010-1, in electric/electronic equipment with respect to applicable standards and safety requirements in accordance with the manufacturer's operating specifications.

Use caution during installation and use of this product; certain parts of the module can carry hazardous voltages and high currents (e.g. power supply, primary conductor).
Ignoring this warning can lead to injury and or/or cause serious damage.
De-energize all circuits and hazardous live parts before installing the product.
All installations, maintenance, servicing operations and use must be carried out by trained and qualified personnel practicing applicable safety precautions.

This transducer is a build-in device, whose hazardous live parts must be inaccessible after installation.
This transducer must be mounted in a suitable end-enclosure.
Besides make sure to have a distance of minimum 30 mm between the primary terminals of the transducer and other neighboring components.

Main supply must be able to be disconnected.
Never connect or disconnect the external power supply while the primary circuit is connected to live parts.
Never connect the output to any equipment with a common mode voltage to earth greater than 30 V.
Always wear protective clothing and gloves if hazardous live parts are present in the installation where the measurement is carried out.
This transducer is a built-in device, not intended to be cleaned with any product. Nevertheless if the user must implement cleaning or washing process, validation of the cleaning program has to be done by himself.
When defining soldering process, please use no cleaning process only.

ESD susceptibility
The product is susceptible to be damaged from an ESD event and the personnel should be grounded when handling it.

Do not dispose of this product as unsorted municipal waste. Contact a qualified recycler for disposal.
Although LEM applies utmost care to facilitate compliance of end products with applicable regulations during LEM product design, use of this part may need additional measures on the application side for compliance with regulations regarding EMC and protection against electric shock. Therefore LEM cannot be held liable for any potential hazards, damages, injuries or loss of life resulting from the use of this product.

Underwriters Laboratory Inc. recognized component

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Absolute maximum ratings

Parameter	Symbol	Unit	Value
Supply voltage (not destructive < 1 min)	U_C	V	8
Supply voltage (not entering non standard modes)	U_C	V	6.5
Primary conductor temperature	T_B	°C	120
Electrostatic discharge voltage (HBM - Human Body Model)	$U_{ESD\ HBM}$	kV	2

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: 5

Standards

- CSA C22.2 NO. 14-10 INDUSTRIAL CONTROL EQUIPMENT - Edition 11 - Revision Date 2011/08/01
- UL 508 STANDARD FOR INDUSTRIAL CONTROL EQUIPMENT - Edition 17 - Revision Date 2010/04/15

Ratings

Parameter	Symbol	Unit	Value
Primary involved potential		V AC/DC	600
Ambient operating temperature	T_A	°C	105
Primary current	I_P	A	According to series primary current
Secondary supply voltage	U_C	V DC	5
Output voltage	U_{out}	V	0 to 5

Conditions of acceptability

1 - These devices have been evaluated for overvoltage category III and for use in pollution degree 2 environment.

2 - A suitable enclosure shall be provided in the end-use application.

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

4 - These devices are intended to be mounted on a printed wiring board of end use equipment. The suitability of the connections (including spacings) shall be determined in the end-use application.

5 - Primary terminals shall not be straightened since assembly of housing case depends upon bending of the terminals.

6 - Any surface of polymeric housing have not been evaluated as insulating barrier.

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

Marking

Only those products bearing the 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.

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Insulation coordination

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC insulation test, 50/60 Hz, 1 min	U_d	kV	4.3	
Impulse withstand voltage 1.2/50 µs	U_{Ni}	kV	8	
Clearance (pri. - sec.)	d_{Cl}	mm	> 8	Shortest distance through air
Creepage distance (pri. - sec.)	d_{Cp}	mm	> 8	Shortest path along device body
Clearance (pri. - sec.)	d_{Cl}	mm	8	When mounted on PCB with recommended layout
Case material	-	-	V0	According to UL 94
Comparative tracking index	CTI	-	600	
Application example	-	V	600	Reinforced insulation, CAT III, PD 2, non uniform field according to IEC 61010
Application example	-	V	1000	Basic insulation, CAT III, PD 2, non uniform field according to IEC 61010
Application example	-	V	1500	Basic insulation, CAT III, PD 2, according to IEC 62109-1 Altitude ≤ 3000 m
Application example	-	V	600	CAT III, PD 2, according to UL 508

Environmental and mechanical characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Ambient operating temperature	T_A	°C	−40		105	
Ambient storage temperature	$T_{A\,st}$	°C	−40		105	
Mass	m	g			5	

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Electrical data HLSR 20-P/SP39

At T_A = 25 °C, U_C = +5, R_L = 10 kΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 10).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		20		
Primary current, measuring range	I_{PM}	A	−50		50	For U_C > 4.6 V
Number of primary turns	N_P			1		
Resistance of primary jumper @ T_A = 25 °C	R_P	mΩ		0.21		
Resistance of primary jumper @ T_A = 105 °C	R_P	mΩ		0.29		T jumper = 120 °C
Supply voltage	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		10	15	
Reference voltage (output)	U_{ref}	V	2.48	2.5	2.52	Internal reference
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2		2	Over operating temperature range
U_{ref} output resistance	R_{ref}	Ω			1	series
U_{out} output resistance	R_{out}	Ω			1	series
Capacitive loading	C_L	nF			10	
Electrical offset voltage @ I_P = 0	U_{OE}	mV	−5		5	
Electrical offset current, referred to primary	I_{OE}	mA	−125		125	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	−180		180	−40 °C … 105 °C
Temperature coefficient of U_{OE}	TCU_{OE}	mV/K	−0.04		0.04	−40 °C … 105 °C
Temperature coefficient of I_{OE}	TCI_{OE}	mA/K	−1.88		1.88	−40 °C … 105 °C
Sensitivity	S_{Th}	mV/A		40		800 mV @ I_{PN}
Sensitivity error	ε_S	%		±0.5		
Linearity error 0 ... I_{PN}	ε_L	% of I_{PN}	−0.5		0.5	
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.25		0.25	
Noise voltage spectral density 100 Hz… 100 kHz	u_{no}	µV/√Hz			14	
RMS noise voltage DC … 10 kHz DC … 100 kHz DC … 1 MHz	U_{no}	mVpp		9.2 22.8 33		
Delay time @ 10 % of the final output value I_{PN} step	t_{D10}	µs		0.5	1	@ 20 A/µs
Delay time @ 90 % of the final output value I_{PN} step	t_{D90}	µs		0.3	0.7	@ 20 A/µs
Frequency bandwidth (±3 dB)	BW	kHz		450		
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1		1	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL85}	% of I_{PN}	−2.7		2.7	See formula note
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL105}	% of I_{PN}	−2.9		2.9	See formula note

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Electrical data HLSR 32-P/SP39

At T_A = 25 °C, U_C = +5, R_L = 10 kΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 10).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		32		
Primary current, measuring range	I_{PM}	A	−80		80	For U_C > 4.6 V
Number of primary turns	N_P			1		
Resistance of primary jumper @ T_A = 25 °C	R_P	mΩ		0.21		
Resistance of primary jumper @ T_A = 105 °C	R_P	mΩ		0.29		T jumper = 120 °C
Supply voltage	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		10	15	
Reference voltage (output)	U_{ref}	V	2.48	2.5	2.52	Internal reference
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2		2	Over operating temperature range
U_{ref} output resistance	R_{ref}	Ω			1	series
U_{out} output resistance	R_{out}	Ω			1	series
Capacitive loading	C_L	nF			10	
Electrical offset voltage @ I_P = 0	U_{OE}	mV	−5		5	
Electrical offset current, referred to primary	I_{OE}	mA	−200		200	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	−180		180	−40 °C … 105 °C
Temperature coefficient of U_{OE}	TCU_{OE}	mV/K	−0.04		0.04	−40 °C … 105 °C
Temperature coefficient of I_{OE}	TCI_{OE}	mA/K	−3		3	−40 °C … 105 °C
Sensitivity	S_{Th}	mV/A		25		800 mV @ I_{PN}
Sensitivity error	ε_S	%		±0.5		
Linearity error 0 ... I_{PN}	ε_L	% of I_{PN}	−0.5		0.5	
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.25		0.25	
Noise voltage spectral density 100 Hz… 100 kHz	u_{no}	µV/√Hz			8.75	
RMS noise voltage DC … 10 kHz DC … 100 kHz DC … 1 MHz	U_{no}	mVpp		 6.2 14 20.7		
Delay time @ 10 % of the final output value I_{PN} step	t_{D10}	µs		0.5	1	@ 20 A/µs
Delay time @ 90 % of the final output value I_{PN} step	t_{D90}	µs		0.3	0.7	@ 20 A/µs
Frequency bandwidth (±3 dB)	BW	kHz		450		
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1		1	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL85}	% of I_{PN}	−2.7		2.7	See formula note
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL105}	% of I_{PN}	−2.9		2.9	See formula note

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Electrical data HLSR 40-P/SP39

At T_A = 25 °C, U_C = +5, R_L = 10 kΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 10).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		40		
Primary current, measuring range	I_{PM}	A	−100		100	For U_C > 4.6 V
Number of primary turns	N_P			1		
Resistance of primary jumper @ T_A = 25 °C	R_P	mΩ		0.21		
Resistance of primary jumper @ T_A = 105 °C	R_P	mΩ		0.29		T jumper = 120 °C
Supply voltage	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		10	15	
Reference voltage (output)	U_{ref}	V	2.48	2.5	2.52	Internal reference
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2		2	Over operating temperature range
U_{ref} output resistance	R_{ref}	Ω			1	series
U_{out} output resistance	R_{out}	Ω			1	series
Capacitive loading	C_L	nF			10	
Electrical offset voltage @ I_P = 0	U_{OE}	mV	−5		5	
Electrical offset current, referred to primary	I_{OE}	mA	−250		250	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	−180		180	−40 °C … 105 °C
Temperature coefficient of U_{OE}	TCU_{OE}	mV/K	−0.04		0.04	−40 °C … 105 °C
Temperature coefficient of I_{OE}	TCI_{OE}	mA/K	−3.75		3.75	−40 °C … 105 °C
Sensitivity	S_{Th}	mV/A		20		800 mV @ I_{PN}
Sensitivity error	ε_S	%		±0.5		
Linearity error 0 ... I_{PN}	ε_L	% of I_{PN}	−0.5		0.5	
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.25		0.25	
Noise voltage spectral density 100 Hz… 100 kHz	u_{no}	µV/√Hz			7	
RMS noise voltage DC … 10 kHz DC … 100 kHz DC … 1 MHz	U_{no}	mVpp		 5.1 11.1 16.6		
Delay time @ 10 % of the final output value I_{PN} step	t_{D10}	µs		0.5	1	@ 20 A/µs
Delay time @ 90 % of the final output value I_{PN} step	t_{D90}	µs		0.3	0.7	@ 20 A/µs
Frequency bandwidth (±3 dB)	BW	kHz		450		
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1		1	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL85}	% of I_{PN}	−2.7		2.7	See formula note
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL105}	% of I_{PN}	−2.9		2.9	See formula note

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Electrical data HLSR 50-P/SP39

At T_A = 25 °C, U_C = +5, R_L = 10 kΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 10).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		50		
Primary current, measuring range	I_{PM}	A	−125		125	For U_C > 4.6 V
Number of primary turns	N_P			1		
Resistance of primary jumper @ T_A = 25 °C	R_P	mΩ		0.21		
Resistance of primary jumper @ T_A = 105 °C	R_P	mΩ		0.29		T jumper = 120 °C
Supply voltage	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		10	15	
Reference voltage (output)	U_{ref}	V	2.48	2.5	2.52	Internal reference
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2		2	Over operating temperature range
U_{ref} output resistance	R_{ref}	Ω			1	series
U_{out} output resistance	R_{out}	Ω			1	series
Capacitive loading	C_L	nF			10	
Electrical offset voltage @ I_P = 0	U_{OE}	mV	−5		5	
Electrical offset current, referred to primary	I_{OE}	mA	−313		313	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	−180		180	−40 °C … 105 °C
Temperature coefficient of U_{OE}	TCU_{OE}	mV/K	−0.04		0.04	−40 °C … 105 °C
Temperature coefficient of I_{OE}	TCI_{OE}	mA/K	−2.5		2.5	−40 °C … 105 °C
Sensitivity	S_{Th}	mV/A		16		800 mV @ I_{PN}
Sensitivity error	ε_S	%		±0.5		
Linearity error 0 ... I_{PN}	ε_L	% of I_{PN}	−0.5		0.5	
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.25		0.25	
Noise voltage spectral density 100 Hz… 100 kHz	u_{no}	μV/√Hz			1	
RMS noise voltage DC … 10 kHz DC … 100 kHz DC … 1 MHz	U_{no}	mVpp		1.8 6.18 18		
Delay time @ 10 % of the final output value I_{PN} step	t_{D10}	μs		0.5	1	@ 20 A/μs
Delay time @ 90 % of the final output value I_{PN} step	t_{D90}	μs		0.3	0.7	@ 20 A/μs
Frequency bandwidth (±3 dB)	BW	kHz		450		
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1		1	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL85}	% of I_{PN}	−2.7		2.7	See formula note
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL105}	% of I_{PN}	−2.9		2.9	See formula note

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Electrical data HLSR 60-P/SP39

At T_A = 25 °C, U_C = +5, R_L = 10 kΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 10).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		60		
Primary current, measuring range	I_{PM}	A	−150		150	For U_C > 4.6 V
Number of primary turns	N_P			1		
Resistance of primary jumper @ T_A = 25 °C	R_P	mΩ		0.21		
Resistance of primary jumper @ T_A = 105 °C	R_P	mΩ		0.29		T jumper = 120 °C
Supply voltage	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		10	15	
Reference voltage (output)	U_{ref}	V	2.48	2.5	2.52	Internal reference
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2		2	Over operating temperature range
U_{ref} output resistance	R_{ref}	Ω			1	series
U_{out} output resistance	R_{out}	Ω			1	series
Capacitive loading	C_L	nF			10	
Electrical offset voltage @ I_P = 0	U_{OE}	mV	−5		5	
Electrical offset current, referred to primary	I_{OE}	mA	−375		375	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	−180		180	−40 °C … 105 °C
Temperature coefficient of U_{OE}	TCU_{OE}	mV/K	−0.04		0.04	−40 °C … 105 °C
Temperature coefficient of I_{OE}	TCI_{OE}	mA/K	−3.125		3.125	−40 °C … 105 °C
Sensitivity	S_{Th}	mV/A		13.33		800 mV @ I_{PN}
Sensitivity error	ε_S	%		±0.5		
Linearity error 0 ... I_{PN}	ε_L	% of I_{PN}	−0.5		0.5	
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.25		0.25	
Noise voltage spectral density 100 Hz… 100 kHz	u_{no}	µV/√Hz			5.6	
RMS noise voltage DC … 10 kHz DC … 100 kHz DC … 1 MHz	U_{no}	mVpp		 4.3 8.8 13.3		
Delay time @ 10 % of the final output value I_{PN} step	t_{D10}	µs		0.5	1	@ 20 A/µs
Delay time @ 90 % of the final output value I_{PN} step	t_{D90}	µs		0.3	0.7	@ 20 A/µs
Frequency bandwidth (±3 dB)	BW	kHz		450		
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1		1	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL85}	% of I_{PN}	−2.7		2.7	See formula note
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL105}	% of I_{PN}	−2.9		2.9	See formula note

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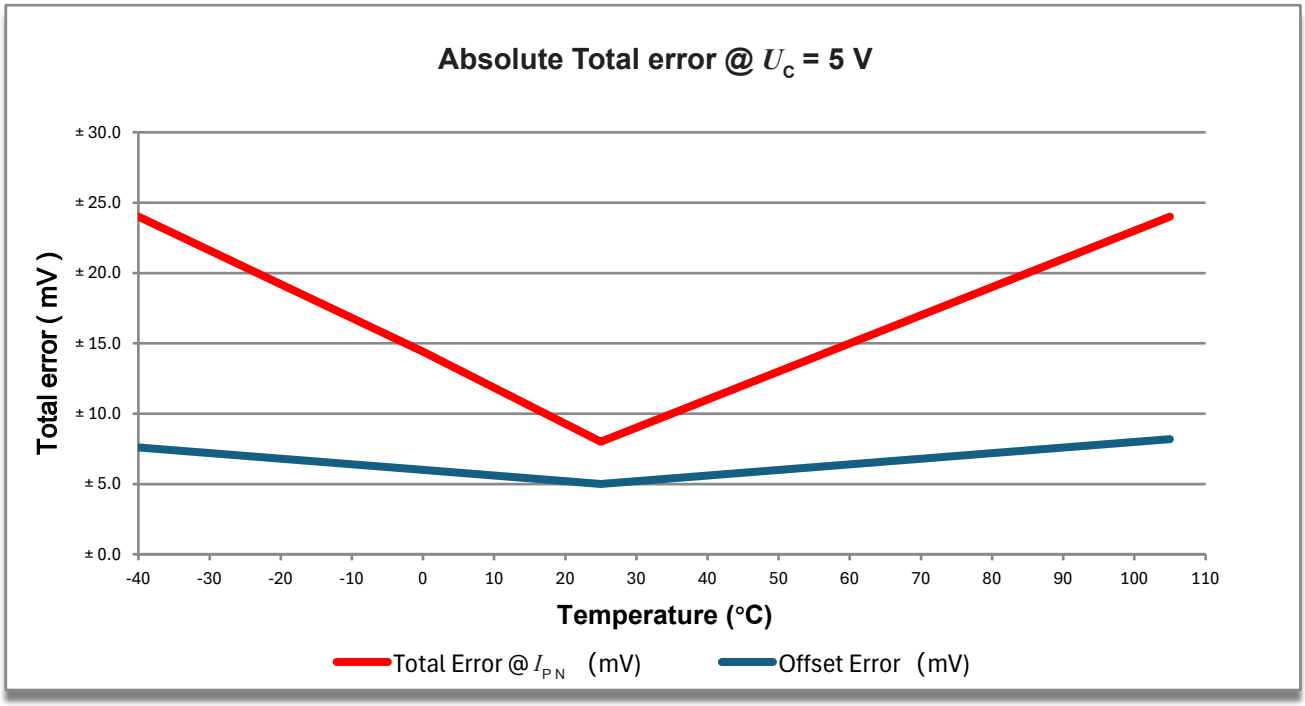
Absolute Total Error



Item	Absolute Total Error					
Temperature (°C)	−40	−20	0	25	65	105
Offset Error (mV)	±7.6	±6.8	±6.0	±5.0	±6.6	±8.2
Total Error @ I_{PN} (mV)	±24.0	±19.2	±14.4	±8.0	±16.0	±24.0
Total Error @ I_{PN} (%)	±3.0	±2.4	±1.8	±1.0	±2.0	±3.0

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.

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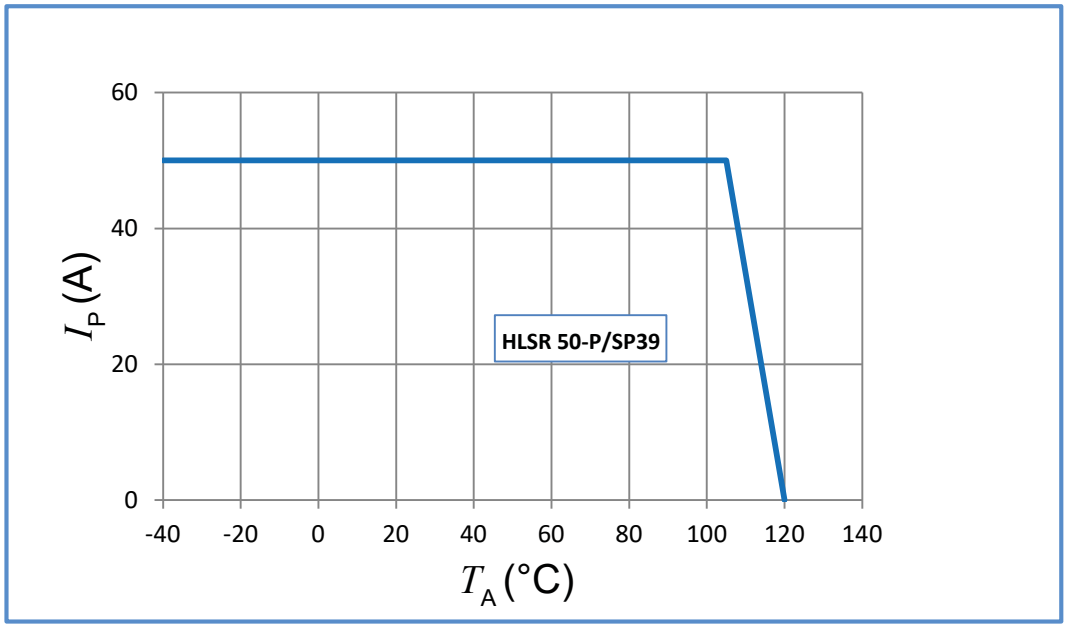
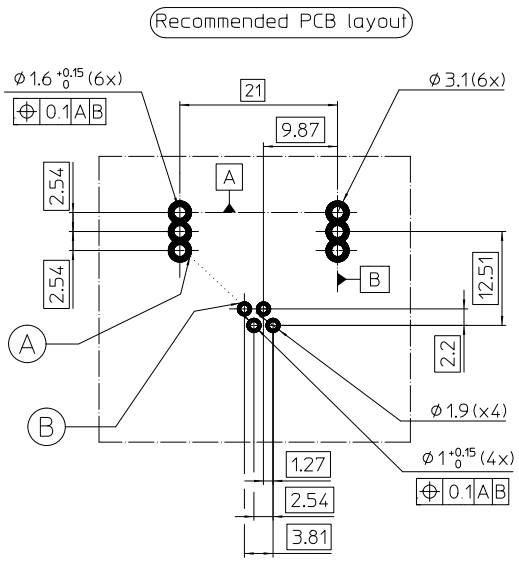
Maximum continuous DC current



Important notice: whatever the usage and/or application, the transducer jumper temperature shall not go above the maximum ratings of 120 °C as stated in page 3 of this datasheet.

PCB footprint (in mm)



	d_{Cl} (mm)	d_{Cp} (mm)
A-B	9.42	9.42

Assembly on PCB

- Recommended PCB hole diameter — 1.6 mm for primary pins
1 mm for secondary pins
- Maximum PCB thickness — 2.4 mm
- Wave soldering profile
No clean process only — maximum 260 °C for 10 s

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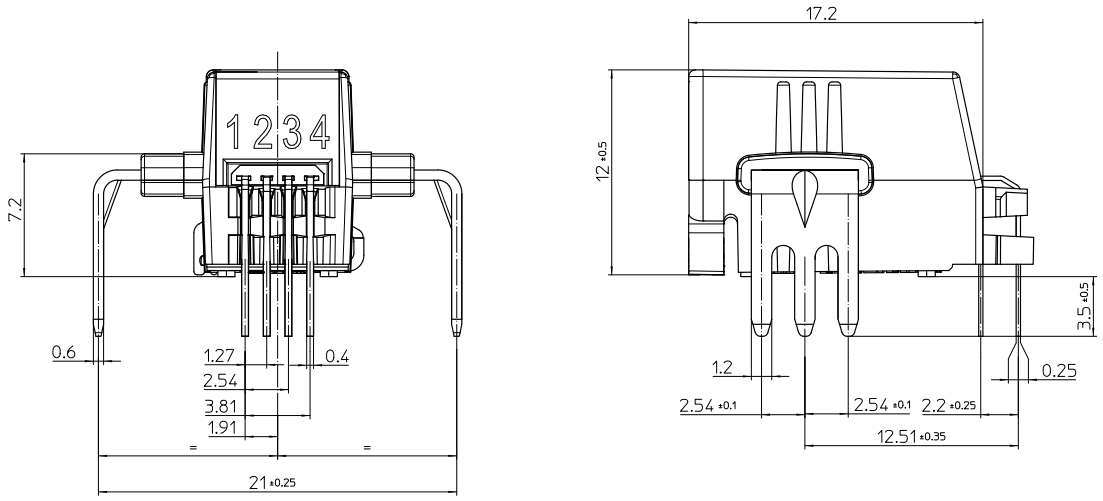
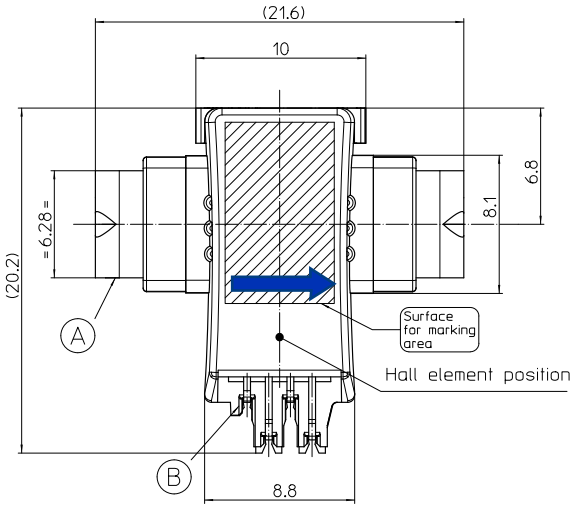
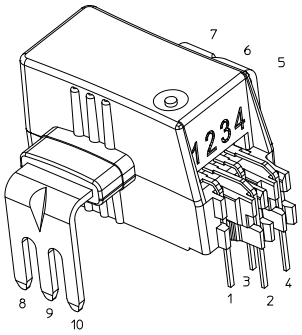
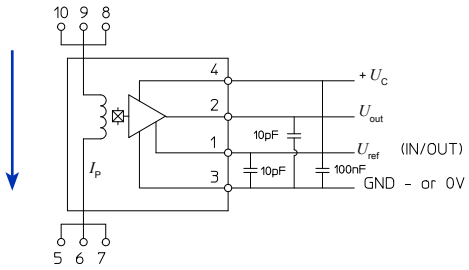
Dimensions (in mm. General linear tolerance ±0.2 mm)







Connection



Remarks

- U_{out} is positive with respect to U_{ref} when positive I_P flows in direction of the arrow shown on the drawing above
- 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: https://www.lem.com/en/file/3137/download/.

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