Integrated Current Sensor GXL AN series

Description

GXL AN is a 200A range Integrated Current Sensor (ICS) built with QFN package technology, providing an excellent power density for power PCB current measurements with built in galvanic insulation. This product is a high precision integrated current sensor (ICS) from LEM, where the current goes through its primary pins and does not require a core (coreless product).

The GXL product family provides a very accurate solution for measuring DC and AC currents in all highly compact and demanding industrial and automotive applications. This product uses a very small QFN package technology with large primary pads and wettable flanks for soldering and visual inspection. It provides analog voltage output with best-in-class accuracy together with overcurrent detections (user configurable and factory set).

The current goes through the primary pins (1 to 8) which have a very low internal resistance (<0.25 mΩ). The secondary pins have 6mm distance creepage / clearance from the primary in order to insure a good enough isolation level.
These features make the device suitable for high voltage applications requiring high precision and strong immunity against external field with its differential sensing solution.

Main features & Advantages

- **Industrial and automotive**
- **Open loop multi-range current sensor: 200A**
- **Low electrical resistance < 0.25mΩ**
- **Dual supply voltage 5V and 3.3V**
- **User settable fast overcurrent detection**
- **Low power consumption**
- **Compact design for surface mount PCB mounting**
- **High bandwidth**
- **Galvanic separation between primary and secondary with 6 mm of dCp/dCl**
- **Reinforced insulation capability**

Typical applications

- **Drives**
- **HVAC Inverters**
- **Appliances**
- **Solar Inverters**
- **Automotive**

Standards

- **IEC 61800-5-1: 2007**
- **IEC 62109-1: 2010**
- **IEC 62368-1: 2018 (replacing IEC 60950-1)**
- **UL 1577: 2014 (Pending)**
- **UL 62638-1 (Pending)**
- **AEC-Q-100 Grade 0 qualified (pending)**

Figure 1: GXL QFN package

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Pinout

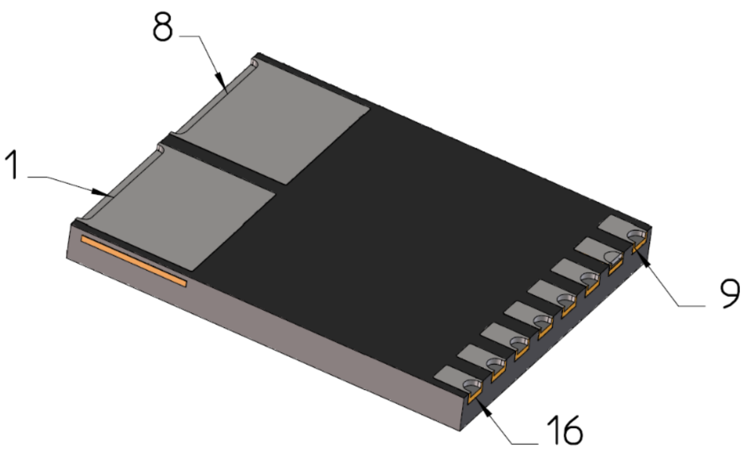

Figure 2: GXL package with pin number (bottom view)

Pin#	Name	Type	Description
1	I_P+	Input	input (+) of the primary current
8	I_P−	Input	Input (-) of the primary current
9	U_C	Power	Supply voltage
10	UE_{OCD}	Input	External OCD threshold voltage terminal
11	OCD_{INT}	Output	Internal OCD
12	U_{out}	Output	Output voltage
13	U_{ref}	Output	Reference voltage
14	*NC*	N/A	Connect to GND
15	OCD_{EXT}	Output	External OCD terminal
16	*GND*	Ground	Ground terminal

Table 1: GXL AN Device Pin Function Description.

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Selection guide

GXL AN 200-80 – 50000A

- Product revision
- Temperature range:
  0: -40 – 150°C
  1: -40 -125°C
- LEM trimming
- Output type:
  0: fixed
  1: ratiometric
- Output type:
  0: bipolar (U_{ref} =Uc/2)
  1: unipolar (U_{ref} =0.5V)
- Supply Voltage U_C:
  5: 5V
  3: 3.3V
- Full scale current – Nominal current.
- Package Type

Standard products

Product name	Full scale range (A peak)	Nominal current (A rms)[1]	Sensitivity (mV/A)	Supply Voltage (V)	Polarity	Output type
GXL AN 125-50 50000B	± 125	±50	16	5 V	Bipolar	Fixed
GXL AN 200-80 50000B	± 200	±80	10	5 V	Bipolar	Fixed
GXL AN 125-50 30000B	± 125	±50	10	3.3 V	Bipolar	Fixed
GXL AN 200-80 30000B	± 200	±80	6.25	3.3 V	Bipolar	Fixed
GXL AN 125-50 50100B	± 125	±50	16	5 V	Bipolar	Ratiometric
GXL AN 200-80 50100B	± 200	±80	10	5 V	Bipolar	Ratiometric
GXL AN 125-50 30100B	± 125	±50	10	3.3 V	Bipolar	Ratiometric
GXL AN 200-80 30100B	± 200	±80	6.25	3.3 V	Bipolar	Ratiometric

Table 2

[1] Trimmings at LEM are done at this nominal current

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Block diagram

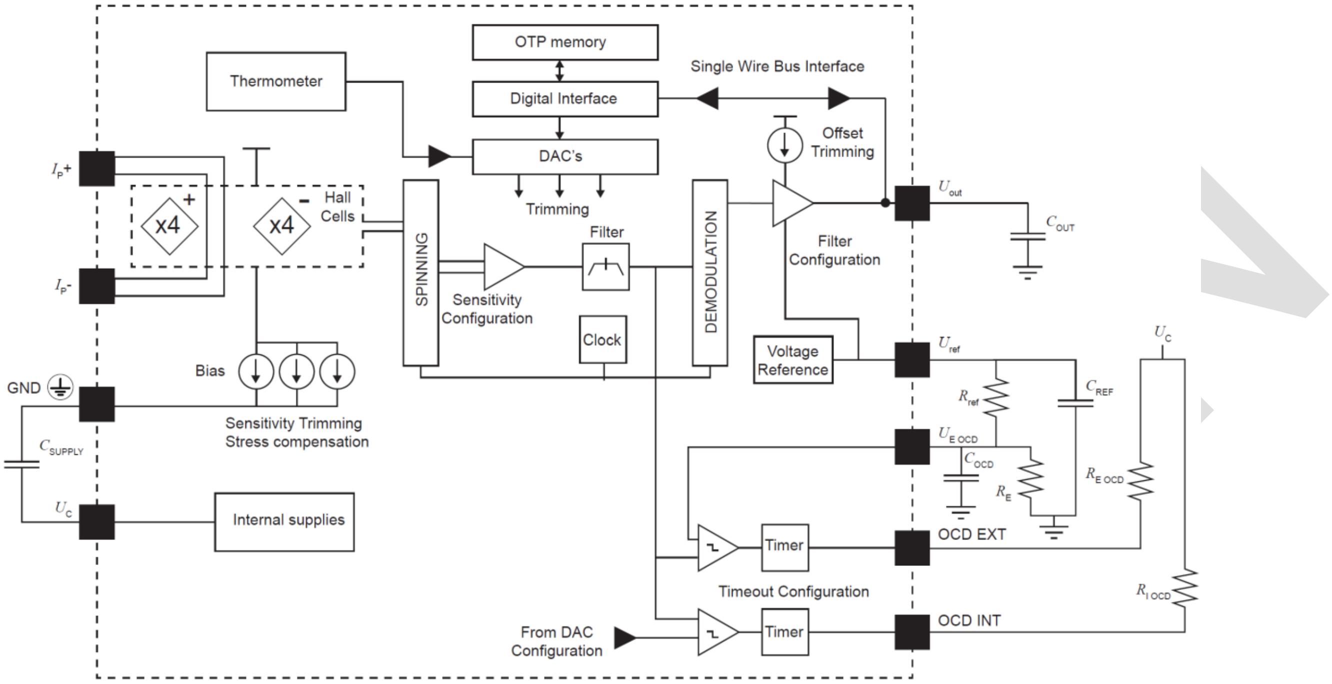

Figure 3 Block diagram GXL AN

External circuit example	Min	Typ	Max	Unit
R_{ref}	4.7	47		kΩ
R_{e}	4.7	47		kΩ
R_{e_ocd}	1	4.7	50	kΩ
R_{i_ocd}	1	4.7	50	kΩ
C_{out}	-	4.7	6	nF
C_{supply}	10	47		nF
C_{ref}	-	4.7	47	nF
C_{out}		4.7		nF

Table 3: Specification Table of External Component Values

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Absolute maximum ratings

Parameter	Symbol	Unit	Value
Maximum supply voltage	$U_{C\ max}$	V	7.5
Maximum voltage on other pins	U_{max}	V	7.5
Electrostatic discharge voltage (HBM - Human Body Model)	$U_{ESD\ HBM}$	kV	2
Electrostatic discharge voltage (CDM - Charged Device Model)	$U_{ESD\ CDM}$	V	500
Maximum junction temperature	$T_{J\ max}$	°C	165

Table 4

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.

Environmental and mechanical characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Ambient operating temperature	T_A	°C	-40		150	
Ambient storage temperature	$T_{A\ st}$	°C	-55		165	
Thermal resistance junction to case[2]	$R_{th\ JC}$	K/W		18		
Thermal resistance junction to ambient[2]	$R_{th\ JA}$	K/W		19		
Mass	m	g		1.4		

Table 5

[3] 100% tested in production.

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Insulation characteristics GXL

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC insulation test, 50Hz, 1min	U_d	kV	4.53[3]	According to IEC 62368-1
Impulse withstand voltage 1.2/50 µs	U_{NI}	kV	6.40	According to IEC 62109-1, IEC 61800-5-1
RMS recurring peak voltage (Partial discharge test)	U_{PD}	V	933	According to IEC 62109-1, IEC 61800-5-1
RMS inception voltage (Partial discharge test)	$U_{t\ inception}$	V	1238	According to IEC 62109-1, IEC 61800-5-1
RMS extinction voltage (Partial discharge test)	$U_{t\ extinction}$	V	990	According to IEC 62109-1, IEC 61800-5-1
Clearance (pri. -sec.)	d_{Cl}	mm	6	Shortest distance through air
Creepage distance (pri. -sec.)	d_{Cp}	mm	6	Shortest path along device body
Case material			V0	According to UL94, flammability
Comparative tracking index	*CTI*		600	Grade requirements mass compound

Table 6

Working voltage according to IEC 62368-1

Working voltage		PD 2	Standards
Basic insulation	RMS voltage (V)	1192	IEC 62368-1 (replacing IEC 60950-1)
Reinforced insulation	RMS voltage (V)	593	

Table 7

Rated insulation voltage according to IEC 61800-5-1

Rated insulation voltage		OV II / PD 2	OV III/ PD 2	Standards
Basic isolation	RMS voltage (V)	1104	600	IEC 61800-5-1
Reinforced isolation	RMS voltage (V)	593	300	

Table 8

Rated insulation voltage according to IEC 62109-1

Rated insulation voltage		OV II / PD 2	OV III/ PD 2	Standards
Basic isolation	RMS voltage (V)	> 1000	600	IEC 62109-1
Reinforced isolation	RMS voltage (V)	593	300	

Table 9

[3] Tested at 4.07 kV in production.

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Common electrical data (independent of sensitivity)

At T_A = 35 °C, U_C = +5 V, R_L = 100 kΩ, unless otherwise noted

Supply characteristics and consumption

Parameter	Symbol	Unit	Min	Typ	Max	Comment
DC supply voltage	U_C	V	4.5	5	5.5	5V versions
DC supply voltage	U_C	V	3.135	3.3	3.465	3V3 versions
DC Current consumption	I_C	mA		20	26	
Start-up time	T_{start}	ms		3		

Table 10

Primary characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Resistance of the primary	R_P	mΩ		<0.25		T_A = 25 °C

Table 11

Output characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Output voltage range	U_{out}-U_{ref}	V	-2		2	5V versions $U_C \geq$ 4.6 V , @ I_{PM}
Output voltage range	U_{out}-U_{ref}	V	-1.25		1.25	3V3 versions @ I_{PM}
Output internal resistance of Uout	R_{out}	Ω		1		
Maximum output current source of Uout	I_{Omax}	mA	20			
Maximum input current sink of Uout	I_{Imax}	mA	20			
Load capacitance on Uout	C_L	nF	0	4.7	6	
Delay time (input slope= Ipn (20A/µs))	t_{D10}	µs		1		@ 10 % of $I_{P N}$
	t_{D90}	µs		1.6		@ 90 % of $I_{P N}$
Frequency bandwidth	BW	kHz		300		@ -3dB

Table 12

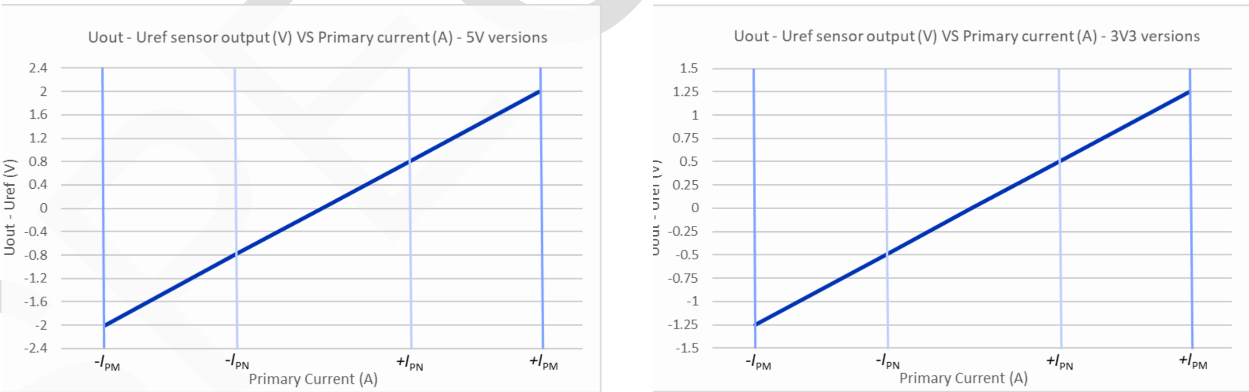

Figure 3 & 4: Sensor output voltage referred to Uref.

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Internal reference characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Internal reference voltage @ I_P = 0 A	U_{Iref}	V	2.48	2.5	2.52	5V versions
Internal reference voltage @ I_P = 0 A	U_{out}-U_{ref}	V	1.64	1.65	1.66	3V3 versions
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K	-220	±75	220	−40 °C ... 150 °C
Output internal resistance of Uref	R_{ref}	Ω		5		
Maximum output current source of Uref	I_{Omax}	mA		0.5	1	
Maximum input current sink of Uref	I_{Imax}	mA		0.5	1	
Load capacitance on Uref	C_L	nF	0	4.7	47	

Table 13

Lifetime parameters

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Sensitivity error drift after ageing	ε_S	%		TBD		TBC based on characterization after qualification.
Offset drift after ageing	U_{OE}	mV		TBD		TBC based on characterization after qualification.
Total accuracy over temp	ε_{tot}	%		TBD		TBC based on characterization after qualification.
Total accuracy over lifetime	ε_{tot}	%		TBD		TBC based on characterization after qualification.

Table 14

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Electrical data GXL AN 125-50 50000B

At T_A = 25 °C, U_C = +5 V, R_L = 100 kΩ, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current	I_{PN}	A		50		
Primary current, measuring range	I_{PM}	A	−125		125	
Nominal sensitivity	S_N	mV/A		16		800 mV @ I_{PN}
Sensitivity error @35°C	ε_S	%	−0.5		0.5	TBC
Sensitivity error @35°C-150°C	ε_{SHOT}	%	-2.1		2.1	From 35°C to 150°C - TBC
Sensitivity error @-40°C-35°C	ε_{SCOLD}	%	-2.3		2.3	From -40°C to 35°C - TBC
Sum of sensitivity and linearity error	ε_{SL25}	% of I_{PM}	-0.7		0.7	@35°C TBC
Electrical offset voltage	U_{OE}	mV	-5		5	U_{out}-U_{Iref} @ U_{Iref} =2.5 V
Electrical offset error @35°C-150°C	U_{OEHOT}	mV	-7		7	U_{out}-U_{ref}
Electrical offset error @-40°C-35°C	U_{OECOLD}	mV	-6.5		6.5	U_{out}-U_{ref}
Noise voltage spectral density	U_{no}	µV/Hz$^{1/2}$				TBC
Linearity error 0 ... ±I_{PN}	ε_L	%	−0.5		0.5	Referred to I_{PN}
Linearity error 0 ... ±I_{PM}	ε_L	%	−0.5		0.5	Referred to I_{PM}
Total error at I_{PM}	ε_{tot}	% of I_{PM}	-2.4		2.4	From -40°C to 150°C

Table 15

Electrical data GXL AN 200-80 50000B

At T_A = 25 °C, U_C = +5 V, R_L = 100 kΩ, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current	I_{PN}	A		80		
Primary current, measuring range	I_{PM}	A	−200		200	
Nominal sensitivity	S_N	mV/A		10		800 mV @ I_{PN}
Sensitivity error @35°C	ε_S	%	−0.5		0.5	TBC
Sensitivity error @35°C-150°C	ε_{SHOT}	%	-2.1		2.1	From 35°C to 150°C - TBC
Sensitivity error @-40°C-35°C	ε_{SCOLD}	%	-2.3		2.3	From -40°C to 35°C - TBC
Sum of sensitivity and linearity error	ε_{SL25}	% of I_{PM}	-0.7		0.7	@35°C TBC
Electrical offset voltage	U_{OE}	mV	-5		5	U_{out}-U_{Iref} @ U_{Iref} =2.5 V
Electrical offset error @35°C-150°C	U_{OEHOT}	mV	-7		7	U_{out}-U_{ref}
Electrical offset error @-40°C-35°C	U_{OECOLD}	mV	-6.5		6.5	U_{out}-U_{ref}
Noise voltage spectral density	U_{no}	µV/Hz$^{1/2}$				TBC
Linearity error 0 ... ±I_{PN}	ε_L	%	−0.5		0.5	Referred to I_{PN}
Linearity error 0 ... ±I_{PM}	ε_L	%	−0.5		0.5	Referred to I_{PM}
Total error at I_{PM}	ε_{tot}	% of I_{PM}	-2.4		2.4	From -40°C to 150°C

Table 16

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Electrical data GXL AN 125-50 30000B

At T_A = 25 °C, U_C = +3.3 V, R_L = 100 kΩ, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current	I_{PN}	A		50		
Primary current, measuring range	I_{PM}	A	−125		125	
Nominal sensitivity	S_N	mV/A		10		500 mV @ I_{PN}
Sensitivity error @35°C	ε_S	%	−0.5		0.5	TBC
Sensitivity error @35°C-150°C	ε_{SHOT}	%	-2.1		2.1	From 35°C to 150°C - TBC
Sensitivity error @-40°C-35°C	ε_{SCOLD}	%	-2.3		2.3	From -40°C to 35°C - TBC
Sum of sensitivity and linearity error	ε_{SL25}	% of I_{PM}	-0.7		0.7	@35°C TBC
Electrical offset voltage	U_{OE}	mV	-5		5	U_{out}-U_{Iref} @ U_{Iref} =2.5 V
Electrical offset error @35°C-150°C	U_{OEHOT}	mV	-7		7	U_{out}-U_{ref}
Electrical offset error @-40°C-35°C	U_{OECOLD}	mV	-6.5		6.5	U_{out}-U_{ref}
Noise voltage spectral density	U_{no}	µV/Hz$^{1/2}$				TBC
Linearity error 0 ... ±I_{PN}	ε_L	%	−0.5		0.5	Referred to I_{PN}
Linearity error 0 ... ±I_{PM}	ε_L	%	−0.5		0.5	Referred to I_{PM}
Total error at I_{PM}	ε_{tot}	% of I_{PM}	-2.4		2.4	From -40°C to 150°C

Table 17

Electrical data GXL AN 200-80 30000B

At T_A = 25 °C, U_C = +3.3 V, R_L = 100 kΩ, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current	I_{PN}	A		80		
Primary current, measuring range	I_{PM}	A	−200		200	
Nominal sensitivity	S_N	mV/A		6.25		500 mV @ I_{PN}
Sensitivity error @35°C	ε_S	%	−0.5		0.5	TBC
Sensitivity error @35°C-150°C	ε_{SHOT}	%	-2.1		2.1	From 35°C to 150°C - TBC
Sensitivity error @-40°C-35°C	ε_{SCOLD}	%	-2.3		2.3	From -40°C to 35°C - TBC
Sum of sensitivity and linearity error	ε_{SL25}	% of I_{PM}	-0.7		0.7	@35°C TBC
Electrical offset voltage	U_{OE}	mV	-5		5	U_{out}-U_{Iref} @ U_{Iref} =2.5 V
Electrical offset error @35°C-150°C	U_{OEHOT}	mV	-7		7	U_{out}-U_{ref}
Electrical offset error @-40°C-35°C	U_{OECOLD}	mV	-6.5		6.5	U_{out}-U_{ref}
Noise voltage spectral density	U_{no}	µV/Hz$^{1/2}$				TBC
Linearity error 0 ... ±I_{PN}	ε_L	%	−0.5		0.5	Referred to I_{PN}
Linearity error 0 ... ±I_{PM}	ε_L	%	−0.5		0.5	Referred to I_{PM}
Total error at I_{PM}	ε_{tot}	% of I_{PM}	-2.4		2.4	From -40°C to 150°C

Table 18

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Electrical data GXL AN 125-50 50100B

At T_A = 25 °C, U_C = +5 V, R_L = 100 kΩ, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current	I_{PN}	A		50		
Primary current, measuring range	I_{PM}	A	−125		125	
Nominal sensitivity	S_N	mV/A		16		800 mV @ I_{PN}
Sensitivity error @35°C	ε_S	%	−0.5		0.5	TBC
Sensitivity error @35°C-150°C	ε_{SHOT}	%	-2.1		2.1	From 35°C to 150°C - TBC
Sensitivity error @-40°C-35°C	ε_{SCOLD}	%	-2.3		2.3	From -40°C to 35°C - TBC
Sum of sensitivity and linearity error	ε_{SL25}	% of I_{PM}	-0.7		0.7	@35°C
Electrical offset voltage	U_{OE}	mV	-5		5	U_{out}-U_{Iref} @ U_{Iref} =2.5 V
Electrical offset error @35°C-150°C	U_{OEHOT}	mV	-7		7	U_{out}-U_{ref}
Electrical offset error @-40°C-35°C	U_{OECOLD}	mV	-6.5		6.5	U_{out}-U_{ref}
Noise voltage spectral density	U_{no}	µV/Hz$^{1/2}$				TBC
Linearity error 0 ... ±I_{PN}	ε_L	%	−0.5		0.5	Referred to I_{PN}
Linearity error 0 ... ±I_{PM}	ε_L	%	−0.5		0.5	Referred to I_{PM}
Total error at I_{PM}	ε_{tot}	% of I_{PM}	-2.4		2.4	From -40°C to 150°C
Ratiometricity Error (sensitivity)	ε_R	%		±0.5		From -40°C to 150°C
Ratiometricity Error (offset)	ε_{RO}	mV	-10		10	From -40°C to 150°C

Table 19

Electrical data GXL AN 200-80 50100B

At T_A = 25 °C, U_C = +5 V, R_L = 100 kΩ, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current	I_{PN}	A		80		
Primary current, measuring range	I_{PM}	A	−200		200	
Nominal sensitivity	S_N	mV/A		10		800 mV @ I_{PN}
Sensitivity error @35°C	ε_S	%	−0.5		0.5	TBC
Sensitivity error @35°C-150°C	ε_{SHOT}	%	-2.1		2.1	From 35°C to 150°C - TBC
Sensitivity error @-40°C-35°C	ε_{SCOLD}	%	-2.3		2.3	From -40°C to 35°C - TBC
Sum of sensitivity and linearity error @ T_A = 25 °C	ε_{SL25}	% of I_{PM}	-0.7		0.7	TBC
Electrical offset voltage	U_{OE}	mV	-5		5	U_{out}-U_{Iref} @ U_{Iref} =2.5 V
Electrical offset error @35°C-150°C	U_{OEHOT}	mV	-7		7	U_{out}-U_{ref}
Electrical offset error @-40°C-35°C	U_{OECOLD}	mV	-6.5		6.5	U_{out}-U_{ref}
Noise voltage spectral density	U_{no}	µV/Hz$^{1/2}$				TBC
Linearity error 0 ... ±I_{PN}	ε_L	%	−0.5		0.5	Referred to I_{PN}
Linearity error 0 ... ±I_{PM}	ε_L	%	−0.5		0.5	Referred to I_{PM}
Total error at I_{PM}	ε_{tot}	% of I_{PM}	-2.4		2.4	From -40°C to 150°C
Ratiometricity Error (sensitivity)	ε_R	%		±0.5		From -40°C to 150°C
Ratiometricity Error (offset)	ε_{RO}	mV	-10		10	From -40°C to 150°C

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Electrical data GXL AN 125-50 30100B

At T_A = 25 °C, U_C = +3.3 V, R_L = 100 kΩ, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current	I_{PN}	A		50		
Primary current, measuring range	I_{PM}	A	−125		125	
Nominal sensitivity	S_N	mV/A		10		500 mV @ $I_{P N}$
Sensitivity error @35°C	ε_S	%	−0.5		0.5	TBC
Sensitivity error @35°C-150°C	ε_{SHOT}	%	-2.1		2.1	From 35°C to 150°C - TBC
Sensitivity error @-40°C-35°C	ε_{SCOLD}	%	-2.3		2.3	From -40°C to 35°C - TBC
Sum of sensitivity and linearity error @ T_A = 25 °C	ε_{SL25}	% of I_{PM}	-0.7		0.7	TBC
Electrical offset voltage	U_{OE}	mV	-5		5	U_{out}-U_{Iref} @ U_{Iref} =2.5 V
Electrical offset error @35°C-150°C	U_{OEHOT}	mV	-7		7	U_{out}-U_{ref}
Electrical offset error @-40°C-35°C	U_{OECOLD}	mV	-6.5		6.5	U_{out}-U_{ref}
Noise voltage spectral density	U_{no}	µV/Hz$^{1/2}$				TBC
Linearity error 0 ... ±$I_{P N}$	ε_L	%	−0.5		0.5	Referred to $I_{P N}$
Linearity error 0 ... ±$I_{P M}$	ε_L	%	−0.5		0.5	Referred to $I_{P M}$
Total error at I_{PM}	ε_{tot}	% of $I_{P M}$	-2.4		2.4	From -40°C to 150°C
Ratiometricity Error (sensitivity)	ε_R	%		±0.5		From -40°C to 150°C
Ratiometricity Error (offset)	ε_{RO}	mV	-10		10	From -40°C to 150°C

Table 21

Electrical data GXL AN 200-80 30100B

At T_A = 25 °C, U_C = +3.3 V, R_L = 100 kΩ, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current	I_{PN}	A		80		
Primary current, measuring range	I_{PM}	A	−200		200	
Nominal sensitivity	S_N	mV/A		6.25		500 mV @ $I_{P N}$
Sensitivity error @35°C	ε_S	%	−0.5		0.5	TBC
Sensitivity error @35°C-150°C	ε_{SHOT}	%	-2.1		2.1	From 35°C to 150°C - TBC
Sensitivity error @-40°C-35°C	ε_{SCOLD}	%	-2.3		2.3	From -40°C to 35°C - TBC
Sum of sensitivity and linearity error @ T_A = 25 °C	ε_{SL25}	% of I_{PM}	-0.7		0.7	TBC
Electrical offset voltage	U_{OE}	mV	-5		5	U_{out}-U_{Iref} @ U_{Iref} =2.5 V
Electrical offset error @35°C-150°C	U_{OEHOT}	mV	-7		7	U_{out}-U_{ref}
Electrical offset error @-40°C-35°C	U_{OECOLD}	mV	-6.5		6.5	U_{out}-U_{ref}
Noise voltage spectral density	U_{no}	µV/Hz$^{1/2}$				TBC
Linearity error 0 ... ±$I_{P N}$	ε_L	%	−0.5		0.5	Referred to $I_{P N}$
Linearity error 0 ... ±$I_{P M}$	ε_L	%	−0.5		0.5	Referred to $I_{P M}$
Total error at I_{PM}	ε_{tot}	% of $I_{P M}$	-2.4		2.4	From -40°C to 150°C
Ratiometricity Error (sensitivity)	ε_R	%		±0.5		From -40°C to 150°C
Ratiometricity Error (offset)	ε_{RO}	mV	-10		10	From -40°C to 150°C

Table 22

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Overcurrent detection (OCD)

Overcurrent detection is a feature included on GXL AN product to detect high peaks of currents happening during operation. Two overcurrent detection types are included in this product:
Internal OCD which offers the fastest reaction time and External OCD with a user settable threshold.

Internal overcurrent detection (OCD_INT pin)

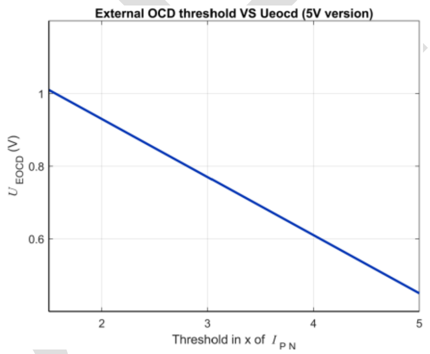
Parameter	Symbol	Unit	Min	Typ	Max	Comment
OCD_INT detection threshold	$I_{I\ OCD\ Th}$	A		3 x $\pm I_{P\ N}$		1.5 to 5 x $\pm I_{P\ N}$ available. Contact LEM for more options
OCD_INT threshold error	$\varepsilon_{I\ OCD\ Th}$	%		±9		U_c = 5V
OCD_INT threshold error	$\varepsilon_{I\ OCD\ Th}$	%		±15		U_c = 3.3V
OCD_INT output on resistance to GND	$R_{on\ I\ OCD}$	Ω		11	46	Open drain output, active low
OCD_INT output on sink capability	$I_{I\ OCDmax}$	mA	16	20		
OCD_INT output hold time	$t_{hold\ I\ OCD}$	µs	8	10	12	
OCD_INT delay time	$t_{D\ I\ OCD}$	µs			0.5	

Table 23

External overcurrent detection (OCD_EXT pin)

Parameter	Symbol	Unit	Min	Typ	Max	Comment
OCD_EXT threshold error	$\varepsilon_{E\ OCD\ Th}$	% of Full Scale		±6.8		U_c = 5V, bipolar
OCD_EXT threshold error	$\varepsilon_{E\ OCD\ Th}$	% of Full Scale		±14		U_c = 3.3V, bipolar
OCD_EXT output on resistance to GND	$R_{on\ E\ OCD}$	Ω		11	46	Open drain output, active low
OCD_EXT output on sink capability	$I_{E\ OCDmax}$	mA	16	20		
OCD_EXT output hold time	$t_{hold\ E\ OCD}$	µs	2.5		10	
OCD_EXT delay time	$t_{D\ E\ OCD}$	µs		1.5	2	

Table 24



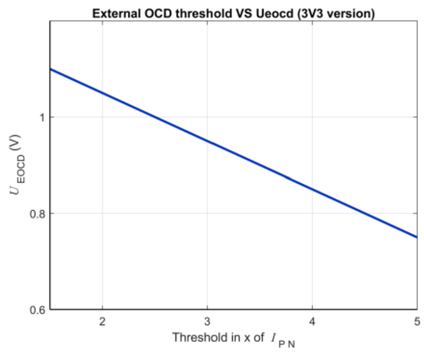


Figure 3 & 4: OCD level threshold for 5V and 3.3V versions

Overcurrent Detection (OCD) Equations

$$U_{E\ OCD} = \frac{R_E}{R_E + R_{ref}} * U_{Source}$$

Eqn1. External OCD Voltage

$$I_{THRESHOLD} = -6.5 * \left(\frac{R_E}{R_E + R_{ref}} * U_{Source}\right) + 7.8125$$

Eqn2. External OCD Current Threshold (in x of Ipn) - 5V versions

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$$I_{\text{THRESHOLD}} = -10 * \left(\frac{R_E}{R_E+R_{ref}} * U_{\text{Source}}\right) + 12.5$$

Eqn3. External OCD Current Threshold (in x of Ipn) - 3.3V versions

Thermal characteristics

When designing a system containing a current sensor, self-heating due to the flow of the current should be considered. When a current pass through, the sensor's temperature will increase, and this may affect its performances. This change on temperature will depend on the current profile, PCB layout, cooling techniques and copper thickness. The following plots show an example of different thermal responses of the GXL AN sensor when used on an evaluation LEM board.

Error! Reference source not found. shows the continuous RMS current that GXM/L AN is capable of measuring d epending on the maximum expected temperature of the system.

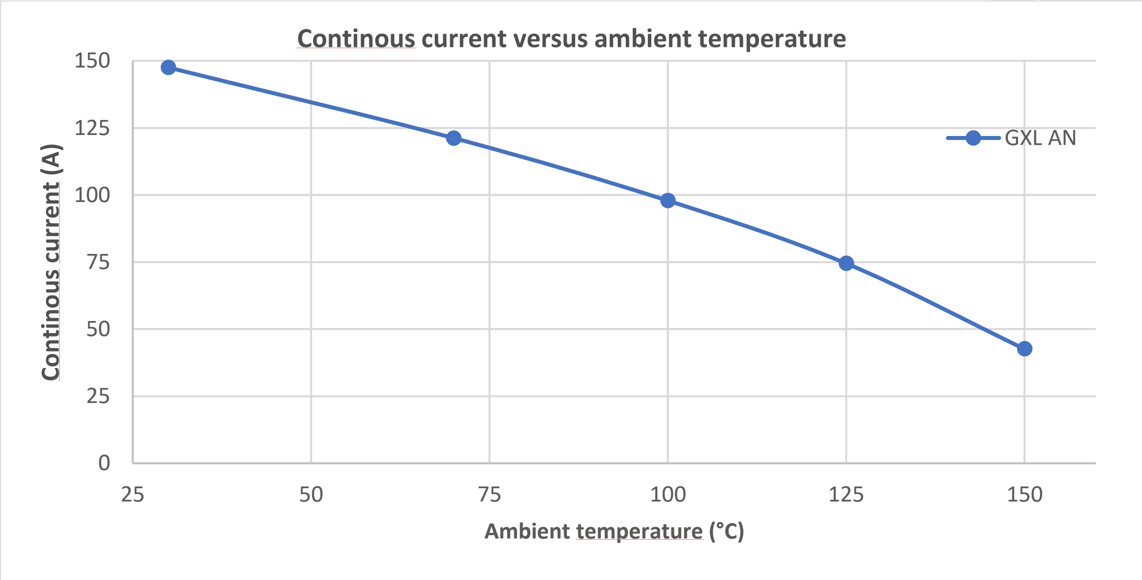

Figure 8 Measuring range vs temperature

Finally, Figure represents the maximum measurement range (peak current) versus the temperature.

The maximum temperature should be evaluated on the final system where the current sensor is integrated on the real application. This temperature should never exceed the maximum junction temperature as shown on the previous paragraphs.

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Evaluation board PCB

All the above results will be based on a LEM evaluation board.

Details on the evaluation board: **to be added soon**

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Recommended application schematics

Typical schematics GXL AN

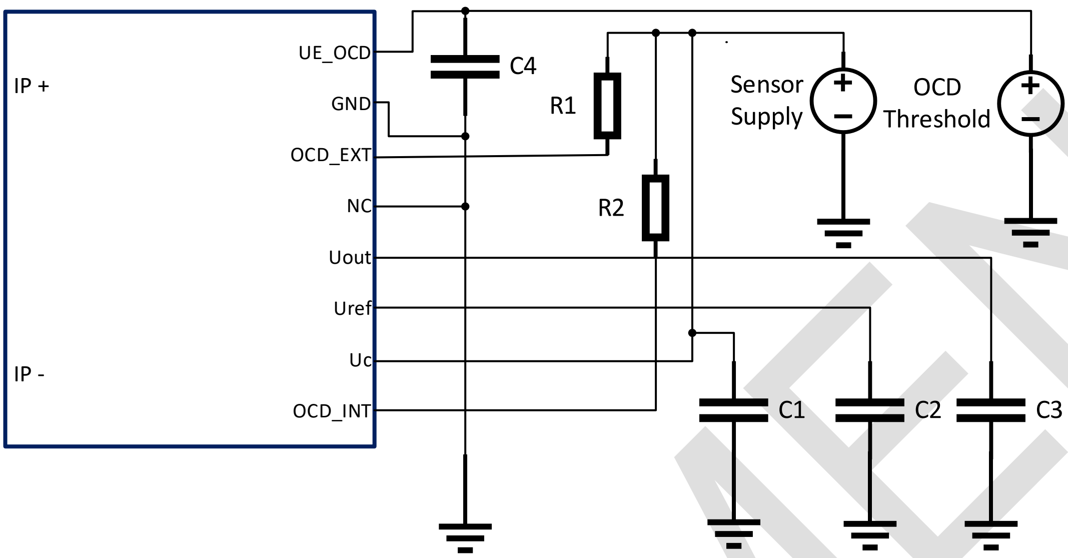

Figure 10: Typical application schematics; AN products

Output measurement is performed using Uout and Uref, both OCD are used.

Reference	Value	Comments
C1	47nF	Decoupling capacitor. To be placed as close as possible to the sensor.
C2	4.7nF	Reference capacitor, mandatory if internal reference voltage is used. Depending on the application, this value can be increased to 47nF to improve the stability. To be placed as close as possible to the sensor.
C3	4.7nF	Output capacitor. Insure stable output operation on full bandwidth. To be placed as close as possible to the sensor.
C4	4.7nF	Only mounted if OCD_EXT functionality is used. This capacitor insure a better immunity of Ue OCD to noise and transients. OCD_EXT accuracy cannot be guaranteed if not mounted. To be placed as close as possible to the sensor.
R1	10kOhms	OCD Pull up. Must be connected to Uc, as close as possible to the sensor.
R2	10kOhms	OCD Pull up. Must be connected to Uc, as close as possible to the sensor.
Supply	5V / 3.3V	Supply voltage matching product requirements.
OCD threshold voltage	See datasheet	OCD threshold voltage source must be very stable to insure an accurate threshold. Different methods can be used to fix the OCD threshold: - External source (DAC, amplifier, Zener diode…) - Resistor divider, connected to Uc or Uref See “External OCD” chapter for more details.

Table 1: Typical recommended components (AN products)

For more details, please read “ICS Products Schematics” application note available on LEM website.

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Terms and definitions

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.

Total error referred to primary

The total error ε_{tot} is the error at $\pm I_{PN}$, relative to the FS (Full Scale). It includes all errors mentioned below:

- the electrical offset I_{OE}
- the magnetic offset I_{OM}
- the sensitivity error ε_S
- the linearity error ε_L (to I_{PN})

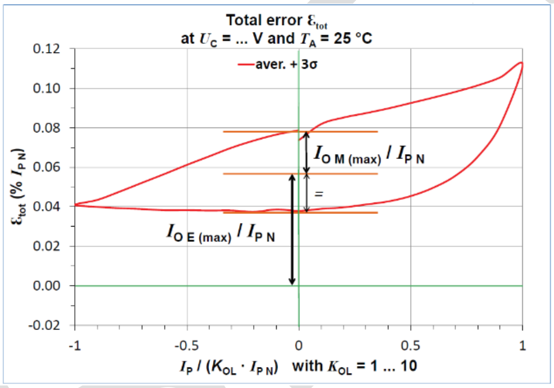

Figure 9 Total error

Electrical offset referred to primary

Using the current cycle shown in figure 7, the electrical offset current I_{OE} is the residual output referred to primary when the input current is zero.

Magnetic offset referred to primary

$$I_{OE} = \frac{I_{P(3)} + I_{P(5)}}{2}$$

$$I_{OM} = \frac{I_{P(3)} - I_{P(5)}}{2}$$

The magnetic offset current I_{OM} is the consequence of a current on the primary side ("memory effect" of the transducer's ferro-magnetic core). It is measured using the following primary current cycle. I_{OM} depends on the current value $I_P \geq I_{PN}$.

K_{OL}: Overload factor

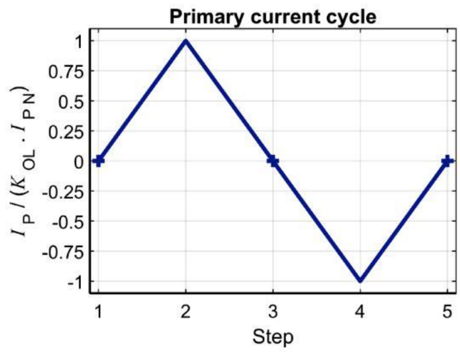

Figure 10 Current cycle used to measure magnetic and electrical offset (transducer supplied)

Sensitivity and linearity

To measure sensitivity and linearity, the primary current (DC) is cycled from 0 to I_P, then to $-I_P$ and back to 0 (equally spaced $I_{PN}/10$ steps). The sensitivity S is defined as the slope of the linear regression line for a cycle between $\pm I_{PN}$.

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

Delay times

The delay time $t_{D\,10}$ @ 10 % and the delay time $t_{D\,90}$ @ 90 % with respect to the primary are shown in the next figure.
Both slightly depend on the primary current di/dt.
They are measured at nominal current.

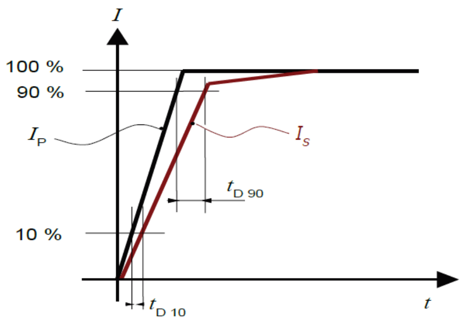

Figure 11 Delay times

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PCB footprint (in mm)

GXL solder pads layout:

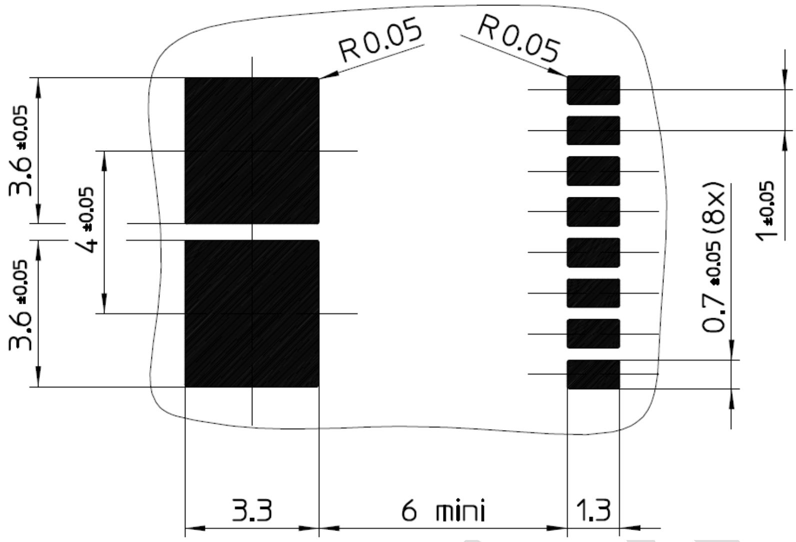

Figure 12 GXL PCB footprint

Soldering on PCB

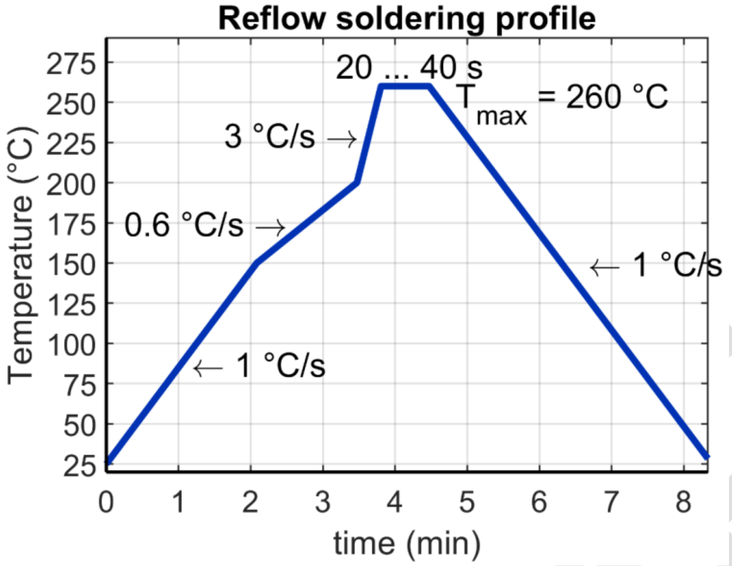

Figure 2 Soldering profile

Soldering remarks:

- GXL is targeted to be qualified MSL3 for storage and mounting purposes.
- Per JEDEC J-STD-020E for packages less than 1.6 mm thick per table 4.2 (Pb-Free Process) of the specification.
- Best practice is to use 7 zones or greater conventional reflow system, limiting the time at reflow temperature as indicated in profile above.
- Rework not recommended.

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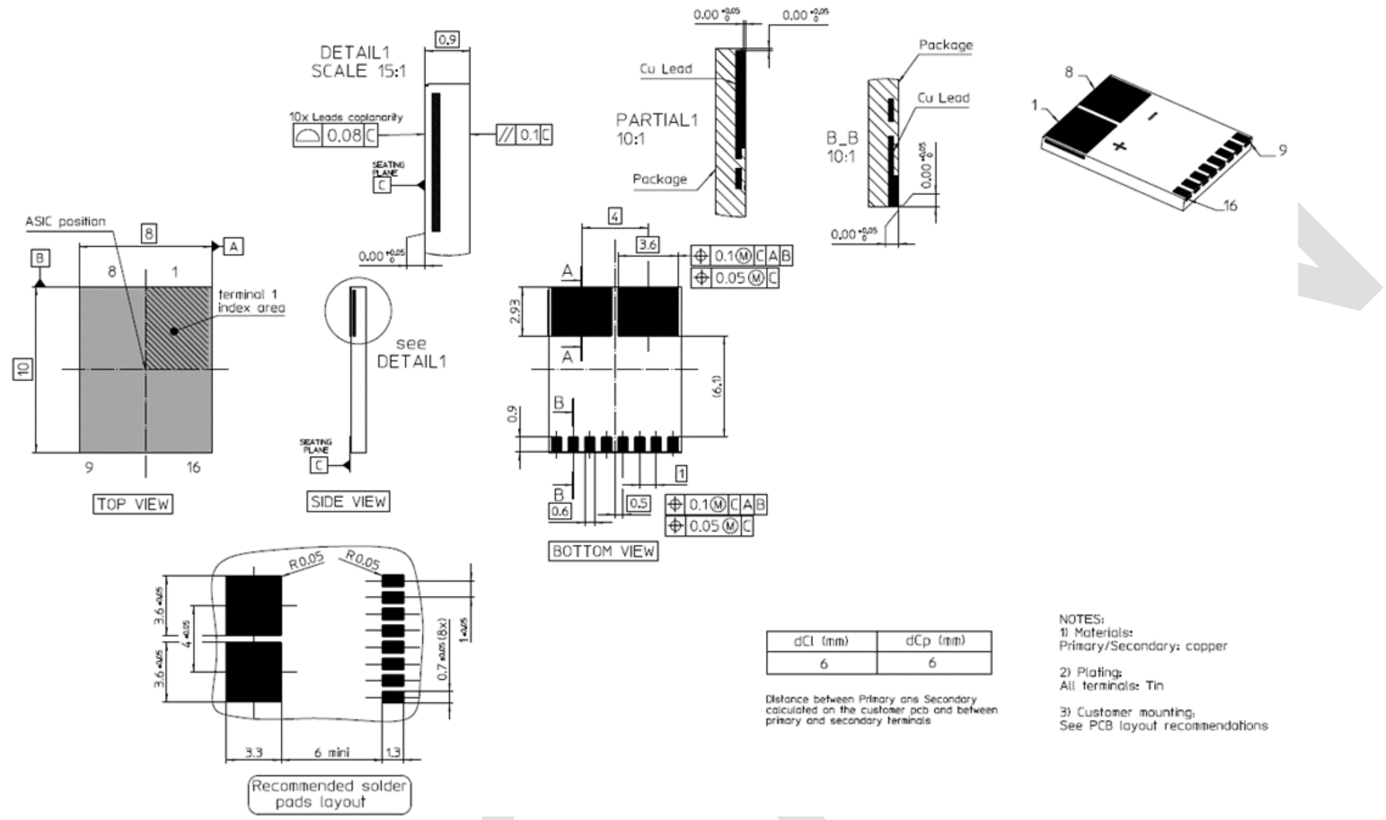
Dimensions (in mm)

GXL drawings:



Mechanical characteristics : General tolerance ±0.15 mm
Remark: $U_{out} - U_{ref}$ is positive when I_P flows in the direction of arrow (pin 1 to pin 8).

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Tape and Reel (in mm)

to be added soon

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Safety

Caution

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

This transducer must be used in limited-energy secondary circuits according to IEC 62368-1.
When operating the transducer, 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.
This transducer is a build-in device, whose hazardous live parts must be inaccessible after installation. A protective enclosure or additional shield could be used. Main supply must be able to be disconnected.

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.

ESD susceptibility

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

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Revision history

Version	Date	Description
0.1	15th of February 2024	Initial Release – target datasheet
0.4	27th of September 2024	8 products listed, performance update based on measurements, minor cosmetics improvements.

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