

# Integrated Current Transducer GO-SMS series

## Definition

The GO-SMS series is a LEM integrated current transducer solution designed to measure AC and DC currents in both industrial and automotive applications. The differential sensing technique allows the sensor to reject an external field coming from a noisy environment. Proprietary stress and temperature compensation algorithms are implemented in order to achieve very good accuracy over wide temperature range. The primary conductor (pins 1 to 8) has a very low electrical resistance of 0.75 mΩ (typical), which enables excellent performance at low power losses. The GO-SMS is capable of measuring continuous currents from 30 to 75 A over wide temperature range. Internal and external overcurrent detection circuits are implemented in order to provide fast, reliable and flexible protection solutions. The galvanic insulation between the primary and secondary eliminates the need for any additional insulation, reducing the total footprint and cost of the system.

## Main features & advantages

- Open loop multi-range current transducer: 75 A
- Low electrical resistance 0.75 mΩ
- Dual supply voltage 5 V or 3.3 V
- Dual overcurrent detection
- Low power consumption
- High bandwidth: 300 kHz
- No magnetic hysteresis
- Galvanic separation between primary and secondary with 7.4 mm of  $d_{Cl}$  and 7.4 mm of  $d_{Cp}$
- Insulated test voltage 4800 V RMS (UL 62368)
- Small footprint with standard surface mount PCB mounting
- AEC-Q-100 Grade 1.

## Typical applications

- Small drives
- HVAC inverters
- Appliances
- Solar inverters
- Automotive & Industry qualified.

## Standards

- IEC 61800-5-1: 2007
- IEC 62109-1: 2010
- IEC 62368-1:2018 (supersedes IEC 60950-1: 2005)
- UL 1577: 2014
- UL 62368: 2019.

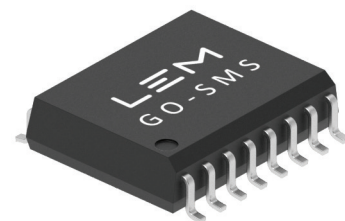


Figure 1: GO-SMS package - SOIC-16 WB  
(Not to scale - For illustration: not representative)

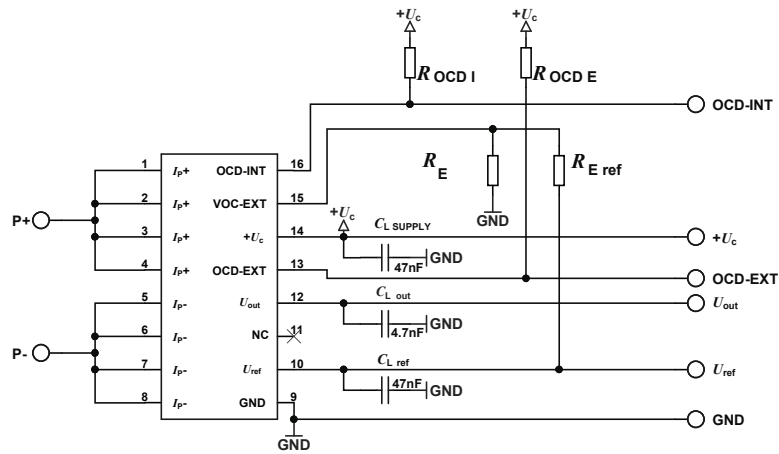


Figure 2: Application circuit

Table 1

Pin#	Name	Function
1 to 4	$I_{p+}$	Input of the primary current
5 to 8	$I_{p-}$	Output of the primary current
9	GND	Ground
10	$U_{ref}$	Reference voltage
11	NC	Not connected
12	$U_{out}$	Output voltage
13	OCD-EXT	External OCD
14	$U_C$	Supply voltage
15	$U_{EOCD}$	External OCD threshold voltage
16	OCD-INT	Internal OCD

Table 2

External circuit example#	Min	Typ	Max	Unit
$R_{E ref}$		100		kΩ
$R_E$		100		kΩ
$R_{EOCD}$		4.7	50	kΩ
$R_{IOCD}$		4.7	50	kΩ
$C_{L out}$		4.7	6	nF
$C_{L supply}$		47		nF
$C_{L ref}$		47	100	nF

**Remark:** Ideally,  $R_E + R_{E ref}$  should have a value around 200 kΩ due to current limitation on  $U_{ref}$ .

**Available products**

Product name#	Current measurement range (A max)	Nominal current (A RMS) <sup>1)</sup>	Supply voltage $U_c$	Ratiometricity	Temperature range (°C)
GO 10-SMS	±25	±10	5 V	N	-40 ... 125 °C
GO 20-SMS	±50	±20	5 V	N	
GO 30-SMS	±75	±30	5 V	N	
GO 4-SMS/SP3	±10.4	±4.17	3.3 V	N	
GO 10-SMS/SP3	±25	±10	3.3 V	N	
GO 20-SMS/SP3	±50	±20	3.3 V	N	
GO 30-SMS/SP3	±75	±30	3.3 V	N	
GO 8-SMS/SP4	±20	±8	3.3 V	Y	
GO 12-SMS/SP4	±30	±12	3.3 V	Y	

Other ratios available, contact LEM for more options (minimum quantities apply).

**Note:** <sup>1)</sup> Trimmings at LEM are done at this nominal current.

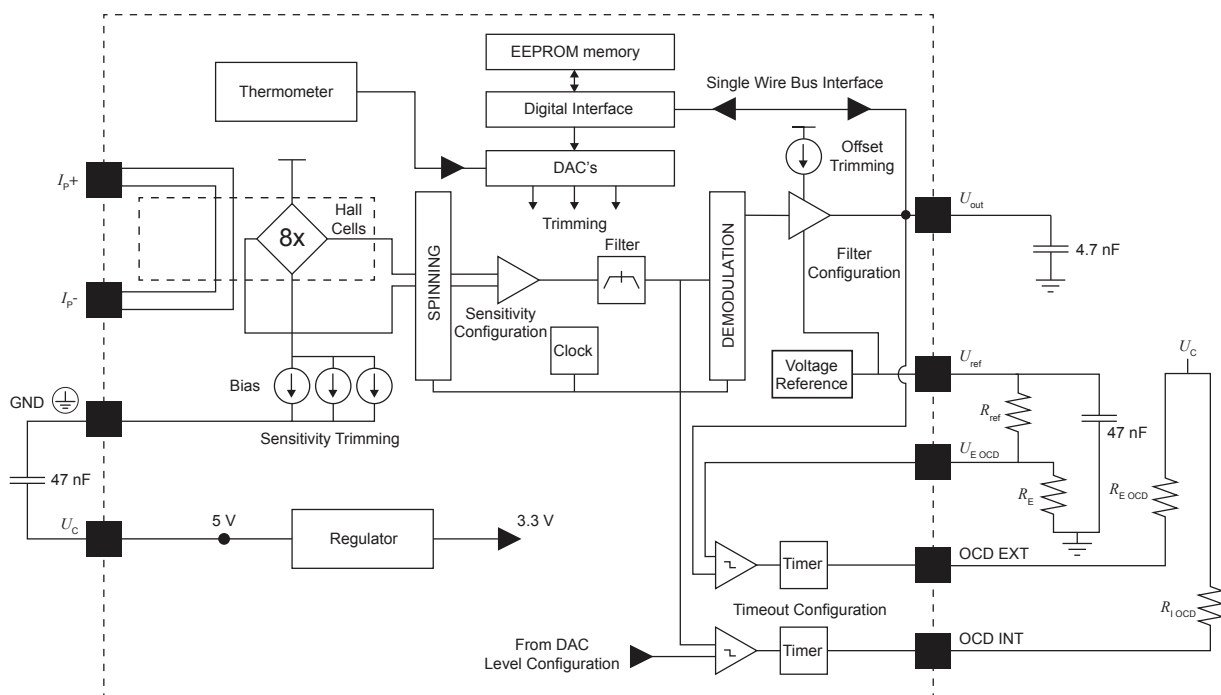
**Block diagram**


Figure 3: Block diagram GO-SMS

**Absolute maximum ratings**

Parameter	Symbol	Unit	Min	Max	Conditions
Ambient operating temperature	$T_A$	°C	-40	125	
Ambient storage temperature	$T_{A\text{st}}$	°C	-40	150	
Maximum junction temperature	$T_{J\text{max}}$	°C		165	
Output sink current		mA		50	
Output source current		mA		25	

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	Value
Maximum supply voltage (not destructive)	$U_{C\text{max}}$	V	8
Maximum supply voltage on other pins (not entering non-standard modes)			6.5
Electrostatic discharge voltage (HMB-Human Body Model)	$U_{\text{ESD HBM}}$	kV	2
Electrostatic discharge voltage (CDM-Charged Device Model)	$U_{\text{ESD CDM}}$	V	500
Thermal resistance junction to board <sup>1)</sup>	$R_{\text{th JB}}$	K/W	9
Time constant (to reach steady state)	$t$	s	1
Mass	$m$	g	0.4

Note: <sup>1)</sup> Done with LEM evaluation board PCB 2325 described on later paragraph.

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC insulation test, 50 Hz, 1 min	$U_d$	kV	4.8 <sup>1)</sup>	According to IEC 62368-1
RMS voltage for AC insulation test, 60 Hz, 1 min	$U_d$	kV	4.8	According to UL 62368-1 & UL 1577
RMS voltage for AC insulation test, 50 Hz, 1 min	$U_d$	kV	4.1 <sup>1)</sup>	According to IEC 62368-1 after 2000 thermal cycles
Impulse withstand voltage 1.2/50 $\mu$ s	$U_{Ni}$	kV	7.6	According to IEC 62109-1, IEC 61800-5-1
Partial discharge test recurring peak voltage	$U_{PD}$	V	660.2	According to IEC 62109-1, IEC 61800-5-1
Partial discharge test inception RMS voltage <sup>2)</sup>	$U_i$	V	1238	According to IEC 62109-1, IEC 61800-5-1
Partial discharge test extinction RMS voltage		V	990	According to IEC 62109-1, IEC 61800-5-1
Clearance (pri. - sec.)	$d_{Cl}$	mm	7.4	Shortest distance through air
Creepage distance (pri. - sec.)	$d_{Cp}$		7.4	Shortest path along body
Comparative tracking index	$CTI$		600	

Notes: <sup>1)</sup> Tested at 3.1 kV in production.

$$^2) U_i = U_{PD} \cdot 1.875$$

### Working voltage according to IEC 62368-1

Working voltages		PD 2	Standards
Basic insulation	RMS voltage	1476 V	According to IEC 62368-1 (replacing IEC 60950-1)
	Peak or DC voltage	2088 V	
Reinforced insulation	RMS voltage	736 V	
	Peak or DC voltage	1041 V	

### Rated insulation voltage according to IEC 61800-5-1 / IEC 62109-1

Rated insulation voltage		OV II / PD 2	OV III / PD 2	Standards
Basic insulation	RMS voltage	1395 / < 1000	600 / 600	According to IEC 61800-5-1 and IEC 62109-1
	Peak or DC voltage	NA/ 1500	NA/ 849	
Reinforced insulation	RMS voltage	600 / 600	300 / 300	
	Peak or DC voltage	NA/ 849	NA/ 424	

### UL 62368-1 Audio/Video, information and communication technology equipment - Component

File # E521147, Vol 1

Audio/Video, Information and Communication Technology Equipment - component, 4800 V AC Insulation

#### Standard

- UL 62368-1, Audio/video, information and communication technology equipment.

#### 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.

**UL 1577 Non Optical isolating devices - Component**

File # E486776, Vol 1

Single protection, non-optical isolators, 2500 V AC insulation

**Standards**

- UL 1577, Optical Isolators;
- CSA Component Acceptance Service Notice N°. 5 A, Component Acceptance Service for Optocouplers and Related Devices.

**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.

**Common electrical data (independent of sensitivity)**

At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$  or  $+3.3\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted  
(see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
DC supply voltage	$U_C$	V	4.5	5	5.5	Standard
DC supply voltage			3.14	3.3	3.47	SP3 & SP4 versions
Output voltage range @ $I_{PM}$	$U_{out} - U_{ref}$	V	-2		2	$U_C = 5\text{ V}$
			-1.25		1.25	$U_C = 3.3\text{ V}$
Output internal resistance of $U_{out}$	$R_{out}$	$\Omega$		1	5	Up to 10 kHz
Primary resistance @ $T_A = 25\text{ °C}$	$R_P$	m $\Omega$		0.75		
Internal series resistance of reference voltage source	$R_{ref}$	$\Omega$	120	200	333	
Maximum output current source of $U_{out}$		mA	25			Up to 10 kHz
Maximum input current sink of $U_{out}$		mA	20			Up to 10 kHz
Output leakage current		$\mu\text{A}$		2	20	
Maximum output current source of $U_{ref}$		mA		0.5		
Maximum input current sink of $U_{ref}$		mA		0.5		
Load capacitance on $U_{out}$	$C_L$	nF	0	4.7	6	
Load capacitance on $U_{ref}$			0	47	100	
DC current consumption	$I_C$	mA		20	26	$U_C = 5\text{ V}$
				20	26	$U_C = 3.3\text{ V}$
Electrical offset voltage	$U_{OE}$	mV	-5		5	$U_{out} - U_{ref}$ @ $U_{ref} = 2.5\text{ V}$
Temperature coefficient of $U_{ref}$	$TCU_{ref}$	ppm/K	-170		170	-40 °C... +125 °C
Temperature coefficient of $U_{OE}$	$TCU_{OE}$	mV/K	-0.075		0.075	-40 °C... +125 °C
Delay time to 10 % of the final output value for $I_{PN}$ step	$t_{D10}$	$\mu\text{s}$			1.5	
Delay time to 90 % of the final output value for $I_{PN}$ step	$t_{D90}$	$\mu\text{s}$			2	
Frequency bandwidth -3 dB, $T_A = 25\text{ °C}$	$BW$	kHz		300		

**Electrical data GO 10-SMS**

At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted  
(see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
Primary nominal RMS current	$I_{PN}$	A		10		
Primary current, measuring range	$I_{PM}$	A	-25		25	
Internal reference voltage @ $I_{PN} = 0$	$U_{Iref}$	V	2.48	2.5	2.52	
Nominal sensitivity	$S_N$	mV/A		80		800 mV @ $I_{PN}$
Temperature coefficient of $S$	$TCS$	ppm/K	-150		150	-40 °C ... 125 °C
Electrical offset current referred to $I_{PN}$	$I_{OE}$	mA	-62.5		62.5	
Temperature coefficient of $I_{OE}$	$TCI_{OE}$	mA/K	-0.94		0.94	-40 °C ... 125 °C
Lifetime offset drift		mV		$\pm 2$		
Noise voltage spectral density	$u_{no}$	$\frac{\mu V}{\sqrt{Hz}}$		13.5		100 Hz ... 100 kHz
Sensitivity error	$\varepsilon_S$	%	-1		1	
Lifetime sensitivity error		% $S$		$\pm 1$	$\pm 2$	
Linearity error 0 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.3		0.3	Referred to $I_{PN}$
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.6		0.6	Referred to $I_{PM}$
Sum of sensitivity and linearity @ $I_{PN}$ , @ $T_A = 25\text{ °C}$	$\varepsilon_{SL25}$	% of $I_{PM}$	-0.7		0.7	
Total error over temperature	$\varepsilon_{tot}$	% of $I_{PM}$	-1		1	

**Electrical data GO 20-SMS**

At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted  
(see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
Primary nominal RMS current	$I_{PN}$	A		20		
Primary current, measuring range	$I_{PM}$	A	-50		50	
Internal reference voltage @ $I_{PN} = 0$	$U_{Iref}$	V	2.48	2.5	2.52	
Nominal sensitivity	$S_N$	mV/A		40		800 mV @ $I_{PN}$
Temperature coefficient of $S$	$TCS$	ppm/K	-150		150	-40 °C ... 125 °C
Electrical offset current referred to $I_{PN}$	$I_{OE}$	mA	-125		125	
Temperature coefficient of $I_{OE}$	$TCI_{OE}$	mA/K	-1.88		1.88	-40 °C ... 125 °C
Lifetime offset drift		mV		$\pm 1$	$\pm 2$	
Noise voltage spectral density	$u_{no}$	$\frac{\mu V}{\sqrt{Hz}}$		7		100 Hz ... 100 kHz
Sensitivity error	$\varepsilon_S$	%	-1		1	
Lifetime sensitivity error		% $S$		$\pm 2$		
Linearity error 0 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.3		0.3	Referred to $I_{PN}$
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.6		0.6	Referred to $I_{PM}$
Sum of sensitivity and linearity @ $I_{PN}$ , @ $T_A = 25\text{ °C}$	$\varepsilon_{SL25}$	% of $I_{PM}$	-0.7		0.7	
Total error over temperature	$\varepsilon_{tot}$	% of $I_{PM}$	-1		1	



**Electrical data GO 30-SMS**

At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted  
(see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
Primary nominal RMS current	$I_{PN}$	A		30		
Primary current, measuring range	$I_{PM}$	A	-75		75	
Internal reference voltage @ $I_{PN} = 0$	$U_{Iref}$	V	2.48	2.5	2.52	
Nominal sensitivity	$S_N$	mV/A		26.67		800 mV @ $I_{PN}$
Temperature coefficient of $S$	$TCS$	ppm/K	-150		150	-40 °C ... 125 °C
Electrical offset current referred to $I_{PN}$	$I_{OE}$	mA	-187		187	
Temperature coefficient of $I_{OE}$	$TCI_{OE}$	mA/K	-2.81		2.81	-40 °C ... 125 °C
Lifetime offset drift		mV		±1	±2	
Noise voltage spectral density	$u_{no}$	$\frac{\mu V}{\sqrt{Hz}}$		5		100 Hz ... 100 kHz
Sensitivity error	$\varepsilon_S$	%	-1		1	
Lifetime sensitivity error		% $S$		±1	±2	
Linearity error 0 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.3		0.3	Referred to $I_{PN}$
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.6		0.6	Referred to $I_{PM}$
Sum of sensitivity and linearity @ $I_{PN}$ , @ $T_A = 25\text{ °C}$	$\varepsilon_{SL25}$	% of $I_{PM}$	-0.7		0.7	
Total error over temperature	$\varepsilon_{tot}$	% of $I_{PM}$	-1		1	

**Electrical data GO 4-SMS/SP3**

At  $T_A = 25\text{ °C}$ ,  $U_C = +3.3\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted  
(see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
Primary nominal RMS current	$I_{PN}$	A		4.17		
Primary current, measuring range	$I_{PM}$	A	-10.4		10.4	
Internal reference voltage @ $I_{PN} = 0$	$U_{Iref}$	V	1.63	1.65	1.67	
Nominal sensitivity	$S_N$	mV/A		120		500 mV @ $I_{PN}$
Temperature coefficient of $S$	$TCS$	ppm/K	-200		200	-40 °C ... 125 °C
Electrical offset current referred to $I_{PN}$	$I_{OE}$	mA	-41.7		41.7	
Temperature coefficient of $I_{OE}$	$TCl_{OE}$	mA/K	-0.625		0.625	-40 °C ... 125 °C
Lifetime offset drift		mV		±2		
Noise voltage spectral density	$u_{no}$	$\frac{\mu V}{\sqrt{Hz}}$		14		100 Hz ... 100 kHz
Sensitivity error	$\varepsilon_S$	%	-1		1	
Lifetime sensitivity error		% $S$		±1	±2	
Linearity error 0 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.3		0.3	Referred to $I_{PN}$
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.6		0.6	Referred to $I_{PM}$
Sum of sensitivity and linearity @ $I_{PN}$ , @ $T_A = 25\text{ °C}$	$\varepsilon_{SL25}$	% of $I_{PM}$	-0.7		0.7	
Total error over temperature	$\varepsilon_{tot}$	% of $I_{PM}$	-1.2		1.2	

**Electrical data GO 10-SMS/SP3**

At  $T_A = 25\text{ °C}$ ,  $U_C = +3.3\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted  
(see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
Primary nominal RMS current	$I_{PN}$	A		10		
Primary current, measuring range	$I_{PM}$	A	-25		25	
Internal reference voltage @ $I_{PN} = 0$	$U_{Iref}$	V	1.63	1.65	1.67	
Nominal sensitivity	$S_N$	mV/A		50		500 mV @ $I_{PN}$
Temperature coefficient of $S$	$TCS$	ppm/K	-150		150	-40 °C ... 125 °C
Electrical offset current referred to $I_{PN}$	$I_{OE}$	mA	-100		100	
Temperature coefficient of $I_{OE}$	$TCl_{OE}$	mA/K	-1.5		1.5	-40 °C ... 125 °C
Lifetime offset drift		mV		±2		
Noise voltage spectral density	$u_{no}$	$\frac{\mu V}{\sqrt{Hz}}$		8		100 Hz ... 100 kHz
Sensitivity error	$\varepsilon_S$	%	-1		1	
Lifetime sensitivity error		% $S$		±1	±2	
Linearity error 0 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.3		0.3	Referred to $I_{PN}$
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.6		0.6	Referred to $I_{PM}$
Sum of sensitivity and linearity @ $I_{PN}$ , @ $T_A = 25\text{ °C}$	$\varepsilon_{SL25}$	% of $I_{PM}$	-0.7		0.7	
Total error over temperature	$\varepsilon_{tot}$	% of $I_{PM}$	-1		1	

**Electrical data GO 20-SMS/SP3**

At  $T_A = 25\text{ °C}$ ,  $U_C = +3.3\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted  
(see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
Primary nominal RMS current	$I_{PN}$	A		20		
Primary current, measuring range	$I_{PM}$	A	-50		50	
Internal reference voltage @ $I_{PN} = 0$	$U_{Iref}$	V	1.63	1.65	1.67	
Nominal sensitivity	$S_N$	mV/A		25		500 mV @ $I_{PN}$
Temperature coefficient of $S$	$TCS$	ppm/K	-150		150	-40 °C ... 125 °C
Electrical offset current referred to $I_{PN}$	$I_{OE}$	mA	-200		200	
Temperature coefficient of $I_{OE}$	$TCI_{OE}$	mA/K	-3		3	-40 °C ... 125 °C
Lifetime offset drift		mV		$\pm 2$		
Noise voltage spectral density	$u_{no}$	$\frac{\mu V}{\sqrt{Hz}}$		4.5		100 Hz ... 100 kHz
Sensitivity error	$\varepsilon_S$	%	-1		1	
Lifetime sensitivity error		% $S$		$\pm 1$	$\pm 2$	
Linearity error 0 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.3		0.3	Referred to $I_{PN}$
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.6		0.6	Referred to $I_{PM}$
Sum of sensitivity and linearity @ $I_{PN}$ , @ $T_A = 25\text{ °C}$	$\varepsilon_{SL25}$	% of $I_{PM}$	-0.7		0.7	
Total error over temperature	$\varepsilon_{tot}$	% of $I_{PM}$	-1.1	0.5	1.1	

**Electrical data GO 30-SMS/SP3**

At  $T_A = 25\text{ °C}$ ,  $U_C = +3.3\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted  
(see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
Primary nominal RMS current	$I_{PN}$	A		30		
Primary current, measuring range	$I_{PM}$	A	-75		75	
Internal reference voltage @ $I_{PN} = 0$	$U_{Iref}$	V	1.63	1.65	1.67	
Nominal sensitivity	$S_N$	mV/A		16.67		500 mV @ $I_{PN}$
Temperature coefficient of $S$	$TCS$	ppm/K	-150		150	-40 °C ... 125 °C
Electrical offset current referred to $I_{PN}$	$I_{OE}$	mA	-300		300	
Temperature coefficient of $I_{OE}$	$TCI_{OE}$	mA/K	-4.5		4.5	-40 °C ... 125 °C
Lifetime offset drift		mV		$\pm 2$		
Noise voltage spectral density	$u_{no}$	$\frac{\mu V}{\sqrt{Hz}}$		4		100 Hz ... 100 kHz
Sensitivity error	$\varepsilon_S$	%	-1		1	
Lifetime sensitivity error		% $S$		$\pm 1$	$\pm 2$	
Linearity error 0 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.3		0.3	Referred to $I_{PN}$
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.6		0.6	Referred to $I_{PM}$
Sum of sensitivity and linearity @ $I_{PN}$ , @ $T_A = 25\text{ °C}$	$\varepsilon_{SL25}$	% of $I_{PM}$	-0.7		0.7	
Total error over temperature	$\varepsilon_{tot}$	% of $I_{PM}$	-1.1	0.5	1.1	

**Electrical data GO 8-SMS/SP4**

At  $T_A = 25\text{ °C}$ ,  $U_C = +3.3\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted (see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
Primary nominal RMS current	$I_{PN}$	A		8		
Primary current, measuring range	$I_{PM}$	A	-20		20	
Internal reference voltage @ $I_{PN} = 0$	$U_{Iref}$	V	1.63	1.65	1.67	
Nominal sensitivity	$S_N$	mV/A		62.5		500 mV @ $I_{PN}$
Temperature coefficient of $S$	$TCS$	ppm/K	-230		230	-40 °C ... 125 °C, including ratiometricity error
Electrical offset current referred to $I_{PN}$	$I_{OE}$	mA	-80		80	
Temperature coefficient of $I_{OE}$	$TCI_{OE}$	mA/K	-1.2		1.2	-40 °C ... 125 °C
Lifetime offset drift		mV		$\pm 2$		
Noise voltage spectral density	$u_{no}$	$\frac{\mu V}{\sqrt{Hz}}$		10		100 Hz ... 100 kHz
Sensitivity error	$\varepsilon_S$	%	-1		1	
Ratiometricity error	$\varepsilon_r$	%		$\pm 0.5$		
Lifetime sensitivity error		% $S$		$\pm 1$	$\pm 2$	
Ratiometricity offset error	$\varepsilon_{rO}$	mV	-10		10	$U_C = 3.3\text{ V} \pm 10\%$
Linearity error 0 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.3		0.3	Referred to $I_{PN}$
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.6		0.6	Referred to $I_{PM}$
Sum of sensitivity and linearity @ $I_{PN}$ , @ $T_A = 25\text{ °C}$	$\varepsilon_{SL25}$	% of $I_{PM}$	-0.7		0.7	
Total error over temperature	$\varepsilon_{tot}$	% of $I_{PM}$	-1.2	0.5	1.2	-40 °C ... 125 °C

**Electrical data GO 12-SMS/SP4**

At  $T_A = 25\text{ °C}$ ,  $U_C = +3.3\text{ V}$ ,  $R_L = 100\text{ k}\Omega$  unless otherwise noted (see Definition of typical, minimum and maximum values paragraph in [page 14](#)).

Parameter	Symbol	Unit	Min	Typ	Max	Conditions
Primary nominal RMS current	$I_{PN}$	A		12		
Primary current, measuring range	$I_{PM}$	A	-30		30	
Internal reference voltage @ $I_{PN} = 0$	$U_{Iref}$	V	1.63	1.65	1.67	
Nominal sensitivity	$S_N$	mV/A		41.67		500 mV @ $I_{PN}$
Temperature coefficient of $S$	$TCS$	ppm/K	-230		230	-40 °C ... 125 °C, including ratiometricity error
Electrical offset current referred to $I_{PN}$	$I_{OE}$	mA	-120		120	
Temperature coefficient of $I_{OE}$	$TCI_{OE}$	mA/K	-1.8		1.8	-40 °C ... 125 °C
Lifetime offset drift		mV		$\pm 2$		
Noise voltage spectral density	$u_{no}$	$\frac{\mu V}{\sqrt{Hz}}$		7		100 Hz ... 100 kHz
Sensitivity error	$\varepsilon_S$	%	-1		1	
Ratiometricity error	$\varepsilon_r$	%		$\pm 0.5$		
Ratiometricity offset error	$\varepsilon_{rO}$	mV	-10		10	$U_C = 3.3\text{ V} \pm 10\%$
Lifetime sensitivity error		% $S$		$\pm 1$	$\pm 2$	
Linearity error 0 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.3		0.3	Referred to $I_{PN}$
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.6		0.6	Referred to $I_{PM}$
Sum of sensitivity and linearity @ $I_{PN}$ , @ $T_A = 25\text{ °C}$	$\varepsilon_{SL25}$	% of $I_{PM}$	-0.7		0.7	
Total error over temperature	$\varepsilon_{tot}$	% of $I_{PM}$	-1.2	0.5	1.2	

**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.

**Overcurrent detection (OCD)**

Overcurrent detection is a feature included on GO product in order to detect high peaks of currents happening during operation. Two overcurrent detections types are included in this product: Internal OCD and External OCD:

**Internal OCD**

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Internal OCD detection threshold	$I_{I\text{OCD Th}}$	A		$2.77 \times \pm I_{PN}$		Standards series
Internal OCD detection threshold	$I_{I\text{OCD Th}}$	A		$2.85 \times \pm I_{PN}$		SP3 and SP4 series with $I_{PN} \geq 10\text{ A}$
Internal OCD detection threshold	$I_{I\text{OCD Th}}$	A		$2.51 \times \pm I_{PN}$		SP3 and SP4 series with $I_{PN} < 10\text{ A}$
Internal OCD threshold error	$\varepsilon_{I\text{OCD Th}}$	%		$\pm 8$		Referred to $I_{PN}$
Internal OCD output on resistance	$R_{\text{on}I\text{OCD}}$	$\Omega$	70	95	100	Open drain output, active low
Internal OCD output hold time	$t_{\text{hold}I\text{OCD}}$	$\mu\text{s}$		10		
Internal OCD delay time	$t_{D I\text{OCD}}$	$\mu\text{s}$	1.3		2.1	

**External OCD**

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
External OCD detection threshold	$U_{E\text{OCD Th}}$	V	$\pm 0.3$		$\pm 2.5$	
External OCD threshold error	$\varepsilon_{E\text{OCD Th}}$	%		$\pm 5$		Referred to $I_{PN}$
External OCD output on resistance	$R_{\text{on}E\text{OCD}}$	$\Omega$	35	200	300	Open drain output, active low
External OCD output hold time	$t_{\text{hold}E\text{OCD}}$	$\mu\text{s}$		10		
External OCD delay time	$t_{D E\text{OCD}}$	$\mu\text{s}$		10		

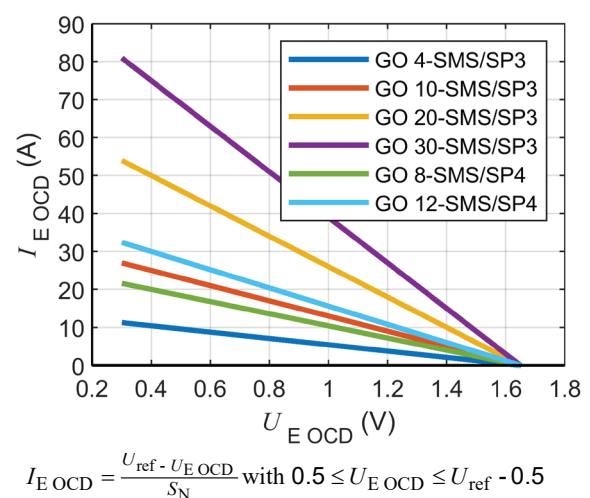
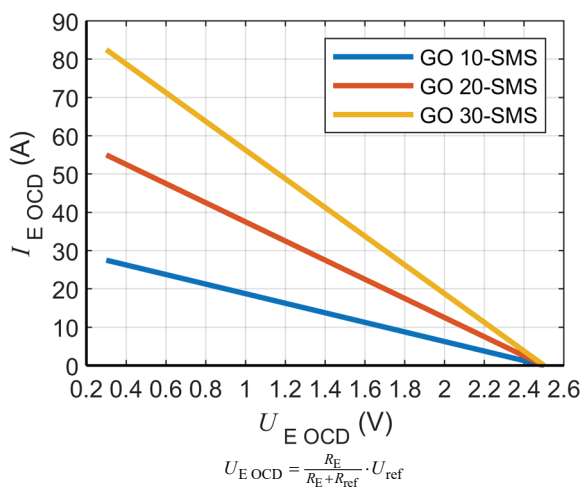
 **$I_{E\text{OCD Th}}$ : External OCD detection threshold at  $U_{\text{ref}} = 2.5\text{ V}$  &  $1.65\text{ V}$** 


Figure 4 and 5: OCD level

Internal OCD behavior

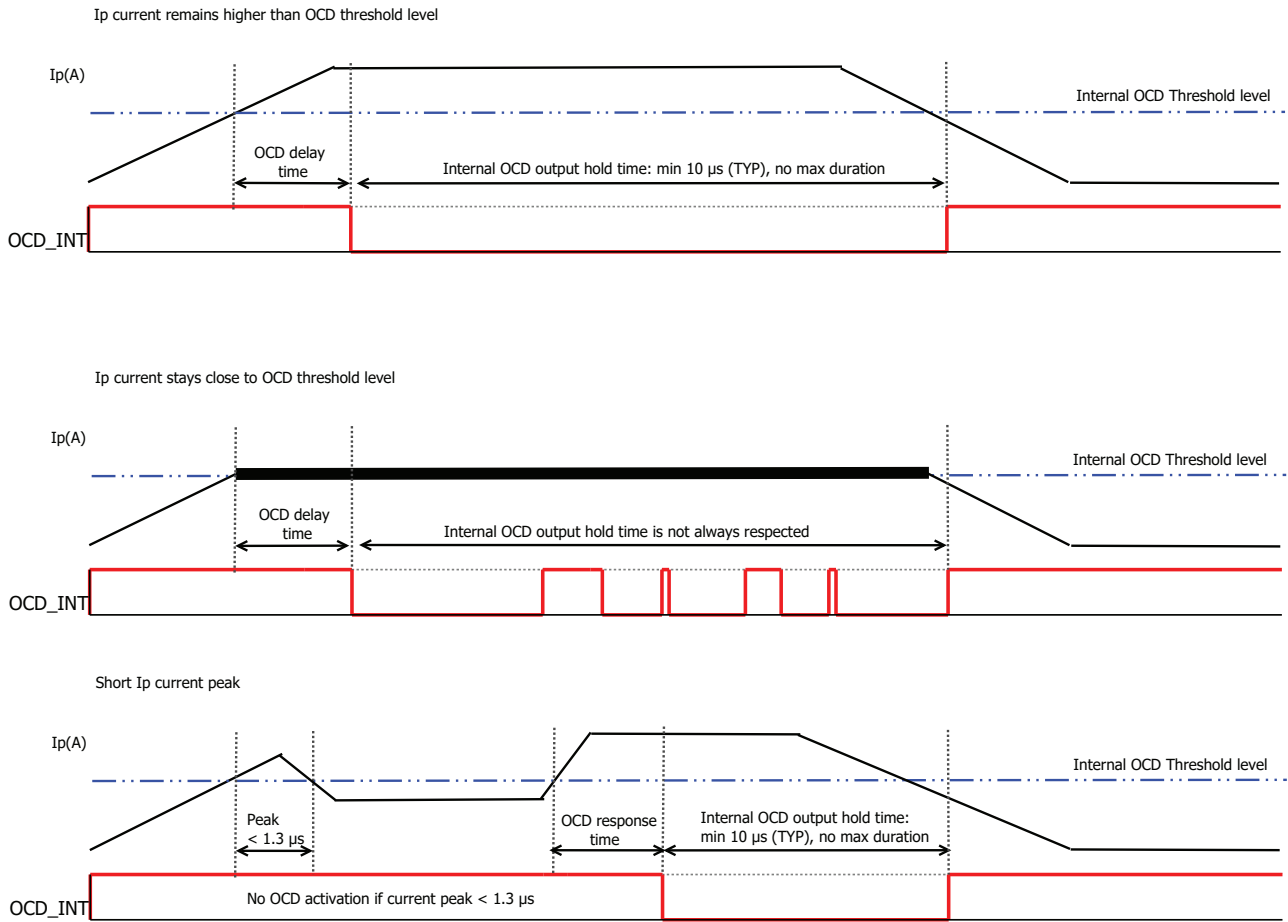


Figure 6: Internal OCD behavior



External OCD behavior

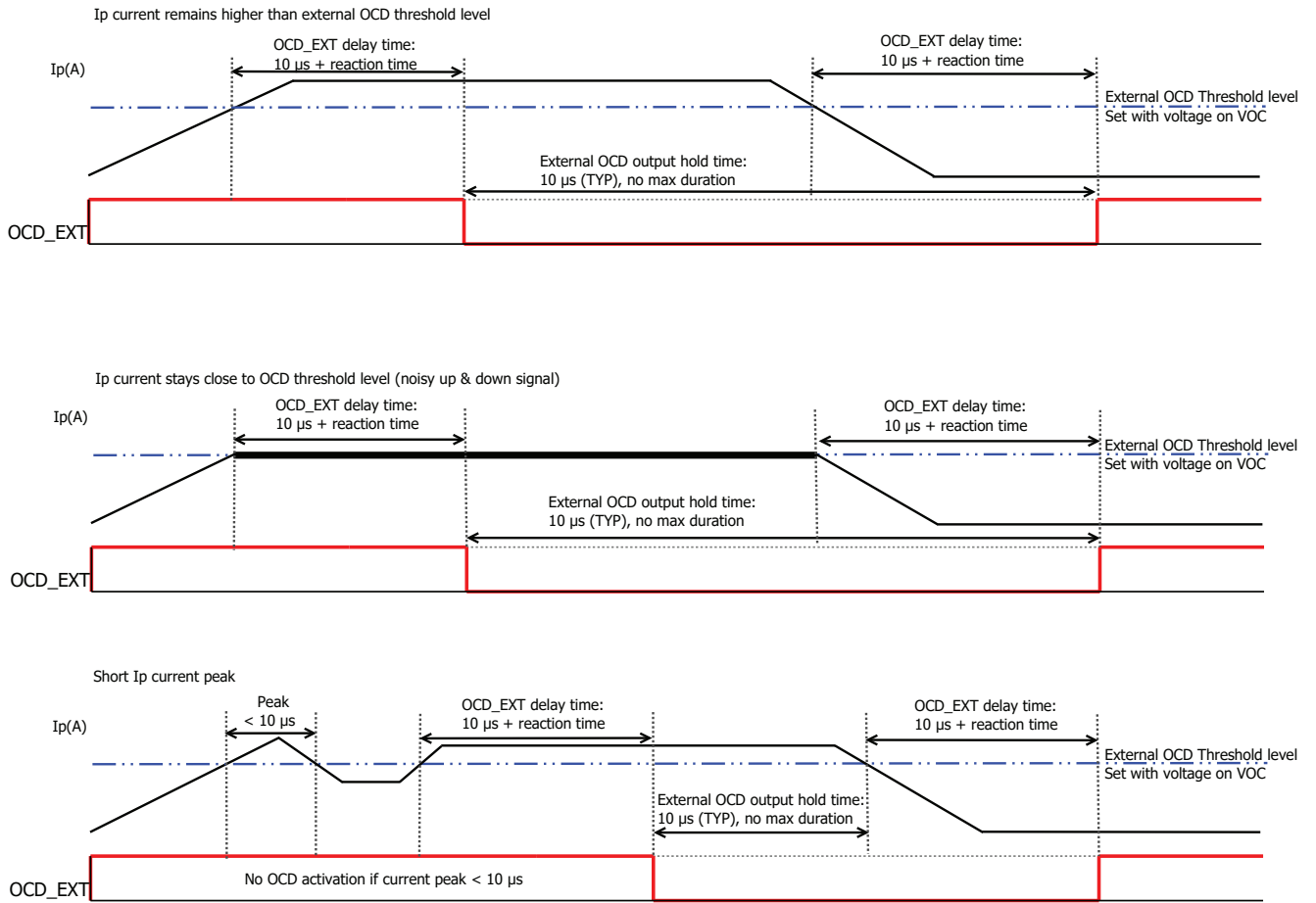


Figure 7: External OCD behaviour

**Thermal characteristics**

When designing a system containing a current transducer, 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 performance. 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 GO-SMS transducer when used on an evaluation LEM board described on later paragraph.

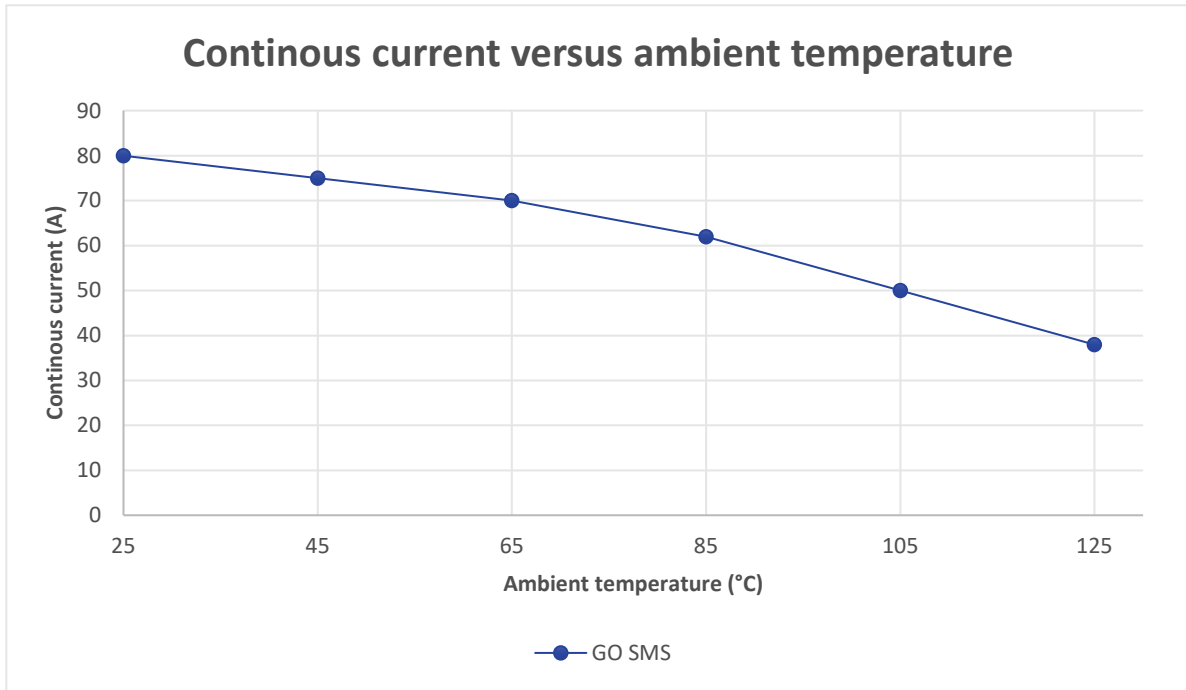


Figure 8: Continuous current vs temperature

The graph shows the mechanical capability of the GO-SMS package. The maximum current measurement range of the product is limited at 75 A. The maximum temperature should be evaluated on the final system where the current sensor is integrated into the real application. This temperature should never exceed the maximum junction temperature as shown on the previous paragraphs.

Sensitivity error

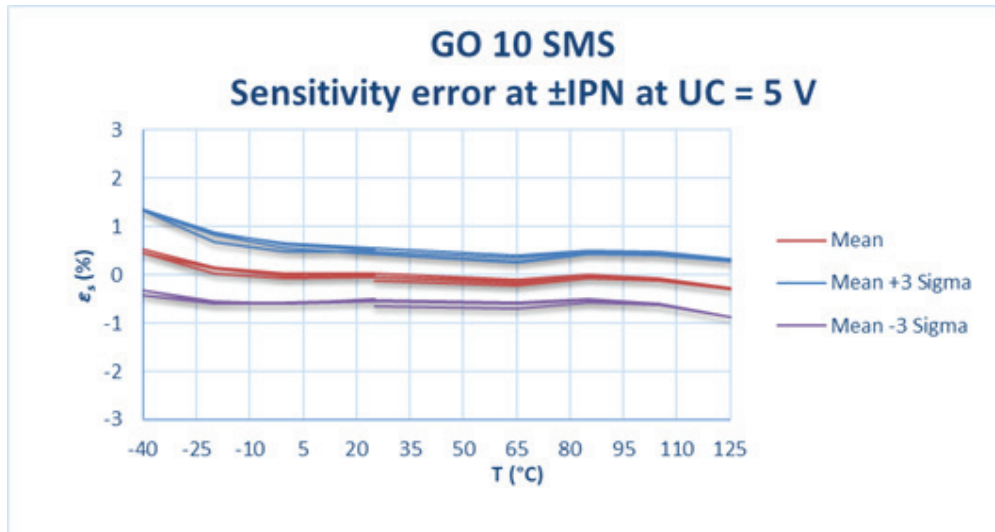


Figure 9: Sensitivity error

Total error

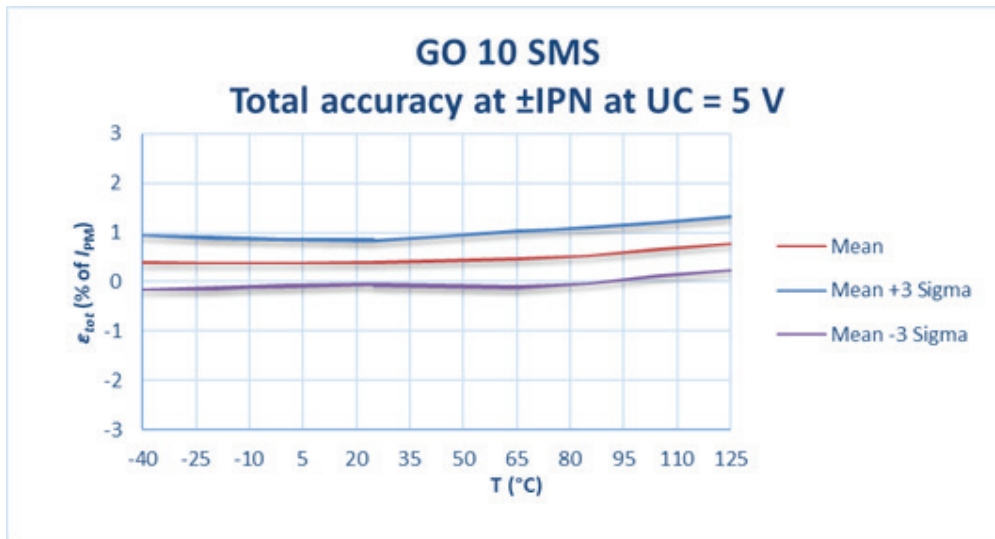


Figure 10: Total error over temperature

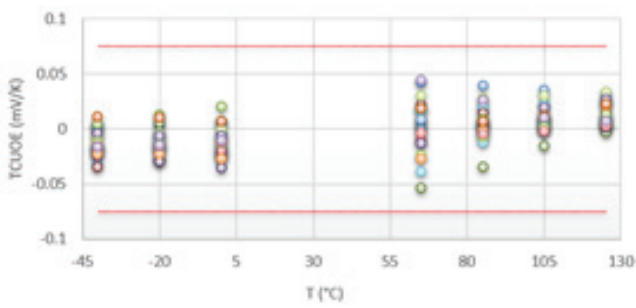
**Delay time**

Typical results measured on GO 10-SMS @  $I_{PN}$

Ambient temperature (°C)	Delay time @ 10 %	Limit	Delay time @ 90 %	Limit
25	1.46	1.50	1.36	2.00
120	1.19	1.50	1.36	2.00
-40	1.42	1.50	1.35	2.00

**Drifts over temperature (GO 10-SMS)**

**Voltage offset drift over temperature**



**Sensitivity drift over temperature**

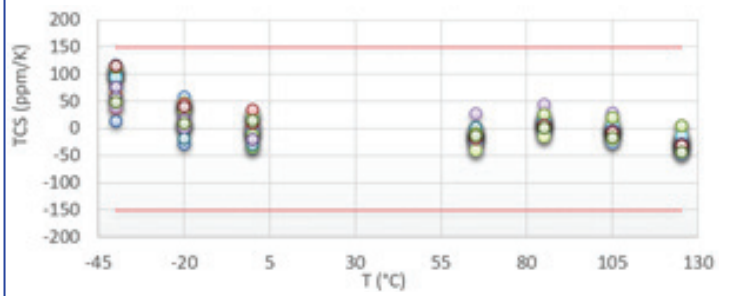


Figure 11: Drifts over temperature

**Evaluation board PCB 2325**

All the above results are based on a LEM evaluation board.  
 This evaluation board is available at our distributors or direct sales (please contact us).

**Description:**

Evaluation board is based on 6 x 105 µm (3oz) copper layers.  
 6 x 500 sq.mm copper stitched on primary side.  
 This layout improves thermal performances of the transducer.

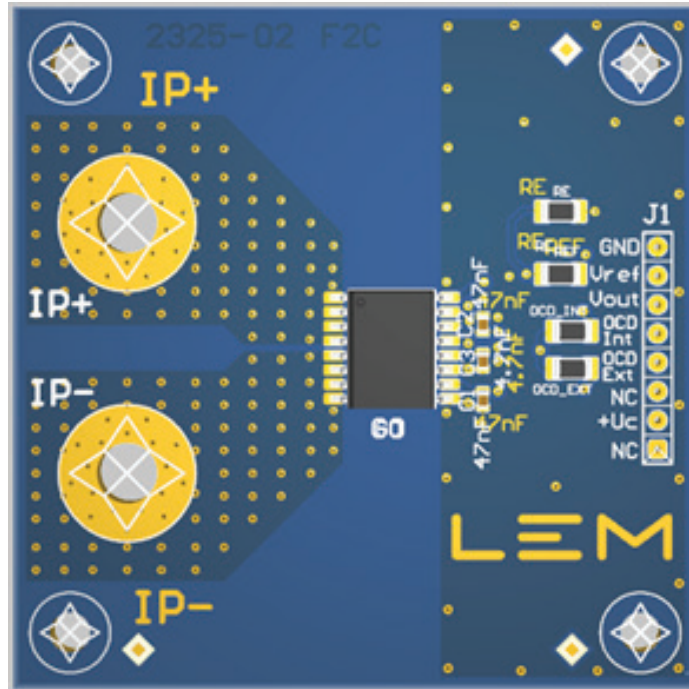


Figure 12: GO-SMS Evaluation board

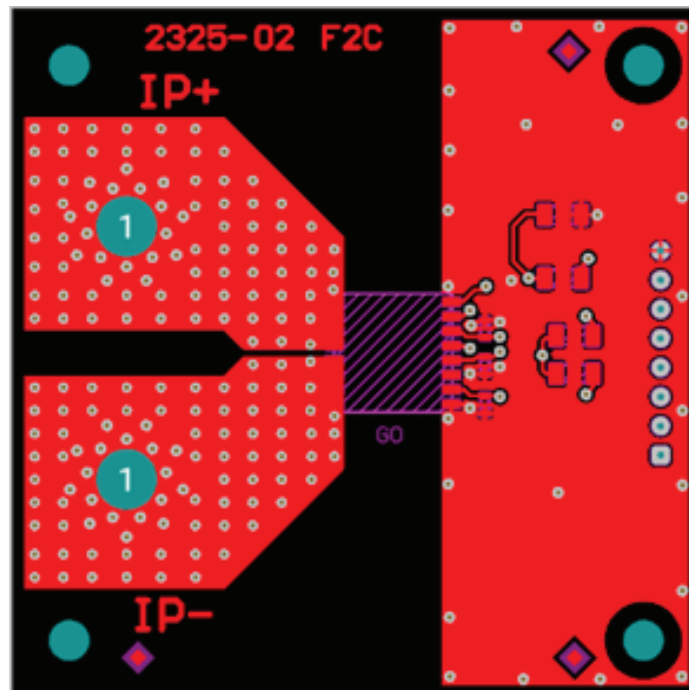


Figure 13: GO-SMS Evaluation board layout

Contact LEM for more information about the evaluation board: <https://www.lem.com/en/go-series>

## Terms and definitions

### Total error referred to primary

The total error  $\epsilon_{tot}$  is the error at  $\pm I_{PN}$ , relative to the rated value  $I_{PN}$ .

It includes all errors mentioned above

- the electrical offset  $I_{OE}$
- the magnetic offset  $I_{OM}$
- the sensitivity error  $\epsilon_S$
- the linearity error  $\epsilon_L$  (to  $I_{PN}$ ).

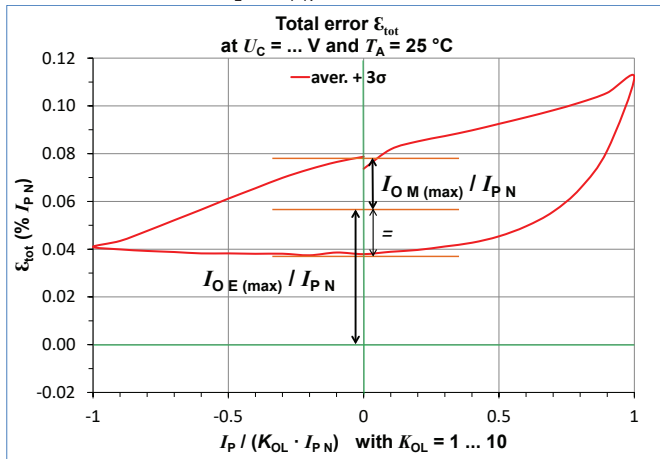


Figure 14: Total error  $\epsilon_{tot}$

### Electrical offset referred to primary

Using the current cycle shown in figure 14, 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 ferromagnetic parts). 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

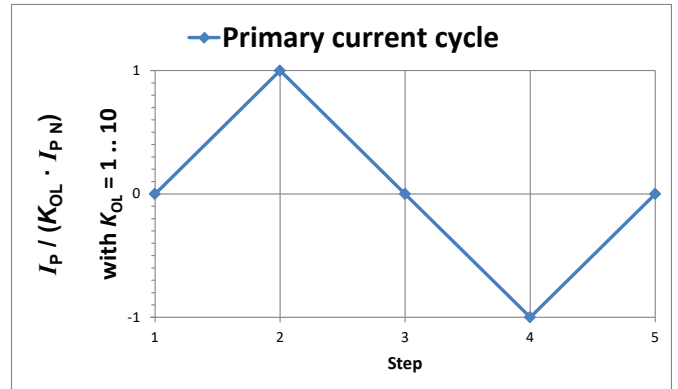


Figure 15: Current cycle used to measure magnetic and electrical offset (transducer supplied)

### 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  $I_p/10$  steps). The sensitivity  $S$  is defined as the slope of the linear regression line for a cycle between  $\pm I_{PN}$ .

The linearity error  $\epsilon_L$  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  $t_{D10}$  @ 10 % and the delay time  $t_{D90}$  @ 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.

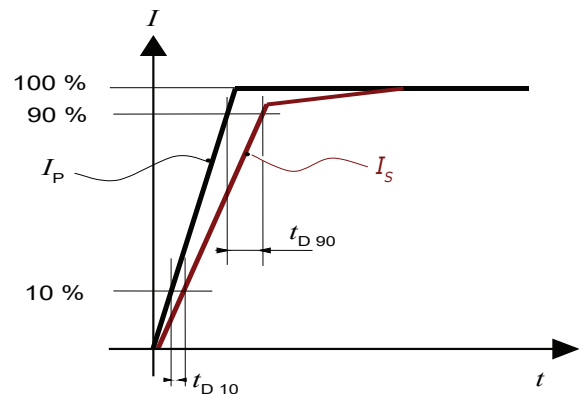
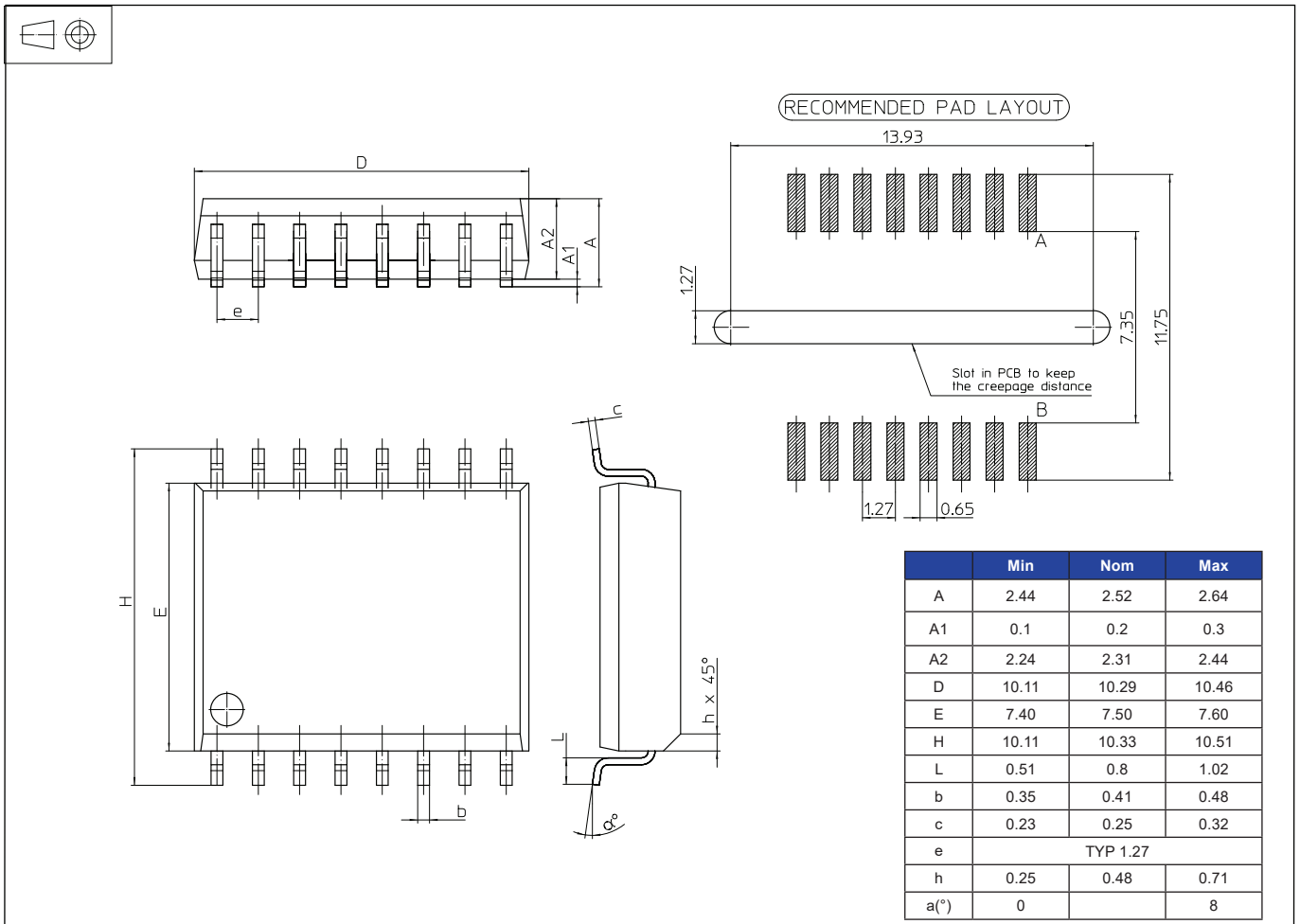


Figure 16:  $t_{D10}$  (delay time @ 10 %) and  $t_{D90}$  (delay time @ 90 %).

PCB footprint & dimensions (in mm)



Mechanical characteristic: General tolerance  $\pm 0.15$  mm

Remark:  $U_{out} - U_{ref}$  is positive when  $I_p$  flows in the direction of arrow (pin 1-4 to pin 5-8).

## Soldering on PCB

### Soldering remarks:

- GO-SMS is qualified MSL3 for storage and mounting purposes.
- Per JEDEC J-STD-020 for packages less than 2.5 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.



Leader & Trailer:

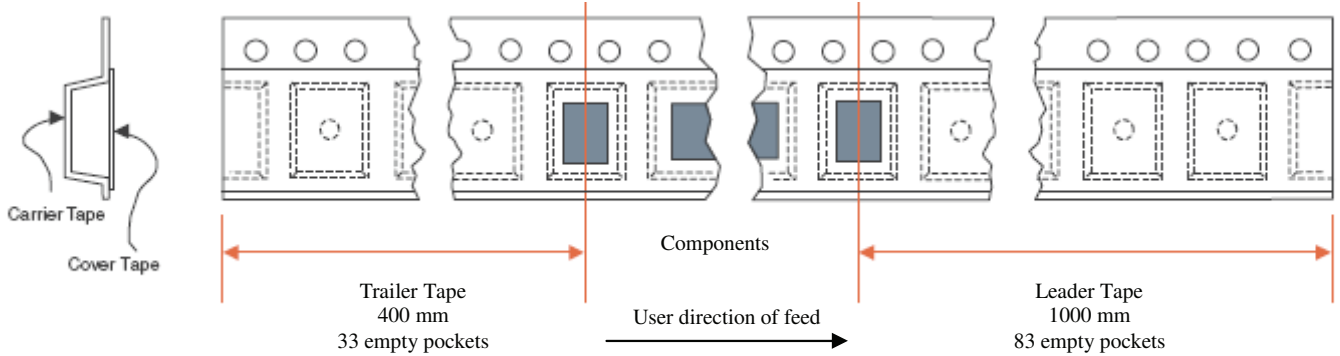


Figure 17: Leader and trailer

Carrier Tape Data:

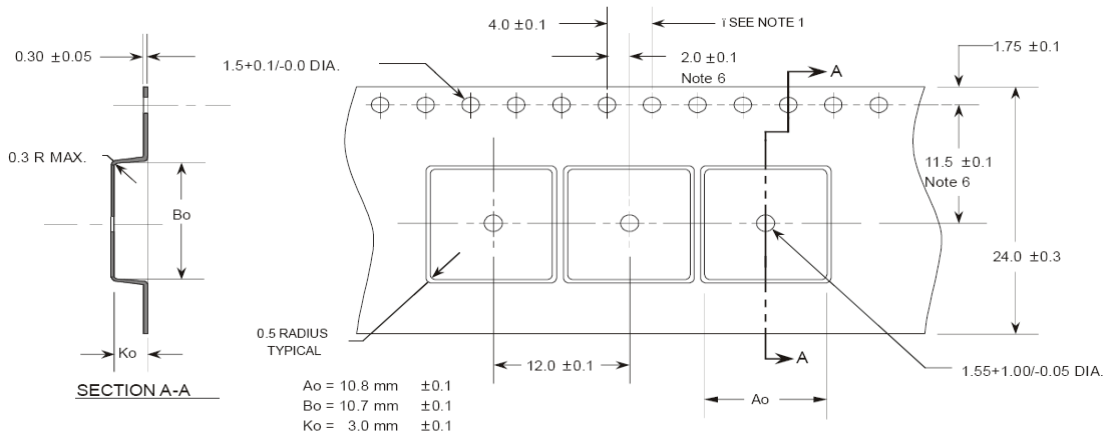


Figure 18: Carrier tape

Plastic Reel Data:

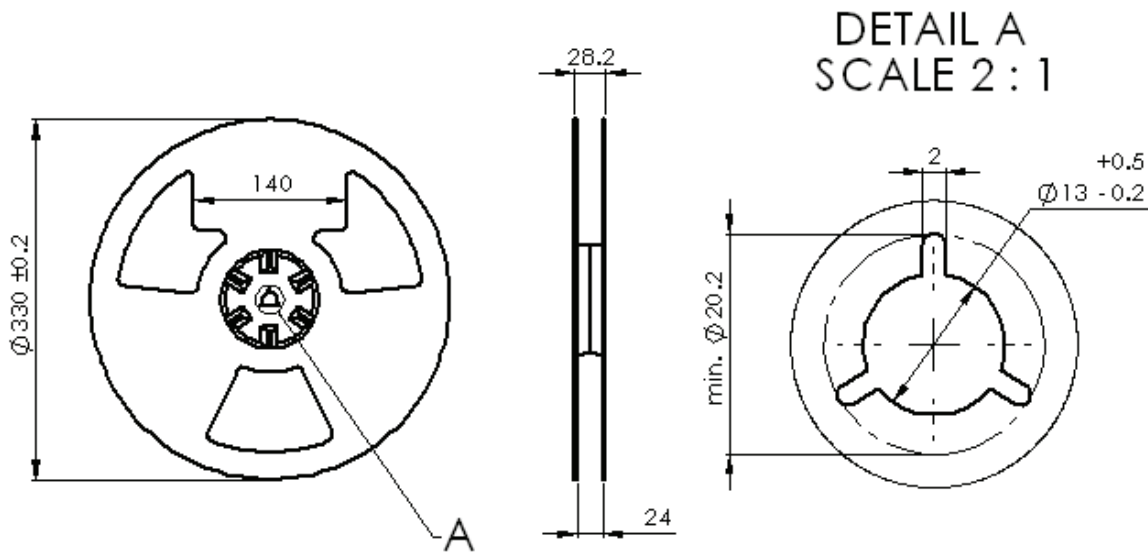


Figure 19: Plastic reel

**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.

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.



Underwriters Laboratory Inc. recognized component

**Version history**

Date	Version	Comments
2 February 2022	0	New generic datasheet with SP products
15 August 2022	1	Modified definition paragraph and modified 3D picture (page 1); deleted comment for CTI data in the first table; replaced ms by µs (page 7) + modified LEM address + last sentence (all pages)