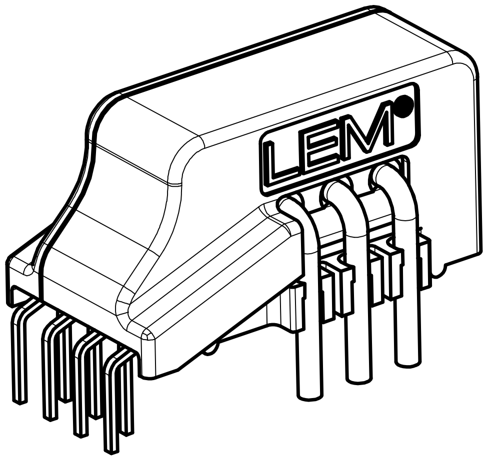
Current Transducer HO 12 ... 33-NP/SPH00-0010 I_{PN} = 7.5 ... 18.4 A

Ref: HO 12-NP/SPH00-0010, HO 14-NP/SPH00-0010, HO 16-NP/SPH00-0010, HO 21-NP/SPH00-0010, HO 23-NP/SPH00-0010, HO 24.9-NP/SPH00-0010, HO 25-NP/SPH00-0010, HO 25.2-NP/SPH00-0010, HO 33-NP/SPH00-0010

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



Features

- Hall effect measuring principle
- Multirange current transducer through PCB pattern lay-out
- Galvanic separation between primary and secondary circuit
- Insulated test voltage 4300 V
- Low power consumption
- Extremely low profile 12 mm
- Single power supply +5 V
- Fixed offset & sensitivity
- Overcurrent detection 2.63 × I_{PN} (peak value)
- Memory check OFF.

Special feature

- Factory adjustment at $I_{PN} \times \sqrt{2} \times 180\ \%$ ($U_{out} - U_{ref}$ = 1.76 V).

Advantages

- Small size and space saving
- Only one design for wide primary current range
- High immunity to external interference
- 8 mm creepage/clearance
- High insulation capability
- Fast delay time.

Applications

- AC variable speed drives
- Static converters for DC motor drives
- Battery supplied applications
- Uninterruptible Power Supplies (UPS)
- Switched Mode Power Supplies (SMPS)
- Power supplies for welding applications
- The solar inverter on DC side of the inverter (MPPT)
- Combiner box.

Standards

- IEC 61800-1: 1997
- IEC 61800-2: 2015
- IEC 61800-3: 2004
- IEC 61800-5-1: 2007
- IEC 62109-1: 2010
- UL 508: 2018.

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 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.
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.

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.

c UL us

Underwriters Laboratory Inc. recognized component

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Absolute maximum ratings

Parameter	Symbol	Unit	Value
Maximum supply voltage (not operating)	$U_{C\ max}$	V	6.5
Maximum primary conductor temperature	$T_{B\ max}$	°C	120
Electrostatic discharge voltage	U_{ESD}	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 12
- UL 508 STANDARD FOR INDUSTRIAL CONTROL EQUIPMENT - Edition 18

Ratings

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

Conditions of acceptability

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

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 have been evaluated for use in 105 °C maximum surrounding air temperature.
5 - The secondary (Sensing) circuit is intended to be supplied by an Isolated Secondary Circuit - Limited voltage circuit defined by UL 508 paragraph 32.5. The maximum open circuit voltage potential available to the circuit and overcurrent protection shall be evaluated in the end use application.
6 - 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.
7 - Primary terminals shall not be straightened since assembly of housing case depends upon bending of the terminals.
8 - Any surface of polymeric housing have not been evaluated as insulating barrier.
9 - Low voltage circuits are intended to be powered by a circuit derived from an isolating source (such as a transformer, optical isolator, limiting impedance or electro-mechanical relay) and having no direct connection back to the primary circuit (other than through the grounding means).

Marking

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

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Insulation coordination

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC insulation test, 50 Hz, 1 min	U_d	kV	4.3	
Impulse withstand voltage 1.2/50 µs	U_{Ni}	kV	8	
Partial discharge extinction test voltage (q_m< 10 pC)	U_t	V	1500	
Clearance (pri. - sec.)	d_{Cl}	mm	8	Shortest distance through air
Creepage distance (pri. - sec.)	d_{Cp}	mm	8	Shortest path along device body
Case material	-	-	V0	According to UL 94
Comparative tracking index	CTI		600	
Application example		V	600	Reinforced insulation, CAT III, PD 2 according to IEC 61800-5-1
Application example		V	300	Reinforced insulation, CAT III, PD 2 non uniform field according to IEC 61800-5-1
Application example		V	1000	Basic insulation, CAT III, PD 2 according to IEC 61800-5-1

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	
Surrounding temperature according to UL 508		°C			105	
Mass	m	g		5		

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Electrical data HO 12-NP/SPH00-0010

At T_A = 25 °C, U_C = +5 V, N_P = 3 turns, R_L = 10 KΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 14).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		7.5		
Primary current, measuring range	I_{PM}	A	−24.9		24.9	
Number of primary turns	N_P			1,2,3		
Supply voltage	U_C	V	5	5.3	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage	U_{ref}	V	2.475	2.5	2.525	Internal reference
External reference voltage	U_{ref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2.3		2.3	
Output voltage @ I_P = 0 A	U_{out}	V		$U_{ref} + U_{OE}$		
Electrical offset voltage	U_{OE}	mV	−7		7	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K			±160	−20 °C ... 85 °C Internal reference
					±190	−40 °C ... 105 °C Internal reference
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K			±0.095	
Nominal sensitivity	S_N	mV/A		92.2		691 mV/ I_{PN} @ U_C = 5 V
Sensitivity error	ε_S	%			±0.5	Factory adjustment @ $U_{out} - U_{ref}$ = 1.76 V
Temperature coefficient of S	TCS	ppm/K			±220	
Linearity error 0 ... I_{PN} × √2 × 180 %	ε_L	% of I_{PN} × √2 × 180 %			±0.5	@ U_C = 5 V
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM} × √2 × 180 %			±1.1	@ U_C = 5 V
Sensitivity error with respect to U_C ±10 %	ε_S	%/%			±0.05	Sensitivity error per U_C drift
Magnetic offset voltage @ I_P = 0 after 2.5 × I_{PN}	U_{OM}	mV			±6	
Delay time @ 10 % of the final output value I_{PN} step	$t_{D\,10}$	µs			2	$di/dt = I_{PN}$/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\,90}$	µs			3.5	$di/dt = I_{PN}$/µs
Frequency bandwidth (−3 dB)	BW	kHz		250		
Noise voltage spectral density (DC ... 100 kHz)	u_{no}	µV/√Hz			30.3	@ U_C = 5 V
RMS noise voltage (DC ... 20 MHz)	U_{no}	mVpp		80		
Standby pin “0” level		V			0.3	
Standby pin “1” level		V	U_C −0.3			
Time to switch from standby to normal mode		µs			20	
Primary current, detection threshold	$I_{P\,Th}$	A	3 × I_{PN}	3.4 × I_{PN}	3.7 × I_{PN}	peak value
Total error @ I_{PN}	ε_{tot}	% of I_{PN}			±1	$= \varepsilon_S + \varepsilon_L$
Total error@ I_{PN} @ T_A = +85 °C	ε_{tot}	% of I_{PN}			±2.9	See formula note [1]
Total error @ I_{PN} @ T_A = +105 °C	ε_{tot}	% of I_{PN}			±3.8	See formula note [1]

Note: [1] Error @ I_P and $\varepsilon_{tot\,TA} = \pm [\varepsilon_{tot} + (TCS/10000) \cdot (T_A - 25) + TCU_{OE} \cdot 100 \cdot (T_A - 25) / (S_N \cdot I_P)]$

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Electrical data HO 14-NP/SPH00-0010

At T_A = 25 °C, U_C = +5 V, N_P = 3 turns, R_L = 10 KΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 14).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		9.6		
Primary current, measuring range	I_{PM}	A	−31.9		31.9	
Number of primary turns	N_P			1,2,3		
Supply voltage	U_C	V	5	5.3	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage	U_{ref}	V	2.475	2.5	2.525	Internal reference
External reference voltage	U_{ref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2.3		2.3	
Output voltage @ I_P = 0 A	U_{out}	V		$U_{ref} + U_{OE}$		
Electrical offset voltage	U_{OE}	mV	−7		7	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K			±160	−20 °C ... 85 °C Internal reference
					±190	−40 °C ... 105 °C Internal reference
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K			±0.095	
Nominal sensitivity	S_N	mV/A		72.0		691 mV/ I_{PN} @ U_C = 5 V
Sensitivity error	ε_S	%			±0.5	Factory adjustment @ $U_{out} - U_{ref}$ = 1.76 V
Temperature coefficient of S	TCS	ppm/K			±220	
Linearity error 0 ... I_{PN} × √2 × 180 %	ε_L	% of I_{PN} × √2 × 180 %			±0.5	@ U_C = 5 V
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM} × √2 × 180 %			±1.1	@ U_C = 5 V
Sensitivity error with respect to U_C ±10 %	ε_S	%/%			±0.05	Sensitivity error per U_C drift
Magnetic offset voltage @ I_P = 0 after 2.5 × I_{PN}	U_{OM}	mV			±6	
Delay time @ 10 % of the final output value I_{PN} step	t_{D10}	µs			2	$\mathrm{d}i/\mathrm{d}t = I_{PN}$/µs
Delay time @ 90 % of the final output value I_{PN} step	t_{D90}	µs			3.5	$\mathrm{d}i/\mathrm{d}t = I_{PN}$/µs
Frequency bandwidth (−3 dB)	BW	kHz		250		
Noise voltage spectral density (DC ... 100 kHz)	u_{no}	µV/√Hz			23.7	
RMS noise voltage (DC ... 20 MHz)	U_{no}	mVpp		60		
Standby pin “0” level		V			0.3	
Standby pin “1” level		V	U_C −0.3			
Time to switch from standby to normal mode		µs			20	
Primary current, detection threshold	I_{PTh}	A	3 × I_{PN}	3.4 × I_{PN}	3.7 × I_{PN}	peak value
Total error @ I_{PN}	ε_{tot}	% of I_{PN}			±1	= $\varepsilon_S + \varepsilon_L$
Total error@ I_{PN} @ T_A = +85 °C	ε_{tot}	% of I_{PN}			±2.8	See formula note [1]
Total error @ I_{PN} @ T_A = +105 °C	ε_{tot}	% of I_{PN}			±3.4	See formula note [1]

Note: [1] Error @ I_P and $\varepsilon_{tot\,TA} = \pm\,[\varepsilon_{tot} + (TCS/10000) \cdot (T_A - 25) + TCU_{OE} \cdot 100 \cdot (T_A - 25) / (S_N \cdot I_P)]$

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Electrical data HO 16-NP/SPH00-0010

At T_A = 25 °C, U_C = +5 V, N_P = 3 turns, R_L = 10 KΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 14).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		12		
Primary current, measuring range	I_{PM}	A	−39.9		39.9	
Number of primary turns	N_P			1,2,3		
Supply voltage	U_C	V	5	5.3	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage	U_{ref}	V	2.475	2.5	2.525	Internal reference
External reference voltage	U_{ref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2.3		2.3	
Output voltage @ I_P = 0 A	U_{out}	V		$U_{ref} + U_{OE}$		
Electrical offset voltage	U_{OE}	mV	−7		7	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K			±160	−20 °C ... 85 °C Internal reference
					±190	−40 °C ... 105 °C Internal reference
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K			±0.095	
Nominal sensitivity	S_N	mV/A		57.6		691 mV/ I_{PN} @ U_C = 5 V
Sensitivity error	ε_S	%			±0.5	Factory adjustment @ $U_{out} - U_{ref}$ = 1.76 V
Temperature coefficient of S	TCS	ppm/K			±220	
Linearity error 0 ... $I_{PN} \times \sqrt{2} \times 180$ %	ε_L	% of $I_{PN} \times \sqrt{2} \times 180$ %			±0.5	@ U_C = 5 V
Linearity error 0 ... I_{PM}	ε_L	% of $I_{PM} \times \sqrt{2} \times 180$ %			±1.1	@ U_C = 5 V
Sensitivity error with respect to U_C ±10 %	ε_S	%/%			±0.05	Sensitivity error per U_C drift
Magnetic offset voltage @ I_P = 0 after 2.5 × I_{PN}	U_{OM}	mV			±6	
Delay time @ 10 % of the final output value I_{PN} step	$t_{D\,10}$	µs			2	$di/dt = I_{PN}$/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\,90}$	µs			3.5	$di/dt = I_{PN}$/µs
Frequency bandwidth (−3 dB)	BW	kHz		250		
Noise voltage spectral density (DC ... 100 kHz)	u_{no}	µV/√Hz			19.0	
RMS noise voltage (DC ... 20 MHz)	U_{no}	mVpp		50		
Standby pin “0” level		V			0.3	
Standby pin “1” level		V	U_C −0.3			
Time to switch from standby to normal mode		µs			20	
Primary current, detection threshold	$I_{P\,Th}$	A	3 × I_{PN}	3.4 × I_{PN}	3.7 × I_{PN}	peak value
Total error @ I_{PN}	ε_{tot}	% of I_{PN}			±1	$= \varepsilon_S + \varepsilon_L$
Total error@ I_{PN} @ T_A = +85 °C	ε_{tot}	% of I_{PN}			±2.8	See formula note [1]
Total error @ I_{PN} @ T_A = +105 °C	ε_{tot}	% of I_{PN}			±3.4	See formula note [1]

Note: [1] Error @ I_P and $\varepsilon_{tot\,TA} = \pm [\varepsilon_{tot} + (TCS/10000) \cdot (T_A - 25) + TCU_{OE} \cdot 100 \cdot (T_A - 25) / (S_N \cdot I_P)]$

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Electrical data HO 21-NP/SPH00-0010

At T_A = 25 °C, U_C = +5 V, N_P = 2 turns, R_L = 10 KΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 14).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		16		
Primary current, measuring range	I_{PM}	A	−53.2		53.2	
Number of primary turns	N_P			1,2,3		
Supply voltage	U_C	V	5	5.3	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage	U_{ref}	V	2.475	2.5	2.525	Internal reference
External reference voltage	U_{ref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2.3		2.3	
Output voltage @ I_P = 0 A	U_{out}	V		$U_{ref} + U_{OE}$		
Electrical offset voltage	U_{OE}	mV	−7		7	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K			±160	−20 °C ... 85 °C Internal reference
					±190	−40 °C ... 105 °C Internal reference
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K			±0.095	
Nominal sensitivity	S_N	mV/A		43.2		691 mV/ I_{PN} @ U_C = 5 V
Sensitivity error	ε_S	%			±0.5	Factory adjustment @ $U_{out} - U_{ref}$ = 1.76 V
Temperature coefficient of S	TCS	ppm/K			±220	
Linearity error 0 ... $I_{PN} \times \sqrt{2} \times 180$ %	ε_L	% of $I_{PN} \times \sqrt{2} \times 180$ %			±0.5	@ U_C = 5 V
Linearity error 0 ... I_{PM}	ε_L	% of $I_{PM} \times \sqrt{2} \times 180$ %			±1.1	@ U_C = 5 V
Sensitivity error with respect to U_C ±10 %	ε_S	%/%			±0.05	Sensitivity error per U_C drift
Magnetic offset voltage @ I_P = 0 after 2.5 × I_{PN}	U_{OM}	mV			±6	
Delay time @ 10 % of the final output value I_{PN} step	$t_{D\,10}$	µs			2	$di/dt = I_{PN}$/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\,90}$	µs			3.5	$di/dt = I_{PN}$/µs
Frequency bandwidth (−3 dB)	BW	kHz		250		
Noise voltage spectral density (DC ... 100 kHz)	u_{no}	µV/√Hz			14.2	
RMS noise voltage (DC ... 20 MHz)	U_{no}	mVpp		40		
Standby pin "0" level		V			0.3	
Standby pin "1" level		V	U_C −0.3			
Time to switch from standby to normal mode		µs			20	
Primary current, detection threshold	$I_{P\,Th}$	A	3 × I_{PN}	3.4 × I_{PN}	3.7 × I_{PN}	peak value
Total error @ I_{PN}	ε_{tot}	% of I_{PN}			±1	$= \varepsilon_S + \varepsilon_L$
Total error@ I_{PN} @ T_A = +85 °C	ε_{tot}	% of I_{PN}			±2.8	See formula note [1]
Total error @ I_{PN} @ T_A = +105 °C	ε_{tot}	% of I_{PN}			±3.4	See formula note [1]

Note: [1] Error @ I_P and $\varepsilon_{tot\,TA} = \pm [\varepsilon_{tot} + (TCS/10000) \cdot (T_A - 25) + TCU_{OE} \cdot 100 \cdot (T_A - 25) / (S_N \cdot I_P)]$

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Electrical data HO 23-NP/SPH00-0010

At T_A = 25 °C, U_C = +5 V, N_P = 3 turns, R_L = 10 KΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 14).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		15		
Primary current, measuring range	I_{PM}	A	−49.9		49.9	
Number of primary turns	N_P			1,2,3		
Supply voltage	U_C	V	5	5.3	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage	U_{ref}	V	2.475	2.5	2.525	Internal reference
External reference voltage	U_{ref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2.3		2.3	
Output voltage @ I_P = 0 A	U_{out}	V		$U_{ref} + U_{OE}$		
Electrical offset voltage	U_{OE}	mV	−7		7	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K			±160	−20 °C ... 85 °C Internal reference
					±190	−40 °C ... 105 °C Internal reference
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K			±0.095	
Nominal sensitivity	S_N	mV/A		46.1		691 mV/ I_{PN} @ U_C = 5 V
Sensitivity error	ε_S	%			±0.5	Factory adjustment @ $U_{out} - U_{ref}$ = 1.76 V
Temperature coefficient of S	TCS	ppm/K			±220	
Linearity error 0 ... I_{PN} × √2 × 180 %	ε_L	% of I_{PN} × √2 × 180 %			±0.5	@ U_C = 5 V
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM} × √2 × 180 %			±1.1	@ U_C = 5 V
Sensitivity error with respect to U_C ±10 %	ε_S	%/%			±0.05	Sensitivity error per U_C drift
Magnetic offset voltage @ I_P = 0 after 2.5 × I_{PN}	U_{OM}	mV			±6	
Delay time @ 10 % of the final output value I_{PN} step	$t_{D\,10}$	µs			2	$di/dt = I_{PN}$/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\,90}$	µs			3.5	$di/dt = I_{PN}$/µs
Frequency bandwidth (−3 dB)	BW	kHz		250		
Noise voltage spectral density (DC ... 100 kHz)	u_{no}	µV/√Hz			15.2	
RMS noise voltage (DC ... 20 MHz)	U_{no}	mVpp		40		
Standby pin “0” level		V			0.3	
Standby pin “1” level		V	U_C −0.3			
Time to switch from standby to normal mode		µs			20	
Primary current, detection threshold	$I_{P\,Th}$	A	3 × I_{PN}	3.4 × I_{PN}	3.7 × I_{PN}	peak value
Total error @ I_{PN}	ε_{tot}	% of I_{PN}			±1	$= \varepsilon_S + \varepsilon_L$
Total error@ I_{PN} @ T_A = +85 °C	ε_{tot}	% of I_{PN}			±2.8	See formula note [1]
Total error @ I_{PN} @ T_A = +105 °C	ε_{tot}	% of I_{PN}			±3.4	See formula note [1]

Note: [1] Error @ I_P and $\varepsilon_{tot\,TA} = \pm\,[\varepsilon_{tot} + (TCS/10000) \cdot (T_A - 25) + TCU_{OE} \cdot 100 \cdot (T_A - 25) / (S_N \cdot I_P)]$

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Electrical data HO 24.9-NP/SPH00-0010

At T_A = 25 °C, U_C = +5 V, N_P = 3 turns, R_L = 10 KΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 14).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		16.5		
Primary current, measuring range	I_{PM}	A	−54.8		54.8	
Number of primary turns	N_P			1,2,3		
Supply voltage	U_C	V	5	5.3	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage	U_{ref}	V	2.475	2.5	2.525	Internal reference
External reference voltage	U_{ref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2.3		2.3	
Output voltage @ I_P = 0 A	U_{out}	V		$U_{ref} + U_{OE}$		
Electrical offset voltage	U_{OE}	mV	−7		7	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K			±160	−20 °C ... 85 °C Internal reference
					±190	−40 °C ... 105 °C Internal reference
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K			±0.095	
Nominal sensitivity	S_N	mV/A		41.9		691 mV/ I_{PN} @ U_C = 5 V
Sensitivity error	ε_S	%			±0.5	Factory adjustment @ $U_{out} - U_{ref}$ = 1.76 V
Temperature coefficient of S	TCS	ppm/K			±220	
Linearity error 0 ... I_{PN} × √2 × 180 %	ε_L	% of I_{PN} × √2 × 180 %			±0.5	@ U_C = 5 V
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM} × √2 × 180 %			±1.1	@ U_C = 5 V
Sensitivity error with respect to U_C ±10 %	ε_S	%/%			±0.05	Sensitivity error per U_C drift
Magnetic offset voltage @ I_P = 0 after 2.5 × I_{PN}	U_{OM}	mV			±6	
Delay time @ 10 % of the final output value I_{PN} step	$t_{D\,10}$	µs			2	$di/dt = I_{PN}$/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\,90}$	µs			3.5	$di/dt = I_{PN}$/µs
Frequency bandwidth (−3 dB)	BW	kHz		250		
Noise voltage spectral density (DC ... 100 kHz)	u_{no}	µV/√Hz			13.8	
RMS noise voltage (DC ... 20 MHz)	U_{no}	mVpp		40		
Standby pin “0” level		V			0.3	
Standby pin “1” level		V	U_C −0.3			
Time to switch from standby to normal mode		µs			20	
Primary current, detection threshold	$I_{P\,Th}$	A	3 × I_{PN}	3.4 × I_{PN}	3.7 × I_{PN}	peak value
Total error @ I_{PN}	ε_{tot}	% of I_{PN}			±1	= $\varepsilon_S + \varepsilon_L$
Total error @ I_{PN} @ T_A = +85 °C	ε_{tot}	% of I_{PN}			±2.8	See formula note [1]
Total error @ I_{PN} @ T_A = +105 °C	ε_{tot}	% of I_{PN}			±3.4	See formula note [1]

Note: [1] Error @ I_P and $\varepsilon_{tot\,TA} = \pm[\varepsilon_{tot} + (TCS/10000) \cdot (T_A - 25) + TCU_{OE} \cdot 100 \cdot (T_A - 25) / (S_N \cdot I_P)]$

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Electrical data HO 25-NP/SPH00-0010

At T_A = 25 °C, U_C = +5 V, N_P = 1 turn, R_L = 10 KΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 14).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		17.5		
Primary current, measuring range	I_{PM}	A	−58.8		58.2	
Number of primary turns	N_P			1,2,3		
Supply voltage	U_C	V	5	5.3	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage	U_{ref}	V	2.475	2.5	2.525	Internal reference
External reference voltage	U_{ref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2.3		2.3	
Output voltage @ I_P = 0 A	U_{out}	V		$U_{ref} + U_{OE}$		
Electrical offset voltage	U_{OE}	mV	−7		7	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K			±160	−20 °C ... 85 °C Internal reference
					±190	−40 °C ... 105 °C Internal reference
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K			±0.095	
Nominal sensitivity	S_N	mV/A		39.5		691 mV/ I_{PN} @ U_C = 5 V
Sensitivity error	ε_S	%			±0.5	Factory adjustment @ $U_{out} - U_{ref}$ = 1.76 V
Temperature coefficient of S	TCS	ppm/K			±220	
Linearity error 0 ... I_{PN} × √2 × 180 %	ε_L	% of I_{PN} × √2 × 180 %			±0.5	@ U_C = 5 V
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM} × √2 × 180 %			±1.1	@ U_C = 5 V
Sensitivity error with respect to U_C ±10 %	ε_S	%/%			±0.05	Sensitivity error per U_C drift
Magnetic offset voltage @ I_P = 0 after 2.5 × I_{PN}	U_{OM}	mV			±6	
Delay time @ 10 % of the final output value I_{PN} step	$t_{D\,10}$	µs			2	$\mathrm{d}i/\mathrm{d}t = I_{PN}$/µs
Delay time @ 90 % of the final output value I_{PN} step	$t_{D\,90}$	µs			3.5	$\mathrm{d}i/\mathrm{d}t = I_{PN}$/µs
Frequency bandwidth (−3 dB)	BW	kHz		250		
Noise voltage spectral density (DC ... 100 kHz)	u_{no}	µV/√Hz			13	
RMS noise voltage (DC ... 20 MHz)	U_{no}	mVpp		40		
Standby pin “0” level		V			0.3	
Standby pin “1” level		V	U_C −0.3			
Time to switch from standby to normal mode		µs			20	
Primary current, detection threshold	$I_{P\,Th}$	A	3 × I_{PN}	3.4 × I_{PN}	3.7 × I_{PN}	peak value
Total error @ I_{PN}	ε_{tot}	% of I_{PN}			±1	$= \varepsilon_S + \varepsilon_L$
Total error @ I_{PN} @ T_A = +85 °C	ε_{tot}	% of I_{PN}			±2.8	See formula note [1]
Total error @ I_{PN} @ T_A = +105 °C	ε_{tot}	% of I_{PN}			±3.4	See formula note [1]

Note: [1] Error @ I_P and $\varepsilon_{tot\,TA} = \pm [\varepsilon_{tot} + (TCS/10000) \cdot (T_A - 25) + TCU_{OE} \cdot 100 \cdot (T_A - 25) / (S_N \cdot I_P)]$

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Electrical data HO 25.2-NP/SPH00-0010

At T_A = 25 °C, U_C = +5 V, N_P = 2 turns, R_L = 10 KΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 14).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		18.4		
Primary current, measuring range	I_{PM}	A	−61.2		61.2	
Number of primary turns	N_P			1,2,3		
Supply voltage	U_C	V	5	5.3	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage	U_{ref}	V	2.475	2.5	2.525	Internal reference
External reference voltage	U_{ref}	V	0.5		2.65	
Output voltage range @ I_{PM}	$U_{out} - U_{ref}$	V	−2.3		2.3	
Output voltage @ I_P = 0 A	U_{out}	V		$U_{ref} + U_{OE}$		
Electrical offset voltage	U_{OE}	mV	−7		7	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K			±160	−20 °C ... 85 °C Internal reference
					±190	−40 °C ... 105 °C Internal reference
Temperature coefficient of U_{OE} referred to primary	TCU_{OE}	mV/K			±0.095	
Nominal sensitivity	S_N	mV/A		37.6		691 mV/ I_{PN} @ U_C = 5 V
Sensitivity error	ε_S	%			±0.5	Factory adjustment @ $U_{out} - U_{ref}$ = 1.76 V
Temperature coefficient of S	TCS	ppm/K			±220	
Linearity error 0 ... I_{PN} × √2 × 180 %	ε_L	% of I_{PN} × √2 × 180 %			±0.5	@ U_C = 5 V
Linearity error 0 ... I_{PM}	ε_L	% of I_{PM} × √2 × 180 %			±1.1	@ U_C = 5 V
Sensitivity error with respect to U_C ±10 %	ε_S	%/%			±0.05	Sensitivity error per U_C drift
Magnetic offset voltage @ I_P = 0 after 2.5 × I_{PN}	U_{OM}	mV			±6	
Delay time @ 10 % of the final output value I_{PN} step	t_{D10}	µs			2	$di/dt = I_{PN}$/µs
Delay time @ 90 % of the final output value I_{PN} step	t_{D90}	µs			3.5	$di/dt = I_{PN}$/µs
Frequency bandwidth (−3 dB)	BW	kHz		250		
Noise voltage spectral density (DC ... 100 kHz)	u_{no}	µV/√Hz			12.4	
RMS noise voltage (DC ... 20 MHz)	U_{no}	mVpp		40		
Standby pin "0" level		V			0.3	
Standby pin "1" level		V	U_C −0.3			
Time to switch from standby to normal mode		µs			20	
Primary current, detection threshold	I_{PTh}	A	3 × I_{PN}	3.4 × I_{PN}	3.7 × I_{PN}	peak value
Total error @ I_{PN}	ε_{tot}	% of I_{PN}			±1	$= \varepsilon_S + \varepsilon_L$
Total error @ I_{PN} @ T_A = +85 °C	ε_{tot}	% of I_{PN}			±2.8	See formula note [1]
Total error @ I_{PN} @ T_A = +105 °C	ε_{tot}	% of I_{PN}			±3.4	See formula note [1]

Note: [1] Error @ I_P and $\varepsilon_{tot\,TA} = \pm [\varepsilon_{tot} + (TCS/10000) \cdot (T_A - 25) + TCU_{OE} \cdot 100 \cdot (T_A - 25) / (S_N \cdot I_P)]$

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Electrical data HO 33-NP/SPH00-0010

At T_A = 25 °C, U_C = +5 V, N_P = 1 turn, R_L = 10 KΩ unless otherwise noted (see Min, Max, typ. definition paragraph in page 14).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{P N}$	A		11		
Primary current, measuring range	$I_{P M}$	A	−36.6		36.6	
Number of primary turns	N_P			1,2,3		
Supply voltage	U_C	V	5	5.3	5.5	
Current consumption	I_C	mA		19	25	
Reference voltage	U_{ref}	V	2.475	2.5	2.525	Internal reference
External reference voltage	U_{ref}	V	0.5		2.65	
Output voltage range @ $I_{P M}$	$U_{out} - U_{ref}$	V	−2.3		2.3	
Output voltage @ I_P = 0 A	U_{out}	V		$U_{ref} + U_{O E}$		
Electrical offset voltage	$U_{O E}$	mV	−7		7	
Temperature coefficient of U_{ref}	TCU_{ref}	ppm/K			±160	−20 °C ... 85 °C Internal reference
					±190	−40 °C ... 105 °C Internal reference
Temperature coefficient of $U_{O E}$ referred to primary	$TCU_{O E}$	mV/K			±0.095	−20 °C … 105 °C
					±0.1	−40 °C … −20 °C
Nominal sensitivity	S_N	mV/A		62.9		691 mV/ $I_{P N}$ @ U_C = 5 V
Sensitivity error	ε_S	%			±0.5	Factory adjustment @ $U_{out} - U_{ref}$ = 1.76 V
Temperature coefficient of S	TCS	ppm/K			±220	
Linearity error 0 ... $I_{P N}$ × √2 × 180 %	ε_L	% of $I_{P N}$ × √2 × 180 %			±0.5	@ U_C = 5 V
Linearity error 0 ... $I_{P M}$	ε_L	% of $I_{P M}$ × √2 × 180 %			±1.1	@ U_C = 5 V
Sensitivity error with respect to U_C ±10 %	ε_S	%/%			±0.05	Sensitivity error per U_C drift
Magnetic offset voltage @ I_P = 0 after 2.5 × $I_{P N}$	$U_{O M}$	mV			±6	
Delay time @ 10 % of the final output value $I_{P N}$ step	$t_{D 10}$	µs			2	$\mathrm{d}i/\mathrm{d}t = I_{P N}$/µs
Delay time @ 90 % of the final output value $I_{P N}$ step	$t_{D 90}$	µs			3.5	$\mathrm{d}i/\mathrm{d}t = I_{P N}$/µs
Frequency bandwidth (−3 dB)	BW	kHz		250		
Noise voltage spectral density (DC ... 100 kHz)	u_{no}	µV/√Hz			10.3	
RMS noise voltage (DC ... 20 MHz)	U_{no}	mVpp		30		
Standby pin “0” level		V			0.3	
Standby pin “1” level		V	U_C −0.3			
Time to switch from standby to normal mode		µs			20	
Primary current, detection threshold	$I_{P Th}$	A	3 × $I_{P N}$	3.4 × $I_{P N}$	3.7 × $I_{P N}$	peak value
Total error @ $I_{P N}$	ε_{tot}	% of $I_{P N}$			±1	= $\varepsilon_S + \varepsilon_L$
Total error @ $I_{P N}$ @ T_A = +85 °C	ε_{tot}	% of $I_{P N}$			±2.8	See formula note [1]
Total error @ $I_{P N}$ @ T_A = +105 °C	ε_{tot}	% of $I_{P N}$			±3.4	See formula note [1]

Note: [1] Error @ I_P and $\varepsilon_{tot\,T\,A} = \pm\,[\varepsilon_{tot} + (TCS/10000) \cdot (T_A - 25) + TCU_{O E} \cdot 100 \cdot (T_A - 25) / (S_N \cdot I_P)]$

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.

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Maximum continuous DC primary current

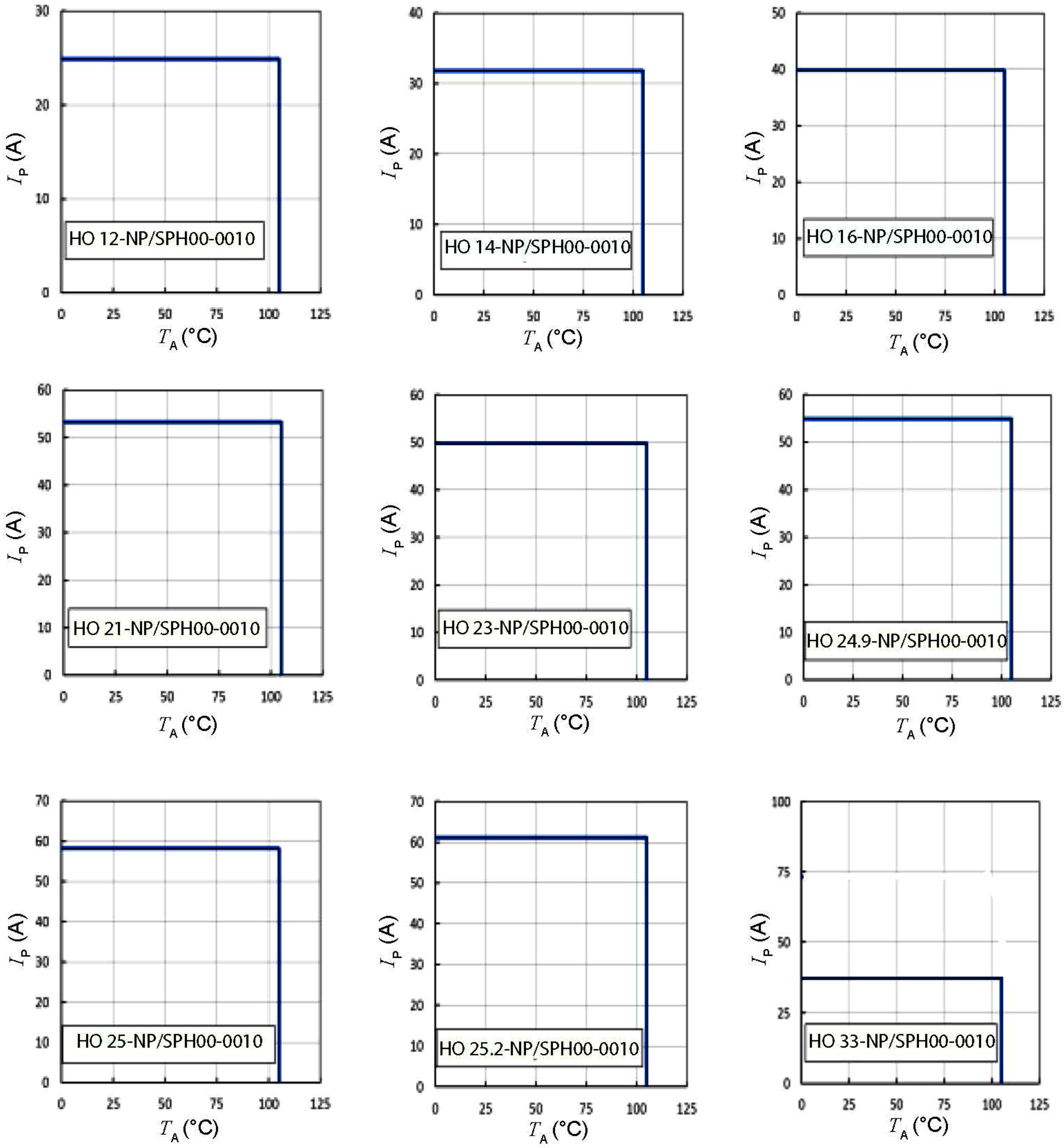


Figure 1: I_P vs T_A for HO series

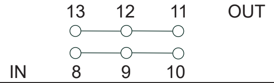
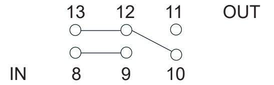
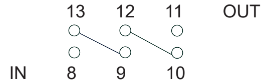
Important notice: whatever the usage and/or application, the transducer jumper temperature shall not go above the maximum rating of 120 °C as stated in page 3 of this datasheet.

Application information

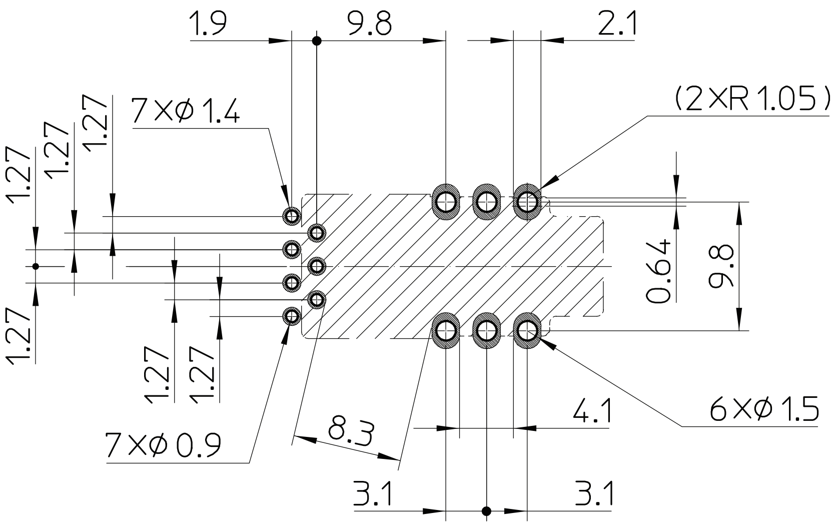
Total primary resistance

The primary resistance is 0.36 mΩ per conductor at 25 °C.

In the following table, examples of primary resistance according to the number of primary turns.

Number of primary turns N_P	Resistance of primary (winding) R_P [mΩ]	Recommended connections	Primary nominal RMS current I_{PN} [A]
1	0.12		30
2	0.54		15
3	1.18		10

PCB Footprint



Assembly on PCB

• Recommended PCB hole diameter	1.5 mm for primary pin 0.9 mm for secondary pin
• Maximum PCB thickness	2.4 mm
• Wave soldering profile No clean process only	maximum 260 °C, 10 s

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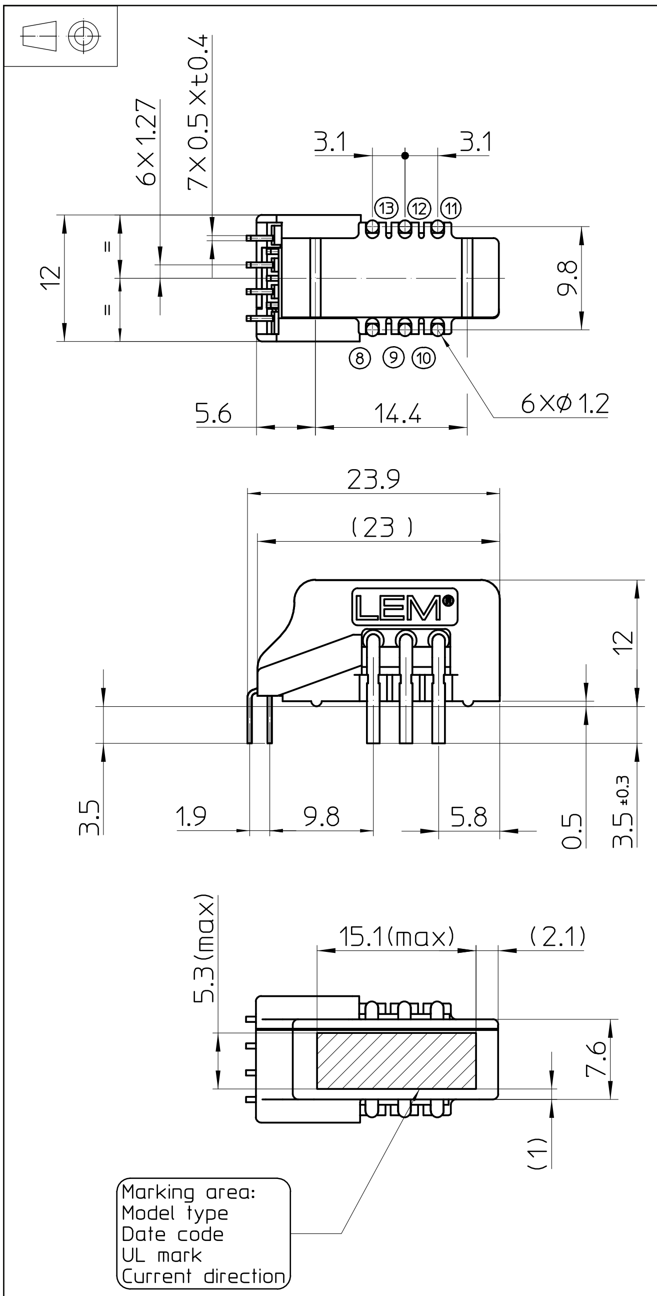
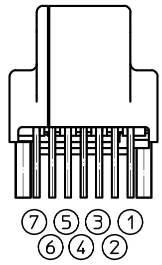
Dimensions (in mm, general linear tolerance ±0.5 mm)



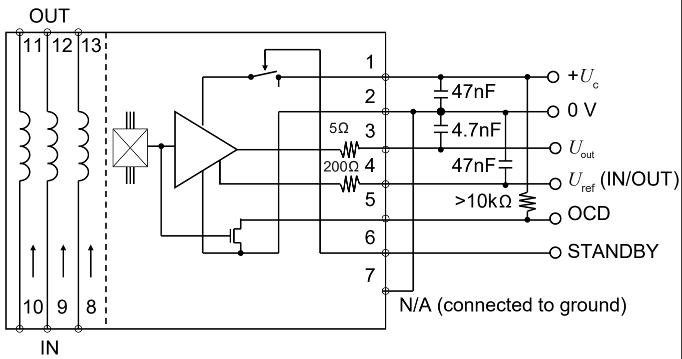


① : $+U_C$
② : 0 V
③ : U_{out}
④ : U_{ref} (IN/OUT)
⑤ : OCD
⑥ : STANDBY
⑦ : N/A (connected to ground)
⑧_⑬/ ⑨_⑫/ ⑩_⑪ : Primary_Pin

	d_{Cl} (mm)	d_{Cp} (mm)
note1)	8.0	8.0

1) Minimum distance from the primary to the core

Connection



Remark

- I_S is positive when I_P flows in the direction of arrow.

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