Current Transducer HO-SW/SP4-0400 I_{PN} = 78.5 ... 236 A
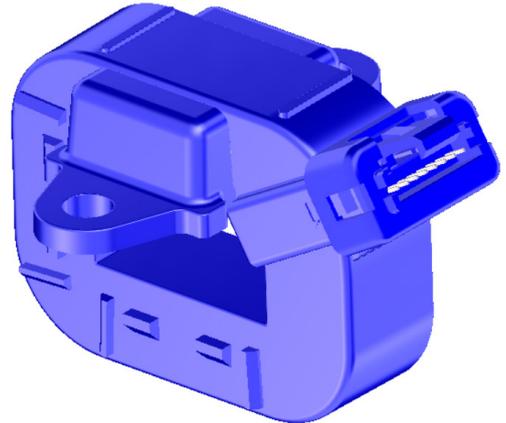
Ref: HO 78.5-SW/SP4-0400; HO 103.5-SW/SP4-0400; HO 126-SW/SP4-0400; HO 154-SW/SP4-0400; HO 205-SW/SP4-0400; HO 236-SW/SP4-0400

Bitstream output from on onboard Sigma Delta modulator. For the electronic measurement of current: DC, AC, pulsed..., with galvanic separation between the primary and the secondary circuit.

Features

- Open loop multi-range current transducer
- Bitstream output from 2nd order Sigma-Delta modulator, (PDM) Pulse Density Modulation
- Single supply +5 V
- Overcurrent detect 2.97 × I_{PN} (peak value)
- EEPROM Control
- Galvanic separation between primary and secondary circuit
- Low power consumption
- Compact design for panel mounting
- Aperture: 15 × 8 mm
- Factory calibrated
- Connection mating with HARWIN:
  - housing M30-1100800
  - contact M30-1060046
- Repositionable mounting foot
- Dedicated parameter settings available on request (see page 17).

Advantages

- Low offset drift
- Creepage / clearance 8 mm
- Fast delay time.

Applications

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

Standards

- IEC 61800-2: 2015
- IEC 61800-3: 2017
- IEC 61800-5-1: 2007
- IEC 62109-1: 2010.

Application Domain

- Industrial.

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

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

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

Underwriters Laboratory Inc. recognized component

Absolute maximum ratings

Parameter	Symbol	Unit	Value
Maximum supply voltage (not destructive)	$U_{C\,max}$	V	8
Maximum supply voltage (not entering non standard modes)	$U_{C\,max}$	V	6.5
Maximum primary conductor temperature	$T_{B\,max}$	°C	120
Maximum electrostatic discharge voltage (HMB-Human Body Model)	$U_{ESD\,HBM}$	kV	2

Stresses above these ratings may cause permanent damage. Exposure to absolute maximum ratings for extended periods may degrade reliability.

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 RMS test voltage (adjusted q_m < 10 pC)	U_t	V	1500	Busbar/Secondary
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, according to IEC 61800-5-1 CAT III, PD2
Application example		V	1000	Basic insulation, according to IEC 61800-5-1, CAT III, PD2

Environmental and mechanical characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Ambient operating temperature	T_A	°C	−40		105	
Ambient storage temperature	$T_{A\,st}$	°C	−40		105	
Mass	m	g		32		

Electrical data HO 78.5-SW/SP4-0400

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

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		78.5		
Primary current, measuring range	I_{PM}	A	−196.25		196.25	
Number of primary turns	N_P	-		1		See application information
Supply voltage [1]	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		24	31	Unloaded and output mode = 0
Density of ones @ I_P = 0 A	D_{out}	%		50		
Density of ones @ ±I_{PN}	D_{out}	%		50 ±16		
Density of ones @ ±I_{PM}	D_{out}	%		50 ±40		
Allowed load capacitance	C_L	pF	0		30	
OCD output on resistance	$R_{on\,OCD}$	Ω	60	95	170	Open drain, active low Over operating temperature range
OCD output hold time	$t_{hold\,OCD}$	ms	0.8	1.2	1.7	Additional time after threshold has released
EEPROM control	D_{out}	%		0		Forced to 0 when EEPROM in an error state
Electrical offset for PDM output (@ I_P = 0 A)	D_{OE}	%	−0.1		0.1	Relative to D_{out} = 50 %
Electrical offset current referred to primary	I_{OE}	A	−0.491		0.491	
Temperature coefficient of I_{OE} @ I_P = 0 A	TCI_{OE}	mA/K	−6.87		6.87	−40 °C … 105 °C
Nominal sensitivity	S_N	%/A		0.2038		16 % @ I_{PN}
Sensitivity error @ I_{PN}	ε_S	%	−1.1		1.1	Factory adjustment (straight bus bar)
Temperature coefficient of S	TCS	ppm/K	−350		350	−40 °C … 105 °C
Linearity error 0 … I_{PN}	ε_L	% of I_{PN}	−0.6		0.6	
Linearity error 0 … I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.92		0.92	One turn
Delay time to @ 90 % of the final output value for I_{PN} step	$t_{D\,90}$	µs			3.5	Determined by digital filter and OSR [2]
Primary current, detection threshold	$I_{P\,Th}$	A	2.67 × I_{PN}	2.97 × I_{PN}	3.27 × I_{PN}	Peak value ±10 %, overcurrent detection (OCD)
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1.7		1.7	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL}	% of I_{PN}	−5.2		5.2	See formula note [3]
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL}	% of I_{PN}	−4.33		4.33	

Notes: [1] 3.3 V SP version available
[2] See page 16
[3] $\varepsilon_{SL}(T_A) = \varepsilon_{SL\,25} + \left(TCS + \dfrac{TCI_{OE}}{I_{PN}} \right) \times |T_A - 25|$

Electrical data HO 103.5-SW/SP4-0400

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

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		103.5		
Primary current, measuring range	I_{PM}	A	−258.75		258.75	
Number of primary turns	N_P	-		1		See application information
Supply voltage [1]	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		24	31	Unloaded and output mode = 0
Density of ones @ I_P = 0 A	D_{out}	%		50		
Density of ones @ ±I_{PN}	D_{out}	%		50 ±16		
Density of ones @ ±I_{PM}	D_{out}	%		50 ±40		
Allowed load capacitance	C_L	pF	0		30	
OCD output on resistance	$R_{on\,OCD}$	Ω	60	95	170	Open drain, active low. Over operating temperature range
OCD output hold time	$t_{hold\,OCD}$	ms	0.8	1.2	1.7	Additional time after threshold has released
EEPROM control	D_{out}	%		0		Forced to 0 when EEPROM in an error state
Electrical offset for PDM output (@ I_P = 0 A)	D_{OE}	%	−0.1		0.1	Relative to D_{out} = 50 %
Electrical offset current referred to primary	I_{OE}	A	−0.647		0.647	
Temperature coefficient of I_{OE} @ I_P = 0 A	TCI_{OE}	mA/K	−9.06		9.06	−40 °C … 105 °C
Nominal sensitivity	S_N	%/A		0.1546		16 % @ I_{PN}
Sensitivity error @ I_{PN}	ε_S	%	−1.1		1.1	Factory adjustment (straight bus bar)
Temperature coefficient of S	TCS	ppm/K	−350		350	−40 °C … 105 °C
Linearity error 0 … I_{PN}	ε_L	% of I_{PN}	−0.6		0.6	
Linearity error 0 … I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.92		0.92	One turn
Delay time to @ 90 % of the final output value for I_{PN} step	$t_{D\,90}$	µs			3.5	Determined by digital filter and OSR [2]
Primary current, detection threshold	$I_{P\,Th}$	A	2.67 × I_{PN}	2.97 × I_{PN}	3.27 × I_{PN}	Peak value ±10 %, overcurrent detection (OCD)
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1.7		1.7	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL}	% of I_{PN}	−5.2		5.2	See formula note [3]
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL}	% of I_{PN}	−4.33		4.33	

Notes: [1] 3.3 V SP version available

[2] See page 16

[3] $\varepsilon_{SL}(T_A) = \varepsilon_{SL\,25} + \left(TCS + \dfrac{TCI_{OE}}{I_{PN}}\right) \times |T_A - 25|$

Electrical data HO 126-SW/SP4-0400

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

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		126		
Primary current, measuring range	I_{PM}	A	−315		315	
Number of primary turns	N_P	-		1		See application information
Supply voltage [1]	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		24	31	Unloaded and output mode = 0
Density of ones @ I_P = 0 A	D_{out}	%		50		
Density of ones @ $\pm I_{PN}$	D_{out}	%		50 ±16		
Density of ones @ $\pm I_{PM}$	D_{out}	%		50 ±40		
Allowed load capacitance	C_L	pF	0		30	
OCD output on resistance	$R_{on\ OCD}$	Ω	60	95	170	Open drain, active low Over operating temperature range
OCD output hold time	$t_{hold\ OCD}$	ms	0.8	1.2	1.7	Additional time after threshold has released
EEPROM control	D_{out}	%		0		Forced to 0 when EEPROM in an error state
Electrical offset for PDM output (@ I_P = 0 A)	D_{OE}	%	−0.1		0.1	Relative to D_{out} = 50 %
Electrical offset current referred to primary	I_{OE}	A	−0.788		0.788	
Temperature coefficient of I_{OE} @ I_P = 0 A	TCI_{OE}	mA/K	−11.03		11.03	−40 °C … 105 °C
Nominal sensitivity	S_N	%/A		0.1270		16 % @ I_{PN}
Sensitivity error @ I_{PN}	ε_S	%	−1.1		1.1	Factory adjustment (straight bus bar)
Temperature coefficient of S	TCS	ppm/K	−350		350	−40 °C … 105 °C
Linearity error 0 … I_{PN}	ε_L	% of I_{PN}	−0.6		0.6	
Linearity error 0 … I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.92		0.92	One turn
Delay time to @ 90 % of the final output value for I_{PN} step	$t_{D\ 90}$	µs			3.5	Determined by digital filter and OSR [2]
Primary current, detection threshold	$I_{P\ Th}$	A	2.67 × I_{PN}	2.97 × I_{PN}	3.27 × I_{PN}	Peak value ±10 %, overcurrent detection (OCD)
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1.7		1.7	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL}	% of I_{PN}	−5.2		5.2	See formula note [3]
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL}	% of I_{PN}	−4.33		4.33	

Notes: [1] 3.3 V SP version available

[2] See page 16

[3] $\varepsilon_{SL}(T_A) = \varepsilon_{SL\ 25} + \left(TCS + \dfrac{TCI_{OE}}{I_{PN}} \right) \times \left| T_A - 25 \right|$

LEM reserves the right to carry out modifications on its transducers, in order to improve them.

Electrical data HO 154-SW/SP4-0400

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

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		154		
Primary current, measuring range	I_{PM}	A	−385		385	
Number of primary turns	N_P	-		1		See application information
Supply voltage [1]	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		24	31	Unloaded and output mode = 0
Density of ones @ I_P = 0 A	D_{out}	%		50		
Density of ones @ ±I_{PN}	D_{out}	%		50 ±16		
Density of ones @ ±I_{PM}	D_{out}	%		50 ±40		
Allowed load capacitance	C_L	pF	0		30	
OCD output on resistance	$R_{on\ OCD}$	Ω	60	95	170	Open drain, active low Over operating temperature range
OCD output hold time	$t_{hold\ OCD}$	ms	0.8	1.2	1.7	Additional time after threshold has released
EEPROM control	D_{out}	%		0		Forced to 0 when EEPROM in an error state
Electrical offset for PDM output (@ I_P = 0 A)	D_{OE}	%	−0.1		0.1	Relative to D_{out} = 50 %
Electrical offset current referred to primary	I_{OE}	A	−0.963		0.963	
Temperature coefficient of I_{OE} @ I_P = 0 A	TCI_{OE}	mA/K	−13.48		13.48	−40 °C … 105 °C
Nominal sensitivity	S_N	%/A		0.1039		16 % @ I_{PN}
Sensitivity error @ I_{PN}	ε_S	%	−1.1		1.1	Factory adjustment (straight bus bar)
Temperature coefficient of S	TCS	ppm/K	−350		350	−40 °C … 105 °C
Linearity error 0 … I_{PN}	ε_L	% of I_{PN}	−0.6		0.6	
Linearity error 0 … I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.92		0.92	One turn
Delay time to @ 90 % of the final output value for I_{PN} step	$t_{D\,90}$	µs			3.5	Determined by digital filter and OSR [2]
Primary current, detection threshold	$I_{P\,Th}$	A	2.67 × I_{PN}	2.97 × I_{PN}	3.27 × I_{PN}	Peak value ±10 %, overcurrent detection (OCD)
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1.7		1.7	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL}	% of I_{PN}	−5.2		5.2	See formula note [3]
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL}	% of I_{PN}	−4.33		4.33	

Notes: [1] 3.3 V SP version available
[2] See page 16
[3] $\varepsilon_{SL}(T_A) = \varepsilon_{SL\,25} + \left(TCS + \dfrac{TCI_{OE}}{I_{PN}} \right) \times |T_A - 25|$

LEM reserves the right to carry out modifications on its transducers, in order to improve them.

Electrical data HO 205-SW/SP4-0400

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

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		205		
Primary current, measuring range	I_{PM}	A	−512.5		512.5	
Number of primary turns	N_P	-		1		See application information
Supply voltage [1]	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		24	31	Unloaded and output mode = 0
Density of ones @ I_P = 0 A	D_{out}	%		50		
Density of ones @ ±I_{PN}	D_{out}	%		50 ±16		
Density of ones @ ±I_{PM}	D_{out}	%		50 ±40		
Allowed load capacitance	C_L	pF	0		30	
OCD output on resistance	$R_{on\,OCD}$	Ω	60	95	170	Open drain, active low Over operating temperature range
OCD output hold time	$t_{hold\,OCD}$	ms	0.8	1.2	1.7	Additional time after threshold has released
EEPROM control	D_{out}	%		0		Forced to 0 when EEPROM in an error state
Electrical offset for PDM output (@ I_P = 0 A)	D_{OE}	%	−0.1		0.1	Relative to D_{out} = 50 %
Electrical offset current referred to primary	I_{OE}	A	−1.281		1.281	
Temperature coefficient of I_{OE} @ I_P = 0 A	TCI_{OE}	mA/K	−17.94		17.94	−40 °C … 105 °C
Nominal sensitivity	S_N	%/A		0.0780		16 % @ I_{PN}
Sensitivity error @ I_{PN}	ε_S	%	−1.1		1.1	Factory adjustment (straight bus bar)
Temperature coefficient of S	TCS	ppm/K	−350		350	−40 °C … 105 °C
Linearity error 0 … I_{PN}	ε_L	% of I_{PN}	−0.6		0.6	
Linearity error 0 … I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.92		0.92	One turn
Delay time to @ 90 % of the final output value for I_{PN} step	$t_{D\,90}$	μs			3.5	Determined by digital filter and OSR [2]
Primary current, detection threshold	$I_{P\,Th}$	A	2.67 × I_{PN}	2.97 × I_{PN}	3.27 × I_{PN}	Peak value ±10 %, overcurrent detection (OCD)
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1.7		1.7	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL}	% of I_{PN}	−5.2		5.2	See formula note [3]
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL}	% of I_{PN}	−4.33		4.33	

Notes: [1] 3.3 V SP version available
[2] See page 16
[3] $\varepsilon_{SL}(T_A) = \varepsilon_{SL\,25} + \left(TCS + \dfrac{TCI_{OE}}{I_{PN}} \right) \times |T_A - 25|$

LEM reserves the right to carry out modifications on its transducers, in order to improve them.

Electrical data HO 236-SW/SP4-0400

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

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	I_{PN}	A		236		
Primary current, measuring range	I_{PM}	A	−590		590	
Number of primary turns	N_P	-		1		See application information
Supply voltage [1]	U_C	V	4.5	5	5.5	
Current consumption	I_C	mA		24	31	Unloaded and output mode = 0
Density of ones @ I_P = 0 A	D_{out}	%		50		
Density of ones @ $\pm I_{PN}$	D_{out}	%		50 ±16		
Density of ones @ $\pm I_{PM}$	D_{out}	%		50 ±40		
Allowed load capacitance	C_L	pF	0		30	
OCD output on resistance	$R_{on\ OCD}$	Ω	60	95	170	Open drain, active low. Over operating temperature range
OCD output hold time	$t_{hold\ OCD}$	ms	0.8	1.2	1.7	Additional time after threshold has released
EEPROM control	D_{out}	%		0		Forced to 0 when EEPROM in an error state
Electrical offset for PDM output (@ I_P = 0 A)	D_{OE}	%	−0.1		0.1	Relative to D_{out} = 50 %
Electrical offset current referred to primary	I_{OE}	A	−1.475		1.475	
Temperature coefficient of I_{OE} @ I_P = 0 A	TCI_{OE}	mA/K	−20.65		20.65	−40 °C … 105 °C
Nominal sensitivity	S_N	%/A		0.0678		16 % @ I_{PN}
Sensitivity error @ I_{PN}	ε_S	%	−1.1		1.1	Factory adjustment (straight bus bar)
Temperature coefficient of S	TCS	ppm/K	−350		350	−40 °C … 105 °C
Linearity error 0 … I_{PN}	ε_L	% of I_{PN}	−0.6		0.6	
Linearity error 0 … I_{PM}	ε_L	% of I_{PM}	−0.5		0.5	
Magnetic offset current (@ 10 × I_{PN}) referred to primary	I_{OM}	A	−0.92		0.92	One turn
Delay time to @ 90 % of the final output value for I_{PN} step	$t_{D\ 90}$	µs			3.5	Determined by digital filter and OSR [2]
Primary current, detection threshold	$I_{P\ Th}$	A	2.67 × I_{PN}	2.97 × I_{PN}	3.27 × I_{PN}	Peak value ±10 %, overcurrent detection (OCD)
Sum of sensitivity and linearity @ I_{PN}	ε_{SL}	% of I_{PN}	−1.7		1.7	
Sum of sensitivity and linearity @ I_{PN} @ T_A = +105 °C	ε_{SL}	% of I_{PN}	−5.2		5.2	See formula note [3]
Sum of sensitivity and linearity @ I_{PN} @ T_A = +85 °C	ε_{SL}	% of I_{PN}	−4.33		4.33	

Notes: [1] 3.3 V SP version available
[2] See page 16
[3] $\varepsilon_{SL}(T_A) = \varepsilon_{SL\ 25} + \left(TCS + \dfrac{TCI_{OE}}{I_{PN}} \right) \times |T_A - 25|$

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, minimum and maximum values are determined during the initial characterization of the product.

HO-SW/SP4-0400 output characteristics

Mode 0 and 8: 2 Wire CMOS
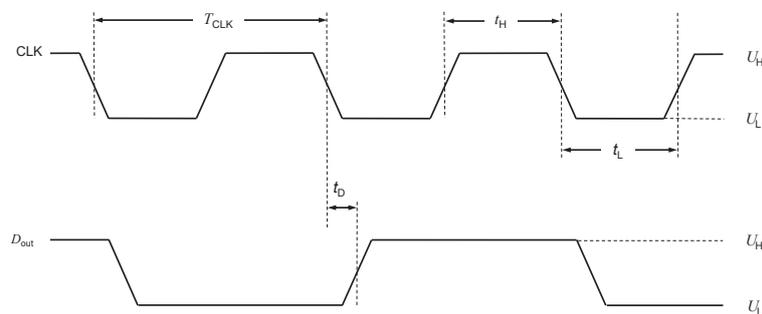
For all allowed capacitive range
● Timing for mode 0

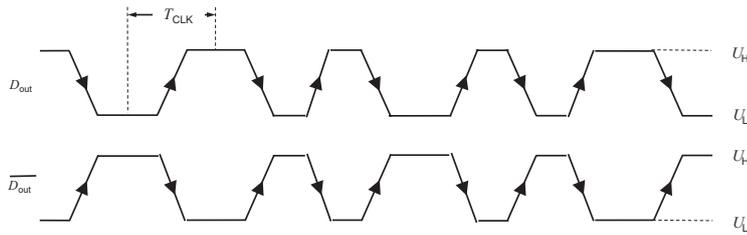| Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock period	T_{CLK}	ns	89	93.5	98	For internal clock
Temperature coefficient of clock period	$TCt_{per\ CLK}$	ppm/K	−400	0	400	−40 °C … 105 °C
Clock high time	$t_{CLK\ H}$	ns	$0.45 \times T_{CLK}$	46.75	$0.55 \times T_{CLK}$	
Clock falling edge to data delay	$t_{CLK\ D}$	ns	−25	0	25	

● Timing for mode 8

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock high time	$t_{CLK\ H}$	ns	$0.45 \times T_{CLK}$	$0.5 \times T_{CLK}$	$0.55 \times T_{CLK}$	
Clock falling edge to data delay	$t_{CLK\ D}$	ns	13	0	49	

In mode 8, you can use external clock from 5 to 10.1 MHz or from 11.4 to 12.5 MHz.
● Levels

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Low voltage	U_L	V			0.4	with $I_{out\ L}$ = 4 mA, unloaded
High voltage	U_H	V	$U_C - 0.4$			with $I_{out\ H}$ = −4 mA, unloaded

LEM reserves the right to carry out modifications on its transducers, in order to improve them.

Mode 1: 2 Wire RS 422 Manchester (ANSI/TIA/EIA-422-B and IEEE 802.3)

For all allowed capacitive range, R_L can be 100 Ohm.
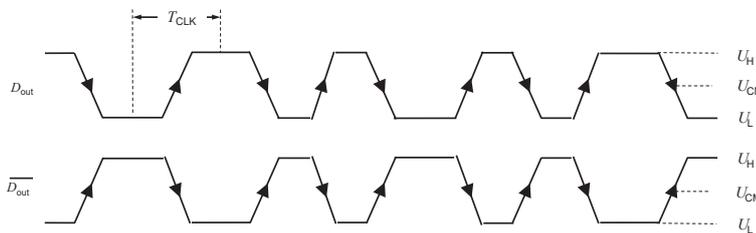Logical 1 is coding on a rising edge on D_{out}.
● Timing for mode 1

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock period	T_{CLK}	ns	89	93.5	98	f_{CLK}= 10.7 MHz ±5 %
Temperature coefficient of clock period	$TCt_{per\,CLK}$	ppm/K	−400	0	400	−40 °C … 105 °C

● Levels

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Low voltage	U_L	V			0.4	with $I_{out\,L}$ = 4 mA , unloaded
High voltage	U_H	V	U_C − 0.4			with $I_{out\,H}$ = −4 mA, unloaded

Mode 3: 2 Wire LVDS Manchester (ANSI/TIA/EIA-644-A and IEEE 802.3)

For all allowed capacitive range, recommended load resistor R_L = 100 Ohm.
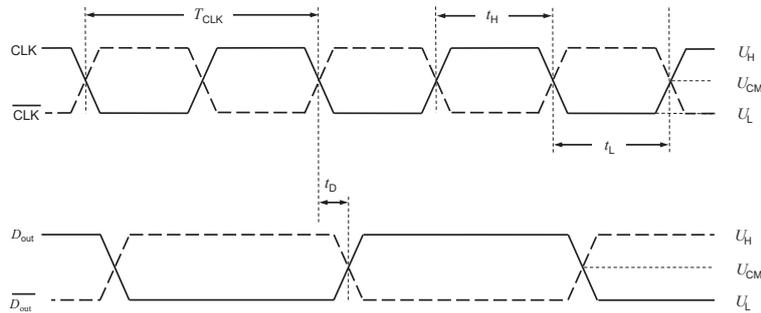Logical 1 is coding on a rising edge on D_{out}.
● Timing for mode 3

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock period	T_{CLK}	ns	89	93.5	98	f_{CLK}= 10.7 MHz ±5 %
Temperature coefficient of clock period	$TCt_{per\,CLK}$	ppm/K	−400	0	400	−40 °C … 105 °C

● Levels

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Low voltage	U_L	mV		$(−3.5 \times R_L) / 2$		Relative to U_{CM}
High voltage	U_H	mV		$(3.5 \times R_L) / 2$		Relative to U_{CM}
Common mode voltage	U_{CM}	V		1.25		

Mode 2 and A: 4 Wire LVDS (ANSI/TIA/EIA-644-A)

For all allowed capacitive range, recommended load resistor R_L = 100 Ohm.
- Timing for mode 2

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock period	T_{CLK}	ns	89	93.5	98	For internal clock
Temperature coefficient of clock period	$TCt_{per\,CLK}$	ppm/K	−400	0	400	−40 °C … 105 °C
Clock high time	$t_{CLK\,H}$	ns	$0.45 \times T_{CLK}$	46.75	$0.55 \times T_{CLK}$	
Clock falling edge to data delay	$t_{CLK\,D}$	ns	−25	0	25	

- Timing for mode A

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock high time	$t_{CLK\,H}$	ns	$0.45 \times T_{CLK}$	$0.5 \times T_{CLK}$	$0.55 \times T_{CLK}$	
Clock falling edge to data delay	$t_{CLK\,D}$	ns	13	0	49	

In mode A, you can use external clock from 5 to 10.1 MHz or from 11.4 to 12.5 MHz.
- Levels

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Low voltage	U_L	mV		$(-3.5 \times R_L) / 2$		Relative to U_{CM}
High voltage	U_H	mV		$(3.5 \times R_L) / 2$		Relative to U_{CM}
Common mode voltage	U_{CM}	V		1.25		

LEM reserves the right to carry out modifications on its transducers, in order to improve them.

Mode 4, C and D: 4 Wire RS 422 (ANSI/TIA/EIA-422-B)
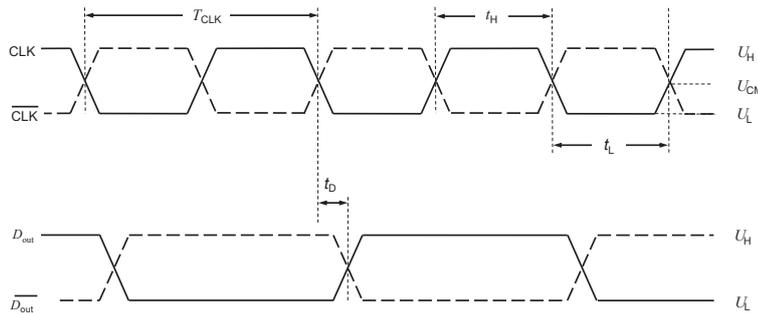
For all allowed capacitive range, R_L can be 100 Ohm.
● Timing for mode 4

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock period	T_{CLK}	ns	89	93.5	98	For internal clock
Temperature coefficient of clock period	$TCt_{per\,CLK}$	ppm/K	−400	0	400	−40 °C … 105 °C
Clock high time	$t_{CLK\,H}$	ns	$0.45 \times T_{CLK}$	46.75	$0.55 \times T_{CLK}$	
Clock falling edge to data delay	$t_{CLK\,D}$	ns	−25	0	25	

● Timing for mode C and D

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock high time	$t_{CLK\,H}$	ns	$0.45 \times T_{CLK}$	$0.5 \times T_{CLK}$	$0.55 \times T_{CLK}$	
Clock falling edge to data delay	$t_{CLK\,D}$	ns	13	0	49	

In mode C and D, you can use external clock from 5 to 10.1 MHz or from 11.4 to 12.5 MHz.
● Levels

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Low voltage	U_L	V			0.4	with $I_{out\,L}$ = 4 mA, unloaded
High voltage	U_H	V	$U_C - 0.4$			with $I_{out\,H}$ = −4 mA, unloaded
Common mode voltage in mode C	U_{CM}	V	$0.35 \times U_C$		$0.75 \times U_C$	
Common mode voltage in mode D	U_{CM}	V		0		

Mode D fully compatible with RS 422 standard (ANSI/TIA/EIA-422-B).
Capacitors on CLK and $\overline{CLK}$ signals needed to avoid common mode voltage.
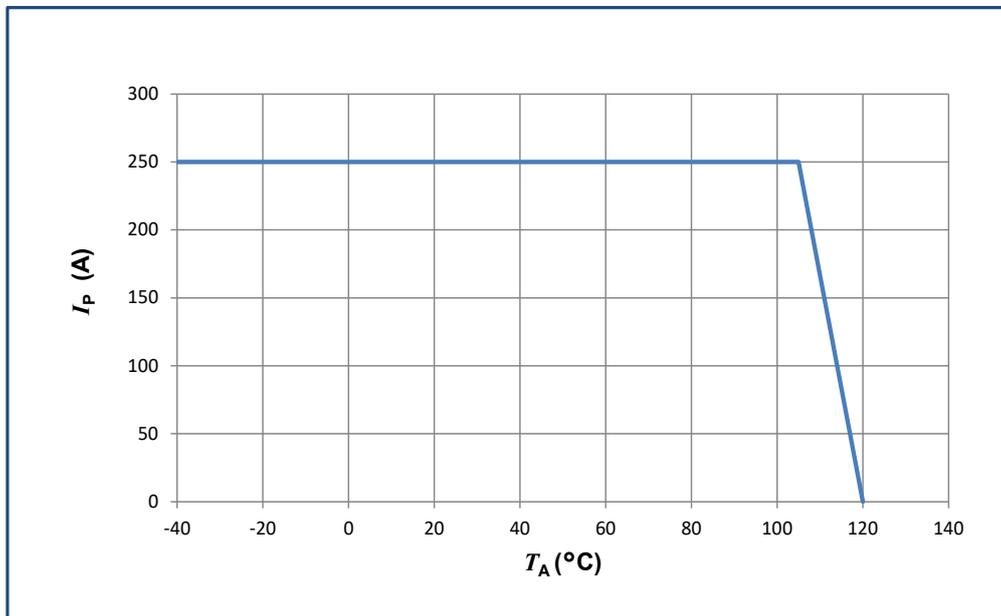
HO-SW/SP4-0400 output characteristics

Modulator output: Density of ones versus % of I_{PN}
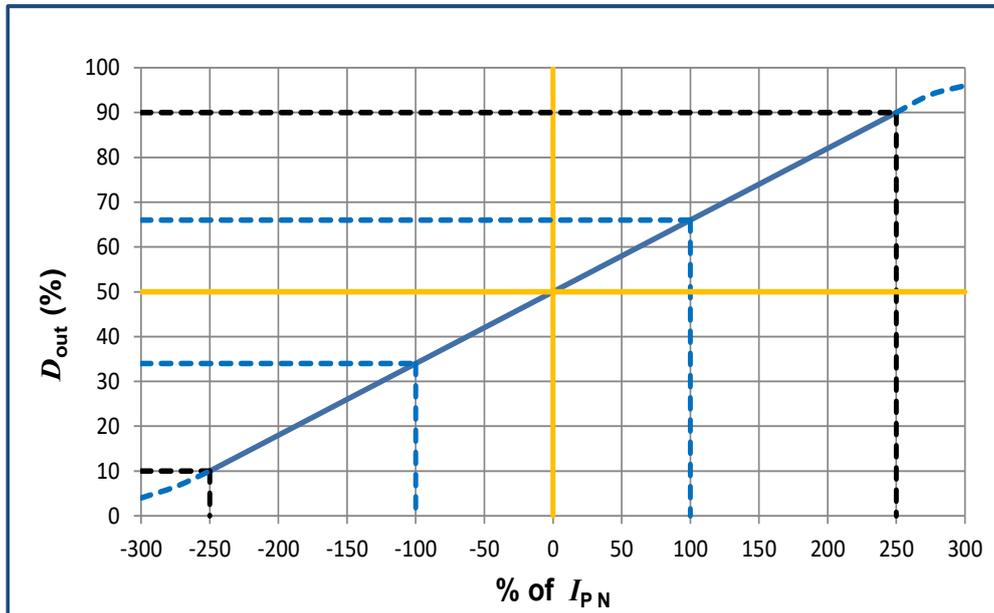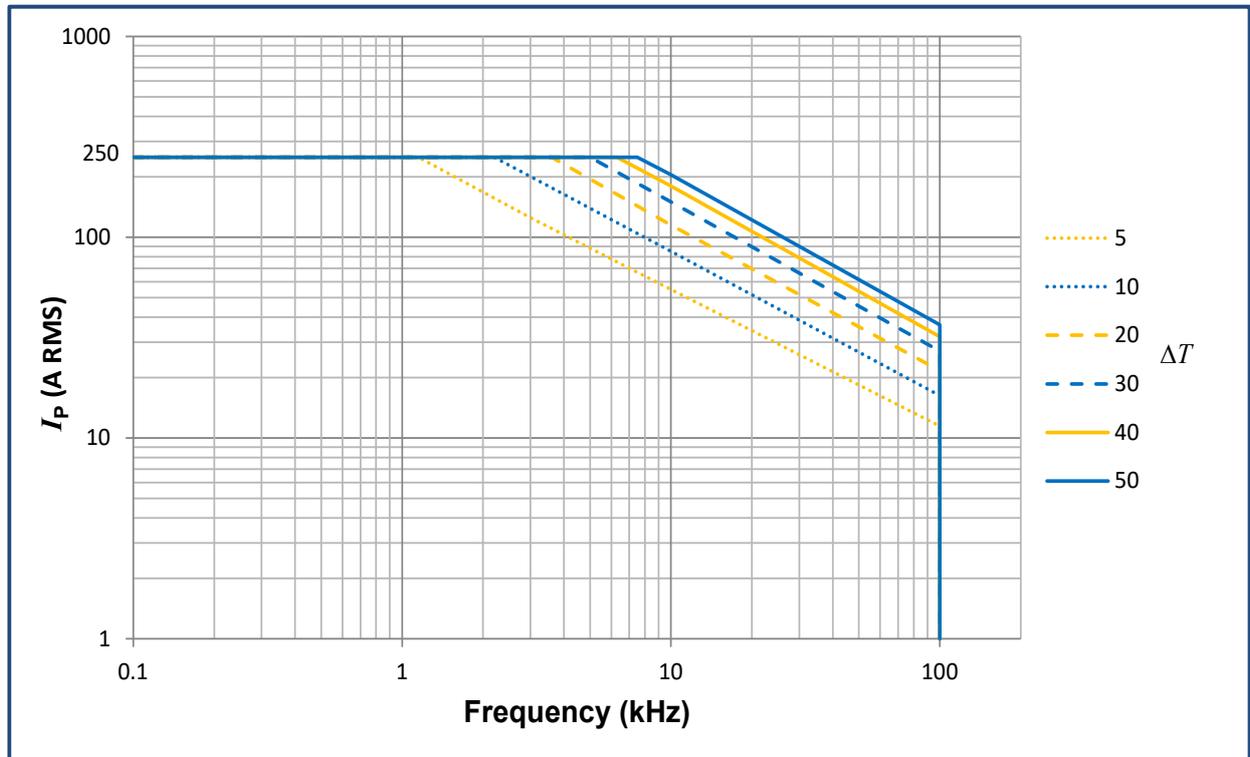

Maximum continuous DC current

For all ranges:

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

HO-SW/SP4-0400 output characteristics

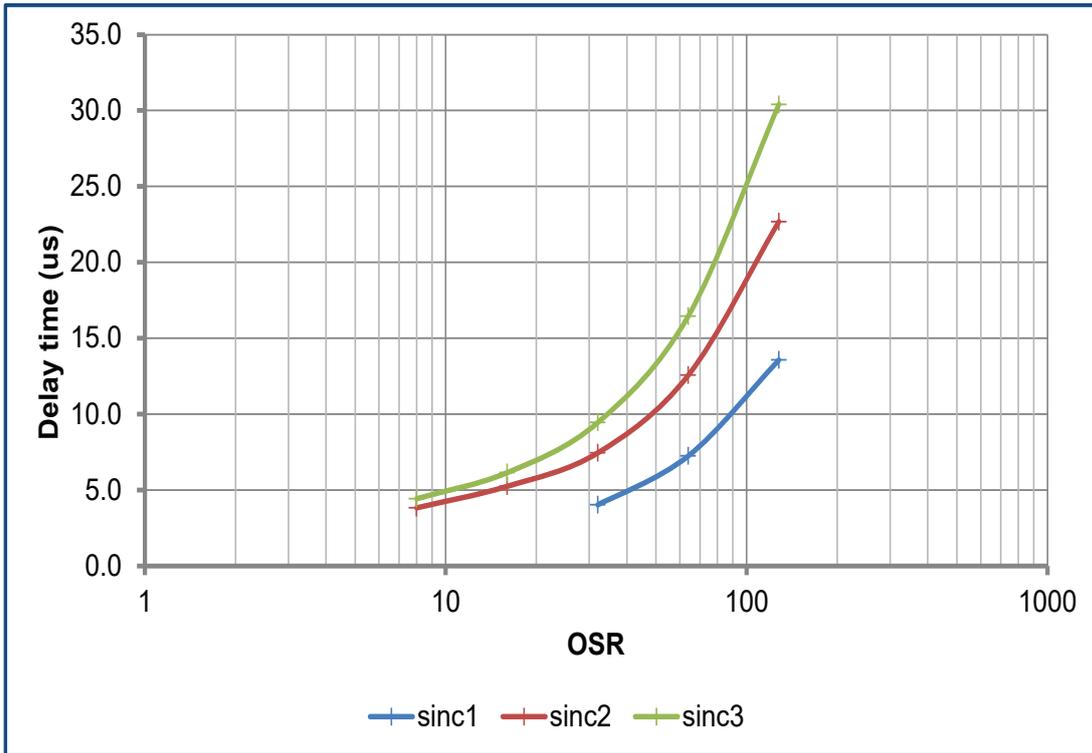### Frequency derating versus primary current and core temperature increase ΔT (°C)

Primary current in A RMS is sine wave.
Example:
Primary current ripple (sine wave): 50 A RMS
Ripple frequency: 20 kHz
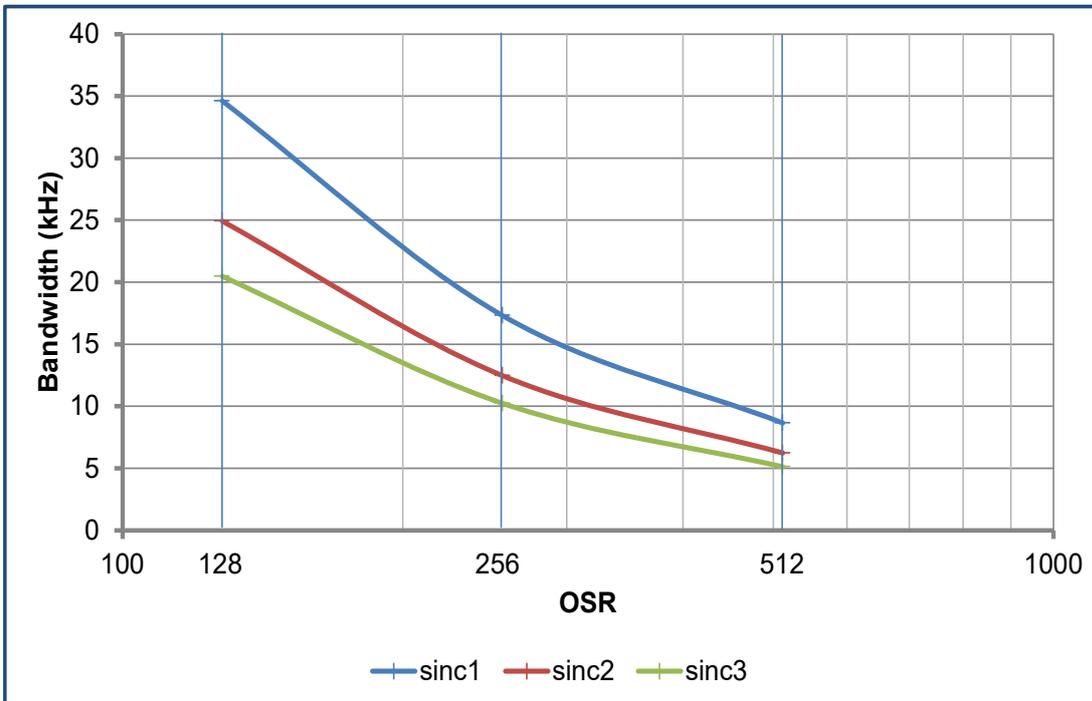- the core temperature increase is 10 °C.

Consumption

Typical values with C_L = 5 pF

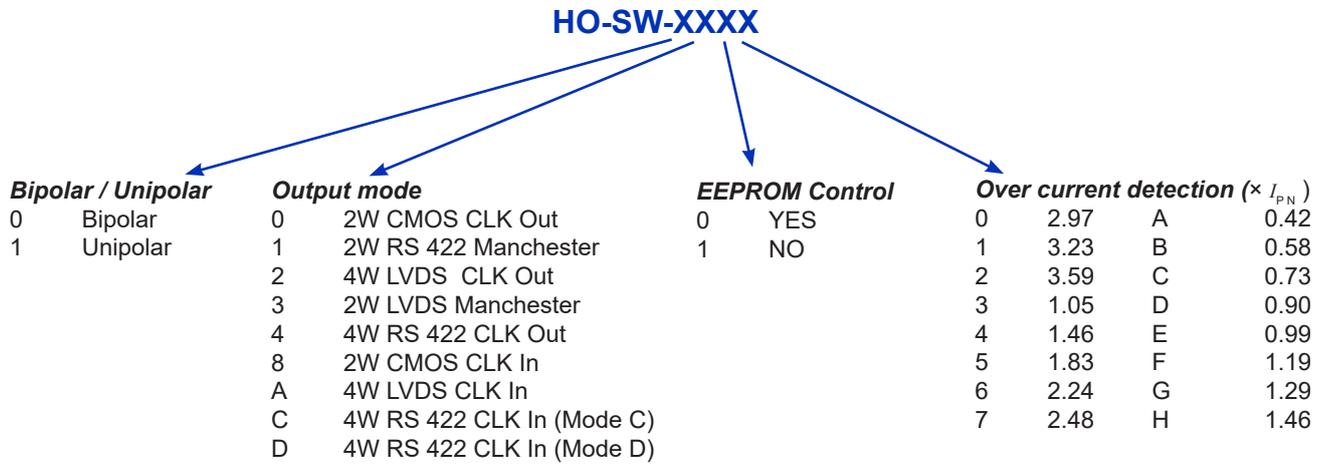| Output Mode	I_C unloaded (mA)	I_C with R_L = 100 Ohm (mA)
0	24	–
1	24	53
2	–	37
3	–	30
4	25	82
8	24	–
A	–	30
C	24	53
D	24	53

Delay time versus OSR

Bandwidth (−3 dB) versus OSR

Theoretical values due to customer filter configuration

HO-SW/SP4-0400: name and codification

HO-SW family products may be ordered **on request** [1] with a dedicated setting of the parameters as described below (standards products are delivered with the setting 0000 according to the table).

HO-SW-XXXX

Bipolar / Unipolar		Output mode		EEPROM Control		Over current detection ($\times I_{PN}$)			
0	Bipolar	0	2W CMOS CLK Out	0	YES	0	2.97	A	0.42
1	Unipolar	1	2W RS 422 Manchester	1	NO	1	3.23	B	0.58
		2	4W LVDS CLK Out			2	3.59	C	0.73
		3	2W LVDS Manchester			3	1.05	D	0.90
		4	4W RS 422 CLK Out			4	1.46	E	0.99
		8	2W CMOS CLK In			5	1.83	F	1.19
		A	4W LVDS CLK In			6	2.24	G	1.29
		C	4W RS 422 CLK In (Mode C)			7	2.48	H	1.46
		D	4W RS 422 CLK In (Mode D)						

Standard products are:

HO 100-SW-0000
HO 150-SW-0000
HO 200-SW-0000
HO 250-SW-0000

Other products available:

HO 100-SW-0100	HO 100-SW-0800
HO 150-SW-0100	HO 150-SW-0800
HO 200-SW-0100	HO 200-SW-0800
HO 250-SW-0100	HO 250-SW-0800
HO 100-SW-0200	HO 100-SW-0A00
HO 150-SW-0200	HO 150-SW-0A00
HO 200-SW-0200	HO 200-SW-0A00
HO 250-SW-0200	HO 250-SW-0A00
HO 100-SW-0300	HO 100-SW-0C00
HO 150-SW-0300	HO 150-SW-0C00
HO 200-SW-0300	HO 200-SW-0C00
HO 250-SW-0300	HO 250-SW-0C00
HO 100-SW-0400	HO 100-SW-0D00
HO 150-SW-0400	HO 150-SW-0D00
HO 200-SW-0400	HO 200-SW-0D00
HO 250-SW-0400	HO 250-SW-0D00

Note: [1] For dedicated settings, minimum quantities apply, please contact your local LEM support.

Application information

- HO-SW series is designed to use a bus-bar or a cable [1] to carry the current through out the aperture with a maximum capacity of 8 × 15 mm.
- Use of a bare conductor is not recommended with panel mounting (either horizontal or vertical) as insulation distances might be compromised between the busbar and fixation screws.

Note: [1] The maximum magnetic offset referred to primary is inversely proportional to the number of turns, thus is divided by 2 with 2 turns.
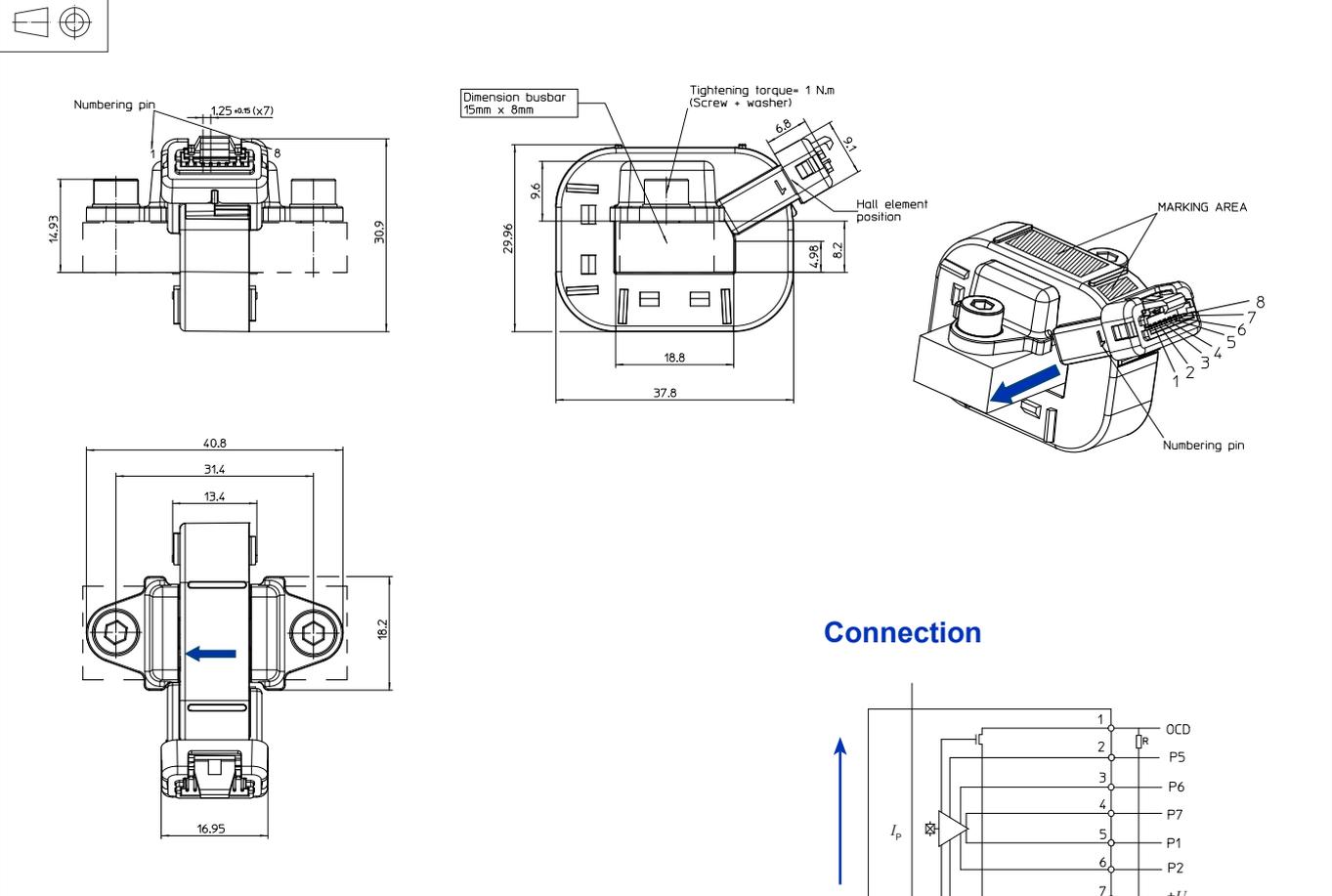
Remark

Installation of the transducer must be done unless otherwise specified on the datasheet, according to LEM Transducer Generic Mounting Rules. Please refer to LEM document N°ANE120504 available on our Web site: **https://www.lem.com/en/file/3137/download**

Insulation distance (nominal values):
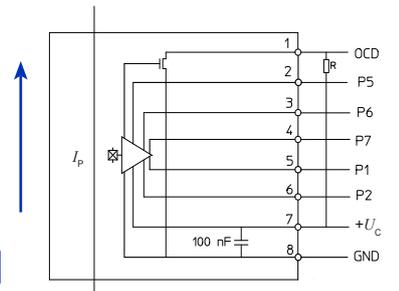
	d_{Cp}	d_{Cl}
Between primary busbar and secondary pin	14.6 mm	-
Between primary busbar and core	-	12.6 mm
Between core and secondary terminal	-	1.18 mm

Dimensions (in mm, general linear tolerance ±0.6 mm)

Mounting example: busbar

	Output Mode	P5	P6	P7	P1	P2
4	4W RS 422 CLK Out	GND or NC	CLK	$\overline{CLK}$	$\overline{D_{out}}$	D_{out}

Connection

Remarks:

- Density of ones is greater than 50 % when positive I_P flows in direction of the arrow shown on the drawing above.
- Connection system: equivalent to HARWIN M30-6100846 type.