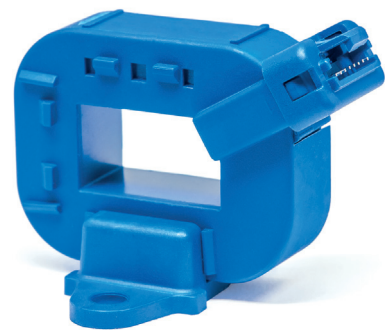


# Current Transducer HO-SW series

$I_{PN} = 100 \dots 250 \text{ A}$

Ref: HO 100-SW; HO 150-SW; HO 200-SW; HO 250-SW

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 2<sup>nd</sup> order Sigma-Delta modulator, (PDM) Pulse Density Modulation
- Single supply +5 V
- Overcurrent detect  $2.97 \times I_{PN}$  (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 16).

## Advantages

- Low offset drift
- Creepage / clearance 8 mm
- Fast response.

## 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
- UL 508: 2013.

## Application Domain

- Industrial.

N° 97.P7.34.000.0; N° 97.P7.34.001.0; N° 97.P7.34.002.0; N° 97.P7.34.003.0; N° 97.P7.34.004.0 N° 97.P7.34.005.0; N° 97.P7.34.006.0; N° 97.P7.34.007.0; N° 97.P7.34.008.0; N° 97.P7.39.000.0; N° 97.P7.39.001.0; N° 97.P7.39.002.0; N° 97.P7.39.003.0; N° 97.P7.39.004.0; N° 97.P7.39.005.0 N° 97.P7.39.006.0; N° 97.P7.39.007.0; N° 97.P7.39.008.0; N° 97.P7.44.000.0; N° 97.P7.44.001.0; N° 97.P7.44.002.0; N° 97.P7.44.003.0; N° 97.P7.44.004.0; N° 97.P7.44.005.0; N° 97.P7.44.006.0; N° 97.P7.44.007.0; N° 97.P7.44.008.0; N° 97.P7.45.000.0; N° 97.P7.45.001.0; N° 97.P7.45.002.0; N° 97.P7.45.003.0; N° 97.P7.45.004.0; N° 97.P7.45.005.0; N° 97.P7.45.006.0; N° 97.P7.45.007.0; N° 97.P7.45.008.0;

## 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.

## 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 17

### Ratings

Parameter	Symbol	Unit	Value
Primary potential involved <sup>1)</sup>		V AC/DC	600
Max 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

**Note:** <sup>1)</sup> Primary potential involved is 600 V AC/DC according to Canadian Standard CSA C22.2.

### 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 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.

**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 $\mu$ s	$U_{Ni}$	kV	8	
Partial discharge RMS test voltage (adjusted $q_m < 10$ pC)	$U_t$	V	1500	Busbar/Secondary Jumper/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	$T_{A\text{st}}$	°C	-40		105	
Mass	$m$	g		32		

**Electrical data HO 100-SW**

 At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 17).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		100		
Primary current, measuring range	$I_{PM}$	A	-250		250	
Number of primary turns	$N_P$	-		1		See application information
Supply voltage	$U_C$	V	4.5	5	5.5	
Current consumption	$I_C$	mA		24	31	Unloaded and output mode = 0
Density of ones @ $I_P = 0\text{ A}$	$D_{out}$	%		50		
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		$50 \pm 16$		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		$50 \pm 40$		
Allowed load capacitance	$C_L$	pF	0		30	
OCD output on resistance	$R_{on\text{OCD}}$	$\Omega$	60	95	170	Open drain, active low Over operating temperature range
OCD output hold time	$t_{hold\text{OCD}}$	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 (@ $I_P = 0\text{ A}$ )	$D_{OE}$	%	-0.1		0.1	Relative to $D_{out} = 50\%$
Electrical offset current referred to primary	$I_{OE}$	A	-0.625		0.625	
Temperature coefficient of $I_{OE}$ @ $I_P = 0\text{ A}$	$TCI_{OE}$	mA/K	-8.75		8.75	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.16		16 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\varepsilon_S$	%	-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 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.6		0.6	
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.5		0.5	
Magnetic offset current (@ $10 \times I_{PN}$ ) 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	$t_{D90}$	$\mu\text{s}$				Determined by digital filter and OSR
Primary current, detection threshold	$I_{PTh}$	A	$2.67 \times I_{PN}$	$2.97 \times I_{PN}$	$3.27 \times I_{PN}$	Peak value $\pm 10\%$ , overcurrent detection (OCD)
Sum of sensitivity and linearity @ $I_{PN}$	$\varepsilon_{SL}$	% of $I_{PN}$	-1.7		1.7	
Sum of sensitivity and linearity @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\varepsilon_{SL}$	% of $I_{PN}$	-5.2		5.2	
Sum of sensitivity and linearity @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\varepsilon_{SL}$	% of $I_{PN}$	-4.33		4.33	See formula note <sup>1)</sup>

**Notes:** <sup>1)</sup> 3.3 V SP version available

<sup>2)</sup> See page 13

<sup>3)</sup> See page 15

<sup>4)</sup> 
$$\varepsilon_{SL}(T_A) = \varepsilon_{SL25} + \left( TCS + \frac{TCI_{OE}}{I_{PN}} \right) \times |T_A - 25|$$

**Electrical data HO 150-SW**

At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 17).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		150		
Primary current, measuring range	$I_{PM}$	A	-375		375	
Number of primary turns	$N_P$	-		1		See application information
Supply voltage	$U_C$	V	4.5	5	5.5	
Current consumption	$I_C$	mA		24	31	Unloaded and output mode = 0
Density of ones @ $I_P = 0\text{ A}$	$D_{out}$	%		50		
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		$50 \pm 16$		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		$50 \pm 40$		
Allowed load capacitance	$C_L$	pF	0		30	
OCD output on resistance	$R_{on\text{OCD}}$	$\Omega$	60	95	170	Open drain, active low Over operating temperature range
OCD output hold time	$t_{hold\text{OCD}}$	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 (@ $I_P = 0\text{ A}$ )	$D_{OE}$	%	-0.1		0.1	Relative to $D_{out} = 50\%$
Electrical offset current referred to primary	$I_{OE}$	A	-0.94		0.94	
Temperature coefficient of $I_{OE}$ @ $I_P = 0\text{ A}$	$TCI_{OE}$	mA/K	-13.1		13.1	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.1067		16 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\varepsilon_S$	%	-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 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.5		0.5	
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.5		0.5	
Magnetic offset current (@ $10 \times I_{PN}$ ) 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	$t_{D90}$	$\mu\text{s}$				Determined by digital filter and OSR
Primary current, detection threshold	$I_{PTh}$	A	$2.67 \times I_{PN}$	$2.97 \times I_{PN}$	$3.27 \times I_{PN}$	Peak value $\pm 10\%$ , overcurrent detection (OCD)
Sum of sensitivity and linearity @ $I_{PN}$	$\varepsilon_{SL}$	% of $I_{PN}$	-1.6		1.6	
Sum of sensitivity and linearity @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\varepsilon_{SL}$	% of $I_{PN}$	-5.1		5.1	See formula note <sup>1)</sup>
Sum of sensitivity and linearity @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\varepsilon_{SL}$	% of $I_{PN}$	-4.23		4.23	

**Notes:** <sup>1)</sup> 3.3 V SP version available

<sup>2)</sup> See page 13

<sup>3)</sup> See page 15

$$\varepsilon_{SL}(T_A) = \varepsilon_{SL25} + \left( TCS + \frac{TCI_{OE}}{I_{PN}} \right) \times |T_A - 25|$$

**Electrical data HO 200-SW**

At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 17).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		200		
Primary current, measuring range	$I_{PM}$	A	-500		500	
Number of primary turns	$N_P$	-		1		See application information
Supply voltage	$U_C$	V	4.5	5	5.5	
Current consumption	$I_C$	mA		24	31	Unloaded and output mode = 0
Density of ones @ $I_P = 0\text{ A}$	$D_{out}$	%		50		
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		$50 \pm 16$		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		$50 \pm 40$		
Allowed load capacitance	$C_L$	pF	0		30	
OCD output on resistance	$R_{on\text{OCD}}$	$\Omega$	60	95	170	Open drain, active low Over operating temperature range
OCD output hold time	$t_{hold\text{OCD}}$	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 (@ $I_P = 0\text{ A}$ )	$D_{OE}$	%	-0.1		0.1	Relative to $D_{out} = 50\%$
Electrical offset current referred to primary	$I_{OE}$	A	-1.25		1.25	
Temperature coefficient of $I_{OE}$ @ $I_P = 0\text{ A}$	$TCI_{OE}$	mA/K	-17.5		17.5	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.08		16 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\varepsilon_S$	%	-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 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.5		0.5	
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.5		0.5	
Magnetic offset current (@ $10 \times I_{PN}$ ) 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	$t_{D90}$	$\mu\text{s}$				Determined by digital filter and OSR
Primary current, detection threshold	$I_{PTh}$	A	$2.67 \times I_{PN}$	$2.97 \times I_{PN}$	$3.27 \times I_{PN}$	Peak value $\pm 10\%$ , overcurrent detection (OCD)
Sum of sensitivity and linearity @ $I_{PN}$	$\varepsilon_{SL}$	% of $I_{PN}$	-1.6		1.6	
Sum of sensitivity and linearity @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\varepsilon_{SL}$	% of $I_{PN}$	-5.1		5.1	
Sum of sensitivity and linearity @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\varepsilon_{SL}$	% of $I_{PN}$	-4.23		4.23	See formula note <sup>1)</sup>

Notes: <sup>1)</sup> 3.3 V SP version available

<sup>2)</sup> See page 13

<sup>3)</sup> See page 15

$$\varepsilon_{SL}(T_A) = \varepsilon_{SL25} + \left( TCS + \frac{TCI_{OE}}{I_{PN}} \right) \times |T_A - 25|$$

**Electrical data HO 250-SW**

 At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 17).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		250		
Primary current, measuring range	$I_{PM}$	A	-625		625	
Number of primary turns	$N_P$	-		1		See application information
Supply voltage	$U_C$	V	4.5	5	5.5	
Current consumption	$I_C$	mA		24	31	Unloaded and output mode = 0
Density of ones @ $I_P = 0\text{ A}$	$D_{out}$	%		50		
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		$50 \pm 16$		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		$50 \pm 40$		
Allowed load capacitance	$C_L$	pF	0		30	
OCD output on resistance	$R_{on\text{OCD}}$	$\Omega$	60	95	170	Open drain, active low Over operating temperature range
OCD output hold time	$t_{hold\text{OCD}}$	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 (@ $I_P = 0\text{ A}$ )	$D_{OE}$	%	-0.1		0.1	Relative to $D_{out} = 50\%$
Electrical offset current referred to primary	$I_{OE}$	A	-1.56		1.56	
Temperature coefficient of $I_{OE}$ @ $I_P = 0\text{ A}$	$TCI_{OE}$	mA/K	-21.9		21.9	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.064		16 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\varepsilon_S$	%	-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 ... $I_{PN}$	$\varepsilon_L$	% of $I_{PN}$	-0.5		0.5	
Linearity error 0 ... $I_{PM}$	$\varepsilon_L$	% of $I_{PM}$	-0.5		0.5	
Magnetic offset current (@ $10 \times I_{PN}$ ) 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	$t_{D90}$	$\mu\text{s}$				Determined by digital filter and OSR
Primary current, detection threshold	$I_{PTh}$	A	$2.67 \times I_{PN}$	$2.97 \times I_{PN}$	$3.27 \times I_{PN}$	Peak value $\pm 10\%$ , overcurrent detection (OCD)
Sum of sensitivity and linearity @ $I_{PN}$	$\varepsilon_{SL}$	% of $I_{PN}$	-1.6		1.6	
Sum of sensitivity and linearity @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\varepsilon_{SL}$	% of $I_{PN}$	-5.1		5.1	
Sum of sensitivity and linearity @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\varepsilon_{SL}$	% of $I_{PN}$	-4.23		4.23	See formula note <sup>1)</sup>

**Notes:** <sup>1)</sup> 3.3 V SP version available

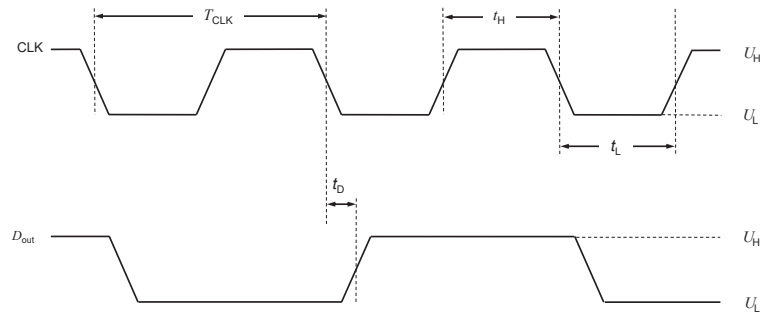
<sup>2)</sup> See page 13

<sup>3)</sup> See page 15

<sup>4)</sup> 
$$\varepsilon_{SL}(T_A) = \varepsilon_{SL25} + \left( TCS + \frac{TCI_{OE}}{I_{PN}} \right) \times |T_A - 25|$$

## HO-SW series 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

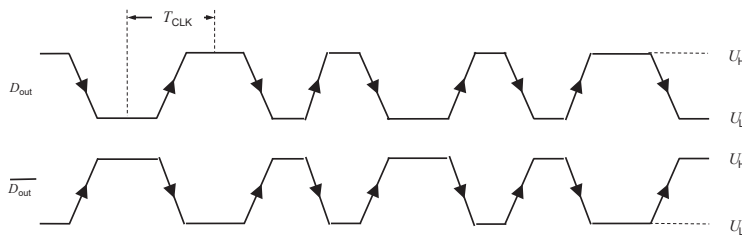
Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock high time	$t_{CLK H}$	ns	$0.45 \times T_{CLK}$	$0.5 \times T_{CLK}$	$0.55 \times T_{CLK}$	
Clock falling edge to data delay	$t_{CLK D}$	ns	13	0	49	

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



**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.

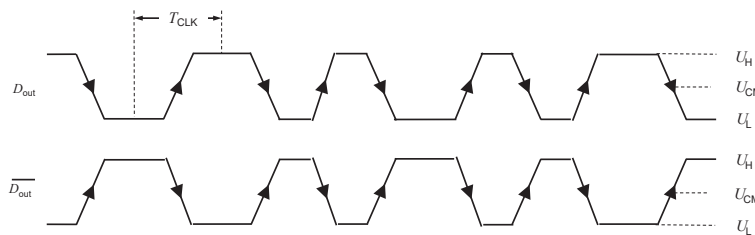
Logical 1 is coding on a rising edge on  $D_{out}$ .

- Timing for mode 1

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock period	$T_{CLK}$	ns	89	93.5	98	$f_{CLK} = 10.7 \text{ MHz} \pm 5 \%$
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 $I_{outL} = 4 \text{ mA}$ , unloaded
High voltage	$U_H$	V	$U_C - 0.4$			with $I_{outH} = -4 \text{ mA}$ , unloaded

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


For all allowed capacitive range, recommended load resistor  $R_L = 100 \text{ Ohm}$ .

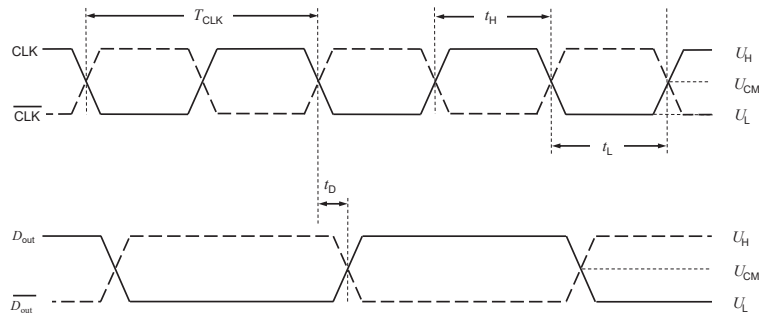
Logical 1 is coding on a rising edge on  $D_{out}$ .

- Timing for mode 3

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock period	$T_{CLK}$	ns	89	93.5	98	$f_{CLK} = 10.7 \text{ MHz} \pm 5 \%$
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  $R_L = 100 \text{ Ohm}$ .

- Timing for mode 2

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

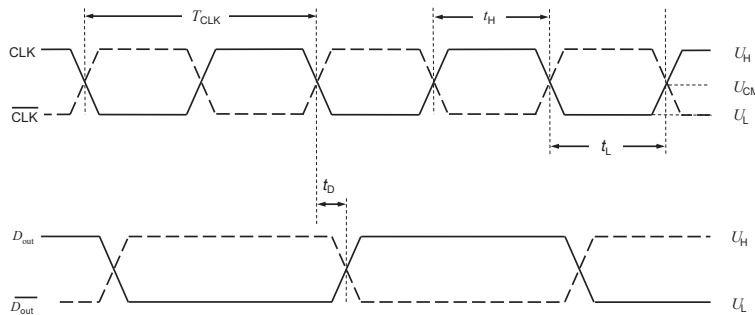
- Timing for mode A

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock high time	$t_{\text{CLK H}}$	ns	$0.45 \times T_{\text{CLK}}$	$0.5 \times T_{\text{CLK}}$	$0.55 \times T_{\text{CLK}}$	
Clock falling edge to data delay	$t_{\text{CLK D}}$	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 $U_{\text{CM}}$
High voltage	$U_H$	mV		$(3.5 \times R_L) / 2$		Relative to $U_{\text{CM}}$
Common mode voltage	$U_{\text{CM}}$	V		1.25		

**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	$TCr_{per CLK}$	ppm/K	-400	0	400	-40 °C ... 105 °C
Clock high time	$t_{CLKH}$	ns	$0.45 \times T_{CLK}$	46.75	$0.55 \times T_{CLK}$	
Clock falling edge to data delay	$t_{CLKD}$	ns	-25	0	25	

- Timing for mode C and D

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock high time	$t_{CLKH}$	ns	$0.45 \times T_{CLK}$	$0.5 \times T_{CLK}$	$0.55 \times T_{CLK}$	
Clock falling edge to data delay	$t_{CLKD}$	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

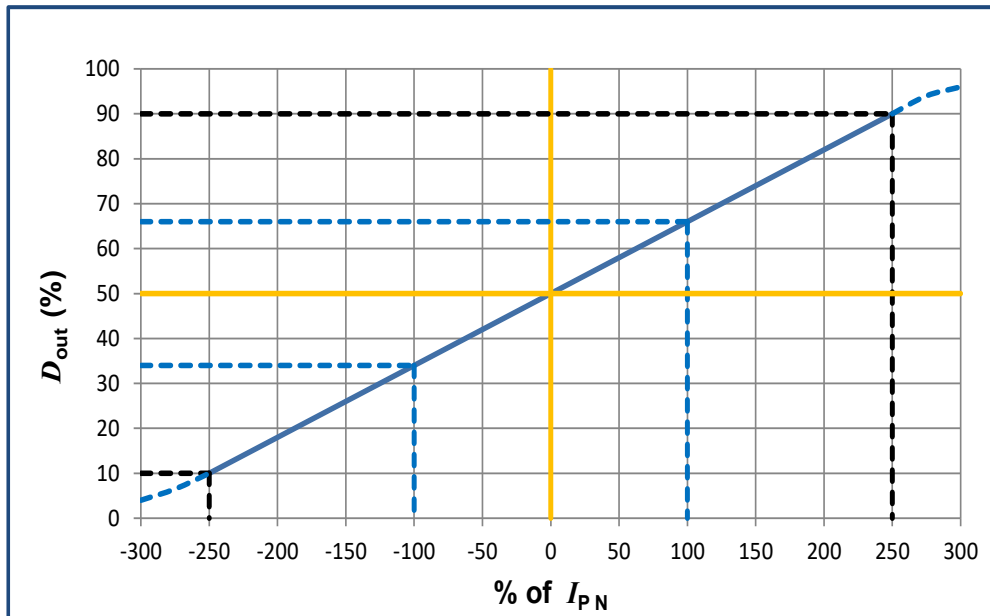
Parameter	Symbol	Unit	Min	Typ	Max	Comment
Low voltage	$U_L$	V			0.4	with $I_{outL} = 4$ mA, unloaded
High voltage	$U_H$	V	$U_C - 0.4$			with $I_{outH} = -4$ mA, unloaded
Common mode voltage in mode C	$U_{CM}$	V	$0.35 \times U_C$		$0.75 \times U_C$	
Common mode voltage in mode D	$U_{CM}$	V		0		

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.

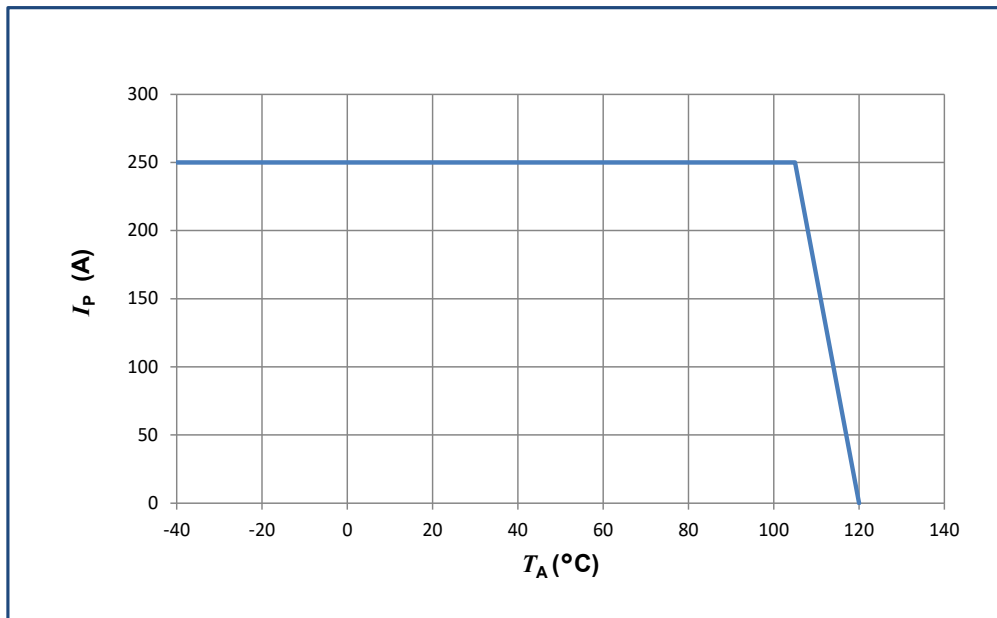
HO-SW series output characteristics

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



Maximum continuous DC current

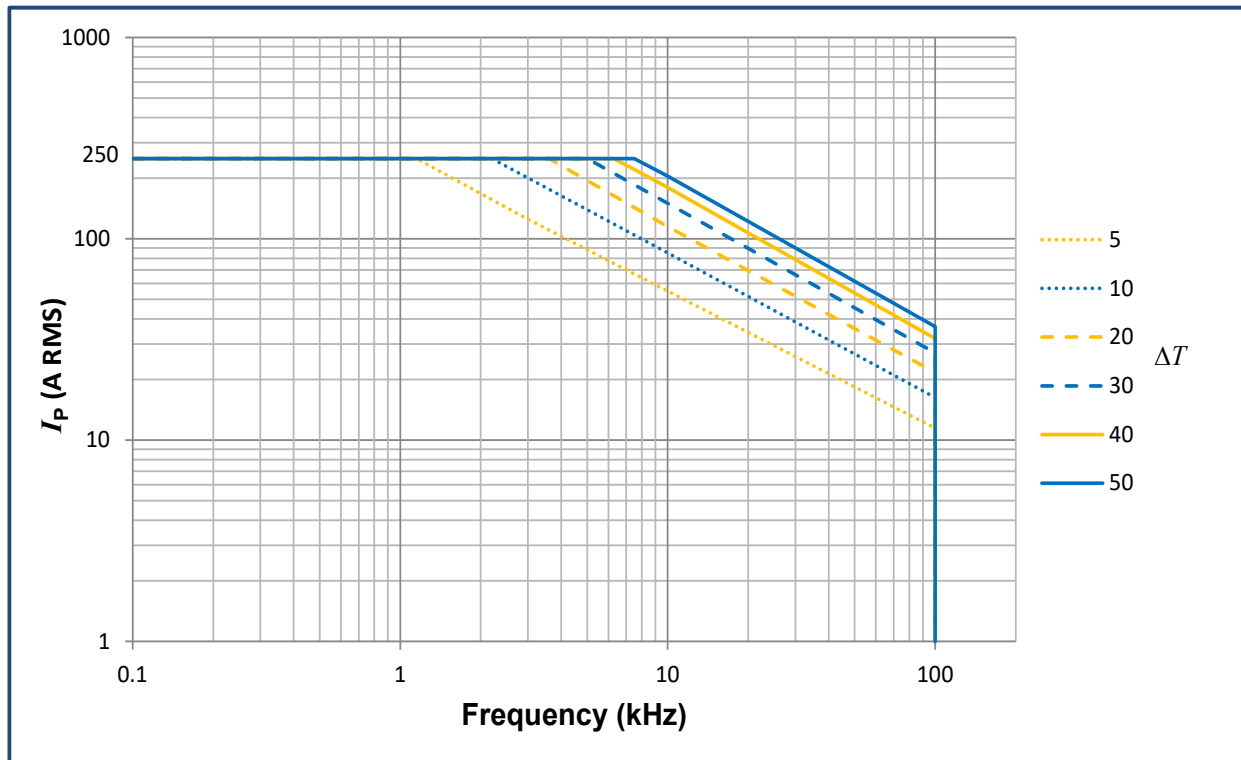
For all ranges:



**Important notice:** whatever the usage and/or application, the transducer primary bar / jumper temperature shall not go above the maximum rating of 120 °C as stated in page 2 of this datasheet.

HO-SW series output characteristics

Frequency derating versus primary current and core temperature increase  $\Delta T$  (°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.

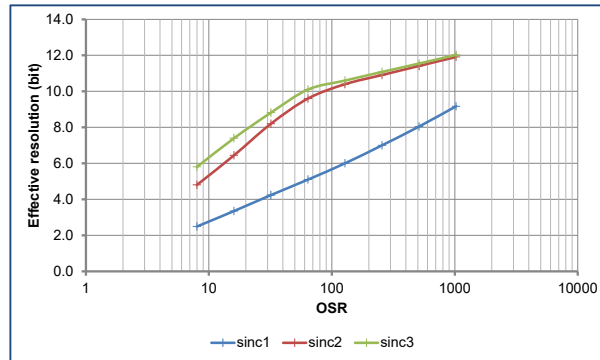
Consumption

Typical values with  $C_L = 5$  pF

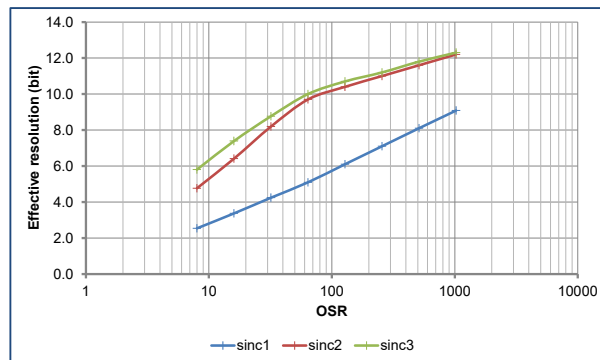
Output Mode	$I_c$ unloaded (mA)	$I_c$ with $R_L = 100$ Ohm (mA)
0	24	-
1	24	53
2	-	37
3	-	30
4	25	82
8	24	-
A	-	30
C	24	53
D	24	53

### Effective resolution versus OSR

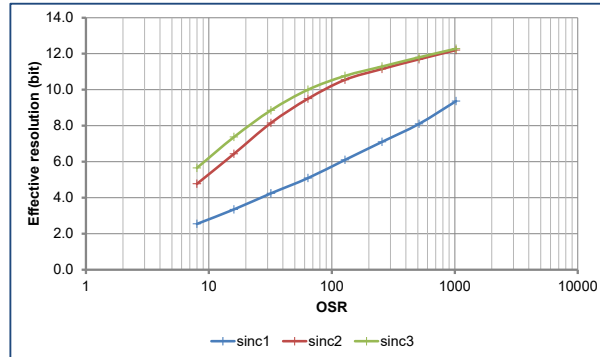
HO 100-SW-xxxx



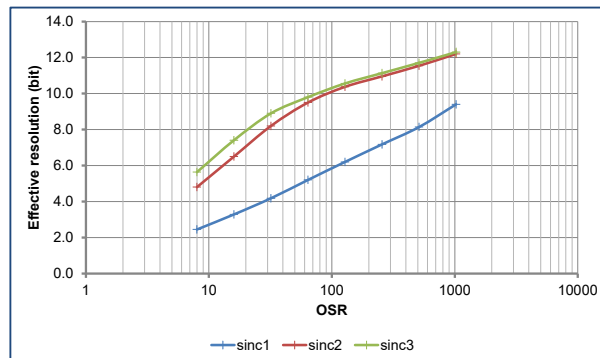
HO 150-SW-xxxx



HO 200-SW-xxxx



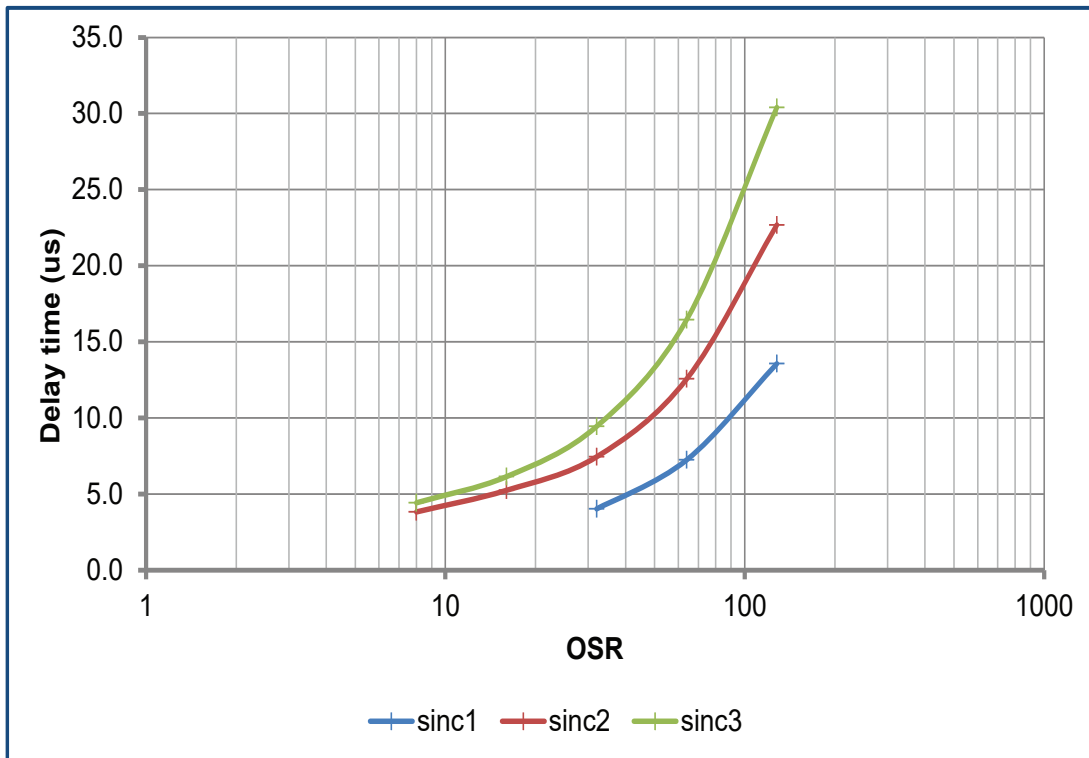
HO 250-SW-xxxx



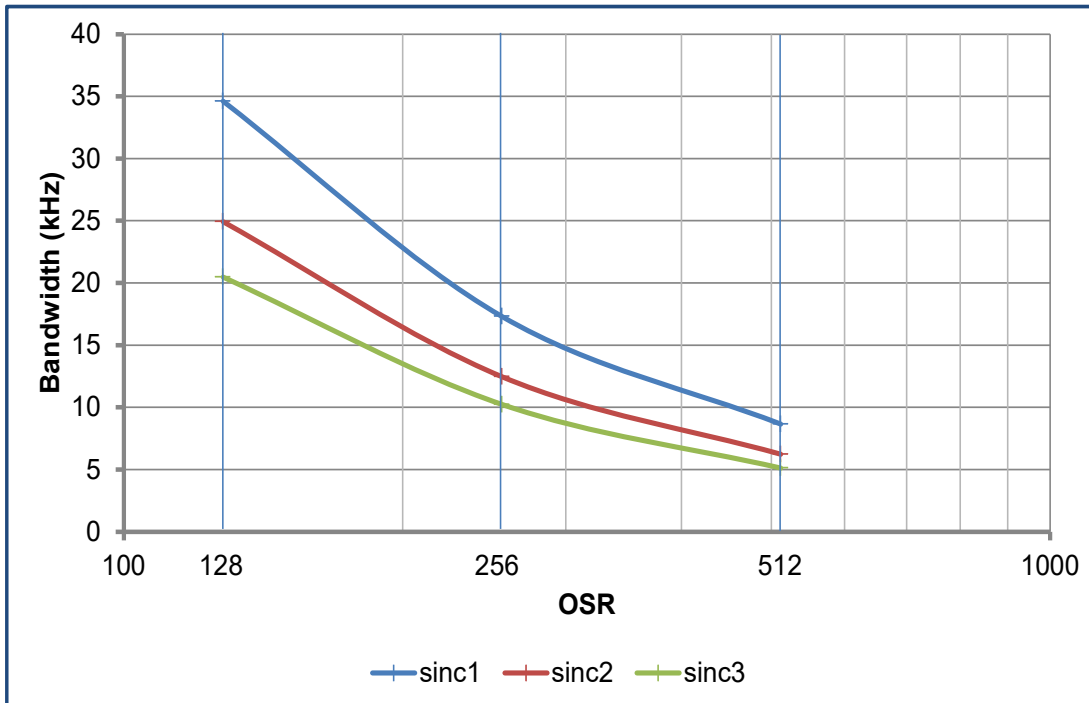
### Signal to noise ratio

$$\text{SNR (dB)} = 20 \cdot \log_{10}(2) / \text{Effective resolution}$$

Delay time versus OSR



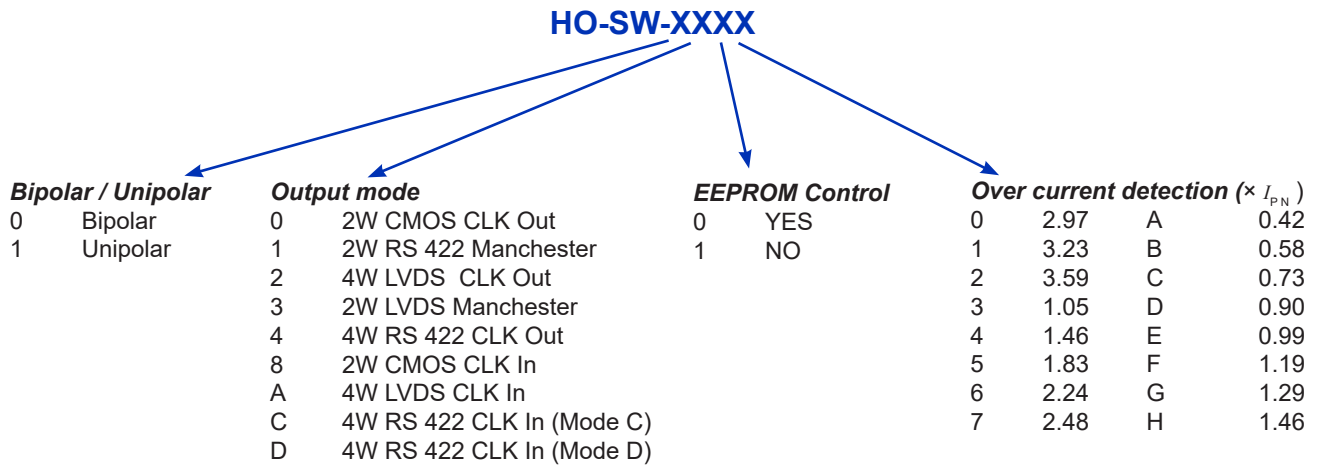
Bandwidth (-3 dB) versus OSR



Theoretical values due to customer filter configuration

**HO-SW series: name and codification**

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



**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:** <sup>1)</sup> 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 <sup>1)</sup> 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:** <sup>1)</sup> The maximum magnetic offset referred to primary is inversely proportional to the number of turns, thus is divided by 2 with 2 turns.

## 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.

## 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>

## Safety

This transducer must be used in limited-energy secondary circuits according to IEC 61010-1.



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

When operating the transducer, certain parts of the module can carry hazardous voltage (eg. primary busbar, power supply). Ignoring this warning can lead to injury and/or cause serious damage. This transducer is a build-in device, whose conducting parts must be inaccessible after installation. A protective housing or additional shield could be used. Main supply must be able to be disconnected.

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

## Insulation distance (nominal values):

	$d_{CP}$	$d_{CI}$
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  $\pm 0.6$  mm)

Mounting example: horizontal

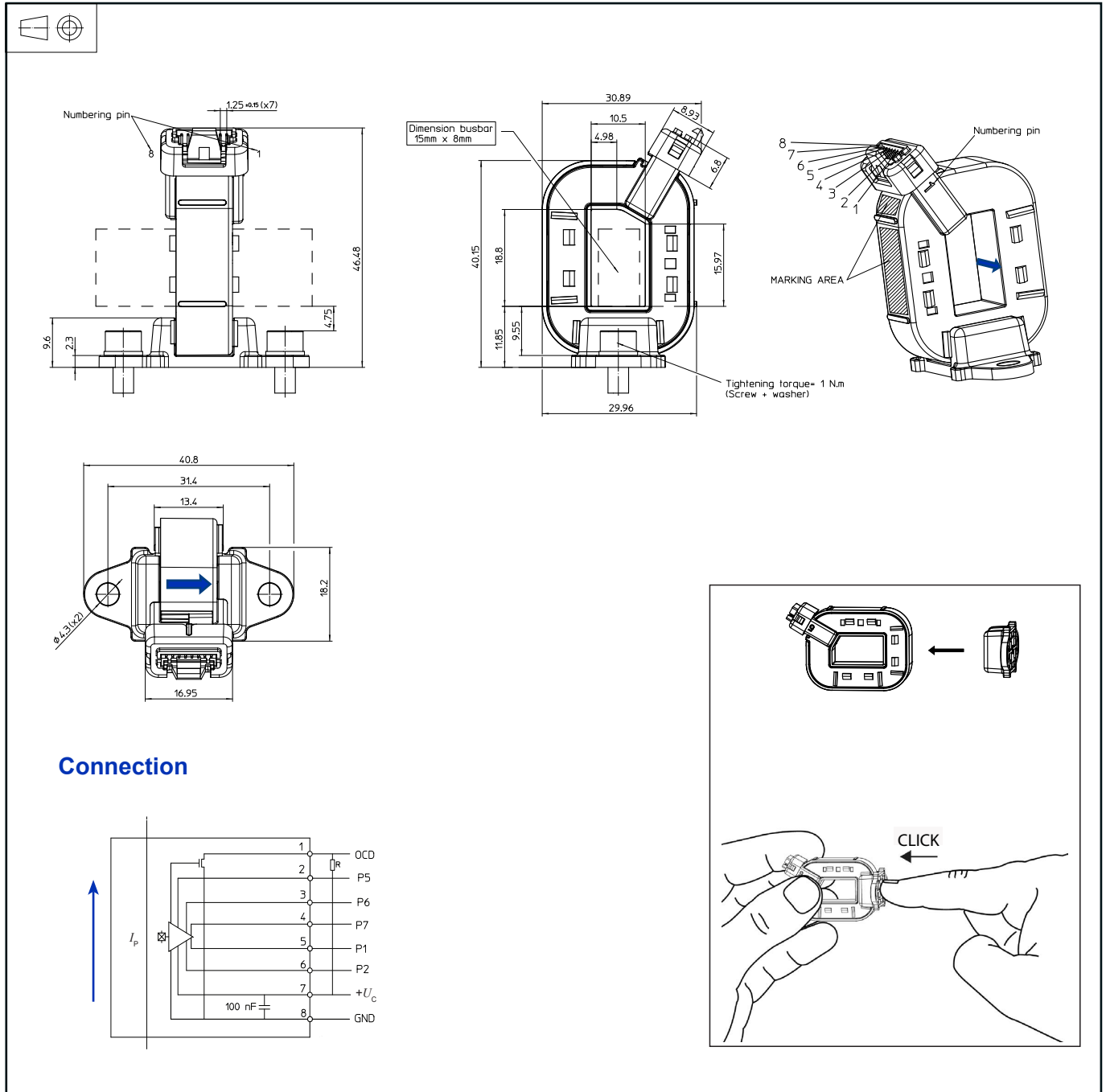
Output Mode	P5	P6	P7	P1	P2
0	2W CMOS CLK Out	GND or NC	NC	CLK	$D_{out}$
1	2W RS 422 MANCHESTER	GND or NC	NC	$\overline{D}_{out}$	$D_{out}$
2	4W LVDS CLK Out	GND or NC	CLK	$\overline{CLK}$	$D_{out}$
3	2W LVDS MANCHESTER	GND or NC	NC	$\overline{D}_{out}$	$D_{out}$
4	4W RS 422 CLK Out	GND or NC	CLK	$\overline{CLK}$	$D_{out}$
8	2W CMOS CLK In	$U_c$	NC	CLK	$D_{out}$
A	4W LVDS CLK In	$U_c$	CLK	$\overline{CLK}$	$D_{out}$
C	4W RS 422 CLK In (Mode C)	$U_c$	CLK	$\overline{CLK}$	$D_{out}$
D	4W RS 422 In (Mode D)	$U_c$	CLK	$\overline{CLK}$	$D_{out}$

**Remarks:**

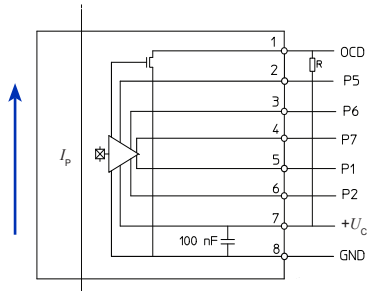
- Density of ones is greater than 50 % when positive  $I_p$  flows in direction of the arrow shown on the drawing above
- Connection system: equivalent to HARWIN M30-6100846 type
- Mounting foot may be removed and repositioned as shown on pages 18,19 and 20 of this datasheet. We recommend to change the mounting foot position just once.

**Dimensions** (in mm, general linear tolerance  $\pm 0.6$  mm)

Mounting example: vertical



**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
- Mounting foot may be removed and repositioned as shown on pages 18,19 and 20 of this datasheet. We recommend to change the mounting foot position just once.

**Dimensions** (in mm, general linear tolerance  $\pm 0.6$  mm)

Mounting example: busbar

The technical drawings include:

- Top view:** Shows a numbering pin (1.25  $\pm 0.05$  (x7)) and a dimension busbar (15mm x 8mm). Dimensions include 14.93, 30.9, 29.96, 9.6, 18.8, 37.8, 4.98, 6.2, 6.8, and 9.1. A note specifies a tightening torque of 1 N.m (Screw + washer).
- Bottom view:** Shows a hall element position and a marking area. Dimensions include 40.8, 31.4, 13.4, 18.2, and 16.95.
- Isometric view:** Shows the MARKING AREA and a numbering pin. Terminals are numbered 1 through 8.
- Mounting diagram:** Illustrates the transducer being pushed onto a busbar with a "CLICK" sound.
- Connection diagram:** Shows the internal circuit with terminals 1-8. Terminal 1 is labeled OCD, 2 is P5, 3 is P6, 4 is P7, 5 is P1, 6 is P2, 7 is +U<sub>c</sub>, and 8 is GND. A 100 nF capacitor is connected between terminals 7 and 8. A current  $I_p$  is shown flowing through the device.

**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
- Mounting foot may be removed and repositioned as shown on pages 18,19 and 20 of this datasheet. We recommend to change the mounting foot position just once.