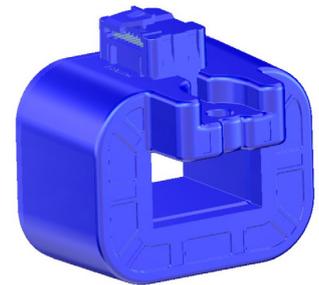


## Digital Current Transducer HOYS-SW/SPFA0 series $I_{PN} = 400 \dots 810 \text{ A}$

Ref: HOYS 400-SW/SPFA0; HOYS 450-SW/SPFA0; HOYS 500-SW/SPFA0;  
HOYS 540-SW/SPFA0; HOYS 700-SW/SPFA0; HOYS 810-SW/SPFA0

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
- EEPROM Control
- Galvanic separation between primary and secondary circuit
- Low power consumption
- For busbar mounting
- Aperture: 21.5 × 13 mm
- Factory calibrated
- Connection mating with HIROSE:
  - housing DF13-8S-1.25C
  - contact DF13G-2630SCF.

### Special features

- $D_{out} = 80 \% @ I_{PN}$
- Potted.

### Advantages

- Low offset drift
- Creepage / clearance > 10.5 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 <sup>1)</sup>
- IEC 61800-3: 2017 <sup>1)</sup>
- IEC 61800-5-1: 2007
- IEC 61010-1: 2010
- UL 508: 2013.

### Application Domain

- Industrial.

**Note:** <sup>1)</sup> Conducted and radiated emission could be applicable only if there will be treatments on external circuits of digital outputs.

## 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/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
Electrostatic discharge voltage (HBM – Human Body Model)	$U_{ESD \text{ HBM}}$	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 ambient operating temperature	$T_A$	°C	105 100
Primary current	$I_P$	A	0-560 A 560-810 A
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 - Any surface of polymeric housing have not been evaluated as insulating barrier
- 5 - Low voltage control circuit shall be supplied by an isolating source (such as a transformer, optical isolator, limiting impedance or electro-mechanical relay).

### 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	5.4	
Impulse withstand voltage 1.2/50 $\mu$ s	$U_{Ni}$	kV	9.6	
Partial discharge RMS test voltage (adjusted $q_m < 10$ pC)	$U_t$	V	1650	Busbar/Secondary According to IEC 61800-5-1
Clearance (pri. - sec.)	$d_{Cl}$	mm	> 10.5	Shortest distance through air
Creepage distance (pri. - sec.)	$d_{Cp}$	mm	> 10.5	Shortest path along device body
Case material	-	-	V0	According to UL 94
Comparative tracking index	$CTI$		600	
Application example			600 V	Reinforced insulation, according to IEC 61800-5-1 CAT III PD2
Application example			1000 V	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		102		

**Electrical data HOYS 400-SW/SPFA0**

 At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 11).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		400		
Primary current, measuring range	$I_{PM}$	A	-532		532	
Supply voltage DC	$U_C$	V	4.5	5	5.5	
Current consumption DC	$I_C$	mA		24	31	Unloaded typical = 53 mA with $C_L = 5\text{ pF}$ and $R_L = 100\text{ }\Omega$
Density of ones @ $I_p = 0\text{ A}$	$D_{out}$	%		50		Internal reference
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		50 $\pm$ 30		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		50 $\pm$ 40		Over operating temperature range
Allowed capacitive loading	$C_L$	pF	0		30	
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 $D_{out} = 50\text{ %}$
Electrical offset current referred to primary	$I_{OE}$	A	-1.33		1.33	
Temperature coefficient of $I_{OE}$ @ $I_p = 0\text{ A}$	$TCl_{OE}$	mA/K	-18.7		18.7	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.075		30 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\epsilon_S$	%	-1		1	Factory adjustment (straight bus bar)
Temperature coefficient of $S$	$TCS$	ppm/K	-350		350	-40 °C ... 105 °C
Linearity error 0 ... $I_{PN}$	$\epsilon_L$	% of $I_{PN}$	-0.6		0.6	
Linearity error 0 ... $I_{PM}$	$\epsilon_L$	% of $I_{PM}$	-0.6		0.6	
Magnetic offset current (@ $10 \times I_{PN}$ ) referred to primary	$I_{OM}$	A		$\pm 1.3$		
Delay time to 90 % of the final output value for $I_{PN}$ step	$t_{D90}$	$\mu\text{s}$			3.5	Determined by digital filter and OSR <sup>1)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$	$\epsilon_{SL}$	% of $I_{PN}$	-1.6		1.6	
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\epsilon_{SL85}$	% of $I_{PN}$	-3.98		3.98	See formula note <sup>2)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\epsilon_{SL105}$	% of $I_{PN}$	-4.77		4.77	
Effective Resolution	sinc3osr64 sinc3osr128 sinc3osr256	bits bits bits		11.6 12.0 12.5		

**Notes:** <sup>1)</sup> See page 14

$$\supset 2) \text{ Total error @ } T_A \text{ (\% of } I_{PN}) = \epsilon_{SL25} + \left( \frac{TCS}{10000} \times (T_A - 25) \right) + \left( \frac{TCl_{OE}}{1000 \times I_{PN}} \times 100 \times (T_A - 25) \right).$$

**Electrical data HOYS 450-SW/SPFA0**

 At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 11).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		450		
Primary current, measuring range	$I_{PM}$	A	-598.5		598.5	
Supply voltage DC	$U_C$	V	4.5	5	5.5	
Current consumption DC	$I_C$	mA		24	31	Unloaded typical = 53 mA with $C_L = 5\text{ pF}$ and $R_L = 100\text{ }\Omega$
Density of ones @ $I_P = 0\text{ A}$	$D_{out}$	%		50		Internal reference
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		50 $\pm$ 30		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		50 $\pm$ 40		Over operating temperature range
Load capacitance	$C_L$	pF	0		30	
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 $D_{out} = 50\text{ }\%$
Electrical offset current referred to primary	$I_{OE}$	A	-1.5		1.5	
Temperature coefficient of $I_{OE}$ @ $I_P = 0\text{ A}$	$TCl_{OE}$	mA/K	-21		21	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.0667		30 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\varepsilon_S$	%	-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 $I_{PM}$	-0.6		0.6	
Magnetic offset current (@ $10 \times I_{PN}$ ) referred to primary	$I_{OM}$	A		$\pm 1.3$		
Delay time to 90 % of the final output value for $I_{PN}$ step	$t_{D90}$	$\mu\text{s}$			3.5	Determined by digital filter and OSR <sup>1)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$	$\varepsilon_{SL}$	% of $I_{PN}$	-1.6		1.6	
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\varepsilon_{SL85}$	% of $I_{PN}$	-3.98		3.98	See formula note <sup>2)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\varepsilon_{SL105}$	% of $I_{PN}$	-4.77		4.77	
Effective Resolution	sinc3osr64 sinc3osr128 sinc3osr256	bits bits bits		11.7 12.3 12.7		

**Notes:** <sup>1)</sup> See page 14

$$^2) \text{ Total error @ } T_A (\% \text{ of } I_{PN}) = \varepsilon_{SL25} + \left( \frac{TCS}{10000} \times (T_A - 25) + \frac{TCl_{OE}}{1000 \times I_{PN}} \times 100 \times (T_A - 25) \right).$$

**Electrical data HOYS 500-SW/SPFA0**

 At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 11).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		500		
Primary current, measuring range	$I_{PM}$	A	-665		665	
Supply voltage DC	$U_C$	V	4.5	5	5.5	
Current consumption DC	$I_C$	mA		24	31	Unloaded typical = 53 mA with $C_L = 5\text{ pF}$ and $R_L = 100\text{ }\Omega$
Density of ones @ $I_P = 0\text{ A}$	$D_{out}$	%		50		Internal reference
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		$50 \pm 30$		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		$50 \pm 40$		Over operating temperature range
Load capacitance	$C_L$	pF	0		30	
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 $D_{out} = 50\text{ %}$
Electrical offset current referred to primary	$I_{OE}$	A	-1.67		1.67	
Temperature coefficient of $I_{OE}$ @ $I_P = 0\text{ A}$	$TCl_{OE}$	mA/K	-23.3		23.3	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.06		30 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\epsilon_S$	%	-1		1	Factory adjustment (straight bus bar)
Temperature coefficient of $S$	$TCS$	ppm/K	-350		350	-40 °C ... 105 °C
Linearity error 0 ... $I_{PN}$	$\epsilon_L$	% of $I_{PN}$	-0.6		0.6	
Linearity error 0 ... $I_{PM}$	$\epsilon_L$	% of $I_{PM}$	-0.6		0.6	
Magnetic offset current (@ $10 \times I_{PN}$ ) referred to primary	$I_{OM}$	A		$\pm 1.3$		
Delay time to 90 % of the final output value for $I_{PN}$ step	$t_{D90}$	$\mu\text{s}$			3.5	Determined by digital filter and OSR <sup>1)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$	$\epsilon_{SL}$	% of $I_{PN}$	-1.6		1.6	
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\epsilon_{SL85}$	% of $I_{PN}$	-3.98		3.98	See formula note <sup>2)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\epsilon_{SL105}$	% of $I_{PN}$	-4.77		4.77	
Effective Resolution		bits				
	sinc3osr64	bits		11.8		
	sinc3osr128	bits		12.3		
	sinc3osr256	bits		12.7		

**Notes:** <sup>1)</sup> See page 14

$$\supset^2 \text{ Total error @ } T_A (\% \text{ of } I_{PN}) = \epsilon_{SL25} + \left( \frac{TCS}{10000} \times (T_A - 25) \right) + \frac{TCl_{OE}}{1000 \times I_{PN}} \times 100 \times (T_A - 25).$$

**Electrical data HOYS 540-SW/SPFA0**

 At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 11).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		540		
Primary current, measuring range	$I_{PM}$	A	-718.2		718.2	
Supply voltage DC	$U_C$	V	4.5	5	5.5	
Current consumption DC	$I_C$	mA		24	31	Unloaded typical = 53 mA with $C_L = 5\text{ pF}$ and $R_L = 100\text{ }\Omega$
Density of ones @ $I_P = 0\text{ A}$	$D_{out}$	%		50		Internal reference
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		50 $\pm$ 30		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		50 $\pm$ 40		Over operating temperature range
Load capacitance	$C_L$	pF	0		30	
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 $D_{out} = 50\text{ %}$
Electrical offset current referred to primary	$I_{OE}$	A	-1.8		1.8	
Temperature coefficient of $I_{OE}$ @ $I_P = 0\text{ A}$	$TCl_{OE}$	mA/K	-25.2		25.2	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.0556		30 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\epsilon_S$	%	-1		1	Factory adjustment (straight bus bar)
Temperature coefficient of $S$	$TCS$	ppm/K	-350		350	-40 °C ... 105 °C
Linearity error 0 ... $I_{PN}$	$\epsilon_L$	% of $I_{PN}$	-0.6		0.6	
Linearity error 0 ... $I_{PM}$	$\epsilon_L$	% of $I_{PM}$	-0.6		0.6	
Magnetic offset current (@ $10 \times I_{PN}$ ) referred to primary	$I_{OM}$	A		$\pm$ 1.3		
Delay time to 90 % of the final output value for $I_{PN}$ step	$t_{D90}$	$\mu$ s			3.5	Determined by digital filter and OSR <sup>1)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$	$\epsilon_{SL}$	% of $I_{PN}$	-1.6		1.6	
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\epsilon_{SL85}$	% of $I_{PN}$	-3.98		3.98	See formula note <sup>2)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\epsilon_{SL105}$	% of $I_{PN}$	-4.77		4.77	
Effective Resolution		bits				
	sinc3osr64	bits		11.8		
	sinc3osr128	bits		12.4		
	sinc3osr256	bits		12.9		

**Notes:** <sup>1)</sup> See page 14

$$^2) \text{ Total error @ } T_A (\% \text{ of } I_{PN}) = \epsilon_{SL25} + \left( \frac{TCS}{10000} \times (T_A - 25) + \frac{TCl_{OE}}{1000 \times I_{PN}} \times 100 \times (T_A - 25) \right).$$

**Electrical data HOYS 700-SW/SPFA0**

 At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 11).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		700		
Primary current, measuring range	$I_{PM}$	A	-931		931	
Supply voltage DC	$U_C$	V	4.5	5	5.5	
Current consumption DC	$I_C$	mA		24	31	Unloaded typical = 53 mA with $C_L = 5\text{ pF}$ and $R_L = 100\text{ }\Omega$
Density of ones @ $I_P = 0\text{ A}$	$D_{out}$	%		50		Internal reference
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		$50 \pm 30$		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		$50 \pm 40$		Over operating temperature range
Load capacitance	$C_L$	pF	0		30	
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 $D_{out} = 50\text{ %}$
Electrical offset current referred to primary	$I_{OE}$	A	-2.33		2.33	
Temperature coefficient of $I_{OE}$ @ $I_P = 0\text{ A}$	$TCI_{OE}$	mA/K	-32.7		32.7	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.0429		30 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\epsilon_S$	%	-1		1	Factory adjustment (straight bus bar)
Temperature coefficient of $S$	$TCS$	ppm/K	-350		350	-40 °C ... 105 °C
Linearity error 0 ... $I_{PN}$	$\epsilon_L$	% of $I_{PN}$	-0.6		0.6	
Linearity error 0 ... $I_{PM}$	$\epsilon_L$	% of $I_{PM}$	-0.6		0.6	
Magnetic offset current (@ $10 \times I_{PN}$ ) referred to primary	$I_{OM}$	A		$\pm 1.3$		
Delay time to 90 % of the final output value for $I_{PN}$ step	$t_{D90}$	$\mu\text{s}$			3.5	Determined by digital filter and OSR <sup>1)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$	$\epsilon_{SL}$	% of $I_{PN}$	-1.6		1.6	
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\epsilon_{SL85}$	% of $I_{PN}$	-3.98		3.98	See formula note <sup>2)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\epsilon_{SL105}$	% of $I_{PN}$	-4.77		4.77	
Effective Resolution		bits				
	sinc3osr64	bits		11.8		
	sinc3osr128	bits		12.4		
	sinc3osr256	bits		12.9		

**Notes:** <sup>1)</sup> See page 14

$$\supset^2) \text{ Total error @ } T_A (\% \text{ of } I_{PN}) = \epsilon_{SL25} + \left( \frac{TCS}{10000} \times (T_A - 25) + \frac{TCI_{OE}}{1000 \times I_{PN}} \times 100 \times (T_A - 25) \right).$$

**Electrical data HOYS 810-SW/SPFA0**

 At  $T_A = 25\text{ °C}$ ,  $U_C = +5\text{ V}$ , unloaded, unless otherwise noted (see Min, Max, typ. definition paragraph in page 11).

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal RMS current	$I_{PN}$	A		810		
Primary current, measuring range	$I_{PM}$	A	-1077.3		1077.3	
Supply voltage DC	$U_C$	V	4.5	5	5.5	
Current consumption DC	$I_C$	mA		24	31	Unloaded typical = 53 mA with $C_L = 5\text{ pF}$ and $R_L = 100\text{ }\Omega$
Density of ones @ $I_P = 0\text{ A}$	$D_{out}$	%		50		Internal reference
Density of ones @ $\pm I_{PN}$	$D_{out}$	%		50 $\pm$ 30		
Density of ones @ $\pm I_{PM}$	$D_{out}$	%		50 $\pm$ 40		Over operating temperature range
Load capacitance	$C_L$	pF	0		30	
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 $D_{out} = 50\text{ %}$
Electrical offset current referred to primary	$I_{OE}$	A	-2.7		2.7	
Temperature coefficient of $I_{OE}$ @ $I_P = 0\text{ A}$	$TCI_{OE}$	mA/K	-37.8		37.8	-40 °C ... 105 °C
Nominal sensitivity	$S_N$	%/A		0.037		30 % @ $I_{PN}$
Sensitivity error @ $I_{PN}$	$\epsilon_S$	%	-1		1	Factory adjustment (straight bus bar)
Temperature coefficient of $S$	$TCS$	ppm/K	-350		350	-40 °C ... 105 °C
Linearity error 0 ... $I_{PN}$	$\epsilon_L$	% of $I_{PN}$	-0.6		0.6	
Linearity error 0 ... $I_{PM}$	$\epsilon_L$	% of $I_{PM}$	-0.6		0.6	
Magnetic offset current (@ $10 \times I_{PN}$ ) referred to primary	$I_{OM}$	A		$\pm 1.3$		
Delay time to 90 % of the final output value for $I_{PN}$ step	$t_{D90}$	$\mu\text{s}$			3.5	Determined by digital filter and OSR <sup>1)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$	$\epsilon_{SL}$	% of $I_{PN}$	-1.6		1.6	
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +85\text{ °C}$	$\epsilon_{SL85}$	% of $I_{PN}$	-3.98		3.98	See formula note <sup>2)</sup>
Sum of sensitivity and linearity error @ $I_{PN}$ @ $T_A = +105\text{ °C}$	$\epsilon_{SL105}$	% of $I_{PN}$	-4.77		4.77	
Effective Resolution		bits				
	sinc3osr64	bits		11.9		
	sinc3osr128	bits		12.6		
	sinc3osr256	bits		13.2		

 Notes: <sup>1)</sup> See page 14

$$^2) \text{ Total error @ } T_A (\% \text{ of } I_{PN}) = \epsilon_{SL25} + \left( \frac{TCS}{10000} \times (T_A - 25) \right) + \left( \frac{TCI_{OE}}{1000 \times I_{PN}} \times 100 \times (T_A - 25) \right).$$

## 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.

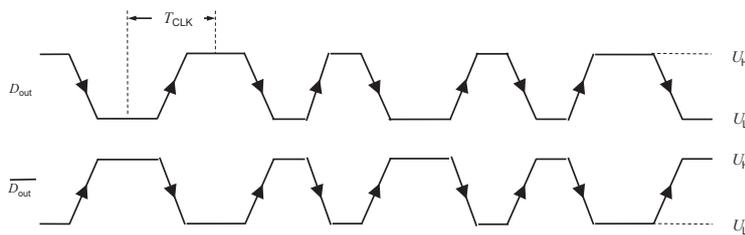
On the other hand, measured values are part of a statistical distribution that can be specified by an interval with upper and lower limits and a probability for measured values to lie within this interval.

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  $-\text{sigma}$  and  $+\text{sigma}$  for a normal distribution. Typical, minimum and maximum values are determined during the initial characterization of the product.

## HOYS-SW/SPFA0 series output characteristics

### 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

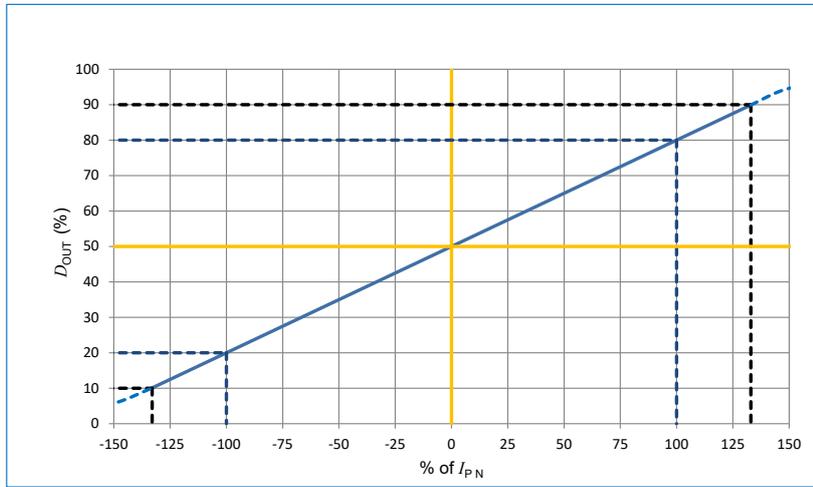
Parameter	Symbol	Unit	Min	Typ	Max	Comment
Clock period	$T_{CLK}$	ns	89	93.5	98	$f_{CLK} = 10.7 \text{ MHz} \pm 5 \%$
Temperature coefficient of clock period	$TCt_{\text{per CLK}}$	ppm/K	-400	0	400	$-40 \text{ }^\circ\text{C} \dots 105 \text{ }^\circ\text{C}$

- Levels

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

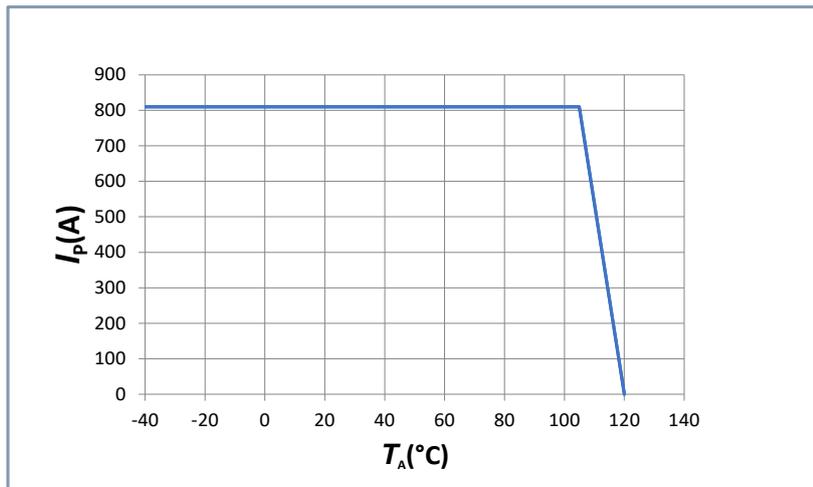
**HOYS-SW series output characteristics**

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



**Maximum continuous DC current**

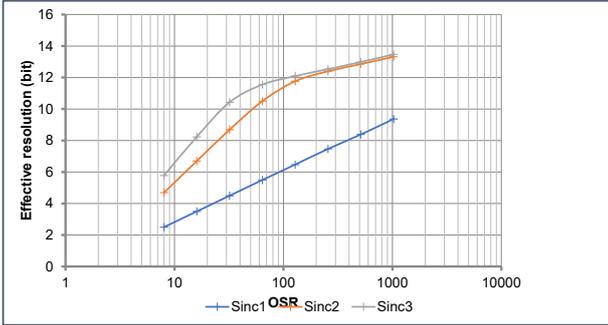
For all ranges:



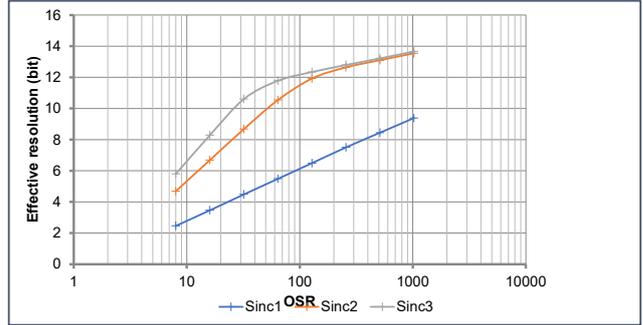
**Important notice:** Whatever the usage and/or application, the transducer primary bar / jumper temperature shall not go above the maximum rating of 120 °C as stated in page 3 of this datasheet.

Effective resolution versus OSR

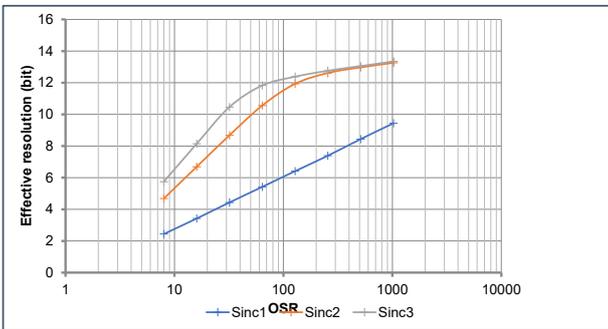
HOYS 400-SW/SPFA0



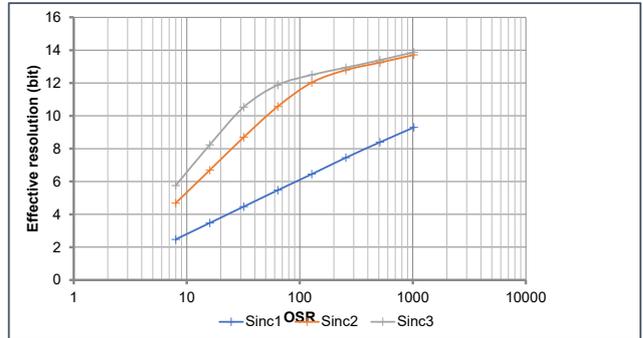
HOYS 450-SW/SPFA0



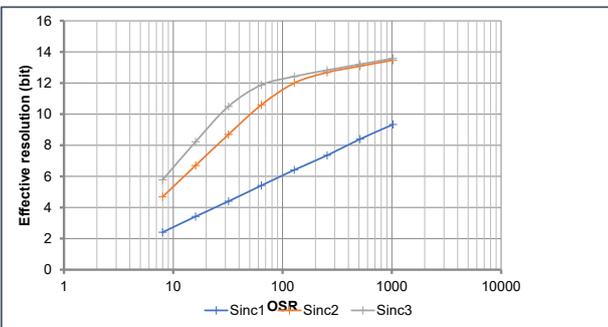
HOYS 500-SW/SPFA0



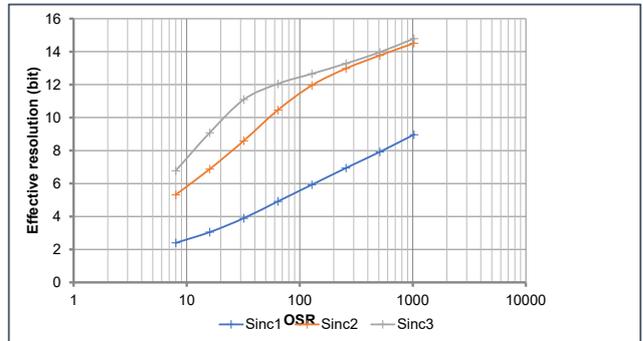
HOYS 540-SW/SPFA0



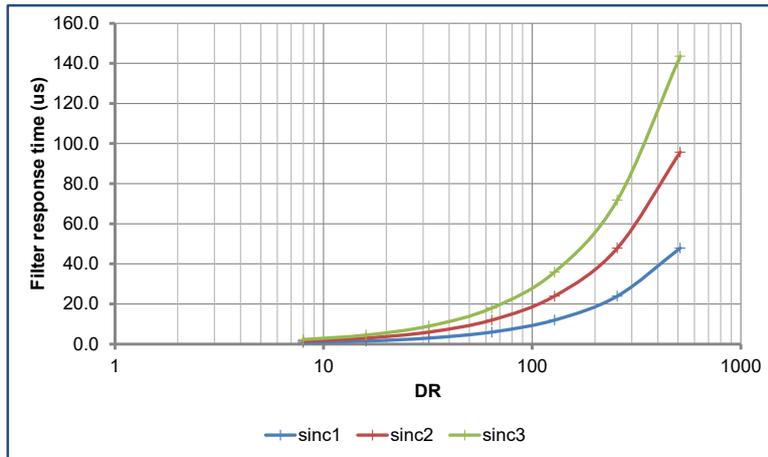
HOYS 700-SW/SPFA0



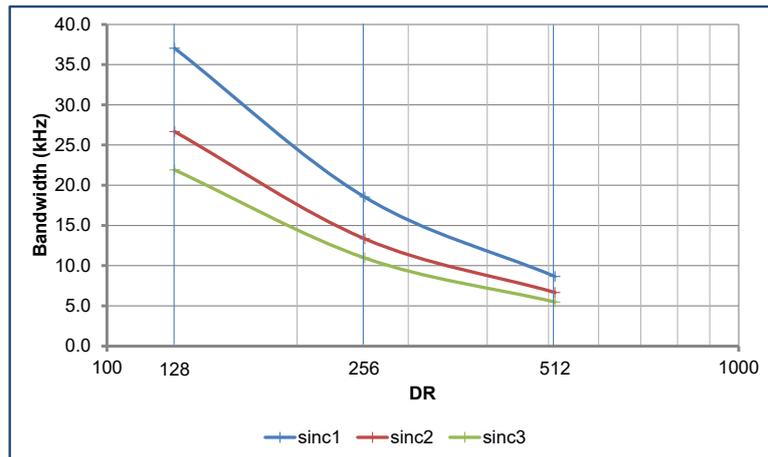
HOYS 810-SW/SPFA0



**Delay time versus DR**



**Bandwidth (-3 dB) versus DR**



### Application information

- HOYS-SW/SPFA0 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 21.5 × 13 mm.

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.

### Remark

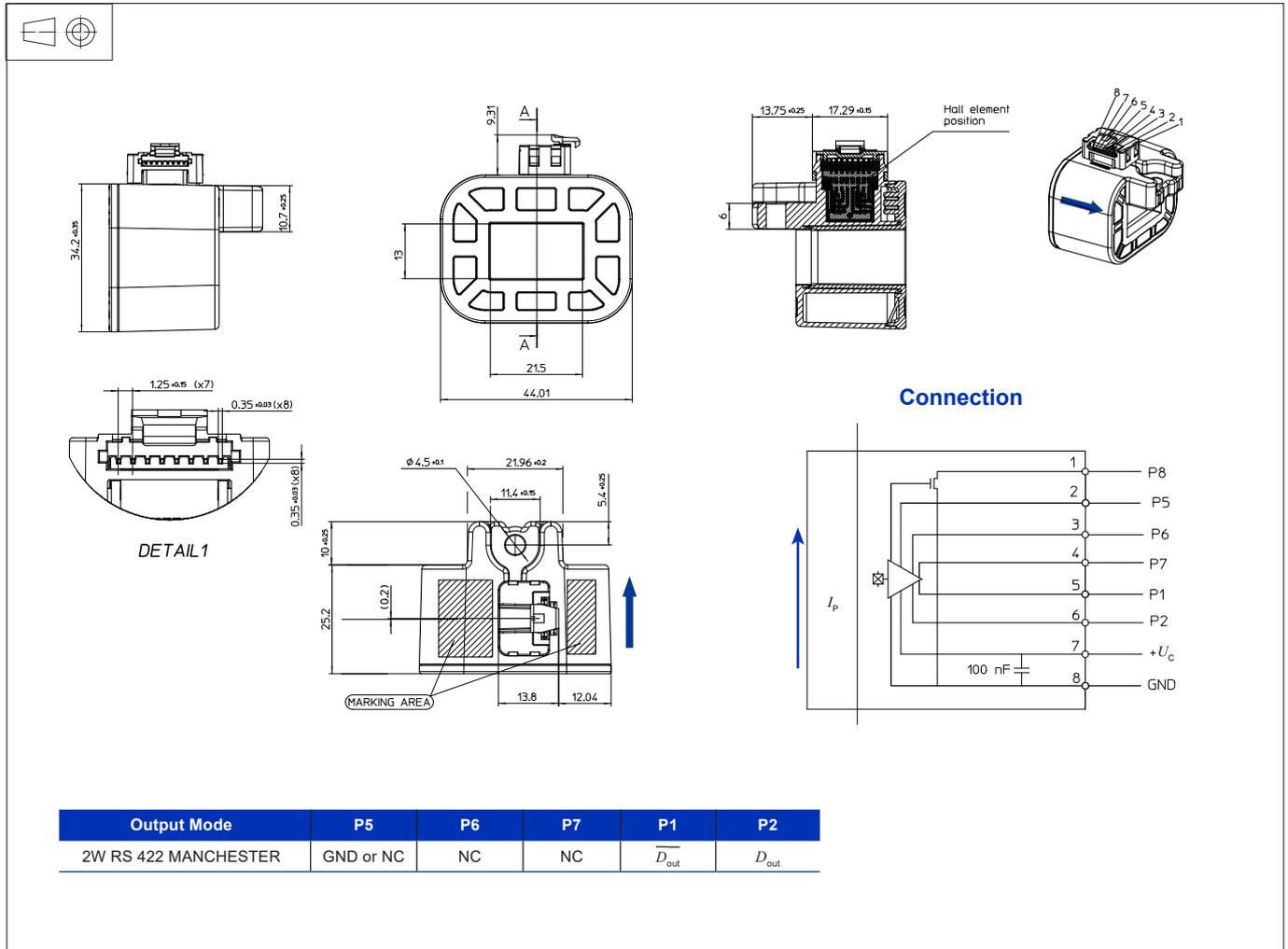
Installation of the transducer must be done unless otherwise specified on the datasheet, according to LEM Transducer Generic Mounting Rules. Please refer to LEM document N°ANE120504 available on our Web site: <https://www.lem.com/en/file/3137/download/>.

### Insulation distance (nominal values):

	$d_{CP}$	$d_{CI}$
Between primary busbar and secondary pin	-	19.4 mm
Between primary busbar and core	16.9 mm	-
Between core and secondary terminal	-	12 mm

**Dimensions** (in mm, general linear tolerance  $\pm 0.3$  mm)

Mounting example: horizontal



**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 HIROSE connector
  - Transducer fastening
    - 1 hole  $\varnothing 4.5$  mm
    - 1 steel screw M4
- Recommended fastening torque      1.5 N·m.