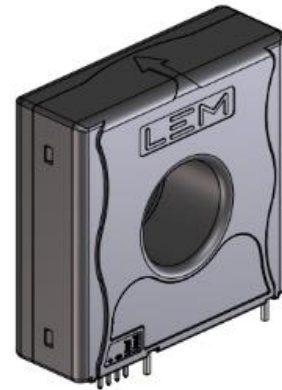


Current Transducer LTS-PB series

$I_{PN} = 350, 400A$

Ref: LTS 350-PB, LTS 400-PB

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



Features

- Closed loop(compensated)
- Current transducer using the Hall effect
- Insulating plastic case recognized according to UL 94-V0
- +12V single power supply with 1200A measurement range
- PCB mounting
- Aperture 23.5mm.

Advantages

- Excellent accuracy
- Very good linearity
- Low temperature drift
- Optimized response time
- Wide frequency bandwidth
- High immunity to external interference
- Current overload capability.

Applications

- Motor controller
- Solar inverter
- Uninterruptible Power Supplies (UPS)
- Battery chargers
- Power conversion system (PCS).

Standards

- IEC 62109-1:2010
- IEC 60664-1:2020
- IEC 61800-5-1:2022
- IEC 62447-1:2007.
- UL 508:2024

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.

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.

This transducer is a built-in device, not intended to be cleaned with any product. Nevertheless if the user must implement cleaning or washing process, validation of the cleaning program has to be done by himself.



ESD susceptibility

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

Do not dispose of this product as unsorted municipal waste. Contact a qualified recycler for disposal.

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



Underwriters Laboratory Inc. recognized component

Absolute maximum ratings

LTS-PB Series

Parameter	Conditions	Unit	Value
Maximum supply voltage	$U_{C \max}$	V	13
Maximum primary current	$I_{P \max}$	A	$10 \times I_{P N}$
Maximum primary conductor temperature	$T_{B \max}$	°C	110

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: 1

Standards

CSA C22.2 NO. 14-18 INDUSTRIAL CONTROL EQUIPMENT - Edition 13

UL 508 STANDARD FOR INDUSTRIAL CONTROL EQUIPMENT - Edition 19

Rating

Parameter	Symbol	Unit	Value
Primary involved potential		V AC/DC	1000
Max surrounding air temperature	T_A	°C	85
Primary current	I_P	A	According to series primary current
Secondary supply voltage	U_C	V DC	12
Output voltage	U_{out}	V	0 to 12

Conditions of Acceptability

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

- 1 - These devices must be mounted in a suitable end-use enclosure.
- 2 - The terminals have not been evaluated for field wiring.
- 3 - LTS-PB Series are intended to be mounted on the printed wiring board of the end-use equipment (with a minimum CTI of 100).
- 4 - LTS-PB Series shall be used in a pollution degree 2 environment.
- 5 - 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).
- 6 - LVLC secondary power supply connector has been considered suitable for factory wiring only.
- 7 - LTS-PB (rated 1000V), a minimum of 8 mm shall be maintained between the primary wires and the secondary circuit of the current transducer.
- 8 - LTS-PB series, the secondary sensing circuit was evaluated as the circuit intended to be supplied from a Limited Voltage/Current circuit defined in UL 508 Standard.

Marking

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

Insulation coordination

LTS-PB Series

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 μ s	U_{Ni}	kV	8	
Partial discharge RMS test voltage (qm < 10 pC)	U_t	kV	1.65	
Case material			V-0	According to UL 94
Clearance (pri. - sec.)	dCl	mm	18.5	Shortest distance through air
Creepage distance (pri. - sec.)	dCp	mm	18.5	Shortest path along device body
Comparative tracking index	CTI	V	600	

Environmental and mechanical characteristics

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Ambient operating temperature	T_A	°C	-40		105	
Ambient storage temperature	T_{st}	°C	-50		105	
Mass	m	g		105		

Electrical data LTS 350-PB

At $T_A = 25\text{ °C}$, $U_C = +12\text{ V}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted.

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current(continuous)	I_{PN}	A		350		
Primary current, measuring range	I_{PM}	A	-1200		1200	< 85°C, 12V power supply
Supply voltage	U_C	V	11.4	12	12.6	
Current consumption	I_C	mA	$10 + I_P(\text{mA})/N_s$			$N_S = 2200$
Reference voltage $I_p = 0$	U_{ref}	V	5.85	6	6.15	Internal reference
Output voltage range	U_{OUT}	V	1.2		10.8	$U_C > 12\text{ V}$
Electronic offset voltage @ $I_p = 0$	U_{OE}	mV	-4		4	100% tested
Electrical offset current @ $I_p = 0$	I_{OE}	A	-1		1	100% tested
Temperature coefficient of I_{OE} refer to primary	TCI_{OE}	mA/K	-15		15	
Nominal Sensitivity	S_N	mV/A		4		1.4V @ I_{PN}
Sensitivity error	ε_s	%	-0.8		0.8	100% tested
Sensitivity temperature coefficient	TCS	ppm/K	-50		50	
Linearity error	ε_L	%	-0.15		0.15	
Magnetic offset current (referred to primary)	I_{OM}	mA	-250		250	
Response time 10%	t_{D10}	μs		1		$di/dt = 50\text{ A/us}$
Response time 90%	t_{D90}	μs		1		$di/dt = 50\text{ A/us}$
Frequency bandwidth(-3dB)	BW	kHz		200		Small signal
Rms noise voltage(10kHz)	U_{NO}	mV		2.5		
Accuracy @ $T_A = +25\text{ °C}$	ε_{SL25}	%	-0.8		0.8	100% tested @ I_{PN}
Accuracy @ $-40\text{ °C} \sim 105\text{ °C}$	ε_{SLTA}	%	-1		1	@ I_{PN}

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 sample to lie in this interval is 99.73 %.

For a normal (Gaussian) distribution, this corresponds to an interval between -3 sigma and +3 sigma. If "typical" values are not obviously mean or average values, those values are defined to delimit intervals with a probability of 68.27 %, corresponding to an interval between -sigma and +sigma for a normal distribution.

Typical, maximal and minimal values are determined during the initial characterization of the product.

Electrical data LTS 400-PB

At $T_A = 25\text{ °C}$, $U_C = +12\text{ V}$, $R_L = 10\text{ k}\Omega$, unless otherwise noted.

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current(continuous)	I_{PN}	A		400		
Primary current, measuring range	I_{PM}	A	-1200		1200	$< 85\text{ °C}$, 12V power supply
Supply voltage	U_C	V	11.4	12	12.6	
Current consumption	I_C	mA	$10 + I_P (\text{mA}) / N_s$			$NS = 2200$
Reference voltage @Ip =0	U_{ref}	V	5.85	6	6.15	Internal reference
Output voltage range	U_{OUT}	V	1.2		10.8	$U_C > 12\text{ V}$
Electrical offset voltage @ Ip=0	U_{OE}	mV	-4		4	100% tested
Electrical offset Current@ Ip=0	I_{OE}	A	-1		1	100% tested
Temperature coefficient of loe refer to primary	TCI_{OE}	mA/K	-15		15	
Nominal Sensitivity	S_N	mV/A		4		1.6V@ I_{PN}
Sensitivity error	ε_s	%	-0.8		0.8	100% tested
Sensitivity temperature coefficient	TCS	ppm/K	-50		50	
Linearity error	ε_L	%	-0.15		0.15	
Magnetic offset current (referred to primary)	I_{OM}	mA	-250		250	
Response time 10%	t_{D10}	μs		1		$di/dt = 50\text{ A/us}$
Response time 90%	t_{D90}	μs		1		$di/dt = 50\text{ A/us}$
Frequency bandwidth(-3dB)	BW	kHz		200		Small signal
Rms noise voltage(10kHz)	U_{NO}	mV		2.5		
Accuracy @ $T_a = +25\text{ °C}$	ε_{SL25}	%	-0.8		0.8	100% tested @ I_{PN}
Accuracy @ $-40\text{ °C} \sim 105\text{ °C}$	ε_{SLTA}	%	-1		1	@ I_{PN}

Ampere-turns and amperes

The transducer is sensitive to the primary current linkage Θ_P (also called ampere-turns).

$$\Theta_P = N_P \cdot I_P$$

Where N_P is the number of primary turn (depending on the connection of the primary jumpers).

Caution: As most applications will use the transducer with only one single primary turn ($N_P = 1$), much of this datasheet is written in terms of primary current instead of current linkages. However, the ampere-turns (A) unit is used to emphasis that current linkages are intended and applicable.

Simplified transducer model

The static model of the transducer with voltage output at temperature T_A is:

$$U_{out} = S \cdot \Theta_P \cdot (1 + \varepsilon)$$

In which (referred to primary):

$$\varepsilon \cdot \Theta_P = I_{OE} + I_{OT} + \varepsilon_S \cdot \Theta_P + \varepsilon_{ST} \cdot \Theta_P + \varepsilon_L(\Theta_{Pmax}) \cdot \Theta_{Pmax} + I_{OM}$$

$\Theta_P = N_P \cdot I_P$: primary current linkage (A)

Θ_{Pmax} : maximum primary current linkage applied to the transducer

I_S : secondary current (A)

U_{out} : output voltage (V)

S : sensitivity of the transducer

T_A : ambient operating temperature ($^{\circ}\text{C}$)

I_{OE} : electrical offset current (A)

I_{OM} : magnetic offset current (A)

I_{OT} : temperature variation of I_{OE} : (A)

ε_S : sensitivity error at 25°C

ε_{ST} : thermal drift of S

$\varepsilon_L(\Theta_{Pmax})$: linearity error for Θ_{Pmax}

This model is valid for primary ampere-turns Θ_P between $-\Theta_{Pmax}$ and $+\Theta_{Pmax}$ only.

This is the absolute maximum error. As all errors are independent, a more realistic way to calculate the error would be used in the following formula:

$$\varepsilon = \sqrt{\sum_{i=1}^N \varepsilon_i^2}$$

Total error referred to primary

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

I_{PN} . It includes all errors mentioned above

- the electrical offset I_{OE}
- the magnetic offset I_{OM}
- the sensitivity error ε_S
- the linearity error ε_L (to I_{PN}).

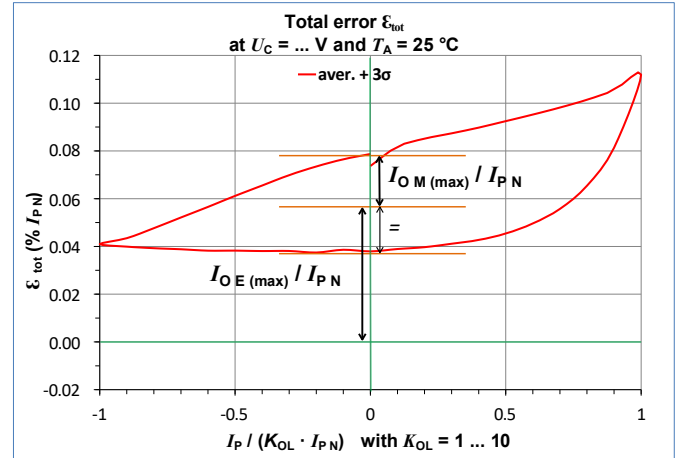


Figure 1: Total error

Electrical offset referred to primary

Using the current cycle shown in figure 2, the electrical offset current I_{OE} is the residual output referred to the primary when the input current is zero.

$$I_{OE} = \frac{I_{P(3)} + I_{P(5)}}{2}$$

The temperature variation I_{OT} of the electrical offset current I_{OE} is the variation of the electrical offset from 25°C to the considered temperature.

$$I_{OT}(T) = I_{OE}(T) - I_{OE}(25^{\circ}\text{C})$$

Magnetic offset referred to primary

The magnetic offset current I_{OM} is the consequence of a current on the primary side ("memory effect" of the transducer's ferromagnetic parts). It is measured using the following primary current cycle. I_{OM} depends on the current value $I_P \geq I_{PN} \cdot K_{OL}$: **Overload factor**.

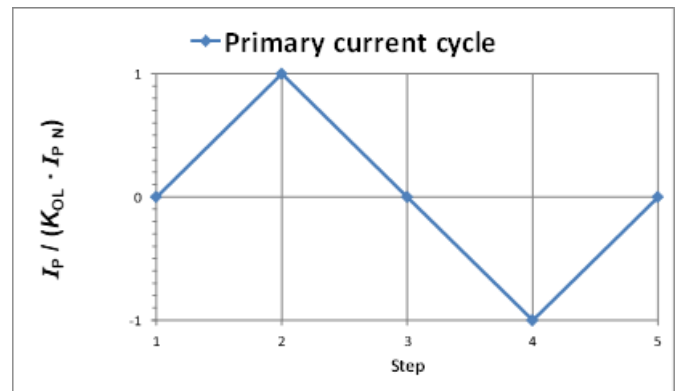


Figure 2: Current cycle used to measure magnetic and electrical offset(transducer supplied)

$$I_{OM} = \frac{I_{P(3)} - I_{P(5)}}{2}$$

Performance parameters definition

Sensitivity and linearity

To measure sensitivity and linearity, the primary current (DC) is cycled from 0 to I_P , then to $-I_P$ and back to 0 (equally spaced $I_P/10$ steps). The sensitivity S is defined as the slope of the linear regression line for a cycle between $\pm I_{PN}$.

The linearity error ε_L is the maximum positive or negative difference between the measured points and the linear regression line, expressed in % of I_{PN} .

Delay times

The delay time t_{D10} @ 10 % and the delay time t_{D90} @ 90 % with respect to the primary are shown in the next figure.

Both slightly depend on the primary current di/dt .

They are measured at nominal current.

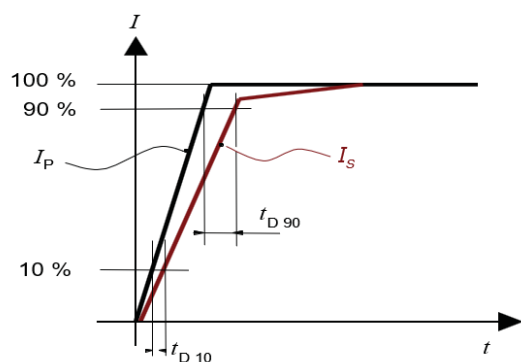
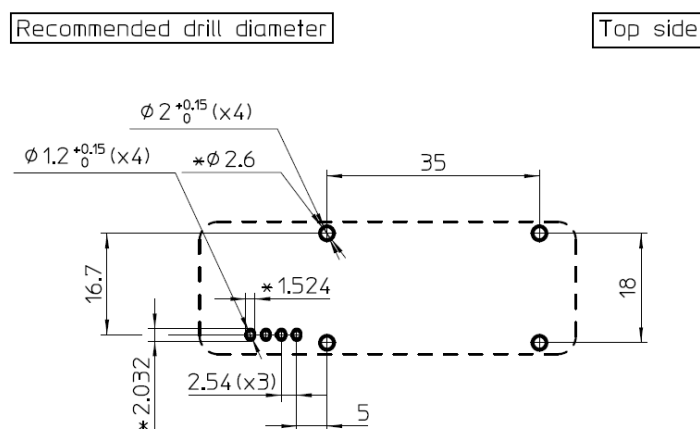


Figure 3: t_{D10} (delay time @ 10%) and t_{D90} (delay time @ 90%)

PCB footprint according to the product (in mm)



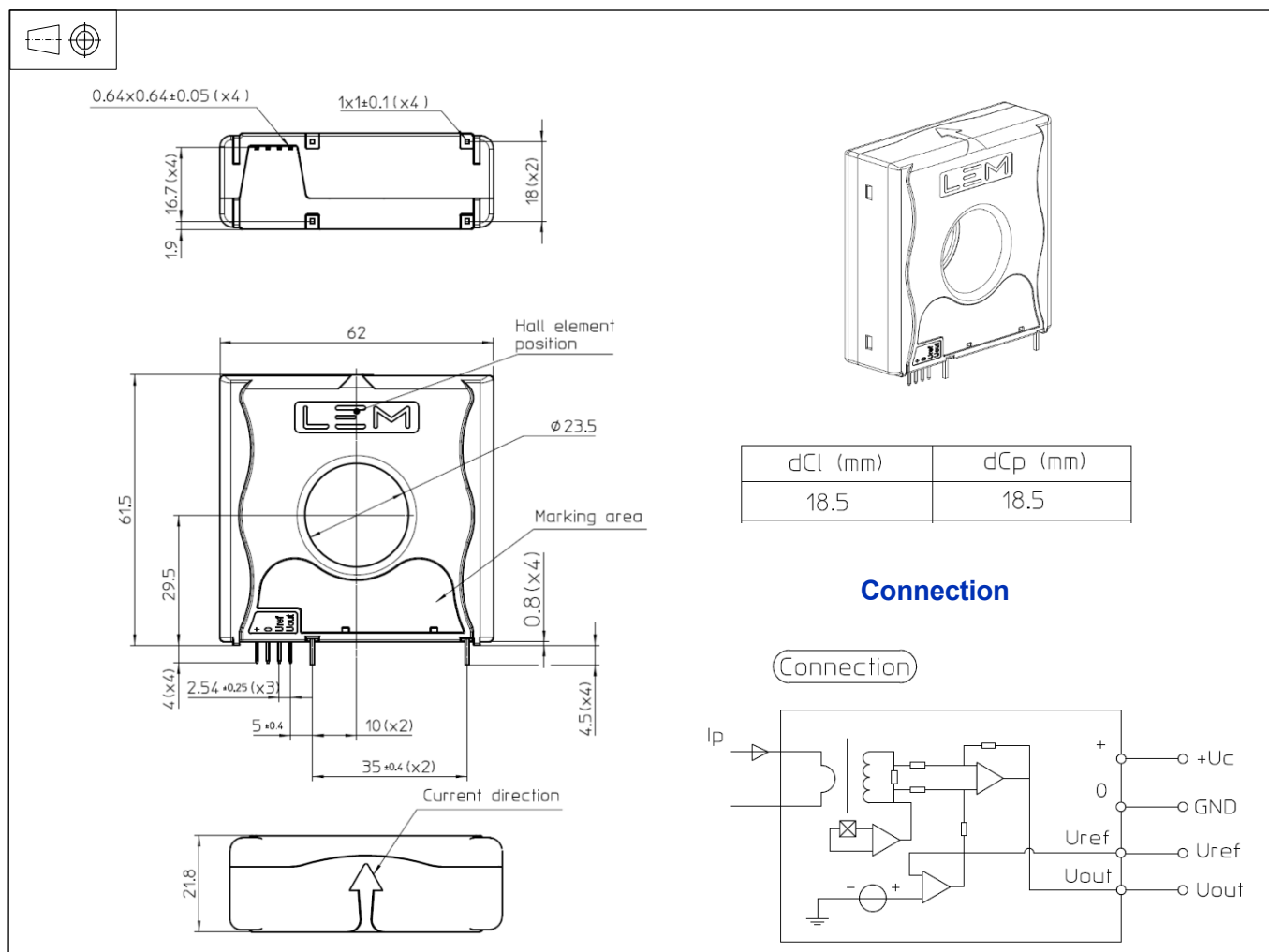
PCB holes diameter:
Secondary Pins: $\varnothing 1.2\text{mm}$
Retention Pins: $\varnothing 2.0\text{mm}$

*=Pads design according to IPC 2221, IPC 2222

Assembly on PCB

- Recommended PCB hole diameter 1.2mm for secondary pin
2mm for retention pin
- Maximum PCB thickness 2.4mm
- Wave soldering profile maximum 265 °C 10 s

The retention pins inserted into the case of the transducer are electrically isolated by the housing.



Mechanical characteristics

- General tolerance ± 0.5 mm
- Color black

Remarks

- I_S is positive when I_P flows in the direction of arrow.
- The secondary cables also have to be routed together all the way.
- 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>

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