Industry Catalogue

Industry Current & Voltage Transducers

LEM

LEM solutions for industry electrical measurements

This catalogue summarizes the most common LEM product offerings for electrical industry measurements. It is our business to support you with both standard and customized products to optimize your application.

Today, the transducer market has two main technology drivers: first, the desire for a greater degree of comfort and finer regulation, and second, the need to save energy. This means that more and more applications that used to be mechanical are changing to fully electronic control which provides increased reliability, improved regulation and higher energy efficiency.

Today, about 15 % of all motors have an inverter control. This control can save 50 % of the total energy consumed, which is a huge potential for savings.

The inverter control used in these newer systems requires reliable, accurate current measurement to enable engineers to develop a system with isolated current measurement directly on the motor phases.

Energy savings is the key word today and this includes the exploitation of the wind and the sun as alternate energies. To use these renewable sources, in the most profitable way in terms of energy efficiency, the use of power electronics is a must. Power electronics are essential to drive and control energy in industrial applications. Modern systems are becoming more complex and require precise coordination between the power semiconductors, the system controller, mechanics, and the feedback sensors. Transducers provide the necessary information from the load to fulfill that function. We can compare the use of transducers to adding eyes to the system.

They can supply the brain of the system, in real time, with information regarding the condition of the controller.

LEM products are already used among a broad spectrum of power electronics applications such as industrial motor drives, UPS, welding, robots, cranes, cable cars, ski lifts, elevators, ventilation, air-conditioning, precision medical systems, power supplies for computer servers, and telecom.

This trend towards more involved power electronics happens in a general manner in the industrial world, for example for the lighting, domestic appliances, computers, telecom applications. Power electronics increases efficiency by delivering the correct type of power at the most efficient voltage, current and frequency.

At LEM, we are finding that our customers not only require an optimal solution to accurately measure the current in their applications, but that they are also looking for a current measurement solution which brings added value to the final application and gives an edge to their competitive environment.

Performance improvement: Customers demand the best solution for all the many applications in the industry worldwide. The transducer business needs to keep up or even anticipate this. LEM remains in close collaboration with its customers and their applications to be able to react quickly to the market requirements and to maintain market leadership position in the transducer industry.

LEM has been a main player in industrial power electronics applications and development for the last 35 years and leverages this vast experience to supply solutions for isolated current and voltage measurements.

With more than 2'500 current and voltage transducers in its portfolio, LEM offers a complete range of accurate, reliable, and galvanically isolated devices for the measurement of currents from 0.1 A to 20 000 A and voltages from 10 V to 6 400 V in various technologies: open loop, closed loop, isolation amplifier, etc.

LEM transducers are designed according to the most demanding international standards (EN50178…) and carry CE marking. UL or UR is also available on most of the models.

We have worldwide ISO 9000 and ISO TS 16949:2002 qualification and offer a 5-year warranty on all of our products.

LEM constantly innovates and strives to improve the performance, cost, and sizes of its products.

LEM is a worldwide company with offices across the globe and production facilities in Europe (included Russia), Asia and America.

We hope you will find this catalogue a useful guide for the selection of our products. Visit our website at www.lem.com and contact our sales network for further assistance. Detailed datasheets and application notes are available.

Sincerely,

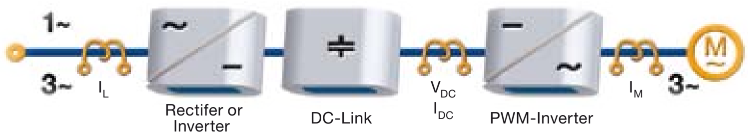
Hans Dieter Huber
Vice President
& Business Segment Manager Industry

Paul Van Iseghem
President
& CEO LEM

Contents Page

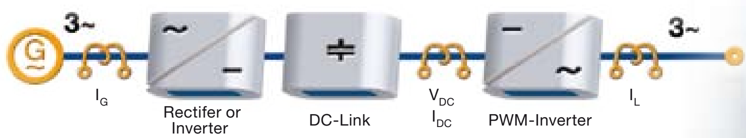
Selection parameters Page

AC Variable Speed Drives and Servo Motor Drives



Typical Applications

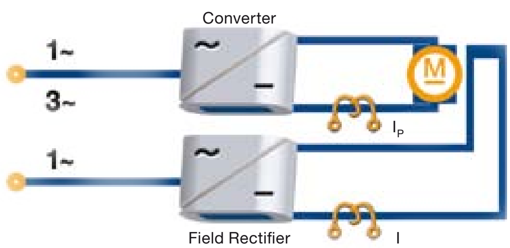
- Machine tools, printing, paper, textile, plastic
- Steel mills
- Lifts
- Cranes
- Robotics
- Pumps
- Washing machines



Typical Applications

- Windmills

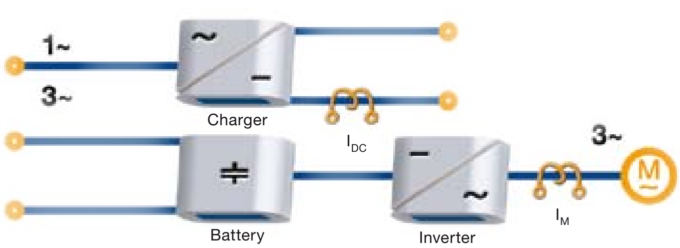
Static Converters for DC Motor Drives



Typical Applications

- Machine tools, paper, printing, plastic
- Cranes
- Escalators
- Electrical door opening systems

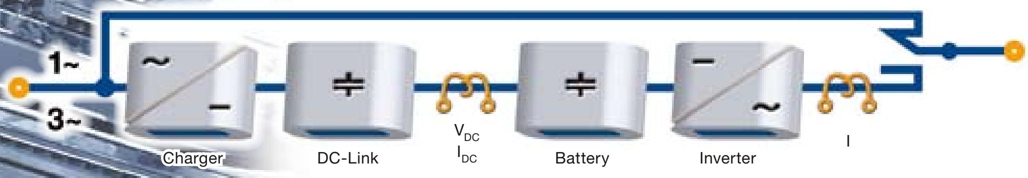
Battery Supplied Applications



Typical Applications

- Electric vehicles (Zero Emission Vehicles, ZEV)
- Fork lift trucks
- Wheel chairs
- Solar power supplies

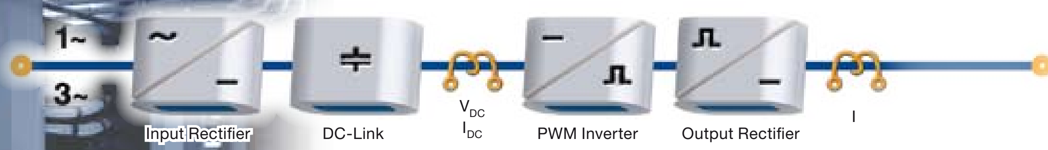
Uninterruptible Power Supplies (UPS)



Typical Applications

- EDP systems
- Telecom
- Security systems

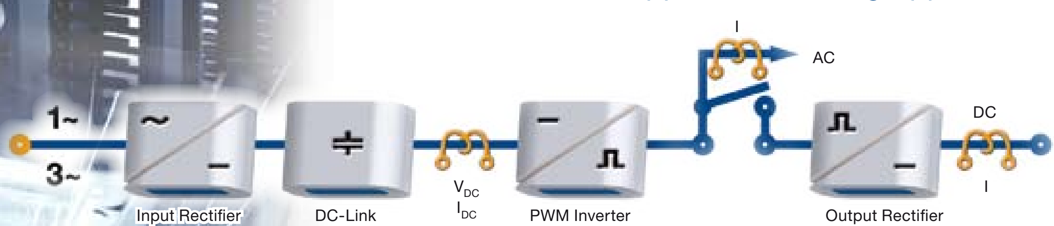
Switched Mode Power Supplies (SMPS)



Typical Applications

- Power supply for electronic equipment and control systems
- Battery chargers
- Telecom
- Voltage and current stabilizer for industry and lab applications
- Electronic ballast

Power Supplies for Welding Applications



Other Applications

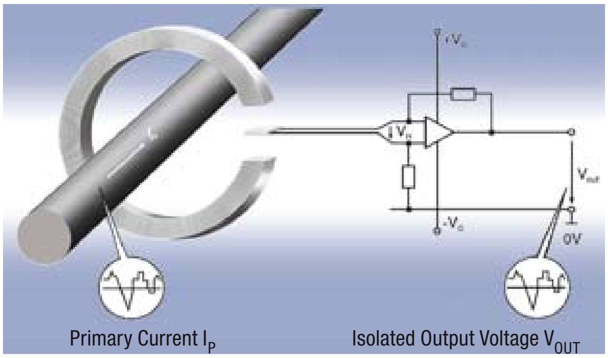
- Test and measurement in laboratories and universities
- Medical X-ray and imaging equipment
- Electrolysis, currents monitoring
- Inductive heating
- Energy management systems. Monitoring of load currents
- Over-current protection
- Control and safety systems
- Electrical traction

Open Loop Current Transducers (O/L)

Features

- Small package size
- Extended measuring range
- Reduced weight
- Low power consumption
- No insertion losses

Operation principle O/L



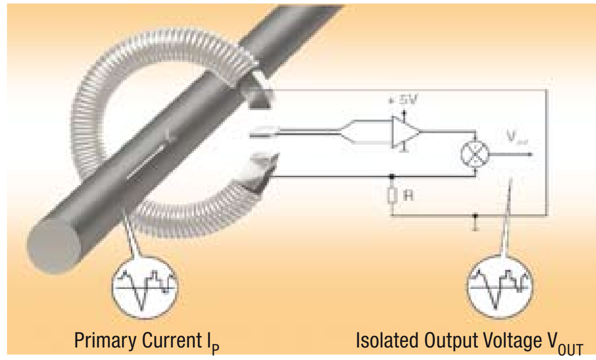
The magnetic flux created by the primary current I_P is concentrated in a magnetic circuit and measured in the air gap using a Hall device. The output from the Hall device is then signal conditioned to provide an exact representation of the primary current at the output.

Eta Current Transducers

Features

- Wide bandwidth
- Extended measuring range
- Very low power consumption
- Unipolar power supply 0 ... + 5 V
- Fast response time

Operation principle Eta



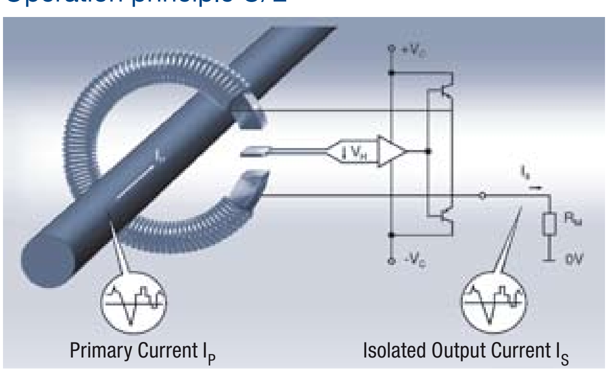
Eta technology combines elements from both the Open Loop and Closed Loop principles previously defined. The result is a device that has the best balance between the features of the both operating principles.

Closed Loop Current Transducers (C/L)

Features

- Wide frequency range
- Good overall accuracy
- Fast response time
- Low temperature drift
- Excellent linearity
- No insertion losses

Operation principle C/L



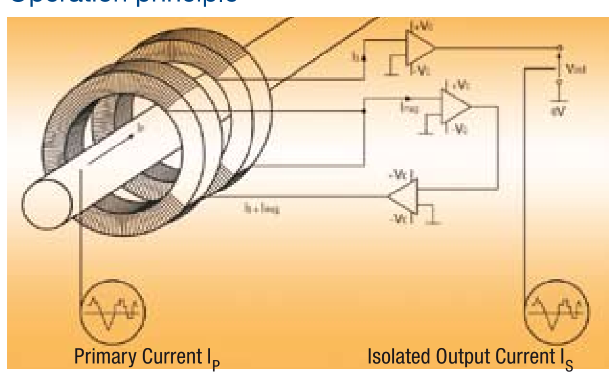
The magnetic flux created by the primary current I_P is balanced by a complementary flux produced by driving a current through the secondary windings. A hall device and associated electronic circuit are used to generate the secondary (compensating) current that is an exact representation of the primary current.

Closed Loop C Types

Features

- High accuracy
- Very wide frequency range
- Reduced temperature drift
- Excellent linearity
- Measurement of differential currents (CD)
- Safety isolation (CV)
- Reduced loading on the primary (CV)

Operation principle



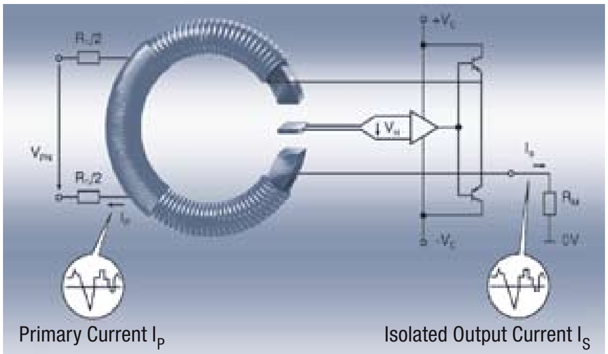
This technology uses two toroidal cores and two secondary windings and operates on the principle of Ampere-turns compensation. For the voltage type a small (few mA) current is taken from the voltage line to be measured and is driven through the primary coil and the primary resistor.

Closed Loop Voltage Transducers (C/L)

Features

- Measurement of high voltages
- Safety isolation
- Good overall accuracy
- Low temperature drift
- Excellent linearity

Operation principle C/L



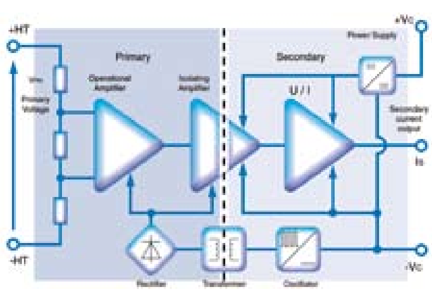
A very small current limited by a series resistor is taken from the voltage to be measured and is driven through the primary coil. The magnetic flux created by the primary current I_P is balanced by a complementary flux produced by driving a current through the secondary windings. A hall device and associated electronic circuit are used to generate the secondary (compensating) current that is an exact representation of the primary voltage. The primary resistor (R_1) can be incorporated or not in the transducer.

AV 100 Type Voltage Transducers

Features

- Any kind of signal, DC, AC, pulsed and complex can be measured
- Galvanic isolation
- Short dynamic response for a good frequency bandwidth
- Fast response time
- Small volume needed

Operation principle



The voltage to measure (V_P) is directly applied on the primary connections through an internal resistor network and some components allowing the signal to feed an isolation amplifier.

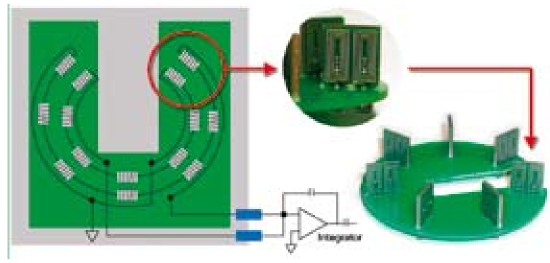
An isolated signal is recovered and conditioned to supply a current at the output, which is an exact representation of the primary voltage.

PRiME Current Transducers

Features

- AC measurement with wide dynamic range
- No magnetic saturation
- High overload capacity
- Good linearity
- Accuracy independent of the position of the cable in the aperture and of external fields
- Light weight and small package
- Low thermal losses

Operation principle



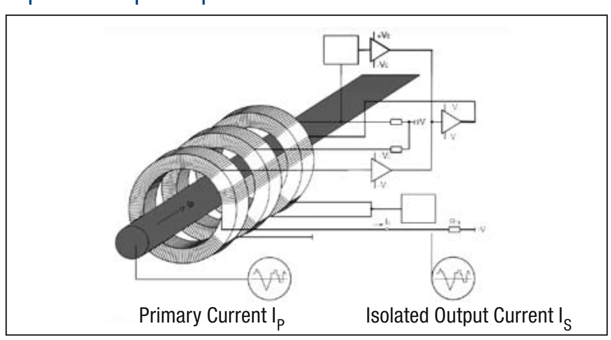
PRiME operates on the basic Rogowski principle. Instead of a traditional wound coil, the measuring head is made of a number of sensor printed circuit boards (PCBs, each made of two separate air cored coils) mounted on a base-PCB. Each sensor PCB is connected in series to form two concentric loops. The induced voltage at their outputs is then integrated in order to obtain both amplitude and phase information for the current being measured.

IT Current Transducers

Features

- Very high global accuracy
- Low noise on the output signal
- Linearity < 1 ppm
- Low cross-over distortion
- High temperature stability
- Wide frequency range

Operation principle



IT current transducers are high accuracy, large bandwidth transducers which do not use Hall generators. The magnetic flux created by the primary current I_P is compensated by a secondary current. The zero-flux detector is a symmetry detector using two wound cores connected to a square-wave generator. The secondary compensating current is an exact representation of the primary current.

* For further information, refer the brochure “Characteristics - Applications - Calculations” or www.lem.com

In today's world it has become critical for industrial manufacturers to be able to save time during the production process.

Electronic components are commonly automatically mounted on a printed circuit board production line. LEM proposes a wide range of transducers to be mounted on a PCB through hole, with an aperture or integrating the conductor carrying the current to be measured. Different sizes, nominal ratings and power supplies are possible to address most of the market requirements.

LEM also thought about the production processes using only surface mounted devices, where the use of components to be soldered through holes is not cost-effective. The HMS current transducer is an isolated surface-mounted current transducer, reducing manufacturing costs, and covering different current ranges.

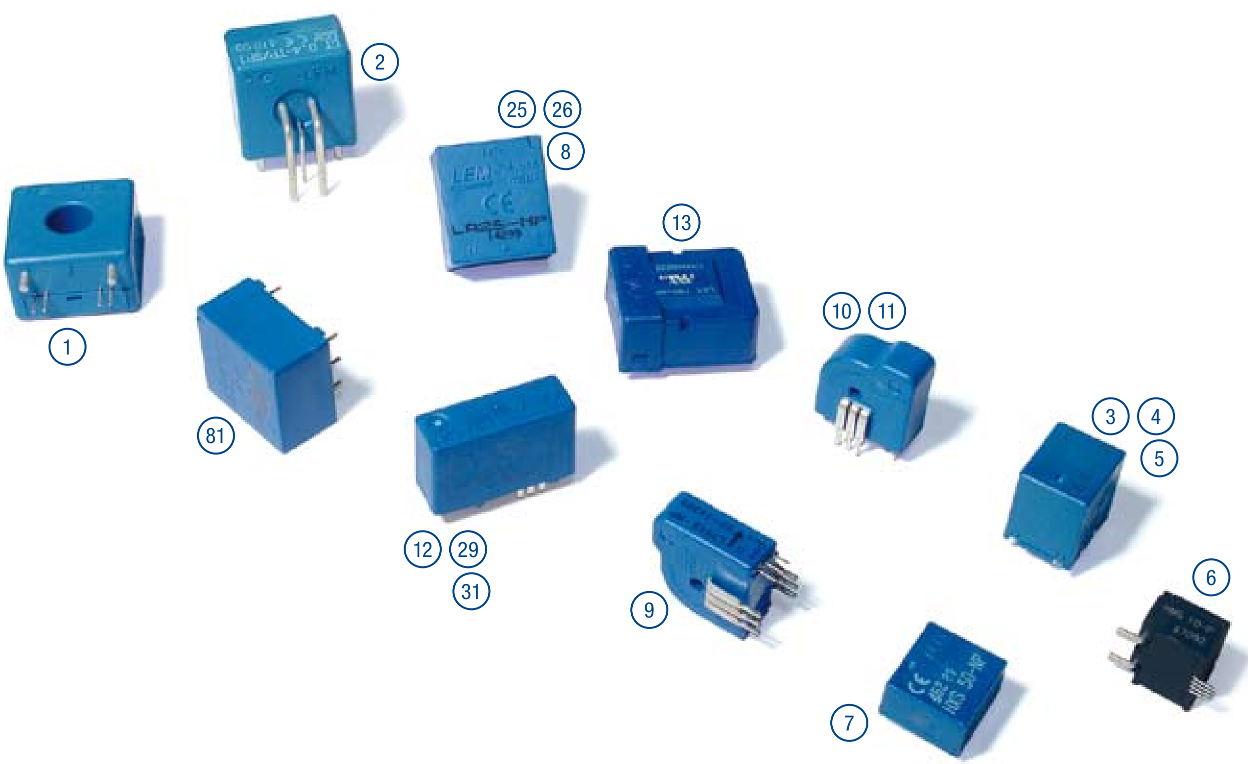
Ready for mass production

LEM current transducers bring added value to your final application. They can integrate the primary conductor to realize the best coupling for dynamic performance (bandwidth, response time...), as well as ensuring a high synergy with modern power electronics.

Even for a bipolar measurement, a lot of current transducers can be power supplied with +5 V, can provide their internal voltage reference on an external pin or receive an external voltage reference to share it with microcontrollers or A/D converters for perfect communication.

Performances such as the offset, gain and offset drifts can be improved by communicating with the microcontroller. Some special ASICs (Application Specific Integrated Circuit) have been designed by LEM to answer to that specific market requirement.

Different current transducer families have been developed based on these ASICs working with Open Loop or Closed Loop Hall effect technology (such as the famous LTS model).



I_{PN} = 0.1 A ... 17 A

Open-loop | Closed-loop | "C"-Types

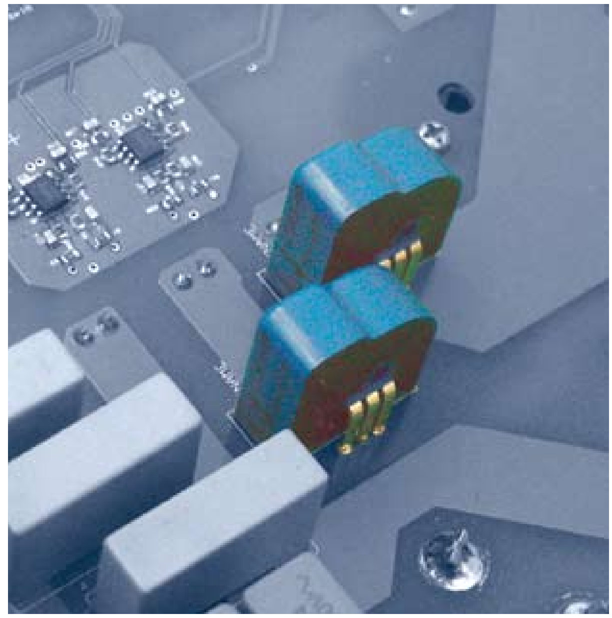
I_{PN} A	I_p A	Technology	V_c V	V_{OUT} I_{OUT} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, bus-bar, other	Connection Secondary PCB	Connection Secondary Other	cULus	Packaging No	Model
0.1	± 0.2	Fluxgate	± 15	5 V	DC-14 (-3dB)	3	-20...+85		●	●		□	1	CT 0.1-P
0.2	± 0.4	Fluxgate	± 15	5 V	DC-16 (-3dB)	3	-20...+85		●	●		□	1	CT 0.2-P
0.4	± 0.8	Fluxgate	± 15	5 V	DC-17 (-3dB)	3	-20...+85		●	●		□	1	CT 0.4-P
0.1	± 0.2	Fluxgate	± 15	5 V	DC-14 (-3dB)	3	-20...+85	●		●		□	2	CT 0.1-TP
0.2	± 0.4	Fluxgate	± 15	5 V	DC-16 (-3dB)	3	-20...+85	●		●		□	2	CT 0.2-TP
0.4	± 0.8	Fluxgate	± 15	5 V	DC-17 (-3dB)	3	-20...+85	●		●		□	2	CT 0.4-TP
0.4	± 0.8	Fluxgate	± 15	5 V	DC-0.2 (-3dB)	3	-20...+85	●		●		□	2	CT 0.4-TP/SP1
3	± 9	O/L	± 12...15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	3	HX 03-P
3	± 9	O/L	+ 12...15	2.5 V±0.625 V	DC-50 (-3dB)[1]	2.6	-25...+85	●		●		■	4	HX 03-P/SP2
5	± 15	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)	1.4	-40...+85	SMD		●		□	6	HMS 05-P[5]
5	± 15	O/L	± 12...15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	3	HX 05-P
5	± 15	O/L	+ 12...15	2.5 V±0.625 V	DC-50 (-3dB)[1]	2.6	-25...+85	●		●		■	4	HX 05-P/SP2
5	± 15	O/L	± 12...15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	5	HX 05-NP[3]
5	± 15	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85	●		●		■	7	HXS 20-NP[5]
5	± 15	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+105	●		●		■	7	HXS 20-NP/SP2[5]
10	± 30	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)	1.4	-40...+85	SMD		●		□	6	HMS 10-P[5]
10	± 30	O/L	± 12...15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	3	HX 10-P
10	± 30	O/L	+ 12...15	2.5 V±0.625 V	DC-50 (-3dB)[1]	2.6	-25...+85	●		●		■	4	HX 10-P/SP2
10	± 30	O/L	± 12...15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	5	HX 05-NP[4]
10	± 30	O/L	± 12...15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	5	HX 10-NP[3]
10	± 30	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85	●		●		■	7	HXS 20-NP[5]
10	± 30	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+105	●		●		■	7	HXS 20-NP/SP2[5]
12.5	± 37.5	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85	●		●		■	7	HXS 50-NP[5]
12.5	± 37.5	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+105	●		●		■	7	HXS 50-NP/SP2[5]
15	± 45	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)	1.4	-40...+85	SMD		●		□	6	HMS 15-P[5]
15	± 45	O/L	± 12...15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	3	HX 15-P
15	± 45	O/L	± 12...15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	5	HX 15-NP[3]
15	± 45	O/L	+ 12...15	2.5 V±0.625 V	DC-50 (-3dB)[1]	2.6	-25...+85	●		●		■	4	HX 15-P/SP2
0.25	± 0.36	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-10...+70	●		●		■	81	LA 25-NP/SP14
0.5	± 0.72	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-40...+70	●		●		■	81	LA 25-NP/SP13
1	± 1.5	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	0...+70	●		●		■	81	LA 25-NP/SP11
1.5	± 2.2	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	0...+70	●		●		■	81	LA 25-NP/SP9
2	± 3	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	0...+70	●		●		■	81	LA 25-NP/SP8
2.5	± 3.6	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	0...+70	●		●		■	81	LA 25-NP/SP7
5	± 7	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		■	8	LA 25-NP
6	± 9	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		■	8	LA 25-NP
6	± 19.2	C/L	+ 5/0	2.5 V±0.625 V	DC-200 (-1dB)	0.7	-40...+85	●		●		■	9	LTS 6-NP
6	± 19.2	C/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-200 (-1dB)	0.7	-40...+85	●		●		■	10	LTSR 6-NP[5]
7	± 14	C/L	± 15	35 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		■	8	LA 35-NP
8	± 12	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		■	8	LA 25-NP
8	± 16	C/L	± 15	32 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		■	8	LA 35-NP
8	± 18	C/L	± 12...15	24 mA	DC-200 (-1dB)	0.4	-25...+85	●		●		■	12	LAH 25-NP
8.33	± 16.66	C/L	+ 5/0	12.5 mA	DC-300 (-1dB)	0.7	-40...+85	●		●		■	11	LTSP 25-NP
11	± 22	C/L	± 15	33 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		■	8	LA 35-NP
12	± 18	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		■	8	LA 25-NP
12	± 27	C/L	± 12...15	24 mA	DC-200 (-1dB)	0.4	-25...+85	●		●		■	12	LAH 25-NP
12.5	± 25	C/L	+ 5/0	12.5 mA	DC-300 (-1dB)	0.7	-40...+85	●		●		■	11	LTSP 25-NP
15	± 48	C/L	+ 5/0	2.5 V±0.625 V	DC-200 (-1dB)	0.7	-40...+85	●		●		■	9	LTS 15-NP
15	± 48	C/L	+ 5/0	2.5V or V_{REF}±0.625V	DC-200 (-1dB)	0.7	-40...+85	●		●		■	10	LTSR 15-NP[5]
16.7	± 50	C/L	± 12...15	25 mA	DC-300 (-1dB)	0.7	-40...+85	●		●		■	13	LAX 100-NP
17	± 34	C/L	± 15	34 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		■	8	LA 35-NP
1	± 2	"C"	± 15	5 V	DC-500 (-3dB)	0.25[2]	-25...+70		●		●		14	CT 1-T
2	± 4	"C"	± 15	5 V	DC-500 (-3dB)	0.15[2]	-25...+70		●		●		14	CT 2-T
5	± 7.5	"C"	± 15	5 V	DC-500 (-3dB)	0.1[2]	-25...+70		●		●		14	CT 5-T
10	± 15	"C"	± 15	5 V	DC-500 (-3dB)	0.1[2]	-25...+70		●		●		14	CT 10-T

1- Small signal bandwidth to avoid excessive core heating at high frequency
2-Global accuracy within the operating temperature range
3-Connected in series
4-Connected in parallel
5-Ref_{IN} & Ref_{OUT} modes
■ recognized □ recognition pending

Dedicated data sheets are the only recognized reference documents for the given performances and data - Datasheets: www.lem.com

LEM's ASICs also contribute to energy saving by allowing +5 V power supply and low current consumption.

The LEM designed ASICs integrate a vital part of the electronics, combining the parts of the traditional current transducers (field sensing elements, all active electronic components such as amplifier, transistors, diodes, zener, voltage reference…) into an integrated circuit. Thanks to the use of silicon technology, some specific functions and improved performances such as better offset and gain drifts have been possible.



Simplified integration

ASICs have been a great contributor towards the miniaturization thanks to this electronic integration onto a unique chip. They allow the design of current transducers as small as the recent HMS model (16 (L) x 13.5 (W) x 12 (H) mm integrating the primary conductor). Smaller, high performance, high isolation, easier integration into and with the remaining electronic components is exactly what today's power electronics need.

These kinds of transducers are becoming interesting for applications in which this integration criteria is essential such as white goods or air conditioning.

Selection parameter 1: Supply voltage

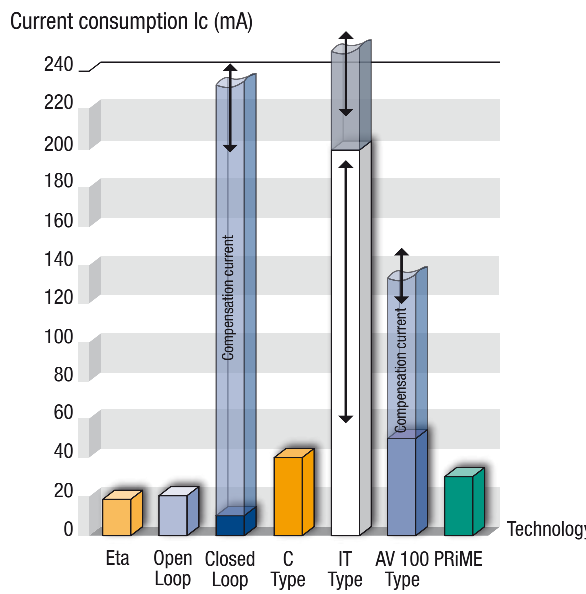
Most of the transducers are working for a bipolar measurement with a bipolar supply voltage.

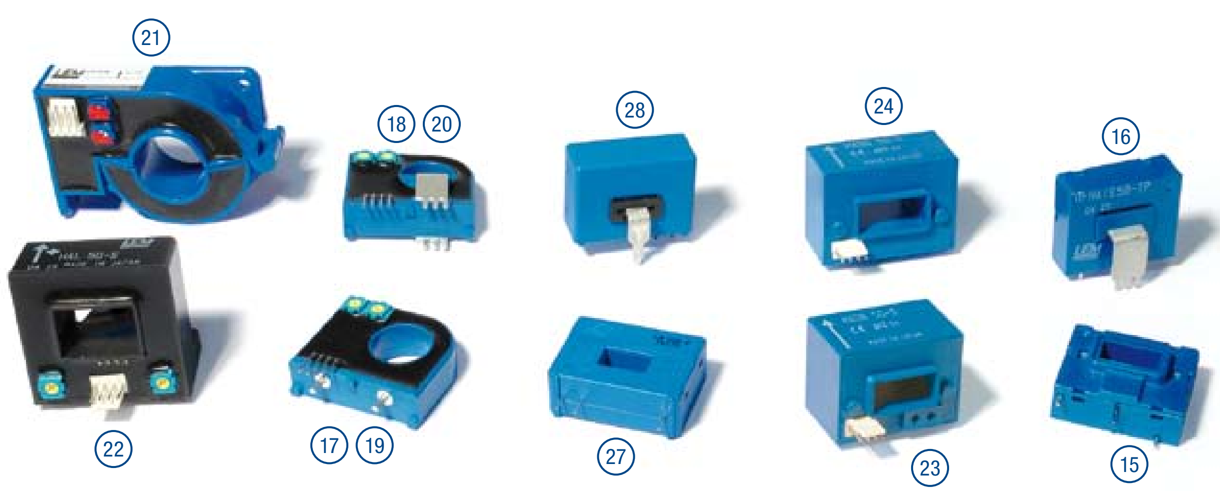
V_C = 0, +/- 12 V ; 0, +/- 15 V ; 0, +/- 24 V ; ...

However, due to Power Electronics evolution and its needs, and thanks to ASIC emergence, a large range of transducers are designed for bipolar measurements with a single unipolar power supply with reference to ground (0 V): V_C = 0 .. +5 V.

This is a great factor of low power consumption.

Power consumption is linked to the kind of technology used for the transducer. For instance, the following typical currents are consumed versus the technologies used (this is an important parameter to take into account at the design phase):





I_{PN} = 20 A ... 50 A

Open-loop | Closed-loop | "C"-Types | Eta

I_{PN} A	I_p A	Technology	V_c V	V_{OUT} I_{OUT} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, bus-bar, other	Connection Secondary PCB	Connection Secondary Other	cULus	Packaging No	Model
20	± 60	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)	1.4	-40...+85	SMD		●		□	6	HMS 20-P[5]
20	± 60	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	3	HX 20-P
20	± 60	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	5	HX 10-NP[4]
20	± 60	O/L	+ 12…15	2.5 V±0.625 V	DC-50 (-3dB)[1]	2.6	-25...+85	●		●		■	4	HX 20-P/SP2
20	± 60	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85	●		●		■	7	HXS 20-NP[5]
20	± 60	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+105	●		●		■	7	HXS 20-NP/SP2[5]
25	± 75	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	3	HX 25-P
25	± 75	O/L	+ 12…15	2.5 V±0.625 V	DC-50 (-3dB)[1]	2.6	-25...+85	●		●		■	4	HX 25-P/SP2
25	± 75	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85	●		●		■	7	HXS 50-NP[5]
25	± 75	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+105	●		●		■	7	HXS 50-NP/SP2[5]
30	± 90	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	5	HX 15-NP[4]
50	± 100	O/L	± 12…15	4 V	DC-10 (-1dB)[1]	3.4	-10...+70		●		●	■	21	HTR 50-SB
50	± 150	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●	●		■	15	HAIS 50-P[5]
50	± 150	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85	●		●		■	16	HAIS 50-TP[5]
50	± 150	O/L	± 15	4 V	DC-50 (-3dB)[1]	1.75	-25...+85		●		●	■	22	HAL 50-S
50	± 150	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.5	-40...+85		●		●	□	23	HASN 50-S
50	± 150	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.75	-20...+80		●	●		■	17	HTB 50-P
50	± 150	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.75	-20...+80	●		●		■	18	HTB 50-TP
50	± 150	O/L	+ 12…15	Vc/2 V +/- 1.667 V	DC-50 (-3dB)[1]	1.5	-25...+85		●	●		■	19	HTB 50-P/SP5
50	± 150	O/L	+ 12…15	Vc/2 V +/- 1.667 V	DC-50 (-3dB)[1]	1.5	-25...+85	●		●		■	20	HTB 50-TP/SP5
50	± 150	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.4	-25...+85	●		●		■	3	HX 50-P
50	± 150	O/L	+ 12…15	2.5 V±0.625 V	DC-50 (-3dB)[1]	2.6	-25...+85	●		●		■	4	HX 50-P/SP2
50	± 150	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85	●		●		■	7	HXS 50-NP[5]
50	± 150	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+105	●		●		■	7	HXS 50-NP/SP2[5]
50	± 150	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●		●	□	24	HASS 50-S[5]
25	± 36	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		■	8	LA 25-NP
25	+ 36	C/L	+ 15/0	25 mA	DC-150 (-1dB)	0.5	0...+70	●		●		■	25	LA 25-NP/SP2
25	± 36	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		■	26	LA 25-NP/SP25
25	± 50	C/L	+ 5/0	12.5 mA	DC-300 (-1dB)	0.7	-40...+85	●		●		■	11	LTSP 25-NP
25	± 75	C/L	± 12…15	25 mA	DC-300 (-1dB)	0.7	-40...+85	●		●		■	13	LAX 100-NP
25	± 55	C/L	± 12…15	25 mA	DC-200 (-1dB)	0.4	-25...+85	●		●		■	12	LAH 25-NP
25	± 80	C/L	+ 5/0	2.5 V±0.625 V	DC-200 (-1dB)	0.7	-40...+85	●		●		■	9	LTS 25-NP
25	± 80	C/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-200 (-1dB)	0.7	-40...+85	●		●		■	10	LTSR 25-NP [5]
33.3	± 53	C/L	± 12…15	50 mA	DC-300 (-1dB)	0.55	-40...+85	●		●		■	13	LAX 100-NP
33.3	± 80	C/L	± 12…15	33.3 mA	DC-300 (-1dB)	0.6	-40...+85	●		●		■	13	LAX 100-NP
35	± 70	C/L	± 15	35 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		■	8	LA 35-NP
50	± 70	C/L	± 12…15	50 mA	DC-200 (-1dB)	0.65[6]	-25...+85		●	●		■	27	LA 55-P
50	± 70	C/L	± 12…15	50 mA	DC-200 (-1dB)	0.45[6]	-25...+85		●	●		■	27	LA 55-P/SP23
50	± 70	C/L	± 12…15	50 mA	DC-200 (-1dB)	0.65[6]	-25...+85	●		●		■	28	LA 55-TP
50	± 100	C/L	± 12…15	25 mA	DC-200 (-1dB)	0.65[6]	-25...+85		●	●		■	27	LA 55-P/SP1
50	± 100	C/L	± 12…15	25 mA	DC-200 (-1dB)	0.65[6]	-25...+85	●		●		■	28	LA 55-TP/SP1
50	± 100	C/L	± 12…15	25 mA	DC-200 (-1dB)	0.65[6]	-40...+85	●		●		■	28	LA 55-TP/SP27
50	± 110	C/L	± 12…15	25 mA	DC-200 (-1dB)	0.3	-25...+85	●		●		■	29	LAH 50-P
50	± 160	C/L	± 12…15	25 mA	DC-300 (-1dB)	0.7	-40...+85	●		●		■	13	LAX 100-NP
25	± 37.5	"C"	± 15	5 V	DC-500 (-3dB)	0.1[2]	-25...+70		●		●		14	CT 25-T
50	± 75	"C"	± 15	5 V	DC-500 (-3dB)	0.1[2]	-25...+70		●		●		30	CT 50-T
50	± 150	Eta	+ 5/0	2.5V or V_{REF} ±0.625V	DC-100 (-1dB)	1.2	-40...+85	●		●		■	31	LAS 50-TP[5]

1-Small signal bandwidth to avoid excessive core heating at high frequency
2-Global accuracy within the operating temperature range
3-Connected in series
4-Connected in parallel
5-Ref_{OUT} and Ref_{IN} modes
6-Accuracy calculated with max. electrical offset instead of typical electrical offset @ V_C = ±15 V
■ recognized □ recognition pending

Above 100 A nominal, PCB mounting is not a viable option for the primary conductor. Therefore, LEM has designed a wide range of Closed and Open Loop panel mounted current transducers. They are housed in common package outlines to accommodate a number of primary conductor options.

The same housing can be proposed for a large range of currents (HASN or HASS models, for instance, are proposed in 7 models to cover nominal current measurement from 50 A to 600 A_{RMS} using the same mechanical design). This simplifies the development of a complete product series covering several power ranges (a complete range of drives from low power to high power is able to share the same current transducer with the same shape proposed at different ratings for the whole range of drives).

Models are even proposed with integrated busbars.

Various shapes and sizes

Need to mount a current transducer without disconnecting the primary conductor in an existing application? This is a job for the HTR or HOP devices. Indeed, they are able to be opened in 2 parts in order to be clamped onto the primary conductor. They're perfect for retrofit applications without disconnection.

Selection parameter 2: Accuracy

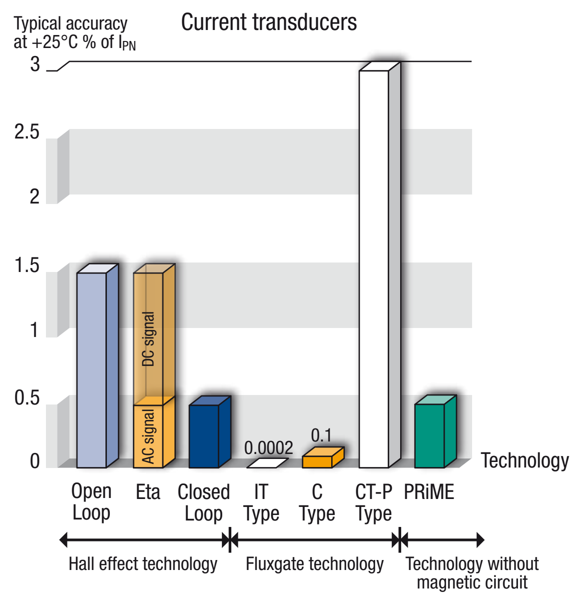
Accuracy is a fundamental parameter in electrical systems. Selecting the right transducer is often a trade-off between several parameters: accuracy, frequency response, weight, size, costs, etc. The measuring accuracy for LEM transducers depends primarily on the operation principle.

Open Loop transducers are calibrated during the manufacturing process and typically provide accuracy better than 2 % of the nominal range at 25 °C. For additional offset and gain drift parameter, please refer to individual datasheets.

New ASIC based Open Loop and Eta transducers are being developed to provide improvement in gain and offset drift over traditional Open Loop transducers.

Closed Loop current and voltage transducers provide excellent accuracy at 25 °C, in general below 1% of the nominal range, and a reduced error over the specified temperature range, thanks to their balanced flux operation.

IT and C types are high performance transducers with exceptional accuracy level over their operating temperature range.



Individual datasheets provide all relevant information to precisely calculate the overall accuracy of a given transducer in a specific application.

I_{PN} = 100 A ... 300 A (part 1)

Open-loop

I_{PN} A	I_p A	Technology	V_c V	V_{OUT} I_{OUT} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, bus-bar, other	Connection Secondary PCB	Connection Secondary Other	cULus	Packaging No	Model
100	± 300	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.7	-10...+80		●		●	■	32	HAC 100-S
100	± 300	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●	●		■	15	HAIS 100-P[5]
100	± 300	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85	●		●		■	16	HAIS 100-TP[5]
100	± 300	O/L	± 15	4 V	DC-50 (-3dB)[1]	1.75	-25...+85		●		●	■	22	HAL 100-S
100	± 300	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.5	-40...+85		●		●	□	23	HASN 100-S
100	± 300	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●		●	□	24	HASS 100-S[5]
100	± 300	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.75	-20...+80		●	●		■	17	HTB 100-P
100	± 300	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.75	-20...+80	●		●		■	18	HTB 100-TP
100	± 300	O/L	+ 12…15	Vc/2 V +/- 1.667 V	DC-50 (-3dB)[1]	1.5	-25...+85		●	●		■	19	HTB 100-P/SP5
100	± 300	O/L	+ 12…15	Vc/2 V +/- 1.667 V	DC-50 (-3dB)[1]	1.5	-25...+85	●		●		■	20	HTB 100-TP/SP5
100	± 200	O/L	± 12…15	4 V	DC-10 (-1dB)[1]	3.4	-10...+70		●		●	■	21	HTR 100-SB
150	± 450	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●	●		■	15	HAIS 150-P[5]
200	± 600	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.7	-40...+85		●		●	■	32	HAC 200-S
200	± 600	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●	●		■	15	HAIS 200-P[5]
200	± 600	O/L	± 15	4 V	DC-50 (-3dB)[1]	1.75	-25...+85		●		●	■	22	HAL 200-S
200	± 600	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.5	-40...+85		●		●	□	23	HASN 200-S
200	± 600	O/L	± 15	4 V	DC-25 (-3dB)[1]	1.75	-10...+80		●		●	■	33	HAT 200-S
200	± 600	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●		●	□	24	HASS 200-S[5]
200	± 300	O/L	± 12…15	4 V	DC-8 (-1dB)[1]	3.75	-10...+70		●		●	■	34	HOP 200-SB
200	± 300	O/L	+ 5/0	Vc/2 V or V_{REF} ±1.25V	DC-20 (-3dB)[1]	1.4	-40...+105		●	●		■	35	HTFS 200-P[5]
200	± 300	O/L	+ 5/0	Vc/2 V or V_{REF} ±1.25V	DC-20 (-3dB)[1]	1.4	-40...+105		●	●		■	36	HTFS 200-P/SP2[5]
200	± 500	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.75	-20...+80		●	●		■	17	HTB 200-P
200	± 500	O/L	+ 12…15	Vc/2 V +/- 1.667 V	DC-50 (-3dB)[1]	1.5	-25...+85		●	●		■	19	HTB 200-P/SP5
200	± 400	O/L	± 12…15	4 V	DC-10 (-1dB)[1]	3.4	-10...+70		●		●	■	21	HTR 200-SB
300	± 900	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.7	-10...+80		●		●	■	32	HAC 300-S
300	± 900	O/L	± 15	4 V	DC-50 (-3dB)[1]	1.75	-25...+85		●		●	■	22	HAL 300-S
300	± 900	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.5	-40...+85		●		●	□	23	HASN 300-S
300	± 900	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●		●	□	24	HASS 300-S[5]
300	± 450	O/L	± 12…15	4 V	DC-8 (-1dB)[1]	3.75	-10...+70		●		●	■	34	HOP 300-SB
300	± 600	O/L	± 12…15	4 V	DC-10 (-1dB)[1]	3.4	-10...+70		●		●	■	21	HTR 300-SB
300	± 600	O/L	± 12…15	4 V	DC-50 (-3dB)[1]	2.75	-20...+80		●	●		■	17	HTB 300-P
300	± 600	O/L	+ 12…15	Vc/2 V +/- 1.667 V	DC-50 (-3dB)[1]	1.5	-25...+85		●	●		■	19	HTB 300-P/SP5

1-Small signal bandwidth to avoid excessive core heating at high frequency
5-Ref_{OUT} & Ref_{IN} modes
■ recognized □ recognition pending

The new trends in Power Electronics designs are size reduction, and perfect integration. The dedicated area for current measurement in applications is often decided with regard to space requirements rather than in regard to the real dimensions of the transducer.

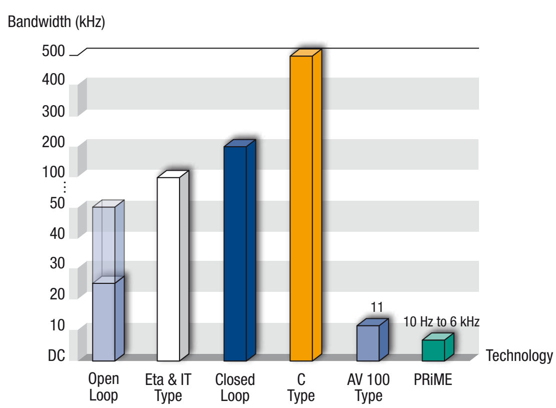
The current transducers must provide a high level of adaptation to be able to be part of the final design.

To this end, different mechanical designs are welcome as well as the possibility to mount a product in different ways.

Multiple mounting possibilities

Models such as the LF series offer several horizontal or vertical mounting possibilities, in very compact packages, allowing the user to select the most appropriate transducer mounting configuration for the application.

LF models are available over a wide measurement range from 100 A_{RMS} to 2000 A_{RMS} with enhanced performances in the line of Hall effect Closed Loop current transducers.



Typical bandwidths per LEM's technology

Selection parameter 3: Frequency response

The frequency response of a transducer is primarily linked to the embedded technology. Some key factors affecting the bandwidth performance, for the different technologies that LEM offers, are for example:

- Open Loop: Core geometry, number and thickness of the laminations, type of core material and Hall effect chip, impact directly the bandwidth.
- Closed Loop, Eta, IT-type (and to a lesser extent, C-type): Coupling between primary and secondary (depending on the mechanical and on magnetic circuit designs) and the core material have an influence on the bandwidth.
- For the AV 100-Type and PRiME technologies, it is a question of electronic limitation.

For Closed Loop Hall effect voltage transducers, bandwidth is limited to some kHz due to the primary inductance, please refer to the response time in the individual data sheets

I_{PN} = 100 A ... 366 A (part 2)

Closed-loop | Eta | "IT"-Types

I_{PN} A	I_p A	Technology	V_c V	V_{OUT} I_{OUT} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, bus-bar, other	Connection Secondary PCB	Connection Secondary Other	c UL us	Packaging No	Model
100	± 150	C/L	± 12…15	50 mA	DC-200 (-1dB)	0.45[6]	-40...+85		●	●		■	27	LA 100-P
100	± 150	C/L	± 12…15	50 mA	DC-200 (-1dB)	0.45[6]	-40...+85	●		●		■	28	LA 100-TP
100	± 160	C/L	± 12…15	50 mA	DC-300 (-1dB)	0.55	-40...+85	●		●		■	13	LAX 100-NP
100	± 160	C/L	± 12…15	50 mA	DC-200 (-1dB)	0.3	-25...+85	●		●		■	29	LAH 100-P
100	± 160	C/L	± 12…15	100 mA	DC-200 (-1dB)	0.45[6]	-25...+70		●	●		■	27	LA 100-P/SP13
100	± 200	C/L	± 12…15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●		●	■	37	LF 205-S/SP3
125	± 200	C/L	± 12…15	125 mA	DC-100 (-1dB)	0.8	-40...+85		●	●		■	38	LA 125-P
125	± 200	C/L	± 12…15	62.5 mA	DC-100 (-1dB)	0.8	-25...+85		●	●		■	38	LA 125-P/SP1
125	± 300	C/L	± 12…15	62.5 mA	DC-100 (-1dB)	0.8	-40...+85		●	●		■	38	LA 125-P/SP4
125	± 200	C/L	± 12…15	125 mA	DC-100 (-3dB)	0.41	-40...+85	●		●		■	39	LAH 125-P
150	± 200	C/L	± 15	75 mA	DC-150 (-1dB)[1]	0.85	-10...+80		●	●		■	40	LA 150-P
200	± 300	C/L	± 12…15	100 mA	DC-100 (-1dB)	0.65	-40...+85		●	●		■	38	LA 200-P
200	± 300	C/L	± 12…15	100 mA	DC-100 (-1dB)	0.65	-25...+85		●	●		■	38	LA 200-P/SP4
200	± 300	C/L	± 12…15	100 mA	DC-100 (-3dB)	0.3	-10...+85		●		●	■	41	LA 205-S
200	± 300	C/L	± 12…15	100 mA	DC-100 (-3dB)	0.3	-10...+85		●		●	■	42	LA 205-S/SP1
200	± 300	C/L	± 12…15	100 mA	DC-100 (-3dB)	0.3	-10...+85		●		●	■	43	LA 205-T
200	± 420	C/L	± 12…15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●		●	■	37	LF 205-S
200	± 420	C/L	± 12…15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●	●		■	44	LF 205-P
200	± 420	C/L	± 12…15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●		●	■	45	LF 205-S/SP1
200	± 420	C/L	± 12…15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●	●		■	46	LF 205-P/SP1
250	± 500	C/L	± 12…18	125 mA	DC-100 (-3dB)	0.3	-10...+85		●		●	■	47	LA 255-S
250	± 500	C/L	± 12…18	125 mA	DC-100 (-3dB)	0.3	-10...+85		●		●	■	48	LA 255-T
300	± 500	C/L	± 12…15	150 mA	DC-100 (-3dB)	0.3	-10...+85		●		●	■	49	LA 205-S/SP30
300	± 500	C/L	± 12…15	120 mA	DC-100 (-3dB)	0.27	-10...+85		●		●	■	50	LA 305-S
300	± 500	C/L	± 12…15	120 mA	DC-100 (-3dB)	0.27	-10...+85		●		●	■	51	LA 305-S/SP5
300	± 500	C/L	± 12…15	120 mA	DC-100 (-3dB)	0.27	-10...+85		●		●	■	52	LA 305-T
300	± 500	C/L	± 12…20	150 mA	DC-100 (-1dB)	0.3	-10...+70		●		●	■	53	LF 305-S
300	± 500	C/L	± 12…15	150 mA	DC-100 (-1dB)	0.3	-25...+70		●		●	■	54	LF 306-S
300	± 500	C/L	± 12…15	150 mA	DC-100 (-1dB)	0.3	-25...+70		●	●		■	55	LF 306-S/SP10
300	± 500	C/L	± 12…20	150 mA	DC-100 (-3dB)	0.3	-40...+85		●		●	■	56	LF 305-S/SP10
300	± 700	C/L	± 15	150 mA	DC-50 (-3dB)	0.4	-40...+85		●		●	□	57	LA 306-S
366	± 950	C/L	± 15	183 mA	DC-100 (-1dB)	0.3	-10...+70		●		●	□	58	LT 305-S
100	± 300	Eta	+ 5/0	2.5V or V_{REF} ±0.625V	DC-100 (-1dB)	1.2	-40...+85	●		●		■	31	LAS 100-TP[5]
150	± 150	"IT"	± 15	200 mA	DC-100 (3dB)	0.0043	10...+50		●		●		59	IT 150-S
300	± 450	"IT"	± 15	150 mA	DC-100 (-3dB)	0.05	-40...+85		●		●		60	ITB 300-S

1-Small signal bandwidth to avoid excessive core heating at high frequency
5-Ref_{OUT} & Ref_{IN} modes
6-Accuracy calculated with max. electrical offset instead of typical electrical offset @ V_C = ±15 V
■ recognized □ recognition pending

Dedicated data sheets are the only recognized reference documents for the given performances and data - Datasheets: www.lem.com

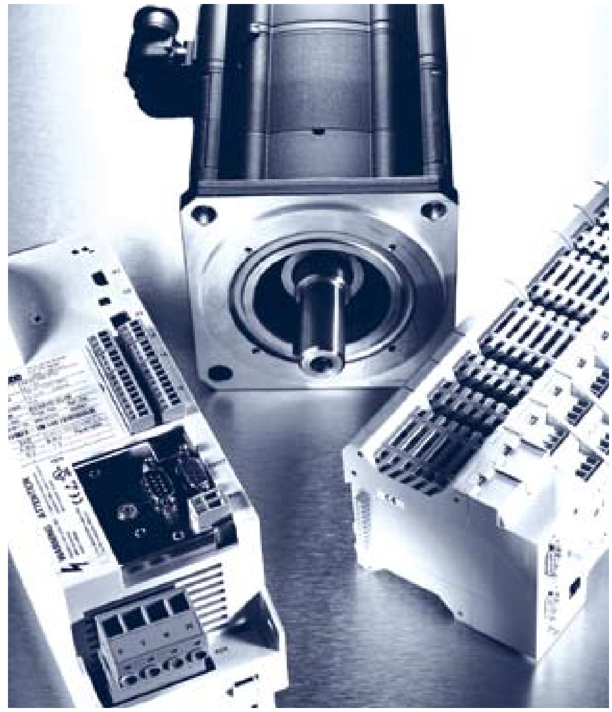
Most industrial applications integrate AC or DC motors managed by an inverter based on power electronics.

The inverter is the solution to efficiently control the motor power and to achieve energy savings.

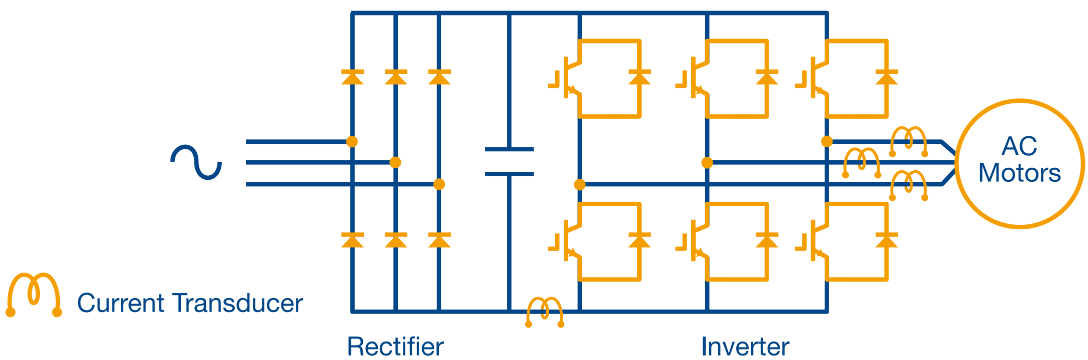
The inverter controls the motor speed by adjusting the frequency and amplitude of the current applied to the motor phases (AC motors) according to the application requirement.

At the Heart of Motors Drives

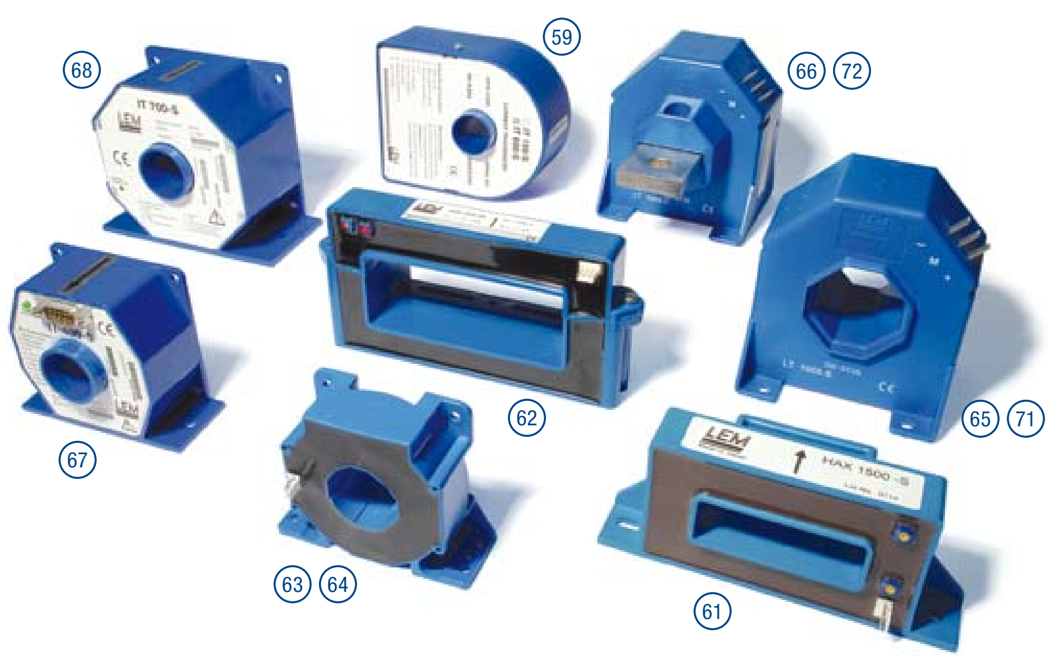
Current transducers are used to supply the exact value of the constantly varying motor phase currents to the Micro-controller to analyze the data and adapt the various parameters versus the needs (for example, in lifts, the signal provided by the transducers causes the motor to adjust its torque to the effective weight of the cabin for smooth acceleration, positioning and stopping).



Picture provided by courtesy of Lenze AG



Current measurement in an inverter is present everywhere there is a signal transformation



I_{PN} = 400 A ... 800 A

Open-loop | Closed-loop | "IT"-Types

I_{PN} A	I_p A	Technology	V_c V	V_{OUT} I_{OUT} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection: Primary PCB	Connection: Primary Aperture, bus-bar, other	Connection: Secondary PCB	Connection: Secondary Other	cULus	Packaging No	Model
400	± 600	O/L	± 12...15	4 V	DC-50 (-3dB)[1]	2.75	-20...+80		●	●		■	17	HTB 400-P
400	± 1200	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.7	-10...+80		●		●	■	32	HAC 400-S
400	± 900	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.5	-40...+85		●		●	□	23	HASN 400-S
400	± 900	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●		●	□	24	HASS 400-S[5]
400	± 1000	O/L	± 15	4 V	DC-50 (-3dB)[1]	1.75	-25...+85		●		●	■	22	HAL 400-S
400	± 1200	O/L	± 15	4 V	DC-25 (-3dB)[1]	1.75	-10...+80		●		●	■	33	HAT 400-S
400	± 600	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●	●		■	15	HAIS 400-P[5]
400	± 600	O/L	± 12...15	4 V	DC-8 (-1dB)[1]	3.75	-10...+70		●		●	■	34	HOP 400-SB
400	± 600	O/L	+ 5/0	Vc/2 V or V_{REF} ±1.25V	DC-20 (-3dB)[1]	1.4	-40...+105		●	●		■	35	HTFS 400-P[5]
400	± 600	O/L	+ 5/0	Vc/2 V or V_{REF} ±1.25V	DC-20 (-3dB)[1]	1.4	-40...+105		●	●		■	36	HTFS 400-P/SP2[5]
400	± 800	O/L	± 12...15	4 V	DC-10 (-1dB)[1]	3.4	-10...+70		●		●	■	21	HTR 400-SB
400	± 600	O/L	+ 12...15	Vc/2 V +/- 1.667 V	DC-50 (-3dB)[1]	1.5	-25...+85		●	●		■	19	HTB 400-P/SP5
500	± 1500	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.7	-10...+80		●		●	■	32	HAC 500-S
500	± 900	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.5	-40...+85		●		●	□	23	HASN 500-S
500	± 900	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●		●	□	24	HASS 500-S[5]
500	± 1000	O/L	± 15	4 V	DC-50 (-3dB)[1]	1.75	-25...+85		●		●	■	22	HAL 500-S
500	± 1500	O/L	± 15	4 V	DC-25 (-3dB)[1]	1.75	-10...+80		●		●	■	33	HAT 500-S
500	± 1500	O/L	± 15	4 V	DC-25 (-3dB)[1]	2.75	-25...+85		●		●	■	61	HAX 500-S
500	± 750	O/L	± 12...15	4 V	DC-8 (-1dB)[1]	3.75	-10...+70		●		●	■	34	HOP 500-SB
500	± 1000	O/L	± 12...15	4 V	DC-10 (-1dB)[1]	2.5	-10...+70		●		●	■	62	HOP 500-SB/SP1
500	± 1000	O/L	± 12...15	4 V	DC-10 (-1dB)[1]	3.4	-10...+70		●		●	■	21	HTR 500-SB
600	± 900	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.5	-40...+85		●		●	□	23	HASN 600-S
600	± 900	O/L	+ 5/0	2.5V or V_{REF} ±0.625V	DC-50 (-3dB)[1]	1.4	-40...+85		●		●	□	24	HASS 600-S[5]
600	± 1000	O/L	± 15	4 V	DC-50 (-3dB)[1]	1.75	-25...+85		●		●	■	22	HAL 600-S
600	± 1800	O/L	± 15	4 V	DC-25 (-3dB)[1]	1.75	-10...+80		●		●	■	33	HAT 600-S
600	± 900	O/L	± 12...15	4 V	DC-8 (-1dB)[1]	3.75	-10...+70		●		●	■	34	HOP 600-SB
800	± 1200	O/L	+ 5/0	Vc/2 V or V_{REF} ±1.25V	DC-20 (-3dB)[1]	1.4	-40...+105		●	●		■	35	HTFS 800-P[5]
800	± 1200	O/L	+ 5/0	Vc/2 V or V_{REF} ±1.25V	DC-20 (-3dB)[1]	1.4	-40...+105		●	●		■	36	HTFS 800-P/SP2[5]
800	± 1800	O/L	± 15	4 V	DC-50 (-3dB)[1]	2.7	-10...+80		●		●	■	32	HAC 800-S
800	± 2400	O/L	± 15	4 V	DC-25 (-3dB)[1]	1.75	-10...+80		●		●	■	33	HAT 800-S
800	± 1600	O/L	± 12...15	4 V	DC-10 (-1dB)[1]	2.5	-10...+70		●		●	■	62	HOP 800-SB
500	± 800	C/L	± 12...15	250 mA	DC-100 (-3dB)	0.24	-10...+85		●		●	■	50	LA 305-S/SP1
500	± 800	C/L	± 12...15	250 mA	DC-100 (-3dB)	0.24	-10...+85		●		●	■	52	LA 305-T/SP1
500	± 800	C/L	± 15...24	100 mA	DC-100 (-1dB)	0.3	-40...+70		●		●	■	63	LF 505-S
500	± 800	C/L	± 15...24	100 mA	DC-100 (-1dB)	0.3	-10...+70		●		●	■	64	LF 505-S/SP15
500	± 1200	C/L	± 15...24	100 mA	DC-150 (-1dB)	0.4	-10...+85		●		●	■	65	LT 505-S
500	± 1200	C/L	± 15...24	100 mA	DC-150 (-1dB)	0.4	-10...+85		●		●	■	66	LT 505-T
400	± 400	"IT"	± 15	200 mA	DC-100 (-0.6dB)	0.0033	10...+50		●		●		67	IT 400-S
600	± 600	"IT"	± 15	400 mA	DC-100 (3dB)	0.0013	10...+50		●		●		59	IT 600-S
700	± 700	"IT"	± 15	400 mA	DC-100 (-0.5dB)	0.0053	10...+50		●		●		68	IT 700-S

1-Small signal bandwidth to avoid excessive core heating at high frequency

5-Ref_{OUT} & Ref_{IN} modes

■ recognized □ recognition pending

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Since 1972, LEM has been able to respond to customer demands, creating and producing a wide range of galvanically isolated current and voltage transducers that have become standards in the measurement field for industries.

The wide variety of LEM transducers is the direct result of our know-how and many years of experience, enabling us to address the many variations of customer requirements within the greatly diversified field of power electronics.

LEM continues to meet the challenges imposed by today's applications, by compact size, reduced weight, higher EMC immunity, safety isolation with enhanced measurement accuracy, increased reliability, and the same high level of performance our customers expect.

LEM Know-How...

Our engineers are available to assist at any point in the development process to ensure the selected transducer is the most appropriate to the application. LEM offers its knowledge and experience to provide application assistance to help maximize the performance of its product in your design. In addition to modern tools like finite element analysis, LEM also has test facilities and test benches to allow us to recreate your operating conditions in our labs. We do this to help you optimize your design and guarantee its final performance.

Selection parameter 4: Package & Mounting options

LEM provides PCB and panel mount options for current and voltage transducers in various packages for flat or stand up mounting, allowing the user to select the most convenient solution for its design and application.

Selection parameter 5: Operating Temperature Range

The operating temperature range is based on the materials, the construction of the selected transducer, and the technology used. The minimum temperatures are typically –40, -25, or –10°C while the maximums are +50, +70, +85, or +105°C.

LEM offers a comprehensive range of transducers optimized for industrial operating environments. The transducers included in this catalogue have various temperature specifications related to their global accuracy over a specific operating temperature range. LEM can also provide transducers with operating temperature ranges outside the listed selection to fulfill a specific requirement.

I_{PN} = 1000 A ... 20000 A

Open-loop Closed-loop

I_{PN} A	I_p A	Technology	V_c V	V_{OUT} I_{OUT} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, bus-bar, other	Connection Secondary PCB	Connection Secondary Other	cULus	Packaging No	Model
1000	± 2500	O/L	± 15	4 V	DC-25 (-3dB)[1]	1.75	-10...+80		●		●	■	33	HAT 1000-S
1000	± 3000	O/L	± 15	4 V	DC-25 (-3dB)[1]	2.75	-25...+85		●		●	■	61	HAX 1000-S
1000	± 2000	O/L	± 12…15	4 V	DC-10 (-1dB)[1]	2.5	-10...+70		●		●	■	62	HOP 1000-SB
1200	± 2500	O/L	± 15	4 V	DC-25 (-3dB)[1]	1.75	-10...+80		●		●	■	33	HAT 1200-S
1500	± 2500	O/L	± 15	4 V	DC-25 (-3dB)[1]	1.75	-10...+80		●		●	■	33	HAT 1500-S
1500	± 4500	O/L	± 15	4 V	DC-25 (-3dB)[1]	2.75	-25...+85		●		●	■	61	HAX 1500-S
1500	± 3000	O/L	± 12…15	4 V	DC-10 (-1dB)[1]	2.5	-10...+70		●		●	■	62	HOP 1500-SB
2000	± 5500	O/L	± 15	4 V	DC-25 (-3dB)[1]	2.75	-25...+85		●		●	■	61	HAX 2000-S
2000	± 3000	O/L	± 12…15	4 V	DC-10 (-1dB)[1]	2.5	-10...+70		●		●	■	62	HOP 2000-SB
2000	± 3000	O/L	± 12…15	4 V	DC-4 (-1dB)[1]	2.5	-10...+70		●		●	■	69	HOP 2000-SB/SP1
2500	± 5500	O/L	± 15	4 V	DC-25 (-3dB)[1]	2.75	-25...+85		●		●	■	61	HAX 2500-S
1000	± 1500	C/L	± 15…24	200 mA	DC-150 (-1dB)	0.3	-10...+85		●		●	■	70	LF 1005-S
1000	± 2000	C/L	± 15…24	200 mA	DC-150 (-1dB)	0.3	-10...+85		●		●	■	71	LT 1005-S
1000	± 2000	C/L	± 15…24	200 mA	DC-150 (-1dB)	0.3	-10...+85		●		●	■	72	LT 1005-T
1000	± 1500	C/L	± 15…24	200 mA	DC-150 (-1dB)	0.3	-10...+85		●		●	■	73	LF 1005-S/SP22
2000	± 3000	C/L	± 15…24	400 mA	DC-100 (-1dB)	0.3	0...+70		●		●	■	74	LT 2005-S
2000	± 3000	C/L	± 15…24	400 mA	DC-100 (-1dB)	0.3	0...+70		●		●	■	75	LT 2005-T
2000	± 3000	C/L	± 15…24	400 mA	DC-100 (-1dB)	0.2	-25...+70		●		●	■	76	LF 2005-S
4000	± 4000	O/L	± 15	10 V	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 4000-SB
4000	± 4000	O/L	± 15	20 mA	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 4000-SBI
4000	± 4000	O/L	± 15	4 mA @ $-I_{PN}$ 20 mA @ $+I_{PN}$	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 4000-SBI/SP1
4000	± 6000	C/L	± 24	800 mA	DC-100 (-1dB)	0.3	-25...+70		●		●		78	LT 4000-S
4000	± 6000	C/L	± 24	800 mA	DC-100 (-1dB)	0.3	-25...+70		●		●		79	LT 4000-T
6000	± 6000	O/L	± 15	10 V	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 6000-SB
6000	± 6000	O/L	± 15	20 mA	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 6000-SBI
6000	± 6000	O/L	± 15	4 mA @ $-I_{PN}$ 20 mA @ $+I_{PN}$	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 6000-SBI/SP1
10000	± 10000	O/L	± 15	10 V	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 10000-SB
10000	± 10000	O/L	± 15	20 mA	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 10000-SBI
10000	± 10000	O/L	± 15	4 mA @ $-I_{PN}$ 20 mA @ $+I_{PN}$	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 10000-SBI/SP1
10000	± 15000	C/L	± 48…60	1 A	DC-100 (-1dB)	0.3	-25...+70		●		●		80	LT 10000-S
12000	± 12000	O/L	± 15	10 V	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 12000-SB
12000	± 12000	O/L	± 15	20 mA	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 12000-SBI
12000	± 12000	O/L	± 15	4 mA @ $-I_{PN}$ 20 mA @ $+I_{PN}$	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 12000-SBI/SP1
14000	± 14000	O/L	± 15	10 V	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 14000-SB
14000	± 14000	O/L	± 15	20 mA	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 14000-SBI
14000	± 14000	O/L	± 15	4 mA @ $-I_{PN}$ 20 mA @ $+I_{PN}$	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 14000-SBI/SP1
20000	± 20000	O/L	± 15	10 V	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 20000-SB
20000	± 20000	O/L	± 15	20 mA	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 20000-SBI
20000	± 20000	O/L	± 15	4 mA @ $-I_{PN}$ 20 mA @ $+I_{PN}$	DC-3 (-3dB)[1]	2	-25...+85		●		●	□	77	HAZ 20000-SBI/SP1

1-Small signal bandwidth to avoid excessive core heating at high frequency

■ recognized □ recognition pending

This product range provides conditioned and electrically isolated outputs for direct and safe interfacing to process control systems (e.g. PLC, meters or any industrial computer). These integrated transducers combine the most advanced sensing technologies with signal conditioning electronic circuits in a single case. They are able to measure DC as well as sinusoidal and distorted alternating currents and provide an instantaneous, RMS or True RMS signal through standard output types (e.g. 4-20 mA, 0-5 V_{DC} or 0-10 V_{DC}). Some integrated transducers also feature threshold detection switching relay outputs allowing even faster reaction to specific conditions.

Other typical features:

- Contactless measurement
- Measuring ranges from a few mA to several thousands of Amps
- Various case types (solid or split core, cable or busbar, DIN Rail or panel mounting, etc.)
- Several power supply types (±15 V_{DC}, 24..48 V_{DC}, 22..38 V_{AC}, self-powered, loop-powered, etc.)

Multiple applications

- AC or DC motor load monitoring (pump, conveyer, fan, machine tool, etc.)
- Energy production and consumption, sub-metering, battery current monitoring
- Safety operations and personnel protection (e.g. ground fault detection)
- Process control and product quality (e.g. monitoring current of electrical heaters)
- Remote condition monitoring and maintenance operations
- Facilities & Infrastructures (HVAC, lights, cathodic protection, etc.)

Selection parameter 6: Output signal

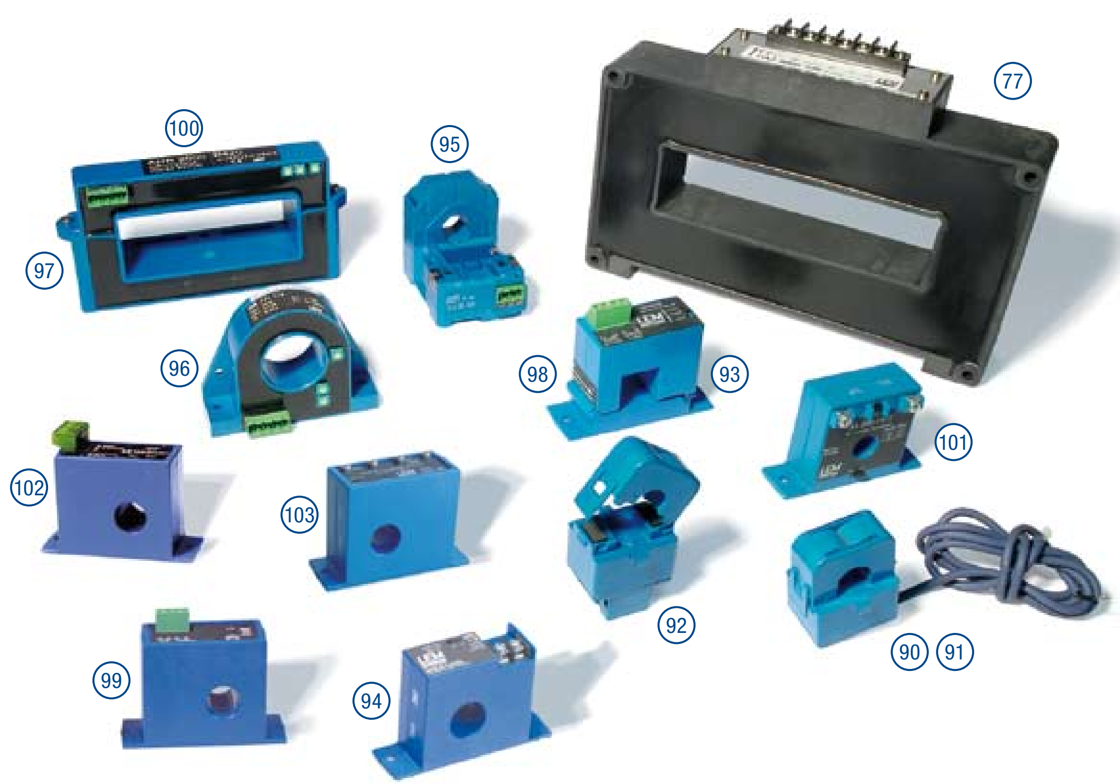
LEM transducers are available with different output signals, depending on the operation principle and the application.

Closed Loop transducers generally provide a current output, proportional to the primary signal. The user can obtain a voltage signal by defining a burden resistor within the limits specified in the datasheet.

Open Loop, Eta, CT type and PRiME transducers directly provide an amplified voltage signal proportional to the primary current. In the case of single supply voltage, the output signal varies around a nonzero reference.

The Process Automation series offers (regardless of the technology) specific output signals, adapted to the process automation applications, such as :

- Standard output signals (e.g. 0-5 V_{DC}, 0-10 V_{DC} or 4-20 mA)
- But also, RMS or TRMS (“True Root Mean Square”) calculation to accurately measure current propagation, even on non-linear loads or in noisy environments.



I_{PN} = 0.005 A ... 20000 A

C.T: current transformer | PRiME | Open-loop

Signal conditioning type	I_{PN} A	Technology	V_c V	Aperture mm	Split Core	DIN Rail	Output	cULus	Packaging No	Model
AC instantaneous	50	C.T	Self powered	ø 8	●		0-16mA	■	90	TT 50-SD
	100	C.T	Self powered	ø 16	●		0-33mA	■	91	TT 100-SD
AC RMS	5, 10. 20, 50, 100, 150	C.T	Self powered	ø 16	●		0-5/10 VDC	△	92	AT 5..150 B5/10
	5, 10. 20, 50, 100, 150	C.T	Loop powered	ø 16	●		4-20 mA	△	92	AT 5..150 B420L
	2, 5, 10, 20, 50, 75, 100, 150, 200	C.T	Self powered	21.7 x 21.7	●	○	0-5/10 VDC	▲	93	AK 5..200 B5/10
	2, 5, 10, 20, 50, 75, 100, 150, 200	C.T	Loop powered	21.7 x 21.7	●	○	4-20 mA	▲	93	AK 5..200 B420L
	2, 5, 10, 20, 50, 75, 100, 150, 200	C.T	Self powered	ø 19		○	0-5/10 VDC	▲	94	AK 5..200 C5/10
	2, 5, 10, 20, 50, 75, 100, 150, 200	C.T	Loop powered	ø 19		○	4-20 mA	▲	94	AK 5..200 C420L
	10, 25, 50, 75, 100, 150, 200, 300, 400	PRiME	24 VDC	ø 18.5	●	●	0-5/10 VDC	▲	95	AP 50..400 B5/10
	10, 25, 50, 75, 100, 150, 200, 300, 400	PRiME	Loop powered	ø 18.5	●	●	4-20 mA	▲	95	AP 50..400 B420L
	750	C.T	Loop powered	ø 76			4-20 mA	▲	104	AK 750 C420L J
	2000	C.T	Loop powered	ø 76			4-20 mA	▲	104	AK 2000 C420L J
AC True RMS	2, 5, 10, 20, 50, 75, 100, 150, 200	C.T	Self powered	21.7 x 21.7	●	○	0-5/10 VDC	▲	93	AKR 5..200 B5/10
	2, 5, 10, 20, 50, 75, 100, 150, 200	C.T	Loop powered	21.7 x 21.7	●	○	4-20 mA	▲	93	AKR 5..200 B420L
	2, 5, 10, 20, 50, 75, 100, 150, 200	C.T	Self powered	ø 19		○	0-5/10 VDC	▲	94	AKR 5..200 C5/10
	2, 5, 10, 20, 50, 75, 100, 150, 200	C.T	Loop powered	ø 19		○	4-20 mA	▲	94	AKR 5..200 C420L
	10, 25, 50, 75, 100, 150, 200, 300, 400	PRiME	24 VDC	ø 18.5	●	●	0-5/10 VDC	▲	95	APR 50..400 B5/10
	10, 25, 50, 75, 100, 150, 200, 300, 400	PRiME	Loop powered	ø 18.5	●	●	4-20 mA	▲	95	APR 50..400 B420L
	750	C.T	Loop powered	ø 76			4-20 mA	▲	104	AKR 750 C420L J
	2000	C.T	Loop powered	ø 76			4-20 mA	▲	104	AKR 2000 C420L J
DC & AC True RMS	100, 200, 300, 400, 500, 600, 1000	O/L	20..50 VDC	ø 32			0-5/10 VDC	△	96	DHR 100..1000 C5/10
	100, 200, 300, 400, 500, 600, 1000	O/L	20..50 VDC	ø 32			4-20 mA	△	96	DHR 100..1000 C420
	500, 800, 1000, 1500, 2000	O/L	20..50 VDC	104 x 40	●		0-5/10 VDC	△	97	AHR 500..2000 B5/10
	500, 800, 1000, 1500, 2000	O/L	20..50 VDC	104 x 40	●		4-20 mA	△	97	AHR 500..2000 B420
	4k, 6k, 10k, 12k, 14k, 20k	O/L	+/- 15 VDC	162 x 42			0-10 VDC	□	77	HAZ 4000..20000 -SRU
	4k, 6k, 10k, 12k, 14k, 20k	O/L	+/- 15 VDC	162 x 42			0-20 mA	□	77	HAZ 4000..20000 -SRI
	4k, 6k, 10k, 12k, 14k, 20k	O/L	+/- 15 VDC	162 x 42			4-20 mA	□	77	HAZ 4000..20000 -SRI/SP1
DC	5, 10, 20, 50, 75, 100, 150, 200	O/L	20..50 VDC	21.7 x 21.7	●	○	4-20 mA		98	DK 20..200 B5/10
	5, 10, 20, 50, 75, 100, 150, 200	O/L	20..50 VDC	21.7 x 21.7	●	○	4-20 mA		98	DK 20..200 B420
	5, 10, 20, 50, 75, 100, 150, 200	O/L	20..50 VDC	ø 19		○	4-20 mA		99	DK 20..200 C5/10
	5, 10, 20, 50, 75, 100, 150, 200	O/L	20..50 VDC	ø 19		○	4-20 mA		99	DK 20..200 C420
DC Bipolar	50, 75, 100, 150, 200	O/L	20..50 VDC	21.7 x 21.7	●	○	4-20 mA		98	DK 50..200 B420 B
	5, 10, 20, 50, 75, 100	O/L	20..50 VDC	ø 19		○	4-20 mA		99	DK 20..200 C420 B
	500, 800, 1000, 1500, 2000	O/L	Loop powered	104 x 40	●		4-20 mA	△	100	DH 500..2000 B420L B
AC Switch	1.5 to 150	C.T	Self powered	21.7 x 21.7	●	○	Solid-state		93	AKS 125 B
	1 to 150	C.T	Self powered	ø 19		○	Solid-state		94	AKS 125 C
	1-6, 6-40, 40-175 (selectable)	C.T	Self powered	21.7 x 21.7	●	○	Solid-state		93	AKS 180 B
	1-6, 6-40, 40-175 (selectable)	C.T	Self powered	ø 14		○	Solid-state		101	AKS 180 C
DC Switch	4-20, 10-50, 20-100 (selectable)	O/L	20..28 VDC	ø 19		○	Solid-state		102	DKS 100 C NOU
DC Relay	4-20, 10-50, 20-100 (selectable)	O/L	20..28 VDC	ø 19		○	SPDT		102	DKS 100 C SDT
Ground fault Switch	5, 10, 30 mA (selectable)	C.T	24 VDC/VAC	ø 19		○	Solid-state		103	AKS 0.03 C NO/NC
	5-950 mA (factory adjusted setpoint)	C.T	24 VDC/VAC	ø 19		○	Solid-state		103	AKS 0.xxx C NO/NC
Ground fault Relay	5, 10, 30 mA (selectable)	C.T	24 VDC/VAC	ø 19		○	SPDT		103	AKS 0.03 C SDT
	5-950 mA (factory adjusted setpoint)	C.T	24 VDC/VAC	ø 19		○	SPDT		103	AKS 0.xxx C SDT

○ with adaptor ▲ UL listed □ recognition pending
■ recognized △ UL pending

Dedicated data sheets are the only recognized reference documents for the given performances and data - Datasheets: www.lem.com

LEM provides a wide selection of solutions for galvanically isolated voltage measurement, at various levels of performance.

There are two different options for voltage measurement

- User specified primary resistor:

  The user connects a primary resistor in series with the transducer. The value of the primary resistor R_1 is selected according to the voltage to be measured. This approach allows for maximum flexibility.

- Integrated primary resistor:

  The integrated primary resistor R_1 predefines the nominal measuring voltage of the transducer. LEM offers a wide selection of nominal voltage levels to cover a variety of applications.

Selectable voltage measurements

Many applications require the assessment of electric power, with the combined measurement of LEM voltage and current transducers. Users can control a variety of systems, like the lighting of airport runways.

Selection parameter 7: Secondary connections

With PCB mount packages, secondary connection is achieved with standard solderable pin terminals.

For Panel mount transducers, LEM offers the following standard secondary connection types:

- Metric (M4, M5) and UNC threaded studs
- Fast-on
- Cable
- Various Molex

LEM also offers custom and specialty connections, i.e. LEMO, Sub-D, etc, as well as AMP, Burndy, JST and other industry standard connectors.

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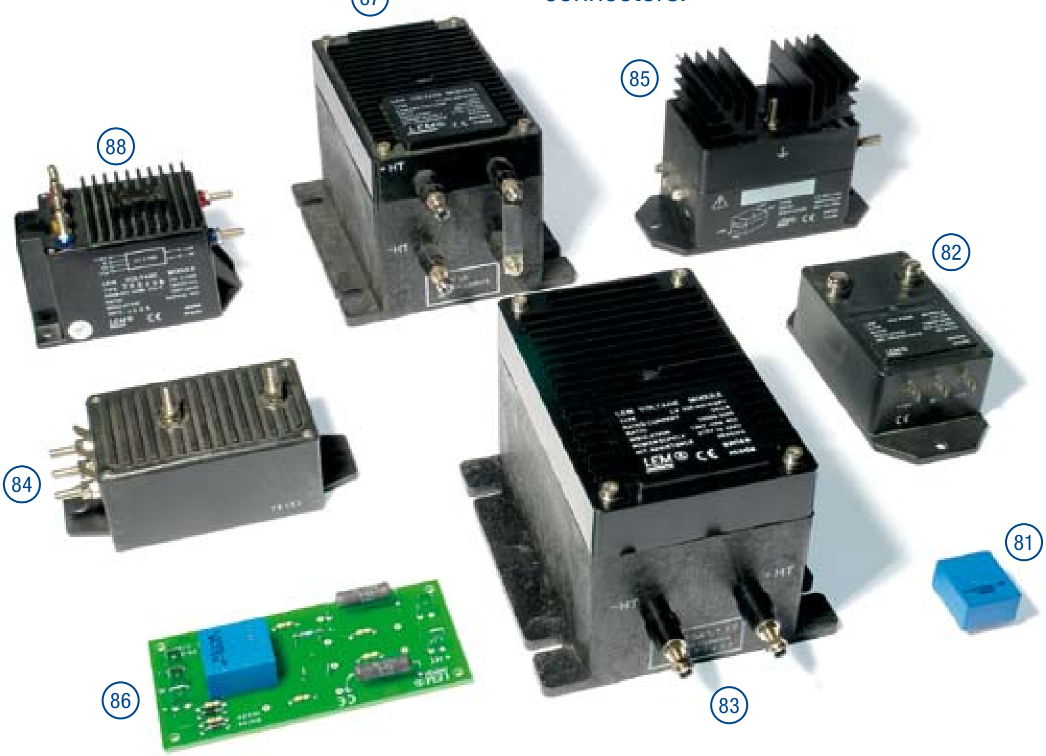


V_{PN} = 10 V ... 2500 V Voltage transducers (without resistor R1)

"C"-Types | Closed-loop | AV Type

I_{PN} (V_{PN}) mA	I_p (Vp) mA	Technology	V_c V	I_{OUT} @ I_{PN} mA	BW kHz	X_G T_A = 25°C % @ I_{PN} with max offset taken	T_A °C	c UR us	Packaging No	Model
10 (10 to 500 V)	± 14 (700 V)	C/L	± 12…15	25 mA	Note 7	0.9	0...+70	■	81	LV 25-P[8]
10 (100 to 2500 V)	± 20 (5000 V)	C/L	± 15	50 mA	Note 7	0.7	0...+70		82	LV 100[9]
20 (100 to 2500 V)	± 40 (5000 V)	C/L	± 15…24	100 mA	Note 7	0.5	-25...+70		83	LV 200-AW/2[9]

7-See response time in the individual data sheet
8-The primary and secondary connections of this transducer are done on PCB

9-Mechanical mounting
■ recognized ☐ recognition pending

Dedicated data sheets are the only recognized reference documents for the given performances and data - Datasheets: www.lem.com

V_{PN} = 50 V ... 400 V Voltage transducers (with built in resistor R1, mechanical mounting)

+/- V_{PN} V	+/- V_p V	Technology	V_c V	V_{OUT} I_{OUT} @ V_{PN}	BW kHz	X_G T_A = 25°C @ V_{PN} with max offset taken %	T_A °C	c UR us	Packaging No	Model
50	75	AV	± 12…24	50 mA	DC-11 (-3dB)	0.7	-40...+85		84	AV 100-50
125	187.5	AV	± 12…24	50 mA	DC-11 (-3dB)	0.7	-40...+85		84	AV 100-125
150	225	AV	± 12…24	50 mA	DC-11 (-3dB)	0.7	-40...+85		84	AV 100-150
250	375	AV	± 12…24	50 mA	DC-11 (-3dB)	0.7	-40...+85		84	AV 100-250
50	75	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-50
100	150	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-100
200	300	C/L	± 12…15	25 mA	Note 7	0.9	-25...+70	☐	86	LV 25-200
200	300	C/L	± 15…24	80 mA	Note 7	0.8	-25...+70		87	LV 200-AW/2/200
300	450	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-300
400	600	C/L	± 12…15	25 mA	Note 7	0.9	-25...+70	☐	86	LV 25-400
400	600	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-400
400	600	C/L	± 15…24	80 mA	Note 7	0.8	-25...+70		87	LV 200-AW/2/400
140	200	"C"	± 15	10 V/200 V	DC-300 (-1dB)	0.2 @ Vp	-40...+85		88	CV 3-200
350	500	"C"	± 15	10 V/500 V	DC-300 (-1dB)	0.2 @ Vp	-40...+85		88	CV 3-500

7-See response time in the individual data sheet ■ recognized ☐ recognition pending

Dedicated data sheets are the only recognized reference documents for the given performances and data - Datasheets: www.lem.com

MOSFET or IGBT commutation generates voltage variations with high dv/dt levels. These fluctuations may induce errors on the output signal of current and voltage transducers due to the capacitive coupling between their primary and secondary.

LEM designs their transducers with particular care in order to keep this error minimal.

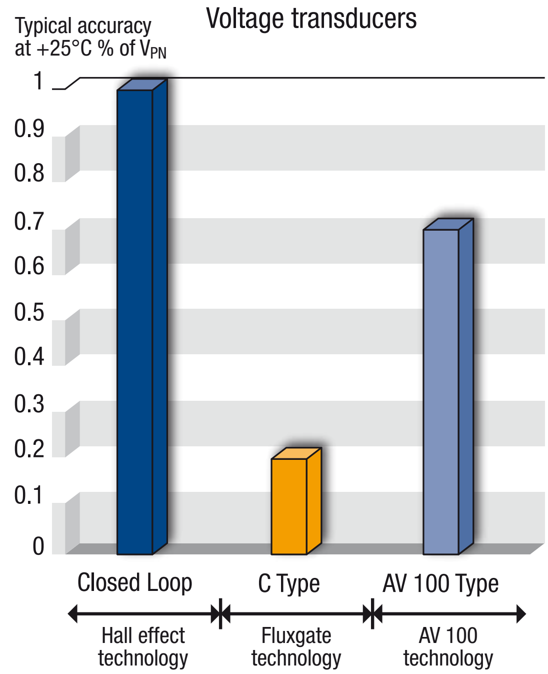
Also, special versions of transducers with a screen between the primary and the secondary circuit have been developed, allowing a significant reduction of error generated by these perturbations.

Addressing EMC / excellent Immunity

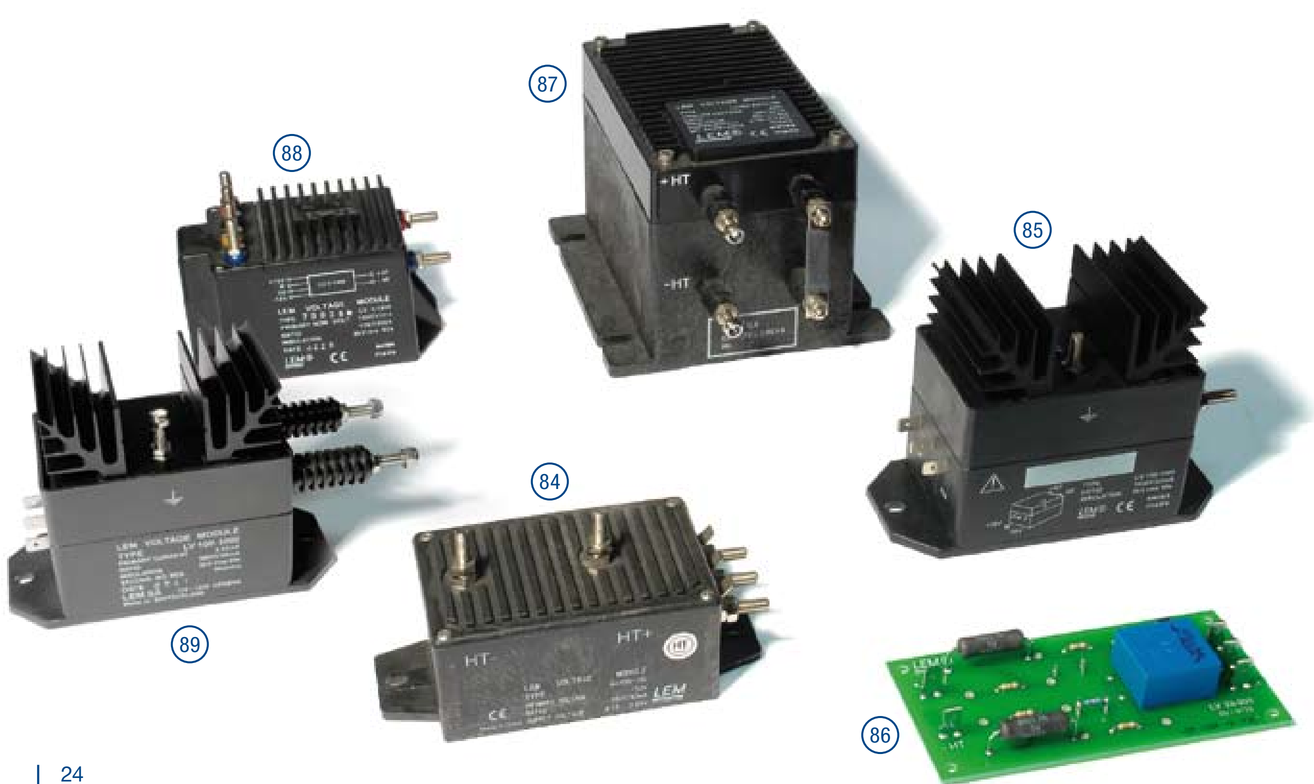
The screen is a standard feature on several series of voltage transducers (CV 3, LV 200-AW/2), and is available as an option on LV 100 series and on some current transducers.

Picture provided by courtesy of Lenze AG

Selection parameter 2: Accuracy



Individual datasheets provide all relevant information to precisely calculate the overall accuracy of a given transducer in a specific application.



AV Type | Closed-loop | "C"-Types

+/- V_{PN} V	+/- V_p V	Technology	V_c V	V_{OUT} I_{OUT} @ V_{PN}	BW kHz	X_G T_A = 25°C @ V_{PN} with max offset taken %	T_A °C	c UL us	Packaging No	Model
500	750	AV	± 12…24	50 mA	DC-11 (-3dB)	0.7	-40...+85		84	AV 100-500
750	1125	AV	± 12…24	50 mA	DC-11 (-3dB)	0.7	-40...+85		84	AV 100-750
1000	1500	AV	± 12…24	50 mA	DC-11 (-3dB)	0.7	-40...+85		84	AV 100-1000
1500	2250	AV	± 12…24	50 mA	DC-11 (-3dB)	0.7	-40...+85		84	AV 100-1500
2000	3000	AV	± 12…24	50 mA	DC-11 (-3dB)	0.7	-40...+85		84	AV 100-2000
500	750	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-500
600	900	C/L	± 12…15	25 mA	Note 7	0.9	-25...+70	□	86	LV 25-600
600	900	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-600
800	1200	C/L	± 12…15	25 mA	Note 7	0.9	-25...+70	□	86	LV 25-800
800	1200	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-800
800	1200	C/L	± 15…24	80 mA	Note 7	0.8	-25...+70		87	LV 200-AW/2/800
1000	1500	C/L	± 12…15	25 mA	Note 7	0.9	-25...+70	□	86	LV 25-1000
1000	1500	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-1000
1200	1800	C/L	± 12…15	25 mA	Note 7	0.9	-25...+70	□	86	LV 25-1200
1200	1800	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-1200
1500	2250	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-1500
1600	2400	C/L	± 15…24	80 mA	Note 7	0.8	-25...+70		87	LV 200-AW/2/1600
2000	3000	C/L	± 15	50 mA	Note 7	0.8	0...+70		85	LV 100-2000
2500	3750	C/L	± 15	50 mA	Note 7	0.8	0...+70		89	LV 100-2500
3000	4500	C/L	± 15	50 mA	Note 7	0.8	0...+70		89	LV 100-3000
3200	4800	C/L	± 15…24	80 mA	Note 7	0.8	-25...+70		87	LV 200-AW/2/3200
3500	5250	C/L	± 15	50 mA	Note 7	0.8	0...+70		89	LV 100-3500
4000	6000	C/L	± 15	50 mA	Note 7	0.8	0...+70		89	LV 100-4000
6400	9600	C/L	± 15…24	80 mA	Note 7	0.8	-25...+70		87	LV 200-AW/2/6400
700	1000	"C"	± 15	10 V/1000 V	DC-500 (-1dB @ 50 % V_{PN})	0.2 @ Vp	-40...+85		88	CV 3-1000
840	1200	"C"	± 15	10 V/1200 V	DC-800 (-1dB @ 40% V_{PN})	0.2 @ Vp	-40...+85		88	CV 3-1200
1000	1500	"C"	± 15	10 V/1500 V	DC-800 (-1dB @ 33% V_{PN})	0.2 @ Vp	-40...+85		88	CV 3-1500
1400	2000	"C"	± 15	10 V/2000 V	DC-300 (-1dB @ 25% V_{PN})	0.2 @ Vp	-40...+85		88	CV 3-2000

7-See response time in the individual data sheet
■ recognized □ recognition pending

Minisens – FHS model
From 2 to 100 Amps

To help your innovation, we make ourselves small.

Traditional measurement systems are not used in markets such as low power domestic electrical products and air conditioning systems for a number of reasons. If isolation is needed in a shunt-based system, an optocoupler is also necessary, adding to the cost and bulk. For current measurements over approximately 10A, the losses in the shunt become significant resulting in an unacceptable temperature rise. At lower current levels, the shunt will need to have a high resistance to ensure that its output is not too small. Generally, an amplifier may also be needed.

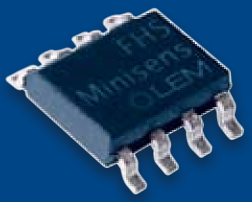
Until today, these factors have been major limitations for the use of current measurement in smaller electrical systems. However, there is a growing demand for current measurement in such systems, as inverter control of electric motors becomes more popular, for greater control of speed and position, and improved energy efficiency. Fortunately, new techniques allow producing smaller and lower-cost transducers that can make current measurement a reality in such systems.

The trend in power electronics is not different to that in other electronics fields: a greater degree of integration coupled with a lower component count.

Minisens, FHS integrated LEM current transducer, for AC and DC isolated current measurement up to 100 kHz, shows the way. This new product combines all the necessary electronics with a Hall-effect sensor and magnetic concentrators in a single eight-pin, surface-mount package (Fig. 1): A step towards miniaturization and manufacturing cost reduction (as part of a standard PCB assembly process).

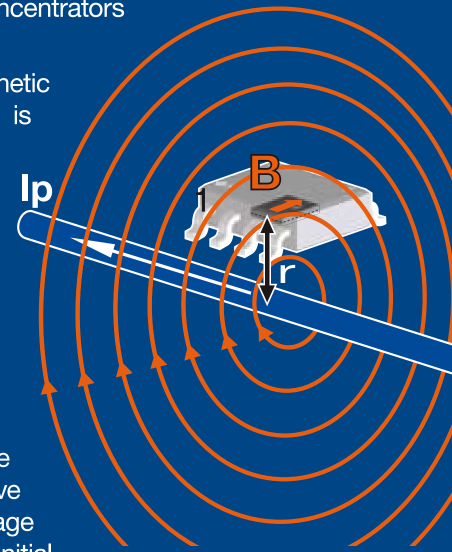
It can be isolated simply by mounting it on a printed circuit board on the opposite side to the track carrying the current to be measured, does not suffer from losses and can make use of PCB design techniques to adjust sensitivity and therefore remove the need for an amplifier.

Fig. 1: Minisens - FHS model



Working principle:

Minisens/FHS converts the magnetic field of a sensed current into a voltage output. This ‘primary’ current flows in a cable or PCB track near the IC and is electrically isolated from it. Hall effect devices integrated in the IC are used to measure the magnetic field, this field being focused in the region of the Hall cells by magnetic concentrators placed on top of the IC.



The IC sensitivity to the magnetic field of the primary current is 600 mV/mT max.

This is the basic working principle of the Hall effect open-loop technology, but all incorporated into a single small IC package.

The current sensed can be either positive or negative. The polarity of the magnetic field is detected to generate either a positive or negative voltage output around a voltage reference defined as the initial offset at no field. The standard initial offset is 2.5 V (internal reference). The user can specify an external reference between +2 and +2.8 V.

It is manufactured in a standard CMOS process and assembled in a SO8-IC package.

Design considerations:

The most common way to use Minisens is to locate it over a PCB track that is carrying the current that needs to be measured. To optimise the function of the transducer, some simple rules need to be applied to the track dimensions. By varying the PCB and track configuration, it is possible to measure currents ranging from 2 to 100 Amps. One possible configuration places the IC directly over a single PCB track (Fig. 2).

Fig. 2: One possible PCB design; The track is located underneath the Minisens

In this configuration, isolation is provided by the distance between the pins of the transducer and the track, and currents in the range from 2 to 20A can be measured.

Insulation can be improved by placing the transducer on the opposite side of the board, but still directly over the line of the track. The thickness of the board and the track itself will both affect the sensitivity, as they directly influence the distance between the sensing elements (located into the IC) and the position of the primary conductor. Sensitivity is also affected by the width of the track (Fig. 3). It is important to note that sensitivity is greater for thinner tracks. However, the thinner the track, the quicker the temperature rises.

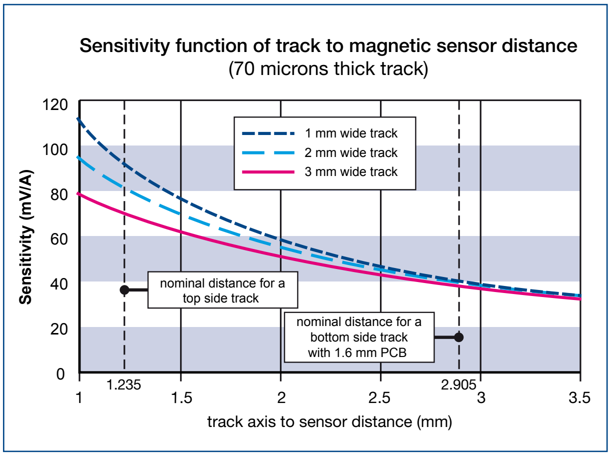
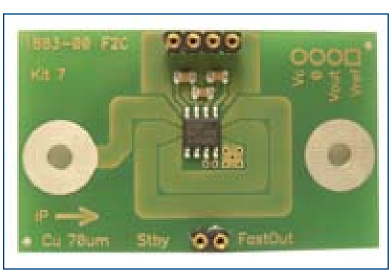
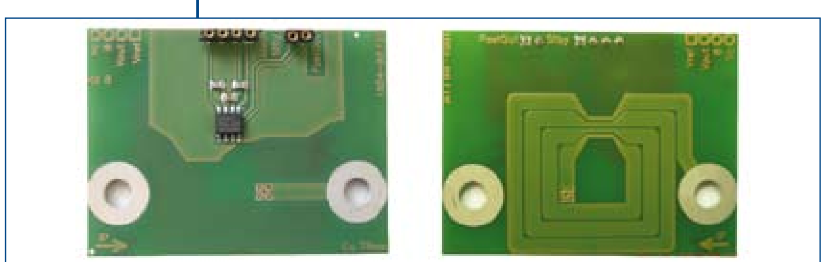


Fig. 3: Sensitivity (mV/A) versus track width and distance between the track and the sensing elements.

The maximum current that can be safely applied continuously is determined by the temperature rise of the track and the ambient temperature. The use of a track with varying width gives the best combination of sensitivity and track temperature rise. To maintain temperature levels, the width, thickness and shape of the track are very important. Minisens' maximum operating temperature is 125°C.

Figs. 4 and 5: Possible "multi-turn" designs.





For low currents (under 10 A), it is advisable to make several turns with the primary track or to use a narrow track to increase the magnetic field generated by the primary current.

As with a single track, it is better to have wider tracks around the Minisens than under it (to reduce temperature rise) (Figs. 4 and 5).

This configuration is also possible on the opposite side of the PCB to the Minisens providing then a higher insulation configuration (Fig. 5) as creepage and clearance distances are improved (longer).

The sensitivity can be increased further by other techniques, such as using a "jumper" (wire) over the Minisens to create a loop with the PCB track, or multiple turns can be implemented in different PCB layers. Larger currents can be measured by positioning the transducer farther from the primary conductor or by using a wider PCB track or busbar. Designs are unlimited, under PCB designer's control, and can lead to needs for insulation, nominal current to measure, sensitivity optimisation, etc. This is full design flexibility.

Special features for added value:

Two outputs are available: one filtered, to limit the noise bandwidth, and one unfiltered which has a response time under 3 µs, for current short-circuit detection (IGBT protection) or threshold detection.

Minisens operates from a +5 V power supply. To reduce power consumption in sensitive applications, it can be switched to a standby mode by means of an external signal to reduce the consumption from 20 milliamps to 20 microamps.

Minisens overall accuracy

Minisens related:
- Gain: +/- 3 % (better measured)
- Initial offset: +/- 10 mV
- Linearity: +/- 1.5 % (better measured)
- Offset drift: +/- 0.15 mV/K
- Gain drift: +/- 300 ppm/K

Mechanical design related
(distance and shape variations of the primary conductor vs the IC):
- PCB thickness
- Copper tracks thickness/width
- Solder joints thickness
- Correct positioning of Minisens

In concrete application on a PCB

Overall accuracy (% of I_{PN})

At +25° C (Initial offset compensated): → 4 % to 7 %
Over temperature range (→ +85° C): → 5 % to 8 %
With calibration:
(over temperature range (→ +85° C) → < 4 %

In addition, a special care to the adjacent perturbing (stray) fields has to be brought.

These mechanical parameters must be closely controlled in the production process. Alternatively, in-circuit calibration of the Minisens or the DSP can be used to avoid most of these errors.

Evaluate Minisens in your application: Evaluation kits

Several PCBs (Figs. 6 and 7) have been developed to demonstrate Minisens as a current transducer in different applications, and to validate simulations which were made to predict the transducer sensitivity: These are available on request for application testing (available on sales on LEM website : www.lem.com).

LEM design guides are also available to orientate and advise PCB designers in the building of their PCBs when using Minisens, in order to optimise the use of the transducer (on request).

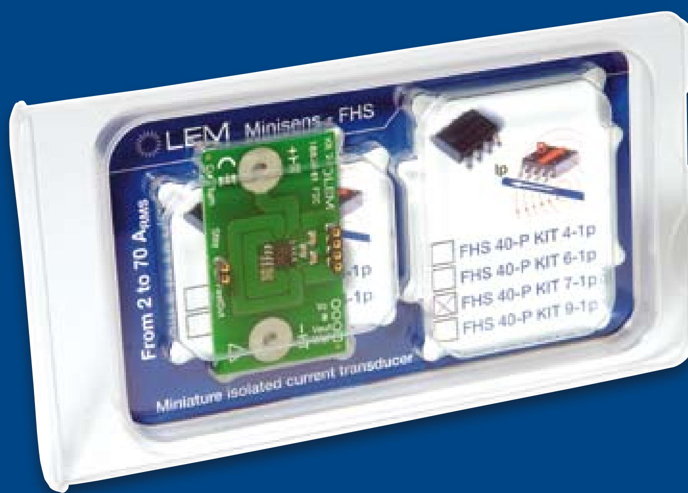


Fig. 6: Minisens kits with low isolation (0.4 mm clearance/creepage)

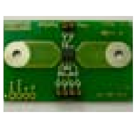
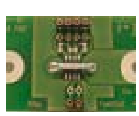
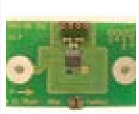
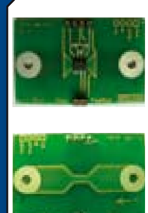
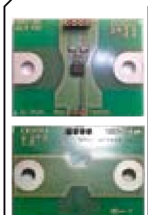
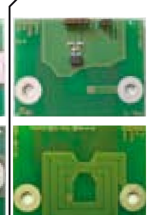
	Kit 4	Kit 6	Kit 7
			
	1 turn	With jumper	Multi turns
I_{PN} (A) @ Tamb = 85° C (Tpcb max 115° C)	16	10	5
I_{PM} (A) @ V_{out} = 2 V	30	10	11
Sensitivity (mV/A) @ 600 mV/mT	67.2	206.2	186.1

Fig. 7: Minisens kits with high isolation (8 mm clearance/creepage)

	Kit 5	Kit 9	Kit 8
			
	1 turn	1 turn	Multi turns
I_{PN} (A) @ Tamb = 85° C (Tpcb max 115° C)	16	30	5
I_{PM} (A) @ V_{out} = 2 V	55	78	16
Sensitivity (mV/A) @ 600 mV/mT	36.3	25.8	125.6

Two typical examples will show the advantages offered by Minisens in today's applications:

Washing Machines:

Designers of modern washing machines are looking for more accurate control of the electric motor, to save energy by improving the efficiency of the system and protect the environment by adjusting washing time and water usage. They are also aiming to improve the performance of the machine, in terms of out-of balance detection, vibration reduction, different programs for different types of clothes and noise reduction. An inverter-based system offers this finer control, allowing the designer to have both new and improved functions. Such a system needs accurate measurement of motor current, and two Minisens transducers can be mounted directly onto the control PCB to provide the necessary measurements.

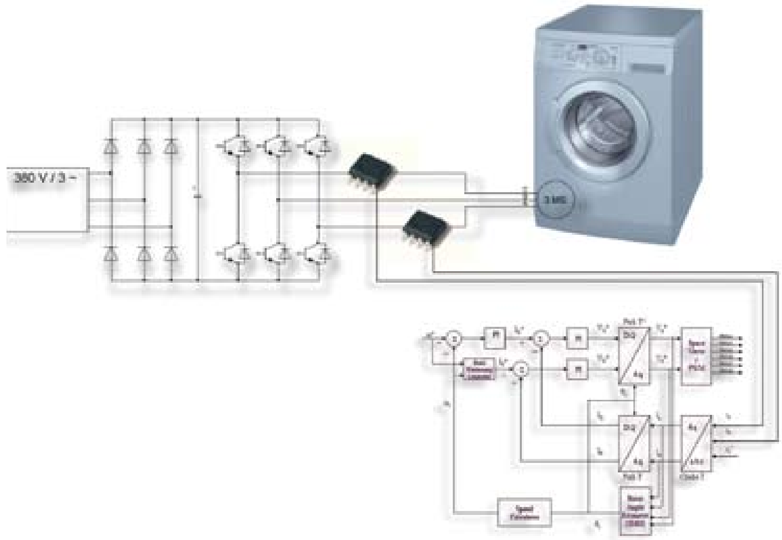
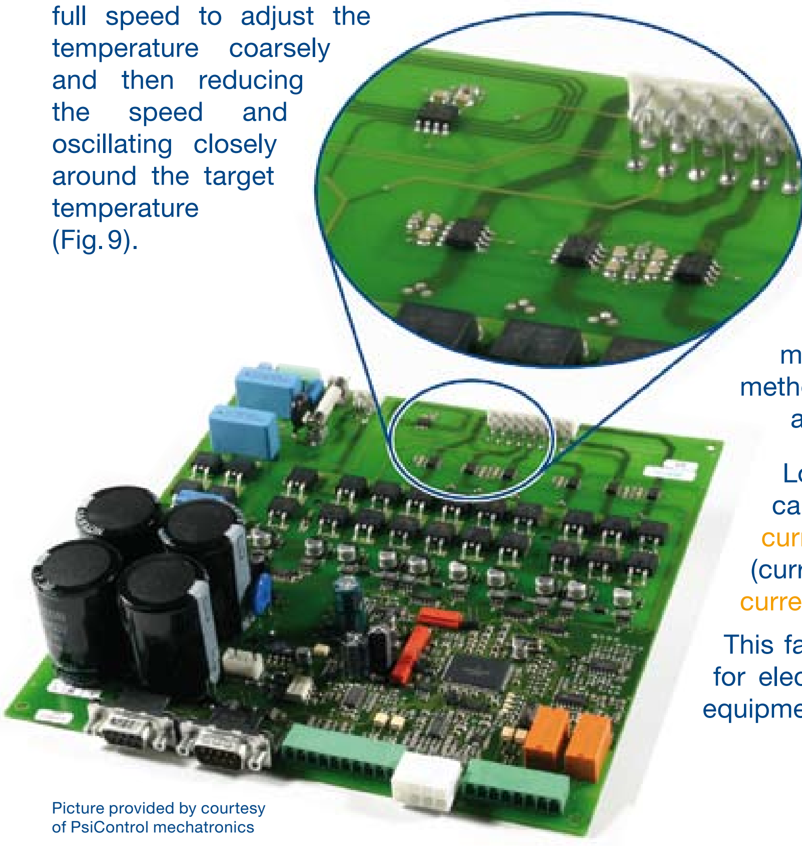


Fig. 8: Motor control in washing machines

Air-conditioning units:

Traditionally, air-conditioning units have relied on simple on/off control of the motor. However, this has resulted in a wide variation of temperature and has required a relatively large motor, which is either off or running at full power – resulting in a lot of noise. Modern air conditioners use inverter control, starting the motor at full speed to adjust the temperature coarsely and then reducing the speed and oscillating closely around the target temperature (Fig. 9).



Picture provided by courtesy of PsiControl mechatronics

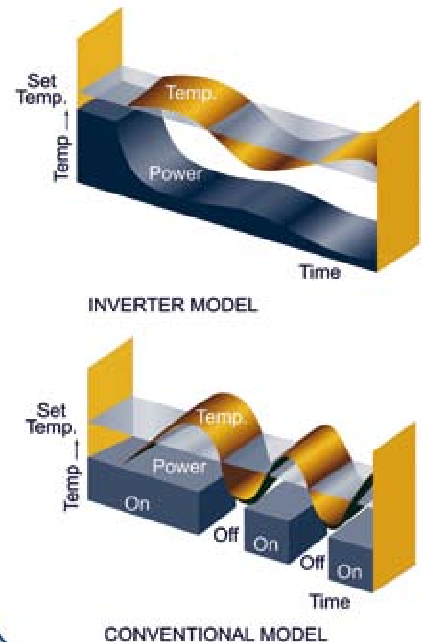


Fig. 9: Inverter control vs. conventional control

Such a system produces less noise, requires less power to maintain the target temperature, and can use a smaller motor. Japanese air-conditioner manufacturers have already moved to this method and those in the United States, China and Europe are now following.

Low cost UPSs as well as battery chargers can benefit from Minisens to ensure the current control as well as the fault protection (current overload detection) or to detect current presence.

This fault protection function has to be fulfilled for electrical shutters, door openers and other equipment of that nature.

LEM is dedicated to deliver products meeting the highest quality standards.

These levels of quality may differ according to the application as well as the necessary standards to comply with.

This quality has to be reached, maintained and constantly improved for both our products and services. The different LEM design and production centers around the world are ISO/TS 16949, ISO 9001 and/or ISO 14001 certified.

LEM SA (SWITZERLAND)	ISO/TS 16949 ISO 14001 ISO 9001: 2000 IRIS
Beijing LEM (CHINA)	ISO 9001: 2000 ISO/TS 16949 ISO 14001
LEM Japan (JAPAN)	ISO 9001: 2000 ISO 14001
LEM USA (UNITED STATES)	ISO 9001: 2000
TVELEM (RUSSIA)	ISO 9001: 2000

Several quality tools have been implemented at LEM to assess and analyze its performances. LEM utilizes this information to take the necessary corrective actions to remain a responsive player in the market.

The most representative are:

- DPT FMEA (Design, Process & Tool Failure Mode Effect Analysis) tool used preventively to:
  - o identify the risks and the root causes related to the product, the process or the machinery
  - o set up the corrective actions
- Control Plan: Description of checks and monitoring actions executed along the production process
- Cpk – R&R (Capability for Processes & Measurement Systems):
  - o Cpk: Statistical tool used to evaluate the ability of a production procedure to maintain the accuracy within a specified tolerance
  - o R&R: Repeatability and Reproducibility: Tool to monitor the accuracy of a measurement device within a pre-determined tolerance
- QOS – 8D (Quality Operating System – Eight Disciplines):
  - o 8D: Problem solving process used to identify and eliminate the recurrence of quality issues
  - o QOS: System used to solve problems
- IPQ (Interactive Purchase Questionnaire): Tool aimed at involving the supplier in the quality of the purchased parts and spare parts.

In addition to these quality programs, and since 2002, LEM embraces Six Sigma as its methodology in pursuit of business excellence. The main goal is to create an environment in which anything less than Six Sigma quality is unacceptable.

Key Six Sigma Statistics

Company Status	Sigma Level	Defect Free	Defects Per Million
Non Competitive	2	65%	308,537
	3	93%	66,807
Industry Average	4	99.4%	6,210
	5	99.976%	233
World Class	6	99.9997%	3.4

Source: Six Sigma Academy, Cambridge Management Consulting

LEM's Standards

LEM transducers for Industry are designed and tested according to recognized worldwide standards.

The EN 50178 standard dedicated to “Electronic Equipment for use in power installations” in industrial applications is our standard of reference for electrical, environmental and mechanical parameters.

It guarantees the overall performances of our products in industrial environments.

All of the LEM Industry products are designed according to the EN 50178 standard.

CE marking is a guarantee that the product complies with the European EMC directive 89/336/EEC and low voltage directive and therefore warrants the electro-magnetic compatibility of the transducers.

UL is used as a reference to define the flammability of the materials (UL94V0).

LEM is currently UL recognized for key products. You can consult the UL website to get the updated list of recognized models at www.UL.com.

The individual datasheets precisely specify the applicable standards, approvals and recognitions for individual products.

The EN 50178 standard is also used as reference to design the creepage and clearance distances for the transducers versus the needed insulation levels (rated insulation voltage) and the conditions of use.

The rated insulation voltage level for transducers in "industrial" applications, is defined according to several criteria listed under the EN 50178 standard and IEC 61010-1 standard ("Safety requirements for electrical equipment for measurement, control and laboratory use"). Some criteria are dependent on the transducer itself when the others are linked to the application.

These criteria are the following:

- Clearance distance (the shortest distance in air between two conductive parts)
- Creepage distance (the shortest distance along the surface of the insulating material between two conductive parts)
- Pollution degree (application specific -- this is a way to classify the micro-environmental conditions having effect on the insulation)
- Overvoltage category (application specific -- characterizes the exposure of the equipment to overvoltages)
- Comparative Tracking Index (CTI linked to the kind of material used for the insulated material) leading to a classification over different Insulating Material groups
- Simple (Basic) or Reinforced isolation need

LEM follows this thought process for all the transducer designs:

Example: LTSP 25-NP, current transducer in a motor drive.

Conditions of use:

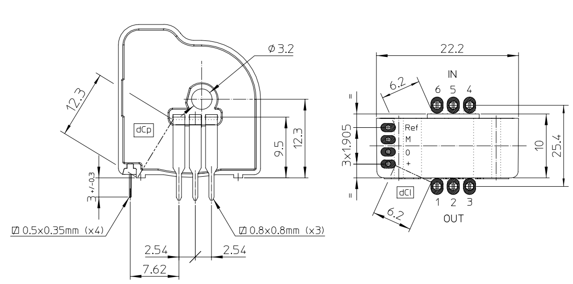
Creepage distance (on case): 12.3 mm

Clearance distance (on PCB, footprint as below figure as an example): 6.2 mm

CTI: 175 V (group IIIa)

Overvoltage category: III

Pollution Degree: 2



Basic or Single insulation

According to EN 50178 and IEC 61010-1 standards:

With clearance distance of 6.2 mm and PD2 and OV III, the rated insulation voltage is of 600 V_{RMS}.

With a creepage distance of 12.3 mm and PD2 and CTI of 175 V (group IIIa), this leads to a possible rated insulation voltage of 1000 V_{RMS}.

In conclusion, the possible rated insulation voltage, in these conditions of use, is 600 V_{RMS} (the lowest value given by the both results from the creepage and clearance distances).

Reinforced insulation

Let's look at the reinforced insulation for the same creepage and clearance distances as previously defined:

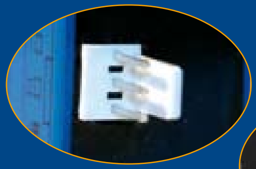
When looking at dimensioning reinforced insulation, from the clearance distance point of view, with OV III and according to EN 50178 and IEC 61010-1 standards, the rated insulation voltage is given whatever the pollution degree at 300 V_{RMS}.

From the creepage distance point of view, when dimensioning reinforced insulation, the creepage distance taken into account has to be the real creepage distance divided by 2, that is to say 12.3 / 2 = 6.15 mm.

With that value, and PD2 and CTI of 175 V (group IIIa), this leads to a possible rated insulation voltage of 500 V_{RMS}.

In conclusion, the possible reinforced rated insulation voltage, in these conditions of use, is of 300 V_{RMS} (the lowest value given by the both results from the creepage and clearance distances).

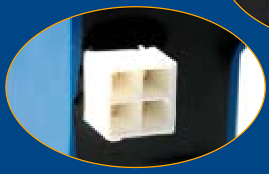
Secondary Connections Options




Various options for secondary connections

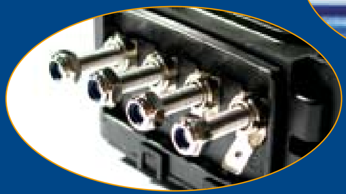
Molex 6410/A
Series connector

JST VH Series
Connector




Molex Mini-Fit, Jr 5566
Series Connector

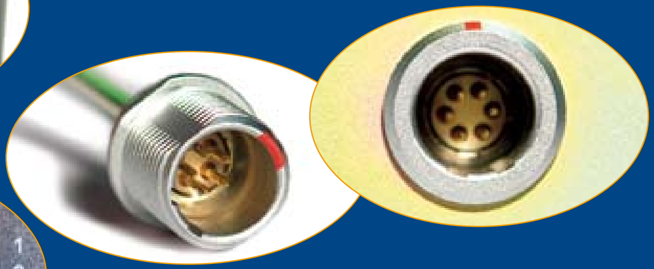
Molex 70543
Series Connector



Threaded Studs, M4, M5, UNC...

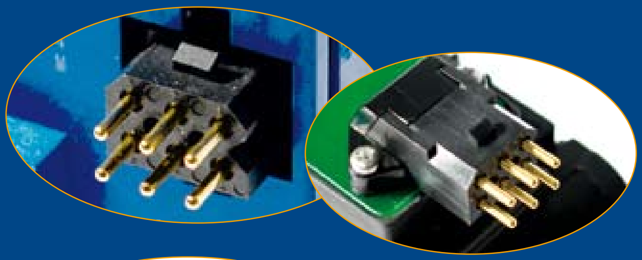
...or Faston 6.30 x 0.80 or screws...
...or the both, in the same time

M4, M5 inserts



LEMO Connectors

AMP Connectors



Burndy Connectors

Sub-D Connectors

Cables, Shielded Cables...

But also Wago, Phoenix, Souriau ... connectors

LEM

DESIGN SPECIFICATION

98.11.11.118.0 indice 5

LEM Subsidiary: ___ **Contact:** ___ **Date:**

Customer information **e-mail:**

Company : ______________________ City : ______________ Country : __________

Contact person : ______________________ Phone : ______________ Fax : __________

Project name : ______________________

Application

Type ☐ industrial ☐ traction ☐ automotive ☐ process autom. ☐ other:

Utilisation ☐ voltage ☐ current ☐ power ☐ other:

Function ☐ control ☐ display ☐ ground fault detection

☐ detection ☐ differential measurement ☐ other (provide a separate descr.)

Electrical & Environmental characteristics *Transducer reference (if relevant)*:

Signal to measure

Type of signal : ☐ AC sin. ☐ DC

☐ square ☐ pulse

☐ other

☐ bidirectional ☐ unidirectional

Nominal value: _____ rms

Peak value _____

(please provide a graph)

Overload value to be measured: _____ rms

Peak:

Duration: _____ s

Non measured overload (to withstand)

Frequency: _____ Hz

duration: _____ ms

di/dt to be followed: _____ A/µs

Bandwidth: _____ kHz

Operating frequency: _____ Hz

Ripple: _____ peak-peak

Ripple frequency: _____ Hz

dv/dt applied on primary circuit: _____ kV/µs

Static and intrinsic values

Global accuracy (% of nominal value, @ 25 °C) _____%

Overall accuracy over operating temperature range _____%

Maximum offset @ 25 °C

Dielectric strength

Primary/secondary (50 Hz/ 1 mn): _____ kV rms

Screen/secondary _____ kV rms

PD Level @ 10 pC _____ kV

OV category: _____ Pollution degree:

Power supply: _____ V ± _____%

☐ bipolar ☐ unipolar

Preferred output: _____ ☐ mA/A ☐ mV/A

_____ ☐ mA/V ☐ mV/V

Turn ratio:

Temperature range

Operating: _____°C to _____°C

Storage: _____°C to _____°C

Mechanical requirements

Maximum dimensions required: L _____ mm x W _____ mm x H _____ mm

Mounting on: ☐ PCB ☐ Panel

Output terminals: ☐ PCB ☐ Faston ☐ Threaded studs M_ ☐ Molex ☐ Cable

☐ other: _____

Primary connection: ☐ through hole: L _____ mm x W _____ mm; or Ø _____ mm

☐ busbar L _____ mm x W _____ mm x H _____ mm

☐ other: _____ For busbar, please provide lay-out

Applicable standards: industrial ☐ EN 50178 traction ☐ EN 50155 other ☐

If other, please specify:

Targets (amounts given in EUR)

Target price

Total quantity for the project: _____ and product life time _____ or quantity per year

Delivery: ☐ Engineering samples Quantity: _____ Date:

☐ Prototype Quantity: _____ Date:

☐ Initial samples Quantity: _____ Date:

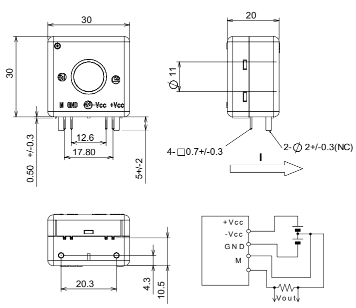
☐ Serie 1 Quantity: _____ Date:

Required response time __________

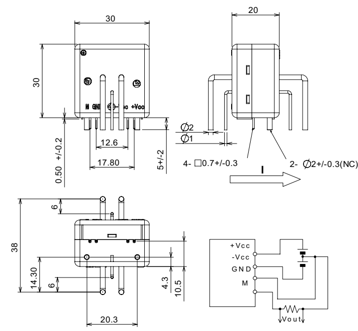
All dimensions are in mm

● Hall effect chip location

1 CT 0.1-P, CT 0.2-P, CT 0.4-P

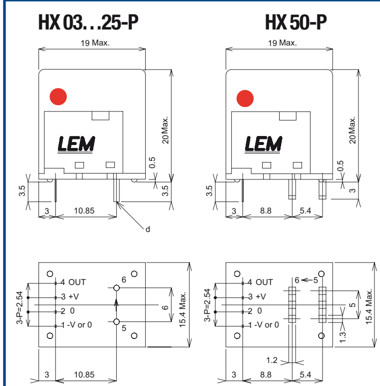


2 CT 0.1-TP, CT 0.2-TP, CT 0.4-TP, CT 0.4-TP/SP1



3 HX 03… 50-P

HX 03…25-P   HX 50-P



Terminal Pin Identification

1 ..... -15 V
2 ..... 0 V
3 ..... +15 V
4 ..... Output
5 ..... Primary input Current (+)
6 ..... Primary input Current (-)

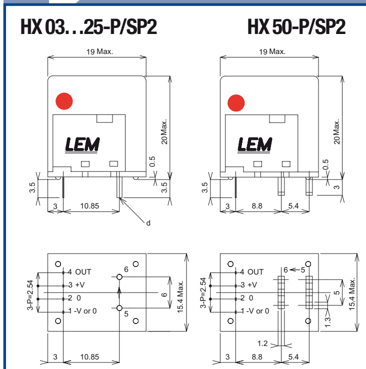
Primary conductor diameter

HX	03-P	05-P	10-P	15-P
d	0.6	0.8	1.1	1.4
HX	20-P	25-P	50-P	
d	1.6	1.6	1.2 x 6.3	

Secondary pins dimension
0.5 x 0.25

4 HX 03… 50-P/SP2

HX 03…25-P/SP2   HX 50-P/SP2



Terminal Pin Identification

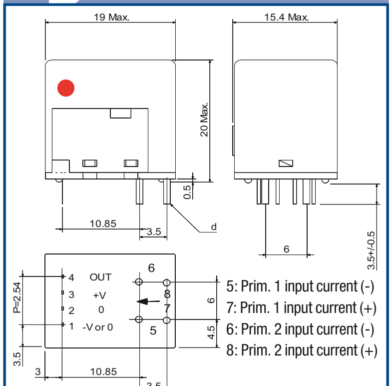
1 ..... 0V
2 ..... 0V
3 ..... +12V to +15V
4 ..... Output
5 ..... Primary input Current (+)
6 ..... Primary input Current (-)

Primary conductor diameter

HX	03-P/ SP2	05-P/ SP2	10-P/ SP2	15-P/ SP2
d	0.6	0.8	1.1	1.4
HX	20-P/ SP2	25-P/ SP2	50-P/ SP2	
d	1.6	1.6	1.2 x 6.3	

Secondary pins dimension
0.5 x 0.25

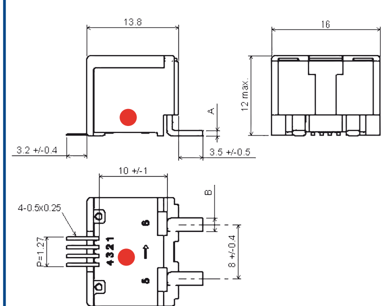
5 HX 05… 15-NP



Primary conductor diameter			
HX	05-NP	10-NP	15-NP
d	0,8	1,0	1,1

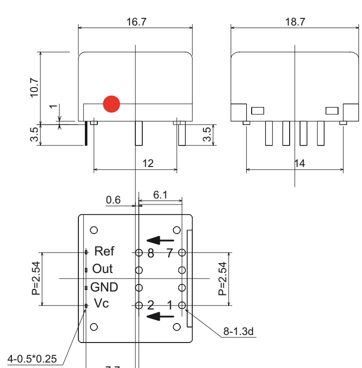
Secondary pins dimension
0,5 x 0,25

6 HMS 05… 20-P

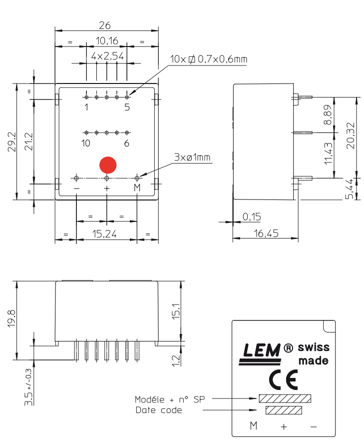


	A	B	TURNS
HMS 05-P	0,8t	2,0W	4t
HMS 10-P			
HMS 15-P	1,2t	2,2W	2t
HMS 20-P			

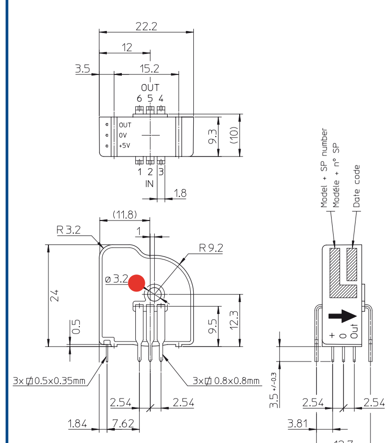
7 HXS 20…50-NP, HXS 20…50-NP/SP2



8 LA 25-NP, LA 35-NP



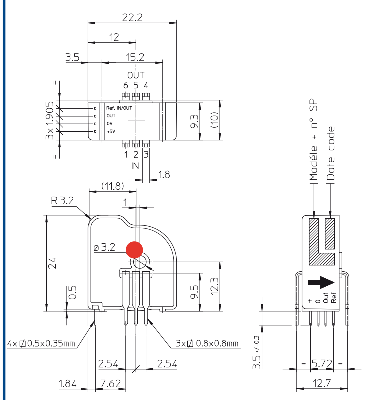
9 LTS 6-NP, LTS 15-NP, LTS 25-NP



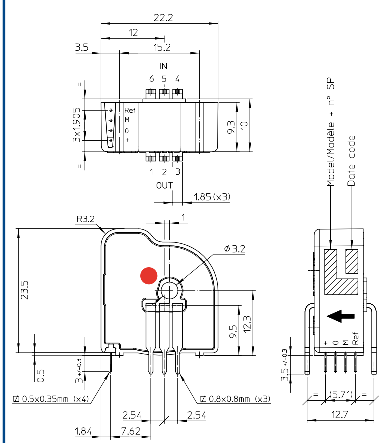
All dimensions are in mm

● Hall effect chip location

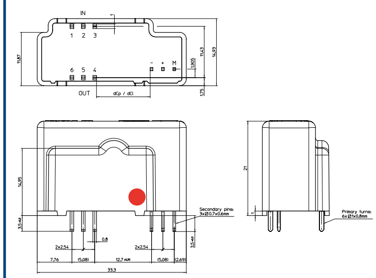
10 LTSR 6-NP, LTSR 15-NP, LTSR 25-NP



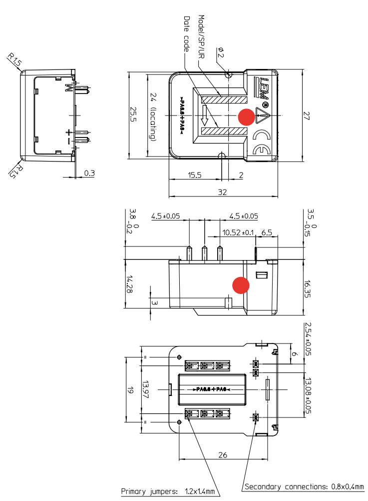
11 LTSP 25-NP



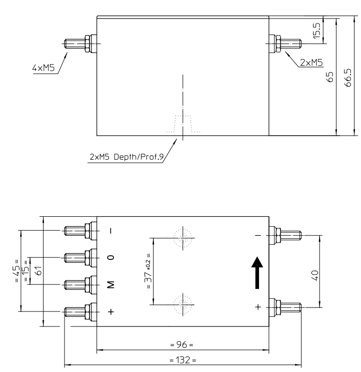
12 LAH 25-NP



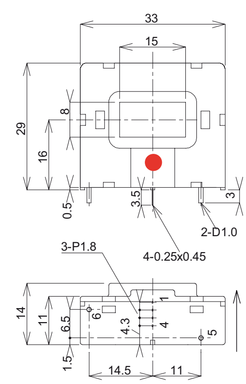
13 LAX 100-NP



14 CT 1-T, CT 2-T, CT 5-T CT 10-T, CT 25-T



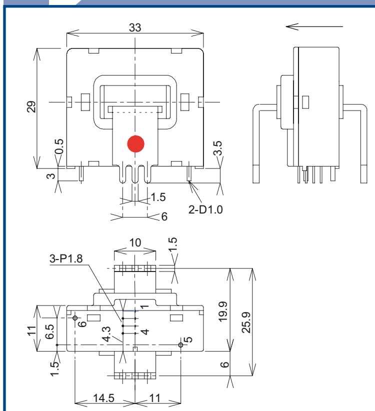
15 HAIS 50…400-P



Terminal Pin Identification

1...+5V
2...0V
3...OUTPUT
4...Vref. (IN/OUT)
5...Core Earth
6...NC.

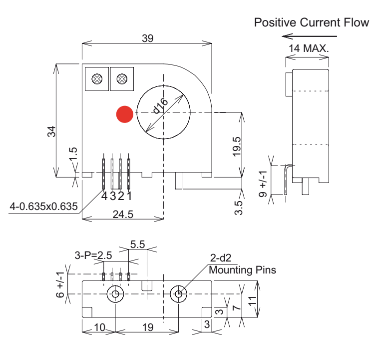
16 HAIS 50…100-TP



Terminal Pin Identification

1...+5V
2...0V
3...OUTPUT
4...Vref. (IN/OUT)
5...Core Earth
6...NC.

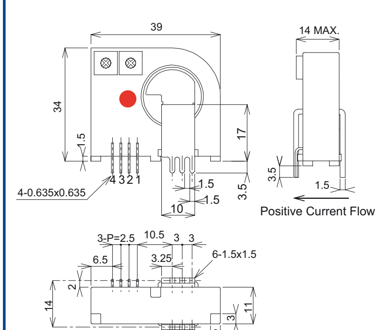
17 HTB 50…400-P



Secondary Pin Identification

1 +Vc
2 -Vc
3 Output
4 0V

18 HTB 50…100-TP



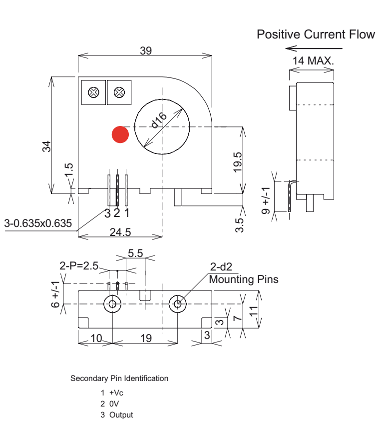
Secondary Pin Identification

1 +Vc
2 -Vc
3 Output
4 0V

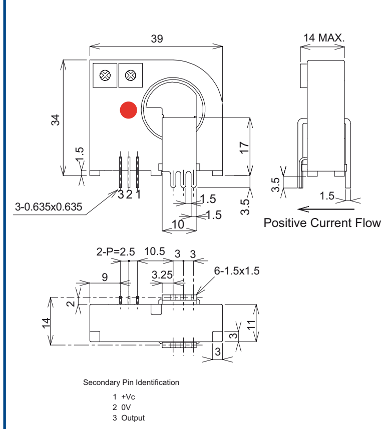
All dimensions are in mm

● Hall effect chip location

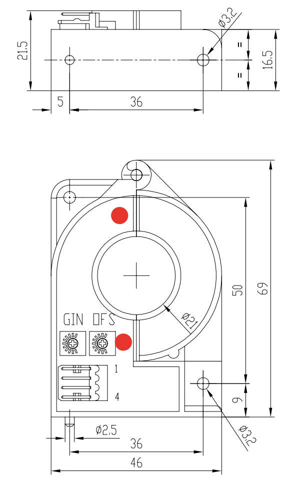
19 HTB 50 … 400-P/SP5



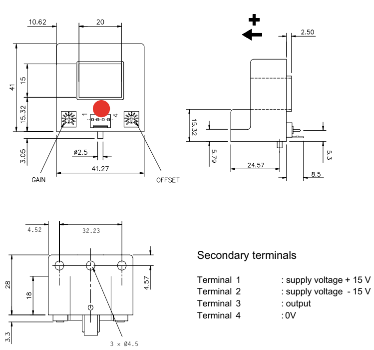
20 HTB 50 … 100-TP/SP5



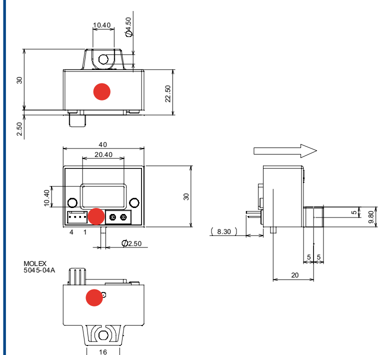
21 HTR 50 … 500-SB



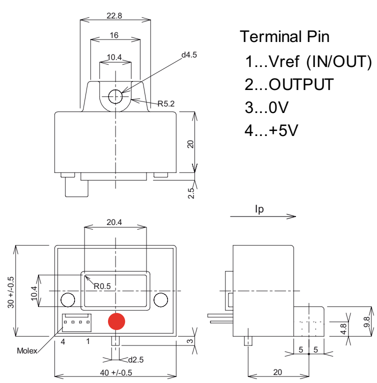
22 HAL 50 … 600-S



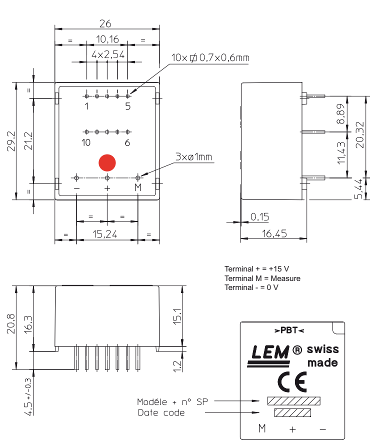
23 HASN 50…600-S



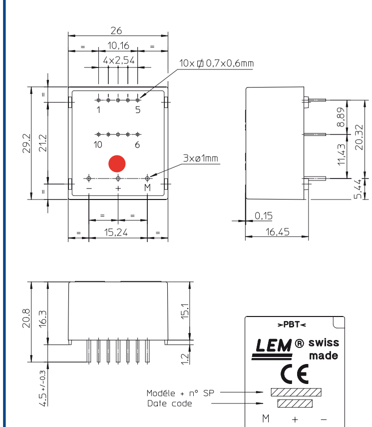
24 HASS 50…600-S



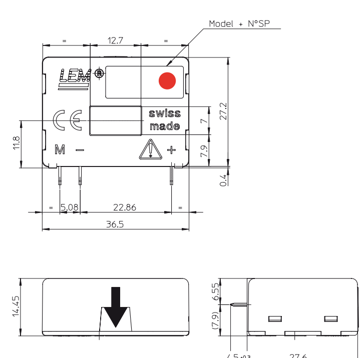
25 LA 25-NP/SP2



26 LA 25-NP/SP25



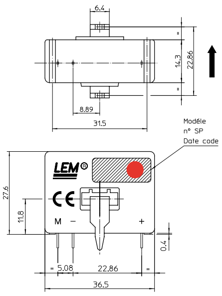
27 LA 55-P, LA 55-P/SP1, SP 23 LA 100-P, LA 100-P/SP 13



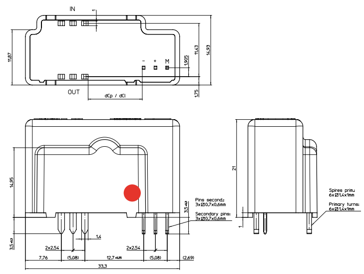
All dimensions are in mm

● Hall effect chip location

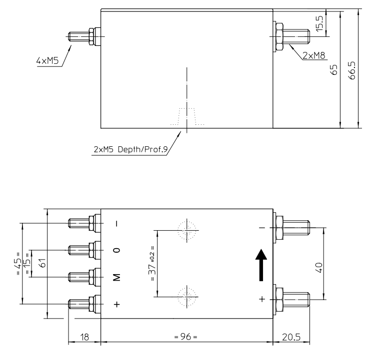
28 LA 55-TP, LA 55-TP/SP1/SP 27 LA 100 - TP



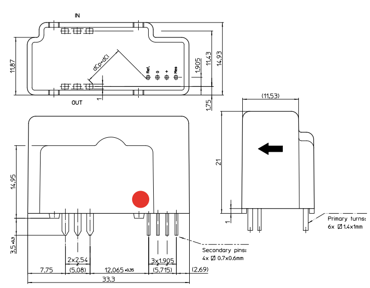
29 LAH 50-P, LAH 100-P



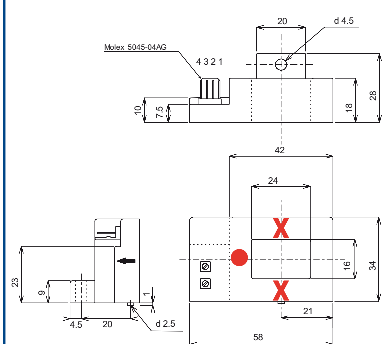
30 CT 50-T



31 LAS 50-TP, LAS 100-TP



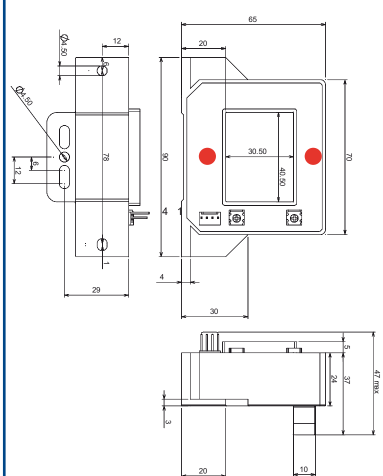
32 HAC 100… 800 - S



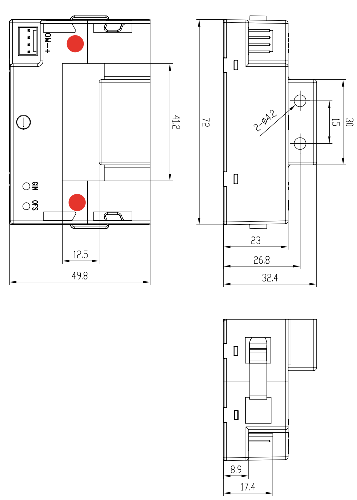
● up to HAC 300 - S

X from HAC 400 - S

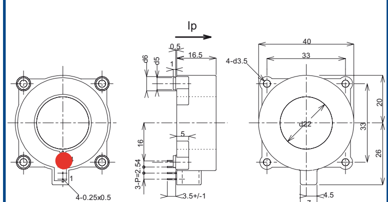
33 HAT 200… 1500 - S



34 HOP 200 ... 600-SB



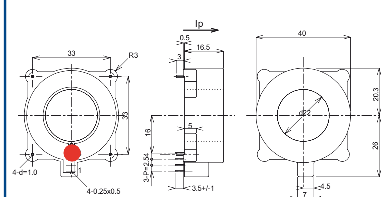
35 HTFS 200 ... 800-P



Terminal Pin

1...+5V
2...0V
3...Output
4...Vref

36 HTFS 200 ... 800-P/SP2



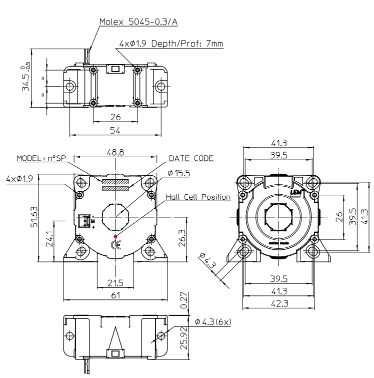
Terminal Pin

1...+5V
2...0V
3...Output
4...Vref(IN/OUT)

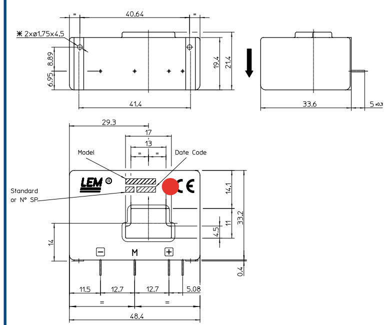
All dimensions are in mm

● Hall effect chip location

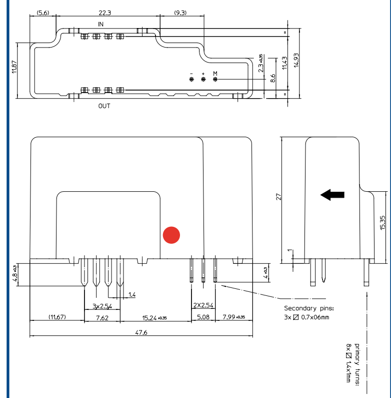
37 LF 205-S, LF 205-S/SP3



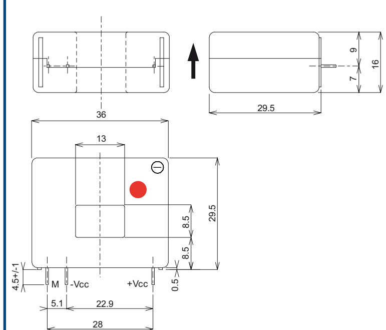
38 LA 125-P, LA 125-P/SP1/SP4 LA 200-P, LA 200-P/SP4



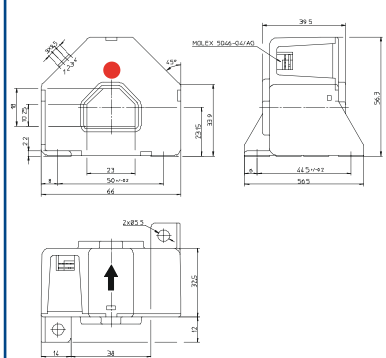
39 LAH 125-P



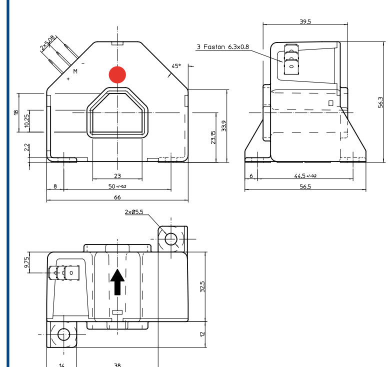
40 LA 150-P



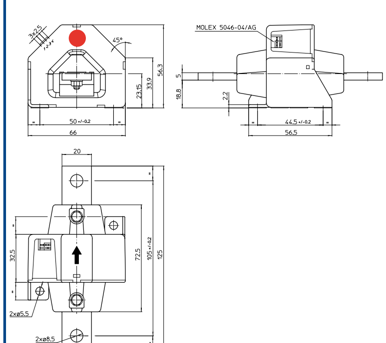
41 LA 205-S



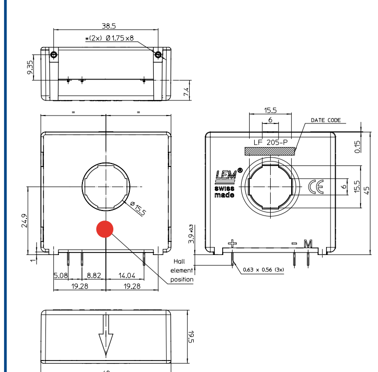
42 LA 205-S/SP1



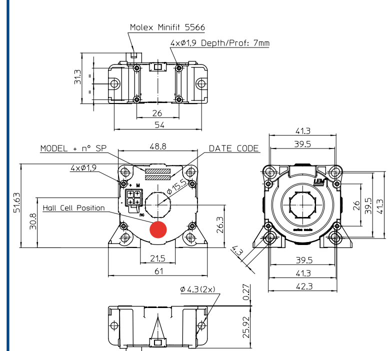
43 LA 205-T



44 LF 205-P



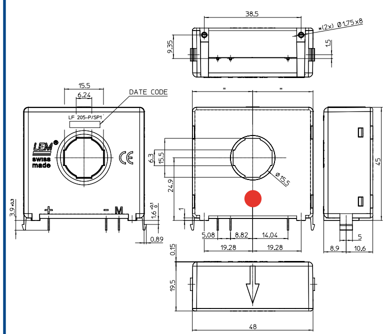
45 LF 205-S/SP1



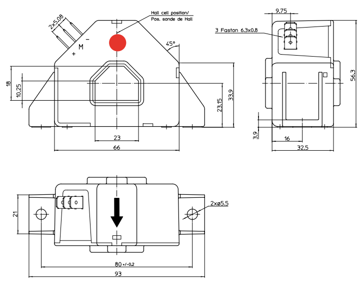
All dimensions are in mm

● Hall effect chip location

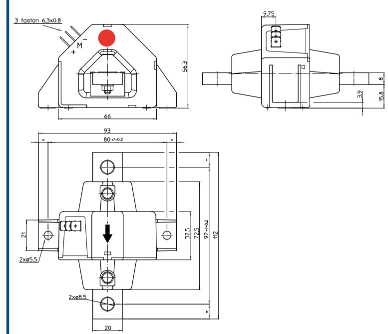
46 LF 205-P/SP1



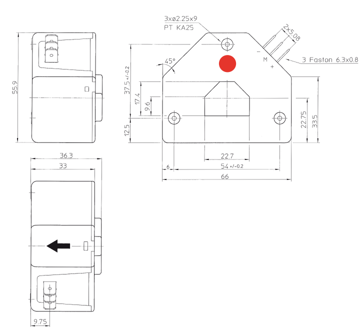
47 LA 255-S



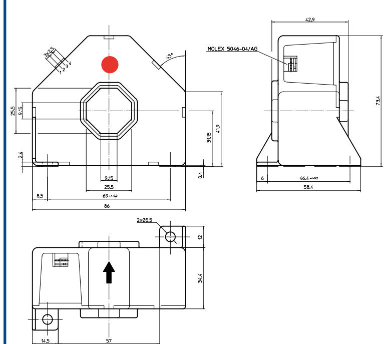
48 LA 255-T



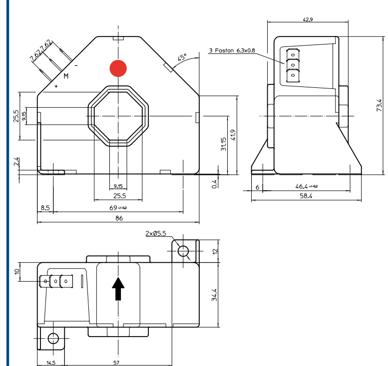
49 LA 205-S/SP 30



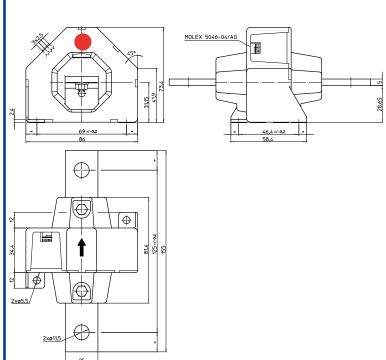
50 LA 305-S, LA 305-S/SP1



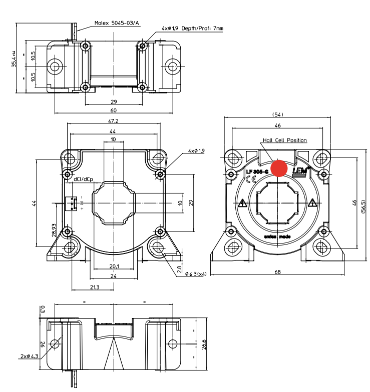
51 LA 305-S/SP5



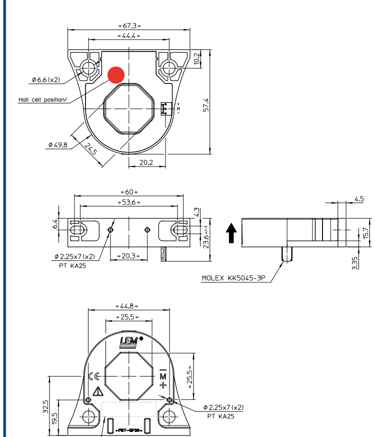
52 LA 305-T, LA 305-T/SP1



53 LF 305-S



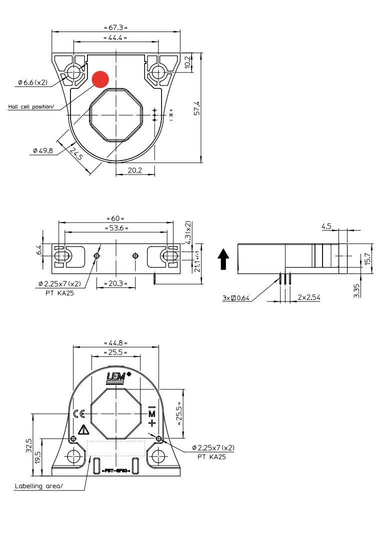
54 LF 306-S



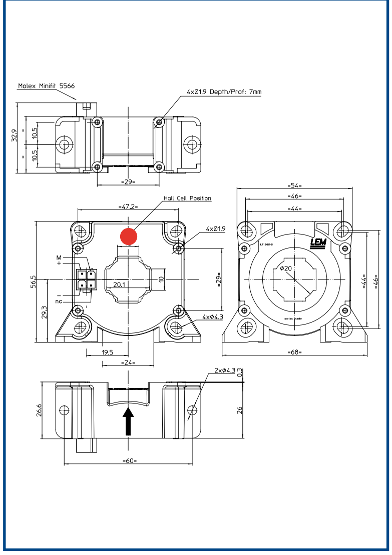
All dimensions are in mm

● Hall effect chip location

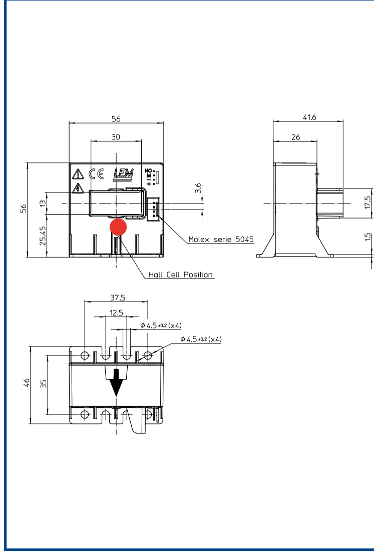
55 LF 306-S/SP10



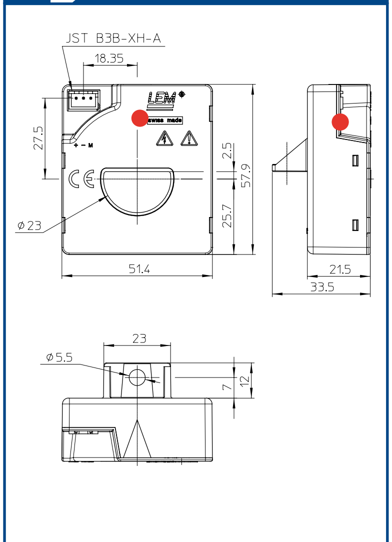
56 LF 305-S/SP 10



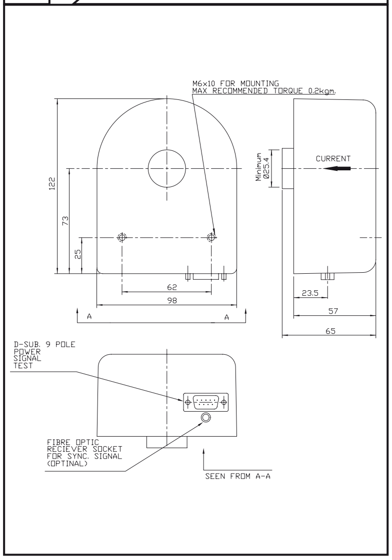
57 LA 306-S



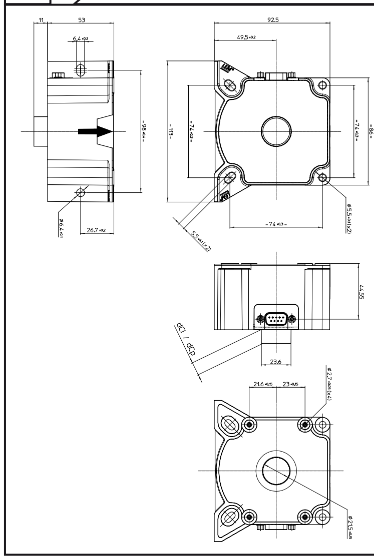
58 LT 305-S



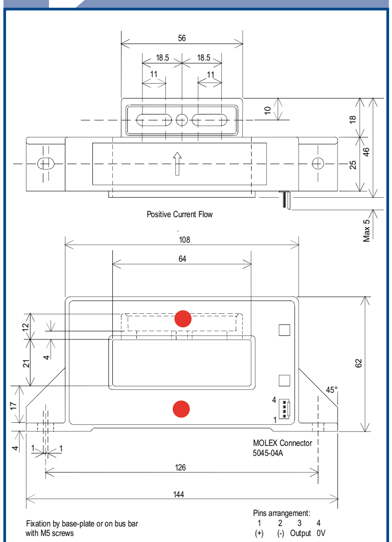
59 IT 150-S, IT 600-S



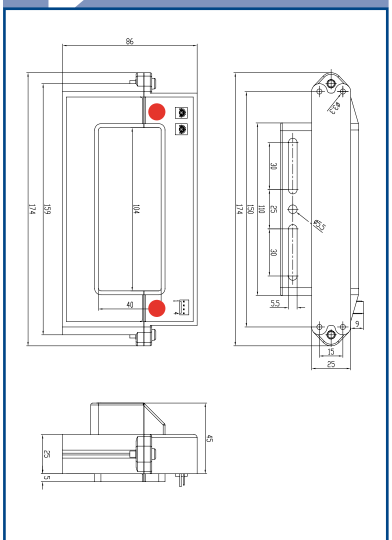
60 ITB 300-S



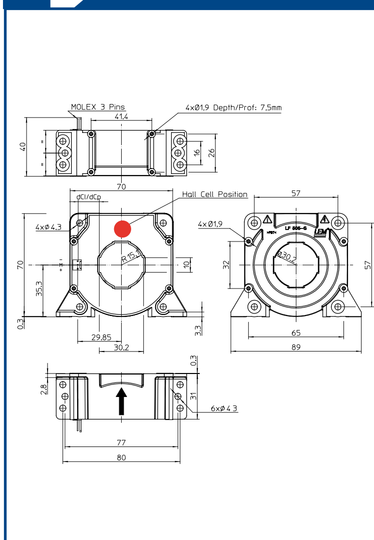
61 HAX 500... 2500-S



62 HOP 500-SB/SP1 HOP 800 ... 2000-SB



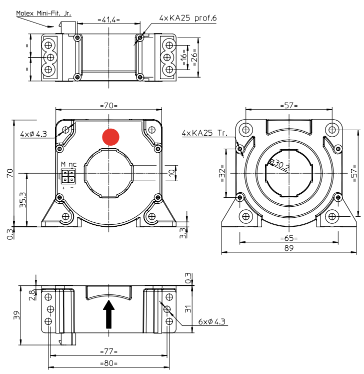
63 LF 505-S



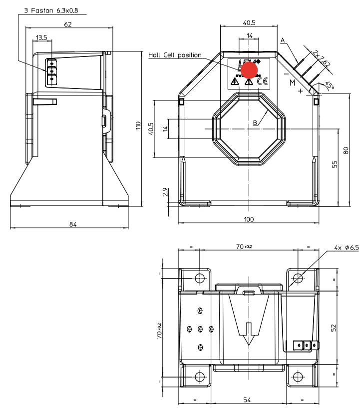
All dimensions are in mm

● Hall effect chip location

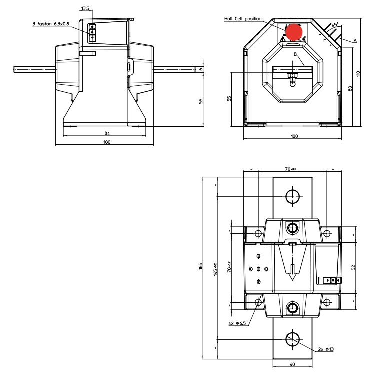
64 LF 505-S/SP15



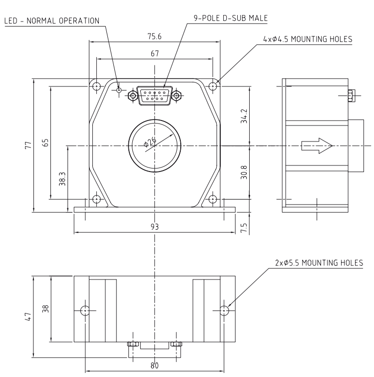
65 LT 505-S



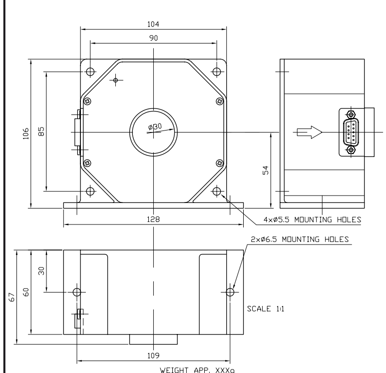
66 LT 505-T



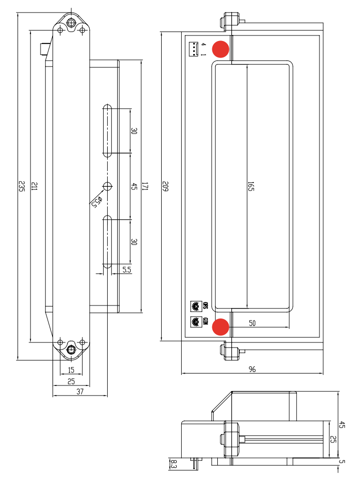
67 IT 400-S



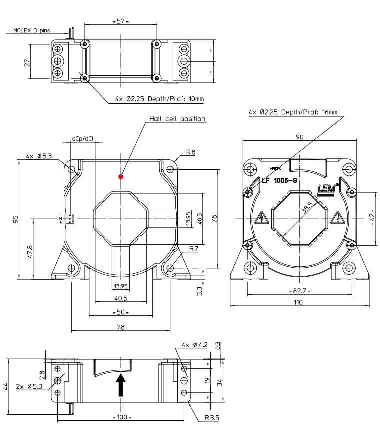
68 IT 700-S



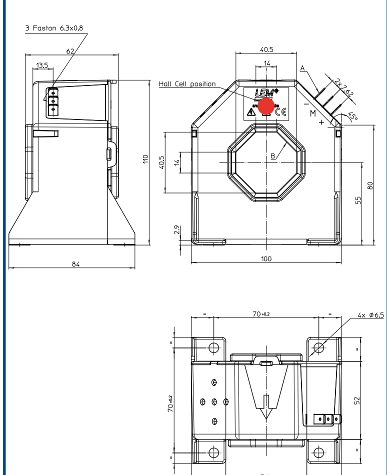
69 HOP 2000-SB/SP1



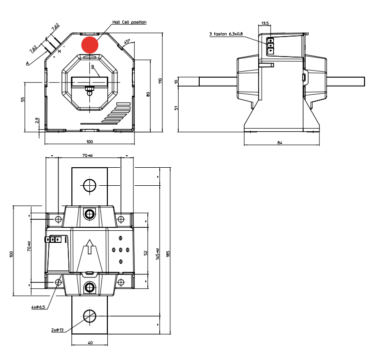
70 LF 1005-S



71 LT 1005-S



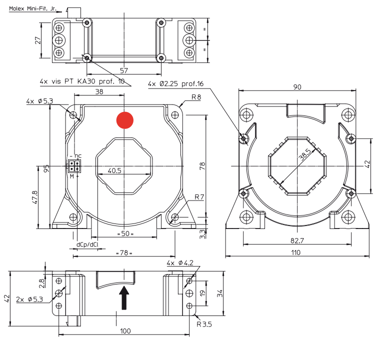
72 LT 1005-T



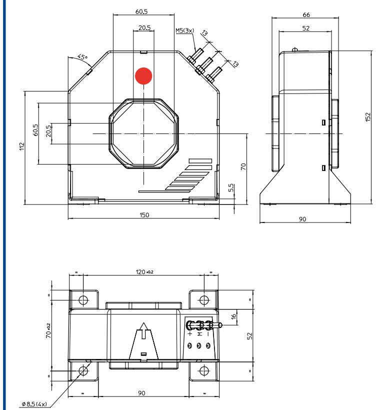
All dimensions are in mm

● Hall effect chip location

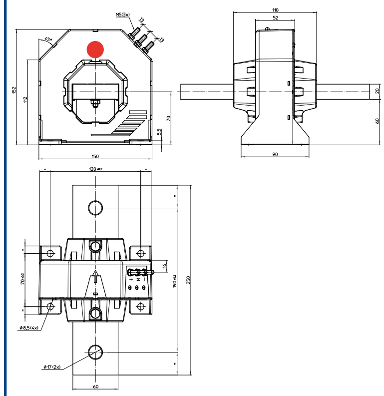
73 LF 1005-S/SP 22



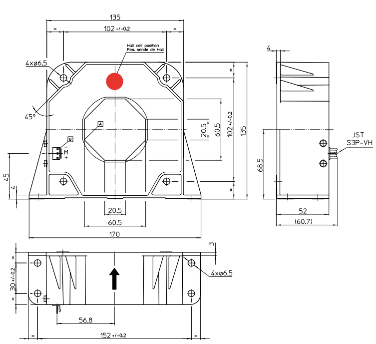
74 LT 2005-S



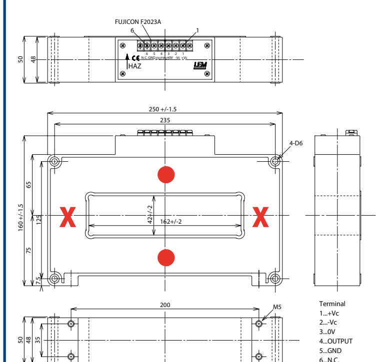
75 LT 2005-T



76 LF 2005-S



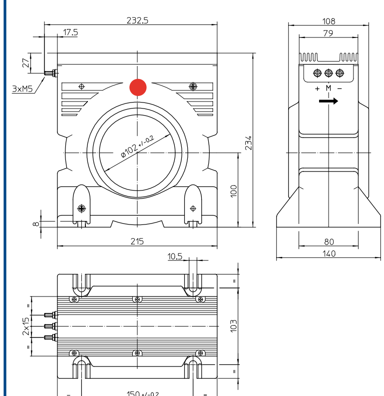
77 HAZ 4000…20000-SB,-SBI, -SBI/SP1,-SRU,-SRI,-SRI/SP1



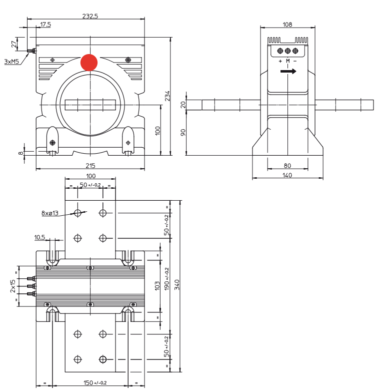
● For HAZ 4000 models

● + X For the other models

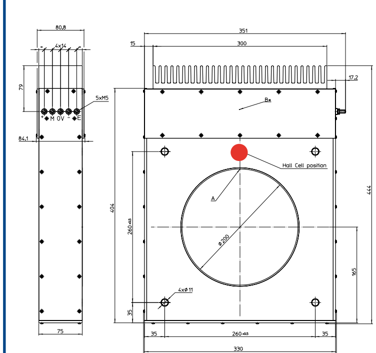
78 LT 4000-S



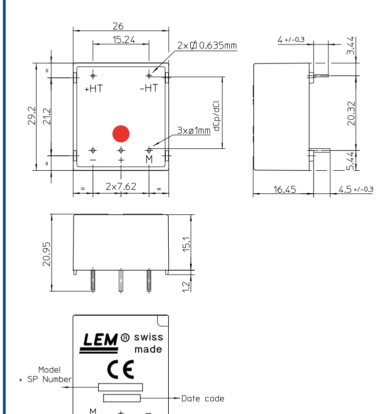
79 LT 4000-T



80 LT 10000-S



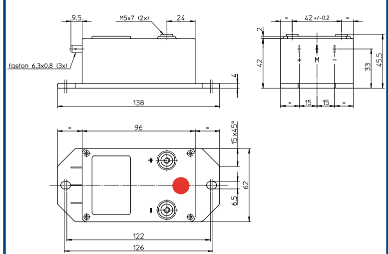
81 LA 25-NP/SP 7/SP 8/SP 9/ SP 11/SP 13/SP 14, LV 25-P



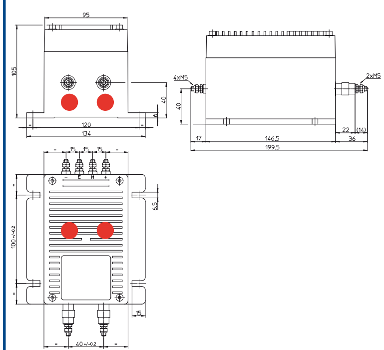
All dimensions are in mm

● Hall effect chip location

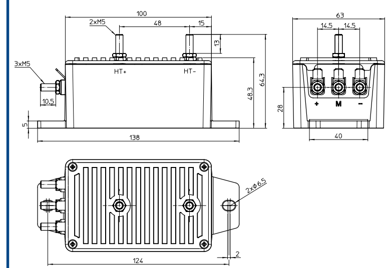
82 LV 100



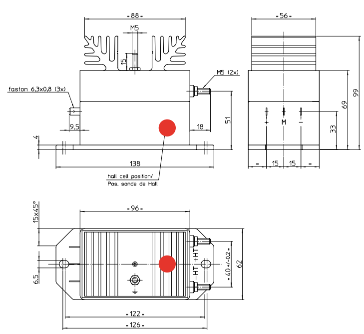
83 LV 200-AW/2



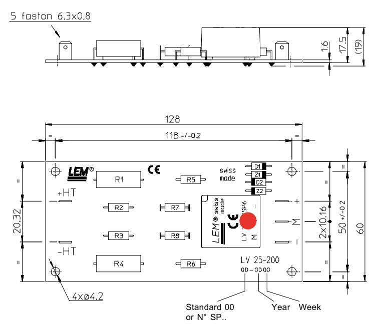
84 AV 100-50…2000



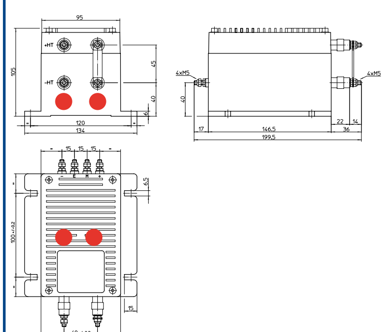
85 LV 100-50 … 2000



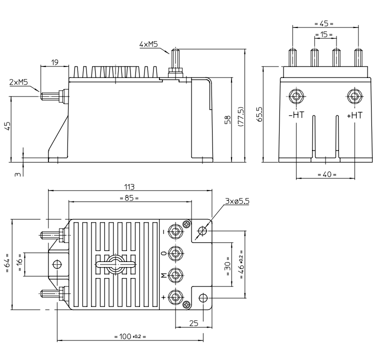
86 LV 25-200… 1200



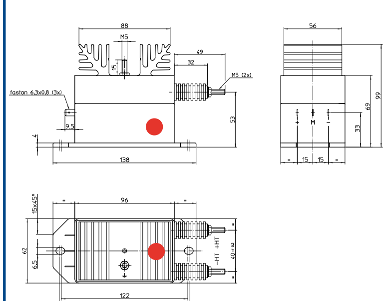
87 LV 200-AW/2/200…6400



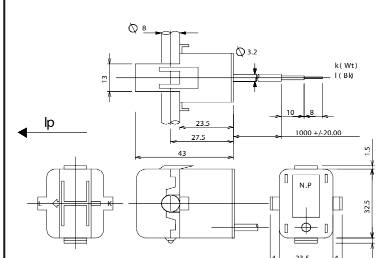
88 CV 3-200…2000



89 LV 100-2500… 4000



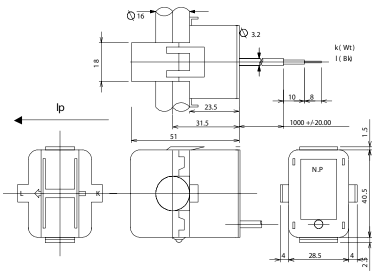
90 TT 50-SD



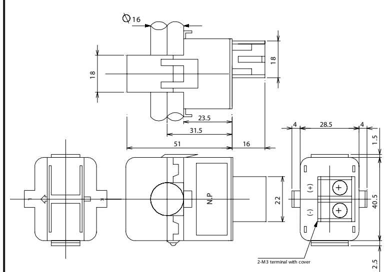
All dimensions are in mm

● Hall effect chip location

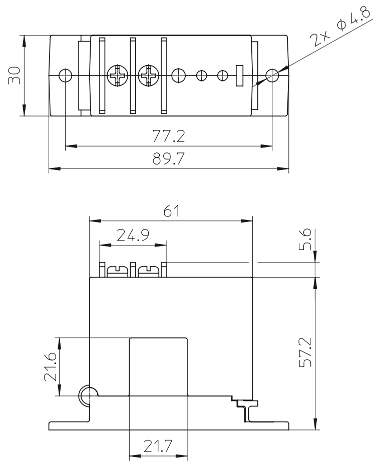
91 TT 100-SD



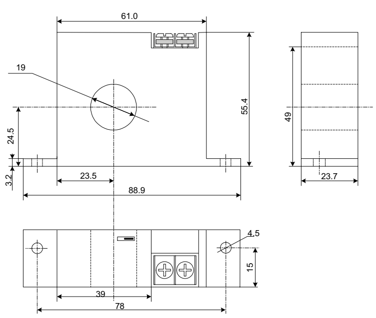
92 AT 5…150 B420 L
AT 5…150 B5/10



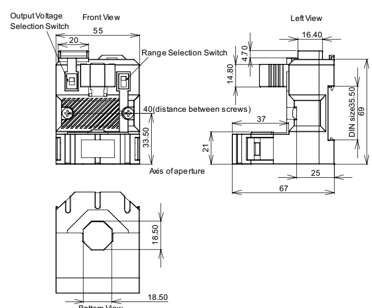
93 AK 5…200 B5/10 & B420 L
AKR 5…200 B5/10 & B420 L, AKS 125 & 180 B



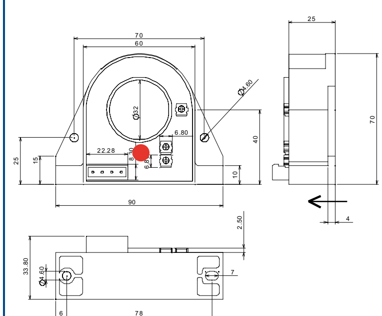
94 AK 5…200 C5/10 & C420 L
AKR 5…200 C5/10 & C420 L, AKS 125 C



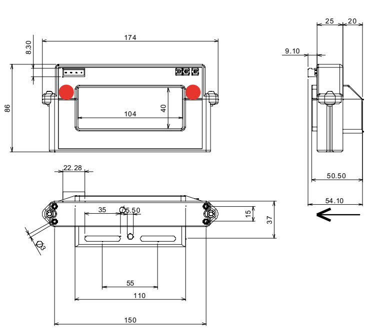
95 AP 50…400 B5/10 & B420 L
APR 50…400 B5/10 & B420 L



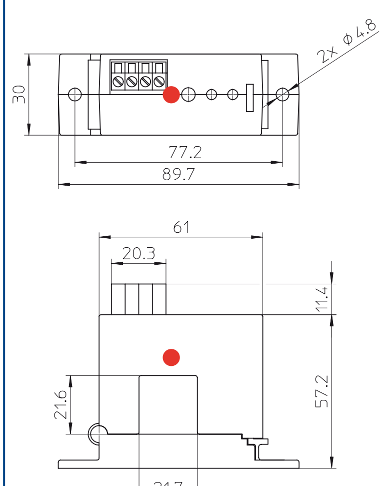
96 DHR 100…1000 C5/10 & C420



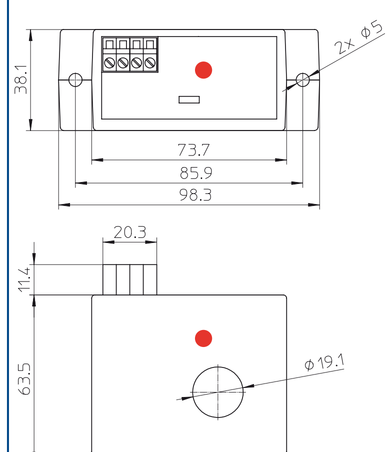
97 AHR 500…2000 B5/10 & B420



98 DK 20…200 B5/10 & B420
DK 50…200 B420 B



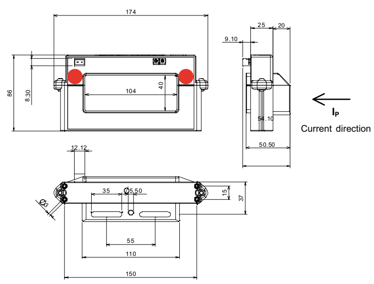
99 DK 20…200 C5/10 & C420
& C420 B



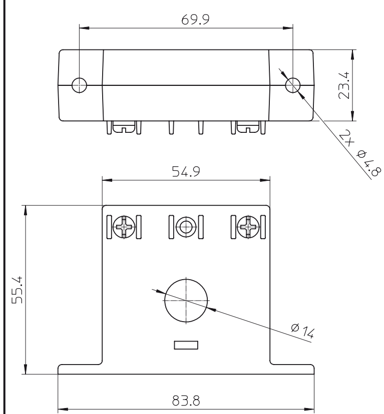
All dimensions are in mm

● Hall effect chip location

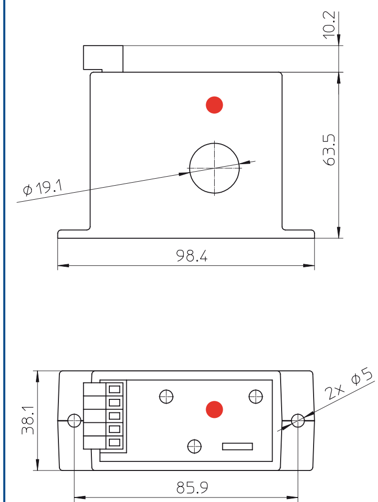
100 DH 500…2000 B420 LB



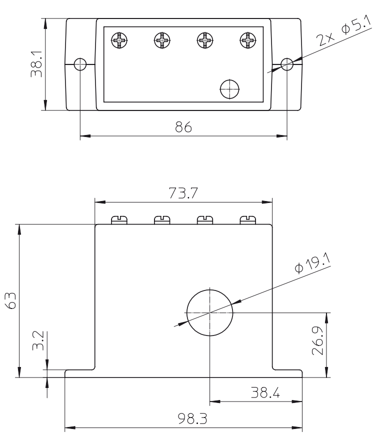
101 AKS 180C



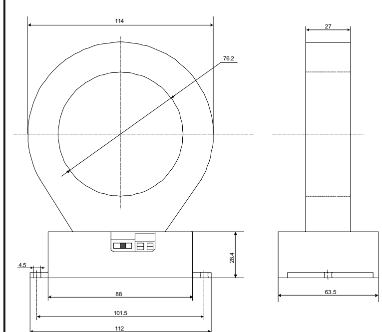
102 DKS 100 CNOU & CSDT



103 AKS 0.03 C NO/NC & C SDT
AKS 0.XXX C NO/NC & C SDT



104 AK 750 & 2000 C420 LJ
AKR 750 & 2000 C420 LJ



Product coding of selected Industrial Transducers

(Excluding current transducers for Process Automation)

LA 305-S/SP1	(Example)
L	LEM, closed loop or Eta system
H	Open loop system
C	High performances closed loop system
I	High-precision closed loop current transducer
A	Transducer using the principle of isolation amplifier
F	Fields detector system
A, X	Current transducer, laminated core
AC, AZ	
AL	Compact, light-weight current transducer
AS	When used with L → LAS: current transducer with secondary winding and unipolar power supply using Eta technology
AT	
ASN	
AX	
AH	Vertical current transducer
C	Current transducer, without case
D	Differential current transducer
F	Current transducer, flat design
T, TA, TB, TL, TY	Current transducer, toroidal core
TR	Opening core
OP	Opening laminated core
Y	Current transducer, compact hybrid for PCB mounting
HS	Hall effect without magnetic compensation; Magnetic concentrators + unidir. p. supply + ref. access When used with F → FHS : Minisens, SO8 transducer
TS	Core + unidirect. power supply
TSP, TSR	Core + unidirect. power supply + ref. access
TFS	Core, flat case + unidirect. power supply + ref. access
XS, AIS, ASS	Laminated core + unidir. p. supply + ref. access
MS	Surface Mounted Device + unidir. p. supply + ref. access
V	Voltage transducer
305	Nom.current - in RMS amperes for current transducer - also in RMS amperes turns for voltage transducers LV
-S (I)	with through hole for primary conductor
-T (I)	with incorporated primary bus bar
-N	multiple range
-P	PCB mounting
-SB	Bidirectional voltage output
-SBI	Bidirectional current output
-1000	Nominal Voltage (1000 meaning 1000 V, with built in primary resistor R_1)
-AW/2	Particular type of voltage transducer
-AW/2/200	Nominal voltage for AW/2 design (200 meaning 200 V, with built in primary resistor R_1)
/SP1	Special characteristics

Symbols and Terms

BW	Frequency bandwidth
G	Sensitivity
I_C	Current consumption
I_O	Zero offset current, T_A = 25°C
I_{OM}	Residual current @ I_P = 0 after an overload
I_{OT}	Thermal drift of offset current
I_{OUT}	Max. allowable output current at I_{PN} or V_{PN}
I_{PN}	Primary nominal RMS current
I_P	Primary current
I_{PM}	Primary current, measuring range
I_S	Secondary current
I_{SN}	Secondary nominal RMS current
K_N	Turns ratio
R_{IM}	Internal measuring resistance
$R_{M\,min}$	Minimum measuring resistance at $T_{A\,max}$
$R_{M\,max}$	Maximum measuring resistance at $T_{A\,max}$
R_1	Primary resistor (voltage transducer)
R_P	Primary coil resistance at $T_{A\,max}$
R_S	Secondary coil resistance at $T_{A\,max}$
T_A	Ambient operating temperature
TCR_{IM}	Temperature coefficient of R_{IM}
TCI_{OUT}	Temperature coefficient of I_{OUT}
TCV_{OUT}	Temperature coefficient of V_{OUT}
TCV_{Ref}	Temperature coefficient of V_{Ref}
TCV_{OUT}/V_{Ref}	Temperature coefficient of V_{OUT}/V_{Ref} @ I_P = 0
TCG	Temperature coefficient of the gain
t_r	Response time
t_{ra}	Reaction time
V_C	Supply voltage
V_b	Rated isolation voltage RMS, reinforced or basic isolation
V_d	RMS voltage for AC isolation test, 50 Hz, 1 min
V_e	RMS voltage for partial discharge extinction @ 10 pc
V_W	Impulse withstand voltage, 1,2/50 µs
V_O	Zero offset voltage, T_A = 25°C
V_{OM}	Residual voltage @ I_P = 0 after an overload
V_{OT}	Temperature variation of offset voltage
V_{OUT}	Output voltage at ± I_{PN} or V_{PN}
V_{PN}	Primary nominal RMS voltage
V_P	Primary voltage, measuring range
V_{Ref}	Reference voltage
X	Typical accuracy, T_A = 25°C
X_G	Global accuracy @ I_{PN} or V_{PN}, T_A = 25 °C

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5 Year Warranty on LEM Transducers

LEM designs and manufactures high quality and high reliability products for its customers over the entire world. Since 1972, we have delivered several million current and voltage transducers which are, for most of them, still in operation on traction vehicles, industrial motor drives, UPS systems and many other applications requiring high quality standards.

Our 5 year warranty applies on all LEM transducers delivered from the 1st. of January 1996 and is valid in addition to the legal warranty. The warranty granted on our Transducers is for a period of 5 years (60 months) from the date of their delivery.

During this period we shall replace or repair at our cost all defective parts (provided the defect is due to defective material or workmanship).

Further claims as well as claims for the compensation of damages, which do not occur on the delivered material itself, are not covered by this warranty.

All defects must be notified to us immediately and faulty material must be returned to the factory along with a description of the defect.

Warranty repairs and or replacements are carried out at our discretion. The customer bears the transport costs. An extension of the warranty period following repairs undertaken under warranty cannot be granted.

The warranty will be invalidated if the buyer has modified or repaired, or has had repaired by a third party the material without LEM's written consent.

The warranty does not cover any damage caused by incorrect conditions of use and cases of force majeure.

No responsibility will apply except legal requirements regarding product liability.

The warranty explicitly excludes all claims exceeding the above conditions.

LEM, Geneva, January 1. 2001

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