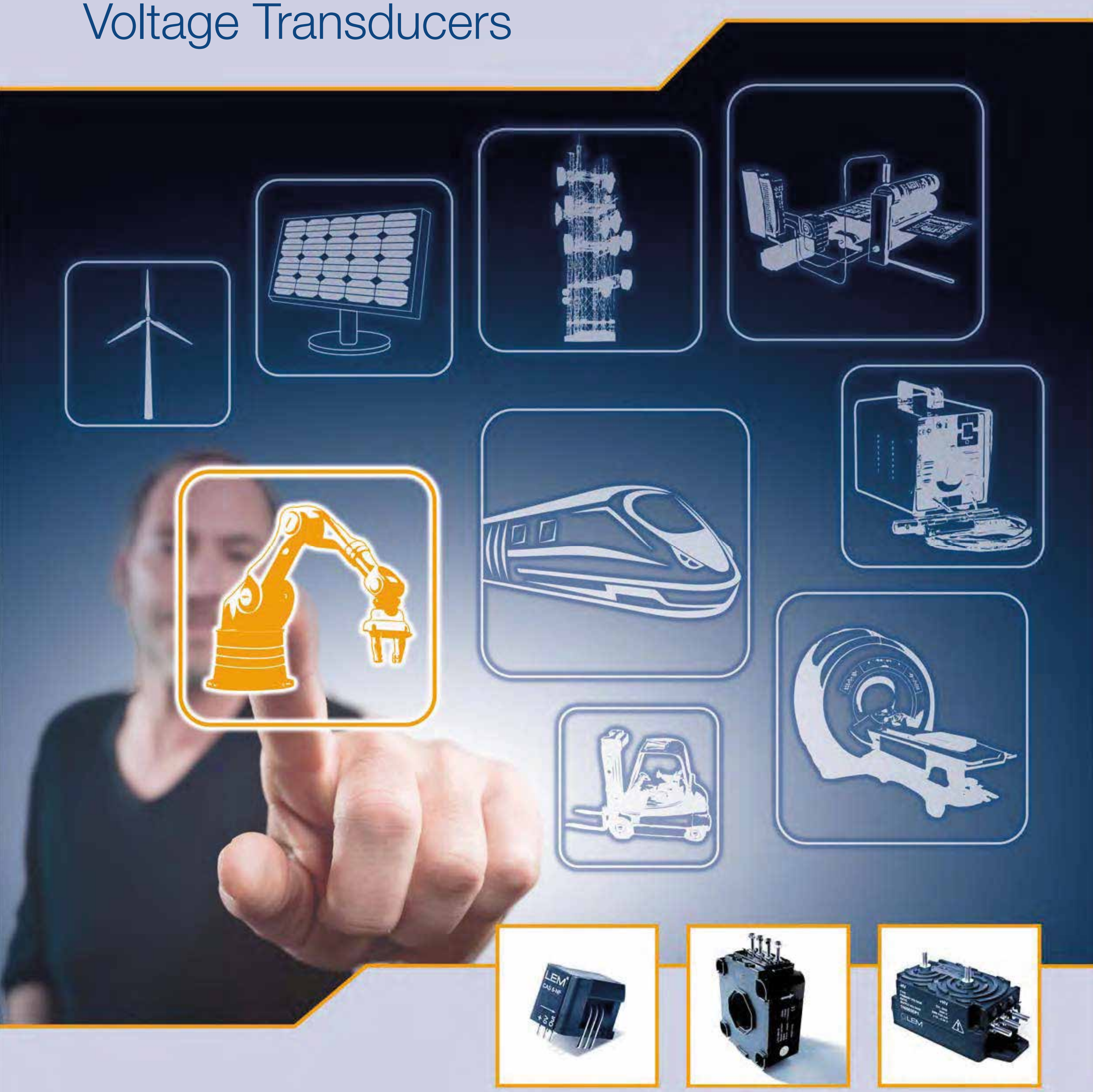
Industry Catalogue

Industry Current & Voltage Transducers



LEM solutions for electrical measurements

This catalogue summarizes the most common LEM product offerings for industrial, railway, high accuracy, and automotive measurements.

LEM is the market leader in providing innovative and high quality solutions for measuring electrical parameters. Its core products - current and voltage transducers - are used in a broad range of applications including drives & welding, renewable energies & power supplies, traction, high precision, conventional and green vehicle businesses.

With higher accuracy and speed, the feedback signal from LEM transducers enables smoother control and energy consumption reduction of many electrical systems.

At the heart of … ELEVATORS

In most lifts installed worldwide, LEM transducers prevent the doors closing on passengers. They keep the cabin stable when people enter, and ensure that the lift rides smoothly by adjusting the torque of the motor.

At the heart of … RENEWABLE ENERGIES

LEM transducers, specifically designed for renewable power systems, control the flow and waveform of energy sent to the grid from photovoltaic and other renewable energy systems. They measure the current to help the windmills and solar installations to work at their maximum efficiency.

At the heart of … TRACTION

Regardless of whether a train is powered by diesel or electricity, traction is provided by electric motors driven by inverters that are relying on LEM transducers to measure, optimize and adjust the power that is sent to the motors, improving both performance and reliability.

At the heart of … HIGH PRECISION APPLICATIONS

The quality of the image provided by MRI scanners is linked directly to the accuracy of the current measurement.
The current transducer used has a direct impact on the image and if the transducer is not precise enough this will lead to a blurred and illegible image. LEM current transducers set a standard for accuracy and are the most precise industrial products in the market today. The transducers provide levels of stability and precision, at about 1–3 parts per million, which makes them references in calibration test benches or in laboratories.

At the heart of … AUTOMOTIVE

In electric and hybrid vehicles, LEM transducers monitor energy levels to and from the battery and are critical in the control of the electric motors.

It is our business to support you with both standard and customized products to optimize your application.

DRIVES & WELDING MARKET
RENEWABLE ENERGIES & POWER SUPPLIES MARKETS

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 inverter 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 and is 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, 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, in lighting, domestic appliances, computers and telecom applications. Power electronics increases efficiency by delivering the correct type of power at the most efficient voltage, current and frequency.

TRACTION & TRACKSIDE MARKET

Today, high speed trains, city transit systems (metro, trams, and trolleybuses) and freight trains are the solutions against pollution and interstate traffic immobility, and provide a significant energy savings.
Power electronics is essential to drive and control energy in these transportation systems.
LEM has been the market leader in traction power electronics applications and development for the last 40 years and leverages this vast experience to supply solutions for isolated current and voltage measurements.
LEM transducers provide control and protection to power converters and inverters that regulate energy to the electric motors (for propulsion) and to the auxiliaries (for air conditioning, heating, lighting, electrical doors, ventilation, etc.). This includes the incoming monitoring of the voltage network (changing by crossing European borders) to make the power electronics work accordingly.
Although this is true for on-board applications, LEM has also provided the same control and protection signals for wayside substations.
The rail industry is under constant changes and evolution. As a recent example, the privatization of the rail networks raised new requirements for which LEM provides: the onboard monitoring of power consumption (EM4T II Energy Meter), solutions to trackside applications, rail maintenance and the monitoring of points (switches) machines or signaling conditions with some new transducers families.
LEM is always available to assist in adapting to these evolving technical applications.
Four decades of railway experience have contributed to establishing LEM as the market leader with worldwide presence to serve you and provide the efficient, safe and reliable operation of the railways.

HIGH PRECISION MARKET

Certain power-electronics applications require such high performance in accuracy, drift and/or response time that is necessary to switch to other technologies to achieve these goals. The validation of customer equipment is made through recognized laboratories using high-performance test benches supported by high-technology equipment including extremely accurate current transducers. These transducers are still in need today for such traditional applications but are more and more in demand in high-performance industrial applications, specifically medical equipment (scanners, MRI, etc.), precision motor controllers, and metering or accessories for measuring and test equipment. LEM has been the leader for years in producing transducers with high performance and competitive costs for these markets. The 2009 acquisition of the Danish company, Danfysik ACP A/S, as being the world’s leader in the development and manufacturing of very-high precision current transducers, reinforced this position.

To achieve this challenging target of accuracy and performance, LEM’s current transducers for the high precision market use an established and proven technology, the Fluxgate technology deployed in different alternatives.
Thanks to this technology, we can claim accuracies in the parts per million (PPMs) of the nominal magnitude and is representative of the performance achieved.

The high-accuracy product range covers transducers for nominal current measurements from 12.5 A to 24 kA while providing overall accuracies at ambient temperatures (25°C) of only a few PPM. Thermal offset drifts are extremely low, only a few PPM per Kelvin (K).

LEM has been the market leader in industrial, railway, high accuracy power electronics applications and development for the last 40 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 0.25 A to 24 000 A and voltages from 10 V to 4 200 V in various technologies: open loop, closed loop, fluxgate, insulating digital technology, Rogowski, current transformer etc.
LEM transducers are designed according to the most demanding international standards (EN50178, EN 50155, EN50124-1, NFF 16101, 16102, etc.) and carry CE marking. UL Recognition (UR) is also available on most models.

We have worldwide ISO 9001, ISO TS 16949 and IRIS (Geneva and Beijing LEM production and design centers) qualification and offer a 5-year warranty on all of our products.

At LEM, we find 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 and 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 constantly strives to innovate and improve the performance, cost and size of its products.

LEM is a world-wide company with regional sales offices across the globe close to its clients' locations and production facilities in Switzerland, Europe (including Russia and Bulgaria) and Asia (China and Japan) for seamless service everywhere.

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 in your region for further assistance.
Detailed data sheets and application notes are available upon request.

Sincerely,

Hans-Dieter Huber
Vice President Industry

François Gabella
CEO LEM

LEM - At the heart of power electronics.

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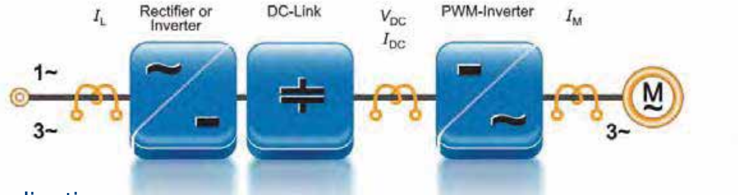
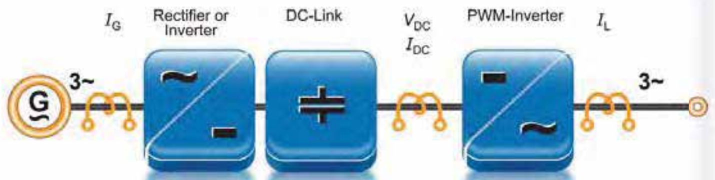
Typical Applications in Power Electronics

AC Variable Speed Drives and Servo Motor Drives



Typical Applications

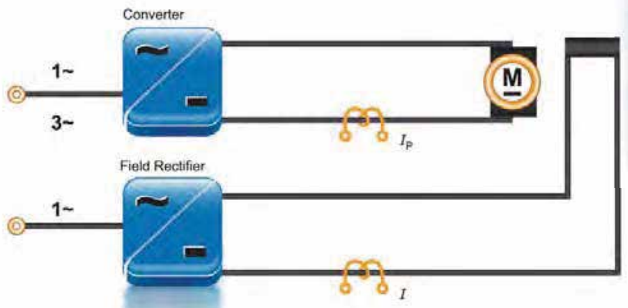
- Machine tools, printing, paper, textile, plastic
- Steel mills
- Lifts
- Cranes
- Robotics
- Pumps
- Washing machines
- On board Main Inverter
- On board Auxiliary Inverter



Typical Applications

- Windmills

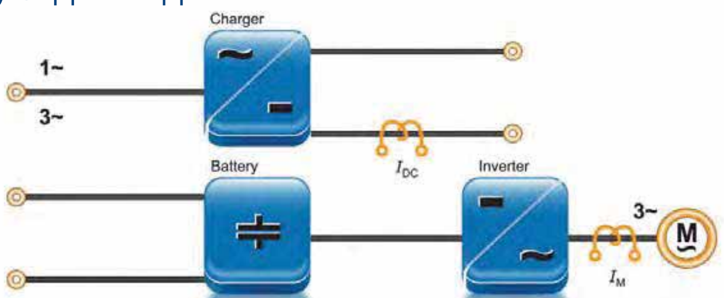
Static Converters for DC Motor Drives



Typical Applications

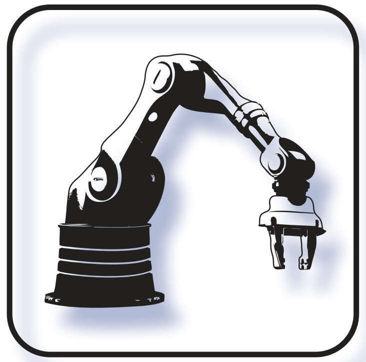
- Machine tools, paper, printing, plastic
- Cranes
- Escalators
- Electrical door opening systems

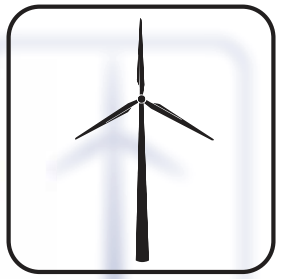
Battery Supplied Applications

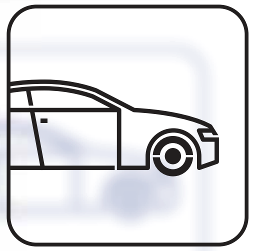


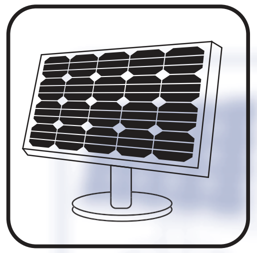
Typical Applications

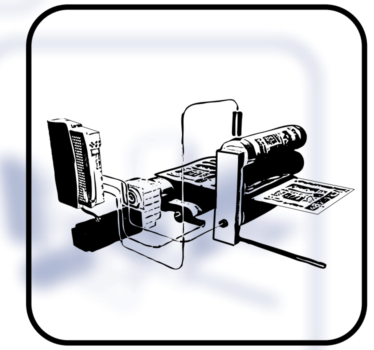
- Electric vehicles (Zero Emission Vehicles, ZEV)
- Fork lift trucks
- Wheel chairs
- Solar power supplies

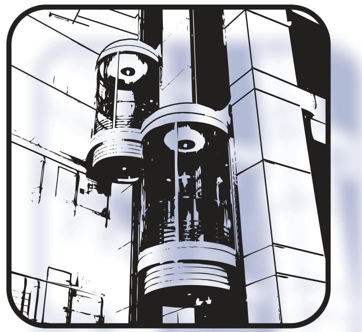


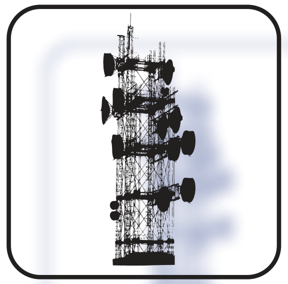


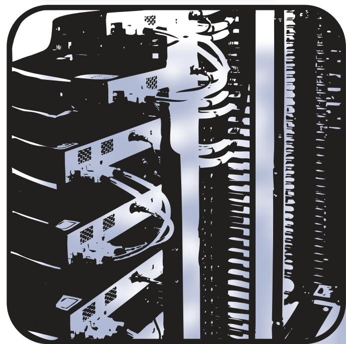


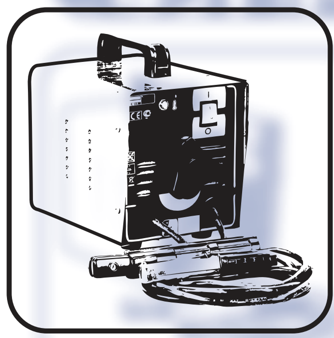


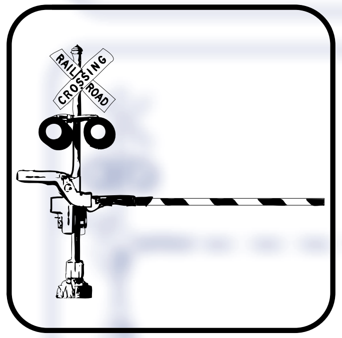


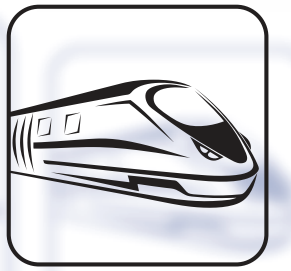








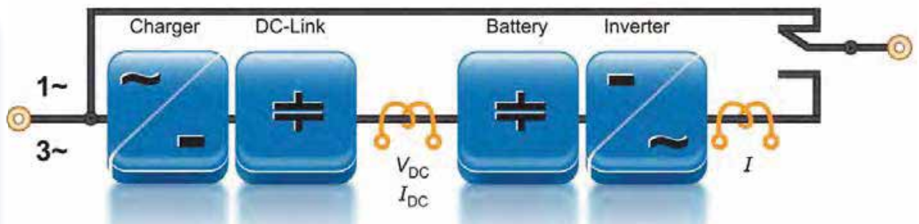




Applications

Typical Applications in Power Electronics

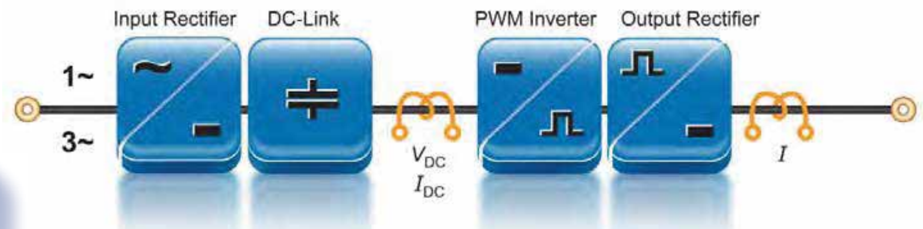
Uninterruptible Power Supplies (UPS)



Typical Applications

- EDP systems
- Telecom
- Security systems

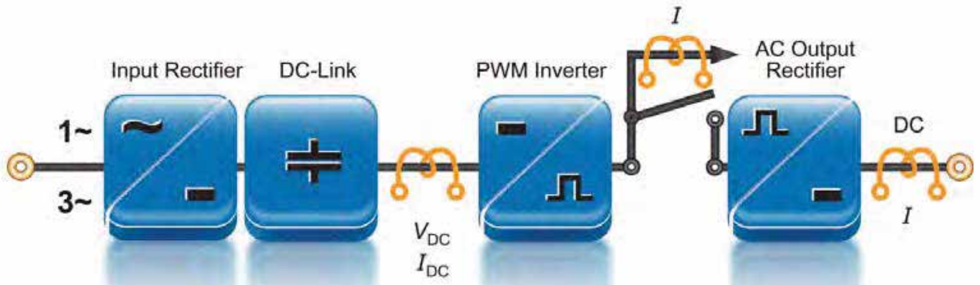
Switched Mode Power Supplies (SMPS)



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

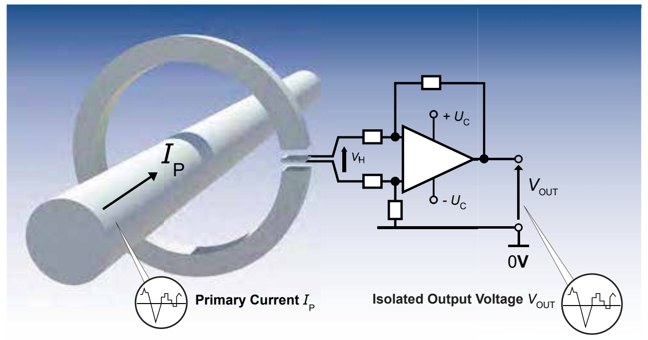
- Test and measurement in laboratories and universities
- Medical X-ray and imaging equipment
- Electrolysis, currents monitoring
- Inductive heating
- Energy management systems. Monitoring of load currents
- Over-current protection
- Control and safety systems
- Electrical traction
- Mining trucks; Wheel drive systems
- Substations: Power transformers; AC/DC Switchgear; Rectifiers
- Trackside applications (points machines, signaling...)

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



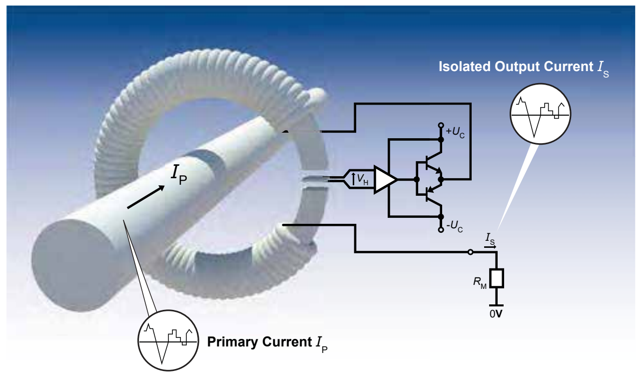
The magnetic flux created by the primary current I_P is concentrated in a magnetic circuit and measured in the air gap using a Hall device. The output from the Hall device is then signal conditioned to provide an exact representation of the primary current at the output.

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



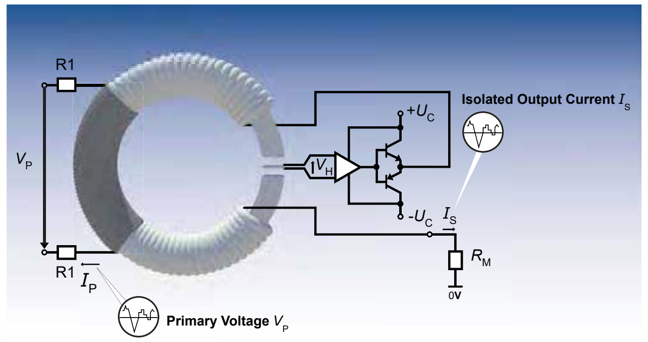
The magnetic flux created by the primary current I_P is balanced by a complementary flux produced by driving a current through the secondary windings. A hall device and associated electronic circuit are used to generate the secondary (compensating) current that is an exact representation of the primary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

Closed Loop Voltage Transducers (C/L)

Features

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

Operation principle C/L



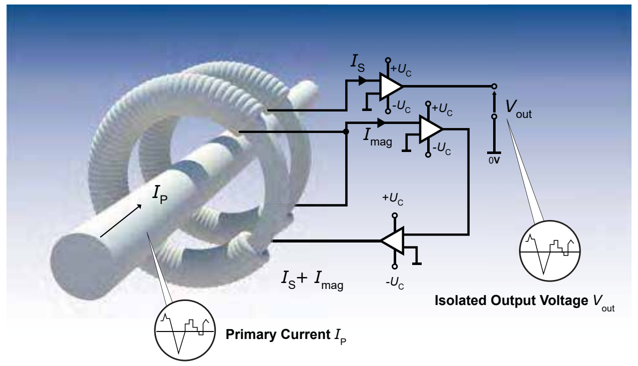
A very small current limited by a series resistor is taken from the voltage to be measured and is driven through the primary coil. The magnetic flux created by the primary current I_P is balanced by a complementary flux produced by driving a current through the secondary windings. A hall device and associated 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.

Closed Loop Fluxgate C Type

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



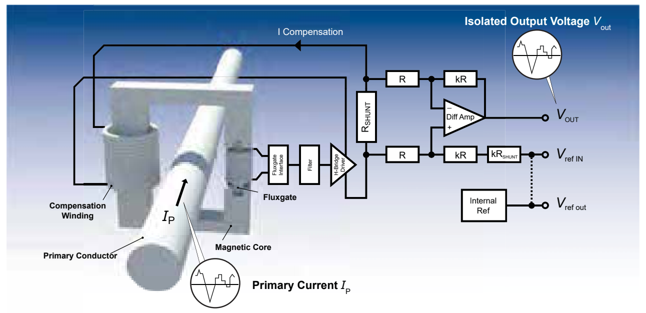
This technology uses two toroidal cores and two secondary windings and operates on a fluxgate principle of Ampere–turns compensation. For the voltage type a small (few mA) current is taken from the voltage line to be measured and is driven through the primary coil and the primary resistor.

Closed Loop Fluxgate CAS-CASR-CKSR type

Features

- Any kind of AC, DC, pulsed and complex signal
- High accuracy
- High accuracy in temperature
- Very low drift in temperature (gain and offset)
- Galvanic isolation
- Fast response time

Operation principle



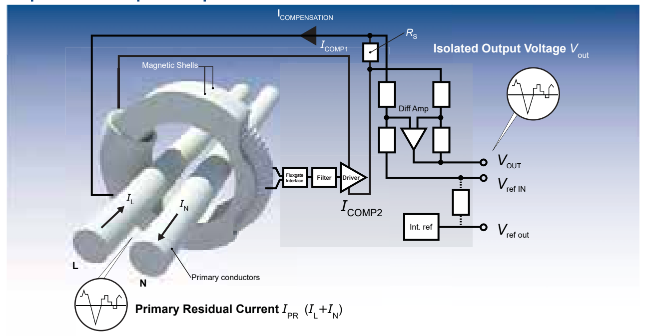
The operating principle is that of a current transformer, equipped with a magnetic sensing element, which senses the flux density in the core. The output of the field sensing element is used as the error signal in a control loop driving a compensating current through the secondary winding of the transformer. At low frequencies, the control loop maintains the flux through the core near zero. As the frequency rises, an increasingly large fraction of the compensating current is due to the operation in transformer mode. The secondary current is therefore the image of the primary current. In a voltage output transducer, the compensating current is converted to a voltage through a precision resistor, and made available at the output of a buffer amplifier.

Closed Loop Fluxgate CTSR type

Features

- Any kind of AC, DC, pulsed and complex signal
- Non-contact measurement of differential currents
- High accuracy for small residual currents
- Very low drift in temperature (gain and offset)
- Protection against parasitic magnetic field
- Galvanic isolation

Operation principle



No use of Hall generators. The magnetic flux created by the primary residual current I_{PR} (sum between I_L and I_N) is compensated by a secondary current. The zero–flux detector is a symmetry detector using a wound core connected to a square–wave generator. The secondary compensating current is an exact representation of the primary current.

In a voltage output transducer, the compensating current is converted to a voltage through a precision resistor, and made available at the output of a buffer amplifier.

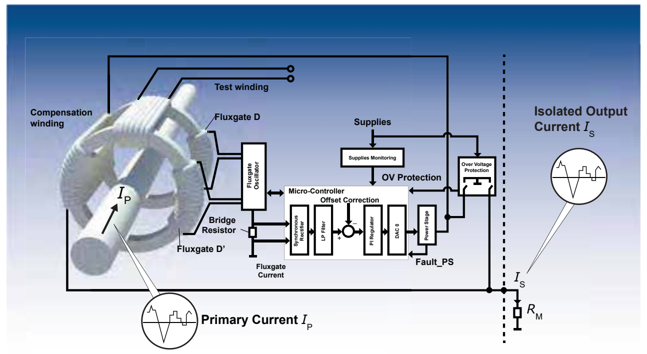
The magnetic core is actually made up of a pair of 2 magnetic shells inside which the detector is located.

Closed loop Fluxgate ITC type

Features

- Excellent linearity
- Better than Class 0.5R according to EN 50463
- Outstanding long-term stability
- Low residual noise
- Very low sensitivity to high external DC and AC fields
- High temperature stability

Operation principle



ITC current transducers are high accuracy transducers using fluxgate technology. This high sensitivity zero–flux detector uses a second wound core (D') for noise reduction. A difference between primary and secondary ampere turns creates an asymmetry in the fluxgate current.

This difference is detected by a microcontroller that controls the secondary current that compensates the primary ampere turns (I_P x N_P).

This results in a very good accuracy and a very low temperature drift.

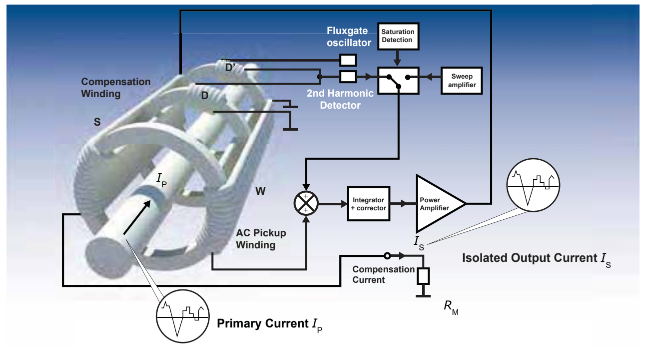
The secondary compensating current is an exact representation of the primary current.

Closed Loop Fluxgate IT type

Features

- Very high global accuracy
- Low residual noise
- Excellent linearity < 1 ppm
- Low cross-over distortion
- High temperature stability
- Wide frequency range

Operation principle



IT current transducers are high accuracy, large bandwidth transducers using fluxgate technology with no 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 to the brochure “Characteristics - Applications - Calculations” or www.lem.com

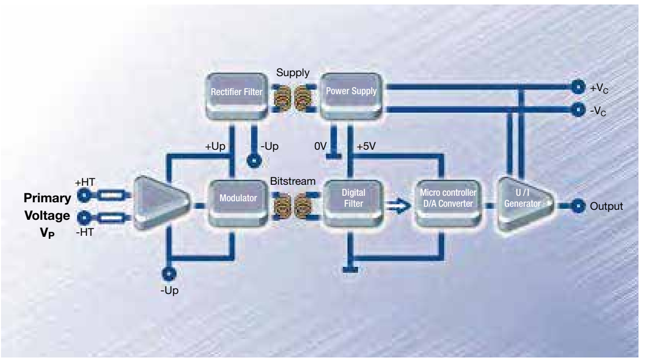
Transducer Technologies

DV & DVL Type Voltage transducers

Features

- Insulating digital technology
- Measurement of all types of signals: DC, AC, pulsed and complex
- Compact size, reduced volume
- High galvanic isolation
- Low consumption and losses
- Very high accuracy, Class 0.5R according to EN 50463 (DV Models)
- Low temperature drift

Operation principle



The measuring voltage, V_P , is applied directly to the transducer primary connections through a resistor network allowing the signal conditioning circuitry to feed a Sigma–Delta modulator that allows to transmit data via one single isolated channel.

The signal is then transmitted to the secondary over an insulating transformer ensuring the insulation between the high voltage side (primary) and the low voltage side (secondary).

The signal is reshaped on the secondary side, then decoded and filtered through a digital filter to feed a micro–controller using a Digital/Analog (D/A) converter and a voltage to current generator.

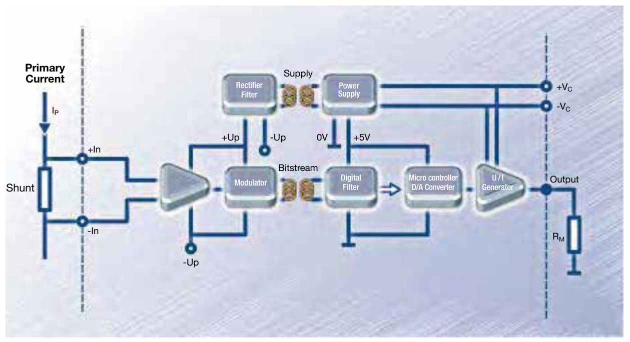
The recovered output signal is completely insulated against the primary and is an exact representation of the primary voltage.

DI Type Current transducers (Shunt isolator)

Features

- Insulating digital technology
- Measurement of all types of signals: DC, AC, pulsed and complex
- Compact size, reduced volume
- High galvanic isolation
- Low consumption and losses
- Very high accuracy, Class 1R according to EN 50463
- Low temperature drift

Operation principle



DI current transducers (Shunt isolator) must be used combined with an external Shunt.

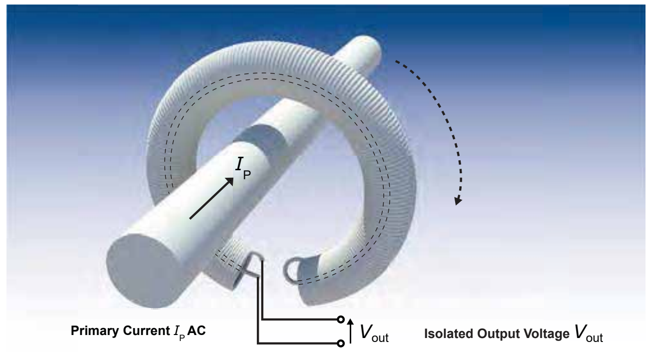
DI current transducers are working as DV voltage transducers except that the input resistor network used inside the DV is replaced by an external Shunt providing then the voltage input to feed the Sigma–Delta modulator that allows to transmit data via one single isolated channel.

Rogowski Current transducers RT type

Features

- Non-contact measurement of AC & pulsed signal
- Thin, lightweight & flexible measuring head
- Easy to use: Can be opened
- Sensitivity to external field disturbances minimized
- Wide frequency range
- Galvanic isolation

Operation principle



Rogowski technology is an Air–core technology (without magnetic circuit).

A pick–up coil is magnetically coupled with the flux created by the current to be measured I_P. A voltage V_{OUT} is induced on the pick–up coil proportional to the derivative of flux and thus proportional to the derivative of the current to be measured I_P. Because the derivative of DC is zero this technology is only useful for the measurement of AC or pulsed currents.

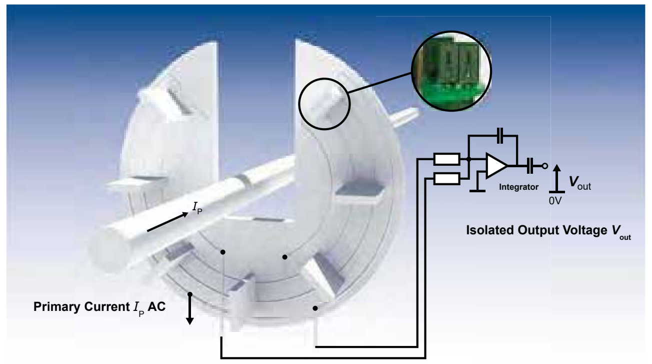
The waveform of the measured current requires the integration of the induced voltage V_{OUT}. Therefore, the current transducer may includes an integration function in the processing electronics (option).

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.

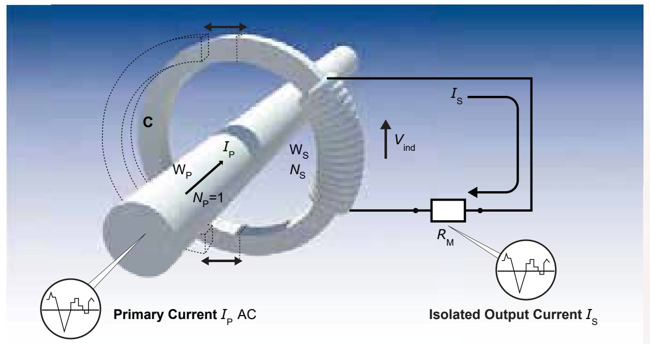
Transducer Technologies

Split Core Current transformers AT & TT type

Features

- Non-contact measurement
- AC & pulsed signal
- No power supply
- Easy to use: Can be opened
- Good overall accuracy
- Galvanic isolation

Operation principle



A transformer is a static electrical device transferring energy by inductive coupling between the windings making part of it. It is made with a primary coil (W_P) with N_P turns and a secondary coil (W_S) with N_S turns, wound around the same magnetic core (C).

A varying current I_P in the primary winding (assimilated here to the primary conductor crossing the aperture: $N_P = 1$) creates a varying magnetic flux in the transformer's core crossing the secondary winding. This varying magnetic flux induces a varying electromotive force or voltage V_{ind} in the secondary winding. Connecting a load to the secondary winding causes a current I_S to flow. This compensating secondary current I_S is substantially proportional to the primary current I_P to be measured so that $N_P.I_P = N_S.I_S$

DC currents are not measured and not suitable because they represent a risk of magnetic saturation. The relationship here above is respected only within the bandwidth of the current transformer. Warning!: Never let the output unloaded because there is a risk of safety for users.

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

I_{PN} = 0.25 A ... 2 A

DRS / REU

Closed–loop | Fluxgate

I_{PN} (A)	I_P (A)	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
0.25	± 0.36	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-10...+70	●		●		●	1	LA 25-NP/SP14	
0.3	± 0.5	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±1.2V	DC-3.5 (-1dB)	1	-40...+105		●	●		●	2	CTSR 0.3-P 5)	
0.3	± 0.85	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±0.7428V	DC-9.5 (-1dB)	0.7	-40...+105		●	●		●	3	CTSR 0.3-P/SP1 5)	
0.3	± 0.5	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±1.2V	DC-3.5 (-1dB)	1	-40...+105		●	●		●	4	CTSR 0.3-P/SP10 5)	TW
0.3	± 0.85	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±0.7428V	DC-9.5 (-1dB)	0.7	-40...+105		●	●		●	5	CTSR 0.3-P/SP11 5)	TW
0.3	± 0.5	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±1.2V	DC-3.5 (-1dB)	1	-40...+105	●		●		●	6	CTSR 0.3-TP/SP4 5)	
0.3	± 0.5	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±1.2V	DC-3.5 (-1dB)	1	-40...+105	●		●		●	7	CTSR 0.3-TP/SP14 5)	TW
0.5	± 0.72	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-40...+70	●		●		●	1	LA 25-NP/SP13	
0.6	± 0.85	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±1.4856V	DC-9.5 (-1dB)	0.7	-40...+105		●	●		●	2	CTSR 0.6-P 5)	
0.6	± 0.85	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±1.4856V	DC-9.5 (-1dB)	0.7	-40...+105		●	●		●	4	CTSR 0.6-P/SP10 5)	TW
0.6	± 0.85	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±1.4856V	DC-9.5 (-1dB)	0.7	-40...+105	●		●		●	6	CTSR 0.6-TP/SP2 5)	
0.6	± 0.85	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±1.4856V	DC-9.5 (-1dB)	0.7	-40...+105	●		●		●	7	CTSR 0.6-TP/SP12 5)	TW
1	± 1.5	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	0...+70	●		●		●	1	LA 25-NP/SP11	
1	± 1.7	Fluxgate CTSR	+ 5/0	2.5V or V_{ref} ±1.2V	DC-9.5 (-1dB)	1	-40...+105		●	●		●	2	CTSR 1-P 5)	
1.5	± 2.2	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	0...+70	●		●		●	1	LA 25-NP/SP9	
1.5	± 5	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 6-NP 5)	
2	± 3	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	0...+70	●		●		●	1	LA 25-NP/SP8	
2	± 6.4	C/L	+ 5/0	2.5 V ± 0.625 V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	9	LTS 6-NP	
2	± 6.4	C/L	+ 5/0	2.5V or V_{ref} ± 0.625V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	10	LTSR 6-NP 5)	

Notes:
1) Small signal bandwidth to avoid excessive core heating at high frequency
5) Ref_{IN} & Ref_{out} modes

I_{PN} = 2 A ... 5 A

DRS / REU

Open–loop | Closed–loop | Fluxgate

I_{PN} (A)	I_P (A)	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
2	± 6.67	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 6-NP	
2	± 6.67	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 6-NP 5)	
2.5	± 3.6	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	0...+70	●		●		●	1	LA 25-NP/SP7	
2.67	± 6.67	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 8-NP-0000 5)	
2.67	± 6.67	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 8-NSM-0000 5)	
2.67	± 6.67	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 8-NP/ SP33-1000 5)	
2.67	± 6.67	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 8-NSM/ SP33-1000 5)	
3	± 9	O/L	± 12...15	4 V	DC-50 (-3dB) 1)	2.4	-25...+85	●		●		●	15	HXN 03-P	
2 x 3	2 x ± 9	O/L	± 15	2 x 4 V	DC-50 (+/-3dB) 1)	3.75	-40...+85	●		●			16	HXD 03-P	DM
3	± 9.6	C/L	+ 5/0	2.5 V±0.625 V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	9	LTS 6-NP	
3	± 9.6	C/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	10	LTSR 6-NP 5)	
3	± 10	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 6-NP	
3	± 10	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 6-NP 5)	
3	± 10	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 6-NP 5)	
3.75	± 12.75	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 15-NP 5)	
4	± 10	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 8-NP-0000 5)	
4	± 10	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 8-NSM-0000 5)	
4	± 10	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 8-NP/ SP33-1000 5)	
4	± 10	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 8-NSM/ SP33-1000 5)	
5	± 7	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		●	17	LA 25-NP	

TW = Test Winding
DM = Dual Measurement

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

I_{PN} = 5 A ... 7.5 A

DRS / REU

Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_C V	V_{out} / I_{out} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Primary Aperture, busbar, other	Secondary PCB	Secondary Other	UR or UL	Packaging No	Type	Features
5	± 12.5	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 15-NP-0000 [5]	
5	± 12.5	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 15-NSM-0000 [5]	
5	± 12.5	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 15-NP/ SP33-1000 [5]	
5	± 12.5	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 15-NSM/ SP33-1000 [5]	
5	± 15	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.4	-25...+85	●		●		●	15	HXN 05-P	
2 x 5	2 x ± 15	O/L	± 15	2 x 4 V	DC-50 (+/-3dB) [1]	3.75	-40...+85	●		●			16	HXD 05-P	DM
5	± 16	C/L	+ 5/0	2.5 V±0.625 V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	9	LTS 15-NP	
5	± 16	C/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	10	LTSR 15-NP [5]	
5	± 17	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 15-NP	
5	± 17	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 15-NP [5]	
6	± 9	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		●	17	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]	
6	± 20	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 6-NP	
6	± 20	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 6-NP [5]	
6	± 20	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 6-NP [5]	
6.25	± 21.25	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 25-NP [5]	
7	± 14	C/L	± 15	35 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		●	17	LA 35-NP	
7.5	± 18.75	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 15-NP-0000 [5]	
7.5	± 18.75	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 15-NSM-0000 [5]	
7.5	± 18.75	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 15-NP/ SP33-1000 [5]	
7.5	± 18.75	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 15-NSM/ SP33-1000 [5]	

8 11 12 14 13 16

I_{PN} = 7.5 A ... 8.34 A

DRS / REU

Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_C V	V_{out} / I_{out} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Primary Aperture, busbar, other	Secondary PCB	Secondary Other	UR or UL	Packaging No	Type	Features
7.5	± 24	C/L	+ 5/0	2.5 V±0.625 V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	9	LTS 15-NP	
7.5	± 24	C/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	10	LTSR 15-NP [5]	
7.5	± 25.5	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 15-NP	
7.5	± 25.5	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 15-NP [5]	
7.5	± 25.5	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 15-NP [5]	
8	± 12	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		●	17	LA 25-NP	
8	± 16	C/L	± 15	32 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		●	17	LA 35-NP	
8	± 18	C/L	± 12...15	24 mA	DC-200 (-1dB)	0.4	-25...+85	●		●		●	18	LAH 25-NP	
8	± 20	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 8-NP-0000 [5]	
8	± 20	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 8-NSM-0000 [5]	
8	± 20	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 8-NP/SP33-1000 [5]	
8	± 20	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 8-NSM/ SP33-1000 [5]	
8.33	± 16.66	C/L	+ 5/0	12.5 mA	DC-300 (-1dB)	0.7	-40...+85	●		●		●	19	LTSP 25-NP	
8.33	± 20.83	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 25-NP-0000 [5]	
8.33	± 20.83	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 25-NSM-0000 [5]	
8.33	± 20.83	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 25-NP/ SP33-1000 [5]	
8.33	± 20.83	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 25-NSM/ SP33-1000 [5]	
8.34	± 26.67	C/L	+ 5/0	2.5 V±0.625 V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	9	LTS 25-NP	
8.34	± 26.67	C/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	10	LTSR 25-NP [5]	
8.34	± 28.34	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 25-NP	
8.34	± 28.34	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 25-NP [5]	

17 9 10 19 15 18

Notes:

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

5) Ref_{IN} & Ref_{out} modes

DM = Dual Measurement

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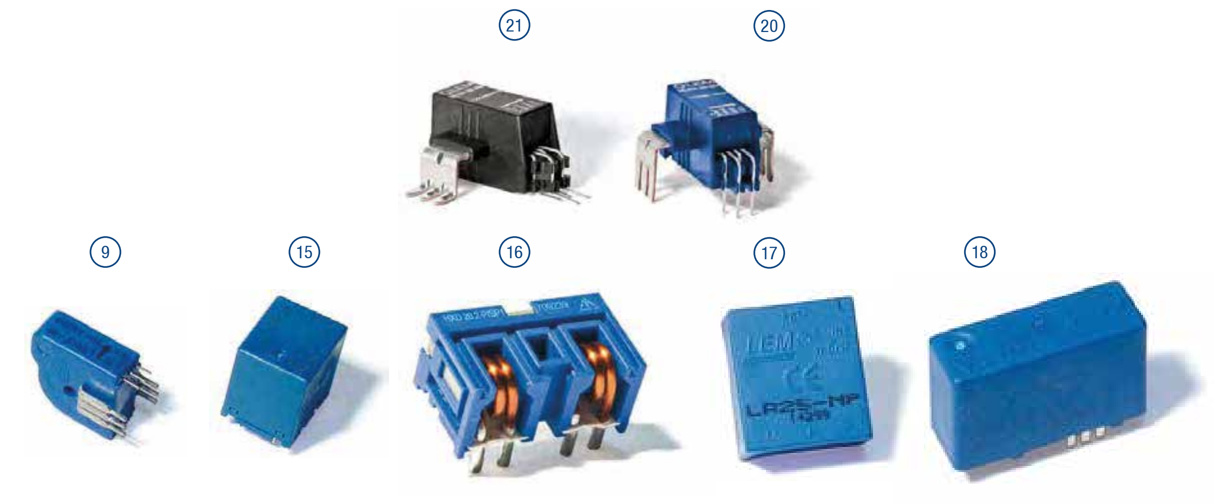
DRS / REU

I_{PN} = 10 A ... 12.5 A

DRS / REU

Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
10	± 25	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 10-P 5)	
10	± 25	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 10-SM 5)	
10	± 25	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 10-P/SP33 5)	
10	± 25	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 10-SM/ SP33 5)	
10	± 30	O/L	± 12...15	4 V	DC-50 (-3dB) 1)	2.4	-25...+85	●		●		●	15	HXN 10-P	
2 x 10	2 x ± 30	O/L	± 15	2 x 4 V	DC-50 (+/-3dB) 1)	3.75	-40...+85	●		●			16	HXD 10-P	DM
11	± 22	C/L	± 15	33 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		●	17	LA 35-NP	
12	± 18	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		●	17	LA 25-NP	
12	± 27	C/L	± 12...15	24 mA	DC-200 (-1dB)	0.4	-25...+85	●		●		●	18	LAH 25-NP	
12.5	± 25	C/L	+ 5/0	12.5 mA	DC-300 (-1dB)	0.7	-40...+85	●		●		●	19	LTSP 25-NP	
12.5	± 31.25	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 25-NP-0000 5)	
12.5	± 31.25	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 25-NSM- 0000 5)	
12.5	± 31.25	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 25-NP/ SP33-1000 5)	
12.5	± 31.25	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 25-NSM/ SP33-1000 5)	
12.5	± 37.5	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 50-NP 5)	
12.5	± 40	C/L	+ 5/0	2.5 V±0.625 V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	9	LTS 25-NP	
12.5	± 40	C/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-200 (-1dB)	0.7	-40...+85	●		●		●	10	LTSR 25-NP 5)	
12.5	± 42.5	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 25-NP	
12.5	± 42.5	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 25-NP 5)	
12.5	± 42.5	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 25-NP 5)	

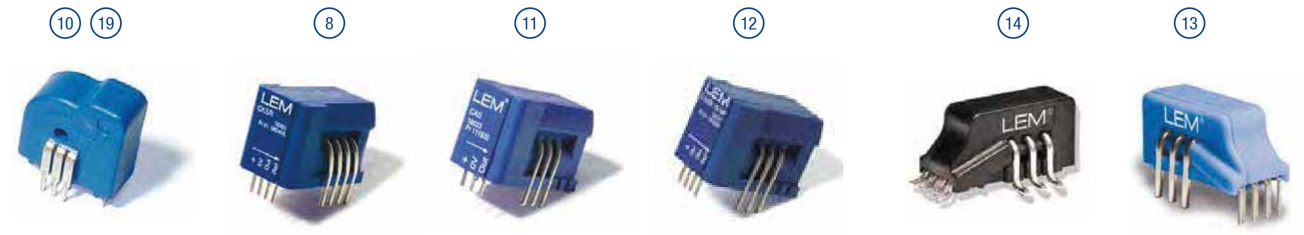


I_{PN} = 15 A ... 20 A

DRS / REU

Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
15	± 37.5	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 15-NP-0000 5)	
15	± 37.5	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 15-NSM- 0000 5)	
15	± 37.5	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 15-NP/ SP33-1000 5)	
15	± 37.5	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 15-NSM/ SP33-1000 5)	
15	± 45	O/L	± 12...15	4 V	DC-50 (-3dB) 1)	2.4	-25...+85	●		●		●	15	HXN 15-P	
2 x 15	2 x ± 45	O/L	± 15	2 x 4 V	DC-50 (+/-3dB) 1)	3.75	-40...+85	●		●			16	HXD 15-P	DM
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)	
15	± 51	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 15-NP	
15	± 51	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 15-NP 5)	
15	± 51	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 15-NP 5)	
16.67	± 50	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 50-NP	
16.67	± 50	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 50-NP 5)	
17	± 34	C/L	± 15	34 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		●	17	LA 35-NP	
20	± 50	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 20-P 5)	
20	± 50	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 20-SM 5)	
20	± 50	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 20-P/ SP33 5)	
20	± 50	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 20-SM/ SP33 5)	
20	± 60	O/L	± 12...15	4 V	DC-50 (-3dB) 1)	2.4	-25...+85	●		●		●	15	HXN 20-P	
2 x 20	2 x ± 60	O/L	± 15	2 x 4 V	DC-50 (+/-3dB) 1)	3.75	-40...+85	●		●			16	HXD 20-P	DM



Notes:
1) Small signal bandwidth to avoid excessive core heating at high frequency
5) Ref_{IN} & Ref_{out} modes

DM = Dual Measurement

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

I_{PN} = 2.67 A ... 25 A

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
2.67 ; 5 ; 8.33	± 6.67 ; ± 12.5 ; ± 20.83	O/L	+ 5/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.8V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	•		•		•	13	HO 25-NPPR [5] Orange for default setting	P
4 ; 7.5 ; 12.5	± 10 ; ± 18.75 ; ± 31.25	O/L	+ 5/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.8V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	•		•		•	13	HO 25-NPPR [5] Orange for default setting	P
8 ; 15 ; 25	± 20 ; ± 37.5 ; ± 62.5	O/L	+ 5/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.8V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	•		•		•	13	HO 25-NPPR [5] Orange for default setting	P
2.67 ; 5 ; 8.33	± 6.67 ; ± 12.5 ; ± 20.83	O/L	+ 5/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.8V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	SMD		SMD		•	14	HO 25-NSMPR [5] Orange for default setting	P
4 ; 7.5 ; 12.5	± 10 ; ± 18.75 ; ± 31.25	O/L	+ 5/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.8V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	SMD		SMD		•	14	HO 25-NSMPR [5] Orange for default setting	P
8 ; 15 ; 25	± 20 ; ± 37.5 ; ± 62.5	O/L	+ 5/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.8V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	SMD		SMD		•	14	HO 25-NSMPR [5] Orange for default setting	P
2.67 ; 5 ; 8.33	± 6.67 ; ± 12.5 ; ± 20.83	O/L	+ 3.3/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.460V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	•		•		•	13	HO 25-NPPR/SP33 [5] Orange for default setting	P
4 ; 7.5 ; 12.5	± 10 ; ± 18.75 ; ± 31.25	O/L	+ 3.3/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.460V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	•		•		•	13	HO 25-NPPR/SP33 [5] Orange for default setting	P
8 ; 15 ; 25	± 20 ; ± 37.5 ; ± 62.5	O/L	+ 3.3/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.460V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	•		•		•	13	HO 25-NPPR/SP33 [5] Orange for default setting	P
2.67 ; 5 ; 8.33	± 6.67 ; ± 12.5 ; ± 20.83	O/L	+ 3.3/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.460V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	SMD		SMD		•	14	HO 25-NSMPR/SP33 [5] Orange for default setting	P
4 ; 7.5 ; 12.5	± 10 ; ± 18.75 ; ± 31.25	O/L	+ 3.3/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.460V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	SMD		SMD		•	14	HO 25-NSMPR/SP33 [5] Orange for default setting	P
8 ; 15 ; 25	± 20 ; ± 37.5 ; ± 62.5	O/L	+ 3.3/0	2.5 ; 1.65 ; 1.5 ; 0.5 V or V_{ref} ±0.460V	DC-100 ; 250 ; 600 (-3dB)	1	-40...+105	SMD		SMD		•	14	HO 25-NSMPR/SP33 [5] Orange for default setting	P

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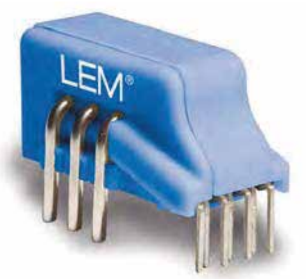


Notes:

5) Ref_{IN} & Ref_{out} modes

P = Programmable by the user at any time for the current range (between 3 ranges) ; The internal reference (between 4 references) ; The response time (between 3 response times) ; Lower comsumption mode ; Overcurrent detection level ; Device faulty indication mode ; Standby mode.

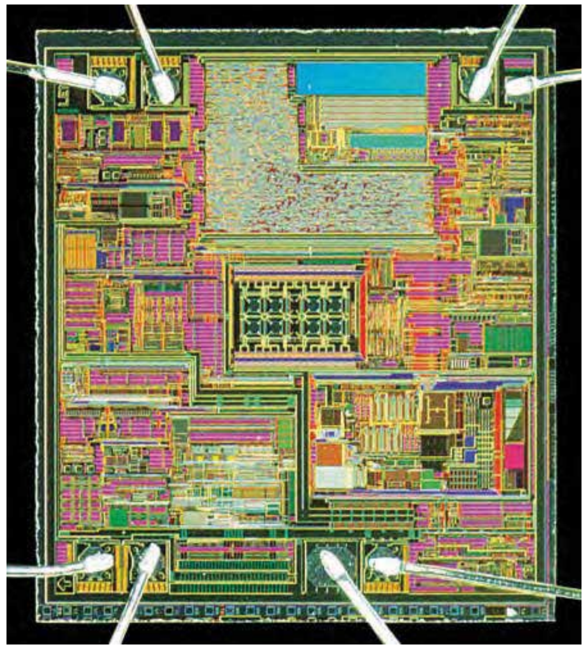
Dedicated data sheets are the only recognized reference documents for the given performances and data – Data sheets: www.lem.com

HO SERIES

Current Transducers with Advanced ASIC Technology Integrating Intelligent and Interactive Functions

Any logistics manager will appreciate the value of a single stock item that covers two or more part numbers: in the case of a current transducer, having one type that can cover several current ranges, offer various response times, and provide several choices for the internal reference voltage, all configurable by the engineering team. Achieving that flexibility has been the key motivation for LEM engineers while optimizing the cost and reducing the size, together with improving performance.

Special effort has been focused on a new Application Specific Integrated Circuit (ASIC) to help achieve these goals, resulting in a new generation of ASIC specific current transducers based on the Open Loop Hall effect technology leading to the development of the HO series.

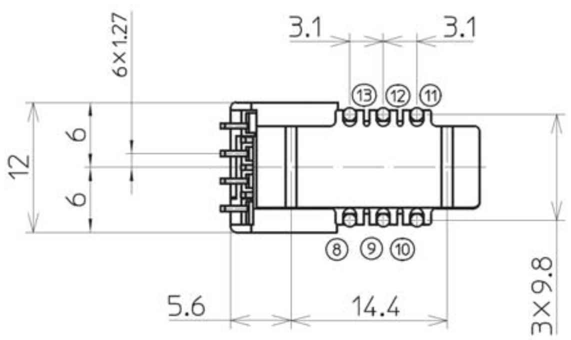


New ASIC die, a complete Open Loop Hall effect current transducer on a single chip.

With this ASIC at its heart, the HO models are designed for current measurements from 2.67 A_{RMS} to 25 A_{RMS} nominal, with nine possible current ranges selectable either by digital programmability or by multi-range PCB configuration.

Possible nominal ranges of HO 25-NPPR/-NSMPR with the various primary bus bar configurations

Number of primary turns	Primary current Range 1 I_{PN} = 8 A	Primary current Range 2 I_{PN} = 15 A	Primary current Range 3 I_{PN} = 25 A
1	8 A	15 A	25 A
2	4 A	7.5 A	12.5 A
3	2.67 A	5 A	8.33 A



Number of primary turns	Recommended connections
1	13 12 11 OUT IN 8 9 10
2	13 12 11 OUT IN 8 9 10
3	13 12 11 OUT IN 8 9 10

Recommended PCB Connection

HO SERIES

HO's main benefits include the following

- Three programmable current ranges: 8 A_{RMS}, 15 A_{RMS}, 25 A_{RMS} (25 A_{RMS} set by default)
- A broad range of programmable functions including Low power mode, Standby mode, and EEPROM control (fault reporting)
- Single + 3.3 V or + 5 V power supply (in two different HO versions)
- Offset and gain drifts two times better than the previous generation
- Programmable over-current detection (OCD) function provided on a dedicated pin, to be set by the user over 16 programmable levels up to 5.8 x I_{PN} (the nominal primary current). The OCD output turns on within 2 µs when programmed over-current occurs, switching from a high (5 V) to a low level (0 V). The over-current threshold is detected with 10 % accuracy; the user can set a minimum duration of the OCD output pulse of 1 ms if required, to ensure that a short overload can still be detected by an external micro-controller
- Programmable slow or quick response time (2 to 6 µs) by choosing specific output filters
- Four programmable internal reference voltages: 2.5, 1.65, 1.5 or 0.5 V (with + 5 V power supply), available on a dedicated pin
- Possible use of an external voltage reference from 0.5 to 2.65 V (with + 5 V power supply)
- Measuring range up to 2.5 x I_{PN}
- -40 to +105 °C operating temperature range.
- High accuracy at +25 °C: 1% of I_{PN} and at +85 °C: 2.9% of I_{PN}
- Creepage & clearance distances: 8 mm + Comparative Tracking Index 600 V
- Small device outline: 12 (W) x 23 (L) x 12 (H)mm
- Through-hole and SMT packages

Key parameters of HO 25-NPPR/-NSMPR models

Programmable Rating I_{PN} (A_{RMS})	8 or 15 or 25	Accuracy @ +25 °C (% of I_{PN})	1
Measuring range I_{PM} (A)	+/- 2.5 x I_{PN}	Accuracy @ +105 °C (% of I_{PN})	3.8
Linearity (% of I_{PN})	0.5	Programmable internal Reference $V_{Ref\ OUT}$ (V)	0.5 / 1.5 / 1.65 / 2.5
Supply Voltage (VDC)	+ 3.3 or + 5 +/-10 %	Frequency Bandwidth (kHz) (3 dB)	DC..100 to 600
Analog Voltage Output (V) @ I_{PN}	0.8	Offset drift (mV/K)	+/-0.095
Programmable Response time @ 90 % of I_{PN} tr (us)	2 - 3.5 - 6	Gain drift (ppm/K)	+/- 220

Users program the HO transducer through a connection to a host microcontroller: when the V_{Ref} pin is forced to the supply voltage, the output pin becomes the I/O port of a single wire bus interface. Over this interface, serial data comprising a 12-bit word conveys the user's configuration choices, such as, amongst others: range selection, the internal refe rence voltage, and the over-current detection threshold. Data is sent over this interface to the transducer at 10 kbits/s, and programming takes only a few hundred milliseconds. This programming procedure may be carried out at any time, so the operating parameters of the HO transducer may be re-assigned, even during operation of the device in its application.

For users who require transducers already programmed to a single set of operating parameters, LEM can also offer models with performance and function already set at the factory.

HO SERIES

HO name and codification

HO 15-NP/SPXXX-1)2)3)4)
HO 15-NP-1)2)3)4)

as example

The 1)2)3)4) digits indicate the individual transducer programming options.

1) Reference out:
- 2.5 V → Code: 0
- 1.65 V → Code: 1
- 1.5 V → Code: 2
- 0.5 V → Code: 3
- Only $V_{ref\ IN}$ → Code: 4 (Low power mode engaged)

2) Response time:
- 3.5 µs → Code: 0
- 2 µs → Code: 1
- 6 µs → Code: 2

3) Control EEPROM:
- YES → Code: 0
- NO → Code: 1

4) Over-current detection (value x I_{PN}):

SET_THRESH = 0
- 2.9 → Code: 0
- 3.6 → Code: 1
- 4.0 → Code: 2
- 4.8 → Code: 3
- 5.2 → Code: 4
- 5.8 → Code: 5
- 1.7 → Code: 6
- 2.3 → Code: 7

SET_THRESH = 1
- 0.67 → Code: A
- 0.94 → Code: B
- 1.17 → Code: C
- 1.4 → Code: D
- 1.6 → Code: E
- 1.9 → Code: F
- 2.1 → Code: G
- 2.3 → Code: H

HO 15-NP/SP33-1)2)3)4) → + 3.3 V power supply
HO 15-NP-1)2)3)4) → + 5 V power supply

As an example:
HO 25-NP-0000: performances and functions are set as follows:
- First digit = 0 → Reference out = 2.5 V
- Second digit = 0 → Response time = 3.5 µs
- Third digit = 0 → Control EEPROM = YES
- Fourth digit = 0 → Overcurrent detection = 2.9 x I_{PN}

DRS / REU

I_{PN} = 25 A ... 40 A

DRS / REU

Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
25	± 36	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		●	17	LA 25-NP	
25	± 36	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		●	22	LA 25-NP/SP25	LP
25	± 50	C/L	+ 5/0	12.5 mA	DC-300 (-1dB)	0.7	-40...+85	●		●		●	19	LTSP 25-NP	
25	± 55	C/L	± 12…15	25 mA	DC-200 (-1dB)	0.4	-25...+85	●		●		●	18	LAH 25-NP	
25	± 62.5	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 25-NP-0000 [5]	
25	± 62.5	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 25-NSM-0000 [5]	
25	± 62.5	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	●		●		●	13	HO 25-NP/SP33-1000 [5]	
25	± 62.5	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-250 (-3dB)	1	-40...+105	SMD		SMD		●	14	HO 25-NSM/SP33-1000 [5]	
25	± 75	O/L	± 12…15	4 V	DC-50 (-3dB) [1]	2.4	-25...+85	●		●		●	15	HXN 25-P	
2 x 25	2 x ± 75	O/L	± 15	2 x 4 V	DC-50 (+/-3dB) [1]	3.75	-40...+85	●		●			16	HXD 25-P	DM
3 x 25	3 x ± 75	O/L	± 12…15	3 x 4 V	DC-10 (-3dB) [1]	4.85	-10...+75		●	●		●	23	HTT 25-P	TM
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]	
25	± 85	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 25-NP	

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10 19

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17 22

18

Notes:
1) Small signal bandwidth to avoid excessive core heating at high frequency
5) Ref_{IN} & Ref_{out} modes

I_{PN} = 25 A ... 40 A

DRS / REU

Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
25	± 85	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 25-NP [5]	
25	± 85	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 25-NP [5]	
25	± 75	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 50-NP	
25	± 75	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 50-NP [5]	
25	± 75	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 50-NP [5]	
32	± 80	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 32-P [5]	
32	± 80	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 32-SM [5]	
32	± 80	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 32-P/SP33 [5]	
32	± 80	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 32-SM/SP33 [5]	
35	± 70	C/L	± 15	35 mA	DC-150 (-1dB)	0.5	-25...+70	●		●		●	17	LA 35-NP	
40	± 100	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 40-P [5]	
40	± 100	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 40-SM [5]	
40	± 100	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 40-P/SP33 [5]	
40	± 100	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 40-SM/SP33 [5]	

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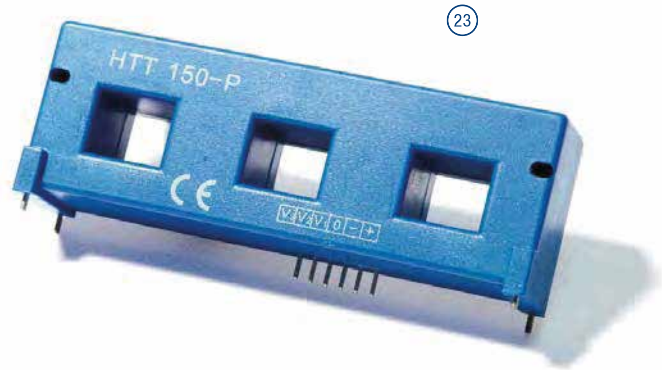


LP = Longer Pins
DM = Dual Measurement
TM = Triplet Measurement

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

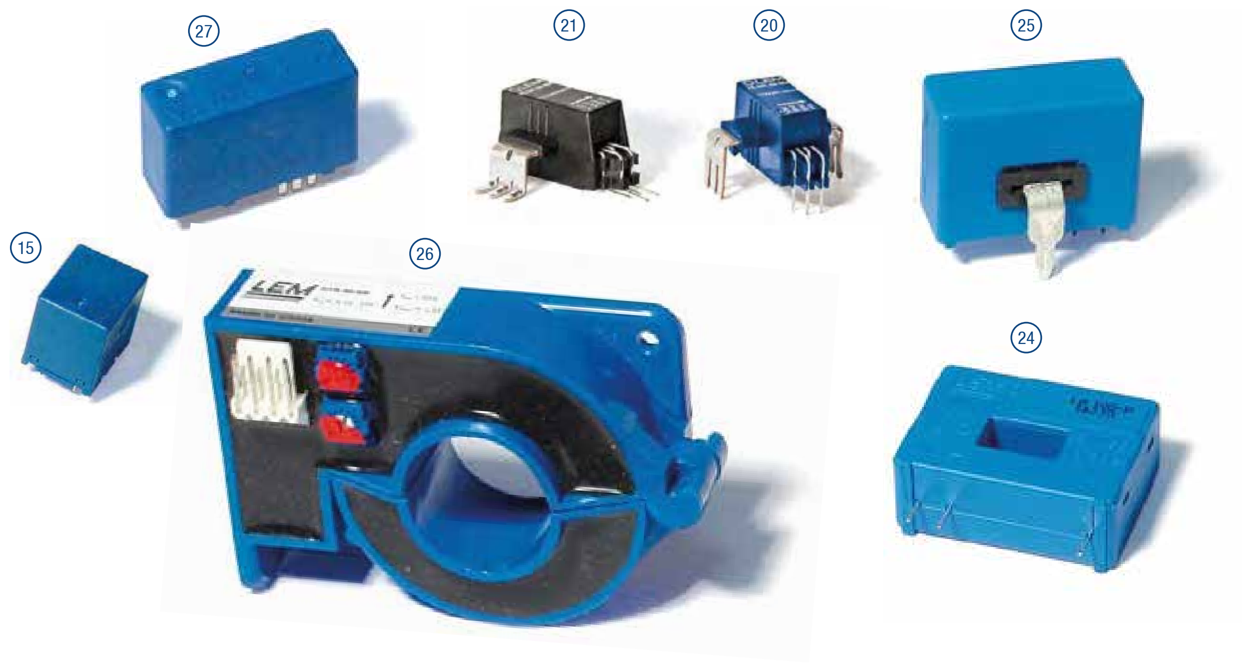
DRS / REU

I_{PN} = 50 A ... 88 A

DRS / REU

Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_C V	V_{out} I_{out} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Primary Aperture, busbar, other	Secondary PCB	Secondary Other	UR or UL	Packaging No	Type	Features
50	± 70	C/L	± 12...15	50 mA	DC-200 (-1dB)	0.65 [6]	-40...+85		●	●		●	24	LA 55-P	
50	± 70	C/L	± 12...15	50 mA	DC-200 (-1dB)	0.45 [6]	-40...+85		●	●		●	24	LA 55-P/SP23	
50	± 70	C/L	± 12...15	50 mA	DC-200 (-1dB)	0.65 [6]	-40...+85	●		●		●	25	LA 55-TP	
50	± 100	C/L	± 12...15	25 mA	DC-200 (-1dB)	0.65 [6]	-40...+85		●	●		●	24	LA 55-P/SP1	
50	± 100	C/L	± 12...15	25 mA	DC-200 (-1dB)	0.65 [6]	-40...+85	●		●		●	25	LA 55-TP/SP1	
50	± 100	C/L	± 12...15	25 mA	DC-200 (-1dB)	0.65 [6]	-40...+85	●		●		●	25	LA 55-TP/SP27	
50	± 100	O/L	± 12...15	4 V	DC-10 (-1dB) [1]	3.4	-10...+70		●		●	●	26	HTR 50-SB	SC
50	± 110	C/L	± 12...15	25 mA	DC-200 (-1dB)	0.3	-25...+85	●		●		●	27	LAH 50-P	
50	± 125	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 50-P [5]	
50	± 125	O/L	+ 5/0	2.5V or V_{ref} ±0.8V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 50-SM [5]	
50	± 125	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	●		●			20	HLSR 50-P/SP33 [5]	
50	± 125	O/L	+ 3.3/0	1.65V or V_{ref} ±0.460V	DC-240 (-3dB)	1	-40...+105	SMD		SMD			21	HLSR 50-SM/SP33 [5]	
50	± 150	Fluxgate CAS	+ 5/0	2.5 V±0.625 V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	11	CAS 50-NP	



Notes:
1) Small signal bandwidth to avoid excessive core heating at high frequency
5) Ref_{IN} & Ref_{out} modes
6) Accuracy calculated with max electrical offset instead of typical electrical offset @ U_C = ± 15 V

I_{PN} = 50 A ... 88 A

DRS / REU

Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_C V	V_{out} I_{out} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Primary Aperture, busbar, other	Secondary PCB	Secondary Other	UR or UL	Packaging No	Type	Features
50	± 150	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+85	●		●		●	12	CASR 50-NP [5]	
50	± 150	Fluxgate CAS	+ 5/0	2.5V or V_{ref} ±0.625V	DC-300 (+/-3dB)	0.8	-40...+105	●		●		●	8	CKSR 50-NP [5]	
50	± 150	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.4	-25...+85	●		●		●	15	HXN 50-P	
50	± 150	O/L	± 15	4 V	DC-50 (-3dB) [1]	2	-25...+85		●		●	●	28	HAL 50-S	
50	± 150	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●		●	●	29	HAS 50-S	
50	± 150	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●	●		●	30	HAS 50-P	
50	± 150	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.75	-40...+80		●	●		●	31	HTB 50-P	
50	± 150	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.75	-40...+80	●		●		●	32	HTB 50-TP	
50	± 150	O/L	+ 12...15	U_C/2 V +/- 1.667 V	DC-50 (-3dB) [1]	1.5	-25...+85		●	●		●	33	HTB 50-P/SP5	
50	± 150	O/L	+ 12...15	U_C/2 V +/- 1.667 V	DC-50 (-3dB) [1]	1.5	-25...+85	●		●		●	34	HTB 50-TP/SP5	
50	± 150	O/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-50 (-3dB) [1]	1.4	-40...+85		●		●	●	35	HASS 50-S [5]	
3 x 50	3 x ± 150	O/L	± 12...15	3 x 4 V	DC-10 (-3dB) [1]	3.75	-10...+75		●	●		●	23	HTT 50-P	TM
3 x 75	3 x ± 225	O/L	± 12...15	3 x 4 V	DC-10 (-3dB) [1]	3.75	-10...+75		●	●		●	23	HTT 75-P	TM
3 x 88	3 x ± 240	C/L	± 15	3 x 22 mA	DC-200 (-1dB)	1	-40...+85		●		●		36	LTT 88-S	TM

SC = Split Core
TM = Triplet Measurement

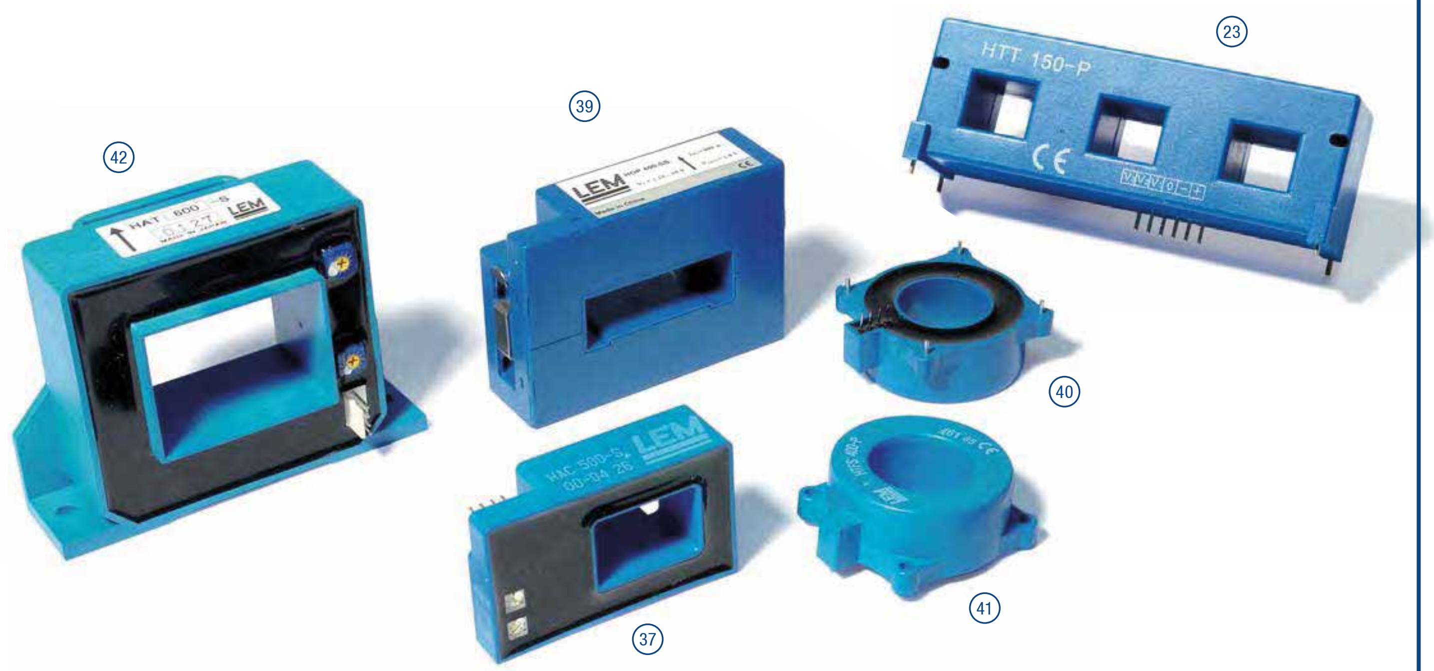
I_{PN} = 100 A ... 200 A

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
100	± 200	O/L	± 12...15	4 V	DC-10 (-1dB) [1]	3.4	-10...+70		●		●	●	26	HTR 100-SB	SC
100	± 300	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.7	-10...+80		●		●	●	37	HAC 100-S	
100	± 300	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	28	HAL 100-S	
100	± 300	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	38	HTA 100-S	
100	± 300	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●		●	●	29	HAS 100-S	
100	± 300	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●	●		●	30	HAS 100-P	
100	± 300	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.75	-40...+80		●	●		●	31	HTB 100-P	
100	± 300	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.75	-40...+80	●		●		●	32	HTB 100-TP	
100	± 300	O/L	+ 12...15	U_C/2 V +/- 1.667 V	DC-50 (-3dB) [1]	1.5	-25...+85		●	●		●	33	HTB 100-P/SP5	
100	± 300	O/L	+ 12...15	U_C/2 V +/- 1.667 V	DC-50 (-3dB) [1]	1.5	-25...+85	●		●		●	34	HTB 100-TP/SP5	
100	± 300	O/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-50 (-3dB) [1]	1.4	-40...+85		●		●	●	35	HASS 100-S [5]	
3 x 100	3 x ± 300	O/L	± 12...15	3 x 4 V	DC-10 (-3dB) [1]	2.7	-10...+75		●	●		●	23	HTT 100-P	TM
150	± 450	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.75	-40...+80		●	●		●	31	HTB 150-P	
3 x 150	3 x ± 450	O/L	± 12...15	3 x 4 V	DC-10 (-3dB) [1]	2.7	-10...+75		●	●		●	23	HTT 150-P	TM
200	± 300	O/L	± 12...15	4 V	DC-8 (-1dB) [1]	3.75	-10...+70		●		●	●	39	HOP 200-SB	SC
200	± 300	O/L	+ 5/0	U_C/2 V or V_{ref} ±1.25V	DC-50 (-3dB) [1]	1.4	-40...+105		●	●		●	41	HTFS 200-P [5]	
200	± 300	O/L	+ 5/0	U_C/2 V or V_{ref} ±1.25V	DC-50 (-3dB) [1]	1.4	-40...+105		●	●		●	40	HTFS 200-P/SP2 [5]	
200	± 400	O/L	± 12...15	4 V	DC-10 (-1dB) [1]	3.4	-10...+70		●		●	●	26	HTR 200-SB	SC
200	± 500	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.75	-40...+80		●	●		●	31	HTB 200-P	

Notes:
1) Small signal bandwidth to avoid excessive core heating at high frequency
5) Ref_{IN} & Ref_{out} modes

I_{PN} = 200 A ... 300 A

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
200	± 500	O/L	+ 12...15	U_C/2 V +/- 1.667 V	DC-50 (-3dB) [1]	1.5	-25...+85		●	●		●	33	HTB 200-P/SP5	
200	± 600	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.7	-10...+80		●		●	●	37	HAC 200-S	
200	± 600	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	28	HAL 200-S	
200	± 600	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	38	HTA 200-S	
200	± 600	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●		●	●	29	HAS 200-S	
200	± 600	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●	●		●	30	HAS 200-P	
200	± 600	O/L	± 15	4 V	DC-25 (-3dB) [1]	1.75	-40...+105		●		●	●	42	HAT 200-S	
200	± 600	O/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-50 (-3dB) [1]	1.4	-40...+85		●		●	●	35	HASS 200-S [5]	
300	± 450	O/L	± 12...15	4 V	DC-8 (-1dB) [1]	3.75	-10...+70		●		●	●	39	HOP 300-SB	SC
300	± 600	O/L	± 12...15	4 V	DC-10 (-1dB) [1]	3.4	-10...+70		●		●	●	26	HTR 300-SB	SC
300	± 600	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.75	-40...+80		●	●		●	31	HTB 300-P	
300	± 600	O/L	+ 12...15	U_C/2 V +/- 1.667 V	DC-50 (-3dB) [1]	1.5	-25...+85		●	●		●	33	HTB 300-P/SP5	
300	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.7	-10...+80		●		●	●	37	HAC 300-S	
300	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	28	HAL 300-S	
300	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	38	HTA 300-S	
300	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●		●	●	29	HAS 300-S	
300	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●	●		●	30	HAS 300-P	
300	± 900	O/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-50 (-3dB) [1]	1.4	-40...+85		●		●	●	35	HASS 300-S [5]	

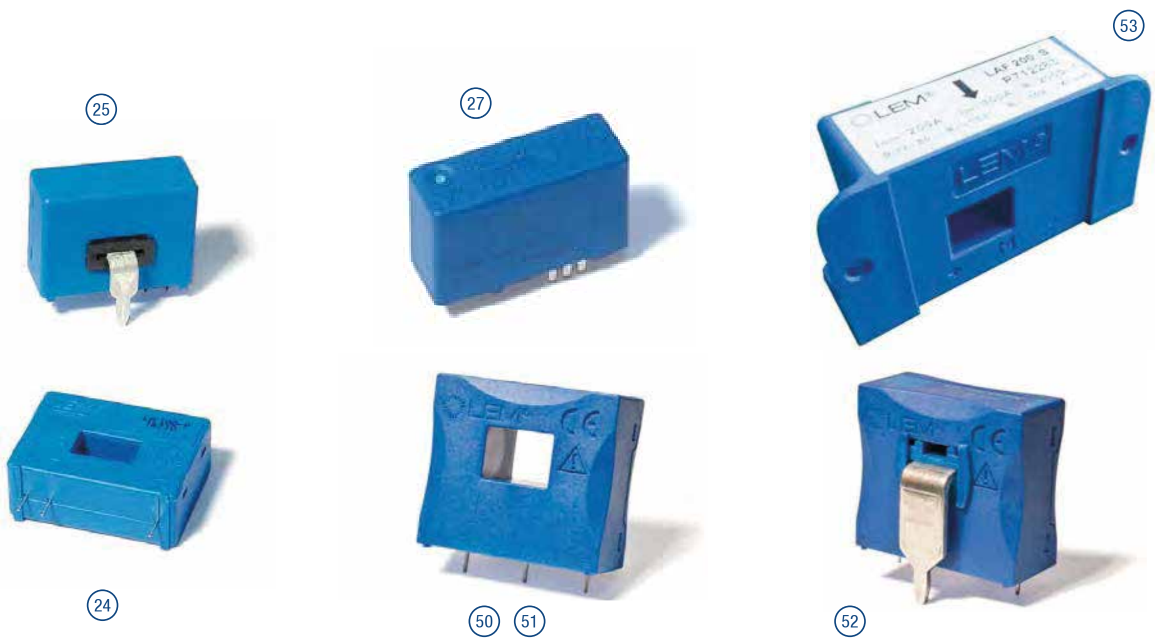


SC = Split Core
TM = Triplet Measurement
Dedicated data sheets are the only recognized reference documents for the given performances and data – Data sheets: www.lem.com

I_{PN} = 100 A ... 150 A

DRS / REU — Closed–loop

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
100	± 150	C/L	± 12...15	50 mA	DC-200 (-1dB)	0.45 [6]	-40...+85		●	●		●	24	LA 100-P	
100	± 150	C/L	± 12...15	50 mA	DC-200 (-1dB)	0.45 [6]	-40...+85	●		●		●	25	LA 100-TP	
100	± 160	C/L	± 12...15	100 mA	DC-200 (-1dB)	0.45 [6]	-25...+70		●	●		●	24	LA 100-P/ SP13	
100	± 160	C/L	± 12...15	50 mA	DC-200 (-1dB)	0.3	-25...+85	●		●		●	27	LAH 100-P	
100	± 200	C/L	± 12...15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●		●	●	43	LF 205-S/SP3	
125	± 200	C/L	± 12...15	125 mA	DC-100 (-1dB)	0.8	-40...+85		●	●		●	47	LA 125-P	
125	± 200	C/L	± 12...15	62.5 mA	DC-100 (-1dB)	0.8	-25...+85		●	●		●	47	LA 125-P/SP1	
125	± 200	C/L	± 12...15	125 mA	DC-100 (-1dB)	0.8	-25...+85		●	●		●	48	LA 125-P/SP3	PC
125	± 300	C/L	± 12...15	62.5 mA	DC-100 (-1dB)	0.8	-40...+85		●	●		●	47	LA 125-P/SP4	
125	± 200	C/L	± 12...15	125 mA	DC-100 (-3dB)	0.41	-40...+85	●		●		●	49	LAH 125-P	
130	± 200	C/L	± 12...15	130 mA	DC-150 (-1dB)	0.5	-40...+85		●	●		Pending	50	LA 130-P	
130	± 200	C/L	± 12...15	65 mA	DC-150 (-1dB)	0.5	-40...+85		●	●		Pending	50	LA 130-P/SP1	
150	± 212	C/L	± 12...15	75 mA	DC-150 (-1dB)	0.5	-40...+85		●	●		Pending	51	LA 150-P	

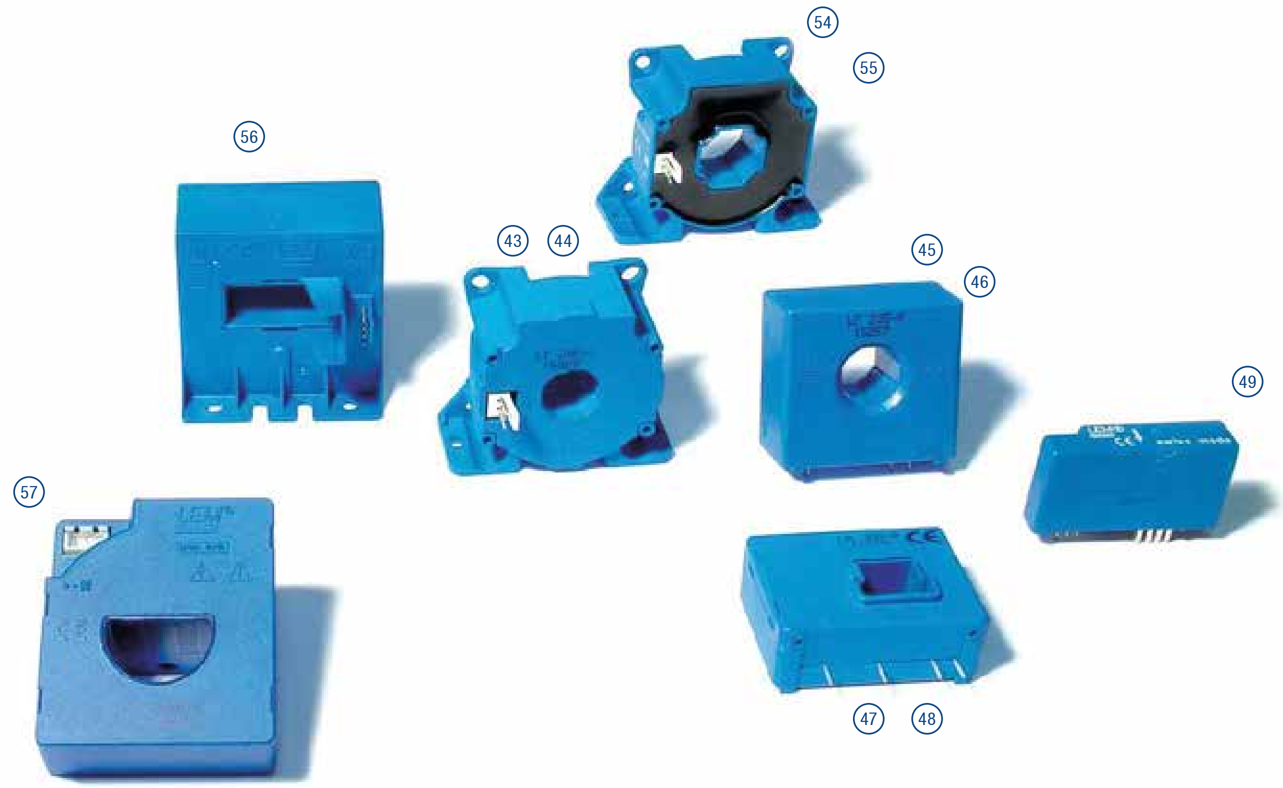


Notes:
6) Accuracy calculated with max electrical offset instead of typical electrical offset @ U_C = ± 15 V

I_{PN} = 150 A ... 366 A

DRS / REU — Closed–loop

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
150	± 212	C/L	± 12...15	150 mA	DC-150 (-1dB)	0.5	-40...+85		●	●		Pending	51	LA 150-P/SP1	
150	± 212	C/L	± 12...15	75 mA	DC-150 (-1dB)	0.5	-40...+85	●		●		Pending	52	LA 150-TP	
200	± 300	C/L	± 12...15	100 mA	DC-100 (-1dB)	0.65	-40...+85		●	●		●	47	LA 200-P	
200	± 300	C/L	± 12...15	100 mA	DC-100 (-1dB)	0.65	-25...+85		●	●		●	47	LA 200-P/SP4	
200	± 300	C/L	± 12...15	100 mA	DC-100 (-1dB)	0.45	-25...+85		●		●		53	LAF 200-S	
200	± 420	C/L	± 12...15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●		●	●	43	LF 205-S	
200	± 420	C/L	± 12...15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●	●		●	45	LF 205-P	
200	± 420	C/L	± 12...15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●		●	●	44	LF 205-S/SP1	
200	± 420	C/L	± 12...15	100 mA	DC-100 (-3dB)	0.4	-40...+85		●	●		●	46	LF 205-P/SP1	
300	± 500	C/L	± 12...20	150 mA	DC-100 (-1dB)	0.3	-40...+85		●		●	●	54	LF 305-S	
300	± 500	C/L	± 12...20	150 mA	DC-100 (-3dB)	0.3	-40...+85		●		●	●	55	LF 305-S/ SP10	
300	± 700	C/L	± 15	150 mA	DC-50 (-3dB)	0.4	-40...+85		●		●	●	56	LA 306-S	
366	± 950	C/L	± 15	183 mA	DC-100 (-1dB)	0.3	-10...+70		●		●		57	LT 305-S	



PC = Pin Compatible LT 100–P

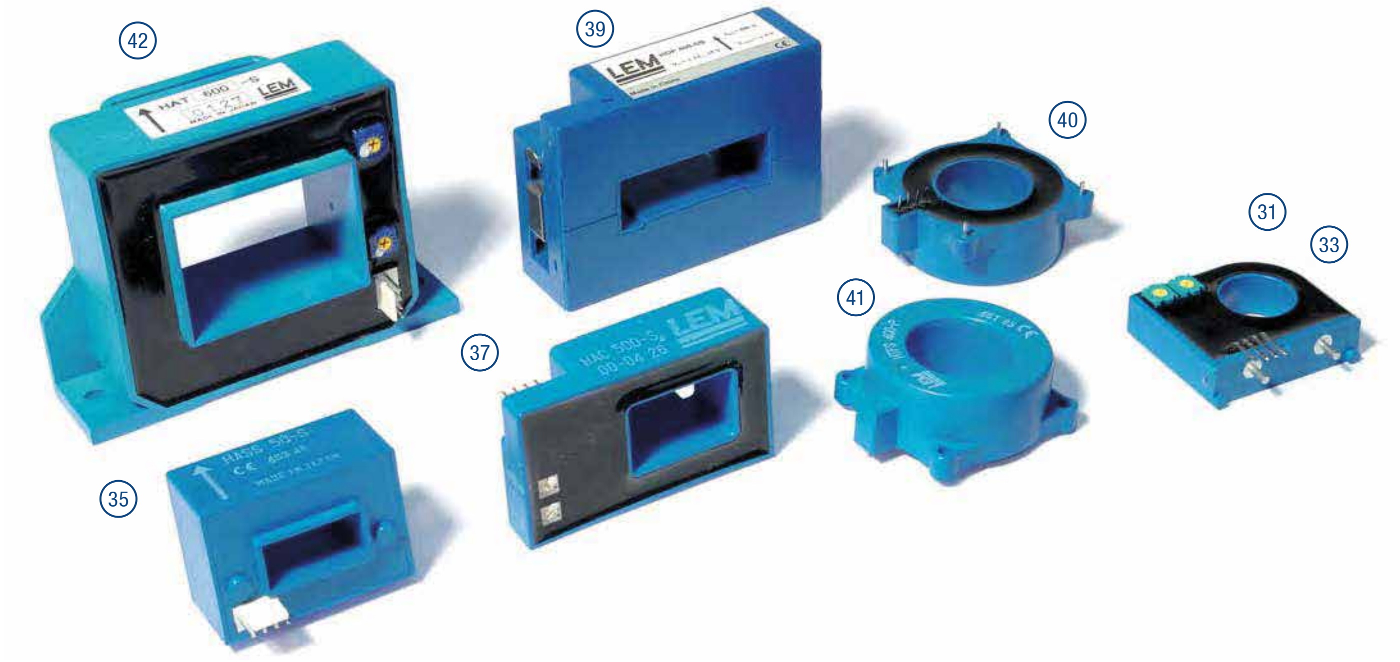
Dedicated data sheets are the only recognized reference documents for the given performances and data – Data sheets: www.lem.com

I_{PN} = 400 A ... 500 A

DRS / REU

Open–loop | Closed–loop

I_{PN} (A)	I_P (A)	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
400	± 600	O/L	± 12...15	4 V	DC-50 (-3dB) [1]	2.75	-40...+80		●	●		●	31	HTB 400-P	
400	± 600	O/L	+ 12...15	U_C/2 V +/- 1.667 V	DC-50 (-3dB) [1]	1.5	-25...+85		●	●		●	33	HTB 400-P/SP5	
400	± 600	O/L	± 12...15	4 V	DC-8 (-1dB) [1]	3.75	-10...+70		●		●	●	39	HOP 400-SB	SC
400	± 600	O/L	+ 5/0	U_C/2 V or V_{ref} ±1.25V	DC-50 (-3dB) [1]	1.4	-40...+105		●	●		●	41	HTFS 400-P [5]	
400	± 600	O/L	+ 5/0	U_C/2 V or V_{ref} ±1.25V	DC-50 (-3dB) [1]	1.4	-40...+105		●	●		●	40	HTFS 400-P/ SP2 [5]	
400	± 800	O/L	± 12...15	4 V	DC-10 (-1dB) [1]	3.4	-10...+70		●		●	●	26	HTR 400-SB	SC
400	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●		●	●	29	HAS 400-S	
400	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●	●		●	30	HAS 400-P	
400	± 900	O/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-50 (-3dB) [1]	1.4	-40...+85		●		●	●	35	HASS 400-S [5]	
400	± 1000	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	28	HAL 400-S	
400	± 1000	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	38	HTA 400-S	
400	± 1200	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.7	-10...+80		●		●	●	37	HAC 400-S	
400	± 1200	O/L	± 15	4 V	DC-25 (-3dB) [1]	1.75	-40...+105		●		●	●	42	HAT 400-S	
500	± 750	O/L	± 12...15	4 V	DC-8 (-1dB) [1]	3.75	-10...+70		●		●	●	39	HOP 500-SB	SC
500	± 800	C/L	± 15...24	100 mA	DC-100 (-1dB)	0.3	-40...+70		●		●	●	58	LF 505-S	
500	± 800	C/L	± 15...24	100 mA	DC-100 (-1dB)	0.3	-10...+70		●		●	●	59	LF 505-S/SP15	
500	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●		●	●	29	HAS 500-S	
500	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●	●		●	30	HAS 500-P	
500	± 900	O/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-50 (-3dB) [1]	1.4	-40...+85		●		●	●	35	HASS 500-S [5]	
500	± 1000	O/L	± 12...15	4 V	DC-10 (-1dB) [1]	2.5	-10...+70		●		●	●	60	HOP 500-SB/ SP1	SC



Notes:

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

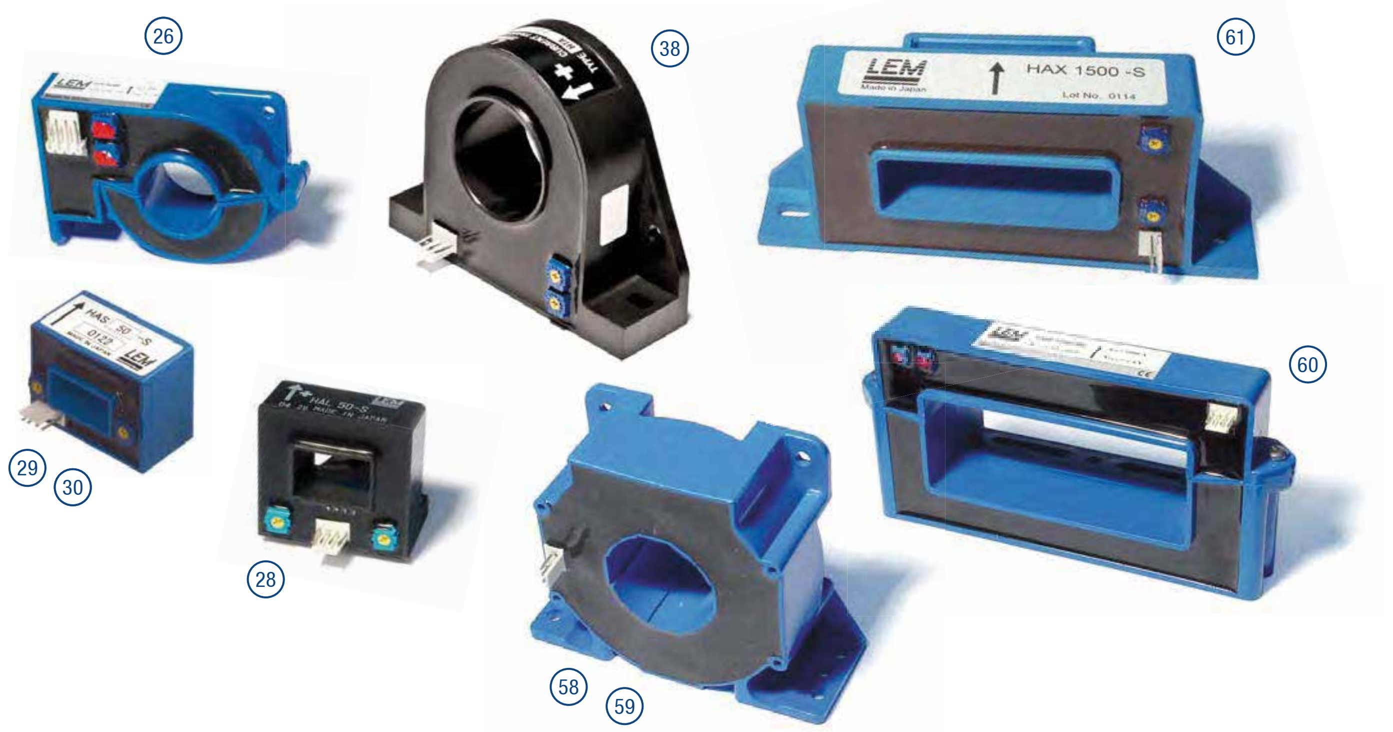
5) Ref_{IN} & Ref_{out} modes

I_{PN} = 500 A ... 800 A

DRS / REU

Open–loop

I_{PN} (A)	I_P (A)	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
500	± 1000	O/L	± 12...15	4 V	DC-10 (-1dB) [1]	3.4	-10...+70		●		●	●	26	HTR 500-SB	SC
500	± 1000	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	28	HAL 500-S	
500	± 1000	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	38	HTA 500-S	
500	± 1500	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.7	-10...+80		●		●	●	37	HAC 500-S	
500	± 1500	O/L	± 15	4 V	DC-25 (-3dB) [1]	1.75	-40...+105		●		●	●	42	HAT 500-S	
500	± 1500	O/L	± 15	4 V	DC-25 (-3dB) [1]	2.75	-25...+85		●		●	●	61	HAX 500-S	
600	± 900	O/L	± 12...15	4 V	DC-8 (-1dB) [1]	3.75	-10...+70		●		●	●	39	HOP 600-SB	SC
600	± 900	O/L	+ 5/0	U_C/2 V or V_{ref} ±1.25V	DC-50 (-3dB) [1]	1.4	-40...+105		●	●		●	41	HTFS 600-P [5]	
600	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●		●	●	29	HAS 600-S	
600	± 900	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.5	-10...+80		●	●		●	30	HAS 600-P	
600	± 900	O/L	+ 5/0	2.5V or V_{ref} ±0.625V	DC-50 (-3dB) [1]	1.4	-40...+85		●		●	●	35	HASS 600-S [5]	
600	± 1000	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	28	HAL 600-S	
600	± 1000	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	38	HTA 600-S	
600	± 1800	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.7	-10...+80		●		●	●	37	HAC 600-S	
600	± 1800	O/L	± 15	4 V	DC-25 (-3dB) [1]	1.75	-40...+105		●		●	●	42	HAT 600-S	
800	± 1200	O/L	+ 5/0	U_C/2 V or V_{ref} ±1.25V	DC-50 (-3dB) [1]	1.4	-40...+105		●	●		●	41	HTFS 800-P [5]	
800	± 1200	O/L	+ 5/0	U_C/2 V or V_{ref} ±1.25V	DC-50 (-3dB) [1]	1.4	-40...+105		●	●		●	40	HTFS 800-P/ SP2 [5]	
800	± 1600	O/L	± 12...15	4 V	DC-10 (-1dB) [1]	2.5	-10...+70		●		●	●	60	HOP 800-SB	SC
800	± 1800	O/L	± 15	4 V	DC-50 (-3dB) [1]	2.7	-10...+80		●		●	●	37	HAC 800-S	
800	± 2400	O/L	± 15	4 V	DC-25 (-3dB) [1]	1.75	-40...+105		●		●	●	42	HAT 800-S	



SC = Split Core

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

I_{PN} = 500 A_{AC} ... 2000 A_{AC}

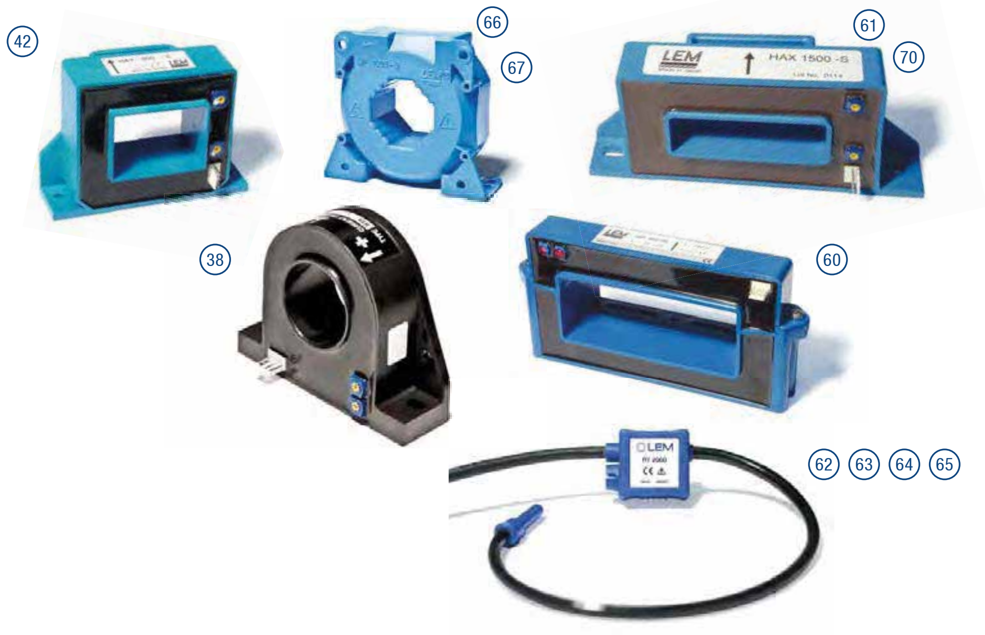
DRS / REU — Rogowski

I_{PN} (A_{AC})	Technology	U_C (V)	V_{out} I_{out} @ I_P	BW (kHz)	X @ I_P T_A = 25°C (%)	T_A (°C)	Connection Primary PCB	Connection Primary Aperture, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
500	Rogowski	Self powered	2.π.M. f.I_{PAC} V [3,4] M.dI_P/dt V [2,4]	700 (+3dB)	0.65 [4,7]	-10...+65		Split core Ø 55 mm Max		1.5 m cable	●	62	RT 500	
500	Rogowski	Self powered	2.π.M. f.I_{PAC} V [3,4] M.dI_P/dt V [2,4]	700 (+3dB)	0.80 [4,7]	-10...+65		Split core Ø 55 mm Max		3 m cable	●	63	RT 500/SP1	
2000	Rogowski	Self powered	2.π.M. f.I_{PAC} V [3,4] M.dI_P/dt V [2,4]	500 (+3dB)	0.65 [4,7]	-10...+65		Split core Ø 125 mm Max		1.5 m cable	●	64	RT 2000	
2000	Rogowski	Self powered	2.π.M. f.I_{PAC} V [3,4] M.dI_P/dt V [2,4]	430 (+3dB)	0.8 [4,7]	-10...+65		Split core Ø 125 mm Max		3 m cable	●	65	RT 2000/SP1	

I_{PN} = 1000 A ... 2000 A

Open–loop / Closed–loop

I_{PN} (A)	I_P (A)	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
1000	± 1000	O/L	± 15	4 V	DC-50 (-3dB) [1]	1.75	-25...+85		●		●	●	38	HTA 1000-S	
1000	± 1500	C/L	± 15…24	200 mA	DC-150 (-1dB)	0.3	-40...+85		●		●	●	66	LF 1005-S	
1000	± 1500	C/L	± 15…24	200 mA	DC-150 (-1dB)	0.3	-10...+85		●		●	●	67	LF 1005-S/SP22	
1000	± 2000	O/L	± 12…15	4 V	DC-10 (-1dB) [1]	2.5	-10...+70		●		●	●	60	HOP 1000-SB	SC
1000	± 2500	O/L	± 15	4 V	DC-25 (-3dB) [1]	1.75	-40...+105		●		●	●	42	HAT 1000-S	
1000	± 3000	O/L	± 15	4 V	DC-25 (-3dB) [1]	2.75	-25...+85		●		●	●	61	HAX 1000-S	
1200	± 2500	O/L	± 15	4 V	DC-25 (-3dB) [1]	1.75	-40...+105		●		●	●	42	HAT 1200-S	
1500	± 2500	O/L	± 15	4 V	DC-25 (-3dB) [1]	1.75	-40...+105		●		●	●	42	HAT 1500-S	
1500	± 3000	O/L	± 12…15	4 V	DC-10 (-1dB) [1]	2.5	-10...+70		●		●	●	60	HOP 1500-SB	SC
1500	± 4500	O/L	± 15	4 V	DC-25 (-3dB) [1]	2.75	-25...+85		●		●	●	61	HAX 1500-S	
2000	± 3000	O/L	± 12…15	4 V	DC-10 (-1dB) [1]	2.5	-10...+70		●		●	●	60	HOP 2000-SB	SC
2000	± 3000	O/L	± 12…15	4 V	DC-4 (-1dB) [1]	2.5	-10...+70		●		●	●	68	HOP 2000-SB/SP1	SC
2000	± 3000	C/L	± 15…24	400 mA	DC-100 (-1dB)	0.2	-40...+85		●		●	●	69	LF 2005-S	



Notes:
1) Small signal bandwidth to avoid excessive core heating at high frequency
2) Instantaneous
3) For sinusoidal wave (f in Hz)
4) M= Transfer ratio 0.064 µH (+/– 5%): RT models are provided with up to 5 % manufacturing tolerance
7) Max positioning error
8) 40 A_{RMS}
9) X_G = Global accuracy

I_{PN} = 2000 A ... 20000 A

DRS / REU — Open–loop / Closed–loop / Fluxgate

I_{PN} (A)	I_P (A)	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
2000	± 5500	O/L	± 15	4 V	DC-25 (-3dB) [1]	2.75	-25...+85		●		●	●	61	HAX 2000-S	
2000	± 5500	O/L	± 15	4 V	DC- 25(-1dB) [1]	2.75	-10...+80		●		●		70	HAXC 2000-S	
2500	± 5500	O/L	± 15	4 V	DC-25 (-3dB) [1]	2.75	-25...+85		●		●	●	61	HAX 2500-S	
4000	± 4000	O/L	± 15	10 V	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 4000-SB	
4000	± 4000	O/L	± 15	20 mA	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 4000-SBI	
4000	± 4000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 4000-SBI/ SP1	
4000	± 6000	C/L	± 24	800 mA	DC-100 (-1dB)	0.3	-25...+70		●		●		72	LT 4000-S	
4000	± 6000	C/L	± 24	800 mA	DC-100 (-1dB)	0.3	-25...+70		●		●		73	LT 4000-T	
4000	± 12000	Fluxgate IT	± 24	1600 mA	DC- 50(1dB) [8]	0.06 [9]	-40...+70		●		●		74	ITL 4000-S	
6000	± 6000	O/L	± 15	10 V	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 6000-SB	
6000	± 6000	O/L	± 15	20 mA	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 6000-SBI	
6000	± 6000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 6000-SBI/ SP1	
10000	± 10000	O/L	± 15	10 V	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 10000-SB	
10000	± 10000	O/L	± 15	20 mA	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 10000-SBI	
10000	± 10000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 10000-SBI/ SP1	
10000	± 15000	C/L	± 48…60	1 A	DC-100 (-1dB)	0.3	-25...+70		●		●		75	LT 10000-S	
12000	± 12000	O/L	± 15	10 V	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 12000-SB	
12000	± 12000	O/L	± 15	20 mA	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 12000-SBI	
12000	± 12000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 12000-SBI/ SP1	
14000	± 14000	O/L	± 15	10 V	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 14000-SB	
14000	± 14000	O/L	± 15	20 mA	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 14000-SBI	
14000	± 14000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 14000-SBI/ SP1	
20000	± 20000	O/L	± 15	10 V	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 20000-SB	
20000	± 20000	O/L	± 15	20 mA	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 20000-SBI	
20000	± 20000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (-3dB) [1]	2	-25...+85		●		●		71	HAZ 20000-SBI/ SP1	

SC = Split Core

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

DRS / REU

DRS / REU

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 10 A, 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.

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.

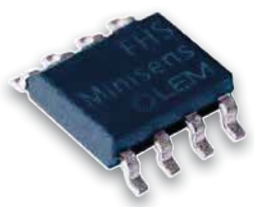
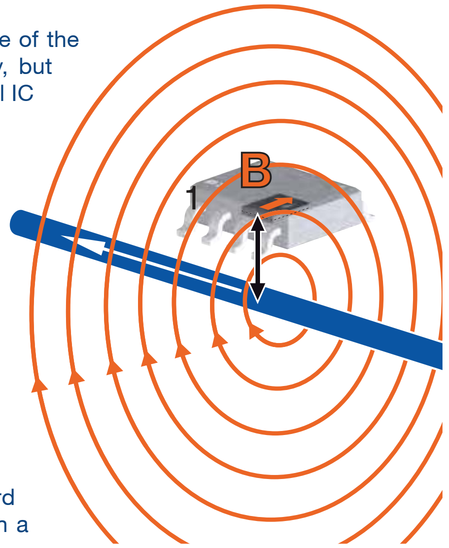


Fig. 1: Minisens - FHS model

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).

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 20 A 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.

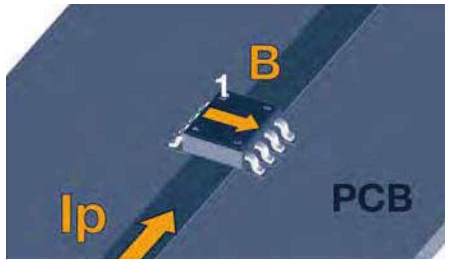


Fig. 2: One possible PCB design; The track is located underneath the Minisens

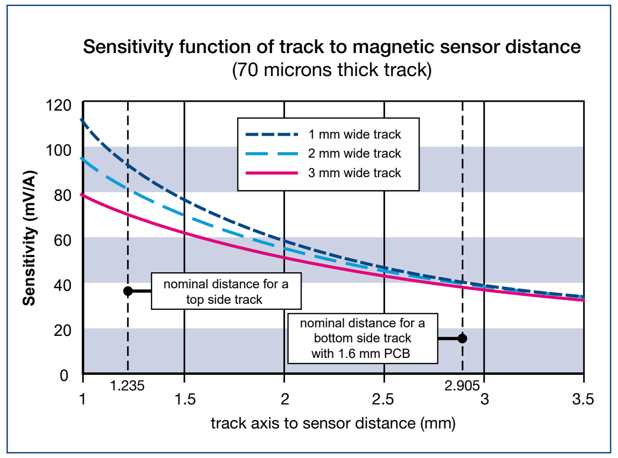
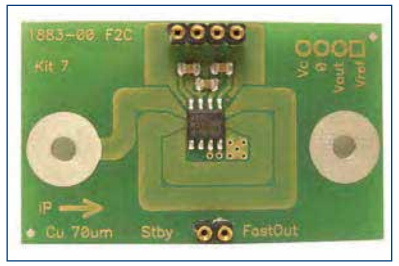
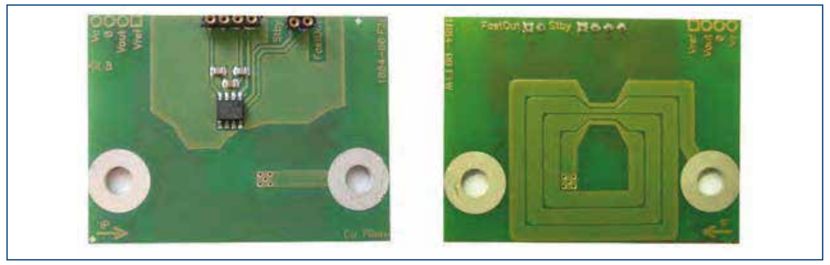


Fig. 3: Sensitivity (mV/A) versus track width and distance between the track and the sensing elements.

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.

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.





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

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.

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

DRS / REU

Current Transducers - Minisens

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 %

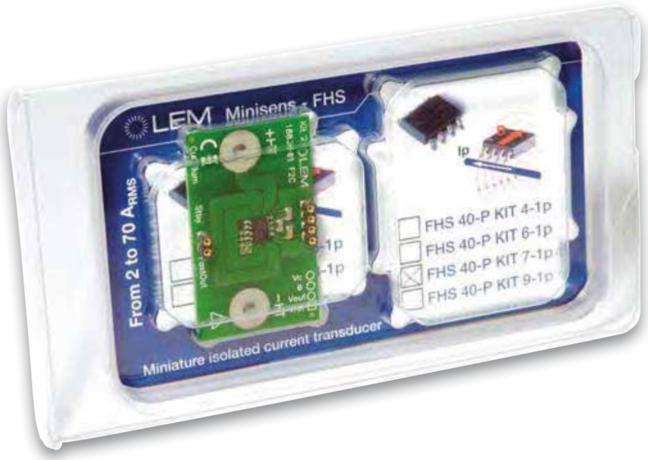
These mechanical parameters must be closely controlled in the production process. Alternatively, in-circuit calibration of the Minisens or the DSP can be used to avoid most of these errors.

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.

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).

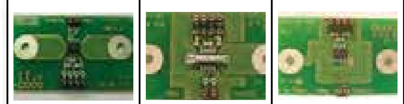
Two typical examples will show the advantages offered by Minisens in today's applications:



Washing Machines:

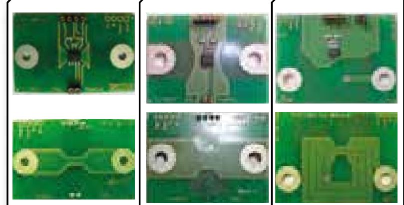
Designers of modern washing machines are looking for more accurate control of the electric motor, to save energy by improving the efficiency of the system and protect the environment by adjusting washing time and water usage. They are also aiming to improve the performance of the machine, in terms of 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. 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

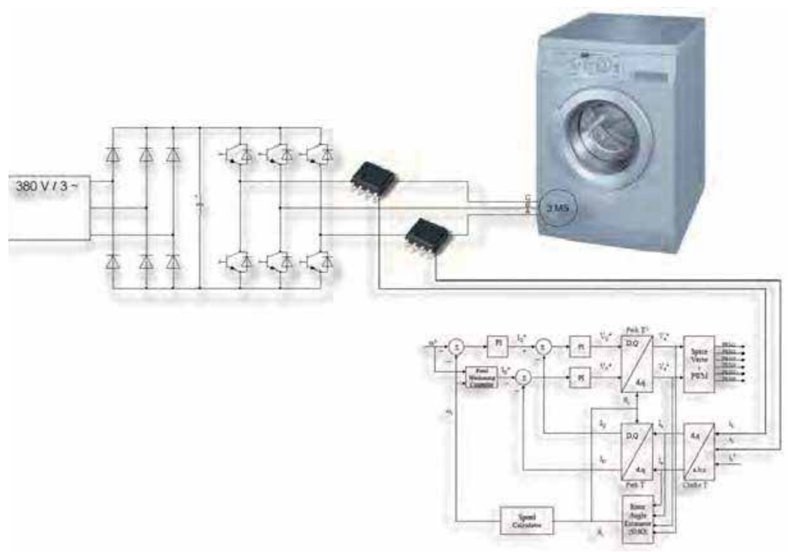


Fig. 8: Motor control in washing machines

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).

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.

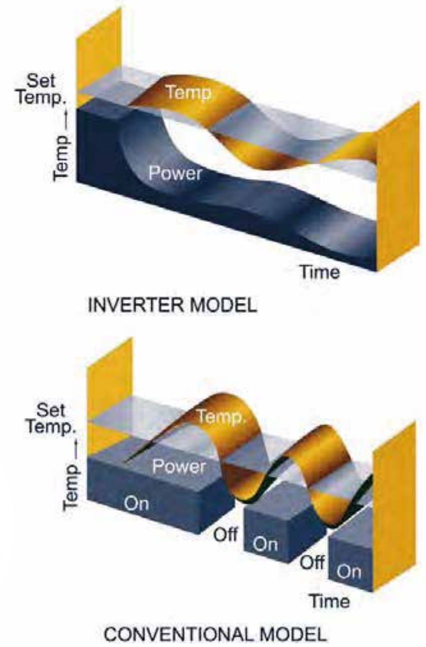
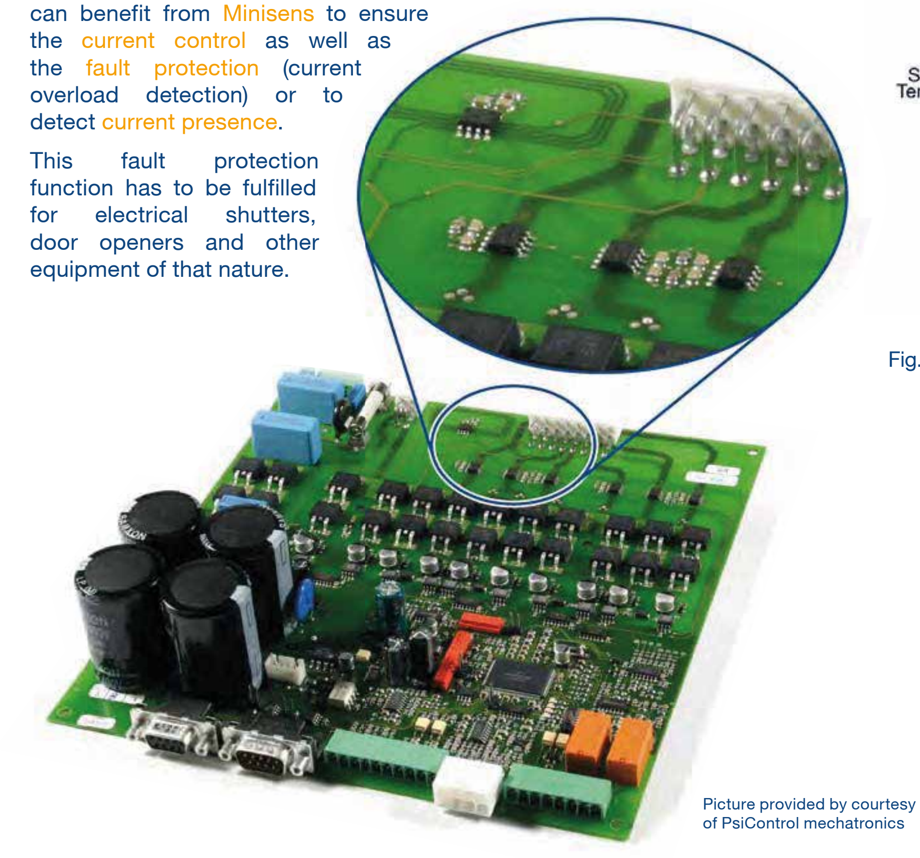


Fig. 9: Inverter control vs. conventional control

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.



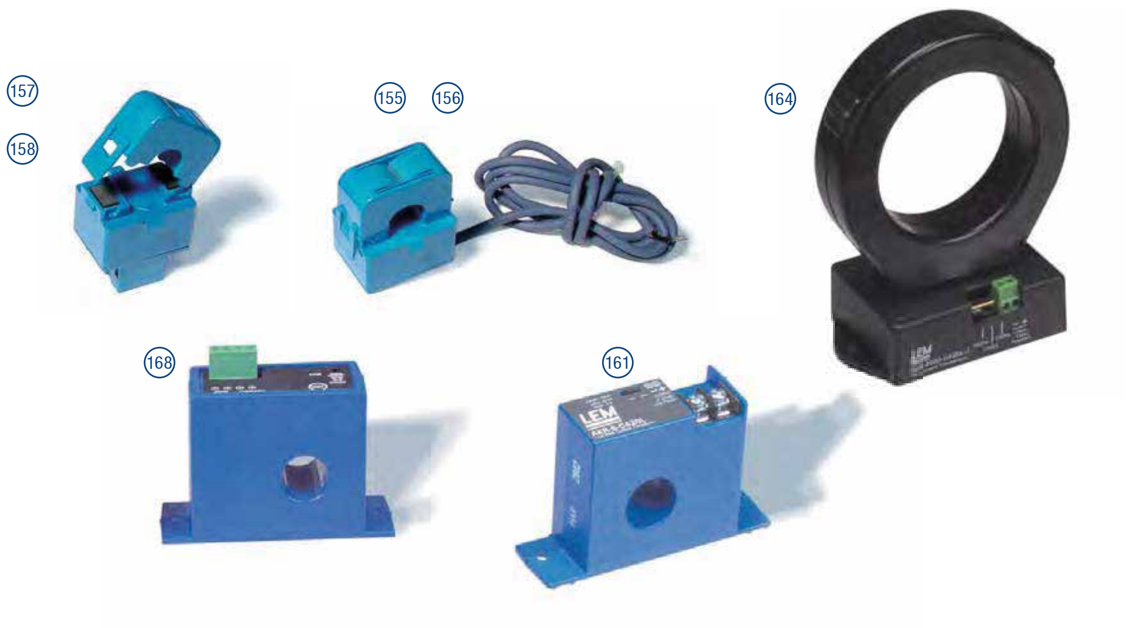
Picture provided by courtesy of PsiControl mechatronics

DRS / REU

I_{PN} = 2 A ... 2000 A

DRS / REU CT PRIME

Signal conditioning type	I_{PN} A	Technology	U_C V	BW kHz	X @ I_{PN} T_A = 25 °C %	T_A °C	Aperture mm	Split Core	DIN Rail	Output	UR or UL	Packaging No	Type	Features
AC instantaneous	50	CT	Self powered	0.05…0.06	1	-20...+70	ø 8	●		0-16mA	■	155	TT 50-SD	
	100	CT	Self powered	0.05…0.06	1	-20...+70	ø 16	●		0-33mA	■	156	TT 100-SD	
AC RMS	5, 10, 20, 50, 100, 150	CT	Self powered	0.05…0.06	1.5 [a]	-20...+60	ø 16	●		0-5/10 V_{DC}	■	157	AT 5..150 B5/10	RMS (average) output
	5, 10, 20, 50, 100, 150	CT	Loop powered +20…30 V_{DC}	0.05…0.06	1.5 [a]	-20...+60	ø 16	●		4-20 mA_{DC}	■	158	AT 5..150 B420L	RMS (average) output
	10, 20, 50, 100, 150, 200	CT	Self powered	0.05…0.06	1	-20...+50	21.7 x 21.7	●	O	0-10 V_{DC}	▲	159	AK 50..200 B10	RMS (average) output
	2, 5, 10, 20, 50, 100, 150, 200	CT	Loop powered +24 V_{DC}	0.02…0.1	1	-20...+50	21.7 x 21.7	●	O	4-20 mA_{DC}	▲	159	AK 5..200 B420L	RMS (average) output
	10, 20, 50, 100, 150, 200	CT	Self powered	0.05…0.06	1	-20...+50	ø 19		O	0-10 V_{DC}	▲	161	AK 50..200 C10	RMS (average) output
	2, 5, 10, 20, 50, 100, 150, 200	CT	Loop powered +24 V_{DC}	0.02…0.1	1	-20...+50	ø 19		O	4-20 mA_{DC}	▲	161	AK 5..200 C420L	RMS (average) output
	10, 25, 50, 75, 100, 150, 200, 300, 400	PRiME	+24 V_{DC}	0.03…2	1 [a]	-20...+60	ø 18.5	●	●	0-5/10 V_{DC}	▲	162	AP 50..400 B5/10	RMS output (average) 0-5/10 V_{DC} switch selectable voltage output Switch selectable measuring ranges
	10, 25, 50, 75, 100, 150, 200, 300, 400	PRiME	Loop powered +12…24 V_{DC}	0.03…2	1 [a]	-20...+60	ø 18.5	●	●	4-20 mA_{DC}	▲	163	AP 50..400 B420L	RMS output (average) Switch selectable measuring ranges
AC True RMS	2, 5, 10, 20, 50, 100, 150, 200	CT	Loop powered +24 V_{DC}	0.01…0.4	1	-20...+50	21.7 x 21.7	●	O	4-20 mA_{DC}	▲	160	AKR 5..200 B420L	True RMS output Switch selectable measuring ranges
	2, 5, 10, 20, 50, 100, 150, 200	CT	Loop powered +24 V_{DC}	0.01…0.4	1	-20...+50	ø 19		O	4-20 mA_{DC}	▲	161	AKR 5..200 C420L	True RMS output Switch selectable measuring ranges
	10, 25, 50, 75, 100, 150, 200, 300, 400	PRiME	+24 V_{DC}	0.03…6	1 [a]	-20...+60	ø 18.5	●	●	0-5/10 V_{DC}	▲	162	APR 50..400 B5/10	True RMS output (average) 0-5/10 V_{DC} switch selectable voltage output Switch selectable measuring ranges
	10, 25, 50, 75, 100, 150, 200, 300, 400	PRiME	Loop powered +12..24 V_{DC}	0.03…6	1 [a]	-20...+60	ø 18.5	●	●	4-20 mA_{DC}	▲	163	APR 50..400 B420L	True RMS output Switch selectable measuring ranges
	375, 500, 750	CT	Loop powered +24 V_{DC}	0.01…0.4	1	-20...+50	ø 76			4-20 mA_{DC}		164	AKR 750 C420L J	True RMS output Switch selectable measuring ranges
	1000, 1333, 2000	CT	Loop powered +24 V_{DC}	0.01…0.4	1	-20...+50	ø 76			4-20 mA_{DC}		164	AKR 2000 C420L J	True RMS output Switch selectable measuring ranges

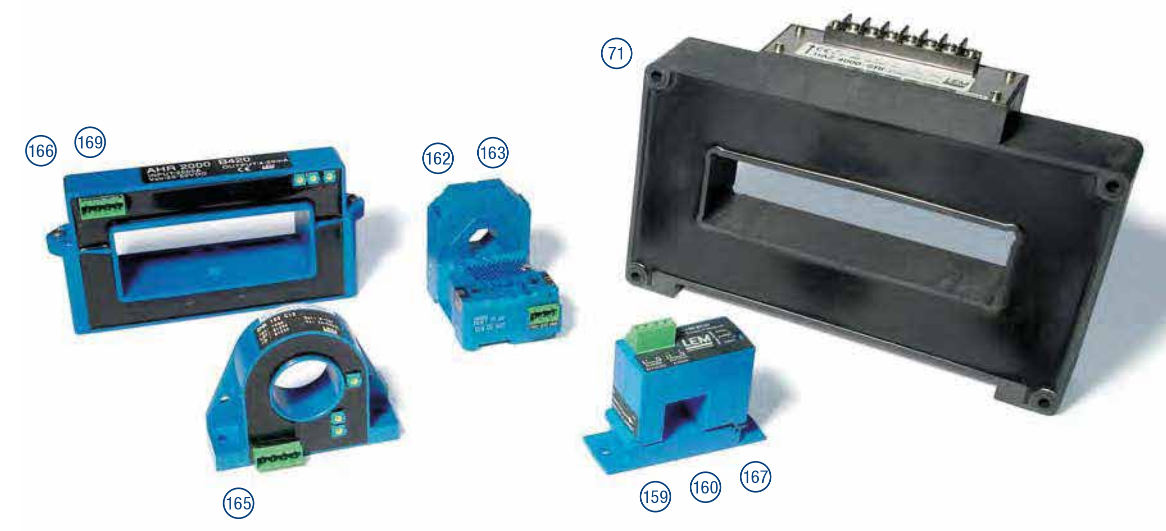


Notes:
a) Excluding offset
b) 2% for 400 A model
o with adapter
▲ UL listed
■ recognized

I_{PN} = 5 A ... 20000 A

DRS / REU Open–loop

Signal conditioning type	I_{PN} A	Technology	U_C V	BW kHz	X @ I_{PN} T_A = 25 °C %	T_A °C	Aperture mm	Split Core	DIN Rail	Output	UR or UL	Packaging No	Type	Features
DC & AC True RMS	100, 200, 300, 400, 500, 600, 1000	O/L	+20..50 V_{DC}	DC & 0.02…6	1 [a]	-40...+70	ø 32			0-5/10 V_{DC}	▲	165	DHR 100..1000 C5/10	UL from 100 to 400 A True RMS output
	100, 200, 300, 400, 500, 600, 1000	O/L	+20..50 V_{DC}	DC & 0.02…6	1 [a]	-40...+70	ø 32			4-20 mA_{DC}	▲	165	DHR 100..1000 C420	UL from 100 to 400 A True RMS output
	500, 800, 1000, 1500, 2000	O/L	+20..50 V_{DC}	DC & 0.02…6	1 [a]	-40...+70	104 x 40	●		0-5/10 V_{DC}		166	AHR 500..2000 B5/10	True RMS output
	500, 800, 1000, 1500, 2000	O/L	+20..50 V_{DC}	DC & 0.02…6	1 [a]	-40...+70	104 x 40	●		4-20 mA_{DC}		166	AHR 500..2000 B420	True RMS output
	4k, 6k, 10k, 12k, 14k, 20k	O/L	+/- 15 V_{DC}	DC & 0.015…3	1 [a]	-25...+85	162 x 42			0-10 V_{DC}		71	HAZ 4000..20000 -SRU	True RMS output
	4k, 6k, 10k, 12k, 14k, 20k	O/L	+/- 15 V_{DC}	DC & 0.015…3	1 [a]	-25...+85	162 x 42			0-20 mA_{DC}		71	HAZ 4000..20000 -SRI	True RMS output
	4k, 6k, 10k, 12k, 14k, 20k	O/L	+/- 15 V_{DC}	DC & 0.015…3	1 [a]	-25...+85	162 x 42			4-20 mA_{DC}		71	HAZ 4000..20000 -SRI/SP1	True RMS output
DC	50, 75, 100, 150, 200, 225, 300, 400	O/L	+20..45 V_{DC}	DC	2	-20...+50	21.7 x 21.7	●	O	0-5/10 V_{DC}		167	DK 100..400 B5/10	Magnitude only - Not the direction Switch selectable measuring ranges Unipolar voltage output
	50, 75, 100, 150, 200, 225, 300, 400	O/L	+20..45 V_{DC}	DC	2	-20...+50	21.7 x 21.7	●	O	4-20 mA_{DC}		167	DK 100..400 B420	Magnitude only - Not the direction - 4 mA at Ip=0 Switch selectable measuring ranges Unipolar current output
	50, 75, 100, 150, 200, 225, 300, 400	O/L	+20..45 V_{DC}	DC	2	-20...+50	21.7 x 21.7	●	O	0-20 mA_{DC}		167	DK 100..400 B020	Magnitude only - Not the direction - 0 mA at Ip=0 Switch selectable measuring ranges Unipolar current output
DC Bipolar	50, 75, 100, 150, 200, 225, 300, 400	O/L	+20..45 V_{DC}	DC	1 [b]	-20...+50	21.7 x 21.7	●	O	4-20 mA_{DC}		167	DK 100..400 B420 B	DC bipolar measurement (magnitude and direction) 12 mA at Ip = 0
	5, 10, 20, 50, 75, 100	O/L	+20..45 V_{DC}	DC	1	-20...+50	ø 19.1		O	4-20 mA_{DC}		168	DK 20..100 C420 B	DC bipolar measurement (magnitude and direction) 12 mA at Ip = 0
	500, 800, 1000, 1500, 2000	O/L	Loop powered +20…30 V_{DC}	DC	1 [a]	-10...+70	104 x 40	●		4-20 mA		169	DH 500..2000 B420L B	DC bipolar measurement (magnitude and direction) 12 mA at Ip = 0



DRS / REU

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V_{PN} = 10 V ... 2500 V

DRS / REU — Closed–loop

I_{PN} (V_{PN}) mA	I_P (V_P) mA	Technology	U_C V	I_{out} @ I_{PN}	BW kHz	X_G T_A = 25 °C % @ I_{PN} with max offset taken	T_A °C	UR or UL	Packaging No	Type
10 (10 to 500 V)	± 14 (700 V)	C/L	± 12...15	25 mA	Note c)	0.9	0...+70	●	76	LV 25-P d)
10 (100 to 2500 V)	± 20 (5000 V)	C/L	± 15	50 mA	Note c)	0.7	0...+70		77	LV 100 e)

V_{PN} = 50 V ... 400 V

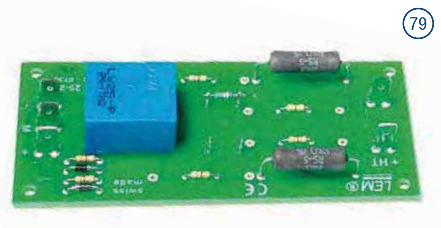
IDT — Closed–loop — Fluxgate

±V_{PN} V	±V_P V	Technology	U_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	UR or UL	Packaging No	Type	Connection primary	Connection secondary
50	75	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 50	2 x M5	3 x M5 + Faston
125	188	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 125	2 x M5	3 x M5 + Faston
150	225	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 150	2 x M5	3 x M5 + Faston
250	375	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 250	2 x M5	3 x M5 + Faston
200	300	C/L	± 12...15	25 mA	Note c)	0.9	-25...+70	O	79	LV 25-200	Faston	Faston
400	600	C/L	± 12...15	25 mA	Note c)	0.9	-25...+70	O	79	LV 25-400	Faston	Faston
140	200	Fluxgate "C"	± 15	10 V/200 V	DC-300 (-1dB)	0.2 @ Vp	-40...+85		80	CV 3-200	2 x M5	4 x M5
350	500	Fluxgate "C"	± 15	10 V/500 V	DC-300 (-1dB)	0.2 @ Vp	-40...+85		80	CV 3-500	2 x M5	4 x M5

V_{PN} = 500 V ... 4200 V

DRS / REU — IDT — Closed–loop — Fluxgate

±V_{PN} V	±V_P V	Technology	U_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	UR or UL	Packaging No	Type	Connection primary	Connection secondary
500	750	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 500	2 x M5	3 x M5 + Faston
750	1125	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 750	2 x M5	3 x M5 + Faston
1000	1500	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 1000	2 x M5	3 x M5 + Faston
1000	1500	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		81	DV 1000	Cable	Cable
1200	1800	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		82	DV 1200/SP2	Cable	M5 + Faston
1500	2250	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 1500	2 x M5	3 x M5 + Faston
1500	2250	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		82	DV 1500	Cable	M5 + Faston
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 2000	2 x M5	3 x M5 + Faston
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		81	DV 2000	Cable	Cable
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		82	DV 2000/SP1	Cable	M5 + Faston
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		83	DV 2000/SP2	M5	M5
2800	4200	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		84	DV 2800/SP4	M5	M5
3000	4500	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.35	-40...+85		84	DV 3000/SP1	M5	M5
4200	6000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		81	DV 4200/SP3	Cable	Cable
4200	6000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		84	DV 4200/SP4	M5	M5
600	900	C/L	± 12...15	25 mA	Note c)	0.9	-25...+70		79	LV 25-600	Faston	Faston
800	1200	C/L	± 12...15	25 mA	Note c)	0.9	-25...+70		79	LV 25-800	Faston	Faston
1000	1500	C/L	± 12...15	25 mA	Note c)	0.9	-25...+70		79	LV 25-1000	Faston	Faston
1200	1800	C/L	± 12...15	25 mA	Note c)	0.9	-25...+70	●	79	LV 25-1200	Faston	Faston
2500	3750	C/L	± 15	50 mA	Note c)	0.9	0...+70		85	LV 100-2500	2 x M5	3 x M5 + Faston
3000	4500	C/L	± 15	50 mA	Note c)	0.9	0...+70		85	LV 100-3000	2 x M5	3 x M5 + Faston
3500	4500	C/L	± 15	50 mA	Note c)	0.9	0...+70		85	LV 100-3500	2 x M5	3 x M5 + Faston
4000	6000	C/L	± 15	50 mA	Note c)	0.9	0...+70		85	LV 100-4000	2 x M5	3 x M5 + Faston
700	1000	Fluxgate "C"	± 15	10 V/1000 V	DC-500 (-1dB @ 50 % V_{PN})	0.2 @ V_P	-40...+85		80	CV 3-1000	2 x M5	4 x M5
840	1200	Fluxgate "C"	± 15	10 V/1200 V	DC-800 (-1dB @ 40% V_{PN})	0.2 @ V_P	-40...+85		80	CV 3-1200	2 x M5	4 x M5
1000	1500	Fluxgate "C"	± 15	10 V/1500 V	DC-800 (-1dB @ 33% V_{PN})	0.2 @ V_P	-40...+85		80	CV 3-1500	2 x M5	4 x M5
1400	2000	Fluxgate "C"	± 15	10 V/2000 V	DC-300 (-1dB @ 25% V_{PN})	0.2 @ V_P	-40...+85		80	CV 3-2000	2 x M5	4 x M5



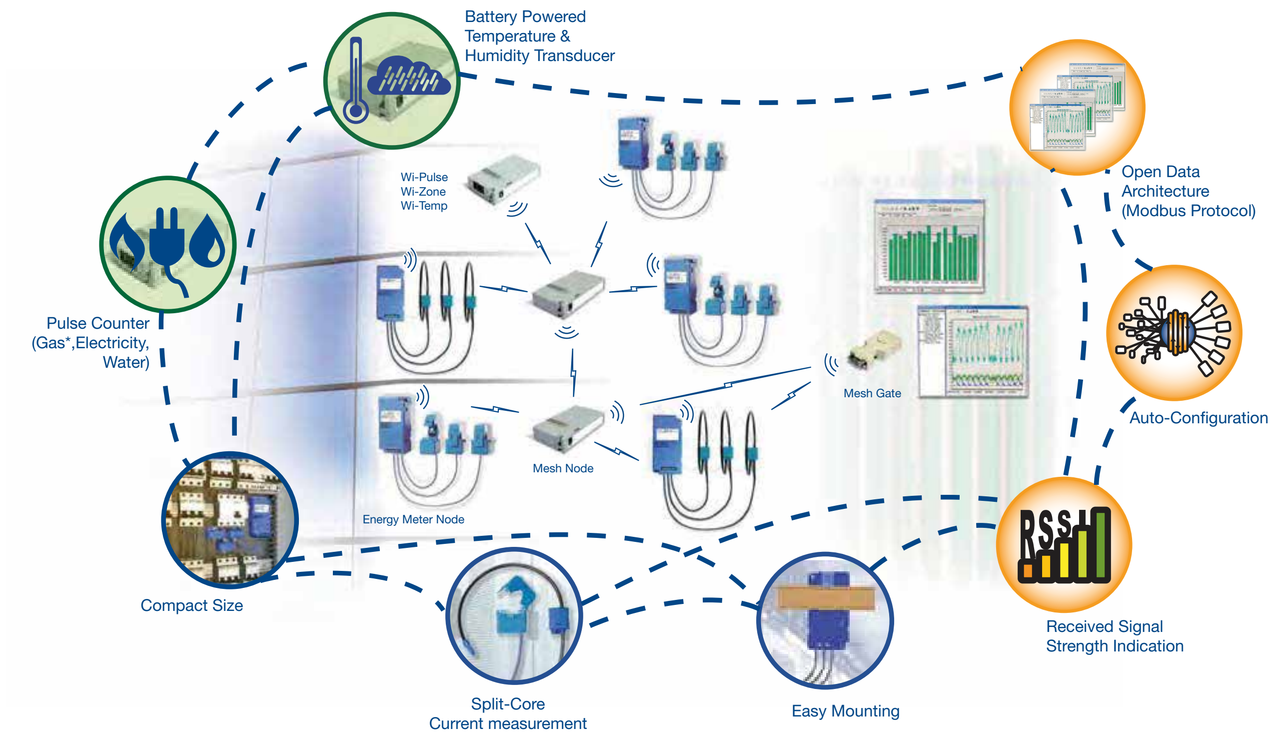
Notes:
c) See response time in individual data sheet
d) The primary and secondary connections of this transducer are done on PCB
e) Mechanical Mounting
O) Recognition pending

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

DRS / REU

Wi-LEM

Wireless Local Energy Meter



- Comprehensive Monitoring Solution
- Cut Installation Costs
- Easy Commissioning

Applications :

- Establish the breakdown of energy use (where does it all go?)
- Allocate energy wastes to users
- Determine efficiency of equipment
- Audit before & after energy use for retrofit projects
- Manage the load profile (peak demand)
- Maintenance and Entreprise Asset Management

* an additional intrinsic safety barrier module is needed

Wi-LEM COMPONENTS


Energy Meter Node (EMN):

Single or three phase energy meter with embedded wireless data transmission module

Measurement ranges:
- Current from 20 to 2000 A
- Voltage from 90 to 500 VAC

Measurement values:

	Interval Based Values (5 to 30 minutes Configurable Reading Intervals)										Cummulated Values			
	L1			L2			L3			SUM	L1	L2	L3	SUM
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max					
Current (A)			■			■			■					
Voltage (V)		■			■			■						
Active Energy (kWh)	■			■			■			■	■	■	■	■
Reactive Energy (kVarh)	■			■			■			■	■	■	■	■
Apparent Energy (kVA)	■			■			■			■	■	■	■	■
Frequency										■				

Wi-Pulse:

A transducer that counts and transmits pulses coming from meters like water or gas*

Wi-Zone:

Temperature and Humidity transducer

Wi-Temp:

Two inputs thermistors based temperature sensors

Mesh Gate:

A gateway managing the mesh network (up to 200 Nodes).
It provides data through serial interface to a PC or RTU

Mesh Node:

Repeater linking various Nodes. They enable wireless communication throughout a large installation

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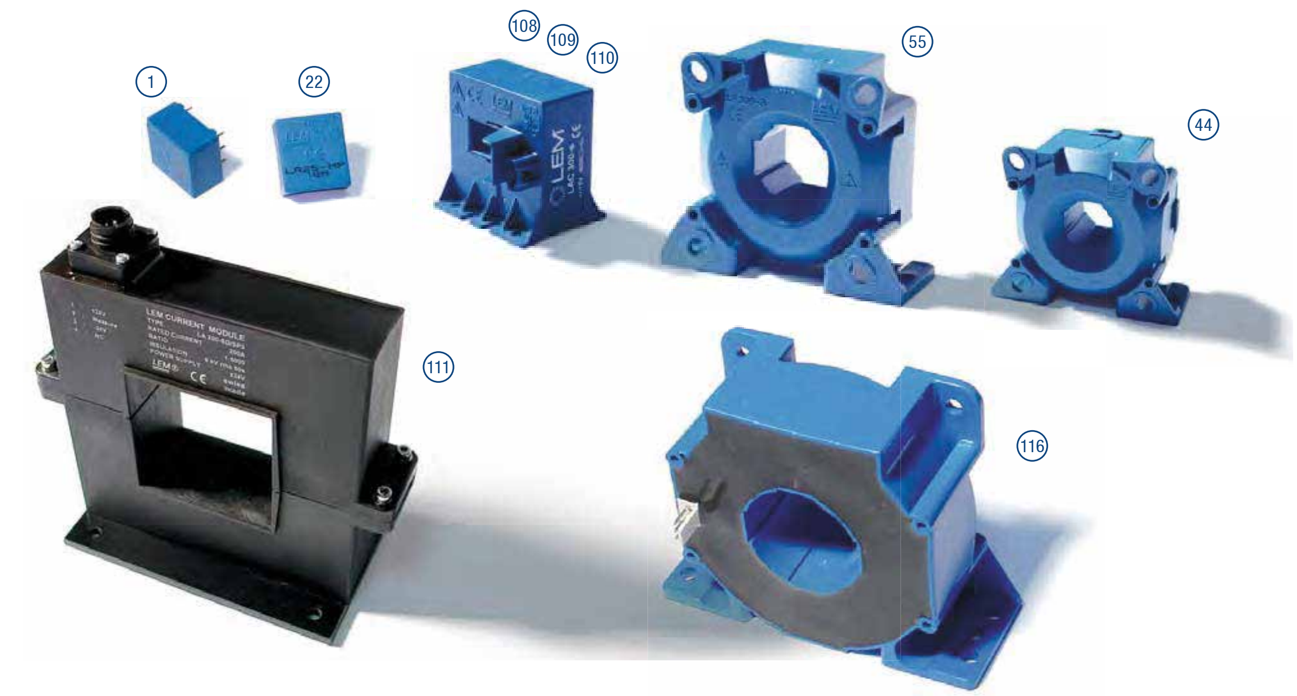
I_{PN} = 0.4 A ... 400 A

TTR - On-Board

Closed–loop

I_{PN}	I_P	Technology	U_C	V_{out} / I_{out}	BW	X @ I_{PN} T_A = 25 °C	X_G @ I_{PN} T_A = 25 °C	T_A	Connection Primary PCB	Connection Primary Aperture, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
A	A		V	@ I_{PN}	kHz	%	%	°C								
0.4	± 0.85	C/L	± 15	30 mA	DC-150 (-1dB)	0.5	0.8	-40...+85	●		●		●	1	LA 25-NP/SP38	
1.5	± 2.2	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	0.9	-40...+85	●		●		●	1	LA 25-NP/SP34	
2	± 2.5	C/L	± 15	40 mA	DC-150 (-1dB)	0.5	0.7	-40...+85	●		●		●	1	LA 25-NP/SP39	
5	± 7	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	0.9	-40...+85	●		●		●	22	LA 25-NP/SP25	
6	± 9	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	0.9	-40...+85	●		●		●	22	LA 25-NP/SP25	
8	± 12	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	0.9	-40...+85	●		●		●	22	LA 25-NP/SP25	
12	± 18	C/L	± 15	24 mA	DC-150 (-1dB)	0.5	0.9	-40...+85	●		●		●	22	LA 25-NP/SP25	
25	± 36	C/L	± 15	25 mA	DC-150 (-1dB)	0.5	0.9	-40...+85	●		●		●	22	LA 25-NP/SP25	
100	± 200	C/L	± 12...15	100 mA	DC-100 (-3dB)	0.4	0.6	-40...+85		Ø 15.5 mm		Molex	●	44	LF 205-S/SP5	Molex Minifit 5566
130	± 1000	C/L	± 24	65 mA	DC-50 (-3dB)	0.5	1.45	-40...+85		Aperture 13x30 mm		Molex	●	108	LAC 300-S/SP5	Molex 70543-0003
200	± 400	C/L	± 24	50 mA	DC-50 (-3dB)	0.5	1	-40...+85		Aperture 13x30 mm		Cable	●	110	LAC 300-S/SP8	
200	± 420	C/L	± 12...15	100 mA	DC-100 (-3dB)	0.4	0.5	-40...+85		Ø 15.5 mm		Molex	●	44	LF 205-S/SP1	Molex Minifit 5566
200	± 500	C/L	± 24	40 mA	DC-100 (-1dB)	0.7	1	-30...+70		Split core Aperture 67x67 mm		AMP		111	LA 200-SD/SP3	AMP CPC 11/4
200	± 700	C/L	± 15	100 mA	DC-50 (-3dB)	0.5	1.25	-40...+85		Aperture 13x30 mm		Molex	●	108	LAC 300-S/SP1	Molex 70543-0003
300	± 500	C/L	± 12...20	150 mA	DC-100 (-3dB)	0.3	0.47	-40...+85		Ø 20 mm		Molex	●	55	LF 305-S/SP10	Molex Minifit 5566
300	± 640	C/L	± 15	100 mA	DC-50 (-3dB)	0.4	1	-40...+85		Aperture 13x30 mm		Molex	●	108	LAC 300-S/SP2	Molex 70543-0003
300	± 910	C/L	± 24	60 mA	DC-50 (-3dB)	0.5	1.4	-40...+85		Aperture 13x30 mm		Molex	●	108	LAC 300-S/SP4	Molex 70543-0003
400	± 600	C/L	± 15	80 mA	DC-50 (-3dB)	0.4	1.1	-40...+85		Aperture 13x30 mm		Molex	●	108	LAC 300-S/SP3	Molex 70543-0003



I_{PN} = 400 A ... 500 A

TTR - On-Board

Closed–loop

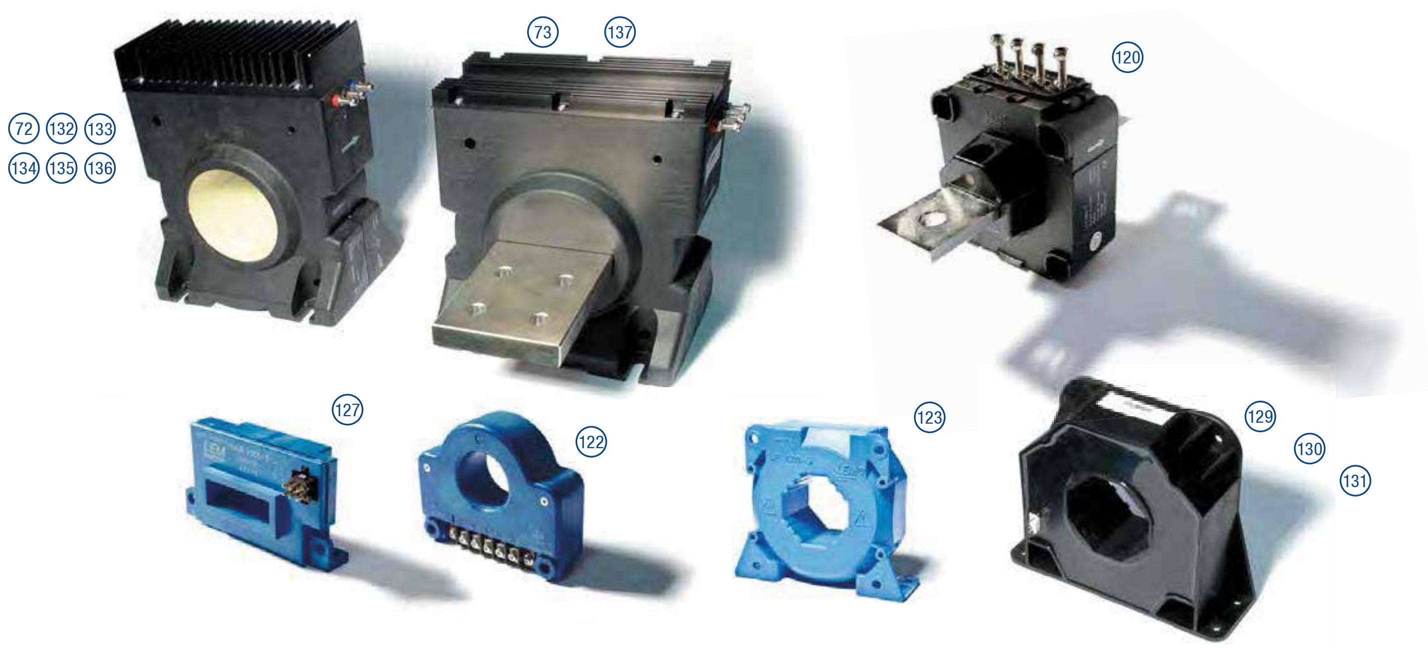
I_{PN}	I_P	Technology	U_C	V_{out} / I_{out}	BW	X @ I_{PN} T_A = 25 °C	X_G @ I_{PN} T_A = 25 °C	T_A	Connection Primary PCB	Connection Primary Aperture, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
A	A		V	@ I_{PN}	kHz	%	%	°C								
400	± 650	C/L	± 15	100 mA	DC-50 (-3dB)	0.4	1	-40...+85		Aperture 13x30 mm		Molex	●	108	LAC 300-S	Molex 70543-0003
400	± 1000	C/L	± 15	133 mA	DC-50 (-3dB)	0.4	1.2	-40...+75		Aperture 13x30 mm		Cable	●	109	LAC 300-S/SP7	
350	± 1200	C/L	± 15...24	175 mA	DC-100 (-1dB)	0.3	0.5	-40...+85		Ø 27.5 mm		4 x M5		112	LTC 350-S	Screen
350	± 1200	C/L	± 15...24	175 mA	DC-100 (-1dB)	0.3	0.5	-40...+85		Ø 27.5 mm		4 x M5 + Faston		113	LTC 350-SF	With feet Screen
350	± 1200	C/L	± 15...24	175 mA	DC-100 (-1dB)	0.3	0.5	-40...+85		Busbar		4 x M5 + Faston		114	LTC 350-T	Screen
350	± 1200	C/L	± 15...24	175 mA	DC-100 (-1dB)	0.3	0.5	-40...+85		Busbar		4 x M5 + Faston		115	LTC 350-TF	With feet Screen
500	± 700	C/L	± 24	100 mA	DC-100 (-1dB)	0.4	1	-30...+70		Split core Aperture 67x67 mm		AMP		111	LA 500-SD/SP2	AMP CPC 11/4
500	± 1000	C/L	± 24	100 mA	DC-100 (-1dB)	0.3	0.6	-40...+85		Ø 30.2 mm		Cable	●	116	LF 505-S/SP23	Screen
500	± 1200	C/L	± 15...24	125 mA	DC-100 (-1dB)	0.4	0.6	-40...+85		Ø 27.5 mm		4 x M5 + Faston		112	LTC 500-S	Screen
500	± 1200	C/L	± 15...24	125 mA	DC-100 (-1dB)	0.4	0.6	-40...+85		Ø 27.5 mm		4 x M5 + Faston		113	LTC 500-SF	With feet Screen
500	± 1200	C/L	± 15...24	125 mA	DC-100 (-1dB)	0.4	0.6	-40...+85		Busbar		4 x M5 + Faston		114	LTC 500-T	Screen
500	± 1200	C/L	± 15...24	125 mA	DC-100 (-1dB)	0.4	0.6	-40...+85		Busbar		4 x M5 + Faston		115	LTC 500-TF	With feet Screen
500	± 1500	C/L	± 15...24	100 mA	DC-100 (-1dB)	0.3	0.7	-40...+85		Ø 42 mm		4 x M5 + Faston	●	117	LTC 600-S	Screen
500	± 1500	C/L	± 15...24	100 mA	DC-100 (-1dB)	0.3	0.7	-40...+85		Ø 42 mm		4 x M5 + Faston	●	118	LTC 600-SF	With feet Screen
500	± 1500	C/L	± 15...24	100 mA	DC-100 (-1dB)	0.3	0.7	-40...+85		Ø 42 mm		4 x M5 + Faston	●	119	LTC 600-SFC	With feet + clamp Screen
500	± 1500	C/L	± 15...24	100 mA	DC-100 (-1dB)	0.3	0.7	-40...+85		Busbar		4 x M5 + Faston	●	120	LTC 600-T	Screen
500	± 1500	C/L	± 15...24	100 mA	DC-100 (-1dB)	0.3	0.7	-40...+85		Busbar		4 x M5 + Faston	●	121	LTC 600-TF	With feet Screen

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

I_{PN} = 1000 A ... 2000 A

TTR | Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_C V	V_{out} / I_{out} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	X_G @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
1000	± 1100	O/L	± 15	10 V	DC-10 (-3dB)1)	1.8	2.3	-40...+85		Ø 40 mm		Screws		122	HTC 1000-S/SP4	
1000	± 1500	C/L	± 24	200 mA	DC-150 (-1dB)	0.3	0.5	-40...+85		Ø 38.5 mm		4 x M4	●	123	LF 1005-S/SP14	Screen
1000	± 2400	C/L	± 15...24	200 mA	DC-100 (-1dB)	0.3	0.4	-40...+85		Ø 42 mm		4 x M5 + Faston	●	117	LTC 1000-S	Screen
1000	± 2400	C/L	± 15...24	250 mA	DC-100 (-1dB)	0.3	0.4	-40...+85		Ø 42 mm		4 x M5 + Faston	●	124	LTC 1000-S/SP1	Screen
1000	± 3000	C/L	± 15...24	250 mA	DC-100 (-1dB)	0.3	0.4	-40...+85		Ø 42 mm		4 x Faston	●	125	LTC 1000-S/SP25	Screen
1000	± 2400	C/L	± 15...24	200 mA	DC-100 (-1dB)	0.3	0.4	-40...+85		Ø 42 mm		4 x M5 + Faston	●	118	LTC 1000-SF	With feet Screen
1000	± 2400	C/L	± 15...24	200 mA	DC-100 (-1dB)	0.3	0.4	-40...+85		Ø 42 mm		4 x M4 + Faston	●	126	LTC 1000-SF/SP24	With long feet Footprint compatible with former LT 1000-SI series Screen
1000	± 2400	C/L	± 15...24	200 mA	DC-100 (-1dB)	0.3	0.4	-40...+85		Ø 42 mm		4 x M5 + Faston	●	119	LTC 1000-SFC	With feet + clamp Screen
1000	± 2400	C/L	± 15...24	200 mA	DC-100 (-1dB)	0.3	0.4	-40...+85		Busbar		4 x M5 + Faston	●	120	LTC 1000-T	Screen
1000	± 2400	C/L	± 15...24	200 mA	DC-100 (-1dB)	0.3	0.4	-40...+85		Busbar		4 x M5 + Faston	●	121	LTC 1000-TF	With feet Screen
1000	± 2500	O/L	± 15	5 V	DC-10 (-3dB)1)	1.7	2	-40...+70		Aperture 18x54 mm		Burndy		127	HAR 1000-S	Burndy SMS6GE4
2000	± 2200	O/L	± 15	10 V	DC-10 (-3dB)1)	1.8	2.3	-40...+85		Ø 40 mm		Screws		122	HTC 2000-S/SP4	
2000	± 3000	Fluxgate ITC	± 24	800 mA	DC-27 (3dB)1)	0.0015	0.01	-40...+85		Ø 63 mm		D-Sub		128	ITC 2000-S/SP1	Class 0.5R accuracy D-Sub male 15cts Test circuit



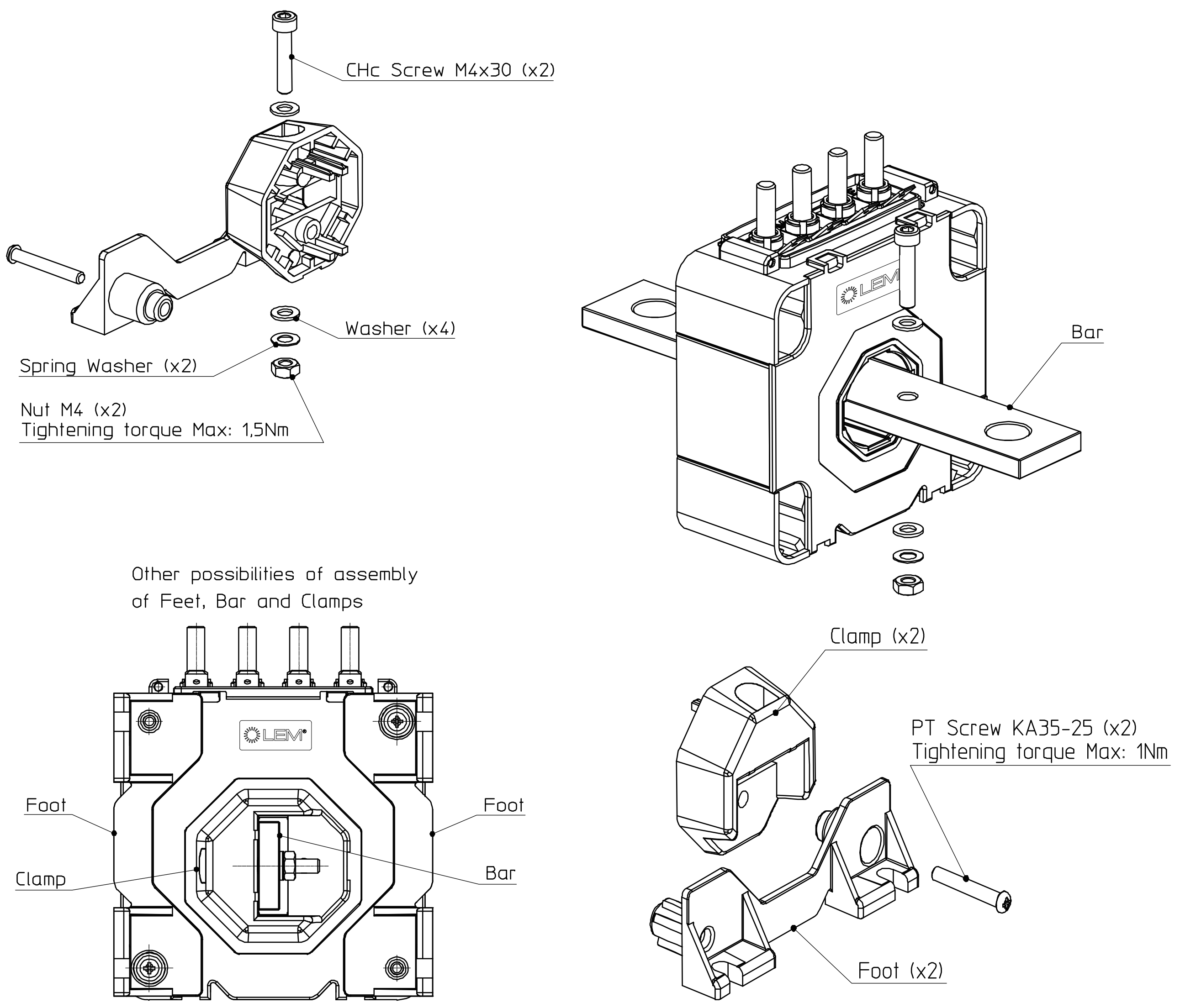
I_{PN} = 2000 A ... 4000 A

TTR | Open–loop | Closed–loop | Fluxgate

I_{PN} A	I_P A	Technology	U_C V	V_{out} / I_{out} @ I_{PN}	BW kHz	X @ I_{PN} T_A = 25°C %	X_G @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
2000	± 3500	C/L	± 15...24	400 mA	DC-150 (-1dB)	0.2	0.325	-40...+85		Ø 56 mm		LEMO	●	129	LF 2005-S/SP1	LEMO EEJ.1B.304. CYC Internal screen
2000	± 3500	C/L	± 15...24	400 mA	DC-100 (-1dB)	0.2	0.325	-40...+80		Ø 56 mm		LEMO	●	130	LF 2005-S/SP27	LEMO EEJ.1B.304. CYC Internal screen Reversed current
2000	± 3500	C/L	± 15...24	400 mA	DC-100 (-1dB)	0.5	0.55	-40...+85		Ø 56 mm		4 x M5	●	131	LF 2005-S/SP28	Screen
3000	± 3300	O/L	± 15	10 V	DC-10 (-3dB)1)	1.8	2.3	-40...+85		Ø 40 mm		Screws		122	HTC 3000-S/SP4	
3300	± 5000	C/L	± 24	660 mA	DC-100 (-1dB)	0.3	0.32	-25...+70		Ø 102 mm		LEMO		132	LT 4000-S/SP24	LEMO EGJ.1B.304. CYC Screen
3300	± 5000	C/L	± 24	660 mA	DC-100 (-1dB)	0.3	0.32	-25...+70		Ø 102 mm		3 x M5		133	LT 4000-S/SP44	Internal screen
4000	± 6000	C/L	± 24	800 mA	DC-100 (-1dB)	0.3	0.5	-25...+70		Ø 102 mm		3 x M5		72	LT 4000-S	
4000	± 6000	C/L	± 24	800 mA	DC-100 (-1dB)	0.3	0.5	-40...+70		Ø 102 mm		AMP		134	LT 4000-S/SP12	AMP CPC 13/9 Test circuit Screen
4000	± 6000	C/L	± 24	800 mA	DC-100 (-1dB)	0.3	0.5	-40...+70		Ø 102 mm		3 x M5		72	LT 4000-S/SP34	
4000	± 6000	C/L	± 24	800 mA	DC-100 (-1dB)	0.3	0.5	-40...+70		Ø 102 mm		LEMO		135	LT 4000-S/SP35	LEMO EGJ.1B.305. CYC Test circuit Internal screen
4000	± 6500	C/L	± 24	1 A	DC-100 (-1dB)	0.3	0.5	-40...+85		Ø 102 mm		Cable		136	LT 4000-S/SP43	Screen
4000	± 6000	C/L	± 24	800 mA	DC-100 (-1dB)	0.3	0.5	-25...+70		Busbar		3 x M5		73	LT 4000-T	
4000	± 6500	C/L	± 24	1 A	DC-100 (-1dB)	0.3	0.5	-40...+85		Busbar		Cable		137	LT 4000-T/SP40	
4000	± 6000	Fluxgate ITC	± 24	1600 mA	DC-82 (3dB)1)	0.0003	0.05	-40...+85		Ø 102 mm		7 x M5 inserts		138	ITC 4000-S	Class 0.5R accuracy Test circuit

Notes:
f) 100 A_{RMS}
1) Small signal bandwidth to avoid excessive core heating at high frequency
Dedicated data sheets are the only recognized reference documents for the given performances and data – Data sheets: www.lem.com

Mechanical adaptation accessories
LTC 350 - 500 models

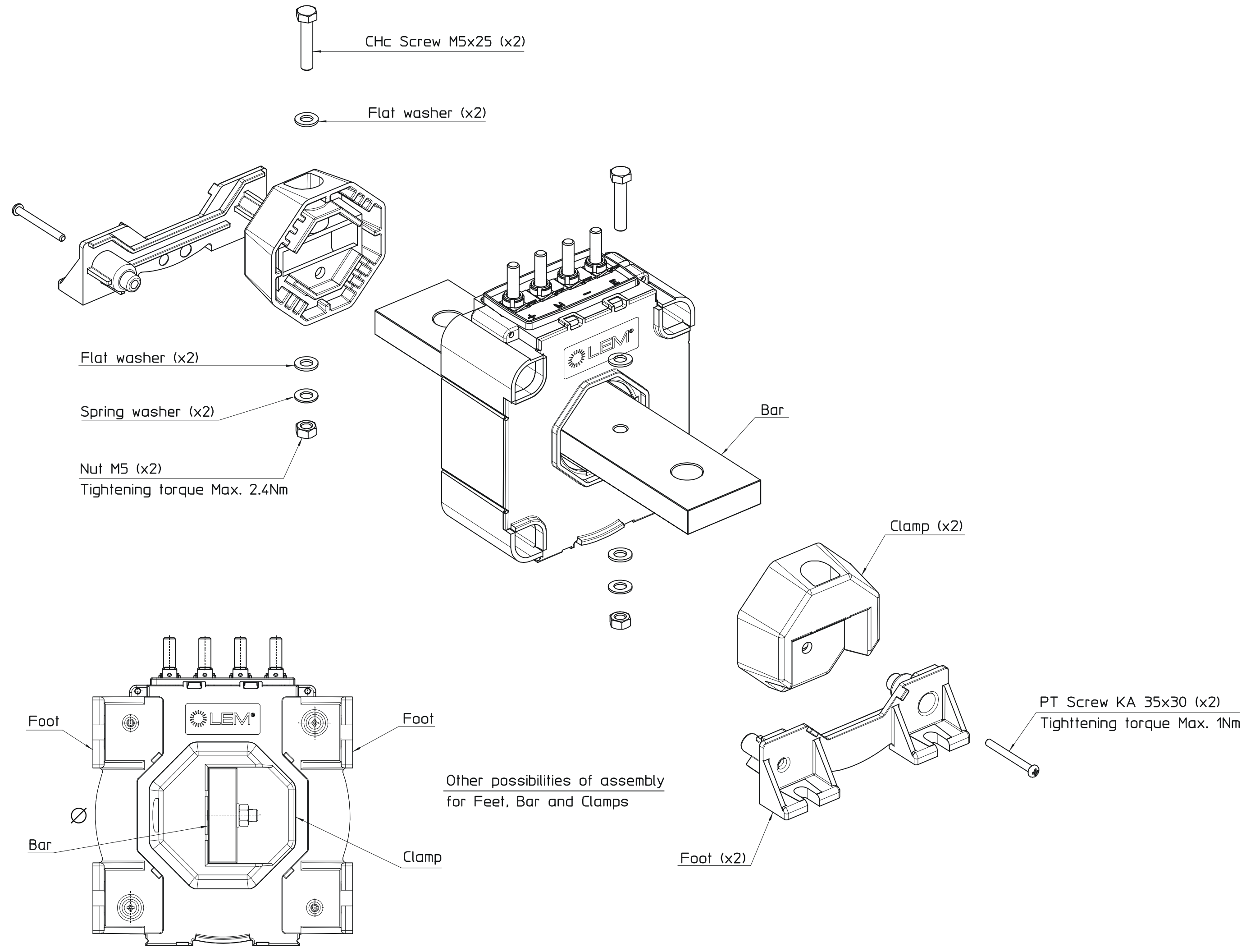


Accessories	References
Busbar Kit * (busbar : 155 x 25 x 6 mm)	93.34.41.100.0
Busbar Kit * (busbar : 112 x 25 x 6 mm)	93.34.41.101.0
Busbar Fastening Kit **	93.34.41.200.0
Feet fixing Kit ***	93.34.43.100.0

* including all the necessary for its mounting such as screws, washers, nuts, 2 clamps, busbar.
** as with * but without the busbar.
*** including screws and 2 feet.

Rms voltage value for partial discharge extinction depends on the busbar.
Refer to the datasheet of the corresponding product.

Mechanical adaptation accessories
LTC 600 - 1000 models



Lines	Accessories	References
1	Busbar KIT * (busbar : 210 x 40 x 12 mm)	93.34.61.100.0
2	Busbar KIT * (busbar : 185 x 40 x 8 mm)	93.34.61.102.0
3	Busbar KIT * (busbar : 285 x 36 x 12 mm)	93.34.61.103.0
4	Busbar KIT * (busbar : 260 x 36 x 12 mm)	93.34.61.104.0
5	Busbar KIT * (busbar : 195 x 36 x 10 mm)	93.34.61.105.0
6	Busbar KIT * (busbar : 36 mm Ø x 325 mm)	93.34.61.106.0
7	Busbar KIT * (busbar : 185 x 40 x 10 mm)	93.34.61.107.0
8	Busbar KIT * (busbar : 180 x 40 x 12 mm)	93.34.61.108.0
9	Busbar Fastening Kit (M5 x 25)** dedicated to busbars from lines 1 to 5 and lines 7, 8.	93.34.61.200.0
10	Busbar Fastening Kit (M5 x 40)** dedicated to busbar from line 6	93.34.61.201.0
11	Feet fixing Kit ***	93.34.63.100.0

* including all the necessary for its mounting such as screws, washers, nuts, 2 clamps, busbar.
** as with * but without the busbar.
*** including screws and 2 feet.

Rms voltage value for partial discharge extinction depends on the busbar.
Refer to the datasheet of the corresponding product.

I_{PN} = 2 A ... 10 A (Fault Detection)

TTR - Spec. App.

Fluxgate

I_{PN} A	I_P A	Technology	U_C V	V_{out} I_{out} @ I_{PN}	BW kHz	X_G @ I_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
2	± 8	Flux "C"	± 15…24	20 mA	DC-10 (-3dB)	3	-25...+70		Ø 63.2 mm		Cable		139	CD 1000-S/SP6	Differential measurement: 2 x 1200 A_{RMS}
10	± 10	Flux "C"	± 24	10 V	DC-20 (-3dB)	3	-40...+70		2 x Busbars: 1 of 20x20x358 mm and 1 of 20x20x206 mm		Cable		140	CD 1000-T/SP7	Differential measurement: 2 x 1500 A_{RMS}

V_{PN} = 0.03 V (Shunt Isolator)

IDT

V_{PN} V	V_P V	Technology	U_C V	V_{out} I_{out} @ V_{PN}	BW kHz	X_G @ V_{PN} T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
0.03	± 0.045	Insulating digital technology	± 15…24	50 mA	DC-10 (3dB)	0.2	-40...+85		Busbar		M5 Connecting		141	DI 30/SP1	Shunt Isolator Class 1R accuracy vs EN50463 when used with Class 0.2 shunt

139 140

141

$I_{P\,AC}$ = 0.1 A_{AC} ... 20 A_{AC} (Interference Frequencies Detection)

TTR

Rogowski

I_P A_{AC}	Technology	U_C V	V_{out} I_{out} @ I_P	BW kHz	X @ I_P T_A = 25°C %	T_A °C	Connection Primary PCB	Connection Primary Aperture, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
0.1…20 Measurement of alternating signal on DC primary current up to 1000 ADC	Rogowski	Self powered	2.π.M. f.I_{PAC} V g) M.dI_P/dt V 2)	0.02…3	3	-40...+85		Ø 42 mm		Cable		142	RA 1005-S	g) For sinusoidal wave 2.π.M= 25.10^{-6} H f in Hz 2) Instantaneous Test circuit
0.1…20 Measurement of alternating signal on DC primary current up to 3000 ADC	Rogowski	Self powered	2.π.M. f.I_{PAC} V h) M.dI_P/dt V 2)	0.02…3	3	-25...+70		Ø 102 mm		Cable		143	RA 2000-S/SP1	h) For sinusoidal wave 2.π.M= 27.657.10^{-6} H f in Hz 2) Instantaneous Test circuit
0.1…20 Measurement of alternating signal on DC primary current up to 4000 ADC	Rogowski	Self powered	2.π.M. f.I_{PAC} V h) M.dI_P/dt V 2)	0.02…3	3	-40...+70		Ø 102 mm		Cable		144	RA 2000-S/SP2	h) For sinusoidal wave 2.π.M= 27.657.10^{-6} H f in Hz 2) Instantaneous Test circuit
0.1…20 Measurement of alternating signal on DC primary current up to 4000 ADC	Rogowski	Self powered	2.π.M. f.I_{PAC} V h) M.dI_P/dt V 2)	0.02…3	3	-40...+70		Ø 102 mm		LEMO connector		145	RA 2000-S/SP3	h) For sinusoidal wave 2.π.M= 27.657.10^{-6} H f in Hz 2) Instantaneous Test circuit
0.1…20 Measurement of alternating signal on DC primary current up to 4000 ADC	Rogowski	Self powered	2.π.M. f.I_{PAC} V h) M.dI_P/dt V 2)	0.02…3	3	-40...+70 IP57		Ø 102 mm		Cable		146	RA 2000-S/SP4	h) For sinusoidal wave 2.π.M= 27.657.10^{-6} H f in Hz 2) Instantaneous Test circuit
0.1…20 Measurement of alternating signal on DC primary current up to 4000 ADC	Rogowski	Self powered	2.π.M. f.I_{PAC} V h) M.dI_P/dt V 2)	0.02…3	3	-40...+70		Busbar 20x100x340 mm		Cable		147	RA 2000-T/SP2	h) For sinusoidal wave 2.π.M= 27.657.10^{-6} H f in Hz 2) Instantaneous Test circuit

143 144 145 146

147

142

TTR

I_{PN} = 10 A ... 6000 A

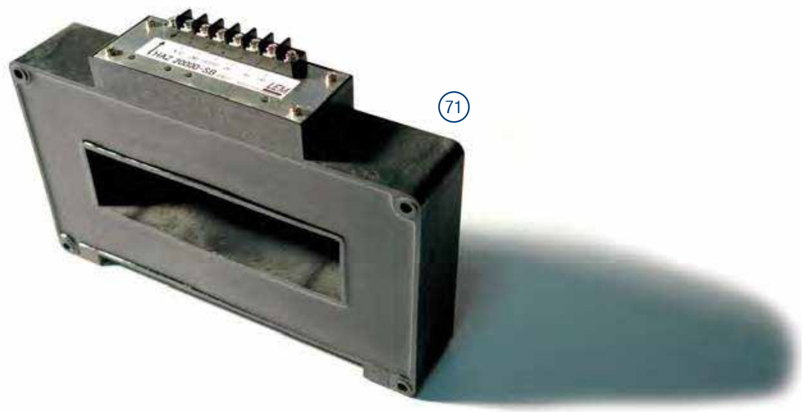
TTR - Track. / Sub.

Open–loop | Closed–loop

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
10	± 20	C/L	+ 24	4-20 mA_{DC} @ -/+I_P	DC	1 [a]	-25...+55 IP67		Split core Ø 15 mm		0.25 m wire + connector		148	PCM 10-P	
10	± 20	C/L	+ 24	4-20 mA_{DC} @ -/+I_P	DC	1 [a]	-25...+55		Split core Ø 15 mm		2 m wire		149	PCM 10-P/SP1	
20	± 40	C/L	+ 24	4-20 mA_{DC} @ -/+I_P	DC	1 [a]	-25...+55 IP67		Split core Ø 15 mm		0.25 m wire + connector		148	PCM 20-P	
20	+ 20	C/L	+ 24	4-20 mA_{DC} @ +I_P	DC	1 [a]	-25...+55		Split core Ø 15 mm		3 m wire		150	PCM 20-P/SP2	
20	+ 20	C/L	+ 24	4-20 mA_{DC} @ +I_P	DC	1 [a]	-25...+55		Split core Ø 15 mm		0.25 m wire + connector		151	PCM 20-P/SP3	
20	+ 20	C/L	+ 24	4-20 mA_{DC} @ +I_P	DC	1 [a]	-25...+55		Split core Ø 15 mm		2.5 m wire + connector		152	PCM 20-P/SP4	
20	± 40	C/L	+ 24	4-20 mA_{DC} @ -/+I_P	DC	1 [a]	-25...+55		Split core Ø 15 mm		3 m wire		150	PCM 20-P/SP6	
30	± 60	C/L	+ 24	4-20 mA_{DC} @ -/+I_P	DC	1 [a]	-25...+55 IP67		Split core Ø 15 mm		0.25 m wire + connector		148	PCM 30-P	
30	+ 30	C/L	+ 24	4-20 mA_{DC} @ +I_P	DC	1 [a]	-25...+55		Split core Ø 15 mm		3 m wire		150	PCM 30-P/SP1	
5	± 25	C/L	+ 24	4-12 mA_{DC}	0.04-1 (-3dB)	2 [a]	-25...+55		Split core Ø 15 mm		0.25 m wire + connector		153	PCM 5-PR/SP1	True RMS output 
5	± 25	C/L	+ 24	4-12 mA_{DC}	0.04-1 (-3dB)	2 [a]	-25...+55 IP67		Split core Ø 15 mm		2 m wire		154	PCM 5-PR/SP2	True RMS output
10	± 30	C/L	+ 24	4-12 mA_{DC}	0.04-1 (-3dB)	2 [a]	-25...+55		Split core Ø 15 mm		0.25 m wire + connector		153	PCM 10-PR/SP1	True RMS output 
4000	± 4000	O/L	± 15	10 V	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 4000-SB	Fujicon F2023A (6 terminals)
4000	± 4000	O/L	± 15	20 mA	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 4000-SBI	Fujicon F2023A (6 terminals)
4000	± 4000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 4000-SBI/SP1	Fujicon F2023A (6 terminals)
4000	± 4000	O/L	± 15	0-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 4000-SRI	True RMS output Fujicon F2023A (6 terminals)
4000	± 4000	O/L	± 15	4-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 4000-SRI/SP1	True RMS output Fujicon F2023A (6 terminals)
4000	± 4000	O/L	± 15	0-10 V_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 4000-SRU	True RMS output Fujicon F2023A (6 terminals)
6000	± 6000	O/L	± 15	10 V	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 6000-SB	Fujicon F2023A (6 terminals)
6000	± 6000	O/L	± 15	20 mA	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 6000-SBI	Fujicon F2023A (6 terminals)
6000	± 6000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 6000-SBI/SP1	Fujicon F2023A (6 terminals)
6000	± 6000	O/L	± 15	0-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 6000-SRI	True RMS output Fujicon F2023A (6 terminals)
6000	± 6000	O/L	± 15	4-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 6000-SRI/SP1	True RMS output Fujicon F2023A (6 terminals)
6000	± 6000	O/L	± 15	0-10 V_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 6000-SRU	True RMS output Fujicon F2023A (6 terminals)

148 149 150 151 152 153 154

71



I_{PN} = 10000 A ... 20000 A

TTR - Track. / Sub.

Open–loop | Closed–loop

I_{PN} A	I_P A	Technology	U_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, busbar, other	Connection Secondary PCB	Connection Secondary Other	UR or UL	Packaging No	Type	Features
10000	± 10000	O/L	± 15	10 V	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 10000-SB	Fujicon F2023A (6 terminals)
10000	± 10000	O/L	± 15	20 mA	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 10000-SBI	Fujicon F2023A (6 terminals)
10000	± 10000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 10000-SBI/SP1	Fujicon F2023A (6 terminals)
10000	± 10000	O/L	± 15	0-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 10000-SRI	True RMS output Fujicon F2023A (6 terminals)
10000	± 10000	O/L	± 15	4-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 10000-SRI/SP1	True RMS output Fujicon F2023A (6 terminals)
10000	± 10000	O/L	± 15	0-10 V_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 10000-SRU	True RMS output Fujicon F2023A (6 terminals)
12000	± 12000	O/L	± 15	10 V	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 12000-SB	Fujicon F2023A (6 terminals)
12000	± 12000	O/L	± 15	20 mA	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 12000-SBI	Fujicon F2023A (6 terminals)
12000	± 12000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 12000-SBI/SP1	Fujicon F2023A (6 terminals)
12000	± 12000	O/L	± 15	0-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 12000-SRI	True RMS output Fujicon F2023A (6 terminals)
12000	± 12000	O/L	± 15	4-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 12000-SRI/SP1	True RMS output Fujicon F2023A (6 terminals)
12000	± 12000	O/L	± 15	0-10 V_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 12000-SRU	True RMS output Fujicon F2023A (6 terminals)
14000	± 14000	O/L	± 15	10 V	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 14000-SB	Fujicon F2023A (6 terminals)
14000	± 14000	O/L	± 15	20 mA	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 14000-SBI	Fujicon F2023A (6 terminals)
14000	± 14000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 14000-SBI/SP1	Fujicon F2023A (6 terminals)
14000	± 14000	O/L	± 15	0-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 14000-SRI	True RMS output Fujicon F2023A (6 terminals)
14000	± 14000	O/L	± 15	4-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 14000-SRI/SP1	True RMS output Fujicon F2023A (6 terminals)
14000	± 14000	O/L	± 15	0-10 V_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 14000-SRU	True RMS output Fujicon F2023A (6 terminals)
20000	± 20000	O/L	± 15	10 V	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 20000-SB	Fujicon F2023A (6 terminals)
20000	± 20000	O/L	± 15	20 mA	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 20000-SBI	Fujicon F2023A (6 terminals)
20000	± 20000	O/L	± 15	4 mA @ -I_{PN} 20 mA @ +I_{PN}	DC-3 (+/-3dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 20000-SBI/SP1	Fujicon F2023A (6 terminals)
20000	± 20000	O/L	± 15	0-20 mA_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 20000-SRI	True RMS output Fujicon F2023A (6 terminals)
20000	± 20000	O/L	± 15	4-20 mADC	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 20000-SRI/SP1	True RMS output Fujicon F2023A (6 terminals)
20000	± 20000	O/L	± 15	0-10 V_{DC}	DC & 0.015...3 (+/-3 dB) [1]	2	-25...+85		Aperture 162x42 mm		Fujicon		71	HAZ 20000-SRU	True RMS output Fujicon F2023A (6 terminals)

Notes:
a) Exclude electrical offset
1) Small signal bandwidth to avoid excessive core heating at high frequency

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

TTR

V_{PN} = 10 V ... 1500 V

TTR - On-Board

Closed–loop

I_{PN} (V_{PN}) mA	I_P (V_P) mA	Technology	U_C V	I_{out} @ I_{PN}	BW kHz	X_G T_A = 25 °C % @ I_{PN} with max offset taken	T_A °C	UR or UL	Packaging No	Type	Features
10 (10 to 1500 V)	± 14 (2100 V)	C/L	± 15	25 mA	Note c)	0.8	-40...+85	•	76	LV 25-P/SP5 note d)	Isolation test voltage: 4.2 kV_{RMS}

V_{PN} = 50 V ... 1500 V

IDT

$\pm V_{PN}$ V	$\pm V_P$ V	Technology	U_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	UR or UL	Packaging No	Type	Connection primary	Connection secondary
50	75	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 50	2 x M5	3 x M5 + Faston
125	188	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 125	2 x M5	3 x M5 + Faston
150	225	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 150	2 x M5	3 x M5 + Faston
250	375	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 250	2 x M5	3 x M5 + Faston
500	750	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 500	2 x M5	3 x M5 + Faston
750	1125	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 750	2 x M5	3 x M5 + Faston
750	1125	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		86	DVL 750/SP2	M5	M5 insert
1000	1500	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 1000	2 x M5	3 x M5 + Faston
1000	1500	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		87	DVL 1000/SP1	M5	Burndy vertical
1000	1500	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		86	DVL 1000/SP5	M5	M5 insert
1000	1500	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		88	DVL 1000/SP7	cable	cable
1000	1500	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		89	DVL 1000/SP8	M5	cable
1000	1500	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		81	DV 1000	Cable	Cable
1200	1800	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		82	DV 1200/SP2	Cable	M5 + Faston
1500	2250	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 1500	2 x M5	3 x M5 + Faston
1500	2250	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		87	DVL 1500/SP1	M5	Burndy vertical
1500	2250	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		86	DVL 1500/SP2	M5	M5 insert
1500	2250	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		88	DVL 1500/SP5	cable	cable
1500	2250	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		89	DVL 1500/SP6	M5	cable
1500	2250	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		82	DV 1500	Cable	M5 + Faston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Notes:
c) See response time in the individual data sheet
d) The primary and secondary connections of this transducer are done on PCB

V_{PN} = 140 V ... 4200 V

TTR - On-Board

IDT | Fluxgate

$\pm V_{PN}$ V	$\pm V_P$ V	Technology	U_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	UR or UL	Packaging No	Type	Connection primary	Connection secondary
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		78	DVL 2000	2 x M5	3 x M5 + Faston
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		87	DVL 2000/SP1	M5	Burndy vertical
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		88	DVL 2000/SP5	cable	cable
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-14 (-3dB)	0.5	-40...+85		89	DVL 2000/SP6	M5	cable
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		81	DV 2000	Cable	Cable
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		82	DV 2000/SP1	Cable	M5 + Faston
2000	3000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		83	DV 2000/SP2	M5	M5
2800	4200	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		90	DV 2800/SP1	M5 vertical	Burndy vertical
2800	4200	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		84	DV 2800/SP4	M5	M5
3000	4500	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.35	-40...+85		84	DV 3000/SP1	M5	M5
4000	6000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		91	DV 4000/SP1	M5	Burndy vertical
4000	6000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		90	DV 4000/SP2	M5 vertical	Burndy vertical
4200	6000	Insulating digital technology	± 15...24	7 V	DC-12 (3dB)	0.3	-40...+85		92	DV 4200/SP1	M5	D-Sub
4200	6000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		81	DV 4200/SP3	Cable	Cable
4200	6000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		84	DV 4200/SP4	M5	M5
4200	6000	Insulating digital technology	± 15...24	50 mA	DC-12 (3dB)	0.3	-40...+85		93	DV 4200/SP5	M5 vertical	D-Sub
140	200	Fluxgate "C"	± 15	10 V/200 V	DC-300 (-1dB)	0.2 @ V_P	-40...+85		80	CV 3-200	2 x M5	4 x M5
350	500	Fluxgate "C"	± 15	10 V/500 V	DC-300 (-1dB)	0.2 @ V_P	-40...+85		80	CV 3-500	2 x M5	4 x M5
700	1000	Fluxgate "C"	± 15	10 V/1000 V	DC-500 (-1dB @ 50 % V_{PN})	0.2 @ V_P	-40...+85		80	CV 3-1000	2 x M5	4 x M5
840	1200	Fluxgate "C"	± 15	10 V/1200 V	DC-800 (-1dB @ 40% V_{PN})	0.2 @ V_P	-40...+85		80	CV 3-1200	2 x M5	4 x M5
1000	1500	Fluxgate "C"	± 15	10 V/1500 V	DC-800 (-1dB @ 33% V_{PN})	0.2 @ V_P	-40...+85		80	CV 3-1500	2 x M5	4 x M5
1400	2000	Fluxgate "C"	± 15	10 V/2000 V	DC-300 (-1dB @ 25% V_{PN})	0.2 @ V_P	-40...+85		80	CV 3-2000	2 x M5	4 x M5

78 86 87 88 89

80

81 82 83 84
90 91 92 93

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TTR - On-Board

Energy Measurement for On-Board Applications: EM4T II

With the liberalization and/or privatization of some of the major rail networks, the opportunity for traction units to cross national boundaries now exists, using both the installed base of rail and planned rail networks.
This gave train designers the daunting task to develop multi-system locomotives to be used on the different existing networks.
These prime movers would be needed to operate on the different supply networks of bordering countries along the route without requiring an equipment exchange at the regional or network supply border.
Today, it is therefore technically possible to transfer people or goods throughout Europe, from Norway to Sicily for example, without any physical exchange of the locomotive (Picture 1).
Changes in the Energy Markets in the form of deregulation and increased competition for large user contracts brought potential benefits for those willing to negotiate for their electrical traction supply requirements.
This negotiation however requires greater knowledge and understanding of the load profile of bulk supply points in one of the harshest electrical environments – the traction supply.
With the energy meter from LEM, the data for the precise calculation of both supplied and regenerated energy for billing purposes can be accomplished on the train, independently of the energy supplier.

The second generation of universal energy meters for traction especially designed for on-board applications

With the EM4T II energy meter LEM introduced the second generation of universal energy meters for electric traction units with the authorization for billings. Thanks to the advanced capability (such as input channels to connect any actual available current and voltage transducer or transformer) of the EM4T II, it is used both in new multi-system locomotives and for retrofitting to all types of electrical rail vehicles already in operation. Recently, the new EN 50463 standards define characteristics of energy measurement function (EMF) as well as transducers for current and voltage DC or AC measurement used for EMF. This evolution led LEM to upgrade EM4T to the latest model: EM4T II.

EM4T II - the load profile provider

EM4T II is a single energy meter complying to all the requirements of EN 50463-x & EN 50155 standards for metering and On-Board use, and thus satisfies the requirements of EC Decision 2011/291/EC (TSI “Locomotives and passenger rolling stock”).

EM4T II processes signals from the transformer and electronic converter systems for current and voltage to calculate energy values which are stored as load profile information.

In this load profile (set and stored in intervals of 1, 2, 3, 5, 10 or 15 minutes period length according to the user), the primary energy (delta) values are recorded together with data such as:

- Date and time stamp
- Events
- Train identification numbers
- Absolute energy values for consumption and regeneration of active and reactive energy
- Frequency of the network (16.7 Hz, 50 Hz, 60 Hz or DC)
- Additional “user” load profile like the voltage with a shorter time interval (feature coming in a second design step)
- Position of the train at the time the load profile was stored and/or the event arose
- Further functions, such as voltage detection can be set.

The measured energy information includes separately the consumed and regenerated active and reactive energy and is stored in the load profile memory (at 5 minutes period length) for at least 300 days.

The input variables (current and voltage) are connected to the measuring circuits of the EM4T II via differential inputs (Picture 2 and 3), designed for connection of all current and voltage transducers/transformers currently available on the market.

Four input channels are proposed for metering of both DC and AC signals of any existing traction network (see chart 1).

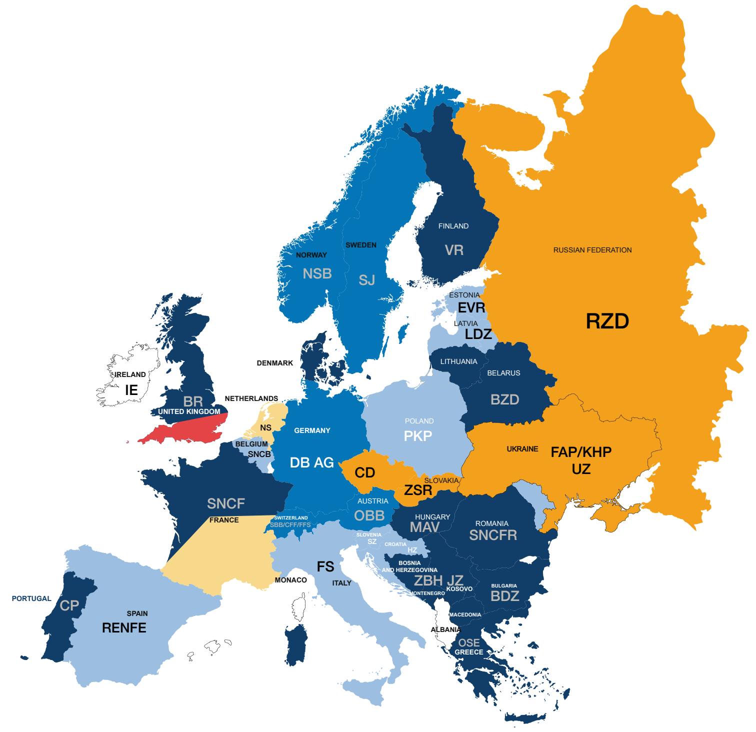
The EM4T II is suitable for usage in multi-system vehicles. Supply systems 25 kV 50/60 Hz and 15 kV 16.7 Hz, or either 600 V DC, 750 V DC, 1.5 kV DC or 3 kV DC are covered. A system change is detected by the energy meter and stored in the load profile.

The requirements for current measurement at this level can be diverse.

A large aperture transducer is appropriate when the primary conductor is highly isolated to support the high level of voltage (15 to 25 kV AC as nominal level): LEM’s ITC Transducer Series is of this category.

Shunts can also be used at this level associated to LEM DI models providing the required insulation and the class 1R accuracy (when used with a class 0.2R shunt).

TTR - On-Board



Picture 1 :
European rail networks

- not electrified
- electrified (DC) tracks
- 1.5 kV DC
- 3 kV DC
- 15 kV 16.7 Hz
- 25 kV 50 Hz
- 3 kV DC / 25 kV 50Hz

EM4T II

Energy meter for electrical traction unit railways

- Data recording according to EN 50463-x
- Accuracy 0.5R according to EN 50463-2
- Multi-System capability for DC, 16.7 Hz, 50 Hz, 60 Hz
- Supply systems according to EN50163: 25 kV 50 Hz, 15 kV 16.7 Hz, 600 V DC, 750 VDC, 1.5 kV DC, 3 kV DC
- Measurement of consumed and regenerated active and reactive energy
- For DC optionally with up to 3 DC current channels
- Input for GPS receiver
- Load profile recording including location data
- RS-type interface for data communication
- Ethernet-interface (Available in the next version)

Picture 2: EM4T II

Siemens Train

Version	Channel 1	Channel 2	Channel 3	Channel 4
AC	AC-voltage	AC-current		
ACDC	AC-voltage	AC-current	DC-voltage	DC-current
DC	DC-voltage	DC-current		
DCDC	DC-voltage	DC-current	DC-current	
DCDCDC	DC-voltage	DC-current	DC-current	DC-current

Chart 1: EM4T II possible configurations for inputs

For the DC networks, the transducer's inherent isolation properties are adequate.

Analog to Digital Sigma-Delta conversion processors suppress high frequency disturbances in all channels, enhancing even further the capacity to handle the often rapid supply transitions within traction supplies.

The microprocessor reads the sampled values and calculates the real energy in adjustable intervals (standard value = 5 min). The results are then saved in flash memory (a special variant of an EEPROM).

The signals from 2 AC and 2 DC input channels (each for U- and I- input) are used to calculate the energy values. The high-accuracy measurement of the energy value is guaranteed by the digitally sampled signal converter implemented, providing the highest level of temperature and long-term stability.

Optionally, the EM4T II for DC measurement is available in a version with a single voltage input and up to three current inputs to measure the energy consumption for vehicles with multiple power supply points.

The EM4T II has a dedicated RS232 interface input for receiving serial GPS-data messages according to NMEA 0183, including the location data of the energy consumption point. It synchronizes also the internal clock of the meter using the obtained time information.

A log book in full conformity with EN 50463-3 is stored in the EM4T II. This log book information contains e.g. loss and gain of the operating voltage, power up/power down events of the supply voltage, clock synchronization, and the modification of parameters influencing the energy calculating.

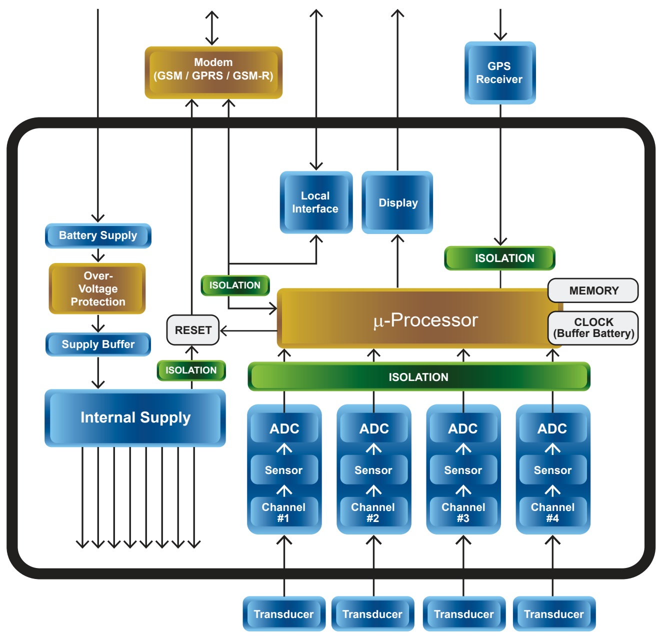
Identification data of the vehicle or train are also stored and can be retrieved separately. The self-luminous display of the EM4T II shows cyclically all relevant energy and status information without required operations of a mechanical or optical button.

All measured and stored data can be read out via the RS-type interface (via modem or local).

The interface versions RS232, RS422 or RS485 are available. The applied data communications protocol is IEC 62056-21 and is therefore easily adaptable by all common remote reading systems. In the next version, the EM4T II will also provide an Ethernet-interface.

The supply voltage is selectable between 24 V and 110 V. Optionally, the EM4T II offers a power supply of 12 V for a communication unit (modem).

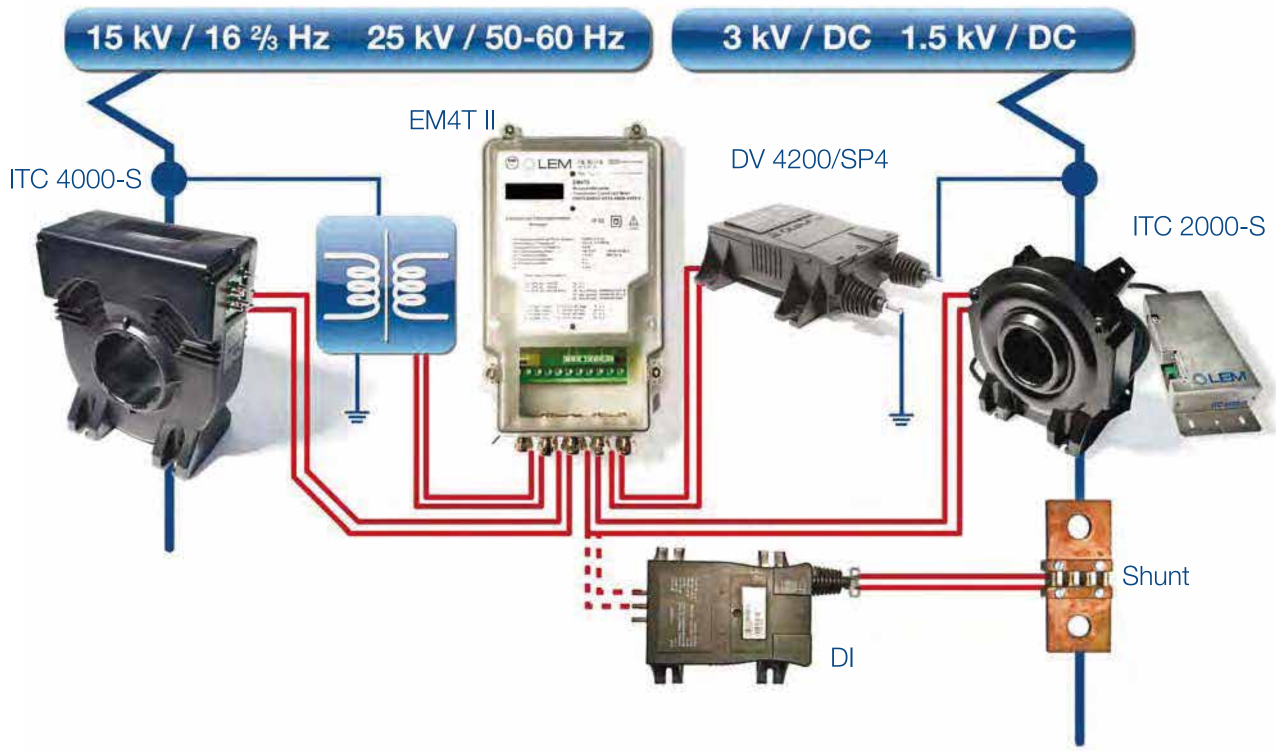
The operating conditions (considering EMC, temperature, vibration, etc.) meet the special requirements for traction use, including EN 50155, EN 50121-3-2, EN 50124-1, and EN 61373. The compact and fire-retardant enclosure provides protection against the ingress of moisture or foreign objects according IP 65.



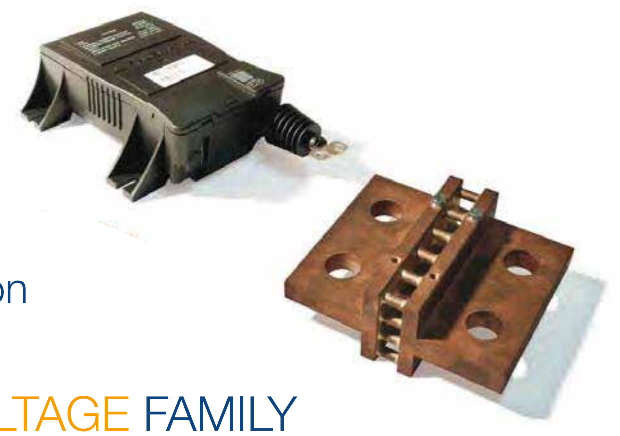
Picture 3: Block diagram of the LEM energy meter

Standards & Regulations

- EN 50463-x (2012): Draft: Railway application, Energy measurement on board trains, DC measurement Class 2, AC measurement Class 1.5
- EN 50155 (2007): Railway applications, Electronic equipment used on rolling stock
- EN 50121-3-2 (2006): Railway applications, Electromagnetic compatibility, Part 3-2: Rolling stock - Apparatus
- EN 61373 (2010): Railway applications, Rolling stock equipment, Shock and vibration tests
- EN 50124-1 (2001): Railway applications, Insulation coordination, Part 1: Basic requirements
- IEC 62056-21 (2002): Electricity metering, Data exchange for meter reading, tariff and load control, Part 21: Direct local data exchange



Part of a high voltage frame of a multi-system locomotive with the positions needed for current & voltage measurement

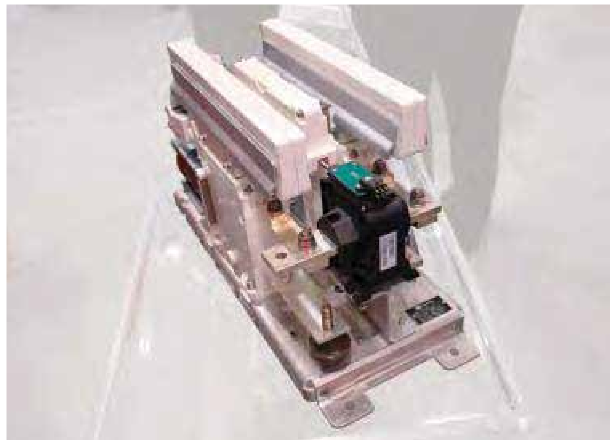


DI 30...200 mV
(Shunt isolator)
Class 1R
High galvanic isolation

DV-VOLTAGE FAMILY
1200 to 4200 V_{RMS}
One unique compact package
Class 0.75R accuracy
Low thermal drift

ITC 2000...4000-S FAMILY
Better than Class 0.5R
High temperature stability

	On-Board												Trackside			Substation		Product Solution	Nominal Range
	Main circuit breaker	Main rectifier	DC Link	Auxiliary inverter	Propulsion inverter	Energy measurement	SECONDARY SYSTEM: Lighting / plugs	SECONDARY SYSTEM: HVAC	SECONDARY SYSTEM: Doors Control	SECONDARY SYSTEM: Battery Charger	SECONDARY SYSTEM	Interference measurement	Points	Relays	Signaling	Switchgear	Package represented on page n°		
CURRENT MEASUREMENT	●					●										●	46-47	LT 4000-S family	3300-4000 A
				●	●		●	●									45-46-47	LTC family	350-1000 A
				●			●	●									44-45	LAC 300-S	130-400 A
				●			●	●		●							44	LF 205-S family	100-200 A
				●			●	●		●							44	LF 305-S family	300 A
				●			●	●									45	LF 505-S family	500 A
				●			●	●									46	LF 1005-S family	1000 A
				●	●	●	●	●									47	LF 2005-S family	2000 A
			●	●			●	●									46	HAR family	1000 A
				●			●	●									46-47	HTC family	1000-3000 A
						●										●	46-47	ITC family	2000-4000 A
																●	52-53	HAZ family	4000-20000 A
	●	●	●	●													50	CD family	2 x 1200 A, 1500 A, 2 to 10 A differential
												●					51	RA family	0.1-20 A AC superposed on 1000 to 4000 A DC
									●				●		●		44	LA 25-NP family	0.4-25 A
													●				52	PCM family	5-10-20-30 A
VOLTAGE				●			●	●					●		●		54	LV 25-P family	10-1500 V
				●	●	●				●							55	CV 3-Voltage family	140-1400 V
			●	●	●					●							54-55	DVL Voltage family	50-2000 V
	●	●	●		●	●										●	54-55	DV-Voltage family	1000-4200 V
ENERGY						●											57	EM4T II	
	●					●										●	50	DI (Shunt Isolator)	30-200 mV


LTC model in circuit breaker. Picture provided by courtesy of Sécheron.


LF 205 models in auxiliary inverter. Picture provided by courtesy of SMA.


LV 25-P/SP5 model in auxiliary inverter.

LAC 300-S/SP1 model in auxiliary inverter.

	I_{PN} A_{DC}	I_{PN} A_{RMS}	I_P A	Technology	U_C V	V_{out} I_{out} @ I_{PN} (DC)	BW kHz Note j)	E_L Linearity (ppm) Note i) k)	I_{OE} V_{OE} Offset (ppm) Note k) l)	Noise (RMS) (ppm) (DC-100Hz) Note k)	Noise (RMS) (ppm) (DC-50kHz) Note k)	TCI_{OE} TCV_{OE} (ppm/K) Note k)	T_A °C	Mounting			Busbar Aperture Diameter (mm)	UR or UL	Packaging No	Type	Features
														PCB	On-board Panel	Measuring head + 19" rack electronic					
Stand-alone DC/AC Current Transducers	12.5	8.8	± 12.5	Fluxgate IT	± 15	50 mA	DC-500 (3dB)	4	500	0.5	10 (DC-100kHz)	2	10...+45	●			Integrated		94	ITN 12-P	Metal housing for high immunity against external influence
	60	42	± 60	Fluxgate IT	± 15	100 mA	DC-800 (3dB)	20	250	1	15	2.5	10...+50		●		26		95	IT 60-S	
	200	141	± 200	Fluxgate IT	± 15	200 mA	DC-500 (3dB)	3	80	1	15	2	10...+50		●		26		95	IT 200-S	
	300	300	± 450	Fluxgate IT	± 15	150 mA	DC-100 (-3dB)	10	666	N/A	N/A	6.66	-40...+85		●		21.5		96	ITB 300-S	
	400	282	± 400	Fluxgate IT	± 15	200 mA	DC-500 (3dB)	3	40	0.5	8	1	10...+50		●		26		95	IT 400-S	
	400	400	± 900	Fluxgate IT	± 15	266.66 mA	DC-200 m) (3dB)	1	10	0.017 (0.125Hz-1kHz)	0.006 (1kHz-30kHz)	0.3	10...+50		●		Integrated busbar 19 mm diameter		97	ITL 900-T	
	600	424	± 600	Fluxgate IT	± 15	400 mA	DC-300 (3dB)	1.5	15	0.3	15 (DC-100kHz)	0.5	10...+50		●		30		98	ITN 600-S	
	700	495	± 700	Fluxgate IT	± 15	400 mA	DC-100 (3dB)	3	50	0.5	6	0.5	10...+50		●		30		99	IT 700-S	
	700	495	± 700	Fluxgate IT	± 15	400 mA	DC-100 (3dB)	3	50	1	16	0.5	10...+50		●		30		100	IT 700-SPR	Programmable from 80 A in step of 10 A
	700	495	± 700	Fluxgate IT	± 15	10 V	DC-100 (3dB)	30	60	2	10	4	10...+50		●		30		99	IT 700-SB	
	900	636	± 900	Fluxgate IT	± 15	600 mA	DC-300 (3dB)	1	10	0.2	10	0.3	10...+50		●		30		99	ITN 900-S	
	1000	707	± 1000	Fluxgate IT	± 15	1 A	DC-500 (3dB)	3	50	N/A	6	0.5	10...+50		●		30		101	IT 1000-S/SP1	High bandwidth
	4000	4000	± 12000	Fluxgate IT	± 24	1.6 A	DC-50 n) (1dB)	100	62.5	125 (0.1Hz-10kHz)	125 (0.1Hz-10kHz)	1.38	-40...+70		●		268		74	ITL 4000-S	

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Notes:

i) Linearity measured at DC

j) Bandwidth is measured under small signal conditions – amplitude of 0.5% I_{PN} (DC)

k) All ppm figures refer to V_{out} or I_{out} @ I_{PN} (DC) except for ITL 900–T where it refers to I_{OUT} = 600 mA

l) Electrical offset current + self magnetization + effect of earth magnetic field @ T_A = +25 °C

m) Small signal 5% of I_{PN} (DC), 32 A_{RMS}

n) Small signal 40 A_{RMS}

o) Bandwidth is measured under small signal conditions – amplitude of 1% I_{PN} (DC)

N/A : Not Available

I_{PN} = 40 A ... 24000 A

Rack System DC/AC Current Transducers

I_{PN} A_{DC}	I_{PN} A_{RMS}	I_P A	Technology	U_C V	V_{out} I_{out} @ I_{PN} (DC)	BW kHz Note j)	E_L Linearity (ppm) Note i) k)	I_{OE} V_{OE} Offset (ppm) Note k) l)	Noise (RMS) (ppm) (DC-100Hz) Note k)	Noise (RMS) (ppm) (DC-50kHz) Note k)	TCI_{OE} TCV_{OE} (ppm/K) Note k)	T_A °C	Mounting: PCB	Mounting: On-board Panel	Mounting: Measuring head + 19" rack electronic	Busbar Aperture Diameter (mm)	UR or UL	Packaging No	Type	Features
600	424	± 600	Fluxgate IT	100-240 VAC - 50/60 Hz	1 A	DC-500 o) (3dB)	1	2	11 (DC-10kHz)	28 (DC-100kHz)	0.1	0...+55 Head +10...+40 Elec.			●	25.4		102 + 103	ITZ 600-SPR	Programmable by steps of 20 A from 40 A to 620 A
600	424	± 600	Fluxgate IT	100-240 VAC - 50/60 Hz	10 V	DC-300 o) (3dB)	10	3	8 (DC-10kHz)	60 (DC-100kHz)	0.3	0...+55 Head +10...+40 Elec.			●	25.4		102 + 103	ITZ 600-SBPR	Programmable by steps of 20 A from 40 A to 620 A
2000	1414	± 2000	Fluxgate IT	100-240 VAC - 50/60 Hz	2 A	DC-300 o) (3dB)	2	2	3 (DC-10kHz)	27 (DC-100kHz)	0.1	0...+55 Head +10...+40 Elec.			●	50		102 + 104	IT 2000-S	
2000	1414	± 2000	Fluxgate IT	100-240 VAC - 50/60 Hz	10 V	DC-300 o) (3dB)	11	3	3 (DC-10kHz)	60 (DC-100kHz)	0.3	0...+55 Head +10...+40 Elec.			●	50		102 + 104	IT 2000-SB	
2000	1414	± 2000	Fluxgate IT	100-240 VAC - 50/60 Hz	1 A	DC-80 o) (3dB)	2	2	7 (DC-10kHz)	42 (DC-100kHz)	0.1	0...+55 Head +10...+40 Elec.			●	50		102 + 104	IT 2000-SPR	Programmable by steps of 125 A from 125 A to 2000 A
2000	1414	± 2000	Fluxgate IT	100-240 VAC - 50/60 Hz	10 V	DC-80 o) (3dB)	11	3	2 (DC-10kHz)	60 (DC-100kHz)	0.3	0...+55 Head +10...+40 Elec.			●	50		102 + 104	IT 2000-SBPR	Programmable by steps of 125 A from 125 A to 2000 A
5000	3535	± 5000	Fluxgate IT	100-240 VAC - 50/60 Hz	2 A	DC-80 o) (3dB)	3	2	2.5 (DC-10kHz)	20 (DC-100kHz)	0.1	0...+55 Head +10...+40 Elec.			●	140.3		102 + 105	IT 5000-S	
5000	3535	± 5000	Fluxgate IT	100-240 VAC - 50/60 Hz	10 V	DC-80 o) (3dB)	11	3	2.5 (DC-10kHz)	60 (DC-100kHz)	0.3	0...+55 Head +10...+40 Elec.			●	140.3		102 + 105	IT 5000-SB	
10000	7070	± 10000	Fluxgate IT	100-240 VAC - 50/60 Hz	2 A	DC-20 o) (3dB)	5	2	8 (DC-10kHz)	20 (DC-100kHz)	0.1	0...+55 Head +10...+40 Elec.			●	100		102 + 106	IT 10000-S	
10000	7070	± 10000	Fluxgate IT	100-240 VAC - 50/60 Hz	10 V	DC-20 o) (3dB)	12	3	8 (DC-10kHz)	60 (DC-100kHz)	0.3	0...+55 Head +10...+40 Elec.			●	100		102 + 106	IT 10000-SB	
16000	11314	± 16000	Fluxgate IT	100-240 VAC - 50/60 Hz	2 A	DC-3 o) (3dB)	6	2	8 (DC-10kHz)	20 (DC-100kHz)	0.1	0...+55 Head +10...+40 Elec.			●	150.3		102 + 107	IT 16000-S	
16000	11314	± 16000	Fluxgate IT	100-240 VAC - 50/60 Hz	10 V	DC-3 o) (3dB)	12	3	8 (DC-10kHz)	60 (DC-100kHz)	0.3	0...+55 Head +10...+40 Elec.			●	150.3		102 + 107	IT 16000-SB	
24000	16970	± 24000	Fluxgate IT	100-240 VAC - 50/60 Hz	3 A	DC-2 o) (3dB)	6	2	8 (DC-10kHz)	20 (DC-100kHz)	0.1	0...+55 Head +10...+40 Elec.			●	150.3		102 + 107	IT 24000-S	

105

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104

103

107

102

Notes:

i) Linearity measured at DC

j) Bandwidth is measured under small signal conditions – amplitude of 0.5% I_{PN} (DC)

k) All ppm figures refer to V_{out} or I_{out} @ I_{PN} (DC) except for ITL 900–T where it refers to I_{OUT} = 600 mA

l) Electrical offset current + self magnetization + effect of earth magnetic field @ T_A = +25 °C

m) Small signal 5% of I_{PN} (DC), 32 A_{RMS}

n) Small signal 40 A_{RMS}

o) Bandwidth is measured under small signal conditions – amplitude of 1% I_{PN} (DC)

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

AUTOMOTIVE

In the automotive market, LEM works with all the major car manufacturers and Tier-1 suppliers in the world, and supplies galvanically-isolated electronic transducers that measure electrical parameters in battery-management and motor-control applications.

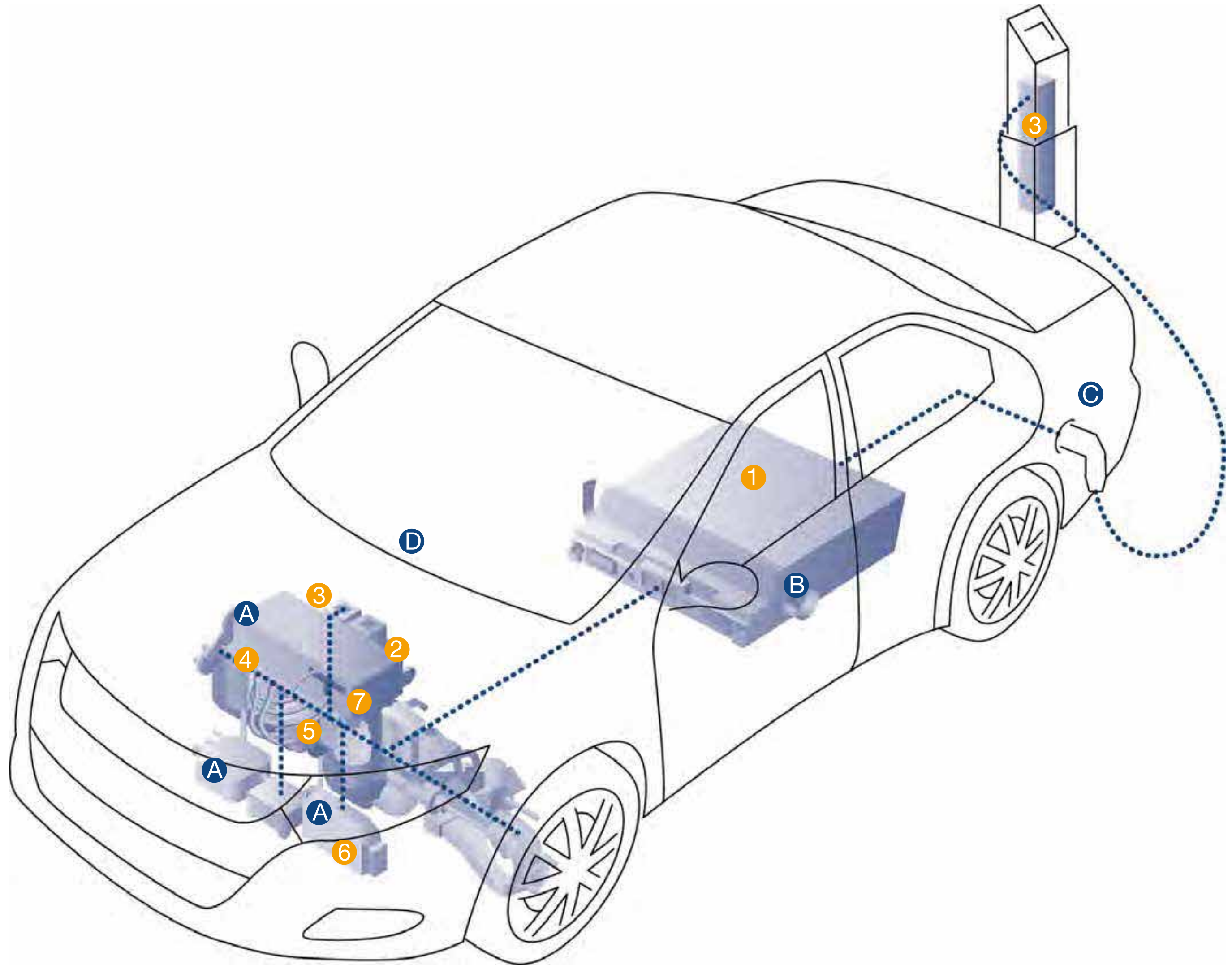
The ever more stringent requirements for energy efficiency and reduced CO2 emissions lead car manufacturers to increasingly depend on on-board electrical components. From electric power-steering and stop-start technologies to on-board navigation and infotainment systems, these components put an additional load on the electrical circuits and particularly the battery, making it essential to control the energy generated and consumed by the various on-board systems. In collaboration with its customers and with the help of powerful simulation techniques, LEM uses the most-appropriate technology (from Hall-cell to fluxgate) to address the specific need of measuring the currents (coulombs) entering and leaving the car's battery and/or the alternator. This allows an intelligent management of available power that leads to the increased efficiency of today's internal-combustion engines. More importantly still, the hybrid- and electric-vehicles entering the market today depend on accurate measurement of battery-pack currents to determine the available driving range and recharging strategy. LEM has the technology.

Not only must battery currents be accurately measured in hybrid- and electric-vehicles, but the electric motors driving the wheels of this new generation of automobiles also need to be precisely controlled to allow smooth operation. Electric motor phase-current sensing has been LEM's core competency since its beginning and remains today a major application for its technology. LEM has a dedicated product range for measuring phase-currents in motors and DC-DC converters essential to all hybrid- and electric-vehicles.

LEM is a key player in the new generation of automobiles, using its know-how acquired over 40 years to develop the specific technologies to measure battery and motor-phase currents that allow the car industry to meet the ever increasing requirements in energy efficiency. The following pages give you an introduction into LEM's technology for automotive applications.

HC2F model in inverter.

Automotive Applications Overview

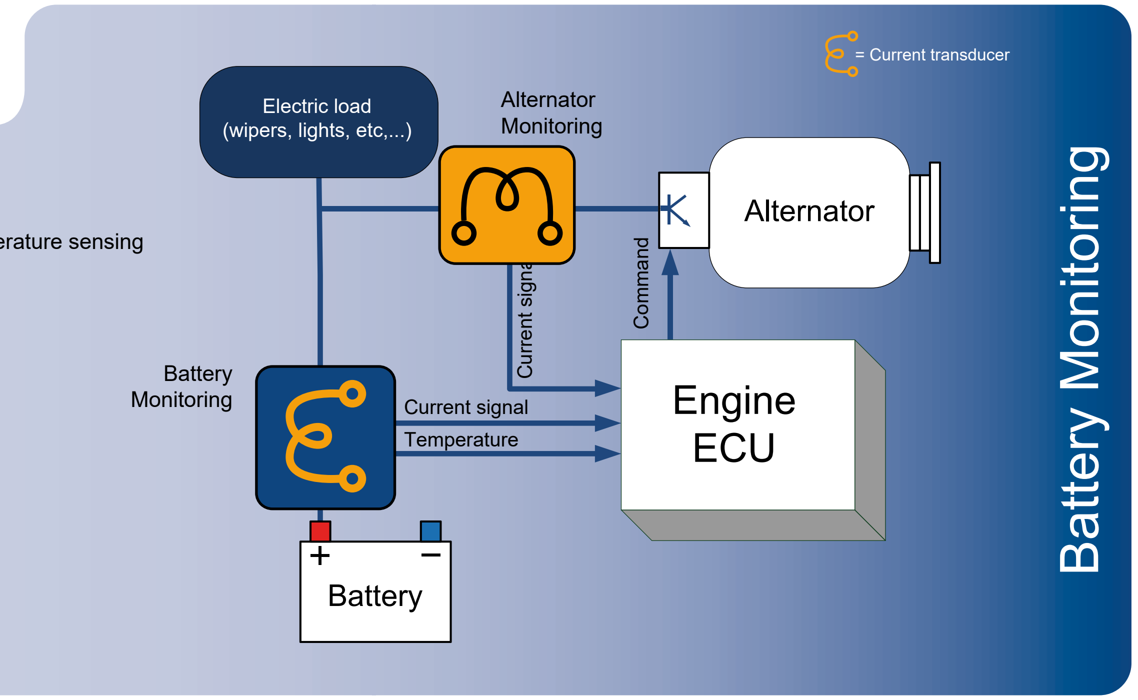


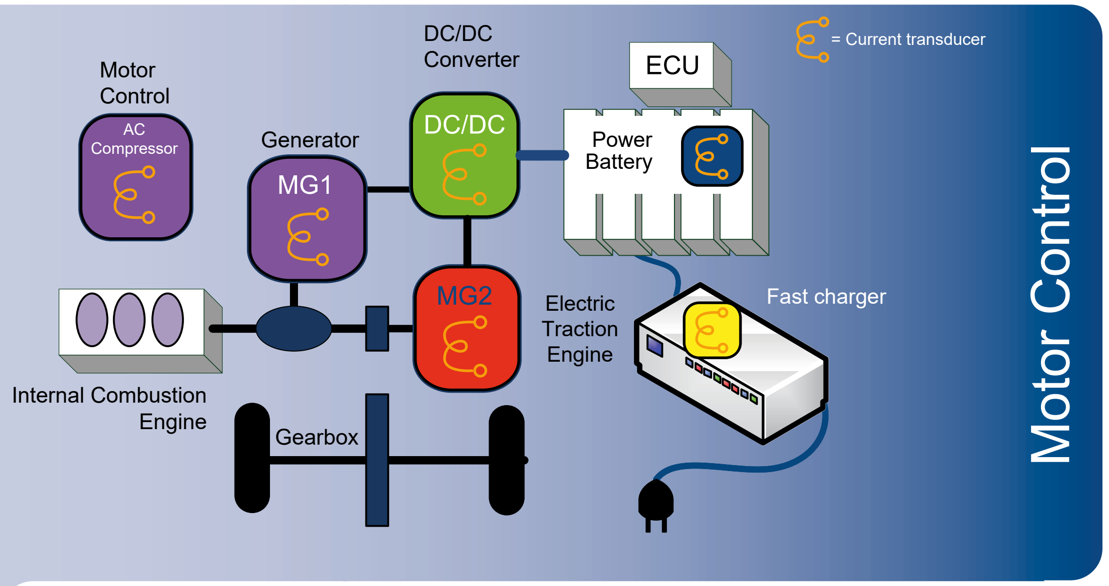
1. High-voltage battery
2. Vehicle control unit
3. Charger
4. Motor controller
5. Electric motor and transaxle
6. DC/DC converter
7. Electric power steering

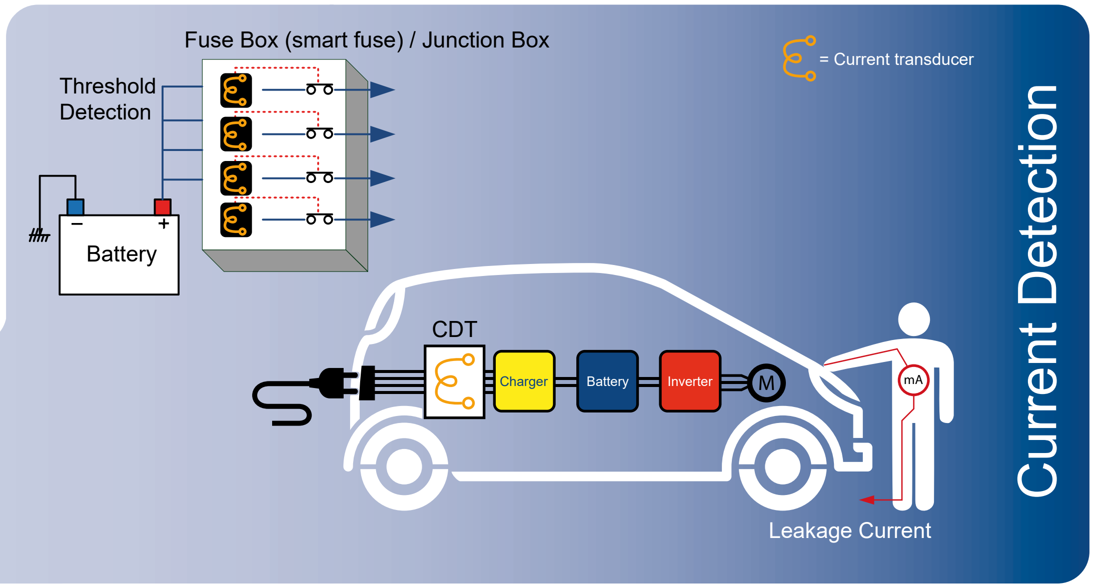
- A HAH1DR - HAH3 - HC2 - HC5 - HC6 - CKSR
- B DHAB - HAH1BV - CAB
- C CDT
- D FHS (dashboard)

Automotive Selection Guide

PRODUCT NAME	MAXIMUM PEAK MEASUREMENT RANGE (A)	OUTPUT SIGNAL	TYPICAL ACCURACY	APPLICATION
HAB	± 400	V / PWM	±2%	Battery Monitoring
HABT	± 100	V	±2%	Battery Monitoring, with temperature sensing
HAG	± 300	V / PWM	±2%	Battery Monitoring, Alternator Monitoring
DHAB	± 1000	V	±2%	Battery Monitoring, Alternator Monitoring
CAB	± 400	CAN / LIN*	±0.1%	Battery Monitoring, Alternator Monitoring
HAH1 BV	± 900	V	±2%	Battery Monitoring
HAH1 DR	± 900	V	±2%	DC/DC Converter, Inverter Drive, Motor Control
HC2F/HC2H	± 250	V	±3%	DC/DC Converter, Inverter Drive, Motor Control
HC6F/HC6H	± 800	V	±3%	DC/DC Converter, Inverter Drive, Motor Control
HC5FW	± 900	V	±1%	DC/DC Converter, Inverter Drive, Motor Control
HC20	± 2000	V	±2%	DC/DC Converter, Inverter Drive, Motor Control
HAH3	± 900	V	±1%	DC/DC Converter, Inverter Drive, Motor Control; 3 phase measurement
HAM	± 250	V	±1%	DC/DC Converter, Inverter Drive, Motor Control, Charger; very high frequency bandwidth
CKSR	± 75**	V	±1%	DC/DC Converter, Motor Control, Charger
FHS40-P	± 100	V	±5%	Threshold Detection
CDT	0.1 A	V	±1mA***	Leakage Current







- Operating temperature for all products: -40°C to 125°C
- Supply Voltage for all products: 5V, Ratiometric
- Customization of standard products possible. Contact us.

* Supply Voltage: 12V
** Operating temperature: -40°C to 105°C
*** Guaranteed error for leakage current detection

Battery Monitoring | Alternator Monitoring | DC/DC Converter | Inverter Drive | Motor Control | Charger | Threshold Detection | Leakage Current

AUTOMOTIVE

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 SWITZERLAND	ISO/TS 16949: 2009 ISO 14001: 2004 ISO 9001: 2008 IRIS: 2009
LEM electronics (CHINA) Co, Ltd	ISO 9001: 2008 ISO/TS 16949: 2009 ISO 14001: 2004 IRIS: 2009
LEM Japan	ISO 9001: 2008 ISO 14001: 2004
TVELEM (RUSSIA)	ISO 9001: 2008

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 and traction are designed and tested according to recognized worldwide standards.

CE marking is a guarantee that the product complies with the European EMC directive 2004/108/EEC and low voltage directive and therefore warrants the electromagnetic compatibility of the transducers. Traction transducers comply to the EN 50121-3-2 standard (Railway EMC standard).

UL is used as a reference to define the flammability of the materials used for LEM products (UL94V0) as well as the NFF 16101 and 16102 standards fot the fire/smoke materials classification when transducers dedicated for traction applications.

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 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 except if dedicated to railway applications.

In that case, the EN 50155 standard dedicated to "Electronic Equipment used on Rolling stock" in railway applications is our standard of reference for electrical, environmental and mechanical parameters.

It guarantees then the overall performances of our products in railway environments.

All of the LEM traction products are designed according to the EN 50155 standard.

The individual data sheets 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.

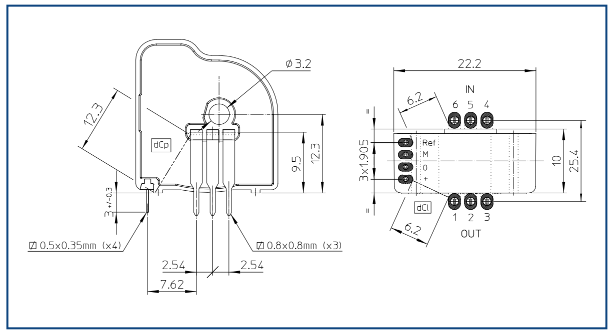
The rated insulation voltage level for transducers in "industrial" applications, is defined according to several criteria listed under the EN 50178 standard and IEC 61010-1 standard ("Safety requirements for electrical equipment for measurement, control and laboratory use"). Some criteria are dependent 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)
- Over-voltage category (application specific - characterizes the exposure of the equipment to over-voltages)
- 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 above figure as an example): 6.2 mm

CTI: 175 V (group IIIa)

Over-voltage 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).

For railway applications, the EN 50124-1 ("Basic requirements - Clearances and creepage distances for all electrical and electronic equipment") standard is 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 allowed by a transducer intended to be used in an application classified as being "Railway", is defined according to several criteria listed under the EN 50124-1 standard.

These criteria are the same as per the EN 50178 (seen previously) and are the following:

- Clearance distance,
- Creepage distance,
- Pollution degree,
- Over-voltage category,
- Comparative Tracking Index (CTI),
- Simple (Basic) or Reinforced isolation need.

LEM follows this thought process for the railway transducer designs:

Example: LTC 600-S, current transducer in an propulsion inverter

Conditions of use:

Creepage distance: 66.70 mm,

Clearance distance: 45.90 mm,

CTI: 600 V (group I),

Over-voltage category: II,

Pollution Degree: 3.

QUALITY

QUALITY

Basic or Single insulation:

According to EN 50124-1 standard: With clearance distance of 45.90 mm and PD3, U_{Ni} (Rated impulse voltage) = 30 kV. With U_{Ni} = 30 kV & OV II, the rated insulation voltage (AC or DC) called "U_{Nm}" can be from >= 6.5 up to < 8.3 kV.
With a creepage distance of 66.70 mm and PD3 and CTI of 600 V (group I), it is allowed to have 12.5 mm/kV, leading to a possible rated insulation voltage U_{Nm} of 5.336 kV.
In conclusion, the possible rated insulation voltage, U_{Nm}, in these conditions of use, is of 5.336 kV (the lowest value given by the both results from the creepage and clearance distances).

Reinforced insulation:

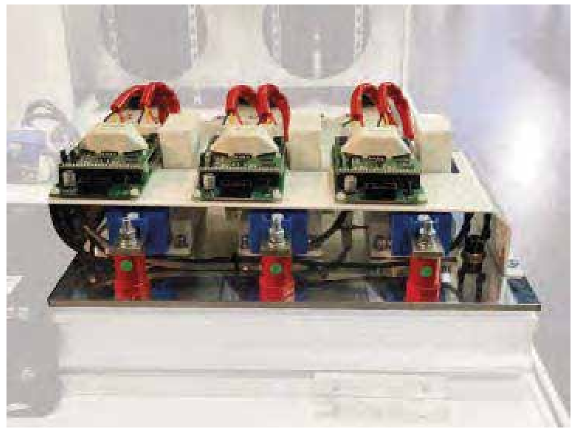
Let's look for the reinforced insulation for the same creepage and clearance distances as previously defined:

When dimensioning reinforced insulation, from the clearance distance point of view, the rated impulse voltage, U_{Ni}, shall be 160% of the rated impulse voltage required for basic insulation.
The clearance distance of 45.90 mm is already designed and then, we look for the reinforced insulation with this distance.
Reinforced U_{Ni} = 30 kV obtained with the clearance distance of 45.90 mm.
Basic U_{Ni} = Reinforced U_{Ni} / 1.6 = 18.75 kV.
Reinforced U_{Nm}: From >= 3.7 up to < 4.8 kV, according to the clearance distance.
From the creepage distance point of view, when dimensioning reinforced insulation, the rated insulation voltage U_{Nm} shall be two times the rated insulation voltage required for the basic insulation.
With a creepage distance of 66.70 mm and PD3 and *CTI* of 600 V (group I), it is then allowed to have 25 mm/kV (2 x 12.5) vs. 12.5 mm/kV previously (for basic insulation), leading to a possible reinforced rated insulation voltage U_{Nm} of 2.668 kV.
In conclusion, the possible reinforced rated insulation voltage U_{Nm}, in these conditions of use, is of 2.668 kV (the lowest value given by the both results from the creepage and clearance distances).

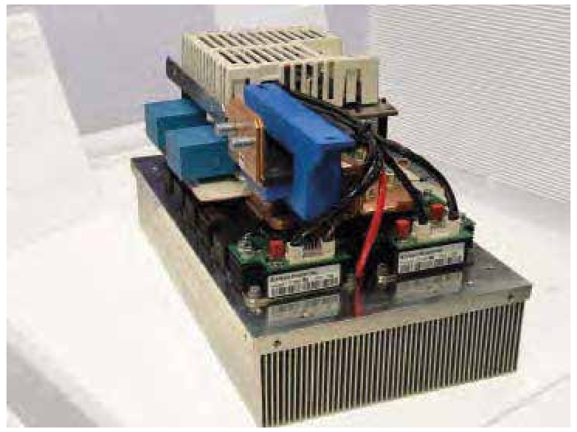
IRIS Certification

RoHS

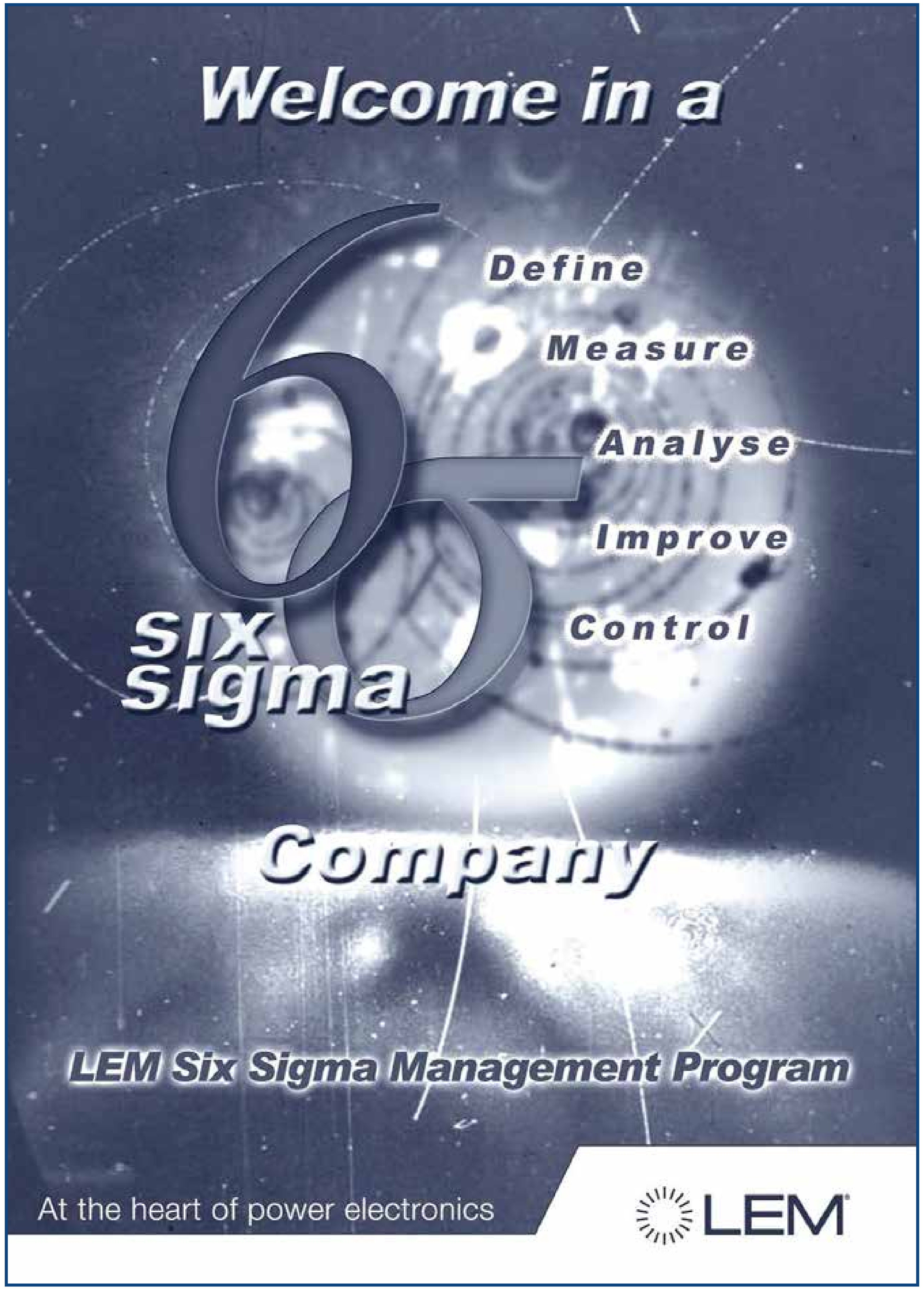
According to RoHS 2 directive 2011/65/EU



HAS model in converter.



HAX model in windmills inverter. Picture provided by courtesy of Infineon.



QUALITY

VARIOUS OPTIONS FOR SECONDARY CONNECTIONS

Molex 6410/A Series connector

JST VH Series Connector

Molex Mini-Fit, Jr 5566 Series Connector

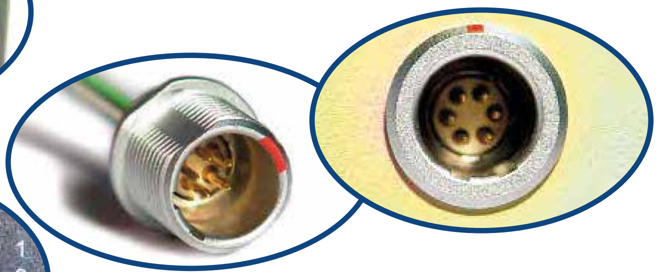
Molex 70543 Series Connector

Threaded Studs, M4, M5, UNC...

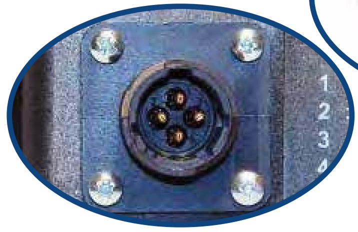
...or Faston 6.30 x 0.80 or screws...

...or the both, in the same time

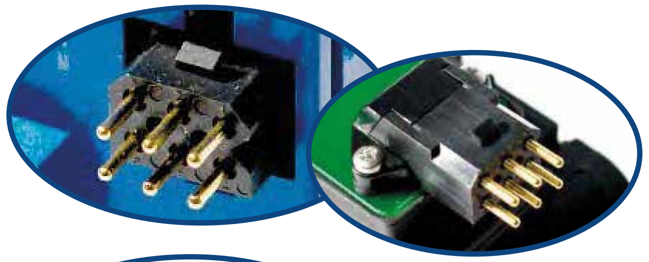
M4, M5 inserts



LEMO Connectors



AMP Connectors



Burndy Connectors

Sub-D Connectors

Cables, Shielded Cables...

But also Wago, Phoenix, Souriau ... connectors

LEM GROUP DESIGN SPECIFICATION

LEM Subsidiary: Contact: Date:

Customer information

e-mail:

Company :
City :
Country :
Contact person :
Phone :
Fax :
Project name :

Application

Market ☐ Drives ☐ UPS, REU ☐ Traction ☐ High precision ☐ Energy solutions ☐ Automotive
Utilization ☐ voltage ☐ current ☐ power ☐ other: _____
Function ☐ control ☐ differential m. ☐ ground fault detection ☐ other: _____

Electrical & Environmental characteristics

Transducer reference (if relevant):

Signal to measure

Type of signal: ☐ AC sin. ☐ DC ☐ square ☐ pulse ☐ other (specify) ☐ bidirectional ☐ unidirectional

Nominal value: _____ rms
Measuring range: _____ pk
(please provide a graph)

Overload value to be measured _____ rms
Peak: _____ pk
Duration: _____ s

Non measured overload: _____ pk
(to withstand) Frequency: _____ Hz
duration: _____ ms

di/dt to be followed: _____ A/µs
Bandwidth: _____ kHz

Operating frequency: _____ Hz
Ripple: _____ pk-pk
Ripple frequency: _____ Hz

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

Power supply: _____ V ± _____ %
☐ bipolar ☐ unipolar

Static and intrinsic values

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

Overall accuracy over operating temperature range _____ %

Maximum offset @ 25 ℃: _____ mA/mV

Dielectric strength:

OV category: Pollution degree:

Rated Insulation Voltage:
Single insulation: _____ V
Reinforced insulation: _____ V

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

Impulse withstand voltage _____ kV rms

Partial discharge level @ 10 pC: _____ kV

Preferred output: _____ ☐ mA/A ☐ mV/A
_____ ☐ mA/V ☐ mV/V
other (specify) _____

Measuring resistance _____ fi ☐ min ☐ max

Turn ratio: _____

Temperature range
Operating: _____ ℃ to _____ ℃
Storage: _____ ℃ to _____ ℃

Mechanical requirements

Maximum dimensions required: L _____ mm x W _____ mm x H _____ mm
Mounting on: ☐ PCB ☐ Panel
Output terminals: ☐ PCB ☐ Faston ☐ Threaded studs M_ ☐ Cable
☐ other: _____
Primary connection: ☐ through hole: L _____ mm x W _____mm; or ⌀ _____ mm
☐ busbar L _____ mm x W _____mm x H _____ mm
☐ other: _____
For the bus bar, please provide layout

Applicable standards: industrial ☐ EN 50178 ☐ IEC 61800-5-1 ☐ IEC 62109-1
traction ☐ EN 50155 ☐ EN 50463
☐ IEC 61010-1 other _____

UL Certified UL508/UL60947 ☐ Other UL standard _____ (if different than UL508)

LEM provides the technical solution for current and voltage measurements from a wide range of possibilities for various parameters, not only electrical but also mechanical.

1. Mechanical features:

- A wide range of transducers to be through hole PCB mounted, surface mounted or panel mounted with an aperture or an integrated primary conductor or both.

- 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.

- Various shapes and sizes

  LEM's ASICs (Application Specific Integrated Circuit) used in LEM transducers have been a great contributor towards the miniaturization of the transducers volumes thanks to the integration of the complete electronics onto a unique chip.

  Various mechanical designs are proposed for various series covering even the same current ranges to answer to different mounting constraints in applications.

  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 in industrial applications or PCM models in trackside applications. Indeed, they are able to be opened and to be clamped onto the primary conductor. They're perfect for retrofit applications without disconnection.

2. Electrical features:

- 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 operating 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 parameters, please refer to corresponding datasheets.

  New ASIC based Open Loop transducers are being developed to provide improvement in gain and offset drift over traditional Open Loop transducers but also to reach an accuracy performance closer to Closed Loop models.

  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.

Fluxgate based transducers are high performance transducers with exceptional accuracy levels over their operating temperature range.

- Supply voltage and consumption

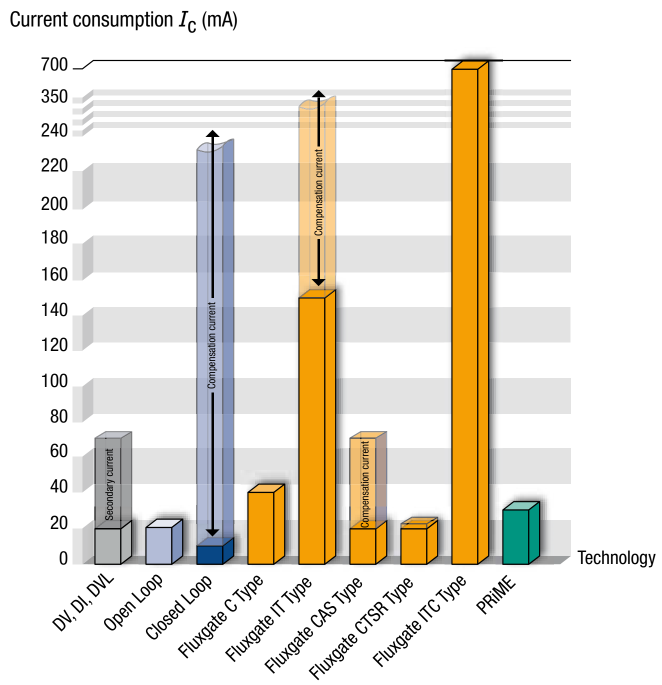
  Most of the transducers are working for bipolar measurements using a bipolar supply voltage.

  U_C = + / - 12 V ; + / - 15 V ; +/- 24 V ; ...

  However, due to power electronics evolution, and thanks to ASIC emergence, a large range of transducers are designed for bipolar measurements with a single unipolar power supply with respect to ground (0 V) : U_C = + 5 V or + 3.3 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):



- Reference access

  Models powered with + 5 V or + 3.3 V, mostly using an ASIC, 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.

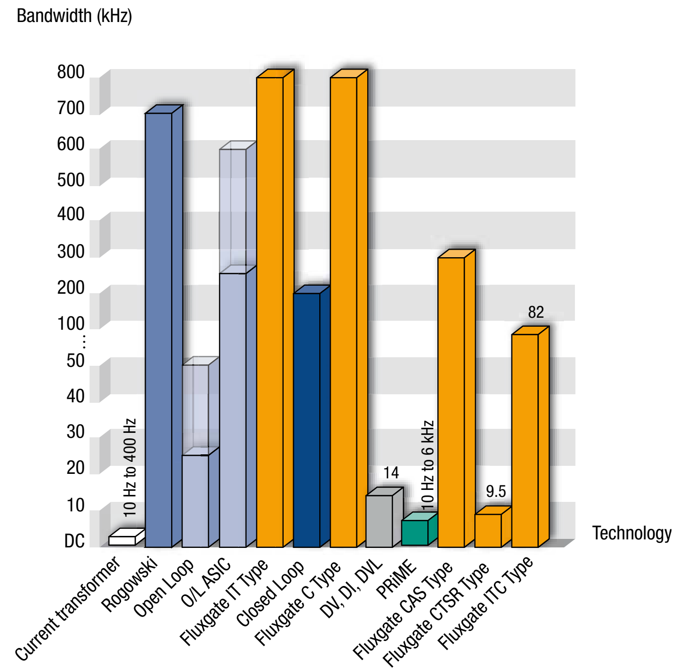
  Performances such as offset, gain and offset drifts can be improved by communicating with the microcontroller directly. Some special ASICs have been designed by LEM to answer to that specific market requirement. Indeed ASICs' technology allows some specific functions and improved performances such as better offset and gain drifts.

- Frequency response

  The frequency response of a transducer is also 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, etc directly impact the bandwidth. However use of the latest generation of ASICs has substantially improved that performance.
  - Closed Loop, Fluxgate types: Coupling between primary and secondary (depending on the mechanical and magnetic circuit designs) and the core material have a large influence on the bandwidth.
  - For the DV, DI, DVL-Type and PRiME technologies, it is a question of electronic limitation of the device output.
  - For Closed Loop Hall effect voltage transducers, bandwidth is limited due to the primary inductance. Please refer to the response time in the individual data sheets.



- 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.

- Output signal

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

  Closed Loop, fluxgate IT & ITC, DV & DVL & DI, current transformer type 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, fluxgate C & CAS & CTSR types, 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.

  Some transducers series offer (regardless of the technology) specific output signals, adapted to the kind applications (trackside, process automation…), such as :

  - Standard output signals (e.g. 0-5 VDC, 0-10 VDC or 4-20 mA)
  - But also, RMS or T-RMS ("True Root Mean Square") calculation to accurately measure current magnitudes, even on non-linear loads or in noisy environments.

- Voltage measurement

  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.

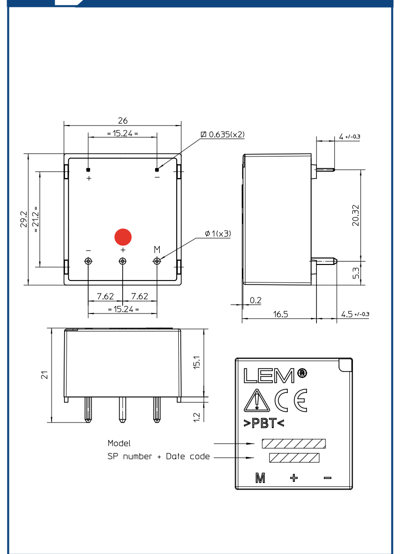
LEM offers a wide selection of nominal voltage levels to cover a variety of applications.

Dimension Drawings

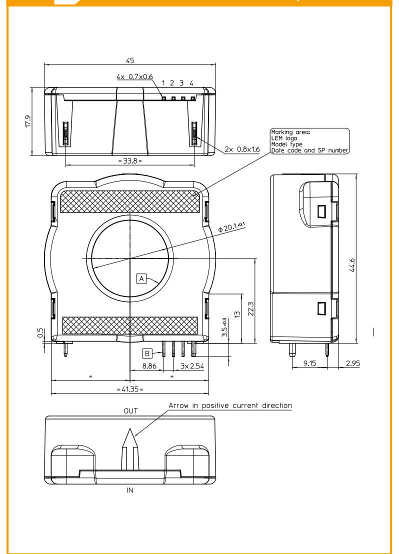
All dimensions are in mm

● Hall effect chip location

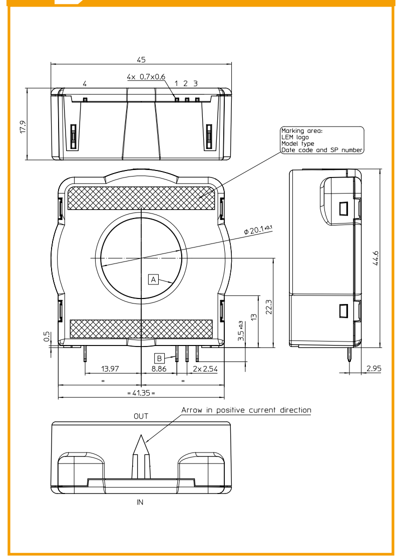
1 LA 25–NP/SP7/SP8/SP9/SP11/SP13/SP14/SP34/SP38/SP39



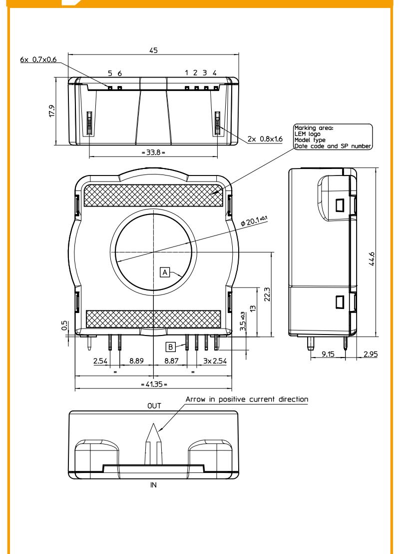
2 CTSR 0.3–P, CTSR 0.6–P, CTSR 1–P



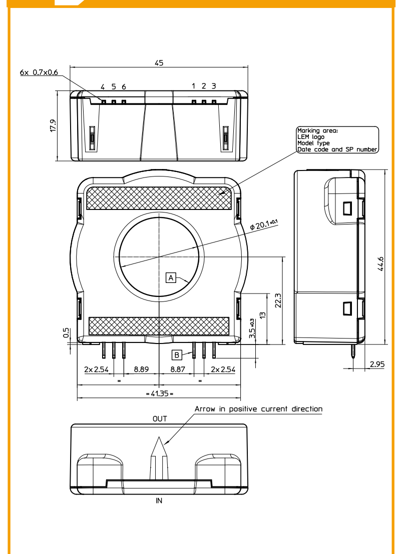
3 CTSR 0.3–P/SP1



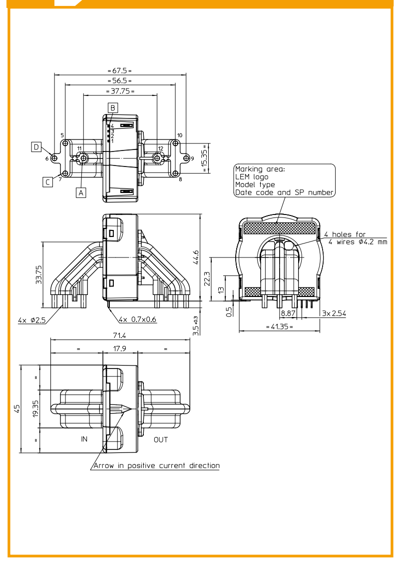
4 CTSR 0.3–P/SP10, CTSR 0.6–P/SP10



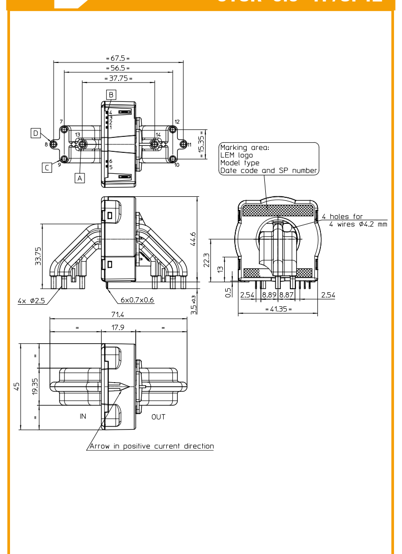
5 CTSR 0.3–P/SP11



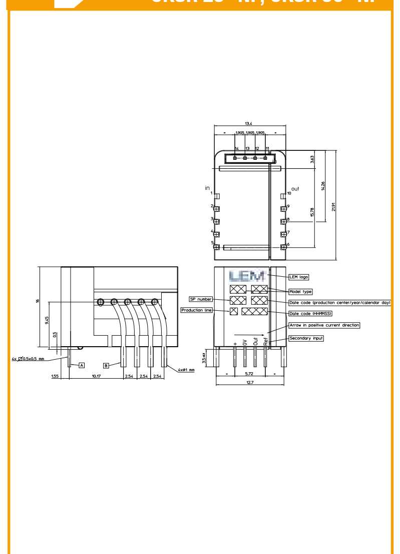
6 CTSR 0.3–TP/SP4, CTSR 0.6–TP/SP2



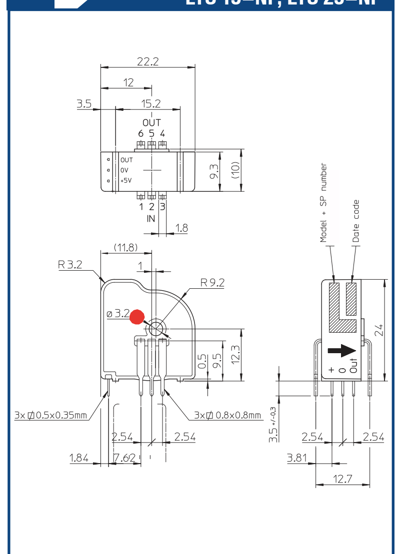
7 CTSR 0.3–TP/SP14, CTSR 0.6–TP/SP12



8 CKSR 6–NP, CKSR 15–NP, CKSR 25–NP, CKSR 50–NP



9 LTS 6–NP, LTS 15–NP, LTS 25–NP

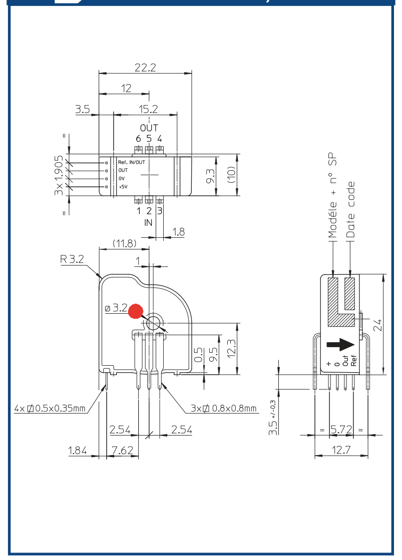


Dimension Drawings

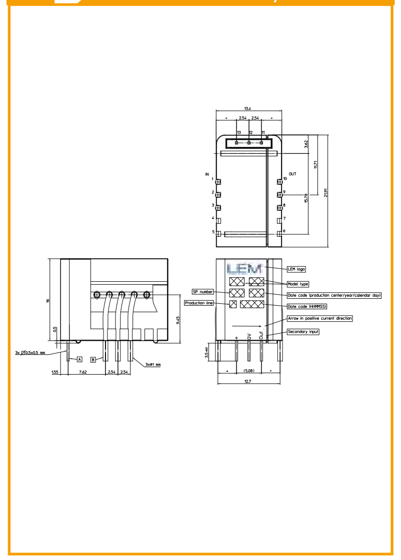
All dimensions are in mm

● Hall effect chip location

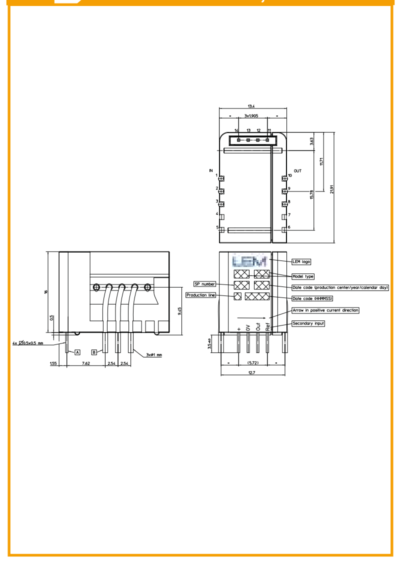
10 LTSR 6–NP, LTSR 15–NP, LTSR 25–NP



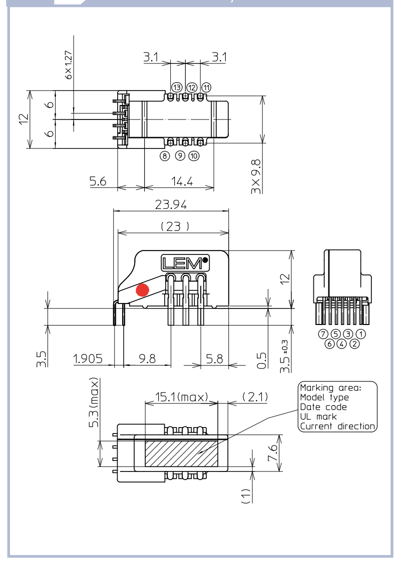
11 CAS 6–NP, CAS 15–NP, CAS 25–NP, CAS 50–NP



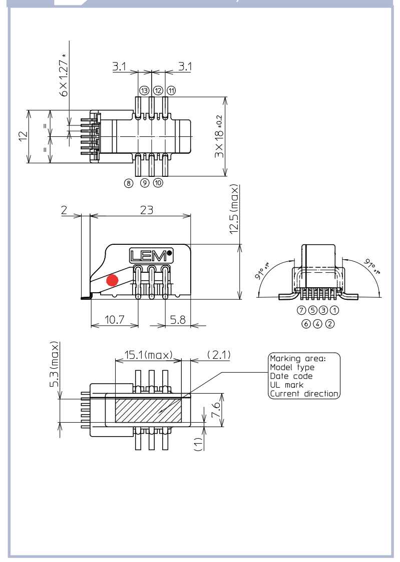
12 CASR 6–NP, CASR 15–NP, CASR 25–NP, CASR 50–NP



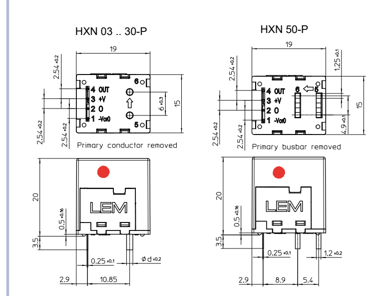
13 HO 25–NPPR, HO 25–NPPR/SP33, HO 8/15/25–NP–0000, HO 8/15/25–NP/SP33–1000



14 HO 25–NSMPR, HO 25–NSMPR/SP33, HO 8/15/25–NSM–0000, HO 8/15/25–NSM/SP33–1000



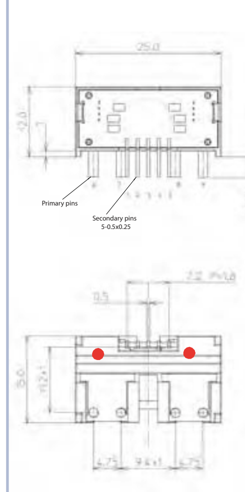
15 HXN 03…50–P



HXN	03-P	05-P	10-P	15-P
d	0.6	0.8	1.1	1.4
HXN	20-P	25-P	30-P	50-P
d	1.6	1.6	1.6	1.2 X 6.3

Terminal Pin Identification
1 : - 15 V
2 : 0 V
3 : + 15 V
4 : Output
5 : Primary input Current (+)
6 : Primary input Current (-)

16 HXD 03…25–P

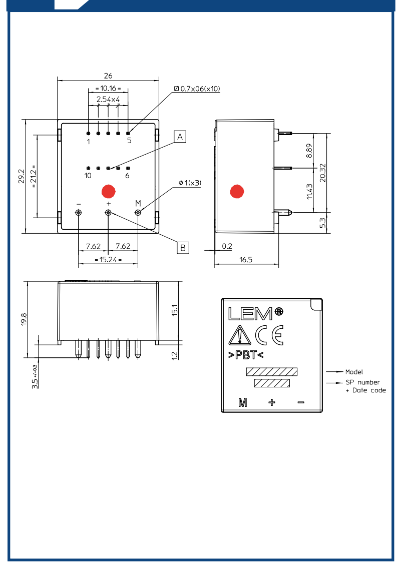


Terminals
1. +Vcc
2. −Vcc
3. Out 1
4. Out 2
5. 0V (GND)
6. Input 1(+)
7. Input 1(−)
8. Input 2(+)
9. Input 2(−)

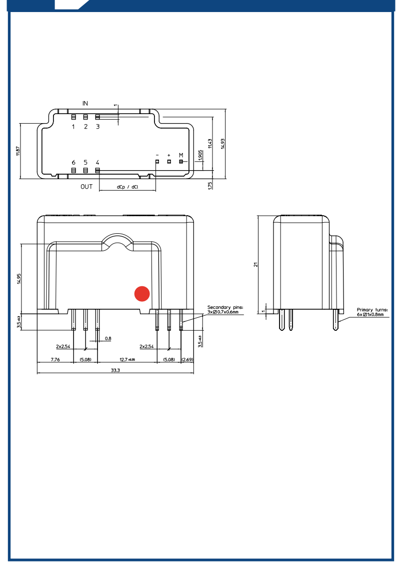
6…9 Terminals

A	d(mm)
3	0.6
5	0.8
10	1.1
15	1.4
20	1.6
25	1.6

17 LA 25–NP, LA 35–NP



18 LAH 25–NP



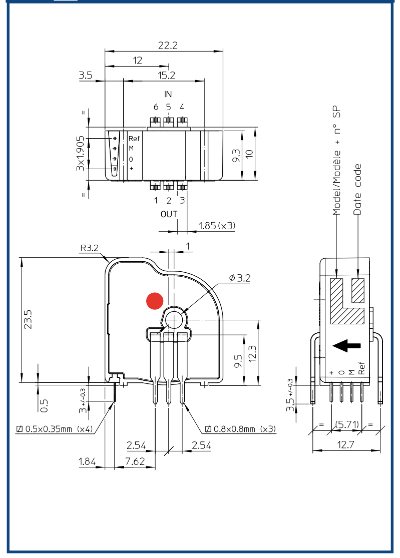
DRAWINGS

Dimension Drawings

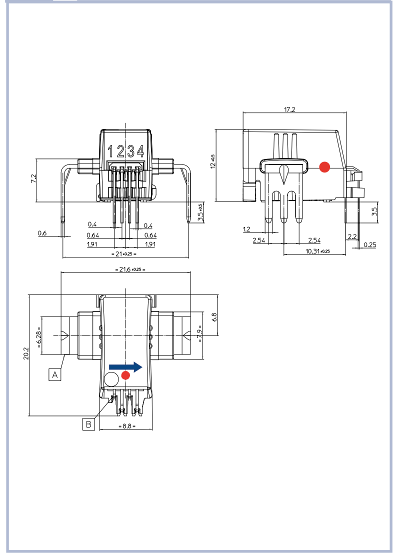
All dimensions are in mm

● Hall effect chip location

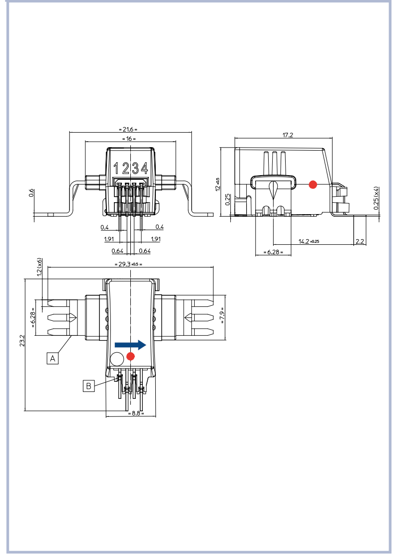
19 LTSP 25–NP



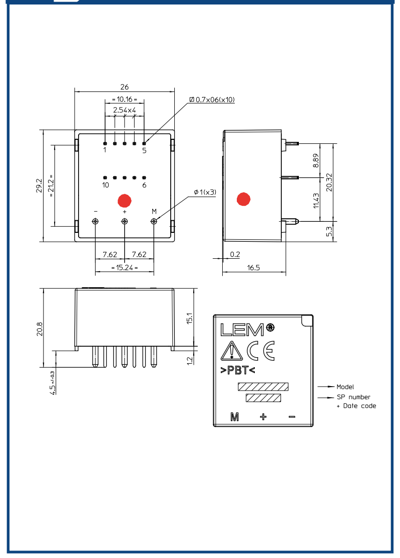
20 HLSR 10/20/32/40/50–P HLSR 10/20/32/40/50–P/SP33



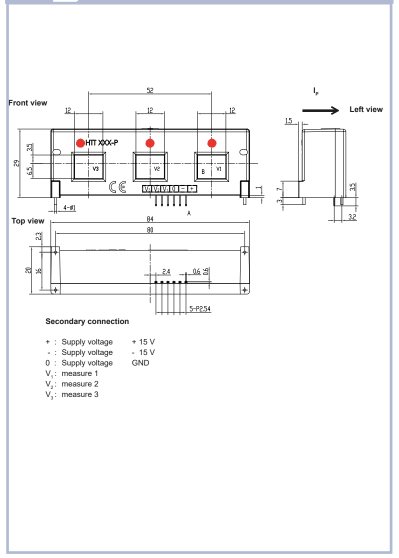
21 HLSR 10/20/32/40/50–SM HLSR 10/20/32/40/50–SM/SP33



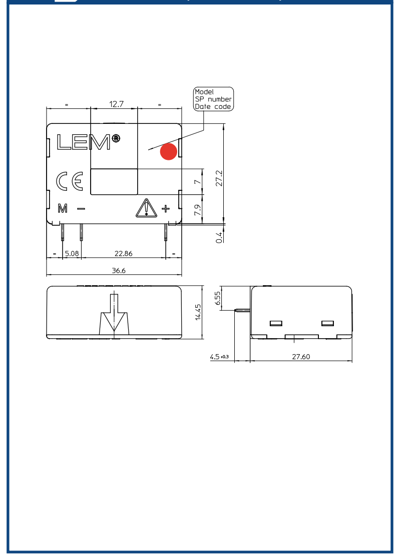
22 LA 25–NP/SP25



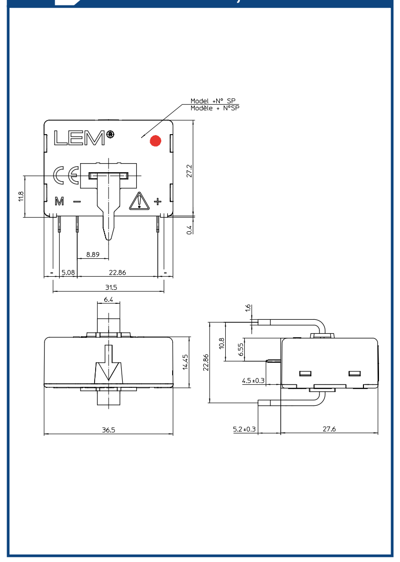
23 HTT 25...150–P



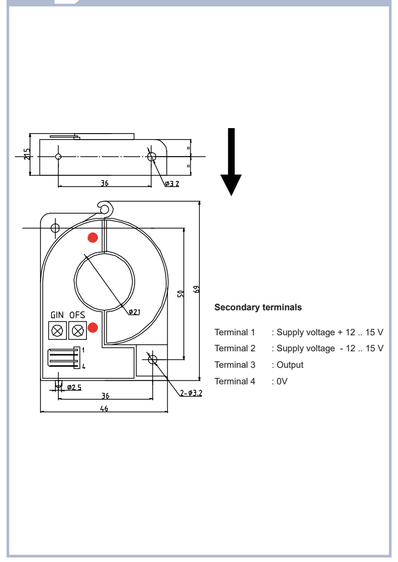
24 LA 100–P, LA 100–P/SP13 LA 55–P, LA 55–P/SP1, LA 55–P/SP23



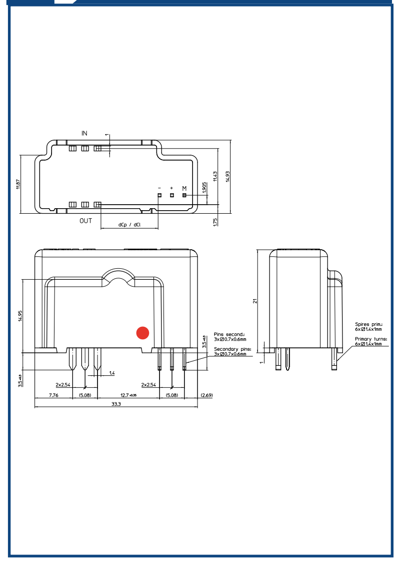
25 LA 100–TP, LA 55–TP, LA 55–TP/SP1, LA 55–TP/SP27



26 HTR 50...500–SB



27 LAH 50–P, LAH 100–P

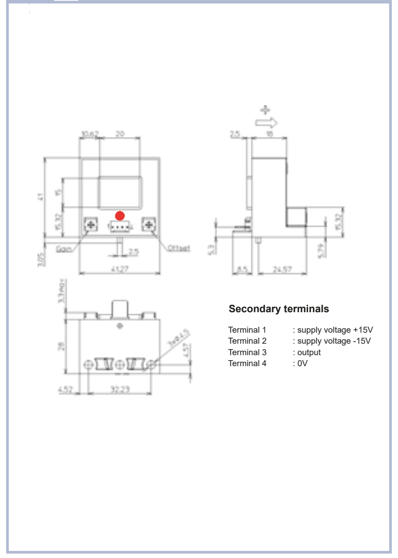


Dimension Drawings

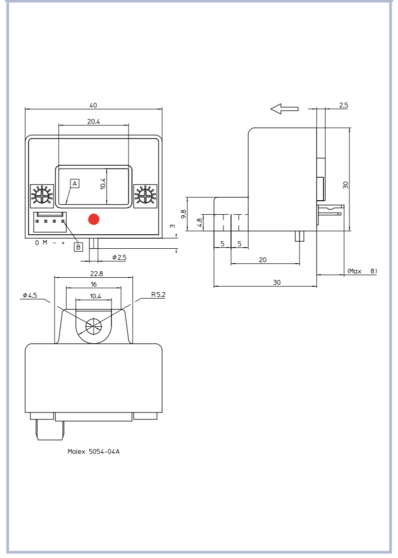
All dimensions are in mm

● Hall effect chip location

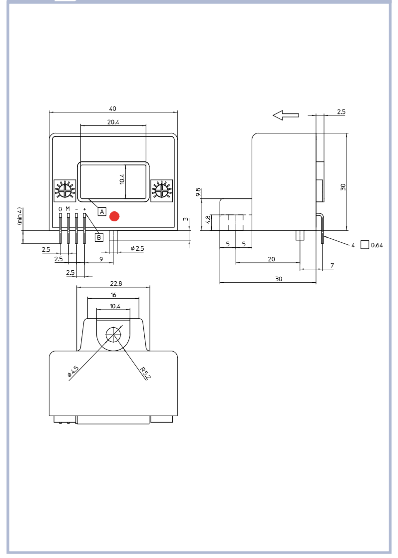
28 HAL 50...600–S



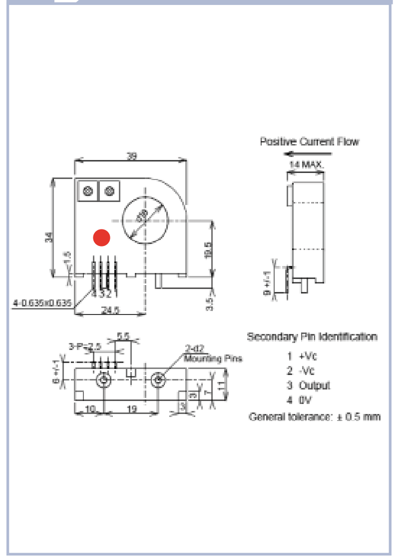
29 HAS 50...600–S



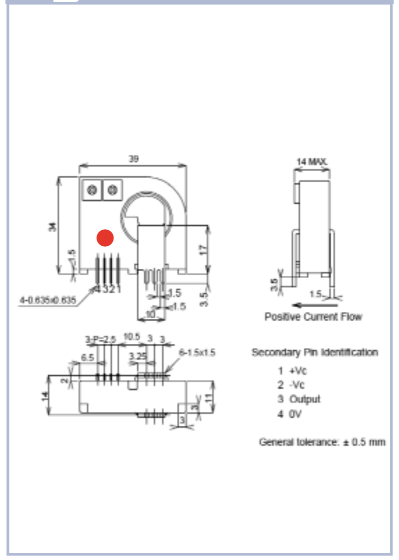
30 HAS 50...600–P



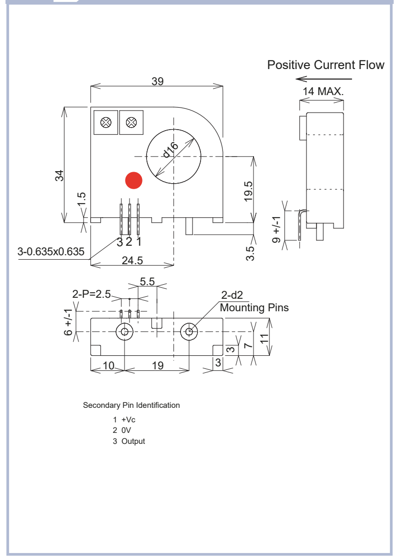
31 HTB 50...400–P



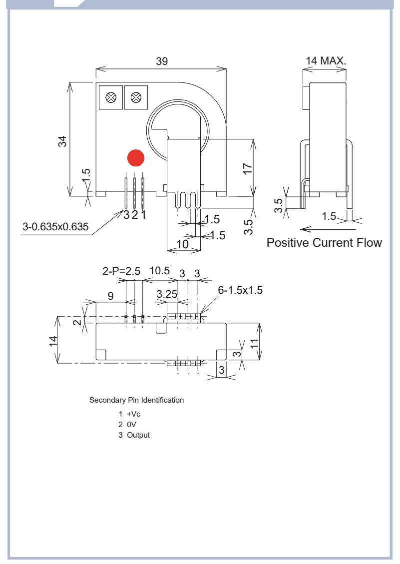
32 HTB 50...100–TP



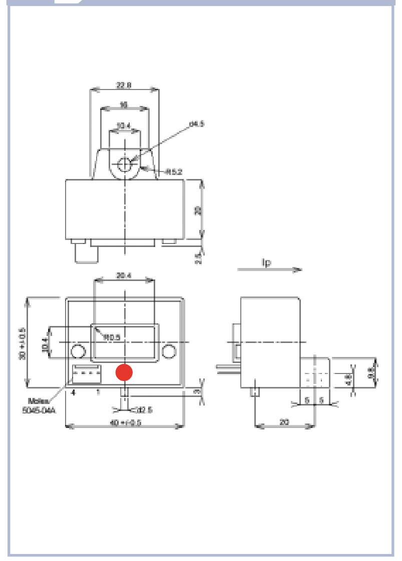
33 HTB 50...400–P/SP5



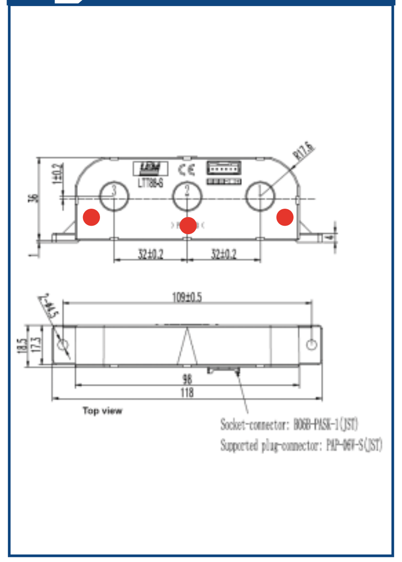
34 HTB 50...100–TP/SP5



35 HASS 50...600–S



36 LTT 88–S



DRAWINGS

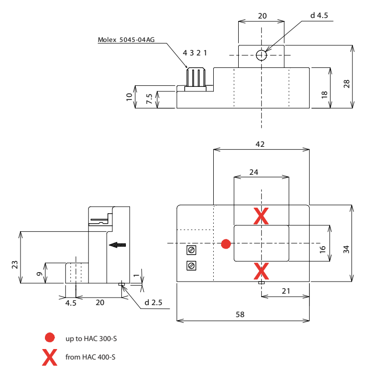
DRAWINGS

Dimension Drawings

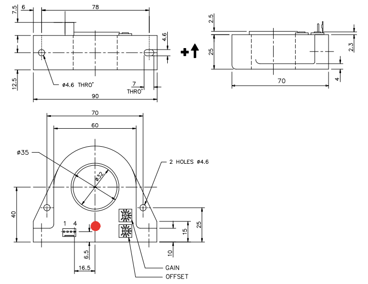
All dimensions are in mm

● Hall effect chip location

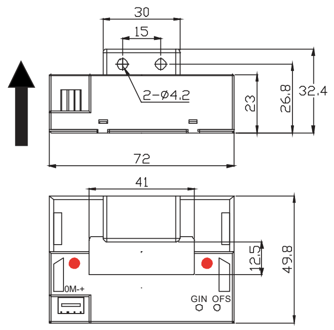
37 HAC 100...800–S



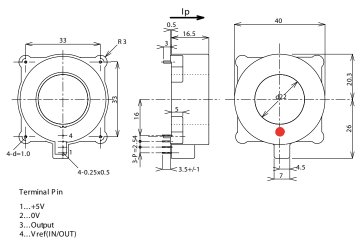
38 HTA 100...1000–S



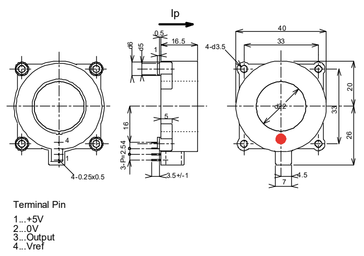
39 HOP 200...600–SB



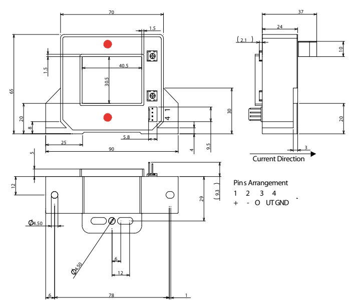
40 HTFS 200...800–P/SP2



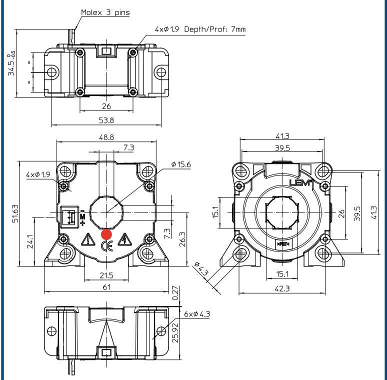
41 HTFS 200...800–P



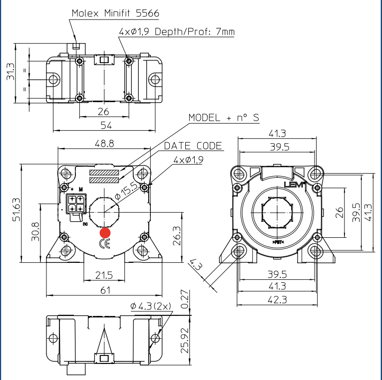
42 HAT 200...1500–S



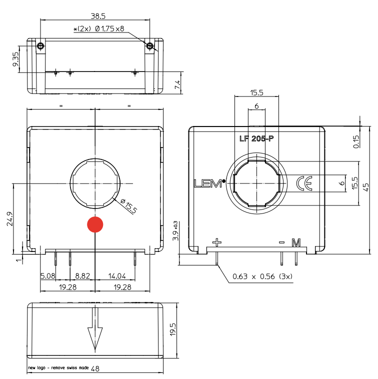
43 LF 205–S, LF 205–S/SP3



44 LF 205–S/SP1, LF 205–S/SP5



45 LF 205–P



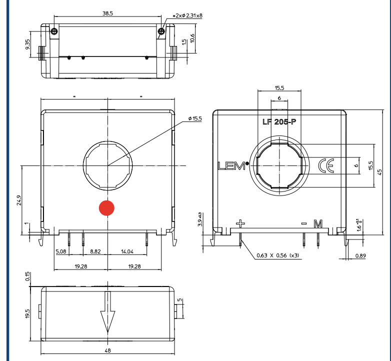
DRAWINGS

Dimension Drawings

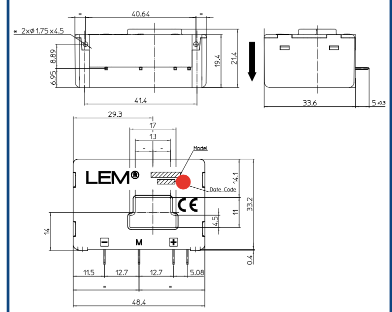
All dimensions are in mm

● Hall effect chip location

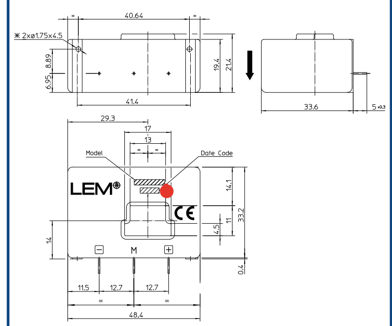
46 LF 205–P/SP1



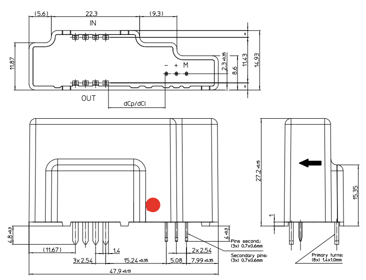
47 LA 200–P, LA 200–P/SP4, LA 125–P, LA 125–P/SP1/SP4



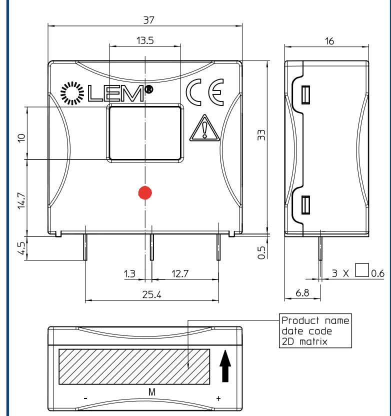
48 LA 125–P/SP3



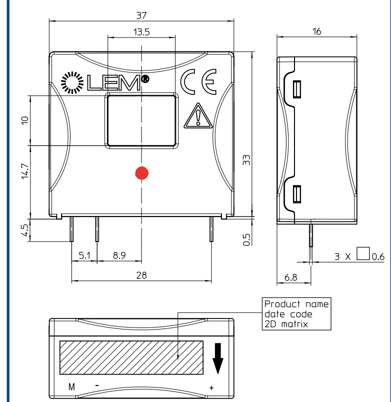
49 LAH 125–P



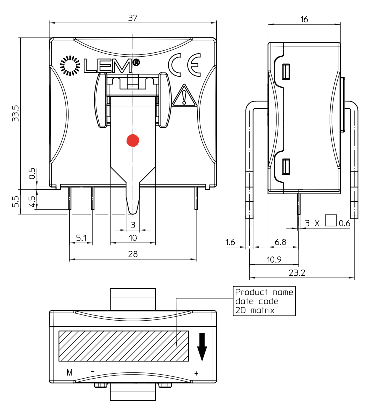
50 LA 130–P, LA 130–P/SP1



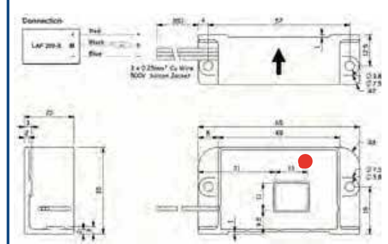
51 LA 150–P, LA 150–P/SP1



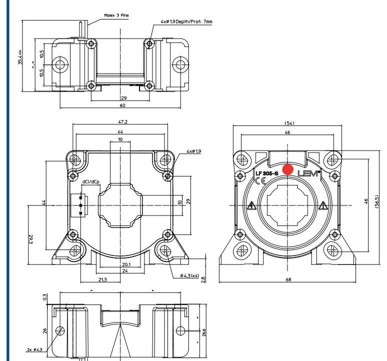
52 LA 150–TP



53 LAF 200–S



54 LF 305–S



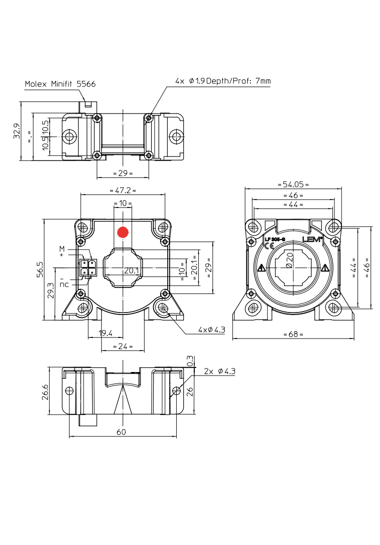
DRAWINGS

Dimension Drawings

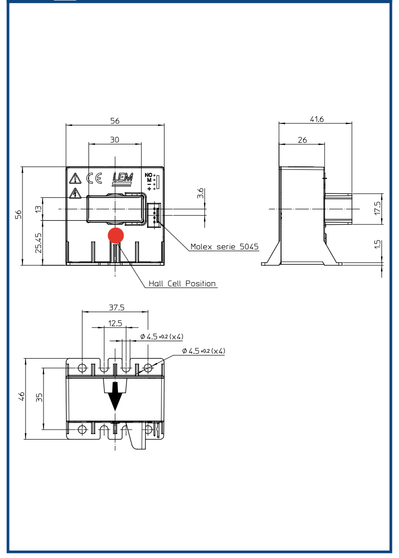
All dimensions are in mm

● Hall effect chip location

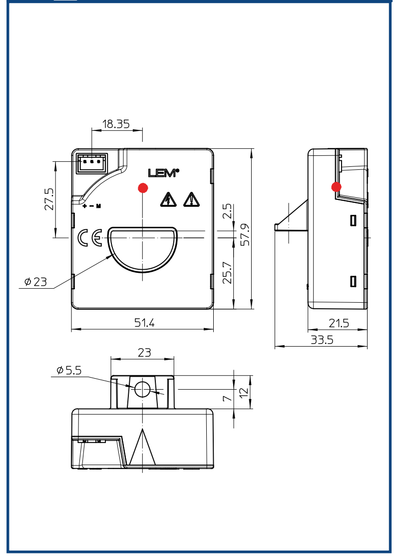
55 LF 305–S/SP10



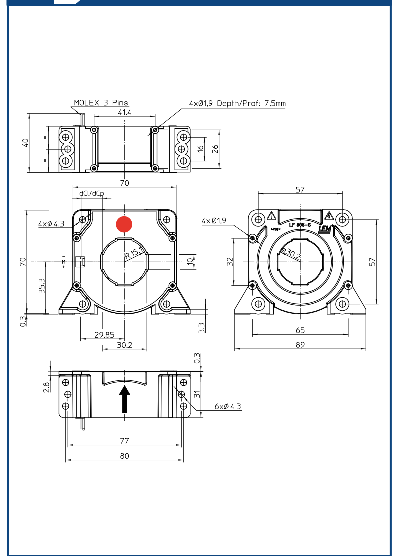
56 LA 306–S



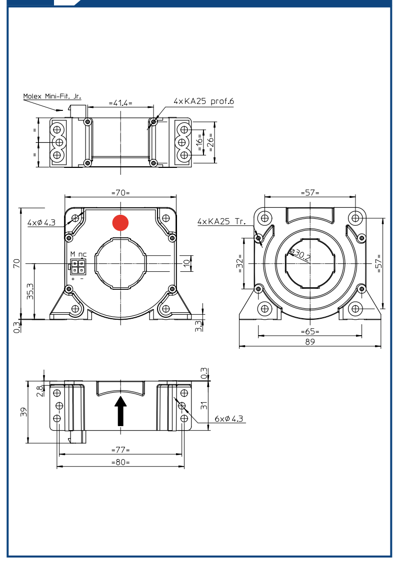
57 LT 305–S



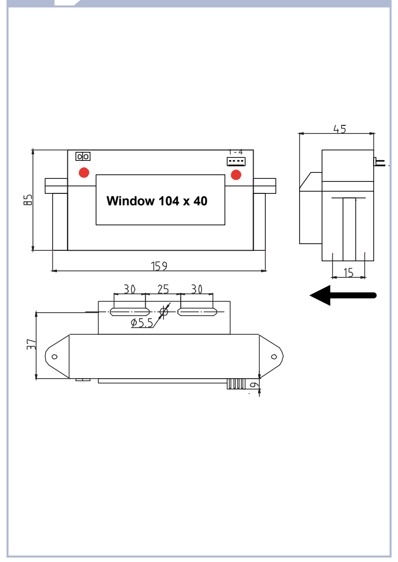
58 LF 505–S



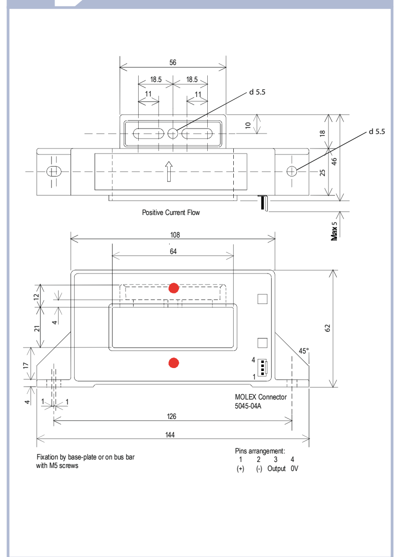
59 LF 505–S/SP15



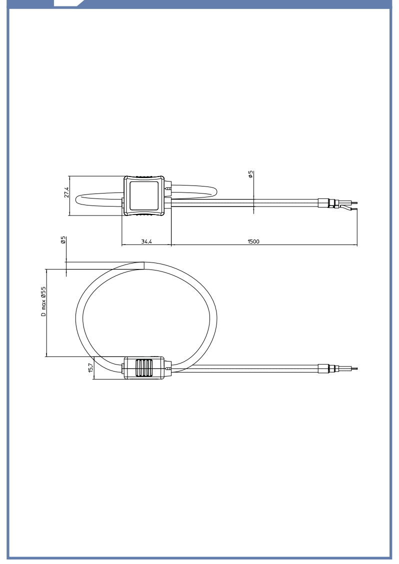
60 HOP 500–SB/SP1 HOP 800…2000–SB



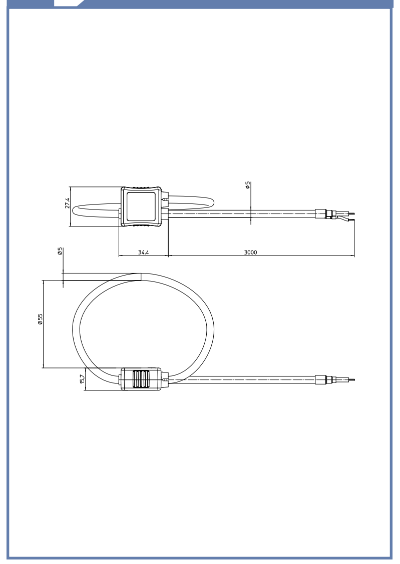
61 HAX 500…2500 – S



62 RT 500



63 RT 500/SP1

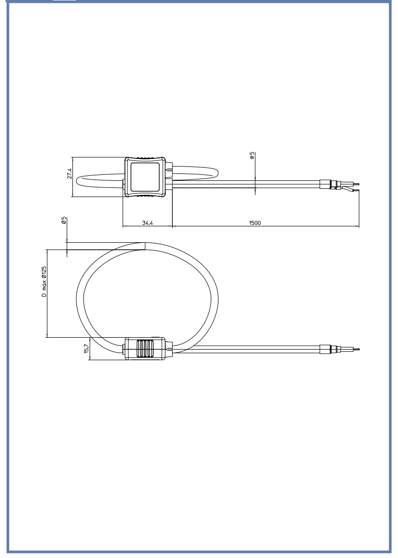


Dimension Drawings

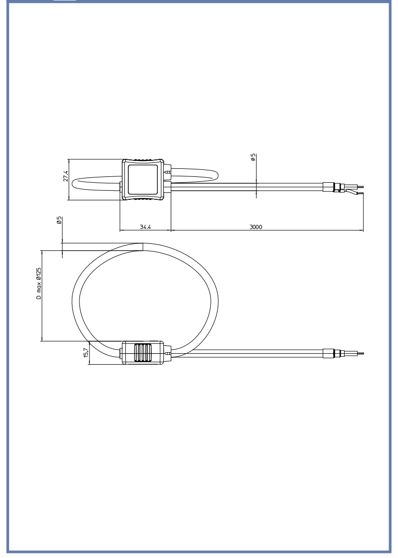
All dimensions are in mm

● Hall effect chip location

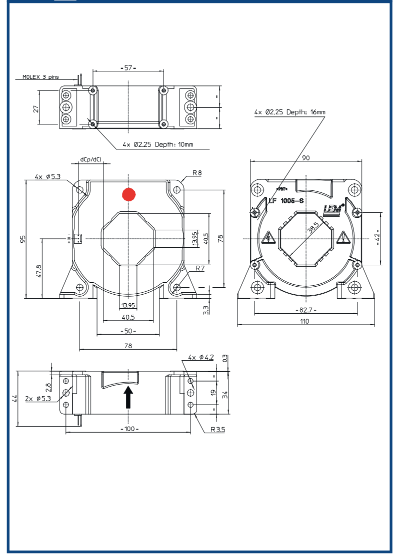
64 RT 2000



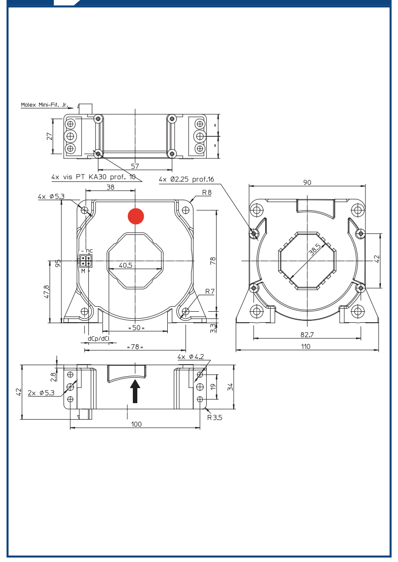
65 RT 2000/SP1



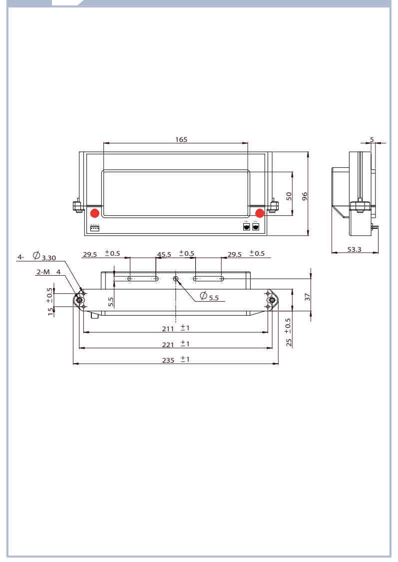
66 LF 1005–S



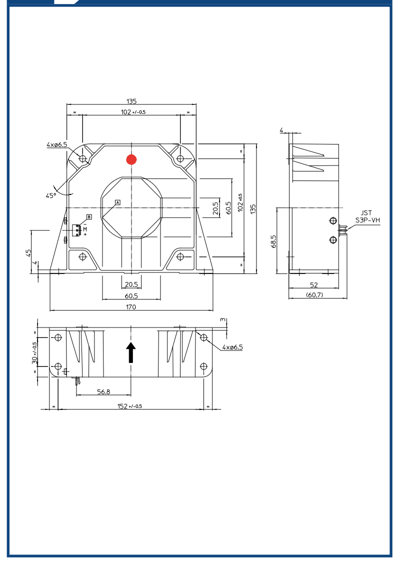
67 LF 1005–S/SP22



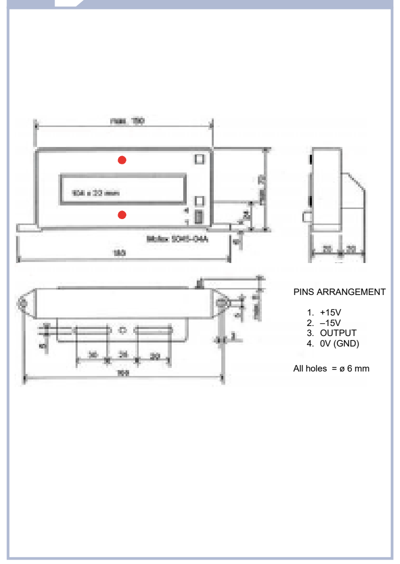
68 HOP 2000–SB/SP1



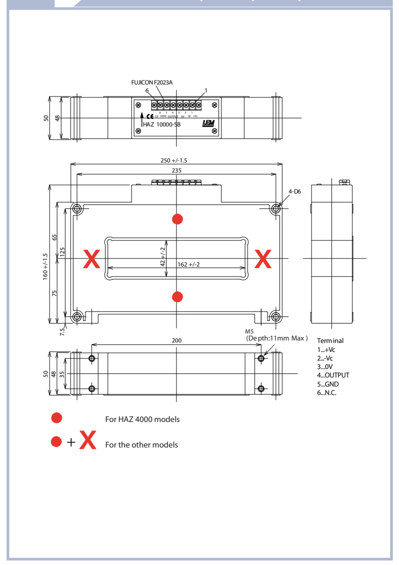
69 LF 2005–S



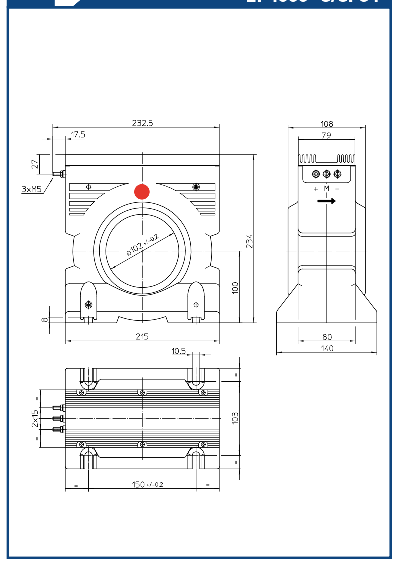
70 HAXC 2000–S



71 HAZ 4000…20000–SB,–SBI, –SBI/SP1, –SRU, –SRI, –SRI/SP1



72 LT 4000–S LT 4000–S/SP34

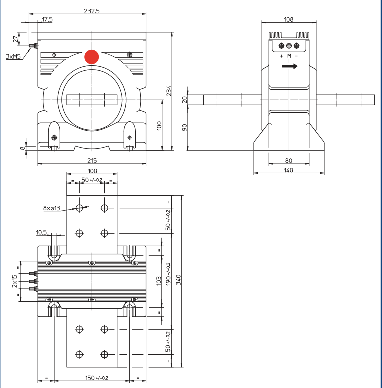


Dimension Drawings

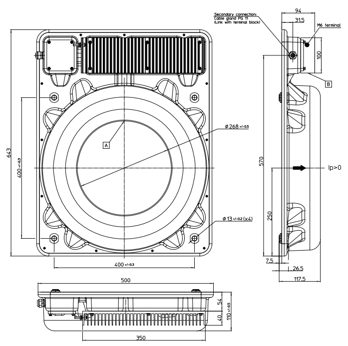
All dimensions are in mm

● Hall effect chip location

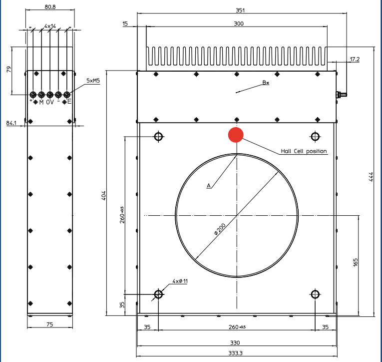
73 LT 4000–T



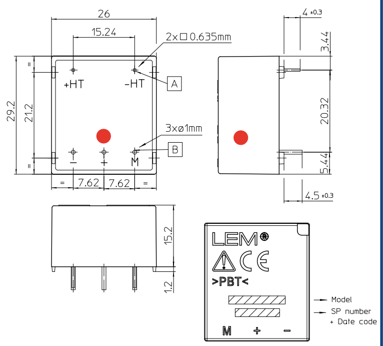
74 ITL 4000–S



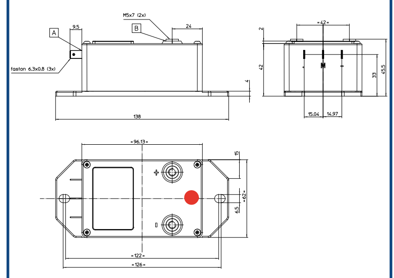
75 LT 10000–S



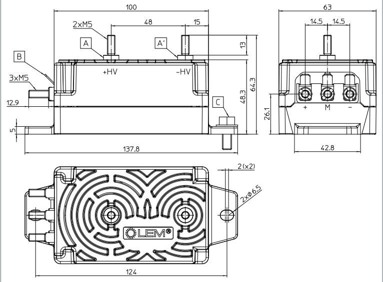
76 LV 25–P, LV 25–P/SP5



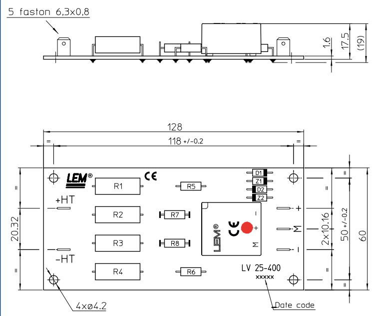
77 LV 100



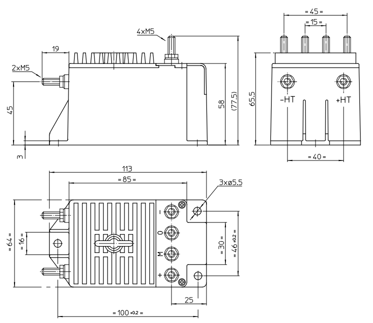
78 DVL 50...2000



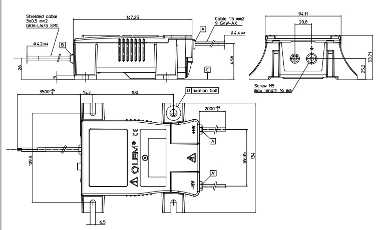
79 LV 25–200...1200



80 CV 3–200...2000



81 DV 1000, DV 2000, DV 4200/SP3

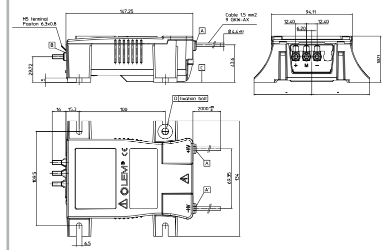


Dimension Drawings

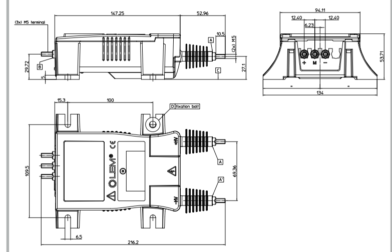
All dimensions are in mm

● Hall effect chip location

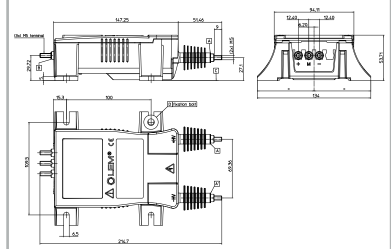
82 DV 1200/SP2, DV 1500, DV 2000/SP1



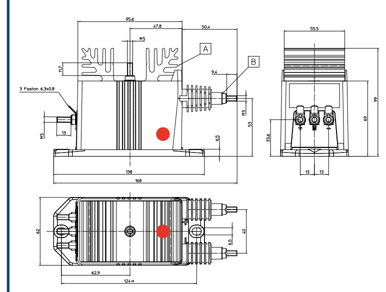
83 DV 2000/SP2



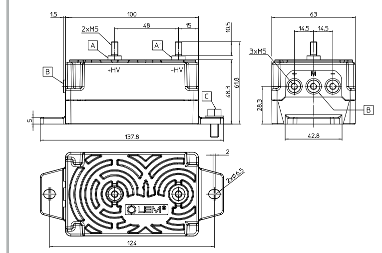
84 DV 2800/SP4, DV 3000/SP1, DV 4200/SP4



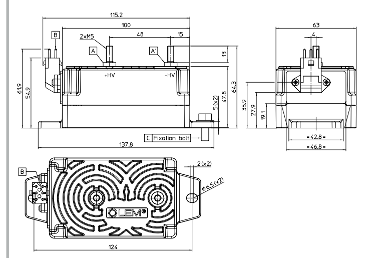
85 LV 100–2500...4000



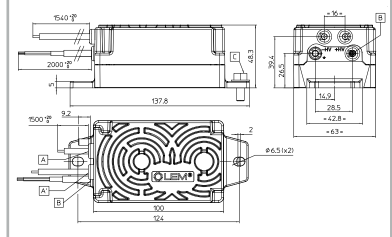
86 DVL 750/SP2, DVL 1000/SP5, DVL 1500/SP2



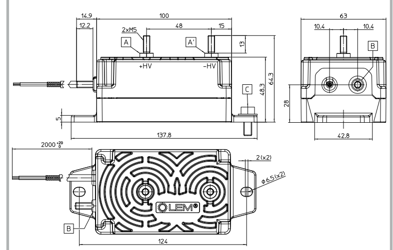
87 DVL 1000/SP1, DVL 1500/SP1, DVL 2000/SP1



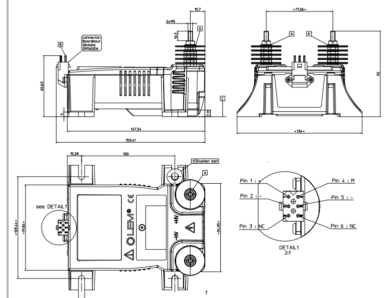
88 DVL 1000/SP7, DVL 1500/SP5, DVL 2000/SP5



89 DVL 1000/SP8, DVL 1500/SP6, DVL 2000/SP6



90 DV 2800/SP1, DV 4000/SP2

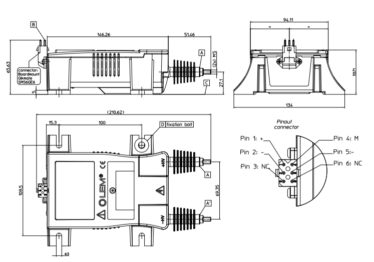


Dimension Drawings

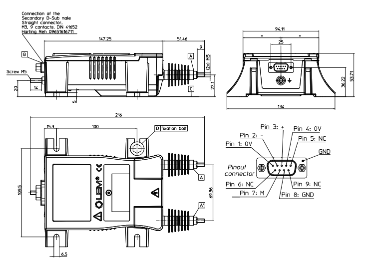
All dimensions are in mm

● Hall effect chip location

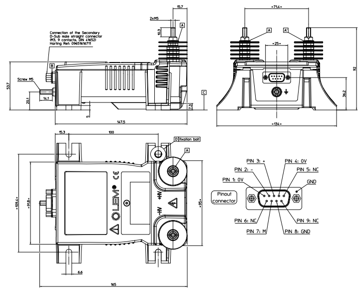
91 DV 4000/SP1



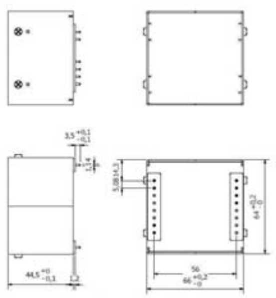
92 DV 4200/SP1



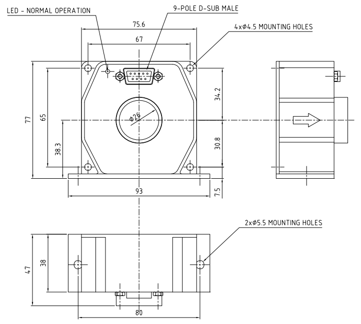
93 DV 4200/SP5



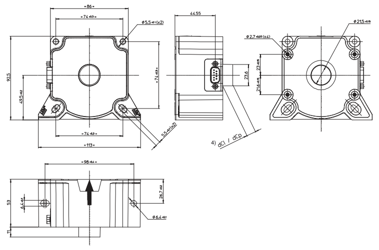
94 ITN 12–P ULTRASTAB



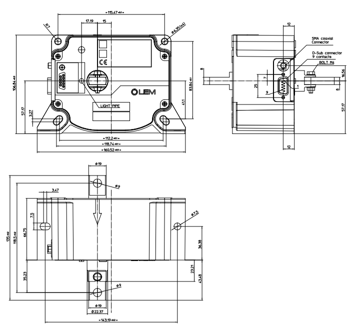
95 IT 60–S, IT 200–S, IT 400–S ULTRASTAB



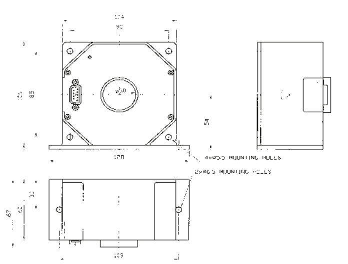
96 ITB 300–S



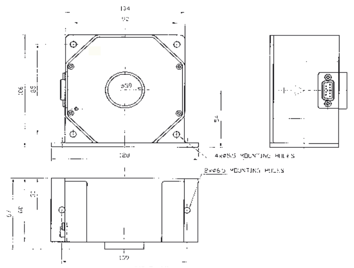
97 ITL 900–T



98 ITN 600–S ULTRASTAB



99 IT 700–S, IT 700–SB, ITN 900–S ULTRASTAB

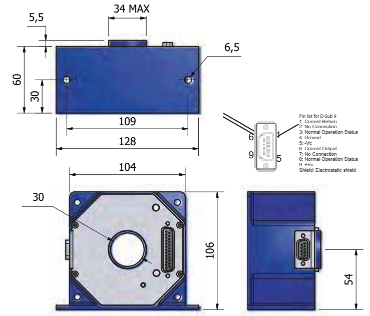


Dimension Drawings

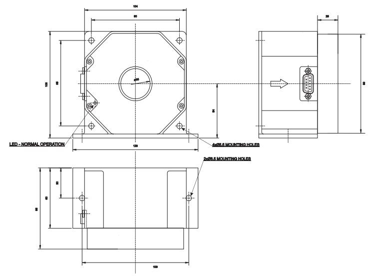
All dimensions are in mm

● Hall effect chip location

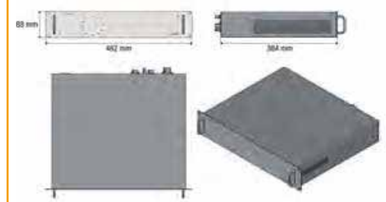
100 IT 700–SPR ULTRASTAB



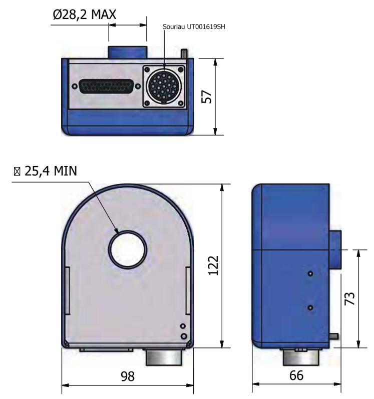
101 IT 1000–S/SP1 ULTRASTAB



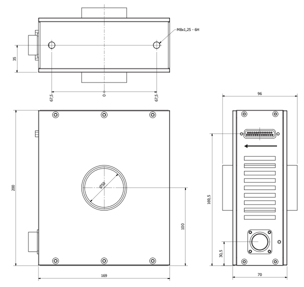
102 ITZ 5000...16000–S,–SB, ITZ 24000–S ITZ 600–SPR,–SBPR, ITZ 2000–S,–SPR,–SB,–SBPR



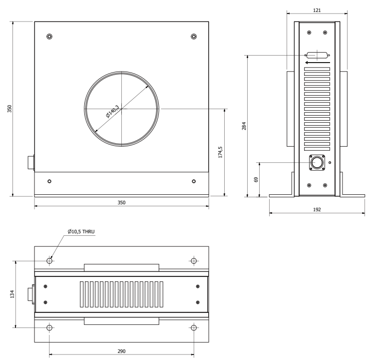
103 ITZ 600–SPR,–SBPR



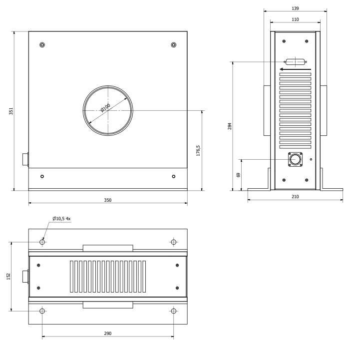
104 ITZ 2000–S,–SB,–SPR,–SBPR



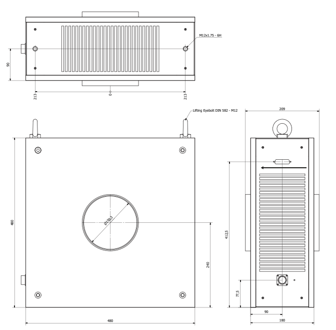
105 ITZ 5000–S,–SB



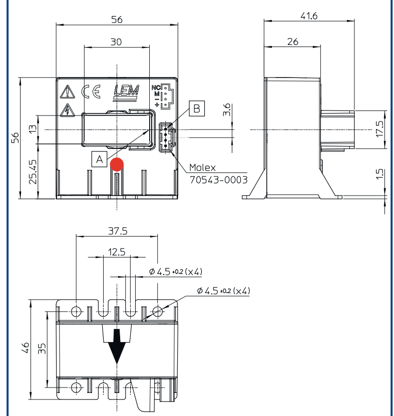
106 ITZ 10000–S,–SB



107 ITZ 16000–S,–SB



108 LAC 300–S, LAC 300–S/SP1/SP2/SP3/SP4/SP5

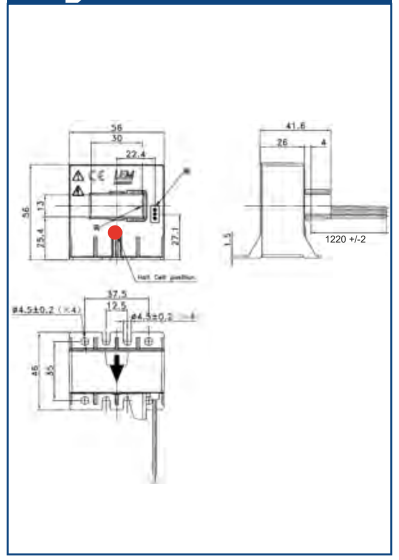


Dimension Drawings

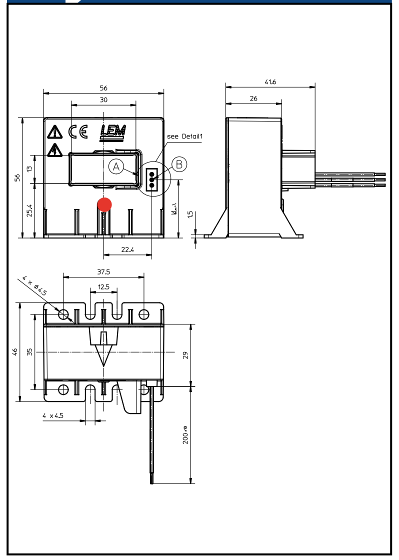
All dimensions are in mm

● Hall effect chip location

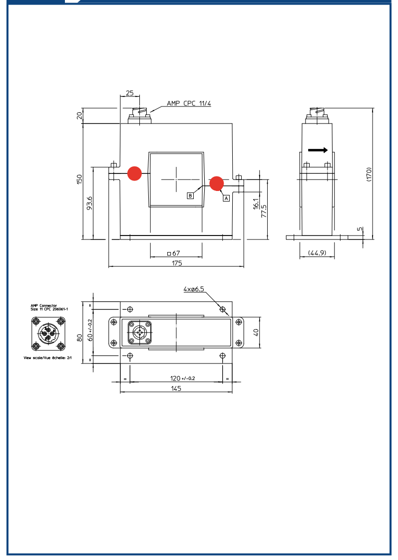
109 LAC 300–S/SP7



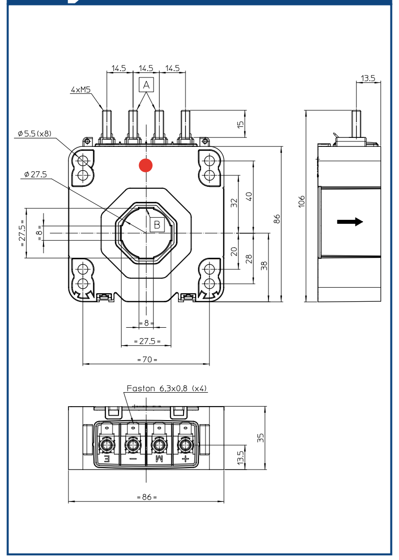
110 LAC 300–S/SP8



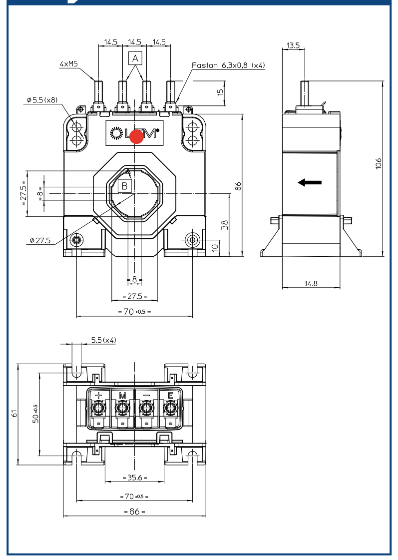
111 LA 200–SD/SP3, LA 500–SD/SP2



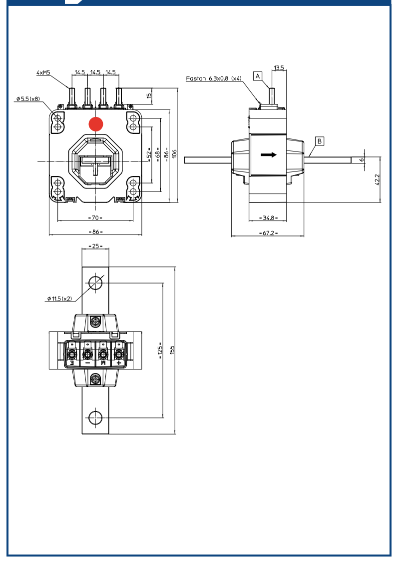
112 LTC 350–S, LTC 500–S



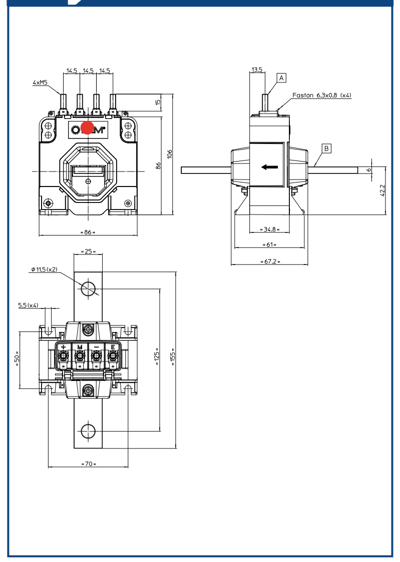
113 LTC 350–SF, LTC 500–SF



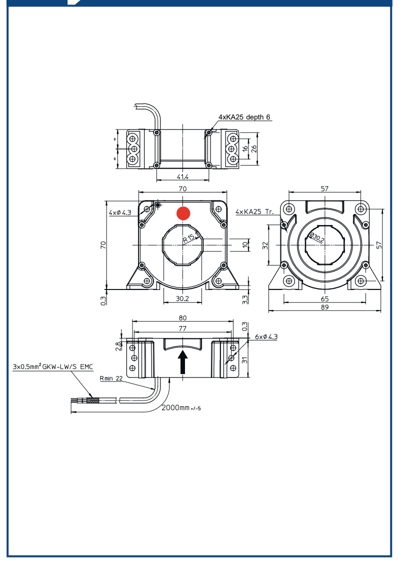
114 LTC 350–T, LTC 500–T



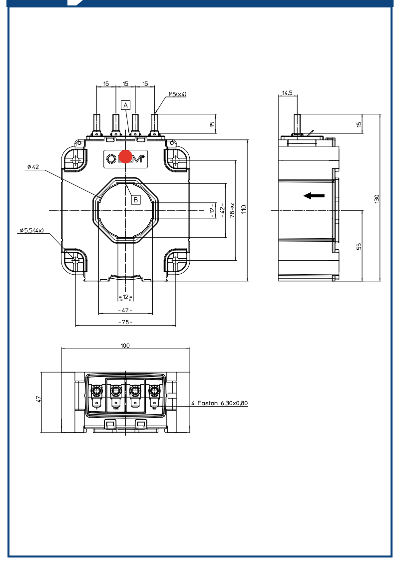
115 LTC 350–TF, LTC 500–TF



116 LF 505–S/SP23



117 LTC 600–S, LTC 1000–S

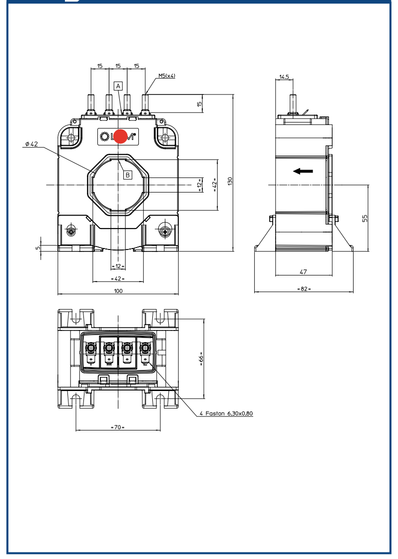


Dimension Drawings

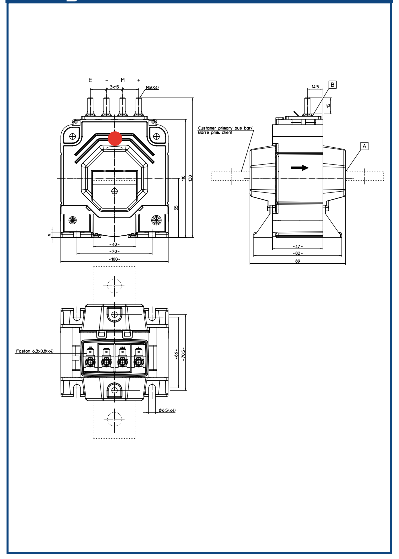
All dimensions are in mm

● Hall effect chip location

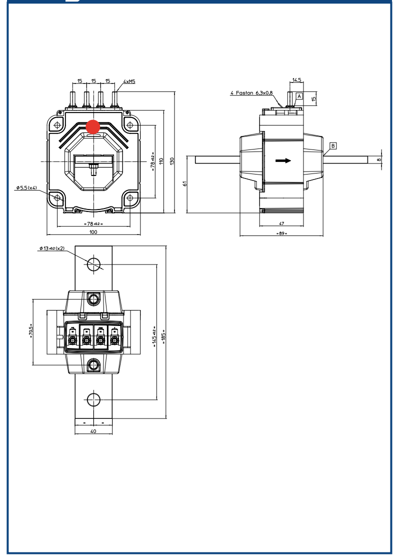
118 LTC 600–SF, LTC 1000–SF



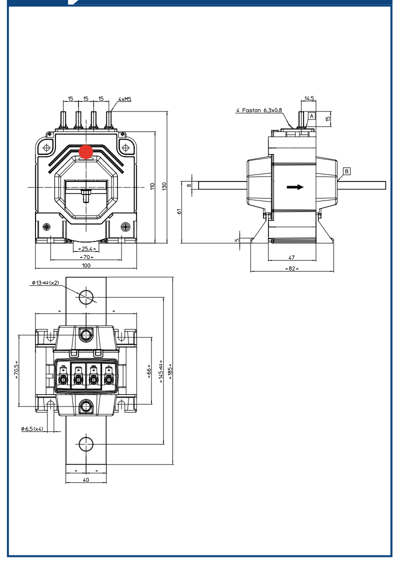
119 LTC 600–SFC, LTC 1000–SFC



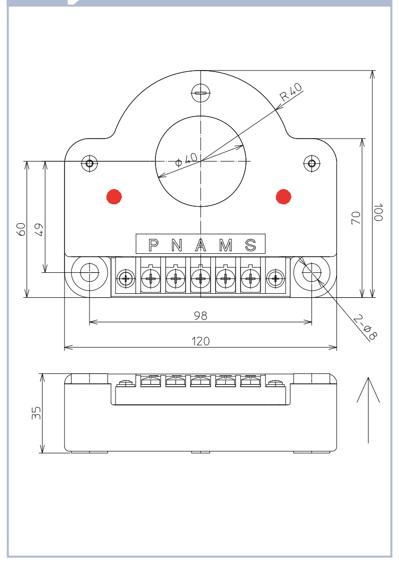
120 LTC 600–T, LTC 1000–T



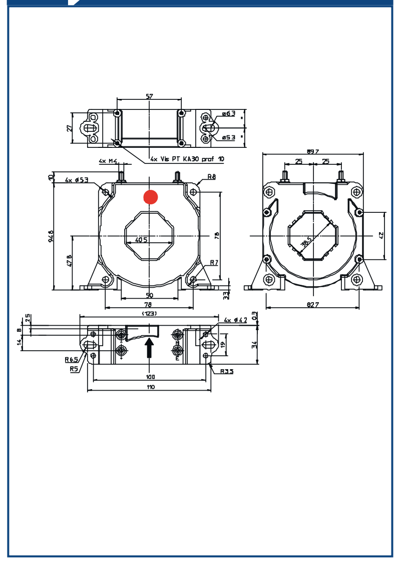
121 LTC 600–TF, LTC 1000–TF



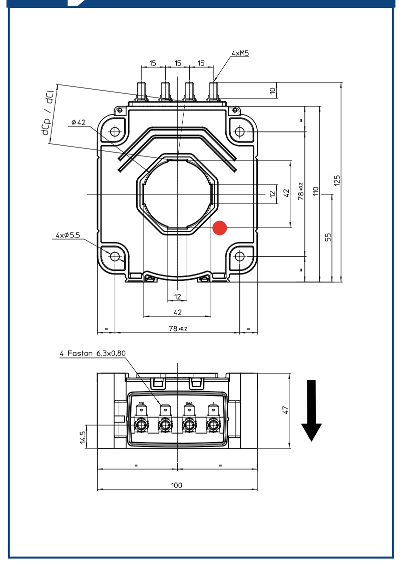
122 HTC 1000...3000–S/SP4



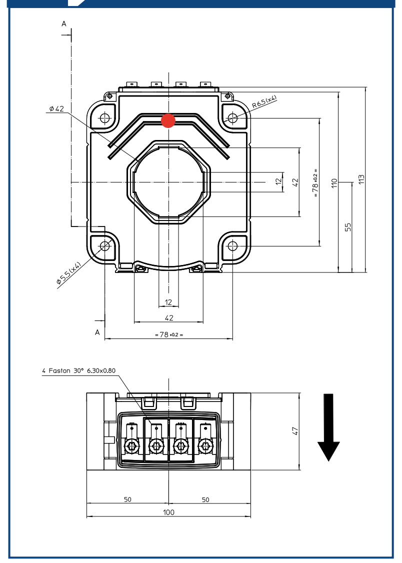
123 LF 1005–S/SP14



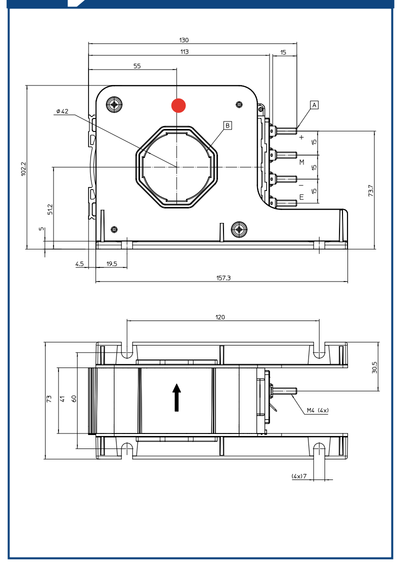
124 LTC 1000–S/SP1



125 LTC 1000–S/SP25



126 LTC 1000–SF/SP24



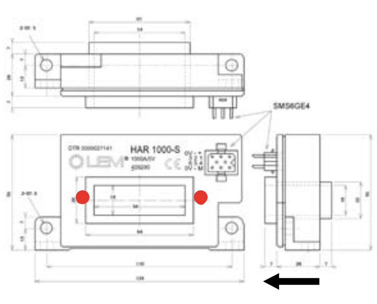
DRAWINGS

Dimension Drawings

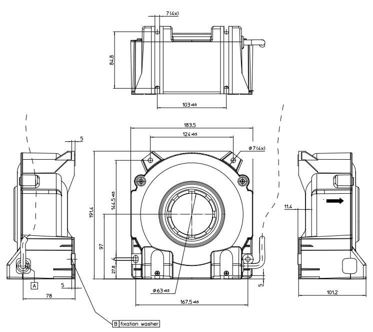
All dimensions are in mm

● Hall effect chip location

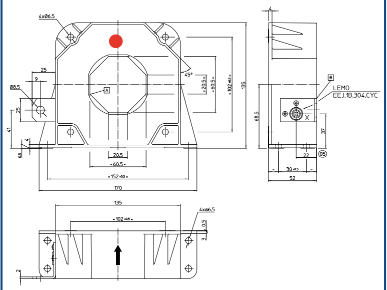
127 HAR 1000–S



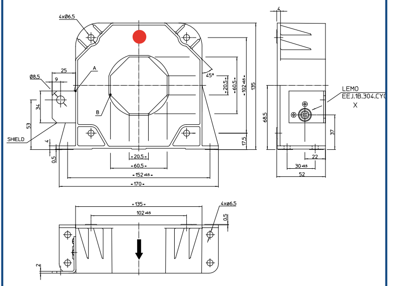
128 ITC 2000–S/SP1



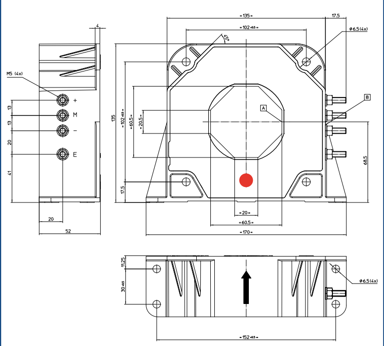
129 LF 2005–S/SP1



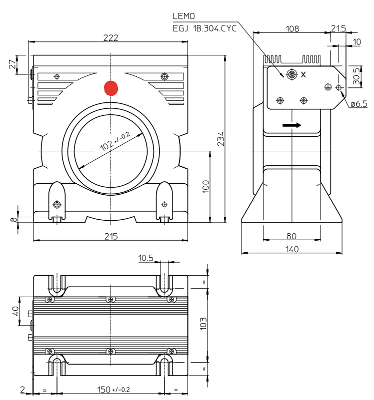
130 LF 2005–S/SP27



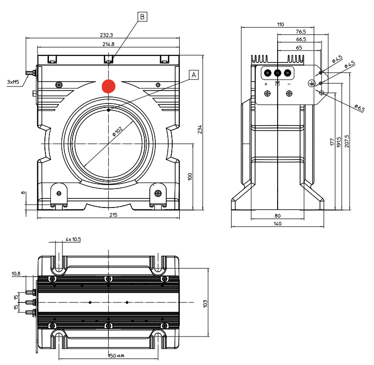
131 LF 2005–S/SP28



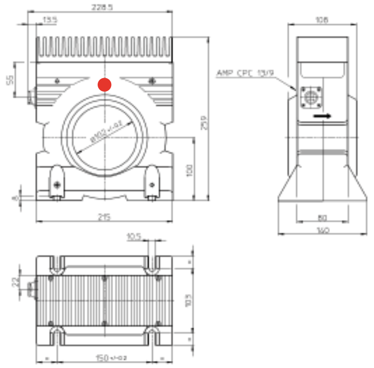
132 LT 4000–S/SP24



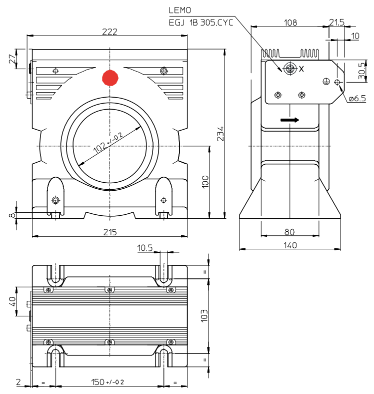
133 LT 4000–S/SP44



134 LT 4000–S/SP12



135 LT 4000–S/SP35

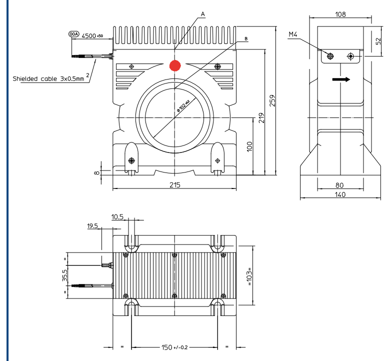


Dimension Drawings

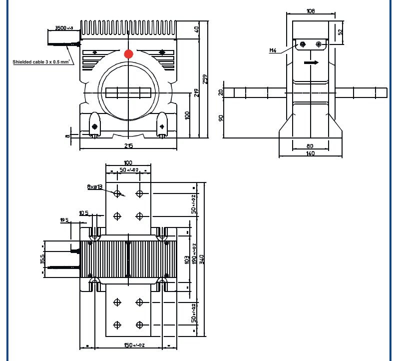
All dimensions are in mm

● Hall effect chip location

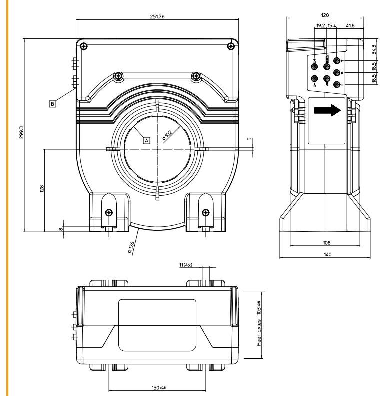
136 LT 4000–S/SP43



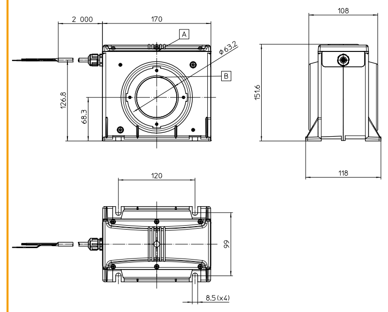
137 LT 4000–T/SP40



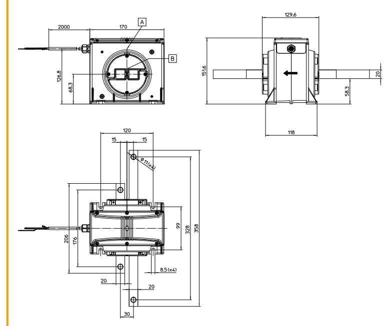
138 ITC 4000–S



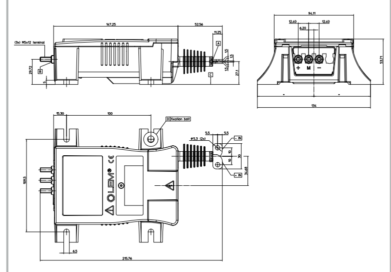
139 CD 1000–S/SP6



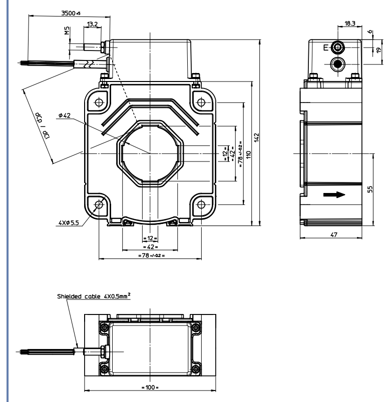
140 CD 1000–T/SP7



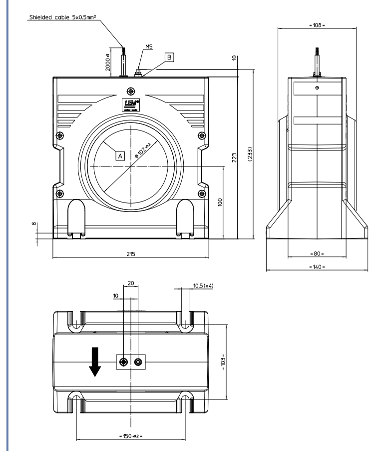
141 DI 30/SP1



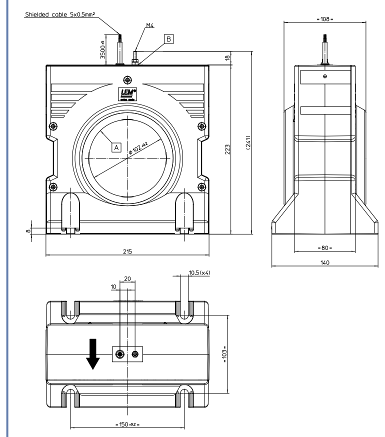
142 RA 1005–S



143 RA 2000–S/SP1



144 RA 2000–S/SP2

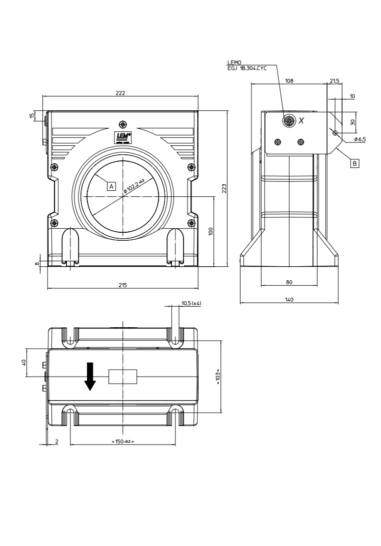


Dimension Drawings

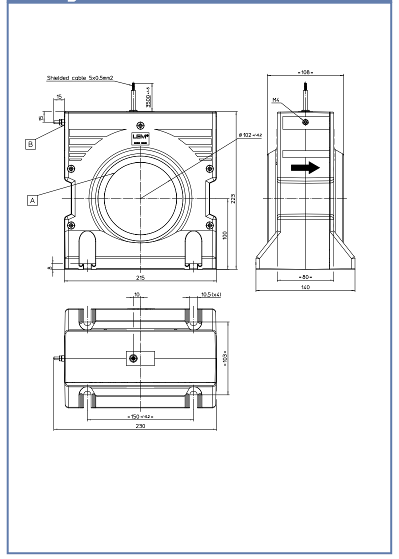
All dimensions are in mm

● Hall effect chip location

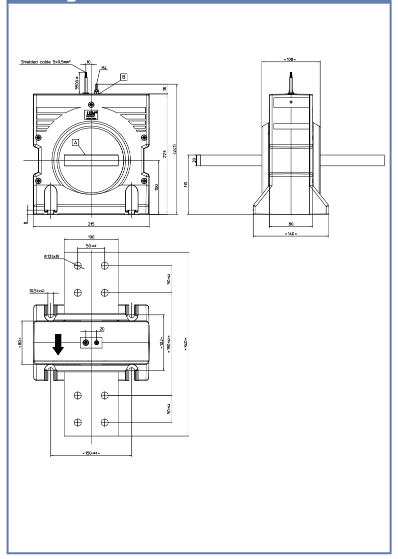
145 RA 2000–S/SP3



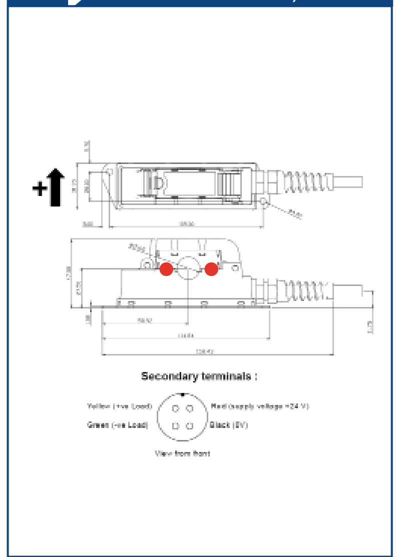
146 RA 2000–S/SP4



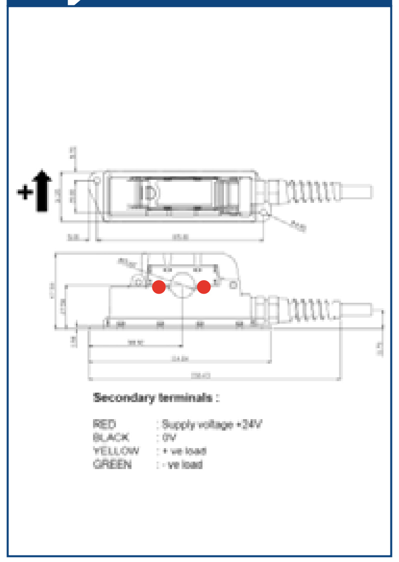
147 RA 2000–T/SP2



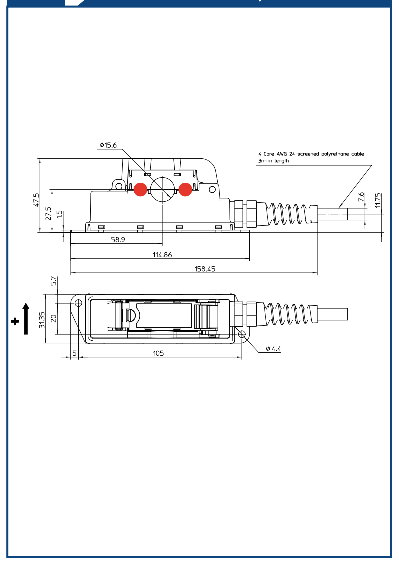
148 PCM 10–P, PCM 20–P, PCM 30–P



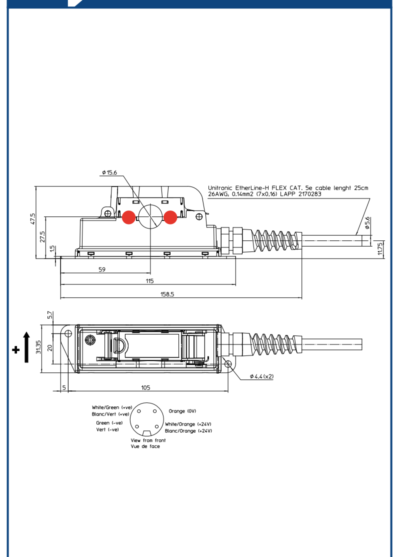
149 PCM 10–P/SP1



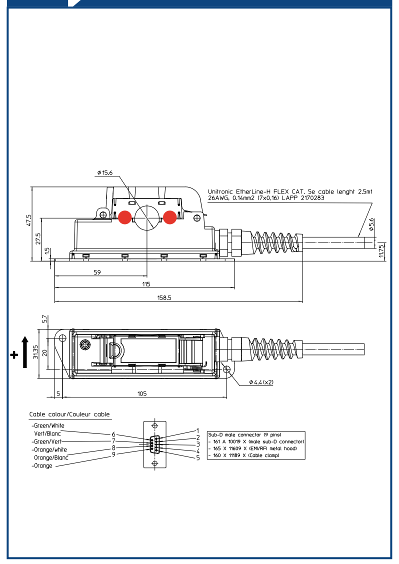
150 PCM 20–P/SP2, PCM 20–P/SP6, PCM 30–P/SP1



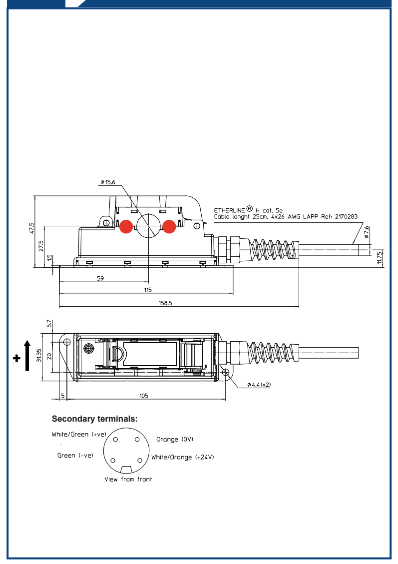
151 PCM 20–P/SP3



152 PCM 20–P/SP4



153 PCM 5–PR/SP1, PCM 10–PR/SP1

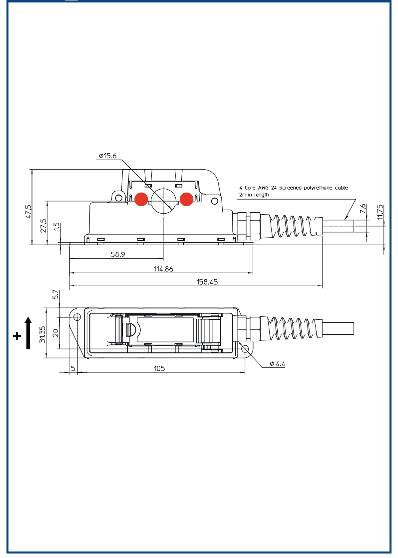


Dimension Drawings

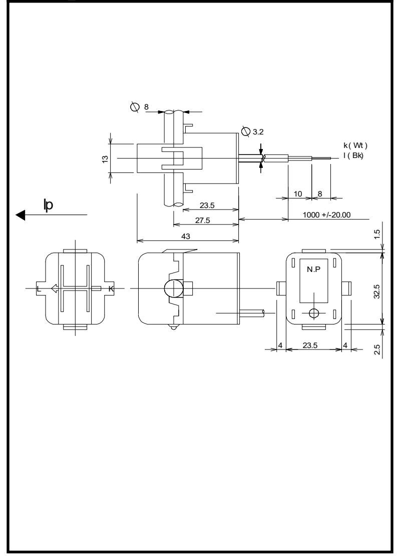
All dimensions are in mm

● Hall effect chip location

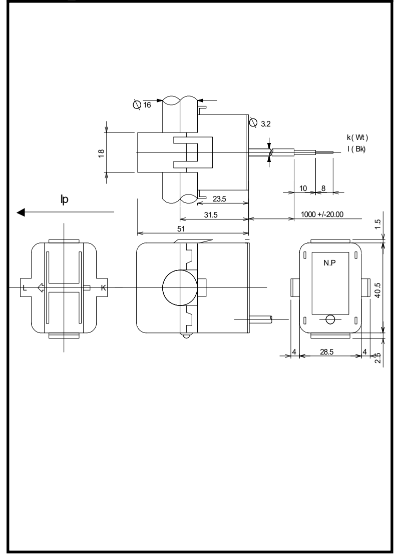
154 PCM 5–PR/SP2



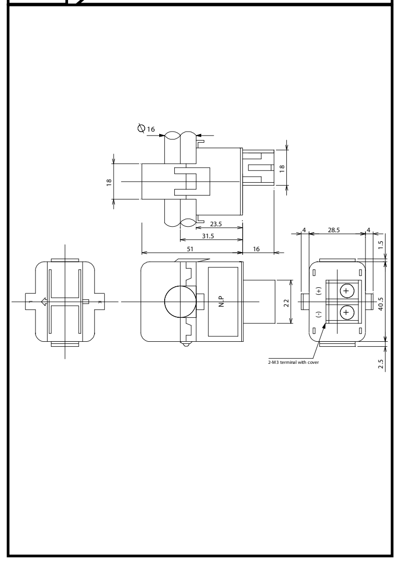
155 TT 50–SD



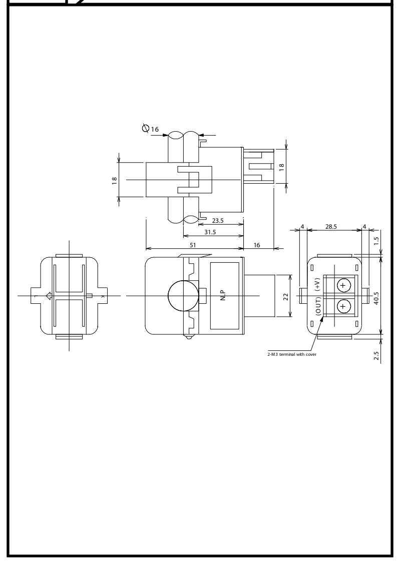
156 TT 100–SD



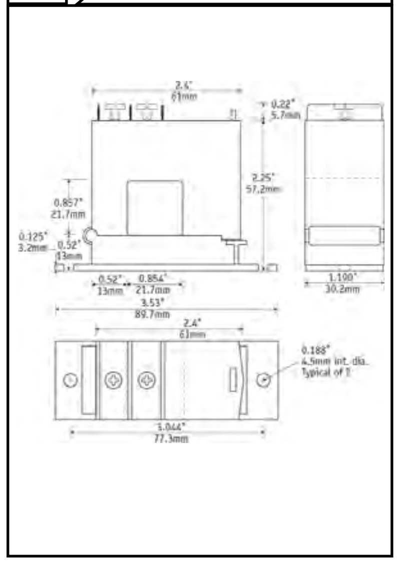
157 AT 5...150 B5/B10



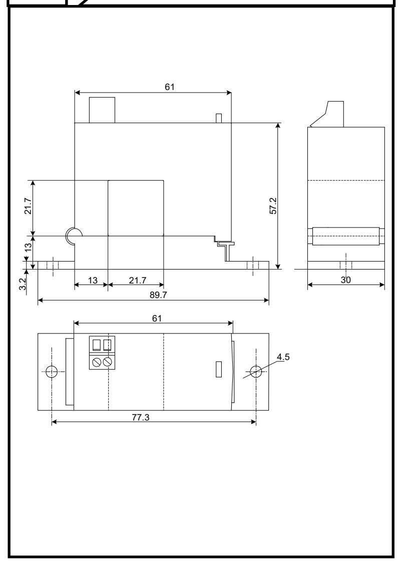
158 AT 5...150 B420L



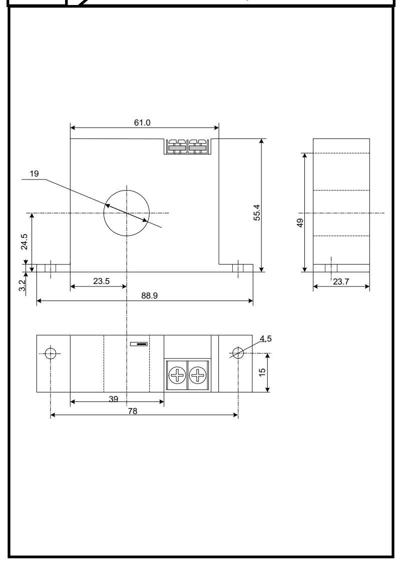
159 AK 50...200 B10, AK 5...200 B420L



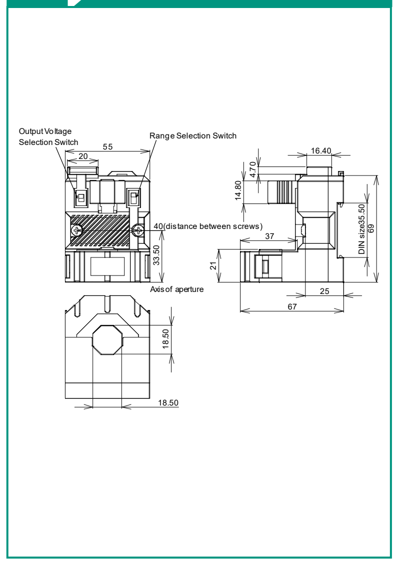
160 AKR 5...200 B420L



161 AK 50...200 C10, AK 5...200 C420L, AKR 5...200 C420L



162 AP 50...400 B5/B10, APR 50...400 B5/B10



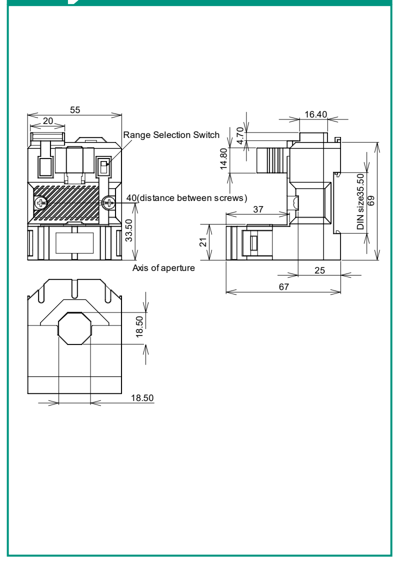
DRAWINGS

Dimension Drawings

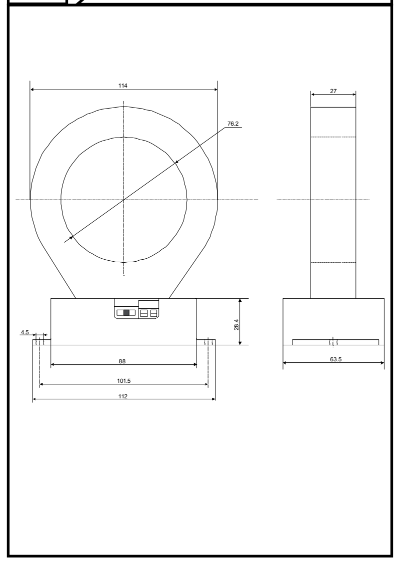
All dimensions are in mm

● Hall effect chip location

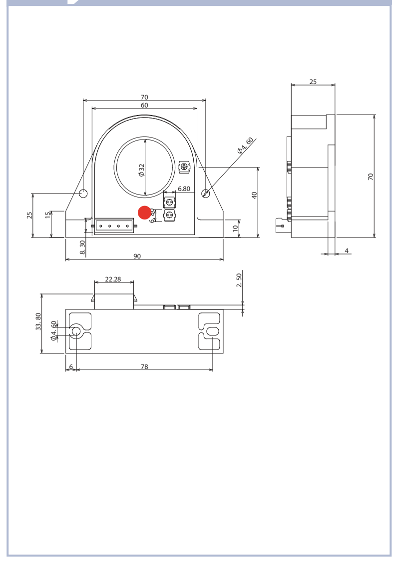
163 AP 50...400 B420L / APR 50...400 B420L



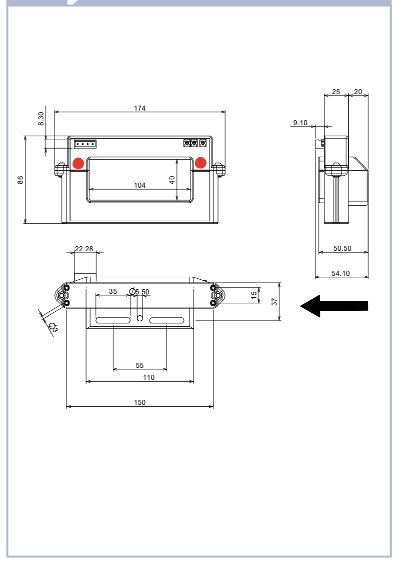
164 AKR 750/2000 C420L J



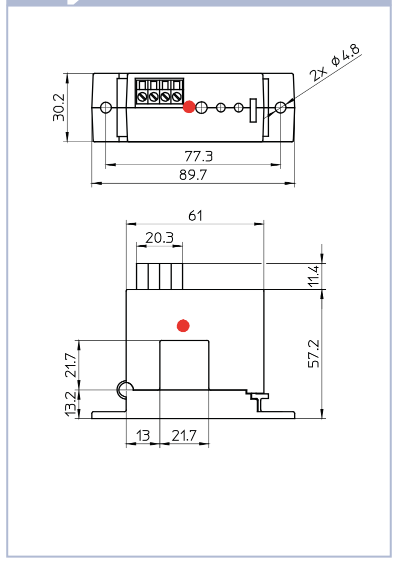
165 DHR 100...1000 C5/C10/C420



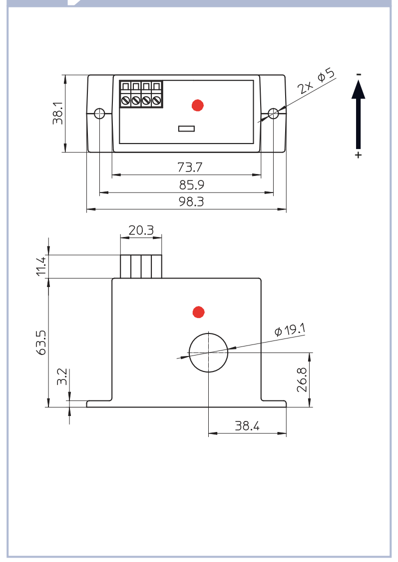
166 AHR 500...2000 B5/B10/B420



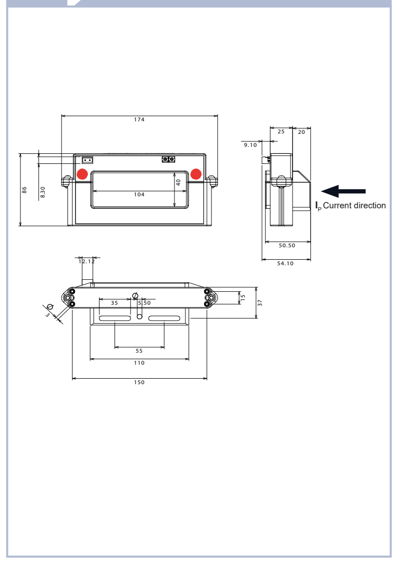
167 DK 100...400 B5/B10/B420/B020/B420 B



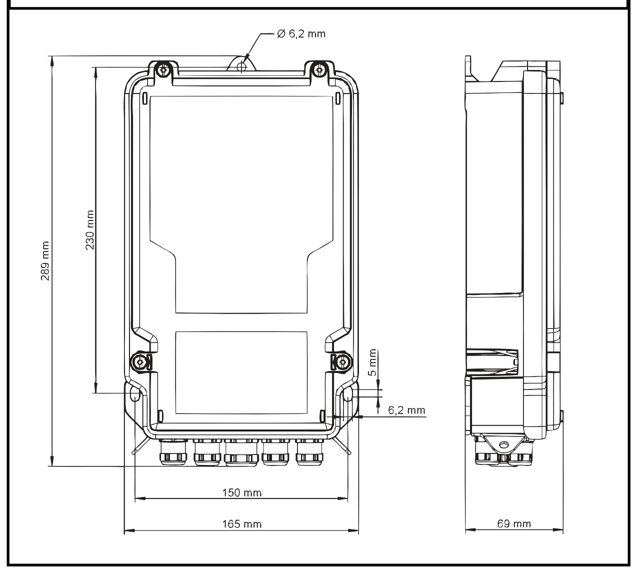
168 DK 20...100 C420 B



169 DH 500...2000 B 420L B



EM4T II



PRODUCT CODING / Industrial & Traction Transducers

Family

- A : transducers using the principle of isolation amplifier
- C : transducers using the principle of fluxgate compensation
- D : digital transducers
- F : transducers using the detector of fields
- H : transducers using the Hall effect without magnetic compensation
- I : compensation current transducers with high accuracy
- L : transducers using the Hall effect with magnetic compensation
- R : transducers using the principle of the Rogowski loop
- T : transducers using the simple transformer effect

Group:

- A or AK or AL or AS 1) or AT or AX or AZ or AXC : with rectangular laminated magnetic circuit
- AR or AW or AC or X or XN : with rectangular laminated magnetic circuit
- AF : with rectangular laminated magnetic circuit and flat housing
- AH : vertical mounting
- AIS, XS, ASS, AFS : rectangular laminated magnetic circuit + unidirectional power supply + reference access
- ASR, KSR, LSR : rectangular magnetic circuit + unipolar power supply + reference access
- AY : rectangular magnetic circuit + hybrid
- B : double toroidal core
- C : apparent printed circuit
- D : differential measurement
- HS : Hall effect without magnetic compensation; magnetic concentrators + unidirectional power supply + reference access. When used with F (FHS): Minisens, SO8 transducer
- F : flat design
- FWS : flat mounting + mounting on wire + unidirectional power supply
- I : shunt isolator
- MS : surface mounted device + unidirectional power supply + reference access
- O : using ASIC providing multitude of options + unidirectional power supply + reference access
- OP : opening laminated magnetic circuit
- TC : transducer reserved for the traction
- TD : double measurement
- TKS, TFS : core, flat case + unidirectional power supply + reference access
- TP, TO, TN, TZ, TL, T, TA, TB, TY : toroidal core
- TR : opening core
- TS : core + unipolar power supply
- TSR, TSP : core + unipolar power supply + reference access
- TT : triple measurement
- V, VL : voltage measurement
- Y : compact hybrid for PCB mounting

Nominal Amperage

- current transducer : rms amperes
- voltage tranducer : rms amperes-turns
  - 0000 : Nominal Voltage (-1000 meaning 1000 V, with built in primary resistor R1)
  - AW/2 : particular type of voltage transducer
  - AW/2/200: Nominal voltage for AW/2 design (200 meaning 200V with built in primary resistor R1)

Execution

- N : multiple range
- P : assembly on printed circuit
- S(I) : with through-hole for primary conductor
- SM : surface mounted
- T(I) : with incorporated primary busbar

Particularities (1or 2 optional characters or figures)

- B : bipolar output voltage
- BI : bipolar current output
- C : fastening kit without bus bar
- D : can be disassembled
- F : with mounting feet
- FC : with mounting feet + fastening kit
- P : assembly on printed circuit
- PR : programmable
- R : rms output
- RI : rms current output
- RS : serial output
- RU : rms voltage output

Variants

Differing from the standard product... /SPXX

1) When used with L (LAS): current transducer with secondary winding and unipolar power supply using Eta technology

When used with C (CAS): current transducer with rectangular magnetic circuit + unipolar power supply

When used with H (HAS): current transducer with rectangular magnetic circuit using O/L Hall effect technology

HLSR 10-SM/...
LTC 600-SF/...

Symbols and Terms

BW	Frequency bandwidth
CTI	Comparative Tracking Index
d_{Cl}	Clearance distance
d_{Cp}	Creepage distance
G	Sensitivity
ε_L	Linearity error
I_C	Current consumption
I_0	Zero offset current, T_A = 25 °C
I_{OE}	Electrical 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_{PR}	Primary residual current
I_S	Secondary current
I_{SN}	Secondary nominal RMS current
IPxx	Protection degree
K_N	Turns ratio
M	Mutual inductance
N	Number of turns
N_P	Number of primary turns
N_S	Number of secondary turns
N_P/N_S	Turns ratio
N_T	Number of turns (test winding)
R_{IM}	Internal measuring resistance
R_L	Load 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}
TCI_{OE}	Temperature coefficient of I_{OE}
TCV_{OUT}	Temperature coefficient of V_{OUT}
TCV_{OE}	Temperature coefficient of V_{OE}
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
U_C	Supply voltage
U_b	Rated isolation voltage RMS, reinforced or basic isolation
U_d	RMS voltage for AC isolation test, 50 Hz, 1 min
U_e	RMS voltage for partial discharge extinction @ 10 pc
U_{Nm}	Rated insulation voltage according to EN 50124–1
U_W	Impulse withstand voltage, 1,2/50 µs
V_H	Hall Voltage
V_0	Zero offset voltage, T_A = 25 °C
V_{OE}	Electrical 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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Terms of delivery and rights to change design or specifications are reserved.

5 Year Warranty on LEM Transducers

We design and manufacture high quality and highly reliable products for our customers all over the world.

We have delivered several million current and voltage transducers since 1972 and most of them are still being used today for traction vehicles, industrial motor drives, UPS systems and many other applications requiring high quality standards.

The warranty granted on LEM transducers is for a period of 5 years (60 months) from the date of their delivery (not applicable to Energy-meter product family for traction and automotive transducers where the warranty period is 2 years).

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

Additional 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 LEM 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 LEM's discretion.

The customer bears the transport costs. An extension of the warranty period following repairs undertaken under warranty cannot be granted.

The warranty becomes invalid 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 useand cases of force majeure.

No responsibility will apply except legal requirements regarding product liability.
The warranty explicitly excludes all claims exceeding the above conditions.

Geneva, 21 June 2011

François Gabella
CEO LEM

June 2011/Version 1

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