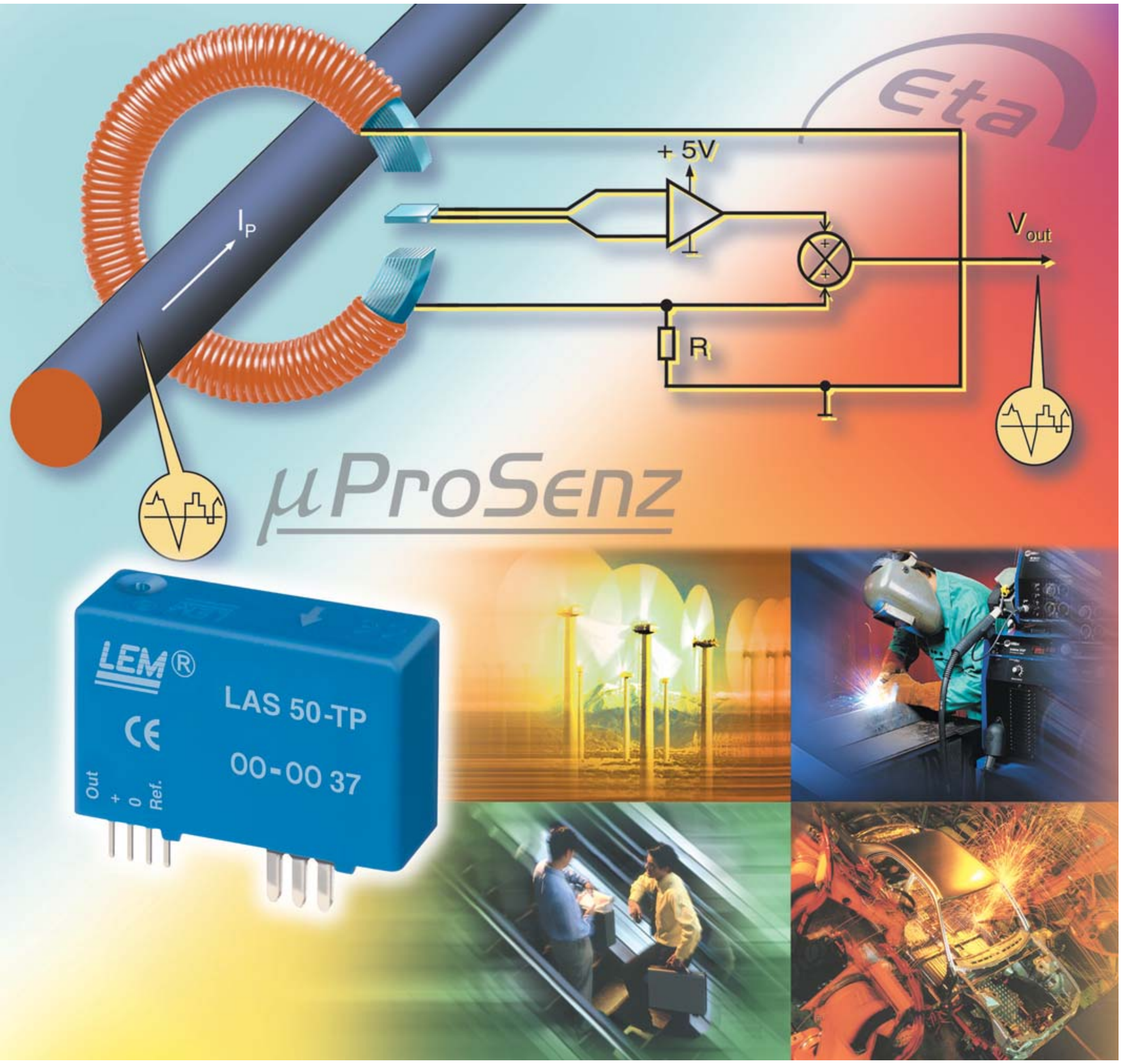
Technical
Information

μProSenz Transducers with Eta technology up to 50 und 100 A nominal



ASIC Based Eta Transducers up to 50 and 100 A nominal

by Rüdiger Bürkel, Pierre Cattanéo, Steve Guex, Hans Dieter Huber, Bernard Richard & Stéphane Rollier.

The use of electronics is steadily increasing in all areas of daily life. It starts in the home with domestic appliances, modern communication devices, intelligent HVAC equipment and continues in many areas ranging from computer and automotive technologies to the fully automated control of industrial processes.
In the field of power supplies, a fundamental change in circuit topologies has occurred during the 90's. Here, digital control components are becoming more and more important. This trend can also be observed in power electronics. IGBT power modules (IGBT = Insulated Gate Bipolar Transistor) are becoming increasingly efficient and compact allowing designers, in conjunction with other electronic components, to build smaller, more compact devices. The objective is always an increase in power density (power per volume) and, at the same time, a reduction in costs. This innovation trend is only possible, if the multitude of new processors is also accompanied by the introduction of appropriate sensors in smaller and more cost-effective versions, equipped with an integrated, electrically isolated interface for measuring the process variables.

In 1997 with the current transducer called LTS 25-NP, LEM introduced a component addressing the requirements of the modern power electronic market for current sensing, providing the designer a cost effective device, with high performance, compact dimensions, immunity from increasingly harsh electric environments isolation, and single 5 V power supply. This solution has been realized by using some innovative ways such as the use of an ASIC (ASIC = Application Specific Integrated Circuit) and new manufacturing techniques. Today, LEM increases its 5 Volt transducer family called the μProSenz family with the LAS 50-TP, LAS 100-TP and SP1 introducing another technology called Eta to reach these same goals.

LEM remains true to our reputation answering to the market's needs by introducing new products based on innovative construction strategies. This is the case today with the introduction of Eta technology.

How does this new technology work? To answer this question, it is necessary to have an overview of the existing technologies:

Open-Loop technology

For the isolated current measurement, Open Loop current transducers (fig. 1) use a magnetic circuit with an air gap, located (without any galvanic contact) around the conductor which carries the current to be measured. A linear Hall element is inserted into the air gap and provides a Hall voltage proportional to the flux produced by the current. This Hall voltage is processed and buffered before being supplied at the transducer output.

Open Loop transducers offer a lot of benefits:

- Simple electronics.
  In contrast to the Closed Loop transducers, no current is needed for the secondary winding, thus eliminating the need for a costly final amplifier power stage.
- Good price/performance ratio.
- Low consumption.
- Small size for higher currents.

The disadvantages are:

- Narrower frequency range.
  Up to 25 kHz and 50 kHz, based on the electronic performance and the quality of the magnetic circuit.

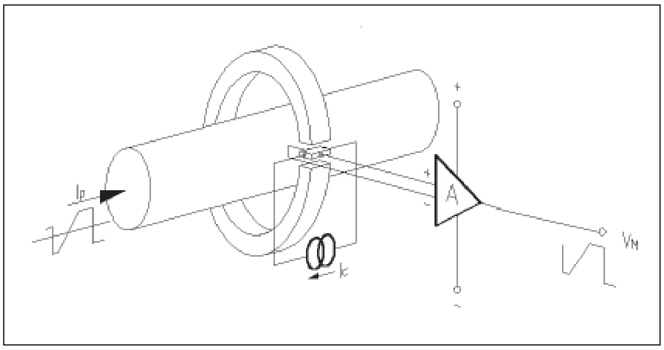


Fig 1. Principle of Open-Loop transducers.

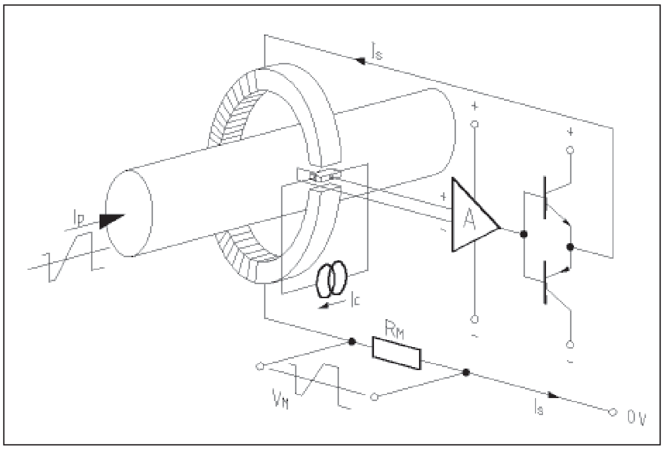


Fig. 2. Principle of Closed Loop transducers.

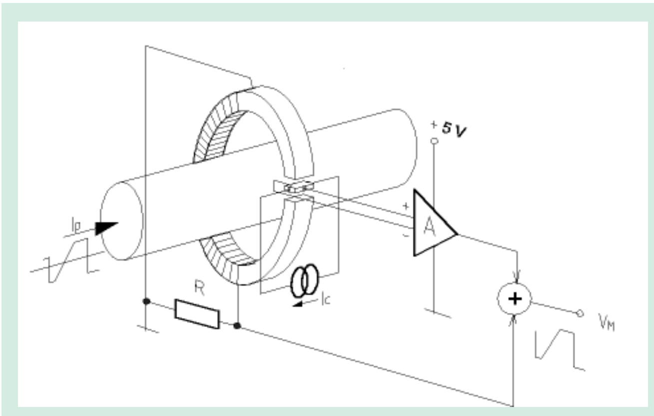


Fig 3. Eta-principle

- Relatively high offset and gain drift.
- Lower accuracy for the measurement of AC and DC currents.
  Certain parameters such as gap length affect the accuracy.
- Overheating at high frequency currents due to magnetic hysteresis and eddy current losses.

Closed Loop technology

As shown in fig. 2, with this principle, the Hall element in the air gap is only used for the detection of flux = 0. A following electronic circuit drives a compensation current through a secondary winding until the primary and secondary ampere-turns are equal. The compensation current can then be measured across a load resistor and is a true reflection of the primary current.

The method shown in fig. 2 has several advantages:

- High bandwidth due to the use of the current transformer effect (frequency measurement up to 100 kHz and even 200 kHz).
- Excellent accuracy, no gain drift. Indeed, the gain depends only on the number of turns.
- Insignificant insertion inductance.

The Closed Loop technology is not without its disadvantages:

- High consumption current; the power supply has to provide the compensation current.
- Costly electronics due to the power output stage.

It was the disadvantages of the Closed Loop technology that lead to the development of Eta technology for the design of a new range of current transducers (Fig. 3). The LEM designers devised a solution that keeps the best points of the well-known already used technologies.

The first models of this new range are the LAS 50-TP and LAS 100-TP respectively expected for a nominal current of 50 A_{RMS} and 100 A_{RMS}. They are both available also under the SP1 model.

Eta technology Principle

With the Eta-principle, LEM has tried to combine the positive properties of the Open Loop and the Closed Loop transducers.
This has only become possible, with the availability of special ASICs that could significantly improve the performance of Open Loop transducers. Fig. 3 shows the construction of this transducer.

In the air gap of the magnetic circuit, there is a high performance ASIC with a temperature-compensated Hall element for the measurement of the magnetic flux. This allows the transducer to measure accurately DC and low-frequency currents.
In the case of AC currents, the secondary coil delivers the output voltage across the load resistor R. Both signals are electronically added to form a common output signal.
As we can see, the Eta is an application of the Ampere theorem

$$\Sigma I = \oint \vec{H} \times \vec{dl}$$

which allows us to write the following practical case (fig. 4):

$$I_P \bullet N_P = H_{air} \bullet l_{air} + H_{fe} \bullet l_{fe}$$

and $I_P \bullet N_P = H_{air} \bullet l_{air} + ns \bullet is$

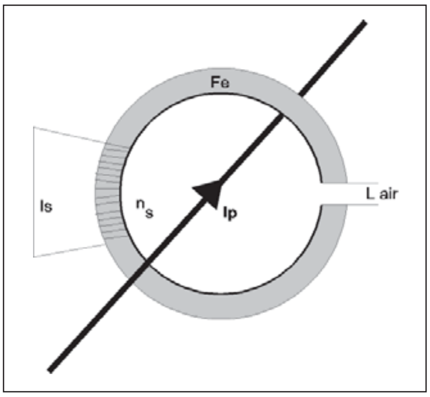


Fig. 4 Application of the Ampere theorem

Advantages & drawbacks of the Eta principle

- The Eta current sensors are very accurate for AC current measurements.
- Optimising the current transformer, we can achieve a very fast transient response. The current sensor is able to follow accurately a dI/dt up to 100 A/µs and even more.
- No overheating at high frequency currents, because the flux inside the magnetic circuit is practically zero. (Primary At ≅ secondary At)
- Very low current consumption.
  For example, below 20 mA for the LAS 50-TP.
- For the measurement of a slightly variable DC current, an Eta current sensor will work on the same principle as a transducer of the “Open Loop” type.

  Consequently, the magnetic circuit must be dimensioned so as to remain far from magnetic saturation. In spite of this precaution, the linearity error will be the same as that obtained with an Open Loop sensor, between 3 and 4 times greater than with a Closed Loop sensor

As the LAS transducers are a combination between an O/L and a C/L transducer, some errors, such as offset and gain thermal drift errors peculiar to O/L transducers were introduced compared to traditional Closed Loop. To improve these performances, LEM designed a custom ASIC allowing an enhanced accuracy when the transducer is working as an O/L in DC and low frequencies. Indeed, in this way the previous errors can be compensated much more easily.

This ASIC, called PACT (**P**rogrammable **A**SIC for **C**urrent **T**ransducer Fig. 5) has been designed to withstand high EMC. The measurement problems linked with the presence of very high dI/dt and dV/dt have been the focus of our attention in particular and we have succeeded in obtaining an ASIC with an exceptional immunity.

We see that for the output amplifier, either an internal and stable 2.5 V reference or an external reference can be used.

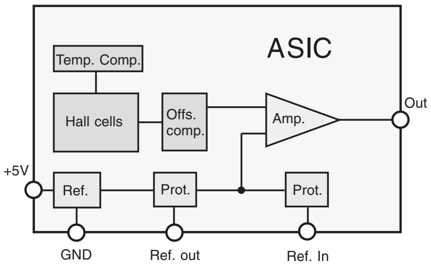


Fig. 5 PACT principle diagram.

Main characteristics

The main characteristics are shown in the table 1:

Table 1 Technical data of the LAS Transducers

	LAS 50-TP	LAS 100-TP	LAS 50-TP/SP1	LAS 100-TP/SP1
Nominal current	50 A	100 A	50 A	100 A
Measuring range	±150 A	±300 A	±150 A	±300 A
Accuracy @ +25 °C	1 %		1 %	
Supply voltage	+ 5 V		+ 5 V	
Reference	2.5 V ± 25 mV		External 2.5 ± 0.2 V	
Thermal drift of V_{out}/V_{ref} at $I_P = 0$	50 ppm/K typical		50 ppm/K typical	
Frequency bandwidth	DC.. 100 kHz (-1dB)		DC .. 100 kHz (-1dB)	
Temperature range	-40 °C .. +85 °C		-40 °C .. +85 °C	
Isolation voltage	5 kV		5 kV	
Power consumption	0.08 W		0.08 W	

The power supply voltage is 0; +5 V which matches the most commonly used processors. In contrast to the existing Closed-Loop current transducers which generally exhibit a factor for current-range to nominal-current ratio of 1.5, a ratio of 2.5 to 3 is obtained with the LAS range. This is an advantage for most applications. The LAS 50-TP (LAS 100-TP) can precisely measure currents up to 150 A (300 A) for a maximum nominal current of 50 A (100 A). The reference point without any primary current is 2.5 V, which is exactly half of the supply rail voltage. The variation span of the amplified output signal is 0.625 V/I_{PN}, which results in an output voltage of 4.375 V at +150 A (+300 A) and 0.625 V at -150 A (-300 A).

Accuracy

Based on the primary signal to be measured (AC or DC), the LAS current transducer series works either according to the Open-Loop principle or the current transformer effect (one of the Closed-Loop technology characteristics), this is exactly the Eta technology principle. The accuracy is different depending on the signal to be measured:

1. (case 1) DC or low frequency: In this case, the transducer is working as an Open-Loop transducer
2. Or (case 2) AC: In this case, the transducer is working as a transformer.

The worst case in terms of accuracy is when the transducer is functioning in the Open-Loop mode. In this case, the max possible error is of ±1% of I_{PN} at +25°C (without electrical, magnetic off-set and linearity error) what is compa-rable to the Open Loop transducer accuracy.
The global accuracy for an Open Loop transducer can be defined as including (note: in brackets the LAS 50-TP values):

- The initial electrical offset at +25 °C at $I_P = 0$ (V_{ref} ±25 mV, with V_{ref} = 2.5 V ±25 mV), this error can be com-pensated with the micro-controller.
- The initial gain adjustment error (±0.5 % of I_{PN} typical, ±1 % of I_{PN} max).
- The magnetic offset: Vom (±0.5 % of I_{PN} after an excursion at I_{PN} = 50 A)
- And the non-linearity error (±0.7 % of I_{PN} including the magnetic offset. The magnetic offset for the LAS 50-TP can't be detached of the linearity error).

The magnetic offset Vom is due to the magnetic circuit remanence after a positive or negative excursion into the transducer measuring range.

What happens exactly?
To answer this question it is necessary to look at deeper into the transducers makeup.
Let's have a look on the magnetic circuit behaviour: A magnetic circuit is defined by an hysteresis cycle as follows:

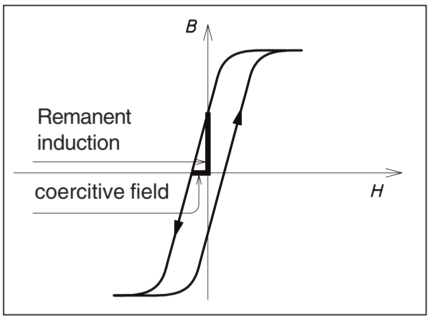


Fig. 6. Magnetic circuit Hysteresis cycle

H being function of the measured current (I_P). B being function of H and of the magnetic circuit used.

The choice of the magnetic circuit and its associated hysteresis cycle establishes the Open Loop transducers measuring range and other properties.

When the primary current is increasing, H increases proportionally and then B also, according to the magnetic circuit hysteresis cycle.
The max current of the measuring range is defined before reaching the magnetic circuit saturation. The saturation happens when B begins to taper off and is complete when B remains constant.
When the current to measure is decreasing, H decreases proportionally and then B also, according to the magnetic circuit hysteresis cycle.
If we look at the theory then B and H should come back to their initial values at 0, but in the real world when H is nearing 0, B reaches a certain value slightly different of 0.

This value is called the remanence (residual magnetism) and its value is more significant if saturation is reached. With all transducers, this value is found back under the form of a magnetic offset called "Vom" and after an excursion to 2 • I_{PN} it can be of ±5 mV max, and ±3 mV max (±0.5 % of I_{PN}) after an excursion up to 1 • I_{PN} = 50 A for the LAS 50-TP.
For the LAS 50-TP, the Vom error (after an excursion to ± I_{PN}) has been incorporated into the linearity error. The linearity error is defined as the error resulting from the difference between the actual measurement and the ideal reference. The max value found along the transducer measuring range is then reported in relation to the nominal current of the transducer and that gives an error range applicable to the whole measuring range. In the present case, the linearity error is evaluated at <±0.7 % of I_{PN} (LAS 50-TP).

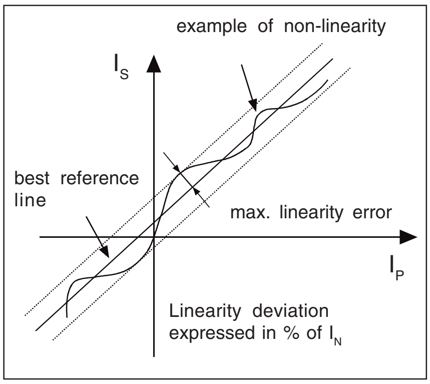


Fig. 7. Linearity definition.

When the LAS 50-TP is operating in DC, over the whole temperature range, the typical thermal drift of the gain is then of 150 ppm/K

In AC measurements, the LAS 50-TP can be compared to a C/L transducer in terms of accuracy because it is working using the same current transformer effect already used by the C/L transducers.

When operating in the current transformer mode, to keep the same ratio and output type (voltage) as in DC conditions of use, a measuring resistor has been integrated into the transducer. LEM has chosen resistors with an accuracy of ±0.5 % and a temperature drift of 50 ppm/K maximum.

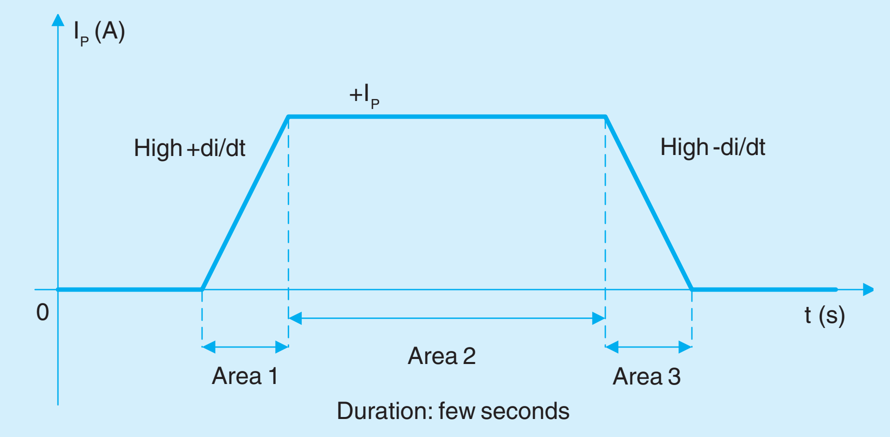


Fig.8 : Typical pulse signal

In the area 1, (Fig 8) the LAS 50-TP is working as a current transformer with no remanence as high positive dI/dt is present. During the area 2, of the waveform, the LAS 50-TP is working as an Open-Loop transducer with a certain remanence value because of the constant DC input. In area 3, the LAS 50-TP is working as a current transformer again with high negative dI/dt. This allows the device to cancel a large part of the previous remanence value.

A new addition for LAS transducers is that the built-in reference is provided externally to the user on an additional pin. The analogue output voltage at I_{PN} = 0 reaches a temperature stability of 80 ppm/K typical. Its absolute accuracy at +25 °C is not important since, in most cases, it can be compensated by a processor in the customer application. The temperature drift correlation between the analogue output voltage and the build in reference at I_{PN} = 0 is the following: TCV_{out}/V_{ref} = 50 ppm/K typical.
The availability of the built-in reference is a way for the user to be able to cancel the error added by the reference drift over temperature. This is usually dealt with by a DSP (Digital Signal Processor) more and more common in the Power Electronic circuits.

On the SP1 version, the reference is provided by the user on a pin and replaces the built- in reference of the LAS 50-TP.

This customer reference must have a value between 2,3 volts and 2,7 volts.

By providing the reference in this way the customer knows and masters exactly the reference allowing him to eliminate the offset in his accuracy calculation.

Power supply
Digital control systems are generally operated with a supply voltage of 0; +5 V. This does not always apply to peripheral analogue components, as is the case with current transducers available in the market today, since they normally require ±12V or ±15 V to function. So far, the signals have been conditioned by using the analogue converter circuits (Fig. 9).

The LAS and LTS series *μProSenz* (Fig. 10) can do without such conversion feeding directly into the A/D converter. The user can now save costs both on the component itself and on surrounding components:

- Additional operational amplifiers, measuring resistor and external reference voltage no longer required
- Smaller size of the printed circuit board since some components are omitted
- Elimination of a ±15 V supply voltage to operate the sensor

At the same time, the LAS 50-TP power consumption is really (around 0,08 W) low and has never been seen so low in Hall Effect based current transducers. This is thanks to the use of the Eta technology and also to the ASIC (and its own technology) used requiring very low current to operate.

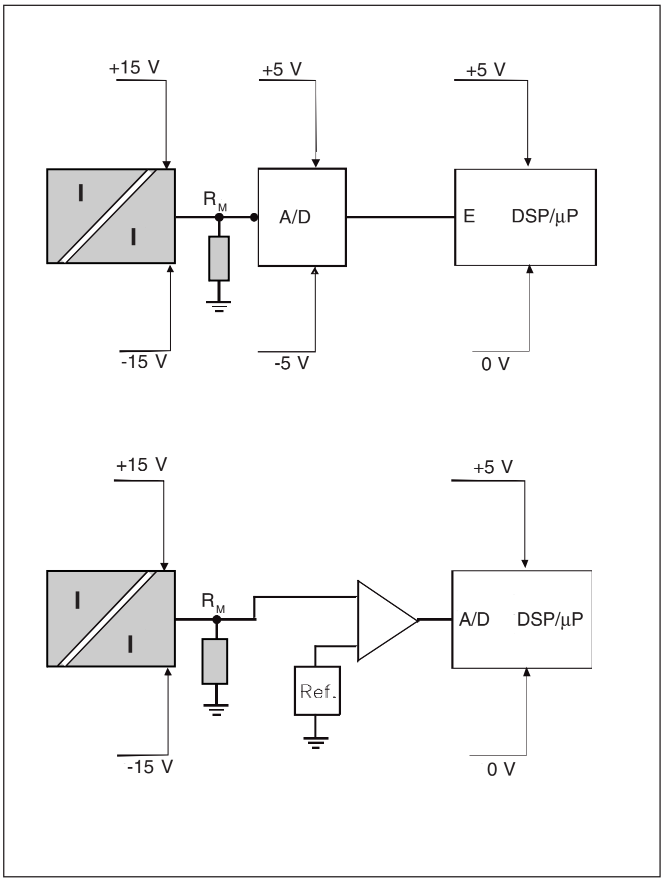


Figure 9 Block diagram of existing digital systems for current measurements

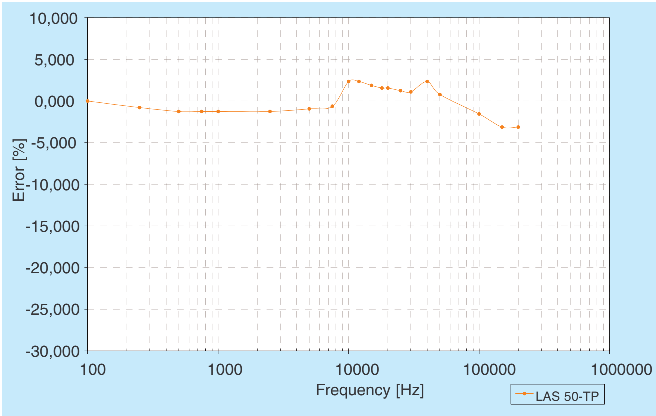


Figure 11 Error versus frequency (LAS 50-TP)

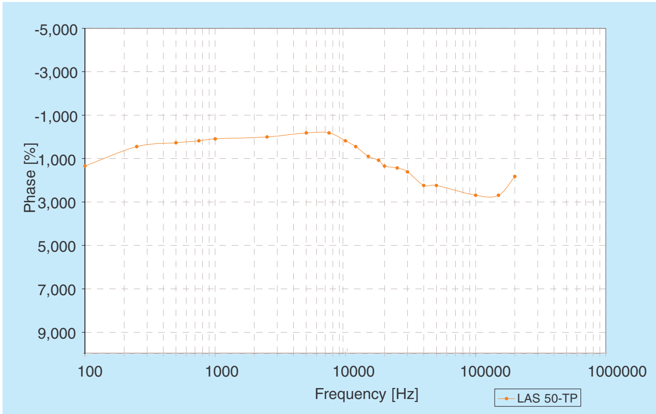


Figure 12 Phase error versus frequency (LAS 50-TP)

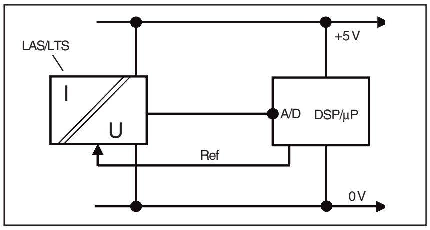


Figure 10 Block diagram of a digital system for current measurements using the LTS and LAS series

Wide frequency bandwidth

Fig. 11 and fig. 12 give the frequency response of the LAS 50-TP. You see the very good response up to more than 100 kHz. The reason is in the excellent combination of the ASIC and the transformer with very good coupling to the primary.
The –1 dB limit is at approx. 100 kHz and thus exceeds all values of conventional state-of-the-art Hall effect transducers.

Behaviour at dV/dt noise

Any electrical component with a galvanic isolation between the primary and the secondary circuit has a capacitive coupling between the isolated potentials. In applications with high switching frequencies and consequently with steep switching slopes (i.e. fast voltage changes on the primary side), this leads to undesirable EMI influences (EMI = Electro Magnetic Interference).

A voltage change of 10 kV/µs in combination with a 10 pF coupling capacity generates a parasitic output current of 100 mA. For the LAS 50-TP, this would be two times the nominal current.

Figure 13 shows the behaviour of the transducer subjected to voltage change of 6 kV/µs and an applied voltage of 1000 V to the primary conductor, with a zero primary current. The maximum disturbance obtained is 440 mV, which corresponds to about 70 % of I_{PN}. It should be noted that 200 ns after the end of the disturbing transients, the output signal of the LAS 50-TP is undisturbed. Note also that the very short duration of the disturbance can be easily filtered. This is very important for the use with digital regulating circuits using pulse width modulation (PWM). In this case, a small filter is sufficient for the attenuation, in order not to reduce the dynamic characteristics of the sensor.

Standards

During the design of the LAS series, rules set down in the EN 50178 standard have been followed. It complies with 5 kV AC-isolation and more than 2 kV partial discharge extinction voltage, all requirements for safety isolation up to a working voltage of 600 V for overvoltage category III.
All materials are UL-listed (UL = Underwriter's Laboratories).
The marking of the product with the CE mark certifies the conformity with the low voltage Directive 72/23/EEC.

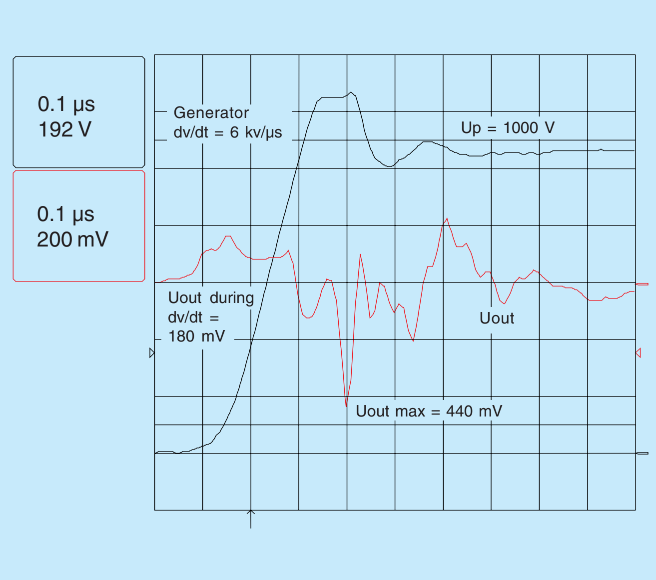


Figure 13 dV/dt behaviour (LAS 50-TP)

Table 2 Advantages and applications of the LAS current transducer in an overview

Advantages of the LAS series

- ▲ Using an unipolar power supply 0; +5 V, positive and negative currents can be measured.
- ▲ Very low power consumption.
- ▲ The Eta technology provides a wide frequency range with a fast response time, an extended measuring range and the capability of measuring short current pulses.
- ▲ Production-friendliness due to simple mounting.
- ▲ Cost-effective solution.

Applications

The LAS opens all applications in low-power electronic systems such as variable speed drives, electrical drives for industrial use in heating, ventilation and air conditioning as well as in appliances and industrial devices, servo drives, uninterruptible power supplies (UPS), and SMPS (Switched Mode Power Supplies), energy management systems and general applications of current monitoring.

Some application advise + information

- Coupling between primary and secondary PCB traces

  Capacitive coupling
  A capacitive coupling between PCB traces is an unwanted effect. This coupling occurs when two tracks are too near one another, or when they are in parallel for too long a distance when a high dV/dt happens (Fig. 14).

  This effect can be reduced by separating the two sensitive traces the one from the other (in our case, mainly the transducer's «Out» output and one of the primary tracks).

  Note: Possibility to create a screening trace, connecting it to a fixed potential. (take care however of maintaining the insulation distances).
  This can happen for example when a trace on one layer of a PCB and the second trace on another layer of the same PCB, but the both tracks the one on the other.

- Noise on the output

  The noise of the LAS Series is generated by the ASIC. The maximum noise met is of 10 mVpp. With a small output filter, this can be reduced easily.

Summary

Table 2 shows all advantages and applications of the LAS series.
This product is the result of a long development process based on many application specific solution details. These have been created in partnership and co-operation with development and design engineers, where the exchange of ideas and information has played a major role. The objective was to improve the customers' products in a very competitive environment.
This cooperation allows LEM to create innovative and cost-effective product solutions which offer both the user and the manufacturer new possibilities of automated production with repeatable performances and a high quality level.

With the new Eta Technology, it's possible to develop a range of 5V transducers having about the accuracy of a Closed Loop type. One big advantage is the very low power consumption of about 5 % compared to a traditional type. The LAS Series is part of the *µProSenz* series.

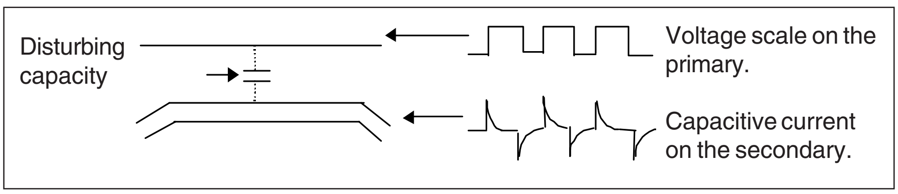


Figure 14

Current Transducer LAS 50-TP & LAS 100-TP I_{PN} = 50 & 100 A

For the electronic measurement of currents: DC, AC, pulsed, mixed, with a galvanic isolation between the primary circuit (high power) and the secondary circuit (electronic circuit).

	Electrical data	LAS 50-TP	LAS 100-TP	
I_{PN}	Primary nominal r.m.s. current	50	100	A
I_P	Primary current, measuring range	0 .. ± 150	0 .. ± 200	A
	at frequency > 1 kHz		0 .. ± 300	A
V_{OUT}	Analog output voltage @ I_P	$V_{REF} \pm (0.625 \cdot I_P/I_{PN})$		V
	$I_P = 0$	$V_{REF} \pm 0.025$		V
V_{REF}	Reference voltage - output	2.5 ± 0.025		V
	V_{REF} Load impedance	≥ 1		MΩ
R_L	Output load resistance	≥ 2		kΩ
R_{OUT}	Output internal resistance	< 20		Ω
C_L	Max. output capacitive load	1		nF
V_C	Supply voltage (± 5 %)	5		V
I_C	Current consumption @ V_C = 5 V Typ	17		mA
V_d	R.m.s. voltage for AC isolation test, 50/60 Hz, 1 mn	5		kV
V_e	R.m.s. voltage for partial discharge extinction @ 10 pC	2		kV
$\hat{V}_w$	Impulse withstand voltage 1.2/50 µs	8		kV

	Accuracy - Dynamic performance data	LAS 50-TP		LAS 100-TP		
X	Accuracy [1] @ I_{PN}, T_A = 25°C	< ± 1				%
ε_L	Linearity error 0 .. I_{PN} [2]	< 0.7		< 0.9		%
		Typ	Max	Typ	Max	
TCV_{OUT}	Thermal drift of V_{OUT} @ I_P = 0 at T_A	80	120	80	120	ppm/K
TCV_{OUT}/V_{REF}	Thermal drift of V_{OUT}/V_{REF} @ I_P = 0 at T_A	50	80	50	80	ppm/K
$TC\varepsilon_G$	Thermal drift of the gain at T_A	150	300	300	500	ppm/K
V_{OM}	Residual voltage @ I_P = 0, after an overload of 2 x $I_{PN\,DC}$	< ± 5		< ± 6		mV
t_{ra}	Reaction time @ 10 % of I_{PN}	< 200				ns
t_r	Response time @ 90 % of I_{PN}	< 500				ns
di/dt	di/dt accurately followed	> 100				A/µs
	Output noise without external filter	< 10				mVpp
f	Frequency bandwidth (- 1 dB)	DC .. 100				kHz

	General data		
T_A	Ambient operating temperature	- 40 .. + 85	°C
T_S	Ambient storage temperature	- 40 .. + 100	°C
m	Mass	20	g
	Insulating material group	I	
	Standards	EN 50178 (971001)	

All Data are given with a R_L = 10 kΩ.

Notes : [1] Excluding electrical, magnetic offsets and linearity
[2] Including magnetic offset.

Features

- Current transducer using Eta-technology
- Unipolar voltage supply
- Insulated plastic case recognized according to UL 94-V0
- Compact design for PCB mounting
- Extended measuring range.

Advantages

- Excellent accuracy
- Very good linearity
- Very low temperature drift
- Optimized response time
- Wide frequency bandwidth
- No insertion losses
- High immunity to external interference
- Current overload capability.

Applications

- AC variable speed drives and servo motor drives
- Static converters for DC motor drives
- Battery supplied applications
- Uninterruptible Power Supplies (UPS)
- Switched Mode Power Supplies (SMPS)
- Power supplies for welding applications.

Current Transducer LAS 50 ..100-TP/SP1

I_{PN} = 50 & 100 A

For the electronic measurement of currents : DC, AC, pulsed, mixed, with a galvanic isolation between the primary circuit (high power) and the secondary circuit (electronic circuit).

Symbol	Electrical data	Condition	LAS 50-TP/SP1		LAS 100-TP/SP1	Unit
I_{PN}	Primary nominal r.m.s. current		50		100	A
I_P	Primary current, measuring range		0 .. ± 150		0 .. ± 200	A
	at frequency > 1 kHz				0 .. ± 300	A
V_{OUT}	Analog output voltage @	I_P		$V_{REF} \pm (0.625 \cdot I_P/I_{PN})$		V
		$I_P = 0$		$V_{REF} \pm 0.025$		V
V_{REF}	Reference voltage - input			2.5 ± 0.2		V
	V_{REF} Load impedance			≥ 1		MΩ
R_L	Output load resistance			≥ 2		kΩ
R_{OUT}	Output internal resistance			< 20		Ω
C_L	Max. output capacitive load			1		nF
V_C	Supply voltage (± 5 %)			5		V
I_C	Current consumption @ V_C = 5 V Typ			17		mA
V_d	R.m.s. voltage for AC isolation test, 50/60 Hz, 1 mn			5		kV
V_e	R.m.s. voltage for partial discharge extinction @ 10 pC			2		kV
$\hat{V}_w$	Impulse withstand voltage 1.2/50 µs			8		kV

Symbol	Accuracy - Dynamic performance data	LAS 50-TP/SP1		LAS 100-TP/SP1	Unit
X	Accuracy [1] @ I_{PN} , T_A = 25°C		< ± 1		%
ε_L	Linearity error 0 .. I_{PN} [2]	< 0.7		< 0.9	%

Symbol	Parameter	LAS 50 Typ	LAS 50 Max	LAS 100 Typ	LAS 100 Max	Unit
TCV_{OUT}/V_{REF}	Thermal drift of V_{OUT}/V_{REF} @ I_P = 0 at T_A	50	80	50	80	ppm/K
$TC\varepsilon_G$	Thermal drift of the gain at T_A	150	300	300	500	ppm/K

Symbol	Parameter	LAS 50-TP/SP1		LAS 100-TP/SP1	Unit
V_{OM}	Residual voltage @ I_P = 0,				
	after an overload of 2 x $I_{PN\,DC}$	< ± 5		< ± 6	mV
t_{ra}	Reaction time @ 10 % of I_{PN}		< 200		ns
t_r	Response time @ 90 % of I_{PN}		< 500		ns
di/dt	di/dt accurately followed		> 100		A/µs
	Output noise without external filter		< 10		mVpp
f	Frequency bandwidth (- 1 dB)		DC .. 100		kHz

Symbol	General data	Value	Unit
T_A	Ambient operating temperature	- 40 .. + 85	°C
T_S	Ambient storage temperature	- 40 .. + 100	°C
m	Mass	20	g
	Insulating material group	I	
	Standards	EN 50178 (971001)	

All Data are given with a R_L = 10 kΩ.

Notes : [1] Excluding electrical, magnetic offsets and linearity
[2] Including magnetic offset.

Features

- Current transducer using Eta-technology
- Unipolar voltage supply
- Insulated plastic case recognized according to UL 94-V0
- Compact design for PCB mounting
- Extended measuring range.

Special feature

- Ref_{IN} input = external reference.

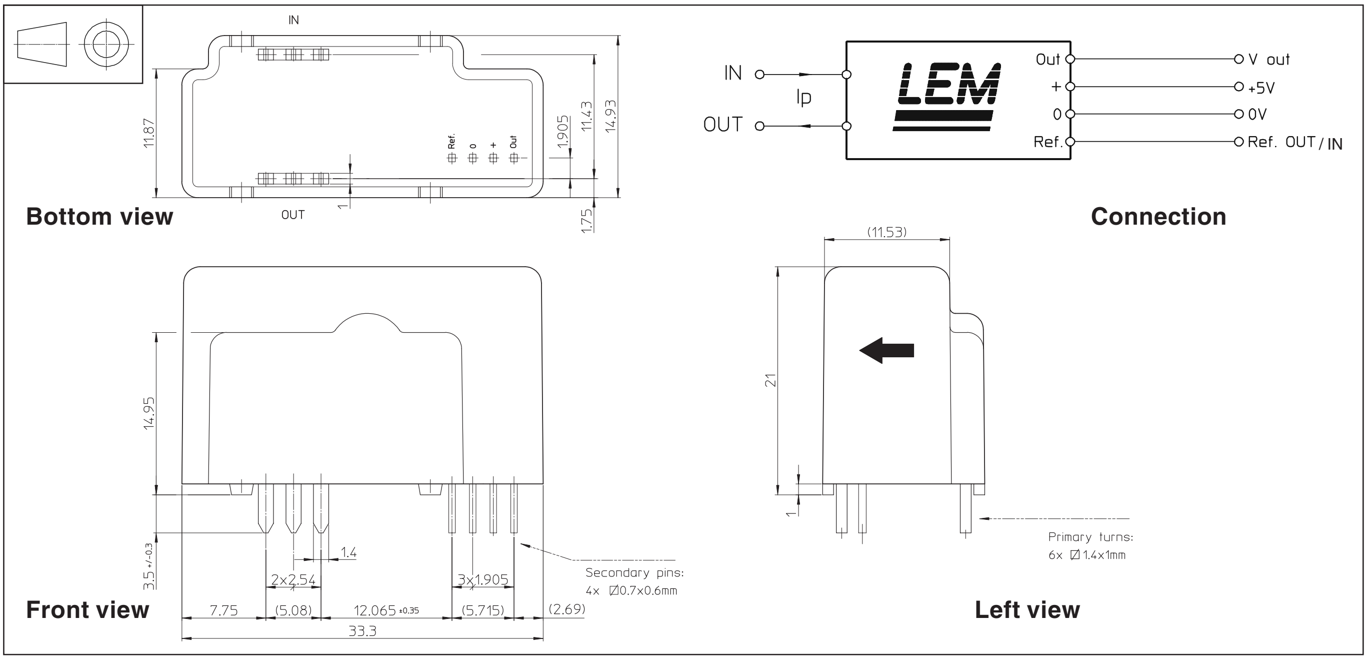
Advantages

- Excellent accuracy
- Very good linearity
- Very low temperature drift
- Optimized response time
- Wide frequency bandwidth
- No insertion losses
- High immunity to external interference
- Current overload capability.

Applications

- AC variable speed drives and servo motor drives
- Static converters for DC motor drives
- Battery supplied applications
- Uninterruptible Power Supplies (UPS)
- Switched Mode Power Supplies (SMPS)
- Power supplies for welding applications.

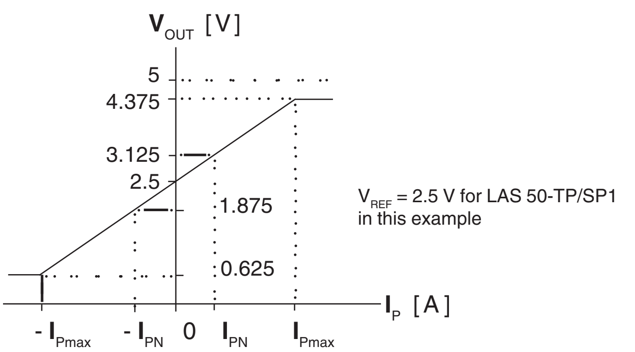
Dimensions LAS 50..100-TP & LAS 50..100-TP/SP1 (in mm. 1 mm = 0.0394 inch)



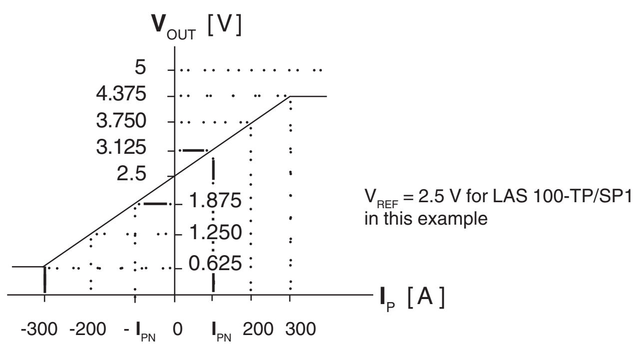
	Number of primary turns	Primary current		Nominal output voltage	Primary resistance	Primary insertion inductance
		Nominal I_{PN} A	Maximal I_P A	V_{OUT} V	R_P mΩ	L_P µH
LAS 50-TP **LAS 50-TP/SP1**	1	50	150	V_{REF} ± 0.625	0.12	0.008
LAS 100-TP **LAS 100-TP/SP1**	1	100	200 (300)	V_{REF} ± 0.625	0.12	0.008

Output Voltage - Primary Current

LAS 50-TP and LAS 50-TP/SP1



LAS 100-TP and LAS 100-TP/SP1



Mechanical characteristics

- General tolerance ± 0.2 mm
- Fastening & connection of primary 6 pins 1.4 x 1 mm
  Recommended PCB hole 2 mm
- Fastening & connection of secondary 4 pins 0.7 x 0.6 mm
  Recommended PCB hole 1.2 mm

Remarks

- **V_{OUT}** is positive when **I_P** flows from terminals "IN" to terminals "OUT".
- Temperature of the primary conductor should not exceed 100°C.

LEM reserves the right to carry out modifications on its transducers, in order to improve them, without previous notice.

5 Years Warranty
on LEM Transducers

LEM designs and manufactures high quality and
high reliability products for its customers over the entire world.

Since 1972, we have delivered several million current and voltage transducers which are, for most of them, still in operation on traction vehicles, industrial motor drives, UPS systems and many other applications requiring high quality standards.

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

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

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

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

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

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

The warranty does not cover any damage caused by incorrect conditions of use and cases of force majeure. No responsibility will apply except legal requirements regarding product liability.

The warranty explicitly excludes all claims exceeding the above conditions.

LEM, Geneva, January 1. 2001
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Paul Van Iseghem
President of LEM Components

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Distributor

Publication CH 24102 E/US (05.04 • 4.5/3 • CDH)