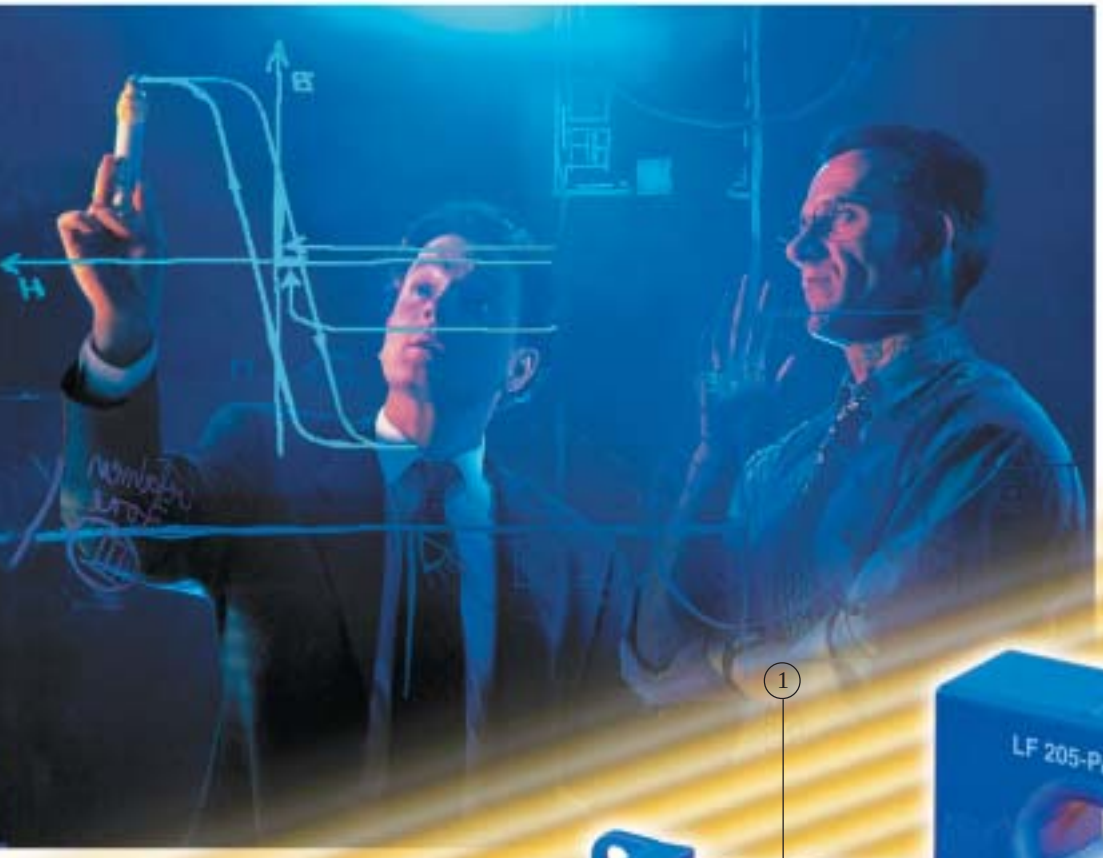
Technical
Information

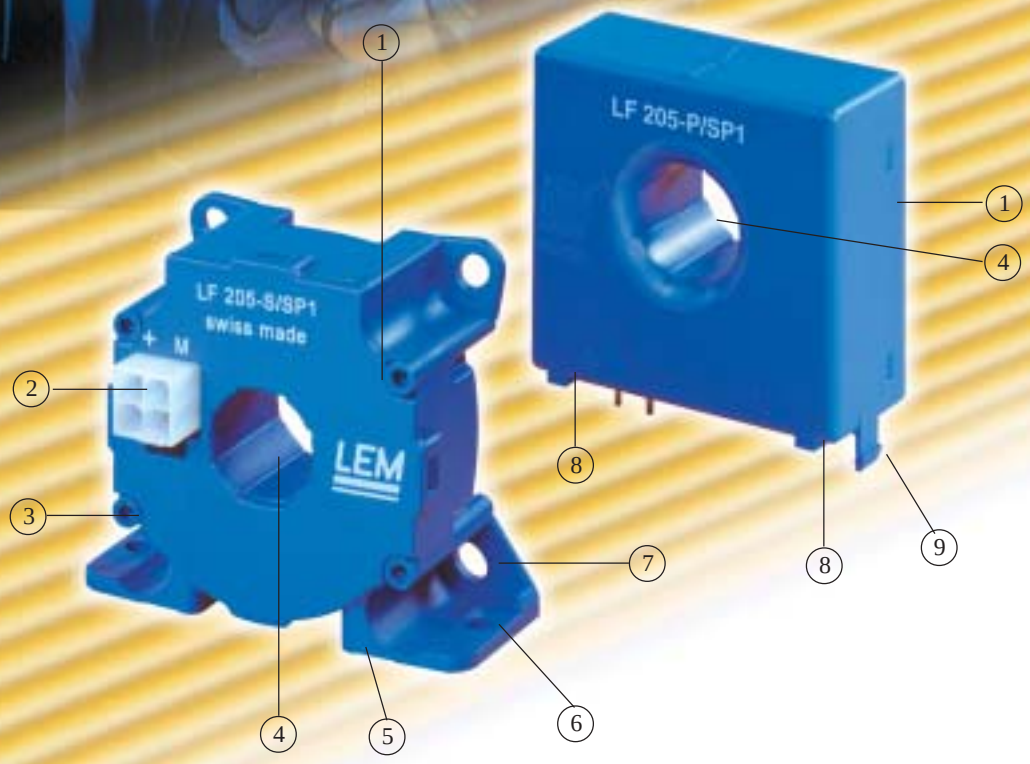
LF Series for current measurement from 200 A up to 2000 A nominal

LEM

LF series for current measurement from 200 A up to 2000 A nominal. Two new 200 A types to begin the series



There are many ways of mounting the LF product range (either vertically or horizontally, each model except LF 205-P) allowing optimum fitting depending on physical constraints and configurations.



LF series advantages

① UL 94-V0 insulated plastic case

② MiniFit Jr Molex connector (on the LF205-S/SP1 version) for safety locking (the mating connector is not supplied with the transducer)

③ 4 holes ∅ 1.9 mm for fixing with recommended screws KA 25

⑦ 4 oblong holes ∅ 4.3 mm

③+⑦ 2 horizontal fixing holes. Mounting area needed = 25.20 cm^2 but mounting this way, the transducer stands only **26.20 mm high.**

④ A large aperture for accommodating 15.5 mm max ∅ primary conductor.

⑤ 4 holes ∅ 1.9 mm for fixing with recommended screws KA 25

⑥ 2 holes ∅ 4.3 mm

⑤+⑥ 2 vertical fixing holes. Mounting area needed = **15.81 cm^2 only**.

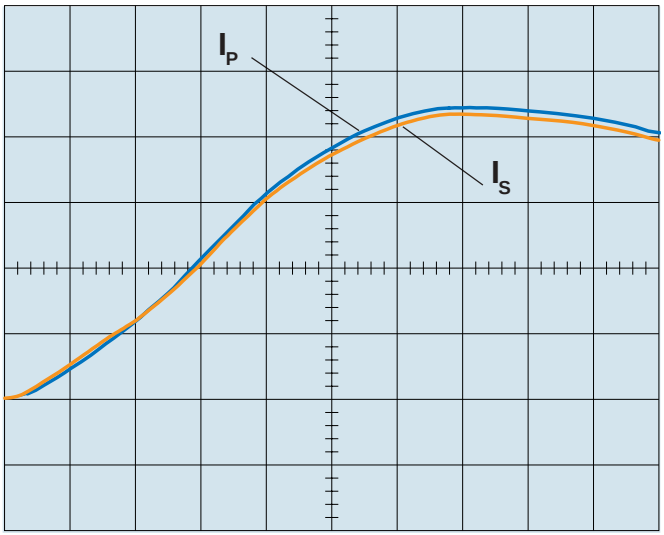
⑧ 2 holes ∅ 1.75 mm for additional fixing to PCBs with 2 supplementary screws.

⑨ 2 clips for fixing to PCBs.

Type	I_{PN} A	I_P A	V_C V	I_{OUT} @I_{PN} mA	f kHz	X @ I_{PN} T_A = +25 °C %	T_A ° C	Output connections	Packaging no.
LF 205-P	200	±420	±12...15	100	DC-100 (-3dB)	0.3	-40...+85	Pins	1
LF 205-P/SP1	200	±420	±12...15	100	DC-100 (-3dB)	0.3	-40...+85	Pins + Clips	1
LF 205-S	200	±420	±12...15	100	DC-100 (-3dB)	0.3	-40...+85	Molex	2
LF 205-S/SP1	200	±420	±12...15	100	DC-100 (-3dB)	0.3	-40...+85	Molex Minifit	2
LF 305-S	300	±500	±12…20	150	DC-100 (-1dB)	0.3	-10...+70	Molex	3
LF 305-S/SP10	300	±500	±12…20	150	DC-100 (-1dB)	0.3	-10...+70	Molex Minifit	3
LF 306-S	300	±500	±12...15	150	DC-100 (-1dB)	0.3	-25...+70	Molex	4
LF 306-S/SP10	300	±500	±12...15	150	DC-100 (-1dB)	0.3	-25...+70	Pins	4
LF 505-S	500	±800	±15…24	100	DC-100 (-1dB)	0.3	-10...+70	Molex	5
LF 505-S/SP15	500	±800	±15…24	100	DC-100 (-1dB)	0.3	-10...+70	Molex Minifit	5
LF 1005-S	1000	±1500	±15...24	200	DC-150 (-1dB)	0.3	-10...+85	Molex	6
LF 1005-S/SP22	1000	±1500	±15...24	200	DC-150 (-1dB)	0.3	-10...+85	Molex Minifit	6
LF 2005-S	2000	±3000	±15...24	400	DC-100 (-1dB)	0.2	-25...+70	JST	7
LF 2005-S/SP23	2000	±3000	±15...24	400	DC-100 (-1dB)	0.2	-25...+70	Molex Minifit	7

Not all transducer data can be specified in the data sheet. Specifically some dynamic performance of di/dt and dv/dt. Below, using the LF 205 as an example, are some main characteristics of the transducer.

di/dt follow up

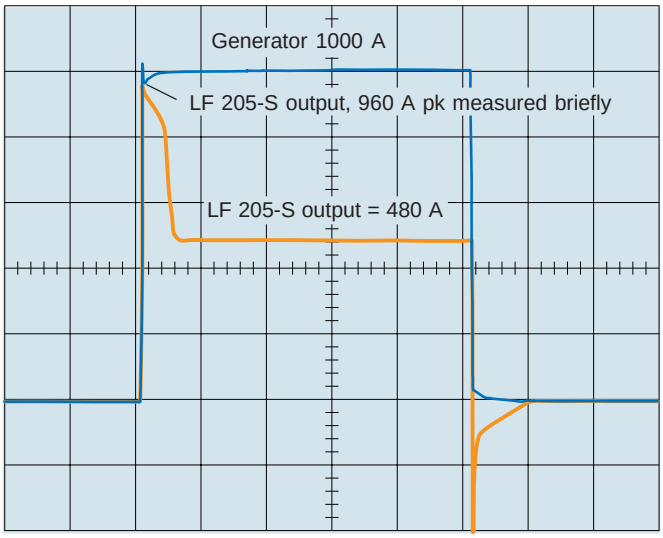


Scaling: CH1: 100 mV/DIV CH2: 1 V/DIV t:1,0 µs/DIV
$R_{Generator}$ = 1 mΩ, R_M = 20 Ω

Fig. 1: LF 205-S or LF 205-P, di/dt follow up: 100 A/µs, I_P = 450 A.

The transducer secondary current follows the primary current very rapidly and accurately.There is practically no delay between the input signal and the output signal up to the measuring range. There is also no overshoot or oscillation after the current step. The signal reaches the final value with almost no delay. The response time @ 90 % of I_{PN} stated in the data sheet is below 1 µs. This characteristic is excellent for short circuit protection applications.

Overload measurement



Scaling: CH1: 200 mv/DIV CH2: 3.3 V/DIV t:1 ms/DIV
$R_{Generateur}$ = 1 mΩ, R_M = 33 Ω, di/dt = 10 A/µs

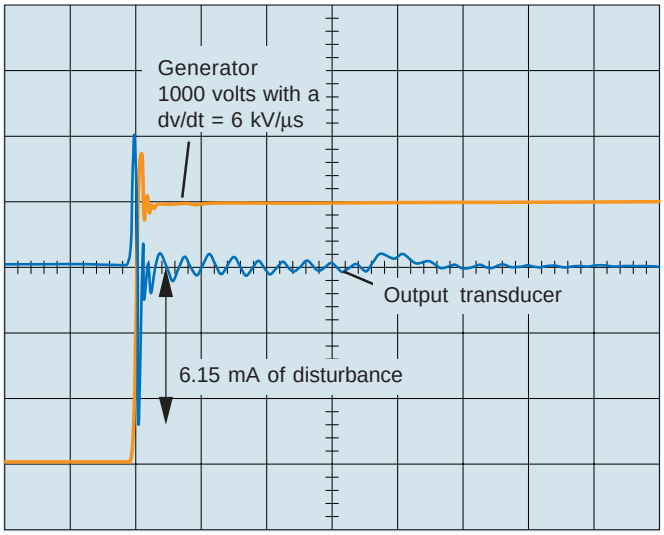
Fig. 2: LF 205-S or LF 205-P: overload measurement
I_P = 1000 A = 5 x I_{PN}

This is typical behavior for a Closed Loop Hall Effect transducer.

The transducer follows the 1000 A until reaching 960 A briefly thanks to the transformer effect. After about 500 µs, the output signal goes down to the static or DC measurement level. This effect happens, when there is good coupling between the primary and the secondary. The difference between good and bad coupling, you can see in the peak measurement level. This overload condition can be used to
detect a short circuit in the application. It is possible to see on the output of the transducer a higher voltage level than the power supply. Therefore the following electronic circuit must be protected against overvoltage. All LF transducers have good coupling between primary and secondary.

Common mode behaviour

One of the most critical parasitic influences in the electronic circuit is the dv/dt behaviour. What happens after a voltage step on the primary side with a high dv/dt value?



Scaling: CH1: 50 mV/DIV CH2: 500 mV/DIV t:2,0 µs/DIV
R_M = 20 Ω

Fig. 3: LF 205-S or LF 205-P common mode behaviour.

The maximum disturbance obtained with the LF 205-S or LF 205-P when they are subjected to a voltage change of 6 kV/µs and an applied voltage of 1000 V is 6,15 mA, which corresponds to about 6,15 % of I_{PN}. This is the disturbance during the dv/dt and therefore a very short spike. After the voltage step, the output signal goes down to its normal value without any significant oscillation.

Main electrical characteristics

Frequency bandwidth

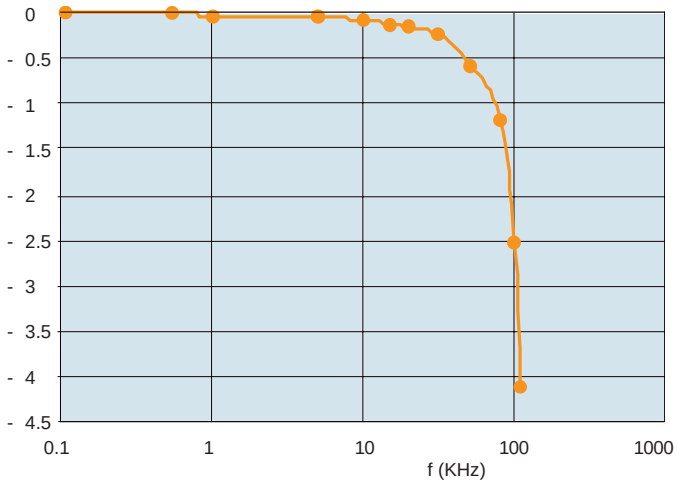


Fig. 4: LF 205 Wide frequency bandwidth
This Figure gives the frequency response of the LF 205 transducers.

The – 3 dB limit is approximately at 100 kHz, thanks to the good coupling between primary conductor and secondary winding. The superimposing of the two effects (Hall and transformer) in a closed loop transducer is very well managed and not seen in the response diagram. This gives a very accurate measurement result at all frequencies.

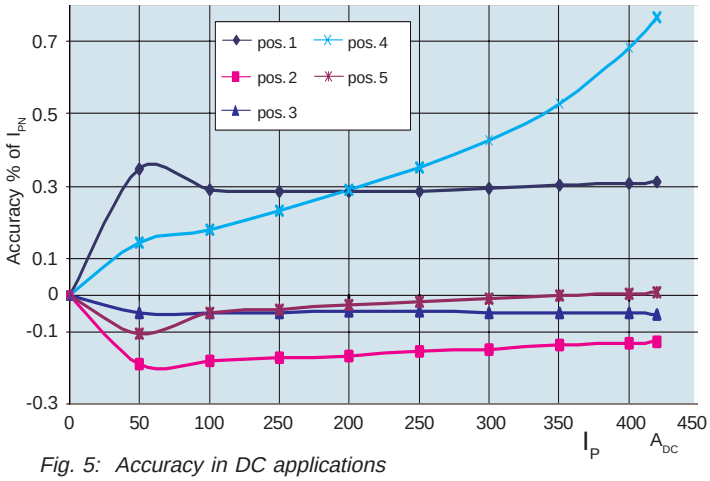


Fig. 5: Accuracy in DC applications

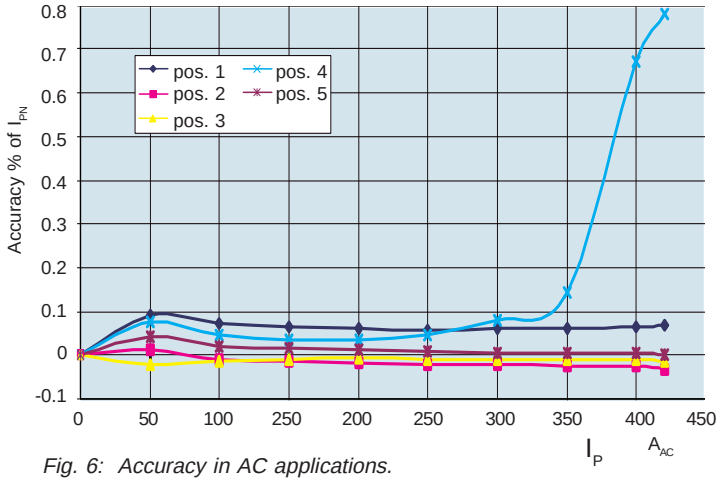


Fig. 6: Accuracy in AC applications.

Mounting recommendations for LF 205-S, LF 205-P

For this evaluation, a round 15 mm diameter busbar was used to completely fill the transducer aperture. A rectangular busbar (15 x 5 mm of section) was used to simulate the return busbar located at 30 mm from the transducer sides. Position 5 represents the transducer accuracy with no return busbar.

Graphs (Fig. 5 and 6) give the accuracy obtained with DC (Fig.5) or AC (Fig. 6) current measurements with the LF 205-S or LF 205-P vs the position of the return busbar around the transducer (position 1, 2, 3 or 4: Fig. 7).

The measurements were done at +25 °C, offset cancelled.

As usual, the return of the busbar on the side of the transducer where the Hall effect chip is located, is the worst case, this position is to banned (position 4).

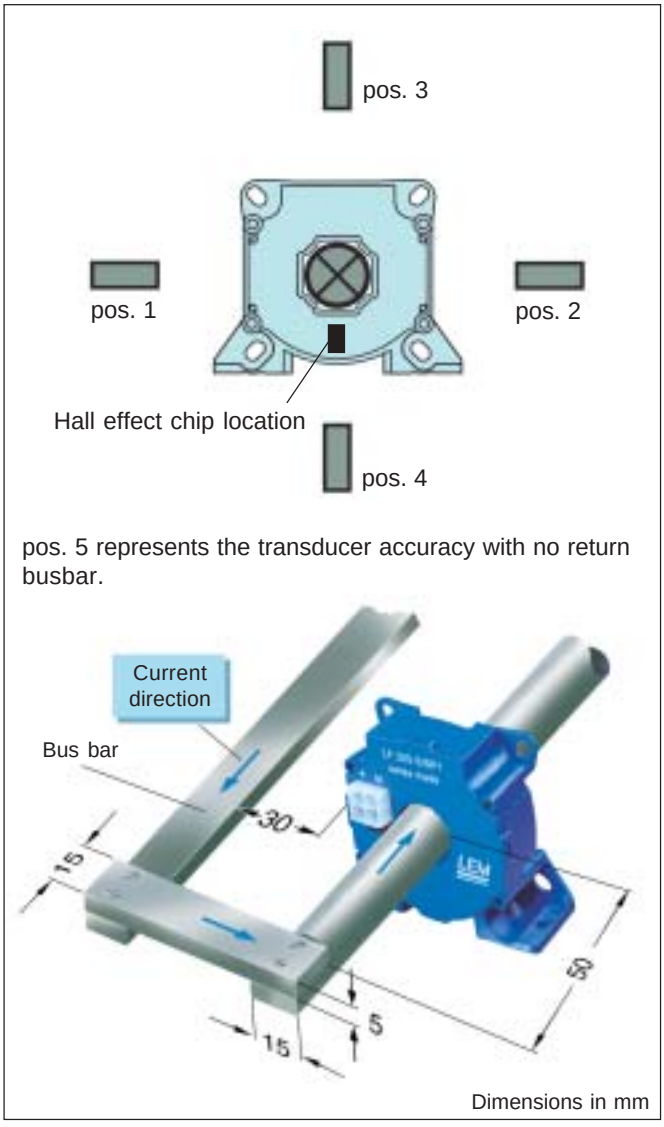


Fig. 7: Mounting configurations, Measurement conditions: Power supply: ±15 V ± 0 V, R_M = 20 Ω @ 0.1 %.

Fig. 8. LF 305-S into an AC drive for Elevators applications

The **MTBF** (Mean Time Between Failure) calculated according to MIL HDBK 217 F standard gives the theoretical reliability prediction for:

• LF 205-S (also valid for LF 205-S/SP1) :2 020 610 hours
• LF 205-P (also valid for LF 205-P/SP1) :3 492 840 hours

in the following hypothetical environmental conditions

- Ambient temperature	+ 40°C
- Environment	Ground Fix
- Power supply	±15 V
- Current	200 A DC
- Measuring resistor	0 Ω
- Winding	2000 turns

These theoretical values, in addition to LEM's long experience in applications during the last three decades and high quality levels, allow us to offer a Five Year Warranty on our products and their performance mentioned in the data sheets (see page 7).

The LF series uses the Closed Loop Hall effect technology to achieve a good typical accuracy at +25 °C of between 0.2 to 0.3 % of I_{PN}, a high frequency bandwidth (up to 150 kHz) and a fast response time (less than 1 µs)(please see chart page 3).

When a better lock between transducer connector and cable connector is needed (due to vibration for instance), each LF model (except LF 306-S model) is available as a special SP model (please see the chart page 3) with a Molex Mini Fit Jr 5566 connector.

It is possible to measure as much as **420 A peak** by using **only around 9.36 cm² of PCB area** with the LF 205-P

On the LF 205-P for PCB mounting (secondary connections on pins), we find 2 additional holes in the case for supplementary fastening to PCBs with 2 screws.

And finally, if you think that is still not enough options, for better fastening to PCBs, the LF 205-P/SP1 has 2 clips integral in its case which locks it onto the PCB.

LF 306-S model

The LF series proposes two options for the 300 A_{RMS} nominal measurements: The LF 305-S and the LF 306-S.
The LF 306-S is the thinnest 300 A Closed Loop transducer on the market. Its flat design has been possible thanks to the use of a special magnetic core and it is really useful when the available free place in applications begins to become a real problem.

As standard, a Molex 5045-03/AG (3 contacts) connector is expected on the LF 306-S for the secondary connections. Special LF 306-S versions allow a PCB mounting for the secondary connections in "flat" (SP10 version) or "vertical" (SP3 version) position by fixing the case mechanically.

The LF series offers dimensions & weight reductions vs the today existing C/L transducers expected for the same current ranges.

Their housings are made of reinforced plastic, potted if relevant to handle even the harshest operating environments. All these transducers are CE marked what guarantees products complying with the European EMC directive 89/336/EEC and low voltage directive 73/23/EEC.
Approval to UL 508 is pending.
EN50178 standard is the reference standard used at LEM to guarantee the overall performance of transducers in industrial environments for electrical, environmental and mechanical parameters.

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
Business Area Components

Paul Van Iseghem
President of LEM Components

LEM International Sales Network

Europe • Middle East

Austria
LEM NORMA GmbH
Liebermannstraße F 01
A-2345 Brunn am Gebirge
Tel. 02236/69 15 02
Fax 02236/69 14 00
e-mail: lna@lem.com

BeNeLux
LEM Belgium sprl-bvba,
Route de Petit-Roeulx, 95
B-7090 Braine-le-Comte
Tel. +32 67 55 01 14
Fax +32 67 55 01 15
e-mail: lbe@lem.com

Croatia
Proteus Electric
Via di Noghere 94/1
I-34147 Muggia-Aquilinia
Tel. +39/40/232188
Fax +39/40/232440
e-mail: dino.fabiani@proteuselectric.it

Czech Republic
PE & ED Spol. S.R.O.
Koblovska 101/23
CZ-71100 Ostrava/Koblov
Tel. 069/6239256
Fax. 069/6239531
email: petr.chlebis@vsb.cz

Denmark
Deltron-Conelec A/S
Banemarksvej 50 B
2605 Broendby
Tel. 45/43434342
Fax 45/43293700
e-mail: sales@conelec.dk

Finland
Etra-Dielectric Oy
Lampputie 2
SF-00740 Helsinki 74
Tel. 09/3699366
Fax 09/3699311
e-mail: hans.akerberg@etra.fl

France
LEM France Sarl,
La Ferme de Courtaboeuf
19 avenue des Indes
F-91969 Courtaboeuf Cedex
Tel. 01/69 18 17 50
Fax 01/69 28 24 29
e-mail: lfr@lem.com

Germany
LEM Deutschland GmbH
Frankfurter Straße 74
D-64521 Groß-Gerau
Tel. 06152/9301-0
Fax 06152/846 61
e-mail: postoffice.lde@lem.com

Hungary
Orszaczky Trading Co. Ltd
Korányi Sandor U. 28
H-1089 Budapest
Tel. 1/3144225
Fax. 1/3144225
email: orszaczky@axelero.hu

Italy
LEM Italia Srl
via V.Bellini, 7
I-35030 Selvazzano Dentro, PD
Tel. 049/805 60 60
Fax 049/805 60 59
e-mail: lit@lem.com

Israel
Ofer Levin Technological Application
PO Box 18247
IL-Tel Aviv 611 81
Tel. 03/5586279
Fax 03/5586282
e-mail: ol_teap@netvision.net.il

Norway
Holst & Fleischer A/S
Box 5404 Majorstuen
N-0305 Oslo
Tel. 22066350
Fax 22066351
e-mail: knut.arneberg@oslo.online.no

Poland
DACPOL Co., Ltd.
Teren Zakladu Lamina
Ul. Pulawska 34
PL-05-500 Piaseczno
Tel. 022/7570713
Fax 022/7570764
e-mail: dacpol@dacpol.com.pl

Portugal
Maquindus Engenharia e
serviços, Lda
Rua da Ponte, 5
P-4435 Rio Tinto
Tel. 01/2485 0280/1
Fax 01/2485 0290
e-mail: xcarvalho@mailtelepac.pt

Rumania
SYSCOM-18 S.r.l.
Calea Plevnei 139, sector 6
R-77131 Bucarest
Tel. 1/222 91 76
Fax 1/222 91 76
e-mail: georgeb@syscom.ro

Russia
TVLEM
Marshall Budionny Str.
170023 TVER
Tel. 0822/44 40 53
Fax 0822/44 40 53
e-mail: tvelem@lem.com

Slovenia
Proteus Electric
Via di Noghere 94/1
I-34147 Muggia-Aquilinia
Tel. +39/40/232188
Fax +39/40/232440
e-mail: dino.fabiani@proteuselectric.it

Spain
SUMELEC
Doris de Schade S.L.
Avd. Sancho Rosa 66
E-28708 San Sebastian de los Reyes
Tel. 91/623 68 28
Fax 91/623 67 02
e-mail:
abisum@santandersupernet.com

Sweden
Beving Elektronik A.B.
Jägerhorns väg 8
S-14105 Huddinge
Tel. 08/680 11 99
Fax 08/680 11 88
e-mail:
information@bevingelektronik.se

Switzerland
SIMPEX Electronic AG
Binzackerstrasse, 33
CH-8622 Wetzikon
Tel. 01/931 10 10
Fax 01/931 10 11
e-mail: contact@simpex.ch

Switzerland
LEM SA
8, Chemin des Aulx
CH-1228 Plan-les-Ouates
Tel. 022/706 11 11
Fax 022/794 94 78
e-mail:lsa@lem.com

Turkey
Özdisan Electronik Pazarlama
Galata Kulesi Sokak N°34
TR-80020 Kuledibi/Istanbul
Tel. 0212/2520884
Fax 0212/2445943
e-mail: oabdi@ozdisan.com

United Kingdom and Eire
LEM U.K.Ltd
Geneva Court, 1
Penketh Place, West Pimbo,
Skelmersdale
Lancashire WN8 9QX
Tel. 01695/72 07 77
Fax 01695/507 04
e-mail: luk@lem.com

Africa • America

Brazil
Intech Engenharia Ltda
5 Andar CJ 52
Av. Adolfo Pinheiro, 1010
BR-04734-002 Sao Paulo
Tel. 011/554 814 33
Fax 011/554 814 33
e-mail:
intech@intech-engenharia.com.br

Canada
Alliance Components Inc.
270 Warden Avenue
CAN-Scarborough, ON M1N 3A1
Tel. 416-690-7810
Fax 416-690-7811

Chile
ELECTROCHILE
Freire 979 of. 303-304
Quilpue
Tel. 032/923222
Fax 032/923222
e-mail: elechile@entchile.net

South Africa
Denver Technical Products Ltd.
P.O. Box 75810
SA-2047 Garden View
Tel. 011/626 2023
Fax 011/626 2009
e-mail: denvertech@pixie.co.za

USA
LEM U.S.A., Inc.
6643 West Mill Road
USA Milwaukee, Wi 53218
Tel. 414/ 353 07 11 or
800/236 53 66
Fax 414/353 07 33
e-mail: lus@lem.com

USA
LEM U.S.A., Inc.
27 Rt 191A
PO Box 1207
USA-Amherst, NH 03031
Tel. 603/672 71 57
Fax 603/672 71 59
e-mail: gap@lem.com

USA
LEM U.S.A., Inc.
7985 Vance Drive
USA Arvada, CO 80003
Tel. 303/403 17 69
Fax 303/403 15 89
e-mail: dlw@lem.com

Asia • Pacific

Australia
Fastron Technologies Pty Ltd.
25 Kingsley Close
Rowville
Melbourne
Victoria 3178
Tel. 61-(0)397635155
Fax. 61-(0)397635166
e-mail: sales@fastron.com.au

China
Beijing LEM Electronics Co. Ltd
No. 1 Standard Factory
Building B
Airport Industria Area
CN-Beijing 101300
Tel. 10/80 49 04 70
Fax 10/80 49 04 73
e-mail: hzh@lem.com

India
Globetek
122/49, 27th Cross
7th Block, Jayanagar
IN-Bangalore-560082
Tel. 80/6635776
Fax 80/6581556
e-mail: globetek@blr.vsnl.net.in

Japan
NANALEM K.K.
1-27-14 Morino, Machida
J-194-0022 Tokyo
Tel. 042/725 8151
Fax 042/728 8119
e-mail: nle@lem.com

Korea
Youngwoo Ind. Co.
P.O.Box 10265
K-Seoul
Tel. 02/593 8146
Fax 02/535 0441
e-mail:ygwoo@korea.com

Singapore
Overseas Trade Center Ltd.
03 - 168 Bukit Merah L.1
BLK 125/Alexandra Vil.
RS-150125 Singapore
Tel. 272 6077
Fax 278 2134
e-mail:octpl@signet.com.sg

Taiwan
Tope Co., Ltd.
P.O. Box 101-356
3F, No. 344, Fu Shing Road
ROC-10483 Taipei
Tel. 02/509 5480
Fax 02/504 3161
e-mail: tope@ms1.hinet.net

Taiwan
LECTRON Co., Ltd.
9F, NO 171, SEC.2,
Tatung. RD. Hsichih City
Taipei Hsien 221
Taiwan, R.O.C
Tel. 886 2 8692 6023
Fax. 886 2 8692 6098
e-mail: silas@lectron.com.tw

BAC/E, 04.02

LEM

LEM Components
8, Chemin des Aulx, CH-1228 Plan-les-Ouates
Tel. +41/22/706 11 11, Fax +41/22/794 94 78
e-mail: lsa@lem.com; www.lem.com

Distributor

Publication CH 22102 E/US (04.02 • 5.5 • CDH)