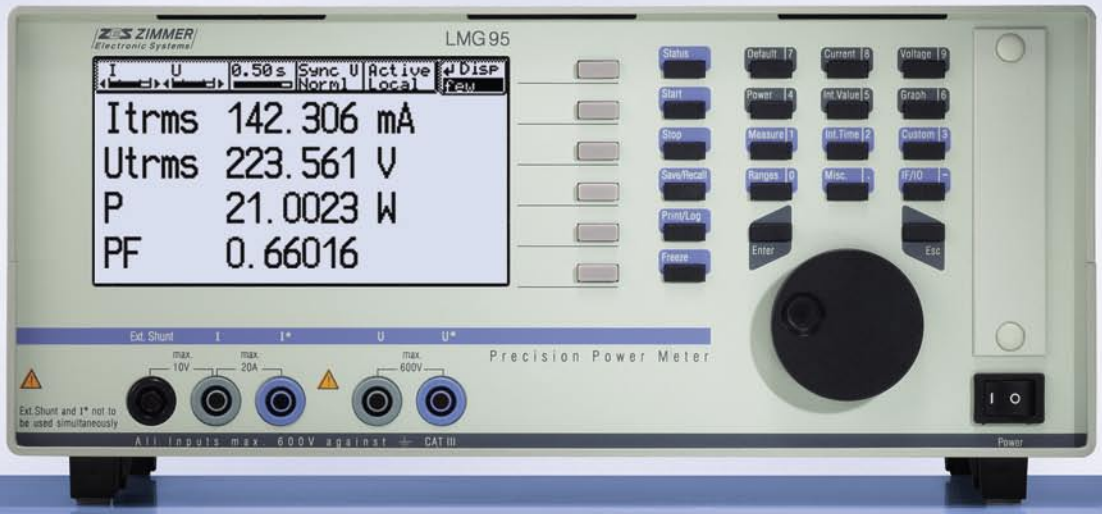
ZES ZIMMER Electronic Systems

Precision Power Meter LMG95

Basic Accuracy 0.03% Precision Range DC...500kHz
Analysis of Devices and Components
in Switched or Modulated Operation
EN61000-3-2/3 Analyser for Harmonics and Flicker



LMG95

LMG95. Precise. Direct. All Waveforms. Transparency Throug

The LMG95 single-phase precision power meter is an outstanding product in the LMG series of proven ZES ZIMMER precision power measuring devices. Highly accurate continuous gap-free signal measurement and processing, ergonomic operation and presentation of the results, interfaces with high data rates for efficient system applications – these are the performance features which distinguish the LMG95.

All Waveforms

The high precision power measurements on components and devices wanted in development, quality assurance and manufacturing can be performed with ease – independent of whether or not the current and voltage are sinusoidal or distorted, whether the load is linear or not, or whether the circuit works in a chopped, pulsed mode or in a modulation mode. Extended possibilities of synchronisation on the periodicity of the signal measured always produce distinct and stable measurement displays and results.

Direct Up to 600V and 20A

Isolated measurement inputs with direct measurements ranges up to 600V ($1600V_{peak}$) and 20A ($960A_{peak}$ for the measurement of inrush currents) and the input for current measurements using a shunt or other transducer measure the incoming measurement signals exactly and without any aberrations.

0.03% Accuracy

With a basic accuracy of 0.03%, this is the most precise instrument in its class and it is therefore used as a reference device for power meters, power measurement transformers and trms-meters for current and voltage.

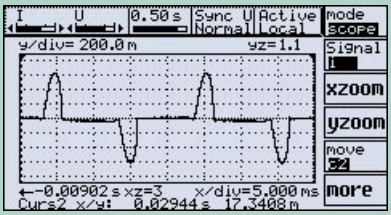
Harmonics and Flicker in Full Compliance With EN61000-3-2/-3

The harmonic analysis in full compliance with the EN61000-3-2 standard is already available in the basic unit. The flicker meter in compliance with EN61000-4-15 for the measurement of flicker (voltage variations) is available as an option. These two functions considerably extend the possible applications of the LMG95 in the laboratory area as well. If suitable stable voltage sources are available, tests for CE compliance can be performed in accordance with EN61000-3-2/-3.

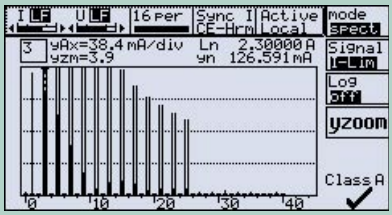
Analysers in CE Test Systems

The LMG95 is used as an analyser in CE test systems to test electrical devices on harmonics and flicker and their effect on mains – for example it is used in the ZES ZIMMER SYS61K test system shown in the adjacent illustration. In 3-phase applications three LMG95 units are used.

Charging current of a switching power supply

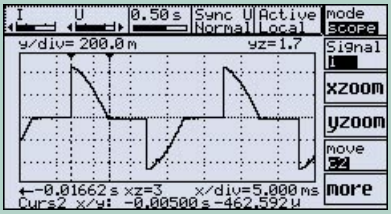


Waveform of charging current



Amplitude spectrum of the current harmonics with CE evaluation in accordance with Class A

Phase-angle control



Waveform of current

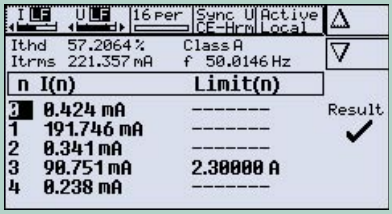
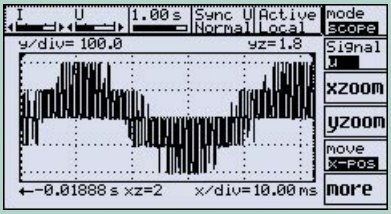
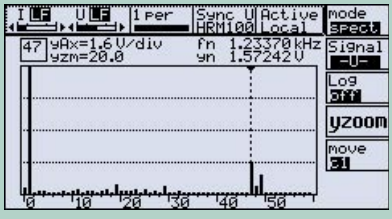


Table of the current harmonics with limits in accordance with Class A

PWM frequency inverter



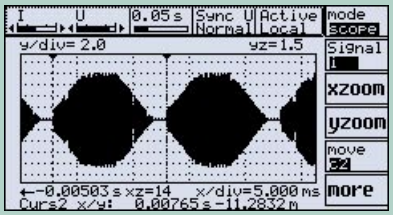
Line voltage against artificial midpoint

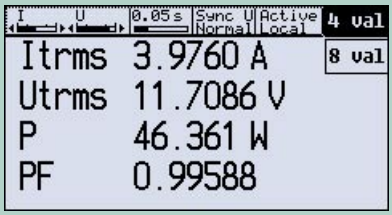


Measurement of the amplitude spectrum of the voltage harmonics in the HRM100 mode. An increase in the 47^{th} and 49^{th}, the frequency of the fundamental amounts to fn/47=26.25Hz

gh Real-time Visualisation in the Time and Frequency Range.

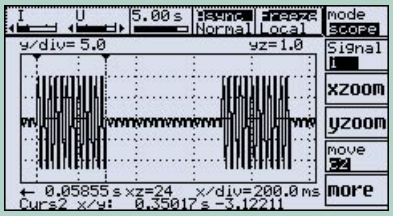
Electronic transformer



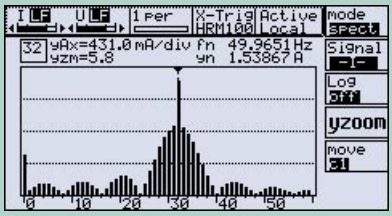


Electronic 12V transformer to supply a halogen lamp.
Amplitude modulated 150 kHz carrier with 100Hz envelope.

Burst firing control of a hot-air fan



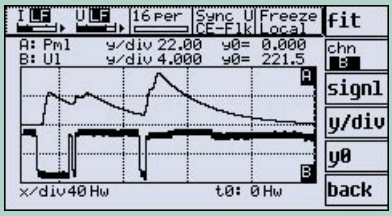
Harmonic analysis



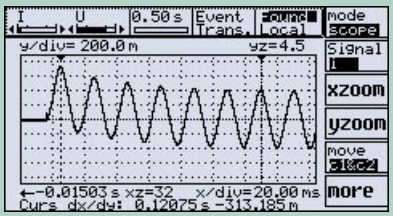
Amplitude spectrum with the help of the HRM100 harmonic analysis. The burst fire presents a 1.56Hz modulation of the carrier (50Hz mains voltage). The DC component of the spectrum results from the blower motor in half-wave operation.
The extended "X-Trig" trigger mode detects the 1.56Hz periodicity which is used for synchronisation.

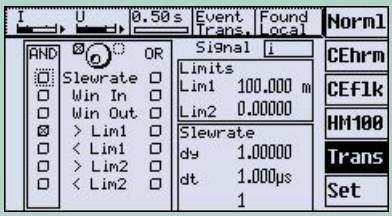
Flicker measurement

Using the plot function the half-wave trms values U_t are plotted over time (lower curve B).
Irregular sags of about 8V can be recognised. The momentary flicker Pmom resulting from these changes is visualised in curve A.



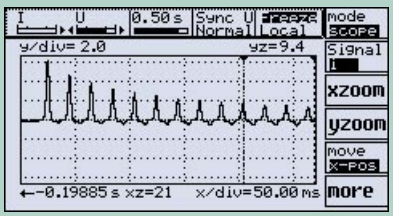
Switch-on current of a fluorescent lamp ballast measured in the transient mode





Switch-on current of a fluorescent lamp ballast.
The iron is not saturated.

Inrush current of a transformer



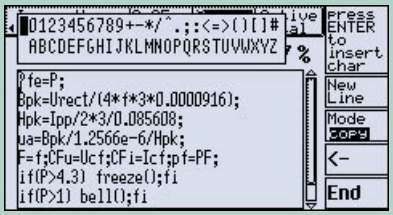
In the moment when the currentless, non-magnetised transformer is switched on a multiple of the nominal current is required to build up the necessary flux. The iron goes rapidly into saturation.
Here I_{inr}/I_{trms}=12.9.

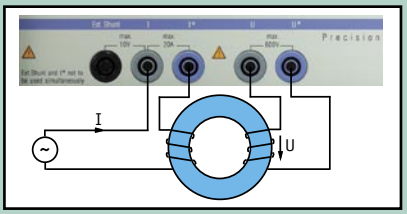
Graphical display

Real-time visualisation, 4 or 8 measured values, measured signals in the time and frequency domain:
• You see the signals which you measure • You can estimate whether the measurement is running correctly • You discover new things depending on current, voltage and power • You better understand the dependencies of the components in the circuit

Core losses at small cosφ and high frequencies

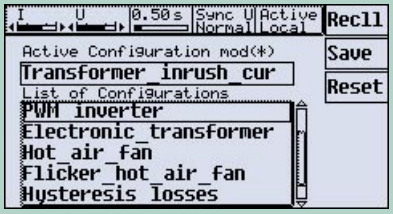
(with optional 500kHz precision band width and delay compensation to 4ns)





The magnetising current I flowing in the primary winding is fed into the current input of the LMG95, and the induced voltage at the open secondary winding is fed into the voltage input. In this way, only the core losses (magnetising losses) are measured, and not the copper losses. The half-wave rectified voltage value, also measured with the LMG95, is a measure of the voltage time area, and therewith for the induced flux. With the formula editor, the values for a B-H characteristic curve can be calculated from the measured electrical values and the geometrical data of the core.

Device settings



Up to 8 device settings can be stored with name, datas of the test sample, etc., with “Save” and called up again with “Recll”.
A high level of user convenience if measurements should be made alternatively on different samples.

Technical data

Voltage measuring ranges

Rated Range value /V	6	12.5	25	60	130	250	400	600	Also available with ranges:
Permissible trms value /V	7.2	14.4	30	60	130	270	560	720	25mV...3V,
Permissible peak value	12.5	25	50	100	200	400	800	1600	100mV...12V
for full scale /V									400mV...60V
Overload capability	1500V for 1s								12V...650V ($3200V_{pk}$)
Input resistance	1MΩ, 20pF								

Current measuring ranges

Rated range value /A	0.15	0.3	0.6	1.2	2.5	5	10	20	120	240	480	960	Also available with ranges:
Permissible trms value /A	0.3	0.6	1.3	2.6	5.2	10	21	21	21	21	21	21	0.6mA...80mA
Permissible peak value	0.469	0.938	1.875	3.75	7.5	15	30	60	120	240	480	960	10mA...1200mA
for full scale /A													40mA...5A
Overload capability	160A for 1s												
Input resistance	5mΩ												

Voltage inputs for current measuring with shunt / transducer

Rated range value /V	0.03	0.06	0.12	0.25	0.5	1	2	4
Permissible trms value /V	0.06	0.13	0.27	0.54	1	2	4	8
Permissible peak value	0.0977	0.1953	0.3906	0.7813	1.563	3.125	6.25	12.5
for full scale /V								
Overload capability	250V for 1s							
Input resistance	100kΩ							

Measuring range selection	Auto, manual or remote controlled
Isolation	Current and voltage path are isolated against each other and may float against earth with 600V. Testing voltage 3250V
Measuring method	Simultaneous sampling of the current and voltage inputs and A/D conversion of the instantaneous values (100kHz). Memory for up to $2 \cdot 10^6$ sampling values.
Measuring cycle, synchronization, averaging	For measurements of the trms values for current, voltage and active power the measuring cycle time is adjustable in the range of 50ms to 60s. In each measuring cycle gapless 100kHz sampling and evaluation. The synchronization can be performed on the measuring signal, the fundamental harmonic, the envelope, the mains or an external signal. Single measurings with stop after one or more cycles are possible, averaging over 1 to 16 cycles.

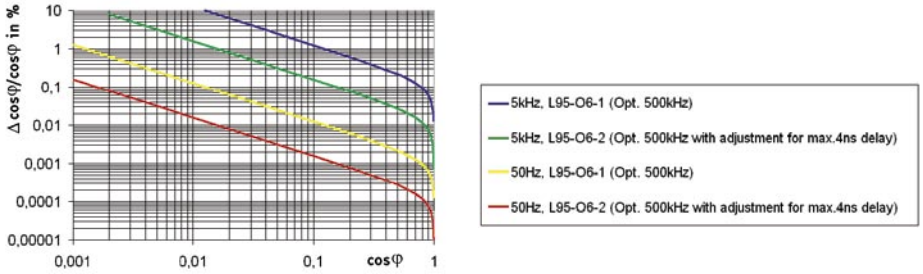
Measuring accuracy (Standard version)

Measuring Accuracy	± (% of measuring value + % measuring range)							
	DC	0.05...15Hz	15...45Hz	45...65Hz	65Hz...1kHz	1...3kHz	3...15kHz	15...50kHz
Voltage	0.02+0.06	0.02+0.04	0.015+0.03	0.01+0.02	0.015+0.03	0.03+0.06	0.1+0.2	0.5+1.0
Current	0.02+0.06	0.02+0.04	0.015+0.03	0.01+0.02	0.015+0.03	0.03+0.06	0.1+0.2	0.5+1.0
Shunt Voltage Input	0.02+0.06	0.02+0.04	0.015+0.03	0.01+0.02	0.015+0.03	0.03+0.06	0.1+0.2	0.5+1.0
Active Power	0.03+0.06	0.035+0.04	0.025+0.03	0.015+0.02	0.025+0.03	0.05+0.06	0.2+0.2	1.0+1.0

Measuring accuracy (500kHz version, Option L95-06-1)

Measuring Accuracy	± (% of measuring value + % measuring range)											
	DC	0.05...15Hz	15...45Hz	45...65Hz	65Hz...1kHz	1...3kHz	3...15kHz	15...100kHz	100...200kHz	200...300kHz	300...400kHz	400...500kHz
Voltage	0.02+0.06	0.02+0.04	0.015+0.03	0.01+0.02	0.015+0.03	0.025+0.05	0.03+0.06	0.1+0.2	0.5+1.0	1.0+2.0	3.0+3.0	4.0+4.0
Current	0.02+0.06	0.02+0.04	0.015+0.03	0.01+0.02	0.015+0.03	0.025+0.05	0.03+0.06	0.1+0.2	0.5+1.0	1.0+2.0	3.0+3.0	4.0+4.0
Shunt Voltage Input	0.02+0.06	0.02+0.04	0.015+0.03	0.01+0.02	0.015+0.03	0.025+0.05	0.03+0.06	0.1+0.2	0.5+1.0	1.0+2.0	3.0+3.0	4.0+4.0
Active Power	0.03+0.06	0.035+0.04	0.025+0.03	0.015+0.02	0.025+0.03	0.04+0.05	0.05+0.06	0.2+0.2	1.0+1.0	2.0+2.0	6.0+3.0	7.0+4.0

Measuring accuracy of cosφ



Accuracies based on

1. sinusoidal voltage and current
2. ambient temperature 23 °C
3. warm up time 1h
4. definition of power range as the product of current and voltage range, $0 \leq |\lambda| \leq 1$ (λ=Power factor=P/S)
5. calibration interval 12 month

Other values	All other values are derived from the values for current, voltage and active power. Accuracies for the derived values depends on the functional relation (e.g. $S = I * U$, $\Delta S/S = \Delta I/I + \Delta U/U$)
Internal time base	±25ppm at 23°C
Frequency measuring	0.05Hz...500kHz ±0.01% of measuring value, measuring channel selectable.
Display of measured and computed values	
Representation	With standard abbreviation of measured magnitudes, numeral values 6 digits (0...999999), with sign, decimal point and unit (e.g. I_{trms} 0.73851mA), 4 to 8 values can be displayed simultaneously, selectable via default or user defined menus
Voltage/Current	Trms value, peak values (min, max, pp), rectified value (rect), mean value (dc), trms value of ac component (ac), form factor, crest factor
Power	Active power (P), reactive power (Q), apparent power (S), phase angle (φ), power factor (λ)
Impedance	Amount (Z), real- und imaginary part of resistor in serial equivalent circuit
Integrated values depending on the measuring time	The integration can be controlled manually, automatically using start and stop times, via external trigger or remote controlled via computer interface
Energy, Charge	Active energy (Ep), reactive energy (Eq), apparent energy (Es), charge (q)
Date and Time, Measuring time	Current date (day, month, year) with time (hour, minutes, seconds), accu buffered real time clock, start time for measurement, running measuring time, on-time, each with days, hours, minutes, seconds
Adjustable parameters	Scaling factors for external shunt, current and voltage transducer
Synchronisation	Synchronisation is made on the periodicity of the measured signal. Periodicity can be determined by the signals u(t), i(t), p(t), $u^2(t)$, $i^2(t)$, each of them can be adapted with selectable filters. By this stable displays also with pulse width modulated signals (e.g. frequency inverter) and amplitude modulated signals (e.g. electronic ballast). Synchronization also by „Line“ and „External“
Scope function	Graphical representation of sampled values (waveform of the signal)
Plot function	Time diagram of calculated values, e.g. trms value and power
Harmonic analysis CE-Hrm	Analysis of current and voltage up to the 40th harmonic (total of 41 with DC component), fundamental in the range 45Hz to 65Hz. Analyser in accordance with EN61000-4-7 with evaluation in full compliance with EN61000-3-2
Harmonic analysis HRM100 (Option L95-010)	Analysis of current, voltage and effective power up to the 99th harmonic (total of 100 with DC component, max. 10/50kHz), fundamental in the range 0.1 Hz to 1.2 kHz; with adjustable divider (1...50), a new fundamental can be set as a reference, for example to determine interharmonics
Flicker measuring (Option L95-04)	Flicker meter in accordance with EN61000-4-15 with evaluation in accordance with EN61000-3-3
Memory Extension (Option L95-011)	Memory extension for scope function up to 4 million samples of U, I and P. Sample values available via interface
Transients – monitoring and storing (Option L95-05)	Storing and graphical displaying of transients with a resolution of 10µs, memory extension (L95-011) is included. Storing depth is 4 Millions sample values, selectable recording duration from 0.05 to 60 seconds. Adjustable pre-trigger, different possibilities of triggering
Computer interface (Option L95-01)	Interfaces: **RS232** and **IEEE488.2**, only one interface can be used at the same time
Remote control	All functions can be remote controlled
Output data	Output of all displayable data possible, data formats of all interfaces are the same, SCPI command set
Transfer rates	RS232: max. 115200 Baud, IEEE488.2: max. 1MByte/sec
Printer interface (included in Option L95-01)	Parallel PC-printer-interface with 25 pin SUB-D socket for printing of values tables and graphics on needle, ink or laser printer
Memory modul (Option L95-02)	For PCMCIA memory cards, data logging of measuring and sample values
Processing signal interface (Option L95-03)	25 pin SUB-D socket: 4 analog inputs for registration of auxiliary quantities (16bit, ±10V) 4 analog ouputs for output of any measured or computed values in real time (16bit, ±10V) 4 digital inputs for registration of status 4 digital outputs to signal states and alarms 1 input for frequency (0.1Hz...500kHz) and direction (e.g. of motors) 1 power supply output 12V/50mA Inputs and outputs are isolated group wise against each other and against the other electronics (testing voltage 500V)
Other data	
External synchronization/trigger	Isolated interface for external control of measurement cycle and integration times, outputs for status signals about the actual measuring
Service RS232 interface	For installing options, firmare and for instrument diagnosis
Auxiliary power supply output	+15V/0.4A and -15V/0.2A for external transducers
Dimensions/weight	-Desktop case, (w)320mm x (h)147mm x (d)274mm, -19“-cassette 84PU, 3HU, (d)274mm, about 5.5kg
Protection class	EN61010 (IEC1010, VDE0411), protection class I, Overvoltage class III

Other data

Electromagnetic compatibility	IEC61000 (EN61000), EN50081, EN50082
Protection system	IP20 in accordance with DIN40050
Operating/storage temperature	0...40°C, -20...50°C
Climatic class	KYG in accordance with DIN40040
Power supply	90...250V, 45...65Hz, about 30W

Special versions and designs

NDL5 Longtime-data logging to harddisk for LMG95/450/500. Communication via Internet/Ethernet, even when recording

LMG95-REF Reference meter for current, voltage, power. Basic accuracy 0.01%. Traceable with calibration certificate by PTB (National Institute of Standards)

L95-Z01
Mounting kit for 19" rack mounting

L95-Z09
Measuring sockets on rear side, e.g. when rack mounted

Accessories (optional)

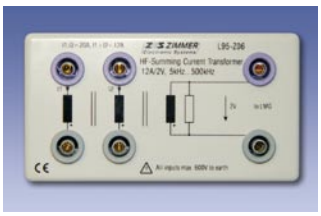
KR-L95
Calibration Certificate, traceable to ISO9000

PSU600
Precision current transformer, max. 600A, ü=1500:1, DC to >100kHz, accuracy <(0.01%MV+0.005%MR)

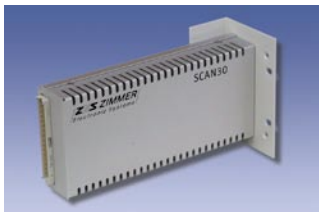
PSU600-K3-L95
Adapter-/supply cord to connect the PSU600 to the measuring sockets „I-I*" of LMG95.
For currents **>50A to 600A**

PSU600-BUR15
Adapter with precision burden and supply cord to connect the PSU600 to the measuring socket „Ext. Shunt".
For currents **>1A bis 600A**

L95-SH-100
Shunt to measure small currents up to 1A, to be connected to the measuring socket „Ext. Shunt" of LMG95.
Customer specific design

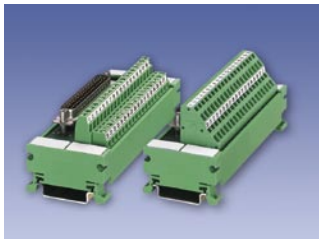


L95-Z06
HF-summing current transformer with burden resistor for current measurements without effecting measure circuitry, e.g. at discharging lamps.



L95-SCAN15/30
Scanner with internal shunts to measure 15 respectively 30 devices under common supply. Sequential measuring. Enhancement of the LMG95 to a multi channel device

HST6-1, HST6-2, HST12-1, HST12-2
Precision high voltage devider for 6/12kV. Single pole isolated high voltage measuring (-1), dual pole isolated high voltage measuring (-2). Accuracy: 0.05% (45-65Hz), 0.3% (DC-100kHz)



L5-IOBOX-S /-F
Adapter (rail mounting) for easy connection of process signals, including 2m connection cable

WR-24-230
Inverter 24VDC to 230VAC/50Hz for supply of LMG instruments

MAS
U-/I- measuring adapter for devices with „Schuko"plug (Grounding outlet)

MAK1
U-/I- measuring adapter for devices with inlet connector (non-heating appliances)

LMG95 Application Software (optional)

TERM-L5	Software for configuration and data logging with LMG95/450/500, applicable with PC via RS232- and IEEE488-interface or with network capable autonomous long term data logger NDL5 via RS232, recording as ASCII for further evaluation e.g. in Microsoft Excel, real time visualisation of selectable measurement values
SYS61K-1-SOFT	Controlling-/data logging-/evaluation software for conformity tests of harmonics and flicker according to IEC61000-3-2/-3 with the LMG95
LWINDRV-L95	LMG95 driver for LabWindows/CVI, for RS232- and IEEE488-interface, with software examples
LVDRV-L95	LMG95 driver for LabVIEW 5.1, for RS232- and IEEE488-interface, with software examples

ZES ZIMMER Electronic Systems

ZES ZIMMER Electronic Systems GmbH
Tabaksmühlenweg 30, D-61440 Oberursel/Ts.
Tel. ++49 6171 628750 Fax ++49 6171 52086
http://www.zes.com e-mail: sales@zes.com