

# Digital Load Measuring System

patented, TÜV-approved for use in weighing systems  
and systems with safety requirement AK 4

## Characteristics

- $\mu$ P-device for simple programming
- For use with maximally 4 resistance strain gauge full-bridge sensors
- 2 freely adjustable limit switches, relay output with restraint
- Freely configurable analog output 0 - 1 (10 V) or 0 (4) - 20 mA, galv. insulation
- Galvanic insulation of interfaces: RS 232; RS 485; Interbus S (2-conductor or optical waveguide); CANbus; Profibus
- Tare function
- Redundant construction for limit switch and test equipment, monitoring of sensor break and short circuit
- Accuracy  $\pm 0,1$  % of end-scale value

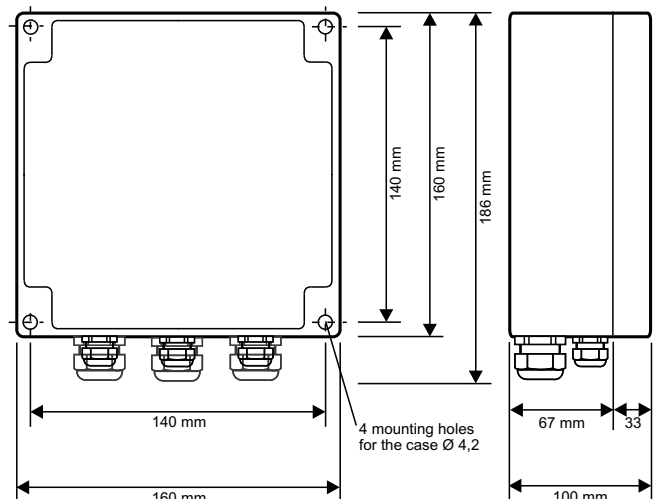


## Description

The DLM-measuring amplifier is used in connection with resistance strain gauge full-bridge sensors. Its main range of application is for cranes and elevators and in theatre technics. Here, it complies with all requirements of today's safety regulations. The limit switch with relay output is redundantly constructed, which guarantees a maximum of safety. The built-in supervisory equipment enables the use in the area of safety devices.

Two adjustable limit switches are available as well as an analog signal output supplying 0 .. 1 (10 V) or 0 (4) .. 20 mA. The conventional RS 232 and RS 485 as well as the INTERBUS S for 2-wire or optical waveguide can be realized at the interfaces. This way, up to 256 devices can be adjusted, read-out and supervised simultaneously by a PC. For the purpose of data registration and programming, there is also a Windows software available. The DLM-HD-measuring amplifier is built-in in a case with optional visible display and corresponds to the IP 65 degree of protection.

Thanks to the digital working method, the range (zero- and scale of display), the analog output (zero and full scale) and the limit values as well as their parameters like hysteresis, Min./Max.-characteristics, On-/Off-delay etc. can be freely configured within the given limits. It is also possible to perform a counterbalance by pressing a key in order not to bring, for example, the own weight of a construction to display. For this purpose, no measuring equipment is needed in situ.



The error output is a galvanic insulated switch output which is normally conductive. If the DLM measuring amplifier detects an error, the error output is set for the duration of the error, i. e. the switch output becomes non-conductive.

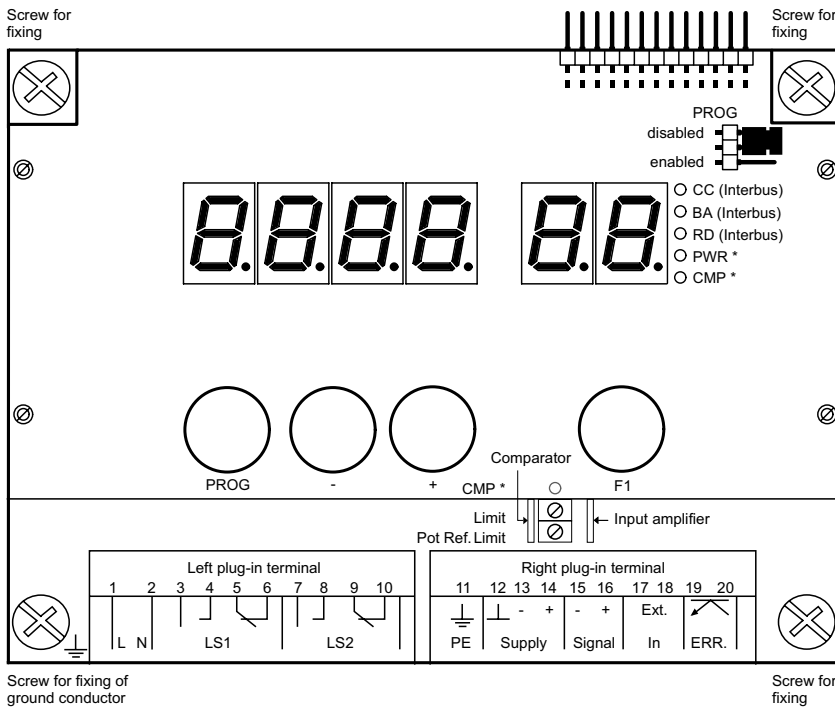
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## Technical data

<b><u>Input</u></b>	Measurement range:	Resistance strain gauge full-bridge 350 Ohm 0 - 10 mV; 0 - 20 mV; 0 - 30 mV (other measurement ranges at request)
	Adjustment:	The display range can be configured freely by means of four keys
<b><u>Output</u></b>	Sensor supply:	10 VDC/350 Ohm (for max. 4 sensors) (other bridge resistances at request)
	Relay outputs:	2, with 2 restraint relays for every output with 1 x NO and 1 x NC contact per relay
	Analog output: (option)	0-10 VDC (12 Bit resolution), galv. insulation 0-20 mA (12 Bit resolution) - load 500 Ohm, galv. insulation 4-20 mA (12 Bit resolution) - load 500 Ohm, galv. insulation
	Digital output: (option)	Interfaces RS 232, RS 485 Interbus S 2-conductor, Interbus S optical waveguide CANbus, Profibus, galv. insulation
	Error output:	NPN transistor line; max. 15 V/300 mA
<b><u>Display</u></b>	Display:	Seven segment LED, height 14 mm, red 4 digits = max. display value 9999 for measurement value and parameters, 2 digits for program number display
	Overflow:	displaying upper segments
	Underflow:	displaying lower segments
	Line break: Limit value 1 in desired range: Limit value 2 in desired range:	flashing display decimal point of left PN - LED lights up decimal point of right PN - LED lights up
<b><u>Accuracy</u></b>	Resolution:	9999 Digit / 12 Bit
	Zero point:	maximally -25% movable
	Measurement error:	+/- 0,1 % of end-scale value
	Temperature coefficient:	50 ppm/K
	Measure rating:	adjustable within 0,01..2,55 sec.
<b><u>Power supply</u></b>	Supply voltage:	230 VAC/115VAC/48VAC ± 10%, 50 - 60 Hz - opt. 24 VDC ± 20%, opt. 24VAC ± 20% galv.ins.
	Power consumption:	approx. 10 VA
<b><u>Ambient conditions</u></b>	Operating temperature:	-20 .. + 60 °C
	Storing temperature:	-20 .. + 80 °C
<b><u>Dimensions</u></b>	Case:	160 x 160 x 100 mm
	Fixing:	internal fixing-holes in screw-channels
	Material of case:	Aluminum pressure diecasting
	Colour:	Bottom part: RAL 7035 light grey / Lid: RAL 7040 anthracite
	Degree of protection:	IP65 / DIN 40050
	Weight:	approx. 2,1 kg
	Terminals:	Plug-in screw terminals in the case for wires up to 2,5 mm <sup>2</sup> through 6 x PG-screwing, MS nickel plated

# Operating, adjustment instructions

## Base PCB with display PCB

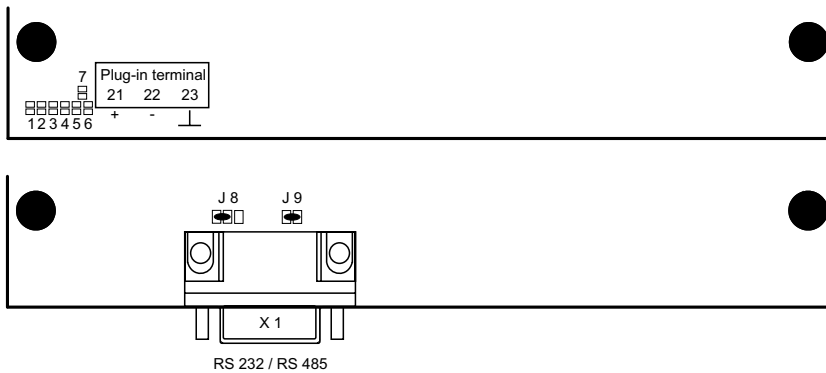


### Base PCB

- 1 Mains phase
- 2 Neutral conductor
- 3/4 Limit switch (1 NO contact)
- 5/6 Limit switch (1 NC contact)
- 7/8 Limit switch (2 NO contact)
- 9/10 Limit switch (2 NC contact)
- 11 PE/grounded conductor
- 12 Shield (sensor wire)
- 13 10 V sensor supply -
- 14 10 V sensor supply +
- 15 Sensor signal input -
- 16 Sensor signal input +
- 17 Ext. In (tare)
- 18 Ext. In (tare)
- 19 Error output emitter
- 20 Error output collector

\* PWR (voltage supply)  
\* CMP (LED Abs. Limit)

## Interface PCB



- Analog output**
- 21: Analog output +
  - 22: Analog output -
  - 23: Shield

- Output Closed solder bridges**
- 0 - 10 V 1, 3
  - 0 - 20 mA 2, 5
  - 4 - 20 mA 2, 5

### X 1 = SUB D 9 F

- RS 232 RS 485** Solder bridges J 8 left
- Pin 2: RXD Pin 2: B closed
  - Pin 3: TXD Pin 3: A J 9 closed
  - Pin 5: GND Pin 5: GND

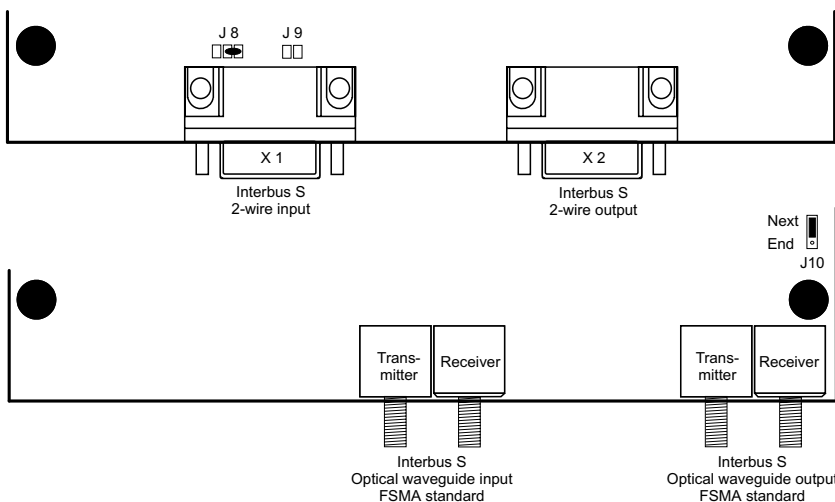
### X 1 = SUB D 9 M; X 2 = SUB D 9 F

- X 1 X 2** Solder bridge J 8
- Pin 1: DO Pin 1: DO right closed
  - Pin 2: DI Pin 2: DI
  - Pin 3: GND Pin 3: GND
  - Pin 6: DO Pin 6: DO
  - Pin 7: DI Pin 7: DI

In the terminal for X 2, pins 5 and 9 must be bridged!

For observing the limit values of EN 50081-1, the following interference preventions must be taken:

- The shields of all connected wires must be connected large-surface to the PG-screwing.
- The wire connected to socket X2 must be fitted with a ferrite Type Würth No. 742 7111 at the inner of the case.



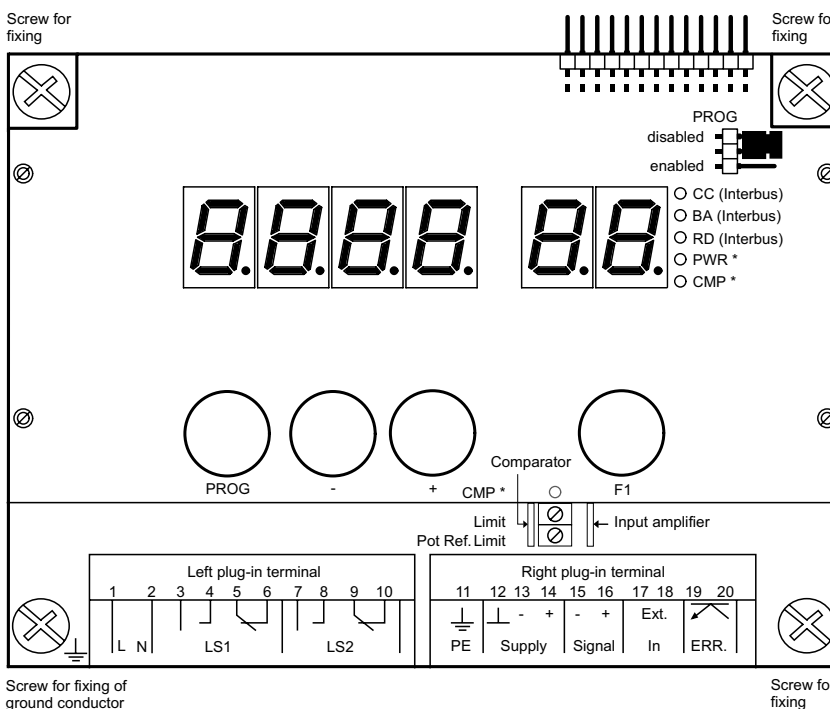
### Optical waveguide terminals: FSMA

**Instructions:** J 10 must be switched to "End" for the last instrument in a chain; for the rest of the instruments in the chain it must be switched to "Next".

# Operating, adjustment instructions

## Operating injunctions

1. To ensure a safety disconnection of the outputs it is always necessary to connect two relay contacts in series. So the N.O. contacts of K1 and K2 respectively the N.O. contacts of K3 and K4 will be connected serial. For safety conformed functions it is only authorized to use N.O. contacts, because they will open under voltage loss.
2. For the avoidance of welding with contact electrodes of the output relay points it is necessary to connect a qualified overcurrent protection element in the safety circuit, whose resolution sensitivity is equivalent to a maximum of 0,6 times of the contact rated current (see DIN VDE 0116, point 8.7).
3. The minimum triggering level of the comparator (P2 on the comparator board) has to be adjusted such as that a safety disconnection by the comparator will be possible under exceeding of the limits which were adjusted with the software.
4. The test level for the comparator (P1 on the comparator board) has to be equivalent to the release level.
5. The limit value switch have to be adjusted such as that the tension point will be disconnected at 1,2 times of the nominal load (see DIN 56925, point 5.2.8.3).
6. The hardware channel including the output relays have to be checked once per year for correct function.
7. The limit value switch is qualified for processes with a fault tolerance time of  $\geq 2$  seconds. Fault tolerance time is the time range in which the efficacy of the safety device may be interfered unless a critical status will arise.



### Base PCB

- |      |                           |
|------|---------------------------|
| 1    | Mains phase               |
| 2    | Neutral conductor         |
| 3/4  | Limit switch 1 NO contact |
| 5/6  | Limit switch 1 NC contact |
| 7/8  | Limit switch 2 NO contact |
| 9/10 | Limit switch 2 NC contact |
| 11   | PE/grounded conductor     |
| 12   | Shield (sensor wire)      |
| 13   | 10 V sensor supply -      |
| 14   | 10 V sensor supply +      |
| 15   | Sensor signal input -     |
| 16   | Sensor signal input +     |
| 17   | Ext. In (tare)            |
| 18   | Ext. In (tare)            |
| 19   | Error output emitter      |
| 20   | Error output collector    |

- \* PWR (voltage supply)
- \* CMP (LED Abs. Limit)

## Adjustment

- a. Press and hold key "PROG"; press "+"-key: Changing the program numbers (PN).
- b. Release "PROG"-key and adjust the desired value corresponding to the selected PN by using the "+" and "-" keys.
- c. Store the selected value by pressing "PROG" and "-" key at the same time. The device will confirm this by displaying "iO\_".
- d. When the device is in the "PROG"-mode and no key is pressed within approx. 10 sec., the device will return to normal operation mode. Every change of parameters that has not yet been stored will be lost.  
(There is one exception: PN 8 will not be left automatically because it is a non-user operated test function. Leave "PROG"-mode by selecting another PN.)
- e. Key F1 is a multifunction key. For the purpose of operation by remote control, this key is connected parallel in series to the terminals 17 and 18 (Ext.In) of the ground PCB and it regularly serves as tare key. By pressing this key, the display value adjusted under PN51 is transferred to the display, if the tare under PN41 is enabled (adjustment 1  $\triangle$  tare active). This way, for example, the own weight of a construction that is to be monitored, that has formerly been displayed, can be suppressed and only the working load will remain. The safety switch-off is not affected by this counterbalancing. If necessary, F1 can be equipped with other functions, by means of software modifications at the factory.
- f. Changing the position of jumper PROG to the upper position will disable the "PROG"-key. This way the device is protected against unintended de-adjusting of parameters. (Jumper switched to **disabled** programming disabled, to **enabled** programming enabled.)

### ATTENTION! Important instruction:

Program numbers 1 and 2 must never be confirmed, unless the corresponding input signal is connected to the input. Confirmations done randomly for the program numbers 1 and 2 will overwrite the calibration and may cause both positions to be adjusted to the same value. This will cause an infinite "amplification" and the instrument will not work properly.

## Program table

PN	Function	Remark	Display
PN00	Version No.		
PN01	Calibration - zero	Connect zero signal to input	0..4095
PN02	Calibration - end-value	Connect end-value signal to input	0..4095
PN03	Display -zero		0..9999
PN04	Display -end-value		0..9999
PN05	Position of decimal point		
PN06	Measure interval	10ms .. 2,56s	1..256
PN07	Number of limit values		1..2
PN08	Limit adjust.of comparator circuit	0 = DMS-Signal, 1 = Ref.-Signal	0..1
PN09	Device address		0 ..255
PN10	Limit value 1		0..9999
PN11	Hysteresis 1		0..9999
PN12	MIN/MAX 1	0 = MIN 1 = MAX	0..1
PN13	Off-delay 1	10ms .. 2,56s	1..256
PN14	On-delay 1	10ms .. 2,56s	1..256
PN15	Test relay 1	0 = off 1 = on	0..1
PN20	Limit value 2		0..9999
PN21	Hysteresis 2		0..9999
PN22	MIN/MAX 2	0 = MIN 1 = MAX	0..1
PN23	Off-delay 2	10ms .. 2,56s	1..256
PN24	On-delay 2	10ms .. 2,56s	1..256
PN25	Test relay 2	0 = off 1 = on	0..1
PN30	Analog output - zero value		0..9999
PN31	Analog output - end-scale value		0..9999
PN40	Time before the display lights out unless key is pressed	0 = permanent-on, e.g.7 = 7 min	0..10
PN41	Tare activation	0 = not active, 1 = active	0..1
PN50	Tare AD value	automatically registered when operating the tare function	0..4095
PN51	Tare display value	Value that shall be displayed when the tare is operated (e.g. 0)	0.. 9999

## Interface description RS 232/RS 485

### Data format

The transmission record has the following data format:  
9.600 bps, 8 data bits, one stop bit, no parity.

### Sender record

Byte	Function	Remark
1	Start Of Text	Always 02 h
2	Device address	01 h ... FFh
3	Command	00 h ... FFh
4	Program number	00 h ... FFh
5	Date LSB	00 h ... FFh
6	Date MSB	00 h ... FFh
7	Checksum LSB	00 h ... FFh
8	Checksum MSB	00 h ... FFh
9	End Of Text	Always 03 h

The checksum is formed by the bytes 2 to 5.

### Receiver record

After the transmission of the sender record a receiver record is obtained from the control unit. The receiver record is arranged the same way as the sender record. The extracted information is contained in the bytes 4 and 5.

### Command list

Command	Function
1	Read display value
2	Read program memory
4	Write program memory
128	Reset DLM system

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# Interface description Interbus

## General information

The DLM system can be provided with an Interbus interface. The DLM system can be connected as slave unit to a remote bus or as 2-wire module or as optical waveguide module. The IDENT-Code is 03 h.

The remote bus signals are connected with 9 pole D-SUB plugs. In the module the wiring of the application with potential separation is realized with help of the INTERBUS info service. The potential separation is performed with a DC/DC converter (15 V / 15 V; 2 W) . If necessary, this device and the corresponding opto electronic couplers may be omitted, whereby a wiring variant results after four 0 ohm resistors have been soldered in: The module can optionally be connected to the left side of the SUP13 module (2-wire local or remote bus unit) or to the right side of the SUP13 module (bus terminal). For the operating mode with bus terminal there is a red alarm LED available, that is connected to the MFP 8 (alarm output of the SUP1 3).

The optical waveguide module serves for realization of the 2-wire record of the optical waveguide. The wiring is done in the same way as for the 2-wire remote bus module. With the help of this module, for example an optical waveguide/RS 485 converter (operating mode-bus terminal) can be realized. The wiring corresponds to the realization example for the INTERBUS optical waveguide interface, as it is to be found in the technical guidelines in "Optische Übertragungstechnik V1.0" of the INTERBUS club.

## Sender record

Byte	Function
1	Command
2	Program number
3	Date MSB
4	Date LSB

## Command list

Command	Function
1	Read program memory
2	Write program memory
255	Reset DLM system

## Receiver record

Byte	Function
1	Reserve
2	DLM status
3	Date MSB
4	Date LSB

## DLM status

Status bit	Function
0	Relay for limit value 1 in use (?)
1	Relay for limit value 2 in use (?)
2	DLM in underflow
3	DLM in overflow
4	No function
5	No function
6	DLM in programming mode
7	Error in DLM system

The functions are indicated through a set bit.

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# DLM control

## Description

The program DLM control serves for the visualization and parametrization of DLM systems over PC. The DLM system and the PC are connected over an RS 232 or RS 485 interface. Since the RS 485 interface is bus compatible, up to 255 instruments can be installed with one PC.

## Installation

For installation, please put the first of the disks in the disk reader, start the program "Setup.exe" and then follow the instructions supplied by the installation program.

## Description "licenced for..."

After the installation the DLM control program must be licenced. After starting the program for the first time the user will be asked to put the last of the installation disks in the disk drive. After the disk has been read, the program is licenced. The corresponding entry can be found under the menu item "Info" in the DLM control soft-ware.

## Operating instructions

### Creating virtual instruments

After starting the program, an empty operating surface will be seen. In order to place the "virtual instruments", the corresponding symbol must be clicked with the mouse. The user subsequently will be asked to provide the symbol with a device address. The address must correspond to the device address of the connected DLM system. After the specification of the device address and the subsequent confirmation, the instrument will emerge on the operating surface. By means of the "+" and "-" switching interface, the size can be adjusted. Alternatively, the instruments can be added using the menu "Insert".

### Parameter processing

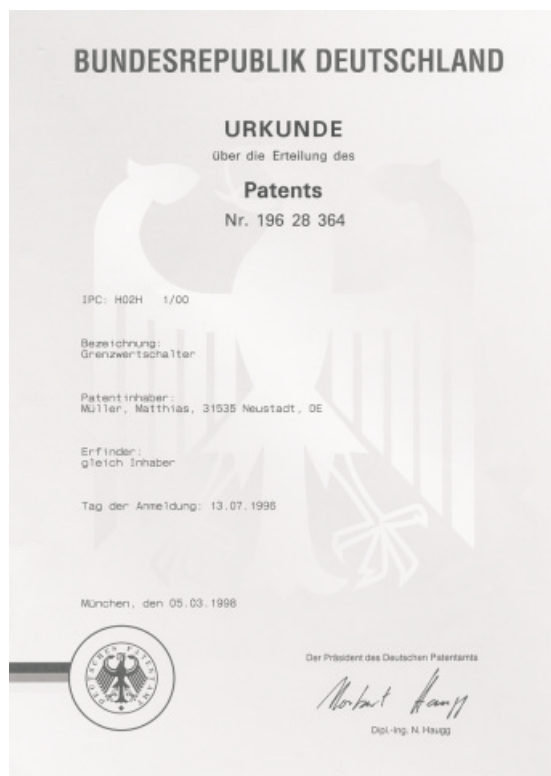
By clicking twice on the instrument symbol it is possible to reach the parameter level. At this level, parameters of the connected DLM system can be read, processed and written back. With the entry "Unit" as well as "Info", the corresponding pieces of information can be displayed on the "virtual instrument".

### Online operating

Over the switch button "Start" it is possible to switch to online operation. The data from the connected DLM systems are then read-out and displayed. The mode can be ended by operating the switch button once more.

**Instruction:** Prior to online operation, the parameters of the connected DLM system must be read in!

## Patent letter and TÜV certificate



## Ordering code

**L S X X X X X X XXX**

No.	Input	Analog output	Digital output	Supply	Display	Dimension	Range
0	1 mV/V	none	none	230 VAC	none	g	none
1	2 mV/V	0 - 10 V galv. insulation	RS 232 galv. insulation	115 VAC	visible	kg	e. g. 0 ... 500
2	3 mV/V	0 - 20 mA galv. insulation	RS 485 galv. insulation	48 VAC		t	
3		4 - 20 mA, galv. insulation	Interbus 2-c. galv.insulation.	24 VDC		N	
4			Interbus S opt. waveguide galv. insulation	24VAC galv. insulation		kN	
5			CANbus galv. insulation			%	
6			Profibus galv. insulation				