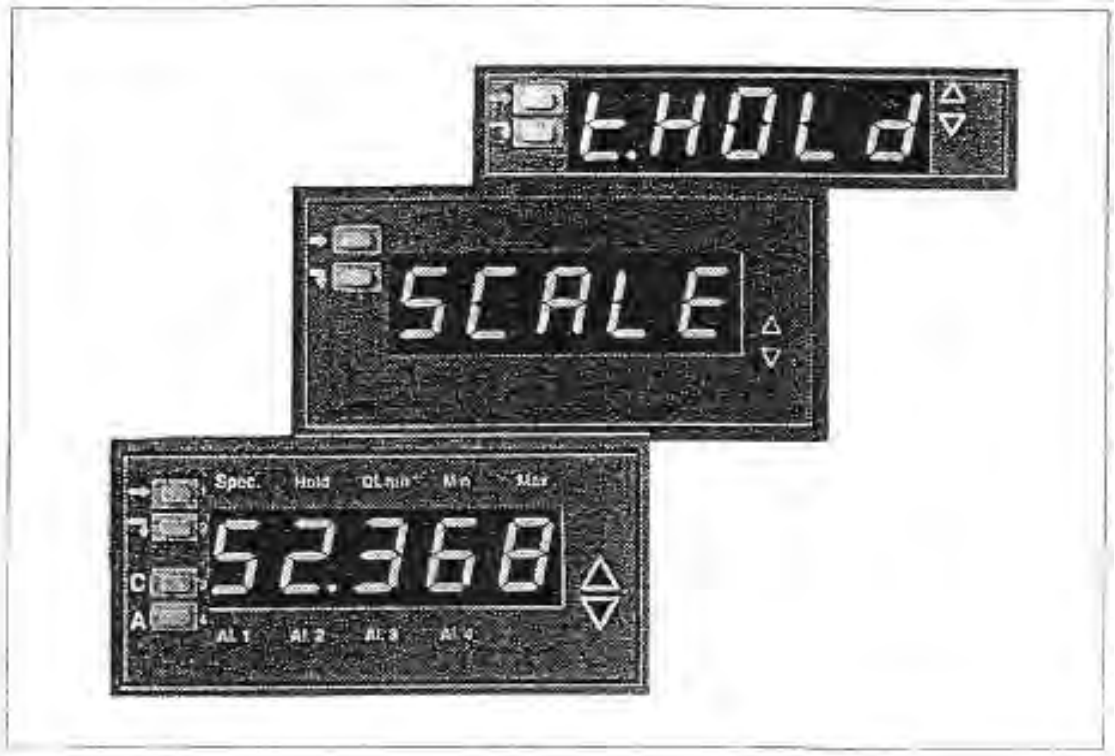

Digital Panel Meters
DPM 24 / 40 000 MF
DPM 48 / 40 000 MF
DPM 48 / 40 000 MF / R2
DPM 48 / 40 000 MF / E1
DPM 48 / 40 000 MF / E2

Operating Manual

GMW GOSSEN Müller & Weigert

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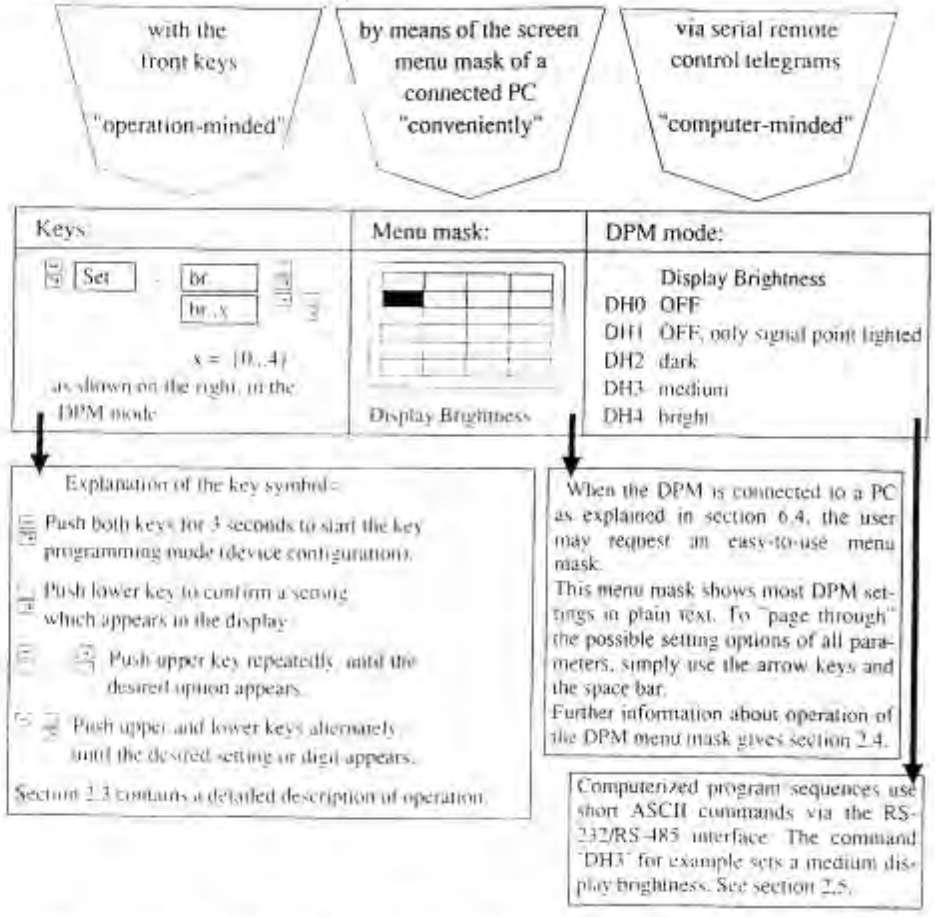
Table of Contents

3 Instructions

Examples of the Operating Manual Instructions

Three alternative methods are available for selecting the required functions and facilities in this DPM..MF series measuring instruments.

The following examples describe the instructions for setting the "Display Brightness" using each of the three configuration methods:



Marked areas apply only to the ..MF/F_ models! Unless otherwise expressly specified, the other data apply to all instruments of the DPM..MF family.

☞ The First Operating Steps → Page 5-1

Digital Panel Meter DPM xx/40000 MF/E..

The DPM..MF are intelligent multifunction panel instruments for measurement of voltage, current and temperature.

The instruments incorporate all measuring ranges and functions for easy adjustment by the user via the front keys or the interfaces.

The measuring scale range allows input signals with a ± 40,000 count resolution to be processed and displayed over a range from – 19,999 to + 99,999.

The microcontroller integrated in the DPM..MF series measuring instruments offers many powerful functions, including:

- Datalogging,
- integral linearization of 10 thermocouple types,
- 4 alarms, and
- comprehensive communication facilities, e.g. to cascade several DPMs or to connect a printer, text display, personal computer (PC) or PLC.

The E1 Option (Designation: DPM 48/40000 MF/E1)

offers, in addition to the basic functions above,

- Measurement of true RMS value
- Illuminated legends in the display facia for status indication
- 4 integral alarm relays, supplementing the 2 OC outputs
- User definable programmable linearization
- RS-485 interface with simple protocol, parallel to RS-232C
- An upgraded analogue output with ± 20 mA maximum range.

The E2 Option (Designation: DPM 48/40000 MF/E2)

presents a 5-digit BCD parallel output for 5...30 V instead of the E1 option's RS-485 interface.

Terminals → Chapter 1

Operation → Chapter 2

Parameters → Chapter 3

Help → Chapter 4

Examples → Chapter 5

Technical Data → Chapter 6

Safety Instructions (IEC 1010-1, Class 1)

In order to preclude any danger to the operator, make sure to adhere to the following instructions:

a) In case any damage or malfunction is detected, take the unit out of operation without delay.

b) Before disassembling the unit, disconnect all inputs/outputs and the supply voltage. When mounting the unit and the connections, make sure all live components are protected from being touched directly.

c) Comply with the generally accepted regulations and safety provisions for electrical, light-current and power systems, in particular the local safety provisions (e.g. VDE 0100).

d) The maximum admissible potentials existing between the pin groups as well as to the external protective conductor must not be exceeded. Refer to the instrument identification label.

e) When connecting the DPM to other devices (e.g. PC's) the wiring requires particular attention. It is possible that internal connections in external units (e.g. GND connected to protective earth) cause inadmissible potentials at the DPM.

f) Make sure that the unit is properly mounted before connection and power on.

In order to preclude any damage to the instrument, the following items must be taken into account:

a) The values indicated as "absolute maximum ratings" must not be exceeded.

b) The maximum admissible potentials between the pin groups must not be exceeded. This applies in particular to high voltage tests!

⚠ Refer to the instruction manual ! ⚠ Warning: Hazardous live voltage !

⚠ WARNING ⚠

Hazardous voltages are present in this electrical equipment during operation. Non-observance of the safety instructions can result in severe personal injury or property damage. Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices and maintenance procedures contained herein.

The successful and safe operation of this equipment is dependent on proper handling, installation, operation and maintenance.

Qualified person

A "qualified person" is one who is familiar with the installation, construction and operation of the equipment and the hazards involved. In addition, he has the following qualifications:

- Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.
- Is trained in the proper care and use of protective equipment in accordance with established safety practices.
- Is trained in rendering first aid.

Safety according to IEC 1010-1, EN 61010, NFC 42020, VDE 0411

Overvoltage category: see pag. 6-9

Pollution degree: 2; indoor use; altitude <2000m; relative humidity <80% up to 31° C; temperature: 5° C to 40° C.

Definition of overvoltage categories according to IEC 664:

CAT I: Special equipment or parts of electric or electronic equipment with small transient overvoltage

CAT II: Appliances, portable equipment

CAT III: Fixed installations regarding distribution and circuits at the input of electric maintenance of buildings

Safety precautions: Before any measurements on electrical power sources, check whether the panel meter overvoltage category is compatible with the source category.

1 Installation and Operation

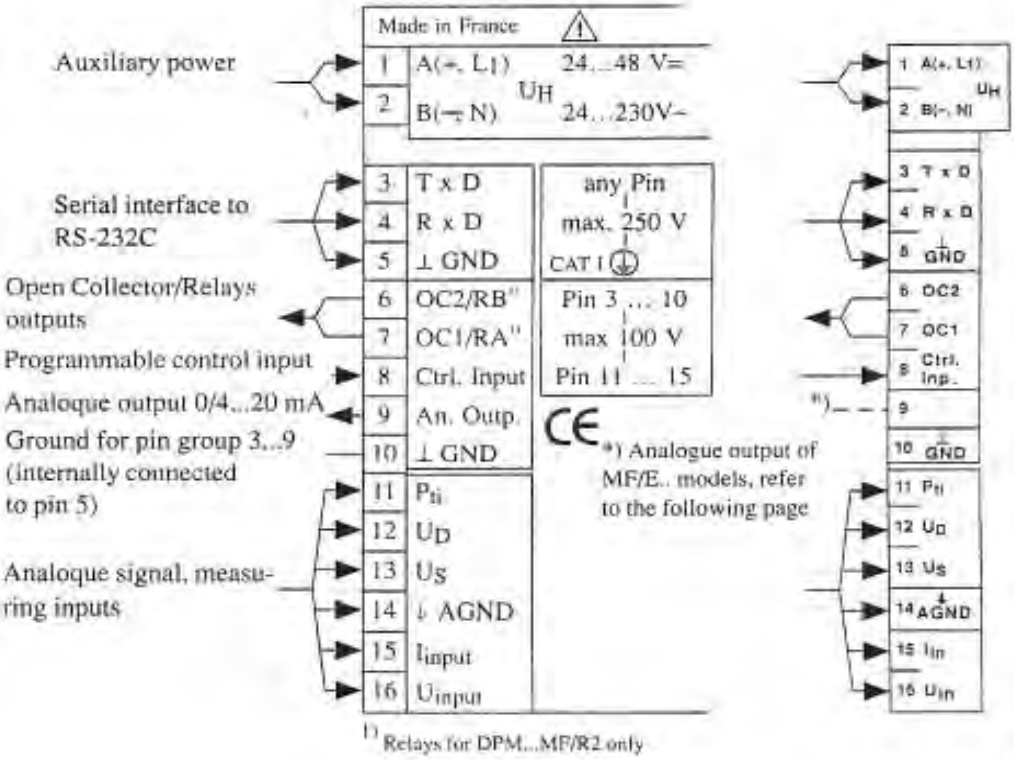
1.1 View - Pin allocation

Measuring function caption:
Space for indication of a measured variable is provided below the LED indicators. A front cover printed specifically according to customer's request is available as optional equipment.

☞ **The meaning and the operation** of the front elements are described in section 2.1.

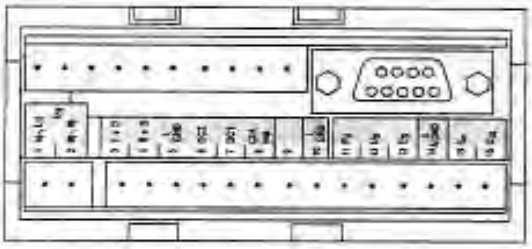
☞ Section 5.1 contains an example for starting-up **"The First Operating Steps"**.

DPM ...MF and MF/R2 **DPM 48/...MF/E**

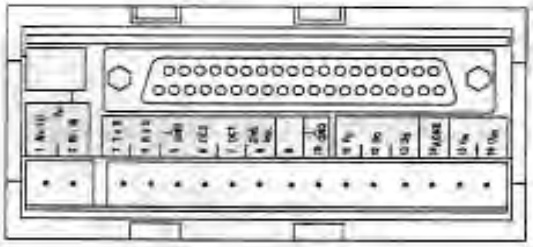


Back views of the MF/E.. models in mounting position

DPM 48/40000 MF and E1
with RS-485



DPM 48/40000 MF/E2
with BCD parallel output



4 Relays:
Rel A, Rel B
Rel C, Rel D

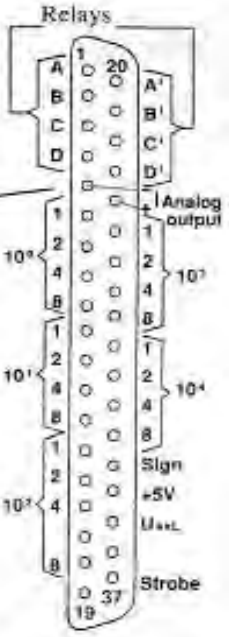
Analogue output
programmable
0/4..+/- 20 mA

9-way Submin
female socket
for RS-485

4 Relays:
Rel A, Rel B
Rel C, Rel D

Analogue output
programmable
0/4..+/- 20 mA

5-digit BCD
parallel output
with Sign and Strobe



Cable connections

The plug-in screw terminal strip supplied with the instrument enables connection of cables/wires (single wire: up to 4 mm^2, fine-stranded: up to 2.5 mm^2). To protect the plug connector on the instrument against unnecessary strain, the leads should be screwed onto the terminal strip before it is plugged on the instrument. All Submin connections on the instrument are female connectors.

1.2 Mechanical Installation

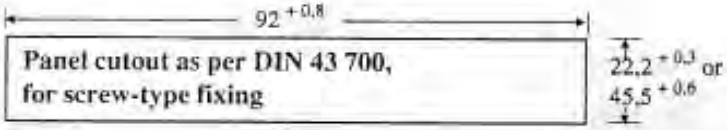
The DPM instruments are available for screw-type fixing (standard) or for snap-in fixing (optional).

Mounting depth: A clearance of 151 mm must be left with reference to the front edge of the panel. Venting slots must be left open. The mechanical strain exerted by cables should be as low as possible.

Screw-type fixing

The instruments are clamped into the panel by means of the screws of a lateral locating device (dovetail guide system). Inserted from the front end, secured from the rear end.

Panel thickness: 1 mm up to 22 mm.

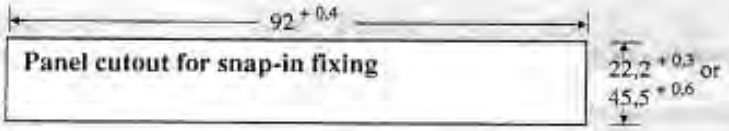


Unit: mm

Snap-in fixing (optional)

The DPM, which has been inserted into the panel cutout from the front end, is retained by lateral leaf springs (front mounting).

Panel thickness: 1.5 mm up to 3.5 mm.
Compared to the DIN standard, the width tolerance is slightly reduced.



Unit: mm

Mosaic fixing

Direct fixing for Subklew, Mauell and other mosaic systems is possible. Further information on request.

Panel thickness: 1.5 mm up to 22 mm

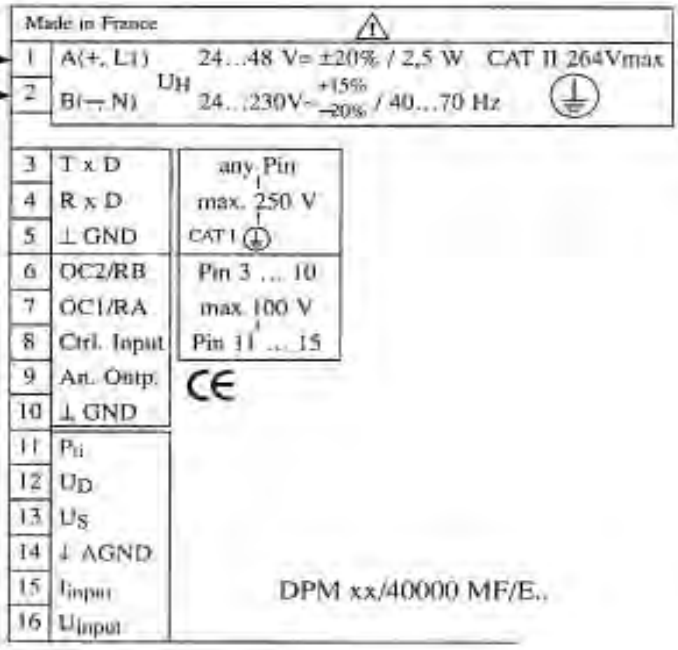
Dimension drawings see section 6.1.

Make sure that the unit is properly mounted before connection and power on.

1.3 Power Supply

A genuine wide range power supply unit enables the direct supply of the instrument at the terminals A and B with any direct and alternating voltages starting from 19 V. The instrument adapts itself automatically to the voltage concerned, so that there is no need for the user to make any adjustments. Direct voltage can be connected to A, B without observing polarity.

- Terminals:
  only A and B
- Voltage range preselection:
  none
- Minimum voltage:
  19 V DC
  19 V AC
- Maximum voltage:
  60 V DC
  266 V AC
- Technical Data,
  see section 6.4.



When the supply voltage is applied, the instrument is switched on and operates within the selected measuring range with the selected system functions.

☞ **Range shifting** is effected via the front keys or by means of a PC connected. Description, see section 3.1.

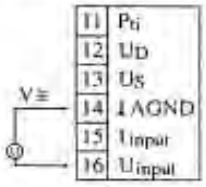
☞ Section 2 contains **general information about operation** and a description of the switch-on behaviour.

any Pin max. 250 V CAT I	The admissible potential between the pin groups (1-2) and (3-10) or (11-16) must not exceed 250 V. Insulation voltage: 3 kV.
Pin 3 ... 10 max 100 V Pin 11 ... 15	The admissible potential between the pin groups (3-10), (11-16) must not exceed 100 V. For rated voltages refer to page 6-9.

1.4 Measuring Connections

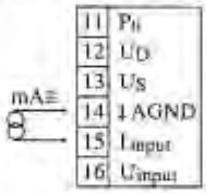
All the ranges shown on this page are standard options in all DPM..MF. The desired range is selected via the menu (see section 3.1).
Connecting pins which are not used must be left open!

Voltage ≅



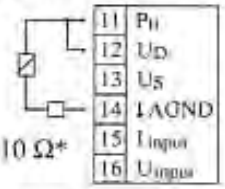
DC U 0,2V	(V11)	AC U 0,5V	(V31)
DC U 0,4V	(V12)	AC U 1V	(V32)
DC U 2V	(V13)	AC U 5V	(V33)
DC U 4V	(V14)	AC U 10V	(V34)
DC U 20V	(V15)	AC U 50V	(V35)
DC U 40V	(V16)	AC U 100V	(V36)
DC U 200V	(V17)	AC U 500V	(V37)
DC U 400V	(V18)	AC U 650V	(V38)
DC U 650V	(V19)	AC U auto	(V30)
DC U auto	(V10)		

Current ≅

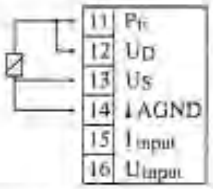


DC I 20mA	(V21)	AC I 50mA	(V41)
DC I 40mA	(V22)	AC I 100mA	(V42)

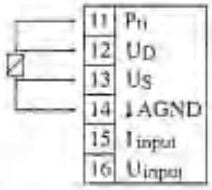
Pt 100



Pt100 2 wire (V60)

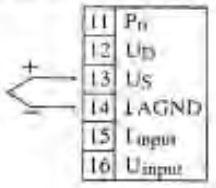


Pt100 3 wire (V80)



Pt100 4 wire (V70)

Thermocouples



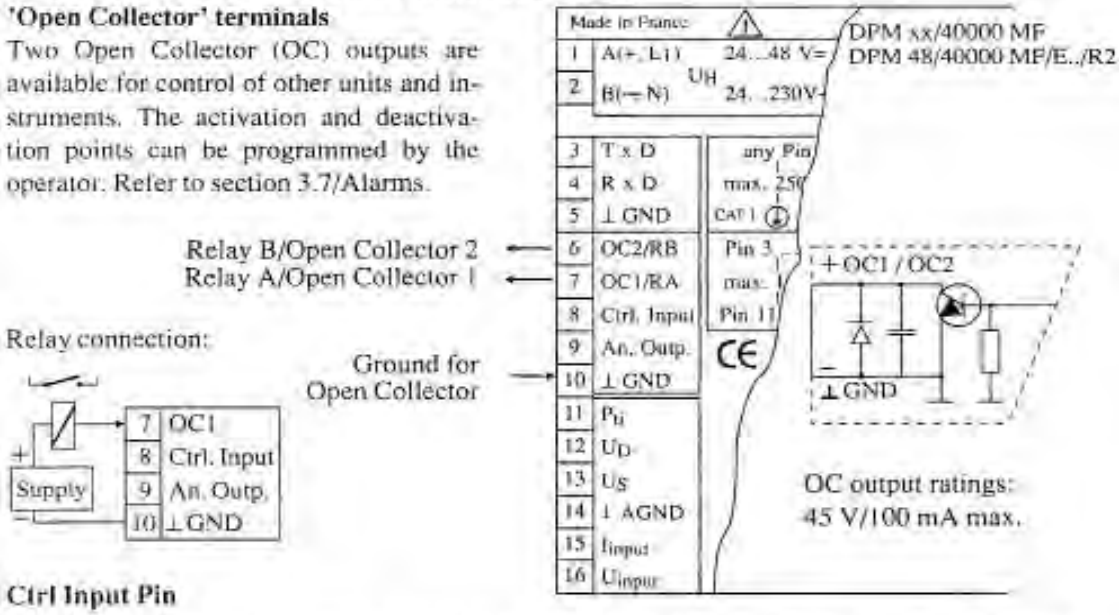
Type R	Pt 13 Rh-Pt	(V90)
Type S	Pt 10 Rh-Pt	(V91)
Type B	Pt 30 Rh-Pt 6 Rh	(V92)
Type J	Fe-CuNi	(V93)
Type T	Cu-CuNi	(V94)
Type E	NiCr-CuNi	(V95)
Type K	NiCr-NiAl	(V96)
Type L	Fe-CuNi	(V97)
Type N	Nicrosil Nisil	(V98)
Type U	Cu-CuNi	(V99)

*) The total cable resistance must be exactly 10 Ohm.

1.5 Control Terminal Connections

'Open Collector' terminals

Two Open Collector (OC) outputs are available for control of other units and instruments. The activation and deactivation points can be programmed by the operator. Refer to section 3.7/Alarms.

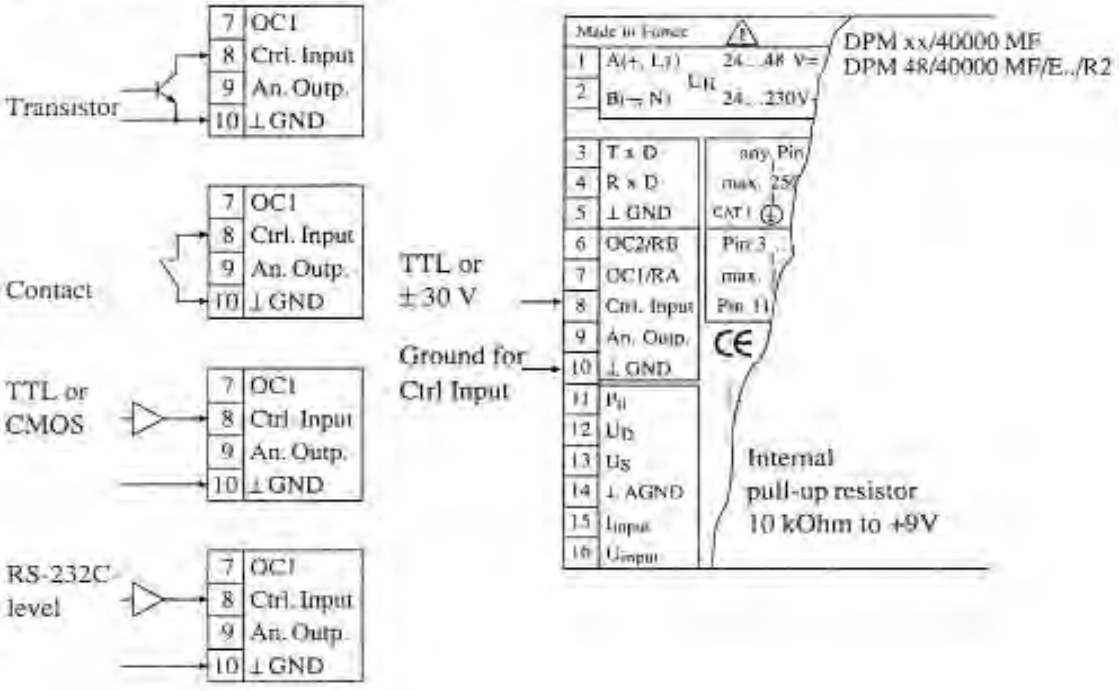


Relay connection:

Ctrl Input Pin

The operator may set a separate input (Ctrl Input) to one of a number of preselected functions (see section 3.6).

Examples for the operation of the "Ctrl Input Pin":



Relay outputs (only DPM 48/40000 MF/R2)

The DPM 48/40000 MF/R2 includes the complete range of functions and specifications of the model DPM 48/40000 MF.

The DPM...R2 provides two alarm relays instead of two open collectors (OC).

	DPM MF	DPM MF/R2
Pin connection:	OC 1/Pin 7	-------> Relay A/Pins 20/21
	OC 2/Pin 6	-------> Relay B/Pins 22/23

⚠ Note: For normally "open" operation the unit has to be configured "alarm output: inverted".

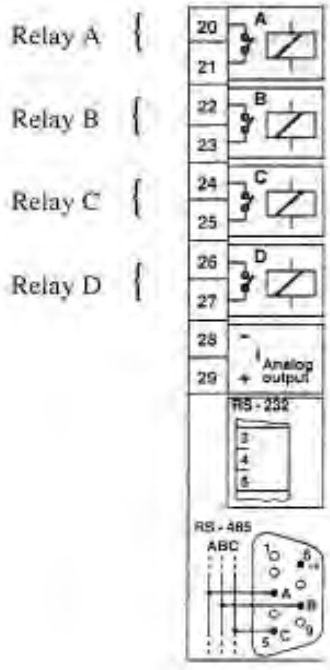
Relay outputs (only MF/E.. models)

Apart from the two "Open Collector" transistor outputs, 4 integral relays are at the user's disposal.

The allocation to certain alarms as well as the activation and deactivation points can be programmed by the user according to section 3.7 (alarms).

These outputs can be individually operated by means of commands via the serial interface, e.g. in order to test any peripherals connected. Refer to section 1.9.

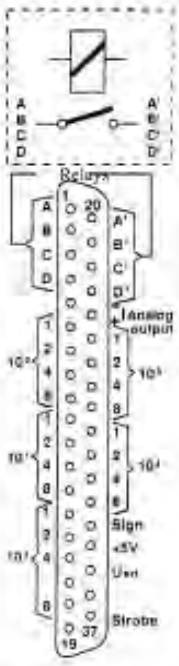
DPM ...MF/E1



DPM ...MF/E2

(37-way Submin female socket on DPM)

Relay A Pins 1/20
Relay B Pins 2/21
Relay C Pins 3/22
Relay D Pins 4/23



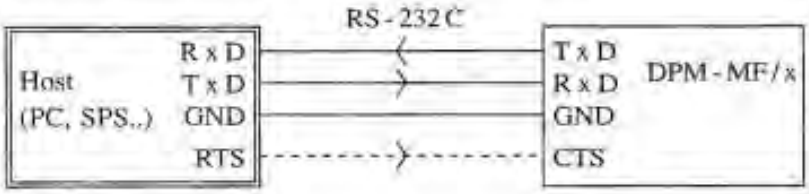
The maximum relay rating is 50 Volt AC / 30 Volt DC for E1 and E 2 models and 30 Volt AC/DC for E2 models. 1 A max. Section 6.3 contains data on contacts.

1.6 Serial Interfaces

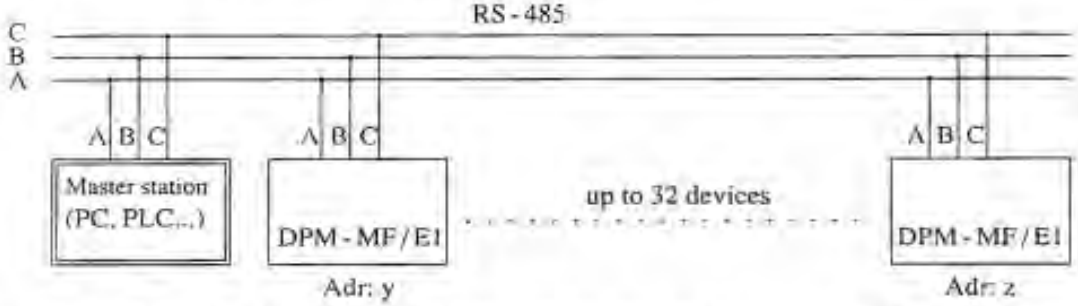
All MF models have an RS-232C interface.

The DPM 48/40000 MF/E1 features both RS-232C and RS-485. Either interface can be used as input/output, and the other one as output only.
The DPM 48/40000 MF/E2 (with BCD output) only has an RS-232C interface.

- **RS-232C** only allows two devices to be connected.



- **The RS-485** is a multidrop connection between two, or more devices (up to a maximum of 32) controlled by a master station (e.g. PC).



When turned on, the DPM/E1 selects the appropriate interface automatically. The interface activated as a standard is RS-232C. Only if
1. a device address is allocated to the DPM (section 3.10.1), and
2. no RS-232 connection is provided (RxD pin open),
the DPM..MF/E1 selects automatically the RS-485's system mode.

So every device is started in the proper mode as determined by the installation, but can be configured via the RS-232C, if required.

Operation of the RS-485 system mode (protocol) is discussed in section 2.2.2.

1.6.1 Installation of RS-232C

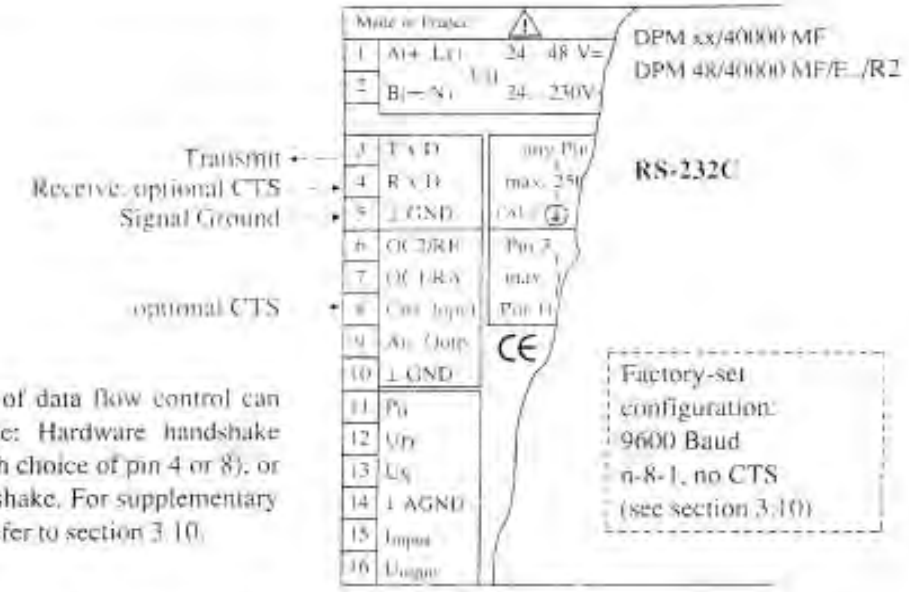
The RS-232C interface is activated whenever no device address has been allocated to the DPM, or if an active RxD line is connected when the DPM is turned on, or if the RxD pin is connected with the GND pin.

With the RS-232C, the following modes are available: Configuration and remote control in DPM mode (sections 2.2 and 2.5), configuration via menu mask (section 2.4), cascading of several DPMs (section 3.11) and continuous data output (3.10.3).

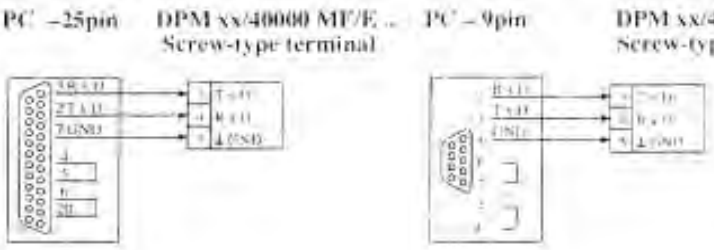
The following settings are possible:
- Baudrates 110/300/1200/2400/4800/9600
- Parity, data word length, number of stop bits
- Transmit delay
- Device address

} see section 3.10

Set to "transmit", the RS-485 interface acts like an RS-422 transmitter which transmits all the information of the RS-232C-TxD line (incl. echo, data, etc.).



EXAMPLE: Connection of a DPM to a PC



1.6.2 Installation of RS-485 (only DPM.../E1)

The RS-485 interface operates only if a device address is allocated to the DPM when the DPM is turned on (see section 3.10.1), and if no active RxD line is connected, or if the RxD pin is open.

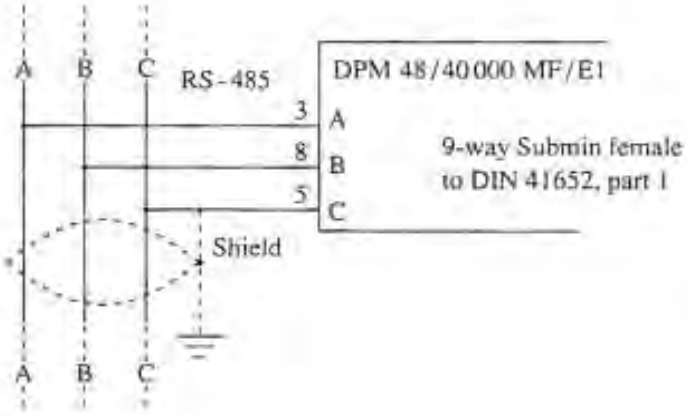
The transmit/receive sequence in the system mode (protocol) is described in section 2.2.2.

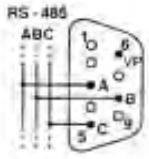
Bit Protocol 9600, 8-e-1

In compliance with DIN 19244, the bit protocol (UART character representation) has the fixed setting 9600, 8-e-1. Consequently there is no need for individual baud rate or parity adjustment.

Interface

Every device is wired to the RS-485 bus lines in the same way, so that the pins A, B and C are matched. Make sure not to mix up the pins!





Safety information

As a rule, it must be ensured that the maximum admissible potential (see "Safety Instructions", section 1.3, and the instrument identification label) is not exceeded even if several instruments are interconnected!

Bus line

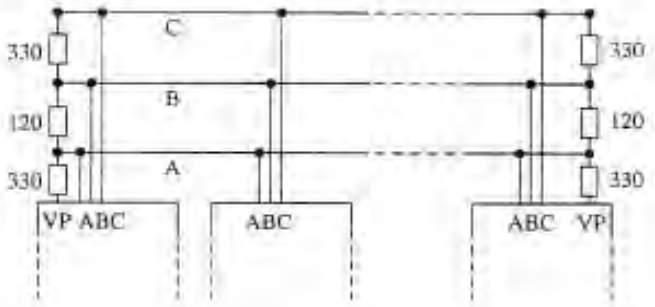
In compliance with the Appendix of the EIA-RS-485 Standard, the following recommendations apply to the bus line:

- Twisted, twin-core cable plus shield
- Wire cross section > 0,22 mm^2 (24 AWG)
- Shield (to improve the EMC)
- Surge impedance 100..120 Ohm at > 100 kHz
- Line capacity < 60 pF/meter
- Total length up to 1.2 km

Termination

The user has to terminate each line on each end by the following resistors:

- 120 Ohm (1/2 W) between A and B
- 330 Ohm (1/4 W) between A and VP (+5V)
- 330 Ohm (1/4 W) between B and C (GND)



Caution: RS-232C's RxD and TxD pins (in the RS-485 mode)

The RxD pin must either be left open, or held at a level > 3V.

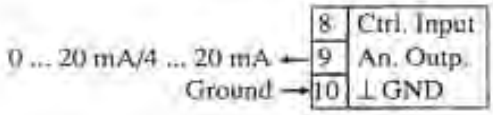
All the data transmitted on the RS-485 is also sent to the RS-232C TxD pin. This allows the data to be monitored on the RS-232C TxD pin for test purposes.

1.7 Analogue output

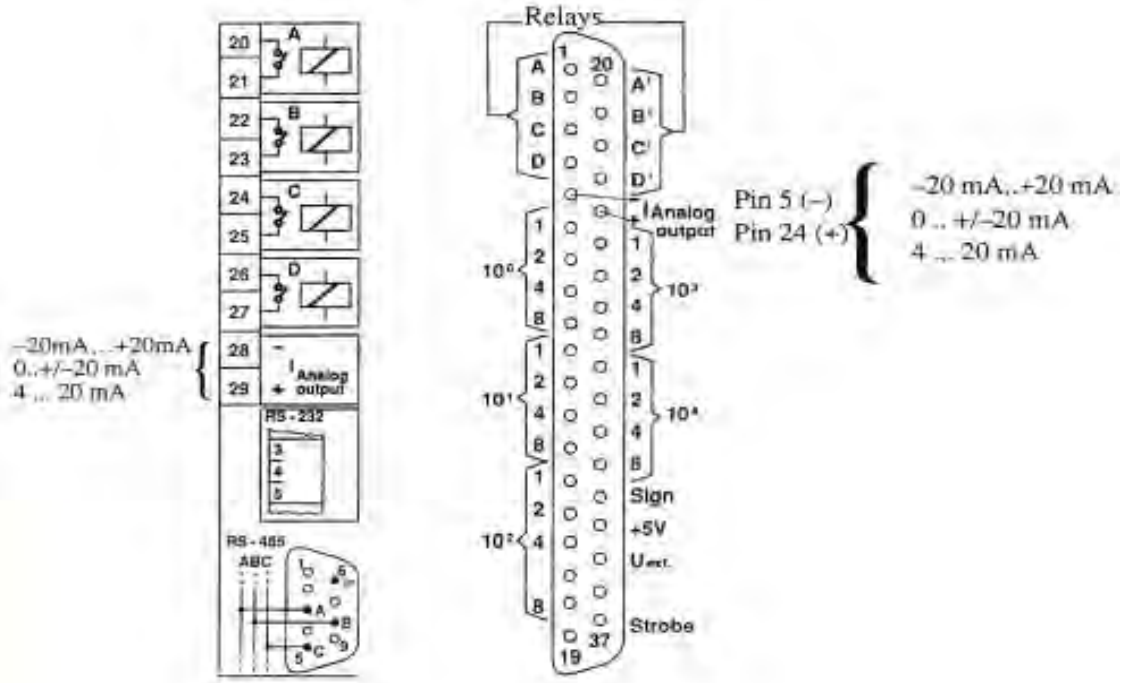
For connection of a graphic recorder or for further processing of signals, an analogue output is available which offers an output choice of 0...20 mA or 4...20 mA, or, in case of the MF/E.. models, of -20 mA...+20 mA, as well.

Setting/programming of the analogue output is discussed in section 3.12.

DPM...MF



DPM...MF/E1 **DPM...MF/E2**

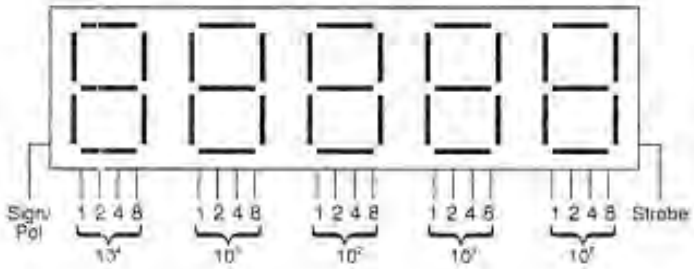


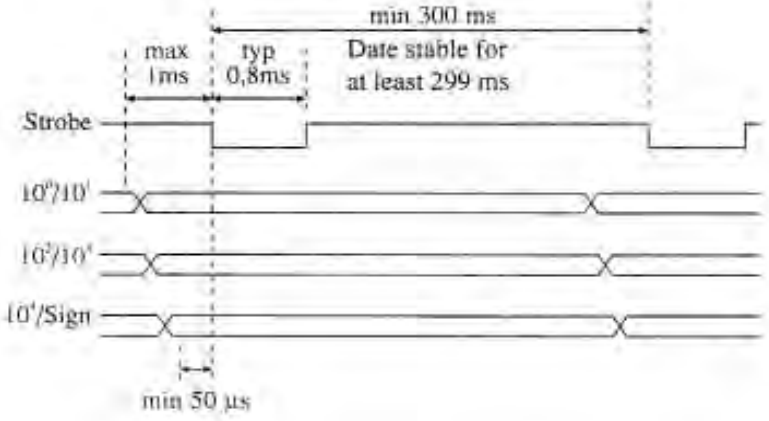
1.8 BCD output (only DPM ... /E2)

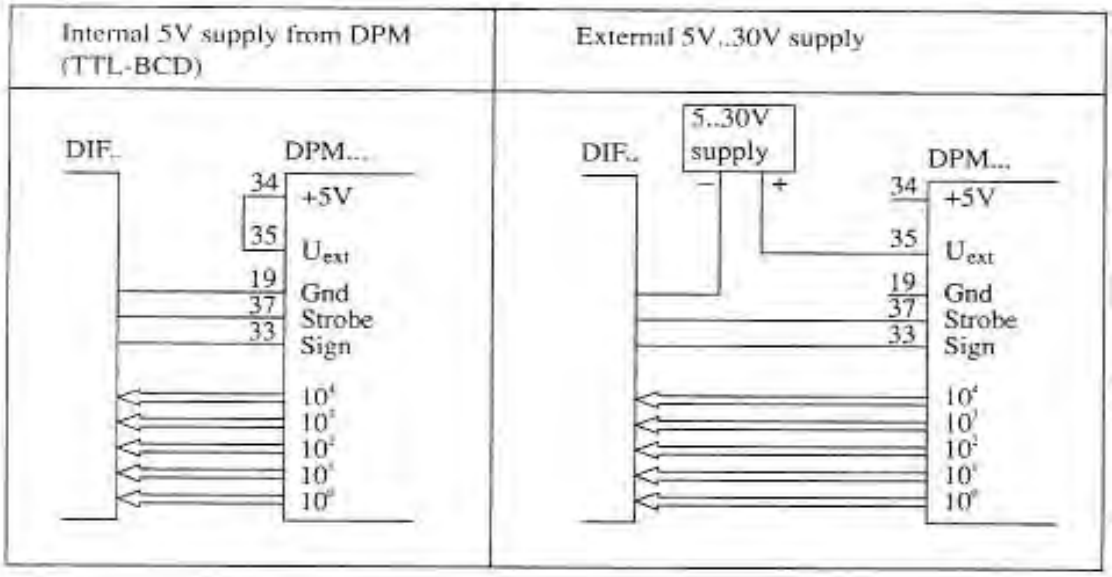
A parallel BCD output transmits continuously the 5 display digits, a sign (sign/pol) and a strobe signal. The decimal point is not outputed.

Each BCD line is electrically isolated by an optocoupler. The optocoupler transistors are all connected to pin 35 "U_{ext}", which should be supplied with a positive voltage between +5 and +30V output current at level "1" : 1mA.

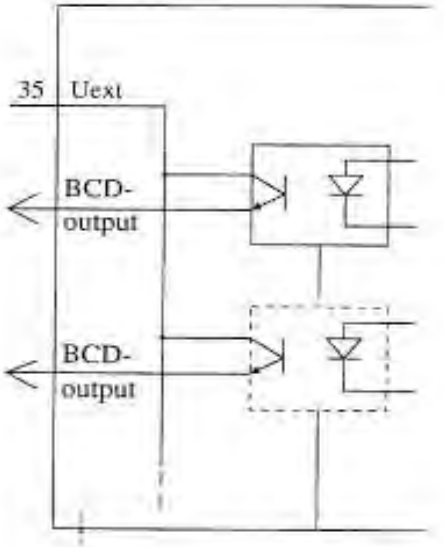
The DPM supplies an isolated +5V output at pin 34 (+5V) which can be linked to pin 35 for 5V BCD operation. The corresponding GND is pin 19. The Strobe pulse also switches to U_{ext}.







Display character	Coding -8	-4	-2	-1	Sign
0	0	0	0	0	x
1	0	0	0	1	x
2	0	0	1	0	x
3	0	0	1	1	x
4	0	1	0	0	x
5	0	1	0	1	x
6	0	1	1	0	x
7	0	1	1	1	x
8	1	0	0	0	x
9	1	0	0	1	x
–	x	x	x	x	0
+	x	x	x	x	1
"	1	0	0	1	1
otherwise	0	0	0	0	1



1.9 Testing OCs, Relays and Display Segments

OC outputs can be activated/deactivated directly by commands in the DPM mode. This allows circuits (e.g. relays) to be tested which are connected to the OC outputs.

Also the integral relays can be activated/deactivated in the DPM mode.

Test of OCs / relays

Keys:	Menu mask:	DPM mode:
Not possible	Not possible	C10 Deactivate OC1/*Relay A**
		C11 Enable OC1/*Relay A**
		C20 Deactivate OC2/*Relay B**
		C21 Enable OC2/*Relay B**
		RA0 Relay A OFF
		RA1 Relay A ON
		RB0 Relay B OFF
		RB1 Relay B ON
		RC0 Relay C OFF
		RC1 Relay C ON
		RD0 Relay D OFF
		RD1 Relay D ON

* *DPM MF/R2 only*

Display segment test

A segment test of the display can be implemented by the following sequence of commands in the DPM mode:

DP0	Floating point
BK0	Deactivate analogue input
BO8.8888	Activate all segments
BO88.888	Pass decimal point through all positions
BO888.88	
BO8888.8	
BO88888.	
BR	Reset setting

Remarks :

2 Operating and Configuration Procedures

A DPM which is used without system functions hardly requires any operator intervention.

Configuration

In the course of design work, all function parameters (e.g. "measuring type", "display scaling", "key function", "continuous data output" etc.) are "configured" in the DPM once, as a rule, and stored permanently in the instrument.

Operation

During operation, certain functions (e.g. "Display Hold", "Alarm Reset" or "Print measured value") can be assigned to the instrument's front keys. At the same time programming the instrument by front keys may be inhibited by a code. The instrument can be remote-controlled. This allows interactive switching-over of all parameters via the interface with or without saving these changes in the devices permanent memory.

There are three ways by which configuration can be accomplished:

1. ... via the keys, directly on the instrument

All configuration parameters can be set via the keys. A complete outline of all menus for key operation is provided in section 2.4. Configuration via the keys is designed to allow simple reconfiguration 'on site' as well.

2. ... via the menu mask on the screen of a PC or terminal

This configuration method using a screen menu is the most convenient. A PC or an RS-232 terminal connected to the instrument serves as the input/output device. The menu mask (see section 2.2) informs in a clear and concise way about all the settings and how to use the menu. It is easy to review all functions at a glance and to select them.

3. ... via the serial interface (remote control function)

All configuration parameters can be changed and programmed by means of short serial commands in the DPM mode (see section 2.5).
This method is particularly recommended for automatic systems where the option to dynamically change parameters of the device during operation is required.

2.1 Operation

2.1.1 Display and keys

Keys

During normal service, pressing a key activates the function allocated to that specific key (e.g. output of a measured value via the serial interface to a printer; change-over to "display hold", or one of the other functions described in section 3.5).
All device parameters can be set via the keys (key programming, see section 2.3). The keys are numbered for easier identification only.

Display

5-digit, seven-segment display / 3 brightness levels / blank (off). It is possible to select, by configuring, the continuous indication of the actual measured value, the serial or analogue input value, the hold, min. and max. value, as well as "alteration/min". Section 3.4 describes the appropriate adjustment. Refer also to data flowchart, section 3.2.

Triangular LED indicators

When activated, they indicate the trend. See section 3.4.

Panel indicators

AL 1 AL 2 AL 3 AL 4

are lit as long as the appropriate alarm is active. Can be switched off together with the display; otherwise they are lit at full brightness.

Spec Spec is lit when anything other than the actual measured, hold, min. or max. value appears in the display (e.g. when the "serial" or the "analogue" input values or trend values are indicated).

Hold Hold is lit as long as the "hold value" appears in the display, or when a constant is to be entered in the course of key programming.

DLrun DLrun is lit as long as the "run" status is active for datalogging.

Min Max Min Max are lit as long as the minimum or the maximum value appears in the display.

2.1.2 Switch-on behaviour

To switch on the DPM..MF, apply the supply voltage. The display remains dark for approx. 3 seconds (internal tests); then the indication [_ _ _ _ _] appears for just a second. In this time the device adjusts it's internal calibration factors. To change the type of measurement or the range, proceed as per section 3.1. Section 5 gives an example.

Malfunction signal

If a malfunction signal [E=01] appears for about 3 seconds after the instrument has been switched on, this means that the configuration parameters of the DPM have not been saved correctly, so that the unit uses the parameters preset in the factory (for INIT parameters, refer to section 3.16).

Cause: This may be due e.g. to the fact that the supply voltage has been switched off during saving (at the end of the configuration stage).

Remedy: Re-configure the DPM as desired, and save the parameters (Keys: [END] ; menu mask: [S] ; DPM mode: "SA").

Error message

Any different message initiated by [E=xx] means that the internal test of the DPM has indicated hardware errors in the unit which cannot be eliminated directly. The unit is defective and cannot be operated. In this case the instrument should be forewarded to an ITT representative for authorized repair, stating the error number.

[9 9 9 9 9] flashes in the display: overflow of analogue input

The injected analogue measuring signal is too high for the selected range. On temperature measurement this also indicates a cable break.

Remedy: Check measuring signal or select different measuring range. See section 3.1.

[" " " " "] flashes in the display: overflow display range

The measurement by the DPM is probably correct, but the measuring result cannot be displayed on the five-digit display. This occurs when the number of figures in a fixed point value is too high on the left side of the decimal point. As the DPM operates normally, except for the display output, the measuring signal may be interrogated via the serial interface. See section 3.3.

2.1.3 Min./Max. Value, Hold Display/Memory

The DPM has three specific memories for measured values:

Memory/Hold value	Min. value	Max. value

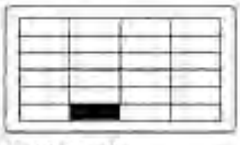
After the DPM has been switched on, the min. and the max. values are reset and are updated continuously by the latest measured value (even if the display is switched off, or if it is set to the status "Display Hold"). Resetting of the min./max. values is possible either by key actuation, by the Ctrl Input Pin (Strobe), via the interface or, in the datalogging mode, automatically any time after the values have been stored in the datalogging memory.

Display Hold means to "freeze" the instantaneous value indicated in the display. At the same time the "Hold" value is saved in an internal memory/hold buffer of the DPM. This value remains stored even after the display has been enabled again.

Display Hold can be triggered by:

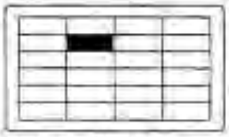
- Actuation of one of the keys, if allocated to that function.
- Activation of one of the functions Fct 1 to Fct 4, if allocated to that function (both steps are described in section 3.5);
- Strobe applied to the Ctrl Input Pin, if allocated to that function;
- Command via the serial interface;
- Actuation of the keys in the Set/Reset menu on the setting level.

Setting Display Hold and Hold Memory

Keys:	Menu mask:	DPM mode:
Set ... S.Hold Switches display over to Hold Set ... rESEt ... r.Hold Resets display Hold	 Hold Display „on" „off"	H Hold Display temporarily ON HR Hold Display temporarily OFF

Statistics Reset

These operations serve to reset the min. and max. value memories. Moreover the front keys (see section 3.5) and the Ctrl Input Pin (see section 3.6) can be programmed to operate as the reset function.

Keys	Menu mask:	DPM mode:
Set ... rESEt ... R.StAt	 Statistic / Values Reset	SR Statistics Reset

Recalling Min./Max./Hold/Memory values

Keys:	Menu mask:	DPM mode:
Set ... dISP d.Lo Min. value; d.HI Max. value; d.Hold Hold / Memory Indicates value in the display until key actuation	 Statistic / Values Hold / Memory Min / Max	MP Recall max. value MV Recall min. value MH Recall hold/memory value

One of these values may be displayed continuously, too. See section 3.3.

2.1.4 Trend indication and trend value

The triangular LEDs on the display can be used for trend indication, according to section 3.3.

The trend value can also be displayed as numerical value in each type of measurement. The adjustment is described in section 3.4 "display function"; an overview gives the flowchart in section 3.2. The display value corresponds approximately to the alteration per minute of the input value. The displayed resolution selected should not be higher than the presetted resolution used for the actual type of measurement. Apart from that, due to the steady internal offset corrections and the rather coarse time pattern, the trend indication only has limited accuracy.

2.1.5 Internal time base

An internal time base, which can be interpreted as a clock and may be set to the time of day is made available in the DPM. This time information is used by the datalogging function.

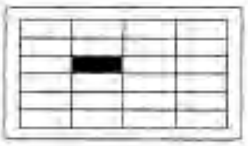
Each time the unit is switched on, time count starts with 00:00:00. To set the clock to the time of day, key actuation or the RS-232 interface can be used. The time information can be interrogated via the serial interface. The internal time base only has limited accuracy.

hh:mm:ss hh = hours mm = minutes ss = seconds

Keys:	Menu mask:	DPM mode:
Set ... s.time ... hh.ss	 Time base Set time	U Read clock USxx Set hours UMxx Set minutes (After setting, the seconds are set to 00)

2.1.6 Automatic Taring

The display value can be reset to zero by key actuation, via an electrical signal at the Ctrl Input Pin or an serial interface command. This results in an alteration of the scaling offset as described in section 3.2.1 (toggle).
The steps for appropriate programming of the keys and/or the Ctrl Input Pin are described in sections 3.5 and 3.6.

Keys:	Menu mask:	DPM mode:
See text	 Display Scaling Tare	BA Automatic taring

2.2 Operation of the Serial Interfaces

2.2.1 RS-232C / Interrogation of Data

The RS-232 interface can be used in three ways:
1. Configuration and remote control of the DPM;
2. Output of measuring values (see section 3.10.3);
3. Entry of measuring values (see section 3.11).

Configuration and remote control

The mask menu has been provided for manual configuration; the DPM mode, which features short ASCII string commands, is intended for automatic systems where the option of remote control is required.

→ Menu mask, refer to section 2.4.
→ DPM mode, refer to section 2.5.

Output of individual data via the serial interface

The DPM's internal values, i.e. "Actual Measured Value", "Min. Value", "Max. Value", "Hold/Memory Value", "Serial Input" and "Analogue Input" can be called individually from the menu mask, or by means of commands in the DPM mode. The serial interface offers in any case the full resolution in the floating point format with all decimal places.

Moreover, these values can be called by:

- Actuation of one of the front keys (see section 3.5);
- Activation of one of the functions Fct. 1 to Fct. 4 (see section 3.5);
- Strobe applied to the Ctrl Input Pin, if allocated to that function (see section 3.5).

Keys:	Menu mask	DPM mode:
Set · · trans t.Hold Hold /Memory value t.Hi Max.value t.lo Min.value	 Statistics / values	M Actual measured value MH Hold/Memory value MV Min. value MP Max. value MA Analogue input MS Serial-Input MD Display value } inter-rogate

2.2.2 RS-485 / Protocol

Up to 32 units can be connected to a three-wire bus line by means of the RS-485 standard (see section 1.6). In that case a central control station (called master, e.g. PC) must be provided to control operation via device addresses. This section describes the rules of data interchange (the protocol) as well as the tasks of the master station.

Terms

Master: The only station connected to the bus which controls the entire data interchange.

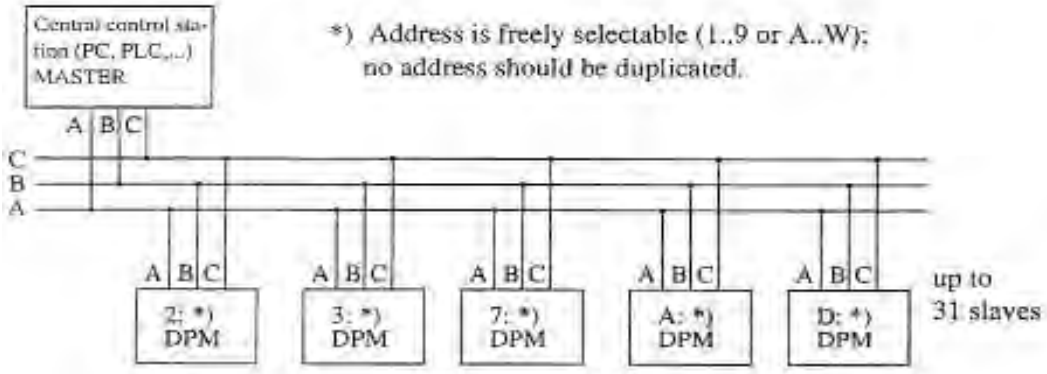
Slave: One or several DPMs controlled by the master which are permitted to transmit data via the bus line only on request.

RS-485 interface: Physical connection between each station and the bus lines, which enables either "listening" or "talking" of the station. The master ensures that only one station on the bus is permitted to "talk" at a time.

Command: Serial instruction transmitted to a DPM; comprises all DPM commands except for 'LL' and all types of 'Z'; moreover 'W' for "repeat" and '?' for polling, discussed in the following section. Each command is terminated by a return character (ASCII CR=0DH).

Telegram: Is transmitted via the bus; comprises an address and an command (example: "2:DH4").

Address: Comprises an ASCII character from the set "1...9" and "A...W", followed by a colon ":" (Hex: 3A). See section 3.10.1.

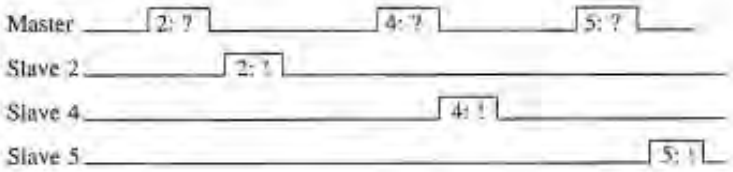


Basic state

All units connected to the bus (slaves) "listen" to check if telegrams begin with their device address. Telegrams with their own device address are interpreted and the command they contain is executed without delay, other telegrams are ignored.

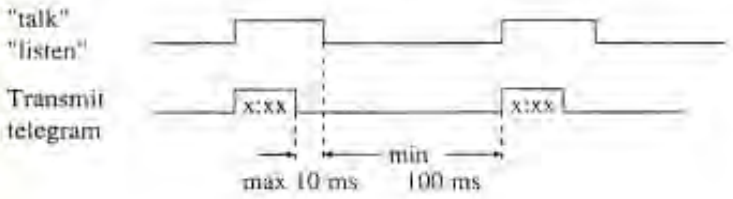
Slaves cannot transmit on their own initiative
Master can poll the slaves with "?"

Every slave must wait for the master to request it to transmit. With the command '?' (telegram 'x:?'), the master can request a slave to reply. If this specific slave has data to be transmitted (e.g. measured value or alarm status), it replies by transmitting this data. If it has no data to be transmitted, it replies '!' (status: ready for operation); i.e. it replies in any case. The master can use the command '?' to poll - i.e. to address - all slaves at regular intervals. This way it recalls any available data and checks the operating state of the slaves within the system. As every slave is bound to reply, the master can recognize a switched-off or defective slave. To detect a slave connected anew, the master requests its address ('x:?') and the slave replies for the first time ('x:!').



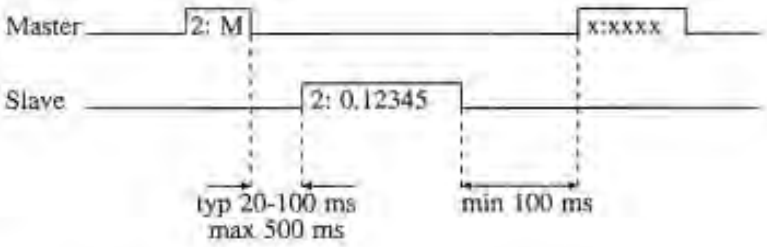
Transmission by the master

The master may transmit telegrams on its own initiative; to this effect its bus interface is switched over briefly to "talk" and then immediately back to "listen" (this action must be programmed in the master; refer also to RS-485 standard).



The slave's response

The master uses certain commands (e.g. telegram '2:M') to request a slave to reply with some measured value. In this case the slave's interface is switched over (automatically and internally) to "talk", and the response is transmitted. The slave takes a maximum of 500 ms to start its reply.



Master can check the correct transmission by "W"

This protocol does not provide for an automatic receive check in the simple mode. If necessary, the master can use the command "W" to request a slave to indicate the last telegram it has understood and processed. The master can verify and, if necessary, take corrective action (e.g. repeat the telegram).

Connection of a station

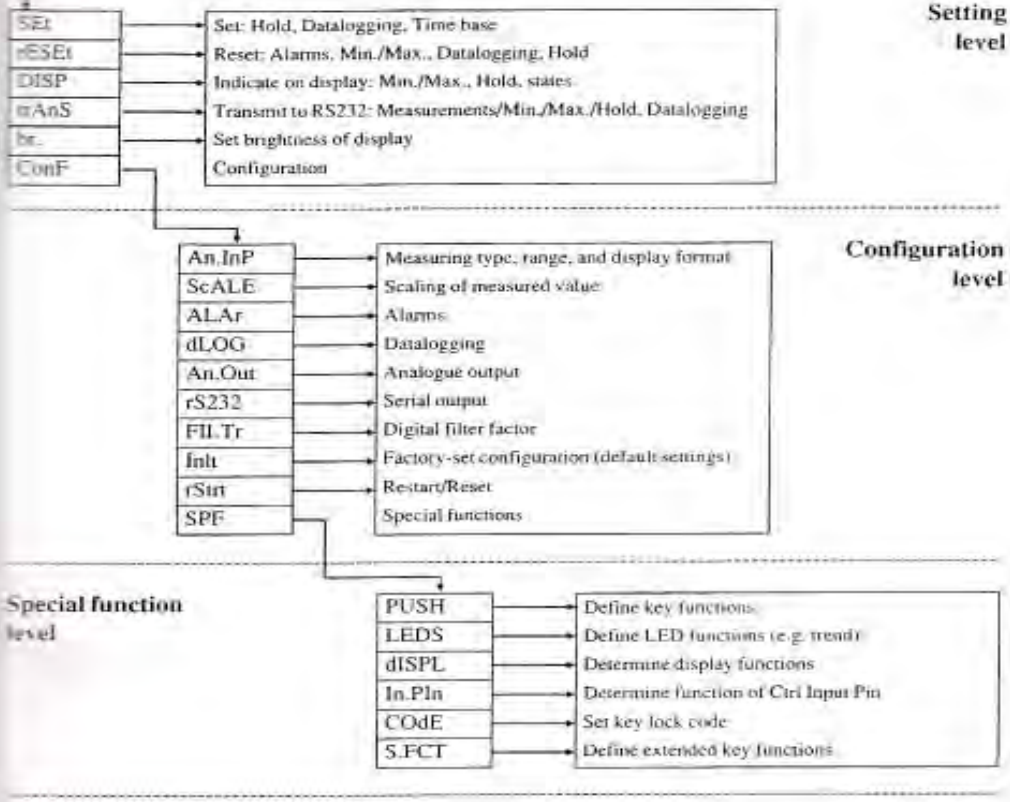
Possibly, connection of a station to an active bus will cause some disturbance. So it may be necessary in systems which provide for connection of stations that the master checks some or all telegrams for correct reception.

Error handling

The protocol does not comprise any automatic error handling procedure. So telegrams recognized to be faulty are discarded without any response (especially without any reply).

2.3 Configuration via the keys

The two front keys on the DPM..MF can be used to configure all the instrument parameters. Assisted by the text appearing in the display, the operator is guided through menus in which he may select and enter the desired settings. If necessary, he will have to pass through submenus, to get to the desired parameters. The parameters are subdivided into three function levels:



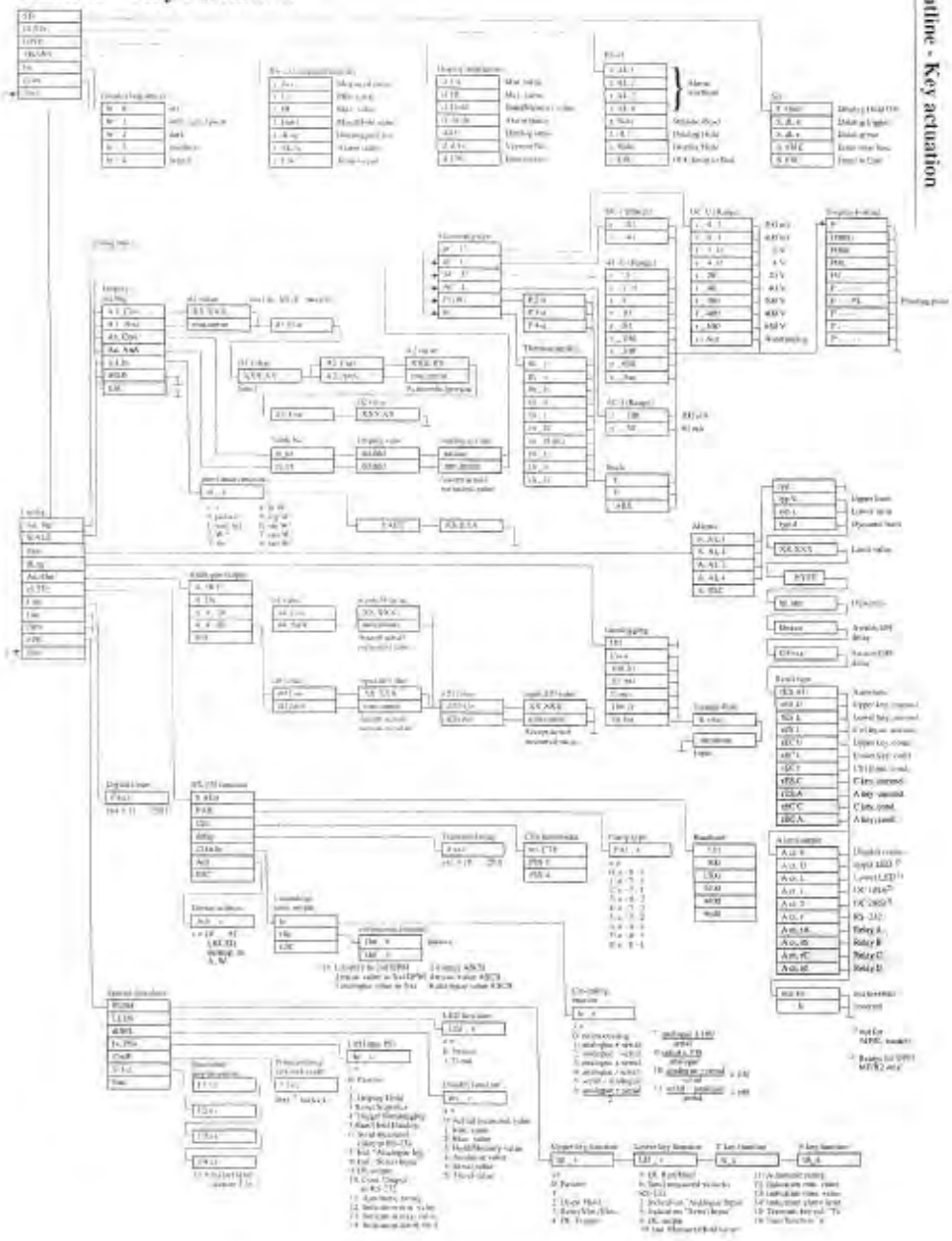
Note:

If no key is pushed for more than 1 minute, the instrument switches back into the measurement mode.

Outline - Key Operation

Open poster, please

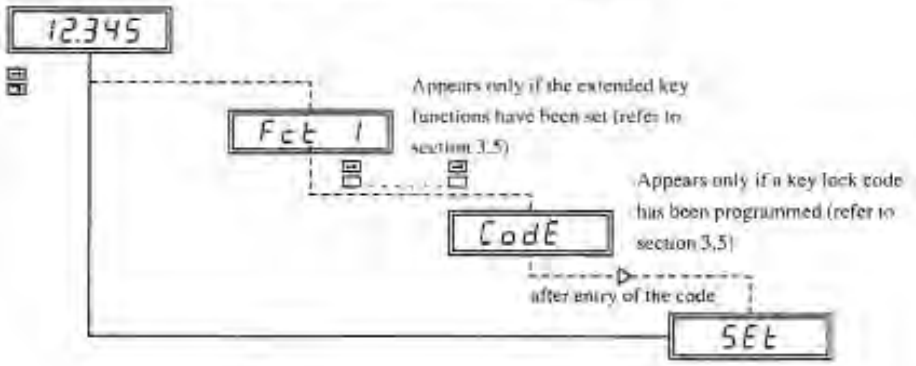
Outline - Key actuation



Starting configuration via the keys

To start key configuration, press both keys simultaneously for approx. 3 seconds.

Generally the first menu item to be displayed is Set .

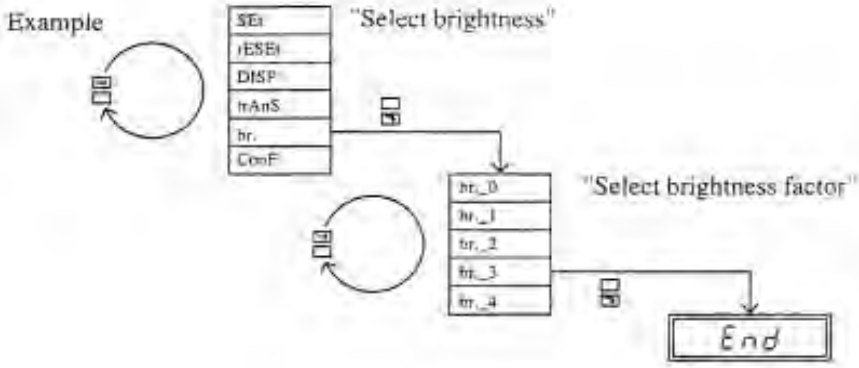


Paging through the menu

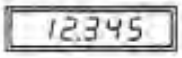
Press upper key briefly to select the next menu item within a group.

Selection of a menu item

Press lower key briefly to select the corresponding submenu.



Entry of numbers



Some menu items require entry of numerical characters:

The digits are entered successively in order at the location concerned; the actual location flashes. Finally the decimal point position can be set.

- By means of the upper key the actual value can be incremented cyclically from 0 to 9, until the desired digit is achieved.
- By means of the lower key a jump is carried out to the next location, which flashes now.

The decimal point will flash as soon as this input cycle is finished. It is shifted by means of the upper key, until it is in the desired position. Subsequently entry is finished using the lower key.

- In order to correct any input error, push the C key (Clear), or push the upper key for 3 seconds. This way the input cycle is repeated from the start, and entry recommences with the digit in the first location.
- In order to accept a **number** which appears correctly, entry may be skipped; to do so, push the A key (Accept), or push the lower key for 3 seconds.

Finish entry

terminates entry

If "PPPPP" is displayed, this means that the parameters are stored permanently in the DPM..MF. In this case the preset adjustment will apply even after the unit has been switched off.

Abort entry

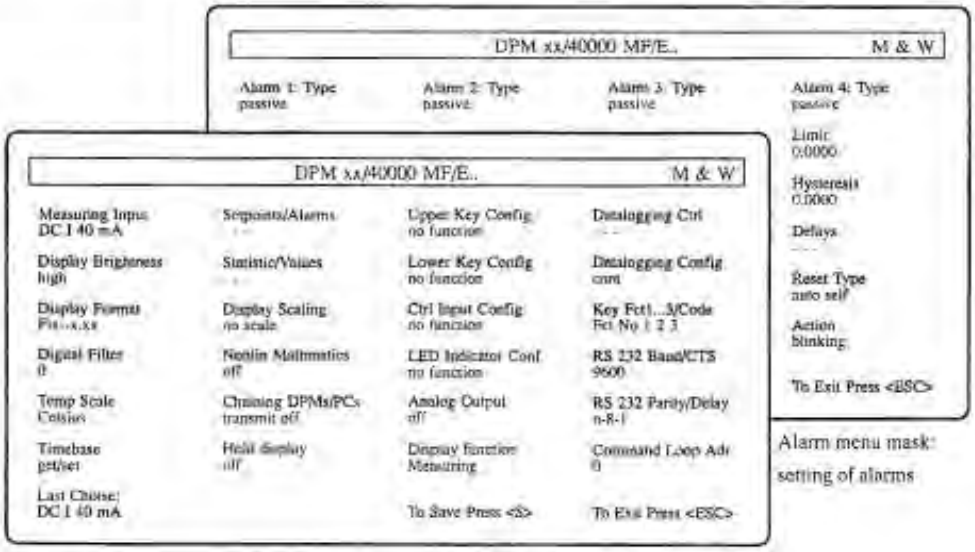
- Press both keys simultaneously for 3 seconds to abort entry.
  In this case the parameters which have been set up to that moment are **not** stored permanently and remain effective only as long as the instrument is connected to the power supply, i.e. as long as it is switched on. After switching off, the parameters are not valid any longer.

2.4 Configuration via the menu mask

Manual configuration is possible by means of a screen menu mask, if the DPM's serial interface is connected to a terminal or a PC. For connection of the DPM, please refer to section 1.6. A progam emulating an RS-232 terminal must be started at the PC, i.e. which writes all the characters transmitted by the DPM, on the screen and which passes all entries via the PC keyboard to the DPM. This may be achieved by various commercially available programs (e.g. PROCOMM by PIL Software Systems), or the program "PC-DPM" available from ITT Instruments.
Refer also to section 5.4.

Operation: To call the operator menu mask, press [Y] <return> [↵]

Using this command, the DPM creates a mask in which all the available parameter settings are indicated in plain text. To change the DPM..MF parameters, simply pass through the available options for setting by keyboard actuation.



Alarm menu mask: setting of alarms

Menu mask: setting of parameters

Operator control:

[↑][→][↓][←]	Select entry block
[Space bar]	Select options (paging forward)
[B]	Select options (paging backward)
[↵]	Set selected option (temporarily)
[S]	Memory command (save parameter permanently in the DPM)
[ESC]	Exit mask; DPM will enter into the DPM mode

The desired block (marked by a bright background) within the mask is selected by means of the arrow keys.
Paging through the options is possible using the space bar or the key "B"
To accept an option, actuate the Enter/Return key.
For some options additional entries might be required at the bottom of the screen.
Outputs, if any, will appear at the bottom of the screen.

2.5 Configuration via serial interface

When the DPM mode is selected, short commands from a control unit connected to the serial interface (PC or PLC or similar device) permit, among other things:

- remote control of all operating and special functions of the DPM;
- interrogation and acknowledgement of alarms, and dynamic alteration of alarm limits;
- scaling of any range by operator, remote-controlled;
- remote control of variable measuring programs;
- recalling measured values, statistics values, datalogging values;
- writing numbers transferred via the RS-232, on the DPM display;
- reconfiguration of the DPM during operation.

Connection:

The serial interface of the DPM..MF must be connected to the control unit as described in section 1.6.

Control of data flow:

No data flow control is necessary for configuration of the DPM..MF in the DPM mode, or for remote control. After each command the transmitter has to wait for the DPM's reply of CRLF (ASCII 0DH,0AH), before the next command is permitted to be sent. On the other hand, handshake may be necessary if the DPM..MF frequently sends data to a slow receiver via its interface. Hardware handshake at the DPM..MF can be effected by selection of a "CTS" line, or the data flow can be reduced by activation of short intervals between the blocks of data to be transmitted (Transmit Delay, refer to 3.10).

Input buffer:

The DPM..MF is equipped with an input buffer (capacity: up to 15 characters) intended for data which is sent to the DPM..MF, so that at least one complete command can be received at a time by the DPM, without any timing problems.

Echo (transmission feedback) for received data:

The DPM sends a repetition of each character received, as soon as the latter is recognized in the DPM. This way the host computer can check the correct reception in the DPM (incl. perfect operation of the DPM), as well as the entire communication line.

Format:

Each command must be terminated by a "Return" character (ASCII CR=0DH). The Return character is supplemented in the DPM by the line feed character (ASCII LF=0AH); both characters (CRLF) are retransmitted by the DPM (possibly after a time delay) only after execution of the command has been finished. As the input buffer is now free, the next command can be sent to the DPM without delay. If the DPM reacts by "?", this indicates that the command could not be interpreted by the instrument.

2.5.1 Command format / Example:

Each DPM command consists of a compact sequence of ASCII characters without blanks and commas. The command is finished by a Return character (ASCII CR=0DH); lower-case letters are accepted as well as upper-case letters.

Examples:	MD <Return>	"fetches" the indicated measuring value
	DH 2 <Return>	sets display brightness degree to "dark"
	FS10 <Return>	sets digital filter factor to "10"
	BK1000 <Return>	sets a multiplication factor of "1000"; causes e.g. indication of millivolts instead of volts.

Each DPM command comprises one or two letters or numerical characters which specify the type of instruction. Each command is followed by a number with or without decimal point (depending on the instruction).

This number may be integer (without decimal point) as well as real (with decimal point). It may include a sign '+' or '-'. For the decimal point, the character '.' (Hex 2E) must be used without fail.

Example:	Valid commands:	'BO1'	'BO-10.5'	'BK-0.998'	'BK1000'
		'1W5'	'2W-1500'	'2H0.005'	'A2-15.12'
	Invalid:	'BO-10,5'	(comma instead of point)		
		'BK -0.998'	(blank between 'K' and '-')		

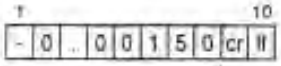
The complete command (incl. end character) must not exceed 15 characters in length.

Attention:

DPM parameters which have been modified in the DPM mode, are valid temporarily (up to the moment the DPM is switched off). They must be saved by the particular DPM command "SA" in order to be permanently available after the DPM has been switched on again.

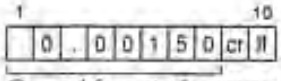
2.5.2 Formats

The general measured data format:



General format of measured values

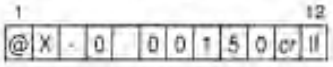
or (with positive numbers):



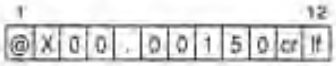
General format of measured values

The output format is in any case: 6 digits, one decimal point and either a sign '-' or a blank instead of a positive sign. The decimal point is placed as far as possible to the left, and it will be preceded by at least one digit (possibly "0").

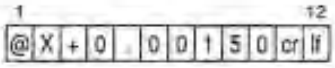
The serial entry format:



or (with positive numbers):

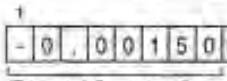
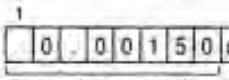
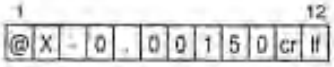
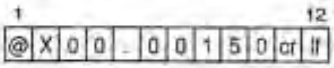


equivalent:



Using this format, values for internal calculation may be entered in the DPM. The above commands apply to the number as such, which does not allow a blank instead of the '+' character.

Formats of data which are transmitted by the DPM without any explicit command:

Action to trigger ...	Data from the DPM
following key actuation, and during continuous output in ASCII format with 'Z2'	 General format of measured values *or (with positive numbers):*  General format of measured values
during continuous output to a second DPM in the format 'Z1'	 *or (with positive numbers):* 
simultaneously the input format for internal chaining of measured values	
Alarm messages	 alarm has become active
only if alarm output is configured in this way	 alarm has become passive

Telegram end character:
cr = ASCII CR (0DH)
lf = ASCII LF (0AH)

DPM commands with reply (see command list, section 2.5.3)

Command to DPM	Feedback from DPM
M cr	M cr lf *Interrogate display value*
This applies in the same way to: MH, MD, MP, MV, MA, MS, MO, MK, MN	- 0 . 0 0 1 5 0 cr lf General format of measured values: *or (with positive numbers):* 0 . 0 0 1 5 0 cr lf General format of measured values:
V cr	V cr lf V 2 1 cr lf
F cr	F cr lf 0 1 2 cr lf
U cr	U cr lf 0 0 : 2 3 : 4 0 cr lf
C O cr	C O cr lf 9 8 6 cr lf
X S cr	X S cr lf P A P P cr lf
L S cr	L S cr lf R - 0 1 6 3 - 0 0 0 1 cr lf
L A cr	L A cr lf - 0 1 6 3 - 0 . 0 0 1 5 0 0 0 : 1 4 : 1 5 cr lf Pointer / Measured value / Time
L M cr	L M cr lf - 1 1 . 0 1 5 0 2 0 0 . 1 0 0 cr lf Min. value / Max. value
L X cr	L X cr lf P A P P cr lf
L L cr	L L cr lf - 0 1 6 3 - 0 . 0 0 1 5 0 0 0 : 1 4 : 1 5 cr lf Pointer / Measured value / Time - 1 1 . 0 1 5 0 2 0 0 . 1 0 0 P A P P cr lf Min. value / Max. value / Status

2.5.3 Command List

Call menu mask

Y	**Call menu mask** (TV905 emulation or PC-DPM)	2.4

Select measuring type

V	Interrogation of measuring type set	
V10	dc-U Volt autoranging	
V11	dc-U 0.2 V-Range	
V12	dc-U 0.4 V-Range	
V13	dc-U 2 V-Range	
V14	dc-U 4 V-Range	
V15	dc-U 20 V-Range	
V16	dc-U 40 V-Range	
V17	dc-U 200 V-Range	
V18	dc-U 400 V-Range	
V19	dc-U 650 V-Range	3.1
V21	dc-I 20 mA-Range	
V22	dc-I 40 mA-Range	3.1
V30	ac-U Volt autoranging	
V31	ac-U 0.5 V-Range	
V32	ac-U 1 V-Range	
V33	ac-U 5 V-Range	
V34	ac-U 10 V-Range	
V35	ac-U 50 V-Range	
V36	ac-U 100 V-Range	
V37	ac-U 500 V-Range	
V38	ac-U 650 V-Range	3.1
V41	ac-I 50 mA-Range	
V42	ac-I 100 mA-Range	3.1
V60	Temperature PT100 2-wire	
V70	Temperature PT100 4-wire	
V80	Temperature PT100 3-wire	3.1
	Thermocouples	
V90	Type R Pt 13 Rh-Pt	
V91	Type S Pt 10 Rh-Pt	
V92	Type B Pt 30 Rh-Pt 6 Rh	
V93	Type J Fe-CuNi	
V94	Type T Cu-CuNi	
V95	Type E NiCr-CuNi	
V96	Type K NiCr-NiAl	
V97	Type L Fe-CuNi	
V98	Type N Nicrosil Nisil	
V99	Type U Cu-CuNi	3.1
GC	Display temperature in °C	
GF	Display temperature in °F	
GA	Display temperature in Kelvin (absolute)	3.9

Save parameters in EEPROM

SA	Save new parameter configuration in EEPROM	2.5.1

Interrogation of measured values

M	Actual measured value	2.2
MD	Display value	
MH	"Hold/Memory" value	
MP	Max. value	
MV	Min. value	
MA	Analogue value	
MS	Serial input value	
MO	Offset value	3.2.1
MK	K value	
MN	n-lin value	
MX	Pointer n to table	
MDn	Display value No. n from table	
MAn	Analogue value No. n from table	3.2

Display

	Display brightness	
DH0	off	
DH1	off, only signal point lighted	
DH2	dark	
DH3	medium	
DH4	bright	3.4
DP1	x.xxxx	**Display format**
DP2	-x.xxx	
DP3	--x.xx	no leading zeros !
DP4	---x.x	
DP5	----x.	
DP0	Floating point	
D0	Activation of leading zeros	3.3
	Display indicates	
AM	Actual measured value	
AH	Hold/Memory value	
AP	Max. value	
AV	Min. value	
AA	Analogue value	
AS	Serial value	
AD	Trend indication (alteration/min)	3.4
H	Display Hold (saves actual measured value in "Hold/Memory")	
HR	Reset Display Hold	2.1.3
	LEDs indicate	
DL0	passive	
DL1	trend	3.4

Analogue output

NA	Activate	
NP	Deactivate	
N0x.x	Indicated value x.x as 0 mA	
N4x.x	Indicated value x.x as 4 mA	
NEx.x	Indicated value x.x as 20 mA	3.12

Scaling / Chaining of measured values

	Set display scaling	
A1x.x	Set 1st analogue value as x.x	
A1A	Set 1st analogue value as measured	
D1x.x	Indicate 1st analogue value as x.x	
A2x.x	Set 2nd analogue value as x.x	
A2A	Set 2nd analogue value as measured	
D2x.x	Indicate 2nd analogue value as x.x	3.2.1
BKx.x	Set slope factor directly	
BOx.x	Set offset factor directly	3.2.1
BD0	Non-linear function is not active	
BD1	Activate user definable linearization	
BD2	x^2	
BD3	$\sqrt{x}$	
BD4	ln x	
BD5	log x	
BD6	sin x	
BD7	cos x	
BD8	tan x	
BNx.x	Set factor n	3.2.3
BR	Reset all scaling factors	
	Offset = 0, k = 1,0	3.2.1
BA	Automatic taring	2.1.4
SXn	Set pointer n to table	3.2.2
SDx.x	Set display value No. n in table	
SAx.x	Set analogue value No. n in table	
SQ	Set actual measured value in table	

Keys / Ctrl Input Pin

Tx0	Passive	x = 1 for upper key 1
Tx2	Display Hold	x = 2 for second key 2
Tx3	Reset Min./Max.	x = 3 for C, key 3
Tx4	Trigger Datalogging	x = 4 for A, key 4
Tx5	Datalogging run/hold	
Tx6	Transmit value to RS232	
Tx7	Indication "Analogue Input"	
Tx8	Indication "Serial Input"	
Tx9	DL output	
Tx10	Indication "Mem/Hold"	
Tx11	Automatic taring	
Tx12	Indication "Min. value"	
Tx13	Indication "Max. value"	
Tx14	Indication "Alarm limit" (level x)	
Tx15	Transmit key number 'Tn'	
Tx16	Start Fct 'n'	3.5
	Funktion, Crtl Input	
TC0	Passive	
TC2	Display "Hold"	
TC3	Reset Statistics	
TC4	Trigger Datalogging	
TC5	Datalogging run/hold	
TC6	Transmit measured value to RS232	
TC7	Indication "Analogue input"	
TC8	Indication "Serial input"	
TC9	DL output	
TC10	Continuous outp. of measured val. via RS-232	
TC11	Automatic taring	
TC12	Indication "Min. value"	
TC13	Indication "Max. value"	
TC14	Indication "Alarm limit"	3.6

Alarms

XS	**Alarm status** Response:: xxxx with x = (A,P) A = active, P = passive Alarms 1...4	3.7
XQ	Acknowledge all alarms	
vQ	Acknowledge alarms separately	3.7
	Activate type v = (1..4) alarms	
vT0	passive	
vT1	Upper limit (OG)	
vT2	Lower limit	
vT3	Dynamic limit (DG)	
vWx.x	Set alarm value to x.x	
vHx.x	Set hysteresis to x.x	3.7
	Set acknowledgement mode	
vR0	Automatic	
vR1	Upper key, unconditional	
vR2	Lower key, unconditional	
vR3	Ctrl Input, unconditional	
vR4	Upper key, conditional	
vR5	Lower key, conditional	
vR6	Ctrl Input, conditional	
vR7	Key C, unconditional	
vR8	Key A, unconditional	
vR9	Key C, conditional	
vR10	Key A, conditional	3.7
	Alarm output	
vA0	Flashing display	
vA1	Upper LED } not with the /E.. models	
vA2	Lower LED } not with the /E.. models	
vA3	OC1 active, low	
vA4	OC2 active, low	
vA5	Serial interface (A,P)	
vA6	Relay A	
vA7	Relay B	
vA8	Relay C	
vA9	Relay D	
vA10	OC1, inverse	
vA11	OC2, inverse	
vA12	Relay A, inverse	
vA13	Relay B, inverse	
vA14	Relay C, inverse	
vA15	Relay D, inverse	3.7
vZn	ON delay n x 0.5 sec.	
vYn	OFF delay n x 0.5 sec.	3.7

Min., Max. values / Filters

SR	Statistics Reset (min./max. values)	2.1.3
F	Interrogation, act. digital filter value	
FSxxx	Set digital filter (xxx = 0...250)	3.8

Extended key functions

W1xx	Set key function 1	*refer to table section 3.5*
W2xx	Set key function 2	
W3xx	Set key function 3	
W4xx	Set key function 4	

Interface / Continuous output

	Baudrate		
R0	9600 baud	becomes effective after Reset of DPM	
R1	4800 baud		
R2	2400 baud		
R3	1200 baud		
R4	300 baud		
R5	110 baud		3.10
	Parity / Data / Stop bits		
P0	n-8-1	n = noparity e = even parity o = odd parity 7/8 = data bits 1/2 = stop bits becomes effective after Reset of DPM	
P1	o-7-1		
P2	e-7-1		
P3	n-8-2		
P4	o-7-2		
P5	e-7-2		
P6	n-8-1		
P7	o-8-1		
P8	e-8-1		3.10
	CTS		
CC0	No CTS	becomes effective after Reset of DPM	
CC4	RxD (pin 4) for CTS		
CC8	Ctrl Input (pin 8) for CTS		3.10
TDxxx	Transmit Delay xxx = [1..250]		3.10
	Continuous serial output		
Z0	No continuous output		
Z1	Display value to 2nd DPM		
Z2	Display value ASCII		
Z3	Measuring value to 2nd DPM		
Z4	Measuring value ASCII		
Z5	Analogue value to 2nd DPM		
Z6	Analogue value ASCII		3.10/3.11
Ex	Assign device address x of DPM x = [0..9] / [A..W] (E0 means: no address)		3.10
@Xx.x	Input format of serial interface for value x.x		3.11

Cascading

	Processing of measured values received serially	
@D0	no computation	
@D1	analogue + serial	
@D2	analogue - serial	
@D3	analogue x serial	
@D4	analogue / serial	
@D5	serial / analogue	
@D6	$\frac{\text{analogue + serial}}{2}$	
@D7	$\frac{\text{analogue x 100}}{\text{serial}}$	
@D8	$\frac{\text{serial x 100}}{\text{analogue}}$	
@D10	$\frac{\text{analogue - serial}}{\text{serial}}$ x 100	
@D11	$\frac{\text{serial - analogue}}{\text{analogue}}$ x 100	3.11

Datalogging

LCD	Continuous	
LVD	Pretrigger 20/160	
LND	Posttrigger 160/20	
LCR	Continuous with Reset	
LVR	Pretrigger 20/160 with Reset	
LNR	Posttrigger 160/20 with Reset	
LWxxx	Set sample rate	
LS	Status call and memory occupancy	
LR	Set Run	
LH	Set Hold	
LT	Trigger Datalogging	
LP	Stop Datalogging	3.13
	Datalogging output	
LL	List call (not in system mode)	
LZxxx	Set pointer to xxx	
L+	Pointer +1	
L–	Pointer –1	3.13
	Data call (according to pointer)	
LA	No., measured value, time	
LM	Min./ max. value	
LX	Alarm status	3.13

Other functions

U	**Interrogation of relative time base of DPM**	
USxxx	Set hours xx = [0...23]	
UMxxx	Set minutes xx = [0...59]	2.1.4
CO	Key lock code interrogation	
CSxxx	Set key lock code to xxx	3.5
	For relay test	
C10	OC1 off	
C11	OC1 on	
C20	OC2 off	
C21	OC2 on	
RA0	Relay A off	
RA1	Relay A on	
RB0	Relay B off	
RB1	Relay B on	
RC0	Relay C off	
RC1	Relay C on	
RD0	Relay D off	
RD1	Relay D on	1.9
	System mode of RS-485	
?	Instrument polling	
W	Repeat preceding command	2.2.2

3 The DPM Device Parameters

The configuration parameters set in the DPM..MF determine the instrument's method of operation.

As a rule, these parameters are defined in the course of design work and "laid down" permanently in the instrument's internal EEPROM. So the selected configuration becomes effective any time the instrument is switched on.

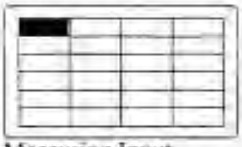
This chapter describes the following possibilities of configuration:

- **Setting of the measuring type:**
  Sensor type, range, temperature scale, display format (section 3.1)
- **Scaling of the measured value:**
  Linear and non-linear scaling; user definable linearization (section 3.2)
- **Display format and display functions:**
  Position of decimal point, display brightness, value indicated in the display, LEDs (sections 3.3 and 3.4)
- **Key function and Ctrl Input Pin:**
  Definition of the action triggered by key actuation and strobe signal (section 3.5 and 3.6)
- **Alarms:**
  Type, value, hysteresis, Reset, output action, acknowledgement, state (section 3.7)
- **Digital filter and temperature scale:**
  Settings (sections 3.8 and 3.9)
- **Serial interface:**
  Baud rate/CTS etc., data output, loop operation of several DPMs (section 3.10)
- **Cascading:**
  Several DPMs process their measured values by common computation (section 3.11)
- **Analogue output:**
  Independent scaling of the display value (section 3.12)
- **Datalogging:**
  Operating modes, table of values, settings/service (section 3.13)
- **Init, Restart and factory-set configuration:**
  Default setting and resetting of the instrument (section 3.14)

3.1 Setting of the measuring type

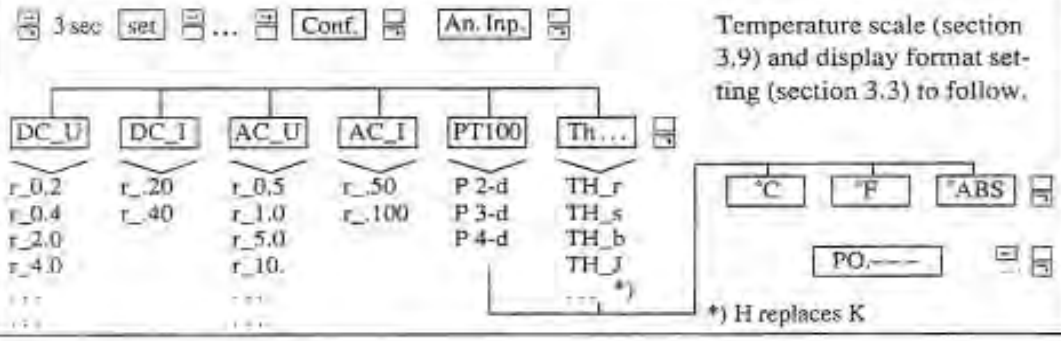
When the measuring connections have been established as described in section 1.4, the desired measuring type and the range are set via the front keys, the menu mask on the PC screen, or via the serial interface using a remote-controlled DPM command. The decimal point is preset as required by the resolution; it may be shifted however as per section 3.3. When the measuring type is selected, this will reset any prior display scaling.

Menu-mask:



Measuring Input

Keys:



Temperature scale (section 3.9) and display format setting (section 3.3) to follow.

*) H replaces K

DPM-mode:

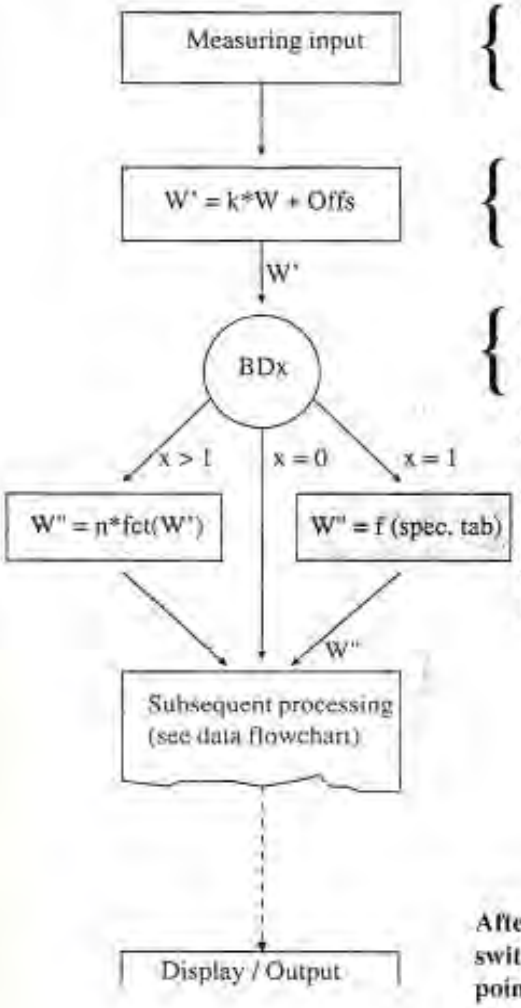
V	Interrogation of actual measuring input type
V10	dc-U Volt autoranging
V11	dc-U 0,2 V-Range
V12	dc-U 0,4 V-Range
V13	dc-U 2 V-Range
V14	dc-U 4 V-Range
V15	dc-U 20 V-Range
V16	dc-U 40 V-Range
V17	dc-U 200 V-Range
V18	dc-U 400 V-Range
V19	dc-U 650 V-Range
V30	ac-U Volt autoranging
V31	ac-U 0,5 V-Range
V32	ac-U 1 V-Range
V33	ac-U 5 V-Range
V34	ac-U 10 V-Range
V35	ac-U 50 V-Range
V36	ac-U 100 V-Range
V37	ac-U 500 V-Range
V38	ac-U 650 V-Range
V21	dc-I 20 mA-Range
V22	dc-I 40 mA-Range
V41	ac-I 50 mA-Range
V42	ac-I 100 mA-Range
V60	Temperature PT100 2-wire
V70	Temperature PT100 4-wire
V80	Temperature PT100 3-wire
V90	TypR Pt 13 Rh-Pt
V91	TypS Pt 10 Rh-Pt
V92	TypB Pt 30 Rh-Pt 6 Rh
V93	TypJ Fe-CuNi
V94	TypT Cu-CuNi
V95	TypE NiCr-CuNi
V96	TypK NiCr-NiAl
V97	TypL Fe-CuNi
V98	TypN Nicrosil Nisil
V99	TypU Cu-CuNi
GC	Display temperature in °C
GF	Display temperature in °F
GA	Display temp. in Kelvin (absolute)

3.2 Scaling of the measured value

Mathematical conversion of the measured value

There are many ways to process the measured value mathematically in the DPM..MF. Apart from a wide range of linear processing possibilities (e.g. offset, scaling up or down the measuring range in the display), the measured value can also be computed with non-linear functions (sin, cos, tan, ln, log, $\sqrt{x}$, x^2).

In the case of the DPM...MF/E versions, the user can enter a specific linearization characteristic of his own which comprises up to 25 analogue/display points.



Measurement of the physical value W (in the case of temperature measurement this will already include linearization)

A linear formula computes the scaled value W' (see section "3.2.1 Linear scaling").

The DPM command 'BDx' selects the operating mode ...

- (x = 0) no linearization
- (x = 1) the user defined characteristic (refer to section "3.2.2 User definable linearization")
- (x > 1) one of the "built-in" non-linear functions (refer to section "3.2.3 Non-linear functions").

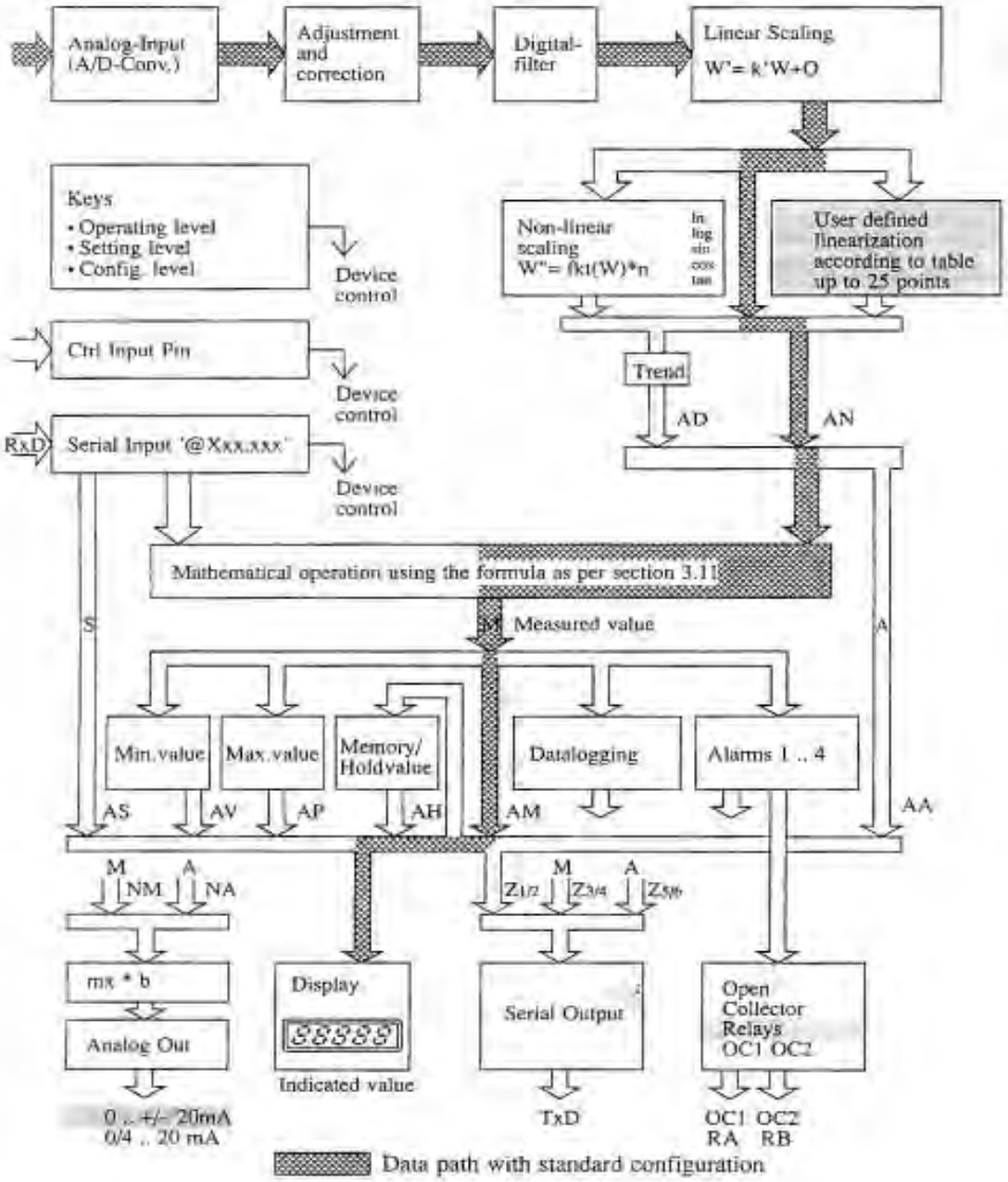
fct (W'): x=

Attention:

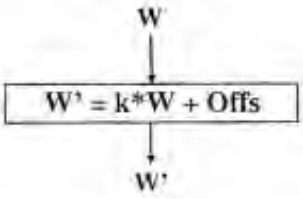
(2) x^2
(3) $\sqrt{x}$
(4) ln x
(5) log x
(6) sin x
(7) cos x
(8) tan x

After scaling, the display format is automatically switched to "Floating Point". Therefore a fixed point which is appropriate for the scaling, must also be selected, if required. In this context, please refer to section 3.3.

Data flow


Analog-Input (A/D-Conv.)
Adjustment and correction
Digital-filter
Linear Scaling
W'= k'W+O
Keys
• Operating level
• Setting level
• Config. level
Device control
Ctrl Input Pin
Device control
RxD
Serial Input '@Xxx.xxx'
Device control
Non-linear scaling
W"= f(x)(W)*n
ln log sin cos tan
User defined linearization according to table up to 25 points
Trend
AD
AN
Mathematical operation using the formula as per section 3.11
S
M Measured value
A
Min.value
Max.value
Memory/ Holdvalue
Datalogging
Alarms 1 .. 4
AS
AV
AP
AH
AM
AA
M
A
NM
NA
Z1/2
Z3/4
Z5/6
mx * b
Analog Out
0 .. +/- 20mA
0/4 .. 20 mA
Display
Indicated value
Serial Output
TxD
Open Collector Relays OC1 OC2
OC1 OC2
RA RB
Data path with standard configuration

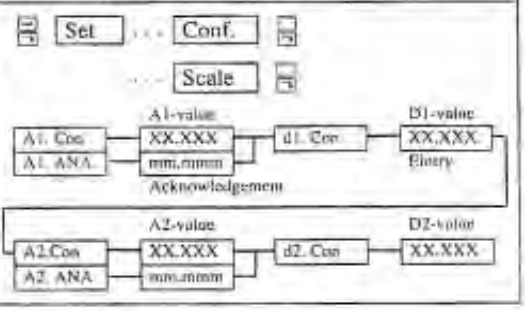
3.2.1 Linear scaling



Direct entry of the slope "k" and of the offset "offs"

Both factors (real numbers) can be entered directly via the serial interface in the DPM mode. Example: When k=0 is selected, the measured value W can be disconnected in mathematic terms, and the offset can be directly displayed as a constant.

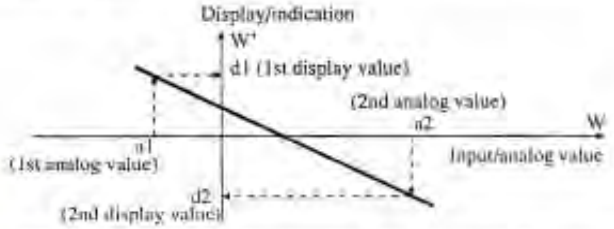
DPM-mode:		Keys:[1] (not for ../E models)
BKx.x	Set slope factor directly	
BOx.x	Set offset factor directly	
BR	Reset all scaling factors Offset = 0, k = 1,0	
BA	Automatic taring (reset to zero). (Sets offset value so that zero appears in the display)	
MK	Interrogate slope factor	
MO	Interrogate offset	



Entry of two analogue/display points to define the scaling straight line

Based on the entry of the analogue value 'a1' to indicate the display value 'd1', and of a second analogue value 'a2' to indicate the display value 'd2', the DPM effects automatically the internal calculation of the factors 'k' and 'Offs'.

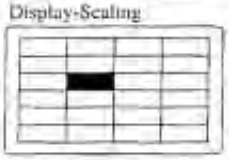
The two pairs of points a1/d1 and a2/d2 can be entered in the DPM mode and in the menu mask. With the E models, the user defined linearization can be set instead via the front keys, which has the same result.



[1] **Warning when setting linear scaling by keys**

Using the stated procedure sets the entered values for linear scaling. However, do not repeat the procedure to 'check' settings as this may modify the d2-value if d1-value is not zero. If required, the settings can be confirmed checked in the MENU MASK mode.

DPM-mode:		Menu-mask:
	Set display scaling	Display-Scaling
A1x.x	Set 1st analogue value as x.x	
A1A	Set 1st analogue value as measured	
D1x.x	Indicate 1st analogue value as x.x	
A2x.x	Set 2nd analogue value as x.x	
A2A	Set 2nd analogue value as measured	
D2x.x	Indicate 2nd analogue value as x.x	

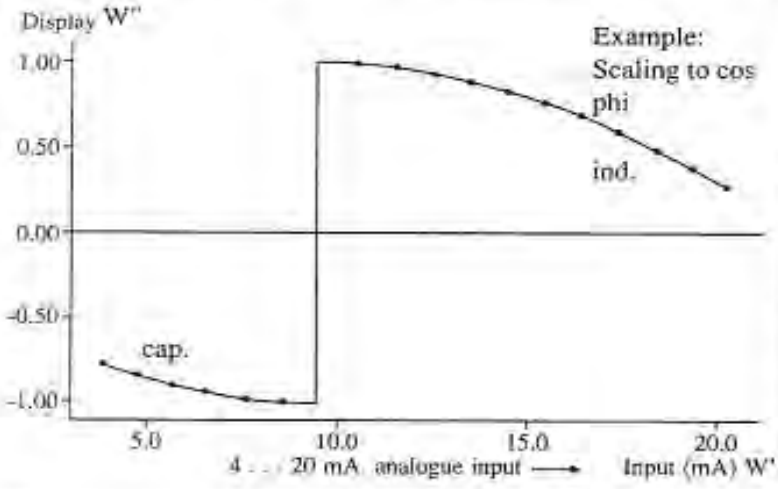


no Scale = Reset scaling
a1-d1 a2-d2 = Enter all mapping points as constant values
inp-d1 a2-d2 = Determine 1st point with measuring signal actually applied
a1-d1 inp-d2 = Determine 2nd point with measuring signal actually applied

Enter the individual numerical values requested together with decimal point. The new display resolution selected by the DPM will be shown as 'Display Resolution'.

The two pairs of points (numerical values) a1/d1 and a2/d2 can be selected really at random, so that any linear mapping of measuring signals (even inverted!) is possible.

3.2.2 User definable linearization



n	Analog W'	Display W"
1	4.00	-0.80
2	4.71	-0.85
3	5.59	-0.90
4	7.05	-0.96
5	7.78	-0.98
6	8.22	-0.99
7	9.38999	-1.00
8	9.39	1.00
9	10.56	0.99
10	11.00	0.98
11	11.73	0.96
12	13.19	0.9
13	14.80	0.8
14	16.05	0.7
15	17.14	0.6
16	18.17	0.5
17	19.19	0.4
18	20.00	0.3
..	.....	....
25	.....	....

The incoming value W' (most simply: the physical value measured at the analogue input) is mapped as a value W" which appears in the display, in accordance with a table which can be defined by the user.

- All pairs of analogue/display numbers are real values with up to 7 digits; the actual measured value can be accepted as analogue value.
- The analogue values must be sorted in ascending or descending order.
- The points may be positioned at random (not necessarily equidistant).
- The table does not have to be complete. Most simply, the entry of two pairs of values (for n=1 and n=2) will be sufficient to represent a linear scaling process.
- The first/last analogue value should be outside of the range, so that the bounds of the range are defined.
- To define the analogue range, a linear scaling as per section 3.2.1 can be effected in accordance with the factors 'k' and 'Offs'.

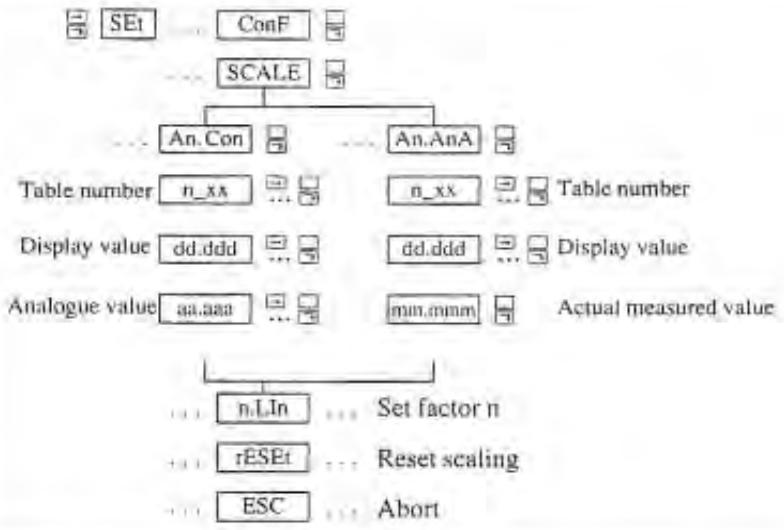
Entry and verification of the tabular values

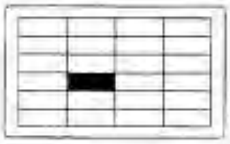
In all entry modes (keys, DPM mode and menu mask), the numbers can be entered and interrogated separately. Typically, this is accomplished as follows:

Steps for entry of tabular values:		Specific adjustment (with measuring signal):	
1.	SX1 Pointer in first position	1.	SX1 Pointer in first position
2.	SDx.x Set 1st display value	2.	SDx.x Set 1st display value
3.	SAy.y Set 1st analogue value	3a.	Apply 1st analogue measuring level
4.	SDz.z Set 2nd display value	3b.	SQ Transfer measured value to table
5.	SAv.v Set 2nd analogue value	4.	SDz.z Set 2nd display value
	..... Repeat steps 2 to 5.	5a.	Apply 2nd analogue measuring level
		5b.	SQ Transfer measured value to table
			..... Repeat steps 2 to 5.

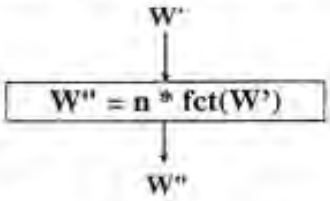
User definable linearization

Keys:

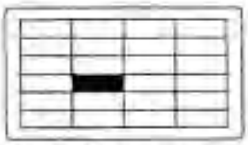


DPM mode:	Menu mask:
To set tabular values: SXn Set pointer to position n in table SDx.x Set display value No. n in table SAx.x Set analogue value No. n in table (increments pointer automatically) SQ Set actual measured value in table (increments pointer automatically) To read out tabular values: MX Read actual pointer position MDn Read display value No. n from table MAn Read analogue value No. n from table BDI Activate used defined linearization	 nonlin mathematics set ulin Set user definable linearization use lin Activate user defined linearization n: xx d:yy.yyy a:v.vvv or a:m for actual measured value
x.x, yy.yyy and v.vvv represent real numbers comprising up to 7 digits	

3.2.3 Non-linear functions

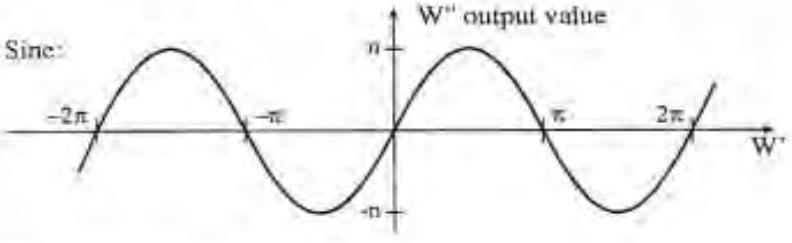


The factor n can be entered in terms of a numerical value; the function fct (W') is selected from the table of available functions.

Keys:	Menu mask:	DPM mode:
Set ... Conf ... Scale ... n. Lin Select non-linear functions nl_-x Enter Factor "n" xx.xxx x = 0 No function x = 1 Activate user definable linearization x = 2 W'^2 x = 3 $\sqrt{W'}$ x = 4 ln W' x = 5 log W' x = 6 sin W' x = 7 cos W' x = 8 tan W'	 Nonlin Mathematics Factor n x.xx Square W'^2 Root $\sqrt{W'}$ ln ln (W') log log (W') sin sin (W') cos cos (W') tan tan (W')	BD0 No function BD1 Activate user definable linearization BD2 W'^2 BD3 $\sqrt{W'}$ BD4 ln W' BD5 log W' BD6 sin W' BD7 cos W' BD8 tan W' BNx.x Entry of factor n

The usual mathematical restrictions for the range apply.

Undefined entries, such as negative numbers for $\sqrt{x}$, as well as excessively high numbers, are signalled on the display by " " " " " " ("Display Overflow").



The cosine is treated accordingly.

3.3 Selection of display format

Generally the measured values appear in the display in a fixed point format which is appropriate to the measuring value. As long as the measuring signal is not being scaled, the DPM will automatically adjust to an appropriate fixed point format.

As soon as a measured value is scaled mathematically, i.e. converted, it will become necessary in general to redefine the display appropriately. In this case the DPM will automatically select the floating point format, and it is up to the operator to select an appropriate fixed point format, if required.

The last digit in the display is rounded, whereas the serial interface will always give the full resolution. That means that display format does not exert any influence on the format of the measured values which are output via the serial interface. These values are output in any case with the full number of digits in floating point format.

The entire display format can be changed by locating the point in a position in the display:

Keys:	Menu mask:	DPM mode:
After An.Inp Section 3.1., then ... P.----. DP5 P.---.- DP4 P.--.-- DP3 P.-.--- DP2 } without leading zeros P0000. DP5 P000.- DP4 P00.-- DP3 P0.--- DP2 P.---- DP1 } with leading zeros P..FL. Floating point w/o leading zeros	Display Format	DP1 Display format x.xxxx DP2 -x.xxx DP3 --x.xx DP4 ---x.x DP5 ----x. } 1) DP0 Floating point D0 Activation of the leading zeros 1) no leading zeros

Definition of places in display: 1. 2. 3. 4. 5. digits.

Attention:

"Display format" only defines the position of the number to be indicated as a whole in the display (in particular the position in which the point is located in the display). "Display format" does not change the real number, and moreover does not shift the point to a different position within the number!

The point position within the real number can be changed by multiplying the measured value by a decade value in the linear scaling function.

3.4 Display and LED functions

9 9 9 9 9 flashes	– Analogue overflow The measuring signal exceeds the selected range; ... increase the measuring range! – Cable break, for the temperature measuring types
flashes	– Display overflow The display value cannot be represented by the five-digit display in the selected fi xed point format. The DPM operates and measures perfectly, but the measuring result does not fit the display. The measuring result can be called e.g. via the serial interface.

Select display brightness:

The DPM enables adjustment of three brightness levels, i.e. – dark (low),
– medium and
– bright (high).

Moreover there are two modes available for a switched-off display (useful if the data is only to be called via the serial interface): – Display entirely off, and
– display only indicates a point to show the instrument is switched on.

Keys:	Menu mask:	DPM mode:
Set ... br. br..x x = {0..4} as DPM mode on the right	Display brightness	**Display brightness** DH0 off DH1 off, only signal point lighted DH2 dark DH3 medium DH4 bright

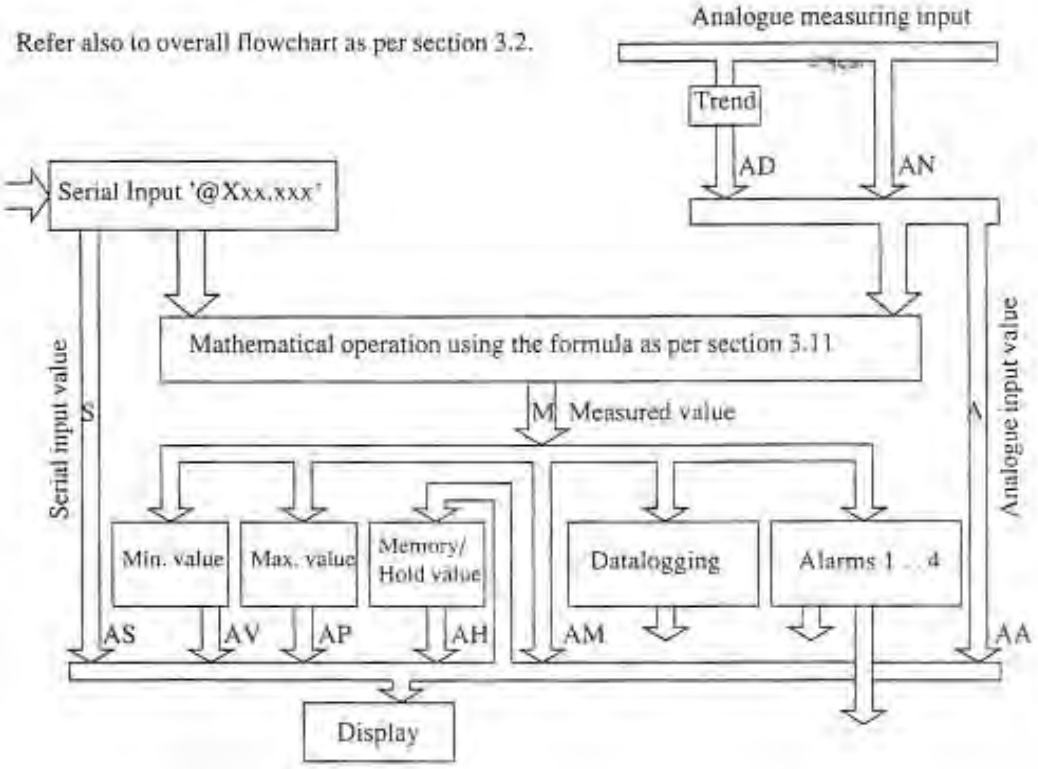
Select LED function:

Keys:	Menu mask:	DPM mode:
Set ... Conf. ... SPP ... LEDs LED_0 LED_1 0 = passive 1 = trend	LED Indicator Fct	LEDs indicate DL0 passive DL1 trend LED for alarm output, refere to section 3.7 f)

Configuring the display functions

The display will generally indicate the actual - possibly scaled - measured value, which may have been combined with the external measuring data from other DPMs.
This condition can be changed for particular applications, so that instead the display indicates continuously any other one of the DPM's internal values. These possibilities are shown in the flowchart:

Refer also to overall flowchart as per section 3.2.



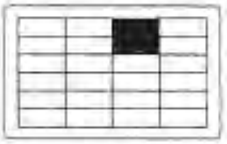
Keys:	Menu mask:	DPM mode:
Set → Conf. / SPF / displ. / dis_x x = (0...7) refer to text on the right	Display Function	Display indicates AM Actual measured value (x=0) AH Hold/Memory value (x=3) AP Max. value (x=2) AV Min. value (x=1) AA Analogue input value (x=4) AS Serial input value (x=5) AD Trend value ON (x=6) AN Trend value OFF (x=7)

Select display format: Refer to section 3.3

3.5 Key functions / Extended key functions / Code

Setting the operating functions of the keys:

A separate, definite function can be assigned to each of the two or four keys. This function is triggered when the key is pressed in the normal measuring mode.

Keys:	Menu mask:	DPM mode:
Set ... Conf. ... SPF ... PUSH upper UP_x ... lower LO_x ... C tc_x A tA_x x according to DPM mode suffix	 Key Selection Key Function [1]	upper / lower / C / A T10 / T20 / T30 / T40 passive T12 / T22 / T32 / T42 Display Hold T13 / T23 / T33 / T43 Reset Min/Max T14 / T24 / T34 / T44 Datalogging trigger T15 / T25 / T35 / T45 Datalogging run/hold T16 / T26 / T36 / T46 Transmit value to RS232 T17 / T27 / T37 / T47 Indication "Analogue input" T18 / T28 / T38 / T48 Indication "Serial input" T19 / T29 / T39 / T49 DL output T110 / T210 / T310 / T410 Indication "memory value" T111 / T211 / T311 / T411 Automatic taring T112 / T212 / T312 / T412 Indication, min. value T113 / T213 / T313 / T413 Indication, max. value T114 / T214 / T314 / T414 Indication, alarm limit T115 / T215 / T315 / T415 Transmit key inf. "Tn" T116 / T216 / T316 / T416 Start function "n"

[1] Information referring to MF/E.. models:
First of all, select the upper panel "Key selection" to select the key which is to be set (upper = first from top; lower = second from top; key C; key A). Subsequently the lower panel "Key function" shows / provides for setting the function to which this key is assigned.
MF models:
The upper and the lower keys have separate entry panels.

Change-over of display - Example:

The keys or the Ctrl Input, can be programmed to change the display between a selected function and normal indication:

T12 sets the change-over function of the upper key between: Hold and normal indication.

T48 sets the change-over function of the key A between the serial input value and normal indication.

Extended key functions:

The functions Fct 1 through Fct 4 define a selective jump into the key operation, even if a key lock code has been activated. Fct 4 is included in the E models only.
So the operator may change e.g. the display brightness. He has however no access to all the other available settings.

Keys:	Menu mask:	DPM mode:
Set ... Conf. / SPF / S.Fct / F1.xx xx according to table below	 Fct No 1 2 3 4	Extended key function W1xx Set key function 1 W2xx Set key function 2 W3xx Set key function 3 W4xx Set key function 4 xx according to table below

3

xx	Function
1	Set Time
2	Quit Alarm 1
3	Quit Alarm 2
4	Quit Alarm 3
5	Quit Alarm 4
6	Statistics Reset
7	Hold Display ON
8	Hold Display OFF
9	Datalogging hold
10	Datalogging run
11	Datalogging trigger
12	Change display brightness
13	Indicate Min. value
14	Indicate Max. value
15	Indicate "Hold" value
16	Indicate alarm status
17	Indicate "Datalogging" status
18	Transmit act. measuring value
19	Transmit Min. value
20	Transmit Max. value
21	Transmit "Hold" value
22	Transmit Datalogging list
23	Transmit alarm status
24	Menu "Set functions"
25	Menu "Reset functions"
26	Menu "Display functions"
27	Menu "Transmit functions"
28	Set Baud rate
29	Set digital filter
30	Set measuring type
31	Set temperature
32	Set display format
33	Configure alarms
34	Configure scaling
35	Configure analogue output
36	Configure Datalogging
37	Configure serial interface
38	Configuration menu
39	SPF menu
40	–
41	Set limit - alarm 1
42	Set limit - alarm 2
43	Set limit - alarm 3
44	Set limit - alarm 4

Access code:

Key programming can be inhibited by a three-digit code as a protection against unauthorized use. Every code from 001 to 999 will inhibit programming. 000 means: no inhibit.

Keys:	Menu mask:	DPM mode:
Set ... Conf. / SPF / Code / Cxxx	 Key Fct 1...3 / Code Key Code xxx	CO Interrogate code CSxxx Set code

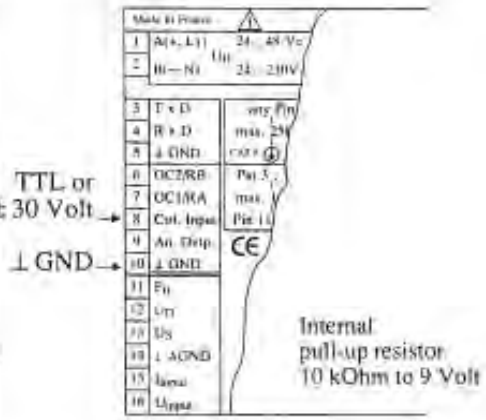
3.6 Ctrl Input Pin

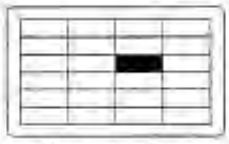
The Ctrl Input Pin serves as a hardware control terminal for the DPM.
Due to the wide voltage range of +/- 30 V and the internal pull-up resistor, the following control options are available, amongst others:

- 5 V TTL level
- 3-15 V CMOS level
- +/– 12 V RS232 level
- OC transistor switch
- Mechanical switch

For questions concerning installation, please refer to section 1.5 "Control terminals".

As with the front keys, various functions can be assigned to the Ctrl Input Pin.



Keys:	Menu mask:	DPM mode:
Set ··· Conf ··· SPF ··· In.Pin ··· In_x x = 10...14) refer to text on the right	 Ctrl Input Config	Funktion Ctrl Input TC0 Passive TC2 Display Hold [1]) TC3 Reset statistics TC4 Trigger Datalogging TC5 Datalogging run/hold [2]) TC6 Transmit measured value to RS232 TC7 Indication "Analogue input" [2]) TC8 Indication "Serial input" [2]) TC9 DL output TC10 Continuous RS232 output [2]) TC11 Automatic taring TC12 Indication "Min. value" TC13 Indication "Max. value" TC14 Indication "Alarm limit"

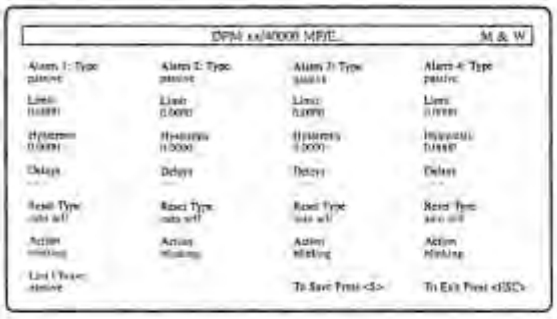
[1]) Hold Display (as long as "active low"). The falling edge at the pin accepts the measured value into the Hold/Memory.
[2]) Only as long as Pin is "active low".

Note: The Ctrl Input Pin also can be used as CTS for the RS-232C interface. See command CC8 in section 3.10.

3.7 Alarms

The instrument provides for 4 identical alarm channels which can be freely defined:

- Alarm number 1
- Alarm number 2
- Alarm number 3
- Alarm number 4



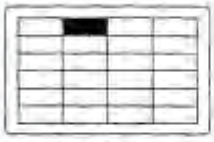
3

The following parameters can be specified separately for each alarm level; they describe the operation of the alarm number concerned.

a) Type
b) Limit value
c) Pickup/dropout delay
d) Hysteresis
e) Resetting options
f) Alarm output/indication
g) Alarm acknowledgement
h) Interrogation of alarm status

How to configure alarms

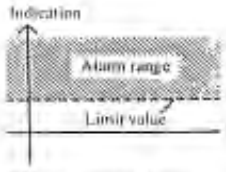
Calling the alarm mask from the menu mask

 Menu mask: Setpoints/Alarms "Alarm menu" <cr>	To return from the alarm mask to the main menu mask, push <ESC>.

a) Alarm type

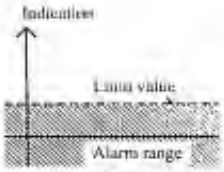
Determines if the alarm is active at all, if it reacts above a certain limit (upper limit), if it reacts below a certain limit (lower limit), or if it reacts to the rate of change in value (dynamic limit).

(1)



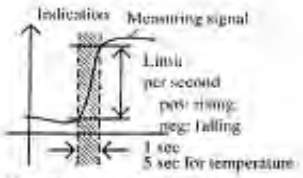
Type: upper limit

(2)

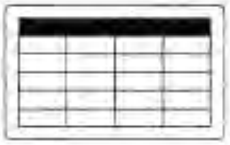


Type: lower limit

(3)



Type: dynamic limit

Keys:	Alarm menu mask:	DPM mode:
E Set ... Conf. / Alarm / A.Alx ... F typ – passive typ U upper limit typ L lower limit typ d dynamic limit ... F x = 1...4 defines the alarm levels	 Alarm v Type	vT0 passive vT1 upper limit vT2 lower limit vT3 dynamic limit v = alarm number (1...4)

b) Limit value (alarm limit)

The alarm function continually checks the displayed value, even if the latter has been mathematically converted (display scaling) or has been derived from computation with the values of another DPM (cascading).

The dynamic limit must be indicated in "variation of value per second".

The signal variation must be detected for at least 1 second (at least 5 seconds for the temperature measuring types). This means that alarm(s) will only be triggered by a persistent signal variation, but not by transients.

Keys:	Alarm menu mask:	DPM mode:
after ... typ x ... xx.xxx xx.xxx is a five-digit real number	 Limit <cr> New Value: xx.xxx	1Wxx.xxx Limit 1 2Wxx.xxx Limit 2 3Wxx.xxx Limit 3 4Wxx.xxx Limit 4
	xx.xxx is a seven-digit number	

c) Pickup delay / dropout delay

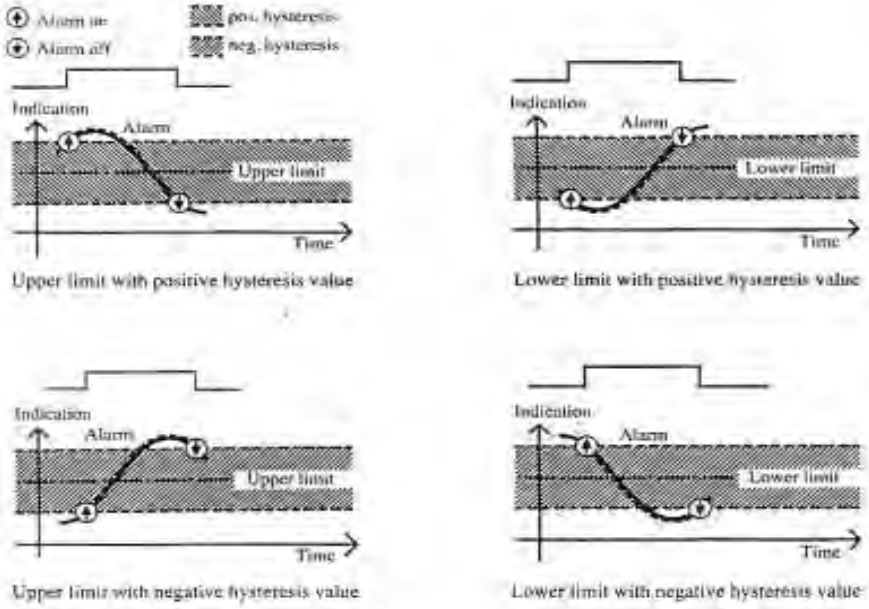
The pickup and the dropout delays can be set separately in steps of 500 ms. The maximum input value of 250 corresponds with a maximum delay of 125 seconds (2 minutes and 5 seconds).

Keys:	Alarm menu mask:	DPM mode:
after entry of hysteresis xxx = 0...250 On xxx yyy = 0...250 Of yyy	 Delay: on delay / off delay x: Set 0...250: ..<cr> ↑ old value ↑ new value	1Zxxx Pick-up delay limit 1 2Zxxx Pick-up delay limit 2 3Zxxx Pick-up delay limit 3 4Zxxx Pick-up delay limit 4 1Yxxx Dropout delay limit 1 2Yxxx Dropout delay limit 2 3Yxxx Dropout delay limit 3 4Yxxx Dropout delay limit 4

d) Alarm hysteresis

Defines the range between the operating point and the alarm limit.

A negative hysteresis value is admissible; in this case the edges for switching on and off are interchanged.



Safety information:

In the case of negative hysteresis values we recommend that additional alarm limits are defined, as required by the application, as a safety feature.

The dynamic limit has similar behaviour; therefore it will not be useful in most cases to set hysteresis for a dynamic limit.

Keys:	Alarm-Menü-Maske:	DPM mode:
after alarm limit xx.xxx	Hysteresis New Value: xx.xxx	1H xx.xxx Set hysteresis 1 2H xx.xxx Set hysteresis 2 3H xx.xxx Set hysteresis 3 4H xx.xxx Set hysteresis 4
xx.xxx is a five-digit real number	xx.xxx is an up to seven-digit real number	

e) Alarm Reset options

Reset (acknowledgement) means to switch off the alarm indication (display, LED, open collector output). This can be effected either automatically (without any operator intervention), or via control functions, such as pushing a key on the front panel, via an electric pulse at Ctrl Input Pin, or by an command via the serial interface.

"Automatically" means: As long as the alarm condition exists, the alarm is indicated; as soon as the alarm condition does not exist any longer, the indication is reset automatically (no Reset by key actuation etc. will be required).

"Unconditional" means: The alarm indication can be acknowledged (switched off) at any moment, even if the alarm condition remains "on".

"Conditional" means: The alarm can be acknowledged only when the alarm condition no longer exists, but not before.

Keys:	Alarm menu mask:	DPM mode:
After delay adjustment rES.AU Automatic Reset rES.U Upper key, unconditional rES.L Lower key, unconditional rES.I Ctrl Input Pin, unconditional rEC U Upper key, conditional rEC L Lower key, conditional rEC I Ctrl Input Pin, cond. rES.C C key, unconditional rES.A A key, unconditional rEC.C C key, conditional rEC.A A key, conditional	 Reset Type	vR0 Automatic Reset vR1 Upper key, unconditional vR2 Lower key, unconditional vR3 Ctrl Input Pin, unconditional vR4 Upper key, conditional vR5 Lower key, conditional vR6 Ctrl Input Pin, conditional vR7 C key, unconditional vR8 A key, unconditional vR9 C key, conditional vR10 A key, conditional v = {1...4} (alarm number) Example: 1R0 = Automatic Reset / alarm number 1

Acknowledgement / Resetting can be effected

- by pressing a key (upper or lower, according to configuration; refer to section 3.5);
- via serial interface (menu mask, DPM mode commands 1Q, 2Q, 3Q, 4Q or XQ);
- via Ctrl Input Pin (if configured accordingly) with the falling edge of the electrical signal (refer to section 3.6).

f) Alarm output (action type)

One of the following methods can be selected for indication/output of the alarm:

0	Display flashes	6	Relay A
1	Upper LED	7	Relay B
2	Lower LED	8	Relay C
3	Open Collector 1 active (low)	9	Relay D
4	Open Collector 2 active (low)		
5	Serial output		

The "inverse" output option reverses (inverts) the normal relay or OC actions.

Keys:		Alarm menu mask:	DPM mode:
after	Type setting		vA0 Display flashes
Act.b	Display flashes		vA1 Upper LED [1] 3)
Act.U	Upper LED [1] 3)		vA2 Lower LED [1]
Act.L	Lower LED [1]		vA3 OC1 active low/Relay A [2]
Act.1	OC 1/Relay A [2]	Action	vA4 OC2 active low/Relay B [2]
Act.2	OC2/Relay A [2]		vA5 Serial interface (A,P)
Act.r	Serial output		vA6 Relay A
Act.rA	Relay A		vA7 Relay B
Act.rb	Relay B		vA8 Relay C
Act.rc	Relay C		vA9 Relay D
Act.rd	Relay D		vA10 OC1 inverted
not.in	.in		vA11 OC2 inverted
not inverted	inverted		vA12 Relay A inverted
			vA13 Relay B inverted
			vA14 Relay C inverted
			vA15 Relay D inverted
			v = {1...4} (alarm number)

[1] Any previous LED settings (as per section 3-4) are overwritten.
[2] DPM 48/40000 MF/R2. For normally "open" operation the unit has to be configurated 'alarm output inverted'.
[3] Not in case of the E... models

Several alarms with the same output will be overlaid (OR function).

Serial output:

Any time there is a transition from passive to active, the DPM signals once, without being requested to do so, the string "A <cr><lf>"; for any transition to passive it signals once the string "P<cr><lf>". Subsequently the host computer can interrogate the status of all alarms by "XS".

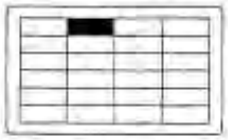
g) Acknowledgement / resetting of alarms:

The methods of acknowledgement of each alarm channel were defined during configuration of the alarms (3.7e).

They may include:

- Actuation of one of the front keys, if allocated to that function;
- Activation of one of the functions Fct 1 to Fct 4, if allocated to that function;
- Strobe applied to the Ctrl Input Pin, if allocated to that function;
- Actuation of the keys in the Reset menu on the setting level.

Moreover, alarms can be reset at any moment by an command via the serial interface, via the menu mask or the key programming:

Keys:	Menu mask:	DPM mode:
Set ... rESEt ... r.AL v v = {1...4}	 Alarm /Setpoints Alarm v v = {1...4}	XQ Reset all alarms vQ Acknowledge alarms individually v = {1...4} (alarm number)

h) Interrogation of alarm status

Keys:	Menu mask:	DPM mode:
Set ... dISP ... d.AL P = passive A = active	 Setpoints / Alarm Status	XS Interrogate alarm status Reply: xxxx mit x = {A,P} e.g. "PAPP" = alarm 2 is the only active one

3.8 Digital Filter

After every measurement, a digital filter with the filter factor x calculates the average of the values which were the last to be measured.
The filtering is intended to attenuate process-related interferences and spikes.

The filter factor can be selected in the range from 1 to 250; in general values ranging from df = 2 to 10 are recommended. The values df = 0 and df = 1 mean: no filtering.

The measuring rate and the display updating rate remain unchanged with all filter factors.

Keys:	Menu mask:	DPM mode:
Set → Conf. → Filtr → F xxx	 Digital Filter "Set Factor 0...250:" xxx	F Interrogate filter factor FSxxx Set filter factor to xxx
xxx = {1...250} (filter factor)		

3.9 Temperature scale

Indication is possible, with the temperature measuring types, in terms of

- Degree Centigrade (C)
- Degree Fahrenheit (F)
- Kelvin (absolute)

Keys:	Menu mask:	DPM mode:
After setting of the measuring type according to section 3.1 °C °F Abs	 Temp Scale „Celsius" „Fahrenheit" „Kelvin"	GC °Centigrade GF °Fahrenheit GA Kelvin (absolute)

3.10 Serial Interface

As described in section 1.6, at switch-on the DPM automatically selects either the RS-232C or the RS-485 mode.

For the **RS-485 mode** except for the device address, the instrument does not require any settings. The baud rate, parity etc. are fixed settings to 9600 8-e-1; the DPM is controlled within a bus system by a master (e.g. a PC) according to a protocol, discussed in section 2.2.2.

In the **RS-232C mode** the following parameters can be adjusted:
- Baudrate (110..9600),
- Parity / data word length / stop bits,
- brief transmit delays.

Alternatively, RS-232C permits the following modes:
- Continuous output of measured values,
- Various DPMs working in the loop mode,
- Cascading of several DPMs (section 3.11).

3.10.1 RS-485 / Loop mode: Setting the address

Keys:	Menu mask:	DPM mode:
Set → Conf. → RS 232 → Adr. → Adr._x x = {0...9} ... {10...32}	 Command Loop Adr. „Set Adr. 1..W"	Ex x = {0...9}...{A...W} ASCII x = 0 means: no address

For the system mode using RS-485, refer also to sections 1.6.2 and 2.2.2.

3.10.2 RS-232: Setting of baud rate / Parity / CTS / Delay

Setting the baud rate:

Keys:	Menu mask:	DPM mode:
Set → Conf. → RS 232 → bAUd → 9600 Effective immediately	 RS 232: Baud/CTS Effective only after restart of the unit	R0 Baud rate to 9600 baud R1 4800 baud R2 2400 baud R3 1200 baud R4 300 baud R5 110 baud Effective only after restart of the unit

Setting of Parity / Data word length / Stop bits:

Keys:	Menu mask:	DPM mode:
Set ... Conf. ... RS 232 ... Adr. ... Adr._x x = 0...8 according to DPM mode	 RS 232 Parity / Delay [1]	P0 n-8-1 [1] P1 o-7-1 P2 e-7-1 P3 n-8-2 P4 o-7-2 n = no Parity P5 e-7-2 e = even Parity P6 n-8-1 o = odd Parity P7 o-8-1 7/8 = Data bits P8 e-8-1 1/2 = Stop bits

Setting of CTS:

When the DPM..MF sends data to a slow output device (e.g. a printer), it may control the data flow via the CTS line. Data transmission is inhibited by a negative voltage or GND potential on the CTS line.

The following configurations are selectable:
1. No CTS
2. Pin 8 (Ctrl-Input) as CTS
3. Pin 4 (RxD) as CTS

Keys:	Menu mask:	DPM mode:
Set ... Conf. ... RS 232 ... Adr. ... no.CTS / PIn 8 / PIn 4	 RS 232 Baud / CTS [1]	CC0 No CTS [1] CC4 Pin 4: Connect RxD as CTS CC8 Pin 8: Connect Ctrl Input Pin as CTS

Note:

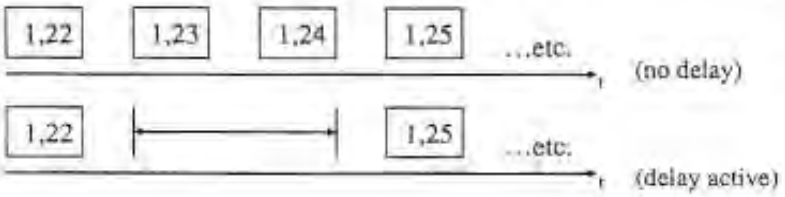
In an application where the DPM..MF only transmits data (e.g. to a printer), without having to receive any, it is useful to choose the pin 4 (RxD) as CTS control line. This way the Ctrl Input Pin is kept free for other control actions (refer to section 3.6).

[1] Effective only after restart of the unit

Setting of Transmit Delay Rate:

This function can be used to reduce the density of data. The delay factor of 1...250 indicates a time delay between the output blocks (1 = no delay; 250 = maximum delay), while the baud rate remains unchanged. The delay rate is a fraction of a second (ms).

☞ Example: Continuous output of measured values



Keys:	Menu mask:	DPM mode:
Set ... Conf. ... RS 232 ... DELAY d xxx	RS 232 Parity / Delay old:nnn; New Rate 1...250; xxx	TDxxx
xxx = 1...250 (Transmit Delay Rate)		

3.10.3 Continuous data output (RS-232C)

The DPM..MF is able to transmit its actual measured values (full resolution of up to 7 digits) via the serial RS-232 interface in terms of

- **Individual values,**
  if the front keys or the Ctrl Input Pin are configured so that their actuation triggers output of a single measured value. This is of interest when a printer is to be connected directly. See sections 3.5 and 3.6.
- **Continuous output in terms of a "pure" ASCII string,**
  for continuous output to a text display or a printer, or for subsequent processing in a process control computer, a PLC, or a PC. This way measured values can be recorded fast and safely, or mapped as graphs by appropriate systems.
- **Continuous output in the "@X" format for cascading of DPMs,**
  in order to interconnect several DPMs, so that the individual measuring signals can be processed by common calculation. Refere to section 3.11 for cascading.

Output is effected continuously. Each measured value is transmitted, as far as this is possible due to the preset baud rate, to the serial interface. The data formats have been described in section 2.5.2.

The data flow can be controlled, if necessary, by a CTS terminal (see section 3.10), and/or be reduced by the integration of pauses via the function "Transmit Delay".

Keys:	Menu mask:	DPM mode:
Set ... Conf ... RS 232 ... chAIn ... out out_x x = 0 . . 6 as in DPM mode	 Chaining DPMs / PCs transmit off out disp (D) out meas (M) out a (A)	Continuous output in ASCII format Z0 no output Z2 Display value (D) Z4 Measured value (M) Z6 Analogue value (A) refer also to section 3.11

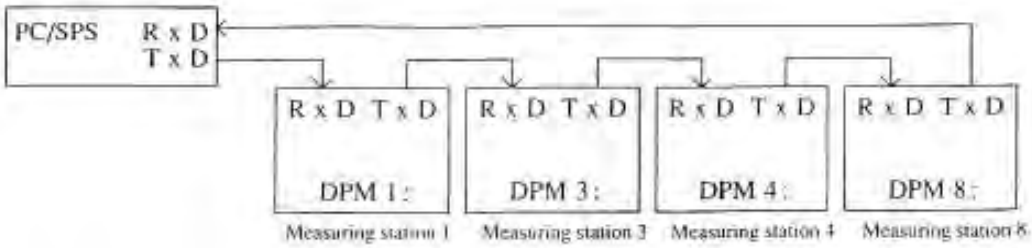
Note:

During the continuous output of data the serial input is invariably set to the DPM mode, so that the DPM can receive and process all DPM commands. The input is not "echoed" however.

A command of particular importance is "Z0", as it is used to deactivate the continuous output.

3.10.4 Loop operation of several DPM..MFs

In this operating mode, several addressable DPM..MFs are operated by a common serial control unit (e.g. process control computer or PLC).



Configuration

A unique address ranging from "1" to "9" must be assigned to each DPM. The address "0" means "no address" and is not admissible for loop operation.

Keys:	Menu mask:	DPM mode:
Set — Conf RS 232 Adr. Adr_x x = {0...9}	 Command Loop Adr. „Set Adr. 1...9"	Ex Assign address x x = {0...9} x = 0 means: no address

Loop operation

1. As long as an address is assigned to a DPM, its interface will be controlled according to the basic rules of this mode, i.e. passing through commands and replies in the "loop mode".
2. The DPM will no longer respond to incorrect entries by "?".
3. When operating in the loop mode, commands must be prefixed with an address (e.g. "3:M"), which consists of an ASCII number (the device identification), and a colon (ASCII 3AH). Then follows - in justified format - the normal DPM command. Example: "3:M" to request a measured value from the device with the address 3. All replies from DPMs are also prefixed by their corresponding addresses (e.g. "3:10.5800").

4. In order to facilitate configuration, DPM..MFs with addresses also react to commands given without an address. This way access to the device configuration is possible even if the address is not known.

Notes:

In a loop configuration, continuous data output, and the menu mask mode are not meaningful! In order to reduce the susceptibility to faults, one of the slower baud rates should be used for the loop mode.

Information for users of DAA or IPP units

In addition to the addressing format "3:command" the DPM..MF also understands the addressing form "ENQ/3 command EOT", which is compatible with DAA and IPP.

Warning:

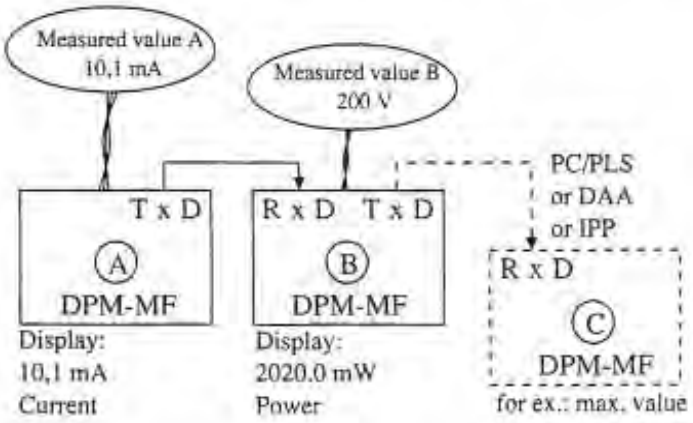
As the operating principle of the loop configuration requires that each command is processed by each unit, this configuration only operates while the devices concerned are switched on and in perfect working order. Due to the operating principle, the response times are relatively long, and a single faulty unit can disturb the entire system.

It is necessary that these factors, which depend on the system's operating principle, are taken into consideration.

We recommend that the DPM..MF/E1 models are operated in the RS-485 interface system mode, instead of the loop mode. The RS-485 mode is much more reliable, permits longer cables and - more importantly - it is not susceptible to the uncertainty factors mentioned above.

3.11 Cascading of several DPM..MFs

Direct processing and indication of several measured values on site is possible by cascading several DPM..MFs.



Example:

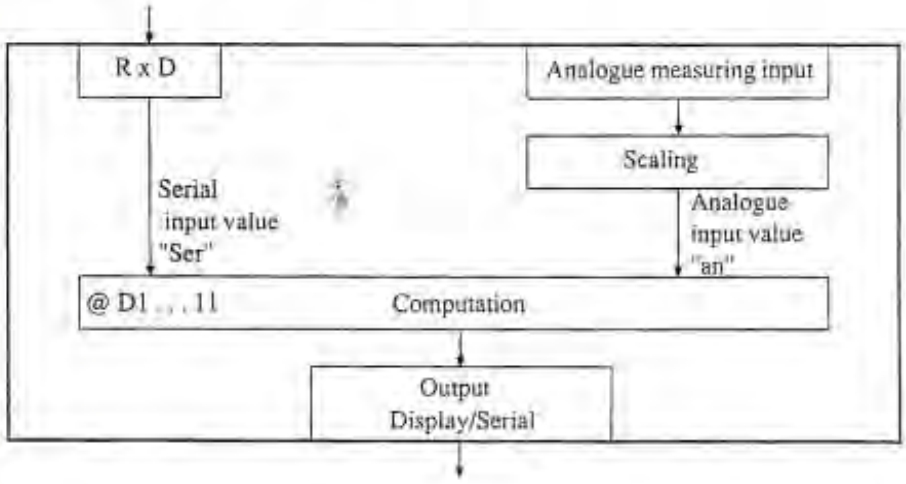
In the DPM "B" the values of the measuring station "A" (10.1 mA), which were received via RxD, are multiplied by the internal measured value (200 V), so that the result (mW) appears.

The DPM..MF is capable of receiving data from any suitable device, and of processing it internally, provided that the data fulfils certain format requirements:

@	X	nn.nnnn	<cr>

mit „@" = ASCII (40Hex)
„X" = ASCII (58Hex)
nn.nnnn = any real number composed of ASCII characters

Description of format, see section 2.5.2.



Configuration (Cascading of several DPMs)

Each DPM receiving and transmitting data must be configured individually, depending on the role it plays within the system.

DPM transmitting data (continuous output to a second DPM..MF)

Keys:	Menu mask:	DPM mode:
Set ... Conf ... RS 232 ... chAIn ... out out_x x = 0...5 as in DPM mode	 Chaining DPMs / PCs transmit off casc disp (D) casc meas (M) casc a (A)	Output to a 2nd DPM (@): Z0 No output Z1 Display value (D) Z3 Measured value (M) Z5 Analogue value (A) refer also to section 3.10.3

DPM receiving data

Keys:	Menu mask:	DPM mode:
Set ... Conf ... RS 232 ... chAIn ... In In_x x = 0...11 as in DPM mode	 Chaining DPMs / PCs no chain input	@D0 no computation @D1 analogue + serial @D2 analogue – serial @D3 analogue x serial @D4 analogue / serial @D5 serial – analogue @D6 $\frac{\text{analogue + serial}}{2}$ @D7 $\frac{\text{analogue x 100}}{\text{serial}}$ @D8 $\frac{\text{serial x 100}}{\text{analogue}}$ @D10 $\frac{\text{analogue – serial}}{\text{serial}}$ x 100 @D11 $\frac{\text{serial – analogue}}{\text{analogue}}$ x 100

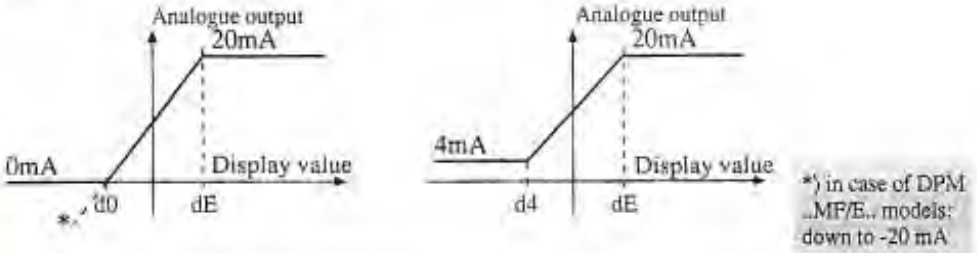
Note:

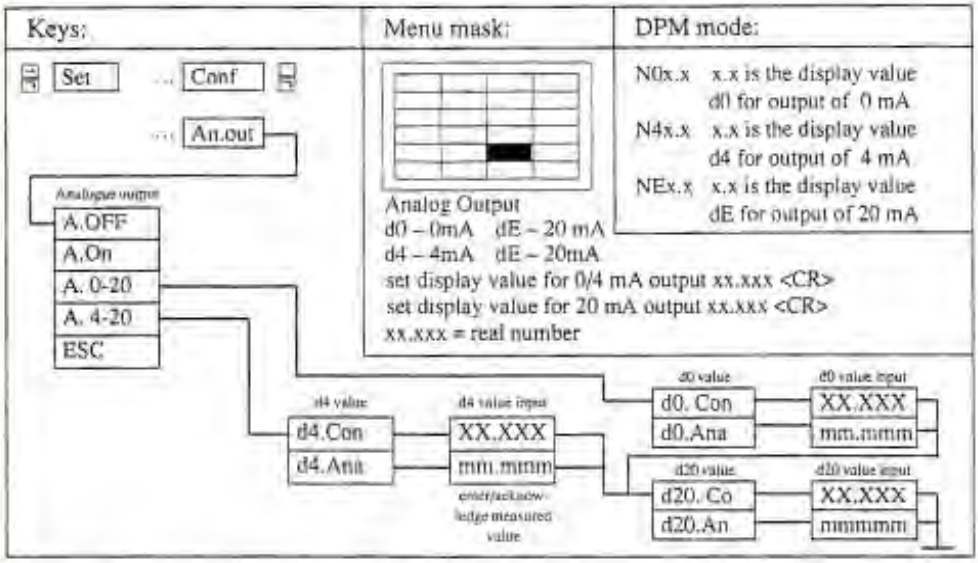
For complex system configurations it may be better to select a transmit delay rate of greater than 1.

3.12 Analogue output

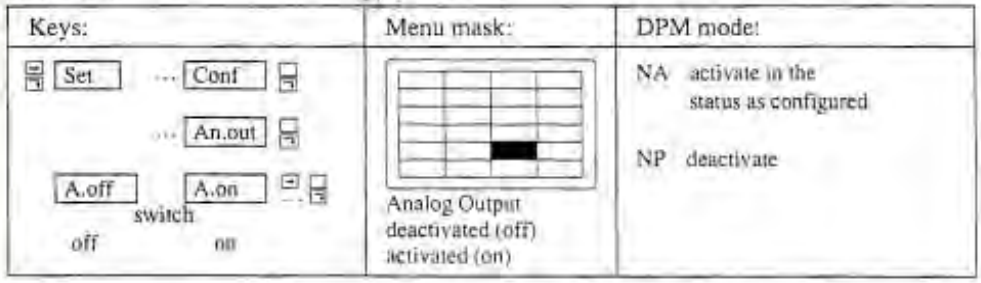
The output of data via the analogue output is derived from the measured value (in most cases appearing in the display). The determination of which display value (d0/d4) is represented by a 0 mA output (or 4 mA output), and which display value (dE) is represented by a 20 mA output, is made in the configuration.
An output of 0-20 mA or 4-20 mA is adjusted according to the configuration desired; either d0 or d4. In both cases, the final value dE is configured in the same way. The DPM..MF/E.. models use the same configuration method, but output can be lower than 0mA down to -20mA if 0-20 mA is selected.

Configuration of the analogue output





Activation



3.13 Datalogging (DL)

Datalogging in the DPM means: recording of measuring data in the internal datalogging memory of the DPM over an extended period of time. The datalogging memory in the DPM provides capacity for up to 180 measured values with additional information. This data is lost if the DPM is switched off.

In the datalogging memory, each measuring data block consists of:
- the measured value (as shown in the display, but with 7 digits);
- Min./Max. values (possibly reset after each trigger event);
- the complete alarm status;
- the relative time of day.

3.13.1 Description of the operating modes DL

Two basic operating modes can be set in the DPM:
1. Continuous logging in a cyclic memory
2. Trigger-controlled logging which is continued until an event releases a trigger signal which stops the logging operation.

Continuous logging

In this mode, the measured data is logged continuously in the datalogging memory, at preselected intervals (sample interval, continuously, 1 second up to several hours).

The data is written continuously into the cyclic memory, so that the last 180 records of measured values are available in the memory.

The min. and max. values can be set to automatically reset after each record, so that min./max. values show the signal profile between 2 sampling points.

After the mode has been set, the instrument starts to operate immediately in the "run" mode and saves measured values. DL operation is stopped temporarily by a "DL hold" command (via keys, Ctrl Input Pin or serial interface), and the buffered measured values can be recalled from the datalogging memory. The "latest" block of measured values, i.e. the last to be buffered before the hold command, is marked by number "-1"; all the previous "older" blocks have higher negative numbers.

Logging controlled by trigger

In this mode - as in the continuous logging mode - measured data is logged in the datalogging memory at a preselected interval (sample interval, continuously, 1 second up to several hours).

In this mode, an external event (e.g. an external alarm) may stop datalogging, thus changing-over to "Hold". After the "trigger event" the DPM memory contains a list which describes the

signal profile over a defined time interval before and after the trigger event. The trigger signal may be by key operation, an electrical Strobe pulse to the control input, via the serial interface, etc. Now this list can be evaluated by an external device.

At the moment the trigger is activated, the block of measured values in the datalogging memory is marked by number "0"; the data blocks logged after the trigger point have ascending positive numbers, and the blocks of measured data prior to the trigger point have descending negative numbers.

"Pretrigger (20/160)" means that 20 blocks of measured data were stored prior to the event (Trigger), and 160 blocks of measured data after the event.

Posttrigger (160/20)" means that 160 blocks of measured data were stored prior to the event (Trigger), and 20 blocks of measured data after the event.

Operation can be stopped temporarily even without trigger by means of "hold"; datalogging can be restarted by "run".

3.13.2 Table of values DL

The datalogging memory can be listed via the serial interface (for example to be processed subsequently by a process control computer). The output can be started, depending on the configuration, by key actuation, via a strobe applied to the Ctrl Input Pin or via a command to the serial interface.

Moreover, individual records data can be selected from the DL memory (data flow control) by a PC or a similar device, by addressing of pointers or by means of certain commands in the DPM mode.

No.	Measured value	Time	Min	Max	Alarm	
-4:	xxxxx	06:14:21	xxxxx	xxxxx	yyyy	Sample-interval: 3 seconds
-3:	xxxxx	06:14:24	xxxxx	xxxxx	yyyy	
-2:	xxxxx	06:14:27	xxxxx	xxxxx	yyyy	
-1:	xxxxx	06:14:30	xxxxx	xxxxx	yyyy	
0:	xxxxx	06:14:33	xxxxx	xxxxx	yyyy	←Trigger point
1:	xxxxx	06:14:36	xxxxx	xxxxx	yyyy	
2:	xxxxx	06:14:39	xxxxx	xxxxx	yyyy	
3:	xxxxx	06:14:42	xxxxx	xxxxx	yyyy	

For setting the DPM's internal time base, refer to section 2.1.5.

3.13.3 Selection of datalogging mode

Enables selection of one of the following modes:

- off (datalogging switched off)
- cont (continuous logging) with/without Min/Max. Reset
- Pretrigger (20/160) with/without Min./Max. Reset
- Posttrigger (160/20) with/without Min./Max. Reset

and permits the entry of the sample interval in seconds. The rate "0" is provided for logging at the highest speed available. This entry causes the immediate change-over to "run".

Keys:	Menu mask:	DPM mode:
Set ... Conf ... dLog off switch off dL Cont LCD 160.20 LND 20.160 LVD Cont.r LCR 160.2r LNR 20.16r LVR	 Datalogging Config. cont Reset 160/20 Reset 20/160 Reset	LP Datalogging OFF LCD Continuous without Min./Max. Reset LVD Pretrigger 20/160 without Min./Max. Reset LND Posttrigger 160/20 without Min./Max. Reset LCR Continuous with Reset LVR Pretrigger with Reset 20/160 LNR Posttrigger with Reset 160/20
After ... S.Rate sssss	Datalogging Ctrl Sample Rate sssss new rate in sec:sssss	LW sssss Sample interval in seconds 0 for measuring rate
sssss = five-digit number (integer), up to 65.000		

Sample interval:
Waiting time between two datalogging entries in the memory, in seconds.
Sample interval: 60 means 1 minute;
3600 means 1 hour.

Example:

Data profile with 180 data blocks	achieved with a sample
for 24 hours	540 (≙ 9 min)
for 1 week	3780 (≙ 63 min)

3.13.4 Datalogging Control

The control of datalogging is restricted to the change-over from "run" to "hold" and vice versa, in the continuous logging mode, and additionally by "trigger" actuation in the trigger mode. This can be achieved as well by a strobe applied to the Ctrl Input Pin, or by pushing one of the front keys (sections 3.5 and 3.6).

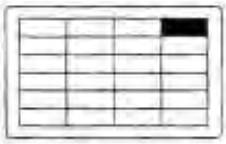
Change-over from "Datalogging - Run / Hold" and vice versa

Keys:	Menu mask:	DPM mode:
Set ... Reset ... r.dlr set to hold done Set ... Reset ... s.dlr set to run done	 Datalogging Ctrl "hold" / "run"	LH activate "Hold" LR activate "Run" without resetting the memory contents! Reset memory with LCD

Datalogging Trigger

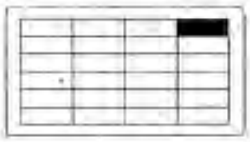
Trigger actuation is possible by:

- Strobe applied to the Ctrl Input Pin (see section 3.6)
- Actuation of one of the front keys (see section 3.5)
- Activation of one of the functions Fct 1 to Fct 3
- Command via the serial interface
- Actuation of the keys in the Set/Reset menu

Keys:	Menu mask:	DPM mode:
Set ... S.dltr ... done	 Datalogging Ctrl trigger	LT Trigger Datalogging

Calling the datalogging status

Signals the operating states "Run" (R) / "Hold" (H) / "Passive" (P) and the pointers on the lower / upper memory records limits.

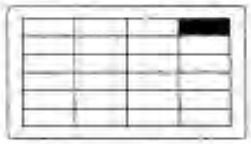
Keys:	Menu mask:	DPM mode:
Set → disp ... d. dl Memory limits are not indicated in the key operating mode	 Datalogging Ctrl Status	LS Status and memory occupancy

Datalogging - List output

Calling the contents of the datalogging memory (list output).

Moreover, in the DPM mode selective access to any individual record is possible via a pointer address (data flow control).

Output is possible only if "Hold" is selected.

Keys:	Menu mask:	DPM mode:
Set ... trans ... t. dl signals done The entire DL memory contents is transmitted as a list via the serial interface.	 Datalogging Ctrl view	LL Call entire list LZn Set pointer to n L+ Increment pointer L– Decrement pointer LA Call No., measured value and time [1] LM Call min., max. values [1] LX Call alarm status [1] [1]) depending on pointer actually set

The data formats for datalogging via the serial interface have been described in section 2.5.2.

3.14 INIT, RESTART and factory-set configuration

All MF units will be delivered (ex works) with the following configuration / default values:

- DC-I-20 mA
- No display scaling / temperature in 'C
- Filter factor 3
- Display function, measured values: "Act Measuring Value"
- Display format according to presetting: DC-I 20 mA
- All alarms passive
- Analogue output off
- Datalogging off
- 9600 baud / no parity / 8 bit / 1 stopbit / no CTS / no delay
- No loop address
- No DPM chaining, no continuous data output
- Keys: without function
- Ctrl Input Pin without function
- Display brightness: bright (high)
- Code 000 (no code)
- LED indicators: passive

Init

The Init function allows a reset to the original default values (as listed above). They are only in the temporary memory. After the confirmation (via keys after END ↵ , or with 'S' or 'SA'), they are written into the EEPROM.

Restart

The Restart function will reset the unit to the parameters which are currently stored in the EEPROM. Following this "warm restart", all temporary data as min/max/hold values and datalogging memory will be lost. Switching off the unit has the same effect as restart.

Keys:	Menu mask:	DPM mode:
Set ··· Conf Init rSrt	not possible	not possible

4 What's the matter if ... ???

if...	Reason ... Remedy ... Refer to section ...
Key lock code lost	The code can be set to "000" (= reset) via the serial interface only: • Connect PC to DPM as described in section 6.4 • Enter DPM mode commands "CS000" <cr> and "SA" <cr> or set code in menu mask to "000" and press "S"
RS-232 interface does not operate	• check Baud rate • CTS switched off ? • Parity correct ? • Delay set to "1" ? or actuate "InIt" on the key configuration level to reset all parameters (see section 3.10).
DPM..MF/E1 models:	Possibly the DPM has an device address and was started to operate in the RS-485 system mode. As discussed in section 1.6, follow these steps in the right order to activate the RS-232 mode: 1. Switch off DPM 2. Connect DPM to the remote station 3. Switch on the remote station (if it's not already on) 4. Switch on DPM now
99999 flashes	Measuring signal exceeds preset range, or cable break in the temperature measuring range. → Increase measuring range (refer to section 3.1)
flashes	The display cannot map the measuring value correctly, as it requires more than 5 display positions. However, the DPM operates correctly, e.g. the measured values can be interrogated via the serial interface.
Interface sends data continuously	A continuous output mode has been configured. → As the DPM nevertheless recognizes DPM mode commands, the continuous output should be deactivated by <cr>"Z0<cr>" (refer to section 3.13), and this condition should be saved permanently, by "SA". Or reset "chain" / "out" to "0" via the keys.
DPM in undefined condition	Overall Reset - actuate "Init" by key input as per section 3.16

if ...	Reason ... Remedy ... Refer to section ...
E = 01	Error message in display (warning): Operating factors in EEPROM defective; refer to section 2.1.2.
E = xx	Unit defective. Refer to section 2.1.2.
Display dark; or only signal point lighted	Set display brightness to 4. Refer to section 3.4.
Wrong characters on screen of PC or terminal.	– check RS-232 cable (refer to 1.6). – check Baud rate / Parity (refer to 3.10).
Menu mask not displayed correctly on the screen.	The terminal emulation must recognize the control characters according to TV905. Refer to section 6.4.
Menu mask does not appear.	An device address has been assigned to the instrument. Reset by 'E0'. Refer to section 3.10.

if ...	Reason ... Remedy ... Refe⁻ to section ...
	Remarks:

5 Examples and first operating steps

- How to connect the DPM ?
- How to adjust a measuring type and a range ?
- How to control a DPM from a PC ?

Chapter 5 provides some examples for practical application of the DPM written as "kitchen recipes":

First-time users of the DPM who "simply want to find out quickly how it works", can follow step by step the information given in this chapter, thus getting acquainted with the most important functions of the unit and learning how to read the operating manual at the same time.

Part 1: Basic operating steps using the front keys

☞ Section 5.1

Connect DPM to power supply

Connection to 20V ..230V

☞ Section 5.2

Adjust DPM to 40 mA range

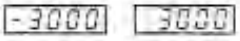
Measuring input 0...40 mA

Example for key operation

☞ Section 5.3

Display scaling: -3000 to +3000

Display range



Part 2: Connection and operation via Personal Computer

☞ Section 5.4

Connect DPM to a computer

Use menu mask: set a filter factor

Change display brightness

Set the alarm levels

Example for operation via PC: menu mask

5.1 Connecting the DPM to the power supply and switching it on

→ Supplying the DPM with auxiliary voltage ...

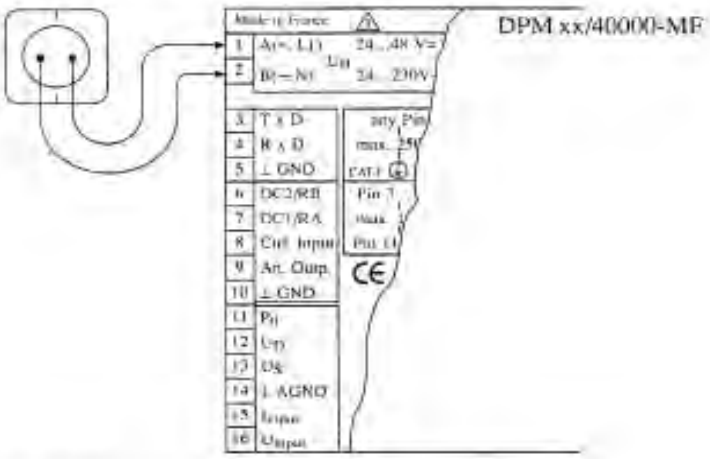
This is particularly easy as the integral po wer supply unit "copes with" all the usual input voltages, even without change-over switch.

Connect terminals A and B (pins 1 and 2) on the DPM to the power supply of 230 V or 110 V (plugbox).

or – connect to DC power supply unit for any voltage between 24 V and 60 V
– connect to transformer AC for any voltage between 24 V and 230 V

Remarks:
- The DPM adjusts fully automatically to the connected voltage.
- No change-over switch, solder links or selections are required.
- With DC, polarity is not important.

→ Refer to section 1.3 - Power supply



→ After switch-on, the DPM responds as follows ...

The display remains "blanked" for approximately 3 seconds. During that time internal tests are executed in the DPM. Subsequently ____ will appear for just one second. This means that the calibration factors for the selected measuring type are adjusted in the DPM. Then the measured value will be indicated.

99999
-9.9.9.9.9.

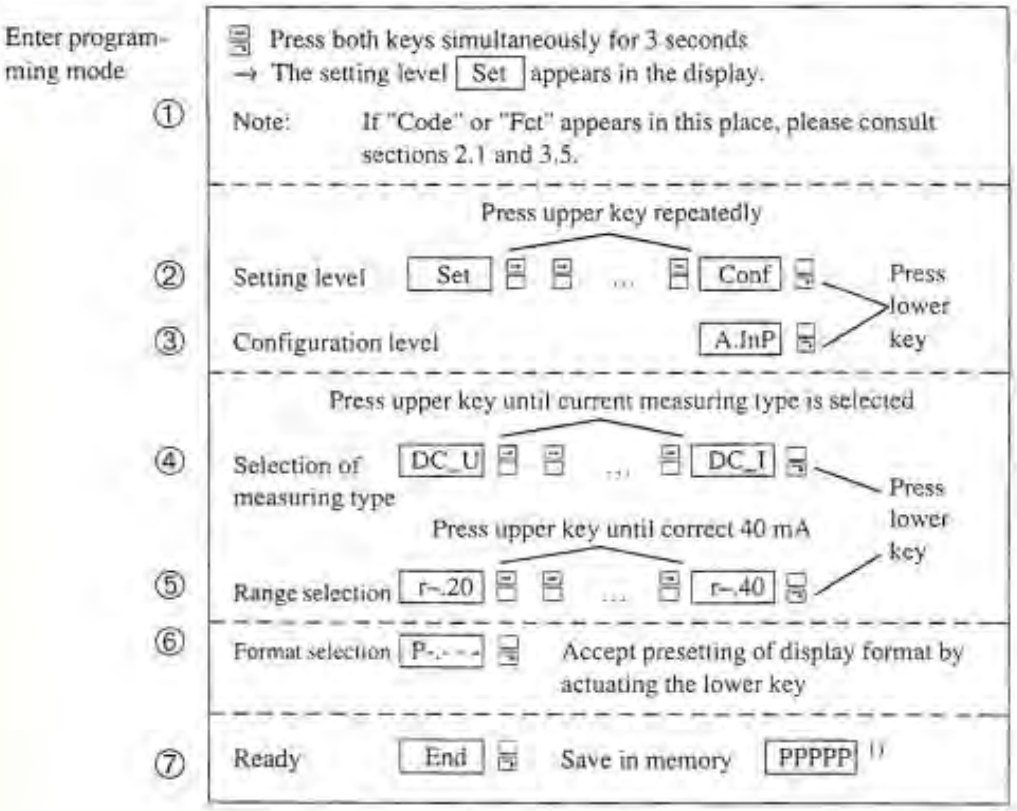
Analogue overflow, or cable break in the temperature measuring types.
Display overflow (indicated number exceeds display positions).

→ Refer to section 2.1.2 "Switch-on behaviour".

5.2 Adjusting DPM to measurement of DC current (40 mA) via the keys

→ Keys: Configuration of DC range of 40 mA ...

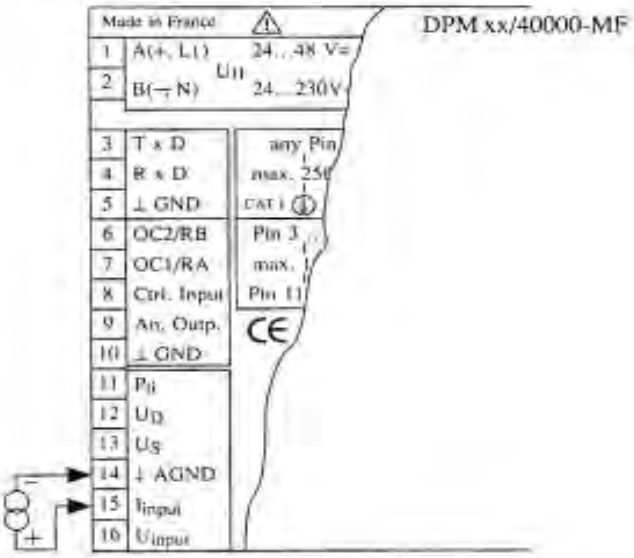
The two front keys can be used to configure all the settings in the DPM in a programming mode (except when a code prohibits access to programming to non-authorized persons).



Latest measured value indicated 11.020 mA

→ In this context, please compare the key outline diagram in section 2.3 and section 3.1 "Setting of measuring type"

1) The new setting DC-I 40 mA is saved permanently in the DPM, so that DC-I 40 mA is selected automatically when the DPM is switched on again.



→ For installation, refer to section 1.4 "Measuring connections".

if 99999 flashes: current value exceeds 40 mA!

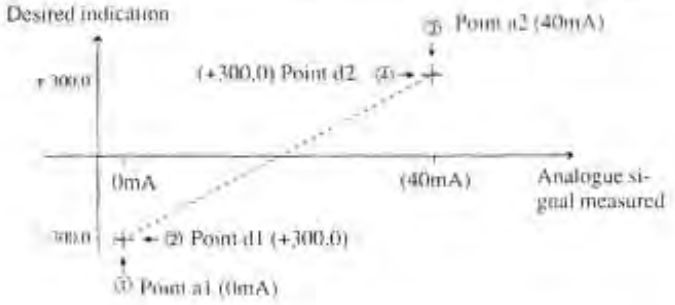
Current ≡ DC I 20mA AC I 50mA
DC I 40mA AC I 100mA

5.3 Display Scaling

Assume, the measured analogue signal (the current of 0...40 mA) is from a flow sensor. 0 mA indicates a negative flow of -300.0 ml, and 40 mA a positive flow of +300.0 ml.

Display scaling is set by means of the four values (linear setting as per section 3.2), i.e.:

① + ②:	0 mA (point a1) is to indicate -300.0 (point d1)
③ + ④:	40 mA (point a2) is to indicate +300.0 (point d2)



5

Enter programming mode by pressing the two keys, as described above:

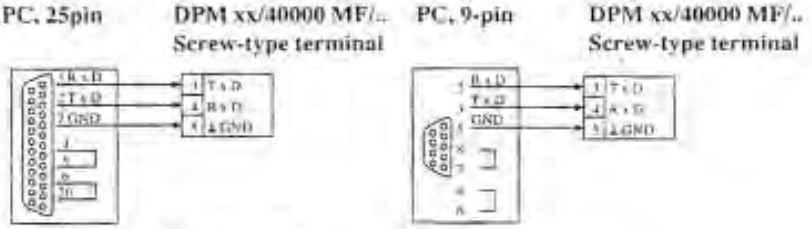
To exit the operating level: Press both keys for 3 seconds

Setting level	Set			Conf
Configuration level				Scale
① Analog:	a1	Set point a1		A1.Con
				00.000
② Display:	d1	Set display d1		d1.Con
				-300.0
③ Analog:	a2	Set point a2		A2.Con
				40.000
④ Display:	d2	Set display d2		d2.Con
				300.00

5.4 Connecting the DPM to a computer

Connection

Connection to a PC or a different RS-232 control requires a cable which enables at least communication of the signals TxD (Transmit Data), RxD (Receive Data) and GND (Signal Ground). The signal CTS (Clear To Send) can be connected optionally. Normally PCs and other RS-232 hosts must be connected by means of a Submin plug, whereas the DPM is connected by means of screw-type terminals.
9600 baud is recommended for operation in the menu mask mode (refer to section 2.4). Also, refer to section 1.6 and 3.10.



Configuration software for use with a PC

"PC-DPM" configuration program: We recommend the use of the ITT Instruments dedicated configuration program "PC-DPM". This is easy to use and generally does not require any additional setup of the PC.

Operation of "PC-DPM": First connect the DPM to the PC, as described above, switch-on and start the program as follows:

1. Insert the "PC-DPM" disc into drive A.
2. At the DOS prompt, type A:PC-DPM<return>, to start the program.
   The first menu (language options) appears on the PC monitor.
3. Type the appropriate letter.
4. Press the Return key to call the menu mask from the DPM.
5. The menu mask is operated by the PC keyboard. Section 2.4 describes the operation of the menu mask mode in detail.

Alternative programs: It is possible to use commercially available "terminal emulation" programs for the PC's serial interface instead of the ITT "PC-DPM". These programs must enable ASCII characters received from the DPM to be displayed on the PC monitor, and PC keyboard entries to be retransmitted to the DPM. The serial port parameters (baud rate, parity etc.) must be set as described in section 3.10. If the DPM menu mask is to be used, the program must be compatible with the control character set of TV905.
After the DPM has been switched on, it should send the message "DPM" which should appear on the PC monitor. In the "Init" state, the DPM should respond with "?" when Return has been pressed. Now DPM commands can be entered as per section 2.5. To call the DPM menu mask, press 'Y' and <return>.
If any bad characters appear on the screen, check the setting of the interface parameters and the TV905 emulation of the program you use on the PC.

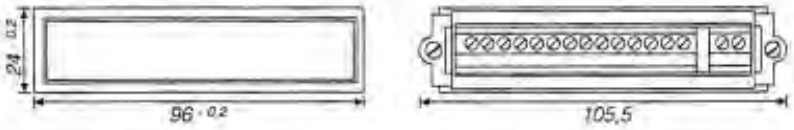
6 Technical Data

6.1 Mechanical data

Case: black
Type of enclosure: Case: IP 65 –Terminals : IP 20 – Frontbezel: IP 65
Standard: DIN 43700 and DIN 43718

DPM 24/40000 MF

Weight: approx. 210 g

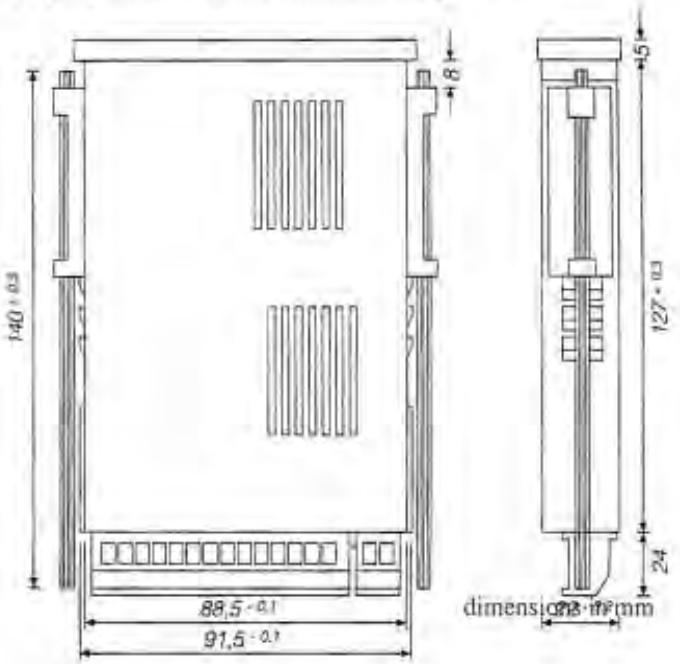


⚠ Make sure that the unit is properly mounted before connection and power on.

Screw-type fixing

Panel cutout:
$92^{+0,8}$ x $22,2^{+0,3}$ mm

Max. panel thickness:
1 - 22 mm



Snap-in fixing

(optional)

Panel cutout:
$92^{+0,4}$ x $22,2^{+0,3}$ mm

Max. panel thickness:
1,5 - 3,5 mm

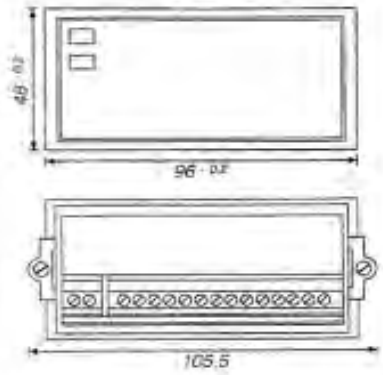
Mosaic-type fixing

Direct fixing for Subklew, Mauell and other mosaic systems is possible. Further information available on request.

Max. panel thickness: 1.5 mm - 22 mm

DPM 48/40000 MF/R2

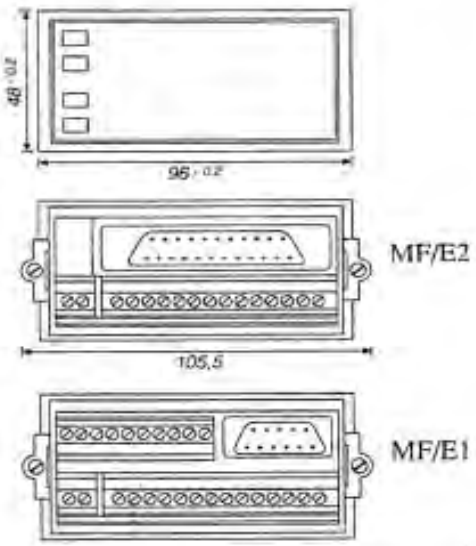
Weight: approx. 260 g



Make sure that the unit are properly mounted before connection and power on.

DPM 48/40000 MF/E . .

Weight: approx. 370 g



Screw-type fixing

Panel cutout:
$92^{+0.8}$ x $45{,}5^{+0.6}$ mm

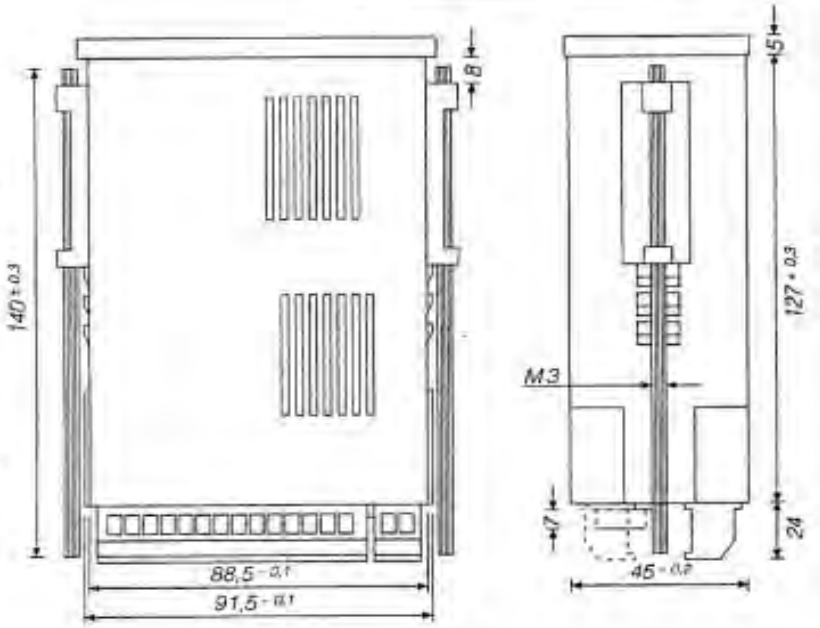
Max. panel thickness:
1 - 22 mm

Snap-in fixing

(optional)

Panel cutout:
$92^{+0.4}$ x $45{,}5^{+0.3}$ mm

Max. panel thickness:
1,5 - 3,5 mm



Mosaic-type fixing

Direct fixing for Subklew, Mauell and other mosaic systems is possible. Further information available on request.

Max. panel thickness: 1.5 mm - 22 mm

6.2 Measurement data

Overview - Measuring types:

DC voltage AC voltage	DC-U AC-U (TRMS[1])	± 200 mV to 650 V 500 mV to 650 V
DC current AC current	DC-I AC-I (TRMS[1])	± 20 mA to 40 mA 50 mA to 100 mA
Temperature measurement	PT 100 Thermocouples	2-, 3-, 4-wire connection Type K, J, T, E, U, L, N, R, S, B

Measuring rate	approx. 10/sec., depending on measuring type

[1] With DPM..MF/E.. models: DC-coupled true RMS value measurement; with the other models: average value measurement.

General data:

CMR	> 140 dB Max 250 V (DC or AC 50 Hz)
NMR	> 50 dB (AC 50 Hz) 40 dB (AC 60 Hz)
Service temperature range	0 °C ... 50 °C
Storage temperature range	– 40 °C ... 80 °C
Supply voltage Influence	in the range of auxiliary voltage of 50 - 250 V AC plus < ± 0,02 % FS

Reference conditions (Ref Cond):

Temperature	23 °C ± 2 °C
Power supply (auxil. voltage)	24 Vdc ± 10 %
Frequency (Measuring range AC)	50 Hz ± 2 Hz

Terms:

LSD	Least Significant Digit (internal resolution; possibly not displayed, but available from the serial interface)
FS	Full Scale

Absolute maximum ratings

U input (16)	650 V
I input (15)	250 mA / 2,5 V
U_S, U_D (13, 12)	25 V
P_{ti} (11)	63 V

Voltage measuring types

DC-U DC voltage Ranges +/–	200mV	400mV	2V	4V	20V	40V	200V	400V	650V
Resolution (LSD)	5 µV	10 µV	50 µV	0,1mV	0,5mV	1mV	5mV	10mV	50mV
Resolution, display	10 µV		0,1mV		1mV		10mV		100mV
Overload	650 V								
Input resistance Leakage current	> 100 M Ohm 20 pA		> 2 M Ohm 20 pA						
Accuracy (Ref. Cond.)	0,04 % FS ± 4 LSD		0,03 % FS ±3 LSD						
TK 0...50 °C	≤ 50 ppm/°C								

Current measuring types

Continuous current DC-I Ranges +/–	20 mA	40 mA
	Higher ranges with external shunt	
Voltage drop	200 mV (10 Ohm)	400 mV (10 Ohm)
Resolution (LSD)	0,5 µA	1 µA
Resolution, display	1 µA	
Overload	250 mA (2,5 Volt)	
Accuracy (Ref. Cond.)	0,04 % FS ± 3 LSD	
TK 0...50 °C	≤ 75 ppm/°C	

AC Voltage measuring types [2])

AC-U AC voltage Ranges	0,5V	1,0V	5V	10V	50V	100V	500V	650V
Resolution (LSD)	50 µV	100 µV	0,5mV	1mV	5mV	10mV	50mV	0,1V
Overload	max. 650 V_{rms} / max. 60 V_{DC}							
Input resistance Leakage current	>100 M Ohm 20 pA		>2 M Ohm 20 pA					
Accuracy (Ref. Cond.)	0,2 % FS ± 4 LSD							
TK 0 ... 50 °C	≤ 100 ppm/°C							
Effect of frequency variations (typ) 40 ... 400 Hz (MF)	2 %		0,1 %					

AC Current measuring types [2])

Alternating current AC-I	50 mA	100 mA
Ranges	Higher ranges with external shunt	
Voltage drop	500 mV (10 Ohm)	1000 mV (10 Ohm)
Resolution (LSD)	5 µA	10 µA
Overload	250 mA_{rms}	
Accuracy (Ref. Cond.)	0,2 % FS ± 4 LSD	
TK 0...50°C	≤ 125 ppm/°C	
Note [2])	All AC spezifications are for input levels above 1/100th of range.	

DPM..MF/E.. models: TRMS (true root mean square value)

Response time	< 2 sec (digital filter 0 .. 3)
Crest factor (typ)	4 (max. crest value + 50 % of measuring range)
Effect of frequency variations plus (typ) from 5 V range	30 .. 1500 Hz – 0,1 % 15 .. 2500 Hz – 1 % 5 .. 5000 Hz – 5 %

Temperature measuring types PT 100

PT 100 as per DIN 43 760 Type of connection	2 wire	4 wire	3 wire
Range	– 200 °C to + 850 °C		
Resolution	0,1 °C		
Current at sensor	< 1 mA		
External resistance	10,00 Ohm [1]	max 500 Ohm	max 50 Ohm symmetrical
Accuracy (Ref. Cond.)	0,2 °C (–200 +200) +/– 1 LSD 0,4 °C (+200 +850) +/– 1 LSD		0,4 °C +/– 1 LSD 0,8 °C +/– 1 LSD
Break indication	Display flashes "99999" [2] Interface *****		
TK 0...50 °C	0,04 °C/K		
Indicating unit	selectable: Centigrade, Fahrenheit, Kelvin		
Note:	[1] External compensation required [2] Not in case of 4 wires		

Thermocouple measurement

Effect of cable resistance	< 1,5 µV/10 Ohm
Break indication	Display flashes "99999" Interface *****
TK 0...50 °C	100 ppm/°C - depends on range and type of thermocouple - related to thermoelectric e.m.f.
Indication adjustable	in °C Centigrade °F Fahrenheit Abs Kelvin

Thermocouple	Range °C Ref-Temp.: 0 °C	Accuracy (Ref. Cond.)	Resolution
Type J IEC 584 Fe-CuNi	-210 / 1200	1,5 °C	0,2 °C
Type L DIN 43710 Fe-CuNi	-200 / 900	1 °C	
Type T IEC 584 Cu-CuNi	-260 / 400	1 °C	
Type U DIN 43710 Cu-CuNi	-200 / 900	1 °C	
Type K IEC 584 NiCr-NiAl	-260 / -150 -150 / 1370	2 °C 1 °C	
Type E IEC 584 NiCr-CuNi	-260 / 1000	1°C	
Type N BS 4937 Nicrosil-Nisil	-260 / -50 -50 / 0 0 / 1000	2°C 1,5 °C 1°C	
Type R IEC 584 Pt 13Rh-Pt	-50 / 1230 1230 / 1770	1,5 °C 2 °C	0,5 °C
Type S IEC 584 Pt 10Rh-Pt	-50 / 1340 1340 / 1770	1,5 °C 2 °C	
Type B IEC 584 Pt 30Rh-Pt 6 Rh	400 / 1820	2 °C	1,0 °C
Remarks:	Accuracy, excluding reference junction Constantan: CuNi Chromel: NiCr		

Cold junction compensation	
Service temperature range	0 - 50 °C
Accuracy, incl. thermal contact	1 °C

6

6.3 Analogue output / Relays

MF models (all data related to display value)

Resolution	> 2000 steps in the range of 0-20 mA > 1600 steps in the range of 4-20 mA
Precision	± 0,5 % of f.s.d. value of 20 mA
Response time	typ 0.1 sec
Voltage range	min 5 V/max. 250 Ohm

MF/E.. models (all data related to display value)

Resolution	> 4050 steps in the range of -20mA to 20mA
Precision	± 0,15 % of f.s.d. value of 20 mA
Response time	typ 0.2 sec
Voltage range	min 7,5 V / max. 375 Ohm

Relay data (MF/E.. and R2 Models only)

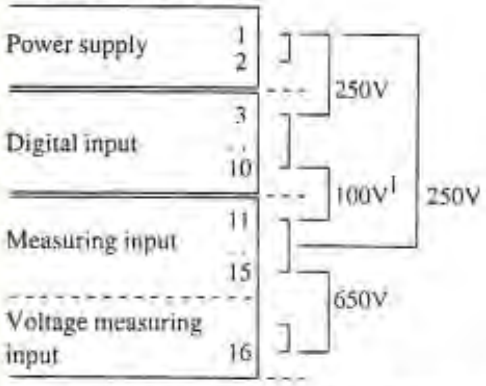
	DPM 48/40000 MF/E1, R2	DPM 48/40000 MF/E2
Rated load	50 Vac 1 A 30 Vdc 1 A	30 Vac 1 A 30 Vdc 1 A

6.4 Power supply unit

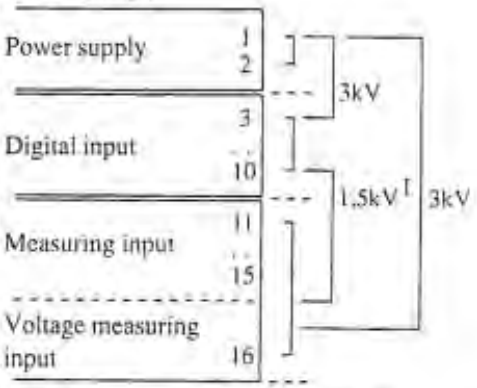
Wide-range power supply unit for DC and AC voltages from 19 V. All voltages are supplied via the terminals A and B. The instrument adapts itself automatically to the voltage concerned, so that there is no need for the user to make any adjustments.

Power supply, auxiliary voltage	DC voltage	AC voltage
Rated voltage ranges	24 .. 48 Volt ± 20 %	24 .. 230 Volt +15% / –20%
Service voltage	19 .. 60 Volt DC	19 .. 266 Volt AC
Power consumption (typ) apparent power at 24 V at 115 V at 230 V	1,6 .. 2,5 Watt	3 Watt 2,5 VA 20 VA 40 VA
External fuse ratings: (Not included with delivery)	24 V: 400mA S	115 V: 200mA S; 230 V: 100mA S
Note:	A, B: polarity of no importance	
Safety class	IEC 1010-1 (1990) + amend. 1 (1992) (NFC42020 (1993)) Power supply: Overvoltage category: CAT II 264Vmax Input/output: Overvoltage category: CAT I 50Vmax Degree of pollution: 2 > 2,5 kV without cables	
EMC	CISPR 11:1990 / EN55011 (1991): group 1, class B IEC 801-2: 1991 / EN50082-1 (1992) level 2 IEC 801-3: 1991 / EN50082-1 (1992) level 2 IEC 801-4: 1991 / EN50082-1 (1992) level 2 CE	
The residual ripple must not exceed the specified voltage ranges.		

Rated / Service voltages



Test voltages



Please note: Any voltages exceeding the max. admissible rated / service voltages may damage the unit internally.

1) DPM 48/40000 MF/E2 rated /service voltage 30 V

6.5 Maintenance

The instrument does not require any maintenance. It is adjusted in an automatic adjustment station. Thus recalibration, as well as repair and service, can only be effected by authorized repair centers or by the factory.

For further information please contact your local representative or the factory.

6.6 Accessories

Accessories supplied with the DPM:

- Plug connectors with screw-type terminals
  8-way
  2-way
  10-way (only DPM 48/40000 MF/E1)
- Leaf spring for snap-in fixing
- Locating device for screw-type fixing
- Sockets for mosaic-type fixing

Accessories, available on request:

- Filter discs with imprint of measuring variables:
  mV, V, kV, µA, mA, A, kW, °C, %, U/min, m, mm, m/min, g.
- Gasket/Sealing 48 x 96 for all DPM 48/... Order Nr. 352 35 86 125, Ref. MC 1089
- Configuration package (one type for all models)
  with RS-232C cable DPM-PC (25-way or 9-way)
  and DOS-compatible software "PC-DPM" for DPM configuration
  on 3 1/2" and 5 1/4" floppy discs

Additional accessories available on request.

Updated: 02'95

Due to the enormous amount of information provided, we regret not to be able to absolutely exclude typographical errors or discrepancies in spite of a meticulous preparation. Thank you for understanding this situation: please do not hesitate to let us know any suggestions for improvement. We cannot accept any liability for the contents of this manual and reserve the right to modify and amend it in the course of technical progress.

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