HYDROTECHNIK
Limburg

Messen mit System

User Manual

for

Multi-Handy 2045

L3160-00-25.50E

Please read the user instructions carefully, before putting the measuring instrument into operation

Preface

This user manual is a description of the hand held measuring instrument Multi-Handy 2045 with the following measuring inputs:

-   2 measuring inputs for sensors with standardised, analogue output signals of 0 to
    20 mA or 4 to 20 mA. The measuring channel p1 is prepared for the measurement
    of pressure only. In the second measuring channel p2 temperature, volume flow rate
    and RPM can be measured additionally, besides pressure.

-   1 interface RS 232 for the transfer of stored measuring values to the PC.
    With an additional interface converter printouts are possible.

Even though difficulties in operating the Multi-Handy 2045 are unlikely to occur, you will only be able to exploit all its efficiency when you know the instrument in full detail.
Should you encounter unexpected problems, please ask for our support.

Alterations are subject to technical progress.

We hope that you will experience your

Multi-Handy 2045

as a reliable partner for exact and easy measurements.

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General

The measuring instrument Multi-Handy 2045 made by company HYDROTECHNIK GmbH, Limburg is an effi-
cient hand held measuring instrument for the measurement of pressure, pressure peaks, pressure differential,
volume flow rate, rev. speed and temperature.
The instrument disposes of an internal memory (15 000 measuring values) for the storage of the measured
physical variables. This measuring data is directly transferred to the PC via a serial interface.
A printer can be connected to the measuring instrument via an interface converter and can print out the measur-
ing data either as a table or a graphic.

Rechargeable batteries make the Multi-Handy 2045 independent from a regular source of current. For recharg-
ing the batteries an external plug-in power supply unit is available.

The Multi-Handy 2045 disposes of two measuring inputs for the connection of sensors with a standardised,
analogue output signal of 0 to 20 mA or 4 to 20 mA.
A direct measurement of frequency can't be realised with this instrument.
However, with corresponding frequency/current converters (F/DC-converters), it is possible to convert the
frequency signals into standardised 4 to 20 mA signals, which can be evaluated by the measuring instrument. In
doing so it is possible to measure RPM and volume flow rate.

Possibilities for the connection of HYDROTECHNIK-sensors to the Multi-Handy 2045

Measurement of temperature

Temperatursensor
4 bis 20 mA

or

Measurement of pressure
Pressure sensor type HD

Measurement of pressure
Pressure sensor type HD
4 to 20 mA

Measurement of volume flow rate

Measuring turbine RE3/RE4
inductive transducer with F/DC-
converter output signal 4 to 20 mA

RS 232 interface

p2   p1

Charging of battery

Mains adapter 230 VAC/
secondary 24 VDC

alternatively

Gear flow meters GFM, with
magnetoresistor sensor and
F/DC-converter, output signal
4 to 20 mA

or printer
connection
via interface
converter

p1 =
[bar] 128.6

Multi Handy 2045

Measurement of RPM

with optical rev. speed
probe DS03 with
F/DC-converter output
signal 4 to 20 mA

or

Measurement of RPM

Scanning of the rev. speed from gear
wheels: inductive transducer with
F/DC-converter output signal 4 to 20 mA

Instructions for charging the batteries

Before each operation of the measuring instrument, you should make sure that the nickel-cadmium batteries are fully charged.
The use of a HYDROTECHNIK plug-in power supply unit (primary 230 VAC, secondary 24 VDC) ensures a continuous charging of the batteries.

Please take into consideration that the batteries are only slightly charged when leaving the manufacturer. We recommend connecting the plug-in power supply unit to the measuring instrument for at least approx. 14 to 16 hours prior to initial use.

The measuring instrument is able to measure when supplied by any other power unit or a car battery but in such cases the recharging of the batteries can not be ensured, as a stabilised power source of 24 to 30 VDC is needed for this.

If a battery is discharged it should be recharged for 16 hours, the instrument being switched off.

The service life of nickel-cadmium batteries can be very long, depending greatly on their respective working conditions. It should be avoided that the batteries are totally discharged, permanently recharged or immediately recharged after each use. Discharging them below 50 % and recharging them afterwards has got a positive impact on the life span of nickel-cadmium batteries. Due to the so-invoked memory-effect that reduces cell capacity, recharging nickel-cadmium batteries after very short time of use cannot be recommended.
If the battery is repeatedly discharged to a minor degree but immediately re-charged, the cell's capacity will soon be reduced. If that is done over a longer period of time the battery can suffer permanent damage.
There is a chance, however, to regenerate said damage by a number of discharging and recharging cycles, i.e. by using the instrument for a longer period and then recharging the battery.

Should the batteries not be charged sufficiently, a warning will be displayed „Charge batteries". In such cases a minimum of 16 hours recharging time is urgently required.

Please take the following, Important comments

concerning your security and the operational security of your instrument, into consideration:

- Don't submit the instrument to extreme heat or humidity.

- Never open the instrument by yourself.

- Please pull the mains adapter out of the wall socket:

  1. during a thunderstorm
  2. if you detect a bad smell or smoke

- Please protect your sensors from:

  1. exceeding the allowed voltage supply range
  2. overloading the allowed pressure measuring range mechanically
  3. wrong pin configuration, especially at sensors from other manufacturers

For your special attention:

Should the housing be polluted, please clean it with a soft cloth, moistened with a mild detergent (Please pay attention to the notes of the manufacturer).
Strong chemical solvents may not be used, as they attack the housing.

Make a contribution to the environmental protection !
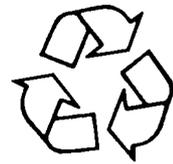
Recycling for environment's sake !

Used batteries do not belong into the household refuse.
Please throw your batteries into a special receptacle for disposal
of refuse and sewage.

1. Operation Multi-Handy 2045

Two measurable variables can be shown at the same time on the 2-line LCD-display.
The first line is reserved for the pressure channel p1. In the second line either pressure p2, , pressure differential dp, temperature T, volume flow rate Q or rev. speed n can be shown.
On the keyboard you will find two keys, which can only be pressed in connection with another key.

These are the keys [Prog / ENT] and [→ $\hat{p}$] .

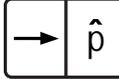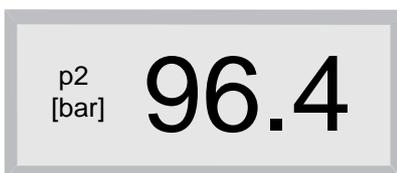In doing so you have to take into consideration that the period between pressing the first and the second key must not be longer than three seconds. After three seconds the key pressed first will be ignored.
All inputs need to be finished with „Prog/ENT".

1.1   Display examples

Depending on the number and the type of variables, the values are displayed in different sizes.
In the following you will find several examples about the display-possibilities of your instrument.

```
  initialisation
  version 1.xx
```

After having switched on the instrument, this menu will appear for approx. three seconds.

After, that, the measuring value display will appear automatically.

```
p1
[bar]   128.5
p2
[bar]    96.4
```

By pressing for example key [p_1] the display shows the corresponding value as a single, enlarged number.
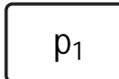
```
p1
[bar] 128.5
```

If the measuring value of p2 shall be shown in the same size, you only have to press key [p_2] and the corresponding pressure measuring value of p2 is displayed.
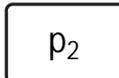
```
p2
[bar]  96.4
```

Another stroke of key [p_2] shows the usual display
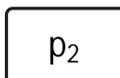
```
p1
[bar]   128.5
p2
[bar]    96.4
```

with two lines, indicating the measuring values of p1 and p2.

```
p1^   128.5  / 345.2

p2^    96.4  / 297.3
```

```
p1
[bar]      128.5
p2
[bar]       96.4
```

```
p1
[bar]      128.5
dp
[bar]       32.1
```

```
p1
[bar]    128.5

dp
[bar]    32.1
```

```
p1
[bar]      128.5
N
[rpm]       1467
```

```
p1
[bar]      128.5
Q
[°C]        128.6
```

```
p1
[bar]      128.5
T
[°C]         19.8
```

If the min./max.-values shall be shown during the pressure measurement, for example the min./max.-values of channel p1 in the first, and of channel p2 in the second line, you have to press the keys
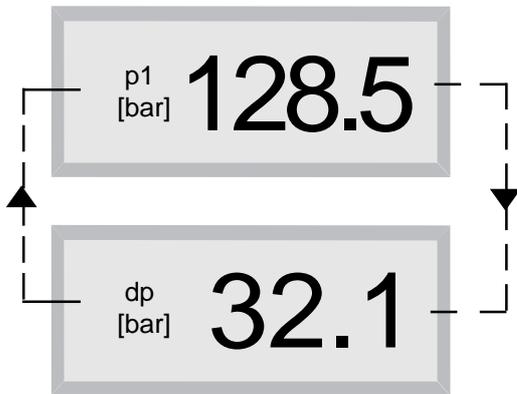
$\boxed{\rightarrow\ \hat{p}}$ and $\boxed{p_1}$ for the first line and the

keys $\boxed{\rightarrow\ \hat{p}}$ and $\boxed{p_2}$ for the second line.

The normal pressure display is shown by pressing

the keys $\boxed{p_1}$ and $\boxed{p_2}$.

This display shows a pressure differential out of both measuring values.

After a stroke of key $\boxed{\uparrow\ \frac{\Delta p}{(p_1 - p_2)}}$ the measuring value:

$$\Delta p = p1 - p2 \quad (128.5 - 96.4 = \mathbf{32.1})$$

is displayed in the second line.

As already described on page 7, an enlargement of

the display can be achieved by pressing key

$\boxed{p_1}$ and key $\boxed{\uparrow\ \frac{\Delta p}{(p_1 - p_2)}}$.

The measurement of RPM N instead of p2 in the second line of the display can be invoked with a

stroke of key $\boxed{n\ Q\ T}$.

The measurement of volume flow rate Q instead of p2 in the second line of the display can be invoked with a

stroke of key $\boxed{n\ Q\ T}$.

The measurement of temperature T instead of p2 in the second line of the display can be invoked with a stroke

of key $\boxed{n\ Q\ T}$.

We have refused to give further examples to avoid confusion.

1.2   Initialisation

It can happen, that the information in digital storage systems is distorted, due to very heavy electromagnetic interference, not within the values of the EN 50081 and EN 50082, that can occur in industrial plants.
This shows itself in an amount of data that must be considered unrealistic or the instrument doesn't react on a keystroke any more.
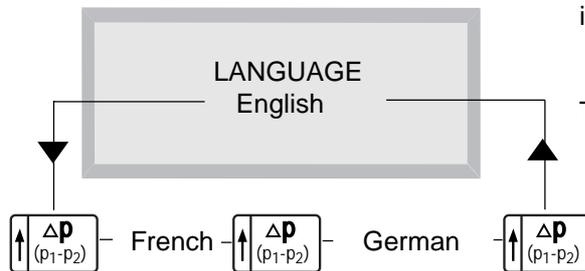For this case you have the possibility to set all data back to a given state by a so-called re-initialisation. However then, all data like calibration value, language, units of measurement, output signal of the pressure- and temperature sensors and all parameters, entered previously by the user, are deleted.

The re-initialisation is started by switching the measuring instrument on and by pressing the following keys within 3 seconds:

p_1 and p_2 and $\Delta p\ (p_1\text{-}p_2)$.

```
initialisation
version 1.xx
```
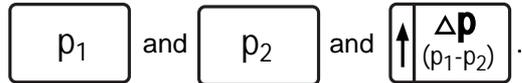
Afterwards you can choose among German, English or French as your operation language by pressing key $\Delta p\ (p_1\text{-}p_2)$, which is now acting as a cursor.

The selection needs to be confirmed with key Prog/ENT .

```
LANGUAGE
English
```

$\Delta p\ (p_1\text{-}p_2)$ — French — $\Delta p\ (p_1\text{-}p_2)$ — German — $\Delta p\ (p_1\text{-}p_2)$

After this, the display for the selection of SI- or US units of measurement appears automatically.
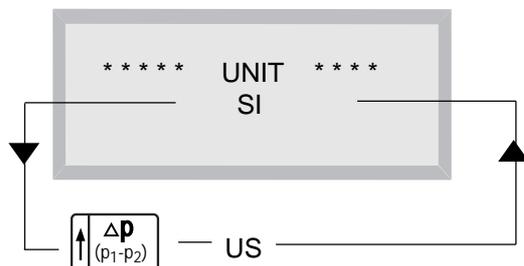
With key $\Delta p\ (p_1\text{-}p_2)$ that is now acting as a cursor, you can switch between SI- and US units of measurements.

```
* * * * *    UNIT    * * * *
SI
```

$\Delta p\ (p_1\text{-}p_2)$ — US

The SI-units are for example bar, °C, l/min., etc..
After the change-over to US-units, the usual units like psi, °F, gal/min. are used.
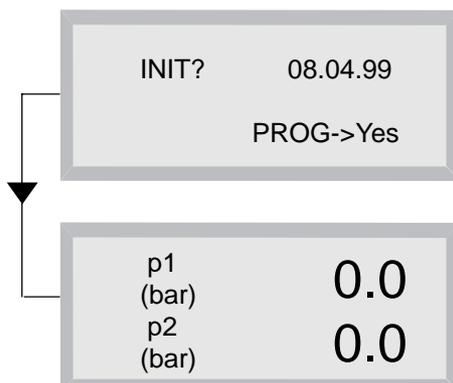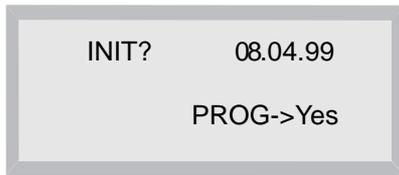
The instrument automatically asks for the initialisation. Here you can decide whether you want to initialise or not.

If no initialisation is requested any key except „Prog/ENT" may be pressed and the measuring value display is shown.

If you request an initialisation, press key Prog/ENT and all

```
INIT?       08.04.99

PROG->Yes
```

```
p1          0.0
(bar)
p2          0.0
(bar)
```

data like calibration value, units of measurement, selection of the output signal of the pressure sensors, entered previously, is deleted.

```
 ┌─────────────────────────┐
 │  INIT?        08.04.99   │
 │                         │
 │            PROG->Yes    │
 └─────────────────────────┘



 ┌─────────────────────────┐
 │                         │
 │         INIT?           │
 │          ✳              │
 │                         │
 └─────────────────────────┘



 ┌─────────────────────────┐
 │  p1                     │
 │  [bar]         0.0      │
 │  p2                     │
 │  [bar]         0.0      │
 └─────────────────────────┘
```

If you request an initialisation, press key o and all data like calibration value, units of measurement, selection of the output signal of the pressure sensors, entered previously, is deleted.

For a short moment, the display shows „INIT" together with a rotating bar, which indicates, that the parameters, entered by you, are deleted and overwritten by the basic adjustments.

Afterwards the instrument returns directly into the measuring value display.

After an initialisation, the following basic adjustments are valid:
Pressure measurement p1 and p2 in the display
Pressure measuring range programmed to 0 to 200 bar
Signal inputs of p1, p2, T, Q and N adjusted to 0 to 20 mA
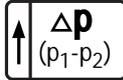Measuring units in SI

2. Programming

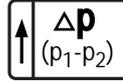**2.1 Selection of pressure sensor for signal 0 to 20 mA or 4 to 20 mA**

As it is possible to connect pressure sensors with an output signal of either 0 to 20 mA or 4 to 20 mA, it is imperative to inform your measuring instrument about the signal-type of your sensor.

By pressing key [Prog/ENT] and key [0-20/4-20], the following programme is invoked.


```
* * PROG   SENSOR TYPE *
p1: 0-20    p2 : 0-20      mA
T  : 0-20    Q  : 0-20
N  : 0-20
```
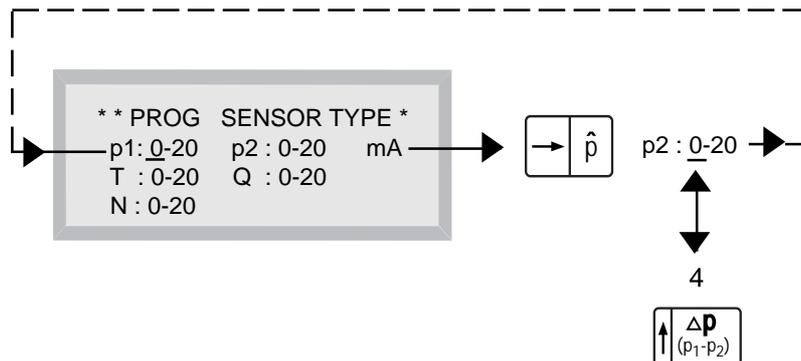
The change-over to 4 to 20 mA is made by a stroke of key $\boxed{\Delta p\ (p_1\text{-}p_2)}$, which is now acting as a cursor and which switches p1 to the requested current signal. Please take into consideration, that a flashing bar signalises the switching from 0 to 4 (mA) in the example.
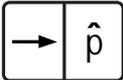
A stroke of key $\boxed{\rightarrow\ \hat{p}}$, which is also used as a cursor in this case, switches directly to p2.

Here the current signal can be switched to 4 to 20 mA with key $\boxed{\Delta p\ (p_1\text{-}p_2)}$, too, as already mentioned above.

The switching back to 0 to 20 mA is made in the same way.

Please don't forget to press key „Prog/ENT" to confirm your selection.

In the example the pressure sensor p2 was switched to 4 to 20 mA, of course the adjustments of every single channel can differ.
With the cursor key, showing to the right, the corresponding measuring channel will be selected. With the cursor key, showing upwards, the current range 0 to 20 mA or 4 to 20 mA can be selected.

The selection must be confirmed with key $\boxed{Prog\ /\ ENT}$.

```
* * * * * * PROG * * * * * *
           ✳
```
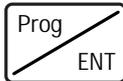
After key $\boxed{\frac{\text{Prog}}{\text{ENT}}}$ was pressed a rotating bar will be shown

for approx. 3 sec. and the selected signal will be stored in the instrument. After this, the measuring value display will be shown automatically.

```
* * PROG   SENSOR TYPE *
 p1: 4-20   p2 : 4-20    mA
 T : 0-20   Q : 0-20
 N : 0-20
```
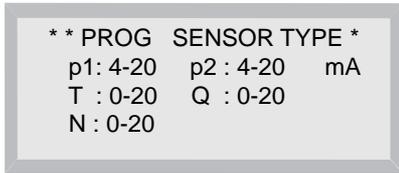
As an example you can see here a display after having switched the pressure channels p1 and p2 to 4 to 20 mA.

2.2 Checking of current signal adjustment
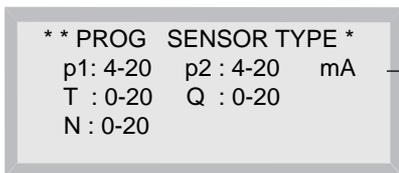
You have the possibility to check which current signals

```
* * PROG   SENSOR TYPE *
 p1: 4-20   p2 : 4-20    mA
 T : 0-20   Q : 0-20
 N : 0-20
```

were chosen, when invoking this display with key $\boxed{\frac{\text{0-20}}{\text{4-20}}}$.

In the example the same current signals were chosen for p1 and p2.

After approx. 3 seconds, the display returns automatically into the measuring value display.

Measuring value display

3 s

```
 p1
 [bar]    0.00
 p2
 [bar]    0.00
```
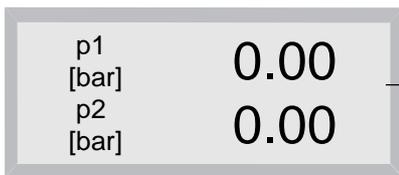
2.3 Error message at 4 to 20 mA sensors

```
 p1
 [bar]    ━ ━ ━ ━ ━ ━
 p2
 [bar]    ━ ━ ━ ━ ━ ━
```
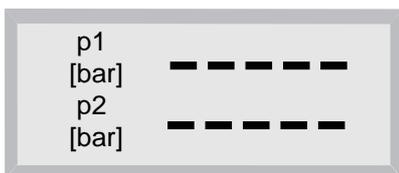
If this display appears, no current signal is lead to the measuring input. A reason for this error can be missing connections (a missing measuring cable) between sensor and measuring input, a parting of a cable or a defective sensor.
In this case, you will be directly informed about possible errors by an optical status display (life-zero recognition). This visual signal is only possible for the signals of 4 to 20 mA.

Please take into consideration, that different adjustments of the current signals can be made for pressure sensors (p1 and p2).

For example: p2 = 4 to 20 mA
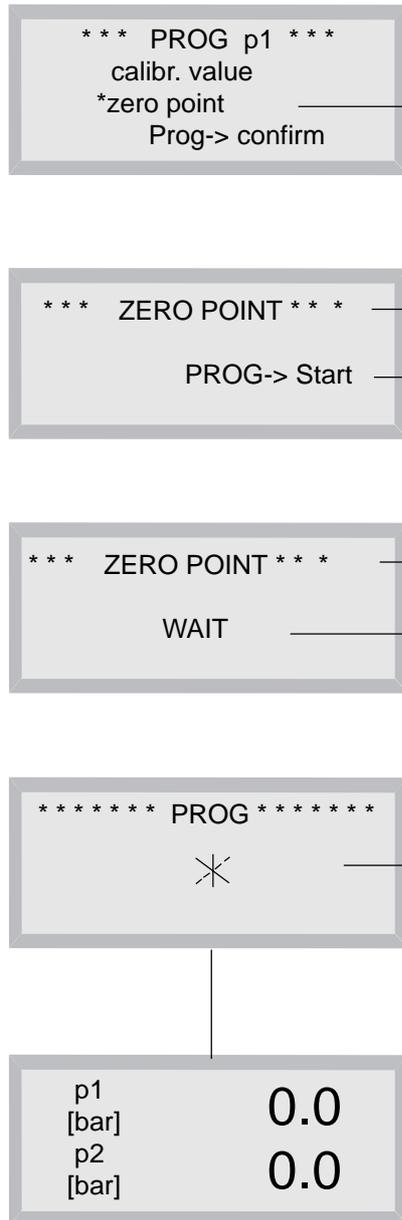   p1 = 0 to 20 mA

2.4 Measuring value display at 4 to 20 mA sensors

```
 p1
 [bar]    0.0
 p2
 [bar]    0.0
```

If the pressure sensor works correctly, the measuring value display will be shown in the usual way without horizontal lines.

3. Measurement of pressure

3.1 Adjustment of pressure measuring range

To be able to measure pressure, you have to select the measuring range of the pressure sensor with the keys [Prog / ENT] and [p_1].

The following display is shown in which you can select among calibration value and zero point alignment with key [$\uparrow$ Δp (p_1-p_2)].

```
* * *   PROG  p1  * * *
 *calibr. value
  zero point
        Prog-> confirm
```

In the example the calibration value is selected. Please pay attention to the star symbol (*) which marks the selection.

With key [Prog / ENT] the selection is confirmed and the following display is shown.

With the cursor key [$\uparrow$ Δp (p_1-p_2)] either -1 or 0 can be entered as the beginning of the measuring range. Please pay attention to the flashing cursor below the figure to be selected.

```
* * *   PROG  p1  * * *
  -1    . . .  6.00    bar
```

After the selection, key [$\rightarrow$ $\hat{p}$] will lead you to the input of the end of the measuring range and the cursor is flashing there. In the example 60.0 is entered as the end of the measuring range.

To store the pressure measuring range in the measuring instrument key [Prog / ENT] must be pressed.


```
* * * *  PROG P1
  0    . . .   60.0    bar
```

```
* * * * * * *  PROG  * * * * * * *
              ✳
```

During the storage a rotating bar is display for approx. 2 sec. and afterwards the measuring value display is shown again.

The pressure measuring range for p2 is adjusted in the same way !

3.2 Zero point alignment

When measuring negative pressures and precise pressure differentials and if the connected pressure sensor has a small zero point deviation, it is advantageous to submit it to a zero point alignment.

```
* * *   PROG  p1  * * *
    calibr. value
  *zero point
       Prog-> confirm
```

Starting from menu „PROG P1" you select the programme „Zero point alignment" by pressing key $\boxed{\uparrow \begin{array}{c} \Delta\mathbf{p} \\ (p_1\text{-}p_2) \end{array}}$.
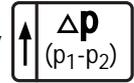
Please pay attention that your selection is marked with a star symbol * and that it is confirmed with key $\boxed{\begin{array}{c}\text{Prog} \\ \text{ENT}\end{array}}$ afterwards.

```
* * *   ZERO POINT * * *


      PROG-> Start
```

For the zero point alignment the pressure sensor p1 must be removed from the plant what means, that the alignment must always be carried out on a depressurized sensor.

```
* * *   ZERO POINT * * *


         WAIT
```

If the sensor has no pressurisation its zero point can be aligned with a stroke of key $\boxed{\begin{array}{c}\text{Prog} \\ \text{ENT}\end{array}}$.

```
* * * * * * * PROG * * * * * * *

           ✳
```
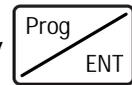
The display shows „WAIT".
The zero point deviation of the pressure sensor is determined and stored as a correction value while a rotating bar is displayed.

```
p1
[bar]        0.0
p2
[bar]        0.0
```

After the zero point alignment the measuring value display is shown automatically.
If pressure measurements are carried out now, an existing zero point deviation is taken into consideration by the internal software as a correction value for all measurements.

If you want to carry out a zero point correction for another pressure sensor, e.g. p2, you should act as described above. You only have to press keys „Prog" and „p2" instead of „Prog" and „p1".

3.3 Measurement of pressure peaks

3.4 Invocation of min./max. values in the display
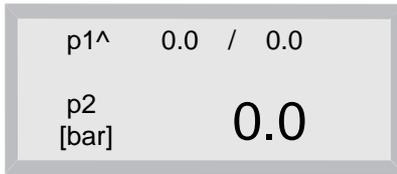
The min./max. values of pressure p1 and p2 are continuously stored in a memory in the background and can be shown in the display on request.

This is made by a stroke of the keys �→ $\hat{p}$ and p_1 .

```
p1^    0.0  /  0.0

p2
[bar]        0.0
```
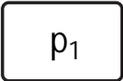
To be able to see the min./max. values in the lower line, too,

press the keys →$\hat{p}$ and p_2 .

```
p1^    42.2 / 267.2
p2^   130.4 / 377.9
```
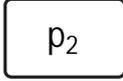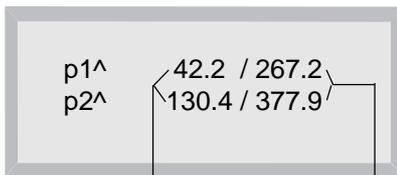
min.-value or max.-value for pressure p1 and p2

The min./max. values can only be shown for the pressure of p1 and p2.
Please take into consideration, that a measurement of pressure peaks is only possible up to the pressure measuring range end value of the pressure sensor, chosen by you, with an additional tolerance of max. 10%. The pressure measuring range end value 600 bar for example, plus additionally 10%, results in a maximum pressure peak value acquisition of 660 bar.
Higher pressure peaks will be limited to 660 bar.

3.5 Deletion of pressure peak

```
p1^     42.2 / 267.2

p2^    130.4 / 377.9
```

By pressing the keys Prog/ENT and →$\hat{p}$,

you can delete the min./max. value memories of p1 and p2. The note, that both min/max. memories are deleted, is shown briefly in the display.

```
* * * * DELETE * * * * *
MIN/MAX-MEMORY
```
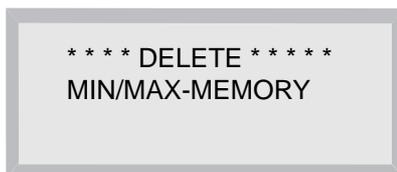
If the pressure sensors measure certain operational pressures, the extreme value memories will be set back to these pressure levels.

```
p1^    320.4 /  320.4

p2^    290.2 /  290.2
```

As an example, a deletion and a setting back to the operational pressures that are existing in the hydraulic plant at that moment, are shown.

3.6 Change-over from measurement of pressure peaks to normal pressure measurement

```
p1
[bar]        42.2
p2
[bar]       377.9
```

With a stroke of key p_1 and key p_2 ,
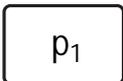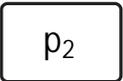
you can switch the instrument back to normal pressure measurement. The example shows the switching over to pressure p1 and p2 (both keys have to be pressed one after the other).

3.7 Measurement of pressure differential

Scheme:
Pressure differential alignment
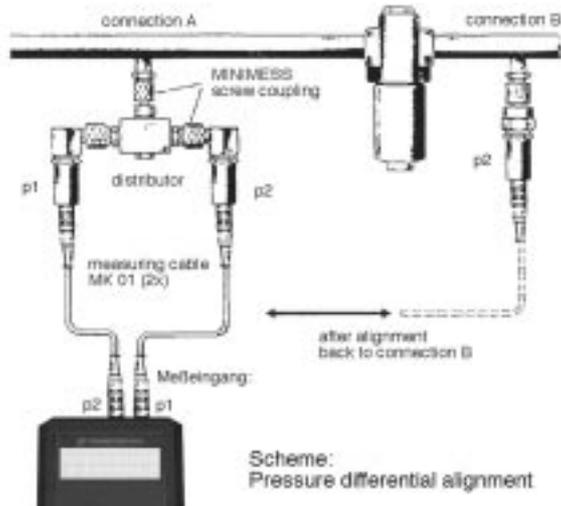
Precise pressure differential measurements are only possible, if both pressure sensors are aligned at the operational pressure, which will be used for the later measurement.
Of course this is the same pressure for both pressure sensors.
To carry out a pressure differential alignment, you have to mechanically connect both pressure sensors p1 and p2 to the same pressure level via a distributor (see scheme „Pressure differential alignment").

You can also use pressure sensors with different pressure measuring ranges, but in this case you should always pay attention to their pressure load on the sensor to avoid a damage of the sensor.

In the example an operational pressure of 308 bar is shown in the display.

| p1 [bar] | 308.7 |
| p2 [bar] | 308.2 |

The change-over with key $\uparrow \Delta p\ (p_1-p_2)$ shows a pressure differential of 0,5 bar.

With a stroke of the keys $Prog\ ENT$ and $\uparrow \Delta p\ (p_1-p_2)$ you can carry out an automatic alignment for approx. 2 seconds, what is shown in the display.

| p1 [bar] | 308.7 |
| dp [bar] | 0.5 |

The deviations of both pressure sensors are set to zero at the corresponding operational pressure level, see display (pressure differential of both pressure sensors = zero).

```
* * *  PROG dP * * *

alignment  2  sec
```

After the alignment you have to mechanically connect the pressure sensor p2 to the connection B (see scheme „Pressure differential alignment").

Now you can carry out precise measurements of pressure differential without being influenced by sensor deviations, temperature drifts and offsets.

| p1 [bar] | 308.7 |
| dp [bar] | 0.0 |

Please take into account, that a pressure differential is always displayed with the correct sign, corresponding to the mathematical formula.

$$(qp = p1 - p2).$$

4. Measurement of temperature

```
p1
[bar]   308.7
T
[°C]     23.8
```

Single display for temperature

```
T
[°C]  23.8
```

Instead of pressure p2 a Pt 100 temperature sensor with a current output signal of 0 to 20 or 4 to 20 mA can be connected to this measuring input.
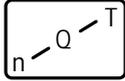
You only have to press key [n Q T] as long as the second line of the display shows T in (°C).

The temperature measurement is shown in the lower line of the display.

The temperature measurement is shown in the lower line of the display.

If you want the temperature measuring value to be displayed, only, press the keys [p_1] and [n Q T] , one after each other.
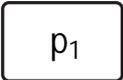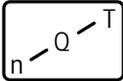
The way to switch over the current signal from 0 to 20 mA to 4 to 20 mA and vice versa, is already described on page 11, chapter 2.1, for pressure sensors.

Please take into account, that the temperature measuring range is fixed (calibration: -50 °C to +200 °C).

```
p1
[bar]   308.7
T
[°C]    -50.0
```
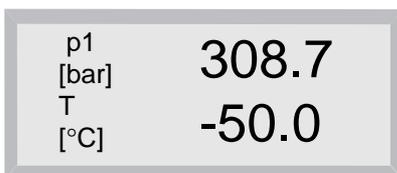
If T (°C) -50 is displayed, the temperature sensor isn't connected to the measuring instrument.
This is only valid for the adjustment of sensor type 0 to 20 mA.

```
p1
[bar]   308.7
T
[°C]    - - - -
```

If T (°C) —— is displayed, the temperature sensor isn't connected to the measuring instrument.
This is only valid for the adjustment of sensor type 4 to 20 mA.

5. Measurement of volume flow rate

A condition for the measurement of volume flow rate is the connection of a measuring turbine or a gear flow meter with integrated F/DC-converter.
That means, the frequency signals measured by the volume flow rate sensor must be converted into current signals from 4 to 20 mA.

```
 p1      308.7
[bar]
 Q       0.000
[l/min]
```
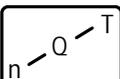
Key [n — Q — T] needs to be pressed until Q in (l/min) is shown in the second line of the display.

5.1 Input of calibration value

```
* * * PROG Q * * *
   *calibr. value
    zero point
PROG -> confirm
```
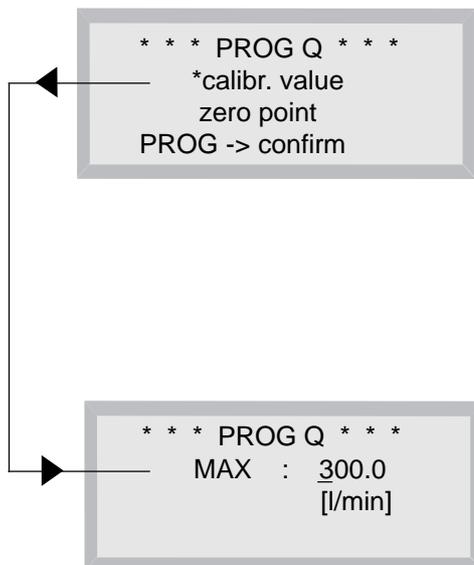
When connecting a volume flow rate sensor, for example turbine or gear flow meter, the max. volume flow rate needs to be entered as a calibration value.

The programme for entering this calibration value is invoked with the keys [Prog / ENT] and [n — Q — T] .
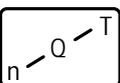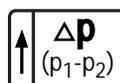
Key [↑ Δp $(p_1 - p_2)$] serves for the switching between the input of the calibration value and the zero point alignment.

```
* * * PROG Q * * *
   MAX  :  300.0
            [l/min]
```

Please take into consideration, that the star * marks the selected line, in this example the line „calibration value".
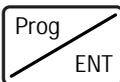
With key [Prog / ENT] the selection needs to be confirmed and instrument immediately asks for the input of the max. volume flow rate (measuring range end value).
The max. volume flow rate can be seen on the label of the volume flow rate sensor, in the example the max. volume flow rate is 300.0 l/min.

The input is made as already described on page 13, paragraph 3.1, however for volume flow rate sensors you have to programme the end of the measuring range, only.

5.2 Zero point alignmenth

```
* * * PROG Q * * *
    calibr. value
   *zero point
PROG -> confirm
```
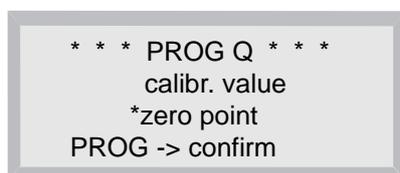
Starting from menu „Prog Q" the key [↑ Δp $(p_1 - p_2)$] serves for the switching between the input of the calibration value and the zero point alignment.
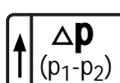
In the example the zero point alignment is selected (* !) and confirmed with key [Prog / ENT] .

Please carry out the zero point alignment as described on page 14, paragraph 3.2.

6.   Measurement of rev. speed

A condition for the measurement of RPM is the connection of a rev. speed sensor with integrated F/DC-converter. That means, the frequency signals measured by the rev. speed sensor must be converted into current signals from 4 to 20 mA.

When connecting an optical rev. speed sensor with F/DC-converter to the instrument, the calibration value needs to be entered as follows:
- when using one reflective foil, the calibration value 9999 needs to be entered
- when using more than one reflective foil, the calibration value can be calculated as follows:
10.000 : Number of reflective foils = calibration value

6.1 Input of calibration value

When connecting an inductive rev. speed sensor with F/DC-converter, e.g. acquisition of the RPM at a gear ring, the calibration value is calculated as follows:

10.000 : Number of pulses per rotation (number of teeth) = calibration value

```
* * * PROG N * * *
    *calibr. value
     zero point
 PROG -> confirm
```

The programme for the input of the calibration for the rev. speed sensor is invoked with the keys [Prog ENT] and [n Q T]. The following display is shown.

```
* * * PROG N * * *
 MAX  :  9999
           [U/min]
```
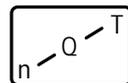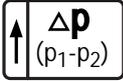
Key [↑ Δp (p₁-p₂)] serves for the switching between calibration value and zero point alignment.

  Please take into consideration, that the star * marks the selected line, in this example the line „calibration value".
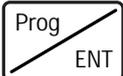
With key [Prog ENT] the selection needs to be confirmed and instrument immediately asks for the input of the max. rev. speed (measuring range end value).
The max. rev. speed can be seen on the label of the rev. speed sensor, in the example the max. rev. speed is: 9999 rpm (referring to one reflective foil).

The input is made as already described on page 13, paragraph 3.1.

Starting from menu „Prog N" the key [↑ Δp (p₁-p₂)] serves for
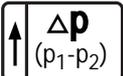
6.2 Zero point alignment

the switching between the input of the calibration value and the zero point alignment.

```
* * * PROG N * * *
    calibr. value
    *zero point
 PROG -> confirm
```

In the example the zero point alignment is selected (* !) and confirmed with key [Prog ENT].
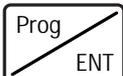
Please carry out the zero point alignment as described on page 14, paragraph 3.2.
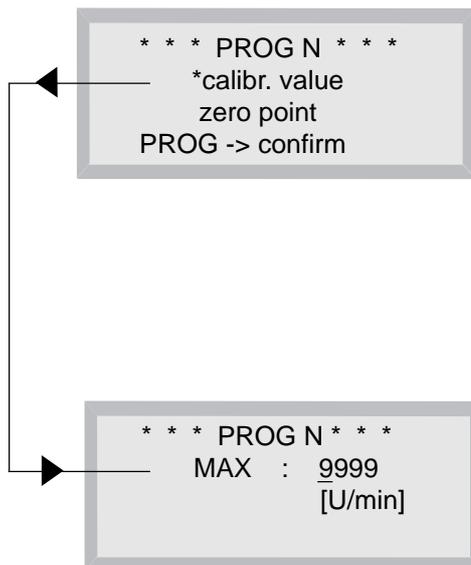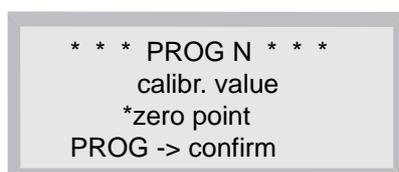
6.3   Further technical advice for the measurement of rev. speed

The rev. speed probe DS 03 with F/DC-converter, used by HYDROTECHNIK, is working as a reflective light barrier, that means, the light-sender as well as the receiver are situated in one housing.
To measure rev. speed the user only has to stick-on a reflective foil on the turning object to be measured.
Pollution, borings or keyways are suppressed effectively by the measuring principle (polarisation filter), only the light reflection of the foil is evaluated as a turning pulse.

At very large diameters of shafts or fans it can happen, that instable or interrupted rev. speeds are displayed. If this is the case, the number of reflective foils should be increased, that means several foils need to be stuck on the object to be measured, one besides the other.
This will improve the optical scanning and a correct measurement of rev. speed is achieved.

If you request rev. speed measurements below 60 min^{-1}, you can realise this by sticking-on several reflective foils. In any case you should modify the input of the pulses per rotation (see above) and take the instructions for the input of calibration values on page 18, paragraph 6.1, into consideration.
Rev. speed measuring range relating to one reflective marking: 60 min^{-1} to 9999 min^{-1}.

If you request measurements of rev. speed on gear wheels, an inductive transducer with integrated amplifier and F/DC-converter needs to be used.
Here, the number of teeth of the gear wheel needs to be entered into the measuring instrument as pulses per revolution, too (see paragraph 6.1 on page 18).
The ideal distance for sticking on the reflective markings depends on the form of the teeth.
Usually the distance between the inductive transducer and the tooth is 1 to 2 mm.

For these very small measuring distances the sensor needs to be fixed **very safe and stable**.

7.   Storage of measuring value

A maximum of 30.000 measuring values can be stored.

7.1 Selection of the measurable variables to be stored

```
* memory channels *
    scanning rate
  PROG -> confirm
```

With the keys [Prog / ENT] and [Memory / Scan] the menu „memory channels / scanning rate" is invoked.

With key [↑ Δp (p_1-p_2)] you can select between „memory channels" and „scanning rate".

The star symbol shows the selection which needs to be confirmed with key [Prog / ENT] .

In the example „memory channels" was selected.

Standard selection p1, p2 and dp

```
*   memory channels  *
*p1                  dp
 p2
 PROG -> confirm
```

The next menu will be displayed immediately in which the corresponding memory channels are to be chosen

with the keys [p_1] or [p_2] or [↑ Δp (p_1-p_2)] ,
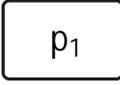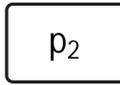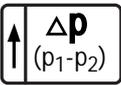
a maximum of three memory channels is possible.
As an example, memory channel p1 was chosen and

the selection was confirmed with key [Prog / ENT] .

Memory selection p1 and Q

```
*   memory channels   *
*p1
 Q
 PROG -> confirm
```

In the display the max. possible storage time is shown for a short moment.

If one of the variables T, N or Q shall be stored, one of these variables needs to be selected in the measuring

mode with key [n _ Q _ T] .
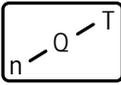
The storage time depends on the adjusted scanning rate, the smaller the scanning rate, the shorter the storage time.

```
    storage time

      15 sec
```

7.2 Adjustment of the scanning rate

```
*    memory channels   *
 *  scanning rate
  PROG -> confirm
```

With the keys [Prog / ENT] and [Memory / Scan] the menu „memory channels / scanning rate" is invoked.
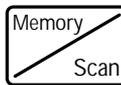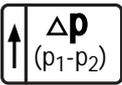
With key [↑ Δp (p_1-p_2)] you select „scanning rate" which is marked with the star symbol.

Press key [Prog / ENT] to confirm you selection.

```
*      scanning rate      *

          1 ms
```
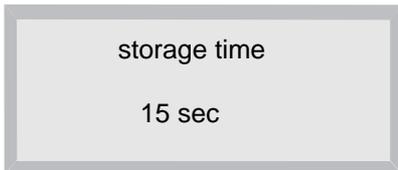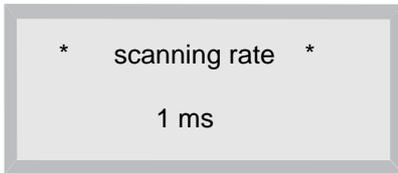
The menu for the input of a corresponding scanning rate is displayed automatically.

The following, fixed scanning rates can be chosen:

1, 10, 100, 500, 1000 and 10 000 ms.
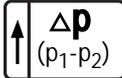
Press key $\boxed{\uparrow \; \begin{array}{c} \Delta p \\ (p_1\text{-}p_2) \end{array}}$ until the requested value is shown

in the display.

As an example a scanning rate of 1 ms was chosen and

confirmed with key $\boxed{\begin{array}{c} Prog \\ \diagup \\ ENT \end{array}}$.

```
       storage time

          15 sec
```

In the display the max. possible storage time is shown for a short moment.

```
p1
[bar]    128.5
p2
[bar]     96.4
```

After that the current measuring value display will be shown again.

7.3 Storage

```
p1
[bar]    128.5  ▯
p2
[bar]     96.4  ▮
```

If you have defined both parameters „memory channels" and „scanning rate", you can start the storage of the

measuring values with the keys $\boxed{\begin{array}{c} Start \\ \diagup \\ Stop \end{array}}$ and

$\boxed{\begin{array}{c} Memory \\ \diagup \\ Scan \end{array}}$.
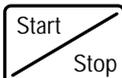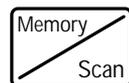
The state of the storage is indicated by a vertical bar, which is filled according to the storage. If the storage is finished, the bar will disappear.
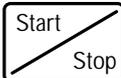
With key $\boxed{\begin{array}{c} Start \\ \diagup \\ Stop \end{array}}$ a storage can be interrupted any

time.

If new measuring data is stored, the old data will be overwritten.

7.4 Storage time (from version 1.0k on)

The following table will give you a general idea of the possible duration of a storage.
The storage time to be expected depends on the scanning rate and the selected memory channels.

scanning rate	memory channel p1 (storage time)	memory channel p1 and p2 (storage time)	stored measuring values (depending on scanning rate)
1 ms	30,00 sec	15,00 sec	each 1 ms
10 ms	5,00 min	2,3 min	arith. value out of 8 meas. values
100 ms	50,00 min	25,00 min	arith. value out of 64 meas. values
500 ms	4,10 h	2,05 h	arith. value out of 64 meas. values
1000 ms	8,20 h	4,10 h	arith. value out of 64 meas. values
10 000 ms	83,20 h	41,4 0 h	arith. value out of 64 meas. values

7.5 Data transfer of the stored measuring values to the PC

To transfer measuring data an adapter cable (4-poles plug at D-Sub box) needs to be connected to the PC via an additional standard RS 232 data cable. The corresponding software HYDROcomsys/WIN is started at the PC and the measuring instrument is switched on.

All further steps for the transfer of measuring data to the PC will be carried out with the software HYDROcomsys.

8. Print out

As the connected printer needs to be adapted to the measuring instrument, you have to fix the correct printer type before a printing.

When selecting a Hewlett-Packard printer, please pay attention to the following peculiarity:

When selecting the printer, you already have to indicate, whether the printout shall be black/white or in colour, due to the variety of HP-printers of series Deskjet. Afterwards, the special HP-printer model needs to be selected (only valid for the HP-printers).

8.1 Selection of printer type

```
* *        PRINTER        * *

            Epson 9
         PROG-> confirm
```

Epson 24

IBM-Propr.

DPU

HP mono

HP color

```
* *        PRINTER        * *

            HP color
         PROG-> confirm
```

```
* *        PRINTER        * *
         HP 400/540/600
            HP 660/890
         PROG-> confirm
```

HP 320/340

HP 500/520
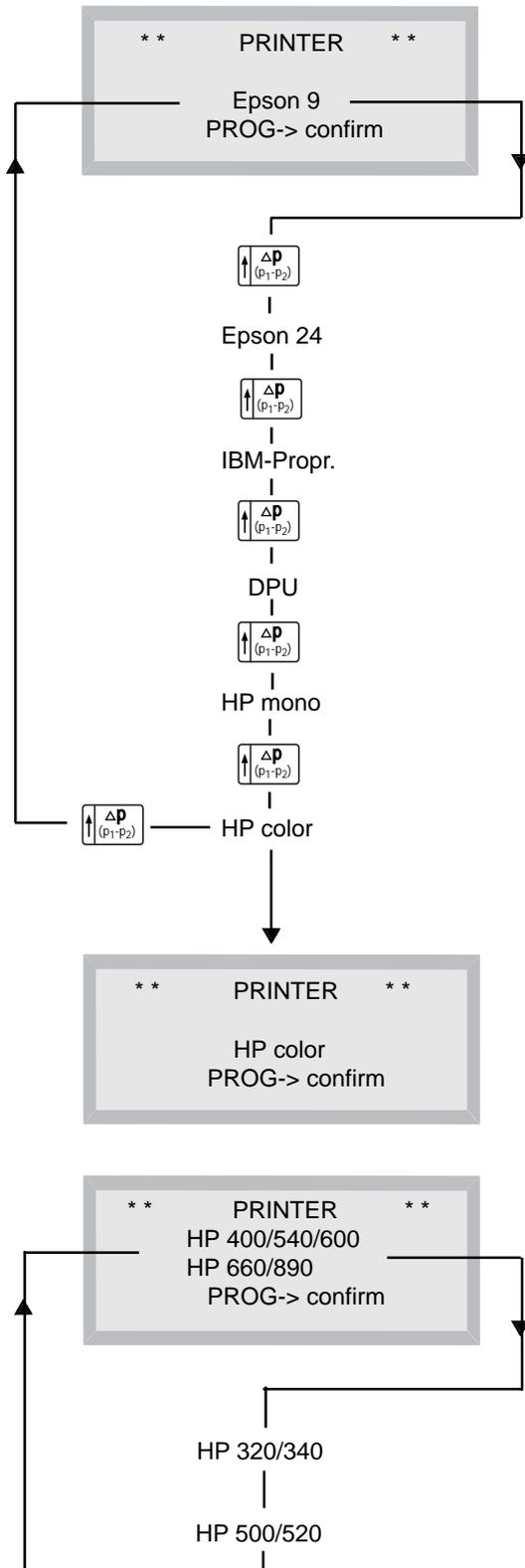
With the keys [Prog / ENT] and [Printer], the printer drivers in the measuring instruments are displayed.

The following printer drivers are supported:

1. Epson 9-pin printer
2. Epson 24-pin printer
3. IBM-Proprinter
4. DPU 411
5. HP-Deskjet b/w
6. HP-Deskjet color

With several strokes of key $\left[\uparrow \dfrac{\Delta p}{(p_1-p_2)}\right]$, all printer types are displayed, see scheme on the left.
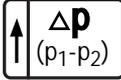
If, for example, the HP color printer is selected and the selection is confirmed with key [Prog / ENT], certain printer drivers are invoked in another display.

The display of further printer drivers can be achieved with key $\left[\uparrow \dfrac{\Delta p}{(p_1-p_2)}\right]$.
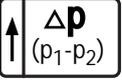
If you have selected the requested printer driver, you have to confirm this with key [Prog / ENT].

```
* * * * * *  PROG  * * * * * * *

              ✳
```

In the display „PROG" and a rotating bar is shown which indicates, that the selected printer driver is stored in the EEPROM.

```
p1
[bar]     128.5
p2
[bar]      96.4
```

After this, the instrument automatically switches back into the measuring value display.

For the transfer of measuring data an interface converter is necessary, which converts the serial data into parallel ones for the printer.

Another condition for the transfer of measuring data is, that data has been stored.

8.2 Selection of printing mode

```
* *       Figure       * *

             table
        PROG-> confirm
```

```
* *       Figure       * *

            GRAPHIC
        PROG-> confirm
```
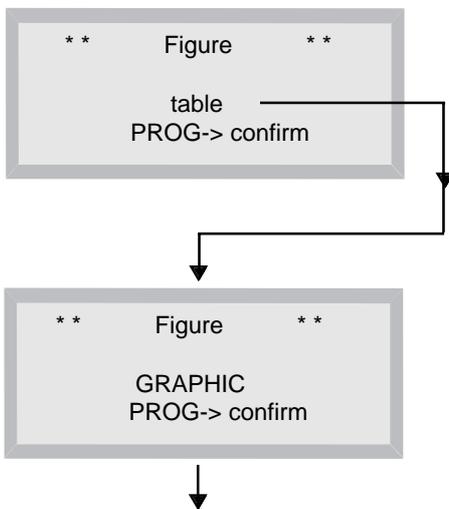
If you want your instrument to print out stored data, you have to press the keys $\boxed{\text{Start}\diagup\text{Stop}}$ and $\boxed{\text{Printer}}$ one after the other and the display, shown on the left, appears.
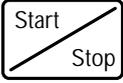
When selecting „Table", all stored measuring values are printed out as a column of numbers.

When selecting „Graphic" with key $\boxed{\uparrow \; \frac{\Delta \mathbf{p}}{(p_1 \text{-} p_2)}}$, you can choose between an automatic and a manual scaling.
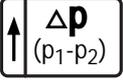
When selecting the automatic scaling all measuring data are adapted to the maximum printing height of the printer.

8.3 Fixing of the scaling

```
* *       Scaling       * *

           automatic
        PROG-> confirm
```

```
* *       Scaling       * *

            manual
        PROG-> confirm
```
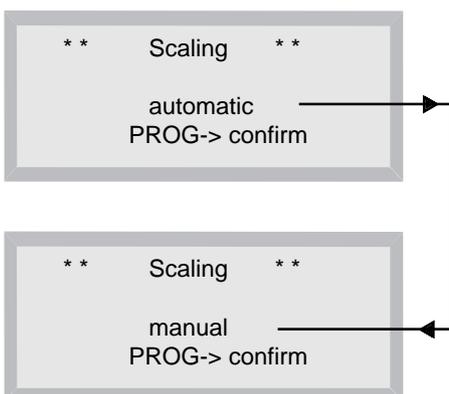
If the measuring values are very close to each other, the corresponding curve can be hard to read.

In this case you should choose the manual scaling.

Please confirm your selection with key $\boxed{\text{Prog}\diagup\text{ENT}}$.

In the example the manual scaling was chosen and the display, shown on the left side, will appear.

```
scaling X         p1
                  bar
*Minval:          25
 Maxval.:         600
```

```
Skalierung        p1
                  bar
 Minval:          25
*Maxval.:         600
```

In this example, the instrument requires the input of the scaling for pressure sensor p1.

The star symbol marks the active input for the minimum value.

To enter the value, please press key [→ | $\hat{p}$] and
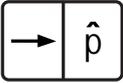
carry out the input, as already described on page 13,

chapter 3.1. For confirmation of the value, press key

[Prog / ENT] .
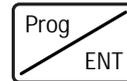
Now, the star symbol is in front of the maximum value and the value is entered in the same way as the minimum value.

```
scaling           Q
                  l/min
*Minval.:         6
 Maxval.:         250
```

```
scaling           Q
                  l/min
 Minval.:         6
*Maxval:          250
```

If you have selected more than one variable during the measuring value storage, this variable needs to be scaled, too. In the example you can see another input for Q.

```
* * * *  PRINTING   * * * *
HP color


Prog->confirm
```

If you have selected more than one variable during the measuring value storage, this variable needs to be scaled, too. In the example you can see another input for Q.

```
* * * *  PRINTING   * * * *
HP color

28%
```

100%

```
p1
[bar]      128.5
p2
[bar]      96.4
```

If you have entered all values for the manual scaling, the instrument activates the previously selected printer type, in the example „HP color" and you can start the

printer with key [Prog / ENT] .

After a few seconds you can see how many percent were printed out, already, and if 100% are achieved, the measuring value display is shown automatically.

A printout can always be interrupted with key [Start / Stop].

Please take into consideration, that you will receive the requested printout only, if you have stored measuring data before or if old data remained in the memory.

9. Technical data of Multi-Handy 2045 (Reference of the specified dat 20 °C ± 3 K)

Measuring inputs:

2 x 5-pole input jacks (Amphenol-Tuchel)
Measuring input p1:for pressure only
Measuring input p2:for pressure, pressure differential dp, can be switched to measurement of temperature or volume flow rate and RPM via F/DC-converter.
Both measuring inputs support standardised current signals of 0 to 20 mA and can be switched over to 4 to 20 mA by internal software.
1 x 4-pole input jack, interface RS 232 for connection to PC.
Printer connection via interface converter serial/parallel.

Measuring ranges:

Pressure:	can be freely adjusted to the corresponding pressure measuring range end value
Temperature:	- 50°C to +200 °C
Volume flow rate:	measuring range end value of the volume flow rate corresponds to an output current signal of 0 to 20 mA or 4 to 20 mA on the F/DC-converter
Rev. speed:	9999 min^{-1} (RPM)

Error limit:

Analogue inputs: ± 0,5% of full scale

Temperature coefficient:

± 0,2 %/10 K

Measuring rate:

Analogue inputs: pressure 1 ms

Resolution A/D-converter:

10 Bit

Measuring value memory:

Max. 30.000 measuring values (depending on selected measurable variable) with scanning rates that can be selected:
1, 10, 100, 500, 1000 and 10.000 ms

Min./max.-value memory:

Min./max.-value storage of p1 and p2 in the background, display by a keystroke

Display:

Graphic display, display of the measuring ranges: max. 5 digits (depending on measuring range and channel)

Power supply:

Internal 14,4 V NiCd-battery, 0,7 Ah for approx. 6 to 8 hours continuous operation with integrated NiCd-battery charger and battery warning device.
External voltage supply via power supply unit
230 VAC or 115 VAC, secondary 24 VDC or via external voltage supply unit (stabilised 24 V - 30 VDC) recommended power supply: 200 mA.

Sensor supply voltage:

supply from the instrument, for battery operation 14,4 V, for plug-in power supply 24 V

Ambience conditions:

Working temperature:0 °C to + 50°C
Relative humidity:<80%, no condensation

Generally:

Material of housing:	Aluminium/ABS-plastic
Dimensions:	152 x 80 x 40 mm (L x W x H)
Weight:	0,695 kg

Modifications, necessary for the technical progress, are subject to change without notice.

Our measuring systems are manufactured according to the European Production Standards and fulfil the EC-directives concerning the electromagnetic compatibility (EMC) according to EN 50081 and EN 50082.

10.   Pin connections of Multi-Handy 2045

Inputs

RS 232   **p2/T**   **p1**

Electrical connection
scheme
Top view of mounting
sockets

Instrument mounting sockets

Attention:
The socket manufacturers have
different names for their
connections.
Please go by our connection
scheme.

p1 =
[bar]   **128.6**

Multi Handy 2045
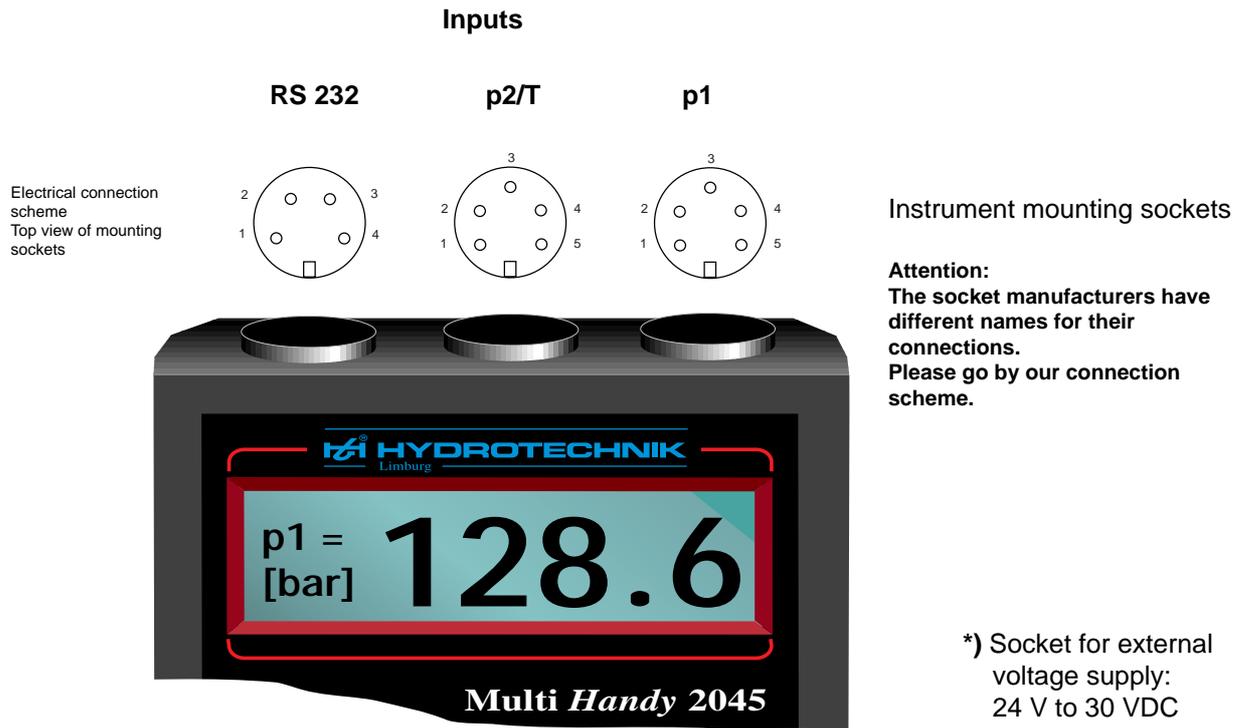
*) Socket for external
    voltage supply:
    24 V to 30 VDC

Small voltage socket
2-poles according
to DIN 45323

Inputs	RS 232	p1		p2	
connection (top view)	Interface RS 232	Analogue signal input		Analogue signal input	
		0 - 20 mA 3-wire	4 - 20 mA 2-wire	0 - 20 mA 3-wire	4 - 20 mA 2-wire
1	GND	Signal + (R_L 100 Ohm)	Signal - (I-) (R_L 100 Ohm)	Signal + (R_L 100 Ohm)	Signal - (I-) (R_L 100 Ohm)
2	RXD	Mass f. Signal- and U_{b-}		Mass f. -Signal and U_{b-}	
3	TXD	int. battery voltage *14,4 VDC I_{out} max. 50 mA	Signal + (I+) *14,4 VDC I_{out} max. 50 mA	int. battery voltage *14,4 VDC I_{out} max. 50 mA	Signal + (I+) *14,4 VDC I_{out} max. 50 mA
4		no connection N/C	no connection N/C	no connection N/C	no connection N/C
5		cable screen	cable screen	cable screen	cable screen

*) Attention when connecting sensors from other manufacturers !!!
When connecting an external voltage supply, e.g. via net adapter of HYDROTECHNIK, the supply voltage for the sensors
is the same as the net adapter voltage of 24 VDC (- approx. 1,5V).
Should you choose a free, external supply voltage for the instrument, the voltage supply for the sensors can be between 24
V and 30 VDC (- approx. 1,5V).

11. Technical background information for connection of pressure sensors, 0 to 20 mA- and 4 to 20 mA-type

pressure sensor 4-20 mA
2-wire technique

Measuring instrument
Multi-Handy 2045

P →

P

I

3 (+I)

1 (-I)   → (4-20 mA)

connection

3   ○ U_b = 14,4 V
      (internal battery)

1   R_L = 100 Ohm

connection

pressure sensor 0-20 mA
3-wire technique

Measuring instrument
Multi-Handy 2045

P →

P

I

3 (power supply)

1 (+signal, 0-20 mA) →

2 (signal- u. U_b-mass)

connection

3   ○ U_b = 14,4 V
      (internal battery)

1

2   R_L = 100 Ohm

connection
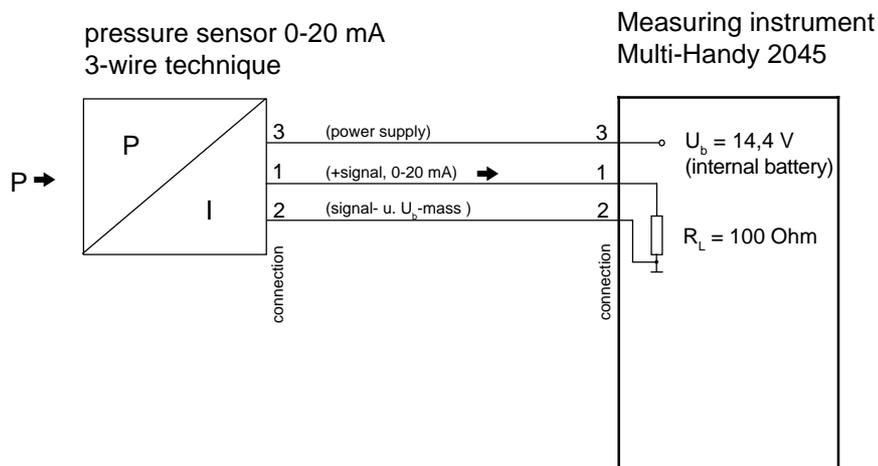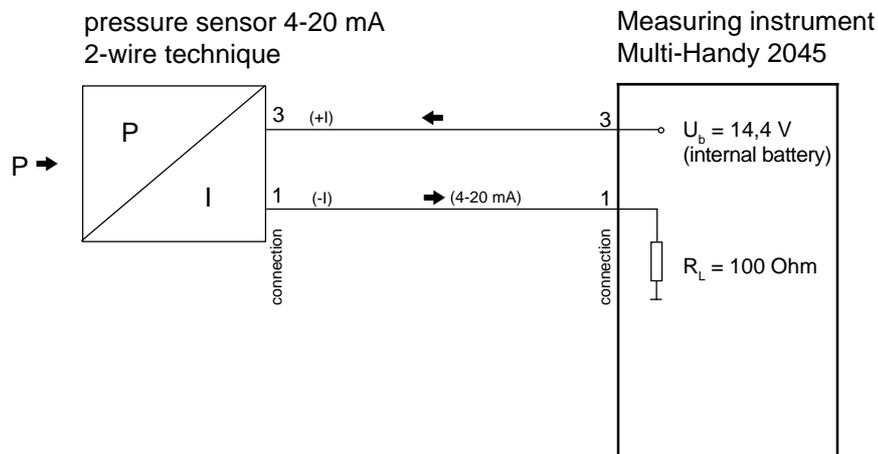
Attention when using sensors from other manufacturers !

With an external voltage supply, for example via the net adapter from HYDROTECHNIK, the supply voltage for the sensors is 24 VDC (- approx. 1,5 V), what is the same as the net adapter voltage. When you connect an external power supply to the Multi-Handy 2045, the supply voltage for the sensors may vary among 24 V and 30 VDC (- approx. 1,5 V).
Please ensure, that the sensors to be connected are designed for this supply voltage, otherwise they could be destroyed.

12. Error detection

The Multi-Handy 2045 has been tested and adjusted at the manufacturer according to the most stringent quality standard. Should you have any problems nevertheless, please check the instrument, according to the following list, first.

Disturbance / wrong operation	Checks / remedy
After the switching-on of the instrument the display shows nothing.	• The battery is empty, please recharge the internal batteries of the instrument with net adapter 230 VAC/ secondary 24 VDC for approx. 14 to 16 hours.
The measuring value display shows horizontal lines, only.	• At 4 to 20 mA sensors it can happen, that the sensor itself, or the measuring cable is not connected or defective. Please check if the sensor or the cable is the reason for the error. Exchange both parts one after the other.
Wrong measurement of pressure or temperature (unlikely measuring values).	• The current signal of the sensor isn't adjusted correctly to 0 to 20 mA or to 4 to 20 mA. Readjust it if necessary. With key $\boxed{{}^{0\text{-}20}\diagup_{4\text{-}20}}$ you can see in the display, which current signal has been chosen.
Temperature display shows -50 °C (room temperature, current signal is adjusted to 0 to 20 mA).	• The measuring cable is not connected with the sensor and the measuring instrument.
The temperature display shows horizontal lines, only.	• The measuring cable is not connected with the sensor and the measuring instrument. The temperature sensor or the measuring cable is defective. This error can occur only when the signal is adjusted to 4 to 20 mA.
Wrong zero point alignment, the values in the measuring value display are too large.	• The zero point alignment was carried out with a pressurized sensor. Please repeat the alignment as described on page 14, chapter 3.2.
Wrong measurement of pressure differential (Dp measuring value is improbable).	• The pressure differential alignment is wrong, please carry out the alignment as described on page 16, chapter 3.7.
Wrong pressure peak values.	• Old min/max. values are still stored in the memory. Before measuring pressure peaks, you always have to delete the content of the memory, see page 15, chapter 3.5.
The display shows „Over".	• The input measuring range has been exceeded. There is either a short circuit in the sensor or the cable or the pressure measuring cell was mechanically overloaded (overpressurized).
The display shows „Charge battery".	• The batteries of the measuring instrument can be recharged with a HYDROTECHNIK net adapter (230 VAC, secondary 24 VDC) or with an external voltage among 24 V and max. 30 V (stabilised) via the external voltage socket. We recommend a charging time of 14 to 16 hours.

13.   Information on guarantee

Within the framework of our guarantee conditions we guarantee the unobjectionable manufacture of our technical instruments.

The guarantee is valid for 6 months.

In principle, the general terms of business are valid.

The right to claim under guarantee becomes invalid, when reparations or interventions are executed by persons, who were not authorised by us.

Within the six months of the guarantee, we will remove free of charge damages or defects, which can be proved to be based on a work's mistake, as far as the customer informs us immediately after having detected it, but within six months at the latest.

The fulfilling of the guarantee is done in a way, that defect parts are repaired or replaced by unobjectionable parts at our choice, free of charge.

Instruments, for which you want to claim under guarantee, have to be sent carriage paid and with a corresponding copy of the invoice or the delivery note to:

HYDROTECHNIK - Service

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14. Maintenance

Your measuring instrument is a precision instrument, which will work without trouble for many years, if it is treated correspondingly.

However, in the case that interference occurs nevertheless, please do not try to repair the instrument by yourself!

Leave the maintenance or the repair up to our

HYDROTECHNIK - Service

Adress   :   HYDROTECHNIK GmbH
                  Holzheimer Straße 94 - 96
                  D-65549 Limburg
                  Tel.: 0 64 31 - 40 04 · 0
                  Fax 0 64 31 - 4 53 08 oder 4 55 52
                  Internet: http://www.hydrotechnik.com
                  e-Mail: hydrotechnik@t-online.de

HYDROTECHNIK
Limburg
Messen mit System

Should your Multi-System 5000 require repair, we depend on your support.
Please describe your complaint as precisely as possible. That enable us to locate the error more easily and you will profit from shorter repair times.

If we have any additional queries, please state the person to contact:

Company:	
Department:	
Name:	
Telephone:	
Fax:	

☒ Please tick the appropriate answer:

Part to repaired:	Your PC	operating system	software
Measuring instr. Sensor Cable Supply unit	386 486 Pentium P 2	DOS Windows 3.1x or Windows 95 NT	HYDROcomsys/DOS: version HYDROcomsys/Windows: version

How to describe an error:

Please leave all parameters etc. unchanged after an error occurs.
Briefly describe your measuring task, connection of sensor, parameter adjustments (for example memory parameters, trigger, how many measuring values are acquired, type of printer, etc.

Your description:

Order data for the Multi-Handy 2040/2045

	part-number
- Hand held measuring instrument Multi-Handy 2040	3160-00-25.00
- Hand held measuring instrument Multi-Handy 2045 with memory and interface	3160-00-25.50
Adaptor 230 VAC / 24 VDC / 340 mA	8812-00-00.19
Adaptor 115 VAC / 24 VDC / 350 mA	8812-00-00.20
Alternating battery	8873-02-00.05

Sensors

							part-number
- **Pressure** (output signal: 4 to 20 mA)	Measuring range	0	to	60	(...	870)	3403-21-A4.37
Pressure sensor type HD	in bar (psi)	0	to	200	(...	29	3403-10-A4.37
		0	to	400	(...	5800)	3403-15-A4.37
		0	to	600	(...	8700)	3403-18-A4.37
Pressure sensor type PR 15 ————————————		-1	to	+6	(-14,5...	8	3403-32-71.37
		0	to	1000	(...	14500)	3403-29-71.37
To select pressure sensors with 0 to 20 mA, the last two numbers of the order-no. need to be changed fro **37** int o **33**, e.g.							3403-xx-xx.33

			part-number
- **Temperature** (screw- in sensor Pt 100) 2-wire technique	Measuring range (°F)	-50 to +200	3969-04-01.00
with output signal 4 to 20 mA, for p/T-test point series 162 (ident.-no.04)		(-58 to +392)	
- **Surface sensor** (Pt 100, 2-wire technique)		(temp.-range:	3170-01-03.00
with output signal 4 to 20 mA, helix cable connectio (approx. 1,2 m stretched)		valid for all	
- **Immersion sensor** (Pt 100, 2-wire technique)		temperature sensors)	3170-02-06.00
with output signal 4 to 20 mA, helix cable connectio (approx. 1,2 m stretched)			

							part-number
- **Volume flow rate**	Measuring range	7,5	to	75	(2 ...	20)	31G7-21-35.00
Measuring turbine RE 3	in l/min (gal/min)	15	to	300	(4 ...	7	31G7-30-35.00
(with f/DC-converter, output signal 4 to 20 mA)		25	to	600	(6,6 ..		31G7-40-35.00
with MINIMESS and p/ T-test points (series 1620)							
(Please see our brochure RE 3 / RE 4 for further technical details)							

							part-number
- **Volume flow rate**	Measuring range	1,0	to	0	(0,26 ...1	2,6)	31G7-01-35.00
Measuring turbine RE 4	in l/min (gal/min)	7,5	to	75	(2 ...	20	31G7-70-35.00
(with f/DC-converter, output signal 4 to 20 mA)		15	to	300	(4 ...	79	31G7-71-35.00
with MINIMESS and p/ T-test points (series 1620)		25	to	600	(6, 6 ...	158	31G7-72-35.00
(Please see our brochure RE 3 / RE 4 for further technical details)							

							part-number
- **Volume flow rate**	Measuring range	0,005	to		(0,0013 1...	0,2 5	3185-01-35.00
Gear flow meter type GFM with f/DC-converter,	in l/min (gal/min)	0,05	t	5	(0,013 .. .	1,3)	3185-02-35.00
output signal 4 to 20 mA		0,2	to	30	(0,05 ...	8	3185-03-35.00
with MINIMESS and p /T-test points (series 1620)		0,7	to	70	(0,18 .. .	1	3185-04-35.00
(Please see our brochure GFM for further technical details)		3,0	to	300	(0,79 ...	79,25)	3185-05-35.00

	part-number
- **Rev. Speed, infrared sensor type DS 03 with analog output 4 to 20 mA** with 25 pieces of reflective foil	3130-06-01.00
- **Adaptor with f/DC-converter 4 to 20 mA,** for retrofitting of rev. speed probe DS 03 with pulse output	3107-00-30.00
- **Reflective foil** (spare parts, 50 pieces)	8840-02-01.01

Accessories

	part-number
- **Measuring cable MK 01** (length 2,5 m) for connection to pressure, temperature- and volume flow rate sensors	8824-91-02.50
- **Connection cable** for external batteries (length 2,5 m)	8824-64-02.50
- **Transport case** (plastic box) for measuring instrument, sensors, direct adapters, measuring cables	3160-00-25.01
- **Transport case** (plastic box) for measuring instrument, sensors, direct adapters, measuring cables and measuring turbine	3160-00-25.02
- **Leather shoulder strap** for Multi-Handy 2040/45	8875-03-00.01
- **Placing shackle**	8845-01-01.02
- **Ink jet colour printer** with plug-in power supply unit and ink cartridges (100 to 240 VAC-50/60 Hz)	8865-01-13.00
- **Spare part ink cartridge,** black	8865-01-09.01
- **Spare part ink cartridge,** colour	8865-01-10.01
- **Data communication cable Centronics** 36-poles/25-poles (interface converter - printer) Accessories for Multi-Handy 2045 only	8824-36-02.00
- **Data communication cable RS 232** to the PC	8824-D4-01.80
- **Interface converter for printer** (serial/parallel)	3160-00-00.33
- **Direct connection for pressure sensor type HD** - straight (series 1620 - M 16 x 2)	2103-07-08.62
- **Direct connection for pressure sensor type HD** - 90 ° (series 1620 - M 16 x 2)	2146-13-05.00
- **Direct connection for pressure sensor type PR 15** - straight (series 1620 - M 16 x 2)	2146-05-30.00
- **Direct connection for pressure sensor type PR 15** - 90 ° (series 1620 - M 16 x 2)	2146-54-19.40
- **p/T-test point 1620** (ident.-no. 04) screw-in thread M 10x1	2149-04-19.13
- **p/T-test point 1620** (ident.-no. 04) screw-in thread ISO 228-G1/4	2149-04-15.13