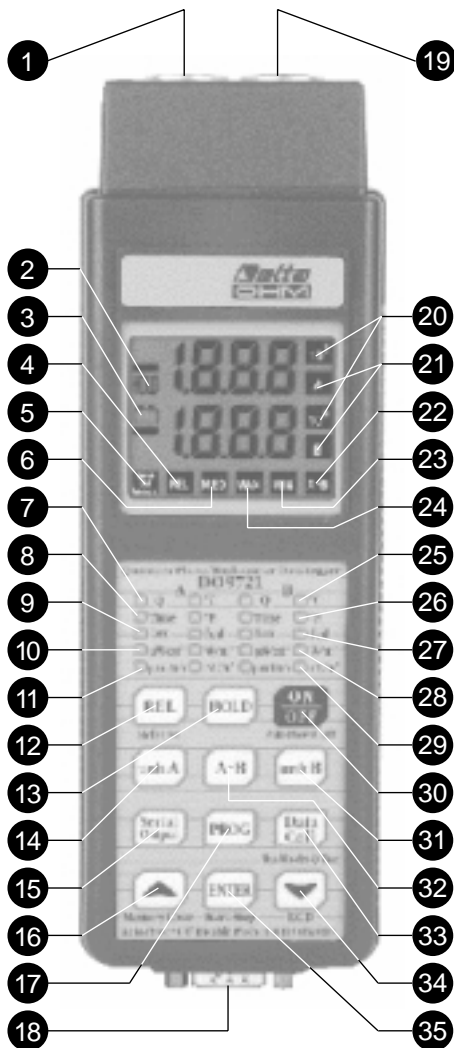


# DO 9721

## INSTRUCTIONS MANUAL



# DO 9721



# DO 9721

QUANTUM-PHOTO RADIOMETER AND THERMOMETER  
DATA-LOGGER

ENGLISH

- 1 Input A, DIN 45326 8-pole connector.
- 2 HOLD symbol, the measurement refers to the moment in which the HOLD key was pressed.
- 3 Battery symbol: flashes during RECORD function, permanently lit if the battery is running low
- 4 REL symbol, indicates that the instrument is making a relative measurement.
- 5 Serial Out/Memory. Fixed symbol: the instrument is storing. Flashing symbol: serial output is enabled.
- 6 MED symbol: the display shows the mean values found during RCD function.
- 7 Q: instrument in Q-energy function, flashes when it has reached the limit.
- 8 Time: the display indicates the integration time, if flashing it has reached the time programmed for integration.
- 9 Lux: the led indicates that the measurement is in lux.
- 10  $\mu\text{W}/\text{cm}^2$ : the led indicates that the measurement is in  $\mu\text{W}/\text{cm}^2$ .
- 11  $\mu\text{mol}/\text{m}^2\text{ s}^{-1}$ : the led indicates that the measurement is in  $\mu\text{mol m}^{-2} \text{ s}^{-1}$ .
- 12 REL key: shows the difference between the current value and the value stored when the REL key is pressed.
- 13 HOLD key for blocking the reading.
- 14 Unit A key: for selecting the measurement unit for input A, depending on the probe fitted. When turned to P0 mode, it sets the Q-energy and Time limits for input A.
- 15 Serial Output: activates data transmission at the RS232C serial output.
- 16 ▲ (Memory clear): increases the parameters in programming mode; when held down it erases the "RCD" memory; when pressed with P1, it erases the permanent memory.
- 17 PROG key: activates the programs P0... P1... P... of the different instrument functions.
- 18 Connector for RS232C (SUB D male 9 pole).
- 19 Input B, DIN 45326 8-pole connector.
- 20 Symbol  $10^3$ : indicates multiplication factor  $10^3$  for the respective channel .
- 21 Symbols A and B: for magnitudes Q and T indicate the channel selected.
- 22 A-B: the bottom display shows the difference between A and B. The top display shows A.
- 23 MIN symbol: the display shows the minimum values found during RCD function.
- 24 MAX symbol: the display shows the maximum values found during RCD function.
- 25 °C: the led indicates that the temperature measurement is in degrees Centigrade.
- 26 °F: the led indicates that the temperature measurement is in degrees Fahrenheit.
- 27 fcd: the led indicates that the measurement is in fcd (foot-candle).
- 28  $\text{W}/\text{m}^2$ : the led indicates that the measurement is in  $\text{W}/\text{m}^2$ .
- 29  $\text{cd}/\text{m}^2$ : the led indicates that the measurement is in  $\text{cd}/\text{m}^2$ .
- 30 On/Off key: for switching the instrument on or off.
- 31 Unit B key: for selecting the measurement unit for input B, depending on the probe fitted. When turned to P0 mode, it sets the Q-energy and Time limits for input B.
- 32 A-B key: shows the difference between the inputs.
- 33 Data Call key (Max - Min - Med - Q - Time): recalls on the display the maximum, mean, minimum, Q and Time values of each input.
- 34 ▼ (RCD): starts and stops the RECORD function, in programming mode it decreases the parameter shown.
- 35 ENTER key: starts and stops storage, confirms the parameters set during programming.

## INTRODUCTION

The **DELTA OHM DO 9721** quantum photo-radiometer and thermometer data logger has been designed for measuring illuminance, radiance, luminance and temperature.

The instrument has two inputs, A and B, and automatically recognises the probes connected, whether they be illuminance, radiance, luminance or temperature probes, and can display the difference between the two inputs.

As the probes are interchangeable, it is possible to choose the most suitable combination for all applications without having to recalibrate the instrument. The DO 9721 is able to take illuminance measurements in lux and in fcd (foot-candle), irradiance measurements in  $W/m^2$ , in  $\mu W/cm^2$  e in  $\mu mol/m^2s$ , luminance measurements in  $cd/m^2$  and temperature measurements in  $^{\circ}C$  or  $^{\circ}F$ .

The instrument's Data Logger function enables it to store up to 30,000 readings. The sampling period is variable from 1 second to 12 hours.





The data acquired may later be transferred to a Personal Computer or a printer by means of the opto-insulated serial line RS232C. For each value stored the date and time of acquisition are indicated; each acquisition block is ended with a report which provides the maximum, minimum and mean values.

With the Serial Output function it is possible to obtain the instantaneous values measured by the instrument at the output of the serial line RS232C, in order to send them to a printer or a computer.

Other functions such as Hold (which blocks the display), Rel (for taking relative measurements), Record (for storing the maximum, minimum and mean values) and Q (integration in time of the measurements with alarm threshold) further enrich the instrument's performance.

Thanks to its versatility and to its storage capacity, the instrument is suitable for a wide variety of applications, both in the field and in the laboratory.

## KEYBOARD DESCRIPTION

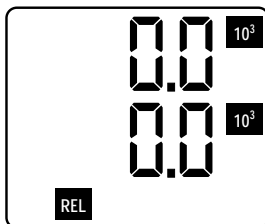
KEY	SIMBOLS LIT BESIDES THE NUMBERS	FUNCTION DESCRIPTION
<b>ON/OFF</b> 	<p>All the symbols are lit for a few seconds after pressing the ON/OFF key. Complete display.</p>	<p>ON/OFF key. Press this key repeatedly to switch the instrument on or off.</p> <p>The instrument has a cut-out system (Auto Power Off) which switches off automatically after about 8 minutes.</p>
<b>HOLD + ON/OFF</b> 	<p>The  symbol flashes to indicate that Auto Power Off is disabled.</p>	<p>HOLD and ON/OFF key. If this key is pressed and held down together with the ON/OFF key while switching on, for the duration of the switching-on routine, the self cut-out function (Auto Power Off) is deactivated.</p> <p>The battery symbol flashes at a frequency of 1 Hz.</p> <p>The instrument can be switched off only by pressing the ON/OFF key.</p>
<b>HOLD</b> 		<p>When this key is pressed during normal operation the value shown on the display is frozen and the HOLD symbol lights up. Updating of the internal data continues.</p> <p>When the key is pressed for the second time the instrument returns to normal operation and the HOLD symbol goes off.</p>

## KEY

SIMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTION

REL

REL



The REL key allows you to display or store relative values or send them immediately onto the serial line. The values for comparison are stored at the precise moment in which the key is pressed. Data may be stored when the REL button is active.

After data has been sent onto the serial line, in immediate or remote mode from the instrument's internal memory, obtained with the REL function active, a report will be provided giving the maximum, minimum and mean relative values and the reference values on which the calculation of the relative values was based.

UNIT A

unit A

When the Unit A key is pressed, it selects the measurement unit in which the magnitude measured by the probe connected to input A is presented at the top of the display. Depending on the type of probe connected, the following units are enabled: °C or °F; lux or fcd; W/m<sup>2</sup> or μW/cm<sup>2</sup>; μmol/m<sup>2</sup>s; cd/m<sup>2</sup>.

This key also gives access to the Q and Time functions. The led corresponding to the unit chosen lights up.

When pressed after the PROG key, in P0 function, the key gives access to the programming of the limits for the integration value Q and for the Time; see the specific section.

## KEY

SIMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTION

## UNIT B

unit B

For channel B, this fulfils a similar function to unit A; it is presented at the bottom of the display.

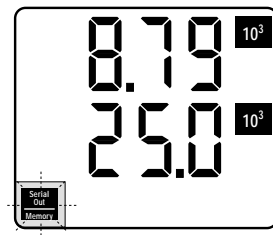
## A-B

A-B

Pressing A-B obtains, at the bottom of the display, the difference between the value at input A and the one at input B.

The measurement unit selected for the two values must be the same for both probes, otherwise an ERR message is given.

## SERIAL OUTPUT

Serial  
Output

The Serial Output key enables the data being acquired to be sent immediately onto the serial line. The Serial Out symbol flashes.

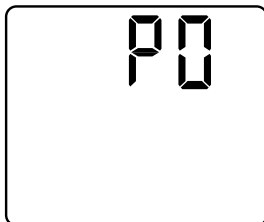
**Note:**

The choice of the baud rate influences the speed at which the data are sent as shown in the table:

BAUD RATE	MINIMUM SENDING INTERVAL
300 Baud	4 sec.
600 Baud	2 sec.
> 600 Baud	1 sec.

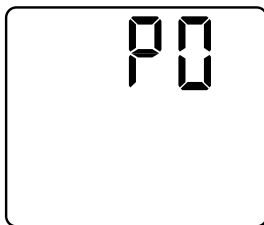


## KEY

SYMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTIONP0+ **- P0 -**

When ENTER is pressed with P0 on the display, the instrument returns to normal operating mode without storing any parameter.

Press the PROG key to move on to step P1.

P0+  or 

When unit A or unit B is pressed with P0 on the display, it gives access to the function for programming the integration or time limits for the probe Q and T functions. For details, see the specific chapter.

P1+  = data dump**- P1 -**

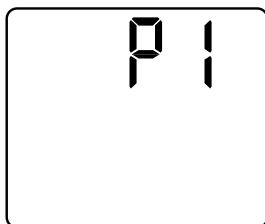
When ENTER is pressed with P1 on the display, the data stored in the memory of the instrument are unloaded (DUMP); press the PROG key to move on to step P2.

During data dumping the message P1 appears on the upper display.

## KEY

SIMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTION

At the end the instrument automatically returns to normal operating mode.



The unloading of data from the instrument memory may be momentarily stopped by pressing the ENTER key. Press the ENTER key again to reactivate data unloading.

When the PROG key is pressed, data unloading is finally concluded. After a few seconds the instrument display returns to normal mode.

At the end of each block the report is sent with the maximum, minimum and mean values calculated on the block.

During the "DUMP" phase the instrument does not switch off automatically, all the key functions are disabled except the ENTER, PROG and ON/OFF keys.

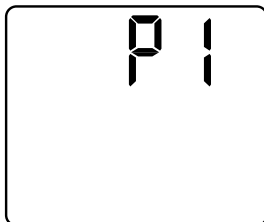
**Note:**


The block is defined at the moment of storage as a group of consecutive recordings. The first interruption of storage ends and determines the block.

## KEY

SYMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTION

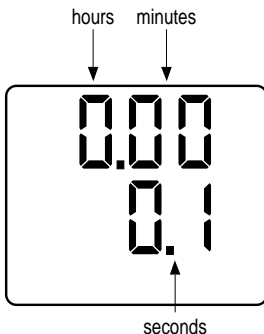
P1+  = erase memory



When the  key (MEMORY CLEAR sub-function) is pressed with P1 on the display, all the stored data are erased. The instrument will display the message Clr and a number indicating the memory blocks available.

At the end the instrument automatically returns to normal operating mode.



P2+  = storage interval programming

**- P2 -**

When ENTER is pressed with P2 on the display, the storage time parameter may be modified.

This parameter is used for the following two functions:

1. Logging time, or time elapsing between two consecutive data storages in the internal memory of the instrument.
2. Data dump interval, or time elapsing between two immediate data dumps on the serial line.

The  and  keys are used to define the desired intervention time.

At bottom right of the display the instrument indicates the seconds (1 - 59).

At top right of the display the instrument indicates the minutes (1 - 59).

At top left of the display the instrument indicates the hours (1 - 12).

**KEY****SIMBOLS LIT BESIDES  
THE NUMBERS****FUNCTION  
DESCRIPTION**

After defining the storage time, press ENTER to return to normal operation, or press the PROG key to move on to step P3.


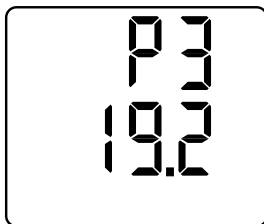
In the storage function the instrument is able to store more than 30,000 acquisitions.

The indicative time taken to fill the memory completely is a function of the recording interval and may be obtained from the following table:

RECORDING INTERVAL	TIME TO FILL THE MEMORY
1 sec	8 hours
1 min	20 days
1 hour	1250 days

If the memory is filled completely during storage status, the storage function is interrupted automatically. The flashing FUL message appears. The instrument switches off after 8 minutes.

## KEY

SYMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTIONP3+  = set Baud Rate**- P3 -**

When ENTER is pressed with P3 on the display, the Baud Rate of the RS232C serial transmission may be modified.

The ▲ and ▼ keys are used to select the desired value.

The possible values are:

19.2 = 19200 Baud

9.6 = 9600 Baud

4.8 = 4800 Baud

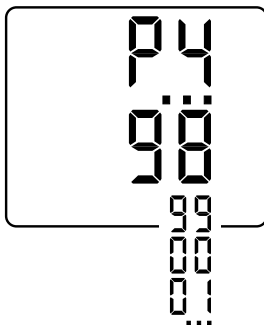
2.4 = 2400 Baud

1.2 = 1200 Baud

0.6 = 600 Baud

0.3 = 300 Baud

Finally press ENTER to return to normal operation, or press the PROG key to move on to step P4.

P4+  = set year**- P4 -**

When ENTER is pressed with P4 on the display, the year value may be set or changed.

The ▲ and ▼ keys are used to select the desired year.

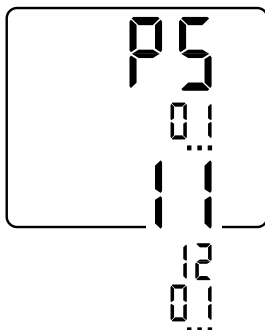
Then press PROG to move on to step P5 (the ENTER key is not active).

# KEY

## SIMBOLS LIT BESIDES THE NUMBERS

## FUNCTION DESCRIPTION

P5+ **ENTER** = set month



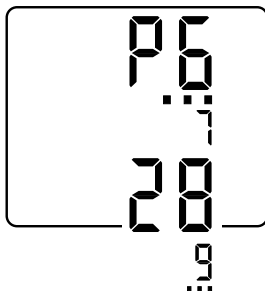
### - P5 -

When ENTER is pressed with P5 on the display, the month may be set or changed.

The ▲ and ▼ keys are used to select the desired month.

Then press PROG to move on to step P6 (the ENTER key is not active).

P6+ **ENTER** = set day



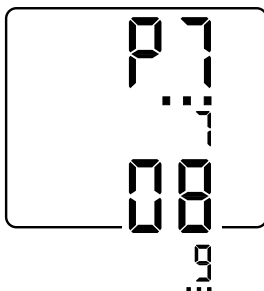
### - P6 -

When ENTER is pressed with P6 on the display, the day may be set or changed.

The ▲ and ▼ keys are used to select the desired day.

Then press PROG to move on to step P7 (the ENTER key is not active).

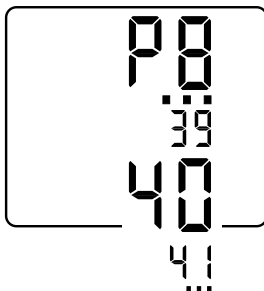
## KEY

SIMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTIONP7+  = set hours**- P7 -**

When ENTER is pressed with P7 on the display, the hour may be set or changed.

The ▲ and ▼ keys are used to select the desired hour.

Then press PROG to move on to step P8 (the ENTER key is not active).

P8+  = set minutes**- P8 -**

When ENTER is pressed with P8 on the display, the minutes may be set or changed.


The ▲ and ▼ keys are used to select the desired minutes.

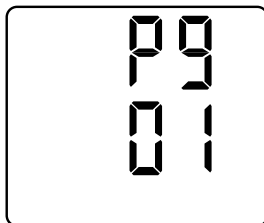
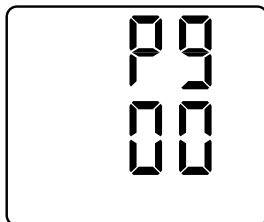
Then press ENTER to return to normal operating mode or PROG to move on to step P9, without updating the internal clock.

**Quitting with the ENTER key updates the internal clock with the date and time just set, setting the seconds at zero at the time of quitting.**

## KEY

SIMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTION

P9+  = enable/disable  
self cut-out

**- P9 -**

When ENTER is pressed with P9 on the display, the instrument enters the program which enables or disables the self cut-out function when it is in storage mode and with a set storage interval higher than or equal to 1 minute.

The ▲ and ▼ keys are used to select the value 00 or 01.

00: with a set storage interval lower than 1 minute, the instrument does not switch off automatically; it always remains lit.

When the ON/OFF key is pressed, storage stops and the instrument switches off.

00: with a set storage interval higher than 1 minute, the display switches off automatically after about 8 minutes. At each set storage interval there is a beep and the display switches on for a few seconds.

The display can be switched on or off by pressing the ON/OFF key. The instrument keeps on storing if you keep it switched on. The display switches off automatically after about 8 minutes.

To stop storage, press the ON/OFF key (if the instrument is off). Press the ENTER key.

01: with a set storage interval lower than 1 minute, the instrument does not switch off automatically.



## KEY

SIMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTION

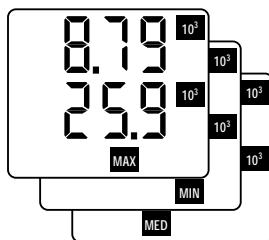
When the ON/OFF key is pressed, storage is interrupted and the instrument switches off.

01: with a set storage interval higher than 1 minute, the display does not switch off automatically; it remains always lit and goes on storing. When the ON/OFF key is pressed the display stops till the next acquisition. Then it switches on again and remains lit.

To stop storage, press the ENTER key.

The ENTER key is used to return to normal operating mode, while pressing the PROG key returns to step P0.

## DATA CALL



DATA CALL key (Mean - Max - Min).

When the DATA CALL key is pressed repeatedly, the Max, Min Mean, Q and Time values measured for both measuring channels are shown on the display.

See the description of the Q and Time functions in the specific paragraph.

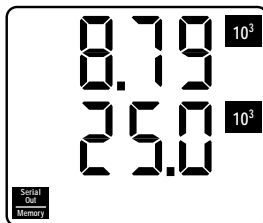
## KEY

SIMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTION

▲ key. When enabled it increases the values of the parameters on the display; when pressed with P1 it enables the memory clear function.

In normal operating mode, when held down, it resets the values recorded in the RCD memory, bringing them all to 0.

ENTER + Start-Stop



ENTER key (Start-Stop sub-function).

The ENTER key is used alternatively to start or stop storage of a new block of data to be kept in the memory of the instrument. Data storage is performed at the rate set during programming of step P2.

The data stored between one start and the following stop form a block.

Different blocks can thus be formed, all ending (during unloading) with the report giving the maximum, minimum and mean values. The Serial Out/Memory symbol remains lit for the whole storage period. The Auto Power Off function is active and the instrument switches itself off after about 8 minutes of inactivity. It is restarted automatically by the clock interrupt control which reactivates the instrument for only the time needed for all the acquisition and storage operations. Once this has been done the instrument swit-

## KEY

SIMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTION

ches itself off again.

During this phase the instrument appears to be off, but it is active in operating mode.

If the Serial Out/Memory symbol lights up when switching on the instrument with the ON/OFF key, this means that the instrument was in storage status.

In this stage the Serial Out and PROG keys are not enabled. When this operative mode is deactivated the Serial Out/Memory symbol is not lit.

The total memory capacity available is 512kbyte, with the possibility of storing more than 30,000 readings.

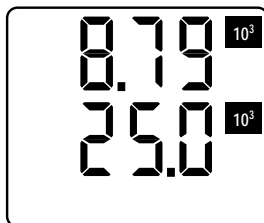
ENTER



During programming this key is used both to enter the desired program and to confirm the value of the parameter considered.



RCD



When pressed repeatedly, the ▼ key, sub-function RCD, starts and stops the record function, which calculates and stores the maximum, minimum, mean, integration (Q) and Time values.

When the RCD key is held down for more than 2 seconds, the instrument emits a short beep followed by a long one. This confirms that the Max., Min., Mean, Q

## KEY

SIMBOLS LIT BESIDES  
THE NUMBERSFUNCTION  
DESCRIPTION

and Time values stored previously are being erased from the memory and a new series of recordings is started which will be used as the basis on which to calculate and store the new Max., Min., Mean, Q and Time values. After resetting of the Max., Min., Mean, Q and Time values, the RCD function has a duration of about 140,000 readings, that is about 20 hours. At the end, the RCD function is automatically interrupted and the values calculated up till then are maintained. During RCD mode the Auto Power Off function is disabled.

**Attention:**

If the battery symbol does not flash at a frequency of 2 Hz when the RCD key is pressed, it means that the RCD function has stored more than the allowed number of readings and cannot continue any further.

After having taken note of the Max., Min., Mean, Q and Time values calculated up till then, reset the RCD function and restart it.



▼ key. During programming or calibration, this key is used to decrease the value of the parameter being considered.

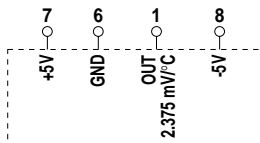
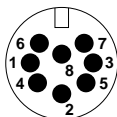
## PROBE CONNECTION

The instrument DO 9721 has two circular Din 45326 8-pole connectors (A and B) which allow the connection of Delta Ohm probes for measuring temperature, type TP870, and probes for measuring the photometric and radiometric intensity, type LP 9021.

The probe model must be chosen to suit the specific application; see the section on accessories.  
The electrical connections to the probes are:

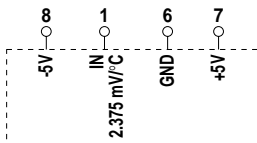
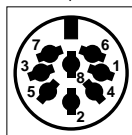
### A) Amplified TEMPERATURE PROBES with a Pt100 platinum-sensitive element

Probe TP 870 series



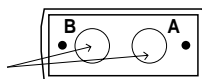
Active probe Pt 100 TP 870 series

Instrument input



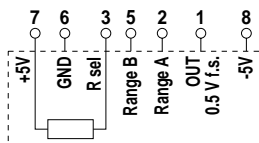
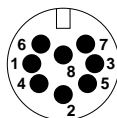
Probe Pt 100 TP 870 series input

DO 9721



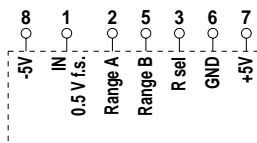
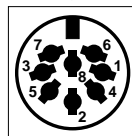
### B) Photometric and radiometric MEASURING PROBES

Probe LP 9021 series



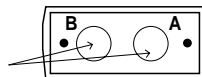
Active probe LP 9021 series

Instrument input



DO 9721 active probe LP 9021 series input

DO 9721



**Notes:**

- a) The Rsel value characterises the probe model.
- b) The Range A and Range B signals, leaving the instrument, manage the switching of the probe signal amplification on four decades.
- c) The +5V and -5V power supplies leaving the instrument are intended solely for feeding the circuitry of the Delta Ohm probes.

**HOW TO MEASURE****1. Press the ON/OFF key to switch on the instrument**

- \* This operation enables the automatic cut-out timer, which intervenes after about 8 minutes of keyboard inactivity. Whenever a key is pressed the timer is re-enabled.

If you wish to suppress the automatic cut-out function, you must hold down the HOLD button while switching on the instrument by pressing the ON/OFF button; the HOLD button should be held down for the duration of the switching-on routine. In this condition the battery symbol flashes at a frequency of 1 Hz, indicating that the Auto Power Off function is disabled.

- \* When the instrument is switched on all the numbers and symbols on the display and all the leds on the keyboard light up for a few moments, allowing you to check that they are working correctly. The change-over to normal operation is automatic.

**2. Checking display**

- \* After all the segments are lit, the instrument is ready to measure in the unit set before the instrument was switched off.
- \* If a probe is broken or is not properly connected, the ERR signal appears. In this case the sensor part and/or the connector must be checked.

**3. Selection of the measuring unit**

- \* Press the Unit A key repeatedly to select the measuring unit for input A (visible at the top of the display); press the Unit B key to select the measuring unit for input B (visible at the bottom of the display).

**4. Switching off the instrument**

- \* The instrument is switched on and off by pressing the ON/OFF key. Because of the Auto Power Off function the instrument may switch itself off during measurements. In this case press the ON/OFF key to switch it on again.
- \* The instrument usually switches off automatically after 8 minutes of inactivity, with the following exceptions:

- a) Instrument in RCD status.
- b) Auto Power Off function disabled.

In these two cases the instrument switches off only when the ON/OFF key is pressed.

- c) Instrument during unloading of stored data.
- d) Instrument during Serial Output of immediate data.

e) Instrument in storage function.

**In the last three cases the instrument switches off automatically 8 minutes after the low battery warning and interrupts storage or transmission of data.**

When it switches on again there are two possibilities:

1. If the battery is definitively low, even when the instrument switches on again LOU appears on the display together with the battery symbol.

The PROG key (P1+ENTER) enables the activation of the unloading of stored data even when the battery is low.

2. If the battery has had time to recover and when the instrument switches on its charge seems, even just a little, higher than the minimum value, LOU appears on the display without the battery symbol for a short period of time (about 4 seconds), after which the instrument returns to normal operation; this is to remind the user that the instrument was previously in storage function and that this procedure was interrupted by the low battery warning.

## 5. Q function and RCD function

\* The function RCD = "Record" allows you to record the maximum, mean and minimum values and the integral sum of the input signals. It also allows the independent setting, for each of the two inputs, of an alarm threshold of the integral threshold, for a determined measuring unit (for example lux or W/m<sup>2</sup>) and/or an integration limit time.

The moment the Record function is started (with the ▼ key), the instrument begins calculating the summation

where  $u(t)$  is the value of the input A or B at the time  $t$ .

$$Q(t) = \sum_0^t u(t) * t$$

As soon as the summation reaches the value  $Q$  of the limit energy threshold set for the same input, or the time exceeds the integration limit time, the  $Q$  led (or the Time led) for the input that has exceeded its threshold begins to flash.

The procedure which allows setting of the two thresholds is given on the next page.

To disable one of the functions (for example Time of input A) it is sufficient to set the value concerned at 0.

Once the  $Q$  and Time parameters have been set, the Record function may be started by means of the RCD key (▼): if the key is pressed and immediately released, the RCD begins without erasing the data already present in the memory and a beep is given; if the key is held down for two seconds, a second beep is given, the previous data are erased and the RCD function is restarted.

The RCD parameters and the integrals may be reset, without restarting the count, using the ▲ key, holding it down. Remember that, if the values are not reset, the resulting new data will be calculated / integrated on the basis of the current ones plus the previous one, even after a period of time (for example data recorded during a session some days or months earlier).

### *Interpretation of the stored data:*

During RCD measurement it is possible to view the stored data; by pressing Data Call you can read in sequence the maximum values, minimum values, mean values, current values of Q(A), current values of Q(B), time of A, time of B.

When the RCD measurement is ended, the same data in sequence may be recalled with the Data Call key.

As well as by manual stopping, the recording of the values of Q(A) and of Q(B), and of their respective times, stops, for A or for B, when the set time or integration limit has been reached.

Reaching of the limit is indicated by the flashing of the Q or Time led associated with the channel. Integration proceeds without any other limit than manual stopping or the maximum value of 19h 59m 59s, if the corresponding quantity is set at zero.

The maximum energy limit that may be integrated is equal to the full scale value for the maximum integration time indicated above.

The value Q is shown on the display in scientific notation, in the form 1.999 E09.

T is displayed as hh.mm.ss .

The presentation of the above values uses the entire area of the display; an indicator (A or B) shows which channel they refer to.

**The integration function is not available for temperature measurements.**

## **6. Setting the limits for the Q/T function**

With the instrument in normal operating mode, press the **PROG** key once to obtain the message **P0** on the display.

To set the limits on channel A, press the **UNIT A** key; likewise press **UNIT B** for channel B.

This gives access to the function for setting the integration **limit time T**; pressing the same key a second time will give access to the function for setting the limit energy Q.

a) Setting the **limit time T**, starting from normal operating mode:

\* Press **PROG** to go to **P0**.

\* Press **UNIT A** or **UNIT B** once, the led T for the channel that the instrument is working on lights up and the display shows:

00.00 corresponding to hours.minutes

00 corresponding to the seconds, flashing

\* The seconds may be altered using the **▲** and **▼** keys.

\* Press **PROG** to pass from setting of the seconds to setting of the hours or minutes.

\* Holding down the **▲** or **▼** keys makes the figures move forward automatically.

\* The maximum time that may be set is 19.59.59.

\* Press **ENTER** to confirm the set value.

b) Setting the **integration limit energy Q**, starting from normal operating mode:

\* Press **PROG** to go to **P0**.

\* Press **UNIT A** or **UNIT B** twice.



(one press corresponds to the previous case), the led Q for the channel that the instrument is working on lights up and the display shows:

0.00 = mantissa

E 00 = exponent, with 00 flashing

The position of the decimal point of the mantissa may vary, depending on the measuring units

- \* The exponent and the position of the decimal point may be altered using the ▲ and ▼ keys, depending on the different decades. The exponent varies only for multiples of 3 (E0, E3, E6, E9), the position of the decimal point indicates the actual decade desired.
- \* Press PROG to pass from regulation of the exponent to that of the mantissa and vice-versa
- \* Holding down the ▲ or ▼ keys makes the figures move forward automatically.
- \* The maximum value that may be set depends on the magnitude chosen.
- \* Press ENTER to confirm the set value.

If any one of the settings (T or Q, channel A or B) is altered, **all the stored measurements will be reset** (same effect as holding down the ▲ key). So, to read the setting of the limits without altering the memory, **NEVER** press the ▲ and ▼ keys before having pressed ENTER.

**The settings indicated above are possible only for photometric and radiometric magnitudes.**

## 7. Various operations

- \* For operations such as HOLD display, relative measurements, RCD storage, DATA CALL, Serial Output, storage in the internal memory, unloading of stored data, erasing of the internal memory, setting of the working parameters, see the description of the instrument keyboard functions.

### Attention when using the keyboard

The use of the keys is relatively simple, but care must be taken to avoid setting it by mistake in an undesired mode.

Ensure that HOLD, RCD, REL, MAX, MIN, MED, Serial Out/Memory are not displayed during normal operation.

## TEMPERATURE MEASUREMENT

**Immersion** temperature measurements are performed by introducing the probe to a minimum depth of 60 mm into the liquid in which you want to take the measurement; the sensor is housed in the end of the probe.

To take measurements **in air**, the probe must be pointed in a transverse direction to the air flow. In both cases, to ensure correct measurement avoid contact of the probe with the walls of the container holding the liquid or of the duct in which the air to be measured is passing.

When taking **penetration** measurements the tip of the probe must be inserted at a depth of at least 60 mm; the sensor is housed in the end of the probe. When taking measurements on frozen blocks it is convenient to use a mechanical tool to make a cavity in which to insert the pointed probe.

To perform a **contact** measurement correctly the surface must be flat and smooth and the probe must be perpendicular to the measuring plain.

**To obtain a correct measurement, the application of a little heat-conductive paste or a drop of oil (water or solvents must absolutely not be used) helps to improve the response time.**

### Light intensity measurements

Different photometric or radiometric measurements may be made using the LP 9021 series of probes. Each type of probe has a distinct field of application, according to type and spectrum, the instrument recognises each model and allows representation of the measurement only in the units contemplated for the connected probe.

For the order codes of the different probes, see the special paragraph.

TYPE OF MEASUREMENT	UNITS ALLOWED	CONVERSION FACTORS
Illuminance (spectral correction according to CIE) (PHOT)	Lux Fcd (foot-candle)	1 lux= 0.0929 fcd 1 fcd= 10.764 lux
Radiance (RAD,UVA,UVB,UVC) (in the respective spectral fields)	W/m <sup>2</sup> μW/cm <sup>2</sup>	1 W/m <sup>2</sup> = 100 μW/cm <sup>2</sup> 1 μW/cm <sup>2</sup> = 0.01 W/m <sup>2</sup>
Active radiation in the field of photosynthesis μmol/m <sup>2</sup> s	μmol/m <sup>2</sup> s	
Luminance (Cd)	Cd/m <sup>2</sup>	

## ORDER CODES

### \* DO 9721K

Basic instrument kit, diplomatic carrying case, instrument, CP RS232C serial connecting cable, 9V battery.

### \* LP 9021 PHOT

Photometric probe for measuring light, ILLUMINANCE, photopic filter complying with CIE, diffuser for correction according to the cosine law. Range 0÷200,000 lux (0÷200,000 foot candle). This is an amplified probe for measuring light in the visible field, with correction according to the human eye response curve; it is suitable for measuring lighting in offices, schools, laboratories, places of entertainment, emergency exits, car parks, galleries, shops, shop windows, factories, etc.

### \* LP 9021 RAD

Radiometric probe for measuring the IRRADIANCE of artificial light sources, irradiance of the sun, etc. Radiometric filter and diffuser for correction according to the cosine law.

Spectral measurement range: 400÷900 nm, range from 0.1  $\mu\text{W}/\text{cm}^2$  to 200  $\text{mW}/\text{cm}^2$ .

The probe is used in greenhouses for measuring artificial light, shade, the performance of solar panels, solar filters, etc.

### \* LP 9021 PAR

Radiometric probe for measuring IRRADIANCE in the region of PAR radiations (Photosynthetically Active Radiation); it works in the field of the chlorophyll process following a special response curve. Radiometric filter and diffuser for correction according to the cosine law.

Spectral measurement range: 400÷700 nm, range from 0.1  $\mu\text{W}/\text{cm}^2$  to 200  $\text{mW}/\text{cm}^2$ .

The measurement is expressed in  $\mu\text{mole per m}^2$  per second, one mole is the equivalent of  $6.0222 \cdot 10^{23}$  photons. Typical applications of the probe are for research in the sector of greenhouse lighting, research in the field and in forestry.

### \* LP 9021 UVA

Radiometric probe for measuring IRRADIANCE in the ultraviolet field.

Radiometric filter and diffuser for correction according to the cosine law.

Spectral measurement range: 315÷400 nm, with peak at 365 nm.

Range from 0.1  $\mu\text{W}/\text{cm}^2$  to 200  $\text{mW}/\text{cm}^2$ .

Suitable for measuring radiation in the ultraviolet region A.

### \* LP 9021 UVB

Radiometric probe for measuring IRRADIANCE in the ultraviolet field.

Radiometric filter and diffuser for correction according to the cosine law.

Spectral measurement range: 280÷315 nm, with peak at 312 nm.

Range from 0.1  $\mu\text{W}/\text{cm}^2$  to 200  $\text{mW}/\text{cm}^2$ .

Suitable for measuring radiation in the ultraviolet region B.

### \* LP 9021 UVC

Radiometric probe for measuring IRRADIANCE in the ultraviolet field.

Radiometric filter and diffuser for correction according to the cosine law.

Spectral measurement range: 190÷280 nm, with peak at 250 nm.

Range from 0.1  $\mu\text{W}/\text{cm}^2$  to 200  $\text{mW}/\text{cm}^2$ .

Suitable for measuring radiation in the ultraviolet region C.

**\* LP 9021 LUM6**

Probe for measuring LUMINANCE, measuring range from 1 to 1999 x 10<sup>3</sup> candles/m<sup>2</sup>.  
Measuring angle 6°. CIE filter for correction of the response according to the human eye.

**\* LP BL**

Stand for supporting and levelling probes.

**\* TP 870**

Immersion temperature probe, Pt100 sensor, diam. 3x230 mm, measuring range -50...+400°C.

**\* TP 870/C**

Contact temperature probe, Pt100 sensor, diam. 4x230 mm, measuring range -50...+400°C.

**\* TP 870/P**

Penetration temperature probe, Pt100 sensor, diam. 4x150 mm, measuring range -50...+400°C.

**\* TP 870/A**

Air temperature probe, Pt100 sensor, diam. 4x230 mm, measuring range -50...+250°C.

**\* CP RS232C**

Connecting cable from SUB D female 9-pole to SUB D female 25-pole, for serial gate RS232C.

## METHOD OF USING THE INSTRUMENT AND WARNINGS

1. Do not expose the probes to gases or liquids that could corrode the material of the sensor or the probe; clean the probe carefully after use.
2. Do not bend the connectors applying upward or downward force.
3. Do not bend or force the contacts when inserting the probe connector in the instrument.
4. Do not bend, deform or drop the probes as this could cause irreparable damage.
5. Always use the most suitable probe for the measurement to be taken.
6. Do not use the temperature probes in the presence of corrosive gases or liquids; the container in which the sensor is housed is made of stainless steel AISI 316, while the container for the contact probe is of AISI 316 plus silver.  
Do not let the surfaces of the probe come in contact with sticky surfaces or with substances that can corrode or damage the probe. If the sensor breaks or becomes faulty it must be replaced. In this case the probe must be recalibrated.
7. Above 400°C, avoid violent blows or thermal shock to the Pt100 temperature probes as these could cause irreparable damage.
8. To obtain a reliable temperature measurement, too fast temperature variations must be avoided.
9. Temperature probes for surface measurements must be held in a vertical position with respect to the surface. Apply a drop of oil or heat-conductive paste between the surface and the sensor so as to improve contact and reduce the reading time. Do not use water or solvents to do this.
10. Temperature measurements on non-metal surfaces require a great deal of time on account of their low heat conductivity.
11. The probes are not insulated from their external casing. Be very careful not to come into contact with live parts (above 48 V) as this could be dangerous not only for the instrument but also for the operator, who could suffer an electric shock.




12. Avoid taking measurements in the presence of high frequency sources, microwaves or large magnetic fields, as the results would not be very reliable.
13. Always clean the probes carefully after use.
14. The instrument is resistant to water but it is not watertight and should not therefore be immersed in water. If it should fall into the water, take it out immediately and check that no water has infiltrated. The instrument must be handled in such a way that water cannot get in through the connector side.


## INSTRUMENT SIGNALS AND MALFUNCTIONS


<b>Err</b>	<ul style="list-style-type: none"> <li>* Error in reading the signal present at input A or B or A-B.</li> <li>* Error when the function A-B is requested, but the probes inserted are not of the same type or the measuring units selected are different (for example °C -°F).</li> <li>* No probe is inserted.</li> </ul>
<b>OFL</b>	Measurement overflow (appears only for light intensity measurements); indicates that the probe is recording an excess of light radiation which does not allow its representation within the contemplated full-scale value.
<b>FUL</b>	Memory full; indicates that the instrument cannot store any more data as its memory space is full.
<b>LOU</b>	When switching on this indicates that the instrument has switched off because the battery voltage was too low when it was in storage or serial output status. Change the battery even if there are no low battery signals.


## LOW BATTERY WARNING AND BATTERY REPLACEMENT

When the instrument battery has run down and its voltage has reached the limit value of 7.2 Volts, the  symbol appears permanently on the display and an alarm beep sounds at regular intervals of about 15 seconds. In these conditions the battery should be replaced as soon as possible.

If you continue to use the instrument and the battery voltage falls as low as 6.5V the instrument is no longer able to ensure correct measurement.

The  symbol appears fixed to indicate that the battery is low. This indication prevails over all the other signals which use the same symbol.

In RCD function, the  symbol flashes at a frequency of 2 Hz.

In the function that suppresses Auto Power Off, the  symbol flashes at a frequency of 1 Hz. The flashing of the RCD function prevails over that of the suppression of Auto Power Off.

## **AFTER CHANGING THE BATTERY CHECK THE CLOCK DATA AND THE SET PARAMETERS**

To change the battery turn the instrument retaining screw in an anti-clockwise direction. After replacing it (with an ordinary 9V alkaline battery) close the instrument, inserting the tag into the slot provided, and turn the screw in a clockwise direction.

The stored data will not be lost even if the instrument remains without batteries as long as the working routines have been completed.



**Ensure that the instrument is switched off before changing the battery.**

## **FAULTY OPERATION WHEN SWITCHING ON AFTER CHANGING THE BATTERY**

After the battery has been changed, it is possible that the instrument may not start again correctly. In this case it is advisable to repeat the operation. Wait a few minutes after disconnecting the battery, to allow the circuit condenser capacities to be completely discharged, then insert the battery.

## WARNING ON USE OF THE BATTERIES

- \* If the instrument is not to be used for a long time the battery must be removed.
- \* If the battery is flat it must be replaced immediately.
- \* Take steps to avoid leakage of liquid from the battery.
- \* Use good quality leakproof batteries, alkaline if possible.

## STORAGE OF THE INSTRUMENT

Instrument storage conditions:

- \* Temperature: -10...+50°C.
- \* Humidity: less than 90% relative humidity, avoid the formation of condensation.
- \* Do not store the instrument in places where:
  1. There is a high degree of humidity.
  2. The instrument is exposed to direct sunlight.
  3. The instrument is exposed to a source of high temperature.
  4. There are strong vibrations.
  5. There is steam, salt and/or corrosive gas.

The instrument body is made of ABS plastic so it must not be cleaned with solvents which can spoil plastic.

## SERIAL INTERFACE RS232C

The instrument is equipped with the standard serial interface RS232C, galvanically insulated; it is supplied with the adapter cable CP RS232C. The following signals are available on the SUB D 9-pin male connector of the instrument:

PIN	SIGNAL	DESCRIPTION
3	TD	Datum transmitted by the instrument
2	RD	Datum received by the instrument
5	GND	Reference logic mass

NOTE: The deflector on the connector of the adapter cable CP RS232C must be turned to COMPUTER or PRINTER position, depending on the chosen connector (this may not be true on some computers or printers).

The signals present in pins 2 and 3 are at logic levels compatible with the standard RS232C.

The standard serial transmission parameters of the instrument are:

* Baud Rate	19200 Baud
* Parity	None
* N. bit	8
* Stop bit	1
* Protocol	Xon/Xoff

The data transmission speed may be changed by pressing the PROG key on the instrument to alter the set-up parameter P3. The possible baud rates are: 19200, 9600, 4800, 2400, 1200, 600, 300. The other transmission parameters are fixed.

All the commands given to the instrument must have the following structure:

XYcr where:

XY constitutes the command code

cr Carriage Return (ASCII 0D)

COMMAND	RESPONSE	NOTES
SA	String of 19 characters containing value and measuring unit channel A	Print channel A for example: ....2.15...W/m <sup>2</sup> ....
SB	As above channel B	Print channel B
SC	As above channel A-B	Print channel A-B
SI	PHOTO/RADIO/THERMOMETER DATA LOGGER rev. Vx Rx	Type of instrument
AA	As above	Type of instrument
AG	Vx Rx	Firmware Version
AH	gg/mm/aa	Firmware Date
Xoff (ctrl-S)		Stop transmission
Xon (ctrl-Q)		Resume transmission

The command characters are exclusively upper case, the instrument replies with a “?” to any other combination of characters sent, the instrument reply strings do not contain control characters (the instrument does not send line-feed or carriage return characters to the terminal). Once a command has been accepted it is possible to obtain repetition of the action by sending only - cr - to the instrument; thus, for example, successive measurements of the same channel may be displayed simply by pressing the return key on the terminal.



## DUMPING DATA FROM THE MEMORY

Press the PROG key twice until P1 appears on the display.

Press the ENTER key.

The instrument will show DUP, on the top display, and will transmit the data from the instrument's internal memory through the serial line.

At the end of data dumping the instrument returns to normal display.

It is possible to stop and resume data dumping by repeatedly pressing the ENTER key.

Once data dumping has been stopped it may be terminated by pressing the PROG key.

Attention: dumping of data does not cause their reset, in this way it is possible to repeat dumping of the same data several times (for example, obtaining several print-outs).

To obtain the print-out of the data on a printer with parallel interface it is necessary to fit a serial-parallel adapter (not standard supply).

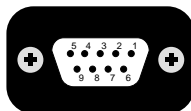
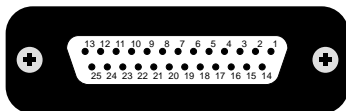
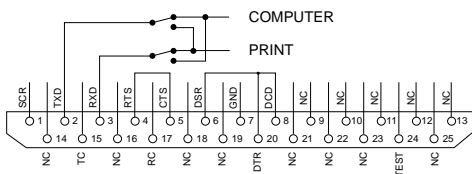
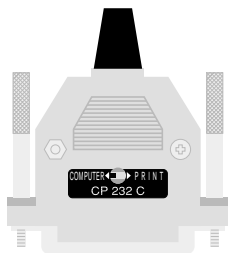
## MEMORY CLEAR

Press the PROG key twice until P1 appears on the display.

Press the ▲ key (memory clear sub-function).

The instrument will erase the internal memory, showing CLr on the display.

At the end of the operation the instrument returns to normal display.



## EXAMPLES OF DATA DUMPING ON THE SERIAL INTERFACE

### PHOTO/RADIO/THERMOMETER DATA LOGGER rev.V1 R1

#### IMMEDIATE SERIAL REPORT

DATE	TIME	--- A ---	--- B ---	--- A-B --
16-03-2000	10:50:39	197.0 C	190.1 Lux	ERR
16-03-2000	10:50:40	197.0 C	190.1 Lux	ERR
16-03-2000	10:50:41	197.0 C	190.0 Lux	ERR
16-03-2000	10:50:42	197.0 C	190.1 Lux	ERR
Maximum Values :		197.0 C	190.1 Lux	ERR
Minimum Values :		197.0 C	190.0 Lux	ERR
Average Values :		197.0 C	190.0 Lux	ERR

Calibration date 16-03-2000

In the above example, note the error indication for the A-B measurement, which is impossible due to the different nature of the probes considered.

### PHOTO/RADIO/THERMOMETER DATA LOGGER rev.V1 R1

#### IMMEDIATE SERIAL REPORT

DATE	TIME	--- A ---	--- B ---	--- A-B --
16-03-2000	10:54:00	112.3E3 umol/mqs	160.2 umol/mqs	112.2E3 umol/mqs
16-03-2000	10:54:01	112.3E3 umol/mqs	160.2 umol/mqs	112.2E3 umol/mqs
16-03-2000	10:54:02	112.3E3 umol/mqs	160.1 umol/mqs	112.1E3 umol/mqs
Maximum Values :		112.3E3 umol/mqs	160.2 umol/mqs	112.2E3 umol/mqs
Minimum Values :		112.3E3 umol/mqs	160.1 umol/mqs	112.1E3 umol/mqs
Average Values :		112.3E3 umol/mqs	160.1 umol/mqs	112.2E3 umol/mqs

Calibration date 16-03-2000

In the above example, note the indication E3 (= multiplier  $10^3$ ) for the measurement of channel A, and for the difference of the two channels. The symbol  $\mu$  which is not always available on printers, is replaced with a small letter u.

**PHOTO/RADIO/THERMOMETER DATA LOGGER rev.V1 R1****STORED DATA REPORT**

DATE	TIME	--- A ---	--- B ---	--- A-B --
16-03-2000	11:08:33	80.7 umol/mqs	149.8 umol/mqs	- 69.2 umol/mqs
16-03-2000	11:08:43	119.7 umol/mqs	149.9 umol/mqs	- 30.2 umol/mqs
16-03-2000	11:08:53	95.6 umol/mqs	149.8 umol/mqs	- 54.2 umol/mqs
16-03-2000	11:09:03	106.5 umol/mqs	149.9 umol/mqs	- 43.4 umol/mqs
16-03-2000	11:09:13	219 umol/mqs	149.9 umol/mqs	69 umol/mqs
16-03-2000	11:09:23	193.1 umol/mqs	149.9 umol/mqs	43.3 umol/mqs
Maximum Values :		219 umol/mqs	149.9 umol/mqs	69 umol/mqs
Minimum Values :		80.7 umol/mqs	149.8 umol/mqs	- 69.2 umol/mqs
Average Values :		135.8 umol/mqs	149.8 umol/mqs	- 14.1 umol/mqs

Calibration date 16-03-2000

The above example differs from the previous ones in that it is a report obtained from the stored acquisitions, at intervals of ten seconds from each other.

If a probe should be replaced, with another of a different type, during the serial transmission of the direct measurements, the transmission will be interrupted and the report will appear as in the example:

**PHOTO/RADIO/THERMOMETER DATA LOGGER rev.V1 R1****IMMEDIATE SERIAL REPORT**

DATE	TIME	--- A ---	--- B ---	--- A-B --
16-03-2000	11:22:26	104.1 umol/mqs	149.8 umol/mqs	- 45.8 umol/mqs
16-03-2000	11:22:36	104.1 umol/mqs	149.8 umol/mqs	- 45.8 umol/mqs
16-03-2000	11:22:46	104.0 umol/mqs	149.8 umol/mqs	- 45.8 umol/mqs

**!!!! LAST READING NOT MEANINGFUL: PROBE CHANGED DURING LOG !!!!**

Calibration date 16-03-2000

The highlighted line indicates that the last reading printed cannot be significant, due to the replacement of a probe during the previous interval.

# PHOTO/RADIO/THERMOMETER DATA LOGGER rev.V1 R1

## IMMEDIATE SERIAL REPORT

DATE	TIME	--- A ---	--- B ---	--- A-B --
16-03-2000	11:37:04	00.0 umol/mqs	00.0 umol/mqs	00.0 umol/mqs
16-03-2000	11:37:14	00.1 umol/mqs	- 00.1 umol/mqs	00.1 umol/mqs
16-03-2000	11:37:24	- 07.9 umol/mqs	00.0 umol/mqs	- 07.9 umol/mqs
16-03-2000	11:37:34	- 13.1 umol/mqs	00.0 umol/mqs	- 13.1 umol/mqs
16-03-2000	11:37:44	110 umol/mqs	- 00.1 umol/mqs	110 umol/mqs
Maximum Values :		110 umol/mqs	00.0 umol/mqs	110 umol/mqs
Minimum Values :		- 13.1 umol/mqs	- 00.1 umol/mqs	- 13.1 umol/mqs
Average Values :		17.7 umol/mqs	- 00.1 umol/mqs	17.8 umol/mqs
Relative to :		104.0 umol/mqs	149.8 umol/mqs	- 45.8 umol/mqs

Calibration date 16-03-2000

The highlighted line indicates that the measurements printed were taken in REL mode, and gives the reference values.

- 
- \* During serial transmission the keyboard is disabled, apart from the Serial Output key and the ON/OFF key.
  - \* During storage, on the other hand, the DATA CALL, A-B and HOLD keys are also active.
  - \* It is not possible to activate the storage function and the direct transmission function at the same time.
  - \* If serial transmission is activated display is in HOLD mode the transmission takes place normally, with the values actually measured (that is not in "hold" mode), the display alone remains frozen at the values present the moment the HOLD key was pressed.

## CALIBRATING THE INSTRUMENT DO 9721

The DO 9721 is calibrated in the factory, however if you think it necessary to perform calibration again, the procedure described below must be followed scrupulously.

- 1) Equipment required:
  - 1.a. TP870 probe simulator for applying on channel A of the instrument.
  - 1.b. Photometric probe simulator for applying on channel B of the instrument.
- 2) Ensure that the date on the instrument clock is correct, if necessary following the instructions to regulate it (program P4 and subsequent steps).
- 3) Switch off the instrument and switch it on again, holding down the PROG key at the same time.
- 4) The message C99 will appear; use the ▲ and ▼ to make the number equal to 17.
- 5) Press ENTER.
- 6) On the top display will appear the temperature value measured on channel A, generated by the simulator. The message C01 will appear at the bottom of the display.
- 7) Select the temperature 0°C on the simulator. Normally the instrument display must show a temperature differing from zero °C by a few tenths.
- 8) Press PROG, the display will indicate 0.0 with the decimal point flashing.
- 9) Press PROG again, the display will gradually come to indicate 0.0, as an effect of the correction applied.
- 10) On the simulator set the temperature of 197 °C, the display must show a temperature differing from this by a few tenths.
- 11) Press PROG, the display will indicate 197.0 with the decimal point flashing.
- 12) Press PROG again, the display will gradually come to indicate 197.0, as an effect of the correction applied.
- 13) Press ENTER, the top of the display will now indicate C01, while the bottom part will display the value in lux corresponding to the voltage applied with the simulator.
- 14) Apply a voltage of 0.0V and make the zero correction, as in the previous case, pressing the PROG key twice.
- 15) The filtering of the photometric measurement channel is different from that of the temperature. At the end of the operation described above, the display may therefore vary between -0.1 and 0.0 or 0.1; this is to be considered normal and acceptable.
- 16) Apply a voltage of 437.0mV, corresponding to 190.0 lux, the instrument must indicate 190.0 with a maximum deviation of a few units.
- 17) As in the previous steps, press PROG twice in sequence, the instrument will indicate 190.0 lux.
- 18) Ensure that the indication is correct: 190.0 and that the scale is in lux.
- 19) Switch off the instrument, when switching on again, check for correct operation.
- 20) The instrument is now calibrated and has recording the date on the clock as its calibration date.

## INSTRUMENT TECHNICAL DATA

Inputs/type of measurement	2: photometric/radiometric or temperature
Connector	DIN 45326 8-pole
Measuring range:	
Photometric measurements:	0 ... 200,000 lux 0 ... 20,000 fcd
Radiometric measurements:	0 ... 2000 W/m <sup>2</sup> 0 ... 200,000 $\mu$ W/cm <sup>2</sup> 0 ... 200,000 $\mu$ mol/m <sup>2</sup> s 0 ... 2,000,000 cd/m <sup>2</sup>
Q energy	depends on the active measurements unit
Integration time	19 hours, 59 minutes, 59 seconds
No. conversions per second	2
Working temperature	-5...+50°C
Working relative humidity	0...90% R.H. (no condensation)
Serial output	RS232C 300...19200 baud (galvanically insulated)
Display	Double LCD 12.5 mm
Functions	Auto Power Off, Autorange, Hold, Record, Maximum, Minimum, Mean, Relative, A-B (differential), Energy
Memory	512kB (FLASH) corr. to 30000 measurements
Power supply	9Vdc alkaline battery
Autonomy	Approx. 30 hours (continuous duty)
Weight / dimensions	320 gr. / 215x73x38 mm

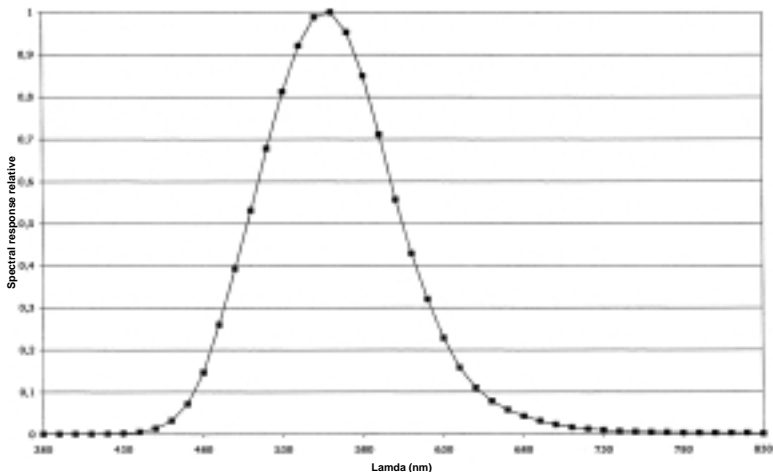
INSTRUMENT PRECISION			
	at 25°C +/-	from -5°C to 50°C +/-	Measuring range +/-
Basic precision, instrument alone	0.1% + 1 digit	0.2% + 1 digit	
Temperature measurements with TP 870	0.6°C 0.4°C 2°C	0.6°C + 0.01°C/°C 0.4°C + 0.01°C/°C 2°C + 0.01°C/°C	(measures -200...-50°C) (measures -50...+200°C) (measures +200...+650°C)

**ILLUMINANCIA probe LP 9021 PHOT**

Range:	0÷200,000 lux
Spectral response:	corrected for Photopic Vision $V(\lambda)$
Calibration incertitude:	<4%
$f_1$ (spectral matches with $V(\lambda)$ curve):	<8%
$f_2$ (mean cosine error):	<3%
$f_3$ (error by non-linearity):	<1%
$f_4$ (error by display unit):	<0.5%
$f_5$ (fatigue):	<0.1%
$\alpha$ (temperature coefficient) $f_6$ (T):	<0.05%/K
Operating temperature range:	0÷50°C

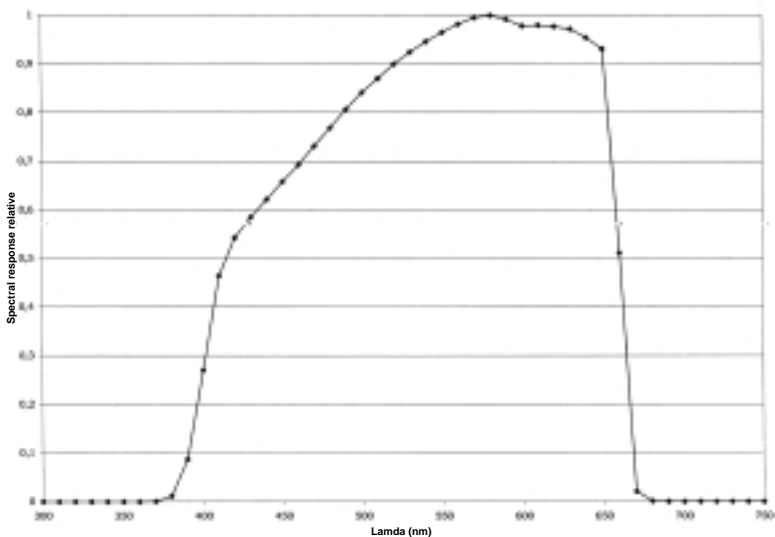
**LUMINANCE probe LP 9021 LUM6**

Range:	0÷2,000 $10^3$ cd/m <sup>2</sup>
Angular field:	6°
Spectral response:	corrected for Photopic Vision $V(\lambda)$
Calibration incertitude:	<5%
$f_1$ (spectral matches with $V(\lambda)$ curve):	<8%
$f_3$ (error by non-linearity):	<1%
$f_4$ (error by display unit):	<0.5%
$f_5$ (fatigue):	<0.1%
$\alpha$ (temperature coefficient) $f_6$ (T):	<0.05%/K
Operating temperature range:	0÷50°C



**IRRADIANCE probe LP 9021 PAR**

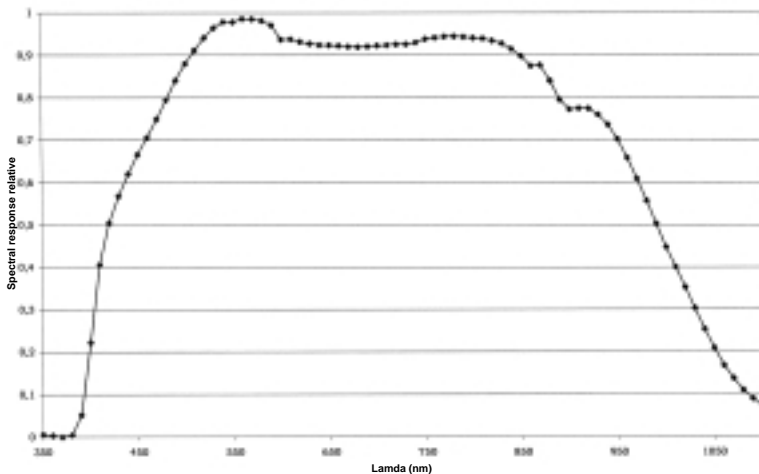
Range:	0÷20,000 $\mu\text{mol}/\text{m}^2\text{s}$
Spectral response:	400÷700 nm
Calibration incertitude:	<5%
Mean cosine error:	<6%
Non-linearity:	<1%
Error by display unit:	$\pm 1$ digit
Fatigue:	<0.1%
$\alpha$ (temperature coefficient) $f_\theta$ (T):	<0.05%/K
Operating temperature range:	0÷50°C





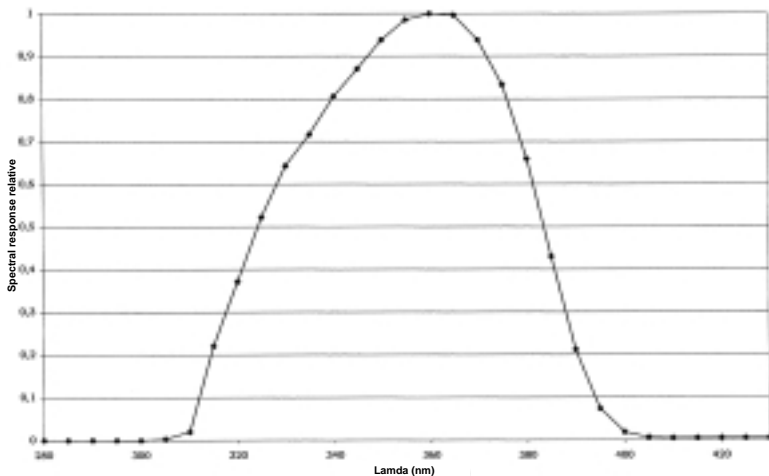
**IRRADIANCE probe LP 9021 RAD**

Range:	10 mW/m <sup>2</sup> ÷2,000 W/m <sup>2</sup>
Spectral response:	450÷950 nm
Calibration incertitude:	<5%
Mean cosine error:	<6%
Non-linearity:	<1%
Error by display unit:	±1 digit
Fatigue:	<0.1%
$\alpha$ (temperature coefficient) $f_0$ (T):	<0.05%/K
Operating temperature range:	0÷50°C



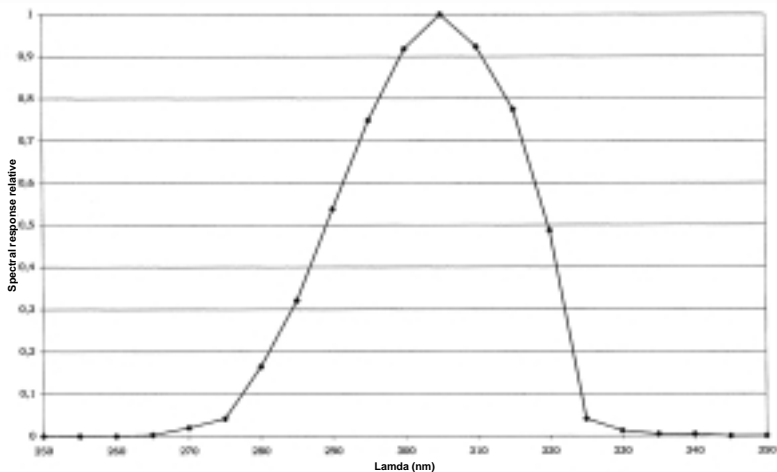
**IRRADIANCE probe LP 9021 UVA**

Range:	10 mW/m <sup>2</sup> ÷2,000 W/m <sup>2</sup>
Spectral response:	315÷400 nm (Peak 360 nm)
Calibration incertitude:	<5%
Mean cosine error:	<6%
Non-linearity:	<1%
Error by display unit:	±1 digit
Fatigue:	<0.1%
$\alpha$ (temperature coefficient) $f_0$ (T):	<0.05%/K
Operating temperature range:	0÷50°C



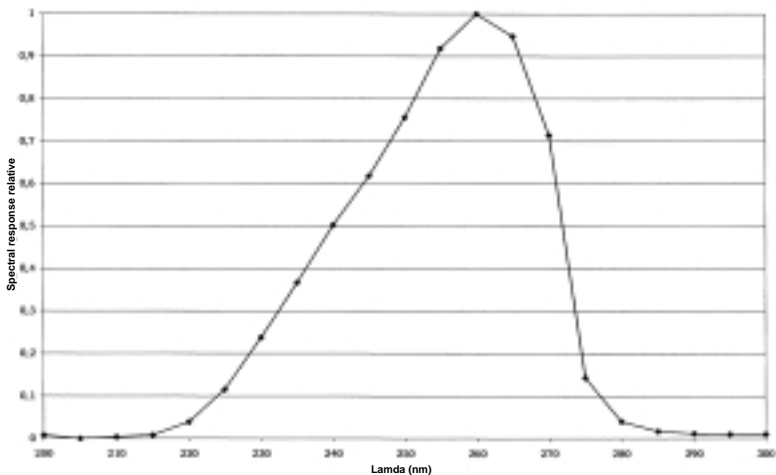
**IRRADIANCE probe LP 9021 UVB**

Range:	10 mW/m <sup>2</sup> ÷2,000 W/m <sup>2</sup>
Spectral response:	280÷315 nm (Peak 305 nm)
Calibration incertitude:	<5%
Mean cosine error:	<6%
Non-linearity:	<1%
Error by display unit:	±1 digit
Fatigue:	<0.1%
$\alpha$ (temperature coefficient) $f_{\theta}$ (T):	<0.05%/K
Operating temperature range:	0÷50°C




**IRRADIANCE probe LP 9021 UVC**

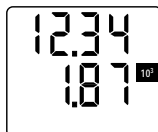
Range:	10 mW/m <sup>2</sup> ÷2,000 W/m <sup>2</sup>
Spectral response:	200÷280 nm (Peak 260 nm)
Calibration incertitude:	<5%
Mean cosine error:	<6%
Non-linearity:	<1%
Error by display unit:	±1 digit
Fatigue:	<0.1%
$\alpha$ (temperature coefficient) $f_{\theta}$ (T):	<0.05%/K
Operating temperature range:	0÷50°C



## EXAMPLES OF USE OF THE KEYBOARD

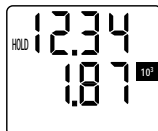
- 1)  Switches the instrument on or off

- 2) Use of the  key



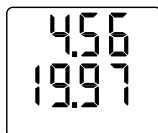
NORMAL MEASUREMENT

--> HOLD is pressed




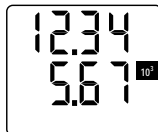
"FROZEN" MEASUREMENT  
the HOLD message appears  
the values on the display are not updated

--> HOLD is pressed



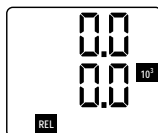
NORMAL MEASUREMENT

- 3)  allows the "relative" values to be displayed and transmitted on the serial line.



NORMAL MEASUREMENT

--> REL is pressed

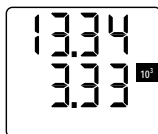


The display shows the relative measurement,  
equal to zero if the input signal is not varied.



The display shows the relative measurement, channel A has increased, channel B has decreased.

--> REL is pressed



NORMAL MEASUREMENT

- 4) **Data Call** when the key is pressed repeatedly, the following are shown, in sequence:



1



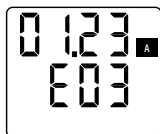
2



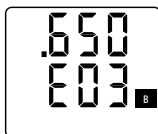
3



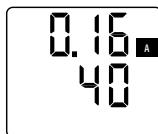
4



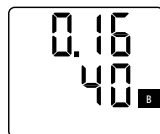
5



6



7



8

- 1) Normal reading
- 2) Maximum reading (both channels)
- 3) Minimum reading (both channels)
- 4) Mean reading (both channels)
- 5) Q of channel A, in exponential format, at the same time led Q of channel A is lit
- 6) Q of channel B, in exponential format, at the same time led Q of channel B is lit
- 7) Time of channel A: hh.mm and ss, at the same time led T of channel A is lit
- 8) Time of channel B: hh.mm and ss, at the same time led T of channel B is lit

**If one of the channels is a temperature channel, the corresponding display of Q and T does not appear.**

## **INSTRUCTIONS FOR CONNECTING DELTA OHM INSTRUMENTS TO A PC WITH WINDOWS OPERATIVE SYSTEM**

### **HARDWARE CONNECTION:**

- 1) The measuring instrument must be switched off.
- 2) Connect the serial gate of the measuring instrument to a free serial gate on the PC (COM1/COM2) using the special Delta Ohm CP RS232C cable.  
Note: the CP RS232C cable ends in a female 25-pin connector; if your PC does not have a compatible connector, use the adapters normally found on the market to make the connection.
- 3) Turn the switch on the CP RS232C cable to COMPUTER 7 position.

### **SOFTWARE CONNECTION WITH WINDOWS 3.1:**

- A) Start WINDOWS.
- B) Select ACCESSORIES (2 click).
- C) Select TERMINAL and activate the communications program (2 click).

D) To alter the communication settings of the terminal, in order to make them compatible with those of the measuring instrument used (unless a terminal setting file has already been saved):

- \* select SETTINGS in the terminal window (1 click).
- \* select COMMUNICATIONS from the pull-down menu (1 click).
- \* the COMMUNICATIONS window for setting the communication procedures will appear on the screen; set:  
 TRANSMISSION SPEED: 19200 which must correspond to the speed set on the instrument (1 click),  
 DATA BITS: 8 (1 click),  
 STOP BITS: 1 (1 click),  
 PARITY: None (1 click),  
 FLOW CONTROL: Xon/Xoff (1 click),  
 CONNECTOR: COM1 or COM2 depending on the gate used for connection (1 click),  
 CHECK PARITY and SHOW CARRIER must remain unmarked,
- \* OK to confirm the setting (1 click).





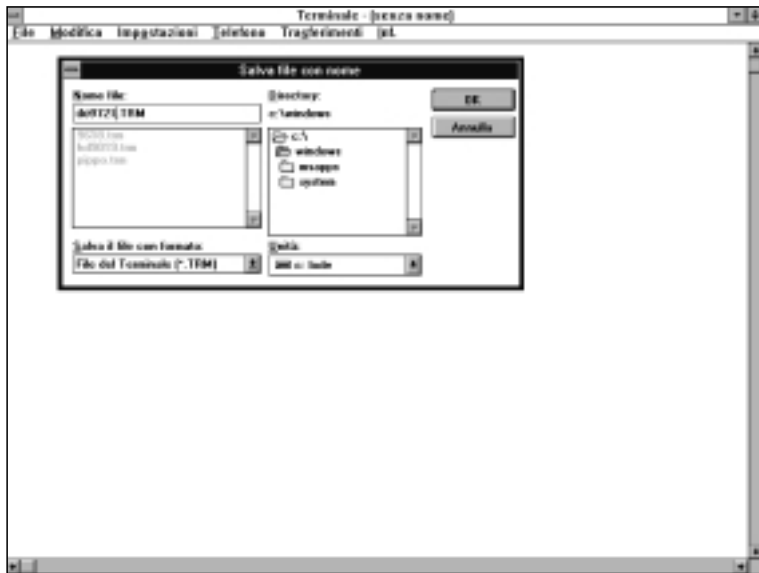
E) To set the correct character type:

- \* select SETTINGS from the terminal window (1 click).
- \* on the pull-down menu select TERMINAL PREFERENCES... (1 click).
- \* the TERMINAL PREFERENCES window appears on the monitor, set:  
mark local Echo (1 click),  
Character type: Terminal,  
Translation: None,  
leave the rest unchanged,
- \* OK to confirm the setting (1 click).



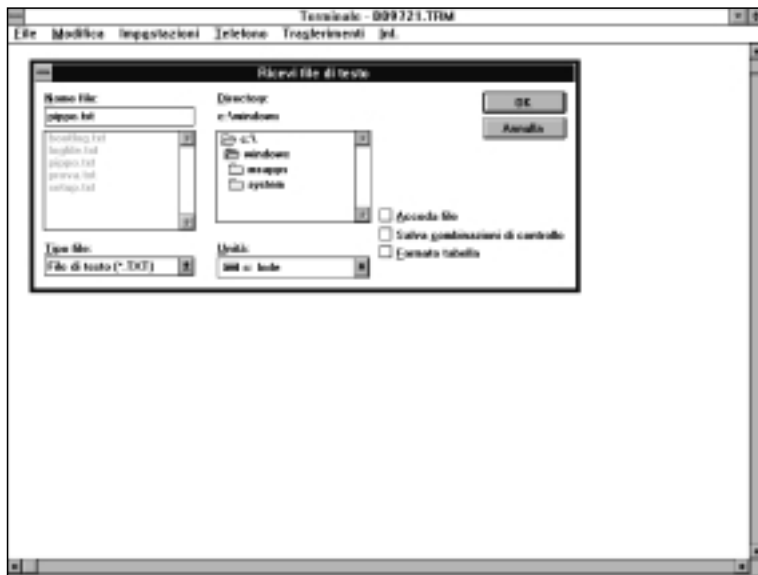
F) If you want to save this terminal setting:

- \* select FILE from the terminal window (1 click).
- \* select SAVE AS from the pull-down menu and the SAVE FILE AS window will appear (1 click).
- \* type the name of the terminal setting file (max. 8 characters) on the line provided.
- \* OK to confirm and save the setting (1 click).



G) To receive and store data from an instrument:

- \* select TRANSFER from the terminal window (1 click).
- \* select RECEIVE TEXT FILE from the pull-down menu and the window will appear (1 click).
- \* type the name of the file in which data are to be stored (max. 8 characters) on the line provided.
- \* OK to confirm and start storage (1 click).



At this point the terminal is ready to receive data from the measuring instrument. Everything sent by the measuring instrument will be stored in the file indicated previously.

H) Switch on the measuring instrument.

When the instrument has completed the switching-on routine, activate the immediate unloading of data at the set rate, pressing the SERIAL OUTPUT button, or activate the unloading of the data stored in the internal memory with the program P1 (press the PROG button twice) and press the ENTER button.

- I) End of storage of the data sent by the instrument:
- \* select TRANSFER from the terminal window (1 click).
  - \* to end storage, select END from the pull-down menu (1 click).



The software returns to the terminal window.

- L) End use of the TERMINAL:
- \* select FILE from the terminal window (1 click).
  - \* select QUIT from the pull-down menu (1 click).

The text file, containing the data received from the measuring instrument connected to the PC, is now stored in your computer. To read and process the file obtained you can use any text or table processing program in the Windows environment (WORD, EXCEL, WORKS, etc.).

## SOFTWARE CONNECTION WITH WINDOWS 95

A) After starting WINDOWS 95, select START, PROGRAMS, ACCESSORIES, HYPERTERMINAL. Run HYPERTRM (2 click).

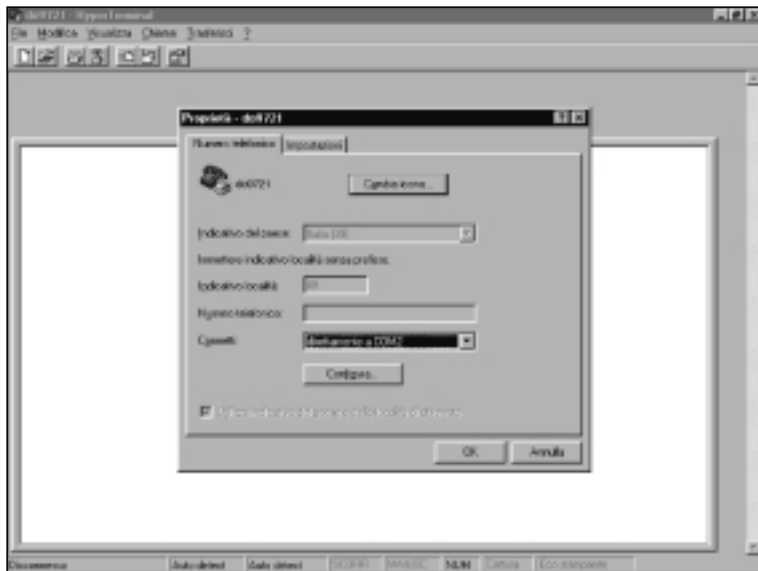
B) Name of the communication:

- \* In the window "Description of connection", give a name to the communication that you want to activate and choose an icon (in subsequent communications it will be possible to activate directly the icon chosen in place of HYPERTRM, automatically recovering all the settings saved with the icon).

- \* OK to confirm.

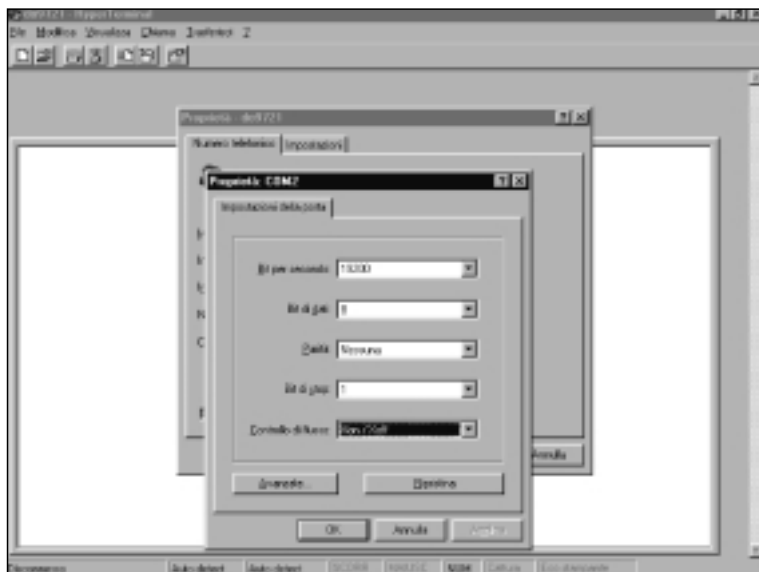
- \* Cancel in the next window.



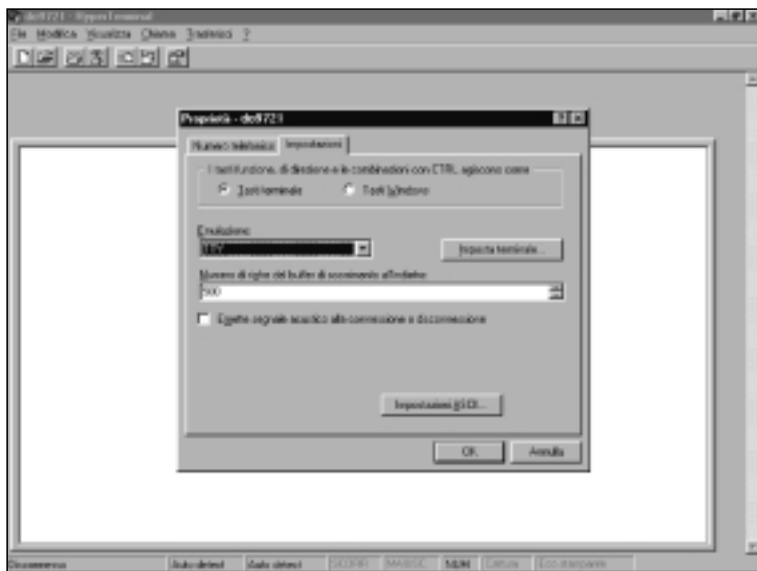


### C) Setting communication:

- \* select FILE from the Hyper Terminal window (1 click).
- \* select PROPERTIES from the pull-down menu (1 click) and the "Properties" window will appear.
- \* on the "Telephone number" card, for the Connect property, choose "Directly to COM1" or "COM2", depending on the serial port that you intend to use for communication with the measuring instrument.
- \* on the "Telephone number" card, select CONFIGURE (1 click) and the "Port settings" card will appear.
- \* on the "Port settings" card select:
  - BITS PER SECOND: 19200,
  - DATA BITS: 8,
  - PARITY: None,
  - STOP BITS: 1,
  - FLOW CONTROL: Xon / Xoff,
- OK to confirm the port setting (1 click).



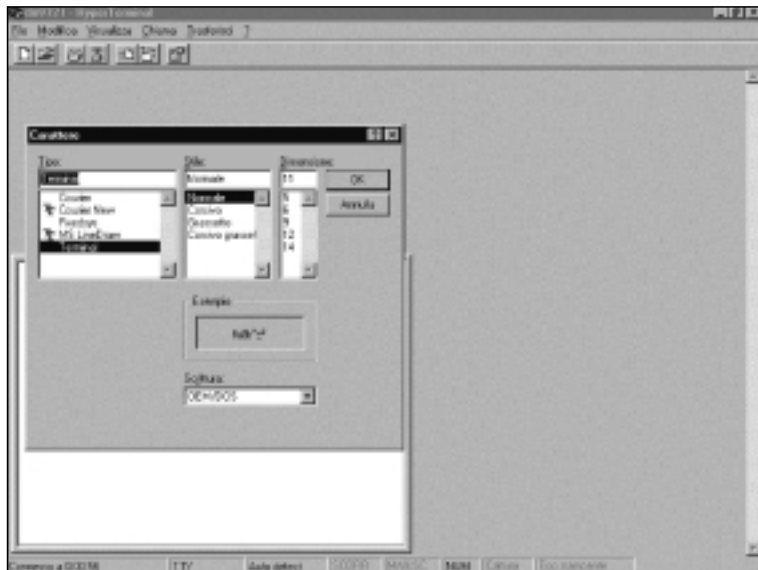
- \* select SETTINGS to display the “Settings” card.
- \* on the “Settings” card, for the “Emulation” property, select TTY.
- \* OK to confirm the “Properties” set (1 click).





D) To set the correct character type:

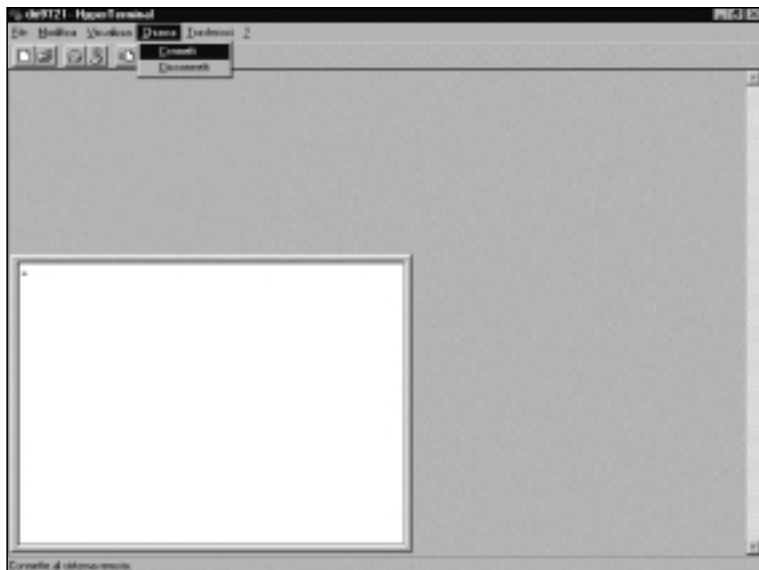
- \* select DISPLAY from the Hyper Terminal window (1 click).
- \* select CHARACTER from the pull-down menu (1 click) and the window for selecting the character will appear; set:  
Terminal.
- \* OK to confirm (1 click).



E) To receive and store data from an instrument:

- \* select CALL from the Hyper Terminal window (1 click).
- \* select CONNECT from the pull-down menu.

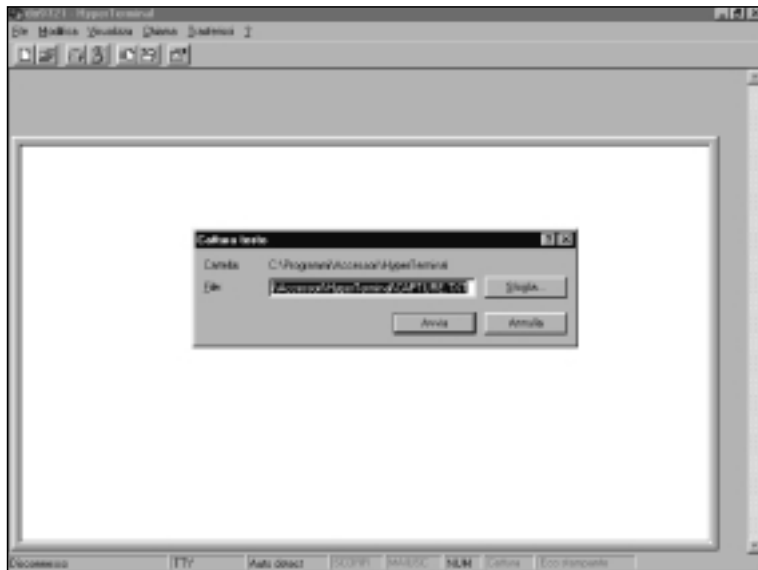
In this way it is possible to receive the characters from the instrument on the monitor.



At this point the Hyper Terminal software is able to receive data from the measuring instrument and store them in the set file.

F) To receive and store data from an instrument:

- \* select TRANSFER from the Hyper Terminal window (1 click).
- \* select CAPTURE TEXT from the menu (1 click) and the window will appear where you have to set the name of the file in which to store the data received from the instrument.
- \* type the name of the file in which data are to be stored on the line provided.
- \* START to set the name of the receiving file (1 click).



G) To end receiving data from an instrument:

- \* select TRANSFER from the Hyper Terminal window (1 click).
- \* select CAPTURE TEXT from the menu (1 click).
- \* select END from the pull-down sub-menu (1 click).

At this point data reception from the instrument is ended and the file stored in the computer can be used with any of the software packages used with WINDOWS 95.



H) To quit running the Hyper Terminal:

- \* select FILE from the Hyper Terminal window (1 click).
- \* select QUIT from the pull-down menu (1 click).
- \* YES (1 click) if you want to save the settings of the communication made.

## SOFTWARE CONNECTION WITH WINDOWS 98

A) After starting WINDOWS 98 select START, PROGRAMS, ACCESSORIES, COMMUNICATIONS, HYPERTERMINAL.

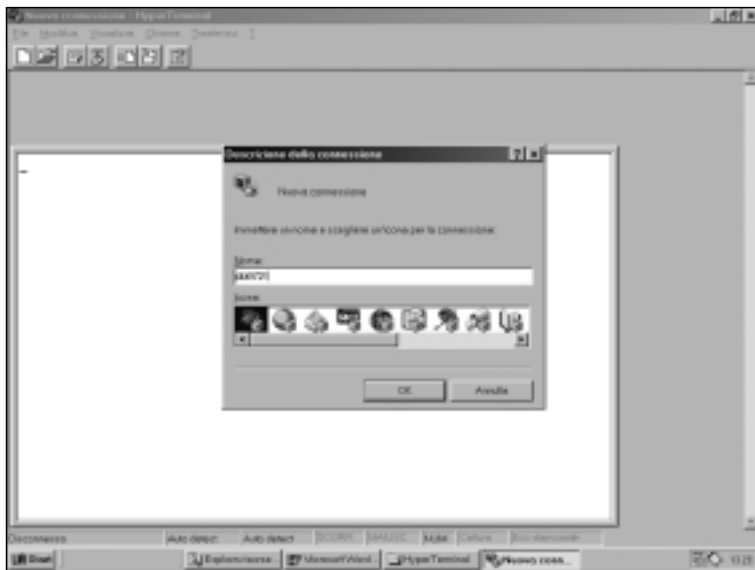
Run HYPERTRM (2 click).

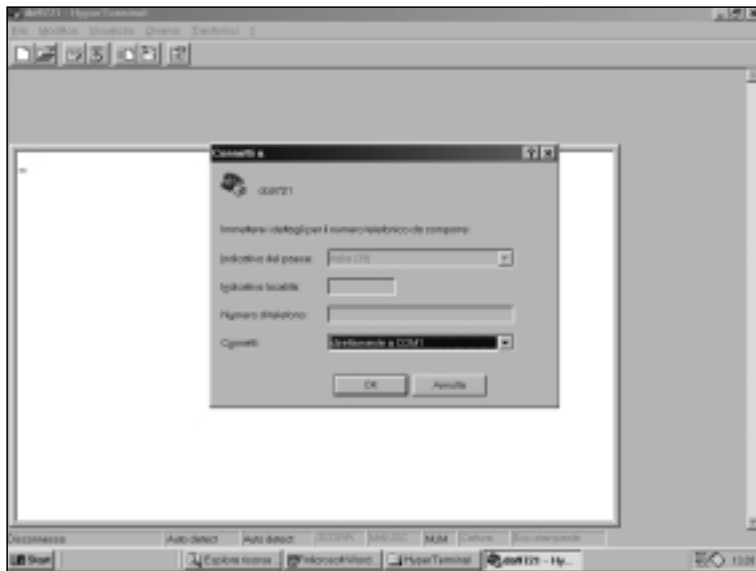
B) Name of the communication:

- \* In the window "Description of connection", give a name to the communication that you want to activate and choose an icon (in subsequent communications it will be possible to activate directly the icon chosen in place of HYPERTRM, automatically recovering all the settings saved with the icon).

- \* OK to confirm.

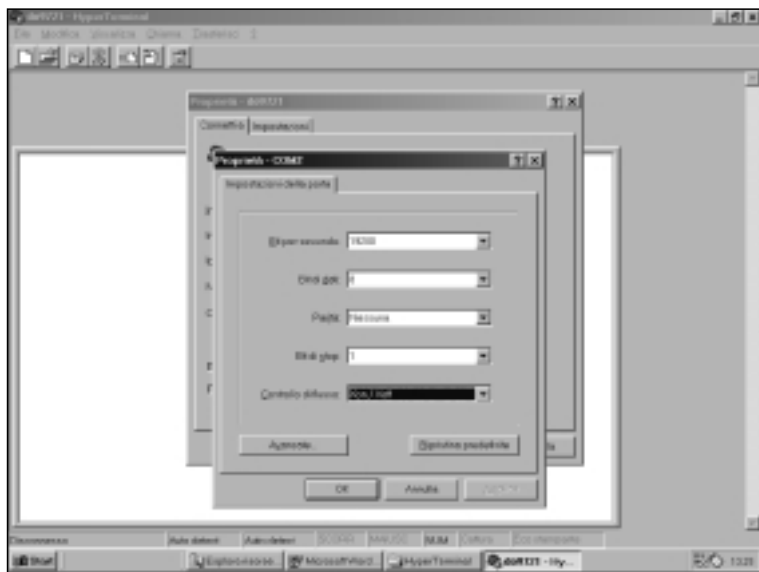
- \* Cancel in the next window.



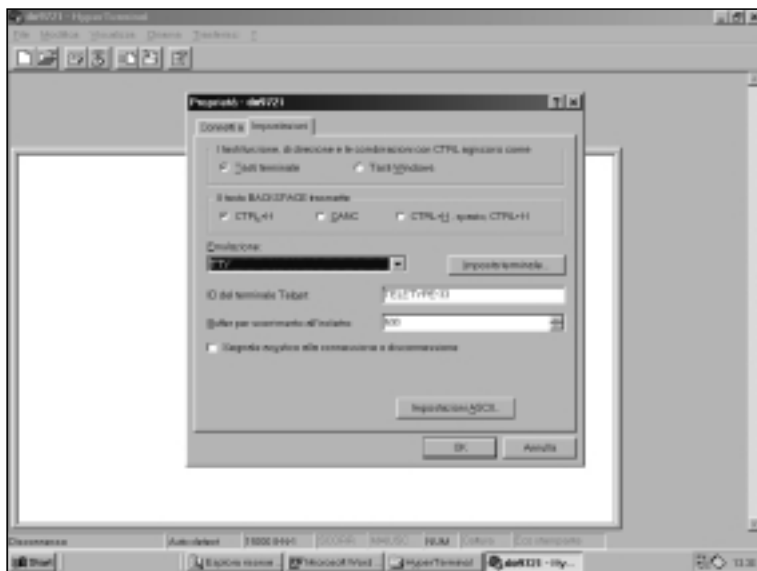


### C) Setting communication:

- \* select FILE from the Hyper Terminal window (1 click).
- \* select PROPERTIES from the pull-down menu (1 click) and the "Properties" window will appear.
- \* on the "Connect to" card, for the Connect property, choose "directly to COM1" or "COM2", depending on the serial port that you intend to use for communication with the measuring instrument.
- \* on the "Connect to" card, select CONFIGURE (1 click) and the "Port settings" card will appear.
- \* on the "Port settings" card select:
  - BITS PER SECOND: 19200,
  - DATA BITS: 8,
  - PARITY: None,
  - STOP BITS: 1,
  - FLOW CONTROL: Xon / Xoff,
- OK to confirm the port setting (1 click).



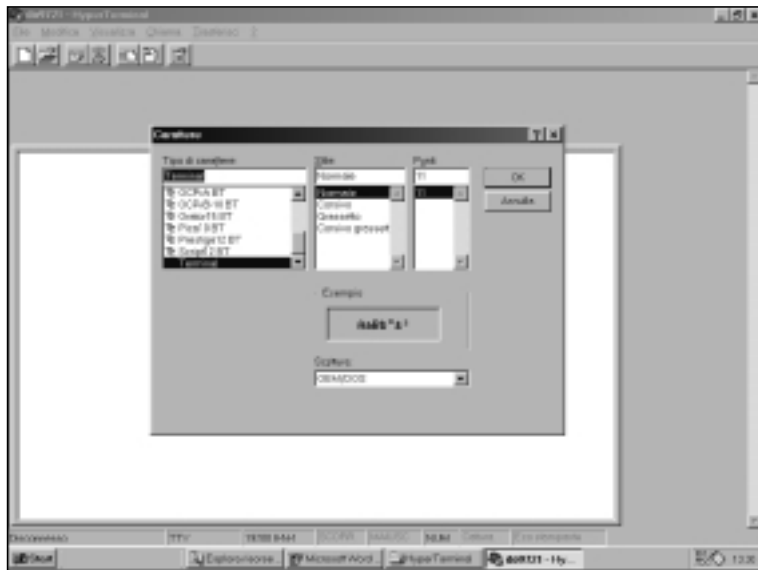
- \* select SETTINGS to display the “Settings” card.
- \* on the “Settings” card, for the “Emulation” property, select TTY.
- \* OK to confirm the “Properties” set (1 click).





D) To set the correct character type:

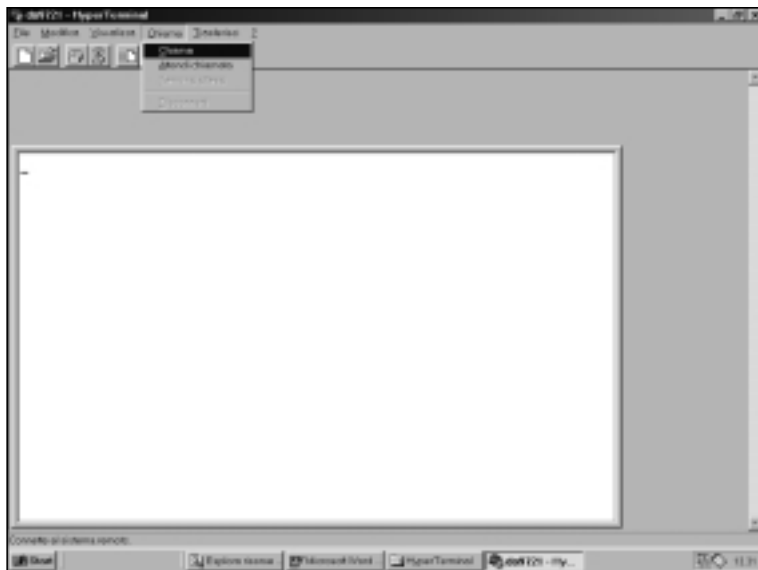
- \* select DISPLAY from the Hyper Terminal window (1 click).
- \* select CHARACTER from the pull-down menu (1 click) and the window for selecting the character will appear; set:  
Terminal.
- \* OK to confirm (1 click).



E) To receive and store data from an instrument:

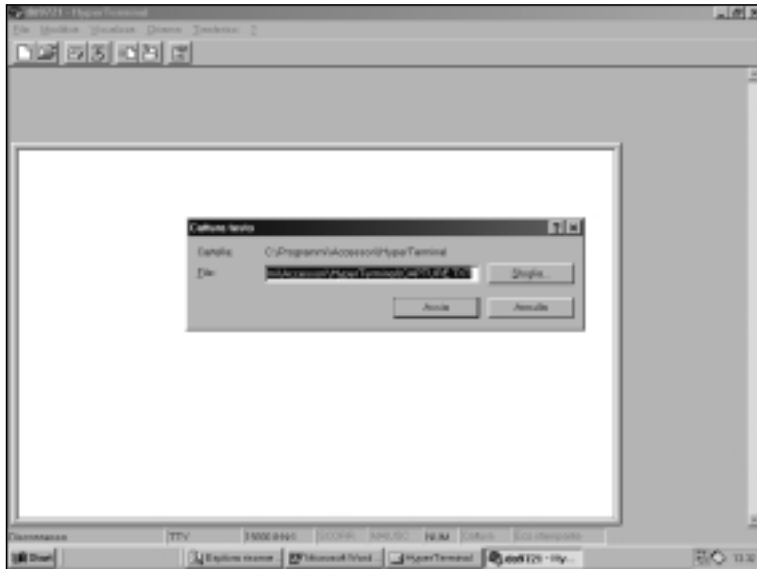
- \* select CALL from the Hyper Terminal window (1 click).
- \* select CALL from the pull-down menu.

In this way it is possible to receive the characters from the instrument on the monitor.



F) To receive and store data from an instrument:

- \* select TRANSFER from the Hyper Terminal window (1 click).
- \* select CAPTURE TEXT from the menu (1 click) and the window will appear where you have to set the name of the file in which to store the data received from the instrument.
- \* type the name of the file in which data are to be stored on the line provided.
- \* START to set the name of the receiving file (1 click).

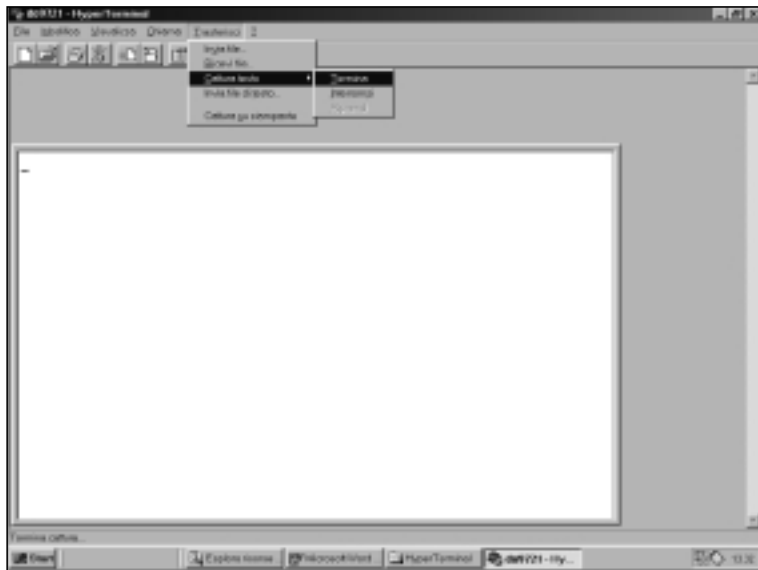


At this point the Hyper Terminal software is able to receive data from the measuring instrument and store them in the set file.

G) To end receiving data from an instrument:

- \* select TRANSFER from the Hyper Terminal window (1 click).
- \* select CAPTURE TEXT from the menu (1 click).
- \* select END from the pull-down sub-menu (1 click).

At this point data reception from the instrument is ended and the file stored in the computer can be used with any of the software packages used with WINDOWS 98.



H) To quit running the Hyper Terminal:

- \* select FILE from the Hyper Terminal window (1 click).
- \* select QUIT from the pull-down menu (1 click).
- \* YES (1 click) if you want to save the settings of the communication made.

## SOFTWARE CONNECTION WITH WINDOWS NT

A) After starting WINDOWS NT select START, PROGRAMS, ACCESSORIES, HYPERTERMINAL, HYPER TERMINAL (1 click).

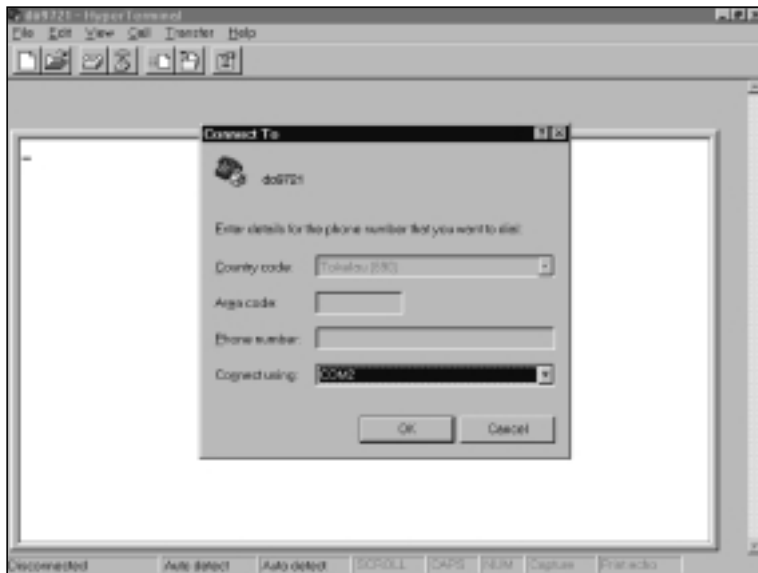
B) Name of the communication:

- \* In the window "Description of connection", give a name to the communication that you want to activate and choose an icon (in subsequent communications it will be possible to activate directly the icon chosen in place of HYPER TERMINAL, automatically recovering all the settings saved with the icon).

- \* OK to confirm.

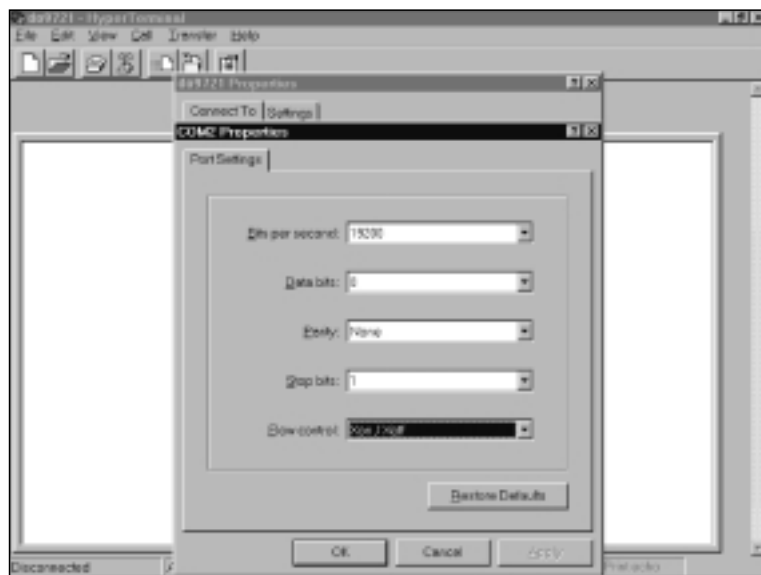
- \* Cancel in the next window.



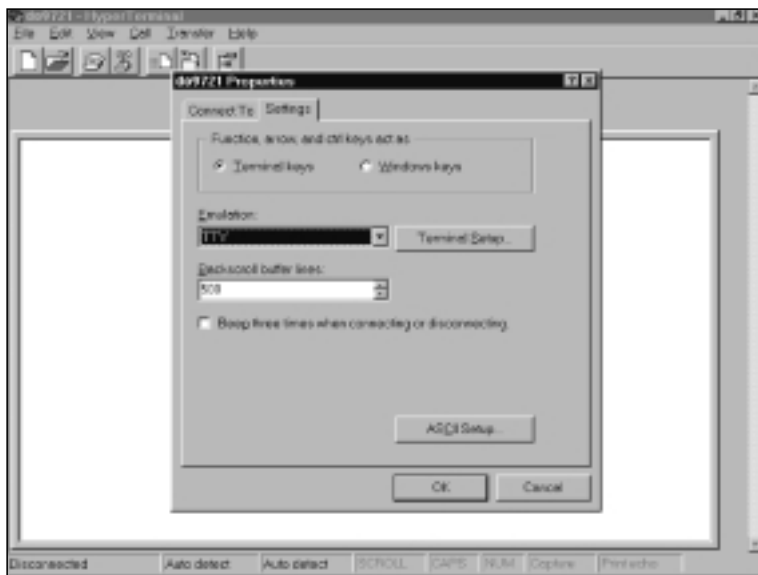


### C) Setting communication:

- \* select FILE from the Hyper Terminal window (1 click).
- \* select PROPERTIES from the pull-down menu (1 click) and the "Properties" window will appear.
- \* on the "Connect to" card, for the Connect property, choose "COM1" or "COM2", depending on the serial port that you intend to use for communication with the measuring instrument.
- \* on the "Connect to" card, select CONFIGURE (1 click) and the "Port settings" card will appear.
- \* on the "Port settings" card select:
  - BITS PER SECOND: 19200,
  - DATA BITS: 8,
  - PARITY: None,
  - STOP BITS: 1,
  - FLOW CONTROL: Xon / Xoff,
- OK to confirm the port setting (1 click).



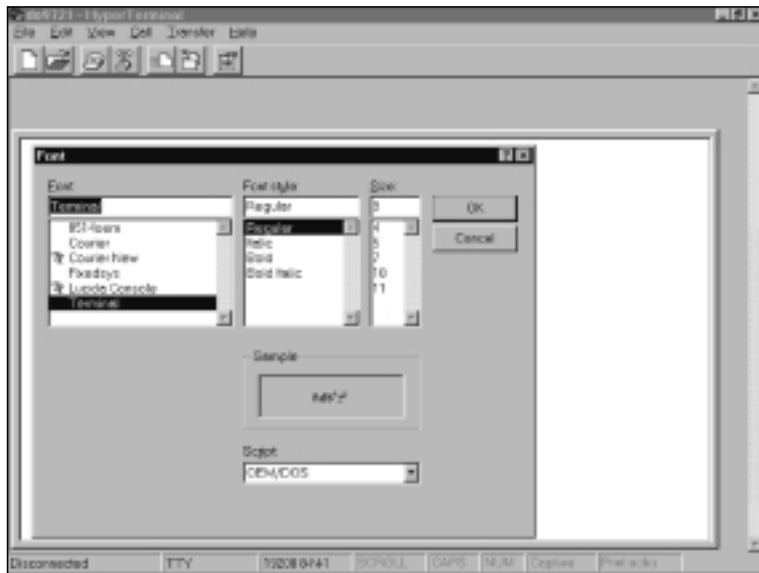
- \* select SETTINGS to display the “Settings” card.
- \* on the “Settings” card, for the “Emulation” property, select TTY.
- \* OK to confirm the “Properties” set (1 click).





D) To set the correct character type:

- \* select DISPLAY from the Hyper Terminal window (1 click).
- \* select CHARACTER from the pull-down menu (1 click) and the window for selecting the character will appear; set:  
Terminal.
- \* OK to confirm (1 click).

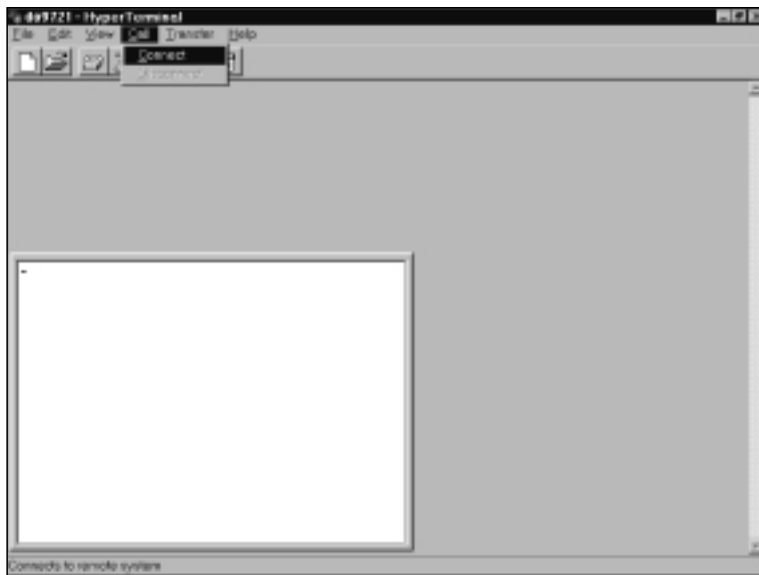


E) To receive and store data from an instrument:

- \* select CALL from the Hyper Terminal window (1 click).

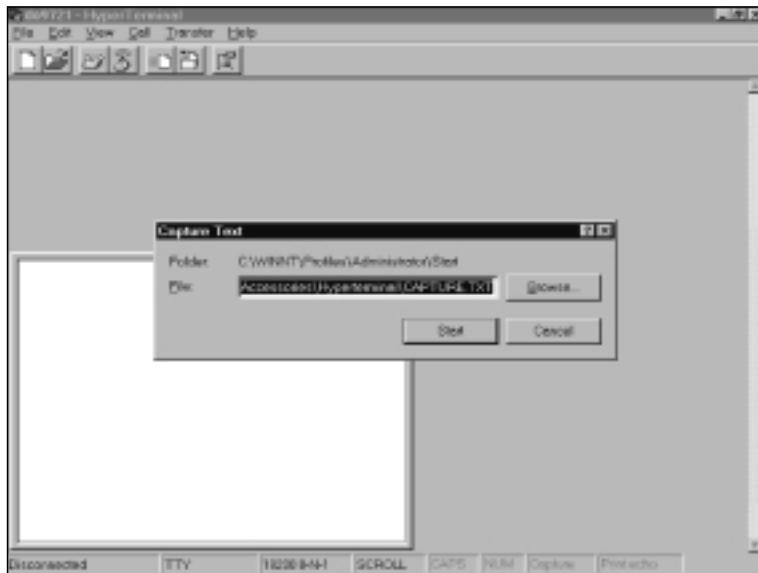
- \* select CONNECT from the pull-down menu.

In this way it is possible to receive the characters from the instrument on the monitor.



F) To receive and store data from an instrument:

- \* select TRANSFER from the Hyper Terminal window (1 click).
- \* select CAPTURE TEXT from the menu (1 click) and the window will appear where you have to set the name of the file in which to store the data received from the instrument.
- \* type the name of the file in which data are to be stored on the line provided.
- \* START to set the name of the receiving file (1 click).

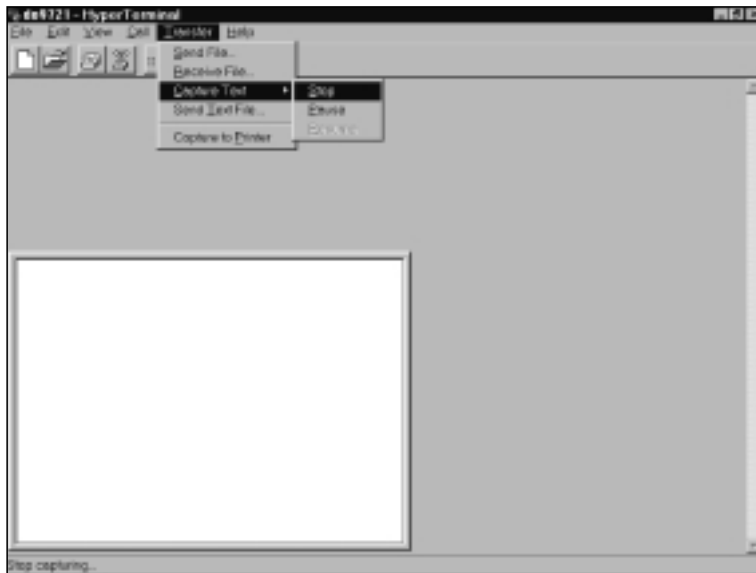


At this point the Hyper Terminal software is able to receive data from the measuring instrument and store them in the set file.

G) To end receiving data from an instrument:

- \* select TRANSFER from the Hyper Terminal window (1 click).
- \* select CAPTURE TEXT from the menu (1 click).
- \* select END from the pull-down sub-menu (1 click).

At this point data reception from the instrument is ended and the file stored in the computer can be used with any of the software packages used with WINDOWS NT.



H) To quit running the Hyper Terminal:

- \* select FILE from the Hyper Terminal window (1 click).
- \* select QUIT from the pull-down menu (1 click).
- \* YES (1 click) if you want to save the settings of the communication made.

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## **GUARANTEE**

This instrument is strictly inspected before being sold. However if there should be any defect due to manufacture and/or transport, apply to the dealer from whom you bought the instrument. The guarantee period is 2 (two) years from the date of purchase. During this period all defects found by us will be repaired free of charge, excluding those due to incorrect use and careless handling. The probes are not covered by the guarantee, as they can be irreparably damaged after only a few minutes of incorrect use.

CE CONFORMITY	
Safety	EN61000-4-2, EN61010-1 level 3
Electrostatic discharge	EN61000-4-2 level 3
Electric fast transients	EN61000-4-4 level 3
Voltage variations	EN61000-4-11
Electromagnetic interference susceptibility	IEC1000-4-3
Electromagnetic interference emission	EN55020 class B



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