Automatic Measuring Systems for the Environment
Ljubljana Technology Park

PMP 124A
PORTABLE METEOROLOGICAL STATION

Manual

Ljubljana, 2000

CONTENTS

1. INTRODUCTION

PMP 124A is small, lightweight, computerised, low power portable meteorological station for ground measurements.

Main features of PMP 124A are:

• can be easily transported
• can be assembled quickly and is fully operational immediately after the assembling
• measures parameters important for ballistics, meteorology, biological or chemical pollution, radiological pollution, and aviation meteorology
• high accuracy
• simple operation
• long autonomy with the built in battery
• internal data storage
• data transfer

2. PARTS OF THE STATION

PMP 124A consists of the following parts:

• Meteorological mast with the accessories
• PMP 124A measuring unit with built-in atmospheric pressure sensor
• Battery charger
• VMT 107A digital wind speed / direction sensor
• DTE 75A non-aspirated air temperature sensor on 0.5 m (T1)
• DTV 124 combined air temperature / relative humidity sensor on 2 m (T2/RH)
• DTZ 124 soil temperature sensor (T3)

Transport set consists of two carrying units: bag with the meteorological mast and carrying case with PMP 124A measuring unit, battery charger, and sensors.

PMP 124A set

2.1 Transport bag for the meteorological mast

Transport bag for the meteorological mast contains the following equipment:

- 2 m telescopic, self-standing meteorological mast with hardware for fixing the sensors and sensor cables.

- 3 pcs. fixing elements for the tripod

- Hammer 500 g

- Cable 20 m for connecting mast to the measuring unit.

Dimensions:

length	1.120 mm
diameter	200 mm
mass	8 kg

2.2 Transport case with measuring unit and sensors
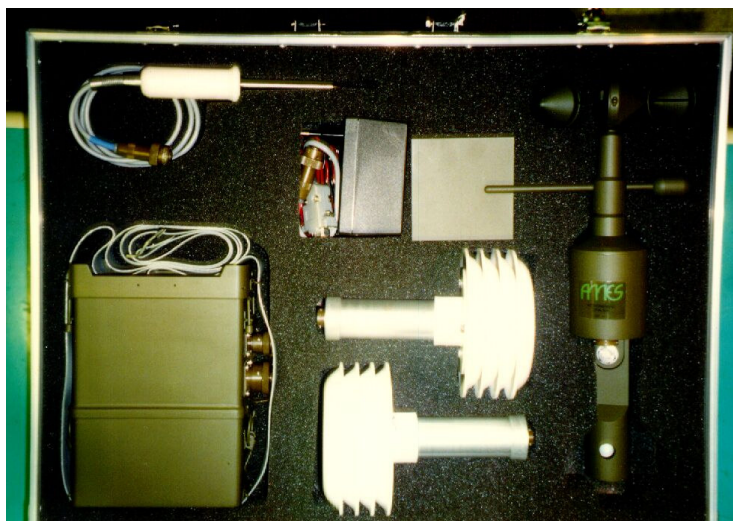
Transport case contains the following elements:

- PMP 124A measuring unit with built-in atmospheric pressure sensor
- Battery charger
- VMT 107A digital wind speed / direction sensor
- DTE 75A non-aspirated air temperature sensor
- DTV 124 combined air temperature / relative humidity sensor
- DTZ 124 soil temperature sensor
- Manual

Dimensions:

length	540 mm
width	410 mm
height	160 mm
mass	7 kg

3. MEASURED DATA

PMP 124A measures the following data:

- air temperature 0.5 m above the ground (T1)
- air temperature 2 m above the ground (T2)
- relative humidity on the height 2 m
- wind speed and direction at top of the mast
- soil temperature (T3)
- atmospheric pressure

For all parameters instant, average, minimum and maximum values can be observed.

Station calculates state of the atmosphere (convection, inversion, neutral)

4. ASSEMBLING

3.1 Orientation and assembling of the meteorological mast

- Take out all elements from the mast - transport bag.

- Pull out telescopic legs of the tripod in such a way, that mast stands in the vertical position. Rotate the mast so that "N" mark on the upper ring (see picture) points to the North. Fine-tune the vertical position of the mast and

fix length of legs with the nuts. Push leg-fixing elements into the ground to assure stable orientation.
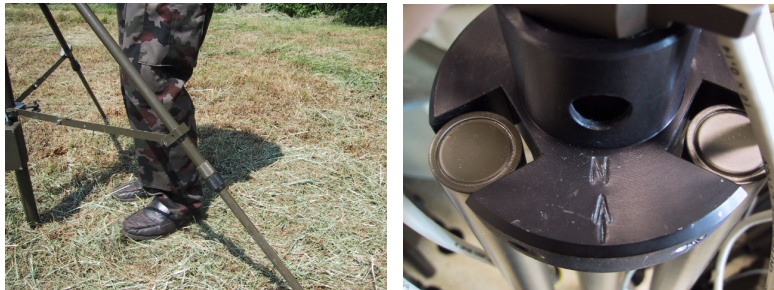
- Take VMT 107A wind sensor out of the carrying case, fix it to the top of the mast and connect cable.

- Fix DTV 124 air temperature (T2) / RH sensor to the upper part of mast (as shown) and connect cable.

- Extend the upper part of the must up, until click.

- Fix DTE 124 (T1) air temperature sensor to the lower part of mast.

- Fix DTZ 124 (T3) soil temperature sensor to the 4-pole female connector on the connection box; push sensor into the ground.

- Connect 20 m cable to the 10-pole female connector on the mast connection box. Extend the cable to the position where PMP 124A measuring unit is located.

The following picture shows fully assembled mast with sensors:
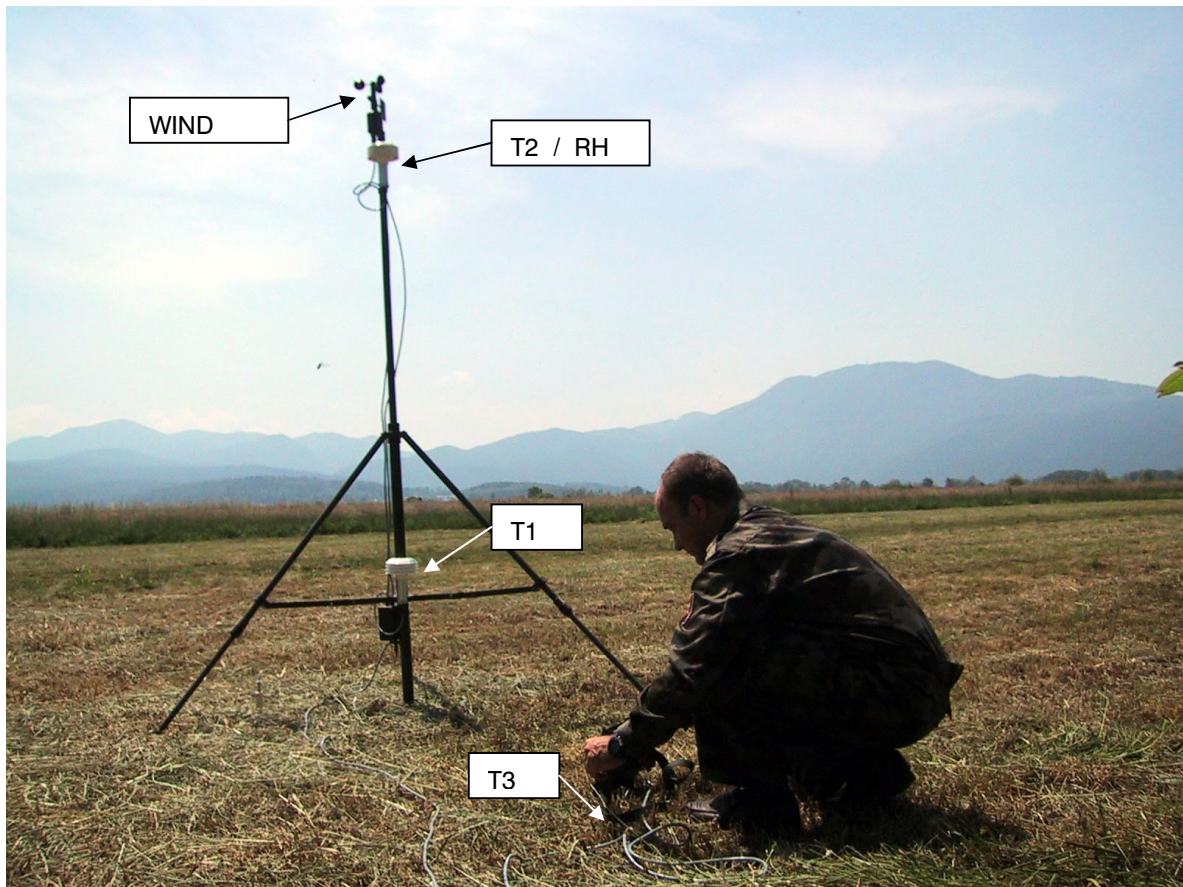
3.2 Connecting the PMP 124A measuring unit:

Connect cable from the mast to the lower connector on the PMP 124A side:

CABLE
FROM THE MAST
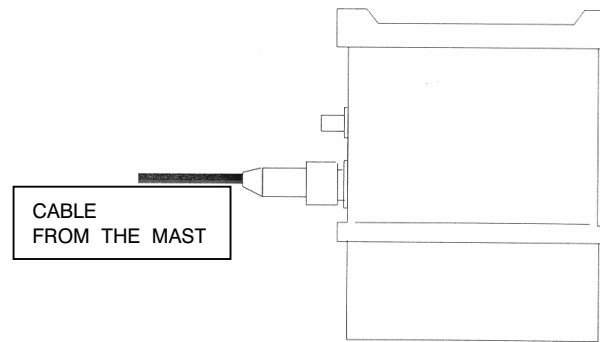
Procedure of preparing PMP 124A station for the operation is finished in aprox. 5 minutes.

Disassemble station in the reverse order!

5. POWERING PMP 124A

PMP 124A can be powered either from the internal battery or from the external AC power source (mains, generator) by means of the supplied battery charger. PMP124A can also be powered from the external 12 - 24 V DC power source (external or car battery).

WARNING!

When operating the station on the battery, be sure that the battery has been previously charged to the sufficient level.

Powering PMP 124A From the Built in Battery

PMP 124A has in it's bottom section hermetically sealed lead battery 12 V / 1.2 Ah. Capacity of the internal battery enables PMP 124 to operate independently up to 24 hours, with display illumination OFF.

If the battery voltage falls below 10.8 V, a LOW BATTERY message is displayed on the LCD. Do not operate the station for a longer time under LOW BATTERY conditions!

WARNING!

Never discharge the internal battery completely! Always store the station with full battery!

Charging the Internal Battery
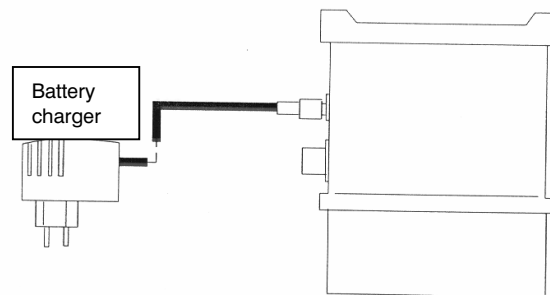
The internal battery can be charged either by the supplied battery charger, connected to the 220 - 240 V 50 / 60 Hz AC source (mains or generator), or from the 12 - 24 V DC external source.

When battery charger is used, it should be connected to the upper connector at the PMP 124A side.

When the external DC source is used it should be connected as described in the next paragraph.

Powering the Station from the External Sources

When battery charger is connected, station can operate on the external AC source.

When external DC source is used, it should be connected to the upper connector on the PMP 124 side as follows:

- pole of 12 -24 V DC source to the contact "C" of the connector
+ pole of 12 - 24 V DC source to the contact "D" of the connector.
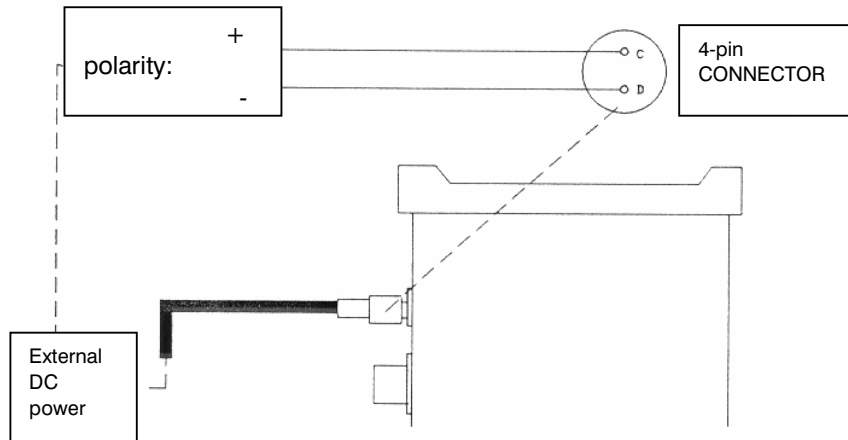
6. DATA TRANSFER
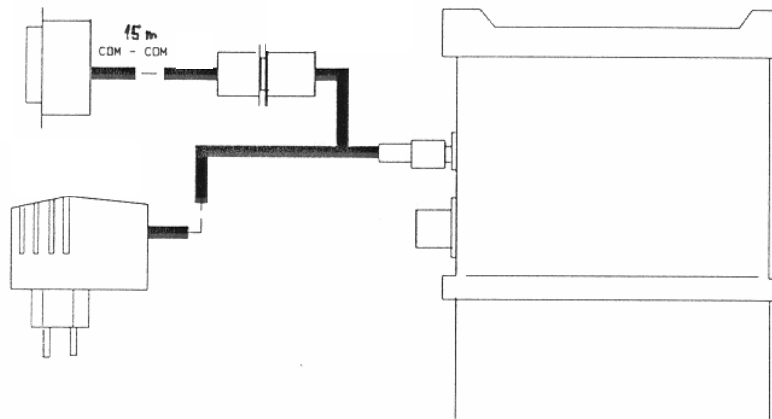
PMP 124 is equipped with an RS 232 interface for transfer of data to the external computer. This transfer can be accomplished over the upper side connector of PMP 124A:

Contact "A" of connector: TX
Contact "B" of connector: RX
Contact "C" of connector: GND

If battery charger is connected, external computer can be connected to the 9-pin RS 232 connector that is part of the charger assembly.

RS 232 transmission is limited to max. 15 m. For longer distances, additional interfaces (such as modems) should be used.

As an option, an RS 485 interface can be built in PMP 124A instead of RS 232 interface.

7. MAINTENANCE

Clean PMP 124A data unit with a wet, soft cloth. Always close the connectors with protective caps!

Handle sensors carefully. When not used, store them in the carrying case.

Keep sensors clean; clean the surface of protective shields with a wet cloth.

A regular calibration of station is recommended once each year, or when sensors are changed. An approved laboratory should do this operation!

8. TECHNICAL DATA

PMP 124A Unit

Dimensions	190 mm * 160 mm * 50 mm
Mass	1.6 kg
Operating temperature	-30 to +50 deg. C
Environmental protection	Hermetically sealed case
Display	LCD, alphanumeric, illuminated, 2 rows by 24 characters
Connectors	SOURIAU, waterproof
Function keys	Sealed, with mechanical contacts
Power supply	internal 12V Pb battery or external source
Autonomy	24 h
Power consumption	50 mA
Battery charging	voltage and current limitter
Data transfer	RS232, serial, adjustable Baud rate, 8 bits, 1 STOP bit, no parity (RS485 as an option)
Distances of data transfer	RS232: 15 m max, RS485: 5000 m max
Air pressure sensor	built in, accuracy 1 mB

Meteorological Mast

Height	2 m, self standing
Number of sections	2
Sensors	Temperature 0.5 and 2 m, RH 2 m, wind top of mast
Cabling	Included

VMT 107A Wind Sensor

Operating temperature	-30 to +50 deg. C
Wind speed transducer	Stroboscope, Robinson's cross
Wind direction transducer	6-bit Gray code encoder, wind vane
Type of transducers	optoelectronic
Wind speed range	0 to 50 m/s
Wind speed constant	23 imp./m
Wind speed accuracy	+/- 0.5 m/s
Resolution of wind direction part	+/- 5.6 deg.

Temperatures

Sensor type	thermolinear thermistor
Accuracy	+/- 0.15 deg. C
Measuring range	-30 to +50 deg. C
Protection	air temperatures: UV resistant radiation shields, soil temperature: stainless steel probe

Relative Humidity

Sensor type	Capacitive
Measuring range	10% to 100% RH
Accuracy	+/- 5% RH

Air Pressure

Sensor type	solid state, built in PMP124A unit
Measuring range	1000 to 1100 hPa
Accuracy	+/- 1 hPa

Battery Charger

Input voltage	220 to 240 V, 50 to 60 Hz AC
Output voltage	13.8 V DC, stabilised

9. OPERATING INSTRUCTIONS

PMP 124A measures and calculates the following values:

• instant
• average (in pre-set intervals)
• maximum (in pre-set intervals)
• minimum (in pre-set intervals)

All parameters that control the functioning of the station can be set by the built-in menu system. They are stored in a non-volatile memory and used at each restart of the station.

At the end of each measuring interval station stores the calculated data into its memory on a FIFO principle. Data buffer is backup by a battery, so data are not lost if the station is powered off. Stored data can be reviewed on a LCD display or transmitted to the external computer. In the data memory there is enough space for 720 measuring intervals. If 1-hour interval is set, that means 30 days data storage.

Pressing the ON key turns on station. Program first writes the identification message to the LCD, then check the system performances.

Message RAM CORRUPTED appears on LCD if data memory do not contain valid data. In this case, after pressing any key, data memory is cleared.

Message EEPROM CORRUPTED appears if constants in EEPROM are not correct. In this case, station uses the default constants and runs in an uncalibrated mode. The situation is definitely an "ERROR" one.

Function keys have two labels. Upper label is used in normal operation, lower label in menu mode:

L C D

| ON LOFF | OFF | LAMP | MENU SET | AVG UP | MIN DOWN | MAX BACK | DISP2 |
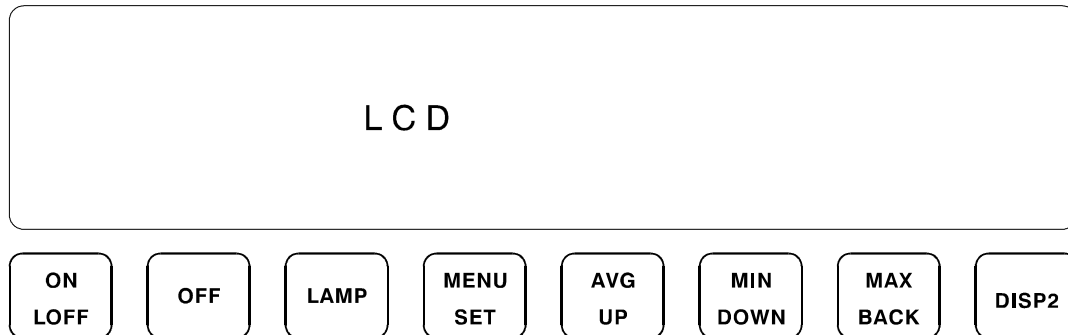
ON / LOFF	turn the station ON / turn off the LCD illumination
OFF	turn the station OFF
LAMP	turn the display illumination on
MENU / SET	enter the menu mode / confirm the function
AVG / UP	display average values / one step up in menu or increase value
MIN / DOWN	display minimum values / one step down in menu or decrease value
MAX / BACK	display maximum values / return from the function
DISP2	show the second part of data

After the start up procedure the following instant data are displayed:

S: 1.2 m/s D: 230° RH=64%
1T=24.1 2T=24.5 3T=18.1

With the meaning:

S: wind speed in m/s
D: wind direction in degrees
RH: relative humidity in % RH
1T: air temperature at 0.5 m in dg. C
2T: air temperature at 2 m in dg. C
3T: soil temperature in dg. C.

If we press the DISP2 key, the following data are displayed:

6-08-94 12:00:17
P=987.5 mbar LO-WIND

Where first line contains date and hour, while the second absolute atmospheric pressure and stability of the atmosphere. Stability is calculated from both air temperatures and wind (always from instant values) and reported as follows:

LO-WIND	wind speed is lower than 0.5 m/s
OVER-WIND	wind speed is higher than 6 m/s
OVER-TEMP	temperature difference is too high
CONVECT	convection
INVERS	inversion
ISOTERM	isotermy

Stability class corresponds to the following diagram:
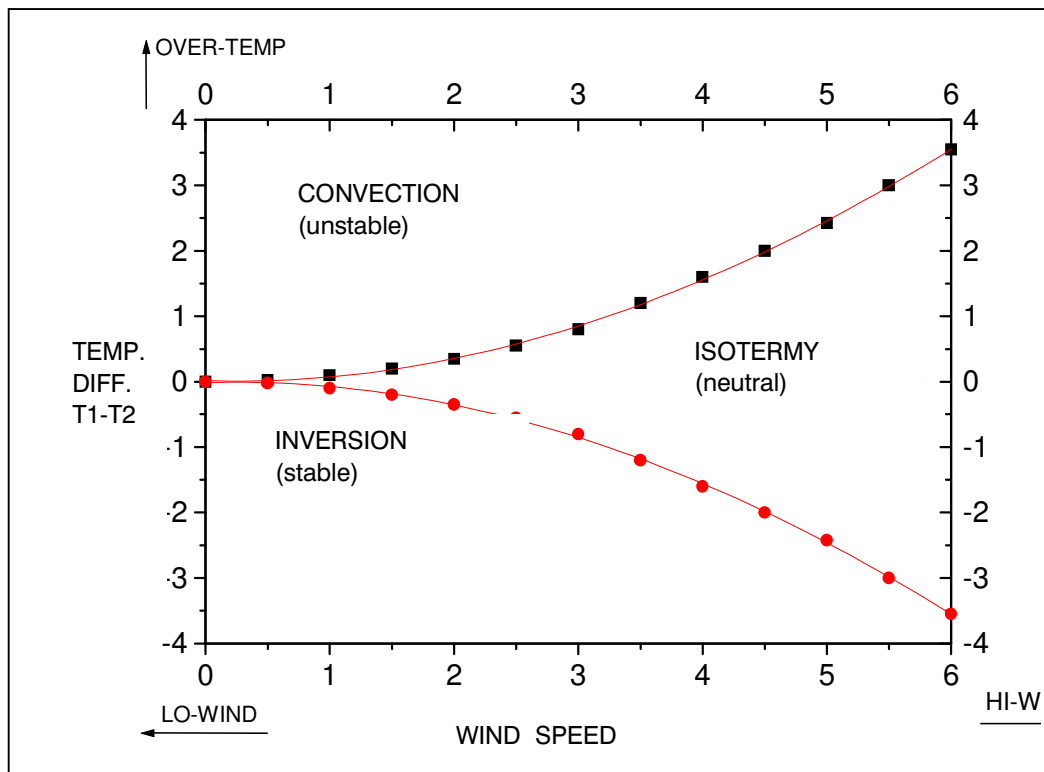
AVG displays average values from the last interval.
MIN displays minimum values from the last interval.
MAX displays maximum values from the last interval.

If AVG, MIN or MAX key is pressed the second time, this returns the display of instant values.

10. MENU STRUCTURE

To enter the menu structure, press MENU/SET key. Display shows: *Operating mode* as the first submenu.

Use UP and DOWN keys to navigate through the menu structure, SET key to enter the function (or confirm the selection) and BACK key to return from the function.

The menu structure looks as follows:

OPERATING MODE	normal (measuring) mode
VIEW TO BUFFER	look to data from the buffer
OPERATING PARAMETERS	set the operating parameters
SERIAL PARAMETERS	set the serial transmission mode
BINARY TEST MODE	look directly to the ADC
MATH PARAMETERS	set the calculation parameters (only in superuser mode)
STATION PARAMETERS	set the station parameters (only in superuser mode)
SHOW / SET TIME DATE	set the time and date
USER MODE	Enter the superuser mode (code protected)
BUFFER RESET	reset the data buffer
COPY BUFFER TO RS232	transfer contents of data buffer to the RS232 channel

Operating Mode

In this mode, PMP 124A performs measuring as described before. Instant, average, min and max data can be observed.

View to Buffer

This mode enables reviewing the data from the station memory. When confirmed (by SET), the following message is displayed:

```
 *** VIEW MENU ***
6-08-94 17:38:00 P:  0
```

in the second line there are date and hour of the last stored interval, and number of intervals already stored in the memory.

Use UP and DOWN to select the desired time interval.
Use SET to confirm the selected interval and display it's average data.
Use MIN, MAX or DISP2 to display different data of the selected interval.
Press SET again to return to the interval selection.
Press BACK to exit the *View to Buffer* menu.

When using UP an DOWN keys to select the value, keep them pressed for more than 3 seconds for fast, and more than 7 seconds for super fast selection mode.

Operating Parameters

Press SET to enter selection of averaging interval.
Use UP and DOWN to set the averaging interval to 1, 2, 5, 10, 15, 30 or 60 minutes. Intervals are always sinhronized to the full hour.
Press SET to confirm the interval and select the wind data processing type.
Use UP and DOWN to select either scalar or vector wind processing.
Use SET to confirm.
Use BACK to exit the menu.

Serial Parameters

Press SET to enter selection of baud rate.
Use UP and DOWN to select Baud rate from 300 to 19200 Bd.
Confirm with SET.
Use UP and DOWN to select the transmission mode:

AUTOMATIC	each measured instant data are transferred automatically
AUTOMATIC WITH TIME	same as previous, time information is added
AUTOMATIC FOR INTERVAL	average data are transferred automatically at the end of each averaging interval
ON EXTERNAL COMMAND	data are transferred on command from the external computer

When in "External command" mode, PMP 124A sends data:

If ASCII "1" is received from external computer, data send have the form:

-20.1 -10.3 -10.4 65.2 0.3 198 910.3

With meaning:

1T   2T   3T   RH   S   D   P   (all instant data)

If ASCII "2" is received, the form of data is:

6-08-94 18:02:00 -20.1 -10.3 -10.4 65.2 0.3 198 910.3

With meaning:

Date   Time   1T   2T   3T   RH   S   D   P
(all average data, date and time representing the end of averaging interval)

Binary Test Mode, Math Parameters, Station Parameters, User Mode

These menus are normally not used by the user.

Buffer Reset

Used to clear the data buffer. To perform this, press SET, DOWN, UP, UP, SET.

WARNING!

All data stored in the data memory are lost when this function is confirmed!

Copy Buffer

Function starts transmission of data from the selected number of averaging intervals over the RS 232 line. Select:

Number of intervals from the last one
Type of transferred data (average or all).

Transmission starts with the last computed interval first. If only average data are transferred, format is:

Date Time 1T 2T 3T RAH S D P (average)

If all data are transferred, format is:

Date Time 1T 2T 3T RH S D P (average)
        1T 2T 3T RH S D P (minimums)
        1T 2T 3T RH S D P (maximums)

11. ERROR MESSAGES

LOW BATTERY (during Operating mode, each 4 seconds for 0.6 sec. in the second LCD row):

Internal battery is empty. Turn the station OFF and charge the battery, or connect the external power supply and continue operation.

RAM CORRUPTED (during start-up procedure):

An error has occurred in the data RAM. RAM is cleared, all data are lost. Not normal, consult service.

EEPROM ERROR (during start-up):

Error in station set-up. Station operates in default (uncalibrated) mode. Call service.

PROGRAM CORRUPTED (during start-up):

Program code is incorrect. Station is unable to operate. Call service.

STATION MALFUNCTION

Microprocessor or peripheral error. Station is unable to operate. Call service.

APENDIX – SENSORS

WIND SPEED AND DIRECTION SENSOR
VMT 107A

- Combined sensor for both wind speed & direction
- Quality construction: anodised aluminium, ball bearings
- Type calibrated in wind tunnel
- Optoelectronic transducers, digital output
- Small dimensions

Wind transmitter VMT 107A is a combined digital optoelectronic sensor for wind speed and wind direction. It is made from naturally anodised aluminium and stainless steel. Quality sealed ball bearings are used for both speed and direction measuring systems.

For wind speed part of the sensor a lightweight three-cup assembly is used which, with a stroboscope disc and optoelectronic elements, gives frequency output proportional to the wind speed.

For wind direction part, a vane with the 6-bit optoelectronic Gray encoder is used. All electronic elements are protected against overvoltages by resistors and Zener diodes. Normal additional mechanical load (freezing) cannot damage the sensor.

On the bottom of VMT 107A there are support for mounting the sensor and 10-pole connector.

TECHNICAL DATA

	WIND SPEED	WIND DIRECTION
Measuring range	0 m/s – 60 m/s	0° - 360°
Starting speed	0.5 m/s	0.5 m/s
Accuracy and linearity	+/- 0.5 m/s	+/- 5°
Resolution	0.1 m/s	5°
Measuring system	optoelectronic	optoelectronic
Output	20 pulses / min	6-bit Gray code
Power supply	12 V DC	
Operating temperature	from –40 to +60 °C	
Connector	Souriau, 10-pole	
Dimensions	ϕ 300 mm x 250 mm	
Weight	0.5 kg	

AIR TEMPERATURE SENSOR
DTE 75A
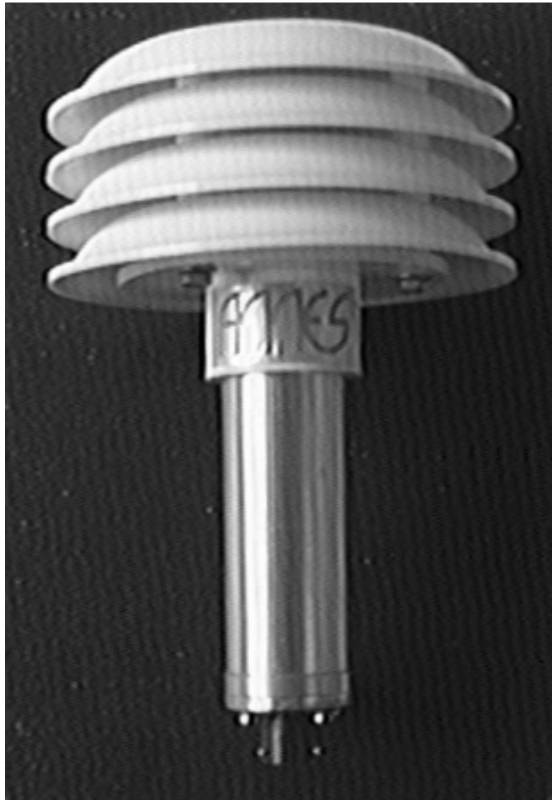
DTE 75A is non aspirated sensor designed to measure air temperature. As a sensing element, thermolinear thermistor is used. It is protected by stainless steel cylinder that is thermally isolated from the case. Case is made of aluminium and UV resistant plastics protecting the sensing element from the sun and precipitation. On the bottom side of the sensor there is a mounting element and three pin waterproof connector to connect the sensor with the measuring system. Sensor has to be mounted upright and should be overvoltage protected. To provide connection between the sensor and the measuring system a two wire shielded cable should be used (Max. length can be up to several hundreds meters, depending on the wire resistance).

TECHNICAL DATA:

Sensing element:	Termolinear thermistor YSI 44203
Measuring range:	-40°C to +60°C
Accuracy:	± 0.15°C
Linearity:	± 0.15°C
Material:	Stainless stell, aluminum and UV resistant plastics
Connection:	3 pin connector and 2 wire shielded cable
Dimensions:	ϕ 110 mm (4.33") by 170 mm (6.7")
Weight:	160g (0.35 lb)

AIR TEMPERATURE AND RELATIVE HUMIDITY SENSOR
DTV 124

DTV 124 is non-aspirated sensor designed to measure air temperature and relative humidity. As a sensing element for temperature, thermolinear thermistor, encapsulated in a stainless steel is used. For RH measurements, there is compensated solid-state capacitive sensor. Both sensing elements are protected from the solar radiation and precipitation by a shield, made of UV resistant plastics. On the bottom side of the sensor there are mounting element and six pin waterproof connector to connect the sensor with the measuring system. Sensor has to be mounted upright and should be overvoltage protected. To provide connection between the sensor and the measuring system a six wire shielded cable should be used (Max. length can be up to several hundreds meters, depending on the wire resistance).

TECHNICAL DATA:

Temp. sensor:	Thermolinear thermistor YSI 44203
Temp. meas. range:	-40°C to +60°C
Temp. accuracy:	± 0.15°C
RH sensor	Semiconductor, capacitive
RH meas. range:	0 – 100% RH
RH accuracy	± 2%
Material:	Stainless steel, aluminium and UV resistant plastics
Connector:	6 pin Souriau connector
Dimensions:	ϕ 110 mm by 170 mm
Weight:	160g

SOIL TEMPERATURE SENSOR
DTZ 124

- Measures soil temperature below surface
- Sensor encapsulated in thermocunductive oil assures accurate temperature measurements

DTZ 124 is specially designed sensor for measuring soil temperature below the surface. Probe is made of stainless steel sensing part, filled with thermoconductive oil at the end of each probe. Sensor is thermolinear thermistor. Oil that surrounds it provides good thermal contact with the sensing area of the probe, while it's connecting cable prevents thermal conductance from the soil surface.

TECHNICAL DATA

Sensing elements	Thermolinear thermistors YSI 44203 in thermoconductive oil
Measuring range:	-30°C to +50°C
Accuracy:	0.15^{o}C
Linearity:	0.15^{o}C
Material:	Stainless steel
Weight:	aprox 300 g