

USER'S MANUAL

Series MPT91 M1




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INDEX


INDEX..... 1

 1.0 GENERAL POINTS 3

 1.1 TECHNICAL CHARACTERISTICS 3

 1.2 DISPLAY MESSAGES 4

 1.3 MPT INSTRUMENT CONNECTION OVERVIEW..... 5

 2.0 INSTALLATION NOTES 9

 2.1 INSTRUMENT WITH HEATING ONLY CONTROL 9

 2.1.1 DIAGRAM MENU WITH HEATING OR COOLING CONTROL 10

 2.2 INSTRUMENT WITH HEATING AND COOLING CONTROL 15

 2.2.1 DIAGRAM MENU WITH HEATING AND COOLING CONTROL 16

 2.3 INSTRUMENT WITH SERVOMOTOR CONTROL 20

 2.3.1 DIAGRAM MENU WITH SERVOMOTOR CONTROL 21

 2.4 INSTRUMENT WITH A VALVE CONTROL 25


 2.4.1 DIAGRAM MENU WITH A VALVE CONTROL 26

 2.5 SET POINT MODIFICATIONS +REMOTE SET-POINT (RSP OPTION).. 31

 2.6 ANALOGUE INPUTS 32

 2.7 FUNCTION OFF-SET (OFFS)..... 32

 2.8 SET UP AL1 32

 3.0 ANALOGUE OUTPUT (option) 33

 3.1 ANALOGUE OUTPUT FOR MOTORIZED VALVE 33

 3.2 ANALOGUE OUTPUT FOR READOUT 33

4.0 REGULATIONS - "CONT" function 34


 4.1 PID TYPE REGULATION 35

 4.1.1 CUTBACK FUNCTION 35

 4.1.2 SELF-TUNING FUNCTION (setu)..... 36


 4.2 ON-OFF TYPE REGULATION 37

 4.3 SOFT-START FUNCTION (sost) 39

 5.0 RAMP SET UP 39

 5.1 KEY FUNCTIONS 40

 5.2 DIAGRAM RAMP MENU 40

 6.0 SERIAL OUTPUT 45

 6.1 DATA READING FROM HOST TO INSTRUMENT MPT91..... 46



 6.2 DATA TRANSMISSION FROM MPT91 TO HOST 47

 6.3 DATA WRITING FROM HOST TO MPT91 48

 6.4 COMMAND CODES 49

 6.5 STATUS WORD 52

MPT91 M1

| | | |
|---|--|----|
| 6.6 | TRASMISSION OF HEXADECIMAL VALUES | 52 |
| 6.7 | RAMP PROGRAMMING WITH SERIAL LINE..... | 52 |
| 6.8 | AN EXAMPLE IN BASIC LANGUAGE | 53 |
| 7.0 | SERIAL OUTPUT (option) with MODBUS protocol..... | 53 |
| 7.1 | READ OUTPUT STATUS (01)..... | 54 |
| 7.2 | READ INPUT STATUS (02)..... | 55 |
| 7.3 | READ OUTPUT REGISTERS (03) | 55 |
| 7.4 | READ INPUT REGISTERS (04) | 56 |
| 7.5 | FORCE SINGLE COIL (05)..... | 56 |
| 7.6 | PRESET SINGLE REGISTER (06)..... | 56 |
| 7.7 | READ STATUS (07) | 57 |
| | FUNCTION | 57 |
| 7.8 | FORCE MULTIPLE COILS (15) | 58 |
| 7.9 | PRESET MULTIPLE REGISTERS (16)..... | 59 |
| 7.10 | ERRORS MANAGEMENT..... | 59 |
| 7.11 | EXCEPTION CODES | 60 |
| 7.12 | MODBUS ADDRESSES | 61 |
|  | 8.0 PASSWORD FUNCTION | 64 |
| 9.0 | DEFAULT PARAMETERS (dEF)..... | 65 |
|  | 10.0 NOTES | 65 |

MPT91 M1



1.0 GENERAL POINTS

The instruments of the family "MPT91" represent a series of " Single Loop" microprocessor temperature regulators in the standard 48x48 dimensions (96 mm. depth.)

The complete version of the MPT91 instrument has the following technical characteristics:

- 1- Input from Thermoresistance PT100 (scale $-40.0 \div 200.0^{\circ}\text{C}$ or $-40 \div 800^{\circ}\text{C}$), or from thermocoupling Fe/CO ($0 \div 600^{\circ}\text{C}$) and Cr/Al ($0 \div 1200^{\circ}\text{C}$) and Pt-Pt/Rh ($0 \div 1710^{\circ}\text{C}$), or from voltage ($0 \div 10 \text{ V}$) and current ($0/4 \div 20 \text{ mA}$) selectable from the keyboard.
- 2- Two display to see Set-Point and Process Value and 4 keys for an easy programmability.
- 3- a contact relay for the regulation of the main intervention point, with regulation ON-OFF or PID.
- 4- Servomotor control drive.
- 5- Soft Start and Self Tuning functions.
- 6- Ramp program with 3 programs with 8 steps each one

Available options:

- 1- A relay contact for (minimum or maximum) alarms signals or for the cooling process control.
- 2- Analogue output ($0 \div 10 \text{ V}$, $4 \div 20 \text{ mA}$ or $0 \div 20 \text{ mA}$) for PID control or read out value.
- 3- Opto-isolated or standard bi-directional serial transmission line for dialogue with host-computer.

1.1 TECHNICAL CHARACTERISTICS

Table 1

| | |
|---------------------------------|---|
| Sensors used | thermoresistance PT100 at 2 or 3 wires: PT r: $-40.0 \div 200.0^{\circ}\text{C}$; Pt E: $-40 \div 800^{\circ}\text{C}$; <u>Thermocouplings:</u> Fe/Co (J): $0 \div 600^{\circ}\text{C}$; Cr/Al (K): $0 \div 1200^{\circ}\text{C}$; Pt/Pt-10% Rh (S): $0 \div 1710^{\circ}\text{C}$ |
| Analogue inputs | $0 \div 10 \text{ V} - 0 \div 20 \text{ mA} - 4 \div 20 \text{ mA}$ |
| Input current resistance | 5Ω |
| Input voltage resistance | $1 \text{ M}\Omega$ |
| Data reading precision | $0.5\% \text{ F.S. } \pm 1 \text{ digit } \pm 1 \text{ degree}$ |
| Controls | on-off / pid |
| On-Off Set Up | HY in the range $0 \div \text{F.S. } ^{\circ}\text{C}/^{\circ}\text{F}$ |
| Pid Set Up | cycle time in the range: $1 \div 200 \text{ sec}$ |

MPT91 M1

| | |
|------------------------------------|--|
| | proportional band: 0 ÷ F.S. °C/°F integrative time: 0 ÷ 6000 sec. derivative time: 0 ÷ 600 sec cutback const.: 0 ÷ F.S. °C/°F |
| Alarms | of min. or max in the range: 0 ÷ F.S. °C/°F |
| Main Outputs | relay contact 220V /5A |
| Alarm output | relay contact 220V /5A |
| Power supply | 90 ÷ 260 Vac/Vdc 20÷30Vac/Vdc |
| Analogue outputs | 0 ÷ 10 V – 0 ÷ 20 mA – 4 ÷ 20 mA |
| Max load for current output | 300 Ω |
| Min load for voltage output | 1 KΩ |
| Max voltage given | 10 V |
| Max current given | 20 mA |
| Resolution | 12 bits |

1.2 DISPLAY MESSAGES

The following table shows a summary of all the messages that the instrument can show on the display. Some are operating signals, others are indications of anomalies or non performance. In these cases we ask you to consult the instruction manual and the service centre, as necessary.

Table 2

| | |
|------------------------|---|
| r01.2 | Release Software |
| LO | temperature under input range, or connection error for the PT100 sensor |
| HI | temperature above input range |
| Err | sensor interrupted or malfunctioning input circuit |
| Err1, Err2, Err3, Err4 | See “Self-Tuning function” |
| Abort | See “Soft Start” and “Self Tuning” functions |
| PV | Blinks during self Tuning |

1.3 MPT INSTRUMENT CONNECTION OVERVIEW DESCRIPTION OF THE FRONT COMMANDS




PV-Upper Display: temperature as read by sensor


SP-Lower Display: set-point (power percentage on manual control)

Led AL: alarm status indication or cooling action or servomotor control drive (if requested)

Led R: ramp function indication (if blinks = ramps delay)



Led ON: load control indication



Key  : access to the programming functions

Key  : increase set-point. Used for programming function

Key  : decrease set-point. Used for programming function

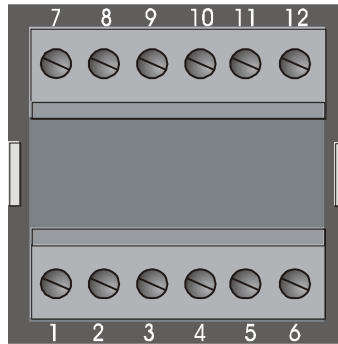
Key  : enter the enable Ramp programs (disabled of the menu)

Key  +  : START/STOP functions. Only ramp functions (disabled of the ramp menu)

Key  +  Keys : % power indication

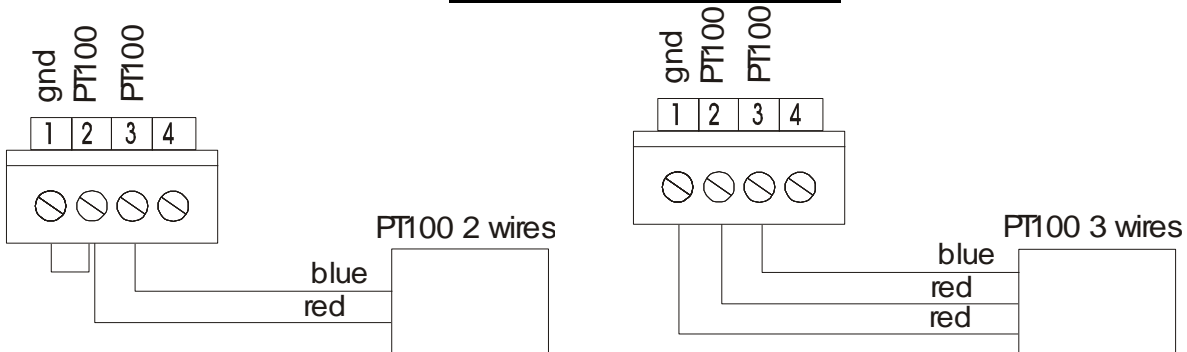
MPT91 M1

DESCRIPTION OF THE TERMINAL BOARD



- Terminals 1 ÷ 3: inputs for sensor
- Terminal 3: transducer power supply (see configurations)
- Terminals 4 ÷ 6: analogue outputs (OAP option) or serial output (if requested)
- Terminals 4, 6: enable second set-point (if RSP option is requested)
- Terminals 7, 8: instrument power supply. Between terminals 7 and 8 power from 90V to 260V , or from 10V to 30V if requested.
- Terminals 9, 10: contact NO of main relay (A option) or static output (C option) or alarm 2 contact (OAP option) and analogue output control.
- Terminals 11, 12: contact NO of alarm relay (if requested: 03 option)

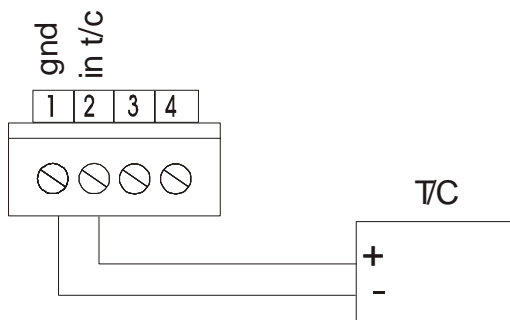
CONNECTIONS PT100



For thermoresistance connection pay attention to the line resistance: if it is too high there may be some errors in readout. Use the same kind of wire for the three connections. If shielded cable is used, connect the shield to ground at one end only.

Attention: control inside configuration.

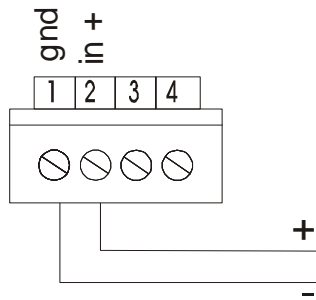
THERMOCOUPLING CONNECTIONS



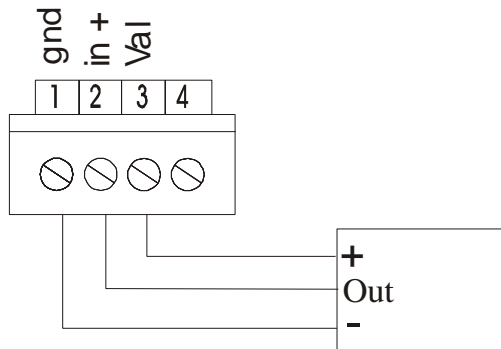
Thermocouplings must be isolated. For thermocoupling connection use only compensated wire for the type of thermocouple in use.

If shielded cable is used, connect the shield to ground at one end only.

VOLTAGE OR CURRENT INPUT CONNECTIONS

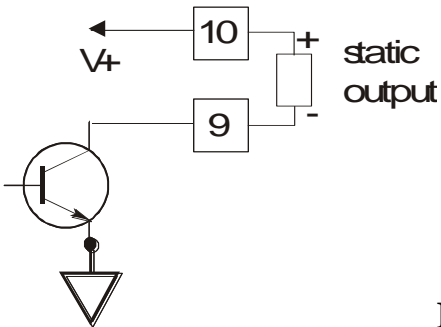


CURRENT/VOLTAGE INPUT CONNECTIONS WITH TRANSDUCER POWER SUPPLY



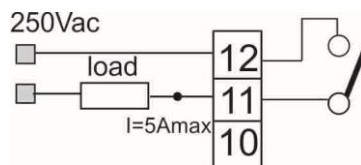
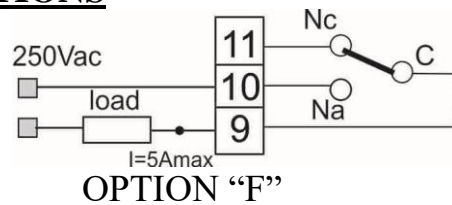
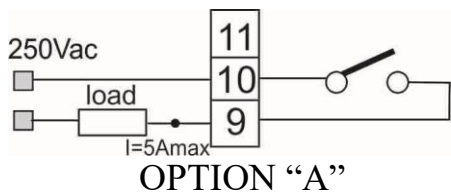
This connection can be used if the transducer power supply is configured (see TERMINAL 3 CONFIGURATION).

STATIC OUTPUTS CONNECTIONS



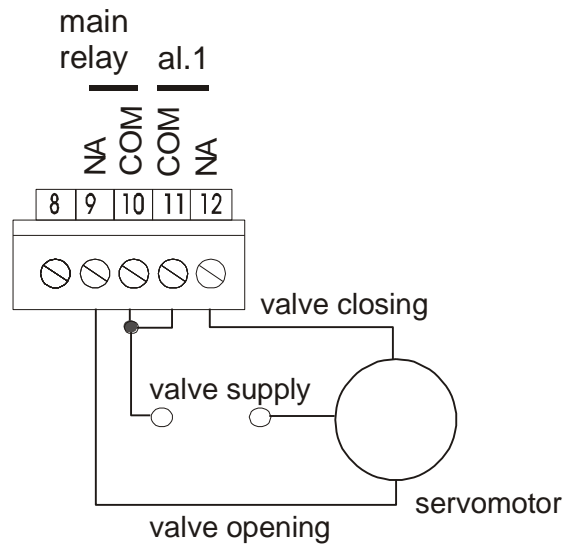
Be careful: this output is not isolated and may be used for an external solid state relay with double isolation between instrument and power line.

RELAY CONNECTIONS



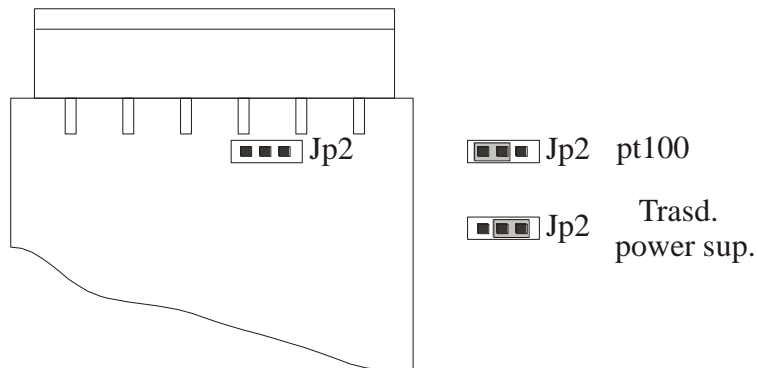
ALARM CONTACT (not available with "F" option)

SERVOMOTOR CONNECTIONS



TERMINAL 3 CONFIGURATION (TRANSDUCER POWER SUPPLY)

Open the instrument and set the jumper JP2 for a PT100 input (standard) or for a transducer power supply connection.



SERIAL OUTPUTS AND ANALOGUE OUTPUTS CONNECTIONS

See dedicated paragraphs.



2.0 INSTALLATION NOTES

1. Copy the connection schemes on pages 6, 7 and 8 taking into account the following points:
 - a- the instrument can operate with analogue inputs or temperature sensors of both thermoresistance and thermocoupling types. Only one of this sensors can be connected (attach the connection only for the chosen sensor, leaving free the other connections.).
 - b- the connector diagram shows all the possible options that the instrument may have; if certain options are not required then the relative connections are not necessary.
2. Follow the instructions of the paragraph:
 - 2.1: for heating or cooling control
 - 2.2: for heating and cooling control
 - 2.3: for a servomotor control
 - 2.4: for a valves control
3. Follow the instructions of the paragraph "Regulations" to optimise control parameters.
4. If the instrument is requested with "OAP" option, it is necessary to consider the paragraph "ANALOGUE OUTPUT".
5. If the instrument is requested with the serial output, see the paragraph "SERIAL OUTPUT".

2.1 INSTRUMENT WITH HEATING ONLY CONTROL

Heating (tCOn = in) or cooling (tCOn = dir) regulation is performed by main relay; it is possible to use one alarm output (if requested) and the analogue output (if requested) that varies with the temperature readout.

Program the instrument following the table below; by "Ramp/Exit" key it is possible to escape immediately from the menu.

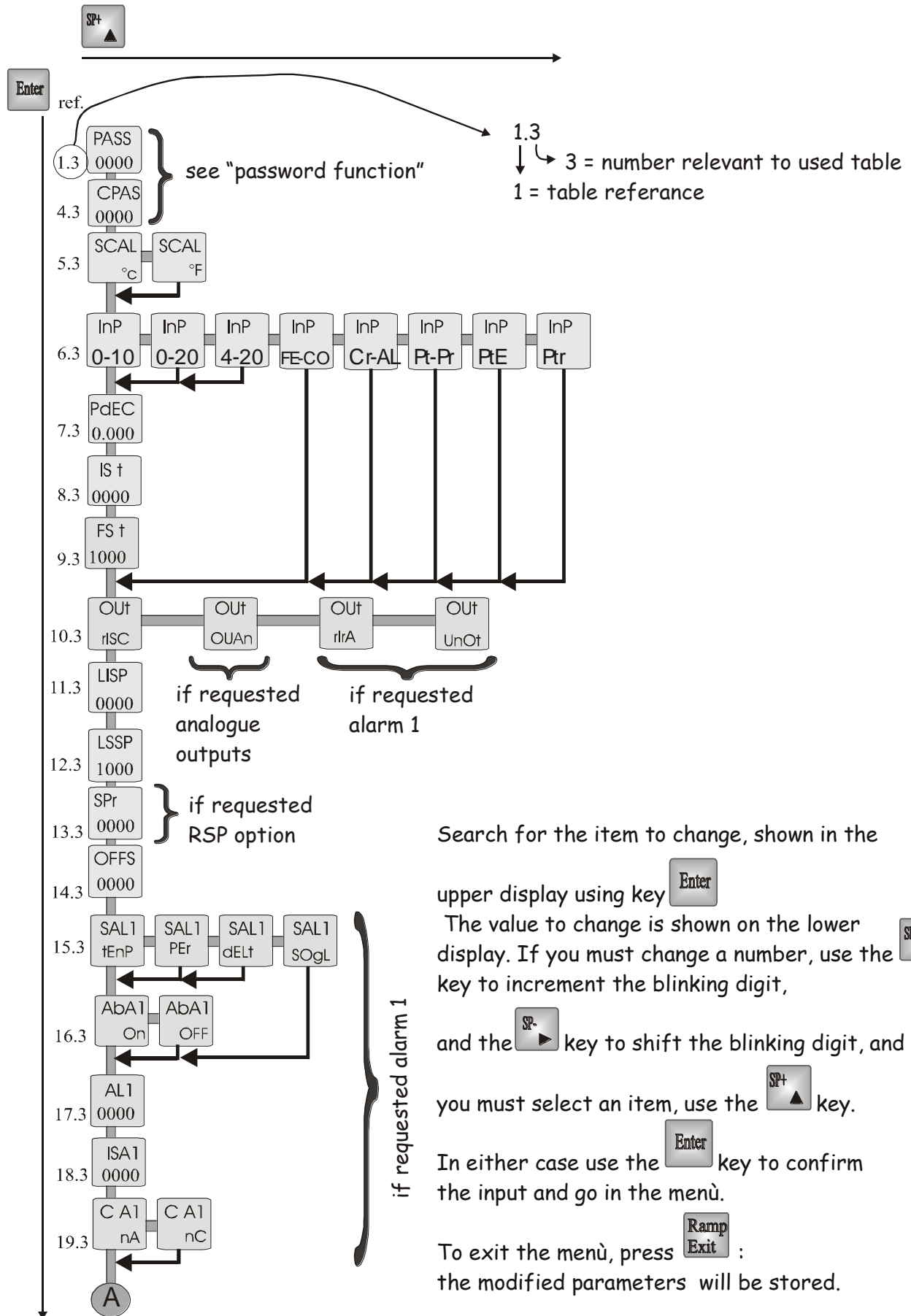
To set up control parameters see paragraph "Regulations".

For an automatic set point function, see paragraph "Ramp programming".

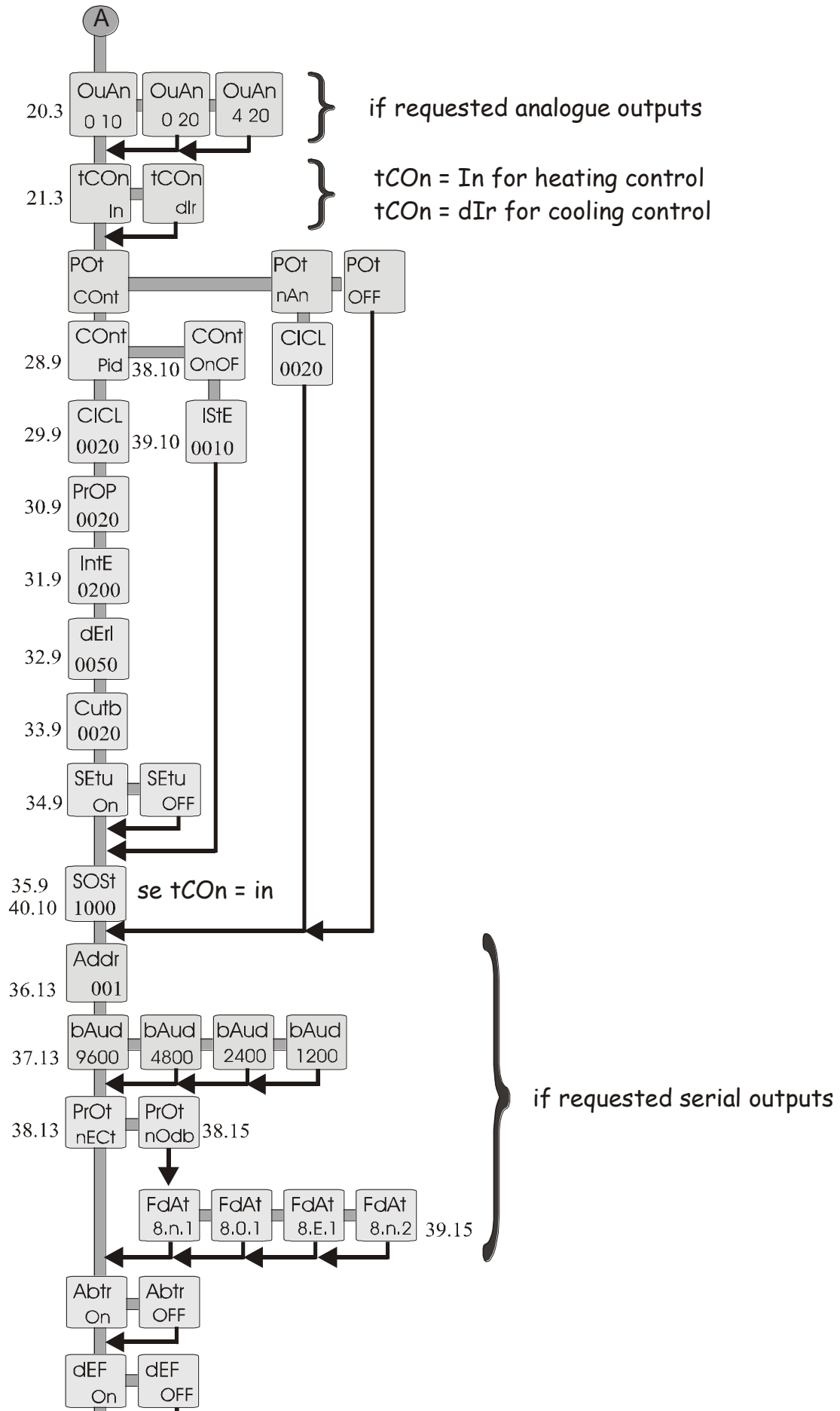
Attention: If out of range menu's item are programmed, they are proposed again at the maximum possible value.

To reset to factory default parameters you can see the paragraph "Default parameters".

2.1.1 DIAGRAM MENU WITH HEATING OR COOLING CONTROL



MPT91 M1



MPT91 M1

Table 3

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|--|----------|
| 1 | enter | PASS | 0 000 | In this phase the instrument asks for the Password in order to save the data already programmed. The number memorized by the factory is 0, but any number between 0 and 9999 can be memorized by writing where CPAS appears (next displayed item). | Pp 64 |
| 2 | SP- ▶ | PASS | 0 <u>0</u> 00 | Set Up Procedure. To digit the desired number touch the key " SP- ▶ " to move the flashing number to the right. | |
| 3 | SP+ ▲ | PASS | 0 <u>1</u> 00 | Touch the key " SP+ ▲ " to increase the flashing number | |
| 4 | enter | CPAS | 0 000 | Number of the access key to the programming of the instrument. The number written in this phase will be requested at "PASS". To digit the number follow the procedure described in points 2 and 3. | Pp 64 |
| 5 | enter | SCAL | °C | Temperature scale: Choose the type of scale required. Set the requested scale (°C or °F) by "SP+ ▲" and confirm with "enter". | |
| 6 | enter | InP | PtE | Choose the type of sensor required. Touch the key "SP+ ▲" until the chosen input appears on "SP" display: FECO = Fe/CO (0 ÷ 600 °C) (J) CrAL = Cr/Al (0 ÷ 1200 °C) (K) PtPr = Pt/Pt-Rh (0 ÷ 1710°C) (S) PtE = PT100 (-40 ÷ 800 °C) Ptr = PT100 (- 40.0 ÷ 200.0 °C) 0 10 = analogue input 0-10V 0 20 = analogue input 0-20mA 4 20 = analogue input 4-20mA To change this item use the "SP+ ▲" key and confirm by "enter" | Pp 31 |
| 7 | enter | PdEC | 0.000 | Decimal point for analogue input. Touch the key "SP+ ▲" to set the decimal point and confirm with | |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|--|----------|
| | | | | "enter" | |
| 8 | enter | IS t | 0000 | Set the requested reading with the beginning of the analogue input. To digit the number see 2 and 3 paragraphs. | Pp 31 |
| 9 | enter | FS t | 1000 | Set the requested reading with the full scale of the analogue input. To digit the number see 2 and 3 paragraphs. | Pp 31 |
| 10 | enter | Out | rISC | Choose rISC for heating regulation with the main relay. Set the requested regulation by "SP+▲" and confirm with "enter". | |
| 11 | enter | LISP | 0 000 | Lower limit set-point. To digit the number follow the procedure described in points 2 and 3 | Pp 31 |
| 12 | enter | LSSP | 0 000 | Upper limit set-point. To digit the number follow the procedure described in points 2 and 3 | Pp 31 |
| 13 | enter | SPr | 0 000 | Setpoint remote value set up (if requested). To digit the number follow the procedure described in points 2 and 3 | |
| 14 | enter | OFFS | 0 000 | Using the number "OFFS" it is possible to correct the displayed temperature by adding or subtracting a constant written in the display "PV". To digit the number follow the procedure described in points 2 and 3 | |
| 15 | enter | S.AL1 | tEnP | Selection the kind of working Alarm1 tEnP = min or max absolute alarm value PEr = percentage alarm dELt = relative alarm at the set point SOGL = max absolute alarm value To change this item use the "SP+▲" key and confirm by "enter" | |
| 16 | enter | AbA1 | On | Minimum alarm 1 enable. On: Minimum alarm relay is always enabled OFF: Minimum alarm relay is | Pp 32 |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|------|---------------|-----------------------|-----------------------|--|----------|
| | | | | enabled after the first time the temperature reaches the alarm value To change this item use the “SP+ ▲ “ key and confirm by “enter” | |
| 17 | enter | AL1 | 0 000 | Alarm value set up (if requested). To digit the value see steps 2 and 3. An alarm can work as minimum alarm (if < set-point) or maximum alarm (if > set-point). | Pp 32 |
| 18 | enter | ISA1 | 001 | Alarm 1 hysteresis set up | Pp 32 |
| 19 | enter | C A1 | nA | Possibility of inverting the relay function nA = normally open nC = normally closed Set the requested regulation by “SP+ ▲ ” and confirm with “enter“. | Pp 32 |
| 20 | enter | OUn | 0 10 | If analogue outputs are requested touch the key "SP+ ▲ " until the output required appears on the display and then confirm with "enter". 0 10 = output 0 ÷ 10 V 0 20 = output 0 ÷ 20 mA 4 20 = output 4 ÷ 20 mA | Pp 33 |
| 21 | enter | tCOn | In | Control type: In = reverse function (main relay = heating) DIr = direct function To change this item use the “SP+ ▲ “ key and confirm by “enter” | |
| | Ramp/ Exit | Read out | Set point | | |

MPT91 M1

2.2 INSTRUMENT WITH HEATING AND COOLING CONTROL

The instrument with heating and cooling control can be used only if the instrument has the alarm relay. In this function, the main relay makes the heating regulation and the alarm relay makes the cooling regulation. The analogue outputs (if requested) change in according to the Process Value.

Program the instrument following the table below; by “Ramp/Exit” key it is possible to escape immediately from the menu. Selecting heating-cooling control the instrument also gives the cooling dead-band item (bAnr).

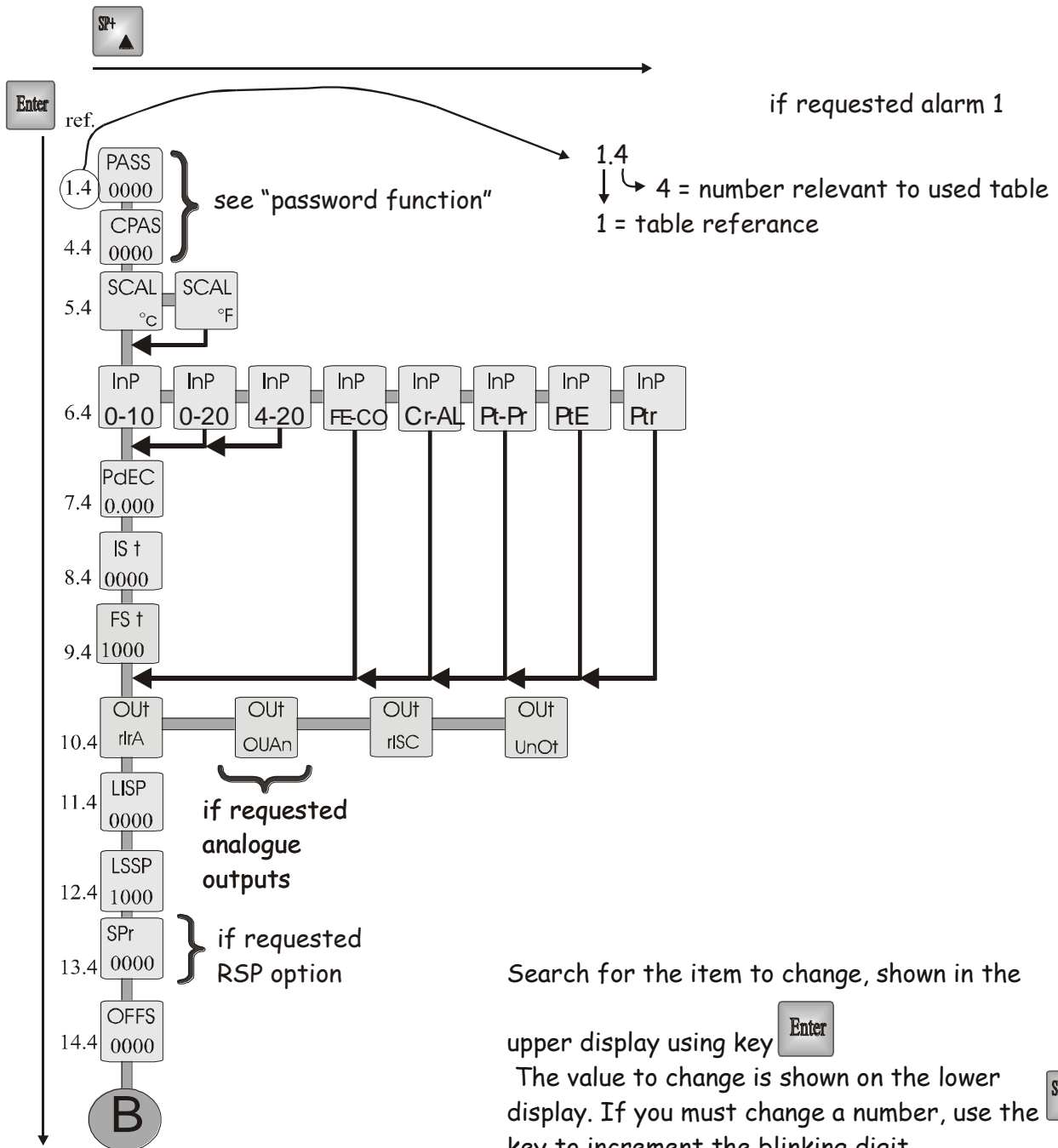
To set up control parameters see paragraph "Regulations".

For an automatic set point function, see paragraph "Ramp programming".

Attention: If out of range menu's item are programmed, they are proposed again at the maximum possible value.

To reset to factory default parameters you can see the paragraph “Default parameters”.

2.2.1 DIAGRAM MENU WITH HEATING AND COOLING CONTROL



Search for the item to change, shown in the

upper display using key

The value to change is shown on the lower display. If you must change a number, use the key to increment the blinking digit,

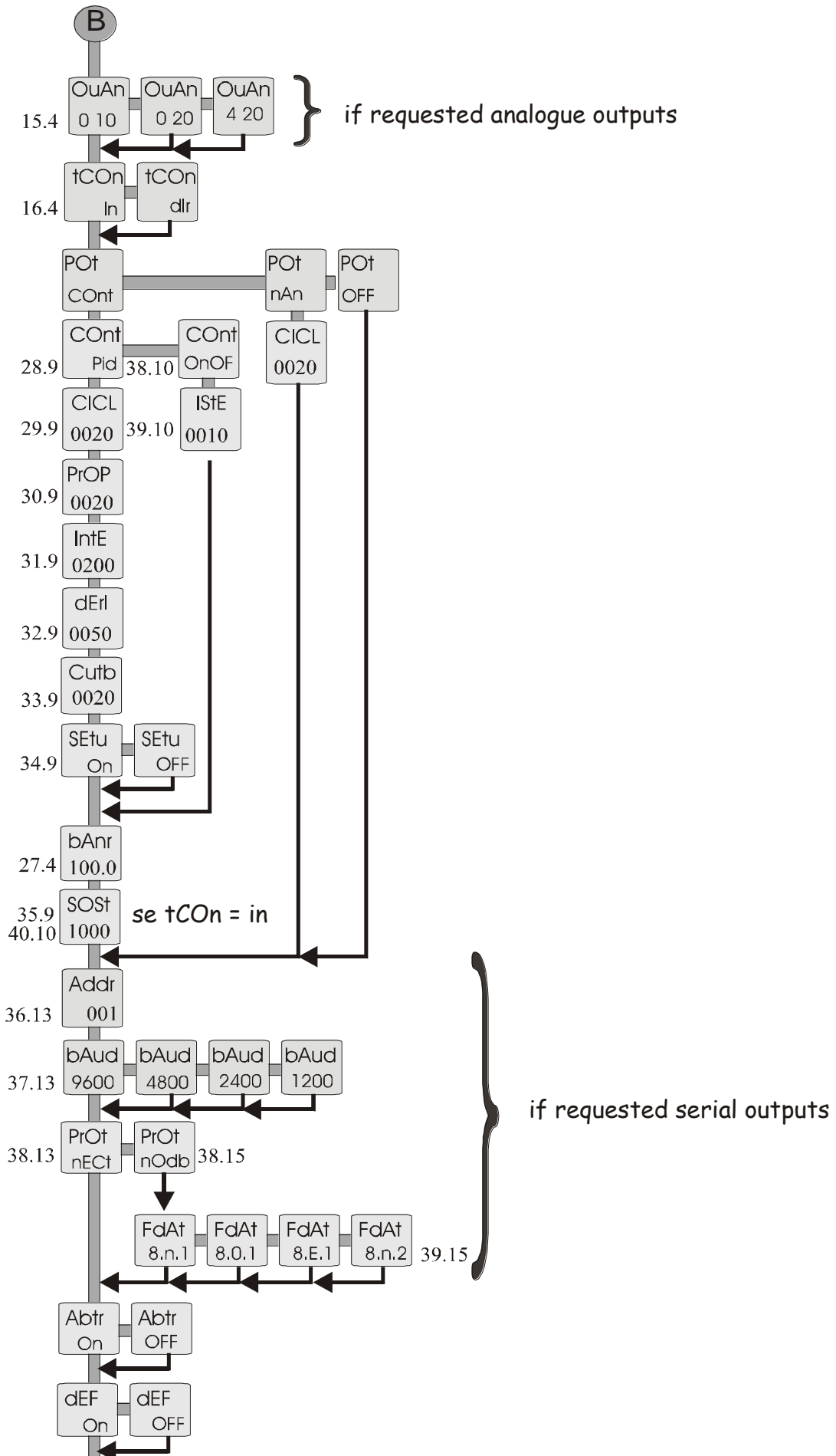
and the key to shift the blinking digit, and if

you must select an item, use the key.

In either case use the key to confirm the input and go in the menu.

To exit the menu, press :
the modified parameters will be stored.

MPT91 M1



MPT91 M1

Table 4

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|--|----------|
| 1 | enter | PASS | 0 000 | In this phase the instrument asks for the Password in order to save the data already programmed. The number memorized by the factory is 0, but any number between 0 and 9999 can be memorized by writing where CPAS appears (next displayed item). | Pp 64 |
| 2 | SP- ▶ | PASS | 0 <u>0</u> 00 | Set Up Procedure. To digit the desired number touch the key " SP- ▶ " to move the flashing number to the right. | |
| 3 | SP+ ▲ | PASS | 0 <u>1</u> 00 | Touch the key " SP+ ▲ " to increase the flashing number | |
| 4 | enter | CPAS | 0 000 | Number of the access key to the programming of the instrument. The number written in this phase will be requested at "PASS". To digit the number follow the procedure described in points 2 and 3. | Pp 64 |
| 5 | enter | SCAL | °C | Temperature scale: Choose the type of scale required. Set the requested scale (°C or °F) by "SP+ ▲" and confirm with "enter". | |
| 6 | enter | InP | PtE | Choose the type of sensor required. Touch the key "SP+ ▲ " until "SP" display appears on the chosen input: FECO = Fe/CO (0 ÷ 600 °C) (J) CrAL = Cr/Al (0 ÷ 1200 °C) (K) PtPr = Pt/Pt-Rh (0 ÷ 1710°C) (S) PtE = PT100 (-40 ÷ 800 °C) Ptr = PT100 (- 40.0 ÷ 200.0 °C) 0 10 = analogue input 0-10V 0 20 = analogue input 0-20mA 4 20 = analogue input 4-20mA To change this item use the | Pp 31 |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|-----------|-----------|-----------------------|-----------------------|---|----------|
| | | | | “SP+▲” key and confirm by “enter” | |
| 7 | enter | PdEC | 0.000 | Decimal point for analogue input. Touch the key “SP+▲” to set the decimal point and confirm with "enter" | |
| 8 | enter | IS t | 0000 | Set the requested reading with the beginning of the analogue input. To digit the number see 2 and 3 paragraphs. | Pp 31 |
| 9 | enter | FS t | 1000 | Set the requested reading with the full scale of the analogue input. To digit the number see 2 and 3 paragraphs. | Pp 31 |
| 10 | enter | Out | rIrA | rIrA: heating-cooling Set the requested regulation by “SP+▲” and confirm with “enter”. | |
| 11 | enter | LISP | 0 000 | Lower limit set-point. To digit the number follow the procedure described in points 2 and 3 | Pp 31 |
| 12 | enter | LSSP | 0 000 | Upper limit set-point. To digit the number follow the procedure described in points 2 and 3 | Pp 31 |
| 13 | enter | SPr | 0 000 | Setpoint remote value set up (if requested). To digit the number follow the procedure described in points 2 and 3 | |
| 14 | enter | OFFS | 0 000 | Using the number "OFFS" it is possible to correct the displayed temperature by adding or subtracting a constant written in the display "PV". To digit the number follow the procedure described in points 2 and 3 | |
| 15 | enter | OUn | 0 10 | If analogue output is requested touch the key "SP+▲" until the output required appears on the display and then confirm with "enter". 0 10 = output 0 ÷ 10 V 0 20 = output 0 ÷ 20 mA | Pp 33 |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|------|---------------|-----------------------|-----------------------|---|----------|
| | | | | 4 20 = output $4 \div 20$ mA | |
| 16 | enter | tCOn | In | Control type: In = reverse function (main relay = heating) DIr = direct function To change this item use the “SP+ ▲ “ key and confirm by “enter” | |
| 27 | enter | bAnr | 10.0 | Touch “enter” the key until the item bAnr appears = cooling dead band (see paragraph) | Pp 35 |
| | Ramp/ Exit | Read out | Set point | | |

2.3 INSTRUMENT WITH SERVOMOTOR CONTROL

The UnOt function can be used only if the instrument has the alarm relay. In this function, the main relay together with alarm relay control the servomotor. Selecting the item “ out = UnOt “, there are other two values to set for the control: “ time “ (time that the servomotor needs for its cycle) and “ bAnO “ (dead band for the servomotor). In “ time “ it is necessary to set the full scale time (in seconds and tenth of second) that the servomotor needs to complete its cycle, while in “bAnO“ it is possible to set an interval (expressed in percentage of “time “) where the servomotor doesn't have the control. Example: full scale “time “ 90 seconds, dead band: 10%. The displacements shorter than 9 seconds are inhibited.

The analogue outputs (if requested) change in according to the Process Value.

Program the instrument following the table below; by “Ramp/ Exit” key it is possible to escape immediately from the menu.

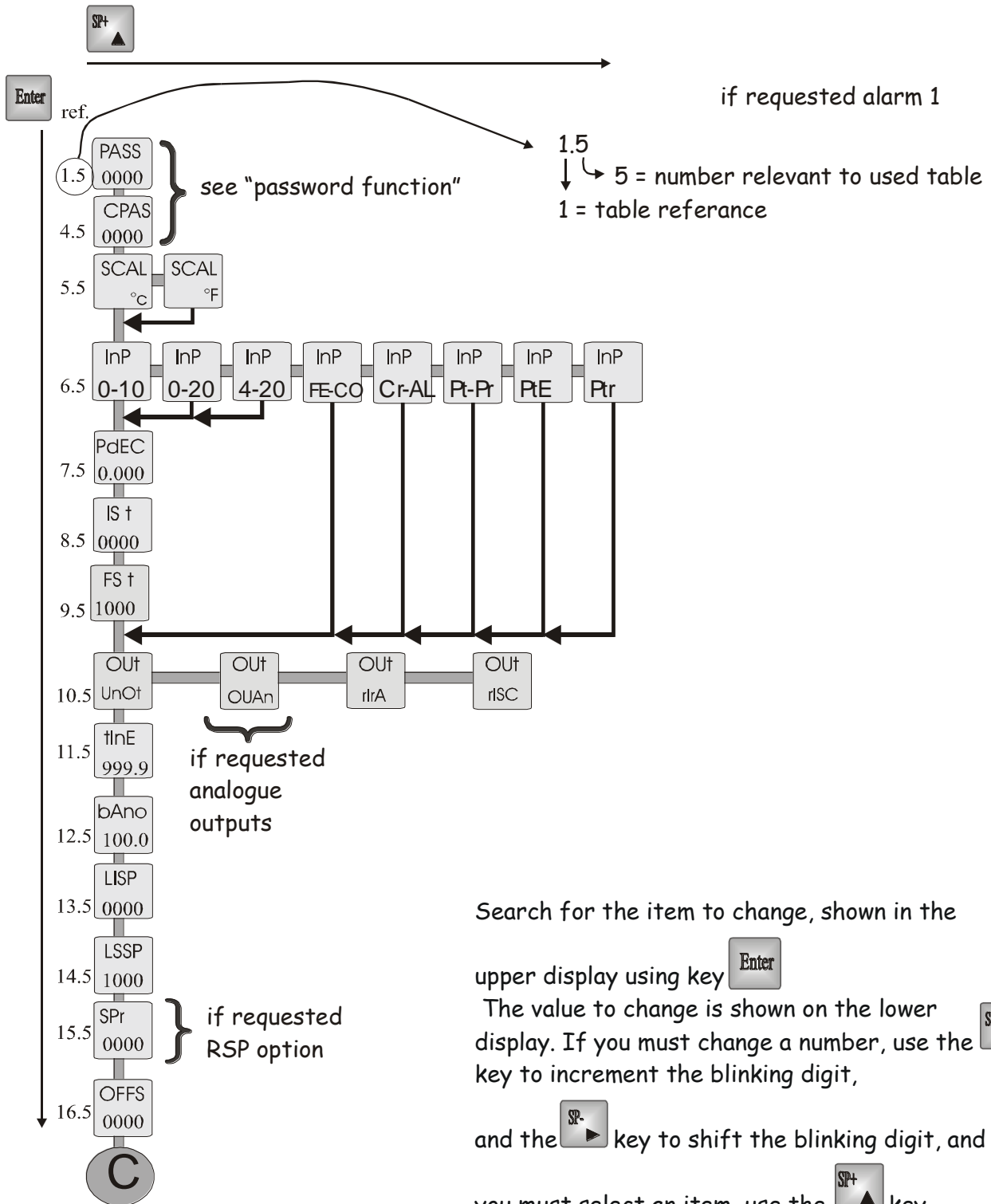
To set up control parameters see paragraph "Regulations".

For an automatic set point function, see paragraph "Ramp programming".

Attention: If out of range menu's item are programmed, they are proposed again at the maximum possible value.

To reset to factory default parameters you can see the paragraph “Default parameters”.

2.3.1 DIAGRAM MENU WITH SERVO MOTOR CONTROL



Search for the item to change, shown in the

upper display using key

The value to change is shown on the lower display. If you must change a number, use the key to increment the blinking digit,

and the key to shift the blinking digit, and if

you must select an item, use the key.

In either case use the key to confirm the input and go in the menu.

To exit the menu, press :
the modified parameters will be stored.

MPT91 M1

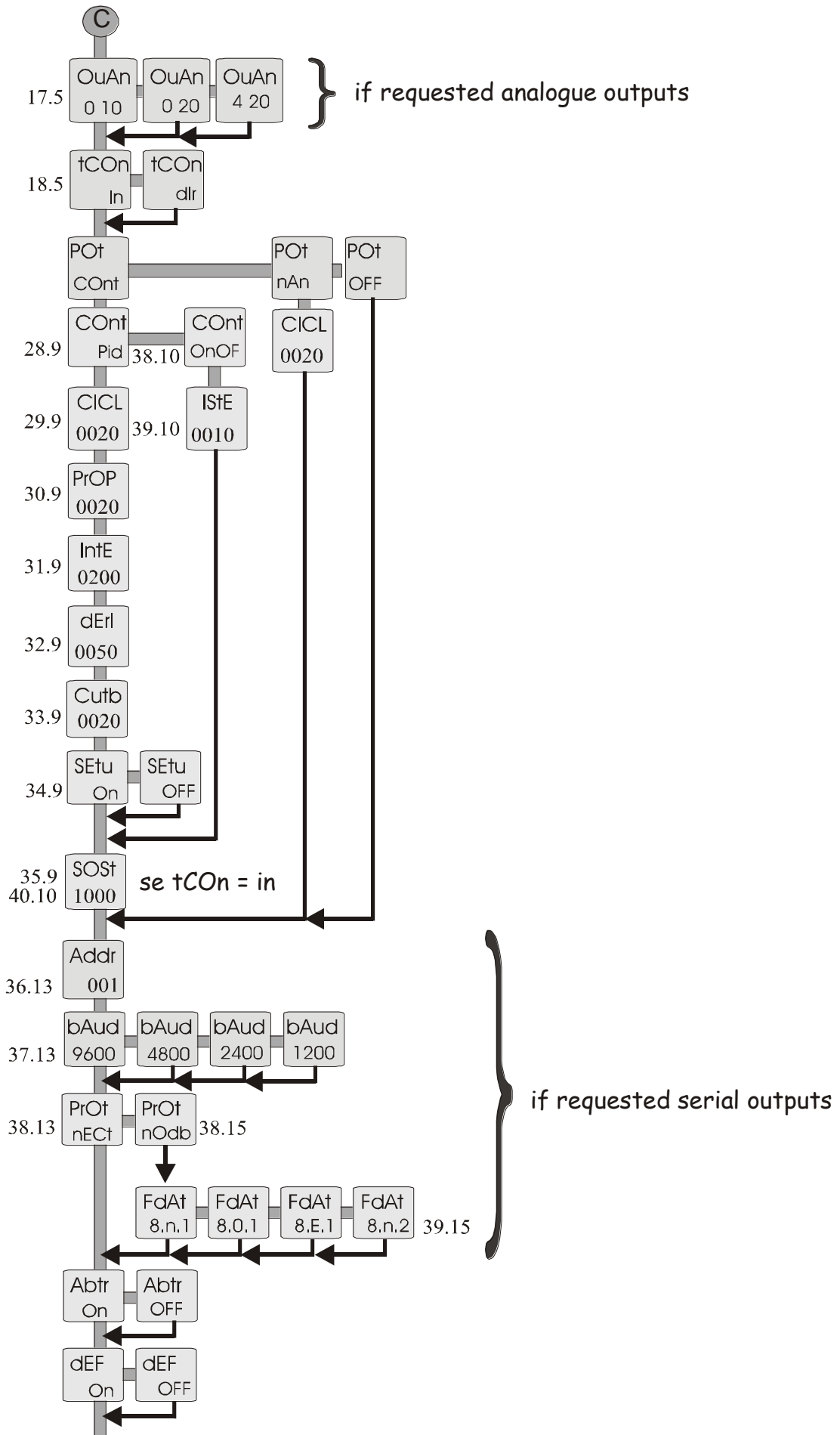


Table 5

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|--|----------|
| 1 | enter | PASS | 0 000 | In this phase the instrument asks for the Password in order to save the data already programmed. The number memorized by the factory is 0, but any number between 0 and 9999 can be memorized by writing where CPAS appears (next displayed item). | Pp 64 |
| 2 | SP- ▶ | PASS | 0 0 00 | Set Up Procedure. To digit the desired number touch the key " SP- ▶ " to move the flashing number to the right. | |
| 3 | SP+ ▲ | PASS | 0 1 00 | Touch the key " SP+ ▲ " to increase the flashing number | |
| 4 | enter | CPAS | 0 000 | Number of the access key to the programming of the instrument. The number written in this phase will be requested at "PASS". To digit the number follow the procedure described in points 2 and 3. | Pp 64 |
| 5 | enter | SCAL | °C | Temperature scale: Choose the type of scale required. Set the requested scale (°C or °F) by "SP+ ▲ " and confirm with "enter ". | |
| 6 | enter | InP | PtE | Choose the type of sensor required. Touch the key "SP+ ▲ " until "SP" display appears on the chosen input: FECO = Fe/CO (0 ÷ 600 °C) (J) CrAL = Cr/Al (0 ÷ 1200 °C) (K) PtPr = Pt/Pt-Rh (0 ÷ 1710°C) (S) PtE = PT100 (-40 ÷ 800 °C) Ptr = PT100 (- 40.0 ÷ 200.0 °C) 0 10 = analogue input 0-10V 0 20 = analogue input 0-20mA 4 20 = analogue input 4-20mA To change this item use the "SP+ ▲ " key and confirm by "enter" | Pp 31 |
| 7 | enter | PdEC | 0.000 | Decimal point for analogue input. | |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|---|----------|
| | | | | Touch the key "SP+▲" to set the decimal point and confirm with "enter" | |
| 8 | enter | IS t | 0000 | Set the requested reading with the beginning of the analogue input. To digit the number see 2 and 3 paragraphs. | Pp 31 |
| 9 | enter | FS t | 1000 | Set the requested reading with the full scale of the analogue input. To digit the number see 2 and 3 paragraphs. | Pp 31 |
| 10 | enter | Out | UnOt | UnOt: servomotor control. Set the requested regulation by "SP+▲" and confirm with "enter". | |
| 11 | enter | tInE | 999.9 | SERVOMOTOR TIME. Program the servomotor's time in seconds and second's decimals and confirm with "enter" | |
| 12 | enter | bAnO | 10.0 | DEAD BAND. Dead band, expressed in %, in which the servomotor is not piloted. Confirm with "enter". | |
| 13 | enter | LISP | 0 000 | Lower limit set-point. To digit the number follow the procedure described in points 2 and 3 | Pp 31 |
| 14 | enter | LSSP | 0 000 | Upper limit set-point. To digit the number follow the procedure described in points 2 and 3 | Pp 31 |
| 15 | enter | SPr | 0 000 | Setpoint remote value set up (if requested). To digit the number follow the procedure described in points 2 and 3 | |
| 16 | enter | OFFS | 0 000 | Using the number "OFFS" it is possible to correct the displayed temperature by adding or subtracting a constant written in the display "PV". To digit the number follow the procedure described in points 2 and 3 | |
| 17 | enter | OUn | 0 10 | If analogue output is requested touch the key "SP+▲" until the | Pp 33 |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|-----------|-----------|-----------------------|-----------------------|---|----------|
| | | | | output required appears on the display and after confirm with "enter" 0 10 = output 0 ÷ 10 V 0 20 = output 0 ÷ 20 mA 4 20 = output 4 ÷ 20 mA | |
| 18 | enter | tCO _n | In | Control type: In = reverse function (main relay = heating) dIr = direct function for cooling function To change this item use the "SP+ ▲" key and confirm by "enter" | |
| | Ramp/Exit | Readout | Set point | | |

2.4 INSTRUMENT WITH A VALVE CONTROL

The OUAn function can be used only if the instrument has the analogue outputs. See paragraph "Analogue outputs".

The voltage heating regulation can be linked to 6 (+) and 4 (-) terminals, the current heating regulation can be linked to 5 (+) and 4 (-) terminals.

Program the instrument following the table below; by "Ramp/Exit" key it is possible to escape immediately from the menu.

For an heating control set "tCO_n = In" and for a cooling control set "tCO_n = dIr".

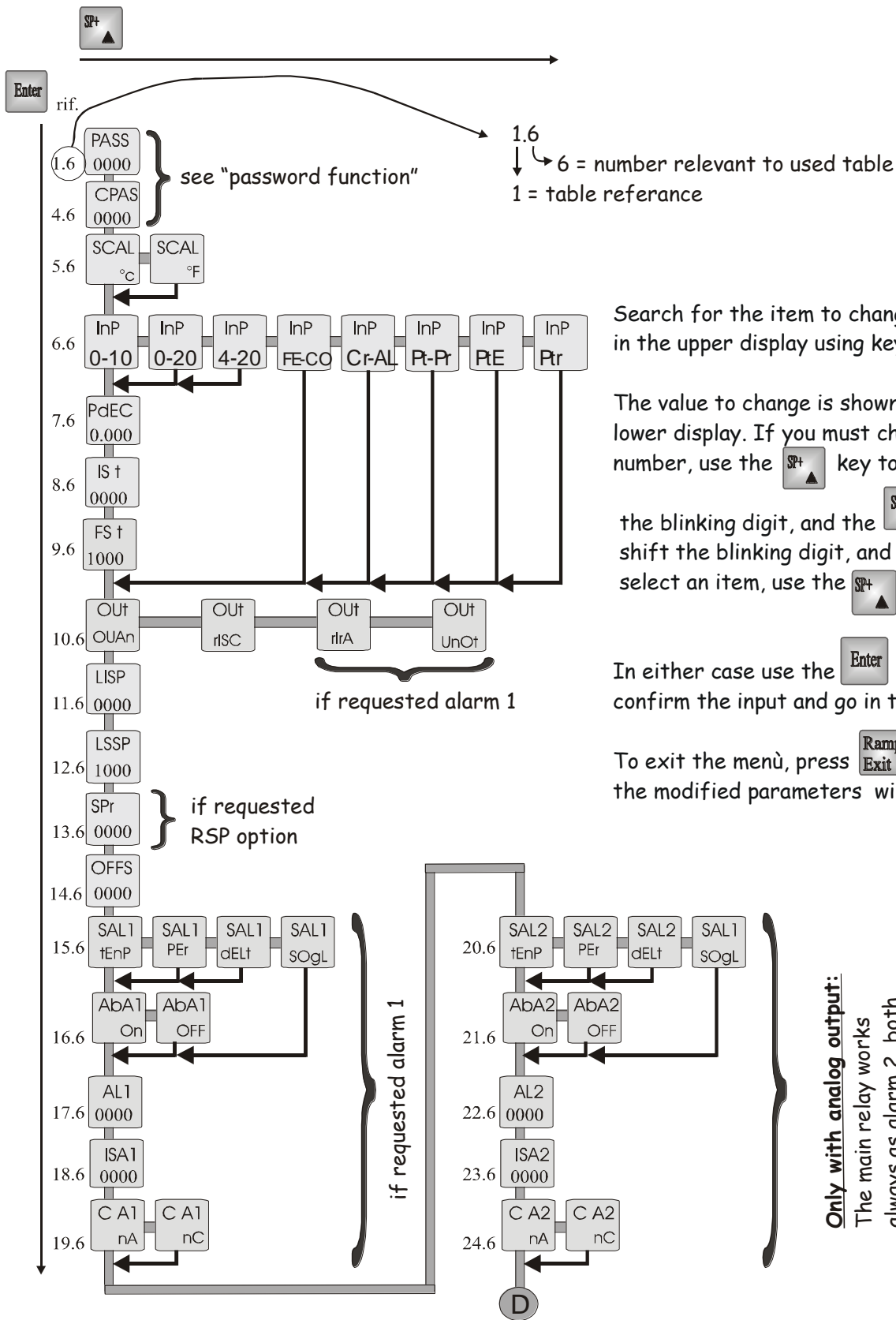
To set up control parameters see paragraph "Regulations".

For an automatic set point function, see paragraph "Ramp programming".

Attention: If out of range menu's item are programmed, they are proposed again at the maximum possible value.

To reset to factory default parameters you can see the paragraph "Default parameters".

2.4.1 DIAGRAM MENU WITH A VALVE CONTROL



Search for the item to change, shown in the upper display using key **Enter**

The value to change is shown on the lower display. If you must change a number, use the **SP+** key to increment the blinking digit, and the **SP-** key to shift the blinking digit, and if you must select an item, use the **SP+** key.

In either case use the **Enter** key to confirm the input and go in the menu.

To exit the menu, press **Ramp Exit**: the modified parameters will be stored.

Only with analog output:
The main relay works always as alarm 2, both if alarm 1 is required or not

MPT91 M1

Table 6

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See Page |
|------|-----------|-----------------------|-----------------------|--|----------|
| 1 | enter | PASS | 0 000 | In this phase the instrument asks for the Password in order to save the data already programmed. The number memorized by the factory is 0, but any number between 0 and 9999 can be memorized by writing where CPAS appears (next displayed item). | Pp 64 |
| 2 | SP- ▶ | PASS | 0 0 00 | Set Up Procedure. To digit the desired number touch the key " SP- ▶ " to move the flashing number to the right. | |
| 3 | SP+ ▲ | PASS | 0 1 00 | Touch the key " SP+ ▲ " to increase the flashing number | |
| 4 | enter | CPAS | 0 000 | Number of the access key to the programming of the instrument. The number written in this phase will be requested at "PASS". To digit the number follow the procedure described in points 2 and 3. | Pp 64 |
| 5 | enter | SCAL | °C | Temperature scale: Choose the type of scale required. Set the requested scale (°C or °F) by "SP+ ▲ " and confirm with "enter". | |
| 6 | enter | InP | PtE | Choose the type of sensor required. Touch the key "SP+ ▲ " until "SP" display appears on the chosen input: FECO = Fe/CO (0 ÷ 600 °C) (J) CrAL = Cr/Al (0 ÷ 1200 °C) (K) PtPr = Pt/Pt-Rh (0 ÷ 1710°C) (S) PtE = PT100 (-40 ÷ 800 °C) Ptr = PT100 (- 40.0 ÷ 200.0 °C) 0 10 = analogue input 0-10V 0 20 = analogue input 0-20mA 4 20 = analogue input 4-20mA To change this item use the "SP+ ▲ " key and confirm by "enter" | Pp 31 |
| 7 | enter | PdEC | 0.000 | Decimal point for analogue input. Touch the key "SP+ ▲ " to set the | |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See Page |
|------|-----------|-----------------------|-----------------------|--|----------|
| | | | | decimal point and confirm with "enter" | |
| 8 | enter | IS t | 0000 | Set the requested reading with the beginning of the analogue input. To digit the number see 2 and 3 paragraphs. | Pp 31 |
| 9 | enter | FS t | 1000 | Set the requested reading with the full scale of the analogue input. To digit the number see 2 and 3 paragraphs. | Pp 31 |
| 10 | enter | Out | OUn | OUn: analogue outputs for motorized valves. Set the requested regulation by "SP+▲" and confirm with "enter". | |
| 11 | enter | LISP | 0 000 | Lower limit set-point. To digit the number follow the procedure described in points 2 and 3 | Pp 31 |
| 12 | enter | LSSP | 0 000 | Higher limit set-point. To digit the number follow the procedure described in points 2 and 3 | Pp 31 |
| 13 | enter | SPr | 0 000 | Setpoint remote value set up (if requested). To digit the number follow the procedure described in points 2 and 3 | |
| 14 | enter | OFFS | 0 000 | Using the number "OFFS" it is possible to correct the displayed temperature by adding or subtracting a constant written in the display "PV". To digit the number follow the procedure described in points 2 and 3 | |
| 15 | enter | SAL1 | tEnP | Selection the kind of working Alarm1 tEnP = min or max absolute alarm value PEr = percentage alarm dELt = relative alarm at the set point SOGL = max absolute alarm value Press the key "SP+▲" to select and confirm with "enter" | Pp 32 |
| 16 | enter | AbA1 | On | Minimum alarm enable. On: Minimum alarm relay is always | Pp 32 |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See Page |
|------|-----------|-----------------------|-----------------------|--|----------|
| | | | | enabled OFF: Minimum alarm relay is enabled after the first time the temperature reaches the alarm value To change this item use the “SP+ ▲ “ key and confirm by “enter” | |
| 17 | enter | AL1 | 0 000 | Alarm value set up (if requested). To digit the value see steps 2 and 3. An alarm can work as minimum alarm (if < set-point) or maximum alarm (if > set-point). | Pp 32 |
| 18 | enter | ISA1 | 001 | Alarm 1 hysteresis set up | |
| 19 | enter | C A1 | nA | Possibility of inverting the relay 1 function nA = normally open nC = normally closed Set the requested regulation by “SP+ ▲ ” and confirm with “enter“. | Pp 32 |
| 20 | enter | SAL2 | tEnP | Selection the kind of working Alarm 2 (Main Relay) tEnP = min or max absolute alarm value PEr = percentage alarm dELt = relative alarm at the set point SOGL = max absolute alarm value Press the key “SP+ ▲ ” to select and confirm with “enter” | Pp 32 |
| 21 | enter | AbA2 | On | Minimum alarm enable. On: Minimum alarm relay is always enabled OFF: Minimum alarm relay is enabled after the first time the temperature reaches the alarm value To change this item use the “SP+ ▲ “ key and confirm by “enter” | Pp 32 |
| 22 | enter | AL2 | 0 000 | Alarm value set up (if requested). To digit the value see steps 2 and 3. An alarm can work as minimum alarm (if < set-point) or maximum alarm (if > set-point). | Pp 32 |
| 23 | enter | ISA2 | 001 | Alarm 2 hysteresis set up | |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See Page |
|------|-----------|-----------------------|-----------------------|--|----------|
| 24 | enter | C A2 | nA | Possibility of inverting the main relay function nA = normally open nC = normally closed Set the requested regulation by "SP+ ▲" and confirm with "enter". | Pp 32 |
| 25 | enter | OUn | 0 10 | If analogue output is requested touch the key "SP+ ▲" until the output required appears on the display and after confirm with "enter". 0 10 = output 0 ÷ 10 V 0 20 = output 0 ÷ 20 mA 4 20 = output 4 ÷ 20 mA | Pp 33 |
| 26 | enter | tCO | In | Control type: In = reverse function (main relay = heating) dIr = direct function for cooling function To change this item use the "SP+ ▲" key and confirm by "enter" | |
| 27 | enter | bAnr | 10.0 | Touch "enter" the key until the item bAnr appears = cooling dead band (see paragraph) | Pp 35 |
| | Ramp/Exit | Read out | Set point | | |

2.5 SET POINT MODIFICATIONS +REMOTE SET-POINT (RSP OPTION)

Using the keys on the panel "SP+ ▲" and "SP- ▼" it is possible to increase or decrease the number corresponding to the set point without having to use the programming menu. For a fast change keep pressed the key. In order to block the movement of the set point between two limits, programme the menu where "LISP" appears for the lower limit and "LSSP" for the upper limit.

If RSP option is requested, it is possible to set the second set-point, shortcircuiting 4 and 6 terminals. To set the second set-point use the item menu "SPr". Also the second set-point is confined from "LISP" to "LSSP". Using the remote set point, the Sp+ ▲ and Sp- ▼ keys are disabled. The instrument works on the visualized set-point.

MPT91 M1

2.6 ANALOGUE INPUTS

The instruments of the "MPT91" series work with these analogue inputs:

- Current input " 4 ÷ 20 mA "
- Current input " 0 ÷ 20 mA "
- Voltage input " 0 ÷ 10 V "

For each inputs it is possible to set any reading value in the range: -999 ÷ 2000.

To set these inputs the " IS t " and " FS t " items will be used for the beginning scale and full scale of the requested input. The programmed value could be corrected with " OFFS " item of the menu. With analogue inputs it is possible to set the decimal point by "PDEC" menu item. The voltage or current input must be linked to terminals number 2 (positive input) and 1 (gnd).

2.7 FUNCTION OFF-SET (OFFS)

If during the normal functioning of the thermoregulator you see a constant difference between the value measured by the sensor or analogue input and the real value, it is sufficient to write the difference in the "OFFS" function.

ATTENTION: the offset must be within -19.9 e 19.9 °C in the scale Pt r (-40.0 ÷ 200.0 °C) otherwise between -199 e 199 °C for all the other scales and is added to the temperature measured by the sensor.

2.8 SET UP AL1

The thermoregulator MPT91 offers the possibility to use one programmable alarm. This alarm can work with the following set up:

S.AL1 = tEnP. The alarm value (AL1) is set up with the absolute value. If $AL1 < SP$ the alarm works when the temperature goes under the AL1 value (it can be enabled at the first switching on if $AbA1 = on$ or after that the temperature has come to the alarm value for the first time if $AbA1 = off$); if $AL1 > SP$ the alarm works when the temperature goes over the AL1 value.

S.AL1 = Per. The alarm value (AL1) is set up with the percentage value based on the set-point (from 0 to $\pm 100.0\%$ of the set point). If AL1 is set up between -0.1% and -100.0% the alarm works when the temperature goes under the SP value – SP percentage (it can be enabled at the first switching on if $AbA1 = on$ or after that the temperature has come to the alarm value for the first time if $AbA1 = off$); if AL1 is set up between $+0.1\%$ and $+100.0\%$ the alarm works when the temperature goes over the SP value + SP percentage.

S.AL1 = dELt. The alarm value (AL1) is set up in °C offset about the set point. If AL1 is set up between -0 and $-F.S.$ °C the alarm works when the temperature goes under the SP value – set up offset (it can be enabled at the first switching on if $AbA1 = on$ or after that the temperature has come to the alarm value for the first time if $AbA1 = off$); if AL1 is set up between $+0$ and $+F.S.$ °C the alarm works when the temperature goes over the SP value + set up offset.

MPT91 M1

S.AL1 = SOGL. The alarm value is set up in absolute value between 0 and F.S. and the alarm works when the processing temperature goes over the AL1 set up temperature.

The alarm contact is configurable as “normally open” or as “normally closed” by the “CA1” item while the alarm relay hysteresis is programmable from 0 to F.S. value (digits/degrees) by the “ISA1” item.

The led on the frontal does not follow the contact programming but it follows the alarm function.

The described functioning is active for alarm 1 just at the moment when “Out” = “rISC” or “Out” = “OUAn”. If “Out” = “rIrA” or “Out” = “UnOt” the alarm 1 respectively works for the cooling or for the servomotor function so the alarm 1 output changes the type of functioning depending on the requested regulation.

If “OUt” = “OUAn”, the main relay works as alarm 2.



3.0 ANALOGUE OUTPUT (option)

The thermoregulator MPT91 offers the possibility to supply the analogue outputs. The instrument is able to supply 3 types of outputs: “0 ÷ 20 mA”, “4 ÷ 20 mA”, “0 ÷ 10 V” to transmit the read out or to control the motorized valves.

Table 7

| | |
|------------------------------------|-----------------------------|
| Analogue outputs | 0÷10 V - 0÷ 20 mA - 4÷20 mA |
| Max load for current output | 300 Ω |
| Min load for voltage output | 1KΩ |
| Max voltage output | 10 V |
| Max current output | 20 mA |
| Resolution | 12 bits |

3.1 ANALOGUE OUTPUT FOR MOTORIZED VALVE

To use analogue output for motorized valve it is necessary to set the voice “Out” = “OUAn” (see paragraph “Instrument with a valve control”).

The analogue output is working as heating regulation if “tCON” item = “In” or as cooling regulation if “tCON” item = “dIr”. The analogue output can be selected in current (0/4 ÷ 20 mA: terminals 5 (+) and 4 -gnd-) or voltage (0 ÷ 10 V: terminals 6 (+) and 4 -gnd-). At the end of the cycle time (“CICL”) the analogue outputs are adjourned from the PID control.

3.2 ANALOGUE OUTPUT FOR READOUT

If the instrument has the analogue output and the voice “Out” is selected as “rISC”, “rIrA”, or “UnOt”, the analogue output is proportional to the readout value.

The output can be selected in voltage or current mode. The terminals for voltage output are 6 (+) and 4 (gnd), while the terminals for current output are 5 (+) and 4 (gnd). The next table shows the couplings of the readout with the analogue outputs.

Table 8

| ANALOGUE OUTPUT RANGE | BEGINNING SCALE OF ANALOGUE OUTPUT | FULL SCALE OF ANALOGUE OUTPUT |
|-----------------------------------|---|--------------------------------------|
| 0÷10V for Pt r | 0V \equiv -40.0 °C | 10V \equiv 200,0 °C |
| 0÷10V for Pt E | 0V \equiv 0 °C | 10V \equiv 800 °C |
| 0÷10V for FE-CO | 0V \equiv 0 °C | 10V \equiv 600 °C |
| 0÷10V for Cr-Al | 0V \equiv 0 °C | 10V \equiv 1200 °C |
| 0÷10V for PtPr | 0V \equiv 0 °C | 10V \equiv 1710 °C |
| 0÷10V for analogue input | 0V \equiv IS t | 10V \equiv FS t |
| 0÷20 mA for Pt r | 0 mA \equiv -40.0 °C | 20 mA \equiv 200,0 °C |
| 0÷20 mA for Pt E | 0 mA \equiv 0 °C | 20 mA \equiv 800 °C |
| 0÷20 mA for FE-CO | 0 mA \equiv 0 °C | 20 mA \equiv 600 °C |
| 0÷20 mA for Cr-Al | 0 mA \equiv 0 °C | 20 mA \equiv 1200 °C |
| 0÷20 mA for PtPr | 0 mA \equiv 0 °C | 20 mA \equiv 1710 °C |
| 0÷20mA for analogue input | 0 mA \equiv IS t | 20 mA \equiv FS t |
| 4÷20 mA for Pt r | 4 mA \equiv -40.0 °C | 20 mA \equiv 200,0 °C |
| 4÷20 mA for Pt E | 4 mA \equiv 0 °C | 20 mA \equiv 800 °C |
| 4÷20 mA for FE-CO | 4 mA \equiv 0 °C | 20 mA \equiv 600 °C |
| 4÷20 mA for Cr-Al | 4 mA \equiv 0 °C | 20 mA \equiv 1200 °C |
| 4÷20 mA for PtPr | 4 mA \equiv 0 °C | 20 mA \equiv 1710 °C |
| 4÷20 mA for analogue input | 4 mA \equiv IS t | 20 mA \equiv FS t |

4.0 REGULATIONS - "CONT" function

The thermoregulator MPT91 allows the possibility to control the temperature in 3 different ways:

1. Automatic regulation (Pot = cont)
2. Manual regulation (Pot = man)
3. Disabled regulation (Pot = OFF)

In the first case (automatic control) the instrument works with ON-OFF or Pid controls (see PID TYPE REGULATION and ON-OFF TYPE REGULATION paragraphs).

In the second case (manual control) the instrument works with a value of power defined from the user. This value appears on SP display and it is possible to modify it by "SP+ ▲ " and "SP- ▶ " items. Set on the menu the necessary cycle time.

In the third case (disabled control) the instrument disables all outputs and "OFF" appears on the SP display.

In the second and third cases it is not possible to use the ramp programs.

MPT91 M1

4.1 PID TYPE REGULATION

The PID regulation, if selected, allows the direct programming of the following keyboard parameters:

- - cycle time (CICL) 1 ÷ 200 sec

Attention: if the cycle time = 1 ÷ 200 sec only the static output works, if the cycle time = 10 ÷ 200 sec the static output works coupled with the main relay.

- - proportional band (ProP) 0 ÷ F.S. °C/°F
- - time req. for integrative action (IntE) 0 ÷ 6000 sec
- - time req. for derivative action (dErI) 0 ÷ 600 sec
- - constant Cutback (CUtb) 0 ÷ F.S. °C/°F

A quick way which guarantees correct operation is automatic parameter calculation by the machine itself using the "SELF-TUNING" function.

The enumerated parameters are valid for the heating control and for the cooling control too. If the instrument is used for a cooling control, a parameter is added and it defines the dead band (bAnr) in which is programmed the % of power under which the control is cancelled.

4.1.1 CUTBACK FUNCTION

With the function "CUTBACK" it is possible to reduce the temperature overshoot that can occur in certain processes. The number "Cutb" that can be programmed is expressed in °C/°F in the range 0 ÷ F.S. of the chosen input. The insertion of this function avoids overshoot.

There are two methods to programme this function:

- 1) AUTOMATIC MODE: launch the self tuning command which calculates the constants P, I, D, and CUTBACK.
- 2) MANUAL MODE: Check manually how many degrees, during the first power on, are above the set-point (regulation made with parameters P - I - D - in line with the controlled thermal system). Write this data in the "CUTBACK" function. To exclude the function described it is sufficient to write "0" in "Cutb" menu item.

Table 9

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|--|----------|
| 1 | enter | PASS | 0 000 | Number of Password | Pp 64 |
| 2 | SP- ▶ | PASS | 0 0 00 | Set Up Procedure. To input the desired number press the key " SP- ▶ " to move the flashing number to the right. | |
| 3 | SP+ ▲ | PASS | 0 1 00 | Touch the key " SP+ ▲ " to increase the flashing number | |
| 4 | enter | CPAS | 0 000 | Number of the access key to the | |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|--|----------|
| | | | | programming of the instrument. The number written in this phase will be requested at "PASS". To digit the number follow the procedure described in points 2 and 3. | Pp 64 |
| 5 | enter | | | Press the key "enter" until to reach the desired menu item "Cont" | |
| 28 | enter | Cont | Pid | Selecting Pid control the instrument will allow the following items | Pp 35 |
| 29 | enter | CICL | 0 000 | Set up the cycle time required for the control. Under 10 sec. only the static output is guided, over 10 sec., the static output plus relay. To input the number follow the procedure described in points 2 and 3 | |
| 30 | enter | ProP | 0 000 | Set up of the proportional band | |
| 31 | enter | IntE | 0 000 | Set up of the integrative constant | |
| 32 | enter | dErI | 0 000 | Set up of the derivative constant | |
| 33 | enter | CUTb | 0 000 | Set up of the temperature overshoot. For all these set ups follow the description of points 2 and 3 | Pp 35 |
| 34 | enter | SEtU | OFF | Function for the automatic calculation of the control constants "Pid". To insert this procedure press the "SP+ ▲ " key until the written "on" appears. | Pp 36 |
| 27 | enter | bAnr | 0000 | Cooling dead band. Only if Out = rIrA or Out = OUA If you control Pid, put in the % of power under which the cooling control is cancelled. | |
| 35 | enter | SoSt | 0 000 | Set up of the temperature value under which the load becomes 30% guided. For all these set ups follow the description of points 2 and 3 | Pp 39 |

4.1.2 SELF-TUNING FUNCTION (setu)

The self-tuning function calculates the parameters of the Pid regulation (proportional band, integrative time, derivative time and CUTBACK function) to obtain a temperature control that is as precise as possible. The calculations of the self tuning function, if set-up in the programming phase, can be seen on the flashing "PV"

MPT91 M1

display. The calculation of the parameters consists of a heating cycle that the thermoregulator must follow with the working set point taking account of the thermal system installation. To use the self-tuning function it is necessary to remember that:

1. the self-tuning action can provoke an overshoot and depending on the thermal system used; the test can last from a few minutes to several hours.
2. eventual "soft-start" programming is not considered but comes into use at the end of self-tuning.
3. for a correct calculation of the parameters it is better from the users point of view to begin the self tuning procedure at room temperature and as far away as possible from the set point.
4. There exist certain conditions in which is not possible to finalize the parameter calculations. In these situations the instrument blocks the "self-tuning" action and displays an error code that defines the type of anomaly found:
 - a) temperature \geq at set-point (Err 1)
 - b) sensor interrupted or over range condition (Err 2)
 - c) set-point too closed to initial temperature (Err 4)

In these conditions the instrument follows the abort function, showing on the "PV" display the message relating to the displayed error and deactivating the actuators. The instrument will work again only when the operator press the "enter" key and corrects the anomaly.

5. The self tuning function is, however, annulable at any moment, it being sufficient to touch "enter", inserting the password number and when the "abort" signal appears, press the "SP+▲" key to make "on" appear and then confirm with "enter".
6. After the self tuning phase it is necessary, to set up the cycle time (if the programming control = "PID" and cycle time = 0 the instrument works like a thermometer).
7. After the self tuning phase it is necessary, to set up the cycle time (if the programming control = "PID" and cycle time = 0 the instrument works like a thermometer).

4.2 ON-OFF TYPE REGULATION

The ON-OFF regulation, if selected, allows hysteresis programming. The hysteresis must be set up in "degrees" relative to the set-point and the variation should be symmetric in relation to the desired temperature.

EXAMPLE: set-point = 300 °C
IStE = 10 °C

the main working relay (RL 1) is on until 310 °C, and it will be on again at 290 °C.

You can set up the values in degrees from 1 (0,1 for the Ptr scale) to F.S. as requested.

The On-OFF control, with heating-cooling regulation, inserts a new item to define a dead band (bAnr). The functioning of this control is described in the following figure.

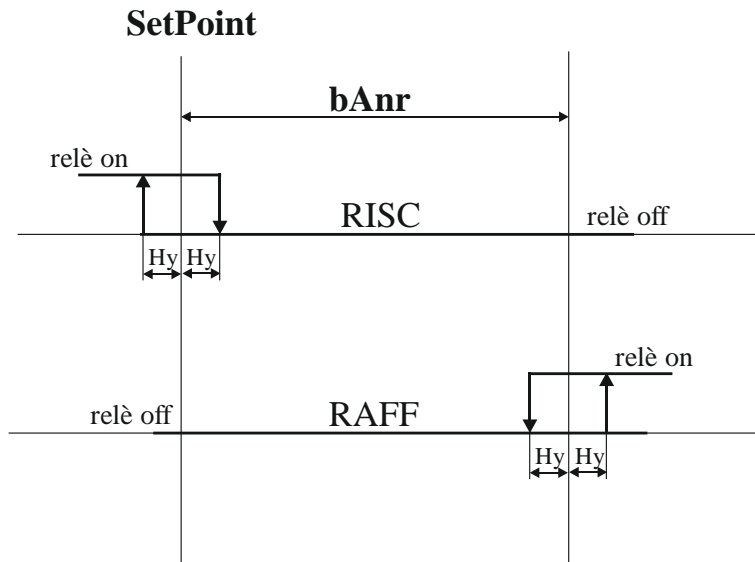


Figure 1

Table 10

| ref. | touch key | appears on PV display | appears on SP display | NOTES | See Page |
|------|------------|-----------------------|-----------------------|--|----------|
| 1 | enter | PASS | 0 000 | Number of Password | Pp 64 |
| 2 | enter | CPAS | 0 000 | Number of the access key to the programming of the instrument. The number written in this phase will be requested at "PASS | Pp 64 |
| 3 | enter | | | Press the "enter" key until to reach the desired "Cont" menu item | |
| 38 | enter | COnT | OnOF | Selecting On-OFF control the instrument will allow the following items | Pp 37 |
| 39 | enter | IStE | 0003 | Set up hysteresis. | |
| 27 | enter | bAnr | 0000 | Cooling dead band. Only if OU _t = rIrA or OU _t = OUA _n . If you have an On-Off control put the band in °C in which will be inhibited the heating and cooling control. | |
| 40 | enter | SoSt | 0 000 | Set up the temperature value under which the load becomes 30% guided | Pp 39 |
| | Ramp/ exit | Read out | Set point | | |

4.3 SOFT-START FUNCTION (*sost*)

The function soft-start guarantees a "cold" departure of the thermoregulator with a command of the heating elements not above 30% of maximum power, in the range of temperature set up at the "SOS_t" command. The value, which can be programmed, is between 0÷F.S. °C/°F, and as a consequence, a higher initial temperature automatically excludes the function. After having set up this system please put off and then start up again the instrument to set working this function.

Also with the "On-Off" regulation it is possible to use the "soft-start" option; this is used with a fixed cycle time of 20 sec.

If the type of control is set up in direct function ("tcon = dir") the soft start function is not available.

After setting up the programme, the soft-start function is, however, annullable at any moment, it being sufficient to press "enter", inserting the password number and when the "abort" signal appears, press the "SP+▲" key to make "on" appear and then confirm with "enter".

The soft-start function, if set up, is shown by both "PV" and "SP" flashing on the display.



5.0 RAMP SET UP

The MPT91 instrument can execute automatic cycles with steps. The ramp set up allows the automatic set point variation while the base regulator functions are programmed in the main menu (see "installation notes"). It is possible to set up 3 programs of 8 steps each (linking together). For each step it is defined the final temperature and its duration up to 99 hours and 99 minutes.

It's not possible to set up the first step of each program with zero duration.

The "Pot" menu item set up is not available when ramps are working.

There are some available options:

RIPR: program repetition. Selecting this item at "on" you qualify the selected programs to be repeated to infinity. This selection excludes the following "COFR" (ramp control at last step).

COFR: ramp control at last step. This menu's item can be selected in "STOP", (marked with led ON and last SP blinking) if is requested that the thermoregulator, ended the programmed cycle, turns off the load, or can be selected in "REG", if is requested that the thermoregulator, ended the programmed cycle, controls with last set-point.

DESP: delay starting program. This menu's item allows to set up a delay time at the beginning of the selected programs. The maximum time that can be set up is 99 hours and 99 minutes. During the delay time the instrument presents the flashing led R. Pressing the "Ramp/Exit" + "enter" keys the instrument resets the actual time delay and immediately enables the ramp to execute. To read the residual delay time you must press the "SP+▲" key.

MPT91 M1

In this case you can read on the displays PV and SP the following information:

trES (residual time)
01.23 (1 hour and 23 minutes)

5.1 KEY FUNCTIONS

“Ramp/Exit” key: access to the “Ramps’ programs”. The “ramp/Exit” key can be disabled by the menu item “Abtr”.

Attention: it is not possible to change the current step.

“Ramp/Exit” key : to get out of the menu is sufficient to press the “Ramp/Exit” key; the instrument goes in process saving the set ups executed till then.

“Ramp/Exit” + “enter” keys: during a ramp program, if the “Ramp/Exit” + “Enter” keys are pressed (STOP function), the instrument turns off the heating and, the SP display and the led on blink. When you press the “Ramp/Exit” + “enter” keys a second time, the instrument starts again the execution of the program from where it had been suspended.

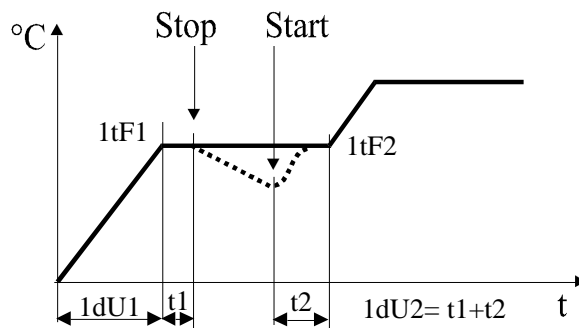


Figure 2

5.2 DIAGRAM RAMP MENU

MPT91 M1

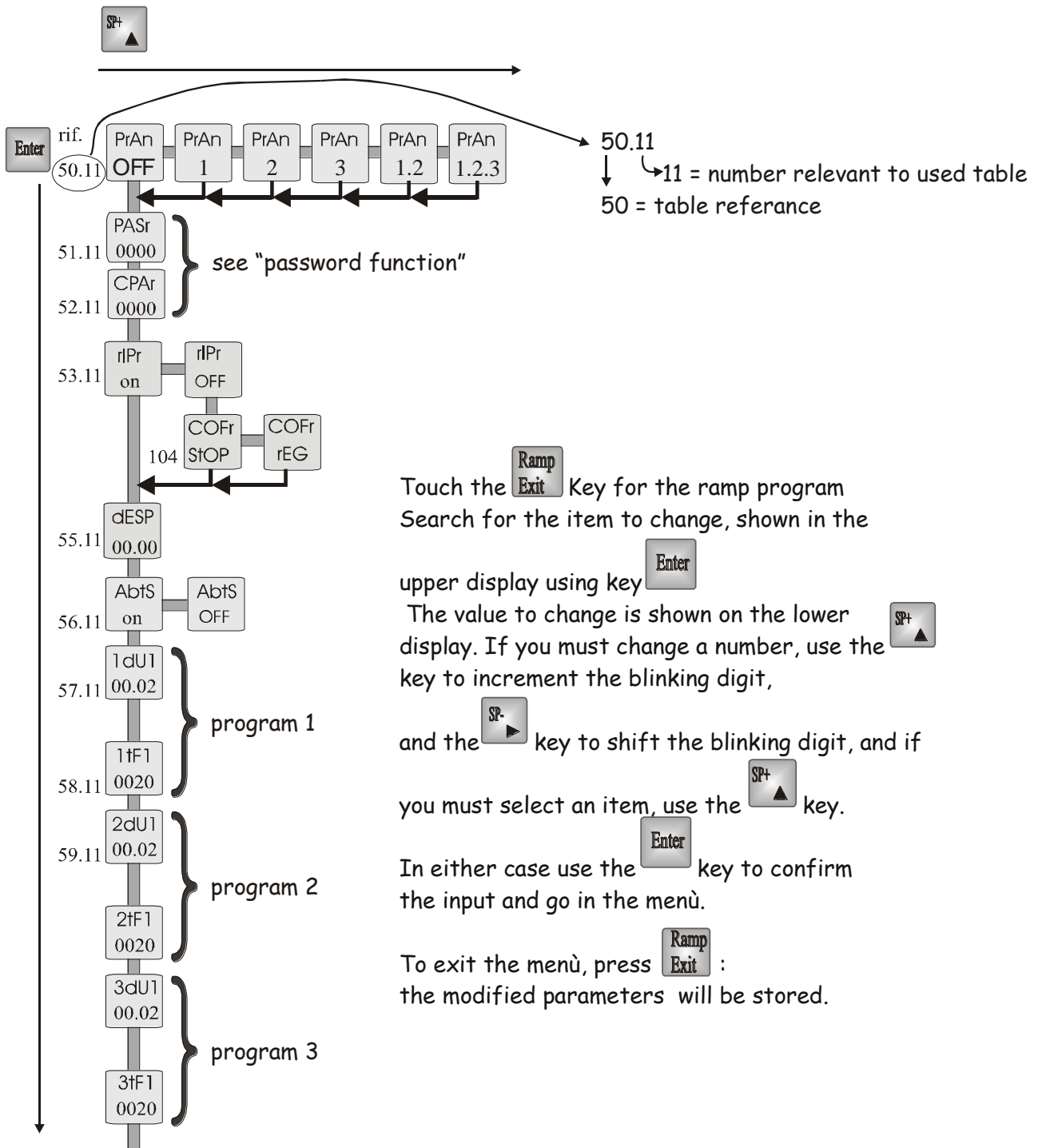


Table 11

| ref. | touch key | appears on PV display | appears on SP display | NOTES |
|------|-----------|-----------------------|-----------------------|---|
| 50 | Ramp/Exit | PrAn | OFF | Program number: OFF: no program 1: program n°1 2: program n°2 3: program n°3 1.2: program n°1 + n°2 1.2.3: program n°1 + n°2 + n°3 To change this set up press the “SP+▲” key and confirm with “enter” |
| 51 | enter | PASr | 0000 | Password number for ramp program |
| 52 | enter | CPAr | 0000 | Password change for ramp program |
| 53 | enter | rIPr | OFF | Repetition selected programs OFF: executes only one time the selected programs On: repeats to infinity the selected programs To change this set up press the “SP+▲” key and confirm with “enter” |
| 54 | enter | COFr | StOP | Ramp control at last step (only if rIPr = OFF) StOP: ended the set up program the instrument goes in stop rEG: ended the set up program the instrument controls on last set point. To change this set up press the “SP+▲” key and confirm with “enter” |
| 55 | enter | dESP | 02.00 | Delay time before to start the program. Set up the time in hours and minutes relative at the requested delay pressing the “SP+▲” + “SP-▶”keys |
| 56 | enter | AbtS | OFF | Enabling “Ramp/Exit” + “enter” keys: OFF: disabled keys On: enabled keys To change this set up press the “SP+▲” key and confirm with “enter” |
| 57 | enter | 1dU1 | 00.30 | Program n°1, step n°1 duration. Input time in hours and minutes for the step using “SP+▲” and “SP-▶”keys. Attention: it is not possible to set at zero the first duration. |

MPT91 M1

| ref. | touch key | appears on PV display | appears on SP display | NOTES |
|------|-----------|-----------------------|-----------------------|--|
| 58 | enter | 1tF1 | 0020 | Program n°1, final temperature for step n°1. Input the desired temperature using the “SP+ ▲ “ key to increase the blinking digit and the “SP- ▶ ” key to shift the blinking digit |
| 59 | enter | 1dU2 | 00.50 | The program set up goes on with the set up of the second step of the first program. At the end of the 8 th step the menu shows the 8 steps of the second program and then the 8 steps of the third program. |

The instrument performs the program selected in the PrAn item of the menu (if PrAn=OFF the instrument works normally). The program starts with the first step. At the end of the program and if rIPr=OFF the instrument shuts down the heating control, the last set point will flash together with the led “on” if COFr=StOP or, vice versa the instrument controls on last set-point if COFr=rEG.

If rIPr=On the instrument starts again from the beginning and repeats to infinity the selected programs. If COFr=StOP at the end of selected program we have a “STOP” function and the instrument shuts down the control and the SP display and led “on” flash. The “STOP” function of the end of the program is also memorized at power off condition.

After a “STOP” condition caused by the end of the program, the instrument will work again if one of the following conditions happen:

- 1 no ramp program set up (PrAn=OFF). The instrument controls on last set-point.
- 2 new ramp program. Selecting in “PrAn” item one available programs, the instrument goes on execution starting from the first programmed step with the same initial measured temperature at that time.
- 3 with “Ramp/Exit” + “Enter” keys press together the instrument starts again from the ramp program that were in execution, starting from the first programmed step with the same initial measured temperature at that time.

When a step program is in progress, the upper (PV) display shows the process temperature, and the lower (SP) display shows the dynamic set point of the regulator. Besides the led “R” is always “on” for the duration of the chosen program.

While the step program is running, it is possible to see the residual time of the step in progress and its final temperature by pressing the “SP+ ▲ “ key: the information will be displayed as:

trES (residual time)

01.23 (1 hour and 23 minutes)

MPT91 M1

tFin (final temperature)

0100 (100 °C)

At the end of the current step, if the temperature is not within 3 grades respect to the computed set point, the regulator waits for this condition before executing the next step.

After a “STOP” because “Ramp/Exit” + “Enter” keys are pressed, the instrument shuts down the control and SP display and led “on” flash. The STOP function is also memorized at the power off of the instrument. The instrument after a STOP phase will work again if one of the following conditions happen:

- 1 no ramp program set up (PrAn=OFF). The instrument controls on last set-point.
- 2 new ramp program. Selecting in “PrAM” item one available programs, the instrument goes on execution starting from the first programmed step with the same initial measured temperature at that time.
- 3 with “Ramp/Exit” + “Enter” keys press together: the instrument controls on suspended ramp (see fig. 2). A ramp is considered finished if the temperature is within $\pm 3^\circ$ of the final programmed temperature.

If during the functioning the instrument is powered off, the current step is stored and at the next power on this stored step is reload. If the temperature, during power off, exits from the range of the stored step, at the power on the instrument will continue as shown in the figures 3, 4, 5, 6.

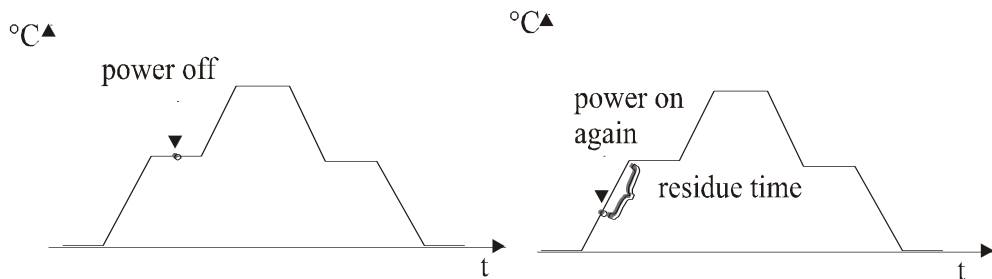


Figure 3

Figure 4

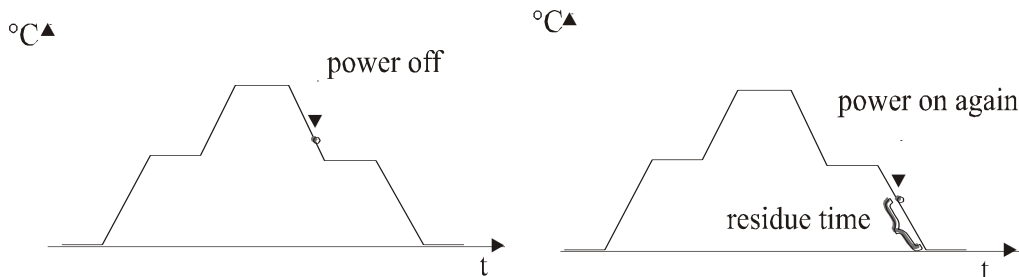


Figure 5

Figure 6

MPT91 M1



6.0 SERIAL OUTPUT

MPT91 models can communicate with an host computer along a standard or optoisolated RS232, RS422, RS485 serial using “mect” or “MODBUS” protocols (see paragraph 7.0).

Bi-directional serial output

By the serial output it is possible to read out and write all parameters of the instrument. It is possible to connect up to 31 instruments (with RS485). All messages are sent and received by the serial output by an ASCII protocol.

Table 12

| SERIAL CHARACTERISTICS | |
|------------------------|--|
| Baud rate | 9600 4800 2400 1200 (programmable by the keyboard) |
| Start bit | 1 bit |
| Length | 8 bit |
| Stop | 1 bit |
| Parity | No |

The MPT91 model with RS232 the wiring diagram is shown in fig A. The MPT91 model with RS422 or RS485 the wiring diagram is shown in fig B. To program the address and the baud rate see the following table.

Table 13

| ref. | touch key | appears on PV display | appears on Sp display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|---|----------|
| 1 | enter | | | Press the "enter" key to get into the programming menu | |
| 2 | enter | PASS | 0 000 | Digit the password number | Pp 64 |
| 3 | enter | PASS | 0 0 00 | Change the Password number and confirm with "enter" | |
| 4 | enter | | | Press the "enter" key until you see the "Addr" message on the "PV" display | |
| 36 | enter | Addr | 0 000 | Write the address code | Pp 45 |
| 37 | enter | bAUd | 9600 | Press the "SP+▲" key until you see the right baud rate (1200, 2400, 4800 o 9600). Confirm by "enter" | Pp 45 |
| 38 | enter | PrOt | nECt | Press the "SP+▲" key until you see "nECt" item. Confirm by "enter". nECt = "mect" protocol nOdb = MODBUS protocol | |

MPT91 M1

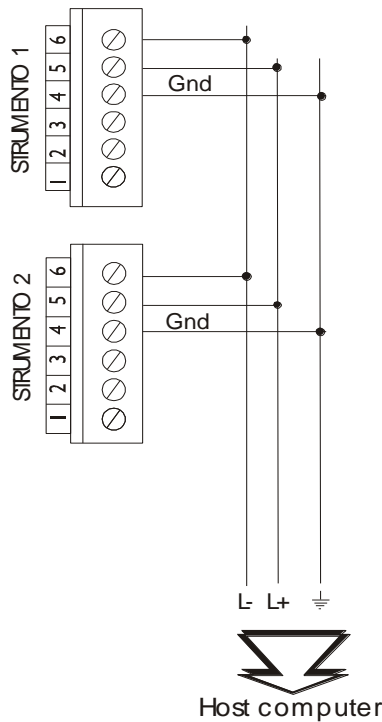


Figure A

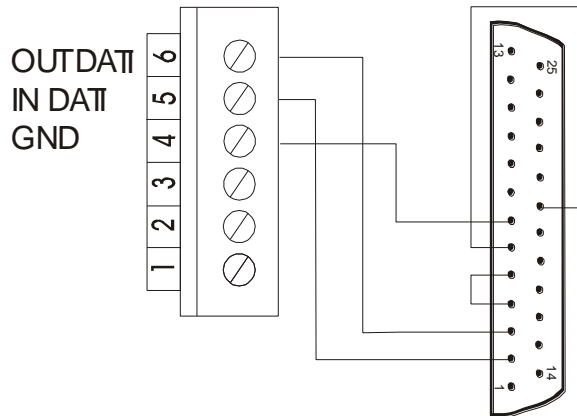


Figure B

6.1 DATA READING FROM HOST TO INSTRUMENT MPT91

Transmission string set-up.

EOT GID GID UID UID C1 C2 ENQ

EOT = EOT from host indicates the start of transmission string

GID = ASCII code for the tenths of the instrument address to transmit twice consecutively

UID = ASCII code for the units of the instrument address to transmit twice consecutively

C1 C2 = mnemonic ASCII code for command to execute. (see paragraph "COMMAND CODES")

EXAMPLE: data transmission string from host to MPT91 with address "01" for data request "Reading scale end" (SP).(controllare)

EOT 0 0 1 1 S P ENQ
04 30 30 31 31 53 50 05 cod. ASCII

The instrument, from the moment in which it receives the first string code transmitted by the host, leaves 400 ms. during which it waits for the end of the transmission operation. When the 400 ms. operation finishes, or when the data reception is completed, the instrument, depending on the information received, can behave in the

MPT91 M1

following four ways:

- 1) If the data string received presents errors which do not allow address identification then the instrument cannot reply and rejects the information received.
- 2) The string has a correct address code but it detects other errors; in this case the instrument transmits the ASCII code: NACK (not understood) and rejects the information received.
- 3) The received data string is totally completed, in this case the instrument transmits the data requested in ASCII format (see paragraph "DATA TRANSMISSION FROM MPT91 TO HOST").
- 4) When the complete message is not received before "timeout" (400 mSec), the instrument rejects the information received and it is ready to receive a new message.

6.2 DATA TRANSMISSION FROM MPT91 TO HOST

Transmission string configuration

STX C1 C2 D1 D6 ETX BCC

STX = start of text

C1 C2 = mnemonic code ASCII relative to command to execute (see paragraph "COMMAND CODES")

D1 ÷D6 = Numbers displayed, including negative sign, ">", decimal points (if it is present) and blank or zero for not significant digits (the transmitted digits must always be 6)

ATTENTION: the data must always be "supported" on the right and in any case the significant numbers cannot be more than five. In the case of positive numbers the sign "+" must not be transmitted.

EXAMPLE: the number -5.6 can be written in two ways

- | | | | | | | |
|----|-------|-------|----|----|----|----|
| 1) | blank | blank | - | 5 | . | 6 |
| | 20 | 20 | 2D | 35 | 2E | 36 |
| 2) | - | 0 | 0 | 5 | . | 6 |
| | 2D | 30 | 30 | 35 | 2E | 36 |

ETX = End of text

BCC = Checksum, obtained using EXCLUSIVE OR, of the transmitted string excluding the code "STX" comprising "ETX" in the indicated order.

$BCC = C1 + C2 + D1 + D2 + D3 + D4 + D5 + D6 + ETX$

EXAMPLE: data string from MPT91 to host in response to example above.

| | | | | | | | | | | |
|-----|----|----|-------|-------|----|----|----|----|-----|--------------|
| STX | S | P | blank | blank | 0 | 1 | 0 | 0 | ETX | BC |
| 02 | 53 | 50 | 20 | 20 | 30 | 31 | 30 | 30 | 03 | 01 cod.ascii |

MPT91 M1

The MPT91 after having transmitted the string with the data requested from the host-computer waits the reply confirming the result of the transmission executed.

- 1) The host-computer replies in ASCII: NACK (not understood). The MPT91 transmits again the data string.
- 2) The host-computer does not reply. In this case the instrument waits the next EOT on the network to set up the next communication.
- 3) The host-computer replies in ASCII: ACK (understood). The instrument waits new commands.

6.3 DATA WRITING FROM HOST TO MPT91

Set up of transmission string

EOT GID GID UID UID STX C1 C2 D1...D6 ETX BCC

EOT = EOT from host indicates the start of transmission string

GID = ASCII code for the tenths of the instrument address to transmit twice consecutively

UID = ASCII code for the units of the instrument address to transmit twice consecutively

C1 C2 = mnemonic ASCII code for command to execute (see paragraph "COMMAND CODES")

D1 ÷ D6 = Digits displayed. The same rules are valid as those described in the paragraph " data transmission from MPT91 to host"

BCC = Checksum, obtained using EXCLUSIVE OR, of the transmitted string excluding the code "STX" comprising "ETX" in the order indicated

$$BCC = C1 + C2 + D1 + D2 + D3 + D4 + D5 + D6 + ETX$$

EXAMPLE: string for writing data from host to MPT91 with "01". address.

| | | | | | | | | | | | | | | | |
|-----|----|----|----|----|-----|----|----|-------|-------|----|----|----|----|-----|-------|
| EOT | 0 | 0 | 1 | 1 | STX | S | P | blank | blank | 0 | 1 | 0 | 0 | ETX | BCC |
| | 04 | 30 | 30 | 31 | 31 | 02 | 53 | 50 | 20 | 20 | 30 | 31 | 30 | 30 | 03 08 |

The instrument, from the moment in which it receives the first code of the data string transmitted by the host, makes to start 400 ms during which it waits for the transmission operation to be completed. When the 400 ms. operation finishes, or when the data reception is completed, the instrument, depending on the information received, can behave in four different ways:

- 1) If the data string received presents errors which do not allow address identification then the instrument cannot reply and rejects the information received.

MPT91 M1

- 2) The string has a correct address code but detects other errors; in this case the instrument transmits the ASCII code: NACK (not understood) and rejects the information received.
- 3) The received data string is totally completed, in which case the instrument writes the information memorized and transmits the code ASCII=ACK (understood)
- 4) When the complete message is not received before "timeout" (400 ms), the instrument rejects the information received and is ready to receive a new message.

6.4 COMMAND CODES

The codes of the variables used for the MPT91 instrument programming, are listed into the following table". Not all the parameters allow the writing from host, in this case the instrument does not work and replies "NACK".

Table 14

| COMMAND CODES | COMMAND DESCRIPTION | ALLOWED SET-UP | TYPE OF CODE |
|---------------|----------------------------|----------------|---|
| SC | Scale (SCAL) | read/write | hexadecimal 0 = °C 1 = °F |
| OU | Output (OUt) | read/write | hexadecimal 0 = RISC 1 = RIRA 2 = VMOT 3 = OA |
| CO | Control (Cont) | read/write | hexadecimal 0 = on-off 1 = Pid |
| IN | Input | read/write | hexadecimal 0 = Fe/Co 1 = Cr/AL 2 = Pt/Pt-Rh 3 = PT100E: 0÷800°C 4 = PT100r:-40.0÷200,0°C 5 = 0 ÷ 10V 6 = 0 ÷ 20 mA 7 = 4 ÷ 20 mA |
| OA | Selection analogue outputs | read/write | hexadecimal 0 = 0.10 (V) 1 = 0.20 (mA) 2 = 4.20 (mA) |
| PD | Decimal point | read/write | hexadecimal |

MPT91 M1

| COMMAND CODES | COMMAND DESCRIPTION | ALLOWED SET-UP | TYPE OF CODE |
|----------------------|------------------------------|-----------------------|--|
| | | | 0 = no point 1 = 199.9 2 = 19.99 3 = 1.999 |
| IT | Beginning scale (IS T) | read/write | ASCII -200÷2000 |
| FT | End of scale (FS T) | read/write | ASCII -200÷2000 |
| B1 | Alarm 1 enable (ABA1) | read/write | hexadecimal 0 = off 1 = on |
| CI | Cycle (CICL) | read/write | ASCII 0÷200 |
| OF | Offset (OFFS) | read/write | ASCII 0÷F.S. |
| A1 | Alarm 1 (AL1) | read/write | ASCII 0÷F.S. |
| C1 | Relay function Al. 1 (C A1) | read/write | hexadecimal 0 = normally open 1 = normally closed |
| I1 | Hy AL1 (ISA1) | read/write | ASCII 0÷F.S. |
| T1 | Selection alarm 1 | read/write | hexadecimal 0 = tEMP 1 = dELt 2 = Per 3 = SOGL |
| TV | Valve time | read/write | ASCII 0÷999.9 |
| BM | Dead band | read/write | ASCII 0÷100.0 |
| BR | Cooling dead band | read/write | ASCII 0÷100.0 |
| KP | Proportional band (PrOP) | read/write | ASCII 0÷F.S. |
| KI | Integrative action (IntE) | read/write | ASCII 0÷6000s |
| KD | Derivative action(dErI) | read/write | ASCII 0÷600s |
| SP | Set-point | read/write | ASCII 0 ÷ F.S. |
| S2 | Remote set-point | read/write | ASCII 0 ÷ F.S. |
| LI | Lower limit set-point (LISP) | read/write | ASCII 0 ÷ F.S. |
| LS | Upper limit set-point (LSSP) | read/write | ASCII 0 ÷ F.S. |
| SS | Soft-start (SOS t) | read/write | ASCII 0÷100°C/°F |
| CB | Cutback (cutb) | read/write | ASCII 0÷F.S. |

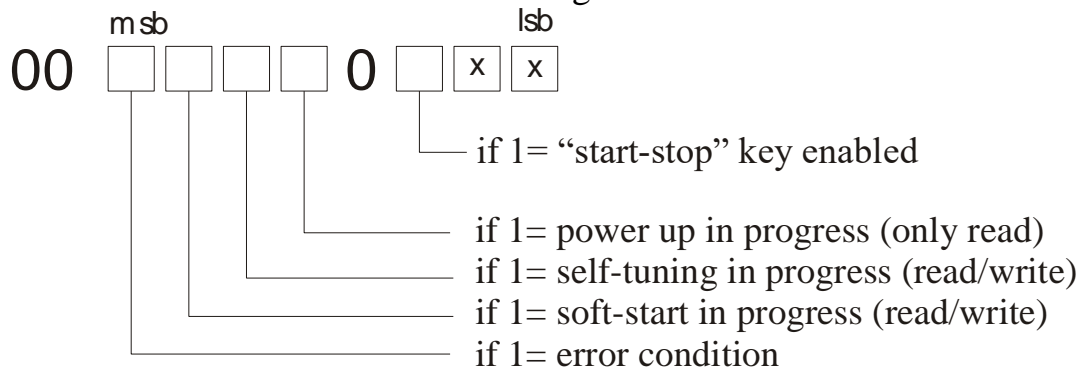
MPT91 M1

| COMMAND CODES | COMMAND DESCRIPTION | ALLOWED SET-UP | TYPE OF CODE |
|----------------------|----------------------------|-----------------------|--|
| TE | Read out | only read | ASCII 0 ÷ F.S. |
| IS | Hysteresis (Hy) | read/write | ASCII 0÷F.S. |
| SW | Status word | read/write | Hexadecimal (see paragr.) |
| SR | Start/stop ramp | read/write | hexadecimal 0 = ramp on 1= ramp in stop |
| PR | Program ramp | read/write | hexadecimal 0=OFF 1=1 2=2 3=3 4=1+2 5=1+2+3 |
| FR | End of ramp control (COFR) | read/write | hexadecimal 0 = OFF 1 = REG |
| TR | Disabled ramp key | read/write | hexadecimal 0 = OFF 1 = On |
| RP | Program repetition (RIPR) | read/write | hexadecimal 0 = OFF 1 = On |
| IP | Delay starting program | read/write | ASCII HH.MM |
| RX | Modify ramp parameters | read/write | ASCII 1÷3 |
| X1-X8 | Time step | read/write | ASCII (see paragraph) |
| Y1-Y8 | Final temperature | read/write | ASCII (see paragraph) |
| PP | % of power | Only read | ASCII -100 ÷ +100 |
| TC | Control type | read/write | hexadecimal 0 = reverse 1 = direct |
| PO | Power | read/write | 0 = automatic regulation 1 = manual regulation 2 = disabled regulation |
| PM | Manual power | read/write | ASCII -100.0 ÷ +100.0 |

MPT91 M1

6.5 STATUS WORD

The status word must be transmitted in a 4 digit hexadecimal format.



6.6 TRANSMISSION OF HEXADECIMAL VALUES

Some values must be transmitted in a 4 digit hexadecimal format. In that case the protocol string must be preceded by the ASCII character ">".

EXAMPLE: for CONT=PID the data will be: blank >0001

EXAMPLE OF READING STATUS WORD

HOST:

| | | | | | | | |
|-----|----|----|----|----|----|----|-----|
| EOT | 0 | 0 | 1 | 1 | S | W | ENQ |
| 04 | 30 | 30 | 31 | 31 | 53 | 57 | 05 |

MPT INSTRUMENT:

| | | | | | | | | | | |
|-----|----|----|-------|----|----|----|----|----|-----|-----|
| STX | S | W | blank | > | 0 | 0 | 0 | 4 | ETX | BCC |
| 02 | 53 | 57 | 20 | 3E | 30 | 30 | 30 | 34 | 03 | 1D |

EXAMPLE OF WRITING STATUS WORD

(self-tuning in progress)

HOST:

| | | | | | | | | | | | | | | | |
|-----|----|----|----|----|-----|----|----|-------|----|----|----|----|----|-----|-----|
| EOT | 0 | 0 | 1 | 1 | STX | S | W | blank | > | 0 | 0 | 2 | 0 | ETX | BCC |
| 04 | 30 | 30 | 31 | 31 | 02 | 53 | 57 | 20 | 3E | 30 | 30 | 32 | 30 | 03 | 1B |

MPT instrument:

ACK
06

6.7 RAMP PROGRAMMING WITH SERIAL LINE

To program ramp functions with serial line, follow this procedure.

Transmit from host the code RX followed by the ramp number to program.

Transmit from host the code X1, X2, X3, ..., X8 to program the duration of the steps of the selected program.

Transmit from host the code Y1, Y2, Y3, ..., Y8 to program the final temperature of the steps of the selected program.

MPT91 M1

6.8 AN EXAMPLE IN BASIC LANGUAGE

Here you can see an example of a program in Basic to read the readout of the instrument with a serial line. Program the instrument with address = 01, baud rate = 9600.

```
on error goto 20
cls
open "com1: 9600, n, 8, 1" for random as #1
print #1, chr$(4) + "0" + "0" + "1" + "1" + "S" + "P" + chr$(5)
print "waiting for answer ..."
cls
a$ = input$(11, #1)
b$ = mid $(a$, 4, 7)
print
print "readout: ";b$
end
20 print "nothing received"
resume
```

7.0 SERIAL OUTPUT (option) with MODBUS protocol

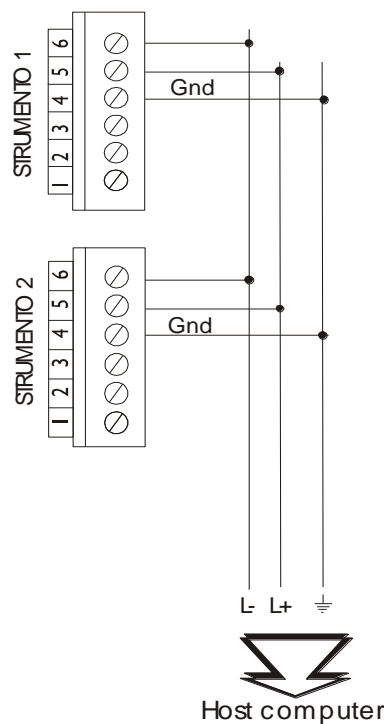
Program the instrument as shown in the following table and use the next connection diagram.

Table 15

| ref. | touch key | appears on PV display | appears on Sp display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|--|----------|
| 1 | enter | | | Press the "enter" key to get into the programming menu | |
| 2 | enter | PASS | 0 000 | write the Password number | Pp 64 |
| 3 | | PASS | 0 0 00 | Change the password number and confirm with "enter" | |
| 4 | enter | | | Press the "enter" key until you see the "Addr" message on the "PV" display | |
| 5 | enter | Addr | 0 000 | Write the address code | Pp 45 |
| 6 | enter | bAUd | 9600 | Press the "SP+▲" key until you see the right speed (1200, 2400, 4800 or 9600). Confirm with "enter". | Pp 45 |
| 7 | enter | PrOt | nOdb | Press the "SP+▲" key until you see the "nOdb" item. Confirm by "enter". nECt = "mect" protocol | |

MPT91 M1

| ref. | touch key | appears on PV display | appears on Sp display | NOTES | See page |
|------|-----------|-----------------------|-----------------------|--|----------|
| | | | | nOdb = MODBUS protocol | |
| 8 | enter | FdAt | 8n1 | Selected the requested item with “SP+▲” key and confirm with “enter”: 8.n.1.: 8 bit given, no parity, 1 stop bit 8.O.1.: 8 bit given, odd parity, 1 stop bit 8.E.1.: 8 bit given, even parity, 1 stop bit 8.n.2.: 8 bit given, no parity, 2 stop bit | |



7.1 READ OUTPUT STATUS (01)

This function allows to request ON or OFF status of binary values

REQUEST

Besides the use of the slave address and of the function code (01), the message contains the starting address (two bytes long) and the number of bits to read (two bytes long). The addresses' numeration starts from zero (bit1 = 0) for the MODBUS.

Example: bit from 0004 to 0015 reading request from slave 17.

| ADDR | FUNC | DATA Start Addr HI | DATA Start Addr LO | DATA Bit # HI | DATA Bit # LO | CRC LO | CRC HI |
|------|------|--------------------|--------------------|---------------|---------------|--------|--------|
| 11 | 01 | 00 | 03 | 00 | 0C | CE | 9F |

MPT91 M1

Answer

Besides the slave's address and the function code (01) the message comprehend a byte which contains the data's number of bytes and the bytes which contain the data. The data are packed, in this way a byte contains 8 bit, the less significant bit of the first byte contains the bit corresponding at the starting Address, and so on. If the number of bit to read is not a 8 multiple, the last byte is filled with zeroes into the more significant bits.

Example: Answer to the above request.

| ADDR | FUNC | DATA Byte Count | DATA Bit 04..11 | DATA Bit 12..15 | CRC LO | CRC HI |
|------|------|-----------------------|-----------------------|-----------------------|-----------|-----------|
| 11 | 01 | 02 | CD | 0B | 6D | 68 |

7.2 READ INPUT STATUS (02)

This function is operatively the same of the function above.

7.3 READ OUTPUT REGISTERS (03)

This function allows to request the value of the 16 bit (word) registers which contains numeric variables.

REQUEST

Beside the **slave's** address and the function code (03), the message contains the starting Address expressed on two bytes and the number of word to read on the two bytes. The maximum number of word which can be read is 125. The numeration of the addresses starts from zero (word1=0) for the MODBUS.

Example: Reading request from the slave 25 of the registers from 069 to 0071.

| ADDR | FUNC | DATA Start Addr HI | DATA Start Addr LO | DATA bword# HI | DATA word# LO | CRC LO | CRC HI |
|------|------|--------------------------|--------------------------|----------------------|---------------------|-----------|-----------|
| 19 | 03 | 00 | 44 | 00 | 03 | 46 | 06 |

Answer

Besides the slave's address and the function code (03) the message comprehend a byte which contains the data's number of bytes and the bytes which contain the data. The registers need two bytes each, the first one contains the most significant byte.

Example: Answer at the request above.

| ADDR | FUNC | DATA Byte Count | DATA Word 69 HI | DATA Word 69 LO | DATA Word 70 HI | DATA Word 70 LO | DATA Word 71 HI | DATA Word 71 LO | CRC LO | CRC HI |
|------|------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------|-----------|
| 19 | 03 | 06 | 02 | 2B | 00 | 00 | 00 | 64 | AF | 7A |

MPT91 M1

7.4 READ INPUT REGISTERS (04)

This function is operatively the same of the function above.

7.5 FORCE SINGLE COIL (05)

This function allows to force a single binary variable ON or OFF.

REQUEST

Beside the slave's address and the function code (05) the message contains the address of the variable to force on two bytes and two bytes the first one is at FFh (255) to force the ON status and 00h to force OFF, the second one is always at zero. The numeration of the addresses starts from zero (bit1 = 0) for the MODBUS.

Example: Request to force ON on the slave number 47 the bit 4.

| ADDR | FUNC | DATA Bit # HI | DATA Bit # LO | DATA ON/OFF | DATA (zero) | CRC LO | CRC HI |
|------|------|---------------------|---------------------|----------------|----------------|-----------|-----------|
| 2F | 05 | 00 | 03 | FF | 00 | 7A | 74 |

Answer

The answer is to transmit again the received message after the variable has been modified.

Example: Answer at the request above.

| ADDR | FUNC | DATA Bit # HI | DATA Bit # LO | DATA ON/OFF | DATA (zero) | CRC LO | CRC HI |
|------|------|---------------------|---------------------|----------------|----------------|-----------|-----------|
| 2F | 05 | 00 | 03 | FF | 00 | 7A | 74 |

7.6 PRESET SINGLE REGISTER (06)

This function allows to set the value of a single 16 bit register.

REQUEST

Beside the slave's address and the function code (06) the message contains the variable's address expressed on two bytes and the value to be stored. The numeration of the addresses starts from zero (word1 = 0) for the MODBUS.

Example: Request to force 926 on the slave number 38 at the address number 26.

| ADDR | FUNC | DATA Bit # HI | DATA Bit # LO | DATA WORD HI | DATA WORD LO | CRC LO | CRC HI |
|------|------|---------------------|---------------------|--------------------|--------------------|-----------|-----------|
| 26 | 06 | 00 | 19 | 03 | 9E | DF | 82 |

MPT91 M1

Answer

The answer is to transmit again the received message after the variable has been modified.

Example: Answer at the request above.

| ADDR | FUNC | DATA Bit # HI | DATA Bit # LO | DATA WORD HI | DATA WORD LO | CRC LO | CRC HI |
|------|------|---------------------|---------------------|--------------------|--------------------|-----------|-----------|
| 26 | 06 | 00 | 19 | 03 | 9E | DF | 82 |

7.7 READ STATUS (07)

This function allows to read the status of 8 fixed bit with a compact message.

REQUEST

The message contains only the slave's address and the function code (07).

Example: Slave 25's status request.

| ADDR | FUNC | CRC LO | CRC HI |
|------|------|-----------|-----------|
| 19 | 07 | 4B | E2 |

Answer

Beside the slave's address and the function code (07) the message contains a byte which contains the status bits.

Status byte

| IND. | FUNCTION |
|-------|-------------------------|
| Bit 0 | Or of instrument alarms |
| Bit 1 | Self tuning on |
| Bit 2 | Soft start on |
| Bit 3 | Ramp in progress |
| Bit 4 | Maintenance ramp |
| Bit 5 | Delay ramp on |
| Bit 6 | |
| Bit 7 | Out of scale alarm |

MPT91 M1

Example: Answer at the request above

| ADDR | FUNC | DATA Status byte | CRC LO | CRC HI |
|------|------|------------------------|-----------|-----------|
| 19 | 07 | 6D | 63 | DA |

7.8 FORCE MULTIPLE COILS (15)

This function allows to force any binary variables' status in contiguous block.

REQUEST

Beside the slave address and the function code (15) the message contains the starting address expressed on two bytes, the number of bits to write, the number of byte which contains the data and the bytes of data. The data are packed, so a byte contains 8 bit status, the bit less significant of the first byte must contain the bit which correspond to the starting address and so on. If the number of bits to write is not a 8 multiple, the last type must be filled with zeroes into the more significant bits. The numeration of the addresses start from zero (bit1 = 0) for the MODBUS.

Example: Request to force, on slave 12, 4 bits from the address 1. I bit 1 and 4 forced to "1", the other to "0".

| ADDR | FUNC | DATA Start addr HI | DATA Start addr LO | DATA Bit # HI | DATA Bit # LO | DATA Byte count | DATA Bit 1..4 | CRC LO | CRC HI |
|------|------|-----------------------------|-----------------------------|---------------------|---------------------|-----------------------|---------------------|-----------|-----------|
| 0C | 0F | 00 | 00 | 00 | 04 | 01 | 09 | 3F | 09 |

Answer

Beside the slave's address and the function code (15) the message contains the starting address and the number of bit written.

Example: Answer at the request above

| ADDR | FUNC | DATA Start addr HI | DATA Start addr LO | DATA Bit # HI | DATA Bit # LO | CRC LO | CRC HI |
|------|------|-----------------------------|-----------------------------|---------------------|---------------------|-----------|-----------|
| 0C | 0F | 00 | 00 | 00 | 04 | 55 | 15 |

MPT91 M1

7.9 PRESET MULTIPLE REGISTERS (16)

This function allows to set up the value of a 16 bit registers' in contiguous block.

REQUEST

Beside the slave's address and the function code (16) the message contains the starting address, the number of word to write, the number of bytes which contains the data and the bytess of data. The addresses' numeration starts from zero (word = 1) for the MODBUS.

Example: To set, on slave 17, 1 word at the address 35, with value 268.

| ADDR | FUNC | DATA Start addr HI | DATA Start addr LO | DATA Word # HI | DATA word # LO | DATA Byte count | DATA Word 35 HI | DATA Word 35 LO | CRC LO | CRC HI |
|------|------|-----------------------------|-----------------------------|-------------------------|----------------------|-----------------------|-----------------------|-----------------------|-----------|-----------|
| 11 | 10 | 00 | 22 | 00 | 01 | 02 | 01 | 0C | 6C | 87 |

Answer

Beside the slave's address and the function code (16) the message contains the starting address, the number of word written.

Example: Answer at the request above

| ADDR | FUNC | DATA Start addr HI | DATA Start addr LO | DATA Word # HI | DATA word # LO | CRC LO | CRC HI |
|------|------|-----------------------------|-----------------------------|----------------------|----------------------|-----------|-----------|
| 11 | 10 | 00 | 22 | 00 | 01 | A3 | 53 |

7.10 ERRORS MANAGEMENT

Two kind of errors exist in the MODBUS, managed differently: transmission errors and operative errors. The transmission errors change the format message, in the parity (if it's used), or in CRC16. The device that reveals these errors in this kind of message, doesn't consider the message valid and it gives no answer. Instead, if the message is correct but the function requested is not executable, this is the case of an operative error. In this situation the slave's device answer with a different message. This message is made of the address, the function code requested, the error code and CRC. To indicate that the answer means an error, the function code is sentback with the more significant bit at "1".

Example: Requested the reading of slave 10 of the bit 1185.

MPT91 M1

| ADDR | FUNC | DATA Start addr HI | DATA Start addr LO | DATA Bit # HI | DATA bit # LO | CRC LO | CRC HI |
|------|------|-----------------------------|-----------------------------|---------------------|---------------------|-----------|-----------|
| 0A | 01 | 04 | A1 | 00 | 01 | AC | 63 |

Answer

The question asks the contents of bit 1185, which doesn't exist on the slave. The slave answers with a error code "02" (ILLEGAL DATA ADDRESS) and the function code 81h (129) appears again.

Example: Exception at the request above.

| ADDR | FUNC | DATA Except.t code | CRC LO | CRC HI |
|------|------|--------------------------|-----------|-----------|
| 0A | 81 | 02 | B0 | 53 |

7.11 EXCEPTION CODES

| Code | Name | Meaning |
|------|--------------------------------|--|
| 01 | ILLEGAL FUNCTION | The function code doesn't correspond at a function allowed on the slave |
| 02 | ILLEGAL DATA ADDRESS | The address of the data field is not allowed from the slave |
| 03 | ILLEGAL DATA VALUE | The value to assign , which is the reference for the data field, is not allowed from the slave. |
| 07 | NAK – NEGATIVE ACKNOWLEDGEMENT | The function cannot be done with the real operative condition or it has been tried to write in a read only value . |

MPT91 M1

7.12 MODBUS ADDRESSES

BIT

| ADDR. | FUNCTION TYPE | NOTES |
|--------------|-------------------------------------|---|
| 0 - 2 | Input probe | 0=J, 1=K 2=S 3=Pt100 800 4=Pt100 200 5=0 10V 6=0 20mA 7=4 20mA |
| 3 | Not used | |
| 4 | Not used | |
| 5 | Control | 0=On/Off 1=Pid |
| 6 | Not used | |
| 7 | Not used | |
| 8 | Scale: | 0 = Celsius 1 = Farenheit |
| 9 | Alarm 1 | 0 = normally off 1 = normally on |
| A | Free | |
| B | Free | |
| D-C | output | 00 = eating 01 = cooling 10 = motorized valve 11 = analogue output |
| E | Enabling alarm 1 | 1 = enabled at power on 0 = enabled after the first alarm set overcoming |
| F | free | |
| 10 | free | |
| 11 | free | |
| 12 | free | |
| 13 | free | |
| 14 | Ramp key enabled | 0 = off 1 = on |
| 15 | Repetition ramp | 0 = off 1 = on |
| 16 | End of ramp control | 0 = turn off 1 = maintenance |
| 17 | Enabling keys "Ramp/exit" + "ENTER" | 0 = disabled 1 = enabled |

MPT91 M1

| | | |
|-------|---------------------|---|
| 18 | Alarm 1 | 00 = absolute 01 = percentage |
| 19 | Alarm 1 | 10 = relative 11 = alarm trigger |
| 1A | free | |
| 1B | free | |
| 1C | free | |
| 1D | TCON (control mode) | 0 = reverse control 1 = direct control |
| 1F-1E | power | 00 = control 01 = manual 10 = OFF |

WORD

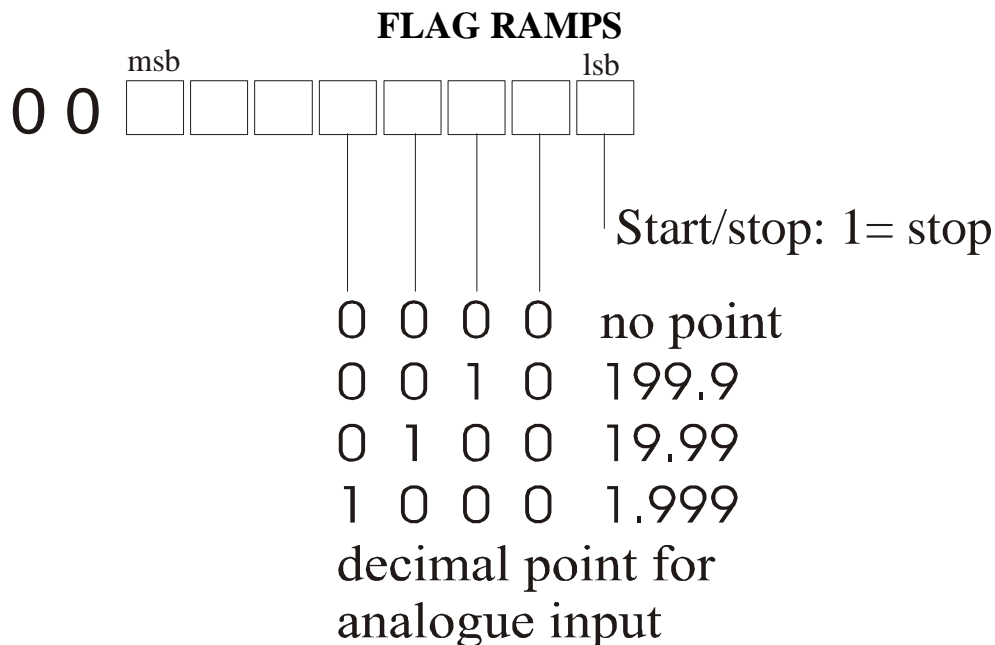
| ADDR. | FUNCTION TYPES | NOTES |
|-------|--------------------------------------|---|
| 100 | Temperature | In decimal degrees |
| 101 | Set point | In decimal degrees |
| 102 | Old set point | In decimal degrees |
| 103 | Alarm 1 | In decimal degrees or percentage (see alarms) |
| 104 | Free | |
| 105 | Free | |
| 106 | Hysteresis of alarm 1 | In decimal degrees |
| 107 | Free | |
| 108 | User offset | In decimal degrees |
| 109 | Set point lower limit | In decimal degrees |
| 10A | Set point upper limit | In decimal degrees |
| 10B | Hysteresis of control on/off | In decimal degrees |
| 10C | Proportional constant | In decimal degrees |
| 10D | Integrative constant | |
| 10E | Derivative constant | |
| 10F | Cutback | In decimal degrees |
| 110 | Cycle | seconds |
| 111 | Soft start | In decimal degrees |
| 112 | Scale's beginning for analogue input | In decimal degrees |
| 113 | End of scale for analogue input | In decimal degrees |
| 114H | Ramp programs | 0 = off 1 = progr. 1 2 = progr. 2 3 = progr. 3 4 = progr. 1+2 5 = progr. 1+2+3 |
| 114L | Ramp flag | Look picture |

MPT91 M1

| | | |
|-----|--------------------------------------|---------------------------------|
| 116 | Dead band motorized valve | |
| 117 | Rotation time motorized valve | |
| 118 | Cooling dead band | Measurement unit as in the menu |
| 119 | Delay start ramps' program | |
| 11A | Baud rate and address serial line | Read only |
| 11C | Manual power | -100.0 +100.0 |
| 200 | Final temperature ramps pr. 1 step 1 | In decimal degrees |
| 201 | Final temperature ramps pr. 1 step 2 | In decimal degrees |
| 202 | Final temperature ramps pr. 1 step 3 | In decimal degrees |
| 203 | Final temperature ramps pr. 1 step 4 | In decimal degrees |
| 204 | Final temperature ramps pr. 1 step 5 | In decimal degrees |
| 205 | Final temperature ramps pr. 1 step 6 | In decimal degrees |
| 206 | Final temperature ramps pr. 1 step 7 | In decimal degrees |
| 207 | Final temperature ramps pr. 1 step 8 | In decimal degrees |
| 208 | Final temperature ramps pr. 2 step 1 | In decimal degrees |
| 209 | Final temperature ramps pr. 2 step 2 | In decimal degrees |
| 20A | Final temperature ramps pr. 2 step 3 | In decimal degrees |
| 20B | Final temperature ramps pr. 2 step 4 | In decimal degrees |
| 20C | Final temperature ramps pr. 2 step 5 | In decimal degrees |
| 20D | Final temperature ramps pr. 2 step 6 | In decimal degrees |
| 20E | Final temperature ramps pr. 2 step 7 | In decimal degrees |
| 20F | Final temperature ramps pr. 2 step 8 | In decimal degrees |
| 210 | Final temperature ramps pr. 3 step 1 | In decimal degrees |
| 211 | Final temperature ramps pr. 3 step 2 | In decimal degrees |
| 212 | Final temperature ramps pr. 3 step 3 | In decimal degrees |
| 213 | Final temperature ramps pr. 3 step 4 | In decimal degrees |
| 214 | Final temperature ramps pr. 3 step 5 | In decimal degrees |
| 215 | Final temperature ramps pr. 3 step 6 | In decimal degrees |
| 216 | Final temperature ramps pr. 3 step 7 | In decimal degrees |
| 217 | Final temperature ramps pr. 3 step 8 | In decimal degrees |
| 218 | Ramp duration pr. 1 step 1 | minutes (max 6039 mins) |
| 219 | Ramp duration pr. 1 step 2 | minutes (max 6039 mins) |
| 21A | Ramp duration pr. 1 step 3 | minutes (max 6039 mins) |
| 21B | Ramp duration pr. 1 step 4 | minutes (max 6039 mins) |
| 21C | Ramp duration pr. 1 step 5 | minutes (max 6039 mins) |
| 21D | Ramp duration pr. 1 step 6 | minutes (max 6039 mins) |
| 21E | Ramp duration pr. 1 step 7 | minutes (max 6039 mins) |
| 21F | Ramp duration pr. 1 step 8 | minutes (max 6039 mins) |
| 220 | Ramp duration pr. 2 step 1 | minutes (max 6039 mins) |
| 221 | Ramp duration pr. 2 step 2 | minutes (max 6039 mins) |
| 222 | Ramp duration pr. 3 step 3 | minutes (max 6039 mins) |

MPT91 M1

| | | |
|-----|------------------------------|-------------------------|
| 223 | Ramp duration pr. 4 step 4 | minutes (max 6039 mins) |
| 224 | Ramp duration pr. 5 step 5 | minutes (max 6039 mins) |
| 225 | Ramp duration pr. 6 step 6 | minutes (max 6039 mins) |
| 226 | Ramp duration pr. 7 step 7 | minutes (max 6039 mins) |
| 227 | Ramp duration pr. 8 step 8 | minutes (max 6039 mins) |
| 228 | Ramp duration pr. 3 step 1 | minutes (max 6039 mins) |
| 229 | Ramp duration pr. 3 step 2 | minutes (max 6039 mins) |
| 22A | Ramp duration pr. 3 step 3 | minutes (max 6039 mins) |
| 22B | Ramp duration pr. 3 step 4 | minutes (max 6039 mins) |
| 22C | Ramp duration pr. 3 step 5 | minutes (max 6039 mins) |
| 22D | Ramp duration pr. 3 step 6 | minutes (max 6039 mins) |
| 22E | Ramp duration pr. 3 step 7 | minutes (max 6039 mins) |
| 22F | Ramp duration pr. 3 step 8 | minutes (max 6039 mins) |
| 300 | Power percentage (read only) | -100 +100 |



8.0 PASSWORD FUNCTION

The user can save the programmed parameters from untoward changes by using the "Password" function. There are two password, one for main menu and another for ramp menu.

The instrument is requested with the password = 0, but any number between 0 and 9999 can be set up as access point to change the functioning data.

In practice the password is requested each time the user enters the programming menu.

The instrument, after receiving the password number, can behave in two different ways.

MPT91 M1

1- correct Password number. The user can gain access to the programming menu and modify any number or functioning.

2- incorrect Password number. The user is allowed to gain access to the programming menu only in order to see the numbers and the functions, but not to modify them.

ATTENTION. The number which will be programmed under the "CPAS" (for main menu) or "CPAR" (for ramp menu) reading, by the user, must be written under the "PASS" (for main menu) or "PASR" (for ramp menu) heading each time that one goes to the programming menu for the changing of the variables.
If the user cannot recognize the exact "secret" number, it is necessary to call the customer service centre to check the instrument.

9.0 DEFAULT PARAMETERS (dEF)

To reset to factory default parameters you can use the "dEF" function, which sets up all the programming parameters at the factory value, eliminating all the error situation .

BE CAREFUL: all previous programmed values will be lost.



10.0 NOTES

The instrument does not have a power on switch and an internal fuse, but it immediately switches on when the correct voltage is applied (see the operating voltage on the instrument label). Keep the power line separate from the signal lines.

For security reasons, it is necessary to provide externally a two phases switch and a protective fuse near the instrument with easy access for the user.

Avoid the presence of other power elements, humidity, acid, heat sources, etc..

Mect srl is not responsible for damages to humans or goods for an improper use of the instrument or not conforming to the characteristics of its instrument..

In mect srl there is a customer service.