



mut □ electronics

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MTR21 CONTROLLER

Installation and operation manual (version 2.7)

December 2010

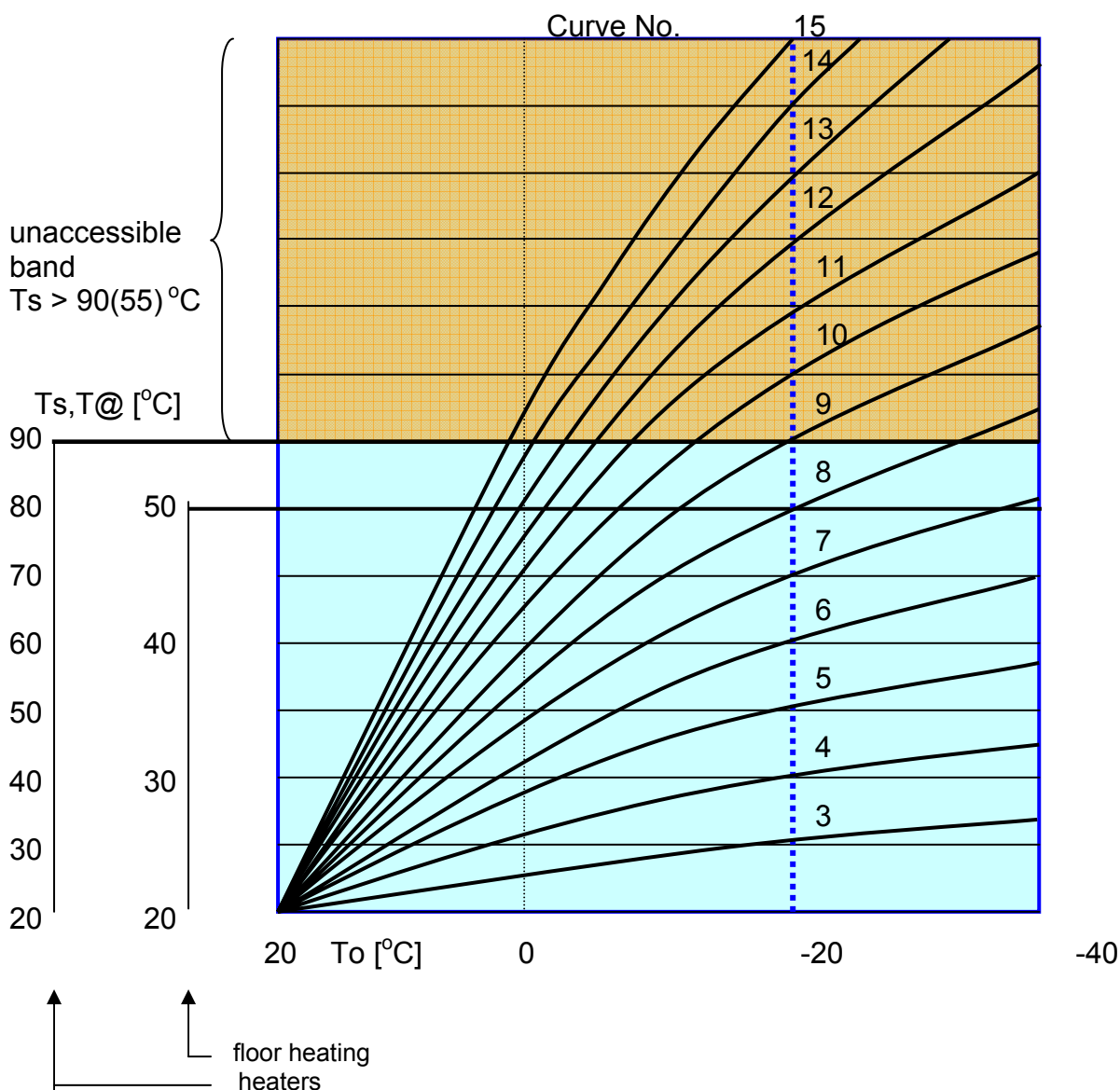
The manufacturer states that the declaration on conformity has been issued by the manufacturer in the sense of Act No. 22/1997 Coll. and governmental regulation 281 and 282

**Note: Read the attached manual thoroughly before use of the controller. The controller must be installed in compliance with applicable regulations.
The function controller does not replace the mandatory security features of the system.**

MTR21 CONTROLLER UNIT

MTR21 is the boiler controller, PID bi-circuit equitherm controller and hot utility water controller.

The equitherm controller can be used for all types of hot water systems (heaters, floor heaters) fitted with a mixing valve.



Protection of devices

starting of the pumps and servo-motors on daily basis at the time they are not used in order to increase their protection

protection of heaters or floor heating by turning the pump when output temperatures exceed the maximum threshold value (max 90°C or max 55°C) - **not used as an emergency feature**

signalling on display and turning the circuits off after sensor failure (short-circuit) or the emergency operation mode (interruption)

installation and user code in order to limit possibilities for misuse

Operation

- easy operation - 7 buttons
- showing of statuses and program steps on LCD alphanumeric display

User

- measurement of temperatures
- controller on/off
- clock, calendar setup
- setting of weekly heating program
- setting of holiday attenuation
- setting of equitherm curves correction (vertical shift +Ts)
- testing

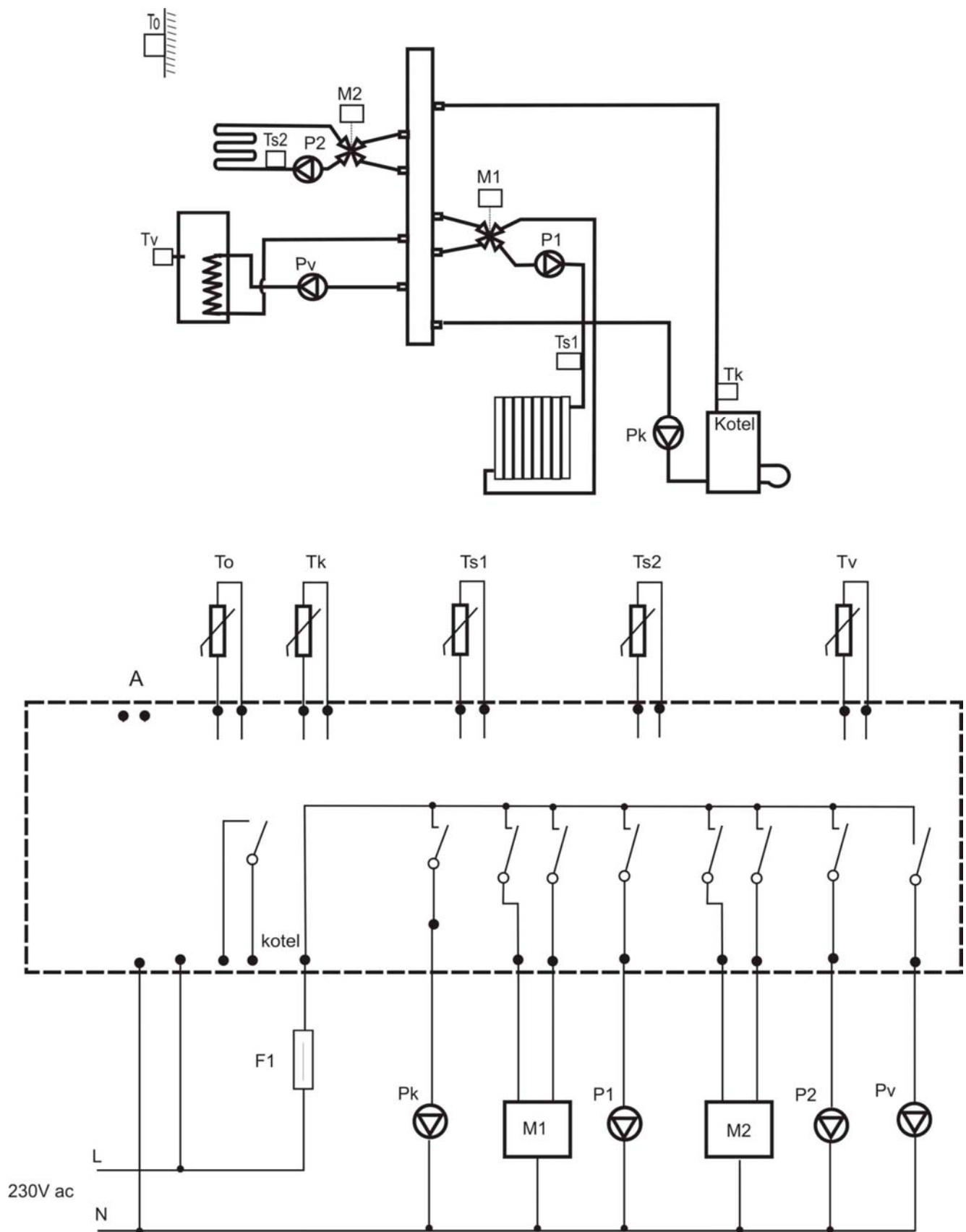
Technician

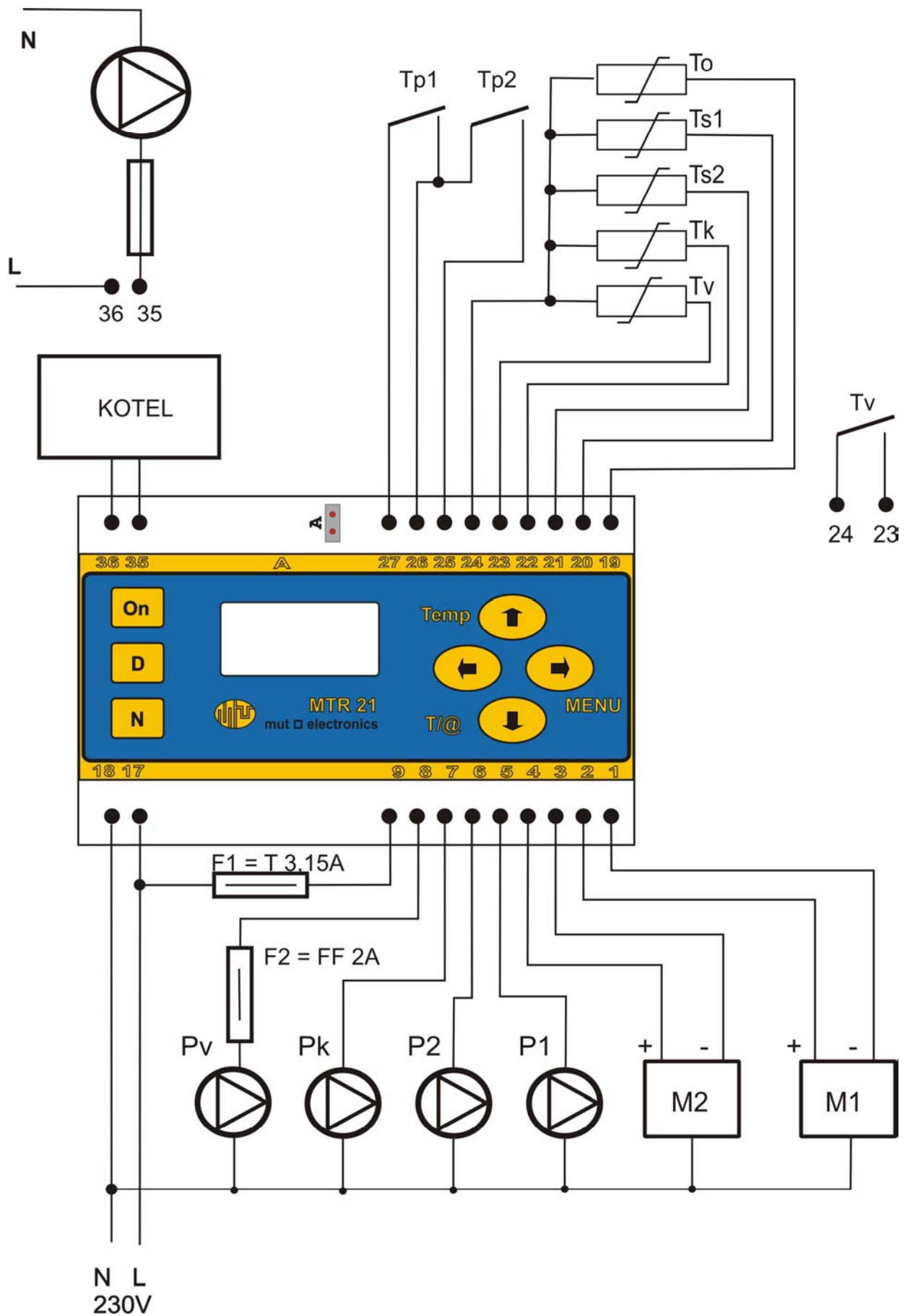
- all user functions
- setting of control parameters

Controller

- power supply 230V+10% -15% , 50 – 60 Hz
 - permitted overvoltage category II according to IEC 664
 - power input 1.8VA (independent controller)

 - triak output Pv (verze RU) AC 24 ... 230V max 200 VA
 - other outputs - relay AC / DC 24V to 230V max 100VA
 - max operating temperature 5 to 40°C
 - max humidity 80%
 - IP rating IP20
 - dimensions 90x106x60mm³
 - weight 400 g
 - temperature sensors thermistor NR355 20 kΩ /25 °C
 - memory backup 1 month (at temperature 25 °C max)
 - battery used NiCd 3.6V 80mAh
- contains cadmium; do not dispose with communal waste; sorted waste only





Description of controller functions

1. Heat source temperature control by turning on the boiler or boiler circuit pump

- to constant temperature
- to temperature specified by equitherm curve
- to temperature according to equitherm curve or required hot water temperature (higher value)
- in summer boiler control mode according to requirement for hot water production
- showing of requested temperature value $T@k$ and real temperature T_k

2. bi-circuit equitherm controller - the controller provides all standard functions of bi-circuit equitherm controller designed for control of the heating mode of buildings fitted with hot water boiler and mixing valve:

- it is possible to set each circuit independently to the mode of heating with heaters or floor heaters
- measurement of open-air temperature (T_o)
- calculation of required temperature of heating water of both circuits according to entered temperature curves ($T@$)
- heating water temperature (T_s) measurement and control for both circuits with PID characteristic (step re-setting of mixing valve by heating water temperature deviation)
- parallel shift of characteristic values
- possibility of use of one common or two independent room thermostats for optimization of heating by transfer to a lower equitherm curve
- real time clock and calendar for years 2008 – 2099
- week and holiday programming of heating attenuation
- daily actuation of motors during the period of summer season
- possibility of manual setup for DAY, NIGHT mode
- showing of open-air temperature T_v , calculated equitherm temperature $T@$, and the system temperature T_s
- protection against misuse with two codes (technician, user)
- tests
- multi-language menu

3. hot utility water temperature control by switching the circuit pump in the mode:

- PWM pulse width modulation with adjustable period and sensitivity
- ON OFF control by switching the circuit pump on
- NTC sensor or a contact thermostat can be connected as temperature sensor
- showing of set hot utility water temperature $T@v$ and real water temperature T_v

Measurement of temperatures:

The NTC 20 k Ω /25 °C sensors are used for measurement of temperatures. Temperatures are evaluated in the following range:

- 40 °C to +40 °C (for T_o open-air thermometer)
- +10 °C to 99 °C (for T_{s1} , T_{s2} , T_v , T_k thermometers)

For higher temperatures ERROR is indicated and the controlled circuit is inactive (sensor failure).

For lower temperatures ERROR is indicated and the relevant control circuit works with the limit value (emergency heating provided in case of sensor damage).

Protection against motor seizure:

Should the circuit be turned off, relevant motors are shortly actuated in 24-hour intervals:

BOILER	P_k
HOT UTILITY WATER	P_v
HEATING	P_1 , P_2 , M_1 , M_2

Commissioning procedure for the controller

Activation - the following indication appears on the display after the controller is connected to mains supply
00 : 00

(00 hours, 00 minutes, date 1.1.2008) and time reading starts (display changes in one minute interval).
Real time must be entered in menu item after backup battery is connected.

Backup battery – the battery is connected with the jumper **A** . Then, the battery provides backup energy for maintaining of values and real time in case of mains supply failure or when the controller is turned off for short time (about 1 month).

Note: do not disconnect the mains supply for longer time (e.g. over summer season).

Control – individual control circuits (boiler, heating, hot utility water) are connected by menu option or by quick menu (On button) - the controller can operate with factory setting without any further setup. All parameters can be re-programmed.

Controller reset to factory setting - disconnect mains supply, reconnect mains supply after a few seconds, press and hold ▼ button and confirm **yes** or **no**

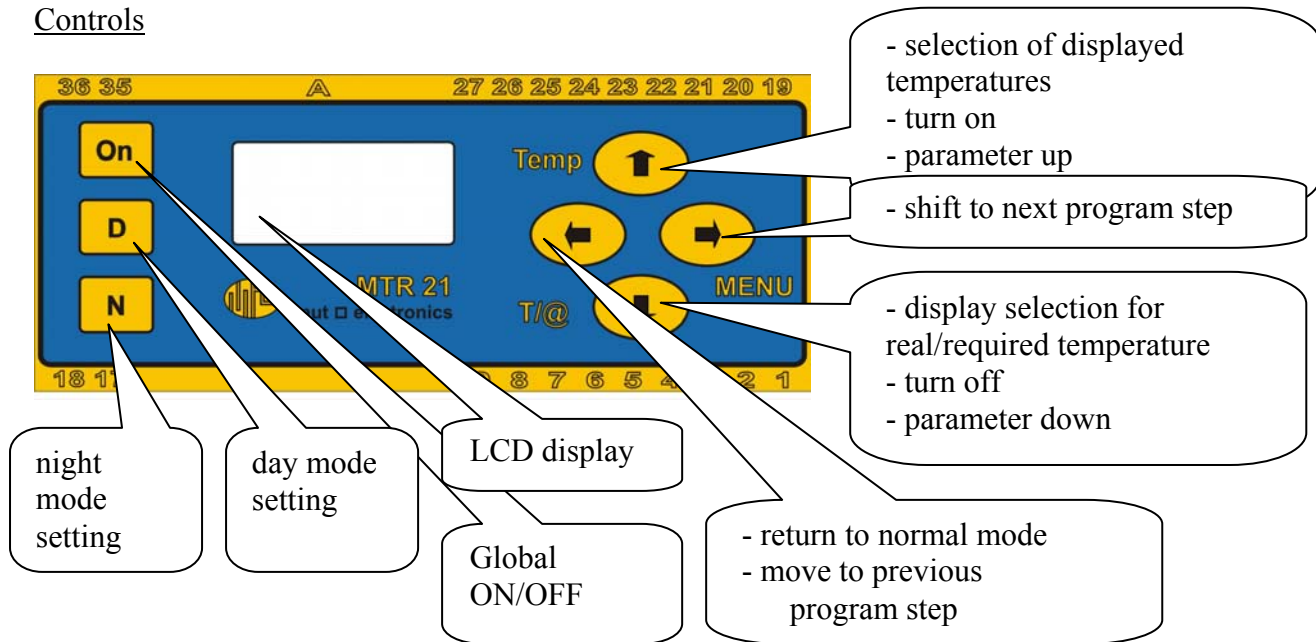
RESET ?
<YES NO>

Note: similarly, when button ▲ is pressed and held, you can display firmware version and the controller serial number, e.g.

ver. 2.7
12345678

Equitherm controller - programming

Controls



Normal mode

Shows time (HH hours MM minutes)
heating mode day or night (D / N)

HH:MM D/N
To/Ts... °C

- ▲
- To open-air temperature
 - Ts1, Ts2 system temperature
 - Tk primary temperature
 - Tv hot utility water temperature

▼ - toggles between measured and calculated temperatures Ts1/T@1, ..., Tv/T@v, with To, displays graphically, immediate output status: KOT (7th position of the first line)
Pv,Pk,P2,P1,M2+,M2-,M1+,M1- (on the second line)

Switch to day heating mode with **D** button (if no program is set)
D operation time setting button ▲▼

day D
.... hour

Switch to night heating mode with **N** button (if no program is set)
N operation time setting button ▲▼

night N
... hour

On button - quick access to turn on/off individual sections of the controller

heating

hot w

Furnance
on/off

Programming access

► Enter code with ▲▼ button, confirm with ► button

Wrong code entered

code

.....

code

?

Programming at technician level

After correct code is entered, the technician can access all sections

\$ 01

programming at user level 😊

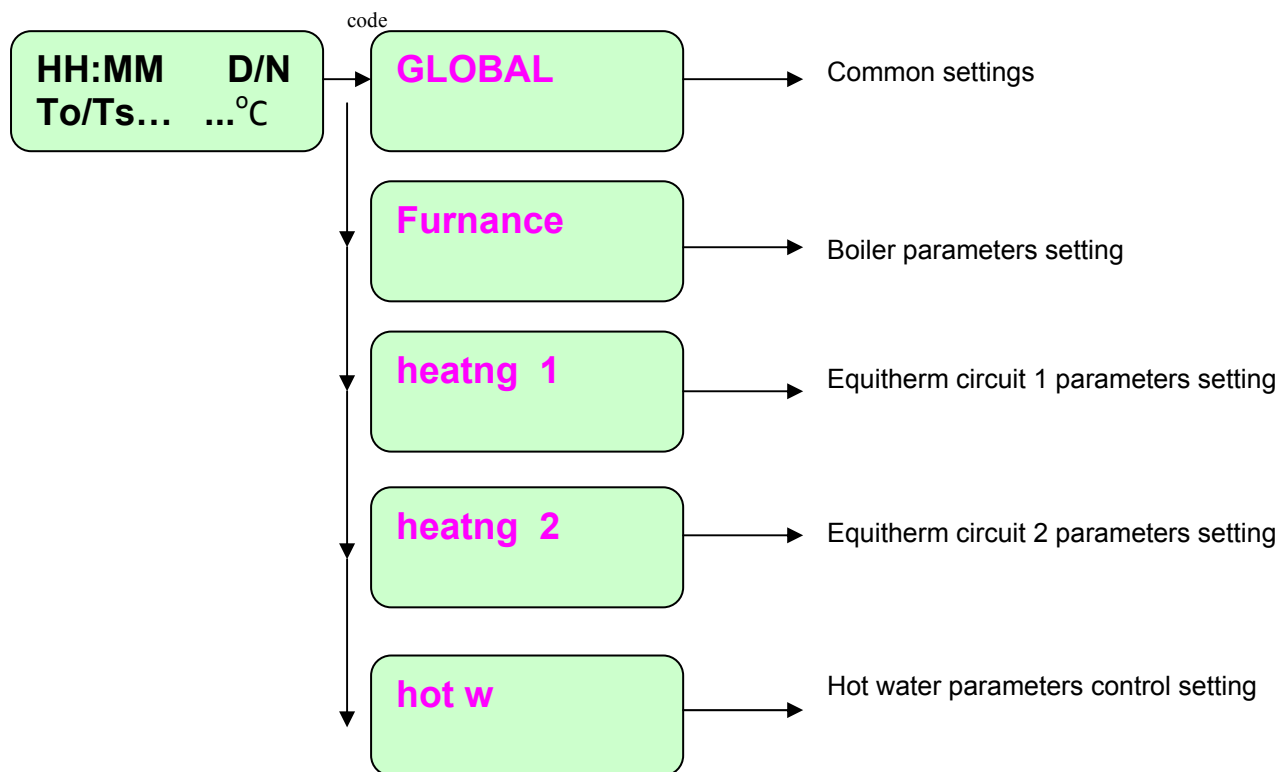
After correct user code is entered, shown are only items in magenta text 😊

\$ 02

Navigation between options ►◀

Note: Symbol \$ indicates factory setting, used elsewhere in this manual.

MAIN MENU 😊



BOILER - furnace

Primary temperature control

THREE MAIN MODES OF THE BOILER OPERATION:

User may not change mode, but T@k or curve only



1. to constant temperature, T@k temperature setting

Const.
T@k ... C

2. by equitherm curve, curve number setting +15 °C
\$ curve 9

EQUI
Curve ...

3. by higher temperature ... equitherm curve+15 °C / hot water
temperature +25 °C setting of equitherm curve

EQUI+Hw
Curve ...

Note: to ensure thermal gradient, select either identical or higher equitherm curve than curves used in HEATING sections; temperature set in this way is increased by 15 °C by the controller
similarly, in case of control by required hot water temperature, the boiler temperature is increased by 25 °C

Setting of parameters for boiler control:

Minimum boiler primary temperature
- lower limit boiler temperature
\$ 40 °C

Tk min
...C

Maximum boiler primary temperature
- upper limit boiler temperature
\$ 90 °C

Tk max
...C

Minimum time between repeated turning the boiler on
\$ 10min

t min
...min

Minimum time of turning the boiler on
\$ 1min

t on
...min

The settings **t min**, **t on** creates the effect of "dynamic hysteresis" - the hysteresis is low at higher heating temperatures (slow temperature increase, i.e. small temperature overshoot in Tk <> T@k control), at lower heating temperatures, the nominal output of the boiler causes bigger overshoot upon turning on, therefore higher hysteresis)

FUNCTION:

BOILER output: turns on at Tk < T@k, active for at least t_{min}, repeated turning is possible only after at least t_{zap}.
Turning off when Tkmax temperature is exceeded or turning on when temperature drops under Tkmin is not blocked by minimum times t_{min}, t_{zap}.
Pk pump output switches on when the boiler turns on and switches off 100 seconds after turning the boiler off.
In summertime, when hot water is produced only, the boiler operation is controlled by hot water consumption (the boiler is turned on only when hot water production is required).

EQUITHERM

SETTING OF CONTROL PARAMETERS

Circuit 1:

heating system selection

The controller is designed for classic heaters (max system temperature 90°C) and floor heating (max system temperature 50°C) \$ HEATER

Radiator/Floor

1

Setting of equitherm curve for day mode

curve No. 3 – 15 corresponds to range 30 to 90 (150) °C (at -20 °C open-air temperature)

selection of equitherm curve used by the controller to calculate required system temperature $T@s1$ from open-air temperature T_o to which the system is then controlled ($Ts1$). The parameter is set with respect to building thermal loss

and heating system output (\$ setting - curve No. 9)

Day
Curve

...

Setting of **night attenuation** (reduction of curve number)

selection of number of curves to reduce the equitherm curve number in night attenuation mode (\$ setting attenuation -2, i.e. curve No.7).

Reduc

- ...

Temperature limits min – max ... optional setting of temperature range limit

\$ setting min 20 °C

LIMIT
T min

...C

\$ setting max 90/55 °C

LIMIT
T max

...C

Setting of opening (closing) **step** of the **mixing valve**

1 to 20sec. - time corresponding to about 1/20 of valve preset time is set. Full presetting of the mixing valve is achieved after 20 steps (\$ setting value 6s, suitable for servo-valves with the presetting time 120s)

Step

.... s

Setting of **switching period** of servo motor 1 to 30 minutes –

Switching period is the time after which the control intervention is repeatedly performed. The value should be selected with respect to maximum valve presetting time and expected dynamic behaviour of the heating system (system time constant, traffic delay) – \$ setting 2 min

Periode

.... min

Selection **space thermostat** in the system:

Tp1 ... Tp1 is used for the first circuit

Tp2 ... Tp2 is used for the first circuit

- ... no space thermostat is used \$

THERMOST
- / Tp1/Tp2

circuit 2

heating system selection

The controller is designed for classic heaters (max system temperature 90°C) and floor heating (max system temperature 50°C) \$ HEATER

Radiator/Floor

1

Setting of equitherm curve for day mode

curve No. 3 – 15 corresponds to range 30 to 90 (150) °C (at -20 °C open-air temperature)

selection of equitherm curve used by the controller

to calculate required system temperature $T@s2$ from

open-air temperature T_o to which the system is then controlled ($Ts2$). The parameter is set with respect to building thermal loss

and heating system output (\$ setting - curve No. 9)

**Day
Curve**

...

Setting of **night attenuation** (reduction of curve number)

selection of number of curves to reduce the equitherm curve number in night attenuation mode (\$ setting attenuation -2, i.e. curve No.7).

Reduc

- ...

Temperature limits min – max ... optional setting of temperature range limit

\$ setting min 20 °C

**LIMIT
T min**

...C

\$ setting max 90/55 °C

**LIMIT
T max**

...C

Setting of opening (closing) **step** of the **mixing valve**

1 to 20sec. - time corresponding to about 1/20 of valve preset time is set. Full presetting of the mixing valve is achieved after 20 steps (\$ setting value 6s, suitable for servo-valves with the presetting time 120s)

Step

.... s

Setting of **switching period** of servo motor 1 to 30 minutes –

Switching period is the time after which the control intervention is repeatedly performed. The value should be selected with respect to maximum valve presetting time and expected dynamic behaviour of the heating system (system time constant, traffic delay) – \$ setting 2 min

Periode

.... min

Selection **space thermostat** in the system:

Tp1 ... Tp1 is used for the second circuit

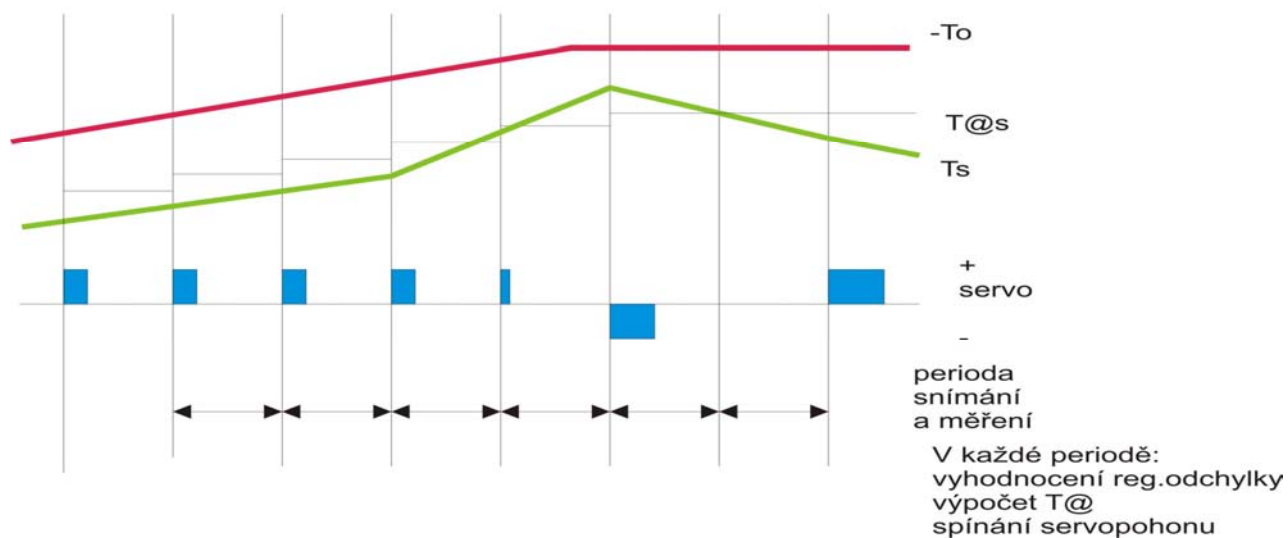
Tp2 ... Tp2 is used for the second circuit

- ... no space thermostat is used \$

**THERMOST
- / Tp1/Tp2**

Note. One thermostat can be used in both circuits.

REGULAČNÍ FUNKCE



FUNCTION:

Required system temperature $T@s$ is set depending on the open-air temperature and equitherm curve set. Calculated temperature is limited by set limit temperature T_{smax} as well as maximum permitted temperature 90°C , or 50°C for floor heating. After PERIOD time and depending on $T_s - T@s$ deviation intensity, output to servo drive is turned on. Switching on time is proportional to the deviation and STEP size set. When T_{max} for 1/2 equitherm is exceeded, appropriate P1/P2 pump is turned off

CONTROL FUNCTION

perioda snímání a měření – sensing and measuring period

v každé periodě... - in each period: evaluation of control deviation, calculation of $T@$, switching the servo-motor on

HOT WATER - hot w

Control

PWM / on off

PWM ... pulse width modulation
on off ...double-status control according
to temperature deviation \$

For PWM

Periode

...S

30s – 2min

Const

...C

Deviation °C / 100% PWM
(proportional control range)

For On/Off

Hyst.

...C

hysteresis - deadband

Hot water temperature

Temp.
T@v

... C

required water temperature
\$ 40



Priority

priority
Hot w

priority
Hw+Heat

HOT WATER ...turns off heating, when
hot water is produced \$

HOT WATER + HEATING ... when
hot water is heated, heating is
not turned off

FUNCTION:

PWM control: At deviation $T@v - T_v > CONST$ the output is switched on permanently.

At deviation $0 < T@v - T_v < CONST$ the output is pulsed with set period and with
repeating proportional to the deviation

At deviation $T@v - T_v > 0$ the output is switched off permanently.

ON OFF control: The output switches on/off depending on $T@v - T_v$ deviation with adjustable hysteresis

Priority: when hot water priority is set, P1 and P2 pumps are turned off when hot water is produced

GLOBAL



Correction (shift) of equitherm curves



– vertical shift of curves +Ts in range 0 to 20 °C

Move

....C

LANGUAGE SELECTION



► language selection ▲▼

language

EN

CZ, RU, **AN \$**, FR, SP, IT, PO

.....

jazyk

CZ

язык

py

TESTS



► Output tests

All outputs must be tested on/off by **On**, button,
output selection by ▲▼ buttons

Servo 1 - closes

TEST

M1- on/off

Servo 1 - opens

TEST

M1+ on/off

Servo 2 - closes

TEST

M2- on/off

Servo 2 - opens

TEST

M2+ on/off

Pump P1 on/off

TEST

P1 on/off

Pump P2 on/off

TEST
P2 on/off

Pump Pk on/off

TEST
Pk on/off

Pump Pv on/off

TEST
Pv on/off

BOILER output on/off

TEST
Fur on/off

CODES

Protection against misuse – the system permits use of two codes:

The installation code with access to the programming sections permitted to a technician only who installed the system and entered his two-digit code (\$ 01)

The user code permits controlling of the system to an authorized user - in this mode, two-digit user code can be entered (\$ 02)

When the user code is lost, the technician may enter the new user code.
When the installation code is lost, the controller must be reset to factory setting and re-programmed.

► Rewriting of the **technician code** (\$ 01)

TECH.
code ...

► Rewriting of the **user code** (\$ 02)



User
code ...

CLOCK



Real time clock setup – setting (including calendar data, i.e. year, month and day) is important for use of the automated weekly or holiday switch to the attenuation mode.

► entering of **date** ▲ ▼ (DD day, MM month, RR year)

date
DD.MM.RR

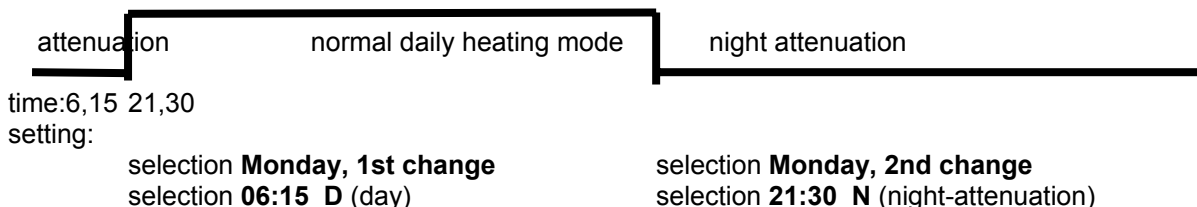
► entering of **time** ▲ ▼ (HH hour, MM minute)

time
HH:MM

PROGRAMMING OF ATTENUATION TIME (max 4 changes per day) 😊

Programming of weekly schedule of switching times to attenuation mode and back to normal mode.

example: shift from attenuation mode to normal morning at 6:15 and shift to attenuation mode at 21:30 in the evening



Note: changes not entered are displayed as --.--; an entered change can be cancelled by the **On/Off** button



▶ navigation to next menu or

setting ▲ ▼ **day (Monday, Tuesday, ...)**
and change serial number (1 – 4)

**PROG
WEEK**

▶ Setting of **hour, minute**

Selection of **night attenuation mode N**
or **normal daily mode D** ▲ ▼

MO/TU/WE/...1/2/3/4

**MO/TU/WE/... 1/2/3/4
HH:MM D/N**

▶ setting of another day and another change (another change is offered)

◀ return to beginning **prg week** and ▶ navigation to next menu

Note: time not entered is displayed as --.--; entered time can be cancelled by **On/Off** button

PROGRAMMING OF HOLIDAY ATTENUATION 😊

Programming of holiday attenuation – entering of date (day, month) for shifting the system to permanent attenuation and date (day, month) for return to normal mode (during this period, the system does not operate the programmed shifts from normal heating mode but remains permanently in the attenuation status).

Note: date not entered are displayed as --.--; an entered change can be cancelled by the **On/Off** button for premature termination of the holiday attenuation and shift to normal heating mode (premature return from holiday), the programmed holiday date must be cancelled by the **On/Off** button

▶ entering of **holiday** time

Vacancy

▶ setting of **start of the attenuation** - **FROM** day **DD**, month **MM**
setting of **end of the attenuation** - **TO** day **DD**, month **MM**

**of DD.MM
to DD.MM**

▶ setting of equitherm attenuation curve during holiday (3 – 8)
\$ 3

**Vacancy
curve**

button On

In normal mode, direct access to the GLOBAL section – on/off controlling of each circuit

General **on/off** of the boiler

Furnance
on/off

Selection **HEATING (winter mode) ON/OFF**

Heating
on/off

Selection **HOT WATER ON/OFF**

Hot w
on/off

Note:

In some menu options, the On button is used for setting the on/off function

button D

Switch to day heating mode with **D** button (if no program is set)
D operation time setting button ▲▼

day D
.... hour

button N

Switch to night heating mode with **N** button (if no program is set)
N operation time setting button ▲▼

night N
.... hour

Forced day or night mode is terminated
after the set time lapses (the system switches to day or night
mode according to time schedule) or the forced mode can
be terminated prematurely by pressing the ◀ button.

HH:MM D/N
T... ...°C

Note:

In some menu options, D and N buttons are used for setting of the parameters in day/night function

The manufacturer reserves right to make changes in design of the controller in order to improve device properties.