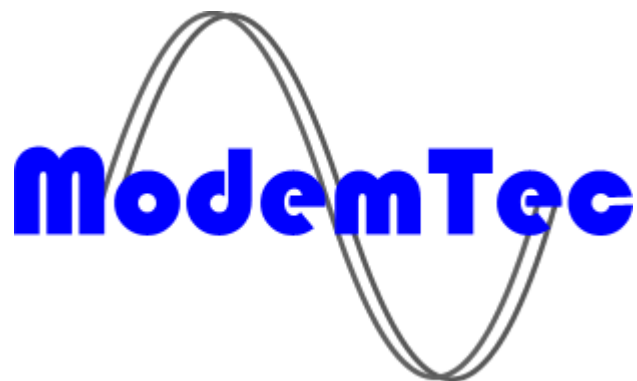


# Technical description

## MT22T



### Warning



The equipment makes a set of two basic modules – MT21T power and link module and MT22T converter module. This setup only is safe from the point of electrical shock. This is the reason for not using other power supplies or connections except presented in this manual.

The equipment is continuously powered from 230V/50Hz network. From this reason any manipulation with the cabinet, leads or parts inside requires extensive care and can be executed just by an authorized person (§6).

The equipment is sufficiently covered in an IP65 installation box against water and high dampness (IP65 – dust proof, water jetting resistant).

Do not place the equipment necessarily in close vicinity of heat sources (heat guns, hot air equipment, etc.).



The equipment will work reliably just in an environment given in this service manual. Any arbitrary changes of operation and servicing can cause equipment function deterioration or destruction.

### GENERAL INSTRUCTIONS – GENERAL DESCRIPTION

The equipment is appointed to make measurements and temperature records in the field of food industry, used at storage and foodstuff processing according to ČSN EN 12 830.

It is intended for using within LV 230V/50Hz distribution network as a transfer unit of measured temperatures to be further processed, by means of superior MT23 PLC module, in PC or individual temperature measurement and record. It has 4 inputs for PT100 four-wire resistance thermometers for DC sensing of the resistance used with independent constant current supplies per each channel. The converter consists of 4 four-channel Sigma-Delta 24 bit converters. Thus a temperature with 0.01°C resolution can be measured. The MT22 module provides a possibility of storing up to 10 000 measured values including measuring time value. It has RS232 output via „jack“ connector located on a front panel. It enables portable computer connection and loading of measured data, converter setup or periodical verification by means of TransTherm program. The manual is hence divided to three individual sections:

#### Operation state

It is a basic function of the equipment. In this state the equipment makes periodical temperature measurement within individual channels, storing in memory and data transport to the superior MT23 PLC module over 230V power distribution network.

#### Programming state

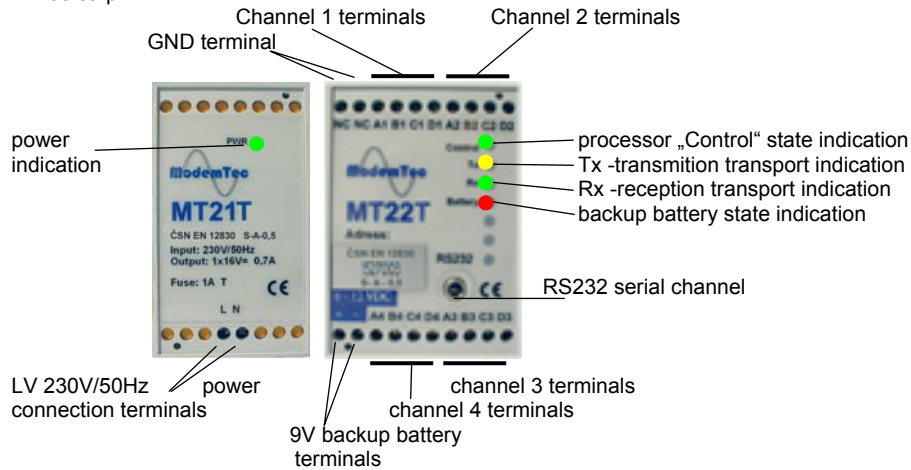
It is a state in which equipment parameters are set-up. This can be reached by two different ways. The first one is a computer connection via serial port directly to converter module and its direct programming. The other one is a remote programming by means of data transport over 230V power distribution network from the superior station (MT23).

#### Periodical verification state

It is a state in which metrological verification of all channel temperature measurement is being executed including temperature record duration verification according to ČSN EN 13 486 or a converter calibration is done. The action can be processed just in a service mode by means of RS 232 serial link.

## PANEL DESCRIPTION AND ITS SIZE

The equipment is embedded inside of Bopla CN 45 AK and CN 55 AK boxes enabling attachment on DIN35 strip.



Bopla CN 55 AK: (CN 45 AK is 45 mm wide)  
mat.: ABS

### Indication elements description:

**Power indication** – indication of MT21T connection to 230V network and 19VDC output voltage presence

**Processor “Control” state indication** – CPU motherboard state indication, when lit – system is OK

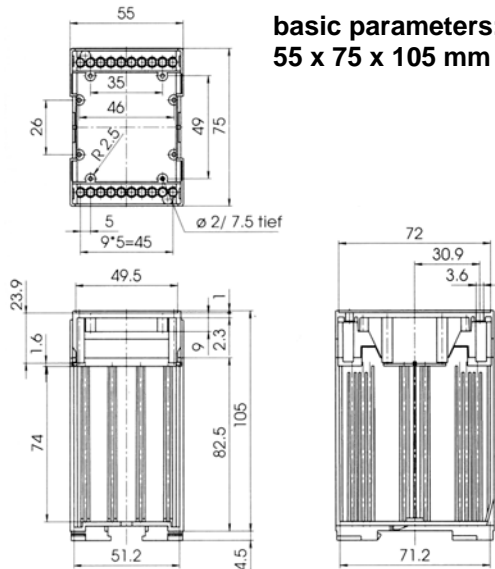
**Tx transmission transport indication** – indicates a state of transmission from processor towards MT21T source unit power amplifier – when lit the transmission is active

**Rx reception transport indication** – indicates a state of reception toward processor from MT21T source power amplifier – when lit the reception is active

**Backup battery state indication** – indicates backup battery voltage:

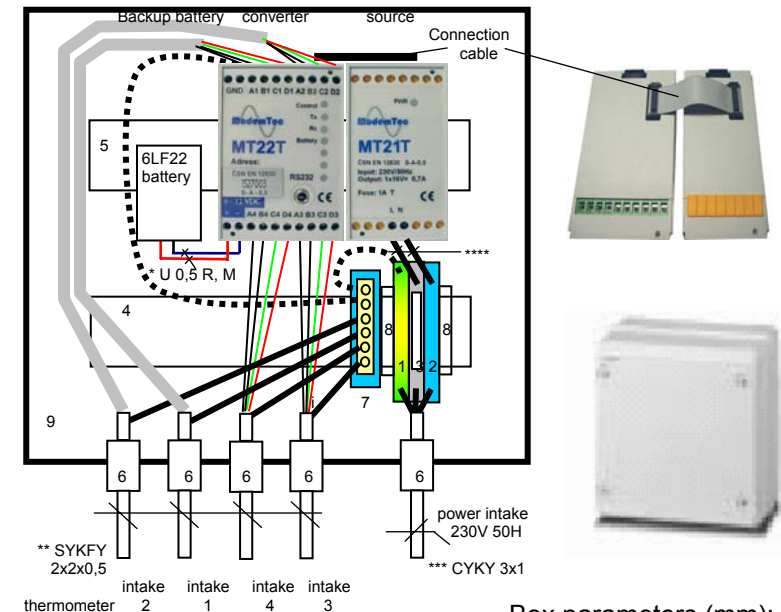
- +6V to +12V voltage – short blink in duration of about 10 sec
- less +6V voltage or battery disconnection – fast blinking

### basic parameters: 55 x 75 x 105 mm



## POWER CONNECTION

Converter with backup battery electrical installation:



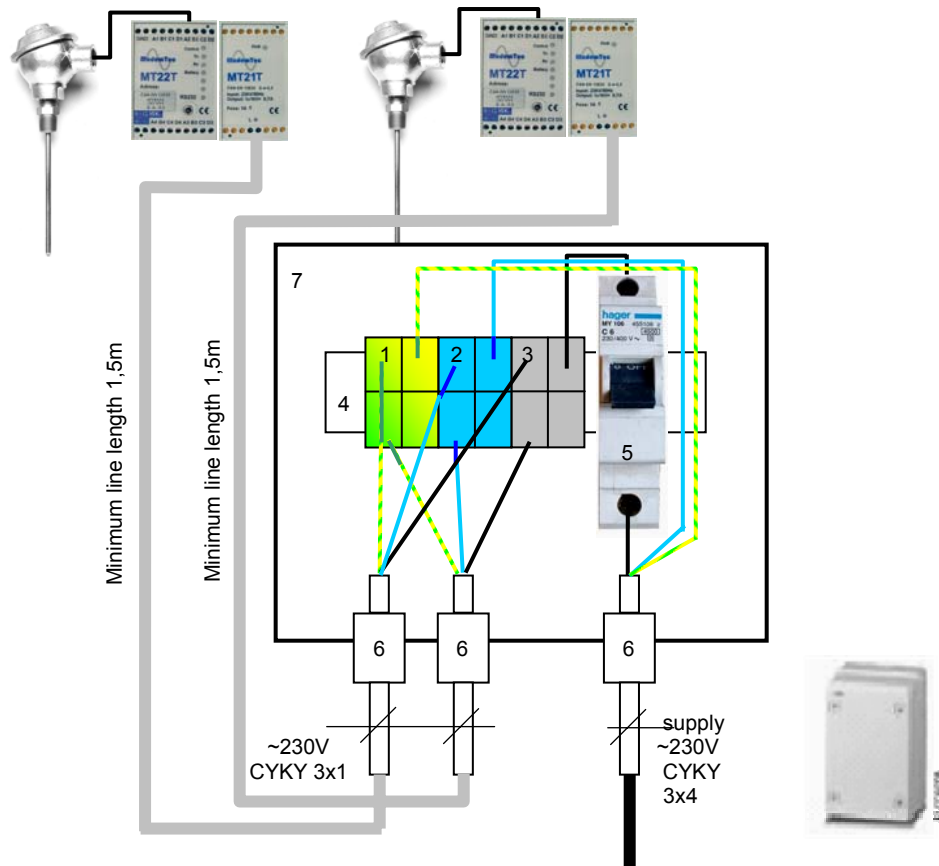
Box parameters (mm):  
205 x 220 x 140

- 1 – WAGO 280-607 protection terminal+ 280-331 terminal
- 2 – blue terminal WAGO 280-602
- 3 – gray terminal WAGO 280-612 with disconnecter or eventually 281-511 fuse holder
- 4,5 – DIN 35 strip (as to the box length)
- 6 – OBO V-TEC Pg 7 cable bushings or side box wall tight opening usage
- 7 – bridge for thermometers wire shielding connection
- 8 – WAGO 246-116 DIN 35 strip end shoe
- 9 – ABB 12 788 box with transparent door or ABB 12 808, both with IP65 cover
  - \* - connection wire 1 x 0,5 (0,75) red and blue (may be PNLV)
  - \*\* - double pair (four wire) cable shielded 2x2x0,5
  - \*\*\* - power wires according what input circuit breaker is used
    - fuse, circuit breaker 6A – wire 3x1
    - fuse, circuit breaker 10A – wire 3x1,5
    - fuse, circuit breaker 16A – wire 3x2,5
  - \*\*\*\* - use one of power cable wires

Similar elements of other manufacturers with equivalent parameters can be used.

Shielded wires ends are connected to the bridge that can afterwards be connected with MT22T module GND terminals or PE protection terminal or with both. Interconnection way depends on interference from external interfering sources. The connection is shown as a dotted line.

MT21 power supply placement along right converter side is also practical from the point of self-interference of the converter coming from the power supply. Physically the converter board is located on the left MT22T box side. MT22 and MT21 interconnection is provided by a flat cable. Proposal of the MT22 module group electrical installation in vicinity of one network node:



- 1 – protection terminal WAGO 264-727
- 2 – blue terminal WAGO 264-724
- 3 – gray terminal WAGO 264-721
- 4 – DIN 35 strip
- 5 – 6A (HAGER MY106 C6) breaker
- 6 - OBO V-TEC Pg 7 cable bushings or side box wall tight opening usage
- 7 – ABB 12 804 box, IP65, š x v x h (140 x 220 x 140)

Existing installation  
230V 50Hz

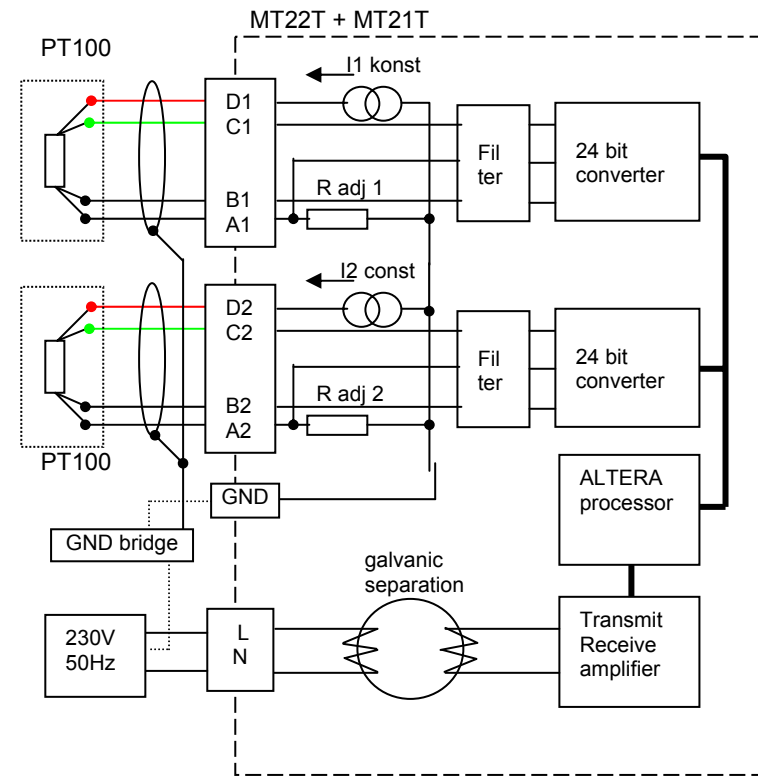
**Box parameters (mm):**  
**140 x 220 x 140**

Similar elements of other manufacturers with equivalent parameters can be used.

During individual modules connection to the 230V distribution network principles of using wires of certain minimal cross-section must be followed. An impedance loop of breaker reliable cut-off by a short circuit current must not be changed. Otherwise the onwards line must be fused by a new breaker with an appropriate cut-off current (see the picture).

- fuse, breaker 6A – wire 3x1
- fuse, breaker 10A – wire 3x1,5
- fuse, breaker 16A – wire 3x2,5

PT100 resistance thermometers with a four wire connection must be used for temperature measurement. Other configurations (three and double wire connections) are not compensatable in the system.



For PT100 connection up to 100m in normal environment, four wire, cable deposited or attached to wall, in a distance of min. 10cm from power line in parallel we recommend:

SYKFY 2x2x0.5 communication cable

It is a four core soft PVC cover shielded cable type TM2. 4x Cu core 0.5mm dia. Shielding makes Al foil and two copper tinned wires 0.4mm dia. Real line resistance is max. 98 Ohm/km. Environment permissible temperature is -25°C to +60°C.

Thermometers can be connected by means of 4 groups of four screw terminals designated by letters A,B,C,D and numbers 1,2,3,4 of the appropriate input. A inputs are power supply minus terminals, B inputs are sensing minus ones, C inputs are sensing plus ones and D inputs power supply plus ones.

Thermometer connecting cable consists of two wire pairs with a color combination of color – white ones. One pair provides power using the white wire for minus pole, other pair is sensing one using the white wire for minus pole again.

## PROGRAMMING STATE

MT22T module must be properly adjusted before PLC module is used.  
Following parameters can be adjusted in the PLC module of MT22T:

**BufRate <0, 16777215 sec>** time between data reading from all temperature channels and data writing down to the module memory in seconds. „0“ value switches off values reading and writing down. As the conversion time of each channel is cca 2 sec, we recommend to set up the value in a range of 4 sec to 1800 sec (30 min) which agrees with a maximum measurement time for ČSN EN 12830 requirements fulfillment.

**RNmb <1, 10 000 řádků>** max. number of rows of measured values that should be transferred to the master module (MT23) during one addressing. This value is stated with respect to whole system size (bigger modules number) and own BufRate so that data could not be downloaded by a superior module from the whole system equally and not to fill up it by own data

**LowLim < -2000, 8500 >** lower temperature limit value from which the module should begin to measure and record temperature values. It is entered as an integer in tenths of centigrades (-40,5 °C = -405). This is valid for all 4 channels. Default value is -2000.

**HighLim < -2000, 8500 >** upper temperature limit value from which the module should begin to measure and record temperature values. It is entered as an integer in tenths of centigrades (40,0 °C = 400). This is valid for all 4 channels. Default value is 8500.

**StartBufTime < datum, čas>** time entry, since the module should start measurement and temperature records. It is entered in the format of day-month-year-hour-minute. It serves also as a setup of internal clock to the superior PLC real time.

**Master\_address** address of the superior module (MT23) that is authorized to address a programmed MT22T module. It can be setup just by means of Password.

**Password** identification word enabling an access to some module setup parts. It consists of 7 alphanumeric characters with the distinction of lower and capital letters. Default password is [ModemTc](#).

Communication with PMC module MT22 can be realized via serial port or PLC network.  
It is assumed that the communication with MT22 will be realized via PLC network in most cases. The serial interface is used for servicing purposes.

„SEMOD“ software is available to the user, which can be downloaded into MS Windows 98/Me, 2000 and XP operation system. Program serves for setup and individual PLC modules operation. The SEMOD software is supplied with PLC adapter of the superior PLC MT23.

An optional, „TRANSTHERM“ evaluation software enabling further processing of measured data can be ordered.

## Communication protocols

Communication protocols can be found on <http://www.modemtec.cz/protocol>.

## OPERATION STATE

After successful parameters setup, according to previous article, the MT22 module can come over to a normal operation state.

The MT22 PLC module supports 2 operation modes:

In the first mode the MT22 answers questions from the superior PLC MT23 and PC at real time (protocol Ctrl 18 a 19).

In the other mode the MT22 measures values on individual input ports in a defined interval (BufRate), stores them in its own data memory and sends the stored data to the superior PLC MT23 when required. The MT22 PLC module has data memory capacity for 10 000 entries.

### Operation with backup batteries.

As the MT22 converter is intended for a long time temperatures registration, it has to work even at ~230V power network failure. From this reason it uses 9V backup battery. To get rid of useless battery discharge the control processor and all higher consumption circuits are switched off. The only active circuit in the system is a clock battery watch-dog circuit using exclusively CMOS logic and MOSFET transistors. The clock consists of an oscillator and prescaler. A signal from there meets another prescaler used for wake-up time setup. This enables a jumper on the converter PCB. A time interval can be set up: (17 minutes interval is setup for MT22 modules, according to ČSN EN 12430 it is max 30 min.).

16 s, 32 s, 1min 4s, 2min 8s, 4min 16s, 8min 32s, 17min, 34min, 1hr 8min,

“Clock switch on” output comes over D flip-flop to processor PCB power supply from which gradually other “sleeping” circuits are switched on.

The battery state must be controlled because of early discharged battery exchange. This is provided by a battery watch-dog circuit. MOSFETs very high impedance and their gate decision level (BSS138 cca 1V at very low I<sub>ds</sub> current) is utilized. Battery voltage is continuously controlled by resistor divider with impedance of > 5MΩ. The divider is designed so that the transistor responds at battery voltage drops close to 6V, which can be esteemed as discharged. LED on front panel starts to indicate the state by fast blinking. The LED is controlled by the D flip-flop of the “battery indication” circuit, which enables extension of driving impulses from the prescaler. As well the processor is getting information about the state from the “battery state” output and enables early staff information. An indication by LED is not provided in backup mode, when voltage is high enough, from saving reasons. A sufficient backup battery voltage is indicated by a short blink during cca ... second interval just when network power is present. **Battery cannot be charged from MT22 power supply module.** Alkaline batteries can be used then as they withstand power up the system at network failure substantially longer.

PLC MT22 module can be extended by a backup battery with MT21B designation. An alkaline battery is used. The module can be powered also from lead (service-free) 12V accus but it will not be recharged.

Minimum module operation time when using backup power supply:

Tab.1

Battery	Capacity	U (V)	Type	Time interval	Operation time
6LF22	0,55 Ah	9	alkaline	17 min	35 days
TP12-1,3	1,3Ah	12	lead	17 min	85 days

Numbers are stated for supplies with full capacity given in the table.

## STATE OF PERIODICAL VERIFICATION

An operator, according to his own needs schedules way and time of MT22T module periodical verification. It must run in compliancy with ČSN EN 13 486 harmonized norm. A thermal offset can be setup at the module just in a service mode and only via uart (cinch) connector. Thermal offset Protocol setup, for every channel separately.

### Thermal offset setup

Ctrl	Module adr.	ST					
16		2	CN	TOffset	reserve	ID	Time
17		3	CN	TOffset	reserve	ID	Time
	24bit	8bit	8bit	32bit	80bit	16bit	32bit

## OPERATION ERRORS

Various module error conditions can arise during operation. Further described are some of basic error conditions with the solution how to get rid of the error.

No.	Indication LED status	Malfunction description	Malfunction elimination
1	No lit, either slowly blinking battery LED	No power on module	<ul style="list-style-type: none"> <li>- check the power supply – whether green LED lights</li> <li>- check the interconnection flat cable between module and power supply</li> <li>- have the module repaired</li> </ul>
2	Red battery LED blinks quickly	Module has no backup battery or the battery is exhausted	<ul style="list-style-type: none"> <li>- check the battery connection – if connection wires are OK</li> <li>- exchange battery</li> </ul>

## MAIN PARAMETERS

usage	storing area, production lines
number of measured points	4 x TP100 with four wire connection
metrology class	0.5
measuring span	-25 °C to +150 °C
resolution	0,01 °C
expanded uncertainty of converter measurement	± 0.02 °C
offset with PT100 of A class	± 0.17 °C (without common calibration)
temperature values record	YES
record interval	adjustable in range of 5sec to 30min
record capacity	10 000 measurements
protection of recorded data	YES
record time relative error	< 0,001%
response time (for PT100 T1027 Nová Paka)	2,5 min
independent power supply	YES +9 to +12V
independent power supply indication	YES – LED on front panel
average operation time with independent PS	35 days (see table 1)
environment	A – record unit outside of cooling area
converter operation temperature	0 °C to +40 °C
temperature limits	-10 °C to +50 °C
storing temperature	-20 °C to +60 °C
outside power supply voltage $U_n$	+ 15V to +19V
power consumption from power supply- standby	cca 0.13 A
- transmitting	cca 0.7A
safety class	III
equipment complies with norms:	ČSN EN 12380, ČSN EN 61010-1, ČSN EN 60529, ČSN EN 61000-6-2, ČSN EN 61000-6-3