TERMEX

PRECISION AT THE HEART OF STABILITY

THERMOSTAT COMMUNICATION PROTOCOL FOR REMOTE CONTROL

User manual

V2.0

CONTENTS

This manual provides the information needed to develop of software applications to control the operation of TERMEX thermostats. Information set out below is true in case of thermostat connection to any hardware device (host) via standard interface RS-485, RS-232 or USB.

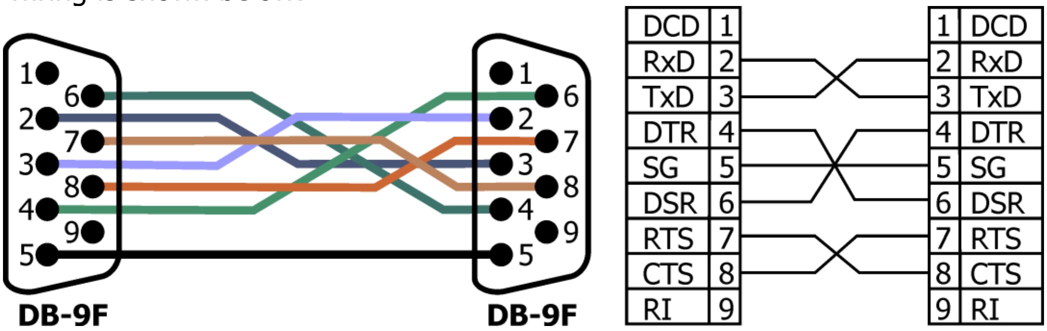
We reserve the right to make changes to the protocol without affecting the functions described below.

CONNECTING

Depending on the model, thermostats can be connected to the host via various interfaces: RS-485, RS-232 or USB.

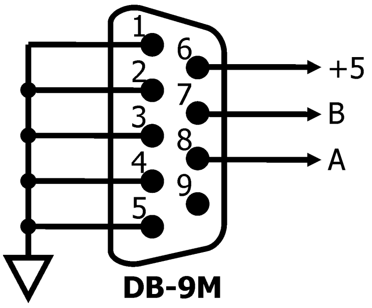
To connect the thermostat via USB interface you should use a standard A-to-B cable for peripherals.

To connect the thermostat to the host via RS-232 interface, use the standard null-modem cable. Its wiring is shown below:



DCD	1	1	DCD
RxD	2	2	RxD
TxD	3	3	TxD
DTR	4	4	DTR
SG	5	5	SG
DSR	6	6	DSR
RTS	7	7	RTS
CTS	8	8	CTS
RI	9	9	RI

To connect the thermostat to the host via RS-485 interface, make special cable. Its wiring at the thermostat side is shown below:



SG	1
SG	2
SG	3
SG	4
SG	5
+5	6
B	7
A	8
	9

CONFIGURING

In the case of USB connection to the host, configuring is made automatically by system driver, because the thermostat is a HID-compatible device that supports two reports: Input and Output. Both reports are an array of 64 bytes. The data is transmitted by means of these reports. If the data size is larger than the report size, the data should be split into several packages.

If you are connecting the thermostat to the host via RS-232 interface you should set the following settings for the host communication port:

- speed — 9600 baud;
- parity — none;
- stop bits — 1;
- DTR — high level;
- RTS — low level.

! *RS-232 interface is galvanically isolated at the thermostat side and the DTR and RTS signals are used to feed power to the optocouplers.*

If you are connecting the thermostat to the host via RS-485 interface you should set the following settings for the host communication port:

- speed — 9600 baud;
- parity — none;
- stop bits — 1.

GENERAL INFORMATION

Data exchange with the thermostat is initiated by the host through sending the query. The query is an ASCII string which starts with ':' and ends with a carriage return symbol (code 13) or any other symbol with the code less than 13. Thermostat also replays by the string, formatted by the same way.

Further in queries description square brackets [] indicate optional parameters.

Query format

Query can be written in uppercase or lowercase. The query string consists of a set of tokens, separated by '.' (dot) and '␣' (space).

In general a query has the basic form:

"***:ADDR NODE OPERATION [DATA]***"

ADDR is a network address of the thermostat. It is a string of up to 8 characters in the set of [0..9], [A..Z], [a..z]. TERMEX thermostats use a unique serial number of the product as a network address. Broadcast address "00000000" (eight zeroes) can be used also. Any thermostat responds to the query with this address.

NODE determines system of the thermostat, which is addressed by the query. It may include additional fields with more detailed information: *NODE[.SUBNODE][.SUBSUBNODE]*.

OPERATION defines an action to perform:

- RD — reading;
- WR — writing.

DATA is needed only when OPERATION is writing. Depending on the query it can be a string, casted to an integer or floating point value.

Response format

A response is formed in the only case if the network address ADDR in the query matches the product serial number or broadcast address.

In general a response to the query has the basic form:

"***:ADDR STA [INFO]***"

ADDR is just the same as in a query form.

STA is a status of the operation. It can take values, displayed in hexadecimal form with 0x prefix:

- 0x00 — the operation was successful;
- 0x01 — invalid query format;
- 0x02 — invalid data format;
- 0x03 — unknown destination node;
- 0x04 — unknown operation;
- 0x05 — the value is out of range.

If STATUS is not zero, there is no INFO in the response. In other case, it contains requested data.

SOLVED QUERIES

SET — setpoints

:ADDR SET.PARAM[.INDEX] OPERATION [DATA]	
PARAM	• MIN — setpoints minimum acceptable value; • MAX — setpoints maximum acceptable value; • IDX — working setpoint index; • VAL — setpoint value.
INDEX	Required, if PARAM = VAL. Setpoint index [1...3]. If not specified, then query is to working setpoint.
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • Setpoint value, if PARAM = VAL; • Setpoint index, if PARAM = IDX.
Thermostat Response	• If OPERATION = RD, then INFO = value of the requested parameter; • If OPERATION = WR, then no INFO.

Query examples:

Setting setpoints maximum acceptable value at 95 °C:

- QUERY ***:ADDR SET.MAX WR 95.0***
- RESPONSE ***:ADDR 0x00***

Setting third setpoint at 60 °C:

- QUERY ***:ADDR SET.VAL.3 WR 60.0***
- RESPONSE ***:ADDR 0x00***

Setting third setpoint as working setpoint:

- QUERY ***:ADDR SET.IDX WR 3***
- RESPONSE ***:ADDR 0x00***

Getting index of working setpoint:

- QUERY ***:ADDR SET.IDX RD***
- RESPONSE ***:ADDR 0x00 3***

Getting value of working setpoint:

- QUERY ***:ADDR SET.VAL RD***
- RESPONSE ***:ADDR 0x00 60.00***

PRG — program sequence

:ADDR PRG.PARAM.SECTION OPERATION [DATA]	
PARAM	• TEMP — temperature; • TIME — duration.
SECTION	Section index [1...10].
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • Temperature in °C, if PARAM = TEMP; • Duration in minutes, if PARAM = TIME.
Thermostat Response	• If OPERATION = RD, then INFO = value of the requested parameter; • If OPERATION = WR, then no INFO.

Query examples:

Setting temperature of the 5th section of the program at 50.5 °C:

- QUERY ***:ADDR PRG.TEMP.5 WR 50.5***
- RESPONSE ***:ADDR 0x00***

Setting duration of the 5th section of the program at 25 minutes:

- QUERY ***:ADDR PRG.TIME.5 WR 25***
- RESPONSE ***:ADDR 0x00***

Getting temperature of the 5th section of the program:

- QUERY ***:ADDR PRG.TEMP.5 RD***
- RESPONSE ***:ADDR 0x00 50.5***

DAT — sensor data

:ADDR DAT.PARAM.[CHANNEL] OPERATION	
PARAM	• T — temperature in °C; • R — resistance in Ohms.
CHANNEL	• 1 — internal temperature sensor; • 2 — external temperature sensor. If not specified, then internal temperature sensor.
OPERATION	RD
Thermostat Response	Value of the requested parameter.

Query examples:

Getting temperature of internal sensor:

- QUERY ***:ADDR DAT.T RD***
- RESPONSE ***:ADDR 0x00 25.80***

Getting resistance of external sensor:

- QUERY ***:ADDR DAT.R.2 RD***
- RESPONSE ***:ADDR 0x00 1090.36***

ALM — excess temperature protection

:ADDR ALM.PARAM OPERATION	
PARAM	• MIN — minimum value of the scale; • MAX — maximum value of the scale; • SET — protection setpoint; • TEMP — temperature of excess protection sensor.
OPERATION	RD
Thermostat Response	Value of the requested parameter.

Query examples:

Getting setpoint of excess temperature protection:

- QUERY ***:ADDR ALM.SET RD***
- RESPONSE ***:ADDR 0x00 75***

Getting temperature of excess protection sensor:

- QUERY ***:ADDR ALM.TEMP RD***
- RESPONSE ***:ADDR 0x00 60***

RTD — parameters of temperature sensors

:ADDR RTD.CHANNEL[.FACTOR] OPERATION [DATA]	
CHANNEL	• 1 — internal temperature sensor; • 2 — external temperature sensor.
FACTOR	• R0 — sensor resistance at 0 °C; • A, B, C — coefficients of Callendar-van Dusen equation for platinum RTD. If not specified, then all factors (for OPERATION = RD only).
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • Factor value.
Thermostat Response	• If OPERATION = RD, then INFO = value of the requested factor; • If OPERATION = WR, then no INFO.

Query examples:

Getting values of all factors (R0, A, B and C) of internal sensor:

- QUERY ***:ADDR RTD.1 RD***
- RESPONSE ***:ADDR 0x00 1000.00 3.9083E-3 -5.7750E-7 -4.1830E-12***

Setting value of A factor of external sensor to $3.92 \cdot 10^{-3}$:

- QUERY ***:ADDR RTD.2.A WR 3.92E-3***
- RESPONSE ***:ADDR 0x00***

PID — parameters of PID controller

:ADDR PID.CHANNEL[.PARAM] OPERATION [DATA]	
CHANNEL	• 1 — internal controller; • 2 — external controller.
PARAM	• SET — controller setpoint; • PWR — actual output control (current heat capacity); • AUTO — automatic mode; • KA — proportional gain in automatic mode; • KP — proportional gain; • TI — integral time; • TD — derivative time.
OPERATION	RD or WR (except PARAM=PWR)
DATA	Required, if OPERATION = WR: • Parameter value (0 or 1 for AUTO).
Thermostat Response	• If OPERATION = RD: ▪ If PARAM specified: INFO = value of the requested parameter; ▪ If PARAM not specified: KP, TI and TD values simultaneously. • If OPERATION = WR, then no INFO.

Query examples:

Getting values of KP, TI and TD parameters of internal controller:

- QUERY ***:ADDR PID.1 RD***
- RESPONSE ***:ADDR 0x00 120.0 10.0 5.0***

Setting derivative time of external controller to 6.2:

- QUERY ***:ADDR PID.2.TD WR 6.2***
- RESPONSE ***:ADDR 0x00***

Getting current heat capacity of internal controller:

- QUERY ***:ADDR PID.1.PWR RD***
- RESPONSE ***:ADDR 0x00 95.2***

RTC — real time clock

:ADDR RTC.PARAM OPERATION [DATA]	
PARAM	• TIME — current time; • ONTIME — turn on time; • OFFTIME — turn off time; • ENON — turn on enable; • ENOFF — turn off enable.
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • String of the form "hh:mm" ("h:mm") for TIME, ONTIME, OFFTIME; • 0 or 1 for ENON, ENOFF.
Thermostat Response	• If OPERATION = RD, then INFO = value of the requested parameter; • If OPERATION = WR, then no INFO.

Query examples:

Getting current time:

- QUERY ***:ADDR RTC.TIME RD***
- RESPONSE ***:ADDR 0x00 18:55***

Setting up the turn on time to 5 am:

- QUERY ***:ADDR RTC.ONTIME WR 5:00***
- RESPONSE ***:ADDR 0x00***

Enabling turn on at preset time:

- QUERY ***:ADDR RTC.ENON WR 1***
- RESPONSE ***:ADDR 0x00***

FSW — refrigerating unit

:ADDR FSW OPERATION [DATA]	
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • 0 — turn managing of the refrigerating unit off; • 1 — turn managing of the refrigerating unit on.
Thermostat Response	• If OPERATION = RD: ▪ INFO = 0 — managing is off; ▪ INFO = 1 — managing is on; • If OPERATION = WR, then no INFO.

Query examples:

Getting the current state of refrigerating unit managing (if it is off):

- QUERY ***:ADDR FSW RD***
- RESPONSE ***:ADDR 0x00 0***

Turning refrigerating unit managing on:

- QUERY ***:ADDR FSW WR 1***
- RESPONSE ***:ADDR 0x00***

RDY — temperature stability indication

:ADDR RDY OPERATION [DATA]	
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • Readiness value.
Thermostat Response	• If OPERATION = RD, then INFO = readiness value; • If OPERATION = WR, then no INFO.

Query examples:

Getting the current readiness value (if it is ±0.05 °C):

- QUERY ***:ADDR RDY RD***
- RESPONSE ***:ADDR 0x00 0.05***

Setting new readiness value to ±0.1 °C:

- QUERY ***:ADDR RDY WR 0.1***
- RESPONSE ***:ADDR 0x00***

SER — product serial number

:ADDR SER OPERATION [DATA]	
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • New serial number.
Thermostat Response	• If OPERATION = RD, then INFO = actual serial number; • If OPERATION = WR, then no INFO.

! *If you change the serial number, the thermostat network address will be changed too. The following query should be executed with the new address.*

Query examples:

Getting the actual serial number:

- QUERY ***:ADDR SER RD***
- RESPONSE ***:ADDR 0x00 12345678***

Setting new serial number:

- QUERY ***:ADDR SER WR 87654321***
- RESPONSE ***:ADDR 0x00***

FLU — thermal fluid type

:ADDR FLU OPERATION [DATA]	
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • 1 — Any; • 2 — Water; • 3 — Polymethylsiloxane PMS-5; • 4 — Polymethylsiloxane PMS-10; • 5 — Polymethylsiloxane PMS-20; • 6 — Polymethylsiloxane PMS-50; • 7 — Polymethylsiloxane PMS-100; • 8 — Ethanol; • 9 — Coolant.
Thermostat Response	• If OPERATION = RD, then INFO = thermal fluid type; • If OPERATION = WR, then no INFO.

Query examples:

Getting the current thermal fluid type (if it is water):

- QUERY ***:ADDR FLU RD***
- RESPONSE ***:ADDR 0x00 2***

Setting new thermal fluid type (ethanol):

- QUERY ***:ADDR FLU WR 8***
- RESPONSE ***:ADDR 0x00***

EXT — external temperature sensor

:ADDR EXT OPERATION [DATA]	
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • 0 — disable external sensor; • 1 — enable external sensor.
Thermostat Response	• If OPERATION = RD: ▪ INFO = 0 — sensor is disabled; ▪ INFO = 1 — sensor is enabled; • If OPERATION = WR, then no INFO.

Query examples:

Getting the current state of external sensor (if it is enabled):

- QUERY ***:ADDR EXT RD***
- RESPONSE ***:ADDR 0x00 1***

Disabling external temperature sensor:

- QUERY ***:ADDR EXT WR 0***
- RESPONSE ***:ADDR 0x00***

COR — temperature correction

:ADDR COR OPERATION [DATA]	
OPERATION	RD or WR
DATA	Required, if OPERATION = WR: • Correction value.
Thermostat Response	• If OPERATION = RD, then INFO = correction value; • If OPERATION = WR, then no INFO.

Query examples:

Getting the current correction value (if it is 1.05 °C):

- QUERY ***:ADDR COR RD***
- RESPONSE ***:ADDR 0x00 1.05***

Resetting the correction value:

- QUERY ***:ADDR COR WR 0.0***
- RESPONSE ***:ADDR 0x00***