Intelligent Temperature Sensor TQS3
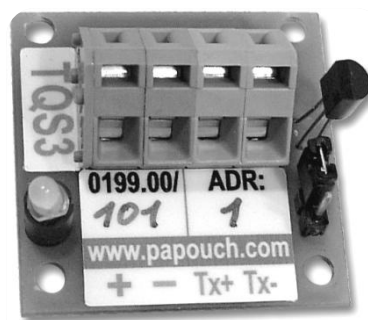
Measuring range -55°C to +125°C

Communication via an RS485 link

TQS3

Datasheet

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Papouch s.r.o.

Address:
   Strasnicka 3164
   102 00 Prague 10
   Czech Republic

Tel:
   +420 267 314 267
   +420 267 314 268
   +420 602 379 954

Fax:
   +420 267 314 269

Internet:
   www.papouch.com

E-mail:
   info@papouch.com

CONTENT

BASIC INFORMATION

Description

TQS3 Module is a digital temperature sensor. It measures temperature within the range from -55°C to +125°C and sends the measured value directly in degrees Celsius. The TQS3 thermometer has a very low consumption and communicates via an RS485 bus line using the Spinel protocol. These features enable connecting more sensors with a four-wire bus line containing an RS485 link and supply cable to the distance of up to 1200m.

The module measures temperature using an integrated unit with the accuracy of ± 0,5°C. The TQS3 module contains an indicator which blinks to signalize the ongoing temperature measurement.

TQS3 is available in the following designs:

- **Outdoor** with IP65 cover and sensor in metal rod of ø 6 mm (TQS3 O) (This design can also be ordered with a holder for wall mounting. See the picture on the right.)

- **Indoor** (TQS3 I)

- **Surface** to measure temperature of pipes (TQS3 P)

- **Board with electronics** (TQS3 E)

Features

- Temperature measuring within the range of -55°C to +125°C

- Transmission of measured temperature directly in degrees Celsius

- Communication via an RS485 link

- Very low **consumption** – typically **only 2 mA**

- Measurement indication

- Spinel communication protocol

- Small size

- Unstabilized supply voltage

- Standardized metal cover diameter (outdoor design)

Usage

- Comprehensive temperature measuring systems

- Industrial measurement and regulation

- Temperature measuring in warehouses, manufacturing and dwelling space

Technical Parameters

Electronics operating temperature.....-40 °C to +85 °C[1]

Sensor temperature range.................-55 °C to +125 °C; resolution 0,1 °C

Accuracy..± 0,5 °C between -10°C and +85°C, otherwise ± 2 °C

Measuring unit DS18B20

Termination......................................No; only 10 kΩ resistances defining the line standby state

Supply voltage ....6 V to 20 V DC with protection against polarity reversal

Consumption ....typically 2 mA, 3 mA maximum (see note 8 on page 16)

Lines connection...............................Wago 236 terminal block

Communication line:

Type...RS485

Addressability ....software

Response time...................................2,5 ms

Communication protocol....................Spinel (see below)

Speed ....up to 115,2 kBd

Number of data bits 8

Parity ....none

Number of stop-bits 1

Wago 236 Terminal Block

Available Designs

Outdoor Design – TQS3 O

Housing type.....................................IP65

Sensor mechanical design.................Metal rod: 6 mm in diameter, 70 mm long

Dimensions.......................................83 (62) mm x 138 (62) mm x 33 mm

Figure 1 – Outdoor Design:

---
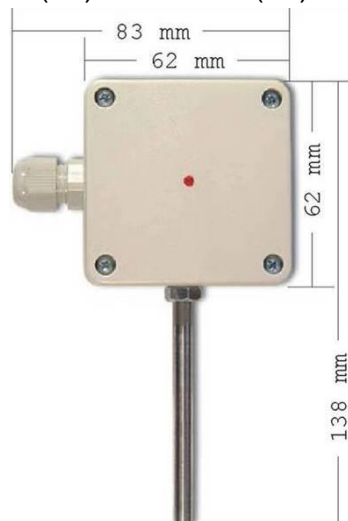
[1] Electronic's operation temperature -20 to +70 for units purchased until the end of year 2007.

Indoor Design – TQS3 I

Housing type IP20

Sensor mechanical design .... Plastic sensor 5x5x5 mm

Dimensions .... 62 mm x 62 mm x 28 mm
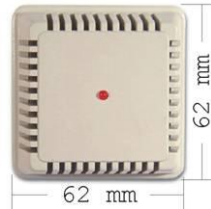
Figure 2 – Indoor Design

Surface Design – TQS3 P

Housing type IP65

Sensor mechanical design .... To be placed on pipes

Dimensions .... 62 mm x 62 mm x 45 mm

A = 11,5 mm
B = 10 mm
C = 9,5 mm
D = 24 mm
E = 48 mm
F = 2,5 mm

Figure 3 – Surface Design   *Figure 4 – Application Part Detail*

Board with Electronics – TQS3 E

Board dimensions .... 35(51) mm x 36 mm x 15 mm

Holes location .... in the corners of 28(44,4) mm x 28 mm rectangle; 3 mm diameter

Sensor mechanical design .... plastic sensor 5 mm x 5 mm x 5 mm
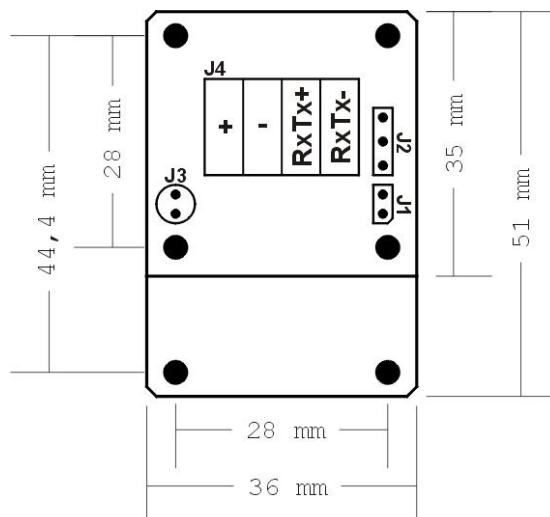
Figure 5 – Board with Electronics Drawing

Signalisation

The TQS module contains a yellow diode indicating operation states:

Blinking.......... Instruction receipt and processing. After switching on it indicates the module internal test.

CONNECTION

Figure 6 illustrates the connection to module terminals.

J2: Measuring unit.

J3: Indicator.

J4: RS485 communication link and supply connection. Supply is connected to "+" and "–" terminal, RS485[2] link is connected to "RxTx+" and "RxTx-" terminal.

Figure 6 – Module Terminals Connection

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[2] The RS485 link wires can also be marked as "A" (for RxTx+) and "B" (for RxTx-).

EASY CONTROL OF TQS3 – EXAMPLES

The following examples are based upon communication with a module in default setup. The control program sends a string indicated in the Enquiry column. (Individual characters must not be separated by a delay longer than 5 sec.) If everything is all right, the module responds in a way indicated in the following line under the Response column.
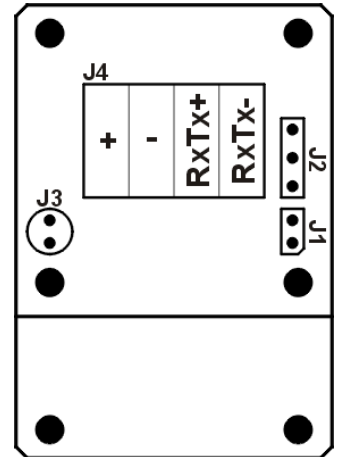
Communication line default parameters are:

Speed.. 9600 Baud
Number of data bits........................... 8
Parity.. none
Number of stop-bits........................... 1

The examples are written in a simpler 66 format, which is suitable for understanding the module, tuning and communication via a terminal.

For the control via your application it is more suitable to use 97 format, which is described in greater detail in the chapter starting on page 15.

Temperature measuring

The following instructions will read the temperature from the thermometer with address 5.[3]

Enquiry	Response		Explanation
`*B5TR↵`		`*B`	Prefix
		`5`	Address It is also possible to use the $ symbol as an address. This symbol represents a universal address and works when there is only one module on the line.
		`TR`	Code of instruction for temperature measurement
		↵	Final mark (enter)
	`*B50+024.3C↵`	`*B`	Prefix
		`5`	Module address
		`0`	Confirmation
		`+024.3C`	Temperature; 7 characters starting with + or – sign and ending with the symbol of temperature.
		↵	Final mark (enter)

---

[3] The default address set by the manufacturer is indicated on the label of the TQS3 sensor. (The address is indicated as an ASCII sign.)

Change of address

The instruction changes the module address from **5** to **f**.

Enquiry	Response		Explanation
First it is necessary to enter a special instruction to enable the configuration. This instruction enables configuration for the immediately following instruction. Then the configuration is again disabled after any immediately following instruction.			
*B5E↵		*B	Prefix
		5	Address
		E	Code of instruction for configuration authorization
		↵	Final mark (enter)
	*B50↵	*B	Prefix
		5	Module address
		0	Confirmation
		↵	Final mark (enter)
Now the configuration is enabled. You can change the address.			
*B5ASf↵		*B	Prefix
		5	Old address
		AS	Code of instruction for address change
		f	New address
		↵	Final mark (enter)
	*B50↵	*B	Prefix
		5	Old address
		0	Confirmation
		↵	Final mark (enter)

LIST OF BASIC INSTRUCTIONS

Description	Code [Enquiry] [Response]	Example (the address in the example is always 1)
Temperature reading	*B[address]TR↵	*B1TR↵
	*B[address]0[temperature]↵	*B10+016.5C↵
Device name and type enquiry	*B[address]?↵	
	*B[address]0TQS3; v.199.01; F66 97↵	
Configuration authorization[4]	*B[address]E↵	*B1E↵
	*B[address]0↵	*B10↵
Address setup[5]	*B[old address]AS[new address]↵	*B1AS5↵
	*B[old address]0↵	*B10↵
Communication speed setup[5]	*B[address]SS[code]↵	*B1SS5↵
	*B[address]0↵	*B10↵

Notes:

[address] ... It is also possible to use the $ symbol as an [address], which represents a universal address. It can be used when there is only one module on the line. In this case it is not necessary to address it.

[address] ... It is also possible to use the % symbol as an address, which means a so called "broadcast". It means that all modules on the line are addressed, and all of them perform the entered instruction but do not respond to prevent any collision on the line.

Communication speed Bd	Code
1200	3
2400	4
4800	5
9600	6
19200	7
38400	8
57600	9
115200	A

[4] It is not possible to use the $ universal address for this instruction.

[5] This instruction must be preceded by the instruction for Configuration Authorization

COMMUNICATION PROTOCOL

The TQS3 module contains the implemented Spinel standardized protocol, as well as 66 (ASCII) and 97 (binary) formats.

Format 97

Structure
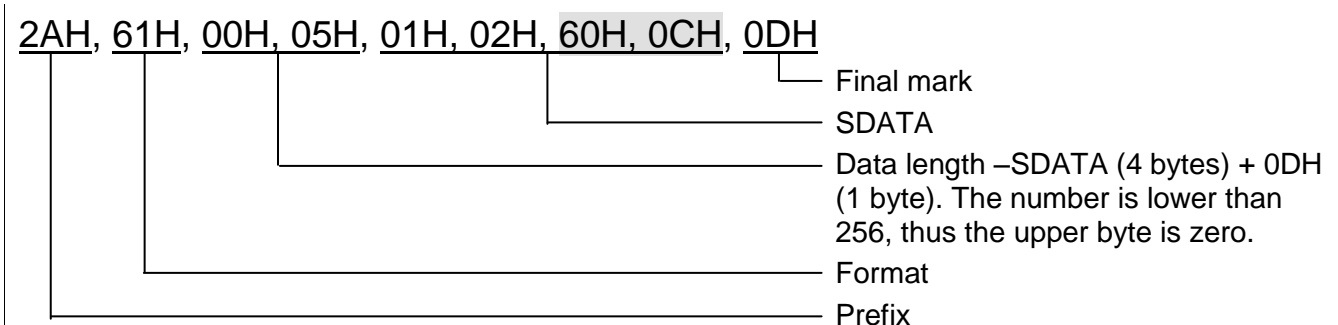
Enquiry:

```
PRE FRM NUM NUM ADR SIG INST DATA… SUMA CR
```

Response:

```
PRE FRM NUM NUM ADR SIG ACK  DATA… SUMA CR
```

PRE	Prefix, 2AH ("*" sign).
FRM	Number of 97 format (61H).
NUM	Number of instruction bytes from the following bit to the end of the frame.
ADR	Address of the module to which the enquiry is being sent or which is responding to it.
SIG	Message description – any number form 00H to FFH. The same number, which was sent in the enquiry, is returned in the response, which makes it easy to see which enquiry the response belongs to.
INST[6]	Instruction code – Module instructions are described in great detail in chapter Preview of TQS3 Module Instructions on page 15.
ACK	Enquiry acknowledgement of whether and how it was executed. ACK can be 00H to 0FH.
DATA[6]	Data. They are described in great detail in chapter Preview of TQS3 Module Instructions (page 15) for each instruction.
SUMA	Check sum.
CR	Final mark (0DH).

Explanatory notes

Example

2AH, 61H, 00H, 05H, 01H, 02H, 60H, 0CH, 0DH

- Final mark
- SDATA
- Data length –SDATA (4 bytes) + 0DH (1 byte). The number is lower than 256, thus the upper byte is zero.
- Format
- Prefix

---

[6] For easy orientation the instructions and data in the examples of following pages are highlighted this way.

Data Length (NUM)

Sixteen-bit value defining the number of bytes until the end of the instruction; number of all bytes found after NUM up to CR (including). It takes the values from 5 to 65535. If lower than 5, the instruction is considered faulty and it is answered (if intended for the relevant device) with ACK "Invalid Data" instruction.

Process of NUM creation:

Ad up the number of bytes after both NUM bytes (i.e. the number of SDATA bytes + 1 CR byte). The resulting sum view as a sixteen-bit. Divide it into the upper and lower byte. The first NUM byte id the upper byte of the number, the second NUM byte is the lower byte of the number. (If the number of bytes is lower than 256, the first NUM byte is 00H.)

Address (ADR)

The FFH address is reserved for broadcast. If the enquiry contains the FFH address, the device operates as if its own address is entered. No response is sent to enquiries with this address.

The FEH address in the universal address. If the enquiry contains the FEH address, the device operates as if its own address is entered. The device enters real, currently set address into the response. The universal address is used in cases where only one device is connected on the line.

Enquiry Acknowledgement (ACK)

ACK informs the superior device on the way of the received instruction processing. Acknowledgement codes:

00H ....EVERYTHING OK
> The instruction was properly received and completely executed.

01H ....ANOTHER ERROR
> Unspecified device error.

02H ....INVALID CODE OF INSTRUCTION
> The received instruction code is unknown.

03H ....INVALID DATA
> Data are of invalid length or contain invalid value.

04H ....ENTRY NOT ALLOWED/ACCESS REFUSED
> - The enquiry was not performed, as some conditions had not been fulfilled.
> - Attempt to enter data into inaccessible memory.
> - Attempt to activate a device function requiring a different configuration (e.g. higher communication speed).
> - Attempt to change configuration without immediately preceding setup acknowledgement.
> - Access into memory protected by a password.

05H ....DEVICE FAILURE
> - Device failure requiring service action.
> - Device internal memory error or setup memory error.
> - Device internal error (operation error or start-up error).
> - Any other error affecting the device proper functioning.

06H ....NO DATA AVAILABLE

0EH ....INSTRUCTION SENT AUTOMATICALLY – CONTINUOUS MEASURING
> - recurring transfer of measured values

Check Sum (SUMA)

Sum of all instruction bytes (sum of all transferred data except CR) subtracted from 255.

Calculation: SUMA = 255 – (PRE + FRM + NUM + ADR + SIG + ACK (INST) + DATA)

No response is made to messages with faulty check sum. (The system waits for the receipt of CR even if a faulty check sum is received.)

Format 66

Format 66 uses only decimal variables or characters, which can be typed using a usual keyboard.

## Structure

Enquiry:

```
PRE FRM ADR INST  DATA… CR
```

Response:

```
PRE FRM ADR ACK   DATA… CR
```

PRE	Prefix, 2AH ("*" sign).
FRM	Number of 66 format ("B" sign).
ADR	Address of the module to which the enquiry is being sent or which is responding to it.
INST[6]	Instruction code – Device instruction codes. These are ASCII consisting of "A" to "Z" and "a" to "z" letter and "0" to "9" numbers. Module instructions are described in great detail in chapter Preview of TQS3 Module Instructions on page 15.
ACK	Enquiry acknowledgement of whether and how it was executed. ACK can be 00H to 0FH.
DATA[6]	Data. ASCII version of transferred variables. It is recommended to transfer data in their common structure and units. Must not include prefix nor CR. They are described in great detail in chapter Preview of TQS3 Module Instructions (page 15) for each instruction.
CR	Final mark (0DH).

Explanatory notes

Example – single measurement

```
* B 1 TR <CR>
```

Final mark (0DH; ↵)[7]
Instruction code
Address
Format
Prefix (2AH)
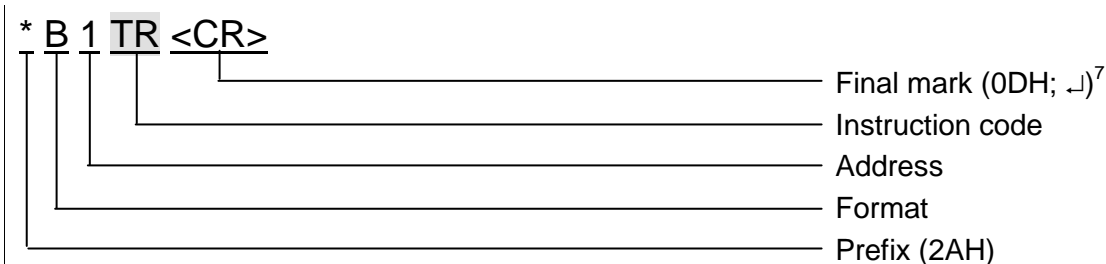
Address (ADR)

Address is one character which unambiguously identifies and distinguishes a particular device from others on a single communication line. A device always uses this number for its identification in responses to enquiries from the superior system. The following ASCII characters can form an address: numbers "0" to "9", lower case letters "a" to "z" and capital letters "A" to "Z". The address must not identical with a prefix or CR.

The "%" address is reserved for broadcast. If the enquiry contains the "%" address, the device operates as if its own address is entered. No response is sent to enquiries with this address.

---

[7] **No final mark <CR> code is given** in the **examples** of instructions in chapter Overview of TQS3 Module Instructions**!** (it is replaced with the ↵ sign.)

The "$" address in the universal address. If the enquiry contains the "$" address, the device operates as if its own address is entered. The device enters real, currently set address into the response. The universal address is used in cases where only one device is connected on the line.

Instruction Code (INST)

Device instruction code.

If a valid instruction is received (correct ADR) and a flag of the received message is set, the device must respond to such instruction.

Enquiry Acknowledgement (ACK)

ACK informs the superior device on the way of the received instruction processing. Acknowledgement codes:

0............EVERYTHING OK

> The instruction was properly received and completely executed.

1............ANOTHER ERROR

> Unspecified device error.

2............INVALID CODE OF INSTRUCTION

> The received instruction code is unknown.

3............INVALID DATA

> Data are of invalid length or contain invalid value.

4............ENTRY NOT ALLOWED/ACCESS REFUSED

> - The enquiry was not performed, as some conditions had not been fulfilled.
> - Attempt to enter data into inaccessible memory.
> - Attempt to activate a device function requiring a different configuration (e.g. higher communication speed).
> - Attempt to change configuration without immediately preceding setup acknowledgement.
> - Access into memory protected by a password

5............DEVICE FAILURE

> - Device failure requiring service action.
> - Device internal memory error or setup memory error.
> - Device internal error (operation error or start-up error).
> - Any other error affecting the device proper functioning.

6............NO DATA AVAILABLE

E ....INSTRUCTION SENT AUTOMATICALLY – CONTINUOUS MEASURING

> - recurring transfer of measured values.

Data (DATA)

Instruction data.

OVERVIEW OF TQS3 MODULE INSTRUCTIONS

Instruction	Code 97 66	Enquiry data (97)	Response data (97)	Page
Basic instructions				
Temperature Measuring	51H ... TR	---	(value)	16
Configuration				
Communication Parameters Reading	F0H ... ---	---	(address)(speed)	18
Communication Parameters Setup	E0H ... AS a SS	(address)(speed)	---	17
Additional				
Configuration Acknowledgement	E4H ... E	---	---	19
Name and Version Reading	F3H ... ?	---	*TQS3; v0199.00; F66 97*	20
Status Reading	F1H ... SR	---	(status)	20
Status Setup	E1H ... SW	(status)	---	19
Saved User Data Reading	F2H ... DR	---	---	22
User Data Saving	E2H ... DW	---	---	22
Check Sum Acknowledgement	EEH .. ---	(status)	---	21
Check Sum Acknowledgement	FEH... ---	---	(status)	21
Manufacturing Data Reading	FAH... ---	---	(product No)(serial No)(manufacturing data)	24
Address Setup using Serial Number	EBH .. ---	(new address)(product No)(serial No)		23
Communication Errors Reading	F4H... ---	---	(errors)	23
Reset	E3H... RE	---	---	21

On the other hand, the examples are presented in their full form – for the 01H address and 02H signature. The indexes [97] or [66] before some paragraphs indicate which format of Spinel protocol they are intended for. If no index appears before a paragraph the given information applies to both protocols 97 as well as 66. (See also note 7 on page 13.)

Basic Instruction

Temperature Measuring

Description: Performs a single temperature measurement.[8]

[97]Enquiry: 51H

[97]Response: (ACK 00H) (value)

[97]Legend: (value)   temperature in the signed int format

$temperature = value / 32$ resulting temperature with resolution of 0,1°C.[9]

[97]*Example: Enquiry: Address 1*

   2AH,61H,00H,05H,01H,02H,51H,1BH,0DH

   Response:

   2AH,61H,00H,07H,01H,02H,00H,01H,05H,64H,0DH
   The temperature in the response is in the format of signed int: 0105H. By dividing by 32
   we will get the measured value in degrees Celsius.
   Conversion into decimal value: 0105H = 261DEC
   Division by 32: 261 / 32 = 8,15625
   The measured temperature is (after rounding up) 8,2 °C.

[66]Enquiry: „TR"   (Temperature Read)

[66]Response: (ACK „0") (value)

[66]Legend: (value)   Temperature as an ASCII string (always 5 characters justifies to the right).
                  Unused characters are filled in with a space (20H).

[66]*Example: Enquiry: Address 1*

   *B1TR↵

   Response: 123,4°C

   *B10123.4↵

---

[8] TQS3 thermometer dynamically changes the internal interval of temperature measuring by the temperature sensor according to the frequency of the instruction of "Temperature Measuring". If you wish to minimize the thermometer current consumption use a measurement interval longer than 30 sec (The internal temperature conversion takes approx. 700 ms. During this time the TQS3 thermometer consumption increases by 0,5 mA.)

[9] After the division the temperature is given with the accuracy of 1/32. The guaranteed accuracy of the temperature sensor is only 1/10. Thus the resulting value is a number rounded to decimals. Rounding of the calculated temperature value is illustrated in the example to this instruction.

Configuration

Communication Parameters Setup

Description: Set the address and communications speed. This instruction <u>must</u> be immediately preceded by the instruction of Configuration Acknowledgement (see page 19). This instruction can not be used with universal or broadcast addresses.

[97]Enquiry: E0H (address) (speed)

[97]Response: (ACK 00H)

[97]Legend: (address) 1 byte; Can be of value between 00H to FDH, if the 66 protocol is also used for communication it is necessary to use only such addresses, which can be formulated as a displayable ASCII character (see paragraph Address on page 13).

                    (speed)   1 byte; communication speed, speed codes can be found in Table 1.

[97]*Example:* *Setup of the 04H address and communication speed of 19200Bd; old address 01H, signature 02H*

             2AH,61H,00H,07H,01H,02H,E0H,04H,07H,7FH,0DH

             Response

             2AH,61H,00H,05H,01H,02H,00H,6CH,0DH

Notes: The new address and communication speed are set after response sending.

             The setup of configuration parameters must be preceded by the instruction of Configuration Acknowledgement (page 19). After the communication parameters are set, the configuration is again disabled.

             Other communication parameters are: 8 bits, no parity, 1 stop-bit. The default communication speed set by the manufacturer is 9600Bd, the address is indicated as an ASCII sign on the thermometer label.

             In case the address is not known and no other device is connected on the line, the address can be found out using the instruction of Communication Parameters Reading. The universal FEH address is used as the device address.

             In case the communication speed is unknown, it is necessary to try out all communication speeds available.

[66]Enquiry: „AS"(address)[10]   (Address Set)

[66]Response: (ACK „0")

[66]Legend: (address)   see the paragraph Address on page 13.

[66]*Example:* *Enquiry: Address 4*

             *B1AS4↵

             Response

             *B10↵

---

[10] The address and communication speed must be set in the protocol 66 via two separated instructions (Protocol 97 this can be done using just a single instruction.)

[66]Enquiry: „SS"(code)[10]   (Speed Set)

[66]Response: (ACK „0")

[66]Legend: (code)   communication speed as defined in Table 1

[66]Example: Enquiry: Speed 19200Bd

   *B1SS7↵

   Response

   *B10↵

Communication Parameters Reading

Communication speed Bd	Code	
	97	66
1200	03H	3
2400	04H	4
4800	05H	5
9600	06H	6
19200	07H	7
38400	08H	8
57600	09H	9
115200	0AH	A

Table 1 – communication speeds codes

Description: Returns the address and communication speed.

[97]Enquiry: F0H

[97]Response: (ACK 00H) (adr) (speed)

[97]Legend: (address)   1 byte; device address

   (speed)   1 byte; communication speed; speed codes can be found in Table 1.

[97]Example: Communication parameters reading; FEH universal address, signature: 02H

   2AH,61H,00H,05H,FEH,02H,F0H,7FH,0DH

   Response- address: 04H, communication speed: 9600Bd

   2AH,61H,00H,07H,04H,02H,00H,04H,06H,5DH,0DH

[97]Notes: This instruction is designed for the detection of the set address of the device in case it is unknown. The enquiry is sent to the FEH universal address. If even the communication speed is not known it is necessary to try out all communication speeds available for the particular device. However, no other device can be connected on the line in this case.

   Other communication parameters are: 8 bits, no parity, 1 stop-bit. The default communication speed set by the manufacturer is 9600Bd, the address is indicated as an ASCII sign on the thermometer label.

A d d i t i o n a l

C o n f i g u r a t i o n   A c k n o w l e d g e m e n t

Description: Enables configurations to be carried out. It must immediately precede some instructions (Communication Parameters Setup and Check Sum Acknowledgement). After a following instruction (even an invalid one) the configuration is again automatically disabled. This instruction can not be used with the universal or broadcast address.

[97]Enquiry: E4H

[97]Response: (ACK 00H)

[97]Example: Configuration acknowledgement

    2AH,61H,00H,05H,01H,02H,E4H,88H,0DH

    Response

    2AH,61H,00H,05H,01H,02H,00H,6CH,0DH

[66]Dotaz: „E"   *(Enable)*

[66]Odpověď: (ACK „0")

[66]Příklad: Enquiry

    *B1E↵

    Response

    *B10↵

S t a t u s   S e t u p

Description: Sets the device status. User-defined byte, which can be used to find out the device condition.

[97]Enquiry: E1H (status)

[97]Response: (ACK 00H)

[97]Legend: (status)   1 byte; device status. After the device is switched on or reset (even software) the status of 00H is set automatically. If a new value is set using the Status Setup instruction it is subsequently easy to identify the current status of the device.

[97]Example: Status of 12H setup; address: 01H, signature: 02H

    2AH,61H,00H,06H,01H,02H,E1H,12H,78H,0DH

    Response

    2AH,61H,00H,05H,01H,02H,00H,6CH,0DH

[66]Enquiry: „SW"(status)   (Status Write)

[66]Response: (ACK „0")

[66]Legend: (status)   character from the interval of "space" to "~" (32 – 126)

[66]Example: Enquiry – A character

    *B1SWA↵

    Response

    *B10

Status Reading

Description: Read the device status. User-defined byte, which can be used to find out the device condition.

[97]Enquiry: F1H

[97]Response: (ACK 00H)(status)

[97]Legend: (status)   1 byte; device status, for more info see Status Setup.

[97]*Example: Status reading; address: 01H, signature: 02H*

> *2AH,61H,00H,05H,01H,02H,F1H,7BH,0DH*

> *Response- status: 12H*

> *2AH,61H,00H,06H,01H,02H,00H,12H,59H,0DH*

[66]Enquiry: „SR"   (Status Read)

[66]Response: (ACK „0")(character)

[66]Legend: (character) character from the interval of "space" to "~" (32 – 126)

[66]*Example: Enquiry*

> **B1SR↵*

> *Response*

> **B10A↵*

Name and Version Reading

Description: Reads the name of the device, version of the internal software and list of possible communication formats (for TQS3 97 and 66 modules). Set by the manufacturer.

[97]Enquiry: F3H

[97]Response: (ACK 00H) (string)

[97]Legend: (string)   Text in the form of: „*TQS3; v0199.01; F66 97*".

[97]*Example: Enquiry*

> *2AH,61H,00H,05H,31H,02H,F3H,49H,0DH*

> *Response*

> *2AH,61H,00H,1BH,31H,02H,00H,54H,51H,53H,33H,3BH,20H,76H,30H,31H,39H*
> *,39H,2EH,30H,31H,3BH,20H,46H,36H,36H,20H,39H,37H,2BH,0DH*

[66]Enquiry: „?"

[66]Response: (ACK „0")

[66]*Example: Enquiry*

> **B1?↵*

> *Response*

> **B10TQS3; V0199.01; F66 97↵*

Reset

Description: Carries out the device reset. The module enters the same condition as after supply switching on.

[97]Enquiry: E3H

[97]Response: (ACK 00H)

[97]Example: Reset; address: 01H, signature: 02H

> *2AH,61H,00H,05H,01H,02H,E3H,89H,0DH*

> *Response*

> *2AH,61H,00H,05H,01H,02H,00H,6CH,0DH*

Note: Reset is carried out after the response is sent.

----

[66]Enquiry: „RE"   *(REset)*

[66]Response: (ACK „0")

[66]Example: Enquiry

> **B1RE⏎*

> *Response*

> **B10⏎*

Check Sum Acknowledgement

Description: Enables the verification of check sum in the incoming messages. This instruction <u>must</u> be immediately preceded by the instruction of Configuration Acknowledgement (see page 19).

[97]Enquiry: EEH (status)

[97]Response: (ACK 00H)

[97]Legend: (status)   1 byte; 01H for check-up switching on; 00H for switching off

[97]Example: Configuration acknowledgement

> *2AH,61H,00H,06H,01H,02H,EEH,01H,7CH,0DH*

> *Response*

> *2AH,61H,00H,05H,01H,02H,00H,6CH,0DH*

Check Sum – Setup Reading

Description: Finds out the current set up of the check sum verification.

[97]Enquiry: FEH

[97]Response: (ACK 00H) (status)

[97]Legend: (status)   1 byte; 01H for verification switching on; 00H for switching off

[97]Example: Setup enquiry

> *2AH,61H,00H,05H,01H,02H,FEH,6EH,0DH*

> *Response – verification switched on*

> *2AH,61H,00H,06H,01H,02H,00H,01H,6AH,0DH*

User Data Saving

Description: The instruction saves user data. The device remembers the data after supply disconnection.

[97]Enquiry: E2H (position)(data)

[97]Response: (ACK 00H)

[97]Legend: (position)   1 byte; address of the memory where the data are to be saved. 00H to 0FH

(data)   1 to 16 bytes; any user data.

[97]*Example:* *Saving the expression "BOILER ROOM 1" on the memory address of 00H; address: 01H, signature: 02H*

2AH,61H,00H,12H,01H,02H,E2H,42H,4FH,49H,4CH,45H,52H,20H,52H,4FH,4FH ,4DH,20H,31H,12H,0D

Response

2AH,61H,00H,05H,01H,02H,00H,6CH,0DH

Notes: The memory for user data has the capacity of 16 bytes. In case the data are being written to the memory address e.g. 0CH, it is possible to write 4 bytes maximum.

[66]Enquiry: „DW"(position)(data)   *(Data Write)*

[66]Response: (ACK „0")

[66]Legend: (position)   address of the memory position to which the data will be written. Interval 0-9 or A-F.

(data)   1 to 16 bytes; any user data. Interval 0-9 or A-F.

[66]*Example:* *Enquiry*

*B1DW0KOTELNA 1↵

Response

*B10↵

Saved User Data Reading

Description: The instruction reads saved user data. The device remembers the data after supply disconnection.

[97]Enquiry: F2H

[97]Response: (ACK 00H)(data)

[97]Legend: (data)   16 bytes; saved user data.

[97]*Example:* *User data reading; address: 01H, signature: 02H*

2AH,61H,00H,05H,01H,02H,F2H,7AH,0DH

Response - "BOILER ROOM 1   "

2AH,61H,00H,15H,01H,02H,00H,42H,4FH,49H,4CH,45H,52H,20H,52H,4FH,4FH ,4DH,20H,31H,20H,20H,20H,91H,0DH

[66]Enquiry: „DR"   *(Data Read)*

[66]Response: (ACK „0")(data)

[66]Legend: (data)   1 to 16 bytes; User data.

[66]*Example:* *Enquiry*

*B1DR↵

Response

*B10KOTELNA 1↵

Communication Errors Reading

Description: The instruction returns the number of communication errors which have occurred since the device switching on or since the last communication errors reading.

[97]Enquiry: F4H

[97]Response: (ACK 00H) (errors)

[97]Legend: (errors)   1 byte; the number of errors which have occurred since the device switching on or since the last errors reading. The following events are considered communication errors:

>>> Prefix is expected but another byte is received

>>> SUMA check sum does not agree

>>> Message is incomplete

[97]*Example: Communication errors reading; address: 01H, signature: 02H*

2AH,61H,00H,05H,01H,02H,F4H,78H,0DH

Response - 5 errors

2AH,61H,00H,06H,01H,02H,00H,05H,66H,0DH

Address Setup using Serial Number

Description: The instruction enables the module address to be set using the serial number only.

[97]Enquiry: EBH(new-address)(product-number)(serial-number)

[97]Response: (ACK 00H)

[97]Legend: (new-address)   1 byte; new address of the module.

(product-number) 2 bytes; product number; for TQS3 thermometer it is always decimally: 199, thus hexadecimally: 00C7.

(serial-number)   2 bytes; the TQS3 thermometer serial number is indicated on the label after the 0199.01/ text. This number can also be found out via the Manufacturing Data Reading instruction.

[97]*Example: Enquiry – new address: 32H, product-number: 199 (= 00C7H),*
serial number: 101 (= 0065H)

2AH,61H,00H,0AH,FEH,02H,EBH,32H,00H,C7H,00H,65H,21H,0DH

Response – the thermometer already responds with the new address

2AH,61H,00H,05H,32H,02H,00H,3BH,0DH

Manufacturing Data Reading

Description: The instruction reads the manufacturing data from the TQS3 thermometer

[97]Enquiry: FAH

[97]Response: (ACK 00H)(product-number)(serial-number)(manufacturing-data)

[97]Legend: (product-number)   2 bytes; product number; for TQS3 thermometer it is always decimally: 199, thus hexadecimally: 00C7.

(serial-number)   2 bytes; the TQS3 thermometer serial number is indicated on the label after the 0199.01/ text.

(manufacturing-data)   4 bytes

[97]Example: Enquiry

2AH,61H,00H,05H,FEH,02H,FAH,75H,0DH

Response – product-number 199 (=00C7H), serial number 101 (=0065H), manufacturing-data 20050923H

2AH,61H,00H,0DH,35H,02H,00H,00H,C7H,00H,65H,20H,05H,09H,23H,B3H,0DH

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Address:

Strasnicka 3164
102 00 Prague 10
Czech Republic

Tel:

+420 267 314 267
+420 267 314 268
+420 602 379 954

Fax:

+420 267 314 269

Internet:

www.papouch.com

E-mail:

info@papouch.com