User manual

SerGEn 2Bi(An)

EnOcean Transceiver – Serial Gateway EnOcean RS232 bidirectional.

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1. General Notice

The radio Transceiver module SerGEn 2 Bi operates as a gateway between sensors, actuators etc, based on the EnOcean radio technology and RS232 serial interface. All telegrams received flawlessly are output unchanged to the COM port. Thus, a bidirectional connection to any devices based on EnOcean radio technology could established.

Technical data:

- Power supply 5 VDC
- Max current consumption – 200 mA
- Wireless protocol – EnOcean Frequency/Modulation 868MHz / ASK /125kbps
- Receiver sensivity - 96 dBm
- Transmit power below 10mW (5dBm)
- Transmit range 300m free field
- Hardware interface – RS232 Full-duplex, async, 9.6kbps
- Tx reliability feature Carrier sense before transmit
- Receiver features Sensitivity can be reduced by SW command or manually in the tied mode.
- Fast Tx power up from standby 2us
- Tx/Rx changeover 0.5u
- Modem functionality 6 bytes per telegram with acknowledge
- Antenna – integrated or external
- Protection – IP65, -20- +50 C, max rH 95 %(without condensing).

2. Data Format

Baud rate: 9600 Baud
Start bit (ST): 1
Data bits: 8
Stop bits (SP): 1
Parity (P): none
Flow control: none

3. Telegram Structure

| Byte	Bit7 ... Bit0		Description
0	SYNC_BYTE1 (A5 Hex)		Start identification
1	SYNC_BYTE0 (5A Hex)		
2	H_SEQ (3Bit)	LENGTH (5 Bit, 0B Hex)	H_SEQ (3Bit) => Reserved LENGTH (5 Bit) => Number of following bytes (11 Dez)
3	TYPE		Telegram identification
4	DATA_BYTE3		Data bytes 0...3
5	DATA_BYTE2		
6	DATA_BYTE1		
7	DATA_BYTE0		
8	ID_BYTE3		32-Bit Sensor/Key-ID
9	ID_BYTE2		
10	ID_BYTE1		
11	ID_BYTE0		
12	STATUS		Status - Field
13	CHECKSUM		Checksum of bytes 2 - 12

4. Data Output Input.

Output from RS232. Each telegram received flawlessly is generally output on the COM port side without any further processing. The meaning of the data bytes DATA_BYTE0...3 is depending on the respective device type. Thus, it is described in the corresponding product data sheets. In Filtering mode the only tied ID could reached the RS232 output. *Input to RS232.* You could send two type of command Gateway configuration command and Transmit command. Detail command description you could find in **APENDIX.**

5. Installation

1. Connect interface to any desired serial COM port, serial cable max length 20m using shielded twisted pair
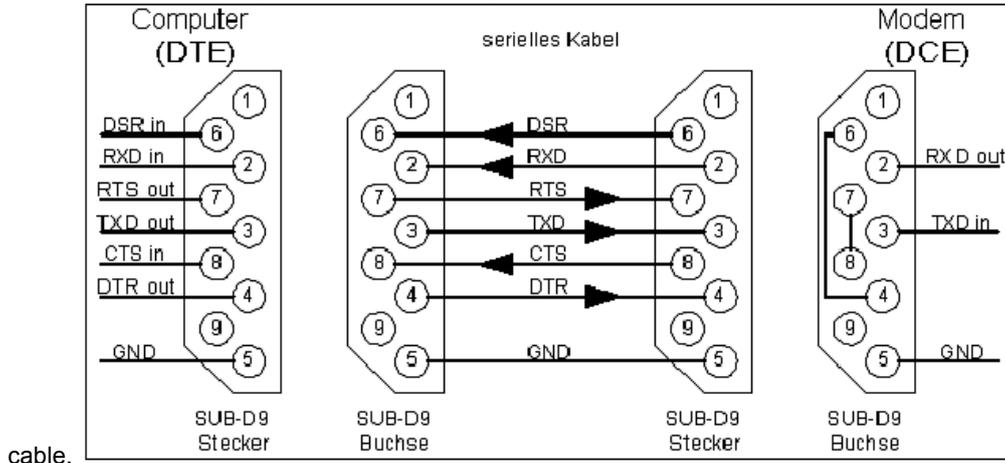
cable.

2. Connect 5 VDC power supply to mini jack attached to serial connector or connect your cable to P3 on the gateway's PCB.

3. Use TCM monitor software for receiving or transmitting EnOcean telegrams or refer to last version of EnOcean communication profile for using other devices supporting free programmed RS232 interfaces. You can use free WinEtel Communication Software (please download it from http://www.enocean.com/en/download/)

4. EnOcean WinEtel receives, sends and analyses EnOcean RF telegrams. Telegrams are displayed and can be logged with time stamp. In combination with tranceivers its possible to simulate e.g. sensors or switch modules (e.g. PTM 200). WinEtel allows to send and retrieve dedicated configuration commands (TCT/RCT). Further it is possible to extend the basic terminal functionality for specific use and application cases with Plug Ins.

6. Transmission range

The main factors that influence the system transmission range are type and location of the antennas of the receiver and the transmitter, type of terrain and degree of obstruction of the link path, sources of interference affecting the receiver, and "dead" spots caused by signal reflections from nearby conductive objects. Since the expected transmission range strongly depends on this system conditions, range tests should categorically be performed before notification of a particular range that will be attainable by a certain application.

The following figures for expected transmission range are considered by using a PTM, a STM or a TCM radio transmitter device and the TCM radio receiver device with preinstalled whip antenna and may be used as a rough guide only:

- Line-of-sight connections: Typically 30 m range in corridors, up to 100 m in halls
- Plasterboard walls / dry wood: Typically 30 m range, through max. 5 walls
- Line-of-sight connections: Typically 30 m range in corridors, up to 100 m in halls
- Ferro concrete walls / ceilings: Typically 10 m range, through max. 1 ceiling
- Fire-safety walls, elevator shafts, staircases and supply areas should be considered as screening.

The angle at which the transmitted signal hits the wall is very important. The effective wall thickness – and with it the signal attenuation – varies according to this angle. Signals should be transmitted as directly as possible through the wall. Wall niches should be avoided. Other factors restricting transmission range:

- Switch mounted on metal surfaces (up to 30% loss of transmission range)
- Hollow lightweight walls filled with insulating wool on metal foil
- False ceilings with panels of metal or carbon fibre
- Lead glass or glass with metal coating, steel furniture

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The distance between EnOcean receivers and other transmitting devices such as computers, audio and video equipment that also emit high-frequency signals should be at least 0.5 m
A summarized application note to determine the transmission range within buildings is available as download from www.enocean.com

7. Package

1. Gateway SerGEn 2Bi.
2. Software and driver CD.
3. User manual.
4. External antenna with 2 m cable (Optional for SerGEn xxxAn design).
5. Power supply unit 220=>5 VDC (Optional).
6. Warrantee card.

8. Ordering art number.

Art number	Name	Description
	SerGEn 2Bi	EnOcean-RS232 gateway bidirectional
	SerGEn 2BiAn	EnOcean-RS232 gateway bidirectional with external antenna.
	SerGEn 4Bi	EnOcean-RS485 (point to point) gateway bidirectional
	SerGEn 4BiAn	EnOcean-RS485 (point to point) gateway bidirectional with external antenna.
	SerGEn 4BiB	EnOcean-RS485 (with bus master topology, 32 gateways on the bus max.) gateway bidirectional.
	SerGEn 4BiBAn	EnOcean-RS485 (with bus master topology, 32 gateways on the bus max.) gateway bidirectional with external antenna.

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TCM Monitor 4.0.0.0

1. TCM Monitor

With the TCM–Monitor you can use the SerGEn 2 Bi to send and receive all kind of EnOcean TRT (Transmit Radio Telegram) and RRT (Receive Radio Telegram) telegrams. You can control as well all the properties of the SerGEn 2 Bi such as the antenna sensitivity, the channel or the communication speed through the serial port; you can do that via the EnOcean TCT (Transmit Control Telegram) and RMT (Receive Control Telegram) telegrams.

In the package (compressed with ZIP) you may normally find all these files: • mfc70.dll • mfc70d.dll • msvcp70.dll • msvcp70d.dll • msvcr70.dll • SerialIO.dll • SerialIOd.dll • TCM–Monitor<version>.exe

2. TCM Monitor Operation

2.1 TCT / RMT

The TCT (Transmit Command Telegram) are the commands transmitted from the PC to the SerGEn 2 Bi module to set/change/retrieve the data or the configuration of the device. As an answer to the TCT, the SerGEn 2 Bi   returns and RMT (Received Message Telegram); these telegrams could be a simple ACK or the data asked.

2.2 TRT / RRT

The TRT (Transmit Radio Telegram) are the telegrams that the SerGEn 2 Bi   should send to the air (towards another TCM120, a RCM, etc.).
The RRT (Received Radio Telegram) are the telegrams that the SerGEn 2 Bi   could receive from the air (coming from another TCM120, a TCM110, a RCM, etc.).
Both of them are compatibles with RCM120 in Mode 0.
Please, refer to TCM120 user manual documentation for further information.
Therefore, in this application you can send TRTs (to the air, via TCM120) and TCTs (to the TCM120). You will receive RRTs (from the air, via TCM120) and RMTs (from TCM120).
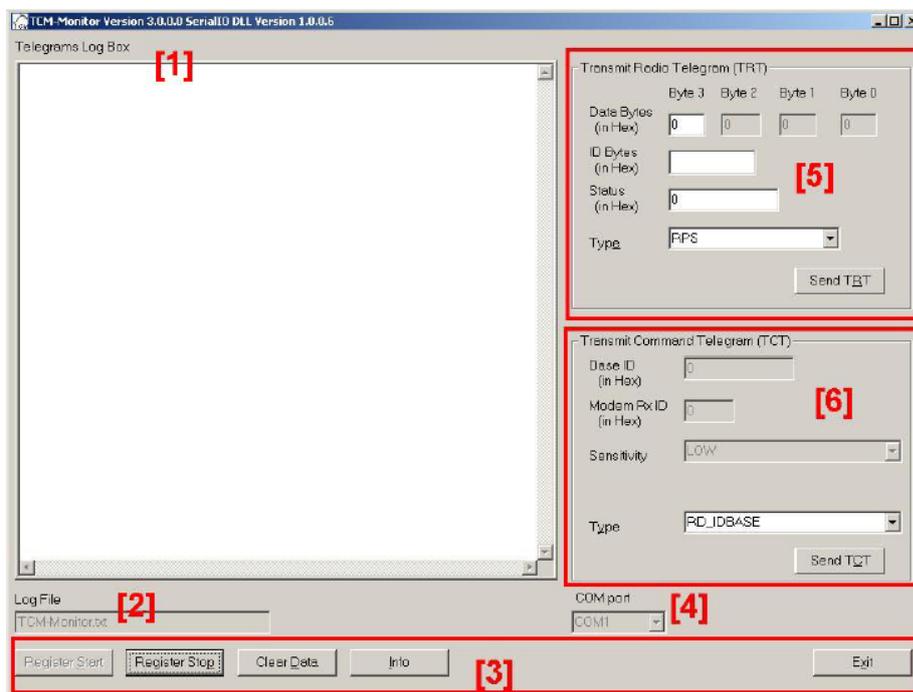

Figure 3 - TCM–Monitor: Main Window

The Figure above represents the Main Window of the TCM–Monitor and shows the basic interface to interact with the SerGEn 2 Bi devices.

TELEGRAM LOG BOX.
The first issue that you see in this window is the Telegrams Log text box [1]; in this box you will see all the telegrams that are sent by / received at the SerGEn 2 Bi.

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The outgoing telegrams (the ones which travel from computer to TCM: TRT and TCT telegrams) will be followed by the symbol "-->".

The incoming telegrams (the ones which travel from TCM to computer: RRT and RMT telegrams) will be followed by the symbol "<--".

The format of the telegrams that will be shown in the log text box depends on the type of the telegram sent / received. See "Detailed Telegram Log Box Information" section for more information about this format.

The typical use of the TCM–Monitor is to receive telegrams. One typical sequence of telegrams could be this one:

```
000001, RRT, RPS, Data: 10,00,00,00, ID: 00075b77 St: 00 2004:03:04 15:52:53:531,<--
000002, RRT, RPS, Data: 00,00,00,00, ID: 00075b77 St: 00 2004:03:04 15:52:53:812,<--
000003, RRT, RPS, Data: 10,00,00,00, ID: 00075b77 St: 00 2004:03:04 15:52:54:453,<--
000004, RRT, RPS, Data: 00,00,00,00, ID: 00075b77 St: 00 2004:03:04 15:52:54:609,<--
000005, RRT, RPS, Data: 10,00,00,00, ID: 00075b77 St: 00 2004:03:04 15:52:54:875,<--
000006, RRT, RPS, Data: 00,00,00,00, ID: 00075b77 St: 00 2004:03:04 15:52:55:046,<--
000007, RRT, 4BS, Data: b0,80,50,08, ID: 000001d1 St: 00 2004:03:04 15:52:55:640,<--
000008, RRT, RPS, Data: 10,00,00,00, ID: 00075b77 St: 00 2004:03:04 15:52:55:843,<--
000009, RRT, RPS, Data: 00,00,00,00, ID: 00075b77 St: 00 2004:03:04 15:52:56:140,<--
```

For detailed information about the text shown for every type of telegram, please, refer to section "List of Telegrams" in this documentation.

LOG FILE

First of all you can choose the name of the log file where you want to store all the information about the telegrams received at TCM120. By default this file is set as "TCM–Monitor.txt" [2]. This name will be automatically modified every time you run the telegram logging (so, every time you click over "Register Start" button), adding the current date and time of the system. The idea is to have a different log file for each different session. For instance, if you run the software at 09:58:27 on January the 13th, 2004, the name of the log file will be "TCM–Monitor2004.01.13-09.58.27.txt".

The format of this file is the same that telegram log box has. See "Detailed Telegram Log Box Information" section for more information about this format.

BUTTONS

In this Main Window you will also find the buttons [3] to start (Register Start) and stop (Register Stop) the logging of telegrams; the Clear Data button, that cleans the log text box; the Info button, which gives you information about the application use, and the Exit button, that finishes and quits the application.

COM PORT

When you set a serial communication you may need to specify a port. You can select the serial port number in this box [4].

TRT TELEGRAMS

Use this window to send TRT telegrams [5].

Figure 4 TCM–Monitor: TRT frame

First you have to select the type of TCT telegram you may want to send [7]. Then, depending on the type of the telegram, you will see enabled or disabled the text boxes [8] for the information you may want to send in the TCT. For detailed information about the boxes enabled for every type of telegram, please, refer to section "List of Telegrams" in this documentation.

Note about the text format of the boxes:

• Data Bytes: these data must be written in hexadecimal format. Note that a byte has two characters in hexadecimal. These characters must be the following: 0, 1, 2, 3, 4, 5, 6, 7, 8 ,9 ,a ,b ,c ,d ,e ,f ,A ,B ,C ,D ,E ,F. If you write only one character, the first will be assumed zero. If you don't write any, the number will be assumed zero. Note for 6DT telegrams: For 6DT telegrams 6 data bytes are needed. The four most significant bytes will be taken from "Byte 3" to "Byte 0". As least significant bytes the two first bytes from ID Bytes will be used. • ID Bytes: these data must be written in hexadecimal format too. Note that every ID has four bytes. Therefore, up to eight characters should be entered. If you enter less, it will be assumed zero characters are in the left. If you don´t write any character, it will be assumed zero. Please see note above for 6DT telegrams. • Status: these data must be written in hexadecimal

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format too. Note that Status has only one byte, that is, two characters in hexadecimal format. Read the "data bytes" instructions above for more information. Finally, you just need to put the information you may want to send and click on the button "Send TCT" [9]. TCT TELEGRAMS Use this window to send TCT telegrams [6].
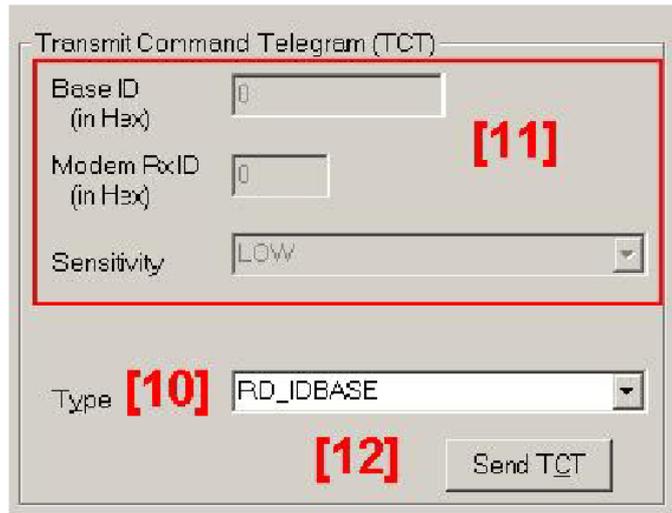

Figure 5 TCM–Monitor: TCT frame

First you have to select the type of TRT telegram you may want to send [10]. Then, depending on the type of the telegram, you will see enabled or disabled the text boxes [11] with the information you may want to send in the TRT. For detailed information about the boxes enabled for every type of telegram, please, reefer to section "List of Telegrams" in this documentation. Note about the text format of the boxes: • Base ID: these data must be written in hexadecimal format. Note that every ID has four bytes. Therefore, up to eight characters should be entered. These characters must be the following: 0, 1, 2, 3, 4, 5, 6, 7, 8 ,9 ,a ,b ,c ,d ,e ,f ,A ,B ,C ,D ,E ,F. If you enter less, it will be assumed zero characters are in the left. If you don´t write any character, it will be assumed zero. • Modem Rx ID: these data must be written in hexadecimal format too. Note this field has two bytes. Therefore, up to four characters should be entered. If you write less, they will be assumed zero. If you don't write any, the number will be assumed zero. Finally, you just need to put the information you may want to send and click on the button "Send TRT" [12].

Detailed telegram log box information.

For every different kind of telegram we send / receive at the TCM120, the TCM–Monitor displays a different kind of information on the Telegram Log Box of the program. This information is the same that it's shown in the log file.

4.1 TRT / RRT telegrams For every row (one telegram) you can see several different columns. The first column (1) of the log text box is just a counter of telegrams. In the Main Window all the telegrams (both sent and received) increase the counter. The second column (2) shows that we have sent a TRT or received a RRT telegram. The third column (3) displays the type of the telegram; these types could be RPS, 1BS, 4BS, HRC or 6DT (see the List of Telegrams for more information). The fourth column (4) shows the Data that was sent with the telegram. Depending on the telegram, the size of these data is different (see the List of Telegrams for more information). The fifth column (5) is the ID of the telegram. As well as the Data, the size depends on the type of telegram (see the List of Telegrams for more information). The sixth column (6) shows the Status of the telegram. For more information about the status, please, refer to "Funk Protocol" documentation. The seventh (7) and eighth (8) columns show the date and time when the telegram was sent / received. The last column (9) indicates whether the telegram was a TRT sent (-->) or a RRT received (<--

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
000001,	TRT,	RPS,	Data: 01,00,00,00,	ID: 05060708,	St: 01,	2004:03:05,	10:34:29:242,	-->
000002,	TRT,	1BS,	Data: 01,00,00,00,	ID: 05060708,	St: 00,	2004:03:05,	10:34:40:086,	-->
000003,	TRT,	4BS,	Data: 01,02,03,04,	ID: 05060708,	St: 00,	2004:03:05,	10:34:49:836,	-->
000004,	TRT,	HRC,	Data: 01,00,00,00,	ID: 05060708,	St: 00,	2004:03:05,	10:34:54:961,	-->
000005,	TRT,	6DT,	Data: 01,02,03,04,05,06,	ID: 0708 ,	St: 01,	2004:03:05,	10:35:01:476,	-->

).

TCT / RMT telegrams.

For every row (one telegram) you can see several different columns. The first column (1) of the log text box is just a counter of telegrams. In the Main Window all the telegrams (both sent and received) increase the counter. The second column (2) shows that we have sent a TRT or received a RMT telegram. The third column (3) displays a text informing the type of the telegram that we have sent (if TCT) or the answer that the TCM120 gives to us (if RMT). For more information on these telegrams see the List of Telegrams section. The fourth (4) and fifth (5) columns

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show the date and time when the telegram was sent / received.

(1)	(2)	(3)	(4)	(5)	(6)
000001,	TCT,	RD_IDBASE sent,	2004:03:05,	14:35:31:222,	-->
000002,	TCT,	RD_MODEM_STATUS sent,	2004:03:05,	14:35:32:706,	-->
000003,	TCT,	RD_RX_SENSITIVITY sent,	2004:03:05,	14:35:34:378,	-->
000004,	TCT,	RD_ SW_VER sent,	2004:03:05,	14:35:37:143,	-->
000005,	TCT,	SET_IDBASE sent ID 0x: 00000000,	2004:03:05,	14:35:47:112,	-->
000006,	TCT,	MODEM_OFF sent,	2004:03:05,	14:35:51:143,	-->
000007,	TCT,	MODEM_ON sent,	2004:03:05,	14:35:53:033,	-->
000008,	TCT,	RESET sent,	2004:03:05,	14:35:54:814,	-->
000009,	TCT,	SET_RX_SENSITIVITY sent. Sensitivity: LOW,	2004:03:05,	14:35:56:721,	-->
000010,	TCT,	SLEEP sent,	2004:03:05,	14:36:00:517,	-->

The last column (6) indicates whether the telegram was a TCT sent (-->) or a RMT received (<--).

List of telegrams

TRT / RRT telegrams

These telegrams are the same as in RCM120: RPS, 1BS, 4BS, HRC. The 6DT telegram is new in TCM120 and it's used in the modem functionality.

TCT telegrams

RD_IDBASE

When this command is sent to the TCM, the base ID range number is retrieved though an INF_IDRANGE telegram. The text shown in the Text Box is "RD_IDBASE sent.".

RD_MODEM_STATUS

This command requests the TCM to send information about its modem current state.

The information is reported back to the user through an INF_MODEM_STATUS telegram. This command informs about what the current parameters of the modem (On/Off, ID, etc).

The text shown in the Text Box is "RD_MODEM_STATUS sent.".

RD_RX_SENSITIVITY

When this command is sent to the TCM this retrieves the sensitivity mode (HIGH or LOW) in which it is currently working in. This information comes within an INF_RX_SENSITIVITY.

The text shown in the Text Box is "RD_RX_SENSITIVITY sent.".

RD_SW_VER

This command requests the TCM to retrieve its current software version number. This information comes in an INF_SW_VERSION telegram generated by the TCM.

The text shown in the Text Box is "RD_SW_VER Sent.".

SET_IDBASE

Through this command the user can rewrite its ID range base number. The user introduces the ID base number in the 4 DataBytes as the command encoding shows. The most significant byte of it is IDRangeByte3. The information of the 25 most significant bits is stored in the TCM as ID Range. This command can only be used a maximum number of 10 times. After successfully ID Range reprogramming, the TCM answers with an OK telegram. If it were not possible the ID Range reprogramming the TCM answers sending an ERR telegram.

The text shown in the Text Box is "SET_IDBASE sent ID 0x:" and the written ID in hexadecimal notation.

MODEM_OFF

This deactivates the TCM modem functionality. When this command has been sent an OK command should be received.

The text shown in the Text Box is "MODEM_OFF Sent.".

MODEM_ON

This activates the TCM modem functionality and, at the same time, it sets the modem ID channel. When this command has been sent an OK command should be received.

The text shown in the Text Box is "MODEM_ON Sent.".

RESET

It performs a reset of the TCM microcontroller.

The text shown in the Text Box is "RESET Sent.".

SET_RX_SENSITIVITY

This command indicates to the TCM that it should work in LOW/HIGH radio sensitivity. In LOW, radio sensitivity signals from far transmitters are not detected by the TCM receiver. This feature is useful when the TCM is in learning mode, where only information from a near transmitter should be processed. When this command has been sent an OK command should be received after TCM sensitivity has been changed.

The text shown in the Text Box is "SET_RX_SENSITIVITY Sent." and then the new sensitivity.

SLEEP

If TCM receives the sleep command it works in an energy saving mode. The TCM will not wake up until it receives data through the serial port.

The text shown in the Text Box is "SLEEP Sent.".

WAKE

TCM will quit its sleep mode after receiving this command.

The text shown in the Text Box is "WAKE Sent.".

RMT telegrams

OK

This command confirms to the user that his action was performed correctly by TCM.

The text shown in the Text Box is "Action performed.".

ERR

It's a possible response to a TCT write command when the operation could not be carried out successfully by the TCM.

The text shown in the Text Box is "Action couldn't be successfully performed.".

ERR_TX_IDRANGE

When a radio telegram intended to be sent has its ID number out of range this message is generated informing the user of this circumstance. The TRT message is not delivered.

The text shown in the Text Box is "Incorrect TRT ID Range.".

ERR_MODEM_NOTACK

This command is sent from the TCM to the user after not receiving the corresponding MDA to a previous 6DT on time. It informs that no acknowledge was received.

The text shown in the Text Box is "6DT not acknowledged.".

ERR_MODEM_NOTWANTEDACK

This message is generated in the following scenarios:

When a 6DT telegram has been sent the TCM waits for a MDA telegram. If a MDA with the right channel comes out of time or after a previous MDA this telegram is transmitted.

The text shown in the Text Box is "6DT acknowledge not wanted.".

INF_IDBASE

This command retrieves information to the user relative to the ID base number of the TCM.

The text shown in the Text Box is "ID Range 0x:" and then the ID range in hexadecimal notation.

INF_MODEM_STATUS

It informs the user about the TCM current modem state. The information provided is the modem state (ON or OFF) and modem reception ID stored.

The text shown in the Text Box is "TCM Modem Status:" and the status in a first line and then "TCM Modem Rx ID:" and the ID in hexadecimal notation in a second line.

INF_INIT

After switching on the TCM or a RESET command, the TCM informs the user through these RMT telegrams which is its initial state. These telegrams are sent at 9600 kbaud. After that, the TCM works at the speed that the user had previously stored.

INF _RX_SENSITIVITY

This is the answer to a RD_RX_SENSITIVITY command. It informs about the current TCM sensitivity. It could be HIGH or LOW.

The text shown in the Text Box is "Sensitivity:" and then the sensitivity.

INF_SW_VER

It informs the user about the TCM current software version number.

The text shown in the Text Box is "TCM Version:" and then the software version.

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A.1 EnOcean serial protocol

When the receiver is in "Serial Interface" mode, it transfers out data blocks of information from the received RF telegrams. As long as no transmitter has been learned, all received EnOcean telegrams are transferred. As soon as at least one transmitter has been learned only telegrams of transmitters learned by the receiver are transmitted via the serial interface. The data block format is explained later in this document; it depends on the type of sensor from which the telegram has been received.

A.1.1 Message format

The following figure shows the message format. A block is composed of 2 synchronization bytes, 1 byte for the header and N bytes for the message data.

Message format for asynchronous serial communication
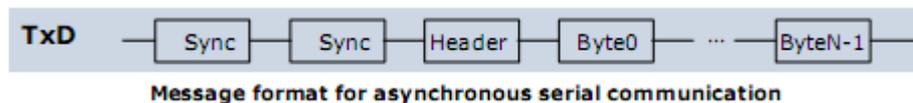
A.1.2 Byte signals and bit order

„ 9600 bps; 8 data bits, no parity bit, one start bit, one stop bit
„ Line idle is binary 1 (standard)
„ Each character has one start bit (binary 0), 8 information bits (least significant bit first) and one stop bit (binary 1)

Signals and bit order sending a byte
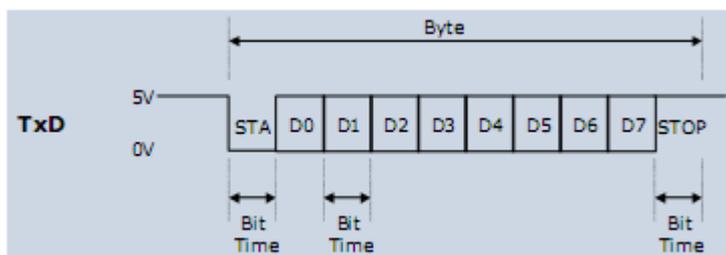
A.2 Radio transmission/reception commands

The following commands are used to transmit and receive radio telegrams.

Command	Response (RMT)
TX_TELEGRAM (TRT)	OK, ERR, ERR_TX_IDRANGE
RX_TELEGRAM (RRT)	

The TX_TELEGRAM and RX_TELEGRAM telegrams have the same structure. The only difference is in the H_SEQ code, TX_TELEGRAM is identified by "3". RX_Telegrams are identified by the H_SEQ codes according to table in A.2.1.

A.2.1 Description of serial data structure

Bit 7   Bit 0

SYNC_BYTE1 (A5 Hex)
SYNC_BYTE0 (5A Hex)
H_SEQ | LENGTH
ORG
DATA_BYTE3
DATA_BYTE2
DATA_BYTE1
DATA_BYTE0
ID_BYTE3
ID_BYTE2
ID_BYTE1
ID_BYTE0
STATUS
CHECKSUM

SYNC_BYTE 0..1 (8 bit each) Synchronization Bytes
H_SEQ (3 bit) Header identification

H_SEQ	Meaning	Mode
0b000	• Unknown transmitter ID received (serial telegram only if no ID has been learned so far!) • For *RPS* also: ○ Known transmitter ID and unknown rocker ○ U-message from known transmitter ID received • For *HRC* also: ○ Known transmitter ID and unknown rocker ○ Scene switch command (last three bits of ID 0b*111*) from known transmitter ID (only first 29 bits are compared!)	Operating Mode
0b001	• For 1BS and 4BS: Known transmitter ID received • For RPS: Known transmitter ID and at least 1 known rocker (1 or 2 rockers operated) • For HRC: Known transmitter ID and known rocker	Operating Mode
0b010	• New transmitter learned (If a switch telegram is received (RPS or HRC), the rocker code (RID) is stored together with the ID.)	Learn Mode
0b110	• Transmitter just deleted (If a switch telegram is received (RPS or HRC), the rocker code (RID) and module ID are checked. The entry is only deleted if module ID and rocker are known.)	Learn Mode

LENGTH (5 bit) Number of octets following the header octet (11 dec)
ORG (8 bit) Type of telegram (see detailed description below)
DATA_BYTE 0..3 (8 bit each) Data bytes 0..3 (see detailed description below) ID_BYTE 0..3 (8 bit each) 32-bit transmitter ID5
   For transmission of unique ID enter 0x00000000
STATUS (8 bit) Status field (see detailed description below)
CHECKSUM (8 bit) Checksum (Last LSB from addition of all octets except sync bytes and checksum)

A.2.2 Detailed description of ORG field

ORG field (hex)	Acronym	Description
0x05	RPS Repeated Switch	Telegram from a PTM switch module received (e.g. PTM 100 or PTM 200)
0x06	1BS 1 Byte Sensor	1 byte data telegram from a STM sensor module (e.g. STM 250)
0x07	4BS 4 Byte Sensor	4 byte data telegram from a STM sensor module (e.g. STM 110, STM 300)
0x08	HRC Hand Remote Control	Telegram from a CTM module received
0xC5	SYS_EX System Extended	Remote Management Telegrams (see separate specification)

A.2.3 Detailed description of STATUS field

If ORG = 5 (Telegram from a PTM switch module):

7			0
Reserved	T21	NU	RP_COUNTER

Reserved (2 bit) For future use
T21 (1 bit) T21=0 Æ PTM switch module of type 1,
  T21=1 Æ PTM switch module of type 2
NU (1 bit) NU=1 Æ N-message, NU=0 Æ U-message.
RP_COUNTER (4 bit) =0..15 Repeater level: 0 is original message (not repeated)

IMPORTANT NOTE FOR SYSTEMS USING AN ENOCEAN RADIO REPEATER:
Within toggle switch applications using the serial receiver mode in combination
with a separate repeater, please ensure that no serial command interpretation
error may occur at the connected control unit. A toggle signal means that the
same telegram is sent for switching something on and off. If e.g. the light is switched on receiving the I-button telegram
from a PTM 200C, the repeated tele-
gram (delay <100 ms) may switch off the light again. It is therefore mandatory to
interpret the RP_COUNTER field. If a repeated telegram (RP_COUNTER>0) is re-
ceived it has to be verified if the same telegram with a lower RP_COUNTER state
has already been received in the previous 100 ms. In this case the repeated mes-
sage has to be discarded.

PTM switch modules of Type 2 (e.g. PTM 200) allow interpretation of operating two buttons
simultaneously:
   • N-message received Æ Only one or two pushbuttons have been pressed.
   • U-message received Æ No pushbutton was pressed when activating the energy genera-

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tor, or more than two pushbuttons have been pressed.

Note for telegrams from PTM transmitters: Due to the mechanical hysteresis of the energy bow, in most rocker switch device implementations, pressing the rocker sends an N-message and releasing the rocker sends a U-message!

If ORG = 6, 7 or 8 (all other telegrams):

7	0
Reserved	RP_COUNTER
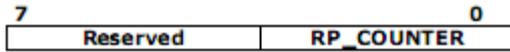
Reserved (4 bit) For future use
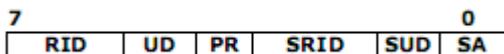RP_COUNTER (4 bit) Repeater level: 0 is original message (not repeated)

Please consider the "IMPORTANT NOTE" above!

A.2.4 Detailed description of DATA_BYTE 3..0 fields

If ORG = 5 and NU = 1 (N-message from a PTM switch module):

DATA_BYTE2..0 always = 0
DATA_BYTE3 as follows:

7					0
RID	UD	PR	SRID	SUD	SA

RID (2 bit) Rocker ID, from left (A) to right (D): 0, 1, 2 and 3
UD (1 bit) UD=1 Æ O-button, UD=0 Æ I-button
PR (1 bit) PR=1 Æ Energy bow pressed, PR=0 Æ Energy bow re-leased
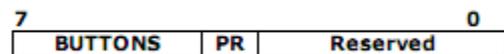SRID (2 bit) Second Rocker ID, from left to right: 0, 1, 2 and 3
SUD (1 bit) (Second) SUD=1 Æ O-button, SUD=0 Æ I-button
SA (1 bit) SA=1 Æ Second action (2 buttons pressed
simultaneously), SA=0 Æ No second action

If ORG = 5 and NU = 0 (U-message from a PTM switch module):

DATA_BYTE2..0 always = 0
DATA_BYTE3 as follows:

7			0
BUTTONS	PR	Reserved	

BUTTONS (3 bit) Number of simultaneously pressed buttons, as following:
PTM 100 (Type1): PTM 200 (Type2):
0 = 0 Buttons   0 = 0 Button
1 = 2 Buttons   1 = not possible
2 = 3 Buttons   2 = not possible
3 = 4 Buttons   3 = 3 or 4 buttons
4 = 5 Buttons   4 = not possible
5 = 6 Buttons   5 = not possible
6 = 7 Buttons   6 = not possible
7 = 8 Buttons   7 = not possible

PR (1 bit) PR = 1 Æ Energy bow pressed,
  PR = 0 Æ Energy bow released
Reserved (4 bit) for future use

If ORG = 6 (Telegram from a 1 Byte STM sensor):

DATA_BYTE2..0 always = 0
DATA_BYTE3 Sensor data byte.

If ORG = 7 (Telegram from a 4 Byte STM sensor):

DATA_BYTE3 Value of third sensor analog input (AD_2)
DATA_BYTE2 Value of second sensor analog input (AD_1)
DATA_BYTE1 Value of first sensor analog input (AD_0)
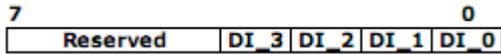DATA_BYTE0 Sensor digital inputs as follows:

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```
7                                    0
┌──────────────┬─────┬─────┬─────┬─────┐
│   Reserved   │DI_3 │DI_2 │DI_1 │DI_0 │
└──────────────┴─────┴─────┴─────┴─────┘
```
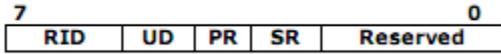
! According to "Standardization EnOcean Communication Profiles" which defines interoperable communication profiles for devices based on EnOcean Technology DI_3=0 indicates a teach-in telegram! DI_3 should therefore not be used for other purposes than signalling a teach-in telegram.

If ORG = 8 (Telegram from a HRC transmitter):

DATA_BYTE2..0 always = 0
DATA_BYTE3 as follows:

```
7                                    0
┌──────┬──────┬──────┬──────┬───────────┐
│ RID  │  UD  │  PR  │  SR  │  Reserved │
└──────┴──────┴──────┴──────┴───────────┘
```

RID (2 bit) Rocker ID, from left (A) to right (D): 0, 1, 2 and 3
UD (1 bit) UD=1 Æ O-button, UD=0 Æ I-button
PR (1 bit) PR=1 Æ Button pushed, PR=0 Æ Button released
SR (1 bit) SR=1 Æ Store, SR=0 Æ Recall (see note)
Reserved (3 bit) for future use

Note: The bit SR is used only when the lower 3 Bits from ID_BYTE0 = 0b111 (scene switch), and RID ≠ 0 (indicates that the memory buttons M0-M5 are operated in the hand-held remote control).

A.3 Command telegrams and messages
A.3.1 ID Range commands

Every TCM 300 supports a unique 32 bit ID and in addition a range of 128 IDs starting at an BaseID address. At production, every TCM 300 is programmed with a unique ID and a BaseID address. The BaseID number can be read via the serial interface. In order to allow a replacement of one unit with another unit (without having to go through the learning pro-cedure with every receiver), the ID range can be changed via the serial interface.
The allowed ID range is from 0xFF800000 to 0xFFFFFFFF.
In order to prevent misuse, this feature can only be used 10 times!
Please note: The unique ID cannot be changed.

Command (TCT)	Response (RMT)
SET_BASEID	OK, ERR, ERR_IDRANGE
RD_BASEID	INF_BASEID

A.3.2 Receiver sensitivity commands

The receiver sensitivity can be changed by the following commands. In LOW sensitivity mode, only transmitters in the vicinity of the module are received.

Command (TCT)	Response (RMT)
SET_RX_SENSITIVITY	OK
RD_RX_SENSITIVITY	INF_RX_SENSITIVITY

A.3.3 Reset command

Command (TCT)	Response (RMT)
RESET	

A.3.4 SW Version

Command (TCT)	Response (RMT)
RD_SW_VER	INF_SW_VER

A.3.5 Error messages

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Error Messages (RMT)
ERR
ERR_TX_IDRANGE
ERR_IDRANGE
ERR_SYNTAX

A.3.6 Command Encoding

OK

Bit 7   Bit 0

0xA5
0x5A
0x8B
0x58
X
X
X
X
X
X
X
X
ChkSum

Standard message used to confirm that an action was performed correctly by the TCM.
In case of full duplex communication it may happen that serial telegrams get corrupted and lost. Therefore it is recommended to check for "OK" where applicable.

ERR

Bit 7   Bit 0

0xA5
0x5A
0x8B
0x19
X
X
X
X
X
X
X
X
ChkSum

Standard error message response if after a TCT command the operation could not be carried out successfully by the TCM.

SET_BASEID

Bit 7   Bit 0

0xA5
0x5A
0xAB
0x18
BaseIDByte3
BaseIDByte2
BaseIDByte1
BaseIDByte0
X
X
X
X
X
ChkSum

With this command the user can rewrite its ID range base number. The most significant ID byte is BaseIDByte3. The information of the 25 most significant bits is stored in FLASH.
The allowed ID range is from 0xFF800000 to 0xFFFFFFFF.
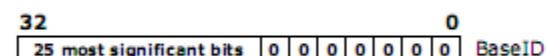
32									0
25 most significant bits	0	0	0	0	0	0	0		BaseID

This command can only be used a maximum number of 10 times. After successfully ID range reprogramming, the TCM answers with an OK telegram. If reprogramming was not successful, the TCM answers sending an ERR telegram if the maximum number

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of 10 times is exceeded or an ERR_IDRANGE telegram if the BaseID is not within the allowed range.

RD_BASEID

Bit 7   Bit 0

0xA5
0x5A
0xAB
0x58
X
X
X
X
X
X
X
X
X
ChkSum

When this command is sent to the TCM, the base ID range number is retrieved though an INF_BASEID telegram.

INF_BASEID

Bit 7   Bit 0

0xA5
0x5A
0x8B
0x98
BaseIDByte3
BaseIDByte2
BaseIDByte1
BaseIDByte0
X
X
X
X
X
ChkSum

This message informs the user about the ID range base number

BaseIDByte3 is the most significant byte.

SET_RX_SENSITIVITY

Bit 7   Bit 0

0xA5
0x5A
0xAB
0x08
Sensitivity
X
X
X
X
X
X
X
X
ChkSum

This command is used to set the TCM radio sensitivity.
In LOW radio sensitivity, signals from remote transmitters are not detected by the TCM receiver. This feature is useful when only information from transmitters in the vicinity should be processed. An OK confirmation telegram is generated after TCM sensitivity has been changed.

Sensitivity=0x00 Low sensitivity
Sensitivity=0x01 High sensitivity

RD_RX_SENSITIVITY

Bit 7   Bit 0

0xA5
0x5A
0xAB
0x4B
X
X
X
X
X
X
X
X
ChkSum

This command is sent to the TCM to retrieve the current radio
sensitivity mode (HIGH or LOW).
This information is sent via a INF_RX_SENSITIVITY command.

INF_RX_SENSITIVITY
Bit 7   Bit 0

0xA5
0x5A
0x8B
0x88
Sensitivity
X
X
X
X
X
X
X
ChkSum

This message informs the user about the current TCM radio sen-
sitivity.
Sensitivity= 0x00 Low sensitivity
Sensitivity= 0x01 High sensitivity

RESET
Bit 7   Bit 0

0xA5
0x5A
0xAB
0x0A
X
X
X
X
X
X
X
X
X
ChkSum

Performs a reset of the TCM microcontroller.

RD_SW_VER
Bit 7   Bit 0

0xA5
0x5A
0xAB
0x4B
X
X
X
X
X
X
X
X
X
ChkSum

This command requests the TCM to send its current software
version number.
This information is provided via an INF_SW_VER telegram by the
TCM.

INF_SW_VER

Bit 7   Bit 0

0xA5
0x5A
0x8B
0x8C
TCM SW Version Pos.1
TCM SW Version Pos.2
TCM SW Version Pos.3
TCM SW Version Pos.4
API Version Pos.1
API Version Pos.2
API Version Pos.3
API Version Pos.4
X
ChkSum

Informs the user about the current software version of the TCM.
Example: Version 1.0.1.16
TCM SW Version Pos.1 = 1
TCM SW Version Pos.2 = 0
TCM SW Version Pos.3 = 1
TCM SW Version Pos.4 =16

ERR_SYNTAX

Bit 7   Bit 0

0xA5
0x5A
0x8B
Field
X
X
X
X
X
X
X
X
X
ChkSum

This telegram is sent automatically through the serial port after
the TCM has detected a syntax error in a TCT telegram.
Errors can occur in the H_SEQ, LENGTH, ORG or CHKSUM
fields/bytes.

Field code:
H_SEQ=0x08   ORG=0x0B
LENGTH=0x09   CHKSUM=0x0A

ERR_TX_IDRANGE

Bit 7   Bit 0

0xA5
0x5A
0x8B
0x22
X
X
X
X
X
X
X
X
X
ChkSum

When a radio telegram intended to be sent has an ID number
outside the ID range, this error message is generated. The radio
telegram is not delivered.

ERR_ IDRANGE

Bit 7   Bit 0

0xA5
0x5A
0x8B
0x1A
X
X
X
X
X
X
X
X
X
ChkSum

This message is generated when the user tries to change the ID range base using the SET_BASEID command to a value outside the allowed range from 0xFF800000 to 0xFFFFFFFF.

<div align="right">APPENDIX B</div>

<div align="center">Example Code for Arduino To Read EnOcean Devices</div>

This code has been written in 'C' for the Arduino controller board, and is a simple reader for the TCM120.

```
// EnOcean reader
// Simple code to read an EnOcean telegram - does not check ID of transmitter at this stage, so will operate from ANY switch

int ledPin=13;
int packet[14];  //used as a rotational buffer
int j=0;

void setup()
{
 Serial.begin(9600);
 pinMode(ledPin,OUTPUT);
 digitalWrite(ledPin,HIGH);
 delay(250);
 digitalWrite(ledPin,LOW);
 Serial.println("EnOcean TCM120 reader");
 //send_packet(0xAB,0x48,0,0,0,0,0,0,0,0);
}

void loop()
{
while (Serial.available())
{
 // Serial.print(packet[j],HEX); Serial.print(" ");
 packet[j++]=Serial.read();
 j=j % 14;
 if((roly(j)==0xA5) && (roly(j+1)==0x5A))
 {
 print_packet(j);
 if(roly(j+2)==0x0B) //now we have sync bytes for receive packet
 {
  if((roly(j+3)==5) && (roly(j+4)==80)) digitalWrite(ledPin,HIGH); //switch is pressed ON
  if((roly(j+3)==5) && (roly(j+4)==0 )) digitalWrite(ledPin,LOW ); //switch released
 }
 }
}
}

void print_packet(int j)
{
 int i,ch=0;
 Serial.print("ORG:");   Serial.print(roly(j+3),HEX);
 Serial.print(" Data:"); for(i=j+4;i<=j+7;i++)  { Serial.print(roly(i),HEX); Serial.print(" "); }
 Serial.print("ID:");    for(i=j+8;i<=j+11;i++) { Serial.print(roly(i),HEX); Serial.print(" "); }
 Serial.print("ST:");    Serial.print(roly(j+12),HEX);
 Serial.print(" Chk:");  Serial.print(roly(j+13),HEX);
 for(i=2;i<13;i++) ch=ch+roly(j+i);
```

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```
 if((ch%0x100)==roly(j+13)) Serial.println(" OK"); else { Serial.print(" "); Serial.print(ch,HEX); Serial.println(" Error"); }
}

void send_packet(int typ,int cmd,int D3,int D2,int D1,int D0,int D_3,int D_2,int D_1,int D_0)  //not tested
{
 Serial.print(0xA5,BYTE);
 Serial.print(0x5A,BYTE);
 Serial.print(typ,BYTE);
 Serial.print(cmd,BYTE);
 Serial.print(D3,BYTE);
 Serial.print(D2,BYTE);
 Serial.print(D1,BYTE);
 Serial.print(D0,BYTE);
 Serial.print(D_3,BYTE);
 Serial.print(D_2,BYTE);
 Serial.print(D_1,BYTE);
 Serial.print(D_0,BYTE);
 Serial.print(0,BYTE);
 Serial.print(0xff & (typ+cmd+D3+D2+D1+D0+D_3+D_2+D_1+D_0));
}

int roly(int n)
{
return packet[n%14];
}
```

Example Code To Read EnOcean Devices

This code has been written in BASIC (Chipmunk Basic on the Mac, but should be simple to convert to other platforms) to read EnOcean devices. It simple reads data from the serial port, does some checking to see what type of device it is, and for one particular STM sensor, converts the analogue data to a real-world temperature. While not a comprehensive data monitoring program, it does demonstrate how simple it is to read data from the EnOcean devices.

```
10 dim ar(32)
20 sp1$ = macfunction("serialpath",1) : print sp1$
30 if sp1$ = "" then stop
40 sp2$ = macfunction("serialpath",2) : print sp2$
50 config$ = "COM1:"+sp1$+":9600,N,8,1"
60 print config$ : print
70 open config$ for input as #2
80 open config$ for output as #1
90 k = 0
100 while k <> 3 : rem control-C to exit
110 if (eof(2)) then
120 x = macfunction("wait",0.5)
130 else
140 a = asc(input$(1,2))
150 print right$("0"+hex$(a),2);" ";
160 ar(ap) = a : ap = ap+1
170 if ap > 13 then
180 if ar(ap-14) = 165 and ar(ap-13) = 90 then
190 print time$;" packet ";right$("0"+hex$(ar(ap-10)),2);" ";
200 print right$("0"+hex$(ar(ap-6)),2);right$("0"+hex$(ar(ap-5)),2);
210 print right$("0"+hex$(ar(ap-4)),2);right$("0"+hex$(ar(ap-3)),2);
220 print " ";
230 if ar(ap-11) = 5 then
240 print "PTM Telegram ";
250 if ar(ap-10) = 48 then print "A"
260 if ar(ap-10) = 112 then print "B"
270 if ar(ap-10) = 16 then print "C"
280 if ar(ap-10) = 80 then print "D"
290 if ar(ap-10) <> 48 and ar(ap-10) <> 112 and ar(ap-10) <> 16 and ar(ap-10) <> 80 then print
300 endif
310 if ar(ap-11) = 6 then
320 print "STM 1BS Telegram ";
330 if ar(ap-6) = 0 and ar(ap-5) = 0 and ar(ap-4) = 37 and ar(ap-3) = 229 then
340 print " SR04," : print "temperature =";
350 print 40*(ar(ap-8)/255);" degrees ";
360 a$ = str$(int(40*(ar(ap-8)/255)))+" degrees "
```

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```
370 say a$
380 if 40*(ar(ap-8)/255) > 27 then say "Hotter than the sun."
390 print 100*(ar(ap-9)/255);"% humidity ";
400 print 10*(ar(ap-10)/255);"setpoint "
410 else
420 print "unknown sensor"
430 endif
440 endif
450 if ar(ap-11) = 7 then
460 print "STM 4BS Telegram "
470 endif
480 endif
490 ap = 0
500 endif
510 endif
520 k$ = inkey$ : k = asc(k$)
530 wend
540 close #2 : close #1
```