USER MANUAL

TM13 / TM14

THICKNESS MONITOR

PREVAC

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Rev. 6

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Precision and Vacuum Technology

PREVAC

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1 INTRODUCTION

Please read this manual carefully to ensure optimum operating conditions right from the start. This user manual handbook contains important information about the functionality, installation, start-up and operation of the TM13/14

1.1 INTENDED TO USE

The TM13/14 device comprises: quartz oscillator, frequency measuring system and communication interface. It is connected to the input element of a quartz resonator. The measurement results are transmitted via RS232 or RS485 (depending of configuration) to the master device: either a PC or TMC13 controller.

1.2 SAFETY

The owner of the equipment must ensure that all users are aware of the Health and Safety information contained in this manual. If the equipment is sold or passed to another owner, this manual must be included with the equipment.

1.2.1 PERSONNEL QUALIFICATIONS

All the work described in this document should only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the end user of the product.

1.2.2 ILLUSTRATION OF RESIDUAL DANGERS

This Operating Manual illustrates safety notes concerning residual dangers as follows:

1. Information on preventing any kind of physical injury

2. Information on preventing extensive equipment and environmental damage

3. Information on correct handling or use. Disregarding safety notes can lead to malfunctions.

4. **Note: Indicates particularly important, but not safety-relevant information.**

1.2.3 GENERAL SAFETY INSTRUCTIONS

For all work you are going to do, adhere to the applicable safety regulations. Also observe all safety notes given in this document and forward the information to all other users of the product. In particular, pay attention to the following safety notes:

WARNING

Improper use.
Improper use can damage the TM14. Use the TM14 only as intended by the manufacturer.

WARNING

Improper installation and operation data.
Improper installation and operation data may damage the TM13 / TM14. Strictly adhere to the stipulated installation and operation data.

WARNING

Individual configuration of the device.
Individual configuration of the device by the client via the service application will void the liability of PREVAC.

1.3 TECHNICAL DATA

This section describes mechanical and ambience parameters, operational information and standards fulfilled by the device.

1.3.1 MECHANICAL DATA

Figure 1.1 shows the TM13 / TM14 dimensions.

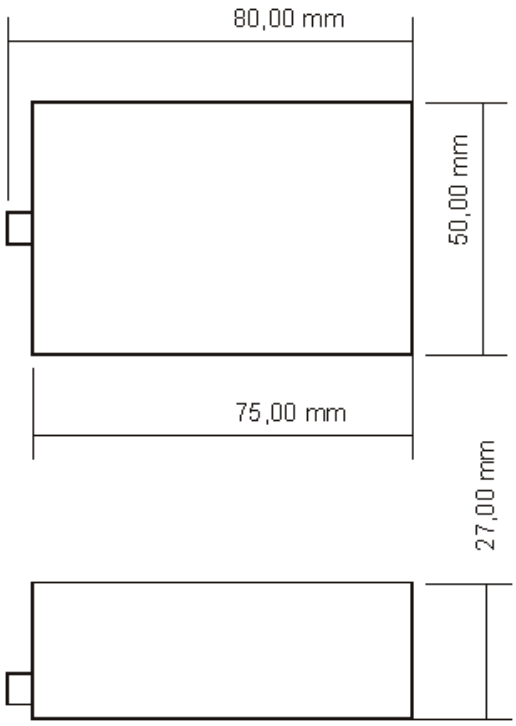

Figure 1.1: Outline dimensions

PARAMETER	VALUE
Power supply	5VDC
Current consumption	Max 500 mA
Communication	RS232 or RS485-2W
Dimensions	Width: 80 mm Height: 50 mm Depth: 27 mm
Net weight	0.1 kg
Use	Desktop device

Table 1.1: Technical data

1.3.2 AMBIENCE

PARAMETER	VALUE
Storage temperature	-20...50°C
Operation temperature	15...40°C
Relative humidity	Max. 80% (up to 31°C), decreasing to max. 50% (above 30°C)
Allocation	Use indoors only

Table 1.2: Ambience

1.3.3 OPERATION

Remote control via TMC13 controller or PC.

1.3.4 MEASURING CHANNEL

The TM13/TM14 device is equipped with an inputs for a suitable vacuum gauges.

PARAMETER	TM13 VALUE	TM14 VALUE
Measured value	Frequency	Frequency
Frequency Resolution	0.1 Hz	0.01 Hz
Number of measurements per second	4(fixed)	0.5, 1, 2, 4, 10 (selectable)
Stability	0.5 ppm	0.5 ppm
Maximum frequency of quartz oscillator	6 MHz	6 MHz

Table 1.3: Accuracy of measurement for pressure channels

1.3.5 STANDARDS

Conformity with the Directive relating to electrical equipment designed for use within certain voltage limits LVD 2006/95/EC.
Conformity with the Directive relating to electromagnetic compatibility EMC 2004/108/WE.
Harmonized and international/national standards and specifications:

- EN 61010-1 - Safety requirements for electrical equipment for measurement, control and laboratory use
- EN 61000-6-2 - Electromagnetic compatibility generic immunity standard
- EN 61000-6-3 - Electromagnetic compatibility generic emission standard

2 INSTALLATION

This chapter describes the procedures for unpacking, mechanical installation and electrical installation.

2.1 UNPACKING

1. Visually inspect the transport packaging for signs of external damage.
2. Unpack the TM13 / TM14 and retain the packaging materials.

   Note: Retain the packaging materials for later use. The TM13 / TM14 must be stored and transported in the original packaging material only.
3. Examine the TM13 / TM14 for completeness.
4. Visually inspect the TM13 / TM14 for signs of damage.

DANGER

Damaged product.
Putting a damaged product into operation can be extremely dangerous. Never attempt to put a damaged product into operation. Secure the damaged product from unintended operation. Send a damage report to the haulage company or the insurer.

2.2 ELECTRICAL INSTALLATION

TM13/14 device is delivered with cables for connecting to either the the TMC13 or a PC

2.2.1 DIAGRAMS OF CABLES

TM13/14 includes two cables which diagrams are listed below:

- Connection cable TM13/14 <-> Computer (2.1)
- Connection cable TM13/14 <-> TMC13 (2.2)

Cable TM13/14 <-> Computer is ended female D-sub connector with terminals compatible to RS232 standard. In order to communicate with the TM13/14 interface RS485-2W obtain the appropriate adapter for your RS485-2W standard. In Figure 2.3 is an example of an adapter for connection TM13/14 to the Moxa converter.

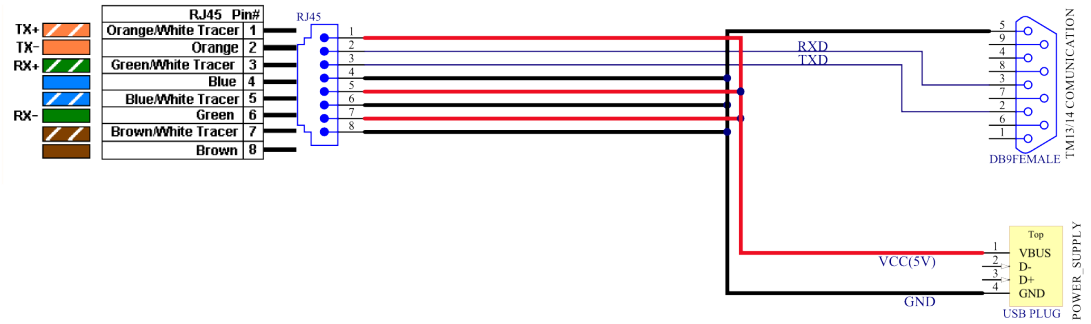

Figure 2.1: Connection cable between TM13/14 and Computer

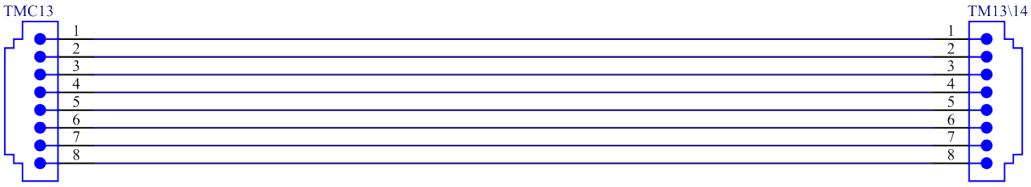

Figure 2.2: Connection cable between TM13/14 and TMC13

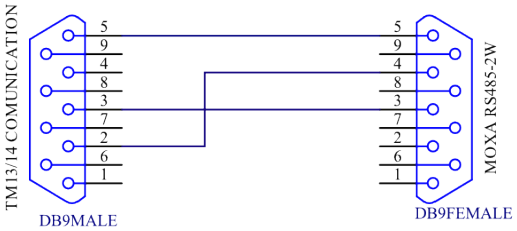

Figure 2.3: Example adapter TM13/14 - MOXA485-2W

2.2.2 OUT CONNECTOR

The device is configured with an RJ45 socket for connecting the communications/power cable. Communication signals is available on pin 2 and 3. Depending on the purchased version of the TM13/TM14 pins 2 and 3 function is different, see table 2.1 and 2.2.

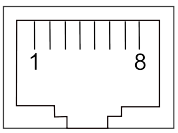

Figure 2.4: RJ45 socket

PIN NUMBER	FUNCTION	DESCRIPTION
Pin 2:	RX	data signal RS232
Pin 3:	TX	data signal RS232
Pin 1, 5, 7:	5 VDC	power supply
Pin 4, 6, 8:	GND	power supply gnd

Table 2.1: RJ45 socket pin description for TM13/14 with RS232

PIN NUMBER	FUNCTION	DESCRIPTION
Pin 2:	A-	data signal RS485-2W
Pin 3:	B+	data signal RS485-2W
Pin 1, 5, 7:	5VDC	power supply
Pin 4, 6, 8:	GND	power supply gnd

Table 2.2: RJ45 socket pin description for TM13/14 with RS485

2.2.3 SENSOR CONNECTOR

Connects to the Quartz microbalance. After connecting the TM13/TM14 to the vacuum system the analog ground (AGND) is connected with the system ground. Use the supplied SMA – BNC adapter for attaching the microbalance to the TM13/TM14 device.

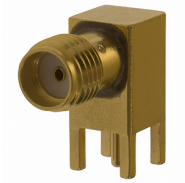

Figure 2.5: SMA connector (for microbalance)

Pin assignment for this connector is shown in Table 2.3.

WARNING

Isolation circuit.
IN input is isolated from the digital part of TM13/TM14 device

PIN NUMBER	FUNCTION	DESCRIPTION
Central pin	IN	Signal IN
Outside socket	AGND	vacuum system ground

Table 2.3: SMA socket pin

2.2.4 CONNECTING TO TMC13

The connection to the TMC13 is a single cable - shielded twisted pair. The TMC13 device does not require any additional power source. If the TMC13 controller is chosen, several devices may be connected together via one of the six slots on the TMC13 rear panel.

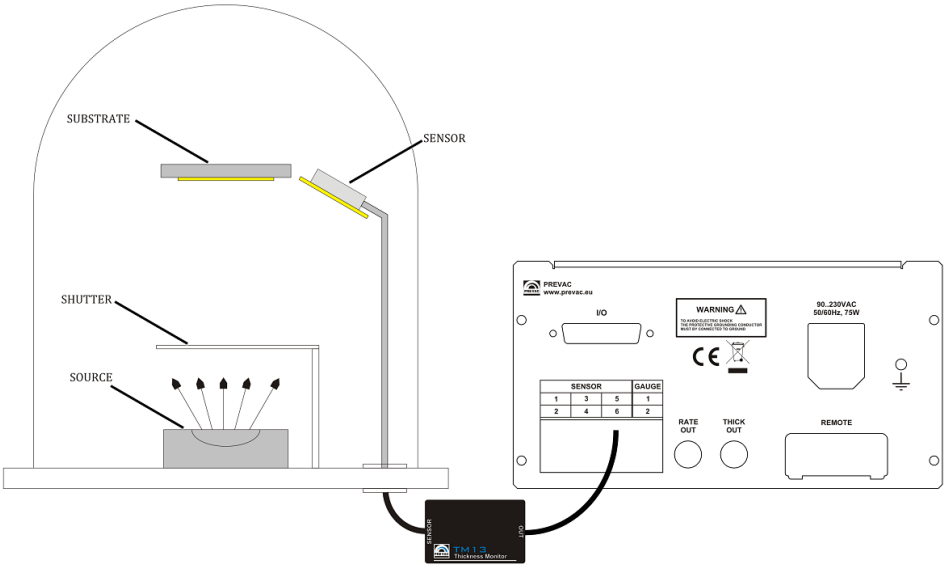

Figure 2.6: Connecting to TMC13

2.2.5 CONNECTING TO COMPUTER

When connecting the TM13/TM14 to a PC, use the RJ45 - D-SUB cable. The RJ45 plug end of the cable is connected to the socket OUT on the TM13/TM14, the D-SUB RS232 (RS485) end of the same cable is connected to an appropriate port on the PC. An expansion card should be used if the PC is not pre-configured with an appropriate serial port. Connect the USB plug, which is an integral part of the cable, to the AC power supply or USB port.

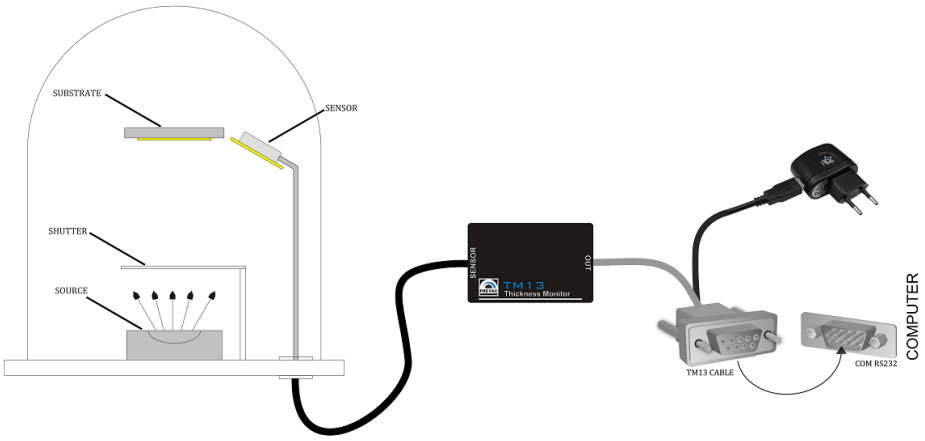

Figure 2.7: Connecting to the PC

WARNING

TM13/14 communication interface version
Before connecting, make sure which version of the TM13 / 14 you have (with RS232 or RS485-2W). See section 2.2.2.

WARNING

USB cable
The USB cable is only used to power the device with 5 VDC voltage.
It is not possible to communicate with the device via USB. Communication takes place via RS232 or RS485.

2.2.6 CONNECTING TO MICROBALANCE

To connect the TM13/14 to the quartz balance, use only the supplied SMA <-> BNC adapter.

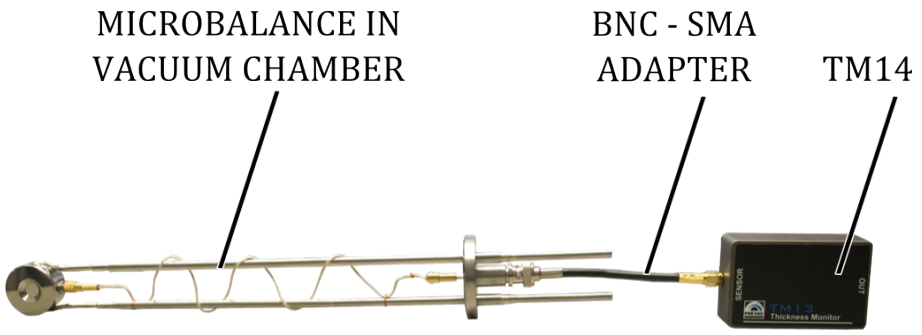

Figure 2.8: Connection diagram

2.2.7 TEST DEVICE

In order to verify proper functionality of the TM13/14, connect test quartz to the measuring input IN via the SMA – BNC adapter (see figure 2.9). After connecting the test quartz, the properly functioning device will indicate a frequency similar to 6000000 Hz.

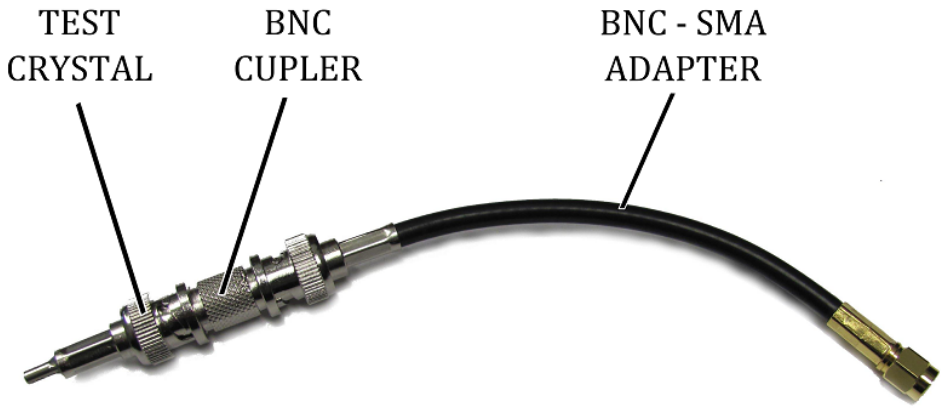

Figure 2.9: Test configuration

3 OPERATION - REMOTE CONTROL

This chapter describes the communication interface. The TM13/TM14 can communicate with a computer via a serial RS-232 interface or serial RS485 interface.

WARNING

TM13/14 communication interface version
Before start, make sure which version of the TM13 / 14 you have (with RS232 or RS485-2W). For proper wiring see section 2.2.1 and 2.2.2.

3.1 PREVAC SERIAL PROTOCOL

Prevac introduce own solution of real-time industry communication protocol. Serial protocol is implement in all Prevac devices. Usually to communicate we use RS485 link layer, but protocol can be used in other possible port types e.g. TCP/IP sockets (OSI-7 Application Layer), USB...

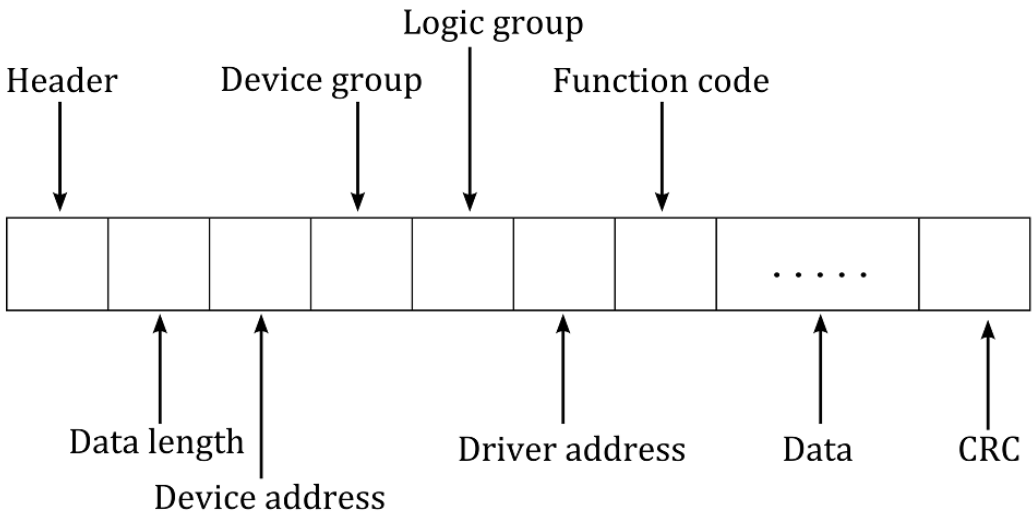

Figure 3.1: Prevac protocol data frame

3.1.1 HEADER

First byte is resposible for identify serial protocol. Header in hexadecimal is 0xAA.

3.1.2 DATA LENGHT

In this byte we have length of the data field. So the maximum data file length is 0xFF (256 bytes).

3.1.3 DEVICE ADDRESS

This byte have identify of hardware device address. So we can send frame data to write hardware device by its address. Default value is 0xC8.

3.1.4 DEVICE GROUP

Identify the type of hardware device eg. EBV Powers Supply (0x91), **TM13/TM14(0xA1)**.

3.1.5 LOGIC GROUP

Identify group of devices in link layer. So it's possible to send broadcast message to group of devices. Default value is 0xC8.

3.1.6 DRIVER ADDRESS

Identify address of sender usually we use 0x01 address.

3.1.7 FUNCTION CODE

In this byte we have code function of procedure

3.1.8 DATA FIELD

In this section we catch data needed to realize defined functions.

3.1.9 CRC

CRC is simple modulo 256 calculate without protocol header byte.

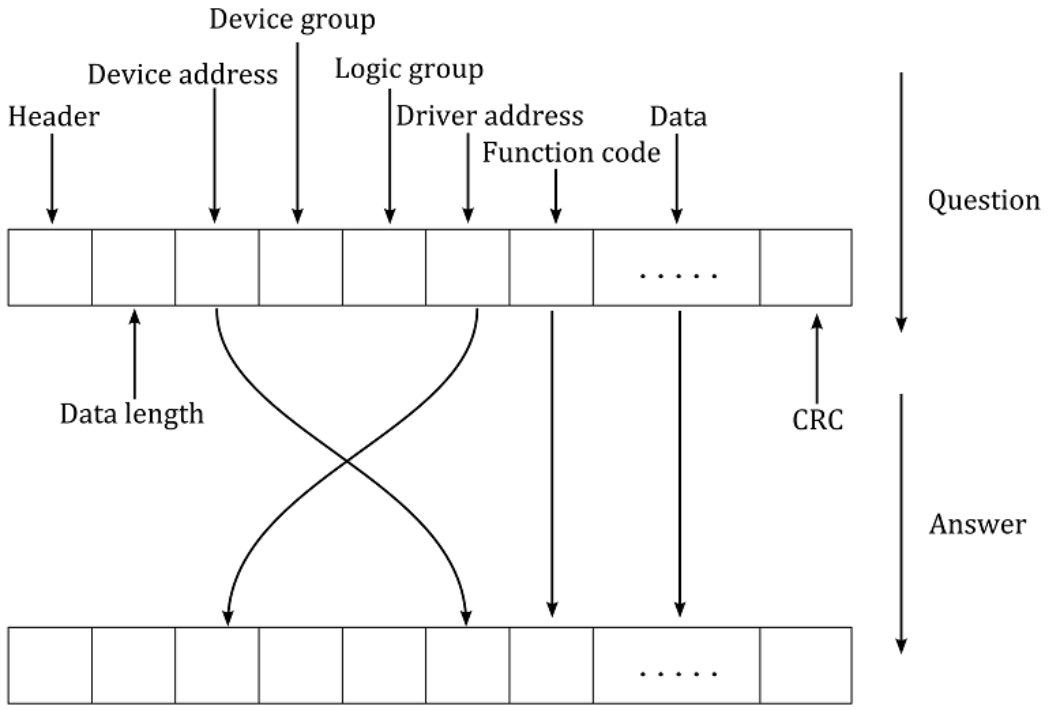

Figure 3.2: Query/Answer description

```
SET DEVICE ADDRESS (FUNCTION CODE 0X58, DEVICE GROUP 0X47)
REQUEST
AA 04 FF 47 FF 01 58 00 00 00 C8 6A

ANSWER
AA 04 01 47 FF C8 58 00 00 00 C8 33

SET LOGIC GROUP (FUNCTION CODE 0X59, DEVICE GROUP 0X47)
REQUEST
AA 04 FF 47 FF 01 59 00 00 00 C8 6B

ANSWER
AA 04 01 47 FF C8 59 00 00 00 C8 34
```

Figure 3.3: Setup device address example

3.2 CONNECTION PARAMETERS

PARAMETER	VALUE
Data bits	8
Parity	None
Stop bits	1
Flow control	None
Baud rate	57600 (fixed value)

Table 3.1: Connection parameters

3.3 RS485 INTERFACE

TM13/14 with RS485 allows to attach multiple devices using single cable. Working at this configuration is possible, provided to set different device addresses for each device. In the case of connecting more than one device to the same port should be used termination resistor as shown in Figure 3.4.

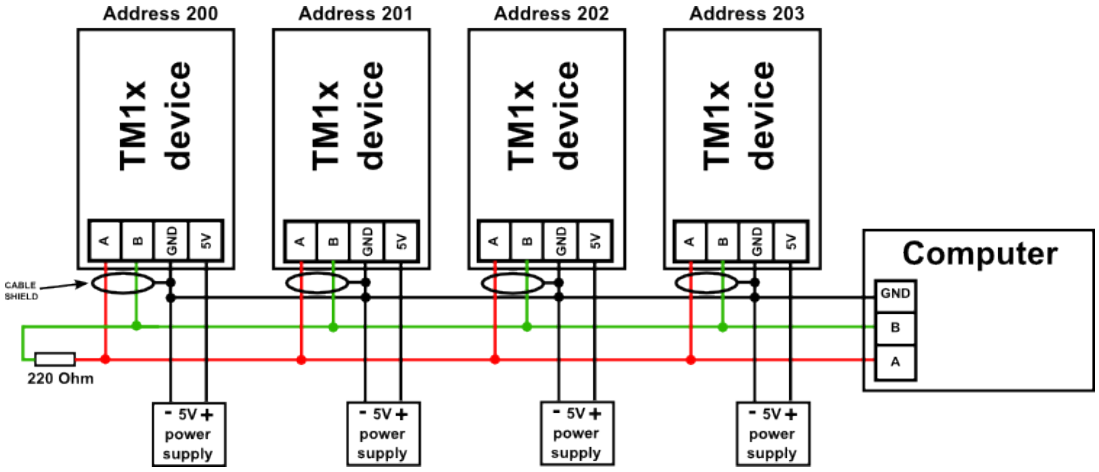

Figure 3.4: Parallel connection example of RS485

3.3.1 Address settings

In order to set a unique address to each device, follow the steps below.

1. Connect single TM13/TM14 to computer,
2. Send order code 0x58 with new address value in data field,
3. Device save address in non-volatile memory,
4. Disconnect single TM13/TM14 device,
5. Go to step 1 if you want to configure next device

3.4 ORDER LIST

ORDER NUMBER 0x53 READ/WRITE PARAMETERS					
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
QUERY					
1	Set measurement frequency (saples per second) - TM14 only 1- 10 samples per second 2- 4 samples per second 3- 2 samples per second 4- 1 sample per second 5- - 0.5 sample per second (time 2s)				
2-4	Must be set to zero				
RESPONSE					
1-4	measured frequency	U32	0.01Hz		
5	OscillatorStatus: informing that the device is connected to the microbalance OscilatorStatus = 1 – microbalance is connected, return frequency is corrected OscilatorStatus = 0 – no microbalance, return frequency is uncorrected	U8			
6	SampleNumber: successive frequency measurements are numbered in order to detect possible lost frames. The numbering of samples runs from 0 to 255	U8			
7-8	Duration of the measurement frequency, expressed in milliseconds	U16	1ms		
9	Device ID Value 13 for TM13 Value 14 for TM14	U8			

Table 3.2: Read/write parameters

ORDER NUMBER 0x58 WRITE DEVICE ADDRESS					
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
QUERY					
1-3	Empty byte (0x00)	U8			
4	Device address	U8		01	254

Table 3.3: Write device address

ORDER NUMBER 0x59 WRITE LOGIC GROUP					
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
QUERY					
1-3	Empty byte (0x00)	U8			
4	Logic group	U8		0	254

Table 3.4: Write logic group

ORDER NUMBER 0xFD READ PRODUCT NUMBER					
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
QUERY					
1-4	Empty byte	U8			
RESPONSE					
1-15	Product number (Chars)	ASCII			

Table 3.5: Read product number

ORDER NUMBER 0XFE READ SERIAL NUMBER					
Byte	**Description**	**Type**	**Unit**	**Min value**	**Max value**
QUERY					
1-4	Empty byte	U8			
RESPONSE					
1-13	Serial number (Chars)	ASCII			

Table 3.6: Read serial number

3.5 REQUEST ->ANSWER EXAMPLE

Below is an example of data exchange between TM14 and master Device(eg. PC). It is a read/write parameters order(code 0x53). In request data field is placed required sampling frequency(0x01 = 10 samples per second). Then in answer TM14 device send: frequency value, oscillator status, sample number, measurement time and device ID.

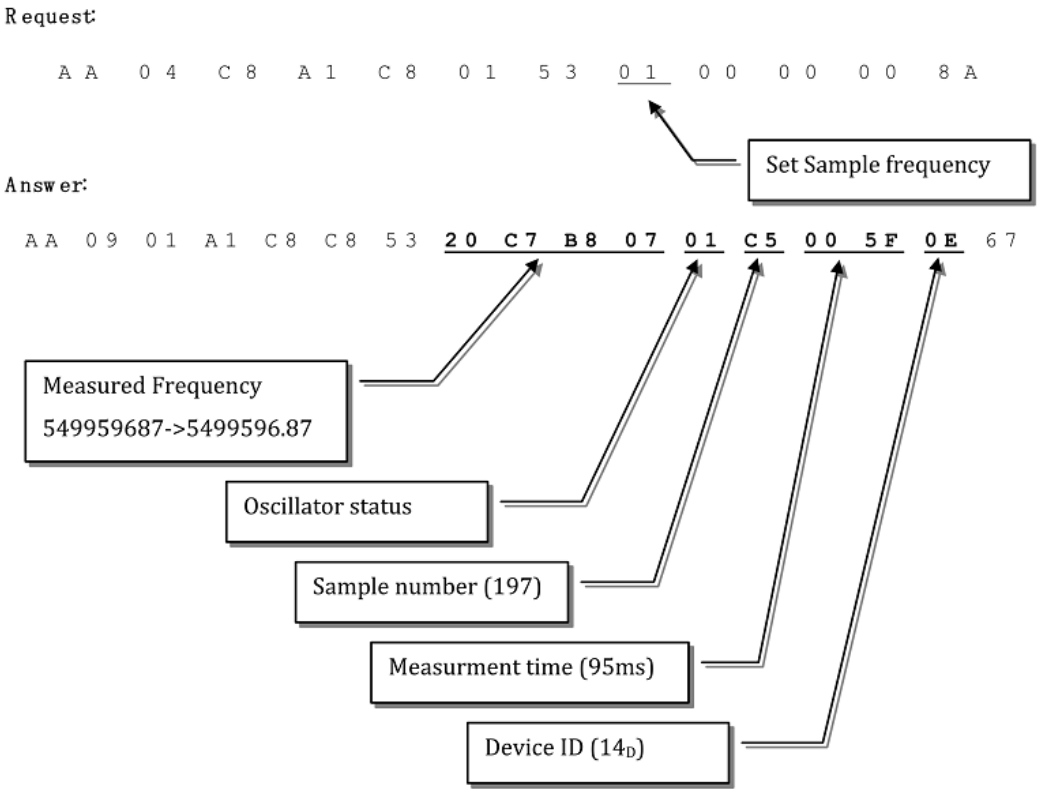

Figure 3.5: Example frame

4 MAINTANCE AND SERVICE

4.1 MAINTANCE

The TM13/TM14 does not require any special maintenance work.

4.2 CLEANING

For cleaning of the outside of the device, a slightly moistened cloth will usually do. Do not use any aggressive or abrasive cleaning agents.

5 STORAGE AND DISPOSAL

5.1 PACKING

Please retain the original packaging. The packaging is required for storing the device and for shipping it to an authorized PREVAC service center.

5.2 STORAGE

The TM13/TM14 should only be stored in a dry room. The following requirements must be met:

PARAMETER	VALUE
Ambient temperature	-20...50°C
Humidity	as low as possible; preferably in an air-tight plastic bag with a desiccant

Table 5.1: Storage parameters

5.3 DISPOSAL

The product must be disposed of in accordance with the relevant local regulations for the environmentally safe disposal of systems and electronic components.