

## Wired M-Bus description for SonoSelect or SonoSafe



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# 1 Information

Identify the needed telegrams from the EN13757 standard and determine how to implement the SonoSelect 10 and SonoSafe 10 communication protocol into an M-Bus telegram. This document contains the description the M-Bus protocol implemented for SonoSelect 10 and SonoSafe 10. The M-Bus protocol will follow the EN13757 standard.

## 2 Arhitecture

According to the software architecture of the SonoSelect 10 and SonoSafe 10 the communication shall be split into three layers.

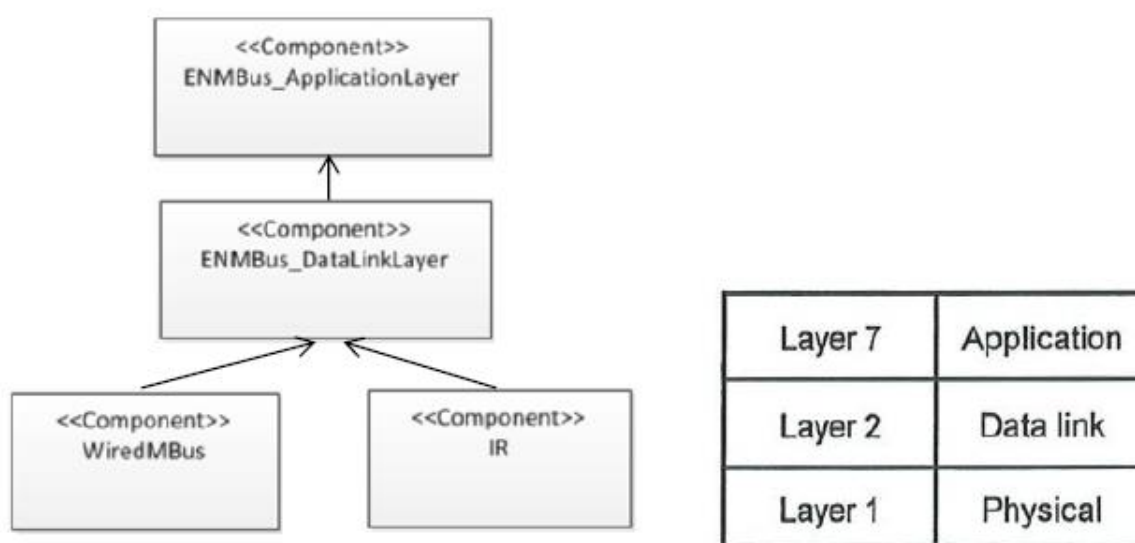


Figure 1 - OSI model and architecture of HM

The M-Bus protocol for the IR and Wired communication will be identical and therefore these two components will share the same data-link and application layer. The M-Bus will only support physical, data-link and combined transportation and application layer. The other layers stated in EN13757-3 are optional and will not be part the wired M-Bus implementation of the SonoSelect 10 and SonoSafe 10. According to the EN13757-1 standard the transportation layer must be handled in an Application Layer.

## 3 Basic information

### 3.1 The physical layer

The physical layer is a serial asynchronous half-duplex communication.

The meter act as a slave and each character communicated consist of 11-bits as shown below:

- 1 start bit ('Space')
- 8 data bits
- 1 parity bit (even)
- 1 stop bit ('Mark')

The master issues a request and the slave respond.

### 3.2 Wake up process and baud rate changes (IR)

Since the optical interface uses the EN 13757-2 protocol, a wake-up message can be sent after every idle time of  $> 330$  bit times to the heat meter. The wake up message consists of zeroes and ones alternating at the desired baud rate for a duration of  $(2,2 \pm 0,1)$  s. After an idle time of 33 bit times to 330 bit times, the communication can start.

### 3.3 Baud rate changes

The baud rate requirements from EN13757-3 are as follows:

- The IR supports 2400 and 4800 Baud
- The wired baud rate supports 300, 2400, 4800 and 9600
- Baud rate is kept after reset of device.

Meters with hardware issue 5 have auto baudrate detection on both the IR and Wired M-Bus interface.

#### **Maximum data records:**

The maximum data record length is 235 bytes

#### **Wildcard search (Secondary address)**

Secondary address is found by using a wildcard search (CI = 52H). The top positions are run through in ten selections from 0-9 (0FFFFFFF – 9FFFFFFF). If slave is found it answers with an ACK and the master requests the full secondary address which is returned in a RSP\_UD from the slave. Any collisions and the master vary the next positions and hold the existing one.

### 3.3.1 Wait time before reply after correct message reception

After reception of valid telegram the slave has to wait between 11bit time and (330 bit times + 50ms) before answering (EN1434-3)

| Baud rate | Min.   | Max.    |
|-----------|--------|---------|
| 300 Baud  | 36,7ms | 1150ms  |
| 2400 Baud | 4,6ms  | 187,5ms |
| 4800 Baud | 2,3ms  | 118,8ms |
| 9600 Baud | 1,2ms  | 84,4ms  |

## 3.4 Data Link layer (DLL)

In this section the data link layer is described. One of the frames used in the M-Bus standard is shown below. The other M-Bus frames can be found in section 4.1.

### Control frame

|             |
|-------------|
| Start = 68h |
| L-Field = 3 |
| L-Field = 3 |
| Start = 68h |
| C-Field     |
| A-Field     |
| CI-Field    |
| Checksum    |
| Stop = 16h  |

### 3.4.1 C field (Control field, Function field) – Field size 1 byte

The function field specifies the direction of the data flow and has various additional tasks in both calling and replying directions but many of these are optional and therefore not implemented.

| Bit Number               | 7 | 6 | 5   | 4   | 3  | 2  | 1  | 0  |
|--------------------------|---|---|-----|-----|----|----|----|----|
| <b>Calling direction</b> | 0 | 1 | FCB | FCV | F3 | F2 | F1 | F0 |
| <b>Reply Direction</b>   | 0 | 0 | ACD | DFC | F3 | F2 | F1 | F0 |

- **Bit7** reserved for future use.
- **Bit6** specifies the direction of the data flow. If it is set to 1 the communication has the direction Master to slave and vice versa if it is set to 0.
- **FCB** The slave do not act on this bit and is always sending new data.
- **FCV** The slave ignores this bit.
- **DFC** (data flow control) Not supported must be 0.
- **ACD** (Access demand) Not supported must be 0.

- **Control field F3-F0** the control field code tells the function or action of the message. The control field has 7 predefined control field shown below.

| Name           | C field binary | C field (HEX) | Telegram     | Description                                      |
|----------------|----------------|---------------|--------------|--|
| <b>SND_NKE</b> | 0100 0000      | 40            | Short frame  | Initialization of slave                          |
| <b>SND_UD</b>  | 01F1 0011      | 53/73         | Long/Control | Send user data to slave                          |
| <b>REQ_UD1</b> | 01F1 1010      | 5A/7A         | Short frame  | Request class 1 data                             |
| <b>REQ_UD2</b> | 01F1 1011      | 5B/7B         | Short frame  | Request class 2 data                             |
| <b>REQ_SKE</b> | 0100 1001      | 49            | Short frame  | Status request                                   |
| <b>RSP_SKE</b> | 0000 1011      | 0B            | Short frame  | Status data, slave to master                     |
| <b>RSP_UD</b>  | 00AD 1000      | 08            | Long/Control | Data transfer from slave to master after request |

REQ\_UD1 telegrams are answered with ACK because the Alarm protocols are not supported.

### 3.4.2 A Field (Address Field) – 1 byte

The primary address of the meter can be set to a value from 0-250. The default primary address is part of the serial number (red letters: sss~~ss~~wwNNyyww) and is always a number from 00-99. To change the primary address either use the SonoApp or M-Bus command described later in this document.

Point-to-point addressing (0xFE) is intended for communication using the infrared eye or for network with only one slave (used for test of network with one slave).

Broadcast (0xFF) is used to communicate across the network to all the slaves e.g. to set a new baud rate on all slaves at the same time. Be aware that no acknowledge byte is replied from the slave in broadcast mode.

The secondary address can be used to select a slave. This slave can then afterwards be contacted using the primary address FDH. All slaves have an unique secondary address which ensures only a single slave answers.

| Addressing Form                         | Slave Addressing |
|---|------------------|
| Primary addressing                      | 0-250            |
| Secondary addressing and selected slave | 253 (FDH)        |
| Point-to-Point addressing               | 254 (FEH)        |
| Broadcast                               | 255 (FFH)        |

### **3.4.3 L Field – 2 fields with a size of 1 byte**

The Length Field (L Field) defines the number of bytes (expressed in hex value) of the Active Data making up the telegram, plus 3 bytes for the C, A and CI Fields.

This field is always transmitted twice in Long Telegrams (RSP\_UD) see 4.1.

### **3.4.4 CS field – 1 byte**

The Checksum (CS Field) serves to recognize transmission and synchronization faults. The checksum is calculated on the Active Data making up the telegram, plus 3 bytes for the C, A and CI Fields. All bytes are added together in a 8 bit unsigned integer, which means that when the value gets larger than FFh it will wrap around and start all over.

### 3.5 Combined Transportation and application layer

#### 3.5.1 CI Field (Control information field)

The CI-Field declares the transportation direction and the Application protocol (if exists). The CI-Field declares also which type of Transport Layer ("None", "Short" and "Long" header) is applied.

In the SonoSelect/Safe meters with wired M-Bus the long header (0x72) is always used.

The SonoSelect/Safe meters supports the following CI-Fields.

| CI-field (HEX) | Direction  |
|----------------|--|
| <b>50</b>      | Application reset  |
| <b>51</b>      | Data send to device  |
| <b>52</b>      | Slave select (no header)                                   |
| <b>72</b>      | The telegram contains data for the master with long header |
| <b>B8</b>      | Set baud rate 300 (only wired M-Bus)                       |
| <b>BB</b>      | Set Baud Rate to 2400                                      |
| <b>BD</b>      | Set Baud Rate to 9600                                      |



### 3.5.2 Long header

The long header contains 12 bytes which is used to identify the Meter, hold track of new or old message and to apply encryption.

The encryption is not currently available for wired Danfoss Meters which means the configuration field always is 0000H.

The 12 byte long header is shown in the table below:

| Byte Nr.     | Size(Byte) | Value(Hex)  | Description                           |
|--------------|------------|-------------|---------------------------------------|
| <b>1-4</b>   | 4          | xx xx xx xx | Meter identification number           |
| <b>5-6</b>   | 2          | D310        | Manufacturer's ID (DFS Danfoss 10D3h) |
| <b>7</b>     | 1          | xx          | Version number firmware (00-FF)       |
| <b>8</b>     | 1          | 04/0C       | Medium: Heat outlet/inlet             |
| <b>9</b>     | 1          | xx          | Access Number (00-FF-> 00)            |
| <b>10</b>    | 1          | xx          | Status                                |
| <b>11-12</b> | 2          | 0000        | Configuration                         |

The identification number (secondary address) is a non-changeable (according to OMS) number in between 00000000 and 99999999. The identification number is part of the Danfoss Meters serial number and is unique. (In installations with other meters where same address is present the address can be change with SonoApp or M-Bus command shown later)

The secondary address is derived from the serial number. The serial number has the following format:

**SSSS**wwNNyy**ww**

The secondary address has the following format

ywwSSSS

The manufactures ID is used to identify the manufacture of the Meter. Each manufacture has a flag consisting of three capital letters which can be combined to two bytes according to EN13757-3. The Danfoss manufacture flag is DFS (10D3h) and this flag is always part of the long header.

The version number is used to identify if the meter is of type:

- SonoSafe (0x01)
- SonoSelect (0x02).

The medium byte identifies the flow sensor installation of the Meter and has two settings for each meter type:

- Heat Inlet meters (supply 0x0C)
- Heat Outlet meters (return 0x04).
- Cooling Meter (Volume measured at return temperature: outlet)

- Cooling Meter (Volume measured at flow temperature: inlet)
- Combined meter
- Water meter (For pulse readout only)

The Access Number has an unsigned binary coding and is incremented (modulo 256) by one after each RSP-UD is send from the slave.

### 3.5.3 Status byte and error handling

The status byte is used to indicate different potential errors in the Meter. The errors are stated in the table below:

| Bit        | Meaning with bit set     | Significance with bit not set |
|------------|--------------------------|-------------------------------|
| <b>0,1</b> | See table 5              | See table 5                   |
| <b>2</b>   | Power Low                | Power Ok                      |
| <b>3</b>   | Permanent error          | No Permanent error            |
| <b>4</b>   | Temporary error          | No Temporary error            |
| <b>5</b>   | Specific to manufacturer | Specific to manufacturer      |
| <b>6</b>   | Specific to manufacturer | Specific to manufacturer      |
| <b>7</b>   | Specific to manufacturer | Specific to manufacturer      |

| Status bit 1 bit 0 |                          |
|--------------------|--------------------------|
| <b>0 0</b>         | No Error                 |
| <b>0 1</b>         | Application busy         |
| <b>1 0</b>         | Any application error    |
| <b>1 1</b>         | Abnormal condition/alarm |

The status bit shall be used in this meaning:

#### Power low:

Warning – The bit “Power Low” is set only to signal interruption of external power supply or end of battery life time

#### Permanent error:

Failure – The bit “Permanent error” is set only if the meter signals a fatal device error which requires a service action.

#### Temporary error:

Warning – The bit “Temporary error” is set only if the meter signals a slight error condition which not immediately requires a service action. This could be an error which may later disappear.

#### Any application error:

The application error shall be used to communicate a failure during the interpretation or execution of a received command, e.g. a message which could not be decrypted.

### Abnormal conditions:

Shall be used if a correct working application detects an abnormal behavior like a permanent high flow.

The most critical active E-number (Error shown in the display) is sent as the status byte. The most critical error is E1 and least critical is E32.

Below is a table showing the bit pattern.

| E-<br>Number | E1   | E2   | E3   | E4   | E5   | E6   | E7   | E8   | E9   | E10  | E11  | E12  | E13  |
|--------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Hex<br>code  | 0x08 | 0x10 | 0x28 | 0x04 | 0x24 | 0x30 | 0x50 | 0x70 | 0x90 | 0xB0 | 0xD0 | 0xF0 | 0x48 |
| E-<br>Number | E14  | E15  | E16  | E17  | E18  | E32  |      |      |      |      |      |      |      |
| Hex<br>code  | 0x40 | 0x44 | 0x60 | 0x62 | 0x13 | 0x92 |      |      |      |      |      |      |      |

| Error type      | E number   |
|-----------------|--|
| Power Low       | E4, E5, E15  |
| Permanent error | E1, E3, E13  |
| Temporary error | E2, E6, E7, E8, E9, E10, E11, E12, E14, E16, E17, E18, E32 |

### 3.5.4 DIF & VIF configuration of data records

The application layer contains the data sent from the slave to the master or vice versa.

Every data record sent which is not manufacture specific have the following data record header (DRH)

| Data Information Block (DIB) |             | Value Information Block (VIB) |              |           |
|------------------------------|-------------|-------------------------------|--------------|-----------|
| DIF                          | DIFE        | VIF                           | VIFE         | Data      |
| 1 Byte                       | 0-10Byte(s) | 1 Bytes                       | 0-10 Byte(s) | 0-n Bytes |

The Data Information Block (DIB) contains at least one DIF but can be extended by 10 DIFE if needed.

The DIFs supported by the Danfoss Meters:

| Bit        | Name                  | Description  |
|------------|-----------------------|--|
| <b>7</b>   | Extension Bit         | Specifies if a DIFE byte follows:<br>0 = No<br>1 = Yes   |
| <b>6</b>   | LSB of Storage Number | 0 if log is not send   |
| <b>5-4</b> | Function Field        | Specifies the kind of value<br>00 = instantaneous value<br>01 = Maximum value<br>10 = Minimum Value<br>11 = Value during error state   |
| <b>3-0</b> | Data Field            | Length and Coding of Data:<br>0001 (0x01): 8 Bit Integer<br>0010 (0x02): 16 Bit Integer<br>0011 (0x03): 24 Bit Integer<br>0100 (0x04): 32 Bit Integer<br>0110 (0x06): 48 bit Integer (only for record)<br>0111 (0x07): 64 Bit Integer (only for record)<br>1001 (0x09): 2 digit BCD<br>1010 (0x0A): 4 digit BCD<br>1011 (0x0B) 6 digit BCD<br>1100 (0x0C): 8 digit BCD<br>1101 (0x0D): Variable length (Only for TX)<br>1111 (0x0F): Manufacture Specific Data |

The DIFE supported by Danfoss Meters:

| Bit        | Name           | Description  |
|------------|----------------|--|
| <b>7</b>   | Extension Bit  | Specifies if a DIFE byte follows:<br>0 = No<br>1 = Yes |
| <b>6</b>   | Unit           | Specifies if it is pulse counter or cooling value      |
| <b>5-4</b> | Tariff         | Used °C*m <sup>3</sup> records                         |
| <b>3-0</b> | Storage number | 0000 (only used for logs)                              |

The DIFE is used for selection of pulse 1 and pulse 2 counters. If first DIFE has the unit set to 1, it is pulse counter 1 and if the unit is set in the second DIFE, it is pulse counter 2 (see 4.4.2.7). The DIFE unit 3 is used for cooling records (Energy, Volume, Max Flow, Max Power).

The DIFE storage number is used to show the log values and which type of log there are sent.

The storage number 1 & 2 are used for year log 1 and 2.

The storage number from 3-26 is used for month log 1-24.

The Value Information Block (VIB) contains minimum 1 VIF but can be extended by 10 VIFE if needed (Danfoss Meters support only one VIF and up to 4 VIFEs).

The coding of the VIF is:

| Bit        | Name              | Description   |
|------------|-------------------|---|
| <b>7</b>   | Extension Bit     | Specifies if a VIFE byte follows the VIF  |
| <b>6-0</b> | Value Information | Contains information for a single value.<br>Unit and multiplier of each data record |

The coding of the VIFE is:

| Bit        | Name              | Description  |
|------------|-------------------|--|
| <b>7</b>   | Extension Bit     | Specifies if a VIFE byte follows the VIFE                              |
| <b>6-0</b> | Value Information | Contains information for a single value.<br>Unit, multiplication, etc. |

### 3.6 The standard read out

- Energy
- Volume
- Flow rate
- Power
- Forward temperature
- Return temperature
- Difference temperature
- External temperature
- Current time
- Operation hours
- Hour Counter OK

The VIF & VIFE combination used in the SonoSelect/Safe meters:

| VIF (HEX) | VIFE (HEX)   | Description | Unit  |
|-----------|--------------|-------------|---|
| <b>00</b> | -            | Energy      | 0.000001 kWh  |
| <b>01</b> | -            | Energy      | 0.00001 kWh   |
| <b>02</b> | -            | Energy      | 0.0001 kWh  |
| <b>03</b> | -            | Energy      | 0.001 kWh   |
| <b>04</b> | -            | Energy      | 0.01 kWh  |
| <b>05</b> | -            | Energy      | 0.1 kWh   |
| <b>06</b> | -            | Energy      | 1 kWh   |
| <b>03</b> | -            | Energy      | 0.000001 MWh  |
| <b>04</b> | -            | Energy      | 0.00001 MWh   |
| <b>05</b> | -            | Energy      | 0.0001 MWh  |
| <b>06</b> | -            | Energy      | 0.001 MWh   |
| <b>07</b> | -            | Energy      | 0.01 MWh  |
| <b>FB</b> | <b>00</b>    | Energy      | 0.1 MWh   |
| <b>FB</b> | <b>01</b>    | Energy      | 1 MWh   |
| <b>0B</b> | -            | Energy      | 0.000001 GJ   |
| <b>0C</b> | -            | Energy      | 0.00001 GJ  |
| <b>0D</b> | -            | Energy      | 0.0001 GJ   |
| <b>0E</b> | -            | Energy      | 0.001 GJ  |
| <b>0F</b> | -            | Energy      | 0.01 GJ   |
| <b>FB</b> | <b>08</b>    | Energy      | 0.1 GJ  |
| <b>FB</b> | <b>09</b>    | Energy      | 1 GJ  |
| <b>FB</b> | <b>8C 74</b> | Energy      | 0.000001 GCal   |
| <b>FB</b> | <b>8C 75</b> | Energy      | 0.00001 GCal  |
| <b>FB</b> | <b>0C</b>    | Energy      | 0.0001 GCal   |
| <b>FB</b> | <b>0D</b>    | Energy      | 0.001 GCal  |
| <b>FB</b> | <b>0E</b>    | Energy      | 0.01 GCal   |
| <b>FB</b> | <b>0F</b>    | Energy      | 0.1 GCal  |
| <b>FB</b> | <b>8F 77</b> | Energy      | 1 GCal  |
| <b>90</b> | <b>70</b>    | Volume      | 0.000000000001 m <sup>3</sup><br>(full resolution pico m <sup>3</sup> ) |
| <b>10</b> | -            | Volume      | 0.000001 m <sup>3</sup>   |
| <b>11</b> | -            | Volume      | 0.00001 m <sup>3</sup>  |
| <b>12</b> | -            | Volume      | 0.0001 m <sup>3</sup>   |
| <b>13</b> | -            | Volume      | 0.001 m <sup>3</sup>  |
| <b>14</b> | -            | Volume      | 0.01 m <sup>3</sup>   |
| <b>15</b> | -            | Volume      | 0.1 m <sup>3</sup>  |
| <b>16</b> | -            | Volume      | 1 m <sup>3</sup>  |
| <b>98</b> | <b>70</b>    | Mass        | 0.000000001 kg  |
| <b>38</b> | -            | Flow rate   | 0.001 l/h   |
| <b>39</b> | -            | Flow rate   | 0.01 l/h  |

|           |              |                                  |                        |
|-----------|--------------|----------------------------------|------------------------|
| <b>3A</b> | -            | Flow rate                        | 0.1 l/h                |
| <b>3B</b> | -            | Flow rate                        | 1 l/h                  |
| <b>3B</b> | -            | Flow rate                        | 0.001 m³/h             |
| <b>3C</b> | -            | Flow rate                        | 0.01 m³/h              |
| <b>3D</b> | -            | Flow rate                        | 0.1 m³/h               |
| <b>3E</b> | -            | Flow rate                        | 1 m³/h                 |
| <b>2B</b> | -            | Power                            | 0.001 kW               |
| <b>2C</b> | -            | Power                            | 0.01 kW                |
| <b>2D</b> | -            | Power                            | 0.1 kW                 |
| <b>2E</b> | -            | Power                            | 1 kW                   |
| <b>58</b> | -            | Forward temperature              | 0.001 °C               |
| <b>59</b> | -            | Forward temperature              | 0.01 °C                |
| <b>5A</b> | -            | Forward temperature              | 0.1 °C                 |
| <b>5B</b> | -            | Forward temperature              | 1 °C                   |
| <b>5C</b> | -            | Return temperature               | 0.001 °C               |
| <b>5D</b> | -            | Return temperature               | 0.01 °C                |
| <b>5E</b> | -            | Return temperature               | 0.1 °C                 |
| <b>5F</b> | -            | Return temperature               | 1 °C                   |
| <b>64</b> | -            | External temperature             | 0.001 °C               |
| <b>65</b> | -            | External temperature             | 0.01 °C                |
| <b>66</b> | -            | External temperature             | 0.1 °C                 |
| <b>67</b> | -            | External temperature             | 1 °C                   |
| <b>60</b> | -            | Difference temperature           | 0.001K                 |
| <b>61</b> | -            | Difference temperature           | 0.01K                  |
| <b>62</b> | -            | Difference temperature           | 0.1K                   |
| <b>63</b> | -            | Difference temperature           | 1K                     |
| <b>FD</b> | <b>09</b>    | Device type                      | Meter type             |
| <b>FD</b> | <b>3A</b>    | Without unit                     | FWChecksum             |
| <b>26</b> | -            | Hour Counter OK                  | 1h                     |
| <b>22</b> | -            | Factory hour counter hours       | 1h                     |
| <b>6C</b> | -            | Date                             | Date (Type G)          |
| <b>6D</b> |              | Current time                     | Date and time (type F) |
| <b>A6</b> | <b>18</b>    | Hour counter Alarm               | 1h                     |
| <b>FD</b> | <b>70</b>    | Battery change date              | Date (Type G)          |
| <b>FD</b> | <b>6C</b>    | Operating time battery           | hours                  |
| <b>FD</b> | <b>74</b>    | Remaining battery life time      | days                   |
| <b>EC</b> | <b>7E</b>    | Next accounting date             | Date (type G)          |
| <b>FD</b> | <b>BA 70</b> | Multiplicative correction factor | 10 <sup>(-6)</sup>     |

## 4 Communication process

### 4.1 M-Bus EN 13757 data frames

There are 4 different data frame formats (See table below) available for communicating between the master and slave using the EN 13757-3 M-Bus standard and these are supported by the Danfoss Meters.

- **Single character frame**, slave uses this frame to send an acknowledgement for the data received from the master.
- **Short frame** which is used to e.g. make a data request master to slave
- **Control frame** is used to e.g. change the baud rate of a slave
- **Long frame** is used to e.g. change which data the slave should return and is used as response frame for the slave containing the data requested by the master.

M-Bus is an asynchronous serial bit transmission in half-duplex mode, which means that it is only possible to transmit in one direction at a time. The standard way of communicating is to send a SND which the slave will answer with an acknowledgement (ACK) or a request (REQ) which the slave will respond on with a RSP.

The communication process will follow one of the following two kinds of transmissions:

Master send / Slave confirm : SND/ACK

Master request / Slave respond : REQ/RSP

The standard communication between an M-Bus master and an M-Bus slave is:

| Command                   | Master  | Slave  |
|---------------------------|---------|--------|
| <b>Deselect old slave</b> | SND_NKE | ACK    |
| <b>Select new slave</b>   | SND_UD  | ACK    |
| <b>Request data</b>       | REQ_UD2 | RSP_UD |

Single character

|            |
|------------|
| Ack. = E5h |
|------------|

Short frame

|             |
|-------------|
| Start = 10h |
| C-Field     |
| A-Field     |
| Checksum    |
| Stop = 16h  |

Control frame

|             |
|-------------|
| Start = 68h |
| L-Field = 3 |
| L-Field = 3 |
| Start = 68h |
| C-Field     |
| A-Field     |
| CI-Field    |
| Checksum    |
| Stop = 16h  |

Long frame

|                                |
|--------------------------------|
| Start = 68h                    |
| L-Field = N + 3                |
| L-Field = N + 3                |
| Start = 68h                    |
| C-Field                        |
| A-Field                        |
| CI-Field                       |
| Userdata<br>(N = 0..252 bytes) |
| Checksum                       |
| Stop = 16h                     |



## 4.2 Pulse readout

The meter supports up to two pulse input when a module is inserted. Each of the pulse interfaces can be configured by SonoApp, to obtain a separate secondary address in the meter. The configuration of the Pulse interface is done using SonoApp.

It is possible to readout each of these pulse meters individually using the RSP\_UD command. The meters returns an accumulated volume register and a month log record with accumulated volume and a timestamp.

The pulse addresses only support readout (+ Slave select and SND\_NKE) and not the rest of the commands in this document. Primary addressing is also not supported to obtain the pulse values.

## 4.3 Application reset

### 4.3.1.1 Application reset

The master is capable of changing the current readout temporary, using the command in 4.4.2.9. The Application Reset, resets the access number to 0 and returns the readout to a normal standard readout telegram. The Application reset telegram is below:

| Field name          | # of Bytes | Value | Description                       | Layer                 |
|---------------------|------------|-------|-----------------------------------|-----------------------|
| <b>Start</b>        | 1          | 68H   | Start of Frame                    | Data Link Layer (DLL) |
| <b>L Field</b>      | 1          | 04H   | 2 <sup>nd</sup> Start to Checksum |                       |
| <b>L Field</b>      | 1          | 04H   | 2 <sup>nd</sup> Start to Checksum |                       |
| <b>Start</b>        | 1          | 68H   | Start of Frame                    |                       |
| <b>C Field</b>      | 1          | 73H   | SND_UD                            |                       |
| <b>A Field</b>      | 1          | FDH   | Primary Address                   | TPL                   |
| <b>CI</b>           | 1          | 50H   | Application reset byte            |                       |
| <b>Reset byte</b>   | 1          | 00H   | Application reset subcode         | DLL                   |
| <b>Checksum</b>     | 1          | C0H   | Checksum                          |                       |
| <b>End of Frame</b> | 1          | 16H   |                                   |                       |

### Answer of the Slave: E5h

The SonoSelect and SonoSafe with the FW 01.03 or above supports multiple application reset telegrams, which changes the outputted registers until another reset arrives.

If the meter is a Combined Meter (Heat and Cooling), the telegrams contains both the heat and cooling accumulated registers.

The M-Bus standard supports the following application resets:

| Application reset subcode   | Telegram data  |
|---|--|
| <b>0x00</b><br><b>Standard Danfoss output</b><br><b>(Diagnosis data will only be part of this telegram)</b>                                   | Accumulated Energy (heat and cooling for combined)<br>Accumulated Volume (heat and cooling for combined)<br>Flow Rate<br>Power<br>Supply Temperature<br>Return Temperature<br>Difference Temperature<br>External Temperature (Enclosure)<br>Current Time<br>Hour counter factory (operating hours since factory)<br>Hour counter ok (Operating hours without error)  |
| <b>0x10</b><br><b>User Data</b>   | Accumulated Energy (heat and cooling for combined)<br>Accumulated Volume (heat and cooling for combined)<br>Current Time<br>Hour counter factory (operating hours since factory)<br>Month log 1 (newest year log) (storage number = 3) <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Energy</li> <li>• Accumulated Volume</li> <li>• Optional (max power and flow)</li> </ul> Year log 1 (newest year log) (storage number = 1) <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Energy (heat and cooling for combined)</li> <li>• Accumulated Volume (heat and cooling for combined)</li> <li>• Optional (max power and flow)</li> </ul> |
| <b>0x20</b><br><b>Simple billing</b>  | Accumulated Energy (heat and cooling for combined)<br>Accumulated Volume (heat and cooling for combined)<br>Flow Rate<br>Power<br>Supply Temperature<br>Return Temperature<br>Difference Temperature<br>Hour counter factory (operating hours since factory)<br>Current Time   |
| <b>0x30</b><br><b>Enhanced billing,</b><br><b>historical energy registers</b><br><b>(Combined meter will only return 6 months and 1 year)</b> | Accumulated Energy (heat and cooling for combined)<br>Accumulated Volume (heat and cooling for combined)<br>Year log 1 (newest year log) (storage number = 1) <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Energy (heat and cooling for combined)</li> </ul> Year log 2 (storage number = 2) <ul style="list-style-type: none"> <li>• Date</li> </ul>  |

**Combined meter has both cooling and heat energy**

- Accumulated Energy
- Month log 1 (newest month log) (storage number = 3)
  - Date
  - Accumulated Energy (heat and cooling for combined)
- Month log 2 (storage number = 4)
  - Date
  - Accumulated Energy (heat and cooling for combined)
- Month log 3 (storage number = 5)
  - Date
  - Accumulated Energy (heat and cooling for combined)
- Month log 4 (storage number = 6)
  - Date
  - Accumulated Energy (heat and cooling for combined)
- Month log 5 (storage number = 7)
  - Date
  - Accumulated Energy (heat and cooling for combined)
- Month log 6 (storage number = 8)
  - Date
  - Accumulated Energy (heat and cooling for combined)
- Month log 7 (storage number = 9)
  - Date
  - Accumulated Energy
- Month log 8 (storage number = 10)
  - Date
  - Accumulated Energy
- Month log 9 (storage number = 11)
  - Date
  - Accumulated Energy
- Month log 10 (storage number = 12)
  - Date
  - Accumulated Energy
- Month log 11 (storage number = 13)
  - Date
  - Accumulated Energy
- Month log 12 (storage number = 14)
  - Date
  - Accumulated Energy

**0x40  
Enhanced billing,  
historical volume  
registers  
(Combined meter will  
only return 6 months and  
1 year)**

- Accumulated Energy
- Accumulated Volume
- Year log 1 (newest year log) (storage number = 1)
  - Date
  - Accumulated Volume (heat and cooling for combined)
- Year log 2 (storage number = 2)
  - Date
  - Accumulated Volume

|  |  |
|--|--|
| <b>Combined meter has both cooling and heat volume</b> | <p>Month log 1 (newest month log) (storage number = 3)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume (heat and cooling for combined)</li> </ul> <p>Month log 2 (storage number = 4)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume (heat and cooling for combined)</li> </ul> <p>Month log 3 (storage number = 5)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume (heat and cooling for combined)</li> </ul> <p>Month log 4 (storage number = 6)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume (heat and cooling for combined)</li> </ul> <p>Month log 5 (storage number = 7)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume (heat and cooling for combined)</li> </ul> <p>Month log 6 (storage number = 8)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume (heat and cooling for combined)</li> </ul> <p>Month log 7 (storage number = 9)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume</li> </ul> <p>Month log 8 (storage number = 10)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume</li> </ul> <p>Month log 9 (storage number = 11)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume</li> </ul> <p>Month log 10 (storage number = 12)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume</li> </ul> <p>Month log 11 (storage number = 13)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume</li> </ul> <p>Month log 12 (storage number = 14)</p> <ul style="list-style-type: none"> <li>• Date</li> <li>• Accumulated Volume</li> </ul> |
| <b>0x50<br/>Instant values</b>                         | <p>Accumulated Energy (heat and cooling for combined)</p> <p>Accumulated Volume (heat and cooling for combined)</p> <p>Flow Rate</p> <p>Power</p> <p>Supply Temperature</p> <p>Return Temperature</p> <p>Difference Temperature</p> <p>External Temperature (Enclosure)</p> <p>Current time</p>  |

|                         |  |
|-------------------------|--|
|                         | Hour counter factory (operating hours since factory)<br>Hour counter ok (Operating hours without error)<br>Hour counter alarm (Operating hour with error)  |
| <b>0x90<br/>Testing</b> | High resolution Accumulated Energy<br>(heat and cooling for combined)<br>High resolution Accumulated Volume<br>(heat and cooling for combined)<br>Flow Rate<br>Power<br>Supply Temperature<br>Return Temperature<br>Difference Temperature |

## 4.4 Send/Confirm procedures available using the Danfoss Meter

### 4.4.1 SND\_NKE

This command is used after an interrupts or as a beginning of communication. A slave selected for secondary addressing is deselected, if a SND\_NKE to address 253 or a command to a non-matching secondary address is received.

The selected slave acknowledges the deselection if a SND\_NKE is received on address 253.

| Field name          | # of Bytes | Value | Description          | Layer                    |
|---------------------|------------|-------|----------------------|--------------------------|
| <b>Start</b>        | 1          | 10H   | Start of short frame | Data Link<br>Layer (DLL) |
| <b>C Field</b>      | 1          | 40H   | SND_NKE              |                          |
| <b>A Field</b>      | 1          | FDH   | Primary Address      |                          |
| <b>Checksum</b>     | 1          | 4AH   | Checksum             |                          |
| <b>End of Frame</b> | 1          | 16H   |                      |                          |

Answer of the Slave: E5h

#### 4.4.2 SND\_UD

These telegrams are used to send data from the master to the slave. The slave confirms any correct receptions (requires correct address, primary or secondary) of these telegrams also if the command received is not supported.

##### 4.4.2.1 Set primary address

This telegram changes a Meters primary address using its current primary address:

| Field name          | # of Bytes | Value | Description                     | Layer                 |
|---------------------|------------|-------|---------------------------------|-----------------------|
| <b>Start</b>        | 1          | 68H   | Start of Frame                  | Data Link Layer (DLL) |
| <b>L Field</b>      | 1          | 06H   | C field to Checksum             |                       |
| <b>L Field</b>      | 1          | 06H   | C field to Checksum             |                       |
| <b>Start</b>        | 1          | 68H   | Start of Frame                  |                       |
| <b>C Field</b>      | 1          | 73H   | SND_UD                          |                       |
| <b>A Field</b>      | 1          | FEH   | Current Primary Address         |                       |
| <b>CI Field</b>     | 1          | 51H   | Data from Master to Slave       | TPL                   |
| <b>DIF</b>          | 1          | 01H   | 8-bit integer                   | APL                   |
| <b>VIF</b>          | 1          | 7AH   | Change primary address          |                       |
| <b>Value</b>        | 1          | 05H   | New Primary Address (address 5) |                       |
| <b>Checksum</b>     | 1          | 42H   | Checksum                        | DLL                   |
| <b>End of Frame</b> | 1          | 16H   |                                 |                       |

Answer of the Slave: E5h

#### 4.4.2.2 Set secondary address

The secondary address has the following structure:

| Byte Nr.   | Size(Byte) | Value(Hex)  | Description                     |
|------------|------------|-------------|---------------------------------|
| <b>1-4</b> | 4          | xx xx xx xx | HM identification number        |
| <b>5-6</b> | 2          | 10D3        | Manufacturer's ID (DFS Danfoss) |
| <b>7</b>   | 1          | xx          | Version number firmware (00-FF) |
| <b>8</b>   | 1          | 04/0C       | Medium: Heat                    |

The secondary address is unique but in installations with other meter types with matching secondary access, it is possible to change the secondary address using this command or SonoAPP.

| Field name                   | # of Bytes | Value | Description  |                       |
|------------------------------|------------|-------|--|-----------------------|
| <b>Start of Frame</b>        | 1          | 68H   | Start of control frame   | Data Link Layer (DLL) |
| <b>L Field</b>               | 1          | 09H   | C field to Checksum  |                       |
| <b>L Field</b>               | 1          | 09H   | C field to Checksum  |                       |
| <b>Start</b>                 | 1          | 68H   |  |                       |
| <b>C Field</b>               | 1          | 73H   | SND_UD   |                       |
| <b>A Field</b>               | 1          | FEH   | Primary address (00-FA = 0-250), FE(point to point), FD selected slave |                       |
| <b>CI Field</b>              | 1          | 51H   |  | TPL                   |
| <b>DIF</b>                   | 1          | 0CH   | 8 digits BCD, 4 byte   | (APL)                 |
| <b>VIF</b>                   | 1          | 79H   | Set secondary address  |                       |
| <b>New secondary address</b> | 1          | 78H   | Digit 7 and 8<br>Range: 00-99  | Application Layer     |
| <b>New secondary address</b> | 1          | 56H   | Digit 5 and 6<br>Range: 00-99  |                       |
| <b>New secondary address</b> | 1          | 34H   | Digit 3 and 4<br>Range: 00-99  |                       |
| <b>New secondary address</b> | 1          | 12H   | Digit 1 and 2<br>Range: 00-99  |                       |
| <b>Checksum</b>              | 1          | 3BH   | Checksum   | DLL                   |
| <b>End of Frame</b>          | 1          | 16H   | Stop character   |                       |

The secondary address can be changed using one of the following DIF types:

- INT32
- 8 Digit BCD
- INT64 (Most data concentrators are using the INT64)

The address must in all types be entered as a BCD code. (e.g. address 12345678 is 0x12345678). The last four bytes in the INT64 will not change anything in the Meter.

#### 4.4.2.3 Set Baud Rate

The Meter supports the Baud Rates 300, 2400, 4800 and 9600 (Meters with Hardware Issue 5 have auto baudrate detection).

The Meter answers with single character acknowledgement (E5h) using the old baud rate. When the ACK is transmitted, the Meter switch to the new baud rate.

The master makes sure that the Meter has changed into the correct baud rate. To do this the master sends a command to the Meter within 2 min of the baud rate change. If the Meter doesn't answer with an ACK after 3 retry, the master has to return to the old baud rate.

If the Meter doesn't support the new baud rate it stays on the old baud rate after sending an ACK.

The command for changing baud rate is:

| Field name          | # of Bytes | Value | Description                       | Layer                 |
|---------------------|------------|-------|-----------------------------------|-----------------------|
| <b>Start</b>        | 1          | 68H   | Start of Frame                    | Data link Layer (DLL) |
| <b>L Field</b>      | 1          | 03H   | 2 <sup>nd</sup> Start to Checksum |                       |
| <b>L Field</b>      | 1          | 03H   | 2 <sup>nd</sup> Start to Checksum |                       |
| <b>Start</b>        | 1          | 68H   | Start of Frame                    |                       |
| <b>C Field</b>      | 1          | 73H   | SND_UD                            |                       |
| <b>A Field</b>      | 1          | XXH   | Primary Address                   | TPL                   |
| <b>CI Field</b>     | 1          | B8H   | 300 Baud                          |                       |
|                     |            | BBH   | 2400 Baud                         |                       |
|                     |            | BCH   | 4800 Baud                         |                       |
|                     |            | BDH   | 9600 Baud                         |                       |
| <b>Checksum</b>     | 1          | ??H   | Checksum                          | DLL                   |
| <b>End of Frame</b> | 1          | 16H   |                                   |                       |

Answer of the Slave: E5h



#### 4.4.2.4 Slave select

To select a Meter the following command must be used:

| Field name               | # of Bytes | Value                         | Description                       |                       |
|--------------------------|------------|-------------------------------|-----------------------------------|-----------------------|
| <b>Start</b>             | 1          | 68H                           | Start of Frame                    | Data Link Layer (DLL) |
| <b>L Field</b>           | 1          | 0BH                           | 2 <sup>nd</sup> Start to Checksum |                       |
| <b>L Field</b>           | 1          | 0BH                           | 2 <sup>nd</sup> Start to Checksum |                       |
| <b>Start</b>             | 1          | 68H                           | Start of Frame                    |                       |
| <b>C Field</b>           | 1          | 73H                           | SND_UD                            |                       |
| <b>A Field</b>           | 1          | FDH                           | Use secondary address             | TPL                   |
| <b>CI Field</b>          | 1          | 52H                           |                                   |                       |
| <b>Secondary address</b> | 8          | xx xx xx<br>xx xx xx<br>xx xx | Current secondary address         |                       |
| <b>Checksum</b>          | 1          | ??H                           | Checksum                          | DLL                   |
| <b>End of Frame</b>      | 1          | 16H                           |                                   |                       |

Answer of the Slave: E5h

#### 4.4.2.5 Date and time

The date and time can be changed using the following SND\_UD frame.

This command requires the Meter to have an access level "Installation".

Example of setting the date and time to: 22/03/2011 08:30 (4 byte M-Bus Type F)

| Field name          | # of Bytes | Value | Description                |                         |
|---------------------|------------|-------|----------------------------|-------------------------|
| <b>Start</b>        | 1          | 68H   | Start of Frame             | Data Link Layer (DLL)   |
| <b>L Field</b>      | 1          | 09H   | C field to Checksum        |                         |
| <b>L Field</b>      | 1          | 09H   | C field to Checksum        |                         |
| <b>Start</b>        | 1          | 68H   | Start of Frame             |                         |
| <b>C Field</b>      | 1          | 73H   | SND_UD                     |                         |
| <b>A Field</b>      | 1          | FEH   | Primary Address            |                         |
| <b>CI Field</b>     | 1          | 51H   | Data from Master to Slave  | TPL                     |
| <b>DIF</b>          | 1          | 04H   | 32 Bit Integer             | Application Layer (APL) |
| <b>VIF</b>          | 1          | 6DH   | Time Point (Date and time) |                         |
| <b>Date Time</b>    | 1          | 1EH   | Date & time (Type F data)  |                         |
| <b>Date Time</b>    | 1          | 28H   | Date & time (Type F data)  |                         |
| <b>Date Time</b>    | 1          | 76H   | Date & time (Type F data)  |                         |
| <b>Date Time</b>    | 1          | 13H   | Date & time (Type F data)  |                         |
| <b>Checksum</b>     | 1          | 02H   | Checksum                   | DLL                     |
| <b>End of Frame</b> | 1          | 16H   |                            |                         |

Answer of the Slave: E5h

#### 4.4.2.6 Set accounting date

The master can change the accounting date of each slave on the network. The accounting date is sent as a M-Bus type G format. The following frame sets the date to 01 June 2012.

| Field name          | # of Bytes | Value | Description               | Layer                   |
|---------------------|------------|-------|---------------------------|-------------------------|
| <b>Start</b>        | 1          | 68H   | Start of Frame            | Data Link layer (DLL)   |
| <b>L Field</b>      | 1          | 08H   | C field to Checksum       |                         |
| <b>L Field</b>      | 1          | 08H   | C field to Checksum       |                         |
| <b>Start</b>        | 1          | 68H   | Start of Frame            |                         |
| <b>C Field</b>      | 1          | 73H   | SND_UD                    |                         |
| <b>A Field</b>      | 1          | FEH   | Primary Address           |                         |
| <b>CI Field</b>     | 1          | 51H   | Data from Master to Slave | TPL                     |
| <b>DIF</b>          | 1          | 02H   | 16-bit integer            | Application Layer (APL) |
| <b>VIF</b>          | 1          | ECH   | Time Point (Date)         |                         |
| <b>VIFE</b>         | 1          | 7EH   | Future value              |                         |
| <b>Value</b>        | 1          | 81H   | Date (Type G)             |                         |
| <b>Value</b>        |            | 16H   | Date (Type G)             |                         |
| <b>Checksum</b>     | 1          | C5H   | Checksum                  | DLL                     |
| <b>End of Frame</b> | 1          | 16H   |                           |                         |

Answer of the Slave: E5h

#### 4.4.2.7 Set Pulse counter 1 and 2

The two pulse counters accumulated values can be configured by the master. The two telegrams below show examples:

##### Counter 1:

| Field name          | # of Bytes | Value | Description                   | Layer                   |
|---------------------|------------|-------|-------------------------------|-------------------------|
| <b>Start</b>        | 1          | 68H   | Start of Frame                | Data Link Layer (DLL)   |
| <b>L Field</b>      | 1          | 0AH   | C field to Checksum           |                         |
| <b>L Field</b>      | 1          | 0AH   | C field to Checksum           |                         |
| <b>Start</b>        | 1          | 68H   | Start of Frame                |                         |
| <b>C Field</b>      | 1          | 73H   | SND_UD                        |                         |
| <b>A Field</b>      | 1          | FEH   | Primary Address               |                         |
| <b>CI Field</b>     | 1          | 51H   | Data from Master to Slave     | TPL                     |
| <b>DIF</b>          | 1          | 84H   | 32 bit integer DIFE follows   | Application layer (APL) |
| <b>DIFE</b>         | 1          | 40H   | Sub unit 1 (Counter 1)        |                         |
| <b>VIF</b>          | 1          | 14H   | Volume 0.01 m <sup>3</sup>    |                         |
| <b>Vol. LSB</b>     | 1          | 4EH   | e.g. 123456,78 m <sup>3</sup> |                         |
| <b>Vol.</b>         | 1          | 61H   |                               |                         |
| <b>Vol.</b>         | 1          | BCH   |                               |                         |
| <b>Vol. MSB</b>     | 1          | 00H   |                               |                         |
| <b>Checksum</b>     | 1          | 05H   | Checksum                      |                         |
| <b>End of Frame</b> | 1          | 16H   |                               | D L L                   |

Answer of the Slave: E5h

Answer of the Slave: E5h

**Counter 2:**

| Field name          | # of Bytes | Value | Description                   | Layer                   |
|---------------------|------------|-------|-------------------------------|-------------------------|
| <b>Start</b>        | 1          | 68H   | Start of Frame                | Data Link Layer (DLL)   |
| <b>L Field</b>      | 1          | 0BH   | C field to Checksum           |                         |
| <b>L Field</b>      | 1          | 0BH   | C field to Checksum           |                         |
| <b>Start</b>        | 1          | 68H   | Start of Frame                |                         |
| <b>C Field</b>      | 1          | 73H   | SND_UD                        |                         |
| <b>A Field</b>      | 1          | FEH   | Primary Address               |                         |
| <b>CI Field</b>     | 1          | 51H   | Data from Master to Slave     | TPL                     |
| <b>DIF</b>          | 1          | 8CH   | 8 digit BCD DIFE follows      | Application layer (APL) |
| <b>DIFE</b>         | 1          | 80H   | DIFE follows                  |                         |
| <b>DIFE</b>         | 1          | 40H   | Sub unit 2 (Counter 2)        |                         |
| <b>VIF</b>          | 1          | 14H   | Volume 0.01 m <sup>3</sup>    |                         |
| <b>Vol. LSB</b>     | 1          | 78H   | e.g. 123456,78 m <sup>3</sup> |                         |
| <b>Vol.</b>         | 1          | 56H   |                               |                         |
| <b>Vol.</b>         | 1          | 34H   |                               |                         |
| <b>Vol. MSB</b>     | 1          | 12H   |                               |                         |
| <b>Checksum</b>     | 1          | 36H   | Checksum                      | DLL                     |
| <b>End of Frame</b> | 1          | 16H   |                               |                         |

Answer of the Slave: E5h

#### 4.4.2.8 Set Correction factor

The correction factor can be changed using the telegram below. The Meter must be in Re-verification mode to run this function. The value send is multiplied with  $10^{-6}$  and the values must not deviated more than  $\pm 5\%$  from 1.0.

| Field name          | # of Bytes | Value | Description                    | Layer                   |
|---------------------|------------|-------|--------------------------------|-------------------------|
| <b>Start</b>        | 1          | 68H   | Start of Frame                 | Data Link Layer (DLL)   |
| <b>L Field</b>      | 1          | 0BH   | C field to Checksum            |                         |
| <b>L Field</b>      | 1          | 0BH   | C field to Checksum            |                         |
| <b>Start</b>        | 1          | 68H   | Start of Frame                 |                         |
| <b>C Field</b>      | 1          | 73H   | SND_UD                         |                         |
| <b>A Field</b>      | 1          | XXH   | Primary Address                |                         |
| <b>CI Field</b>     | 1          | 51H   | Data from Master to Slave      | TPL                     |
| <b>DIF</b>          | 1          | 04H   | 32 bit integer DIFE follows    | Application layer (APL) |
| <b>VIF</b>          | 1          | FDH   | True VIF is given in next VIFE |                         |
| <b>VIFE</b>         | 1          | BAH   | No Unit                        |                         |
| <b>VIFE</b>         | 1          | 70H   | Correction factor * $10^{-6}$  |                         |
| <b>LSB</b>          | 1          | 47H   | e.g 1.034567                   |                         |
|                     | 1          | C9H   |                                |                         |
|                     | 1          | 0FH   |                                |                         |
| <b>MSB</b>          | 1          | 00H   |                                |                         |
| <b>Checksum</b>     | 1          | 0CH   | Checksum                       | DLL                     |
| <b>End of Frame</b> | 1          | 16H   |                                |                         |

#### 4.4.2.9 Read out desired data

It is possible to configure the read out to any customer requirements without having to change the code. To do so it is possible to configure the read out to contain 1-24 data records. The records can be found in Annex A.. After a change the read out will be the chosen until an application reset is made or until the Slave has a power reset. It will then return to default settings. To make a permanent change use the SonoAPP.

The data record 00H is interpreted as no record and shall be used if a field is not used.

The 8 first records must be used before the next 8 records (9-16, 17-24) can be occupied and the data must be sent MSB.

The telegram for setting 1-8 records is:

| Field name             | # of Bytes | Value | Description                    |                         |
|------------------------|------------|-------|--------------------------------|-------------------------|
| <b>Start of Frame</b>  | 1          | 68H   | Start of Frame                 | Data Link Layer (DLL)   |
| <b>L Field</b>         | 1          | 0FH   | C field to Checksum            |                         |
| <b>L Field</b>         | 1          | 0FH   | C field to Checksum            |                         |
| <b>Start</b>           | 1          | 68H   | Start of Frame                 |                         |
| <b>C Field</b>         | 1          | 73H   | SND_UD                         |                         |
| <b>A Field</b>         | 1          | xx    | Primary Address                |                         |
| <b>CI Field</b>        | 1          | 51H   | Data from Master to Slave      | TPL                     |
| <b>DIF</b>             | 1          | 07H   | 64 bit Integer, 8 byte         | Application Layer (APL) |
| <b>VIF</b>             | 1          | FDH   | True VIF is given in next VIFE |                         |
| <b>VIFE</b>            | 1          | 8BH   | Parameter Set Identification   |                         |
| <b>VIFE</b>            | 1          | 0CH   | Add to readout list            |                         |
| <b>Read out record</b> | 1          | xx    | Record 1                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 2                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 3                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 4                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 5                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 6                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 7                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 8                       |                         |
| <b>Checksum</b>        | 1          | xx    | Checksum                       | DLL                     |
| <b>End of Frame</b>    | 1          | 16H   |                                |                         |

Answer of the Slave: E5h

Telegram for setting 1-16 records is:

| Field name             | # of Bytes | Value | Description                    |                         |
|------------------------|------------|-------|--------------------------------|-------------------------|
| <b>Start of Frame</b>  | 1          | 68H   | Start of Frame                 | Data Link Layer (DLL)   |
| <b>L Field</b>         | 1          | 1BH   | C field to Checksum            |                         |
| <b>L Field</b>         | 1          | 1BH   | C field to Checksum            |                         |
| <b>Start</b>           | 1          | 68H   | Start of Frame                 |                         |
| <b>C Field</b>         | 1          | 73H   | SND_UD                         |                         |
| <b>A Field</b>         | 1          | xx    | Primary Address                |                         |
| <b>CI Field</b>        | 1          | 51H   | Data from Master to Slave      | TPL                     |
| <b>DIF</b>             | 1          | 07H   | 64 bit Integer, 8 byte         | Application Layer (APL) |
| <b>VIF</b>             | 1          | FDH   | True VIF is given in next VIFE |                         |
| <b>VIFE</b>            | 1          | 8BH   | Parameter Set Identification   |                         |
| <b>VIFE</b>            | 1          | 0CH   | Add to readout list            |                         |
| <b>Read out record</b> | 1          | Xx    | Record 1                       |                         |
| <b>Read out record</b> | 1          | Xx    | Record 2                       |                         |
| <b>Read out record</b> | 1          | Xx    | Record 3                       |                         |
| <b>Read out record</b> | 1          | Xx    | Record 4                       |                         |
| <b>Read out record</b> | 1          | Xx    | Record 5                       |                         |
| <b>Read out record</b> | 1          | Xx    | Record 6                       |                         |
| <b>Read out record</b> | 1          | Xx    | Record 7                       |                         |
| <b>Read out record</b> | 1          | Xx    | Record 8                       |                         |
| <b>DIF</b>             | 1          | 07H   | 64 bit Integer, 8 byte         | Application Layer (APL) |
| <b>VIF</b>             | 1          | FDH   | True VIF is given in next VIFE |                         |
| <b>VIFE</b>            | 1          | 8BH   | Parameter Set Identification   |                         |
| <b>VIFE</b>            | 1          | 8CH   | Add to readout list            |                         |
| <b>VIFE</b>            | 1          | 0CH   | Add to readout list            |                         |
| <b>Read out record</b> | 1          | xx    | Record 9                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 10                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 11                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 12                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 13                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 14                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 15                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 16                      |                         |
| <b>Checksum</b>        | 1          | xx    | Checksum                       | DLL                     |
| <b>End of Frame</b>    | 1          | 16H   |                                |                         |

Answer of the Slave: E5h



Telegram for setting 1-24 records is:

| Field name             | # of Bytes | Value | Description                    |                         |
|------------------------|------------|-------|--------------------------------|-------------------------|
| <b>Start of Frame</b>  | 1          | 68H   | Start of Frame                 | Data Link Layer (DLL)   |
| <b>L Field</b>         | 1          | 2AH   | C field to Checksum            |                         |
| <b>L Field</b>         | 1          | 2AH   | C field to Checksum            |                         |
| <b>Start</b>           | 1          | 68H   | Start of Frame                 |                         |
| <b>C Field</b>         | 1          | 73H   | SND_UD                         |                         |
| <b>A Field</b>         | 1          | xx    | Primary Address                |                         |
| <b>CI Field</b>        | 1          | 51H   | Data from Master to Slave      | TPL                     |
| <b>DIF</b>             | 1          | 07H   | 64 bit Integer, 8 byte         | Application Layer (APL) |
| <b>VIF</b>             | 1          | FDH   | True VIF is given in next VIFE |                         |
| <b>VIFE</b>            | 1          | 8BH   | Parameter Set Identification   |                         |
| <b>VIFE</b>            | 1          | 0CH   | Add to readout list            |                         |
| <b>Read out record</b> | 1          | xx    | Record 1                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 2                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 3                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 4                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 5                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 6                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 7                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 8                       |                         |
| <b>DIF</b>             | 1          | 07H   | 64 bit Integer, 8 byte         | Application Layer (APL) |
| <b>VIF</b>             | 1          | FDH   | True VIF is given in next VIFE |                         |
| <b>VIFE</b>            | 1          | 8BH   | Parameter Set Identification   |                         |
| <b>VIFE</b>            | 1          | 8CH   | Add to readout list            |                         |
| <b>VIFE</b>            | 1          | 0CH   | Add to readout list            |                         |
| <b>Read out record</b> | 1          | xx    | Record 9                       |                         |
| <b>Read out record</b> | 1          | xx    | Record 10                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 11                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 12                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 13                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 14                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 15                      |                         |
| <b>Read out record</b> | 1          | xx    | Record 16                      |                         |
| <b>DIF</b>             | 1          | 07H   | 64 bit Integer, 8 byte         | Application Layer (APL) |
| <b>VIF</b>             | 1          | FDH   | True VIF is given in next VIFE |                         |
| <b>VIFE</b>            | 1          | 8BH   | Parameter Set Identification   |                         |
| <b>VIFE</b>            | 1          | 8CH   | Add to readout list            |                         |
| <b>VIFE</b>            | 1          | 0CH   | Add to readout list            |                         |

|                        |   |     |           |     |
|------------------------|---|-----|-----------|-----|
| <b>Read out record</b> | 1 | xx  | Record 17 | DLL |
| <b>Read out record</b> | 1 | xx  | Record 18 |     |
| <b>Read out record</b> | 1 | xx  | Record 19 |     |
| <b>Read out record</b> | 1 | xx  | Record 20 |     |
| <b>Read out record</b> | 1 | xx  | Record 21 |     |
| <b>Read out record</b> | 1 | xx  | Record 22 |     |
| <b>Read out record</b> | 1 | xx  | Record 23 |     |
| <b>Read out record</b> | 1 | xx  | Record 24 |     |
| <b>Checksum</b>        | 1 | xx  | Checksum  |     |
| <b>End of Frame</b>    | 1 | 16H |           |     |

Answer of the Slave: E5h

#### 4.4.3 REQ\_UD2

This command is used by the master to request data from the slave. The slave must confirm the reception of a correct telegram with a RSP\_UD answer.

| Field name          | # of Bytes | Value               | Description   | Data Link Layer (DLL) |
|---------------------|------------|---------------------|---|-----------------------|
| <b>Start</b>        | 1          | 10H                 | Start Request   |                       |
| <b>C Field</b>      | 1          | 5B/7BH<br>01FV1011b | F = FCB-Bit<br>V = FCV-Bit (must be 1 in REQ_UD2 request) |                       |
| <b>A Field</b>      | 1          | ??H                 | Primary Address or FDH                                    |                       |
| <b>Checksum</b>     | 1          | ??H                 | Checksum  |                       |
| <b>End of Frame</b> | 1          | 16H                 |   |                       |

Answer of the Slave: RSP\_UD

#### 4.4.4 RSP\_UD

The slave answers the REQ\_UD2 with a RSP\_UD telegram. The telegram has the following structure:

| Field name                   | # of Bytes | Value  | Description   |                            |
|------------------------------|------------|--------|---|----------------------------|
| <b>Start of Frame</b>        | 1          | 68H    | Start of Frame                                      | Data Link Layer (DLL)      |
| <b>L Field</b>               | 1          | ??H    | C Field to Checksum                                 |                            |
| <b>L Field</b>               | 1          | ??H    | C Field to Checksum                                 |                            |
| <b>Start</b>                 | 1          | 68H    | Start of Frame                                      |                            |
| <b>C Field</b>               | 1          | 08H    | RSP_UD (Long frame)                                 |                            |
| <b>A Field</b>               | 1          | ??H    | Primary Address                                     |                            |
| <b>CI Field</b>              | 1          | 72h    | Variable data response<br>72h: 12 bytes data header | Transportation Layer (TPL) |
| <b>Identification number</b> | 4          | ??H    | Product serial number (Secondary address)           |                            |
| <b>Manufacturer's mark</b>   | 2          | ??H    | Manufacturer's mark                                 |                            |
| <b>Version number</b>        | 1          | ??H    | Version number (00-FF)                              |                            |
| <b>Medium</b>                | 1          | 04H    | Medium: Heat  |                            |
| <b>Access number</b>         | 1          | ??H    | Incremented after each REQ_UD2 (00-FF->00)          |                            |
| <b>Status</b>                | 1          | ??H    | Status  | APL                        |
| <b>Configuration</b>         | 2          | ??H    | Always 0000H i.e. not used)                         |                            |
| <b>Data</b>                  | 0-235      | xx..xx | Read-out data<br>Data record 1-24                   | DLL                        |
| <b>Checksum</b>              | 1          | ??H    | Checksum  |                            |
| <b>End of Frame</b>          | 1          | 16H    | End frame   |                            |

# Annex A

The table below holds the list of parameters which can be used in the read out of desired data.

| Parameter                        | HEX  |
|----------------------------------|------|
| No record                        | 0x0  |
| Heat Energy                      | 0x1  |
| Heat Volume                      | 0x2  |
| Flow Rate                        | 0x3  |
| Power                            | 0x4  |
| Forward Temperature              | 0x5  |
| Return Temperature               | 0x6  |
| Difference temperature           | 0x7  |
| External temperature (Enclosure) | 0x8  |
| Current time                     | 0x9  |
| Hour Counter Factory             | 0xA  |
| Hour Counter OK                  | 0xB  |
| Hour Counter Alarm               | 0xC  |
| Remaining Battery Life Time      | 0xD  |
| Time On Battery                  | 0xE  |
| Accounting Date                  | 0xF  |
| Meter Type                       | 0x10 |
| Year log 1                       | 0x11 |
| Year log 2                       | 0x12 |
| Month Log 1                      | 0x13 |
| Month Log 2                      | 0x14 |
| Month Log 3                      | 0x15 |
| Month Log 4                      | 0x16 |
| Month Log 5                      | 0x17 |
| Month Log 6                      | 0x18 |
| Month Log 7                      | 0x19 |
| Month Log 8                      | 0x1A |
| Month Log 9                      | 0x1B |
| Month Log 10                     | 0x1C |
| Month Log 11                     | 0x1D |
| Month Log 12                     | 0x1E |
| Month Log 13                     | 0x1F |
| Month Log 14                     | 0x20 |
| Month Log 15                     | 0x21 |
| Month Log 16                     | 0x22 |
| Month Log 17                     | 0x23 |
| Month Log 18                     | 0x24 |
| Month Log 19                     | 0x25 |

|   |      |
|---|------|
| <b>Month Log 20</b>                             | 0x26 |
| <b>Month Log 21</b>                             | 0x27 |
| <b>Month Log 22</b>                             | 0x28 |
| <b>Month Log 23</b>                             | 0x29 |
| <b>Month Log 24</b>                             | 0x2A |
| <b>Energy Cooling</b>                           | 0x2B |
| <b>Volume Cooling</b>                           | 0x2C |
| <b>High Resolution Energy Cooling</b>           | 0x2D |
| <b>High Resolution Volume Cooling</b>           | 0x2E |
| <b>Mass</b>                                     | 0x2F |
| <b>Pulse Counter One</b>                        | 0x30 |
| <b>Pulse Counter Two</b>                        | 0x31 |
| <b>FWChecksum</b>                               | 0x32 |
| <b>Correction Factor</b>                        | 0x33 |
| <b>High Resolution Heat Energy</b>              | 0x34 |
| <b>High Resolution Heat Volume</b>              | 0x35 |
| <b>Tariff Register One</b>                      | 0x36 |
| <b>Tariff Register Two</b>                      | 0x37 |
| <b>Year Log Energy 1 (Only Energy record)</b>   | 0x38 |
| <b>Year Log Energy 2 (Only Energy record)</b>   | 0x39 |
| <b>Month Log Energy 1 (Only Energy record)</b>  | 0x3A |
| <b>Month Log Energy 2 (Only Energy record)</b>  | 0x3B |
| <b>Month Log Energy 3 (Only Energy record)</b>  | 0x3C |
| <b>Month Log Energy 4 (Only Energy record)</b>  | 0x3D |
| <b>Month Log Energy 5 (Only Energy record)</b>  | 0x3E |
| <b>Month Log Energy 6 (Only Energy record)</b>  | 0x3F |
| <b>Month Log Energy 7 (Only Energy record)</b>  | 0x40 |
| <b>Month Log Energy 8 (Only Energy record)</b>  | 0x41 |
| <b>Month Log Energy 9 (Only Energy record)</b>  | 0x42 |
| <b>Month Log Energy 10 (Only Energy record)</b> | 0x43 |
| <b>Month Log Energy 11 (Only Energy record)</b> | 0x44 |
| <b>Month Log Energy 12 (Only Energy record)</b> | 0x45 |
| <b>Month Log Energy 13 (Only Energy record)</b> | 0x46 |
| <b>Month Log Energy 14 (Only Energy record)</b> | 0x47 |
| <b>Month Log Energy 15 (Only Energy record)</b> | 0x48 |
| <b>Month Log Energy 16 (Only Energy record)</b> | 0x49 |
| <b>Month Log Energy 17 (Only Energy record)</b> | 0x4A |
| <b>Month Log Energy 18 (Only Energy record)</b> | 0x4B |
| <b>Month Log Energy 19 (Only Energy record)</b> | 0x4C |
| <b>Month Log Energy 20 (Only Energy record)</b> | 0x4D |
| <b>Month Log Energy 21 (Only Energy record)</b> | 0x4E |
| <b>Month Log Energy 22 (Only Energy record)</b> | 0x4F |
| <b>Month Log Energy 23 (Only Energy record)</b> | 0x50 |

|   |      |
|---|------|
| <b>Month Log Energy 24 (Only Energy record)</b> | 0x51 |
| <b>Year Log Volume 1 (Only Volume record)</b>   | 0x52 |
| <b>Year Log Volume 2 (Only Volume record)</b>   | 0x53 |
| <b>Month Log Volume 1 (Only Volume record)</b>  | 0x54 |
| <b>Month Log Volume 2 (Only Volume record)</b>  | 0x55 |
| <b>Month Log Volume 3 (Only Volume record)</b>  | 0x56 |
| <b>Month Log Volume 4 (Only Volume record)</b>  | 0x57 |
| <b>Month Log Volume 5 (Only Volume record)</b>  | 0x58 |
| <b>Month Log Volume 6 (Only Volume record)</b>  | 0x59 |
| <b>Month Log Volume 7 (Only Volume record)</b>  | 0x5A |
| <b>Month Log Volume 8 (Only Volume record)</b>  | 0x5B |
| <b>Month Log Volume 9 (Only Volume record)</b>  | 0x5C |
| <b>Month Log Volume 10 (Only Volume record)</b> | 0x5D |
| <b>Month Log Volume 11 (Only Volume record)</b> | 0x5E |
| <b>Month Log Volume 12 (Only Volume record)</b> | 0x5F |
| <b>Month Log Volume 13 (Only Volume record)</b> | 0x60 |
| <b>Month Log Volume 14 (Only Volume record)</b> | 0x61 |
| <b>Month Log Volume 15 (Only Volume record)</b> | 0x62 |
| <b>Month Log Volume 16 (Only Volume record)</b> | 0x63 |
| <b>Month Log Volume 17 (Only Volume record)</b> | 0x64 |
| <b>Month Log Volume 18 (Only Volume record)</b> | 0x65 |
| <b>Month Log Volume 19 (Only Volume record)</b> | 0x66 |
| <b>Month Log Volume 20 (Only Volume record)</b> | 0x67 |
| <b>Month Log Volume 21 (Only Volume record)</b> | 0x68 |
| <b>Month Log Volume 22 (Only Volume record)</b> | 0x69 |
| <b>Month Log Volume 23 (Only Volume record)</b> | 0x6A |
| <b>Month Log Volume 24 (Only Volume record)</b> | 0x6B |
| <b>Ultra-High Resolution Heat Volume</b>        | 0x6C |
| <b>Ultra-High Resolution Cooling Volume</b>     | 0x6D |
| <b>Max Flow rate heat timestamp</b>             | 0x6E |
| <b>Max flow rate heat</b>                       | 0x6F |
| <b>Max flow rate Cooling timestamp</b>          | 0x70 |
| <b>Max flow rate Cooling</b>                    | 0x71 |
| <b>Max power heat timestamp</b>                 | 0x72 |
| <b>Max power heat</b>                           | 0x73 |
| <b>Max power cooling timestamp</b>              | 0x74 |
| <b>Max power Cooling</b>                        | 0x75 |
| <b>Ultra-High resolution Heat energy</b>        | 0x76 |
| <b>Ultra-High resolution Cooling energy</b>     | 0x77 |