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.

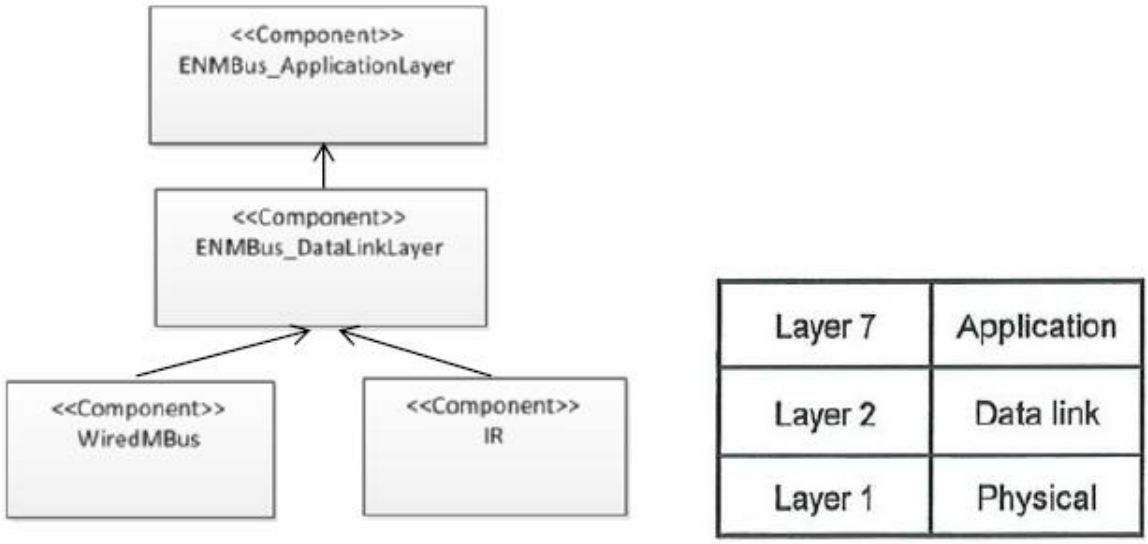

Figure 1 - OSI model and architecture of HM

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 idie 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 ± 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
Calling direction	0	1	FCB	FCV	F3	F2	F1	F0
Reply Direction	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
SND_NKE	0100 0000	40	Short frame	Initialization of slave
SND_UD	01F1 0011	53/73	Long/Control	Send user data to slave
REQ_UD1	01F1 1010	5A/7A	Short frame	Request class 1 data
REQ_UD2	01F1 1011	5B/7B	Short frame	Request class 2 data
REQ_SKE	0100 1001	49	Short frame	Status request
RSP_SKE	0000 1011	0B	Short frame	Status data, slave to master
RSP_UD	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: sssswwNNyyww) 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 Cl 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 Cl 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-Bust the long header (0x72) is always used.

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

CI-field (HEX)	Direction
50	Application reset
51	Data send to device
52	Slave select (no header)
72	The telegram contains data for the master with long header
B8	Set baud rate 300 (only wired M-Bus)
BB	Set Baud Rate to 2400
BD	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
1-4	4	xx xx xx xx	Meter identification number
5-6	2	D310	Manufacturer's ID (DFS Danfoss 10D3h)
7	1	xx	Version number firmware (00-FF)
8	1	04/0C	Medium: Heat outlet/inlet
9	1	xx	Access Number (00-FF-> 00)
10	1	xx	Status
11-12	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:

ssssswwNNyyww

The secondary address has the following format

ywwssssss

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
0,1	See table 5	See table 5
2	Power Low	Power Ok
3	Permanent error	No Permanent error
4	Temporary error	No Temporary error
5	Specific to manufacturer	Specific to manufacturer
6	Specific to manufacturer	Specific to manufacturer
7	Specific to manufacturer	Specific to manufacturer

Status bit 1 bit 0	
0 0	No Error
0 1	Application busy
1 0	Any application error
1 1	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-Number	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13
Hex code	0x08	0x10	0x28	0x04	0x24	0x30	0x50	0x70	0x90	0xB0	0xD0	0xF0	0x48
E-Number	E14	E15	E16	E17	E18	E32							
Hex 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
7	Extension Bit	Specifies if a DIFE byte follows: 0 = No 1 = Yes
6	LSB of Storage Number	0 if log is not send
5-4	Function Field	Specifies the kind of value 00 = instantaneous value 01 = Maximum value 10 = Minimum Value 11 = Value during error state
3-0	Data Field	Length and Coding of Data: 0001 (0x01): 8 Bit Integer 0010 (0x02): 16 Bit Integer 0011 (0x03): 24 Bit Integer 0100 (0x04): 32 Bit Integer 0110 (0x06): 48 bit Integer (only for record) 0111 (0x07): 64 Bit Integer (only for record) 1001 (0x09): 2 digit BCD 1010 (0x0A): 4 digit BCD 1011 (0x0B) 6 digit BCD 1100 (0x0C): 8 digit BCD 1101 (0x0D): Variable length (Only for TX) 1111 (0x0F): Manufacture Specific Data

The DIFE supported by Danfoss Meters:

Bit	Name	Description
7	Extension Bit	Specifies if a DIFE byte follows: 0 = No 1 = Yes
6	Unit	Specifies if it is pulse counter or cooling value
5-4	Tariff	Used °C*m^3 records
3-0	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
7	Extension Bit	Specifies if a VIFE byte follows the VIF
6-0	Value Information	Contains information for a single value. Unit and multiplier of each data record

The coding of the VIFE is:

Bit	Name	Description
7	Extension Bit	Specifies if a VIFE byte follows the VIFE
6-0	Value Information	Contains information for a single value. 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
00	**-**	Energy	0.000001 kWh
01	**-**	Energy	0.00001 kWh
02	**-**	Energy	0.0001 kWh
03	**-**	Energy	0.001 kWh
04	**-**	Energy	0.01 kWh
05	**-**	Energy	0.1 kWh
06	**-**	Energy	1 kWh
03	**-**	Energy	0.000001 MWh
04	**-**	Energy	0.00001 MWh
05	**-**	Energy	0.0001 MWh
06	**-**	Energy	0.001 MWh
07	**-**	Energy	0.01 MWh
FB	**00**	Energy	0.1 MWh
FB	**01**	Energy	1 MWh
0B	**-**	Energy	0.000001 GJ
0C	**-**	Energy	0.00001 GJ
0D	**-**	Energy	0.0001 GJ
0E	**-**	Energy	0.001 GJ
0F	**-**	Energy	0.01 GJ
FB	**08**	Energy	0.1 GJ
FB	**09**	Energy	1 GJ
FB	**8C 74**	Energy	0.000001 GCal
FB	**8C 75**	Energy	0.00001 GCal
FB	**0C**	Energy	0.0001 GCal
FB	**0D**	Energy	0.001 GCal
FB	**0E**	Energy	0.01 GCal
FB	**0F**	Energy	0.1 GCal
FB	**8F 77**	Energy	1 GCal
90	**70**	Volume	0.000000000001 m^3 (full resolution pico $m^{3)}$
10	**-**	Volume	0.000001 m^3
11	**-**	Volume	0.00001 m^3
12	**-**	Volume	0.0001 m^3
13	**-**	Volume	0.001 m^3
14	**-**	Volume	0.01 m^3
15	**-**	Volume	0.1 m^3
16	**-**	Volume	1 m^3
98	**70**	Mass	0.000000001 kg
38	**-**	Flow rate	0.001 l/h
39	**-**	Flow rate	0.01 l/h

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

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
Deselect old slave	SND_NKE	ACK
Select new slave	SND_UD	ACK
Request data	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 (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
Start	1	68H	Start of Frame	Data Link Layer (DLL)
L Field	1	04H	2nd Start to Checksum	
L Field	1	04H	2nd Start to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	FDH	Primary Address	
CI	1	50H	Application reset byte	TPL
Reset byte	1	00H	Application reset subcode	
Checksum	1	C0H	Checksum	DLL
End of Frame	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
0x00 **Standard Danfoss output (Diagnosis data will only be part of this telegram)**	Accumulated Energy (heat and cooling for combined) Accumulated Volume (heat and cooling for combined) Flow Rate Power Supply Temperature Return Temperature Difference Temperature External Temperature (Enclosure) Current Time Hour counter factory (operating hours since factory) Hour counter ok (Operating hours without error)
0x10 **User Data**	Accumulated Energy (heat and cooling for combined) Accumulated Volume (heat and cooling for combined) Current Time Hour counter factory (operating hours since factory) Month log 1 (newest year log) (storage number = 3) • Date • Accumulated Energy • Accumulated Volume • Optional (max power and flow) Year log 1 (newest year log) (storage number = 1) • Date • Accumulated Energy (heat and cooling for combined) • Accumulated Volume (heat and cooling for combined) • Optional (max power and flow)
0x20 **Simple billing**	Accumulated Energy (heat and cooling for combined) Accumulated Volume (heat and cooling for combined) Flow Rate Power Supply Temperature Return Temperature Difference Temperature Hour counter factory (operating hours since factory) Current Time
0x30 **Enhanced billing, historical energy registers (Combined meter will only return 6 months and 1 year)**	Accumulated Energy (heat and cooling for combined) Accumulated Volume (heat and cooling for combined) Year log 1 (newest year log) (storage number = 1) • Date • Accumulated Energy (heat and cooling for combined) Year log 2 (storage number = 2) • Date

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

Combined meter has both cooling and heat volume	Month log 1 (newest month log) (storage number = 3) • Date • Accumulated Volume (heat and cooling for combined) Month log 2 (storage number = 4) • Date • Accumulated Volume (heat and cooling for combined) Month log 3 (storage number = 5) • Date • Accumulated Volume (heat and cooling for combined) Month log 4 (storage number = 6) • Date • Accumulated Volume (heat and cooling for combined) Month log 5 (storage number = 7) • Date • Accumulated Volume (heat and cooling for combined) Month log 6 (storage number = 8) • Date • Accumulated Volume (heat and cooling for combined) Month log 7 (storage number = 9) • Date • Accumulated Volume Month log 8 (storage number = 10) • Date • Accumulated Volume Month log 9 (storage number = 11) • Date • Accumulated Volume Month log 10 (storage number = 12) • Date • Accumulated Volume Month log 11 (storage number = 13) • Date • Accumulated Volume Month log 12 (storage number = 14) • Date • Accumulated Volume
0x50 **Instant values**	Accumulated Energy (heat and cooling for combined) Accumulated Volume (heat and cooling for combined) Flow Rate Power Supply Temperature Return Temperature Difference Temperature External Temperature (Enclosure) Current time

	Hour counter factory (operating hours since factory) Hour counter ok (Operating hours without error) Hour counter alarm (Operating hour with error)
0x90 **Testing**	High resolution Accumulated Energy (heat and cooling for combined) High resolution Accumulated Volume (heat and cooling for combined) Flow Rate Power Supply Temperature Return Temperature 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
Start	1	10H	Start of short frame	Data Link Layer (DLL)
C Field	1	40H	SND_NKE	
A Field	1	FDH	Primary Address	
Checksum	1	4AH	Checksum	
End of Frame	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
Start	1	68H	Start of Frame	Data Link Layer (DLL)
L Field	1	06H	C field to Checksum	
L Field	1	06H	C field to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	FEH	Current Primary Address	
CI Field	1	51H	Data from Master to Slave	TPL
DIF	1	01H	8-bit integer	APL
VIF	1	7AH	Change primary address	
Value	1	05H	New Primary Address (address 5)	
Checksum	1	42H	Checksum	DLL
End of Frame	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
1-4	4	xx xx xx xx	HM identification number
5-6	2	10D3	Manufacturer's ID (DFS Danfoss)
7	1	xx	Version number firmware (00-FF)
8	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	
Start of Frame	1	68H	Start of control frame	Data Link Layer (DLL)
L Field	1	09H	C field to Checksum	
L Field	1	09H	C field to Checksum	
Start	1	68H		
C Field	1	73H	SND_UD	
A Field	1	FEH	Primary address (00-FA = 0-250), FE(point to point), FD selected slave	
CI Field	1	51H		TPL
DIF	1	0CH	8 digits BCD, 4 byte	Application Layer (APL)
VIF	1	79H	Set secondary address	
New secondary address	1	78H	Digit 7 and 8 Range: 00-99	
New secondary address	1	56H	Digit 5 and 6 Range: 00-99	
New secondary address	1	34H	Digit 3 and 4 Range: 00-99	
New secondary address	1	12H	Digit 1 and 2 Range: 00-99	
Checksum	1	3BH	Checksum	DLL
End of Frame	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
Start	1	68H	Start of Frame	Data link Layer (DLL)
L Field	1	03H	2nd Start to Checksum	
L Field	1	03H	2nd Start to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	XXH	Primary Address	
CI Field	1	B8H BBH BCH BDH	300 Baud 2400 Baud 4800 Baud 9600 Baud	TPL
Checksum	1	??H	Checksum	DLL
End of Frame	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	
Start	1	68H	Start of Frame	Data Link Layer (DLL)
L Field	1	0BH	2nd Start to Checksum	
L Field	1	0BH	2nd Start to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	FDH	Use secondary address	
CI Field	1	52H		TPL
Secondary address	8	xx xx xx xx xx xx xx xx	Current secondary address	
Checksum	1	??H	Checksum	DLL
End of Frame	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	
Start	1	68H	Start of Frame	Data Link Layer (DLL)
L Field	1	09H	C field to Checksum	
L Field	1	09H	C field to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	FEH	Primary Address	
CI Field	1	51H	Data from Master to Slave	TPL
DIF	1	04H	32 Bit Integer	Application Layer (APL)
VIF	1	6DH	Time Point (Date and time)	
Date Time	1	1EH	Date & time (Type F data)	
Date Time	1	28H	Date & time (Type F data)	
Date Time	1	76H	Date & time (Type F data)	
Date Time	1	13H	Date & time (Type F data)	
Checksum	1	02H	Checksum	DLL
End of Frame	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 send as a M-Bus type G format. The following frame sets the date to 01 june 2012.

Field name	# of Bytes	Value	Description	Layer
Start	1	68H	Start of Frame	Data Link layer (DLL)
L Field	1	08H	C field to Checksum	
L Field	1	08H	C field to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	FEH	Primary Address	
CI Field	1	51H	Data from Master to Slave	TPL
DIF	1	02H	16-bit integer	Application Layer (APL)
VIF	1	ECH	Time Point (Date)	
VIFE	1	7EH	Future value	
Value	1	81H	Date (Type G)	
Value		16H	Date (Type G)	
Checksum	1	C5H	Checksum	DLL
End of Frame	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
Start	1	68H	Start of Frame	Data Link Layer (DLL)
L Field	1	0AH	C field to Checksum	
L Field	1	0AH	C field to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	FEH	Primary Address	
CI Field	1	51H	Data from Master to Slave	TPL
DIF	1	84H	32 bit integer DIFE follows	Application layer (APL)
DIFE	1	40H	Sub unit 1 (Counter 1)	
VIF	1	14H	Volume 0.01 m^3	
Vol. LSB	1	4EH	e.g. 123456,78 m^3	
Vol.	1	61H		
Vol.	1	BCH		
Vol. MSB	1	00H		
Checksum	1	05H	Checksum	
End of Frame	1	16H		DLL

Answer of the Slave: E5h

Answer of the Slave: E5h

Counter 2:

Field name	# of Bytes	Value	Description	Layer
Start	1	68H	Start of Frame	Data Link Layer (DLL)
L Field	1	0BH	C field to Checksum	
L Field	1	0BH	C field to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	FEH	Primary Address	
CI Field	1	51H	Data from Master to Slave	TPL
DIF	1	8CH	8 digit BCD DIFE follows	Application layer (APL)
DIFE	1	80H	DIFE follows	
DIFE	1	40H	Sub unit 2 (Counter 2)	
VIF	1	14H	Volume 0.01 m^3	
Vol. LSB	1	78H	e.g. 123456,78 m^3	
Vol.	1	56H		
Vol.	1	34H		
Vol. MSB	1	12H		
Checksum	1	36H	Checksum	DLL
End of Frame	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 +-5% from 1.0.

Field name	# of Bytes	Value	Description	Layer
Start	1	68H	Start of Frame	Data Link Layer (DLL)
L Field	1	0BH	C field to Checksum	
L Field	1	0BH	C field to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	XXH	Primary Address	
CI Field	1	51H	Data from Master to Slave	TPL
DIF	1	04H	32 bit integer DIFE follows	Application layer (APL)
VIF	1	FDH	True VIF is given in next VIFE	
VIFE	1	BAH	No Unit	
VIFE	1	70H	Correction factor * 10^-6	
LSB	1	47H	e.g 1.034567	
	1	C9H		
	1	0FH		
MSB	1	00H		
Checksum	1	0CH	Checksum	DLL
End of Frame	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	
Start of Frame	1	68H	Start of Frame	Data Link Layer (DLL)
L Field	1	0FH	C field to Checksum	
L Field	1	0FH	C field to Checksum	
Start	1	68H	Start of Frame	
C Field	1	73H	SND_UD	
A Field	1	xx	Primary Address	
CI Field	1	51H	Data from Master to Slave	TPL
DIF	1	07H	64 bit Integer, 8 byte	Application Layer (APL)
VIF	1	FDH	True VIF is given in next VIFE	
VIFE	1	8BH	Parameter Set Identification	
VIFE	1	0CH	Add to readout list	
Read out record	1	xx	Record 1	
Read out record	1	xx	Record 2	
Read out record	1	xx	Record 3	
Read out record	1	xx	Record 4	
Read out record	1	xx	Record 5	
Read out record	1	xx	Record 6	
Read out record	1	xx	Record 7	
Read out record	1	xx	Record 8	
Checksum	1	xx	Checksum	DLL
End of Frame	1	16H		

Answer of the Slave: E5h

Telegram for setting 1-16 records is:

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

Answer of the Slave: E5h

Telegram for setting 1-24 records is:

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

Read out record	1	xx	Record 17	
Read out record	1	xx	Record 18	
Read out record	1	xx	Record 19	
Read out record	1	xx	Record 20	
Read out record	1	xx	Record 21	
Read out record	1	xx	Record 22	
Read out record	1	xx	Record 23	
Read out record	1	xx	Record 24	
Checksum	1	xx	Checksum	DLL
End of Frame	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	
Start	1	10H	Start Request	Data Link Layer (DLL)
C Field	1	5B/7BH 01FV1011b	F = FCB-Bit V = FCV-Bit (must be 1 in REQ_UD2 request)	
A Field	1	??H	Primary Address or FDH	
Checksum	1	??H	Checksum	
End of Frame	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	
Start of Frame	1	68H	Start of Frame	Data Link Layer (DLL)
L Field	1	??H	C Field to Checksum	
L Field	1	??H	C Field to Checksum	
Start	1	68H	Start of Frame	
C Field	1	08H	RSP_UD (Long frame)	
A Field	1	??H	Primary Address	
CI Field	1	72h	Variable data response 72h: 12 bytes data header	Transportation Layer (TPL)
Identification number	4	??H	Product serial number (Secondary address)	
Manufacturer's mark	2	??H	Manufacturer's mark	
Version number	1	??H	Version number (00-FF)	
Medium	1	04H	Medium: Heat	
Access number	1	??H	Incremented after each REQ_UD2 (00-FF->00)	
Status	1	??H	Status	
Configuration	2	??H	Always 0000H i.e. not used)	
Data	0-235	xx..xx	Read-out data Data record 1-24	APL
Checksum	1	??H	Checksum	DLL
End of Frame	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

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

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