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Communication over interfaces
Version 1.3

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Abbreviations and definitions

LSB	Least Significant Byte
MSB	Most Significant Byte
LSW	Least Significant Word
MSW	Most Significant Word
CRC	Cyclic Redundancy Check
0xHH	Hexadecimal number HH
NKS	Decimal places

Change history

Version	Items changed	Date
1.0	First release	28.09.2006
1.1	Name and interface variants changed	01.12.2006
1.2	Chapter 3.4 volume test added Chapter 2.5.1 Link Layer added	23.03.2007

References

[EN1434] Heat meter standard EN1434, Parts 1-6, 02/2003
[PTB-A] PTB-A 50.7-1, "Software requirements for test equipment and additional equipment as per PTB-A 50.7", Appendix 1, 04/2002
[MBApp] M-Bus, "Dedicated Application Layer", Prof. Dr. H. Ziegler, 02/2001 (W4B160201.doc)

Contents

1 Interfaces

The meteris equipped with various interfaces as follows:

Interface	Communication	Priority	Remarks
IrDA optical	bidirectional	1 high	In all variants
ZVEI optical	bidirectional	2	In all variants
M-Bus	bidirectional	3	M-Bus or M-Bus/pulse variant
L-Bus	bidirectional	4 low	L-Bus/pulse variant
Pulse	unidirectional	adjustable	M-Bus/pulse variant or L-Bus/pulse variant

Four communication interfaces can be used for non-reactive communication with the meter, data readout and parametrization. The pulse interface is only designed for output of unidirectional decadic volume pulses.
As only one interface can be active at any one time, they are processed according to priority, but any communication already in progress is always completed first.

2 Communication

2.1 M-Bus / L-Bus

The M-Bus interface is bidirectional as per CEN TC 176 (or heat meter standard DIN EN 1434-3).

The two transmission speeds 2400 bauds and 300 bauds are supported. The meter is equipped with automatic baud rate detection and operates with the following parameters:

- 8 data bits
- even parity
- 1 stop bit

The L-Bus interface uses the same protocol as the M-Bus interface and differs only in the electrical characteristics:

- 3.2 V bus voltage
- no potential separation
- no power supply for the meter (slave) via the bus
- bus length < 10 m
- max. 8 slaves on one bus

Connection set-up:
After connection to the M-Bus, max. 590 ms must elapse before reliable communication is possible. A wait time of at least 590 ms must therefore be observed between connection to the M-Bus and the start of communication.

2.2 ZVEI

The ZVEI optical interface operates with the following parameters:

- Physical Layer: ZVEI with MUX LED; reduced optical characteristics
- Setting up contact: as per EN601107
- Scan frequency 0.5 Hz
- 2400 bauds
- 8 data bits
- Even parity
- 1 stop bit
- Link Layer: M-Bus EN1434-3
- Application Layer: M-Bus EN1434-3

Connection set-up:
To avoid excessively loading the power consumption of the meter, ZVEI communication can only take place with an interface that has been previously opened. This requires a wake-up sequence for byte 0x55 of 2.2+/-0.1 seconds at 2400 bauds with **8** data bits, **N**o parity and **1** stop bit [1]. The interface of the meter is ready to receive for 3 seconds after the end of the wake-up sequence. The interface also remains ready to receive for 3 more seconds after the end of each communication.
The protocol is equivalent to the M-Bus/L-Bus protocol as per EN 1434-3.

2.3 IrDA

- The Physical Layer corresponds to Infrared Data Association® for timing, bit and byte structure.
- Reduced optical characteristics; range approx. 6 cm with commercially available IrDA optical probes
- Setting up contact: scan frequency 0.5 Hz, wake-up signal 0x00
- 9600 bauds
- 8 data bits
- Even parity
- 1 stop bit
- Link Layer: Diehl Metering-specific (see below)
- Application Layer: Based on M-Bus EN1434-3

Like the ZVEI interface, the IrDA interface also requires a wake-up sequence. The higher scan frequency in this case results in a wake-up sequence with byte 0x00 of 0.6 +/-0.1 seconds for the same interface parameters (9600 bauds, 8,e,1), but the IrDA interface operates with a different Link Layer, which is explained below. The Application Layer is largely identical to the M-Bus Application Layer, so that the same routines can be used here (see below). The faster baud rate and the more efficient Link Layer provides a clear speed advantage over ZVEI or M-/L-Bus communication.

2.4 Link & Application Layer M-Bus/L-Bus/ZVEI

The following services are supported:

Name	C-field	CI-field	Description	Response
SND_NKE	0x40	-	Communication Reset	0xE5
SND_UD	0x53/0x73	 0x51 0x52	Send Data Mode1 Selection only if A-field = 0xFD	 0xE5 0xE5
REQ_UD1	0x5A	-	Request class 1 data, time-critical data. (Alarm protocol not implemented, instead response 0xE5 = no time-critical data, no alarm)	0xE5
REQ_UD2	0x7B / 0x5B	-	Request class 2 data	Variable response as per Application Reset
RSP_UD	0x08	0x72	Variable response mode 1	

[1] A wake-up sequence of 2.2+/-0.1 seconds 2400 bauds 8,e,1 (with parity bit) can also switch the meter to ready to receive. The interface is then ready to receive between 1..3 seconds.

2.4.1 SND_NKE -> E5h

Byte no.	Value	Meaning / description
1	10h	1st start character
2	40h	C-field (SND_NKE)
3	A	A-field: M-Bus primary address of meter (standard: 0)
4	CHK	Checksum
5	16h	Stop character

- Deselection
- Acknowledge with E5h

2.4.2 SND_UD -> E5h

All telegrams conform to the following structure and are acknowledged by the single character E5h if the telegram is received correctly.

Service: SND_UD Byte no.	Value	Meaning / description
1	68h	1st start character
2	Len	Long field
3	Len	Long field
4	68h	2nd start character
5	53h/73h	C-field
6	A	A-field (network layer)
7..n	DataSNDMBus	See Appendix
n+1	Checksum	Checksum
n.2	16h	Stop character

The following telegrams are supported:

- M-Bus selection
- Application Reset
- Set M-Bus primary address
- Set M-Bus identification number (secondary address)
- Set new due date
- Change pulse value 1 or 2
- Diehl Metering-specific functions

These telegrams are activated by the "DataSNDMBus" field and are described in the Appendix under "User Data".

2.4.3 REQ_UD2 -> RSP_UD

Byte no.	Value	Meaning / description
1	10h	1st start character
2	5bh/7bh	C-field (REQ_UD2)
3	AA	A-field: M-Bus primary address of meter (standard: 0)
4	CHK	Checksum
5	16h	Stop character

2.4.4 RSP_UD

Service: RSP_UD		
Byte no.	**Value**	**Meaning / description**
1	68h	1st start character
2	Len	Long field
3	Len	Long field
4	68h	2nd start character
5	C	C-field
6	A	A-field: M-Bus primary address of meter (standard: 0)
7	0x72	CI-field, variable response, fixed header 12 bytes
8	IdentNum	M-Bus device identification number 8-digit BCD
9	IdentNum	ditto
10	IdentNum	ditto
11	IdentNum	ditto
12	manufacture ID	Manufacturer's ID
13	manufacture ID	e.g. 0x2324 = "HYD"
14	generation of meter	Software ID = 0x49
15	device type	Medium (hot water 0x06, cold water = 0x07)
16	access number	Access counter
17	status	M-Bus status byte
18	signature	0x00 unencrypted
19	signature	0x00 unencrypted
20..n	DataRSPMBus	As per Application Reset response telegram; see Appendix
n+1	Checksum	Checksum
n+2	16h	Stop character

The "DataRSPMBus" field represents the alternative telegrams depending on Application Reset + subcode. The following subcodes are defined:

- 0x10 standard response (user billing)
- 0x20 enhanced response (simple billing)
- 0xb0 proprietary RAM response (manufacturing)
- 0xb1 proprietary RAM response (manufacturing)

The content of the individual telegrams is described in the Appendix under "Application Reset". Unsupported subcodes are treated as an application subcode 0x10.

2.4.5 General Communication Flow

1. Optional: SND_NKE -> Communication Reset
2. Optional SND_UD (e.g. Application Reset 0x10) -> set response
3. REQ_UD2 -> request response

2.5 Link & Application Layer IrDA

2.5.1 Link Layer

The IrDA Link Layer is Diehl Metering-specific and supports contact set-up (similar to ZVEI).
Wake-up header 0x00 with or without directly attached telegram.

The IrDA optical interface is ready to receive for another three seconds after communication.

The following Link Layer is implemented:

SYNC	**BOF**	**LEN**				**C**	**DATA**	**FCS**		**EOF**
8 bits	8 bits	32 bits				8 bits	variable	16 bits		8 bits
		L-field		L-field repeated				LSByte	MSByte	
		LSByte	MSByte	LSByte	MSByte					

SYNC Synchronization character for brightness adjustment = 00h

BOF Beginning Of Frame = start character = BFh; the receiver checks this for correctness

LEN Length = 2 identical long fields of 16 bits: Number of following bytes from C to DATA inclusive, i.e. all bytes in the DATA field + 1; the receiver checks that the two long fields are identical

C Control field = control characters

DATA Data container for higher level protocol layers

FCS Frame Check Sequence = checksum as per CCITT CRC (see next section); the CRC checksum is calculated from LEN to the last byte of the data (DATA), i.e. excluding FCS.

EOF End Of Frame = stop character = Efh; the receiver checks this for correctness

2.5.1.1 C-Field

The C-field contains the 1-bit sequence number and a Link Layer function code:

B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0
1 PRM 0	FCB	FCV	DFC	Function			

Primary to secondary station (action)

Secondary to primary station (reaction)

FCB Frame Count Bit

FCV Frame Count Valid
0 = FCB is invalid and not to be evaluated
1 = FCB is valid and to be evaluated

DFC Data Flow Control
0 = more messages will be accepted
1 = more messages will cause an overflow

PRM Primary Message
0 = message from the responding (secondary) station
1 = message from the initiating (primary) station

The primary station is the station that initiates communication. In the case of IrDA communication, communication is initiated by a wake-up sequence. The response to the optical wake-up therefore comes from the secondary station.

The FCB provides an ACK/NACK mechanism. This can take place implicitly during the mutual transmission of data or explicitly through dataless messages. The FCV signals whether or not the FCB is to be evaluated. FCV = 1 for data transmission with the C-fields for SETUP(Link Parameter), SEND(No Data) and SEND(Data). For C-fields for resetting (RESET) and ending (STOP) communication, FCV = 0 and FCB is undefined. If communication is buffered, the DFC bit provides data flow control.

The 4 bits of the function field are assigned as follows:

Dec.	Hex	Message type	Service (PRM = 1, primary station)
0	0	RESET	Reaction as after WAKE-UP
1	1	SEND(No Data)	Send without data as ACK/NACK. Can be used to implement REQUEST → RESPOND procedures. The information for positive acknowledge or negative acknowledge is provided by the FCB. (See status diagram)
2	2	SEND(Data)	Send message of variable length with simultaneous ACK/NACK of a previously received message. The information for positive acknowledge or negative acknowledge is provided by the FCB. (See status diagram)
3-15	3-E		Reserved

Dec.	Hex	Message type	Service (PRM = 0, secondary station)
0	0	SETUP(Link Parameter)	Response after WAKE-UP and RESET (optional). This response can be sent by devices that would like to change their baud rate after the IrDA wake-up
1	1	SEND(No Data)	Send without data as ACK/NACK. Can be used to implement REQUEST → RESPOND procedures. The information for positive acknowledge or negative acknowledge is provided by the FCB. (See status diagram)
2	2	SEND(Data)	Send message of variable length with simultaneous ACK/NACK of a previously received message. The information for positive acknowledge or negative acknowledge is provided by the FCB. (See status diagram)
3-15	3-F		Reserved

2.5.1.2CCITT-CRC 16-Bit Cyclic Redundancy Check

Generator polynom: $X^{16} + X^{12} + X^5 + 1$

Initialization with 0xffff, then invert bits.

2.5.2 Application Layer

The Application Layer comprises the above-mentioned DATA field.
The "DataSNDMBus" and "DataRSPMBus" fields are identical with the M-/L-Bus/ZVEI protocol, which is described in the Appendix.

2.5.2.1 Wake-up Header 0x00

Service: SEND (DATA)		
Byte no.	**Value**	**Meaning / description**
1	00h	Synchronization character (for bit synchronization and brightness adjustment)
2	BFh	Start character BOF (for byte synchronization and as start marker)
3	LenLo	16-bit long field low byte
4	LenHi	16-bit long field high byte (max. length 4095 bytes)
5	LenLo	16-bit repeated long field low byte
6	LenHi	16-bit repeated long field high byte (max. length 4095 bytes)
7	0xA2/0xE2/0xA1/0xE1	C-field IrDA Link Layer
8	AppSel = 0x02	Application Layer Selection (M-BUS=0x02)
9..n	DataSNDMBus	See Appendix "User Data"
n+1	CRCLo	CCITT CRC low byte
n+2	CRCHi	CRC over bytes 3 to n
n+3	EFh	Stop character, EOF

Service: SEND(DATA) – response to wake-up header 0x00		
Byte no.	**Value**	**Meaning / description**
1	00h	Synchronization character (for bit synchronization and brightness adjustment)
2	BFh	Start character BOF (for byte synchronization and as start marker)
3	LenLo	16-bit long field low byte
4	LenHi	16-bit long field high byte (max. length 4095 bytes)
5	LenLo	16-bit repeated long field low byte
6	LenHi	16-bit repeated long field high byte (max. length 4095 bytes)
7	C	Control byte for Link Layer = response to wake-up + parameters
8	AppSel	Application Layer Selection: M-BUS 0x02
9	0x72	CI field (as M-Bus), variable response, fixed header
10	IdentNum	M-Bus device identification number 8-digit BCD
11	IdentNum	ditto
12	IdentNum	ditto
13	IdentNum	ditto
14	manufacture ID	Manufacturer's ID
15	manufacture ID	e.g. 0x2324 = "HYD"
16	generation of meter	Software ID (generation of meter) tbd.
17	device type	Medium (forward 0x0c, return = 0x04, climate = 0xcd)
18	access number	Access counter
19	status	Status byte
20	signature	0x00 unencrypted
21	signature	0x00 unencrypted
22..n	DataRSPMBus	See Appendix "Application Reset"
n+1	CRCLo	CCITT CRC low byte
n+2	CRCHi	Create CRC with bytes n+2 up to and incl. n + 28·LenHi + LenLo
n+3	EFh	Stop character, EOF

3 Appendix

3.1 Status Byte

Bit	Description	Use
0	Reserved	-
1	Reserved	-
2	Power low	-
3	Permanent error	C-1
4	Temporary error	F-4, F-5
5	Proprietary	*1)
6	Proprietary	*1)
7	Proprietary	*1)

*1)

Error	C-1	F-4	F-5
Proprietary bit 5, 6, 7	0, 0, 0	1, 0, 0	1, 0, 1

C-1: Inconsistent memory
F-5: Communication limit of ZVEI/IRDA/L-BUS reached, no more communication possible over these interfaces
F-4: Volume sensor defective

3.2 Special Codes in Values

The character "B" stands for "F"
The character "D" stands for space
The character "F" stands for "-" sign
Example: BF4D : "F-4 "
F0023 : "-0023"

3.3 User Data

3.3.1 M-Bus Selection / Secondary Address

7	52h	CI-field: selection of slave, mode 1
8	IdentNum	M-Bus device identification number 8-digit BCD
9	IdentNum	ditto
10	IdentNum	ditto
11	IdentNum	ditto
12	manufacture ID	Manufacturer's ID
13	manufacture ID	e.g. 0x2324 = "HYD"
14	generation of meter	Software ID = tbd.
15	device type	

Secondary addressing is based on the system of dynamic assignment of the primary address 0xFD. This assignment of which meter is to respond to the primary address 0xFD is made using a selection telegram to the primary address 0xFD. A selection already made can be cancelled using a stop filter or a deselection telegram (SND_NKE).

Selection

Request telegram	Response
68 0B 0B 68 53 FD 52 NN NN NN NN HH HH ID MM CS 16	E5 (only if filter matches)

Structure of filter:

4 bytes IdentNum (MbusID))	NN	0xF	digit joker
2 bytes HST (manufacturer's ID)	HH	0xFF	byte joker
1 byte ID (software ID 0x29)	ID	0xFF	joker
1 byte device type	MM	0xFF	joker

Deselection

Request telegram	Response
10 40 FD CS 16	E5

After selection, the meter behaves as if it had the primary address 0xFD and can therefore be operated via the primary address 0xFD.

3.3.2 Application Reset

Byte no.	Value	Meaning / description
7	50h	CI-field = Application Reset
8	SC	Subcode: 0x10: standard response (user billing) 0x20: enhanced response (simple billing) 0xb0: RAM response 0x200-0x2ec 0xb1: RAM response 0x2ec-0x3d8

*) 0x200-0x400 for IrDA after AppReset 0xb0/0xb1

Non-implemented subcodes are ignored and result in the standard response as output, likewise Application Reset without subcode.

Once a telegram has been set, it can be requested with REQ_UD2.
Different response telegrams can be set for IrDA and ZVEI/M-Bus/L-Bus, but to obtain the desired data it is recommended that a corresponding Application Reset is always sent before requesting a non-standard response.

3.3.3 Set M-Bus Primary Address

Byte no.	Value	Meaning / description
7	51h	CI-field: data send mode 1
8	01h	VDB1
9	7Ah	VDB2
10	AA	New primary address

Example (address 233): 0x68 0x06 0x06 0x68 0x53 0xFE 0x51 0x01 0x7A 0xE9 0x06 0x16

Caution: If the telegram does not contain the address value to be set (0xE9 in this case), a random value (which happens to be in the communication register of the processor) is used as primary address.

3.3.4 Set M-Bus Identification Number

Byte no.	Value	Meaning / description
7	51h	CI-field: data send mode 1
8	0ch	VDB1: DIF 4-byte BCD
9	79h	VDB2: enhanced identification
10	IdentNum	M-Bus device identification number 8-digit BCD
11	IdentNum	ditto
12	IdentNum	ditto
13	IdentNum	ditto

Caution: If the telegram does not contain the address value to be set (0xE9 in this case), a random value (which happens to be in the communication register of the processor) is used as primary address.

3.3.5 Set New Due Date

Byte no.	Value	Meaning / description
7	51h	CI-field: data send mode 1
8	42h	VDB1: DIF, StorageNo. 1, 16 bits, tariff 0
9	ECh	VDB2: Time Point Date, type G
10	7Eh	VDB3: VIFE, future value
11	VDB3	New next due date, data type G
12	VDB4	New next due date, data type G

VDB3 and VDB4 are used as new next due date (data type G).

Example: New due date (in this case 31.12.03, data type G):

SND_UD with CI=0x51, A=0xE9=233
68 08 08 68 53 E9 51 42 EC 7E 7F 0C C4 16

Caution: If the telegram does not contain the due date to be set or only a part (0x7F 0x0C in this case), a random value (which happens to be in the communication register of the processor) is used as next due date. The validity of the next due date is not checked either.

3.3.6 Set Pulse Value 1

Byte no.	Value	Meaning / description
7	51h	CI-field: data send mode 1
8	0ah	DIF: 2-byte BCD
		VIF: pulse resolution; dependent on the number of decimal places (NKS) indicated in the main display:
		0NKS: 0x94
		1NKS: 0x93
		2NKS: 0x92
9	PA	3NKS: 0x91
		VIFE: increment per output pulse on output channel #0 (pulse
10	2ah	value 1)
11	VDB1	Pulse value BCD LSB
12	VDB2	Pulse value BCD MSB

Valid settings for the pulse value are 1, 10, 100 and 1000

3.3.7 Set Pulse Value 2

Byte no.	Value	Meaning / description
7	51h	CI-field: data send mode 1
8	0ah	DIF: 2-byte BCD
9	PA	VIF: pulse resolution; dependent on the number of decimal places (NKS) indicated in the main display: 0NKS: 0x94 1NKS: 0x93 2NKS: 0x92 3NKS: 0x91 VIFE: increment per output pulse on output channel #1 (pulse
10	2bh	value 2)
11	VDB1	Pulse value BDC LSB
12	VDB2	Pulse value BCD MSB

Valid settings for the pulse value are 1, 10, 100 and 1000

3.3.8 Diehl Metering-specific Functions

Byte no.	Value	Meaning / description
7	51h	CI-field: data send mode 1
8	0fh	VDB1: DIF 4-byte BCD
9	CMD	Command
10	Data1	Optional: Manufacturer's data depending on command
11	Data2	Optional: Manufacturer's data depending on command

The following functions are implemented that can be executed in the field:

CMD	Meaning	Parameters
0x00	No function	
0x01	Reserved	
0x02	Start volume calibration	
0x03	Stop volume calibration	
0x04	Reserved	
0x05	Reserved	
0x06	Reserved	
0x0b	Display on/off (permanently on, otherwise switches off after approx. 4 minutes)	1st byte = 0 => off 1st byte <> 0 => on
0x0c	Set pulse mode	1st byte Bit 0: pulse output 1: forward pulses; pulse output 2: return pulses Bit 1: pulse output 1: forward and return pulses; pulse output 2: direction indication Bit 2: pulse output 1: forward pulses; pulse output 2: no output Bit 3: pulse output 1: forward pulses; pulse output 2: forward pulses Bit 7: 1 = all pulses off
0x09	Reserved	
0x0a	Reserved	
0x0b..0xff	Reserved	

3.3.8 Standard Response Application Reset 0x10

The VIFs refer to an example meter with m³ configuration and 3 decimal places

Byte Offset	Variable Data Blocks (VDB) = DataRSPMBus		
1	Current accumulated total volume	DIFVolume	0x0c = current value, 8-digit BCD
2		VIFVolume	e.g. 0x13 = volume in litres
3		Value record 1	Accumulated total volume
4		Value record 1	Accumulated total volume
5		Value record 1	Accumulated total volume
6		Value record 1	Accumulated total volume
7	Current accumulated high-resolution volume	DIFVolumeE	0x8c = current value, 8-digit BCD
8		DIFETarif1	0x10 = tariff 1
9		VIFVolume	e.g. 0x11 = volume in ml
10		Value record 2	Accumulated high-resolution volume
11		Value record 2	Accumulated high-resolution volume
12		Value record 2	Accumulated high-resolution volume
13		Value record 2	Accumulated high-resolution volume
14	Current flow rate	DIFFlow	0x0b = current value, 6-digit BCD
15		VIFFlow	e.g. 0x3c = flow rate in l/h
16		Value record 3	Instantaneous flow rate
17		Value record 3	Instantaneous flow rate
18		Value record 3	Instantaneous flow rate
19	Current accumulated forward volume	DIFVolumeE	0x8c = current value, 8-digit BCD
20		DIFETarif2	0x20 = tariff 2
21		VIFVolume	e.g. 0x13 = volume in litres
22		Value record 4	Accumulated forward volume
23		Value record 4	Accumulated forward volume
24		Value record 4	Accumulated forward volume
25		Value record 4	Accumulated forward volume
26	Current accumulated return volume	DIFVolumeE	0x8c = current value, 8-digit BCD
27		DIFETarif3	0x30 = tariff 3
28		VIFVolume	e.g. 0x13 = volume in litres
29		Value record 5	Accumulated return volume
30		Value record 5	Accumulated return volume
31		Value record 5	Accumulated return volume
32		Value record 5	Accumulated return volume
33	Current time / date	DIFInt32	0x04 = current value, 32-bit integer
34		VIFDateTime	0x6d = time, time and date, data type F
35		Value record 6	Current time and date
36		Value record 6	Current time and date
37		Value record 6	Current time and date
38		Value record 6	Current time and date
39	Due date volume	DIFDueDateValue	0x4c = memory number 1, 8-digit BCD
40		VIFVolume	0x13 = volume (here in 10^{-3} l)
41		Value record 7	Due date volume
42		Value record 7	Due date volume
43		Value record 7	Due date volume

44		Value record 7	Due date volume
45	Due date	DIFDueDate	0x42 = memory number 1, 16-bit integer
46		VIFDate	0x6c = time only date, data type G
47		Value record 8	Due date
48		Value record 8	Due date
49	Next due date	DIFNextDueDate	0x42 = memory number 1, 16-bit integer
50		VIFNextDate	0xec = time only date, data type G, VIFE follows
51		VIFEFuture	0x7e = next value
52		Value record 9	Next due date main energy
53		Value record 9	Next due date main energy
54	Pulse value 1	DIFPulse1	0x0a = current value, 4-digit BCD
55		VIFPulseE	(0x91) = volume (here in 10 ml)
56		VIFEPulse1	0x2a = pulse output 1 (channel #0)
57		Value record 10	Pulse value 1
58		Value record 10	Pulse value 1
59	Pulse value 2	DIFPulse2	0x0a = current value, 4-digit BCD
60		VIFPulseE	(0x91) = volume (here in 10 ml)
61		VIFEPulse2	0x2b = pulse output 2 (channel #1)
62		Value record 11	Pulse value 2
63		Value record 11	Pulse value 2

3.3.9 Enhanced Response Application Reset 0x20

The VIFs refer to an example meter with m³ configuration and 3 decimal places

Byte Offset	Variable Data Blocks (VDB) = DataRSPMBus		
1	Due date volume	DIFDueDateValue	0x4c = memory number 1, 8-digit BCD
2		VIFVolume	0x13 = volume (here in 10^{-3} l)
3		Value record 7	Due date volume
4		Value record 7	Due date volume
5		Value record 7	Due date volume
6		Value record 7	Due date volume
7	Due date	DIFDueDate	0x42 = memory number 1, 16-bit integer
8		VIFDate	0x6c = time only date, data type G
9		Value record 8	Due date
10		Value record 8	Due date
11	Next due date	DIFNextDueDate	0x42 = memory number 1, 16-bit integer
12		VIFNextDate	0xec = time only date, data type G, VIFE follows
13		VIFEFuture	0x7e = next value
14		Value record 9	Next due date main energy
15		Value record 9	Next due date main energy
16	Proprietary	DIFManufacture	0x0f = start manufacturer-specific data until end
17	History	Value	Monthly value 1, latest value (from previous month)
18		Value	Monthly value 1, latest value (from previous month)
19		Value	Monthly value 1, latest value (from previous month)
20		Value	Monthly value 1, latest value (from previous month)
21		Value	Monthly value 2
22		Value	Monthly value 2
23		Value	Monthly value 2
24		Value	Monthly value 2

25	Value	Monthly value 3
26	Value	Monthly value 3
27	Value	Monthly value 3
28	Value	Monthly value 3
29	Value	Monthly value 4
30	Value	Monthly value 4
31	Value	Monthly value 4
32	Value	Monthly value 4
33	Value	Monthly value 5
34	Value	Monthly value 5
35	Value	Monthly value 5
36	Value	Monthly value 5
37	Value	Monthly value 6
38	Value	Monthly value 6
39	Value	Monthly value 6
40	Value	Monthly value 6
41	Value	Monthly value 7
42	Value	Monthly value 7
43	Value	Monthly value 7
44	Value	Monthly value 7
45	Value	Monthly value 8
46	Value	Monthly value 8
47	Value	Monthly value 8
48	Value	Monthly value 8
49	Value	Monthly value 9
50	Value	Monthly value 9
51	Value	Monthly value 9
52	Value	Monthly value 9
53	Value	Monthly value 10
54	Value	Monthly value 10
55	Value	Monthly value 10
56	Value	Monthly value 10
57	Value	Monthly value 11
58	Value	Monthly value 11
59	Value	Monthly value 11
60	Value	Monthly value 11
61	Value	Monthly value 12
62	Value	Monthly value 12
63	Value	Monthly value 12
64	Value	Monthly value 12
65	Value	Monthly value 13
66	Value	Monthly value 13
67	Value	Monthly value 13
68	Value	Monthly value 13
69	Value	Monthly value 14
70	Value	Monthly value 14
71	Value	Monthly value 14
72	Value	Monthly value 14
73	Value	Monthly value 15
74	Value	Monthly value 15
75	Value	Monthly value 15
76	Value	Monthly value 15
77	Value	Monthly value 16
78	Value	Monthly value 16
79	Value	Monthly value 16

80		Value	Monthly value 16
81		Value	Monthly value 17
82		Value	Monthly value 17
83		Value	Monthly value 17
84		Value	Monthly value 17
85		Value	Monthly value 18 (oldest value)
86		Value	Monthly value 18 (oldest value)
87		Value	Monthly value 18 (oldest value)
88		Value	Monthly value 18 (oldest value)
89	Error log	Value	Error log, byte 1
90		Value	Error log, byte 2
91		Value	Error log, byte 3
92		Value	Error log, byte 4
93		Value	Error log, byte 5
94		Value	Error log, byte 6
95		Value	Error log, byte 7
96		Value	Error log, byte 8
97		Value	Error log, byte 9
98		Value	Error log, byte 10
99		Value	Error log, byte 11
100		Value	Error log, byte 12
101		Value	Error log, byte 13
102		Value	Error log, byte 14
103		Value	Error log, byte 15
104		Value	Error log, byte 16
105		Value	Error log, byte 17
106		Value	Error log, byte 18
107		Value	Error log, byte 19
108		Value	Error log, byte 20
109		Value	Error log, byte 21
110	Special values	Value	HY serial number, LSD
111		Value	HY serial number
112		Value	HY serial number
113		Value	HY serial number, MSD
114		Value	Production date
115		Value	Production date
116		Value	Calibration accumulator
117		Value	Calibration accumulator
118		Value	Calibration accumulator
119		Value	Calibration accumulator
120	Firmware	SWVersionMain	Firmware version, byte 1
121		SWVersionSub	Firmware version, byte 2
122		SWVersionPatch	Firmware version, byte 3
123		SWVersionEich	Firmware version, byte 4 – subject to calibration
124		SWVersionNichtEich	Firmware version, byte 5 – not subject to calibration
125	Catalogue ID	Value	Catalogue ID, 1 byte
126	M-Bus primary address	Value	M-Bus primary address
127	Status	Value	Meter status byte
128	Control	Value	Control byte 0
129		Value	Control byte 1
130	Duplex Modes	Value	Control byte 2
131	Protection	Value	Protection

3.4 Volume test

The following procedure is required for the automatic start/stop volume test:

1.) Install and flush the meter, then stop the water flow.
2.) Start volume calibration command: 0x2
    Example IrDA: 00 BF 05 00 05 00 A2 02 51 0F 02 83 8F EF acknowledge: standard response
    Example M-Bus/ZVEI: 68 05 05 68 53 FE 51 0F 02 B3 16 acknowledge: E5h
3.) Set test volume with test flow
4.) Stop volume calibration command: 0x3
    Example IrDA: 00 BF 05 00 05 00 A2 02 51 0F 03 0A 9E EF acknowledge: standard response
    Example M-Bus/ZVEI: 68 05 05 68 53 FE 51 0F 03 B4 16 acknowledge: E5h

5.) Read test volume from display or request by communication. The display is switched off at the next date change.

For requesting the test volume by communication, the meter must be read using the following command:

IrDA SEND(DATA): 00 BF 09 00 09 00 A2 02 51 0F 07 04 00 BE 02 A1 BC EF
RSP: 00 BF 16 00 16 00 62 02 72 18 11 80 33 24 23 49 0719 00 00 00 0F BE 02 36 88 35 00 3F 11 EF

M-Bus/ZVEI SND_DU: 68 09 09 68 53 FE 51 0F 07 04 00 BE 02 7C 16
RSP: E5
M-Bus/ZVEI REQ_UD2: 10 7B FE 79 16
RSP: 68 16 16 68 08 00 72 18 11 80 33 24 23 49 07 1A 00 00 00 0F BE 02 36 88 35 00 C9 16

Calibration volume BCD [0..7] LSB 36 88 35 00 MSB corresponds to **0035883** in display. The least significant digit is not displayed, only the digits [1..7]. The unit depends on the meter configuration. The resolution is 3 decimal places higher than the least significant digit in basic display.
Alternatively the calibration accumulator can also read by ApplicationReset 0x20 (see also 3.3.10).