M-Bus protocol
CALEC® energy master

Manufacturer:	Aquametro AG
Device:	CALEC® energy master
Firmware version:	1.03.XX or higher
Manufacturer code:	05B4h
Device version:	D0 (inactive), D1(Flow), D2 (Standard), D3 (BDE), D4 (BDV), D5 (TWIN V), D7 (saturated steam), D8 (steam)

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1 Overview

1.1 Versions of CALEC® energy master

There are various versions of the CALEC® energy master This document describes the M-Bus protocol for all versions.

Version	Device version (DEV):	Explanation
Standard	D2	Water heat carrier (fluid as option)
BDE	D3	Bidirectional energy measurement, temperature controlled
BDV	D4	Bidirectional energy measurement, volume controlled
TWIN-V	D5	For composite or dual volume transmitters
Flow	D1	Flow calculator
Inactive	D0	Inactive
Saturated steam	D7	Saturated steam
Steam	D8	Steam

1.2 M-Bus interfaces

The CALEC® energy master has up to 4 independent M-Bus interfaces. Infrared in accordance with IEC870-5 and IrDA are always available. There is also the option of fitting an additional two M-Bus modules.
The interfaces are independent of one another and can be operated at the same time. The baud rates and reply telegrams can also be configured independently of one another.

1.3 3 calculators

The CALEC® energy master has up to 3 calculators.
On the M-Bus, the device reacts in the same way as 3 independent counters. Each counter (calculator) has its own primary and secondary address. If the device is addressed via point to point address 254, only calculator 1 reacts.

1.4 Explanation of abbreviations

Abbreviation	Explanation
REQ_UD2	Request for an RSP_UD telegram
RSP_UD	Data telegram from the CALEC
SND_UD	Data telegram to the CALEC
SND_NKE	Initialisation telegram in accordance with EN 13757
ACK	Confirmation telegram in accordance with EN 13757
PADR	Place-holder for the primary address (1 byte)
LEN	Place-holder for the length byte (1 byte), calculated in accordance with EN 13757
IDENT	Place-holder for the secondary address (4 bytes)
MAN	Place-holder for the manufacturer code (2 bytes)
DEV	Place-holder for the device version (1 byte)
MED	Place-holder for the medium (1 byte)
ACC	Place-holder for the access counter (1 byte)
STAT	Place-holder for the status (1 byte)
CS	Place-holder for the checksum (1 byte), calculated in accordance with EN 13757

1.5 Baud rates

The CALEC® energy master can communicate at 300, 2400 and 9600 baud.
For IrDA, the baud rate is 57.6 kbaud, which is configured automatically. If using a virtual COM port such as IrCOMM2k, the baud rate setting in the application software is ignored.
The factory setting for the baud rate is 2400.

1.6 M-Bus addressing

The device supports primary and secondary addressing in accordance with EN 13757.

Addressing	PADR	For details see chapter
Primary addressing	0… 250 (Default: 0)	2.1 Primary addressing
Point to point addressing	254	2.2 Point to point addressing
Broadcast addressing	255	2.3 Broadcast addressing
Secondary addressing	253	3 Secondary addressing

1.7 Readout

The CALEC® energy master recognises 5 different kinds of reply telegrams.
The factory setting for the device is an active standard telegram.

Reply telegram	Quantity	Content	For details see chapter
Standard	1	Current meter readings	4.2.1 Standard telegram
Billing date	2	Billing date data	4.2.2 Billing date telegram
Logger	100	Logger data	4.2.2 Billing date telegram
No data	1	No data available	4.2.4 No data telegram
Service	1	for service purposes	4.2.5 Service telegram

1.8 Parameterisation and operating modes

There are 3 coded operating modes which allow access to different parameters.

Mode	Operating mode	
User	Standard	Locked padlock symbol on the display The keys cannot be used to change parameters. Only non-counter-related parameters, can be changed via M-Bus
Service	Medium	Open padlock symbol on the display The keys or M-Bus can only be used to amend parameters which are not subject to metrological verification.
Program	Low	No padlock symbol on the display The keys or M-Bus can be used to amend all parameters. Changing the protection type to programming may involve destroying the verification seal.

Parameter	Protection type	For details see chapter
Baud rate	User	5.1.1 Parameterise baud rate
Primary address	User	5.1.2 Parameterise primary address
Secondary address	User	5.1.3 Parameterise secondary address
Reply telegram	User	5.1.4 Parameterise response telegram
Date/Time	User	5.1.5 Parameterise date/time
Billing date 1, 2	User	5.1.6/7 Parameterise billing date 1
Customer text field 1	User	5.1.8 Parameterise customer text field 1
Customer text field 2	User	5.1.8 Parameterise customer text field 1
Error hours counter	Programming mode	5.1.9 Error hours counter

1.9 Variable units

The units and resolutions of the meter readings and pulse values of the CALEC® energy master can be parameterised in any way. This has a direct impact on the transfer of data to the M-Bus in the form of different VIF.

2 Primary addressing

2.1 Primary addressing

Individual CALEC® energy masters can be addressed via primary addressing in an M-Bus network. The primary address range allowed is 0...250. Each telegram contains the primary address in the A field.

2.2 Point to point addressing

If the M-Bus network consists of a single CALEC® energy master, point to point addressing can be used. To do this, the A field in the Master telegram is set to 254 (FEh). The CALEC® energy master responds to point to point telegrams irrespective of how the primary address is parameterised. If multiple calculators are active, then only calculator 1 will respond.

2.3 Broadcast addressing

If all the meters in a network are to receive a telegram (e.g. setting the date) and process it at the same time, broadcast addressing can be used. The A field in the telegram of the Master is set to 255 (FFh). The CALEC® energy master does not respond to broadcast telegrams, but executes the commands. It makes no difference how the primary address is parameterised. If multiple calculators are active, the command is executed by all of them.

3 Secondary addressing

If an M-Bus network contains more then 250 meters, secondary addressing is used.
Secondary addressing uses the A field: 253 (FDh) with the 8-byte header selected.
Secondary addressing must be set up before the actual communication with the CALEC® energy master using a slave select telegram. Secondary addressing needs to be removed again after the actual communication.

3.1 Slave select telegram

The CALEC® energy master can be selected for secondary addressing using the following telegram:

Name	Number of bytes	Value	Explanation / example
Start	1	68h	
L field	1	0Bh	
L field	1	0Bh	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	FEh	Secondary addressing
CI field	1	52h	Slave select
Secondary add.	4	IDENT	Secondary address
Manufacturer code	2	MAN	05B4h = Aquametro
Device version	1	DEV	D2h = Standard energy
Medium	1	MED	04h = return / 0Ch = flow
Checksum	1	CS	
Stop	1	16h	

C field: The CALEC® energy master does not distinguish between 53h and 73h.
IDENT: The 4-bit wildcard Fh can also be used instead of the exact secondary address. Example FFFFF344h: It selects all devices whose secondary address ends with 344h.
MAN: The 16-bit wildcard FFFFh can also be used instead of the 05B4h.
DEV The 8-bit wildcard FFh can be used instead of, for example, D2h.
MED: The 8-bit wildcard FFh can be used instead of, for example, 04h.

- If all 4 details tally with the parameterisation of the device, it is selected and responds with an ACK telegram.
- If at least one of the details does not match the parameterisation of the device, it is deselected and does not respond.

3.2 SND_NKE Telegram

Secondary addressing can be cleared with the following telegram:

Name	Number of bytes	Value	Explanation
Start	1	10h	
C field	1	40h	SND_NKE
A field	1	FEh	
Checksum	1	CS	
Stop	1	16	

• The CALEC® energy master responds with an ACK telegram.

4 Readout

Readout is always initiated by the central unit by means of an REQ_UD2 telegram. The CALEC® energy master responds with the RSP_UD telegram set.

4.1 REQ_UD2 telegram

Name	Number of bytes	Value	Explanation
Start field	1	10h	
C field	1	5Bh / 7Bh	REQ_UD2
A field	1	PADR	Primary address
Checksum	1	CS	
Stop	1	16	

• The CALEC® energy master does not distinguish between 5Bh and 7Bh in the C field.
• The CALEC responds with the RSP_UD telegram activated.

4.2 RSP_UD Telegram

The CALEC® energy master has 5 different RSP_UD telegrams. The parameterisation of the telegrams is described in Chapter 5.1.4.

4.2.1 Standard telegram

Data in hex format

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
Start	1	68h	68h	68h	68h	68h	
L field	1	LEN	LEN	LEN	LEN	LEN	
L field	1	LEN	LEN	LEN	LEN	LEN	
Start	1	68h	68h	68h	68h	68h	
C field	1	08h	08h	08h	08h	08h	RSP_UD
A field	1	PADR	PADR	PADR	PADR	PADR	Primary address
CI field	1	72h	72h	72h	72h	72h	Readout
Secondary add.	4	IDENT	IDENT	IDENT	IDENT	IDENT	Secondary address
Manufacturer code	2	B4 05	B4 05	B4 05	B4 05	B4 05	05 B4 = Aquametro
Device version	1	D2 / D5	D3 / D4	D1	D7	D8	CALEC® energy master
Medium	1	MED	MED	MED	MED	MED	04 = return / 0C = flow
Readout counter	1	ACC	ACC	ACC	ACC	ACC	Incremented on each readout
Status	1	STAT	STAT	STAT	STAT	STAT	Status as per EN 13757

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
Signature	2	0000	0000	0000	0000	0000	not used
DIF	1	04		04*2	04	04	
VIF (VIFE)	1 (2)	VIF1		VIF1*2	VIF1	VIF1	
Value	4						Energy counter reading
DIF	1		04				
VIF (VIFE)	2 (3)		VIF1 3B				
Value	4						Energy counter reading positive
DIF	1		04				
VIF (VIFE)	2 (3)		VIF1 3C				
Value	4						Energy counter reading negative
DIF	1	04		04*2	04	04	
VIF (VIFE)	1 (2)	VIF2		VIF2*2	VIF2	VIF2	
Value	4						Volume counter reading
DIF	1		04				
VIF (VIFE)	2 (3)		VIF2 3B				
Value	4						Volume counter reading positive
DIF	1		04				
VIF (VIFE)	2 (3)		VIF2 3C				
Value	4						Volume counter reading negative
DIF	1	04		04*2	04	04	
VIF (VIFE)	1 (2)	VIF3		VIF3*2	VIF3	VIF3	
Value	4						Mass counter reading
DIF	1		04				
VIF, VIFE	2 (3)		VIF3 3B				
Value	4						Mass counter reading positive
DIF	1		04				
VIF, VIFE	2 (3)		VIF3 3C				
Value	4						Mass counter reading negative
DIF	1			04*2			
VIF (VIFE)	1			6E*2			
Value	4						HCA
DIF, DIFE	2	84 10	84 10	84 10	84 10	84 10	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 1*1
DIF, DIFE	2	84 20	84 20	84 20	84 20	84 20	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 2*1
DIF, DIFE	2	84 30	84 30	84 30	84 30	84 30	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 3*1
DIF, DIFE	3	84 80 10	84 80 10	84 80 10	84 80 10	84 80 10	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 4*1
DIF	1	05	05		05	05	
VIF	1	5B	5B		5B	5B	
Value	4						Flow temperature [°C]

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
DIF	1	05	05		05	05	D7/D8: closed circuit only
VIF	1	5F	5F		5F	5F	
Value	4						Return temperature [°C]
DIF	1	05	05		05	05	D7/D8: closed circuit only
VIF	1	63	63		63	63	
Value	4						differential Temperature [K]
DIF	1	05	05	05*2	05	05	
VIF	1	2B	2B	2B*2	2B	2B	
Value	4						Power [W]
DIF, DIFE	2	85 40	85 40	85 40			Option: Chiller
VIF, VIFE	2	AB 3A	AB 3A	AB 3A			
Value	4						Power [RT]
DIF,DIFE1,DIFE2	3	85 80 40	85 80 40	85 80 40			Option: Chiller
VIF,VIFE1,DIFE2	3	AB B2 3A	AB B2 3A	AB B2 3A			
Value	4						Efficiency [RT/kW]
DIF	1	05	05	05*2	05	05	
VIF	1	3B	3B	3B*2	3B	3B	
Value	4						Flow [l/h]
DIF	1	05	05	05*2	05	05	
VIF	1	53	53	53*2	53	53	
Value	4						Mass flow [kg/h]
DIF	1				05	05	
VIF	1				6B	6B	
Value	4						Pressure [bar]
DIF	1	05	05		05	05	
VIF, VIFE	2	9B 2C	9B 2C		9B 2C	9B 2C	
Value	4						Density [kg / l]
DIF	1	05	05				
VIF, VIFE	2	83 33	83 33				
Value	4						k-factor [Wh / K / l]
DIF	1	05	05		05	05	D7/D8: closed circuit only
VIF, VIFE	2	83 2E	83 2E		83 2E	83 2E	
Value	4						differential Enthalpy [Wh/kg]
DIF	2				85 40	85 40	
VIF, VIFE	2				83 2E	83 2E	
Value	4						Enthalpy flow [Wh/kg]
DIF	3				85 80 40	85 80 40	D7/D8: closed circuit only
VIF, VIFE	2				83 2E	83 2E	
Value	4						Enthalpy return [Wh/kg]
DIF	1			05*2			
VIF (VIFE)	2			EE 20*2			
Value	4						Frequency [Hz]
DIF	1	04	04	04	04	04	
VIF	1	22	22	22	22	22	
Value	4						Operating hours [h]
DIF	1	34	34	34	34	34	
VIF	1	22	22	22	22	22	
Value	4						Error hours [h]

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
DIF	1	04	04	04	04	04	
VIF	1	6D	6D	6D	6D	6D	
Value	4						Current date and time
DIF	1	42	42	42	42	42	
VIF, VIFE	2	EC 7E	EC 7E	EC 7E	EC 7E	EC 7E	
Value	2						Date of next billing date 1
DIF, DIFE	2	82 01	82 01	82 01	82 01	82 01	
VIF, VIFE	2	EC 7E	EC 7E	EC 7E	EC 7E	EC 7E	
Value	2						Date of next billing date 2
DIF	1	0D	0D	0D	0D	0D	
VIF, VIFE	2	FD 11	FD 11	FD 11	FD 11	FD 11	
	1	00..14	00..14	00..14	00..14	00..14	Number of bytes for customer text field 1
Value	0..20						Customer text field 1
DIF, DIFE	2	8D 40	8D 40	8D 40	8D 40	8D 40	
VIF, VIFE	2	FD 11	FD 11	FD 11	FD 11	FD 11	
	1	00..14	00..14	00..14	00..14	00..14	Number of bytes for customer text field 2
Value	0..20						Customer text field 2
Checksum	1	CS	CS	CS	CS	CS	
Stop	1	16	16	16	16	16	

*1 Tariff counter readings are only transferred if tariffs have been configured
*2 Only available if there is an auxiliary counter on the relevant unit

- Date of next billing date 1 and 2 are coded as AnyYear, i.e. the year figure is transferred as 127. The year makes no difference to the parameterisation of the billing dates, the CALEC Master ignores this information.
- Customer text fields are variable in length. They can be 1 to 20 bytes. The length code can be found between VIFE and the text field.

4.2.2 Billing date telegrams

The CALEC® energy master has two billing dates. The only difference between the two telegrams is the memory number

- The memory numbers are coded as 1-2 in DIF, DIFE in accordance with EN13757-3.
- The data type for all memory values is INT4.
- Tariffs 1-4 are coded as 1-4 in DIF, DIFE in accordance with EN13757-3.
- Error hours are coded in DIF as an "Error" function.

Data in hex format

Name	**No. bytes**	**Version D2 (Std) D5 (TWIN)**	**Version D3 (BDE) D4 (BDV)**	**Version D1 (Flow)**	**Version D7 Saturated steam**	**Version D8 Steam**	**Explanation**
Start	1	68	68	68	68	68	
L field	1	LEN	LEN	LEN	LEN	LEN	
L field	1	LEN	LEN	LEN	LEN	LEN	
Start	1	68	68	68	68	68	
C field	1	08	08	08	08	08	RSP_UD
A field	1	PADR	PADR	PADR	PADR	PADR	Primary address
CI field	1	72	72	72	72	72	Readout
Secondary add.	4	IDENT	IDENT	IDENT	IDENT	IDENT	Secondary address
Manufacturer code	2	B4 05	B4 05	B4 05	B4 05	B4 05	05 B4 = Aquametro
Device version	1	D2 / D5	D3 / D4	D1	D7	D8	CALEC® energy master
Medium	1	MED	MED	MED	MED	MED	04 = return / 0C = flow
Readout counter	1	ACC	ACC	ACC	ACC	ACC	Incremented on each readout
Status	1	STAT	STAT	STAT	STAT	STAT	Status as per EN 13757
Signature	2	0000h	0000h	0000h	0000h	0000h	not used
DIF	1	44		44*[2]	44	44	
VIF (VIFE)	1 (2)	VIF1		VIF1*[2]	VIF1	VIF1	
Value	4						Energy counter reading at memory time
DIF	1		44				
VIF (VIFE)	2 (3)		VIF1 3B				
Value	4						Energy counter reading positive at memory time
DIF	1		44				
VIF (VIFE)	2 (3)		VIF1 3C				
Value	4						Energy counter reading negative at memory time
DIF	1	44		44*[2]	44	44	
VIF (VIFE)	1 (2)	VIF2		VIF2*[2]	VIF2	VIF2	
Value	4						Volume counter reading at memory time
DIF	1		44				
VIF (VIFE)	2 (3)		VIF2 3B				
Value	4						Volume counter reading positive at memory time
DIF	1		44				
VIF (VIFE)	2 (3)		VIF2 3C				
Value	4						Volume counter reading negative at memory time

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
DIF	1	44		44*2	44	44	
VIF (VIFE)	1 (2)	VIF3		VIF3*2	VIF3	VIF3	
Value	4						Mass counter reading at memory time
DIF	1		44				
VIF, VIFE	2 (3)		VIF3 3B				
Value	4						Mass counter reading positive. at memory time
DIF	1		44				
VIF, VIFE	2 (3)		VIF3 3C				
Value	4						Mass counter reading negative at memory time
DIF	1			44*2			
VIF (VIFE)	1			6E*2			
Value	4						HCA at memory time
DIF, DIFE	2	C4 10	C4 10	C4 10	C4 10	C4 10	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 1 / Note 1* at memory time
DIF, DIFE	2	C4 20	C4 20	C4 20	C4 20	C4 20	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 2 / Note 1* at memory time
DIF, DIFE	2	C4 30	C4 30	C4 30	C4 30	C4 30	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 3 / Note 1* at memory time
DIF, DIFE	3	C4 80 10	C4 80 10	C4 80 10	C4 80 10	C4 80 10	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 4 / Note 1* at memory time
DIF, DIFE	1	44	44	44	44	44	
VIF	1	22	22	22	22	22	
Value	4						Operating hours [h] at memory time
DIF, DIFE	1	74	74	74	74	74	
VIF	1	22	22	22	22	22	
Value	4						Error hours [h] at memory time
DIF, DIFE	1	44	44	44	44	44	
VIF	1	6D	6D	6D	6D	6D	
Value	4						Date + time of memory time
Checksum	1	CS	CS	CS	CS	CS	
Stop	1	16	16	16	16	16	

*2 Only available if there is an auxiliary counter set on the relevant unit

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
Start	1	68	68	68	68	68	
L field	1	LEN	LEN	LEN	LEN	LEN	
L field	1	LEN	LEN	LEN	LEN	LEN	
Start	1	68	68	68	68	68	
C field	1	08	08	08	08	08	RSP_UD
A field	1	PADR	PADR	PADR	PADR	PADR	Primary address
CI field	1	72	72	72	72	72	Readout
Secondary add.	4	IDENT	IDENT	IDENT	IDENT	IDENT	Secondary address
Manufacturer code	2	B4 05	B4 05	B4 05	B4 05	B4 05	05 B4 = Aquametro
Device version	1	D2 / D5	D3 / D4	D1	D7	D8	CALEC® energy master
Medium	1	MED	MED	MED	MED	MED	04 = return / 0C = flow
Readout counter	1	ACC	ACC	ACC	ACC	ACC	Incremented on each readout
Status	1	STAT	STAT	STAT	STAT	STAT	Status as per EN 13757
Signature	2	0000	0000	0000	0000	0000	not used
DIF	2	84 01		84 01*2	84 01	84 01	
VIF (VIFE)	1 (2)	VIF1		VIF1*2	VIF1	VIF1	
Value	4						Energy counter reading at memory time
DIF	2		84 01				
VIF (VIFE)	2 (3)		VIF1 3B				
Value	4						Energy counter reading positive at memory time
DIF	2		84 01				
VIF (VIFE)	2 (3)		VIF1 3C				
Value	4						Energy counter reading negative at memory time
DIF	2	84 01		84 01*2	84 01	84 01	
VIF (VIFE)	1 (2)	VIF2		VIF2*2	VIF2	VIF2	
Value	4						Volume counter reading at memory time
DIF	2		84 01				
VIF (VIFE)	2 (3)		VIF2 3B				
Value	4						Volume counter reading positive at memory time
DIF	2		84 01				
VIF (VIFE)	2 (3)		VIF2 3C				
Value	4						Volume counter reading negative at memory time
DIF	2	84 01		84 01*2	84 01	84 01	
VIF (VIFE)	1 (2)	VIF3		VIF3*2	VIF3	VIF3	
Value	4						Mass counter reading at memory time
DIF	2		84 01				
VIF, VIFE	2 (3)		VIF3 3B				
Value	4						Mass counter reading positive at memory time
DIF	2		84 01				
VIF, VIFE	2 (3)		VIF3 3C				
Value	4						Mass counter reading negative at memory time

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
DIF	2			84 01*2			
VIF (VIFE)	1			6E*2			
Value	4						HCA at memory time
DIF, DIFE	2	84 11	84 11	84 11	84 11	84 11	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 1 / Note 1* at memory time
DIF, DIFE	2	84 21	84 21	84 21	84 21	84 21	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 2 / Note 1* at memory time
DIF, DIFE	2	84 31	84 31	84 31	84 31	84 31	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 3 / Note 1* at memory time
DIF, DIFE	3	84 81 10	84 81 10	84 81 10	84 81 10	84 81 10	
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 4 / Note 1* at memory time
DIF, DIFE	2	84 01	84 01	84 01	84 01	84 01	
VIF	1	22	22	22	22	22	
Value	4						Operating hours [h] at memory time
DIF, DIFE	2	B4 01	B4 01	B4 01	B4 01	B4 01	
VIF	1	22	22	22	22	22	
Value	4						Error hours [h] at memory time
DIF, DIFE	2	84 01	84 01	84 01	84 01	84 01	
VIF	1	6D	6D	6D	6D	6D	
Value	4						Date + time of memory time
Checksum	1	CS	CS	CS	CS	CS	
Stop	1	16	16	16	16	16	

*2 Only available if there is an auxiliary counter set on the relevant unit

4.2.3 Logger telegrams

The CALEC® energy master has 100 logger values. For each memory time, there is a separate telegram with its own memory number.

- The memory numbers are coded as 3-102 in DIF, DIFE in accordance with EN13757-3.
- The data type for all memory values is INT4.
- Tariffs 1-4 are coded as 1-4 in DIF, DIFE in accordance with EN13757-3.
- Error hours are coded in DIF as an "Error" function.
- If there is no date for a time (for new devices), the 'no data telegram' is transmitted instead of the logger telegram.

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
Start	1	68h	68h	68h	68h	68h	
L field	1	LEN	LEN	LEN	LEN	LEN	
L field	1	LEN	LEN	LEN	LEN	LEN	
Start	1	68h	68h	68h	68h	68h	
C field	1	08h	08h	08h	08h	08h	RSP_UD
A field	1	PADR	PADR	PADR	PADR	PADR	Primary address
CI field	1	72h	72h	72h	72h	72h	Readout
Secondary add.	4	IDENT	IDENT	IDENT	IDENT	IDENT	Secondary address
Manufacturer code	2	B4 05	B4 05	B4 05	B4 05	B4 05	05 B4 = Aquametro
Device version	1	D2 / D5	D3 / D4	D1	D7	D8	CALEC® energy master
Medium	1	MED	MED	MED	MED	MED	04 = return / 0C = flow
Readout counter	1	ACC	ACC	ACC	ACC	ACC	Incremented on each readout
Status	1	STAT	STAT	STAT	STAT	STAT	Status as per EN 13757
Signature	2	0000h	0000h	0000h	0000h	0000h	not used
DIF							
VIF (VIFE)	1 (2)	VIF1		VIF1*[2]	VIF1	VIF1	
Value	4						Energy counter reading at memory time
DIF							
VIF (VIFE)	2 (3)		VIF1 3B				
Value	4						Energy counter reading positive at memory time
DIF							
VIF (VIFE)	2 (3)		VIF1 3C				
Value	4						Energy counter reading negative at memory time
DIF							
VIF (VIFE)	1 (2)	VIF2		VIF*[2]	VIF2	VIF2	
Value	4						Volume counter reading at memory time
DIF							
VIF (VIFE)	2 (3)		VIF2 3B				
Value	4						Volume counter reading positive at memory time
DIF							
VIF (VIFE)	2 (3)		VIF2 3C				
Value	4						Volume counter reading negative at memory time
DIF							
VIF (VIFE)	1 (2)	VIF3		VIF3*[2]	VIF3	VIF3	
Value	4						Mass counter reading at memory time
DIF							
VIF, VIFE	2 (3)		VIF3 3B				
Value	4						Mass counter reading positive at memory time
DIF							
VIF, VIFE	2 (3)		VIF3 3C				
Value	4						Mass counter reading negative at memory time

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
DIF							
VIF (VIFE)	1			6E*2			
Value	4						HCA at memory time
DIF, DIFE							
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 1 / Note 1* at memory time
DIF, DIFE							
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 2 / Note 1* at memory time
DIF, DIFE							
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 3 / Note 1* at memory time
DIF, DIFE							
VIF, VIFE	2 (3)	VIFx	VIFx	VIFx	VIFx	VIFx	
Value	4						Counter reading tariff 4 / Note 1* at memory time
DIF, DIFE							
VIF	1	22	22	22	22	22	
Value	4						Operating hours [h] at memory time
DIF, DIFE							
VIF	1	22	22	22	22	22	
Value	4						Error hours [h] at memory time
DIF, DIFE							
VIF	1	6D	6D	6D	6D	6D	
Value	4						Date + time of memory time
DIF, DIFE							
VIF	1	2B	2B	2B*2	2B	2B	
Value	4						max. power in logger period [W]
DIF, DIFE							
VIF, VIFE	2	AB 39	AB 39	AB 39*2	AB 39	AB 39	
Value	4						Time of max. power
DIF, DIFE							
VIF	1	3B		3B*2	3B	3B	
Value	4						max. flow [l/h] for logger period
DIF, DIFE							
VIF, VIFE	2	BB 39	BB 39	BB 39	BB 39	BB 39	
Value	4						Time of maximum flow
DIF, DIFE							
VIF	1		53	53*2			
Value	4						max. mass flow [kg/h] for logger period
DIF, DIFE							
VIF, VIFE	2	D3 39	D3 39	D3 39	D3 39	D3 39	
Value	4						Time of maximum mass flow
DIF, DIFE							
VIF	1	5B	5B		5B	5B	
Value	4						Maximum flow temperature [°C] for logger period
DIF, DIFE							
VIF, VIFE	2	DB 39	DB 39		DB 39	DB 39	
Value	4						Time of maximum flow temperature

Name	No. bytes	Version D2 (Std) D5 (TWIN)	Version D3 (BDE) D4 (BDV)	Version D1 (Flow)	Version D7 Saturated steam	Version D8 Steam	Explanation
DIF, DIFE							
VIF	1	5F	5F		5F	5F	
Value	4						Maximum return temperature [°C] for logger period
DIF, DIFE							
VIF, VIFE	2	DF 39	DF 39		DF 39	DF 39	
Value	4						Time of maximum flow temperature
Checksum	1	CS	CS	CS	CS	CS	
Stop	1	16	16	16	16	16	

*2 Only available if there is an auxiliary counter set on the relevant unit

4.2.4 No data telegram

If no logger data is available, the 'No data telegram' is transmitted instead of these telegrams.

Name	No. bytes	Value	Explanation / example
Start	1	68	
L field	1	0F	
L field	1	0F	
Start	1	68	
C field	1	08	RSP_UD
A field	1	PADR	Primary address
CI field	1	72	Readout
Secondary add.	4	IDENT	Secondary address
Manufacturer code	2	B4 05	05 B4 = Aquametro
Device version	1	DEV	CALEC® energy master
Medium	1	MED	e.g. 04 = return
Readout counter	1	ACC	Incremented on each readout
Status	1	STAT	Status as per EN 13757
Signature	2	0000	not used
Checksum	1	CS	
Stop	1	16	

4.2.5 Service telegram

The service telegram transfers data required for service, testing and production.

Name	No. bytes	Value	Explanation
Start	1	68	
L field	1	0F	
L field	1	0F	
Start	1	68	
C field	1	08	RSP_UD
A field	1	PADR	Primary address
CI field	1	72	Readout
Secondary add.	4	IDENT	Secondary address
Manufacturer code	2	B4 05	05 B4 = Aquametro
Device version	1	DEV	CALEC® energy master
Medium	1	MED	e.g. 04 = return
Readout counter	1	ACC	Incremented on each readout
Status	1	STAT	Status as per EN 13757
Signature	2	0000	not used

Name	No. bytes	Value	Explanation
DIF, DIVE	2	85 40	
VIF, VIFE	2	DB 3A	
Value	4		Mean PT100 input 1
DIF, DIVE	3	85 80 40	
VIF, VIFE	2	DB 3A	
Value	4		Standard deviation PT100 input 1
DIF, DIVE	2	85 40	
VIF, VIFE	2	DF 3A	
Value	4		Mean PT100 input 2
DIF, DIVE	3	85 80 40	
VIF, VIFE	2	DF 3A	
Value	4		Standard deviation PT100 input 2
DIF	1	01	
VIF	1	7A	
Value	1		Primary address
DIF	1	0C	
VIF	1	79	
Value	4		Secondary address
DIF	1	0C	
VIF	1	78	
Value	4		Production number
DIF	2	8C 40	
VIF	1	78	
Value	4		Print number
DIF	1	02	
VIF, VIFE	2	EC 39	
Value	2		Production date
DIF	1	04	
VIF, VIFE	2	FD 66	
Value	4		Validation time
DIF, DIFE	2	84 40	
VIF, VIFE	2	FD 66	
Value	4		Validation time invalid
DIF	1	0B	
VIF, VIFE	2	FD 0E	
Value	3		Firmware version
DIF	1	0C	
VIF, VIFE	2	FD 0D	
Value	4		Hardware version
Checksum	1	CS	
Stop	1	16	

5 Parameterisation

All parameters are saved in EEPROM and are not lost even when the power goes down or the batteries are replaced. All parameter settings are prefixed with an SND-UD telegram by the M-Bus master. The CALEC® energy master does not distinguish between 53h and 73h in the C field. The CALEC® energy master responds with an ACK telegram.

5.1 SND_UD telegrams

A separate telegram is required for each parameterisable value. Only one parameter can be changed with each telegram. Multiple parameters cannot be combined in a single telegram.

5.1.1 Parameterise baud rate

The CALEC® energy master supports 300, 2400 and 9600 baud. It is parameterised to 2400 baud on delivery. The baud rate can be parameterised using the following telegrams.

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	03h	
L field	1	03h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	B8h / BBh / BDh	B8h = 300 baud / BBh = 2400 baud / BDh = 9600 baud
Checksum	1	CS	
Stop	1	16h	

- The CALEC® energy master responds with an ACK telegram at the old baud rate and then switches to the new baud rate.

5.1.2 Parameterise primary address

The primary address can be parameterised using the following telegrams. The value range is 0 to 250. The primary address is parameterised to 0 on delivery.

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	06h	
L field	1	06h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	(old) primary address
CI field	1	51h	Parameterisation
DIF	1	01h	
VIF	1	7Ah	
Value	1		New primary address 0 ..250
Checksum	1	CS	
Stop	1	16h	

5.1.3 Parameterise secondary address

The secondary address can be parameterised using the following telegrams.
The primary address is parameterised to the production number on delivery.

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	09h	
L field	1	09h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF	1	0Ch	
VIF	1	79h	
Value	4		New secondary address
Checksum	1	CS	
Stop	1	16h	

5.1.4 Parameterise response telegram (data selection)

The response telegram can be selected using the following telegram. The telegram always has the same structure. The appropriate DIF, DIFE and VIF must be used depending on the response telegram required.
The factory setting for the CALEC® energy master is an active standard telegram.

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	LEN	
L field	1	LEN	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF, DIFE	Variable		See column "DIF, DIFE" of table “response telegram”
VIF	1		See column "VIF" of of table “response telegram”
Checksum	1	CS	
Stop	1	16h	

Reply telegram	DIF, DIFE	VIF
Standard	08h	7Eh
Billing date 1	48h	7Eh
Billing date 2	8801h	7Eh
Logger 1	C801h	7Eh
Logger 2	8802h	7Eh
Logger 3	C802h	7Eh
Logger 4	8803h	7Eh
Logger 5	C803h	7Eh
Logger 6	8804h	7Eh
Logger 7	C804h	7Eh
Logger 8	8805h	7Eh
Logger 9	C805h	7Eh
Logger 10	8806h	7Eh
etc.		
Logger 99	C88203h	7Eh
Logger 100	888303h	7Eh
Service	08h	7Fh

5.1.5 Parameterise date/time

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	09h	
L field	1	09h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF	1	04h	
VIF	1	6Dh	
Value	4		New date/time
Checksum	1	CS	
Stop	1	16h	

5.1.6 Parameterise billing date 1

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	08h	
L field	1	08h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF	1	42h	
VIF, VIFE	2	EC7Eh	
Value	2		New billing date 1
Checksum	1	CS	
Stop	1	16h	

- The year figure in the date transmitted is ignored and set internally to 127 (AnyYear). The day and month are adopted.

5.1.7 Parameterise billing date 2

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	09h	
L field	1	09h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF, DIFE	2	8201h	
VIF, VIFE	2	EC7Eh	
Value	2		New billing date 2
Checksum	1	CS	
Stop	1	16h	

- The year figure in the date transmitted is ignored and set internally to 127 (AnyYear). The day and month are adopted.

5.1.8 Parameterise customer text field 1

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	LEN	
L field	1	LEN	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF	1	0Dh	
VIF, VIFE	2	FD11h	
	1	0h..14h	Number of bytes for customer text field
Value	0..20		Customer text field (ASCII string)
Checksum	1	CS	
Stop	1	16h	

- Customer text fields are variable in length. They can be 0 to 20 bytes. The length code can be found between VIFE and the text field.

5.1.9 Parameterise customer text field 2

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	LEN	
L field	1	LEN	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF, DIFE	2	8D40h	
VIF, VIFE	2	FD11h	
	1	0h…14h	Number of bytes for customer text field
Value	0…20		Customer text field (ASCII string)
Checksum	1	CS	
Stop	1	16h	

- Customer text fields are variable in length. They can be 0 to 20 bytes. The length code can be found between VIFE and the text field.

5.1.10 Parameterise error hour counter

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	LEN	
L field	1	LEN	
Start	1	68h	
C field	1	53 / 73	SND_UD
A field	1	PADR	Primary address
CI field	1	51	Parameterisation
DIF, DIFE	2	34	
VIF, VIFE	2	22	
Value	4	00 00 00 00	Value of error hour counter: 0 value transmitted as integer to delete
Checksum	1	CS	
Stop	1	16h	

- Parameterising the error hour counter involves damaging the verification seal (programming mode); this counter is normally deleted, i.e. reset to zero.

5.2 ACK telegram

Name	Number of bytes	Value	Explanation
ACK	1	E5h	

If the device responds with an ACK telegram, this means the command in the SND_UD telegram has been successfully executed. If it cannot be correctly executed, the device does not respond and there is a timeout.

6 Application reset

The CALEC® energy master supports application reset and an extension of it which involves what is known as subcode. The commands only affect the choice of response telegram.

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	03h (04h)	
L field	1	03h (04h)	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	50h	Application reset
	0 (1)		Subcode
Checksum	1	CS	
Stop	1	16h	

Subcode	Function
None	Standard telegram
00h	Standard telegram
B0h	Service telegram

7 Variable units

The CALEC® energy master transfers all the counter readings in the same format and resolution as they are displayed on the device display.

7.1 Energy units (VIF1)

Resolution	Unit	VIF (VIFE)
0.001	kWh	03h
0.01	kWh	04h
0.1	kWh	05h
1	kWh	06h
0.001	MWh	06h
0.01	MWh	07h
01	MWh	FB00h
1	MWh	FB01h
0.001	MJ	0Bh
0.01	MJ	0Ch
0.1	MJ	0Dh
1	MJ	0Eh
0.001	GJ	0Eh
0.01	GJ	0Fh
0.1	GJ	FB08h
1	GJ	FB09h
0.001	kcal	883Dh
0.01	kcal	893Dh
01	kcal	8A3Dh
1	kcal	8B3Dh
0.001	kBtu	803Dh
0.01	kBtu	813Dh
01	kBtu	823Dh
1	kBtu	833Dh
0.001	MBtu	833Dh
0.01	MBtu	843Dh
0.1	MBtu	853Dh
1	MBtu	863Dh

Resolution	Unit	VIF (VIFE)
0.001	therm	823Dh
0.01	therm	833Dh
0.1	therm	843Dh
1	therm	853Dh

• CALEC® energy master can also display kcals as a unit. But this unit is not supported on the M-Bus.

7.2 Volume units (VIF2)

Resolution	Unit	VIF (VIFE)
0,001	L	10h
0.01	L	11h
0.1	L	12h
1	L	13h
0.001	m3	13h
0.01	m3	14h
0.1	m3	15h
1	m3	16h
0.001	cuft	FBA174h
0.01	cuft	FBA175h
0.1	cuft	FB21h
1	cuft	FBA177h
0.001	USgal	933Dh
0.01	USgal	943Dh
0.1	USgal	953Dh
1	USgal	963Dh
0.001	UKgal	93BD3Dh
0.01	UKgal	94BD3Dh
0.1	UKgal	95BD3Dh
1	UKgal	96BD3Dh

• CALEC® energy master can also display UKgal as a unit. But this unit is not supported on the M-Bus.

7.3 Mass units (VIF3)

Resolution	Unit	VIF (VIFE)
0.001	kg	18h
0.01	kg	19h
0.1	kg	1Ah
1	kg	1Bh
0.001	t	1Bh
0.01	t	1Ch
01	t	1Dh
1	t	1Eh
0.001	ton	9B3Dh
0.01	ton	9C3Dh
01	ton	9D3Dh
1	ton	9E3Dh

7.4 All units (VIFx)

Depending on the device parameterisation, some counter readings can show all available units. These are as follows:

All VIF1
All VIF2
All VIF3
Plus HCA (VIF = 6Eh)

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