M-Bus protocol

CALEC® ST
AMBILL® 36, 230 / AMTRON® X-50

Manufacturer:	Aquametro AG
Device:	CALEC® ST
Firmware version:	1.00.00 to 1.06.XX
Manufacturer code:	05 B4
Device version:	C0 (Volume), C1 (Mass), C2 (Flow), C3 (Solar), C4 (BDE), C5 (AMTRON X-50), C6 (AMBILL), C7 (Tariff)
Medium:	04h (heat return), 0Ch (heat supply), 07h (water)

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1 Overview

1.1 Versions of CALEC ST /AMTRON X-50 / AMBILL

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

Up to firmware V1.01:

Version	Device version (DEV):	Explanation
Standard	C0	Water heat carrier, volume display
Mass	C1	Water heat carrier, mass display
Heat carrier	C3	Special heat carrier, volume display (SOLAR)

Table 1 Versions of CALEC ST up to V1.01

As of firmware V1.02.

Version	Device version (DEV):	Explanation
Flow	C2	Flow calculator
BDE	C4	Bidirectional energy measurement

Table 2 Versions of CALEC ST as of V1.02

As of firmware V1.05.

Version	Device version (DEV):	Explanation
AMTRON X-50	C5	AMTRON X-50 calculator

Table 3 Versions of CALEC ST as of V1.05

As of firmware V1.06

Version	Device version (DEV):	Explanation
Tariff	C7	TGR tariff function
AMBILL	C6	

Table 4 Versions of CALEC ST as of V1.06

The model for heat carriers apart from water is available as an option for all versions as of firmware V1.02 and is no longer a separate version.

A distinction is made between these versions in the M-Bus protocol as follows:

- The device version (DEV byte) is different.
- In the mass version, the mass counter reading is transmitted instead of the volume meter reading.
- The flow version is a flow calculator and does not contain heat counter-specific data.
- The BDE version has an additional channel for energy in the negative direction. The direction-dependent data is coded with DIFE 3B or 3C.
- Tariff function has 2 additional energy registers named tariff 1 and tariff 2.

The difference between the M-Bus protocol as of V1.02 and V1.01 is as follows:

- coding of non-SI units based on EN13757-3 instead of EN1434-3.

1.2 M-Bus interfaces

The CALEC ST has two independent M-Bus channels. This means the device can be operated in two M-Bus networks at the same time. These channels are shown as no. 1 and no. 2 in the display.
The baud rate and the response telegram can be parameterised separately for each channel. Example: On channel 1, the standard telegram can be read at 2400 baud and the service telegram can be read on channel 2 at 300 baud at the same time.
The parameterisation of the baud rate and readout telegram always affects the channel currently in use. For example, you cannot use channel 1 to change the baud rate for channel 2.

The CALEC ST has three M-Bus interfaces. The infrared interface (IR) is always available, Depending on the options fitted, M-Bus interfaces no. 1 and no. 2 are available.

M-Bus interface no. 1 uses channel 1. M-Bus interface no. 2 and the IR interface shares channel 2. This means M-Bus no. 1 is always available. However, M-Bus no. 2 and the IR interface are only active alternately. The IR interface has priority, though. As soon as an IR reader head is fitted to the device, M-Bus no. 2 is blocked and the IR interface is activated.

It should also be noted that M-Bus no. 2 is only operational if the mains version of the CALEC ST has an external power supply and there is a voltage of at least 12 V on M-Bus no. 1 for the battery version of the CALEC ST.

	Channel 1	Channel 2	
Interface	Mains version Standard Battery version M-Bus card option	M-Bus 2 card option	IR interface
active	always	no IR reader head fitted ext. power for mains version M-Bus 1 under voltage	always
Baud rate	No. 1 in display	No. 2 in display	
Access counter (readout)	Ac 1 in display	Ac 2 in display	
Telegram	Can be parameterised separately	Can be parameterised separately	
Primary address	Shared by both channels		

Table 5 M-Bus interfaces

1.3 Firmware versions

This document is valid for firmware versions 1.00.00 to 1.06.XX.

1.4 Explanation of abbreviations

Abbreviation	Explanation
REQ_UD2	Request for an RSP_UD telegram
RSP_UD	Data telegram from CALEC ST -> Master
SND_UD	Data telegram from Master -> CALEC ST
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

Table 6 Abbreviations

1.5 M-Bus services

The device communicates in accordance with EN 13757-2 and EN 13757-3. In this document, both standards are grouped together as EN 13757.
This norm provides a range of telegrams of which the device only needs some.

Service	Master	CI	CALEC ST	For details see chapter
Slave selection	SND_UD	52h	ACK	3.1.1 Slave select telegram
Slave selection Reset	SND_NKE		ACK	3.2 SND_NKE Telegram
Read out data	REQ_UD2		RSP_UD	4 Readout
Parameterising	SND_UD	51h	ACK	5 Parameterisation

Service	Master	CI	CALEC ST	For details see chapter
Application reset	SND_UD	50h	ACK	6 Application reset

Table 7 M-Bus services

1.6 Baud rates

The CALEC ST can communicate at 300 and 2400 baud.
The factory setting for the baud rate is 2400.

1.7 M-Bus addressing

The device supports primary and secondary addressing in accordance with EN 13757.
The factory setting for the device's primary address is 0.

Addressing	PADR	For details see chapter
Primary addressing	0 .. 250	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

Table 8 Overview of M-Bus addressing

1.8 Readout

The CALEC ST recognises 5 different kinds of response telegrams.
The factory setting for the device is the standard telegram.

Response 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	60 (28)	Logger data	0 *1 *Only available if there is an auxiliary meter set on the relevant unit*Logger telegram
Freeze	1	Frozen counter readings	4.2.3 Freeze telegram
No data	1	No data available	4.2.4 No data telegram
Service	1	for service purposes	4.2.5 Service telegram

Table 9 Overview of response telegrams

1.9 Parameterisation

The CALEC ST is protected against unauthorised manipulation by means of a protection system. There are three levels of protection:

User (highest level of protection)
- Locked padlock symbol on the display
- The keys cannot be used to change parameters.
- Only non-meter-related parameters can be changed using M-Bus.

Service (medium level of protection)
- 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.

Programming (lowest level of protection)
- 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.

Parameters	Protection type	For details see chapter
Baud rate	User	5.1.1 Parameterise baud rate
Primary address	User	5.1.2 Parameterise primary address
Reply telegram	User	5.1.3 Parameterise response telegram
Date/Time	User	5.1.4 Parameterise date/time
Billing date 1	User	5.1.5 Parameterise billing date 1
Billing date 2	User	5.1.6 Parameterise billing date 2
Customer text field	User	5.1.7 Parameterise customer text field
Freeze	User	5.1.8 Freeze command
Impulse value for auxiliary meter 1	Service	5.1.9 Parameterise impulse value for auxiliary meter 1
Impulse value for auxiliary meter 2	Service	5.1.10 Parameterise impulse value for auxiliary meter 2
Impulse value for auxiliary meter 3	Service	5.1.11 Parameterise impulse value for auxiliary meter 3
Counter reading for auxiliary meter 1	Service	5.1.12 Parameterise readout for auxiliary meter 1
Counter reading for auxiliary meter 2	Service	5.1.13 Parameterise readout for auxiliary meter 2
Counter reading for auxiliary meter 3	Service	5.1.14 Parameterise readout for auxiliary meter 3
Impulse value	Programming	5.1.15 Parameterise impulse value
Installation side	Programming	5.1.16 Parameterise installation side
Protection type		5.1.17 Protection type
Units		5.1.18 Units

Table 10 Overview of parameterisation telegrams

1.10 Variable units

The units and resolutions of the meter readings and pulse values of the CALEC ST can be parameterised in any way. This has a direct impact on the transfer of data on the M-Bus. In the protocol descriptions, these variable units are described as VIF1, VIF2, etc. More details can be found in Chapter 7.

Value	Variable unit
Energy counter readings	VIF1
Volume / Mass counter readings	VIF2
Auxiliary meter readings	VIF3
Auxiliary meter impulse values	VIF4

Table 11 Overview of variable units

The units for the actual values are fixed on the M-Bus and cannot be changed. However, a different unit can be set for the display. This does not affect data transfer on the M-Bus.

2 Primary addressing

2.1 Primary addressing

Individual CALEC ST's 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® ST and a 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 ST responds to point to point telegrams irrespective of how the primary address is parameterised.

2.3 Broadcast addressing

Broadcast addressing can be used when all the counters in a network are to receive a telegram at the same time (e.g. setting the date) which they need to process. The A field in the telegram of the Master is set to 255 (FFh). The CALEC ST does not respond to broadcast telegrams, but executes the commands. It makes no difference how the primary address is parameterised in the CALEC ST.

3 Secondary addressing

If an M-Bus network contains more than 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 ST using a slave select telegram. Secondary addressing needs to be removed again after the actual communication.

3.1.1 Slave select telegram

The CALEC ST can be selected for secondary addressing using the following telegram:

Name	Number of bytes	Value	Explanation (examples)
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 of the CALEC ST
Manufacturer code	2	MAN	05B4h = Aquametro
Device version	1	DEV	C0h = CALEC ST
Medium	1	MED	04h = return / 0Ch = flow
Checksum	1	CS	
Stop	1	16h	

Table 12 Slave-Select Telegram

C field: The CALEC ST 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 CALEC ST 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 COh.
MED: The 8-bit wildcard FFh can be used instead of 04h / 0Ch.

- If all 4 details match with the parameterisation of the CALEC ST, it is selected and responds with an ACK telegram.
- If at least one of the details does not match the parameterisation of the CALEC ST, it is deselected and does not respond.
- The secondary address of the CALEC ST corresponds to the production number and cannot be amended.

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	PADR	Primary address
Checksum	1	CS	
Stop	1	16	

Table 13 SND_NKE Telegram

- The CALEC ST responds with an ACK telegram.

4 Readout

Readout is always initiated by the master by means of an REQ_UD2 telegram. The CALEC ST 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	

Table 14 REQ_UD2 Telegram

- The CALEC ST does not distinguish between 5Bh and 7Bh in the C field.
- The CALEC ST responds with the RSP_UD telegram activated.

4.2 RSP_UD Telegram

The CALEC ST has 5 different RSP_UD telegrams. The parameterisation of the telegram is described in Chapter 5.1.3.

4.2.1 Standard telegram

Fields in grey are available in a short protocol.

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	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 of the CALEC ST

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	Explanation
Manufacturer code	2	B405h	B405h	B405h	B405h	B405h	05B4h = Aquametro
Device version	1	DEV	DEV	DEV	DEV	DEV	CALEC ST
Medium	1	MED	MED	MED	MED	MED	04h = return / 0Ch = 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	04h	04			04	
VIF (VIFE)	1 (2)	VIF1	VIF1			VIF1	
Value	4						Energy counter reading
DIF	1				04		
VIF (VIFE)	2 (3)				VIF1 3B		
Value	4						Energy counter reading pos.
DIF	1				04		
VIF (VIFE)	2 (3)				VIF1 3C		
Value	4						Energy counter reading neg.
DIF	2					84 10	
VIF (VIFE)	1 (2)					VIF1	
Value	4						Tariff 1
DIF	2					84 20	
VIF (VIFE)	1 (2)					VIF1	
Value	4						Tariff 2
DIF	1	04				04	
VIF (VIFE)	1 (2)	VIF2				VIF2	
Value	4						Volume counter reading
DIF	1				04		
VIF (VIFE)	2 (3)				VIF2 3B		
Value	4						Volume counter reading pos.
DIF	1				04		
VIF (VIFE)	2 (3)				VIF2 3C		
Value	4						Volume counter reading neg.
DIF	1		04				
VIF (VIFE)	1 (2)		VIF2				
Value	4						Mass counter reading
DIF	1			04			
VIF (VIFE)	1 (2)			VIF3			
Value	4						Counter reading for auxiliary meter 1
DIF, DIFE	2	84 40	84 40	84 40	84 40	84 40	
VIF (VIFE)	1 (2)	VIF3	VIF3	VIF3	VIF3	VIF3	
Value	4						Counter reading for auxiliary meter 2
DIF, DIFE	3	84 80 40	84 80 40	84 80 40	84 80 40	84 80 40	
VIF (VIFE)	1 (2)	VIF3	VIF3	VIF3	VIF3	VIF3	
Value	4						Counter reading for auxiliary meter 3
DIF	1	05	05	05*1	05	05	
VIF	1	2B	2B	2B*1	2B	2B	
Value	4						Power [W]
DIF	1	05		05*1	05	05	
VIF	1	3B		3B*1	3B	3B	
Value	4						Flowrate [l/h]
DIF	1		05	05*1			

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	Explanation
VIF	1		53	53 [1]			
Value	4						Mass flow [kg/h]
DIF	1	05	05		05	05	
VIF	1	5B	5B		5B	5B	
Value	4						Flow temperature [°C]
DIF	1	05	05		05	05	
VIF	1	5F	5F		5F	5F	
Value	4						Return temperature [°C]
DIF	1	05	05		05	05	
VIF	1	63	63		63	63	
Value	4						Temperature difference [K]
DIF	1	05	05		05	05	
VIF, VIFE	2	83 33	83 33		83 33	83 33	
Value	4						k-factor [Wh / K / l]
DIF	1	05	05		05	05	
VIF, VIFE	2	9B 2C	9B 2C		9B 2C	9B 2C	
Value	4						Density [kg / l]
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]
DIF	1	04	04	04	04	04	
VIF	1	6D	6D	6D	6D	6D	
Value	4						Current date and time
DIF	1	05	05		05	05	
VIF, VIFE	2	93 28	93 28		93 28	93 28	
Value	4						Impulse value [l]
DIF	1			05			
VIF, VIFE	2			VIF4			
Value	4						Impulse value for auxiliary meter 1
DIF, DIFE	2	85 40	85 40	85 40	85 40	85 40	
VIF, VIFE	2	VIF4	VIF4	VIF4	VIF4	VIF4	
Value	4						Impulse value for auxiliary meter 2
DIF, DIFE	3	85 80 40	85 80 40	85 80 40	85 80 40	85 80 40	
VIF, VIFE	2	VIF4	VIF4	VIF4	VIF4	VIF4	
Value	4						Impulse value for auxiliary meter 3
DIF	1	01	01	01	01	01	
VIF	1	7A	7A	7A	7A	7A	
Value	1						Primary address
DIF	1	0C	0C	0C	0C	0C	
VIF	1	78	78	78	78	78	
Value	4						Secondary address
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..20	00..20	00..20	00..20	00..20	Size customer text field

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	Explanation
Value	0-32						Customer text field
DIF	1	0B	0B	0B	0B	0B	
VIF, VIFE	2	FD 0E	FD 0E	FD 0E	FD 0E	FD 0E	
Value	3						Firmware version
DIF	1	0C	0C	0C	0C	0C	
VIF, VIFE	2	FD 0D	FD 0D	FD 0D	FD 0D	FD 0D	
Value	4						Hardware version
Checksum	1	CS	CS	CS	CS	CS	Checksum
Stop	1	16	16	16	16	16	Stop

Table 15 Standard telegram

*1 Only available if there is an auxiliary meter set on the relevant unit

- The current date and time supports both the millennium and summer/winter time bits.
- 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 ST ignores this information.
- Customer text fields are variable in length. They can be 1 to 32 bytes. The length code can be found between VIFE and the text field.

4.2.2 Billing date telegram

The CALEC ST has two billing dates. There is a separate telegram for each billing date. The data for billing date 1 is transferred as M-Bus memory number 1, and for billing date 2 it is M-Bus memory number 2.

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	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 of the CALEC ST
Manufacturer code	2	B405h	B405h	B405h	B405h	B405h	05B4h = Aquametro
Device version	1	DEV	DEV	DEV	DEV	DEV	CALEC ST
Medium	1	MED	MED	MED	MED	MED	04h = return / 0Ch = 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	42	42	42	42	42	
VIF	1	6C	6C	6C	6C	6C	
Value	2						Date of billing date 1
DIF	1	44	44			44	
VIF (VIFE)	1 (2)	VIF1	VIF1			VIF1	
Value	4						Energy counter reading at billing date1
DIF	1				44		
VIF (VIFE)	2 (3)				VIF1 3B		
Value	4						Energy counter reading pos. at billing date 1
DIF	1				44		
VIF (VIFE)	2 (3)				VIF1 3C		
Value	4						Energy counter reading neg. at billing date 1
DIF	2					C4 10	
VIF (VIFE)	1 (2)					VIF1	
Value	4						Tariff 1 at billing date 1
DIF	2					C4 20	
VIF (VIFE)	1 (2)					VIF1	
Value	4						Tariff 2 at billing date 1
DIF	1	44				44	
VIF (VIFE)	1 (2)	VIF2				VIF2	
Value	4						Volume counter reading at billing date 1
DIF	1				44		
VIF (VIFE)	2 (3)				VIF2 3B		
Value	4						Volume counter reading pos. on billing date 1
DIF	1				44		
VIF (VIFE)	2 (3)				VIF2 3C		
Value	4						Volume counter reading neg. at billing date 1
DIF	1		44[*1]				

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	Explanation
VIF (VIFE)	1 (2)		VIF2*1				
Value	4						Mass counter reading at Billing date 1
DIF	1			44			
VIF (VIFE)	1 (2)			VIF3			
Value	4						Counter reading for auxiliary meter 1 Billing date 1
DIF, DIFE	2	C4 40	C4 40	C4 40	C4 40	C4 40	
VIF (VIFE)	1 (2)	VIF3	VIF3	VIF3	VIF3	VIF3	
Value	4						Counter reading for auxiliary meter 2 Billing date 1
DIF, DIFE	3	C4 80 40	C4 80 40	C4 80 40	C4 80 40	C4 80 40	
VIF (VIFE)	1 (2)	VIF3	VIF3	VIF3	VIF3	VIF3	
Value	4						Counter reading for auxiliary meter 3 Billing date 1
DIF	1	74	74	74	74	74	
VIF	1	22	22	22	22	22	
Value	4						Error hours [h] on billing date 1
Checksum	1	CS	CS	CS	CS	CS	
Stop	1	16	16	16	16	16	

Table 16 Billing date telegram 1

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

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	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 of the CALEC ST
Manufacturer code	2	B405h	B405h	B405h	B405h	B405h	05B4h = Aquametro
Device version	1	DEV	DEV	DEV	DEV	DEV	CALEC ST
Medium	1	MED	MED	MED	MED	MED	04h = return / 0Ch = 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	2	82 01	82 01	82 01	82 01	82 01	
VIF	1	6C	6C	6C	6C	6C	
Value	2						Date of billing date 2
DIF	2	84 01	84 01			84 01	
VIF (VIFE)	1 (2)	VIF1	VIF1			VIF1	
Value	4						Energy counter reading Billing date 2
DIF	2				84 01		
VIF (VIFE)	2 (3)				VIF1 3B		
Value	4						Energy counter reading

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	Explanation
							pos. at billing date 2
DIF	2				84 01		
VIF (VIFE)	2 (3)				VIF1 3C		
Value	4						Energy counter reading neg. at billing date 2
DIF	2					84 11	
VIF (VIFE)	1 (2)					VIF1	
Value	4						Tariff 1 at billing date 2
DIF	2					84 21	
VIF (VIFE)	1 (2)					VIF1	
Value	4						Tariff 2 at billing date 2
DIF	2	84 01				84 01	
VIF (VIFE)	1 (2)	VIF2				VIF2	
Value	4						Volume counter reading at billing date 2
DIF	2				84 01		
VIF (VIFE)	2 (3)				VIF2 3B		
Value	4						Volume counter reading pos. at billing date 2
DIF	2				84 01		
VIF (VIFE)	2 (3)				VIF2 3C		
Value	4						Volume counter reading neg. at billing date 2
DIF	2		84 01*1				
VIF (VIFE)	1 (2)		VIF2*1				
Value	4						Mass counter reading at billing date 2
DIF	2			84 01*1			
VIF (VIFE)	1 (2)			VIF3*1			
Value	4						Counter reading for Auxiliary meter 1 Billing date 2
DIF, DIFE	2	84 41	84 41	84 41	84 41	84 41	
VIF (VIFE)	1 (2)	VIF3	VIF3	VIF3	VIF3	VIF3	
Value	4						Counter reading for auxiliary meter 2 Billing date 2
DIF, DIFE	3	84 81 40	84 81 40	84 81 40	84 81 40	84 81 40	
VIF (VIFE)	1 (2)	VIF3	VIF3	VIF3	VIF3	VIF3	
Value	4						Counter reading for auxiliary meter 3 Billing date 2
DIF	2	B4 01	B4 01	B4 01	B4 01	B4 01	
VIF	1	22	22	22	22	22	
Value	4						Error hours [h] on billing date 2
Checksum	1	CS	CS	CS	CS	CS	
Stop	1	16	16	16	16	16	

Table 17 Billing date telegram

*1 Only available if there is an auxiliary meter set on the relevant unit

Logger telegram

Loggers up to firmware V1.01:
the CALEC ST has 28 memory positions for the data logger. There is a separate telegram for each memory position. The data for logger 1 is transferred as M-Bus memory number 3, and for logger 2 it is M-Bus memory number 4.

Loggers as of firmware V1.02:
As of V1.02, the CALEC ST has 60 memory positions for data loggers. There is a separate telegram for each memory position. The data for logger 1 is transferred as M-Bus memory number 100, and for logger 2 it is M-Bus memory number 101.
In order to ensure backwards compatibility with V1.01, loggers 1 to 28 are also transmitted with memory numbers 3 to 30.

Coding of memory numbers:
The memory numbers are coded in DIF, DIFE in accordance with EN13757-3. As they are variable, they are not listed in the table below.
The maximum values are also coded in DIF in accordance with EN13757-3.

No logger data:
If there is no date for a logger (for new devices), the 'no data telegram' is transmitted instead of the logger telegram.

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	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 of the CALEC ST
Manufacturer code	2	B405h	B405h	B405h	B405h	B405h	05B4h = Aquametro
Device version	1	DEV	DEV	DEV	DEV	DEV	CALEC ST
Medium	1	MED	MED	MED	MED	MED	04h = return / 0Ch = 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, DIFE							
VIF	1	6C	6C	6C	6C	6C	
Value	2						Logger period date
DIF, DIFE							
VIF (VIFE)	1 (2)	VIF1	VIF1			VIF1	
Value	4						Logger energy counter reading
DIF							
VIF (VIFE)	2 (3)				VIF1 3B		
Value	4						Pos. logger energy counter reading
DIF							
VIF (VIFE)	2 (3)				VIF1 3C		
Value	4						Neg. logger energy counter reading
DIF							
VIF (VIFE)	1 (2)					VIF1	
Value	4						Logger tariff 1
DIF							
VIF (VIFE)	1 (2)					VIF1	
Value	4						Logger tariff 2

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	Explanation
DIF							
VIF (VIFE)	1 (2)	VIF2				VIF2	
Value	4						Logger volume counter reading
DIF							
VIF (VIFE)	2 (3)				VIF2 3B		
Value	4						Pos. logger volume counter reading
DIF							
VIF (VIFE)	2 (3)				VIF2 3C		
Value	4						Neg. logger volume counter reading
DIF							
VIF (VIFE)	1 (2)		VIF2*1				
Value	4						Logger mass counter reading
DIF							
VIF (VIFE)	1 (2)			VIF3			
Value	4						Counter reading Logger auxiliary meter 1
DIF, DIFE							
VIF (VIFE)	1 (2)	VIF3	VIF3	VIF3	VIF3	VIF3	
Value	4						Counter reading Logger auxiliary meter 2
DIF, DIFE							
VIF (VIFE)	1 (2)	VIF3	VIF3	VIF3	VIF3	VIF3	
Value	4						Counter reading for auxiliary meter 3
DIF							
VIF	1	22	22	22	22	22	
Value	4						Logger error hours [h]
DIF, DIFE							
VIF	1	2B	2B	2B *1	2B	2B	
Value	4						max. power in logger period [W]
DIF, DIFE							
VIF, VIFE	2	AB 39	AB 39	AB 39*1	AB 39	AB 39	
Value	4						Time of maximum power
DIF, DIFE							
VIF	1	3B		3B*1	3B	3B	
Value	4						max. flowrate [l/h] at point of maximum power
DIF, DIFE							
VIF	1		53	53*1			
Value	4						max. mass flow [kg/h] at point of maximum power
DIF, DIFE							
VIF, VIFE	2	BB 39	BB 39	BB 39	BB 39	BB 39	
Value	4						Time of maximum power / mass flow
DIF, DIFE							
VIF	1	5B	5B		5B	5B	
Value	4						Maximum flow temperature [°C] at time of maximum power
DIF, DIFE							
VIF, VIFE	2	DB 39	DB 39		DB 39	DB 39	

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	Explanation
Value	4						Time of maximum flow temperature
DIF, DIFE							
VIF	1	5F	5F		5F	5F	
Value	4						Maximum return temperature [°C] at time of maximum power
DIF, DIFE							
VIF, VIFE	2	DF 39	DF 39		DF 39	DF 39	
Value	4						Time of maximum return temperature
Checksum	1	CS	CS	CS	CS	CS	
Stop	1	16	16	16	16	16	

Table 18 Logger telegram

**1* Only available if there is an auxiliary meter set on the relevant unit

Notes on maximum values:
In each logger period, the CALEC ST calculates the value for the maximum power. The flowrate, flow and return temperatures are also recorded at the point this maximum power occurs. These four values are transferred as the max. power, the max. flowrate, the max. flow temperature and the max. return temperature. The time of occurrence is also transmitted for each of these four values. These four times are always the same, but are transmitted to simplify data evaluation.

4.2.3 Freeze telegram

The 'Freeze' command (See Chapter 5.1.8) allows the current values to be frozen. These frozen values can be read out using the 'Freeze telegram'. This telegram has the same structure as the logger telegram. The values are transmitted as M-Bus memory number 31.

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
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 of the CALEC ST
Manufacturer code	2	B4 05	05 B4 = Aquametro
Device version	1	DEV	CALEC ST
Medium	1	MED	04 = return / 0C = flow
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	

Table 19 No data telegram

4.2.5 Service telegram

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

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	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 of the CALEC ST
Manufacturer code	2	B405h	B405h	B405h	B405h	B405h	05B4h = Aquametro
Device version	1	DEV	DEV	DEV	DEV	DEV	CALEC ST
Medium	1	MED	MED	MED	MED	MED	04h = return / 0Ch = 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	04	04	04[*1]		04	
VIF (VIFE)	1 (2)	VIF1	VIF1	VIF1[*1]		VIF1	
Value	4						Energy counter reading
DIF	1				04		
VIF (VIFE)	2 (3)				VIF1 3B		
Value	4						Energy counter reading pos.
DIF	1	05	05	05[*1]		05	
VIF (VIFE)	1 (2)	VIF1	VIF1	VIF1[*1]		VIF1	
Value	4						Energy counter reading remaining register
DIF	1				05		
VIF (VIFE)	2 (3)				VIF1 3B		
Value	4						Energy counter reading pos. remaining register
DIF	1	04		04[*1]		04	
VIF (VIFE)	1 (2)	VIF2		VIF2[*1]		VIF2	
Value	4						Volume counter reading
DIF	1				04		
VIF (VIFE)	2 (3)				VIF2 3B		
Value	4						Volume counter reading pos.
DIF	1	05		05[*1]		05	
VIF (VIFE)	1 (2)	VIF2		VIF2[*1]		VIF2	
Value	4						Volume counter reading remaining register
DIF	1				05		
VIF (VIFE)	2 (3)				VIF2 3B		
Value	4						Volume counter reading pos. remaining register
DIF	1		04[*1]				

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	Explanation
VIF (VIFE)	1 (2)		VIF2*1				
Value	4						Mass counter reading
DIF	1		05*1				
VIF (VIFE)	1 (2)		VIF2*1				
Value	4						Mass counter reading remainder register
DIF	1	15	15	15*1	15	15	
VIF	1	2B	2B	2B*1	2B	2B	
Value	4						max. power [W]
DIF	1	15		15*1	15	15	
VIF	1	3B		3B*1	3B	3B	
Value	4						max. flowrate [l/h]
DIF	1		15	15*1			
VIF	1		53	53*1			
Value	4						max. mass flow [kg/h]
DIF	1	15	15		15	15	
VIF	1	5B	5B		5B	5B	
Value	4						max. flow temperature [°C]
DIF	1	15	15		15	15	
VIF	1	5F	5F		5F	5F	
Value	4						max. return temperature [°C]
DIF	1	15	15		15	15	
VIF	1	63	63		63	63	
Value	4						max. temperature difference [K]
DIF	1	45	45		45	45	
VIF, VIFE	2	FD 3A	FD 3A		FD 3A	FD 3A	
Value	4						Arithmetic mean value on hot side
DIF, DIFE	2	85 01	85 01		85 01	85 01	
VIF, VIFE	2	FD 3A	FD 3A		FD 3A	FD 3A	
Value	4						Arithmetic mean value on cold side
DIF, DIFE	2	C5 01	C5 01		C5 01	C5 01	
VIF, VIFE	2	FD 3A	FD 3A		FD 3A	FD 3A	
Value	4						Standard deviation hot side
DIF, DIFE	2	85 02	85 02		85 02	85 02	
VIF, VIFE	2	FD 3A	FD 3A		FD 3A	FD 3A	
Value	4						Standard deviation cold side
DIF, DIFE	2	C5 02	C5 02		C5 02	C5 02	
VIF, VIFE	2	FD 3A	FD 3A		FD 3A	FD 3A	
Value	4						Calibration factor hot side
DIF, DIFE	2	85 03	85 03		85 03	85 03	
VIF, VIFE	2	FD 3A	FD 3A		FD 3A	FD 3A	
Value	4						Calibration factor heat side
DIF, DIFE	2	C5 03	C5 03		C5 03	C5 03	
VIF, VIFE	2	FD 3A	FD 3A		FD 3A	FD 3A	
Value	4						Zero point hot side
DIF, DIFE	2	85 04	85 04		85 04	85 04	
VIF, VIFE	2	FD 3A	FD 3A		FD 3A	FD 3A	
Value	4						Zero point cold side
DIF	2	74	74	74	74	74	
VIF	1	6D	6D	6D	6D	6D	
Value	4						Service date for

Name	No. bytes	Version C 0,3,5,6	Version C 1	Version C 2	Version C 4	Version C 7	Explanation
							counter overflow
DIF, DIFE	2	B4 01	B4 01	B4 01	B4 01	B4 01	
VIF	1	6D	6D	6D	6D	6D	
Value	4						Service date for counter reset
DIF, DIFE	2	F4 01	F4 01	F4 01	F4 01	F4 01	
VIF	1	6D	6D	6D	6D	6D	
Value	4						Service date for temperature alarm
DIF, DIFE	2	B4 02	B4 02	B4 02	B4 02	B4 02	
VIF	1	6D	6D	6D	6D	6D	
Value	4						Service date for programming button
DIF	1	05	05		05	05	
VIF, VIFE	2	93 28	93 28		93 28	93 28	
Value	4						Impulse value [l]
DIF	1			05			
VIF, VIFE	2			VIF4			
Value	4						Impulse value for auxiliary meter 1
DIF	1	02	02	02	02	02	
VIF, VIFE	2	EC 39	EC 39	EC 39	EC 39	EC 39	
Value	2						Manufacturing date
Checksum	1	CS	CS	CS	CS	CS	
Stop	1	16	16	16	16	16	

Table 20 Service telegram

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

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 master. The CALEC ST responds with an ACK telegram. The CALEC ST does not distinguish between 53h and 73h in the C field.

5.1 SND_UD telegrams

There is a separate telegram for each parameterisable value. Only one parameter can be changed with each telegram. It is not possible to summarise multiple values in one telegram.

5.1.1 Parameterise baud rate

The CALEC ST supports 300 and 2400 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	B8h = 300 baud / BBh = 2400 baud
Checksum	1	CS	
Stop	1	16h	

Table 21 Baud rate parameterisation

- The CALEC ST does not distinguish between 53h and 73h in the C field.
- The CALEC ST 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	

Table 22 Primary address parameterisation

5.1.3 Parameterise response telegram

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. These can be seen in Table 24.
The factory setting for the CALEC ST 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 24
VIF	1		See column "VIF" of Table 24
Checksum	1	CS	
Stop	1	16h	

Table 23 Response telegram parameterisation frame

Up to firmware V1.01:

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
Logger 11	C806h	7Eh
Logger 12	8807h	7Eh
Logger 13	C807h	7Eh
Logger 14	8808h	7Eh
Logger 15	C808h	7Eh
Logger 16	8809h	7Eh
Logger 17	C809h	7Eh
Logger 18	880Ah	7Eh
Logger 19	C80Ah	7Eh
Logger 20	880Bh	7Eh
Logger 21	C80Bh	7Eh
Logger 22	880Ch	7Eh
Logger 23	C80Ch	7Eh
Logger 24	880Dh	7Eh
Logger 25	C80Dh	7Eh
Logger 26	880Eh	7Eh
Logger 27	C80Eh	7Eh
Logger 28	880Fh	7Eh
Freeze	C80Fh	7Eh
Service	08h	7Fh

Table 24 Response telegram parameterisation values to V1.01

As of firmware V1.02.

Reply telegram	DIF, DIFE	VIF
Standard	08h	7Eh
Billing date 1	48h	7Eh
Billing date 2	8801h	7Eh
Logger 1	888203h	7Eh
Logger 2	C88203h	7Eh
Logger 3	888303h	7Eh
Logger 4	C88303h	7Eh
Logger 5	888403h	7Eh
Logger 6	C88403h	7Eh
Logger 7	888503h	7Eh
Logger 8	C88503h	7Eh
Logger 9	888603h	7Eh
Logger 10	C88603h	7Eh
Logger 11	888703h	7Eh
Logger 12	C88703h	7Eh
Logger 13	888803h	7Eh
Logger 14	C88803h	7Eh
Logger 15	888903h	7Eh
Logger 16	C88903h	7Eh
Logger 17	888A03h	7Eh
Logger 18	C88A03h	7Eh
Logger 19	888B03h	7Eh
Logger 20	C88B03h	7Eh
Logger 21	888C03h	7Eh
Logger 22	C88C03h	7Eh
Logger 23	888D03h	7Eh
Logger 24	C88D03h	7Eh
Logger 25	888E03h	7Eh
Logger 26	C88E03h	7Eh
Logger 27	888F03h	7Eh
Logger 28	C88F03h	7Eh
Logger 29	888004h	7Eh
Logger 30	C88004h	7Eh
Logger 31	888104h	7Eh
Logger 32	C88104h	7Eh
Logger 33	888204h	7Eh
Logger 34	C88204h	7Eh
Logger 35	888304h	7Eh
Logger 36	C88304h	7Eh
Logger 37	888404h	7Eh
Logger 38	C88404h	7Eh
Logger 39	888504h	7Eh
Logger 40	C88504h	7Eh
Logger 41	888604h	7Eh
Logger 42	C88604h	7Eh
Logger 43	888704h	7Eh
Logger 44	C88704h	7Eh
Logger 45	888804h	7Eh
Logger 46	C88804h	7Eh
Logger 47	888904h	7Eh
Logger 48	C88904h	7Eh
Logger 49	888A04h	7Eh
Logger 50	C88A04h	7Eh
Logger 51	888B04h	7Eh
Logger 52	C88B04h	7Eh
Logger 53	888C04h	7Eh
Logger 54	C88C04h	7Eh
Logger 55	888D04h	7Eh

Reply telegram	DIF, DIFE	VIF
Logger 56	C88D04h	7Eh
Logger 57	888E04h	7Eh
Logger 58	C88E04h	7Eh
Logger 59	888F04h	7Eh
Logger 60	C88F04h	7Eh
Freeze	C80Fh	7Eh
Service	08h	7Fh

Table 25 Response telegram parameterisation values as of V1.02

In order to ensure backwards compatibility with V1.01, loggers 1 to 28 can be selected not only with the values in Table 25 but also with values as set out in Table 24. In the RESP_UD telegram, the device always responds with the same memory number (DIF, DIFE) as was used for the parameterisation of the response telegram.

5.1.4 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	

Table 26 Date / time parameterisation

- The date and time supports both the millennium and summer/winter time bits.

5.1.5 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	

Table 27 Billing date 1 parameterisation

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

5.1.6 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	

Table 28 Billing date 2 parameterisation

- 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 customer text field

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	1h..20h	Number of bytes for customer text field
Value	1h..20h		Customer text field (ASCII string)
Checksum	1	CS	
Stop	1	16h	

Table 29 Parameterise customer text field

- Customer text fields are variable in length. They can be 1 to 32 bytes. The length code can be found between VIFE and the text field.

5.1.8 Freeze command

This command allows the current values to be frozen. The frozen values are stored in EEPROM until another freeze command and can be read out using the 'Freeze telegram'.

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	07h	
L field	1	07h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF, DIFE	2	C00Fh	
VIF, VIFE	2	FE0Bh	
Checksum	1	CS	
Stop	1	16h	

Table 30 Freeze command

5.1.9 Parameterise impulse value for auxiliary meter 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, DIFE	1	05h	
VIF, VIFE	2	VIF4	
Value	4		Impulse value for auxiliary meter 1
Checksum	1	CS	
Stop	1	16h	

Table 31 Parameterise impulse value for auxiliary meter 1

- For this parameterisation, the CALEC ST must be in service protection level or lower.

5.1.10 Parameterise impulse value for auxiliary meter 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	8540h	
VIF, VIFE	2	VIF4	
Value	4		Impulse value for auxiliary meter 2
Checksum	1	CS	
Stop	1	16h	

Table 32 Parameterise impulse value for auxiliary meter 2

- For this parameterisation, the CALEC ST must be in service protection level or lower.

5.1.11 Parameterise impulse value for auxiliary meter 3

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	3	858040h	
VIF, VIFE	2	VIF4	
Value	4		Impulse value for auxiliary meter 3
Checksum	1	CS	
Stop	1	16h	

Table 33 Parameterise impulse value for auxiliary meter 3

- For this parameterisation, the CALEC ST must be in service protection level or lower.

5.1.12 Parameterise readout for auxiliary meter 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, DIFE	1	04h	
VIF, (VIFE)	1 (2)	VIF3	
Value	4		Readout for auxiliary meter 1
Checksum	1	CS	
Stop	1	16h	

Table 34 Parameterise readout for auxiliary meter 1

- For this parameterisation, the CALEC ST must be in service protection level or lower.

5.1.13 Parameterise readout for auxiliary meter 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	8440h	
VIF, (VIFE)	1 (2)	VIF3	
Value	4		Readout for auxiliary meter 2
Checksum	1	CS	
Stop	1	16h	

Table 35 Parameterise readout for auxiliary meter 2

- For this parameterisation, the CALEC ST must be in service protection level or lower.

5.1.14 Parameterise readout for auxiliary meter 3

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	3	848040h	
VIF, (VIFE)	1 (2)	VIF3	
Value	4		Readout for auxiliary meter 3
Checksum	1	CS	
Stop	1	16h	

Table 36 Parameterise readout for auxiliary meter 3

- For this parameterisation, the CALEC ST must be in service protection level or lower.

5.1.15 Parameterise impulse value

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	0Ah	
L field	1	0Ah	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF	1	05h	
VIF, VIFE	2	9328h	
Value	4		Impulse value [l]
Checksum	1	CS	
Stop	1	16h	

Table 37 Parameterise impulse value

- For this parameterisation, the CALEC ST must be in programming protection level.

5.1.16 Parameterise installation side

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	07h	
L field	1	07h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	51h	Parameterisation
DIF	1	01h	
VIF, VIFE	2	FD09h	
Value	1	04h / 0Ch	Installation side: 04h = return, 0Ch = flow (medium byte in accordance with EN 13757)
Checksum	1	CS	
Stop	1	16h	

Table 38 Parameterise installation side

- For this parameterisation, the CALEC ST must be in programming protection level.

5.1.17 Protection type

This command allows the protection level to be set permanently. However, the values set can only be equal to or greater than the current (temporary) protection level.
If the protection level needs to be reduced, this need to be effected using the keys first. The level of protection can then be set permanently using the following command.

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	0Fh	Manufacturer-specific telegram
	3	03060Bh	Code for protection level
Value	1		03h = User, 02h = Service, 01h = Programming
Checksum	1	CS	
Stop	1	16h	

Table 39 Parameterise protection level

5.1.18 Units

There are no M-Bus commands for parameterising units. These are converted using the keys on the CALEC ST. Where devices have been validated with metrological verification, this means destroying the validation seal. It should also be noted that if a unit is converted or a counter reading deleted, the counter should be reset to 0.

If several devices are required with specific settings, these can be configured accordingly by Aquametro at the factory. This option can be ordered by quoting item no. 96'148

5.2 ACK telegram

Name	Number of bytes	Value	Explanation
ACK	1	E5h	

Table 40 ACK telegram

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 ST supports application reset and an extension of it which involves what is known as subcode. These commands only affect the choice of response telegram.

- The application reset telegrams are prefixed with an SND-UD telegram by the master. The CALEC ST responds with an ACK telegram. The CALEC ST does not distinguish between 53h and 73h in the C field.

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	50h	Application reset
Checksum	1	CS	
Stop	1	16h	

Table 41 Application reset

- The application reset activates the standard telegram and has exactly the same effect as the relevant parameter command.

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	04h	
L field	1	04h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	50h	Application reset
	1	B0h	Subcode B0h
Checksum	1	CS	
Stop	1	16h	

Table 42 Application reset with subcode B0h

- The application reset with subcode B0h activates the service telegram and has exactly the same effect as the relevant parameter command.

Name	Number of bytes	Value	Explanation
Start	1	68h	
L field	1	04h	
L field	1	04h	
Start	1	68h	
C field	1	53h / 73h	SND_UD
A field	1	PADR	Primary address
CI field	1	50h	Application reset
	1	05h	Subcode 05h
Checksum	1	CS	
Stop	1	16h	

Table 43 Application reset with subcode B0h

- The application reset with subcode 05h activates the short standard telegram.

7 Variable units

Most units are variable and can be parameterised. The M-Bus norm considers the unit and resolution as a single unit, i.e. a conversion from, for example, kWh to kJ works on the same principle as changing the resolution by, for example, a factor of 100. Units and resolution for energy counter readings (VIF1).
All energy counter reading are saved as 4 byte integers. Every meter counter reading also has a remaining energy register. This is a 4 byte float. The counter reading and remaining register always have the same unit/resolution.
In the display and M-Bus, the energy counter readings are always shown with the same unit/resolution.
All counter readings described with VIF1 can have the following units and resolutions:

Up to firmware V1.01: (as per EN1434-3)

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
0.1	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

Table 43 Variable units for energy counter readings VIF1 to V1.01

As of firmware V1.02. (as per EN13757-3)

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
0.1	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	kBtu	803Dh
0.01	kBtu	813Dh
0.1	kBtu	823Dh
1	kBtu	833Dh
0,001	MBtu	833Dh
0.01	MBtu	843Dh
0.1	MBtu	853Dh
1	MBtu	863Dh

Table 44 Variable units for energy counter readings VIF1 as of V1.02

7.1 Units and resolution for volume/mass counter readings (VIF2).

All volume/mass counter reading are saved as 4 byte integers. Every meter reading also has a remaining volume register. This is a 4 byte float. The counter reading and remaining volume register always have the same unit/resolution.
The CALEC ST display always shows the volume/mass counter readings in the same unit/resolution as on the M-Bus.

All counter readings described with VIF2 can have the following units and resolutions:

Up to firmware V1.01: (as per EN1434-3)

Resolution	Unit	VIF / VIFE
0,001	m^3	13h
0.01	m^3	14h
0.1	m^3	15h
1	m^3	16h
0.1	USgal	FB22h
1	USgal	FB23h
0,001	T	1Bh
0.01	T	1Ch
0.1	T	1Dh
1	T	1Eh

Table 45 Variable units for volume/mass counter readings VIF2 to V1.01

As of firmware V1.02. (as per EN13757-3)

Resolution	Unit	VIF / VIFE
0,001	m^3	13h
0.01	m^3	14h
0.1	m^3	15h
1	m^3	16h
0.1	USgal	923Dh
1	USgal	933Dh
0,001	T	1Bh
0.01	T	1Ch
0.1	T	1Dh
1	T	1Eh

Table 46 Variable units for volume/mass counter readings VIF2 as of V1.02.

7.2 Units and resolution for auxiliary meter readings (VIF3).

The medium, unit and resolution of the auxiliary meters are variable.
All auxiliary meter reading are saved as 4 byte integers. Every meter reading also has a remaining register. This is a 4 byte float. The meter reading and remaining register always have the same unit/resolution.
The CALEC ST display always shows the auxiliary counter readings in the same unit/resolution as on the M-Bus.

All counter readings described with VIF3 can have the following units and resolutions:

Up to firmware V1.01: (as per EN1434-3)

Medium	Resolution	Unit	VIF / VIFE
Energy	0,001	kWh	03h
„	0.01	kWh	04h
„	0.1	kWh	05h
„	1	kWh	06h
„	0,001	MWh	06h
„	0.01	MWh	07h
„	0.1	MWh	FB00h
„	1	MWh	FB01h

Medium	Resolution	Unit	VIF / VIFE
„	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
Volumes	0,001	m^3	13h
„	0.01	m^3	14h
„	0.1	m^3	15h
„	1	m^3	16h
„	0.1	USgal	FB22h
„	1	USgal	FB23h
Mass	0,001	t	1Bh
„	0.01	t	1Ch
„	0.1	t	1Dh
„	1	t	1Eh
No units	1	HCA	6Eh

Table 47 Variable units for auxiliary meter readings VIF3 to V1.01

As of firmware V1.02. (as per EN13757-3)

Medium	Resolution	Unit	VIF / VIFE
Energy	0,001	kWh	03h
„	0.01	kWh	04h
„	0.1	kWh	05h
„	1	kWh	06h
„	0,001	MWh	06h
„	0.01	MWh	07h
„	0.1	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	kBtu	803Dh
„	0.01	kBtu	813Dh
„	0.1	kBtu	823Dh
„	1	kBtu	833Dh
„	0,001	MBtu	833Dh
„	0.01	MBtu	843Dh
„	0.1	MBtu	853Dh
„	1	MBtu	863Dh
Volumes	0,001	m^3	13h
„	0.01	m^3	14h
„	0.1	m^3	15h
„	1	m^3	16h
„	0.1	USgal	923Dh
„	1	USgal	933Dh
Mass	0,001	t	1Bh
„	0.01	t	1Ch
„	0.1	t	1Dh
„	1	t	1Eh
No units	1	HCA	6Eh

Table 48 Variable units for auxiliary meter readings VIF3 as of V1.02

7.3 Units for auxiliary meter impulse values (VIF4)

The units for the auxiliary meter impulse values depend on the medium set. The counter reading and impulse value always have the same unit. While the resolution for the counter reading can be configured, this is not necessary for the impulse value as it is a floating point value.

All counter readings described with VIF4 can have the following units and resolutions:

Medium	Unit	VIF / VIFE
Energy	Wh / pulse	8328h
Volumes	l / pulse	9328h
Mass	kg / pulse	9B28h
No units	HCA / pulse	EE28h

Table 49 Variable units for auxiliary counter impulse values VIF4

7.4 Notes on units for all other values

All the values and units not described in chapters 0 to 7.3 are fixed on the M-Bus and cannot be amended.

However, they can be changed in the display of the CALEC ST such that the values on the M-Bus and the display are shown differently. However, correct physical conversion between the units is guaranteed in all cases.

8 Compatibility with CALEC MB/light, AMTRON-N/NW, AMBUS-IS

The CALEC ST is a new-generation device from Aquametro which is significantly different from the earlier generation of CALEC MB, CALEC light, AMTRON-N, AMTRON-NW and AMBUS IS devices.
The M-Bus telegram of the CALEC ST has also been reworked in some areas in order to ensure compliance with EN 13757. The major differences are described in the sections below.

8.1 Baud rates

The CALEC ST supports 300 and 2400 baud.
600, 1200, 4800 and 9600 baud are no longer supported.

8.2 Data selection

The CALEC ST has 6 different RSP_UD telegrams. The data transmitted is fixed and cannot be modified.
There is no longer the option of selecting individual data items using VIF 08.

8.3 Combination of slave select and parameterisation

The combined telegram which could execute slave select and parameterisation or data selection at the same time is no longer supported by CALEC ST.

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	
A field	1	FEh	
CI field	1	51h / 52h	No distinction between 51h / 52h
Secondary add.	4	IDENT	
Manufacturer code	2	MAN	

Name	Number of bytes	Value	Explanation
Device version	1	DEV	
Medium	1	MED	
Idle fillers	4	FFFFFFFFh	
DIF			Data selection or parameterisation
VIF			
Value			
Checksum	1	CS	
Stop	1	16h	

Table 50 Combi telegram no longer supported

8.4 Alternative SND_UD telegrams

As the combination telegram (Chapter 8.3) no longer exists, an alternative SND_UD telegram has been implemented in CALEC ST which increases compatibility with earlier generations of Aquametro devices.
These alternative SND_UD telegrams can be used instead of the telegrams in Chapter 5.1. The CALEC ST's responses and the function are identical.

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
12 byte header	12	FFFFFFFFFFFFFFFFFFFFFFFFh	Additional 12 bytes
DIF			
VIF			
Value			
Checksum	1	CS	
Stop	1	16h	

Table 51 Alternative SND_UD-telegrams

The alternative SND_UD telegram has an additional 12 bytes. So it has the same structure as the RSP_UD telegram and the combi-telegram.
The first 8 of the additional 12 bytes must either all have the value FFh or correspond to the secondary address of the CALEC ST. If these bytes include an invalid secondary address, the CALEC STs do not react to the telegram.
The last 4 of the additional 12 bytes can contain any values. They are not evaluated.

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