

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 <small>(readout)</small> | 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 C0h.
- 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 |
| Cl 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 | | | |
| 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 data 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 [I] |
| 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 [I] |
| 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.