# Brunata HG

Technical Manual for HGW-series

– Tap Water Meter

Brunata

# Brunata HG meters

In 1999 Brunata took over HG International a/s, a modern wholly Danish owned company focusing on the development and production of electronic water and energy meters based on the magnetic induction metering principle. Thanks to an unswerving commitment to new technology we today supply some of the most advanced, reliable and accurate meters on the market.

Since production began in 1953 the HG meters have undergone a considerable transformation. They have changed from being mechanical to fully electronic devices without a single moving part. The electronics have become increasingly compact, and the functionality has expanded enormously. Today's meters are like small computers, with all the software contained on a single integrated circuit.

Today, our range of products includes meters for hot and cold water and for energy metering in heating and cooling systems. We offer on of the widest selections of meters on the market, covering capacities from 1 l/h to 660 $m^3$/h.

## The Brunata Group

Brunata is a wholly Danish owned production and engineering company with approx. 400 employees that develops and manufactures mechanical and electronic equipment for the metering of heat and water and that also prepares the associated billing. In Denmark, Brunata has its head office in the outskirts of Copenhagen and is represented nationwide through local branches. Furthermore, the company exports to most European countries through subsidiaries and license partners.

UK-QB 10.1482/25.04.2006

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# 1. Introduction

This manual is intended for skilled technicians and accredited laboratory personal.

The Brunata HG solid state small and medium size meters are designed as

- Water Meters, type HGW, versions 770-779 covering the flow range from 1.6 to 16 $m^3/h$
- Volume Meters for heating and cooling systems, type HGQ and HGS versions 07/107-179 covering the flow range from 1.2 to 16 $m^3/h$
- Energy Meters for heating and cooling systems, type HGQ and HGS versions 180 – 189, covering the flow range from 1.2 to 16 $m^3/h$.

This manual covers the HGW water meters intended for metering and billing of potable drinking water. HGW is approved according to the international recommendation OIML R 49 (2000)

HGQ and HGS meters are designed for measuring of thermal heat energy in district heating and cooling systems or in the industry, and are described in a separate manual.

# 2. Reference documents

## 2.1 Nomenclature list

Reference: OIML R49-1, R49-2 and R49-3

### 2.1.1 Flow-rates

| | |
|---|---|
| $Q_4$ | According to OIML R 49-1, 3.1.6 $Q_4$ is defined as $Q_3$ + 25%. The measuring limit of the meter, see chapter 4. |
| $Q_3$ | The designated flow-rate, $Q_3$, is chosen according to OIML R 49-1, 3.1.3. |
| $Q_2$ | The transitional flow-rate, $Q_2$, is defined as $Q_1$ + 60% according to OIML R 49-1, 3.1.5. |
| $Q_1$ | Minimum flow-rate, $Q_1$, is defined as a fraction of $Q_3$, and ratio $Q_3/Q_1$ is chosen as 250 |
| Q | Current flow-rare |

### 2.1.2 Miscellaneous

| | |
|---|---|
| MPE | Maximum Permissible Error |
| T | Pulse period. $T = t_{on} + t_{off}$ |
| $V_p$ | Volume pulse value (litre/pulse) |
| v | The water volume flow velocity |
| k | The water heat coefficient (enthalpy) from heat enthalpy table, ref. EN 1434. |
| BxRy | Data bank x, Register y. Internal data, not accessible by the user. |
| EC | ErrorCode |

## 2.2 List of appendixes

Following documents are enclosed as appendixes to this manual

| | |
|---|---|
| A.1 | Meter data sheets |
| A.1.1 | Data sheet HGW Water Meter |
| A.2 | User manuals |
| A.1.4 | Users manual for HGW Water Meter |
| A.1.5 | Installation manual for HGW Meter |
| A.3 | Analogue Box |
| A.3.1 | Data sheet HG Analogue Box |
| A.3.2 | Installation Guide HG Analogue Box (HG-420) |
| A.4 | Data sheet HG-LON module |
| A.5 | Communication protocol |
| A.5.1 | M-Bus protocol |
| A.5.2 | M-Bus data sheet |
| A.6 | Type Approvals |
| A.6.1 | Reference letter from Force Technology |
| A.6.2 | Water meter: OIML R 49 TS 22.36.004 (Danish) |

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# 3. General Description

The HGW meter consists of a Flow Sensor with polished stainless steel electrodes and an advanced electronic unit for wall mounting. The HGW-meter has low-pressure loss and contains no moving parts, which could be worn or choked up. The meter is very robust and is unaffected by excess flow. The Flow Sensor can be freely mounted horizontal, vertical or as required as long as it is always full of water. There is no need for straight length of pipe before or after the meter.

| General | | |
|---|---|---|
| Accuracy | OIML R49 Class 2 | |
| Approvals | OIML R49 | TS 22.36.004 |
| Environmental Class | EN 1434 Class C | |
| Dynamic range | 1:250 | |
| Storage temperature | -20 °C to 60 °C | |

| Flow sensor | |
|---|---|
| Connection | G¾B, G1B or G1¼B |
| Liner | HGQ: Ultrason S HGS5 & 9:<br>Polysulfone HGS16: PTFE |
| Tube | Special brass (CuZn36PbAs) |
| Flange | Mild steel (stainless steel on request) |
| Required conductivity | > 1 mS/m [10µS/cm] |
| Electrodes | AISI 316 |
| Protection Class | IP54 |
| Fluid temperature | Tmax = 130 °C |
| Pressure Class | PN16 ($P_{max}$ = 16 bar abs.) |

| Electronics | |
|---|---|
| Mains | 230 VAC 50Hz or 24 VAC 50Hz |
| Power consumption | < 5 Watt |
| Pulse output | Yes |
| Analogue output | Optional |
| MBus-Protocol | Yes |
| RS232-Communikation | Yes |
| Pulse input (ext. meters) | Yes max. 2 |
| Local indication and totalization [1)] | Yes |
| Protection Class | IP44 |
| Sorrounding temperature during operation | 5 °C to 55 °C at 60 % Rh |

1) For display version

## 3.1 HGQ / HGS Volume Meter

HG volume meters are designed to measure cold, potable drinking water. The flow sensor's temperature operating range covers from -10 °C to +120 °C and measures cold or hot water with same accuracy.

Following meter versions works with the whole range of flow sensors:

- Version -774 is complete volume meters with display and remote reading options, showing peak values, actual flow rates etc. The meter has 12 months log, pulse output and room for insertion of a communication module. As option 2 pulse counters for other meters.
- Version -778 has same facilities as -174 only with 24 months log and in addition tariff functions as described in chapter 4.7 Tariff function. The tariff function can be used as extra register for registration of overflow or registration of consumption during certain periods, f.inst. during the night.
- The display is versatile and can be programmed to individual needs.

*HGQ Tap Water Meter*

## 3.2 Flow sensors

The HGW-meter works fully electronic and has no moving parts. The meter tube is made of a special copper and zinc alloy, suitable for drinking water, lined with Ultrasone S (HGW2), Polysulfone / PSU (HGW6 and 10) and PTFE (HGW16). The measuring principle is based on Faraday's magnetic induction principle, where the water movement induces a voltage across the electrodes. The Faraday principle is used where high precision measuring of flow is needed.

The HGW-meter has an extended measuring range better than 1 to 250, which means that it can measure flow velocity down to 0,4 % of the maximum flow. The total measuring range is 1 to 1500.

The flow sensor's temperature operating range covers from -10 °C to +90 °C and measures cold or hot water with same accuracy and shall always be kept together.

*Attention:*

The flow sensor cable must NOT be modified by any means. The sensor with its cable is calibrated as one unit together with the meter electronics. They share identical serial numbers and must not be interchanged.

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## 3.3 HGW Electronics

The HGW electronics is designed with the latest microprocessor technology and has a built-in clock which is backed up by a small long-life battery.

Taken as a whole, the HGW meters features following facilities:

- Surveillance and remote reading through serial data bus, M-Bus protocol
- »Easy to read« LCD-Display with self-explained icons
- Display with back-light activated by the push button
- Service and error indications
- Visual indication of flow pulses
- In case of power dropouts all data are saved in an EEPROM
- Self start: Automatic data and set up recovery from EEPROM
- Allows input and storage of pulses from other meters, such as electricity-, gas- and water meters. The pulses are programmed to actual pulse value and showed as real units in for instance kWh
- Programmable pulse output (litre/pulse)
- Saves peak and total values
- Saves all registered data at 12 or 24 accounting dates selected by customer

## 3.4 Type approvals

The HGW meter series is designed and approved according to European standard OIML R 49 class 2, environmental class C (industrial applications). The meters are also approved according to the recommendation OIML R 49. The approvals are enclosed as appendixes to this manual comprising:

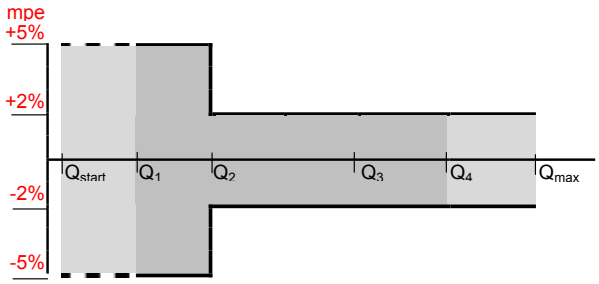
Approvals according to OIML R 49 class 2

- Type approval certificate for HGW cold water meter TS 22.36.004, rev. 1. Certificate no. 2003-7053-1907, date 05.09.2003. Valid until 05.09.2005.

## 3.5 Accuracy

The accuracy of HGW-meter are calculated as a combined class 2 – instrument according to OIML R 49-1, 3.2.2, where the MPE is:

- In upper flowrate zone ($Q_2 \cdot Q \cdot Q_4$) MPE is ± 2 % for water temperatures from 0.3 °C to 30 °C and ± 3 % for water greater than 30 °C
- In lower flowrate zone ($Q_1 \cdot Q \cdot Q_2$) MPE is ± 5%.




## 3.6 Types and versions

The HGW-meter has following type description and ordering code.

HGWx-zz-vvv/abcde

Example:

HGW10-R4-774/1B2M24 a water meter with designated flow Q3 10 m³/h, connection sixe R1B x 190 mm, display version 774, connection 230 VAC, display with back light, 2 pulse input, inserted M-Bus module and 24 accounting periods / logs.

On next page is shown an overview of the ordering codes.





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| Meter type | Meter type | Permanent flow, $q_p$ | C | Version | Volt-age | Back-light | AUX-meters | Commu-nication Module | Accounting periods | Glycol % |
|---|---|---|---|---|---|---|---|---|---|---|
| **HG** | **x** | **yy** | **zz** | **vvv** | **/ a** | **b** | **c** | **d** | **e** | **f** |
| HGW | W | - | - | - | - | - | - | - | - | - |
| 1.6 m³/h | - | 2 | - | - | - | - | - | - | - | - |
| 6.3 m³/h | - | 6 | - | - | - | - | - | - | - | - |
| 10 m³/h | - | 10 | - | - | - | - | - | - | - | - |
| 16 m³/h | - | 16 | - | - | - | - | - | - | - | - |
| G¾B x 110 | - | - | R0 | - | - | - | - | - | - | - |
| G1B x 105 | | | R2 | | | | | | | |
| G¾B x 130 | - | - | R1 | - | - | - | - | - | - | - |
| G¾B x 165 | - | - | R2 | - | - | - | - | - | - | - |
| G1B x 130 | - | - | R3 | - | - | - | - | - | - | - |
| G1B x 190 | - | - | R4 | - | - | - | - | - | - | - |
| G1B x 220 | - | - | R5 | - | - | - | - | - | - | - |
| G5¼B x 260 | - | - | R6 | - | - | - | - | - | - | - |
| Standard meter | - | - | - | 774 | - | - | - | - | - | - |
| Tariff meter | - | - | - | 778 | - | - | - | - | - | - |
| Voltage supply 230 V AC | - | - | - | - | 1 | - | - | - | - | - |
| Voltage supply 24 V AC | - | - | - | - | 2 | - | - | - | - | - |
| No backlight in display | - | - | - | - | - | - | - | - | - | - |
| Backlight in display | - | - | - | - | - | B | - | - | - | - |
| Nos of external meters | - | - | - | - | - | - | 0 | - | - | - |
| Nos of external meters | - | - | - | - | - | - | 1 | - | - | - |
| Nos of external meters | - | - | - | - | - | - | 2 | - | - | - |
| Communication module None | - | - | - | - | - | - | - | - | - | - |
| Communication module M-Bus | - | - | - | - | - | - | - | M | - | - |
| Communication module RS 232 | - | - | - | - | - | - | - | R | - | - |
| Communication module LonWorks | - | - | - | - | - | - | - | L | - | - |
| Accounting periods | - | - | - | - | - | - | - | - | 0 | - |
| Accounting periods | - | - | - | - | - | - | - | - | 6 | - |
| Accounting periods | - | - | - | - | - | - | - | - | 12 | - |
| Accounting periods | - | - | - | - | - | - | - | - | 24 | - |

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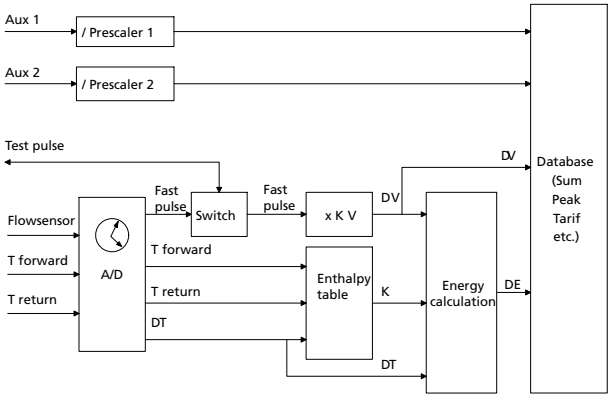
# 4. Operating principles

## 4.1 Operating principles for HGW Meters




The analogue section measures the flow and converts it to a digital value. The flow is represented as a fast pulse train (also used as test signal. The flow for one measuring period (1.6 s) is calculated and sent to the database (DE) where the flow is accumulated. The database section also handles the AUX inputs, and the calculation of min, max, mean temperatures etc.

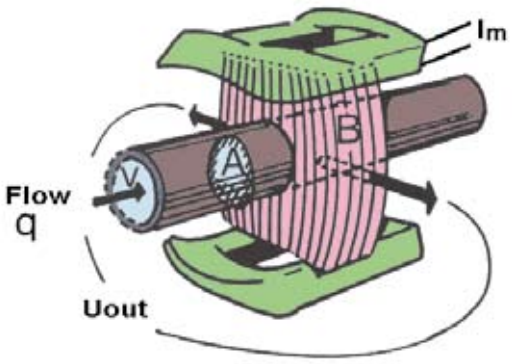
The Digital Signal Processing communicates simultaneously with HG's service software (see chapt. 11), via the serial connection Test / Cal. / Adj.

The serial data communication M-Bus / RS232 is handled by the communication unit. All registers within the Database Unit can be accessed via standard M-Bus protocol.

## 4.2 Volume measuring

The measuring principle of the HGW-meter is based on Faraday's magnetic induction principle: When a conductor passes through a magnetic field a voltage is induced. The voltage is proportional to the velocity of the conductor. In the HG-meter the water act as moving conductor.

The Digital Signal Processing circuit generates the magnetic field in the Flow Sensor and the entire measurement is synchronised with the mains 50 Hz. The magnetic field is operated as a pulsating DC field, with every second field in the negative direction to avoid DC offsets.




The magnetic field combined with the velocity of the water flow generates a signal $U_{out}$, which is received by the Analogue Signal Processing. Subsequent to the analogue processing, the signal will be digitised and additionally processed by the Digital Signal Processing.

The Digital Signal Processing, which has been carried out by the latest microprocessor technology, generates also the signals used for calibration purposes.

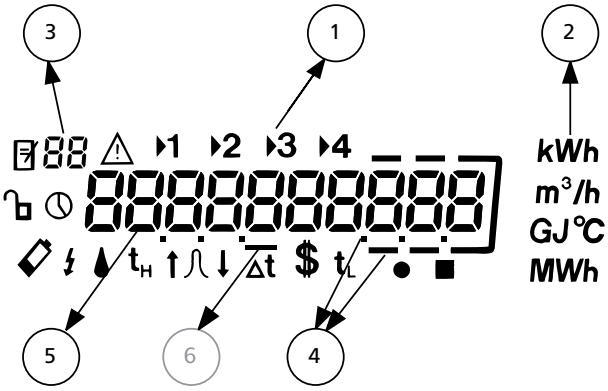
## 4.3 Menu structure and description

While keeping the pushbutton pressed the display will run sequentially through the different menus. There are 4 menus available, they are indicated as ▸2, ▸3, ▸4 on the upper display section, however menu#1 has no such indication.

| | | | |
|---|---|---|---|
| | Stored data | | Mean values |
| | Meter unlocked | | Max values |
| | Low battery | | Peak values |
| | Error | | Min values |
| | Clock | | Tariff |
| | Remote reading | | Current value |
| $t_L$ | Temperature, low | | Low res. volume pulse output |
| $t_H$ | Temperature, high | | Flow sensor volume |
| $\Delta t$ | Temperature, Difference | | |

When the desired menu icon is displayed just release the button and the chosen menu will be active. In order to monitor the associated displays in this particular menu you click the pushbutton once repeatedly.

A double click is only used when displaying the historic menu in order to switch to the following data set of the accounting date. Refer to chapter 4.5 Accounting dates.




1 Menu number

2 Unit

3 Accounting period number with stored data

4 Decimal point and frame indicating decimal fraction

5 numerical value

6 Indicates cooling mode on combined heating and cooling meters

Note: Grey text indicates functions not available in the HGW meter.





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## 4.4 Display functions

The HGW meter has free programmable selection and sequence of display. The display sequence of the HGW meter is fully flexible and the different displays can be placed in any of the 4 menus. On a standard meter, however, the displays are organised as follows:

User menu basic (no indication):

The most relevant information for the user such as accumulated consumption, current error code, and elapsed operating hours.

User menu extended [▸2]:

Other user information such as temperatures, peak values, tariff consumption, actual flow and power etc.

File menu [▸3]:

Stored data, maximum 24 accounting periods. All registered data including mean values but not current values such as actual flow.

Service menu [▸4]:

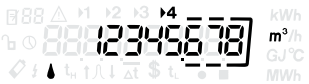
Service information such as display test, clock, pulse values, communication address, serial no etc.

In the following the different displays are illustrated. Above each display you'll find the relevant menu for standard meters. Displays designed for an energy meter are not applied on a volume meter, and some versions have a limited number of displays.

1 Error message with error code


3 Accumulated volume consumption [m³] used for integration of energy consumption

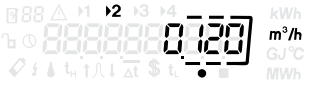

4 Accumulated volume consumption [m³] registered by flow sensor




5 Operating hours [h]

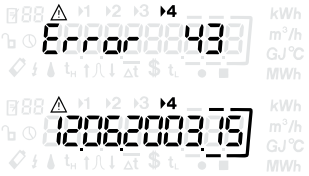

6 Accumulated error time in hours [h]


10 Actual flow [m³/h]

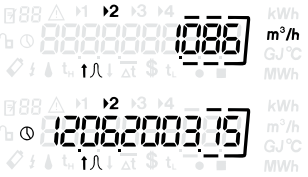



11 Actual date and time [date is June 13, 2003 and time is between 10 and 11 hours]

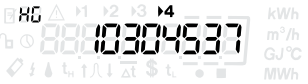

12 Latest error code and date/time it occurred




13 Highest peak flow [m³/h] in current accounting period with date/time it occurred




18 The meters manufacturing (serial) number.




19 Communication address. Default setting is last 2 digits in serial number.


20 Display for customer code. Default setting is Brunata HG.

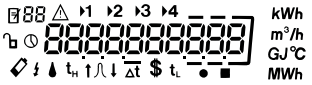

22 Accumulated tariff volume consumption [$ + m³]


23 Criteria for tariff and special setting

- Tariff based on a period during the day [ + $]


- Tariff based on maximum flow level [↑+ $ + m³/h]


24 Display test




25 External meter no. 1 [in this example programmed as m³]


26 External meter no. 2 [ in this example programmed as kWh]


29 Latest error code corrected with date


30 Latest date/time the meters has been read remote


31 Programmed volume pulse value [litres per pulse]


32 Flow counter, only for test purpose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33 Flow counter, only for test purpose


34 Accounting date sequence

- Store data every day [Fr. d01]
- Store data every seven days [Fr. d07]
- Store data every month [Fr. C1]
- Store data every quarter [Fr. C3]
- Store data once a year [Fr. C12]


38 Accumulated HF-pulses from flow sensor


60 Date and time for stored data. First display in all accounting periods


*Note:*

The underlined display numbers indicate values stored in File Menu.

## 4.5 Accounting dates

Storing of data at selected accounting dates means that you always have the metered consumption available at the exact accounting date even if the meter have not been read. The user can always go back and find the relevant information in the storage of the meter (menu #3, file menu). Up to 24 accounting dates can be factory programmed. The storing of data occurs always at midnight at 00:01 (can not be altered). They can be seen on the display and are not accessible via the remote readout function.

There are 4 modes the accounting dates can be (factory) programmed:

- One selected day each month
- Two selected days each month
- Each x day
- Each x month

The contents and the sequence of this menu #3 depend on the contents of menu #1, #2, and #4.

An underlined display number, like 14 indicate the data stored in File Menu (see chapter 4.4 Display functions).

Tariff volume is registered only when the programmed prerequisites are fulfilled. Refer to chapter 4.6 Tariff function.

The stored data menu will be empty and is displayed as _ _.-_ _.-_ _.-_ _ until the first accounting date has passed.

In connection with the automatic remote readout the peak values in user menu#2 are reset.

## 4.6 Tariff function

Refer to appendix User manuals.

The meter can be factory programmed to register volume in special (tariff-)registers, when certain conditions and criteria are fulfilled:

- Code for tariff criteria
- Conditions for tariff registration
- Stop time for tariff criteria

Tariff criteria can be relected amongst the 2 different types, see display no. 23 in chapter 4.4 Display functions.

In case the criteria is fulfilled normally volume are registered in the tariff register in the extended user menu#2.

NB: The meter does NOT take summer/winter time into account!

## 4.7 Backlight

In order to make the meter display readable even under dark light condition the meter is provided with a back light which function can be factory programmed in 3 modes:

- No back light (standard)
- Automatic back light (standard)
- Back light on all the time (optional)

In automatic mode the backlight is lit, whenever the pushbutton is pushed and extinguishes after one minute. Whenever an error code is displayed the backlight will flash simultaneously.

## 4.8 Reset function

A number of parameters can be reset.

- RESET is accomplished by the black push button while the hardware lock jumper is removed. Beware of the sealing!
- Push the button in exceed of 0.6 seconds and - while still keeping the button pushed - mount the hardware lock jumper.
- After the jumper has been mounted it is necessary to keep the button pushed for at least additional 3 seconds to accomplish the desired RESET.

The following data are affected by the RESET:

- All peak and mean variables/times, which otherwise are zeroed at the beginning of the closing dates
- Accumulated error time (B0R12)
- Latest error code (B0R0)
- If current error code register (B0R30) is empty – irrespective a possible Power On error – the Time error happened register (B0R29) would be reset.
- The table below shows an example of the RESET function

| Error Time | | 0 | h |
|---|---|---|---|
| Peak | Flow | 0,000 | m³/h |
| | Flow, Date | 01-01-1990 | - |
| | Flow, Time | 00:00:00 | - |





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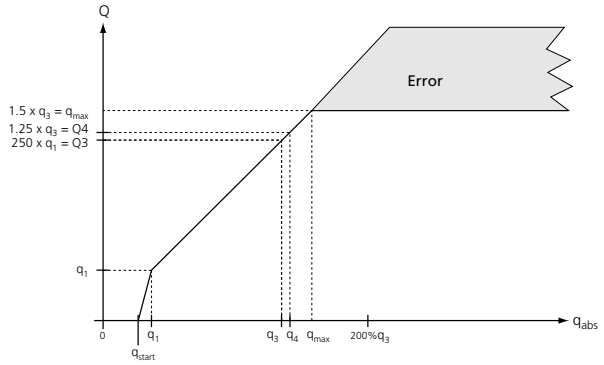
## 4.9 Flow rates above Q3

When the flow rate exceeds 150 % of the permanent flow Q3, the meter will constantly register 150 % (Q4 = 1,25xQ3), which means there is no stop or interferences at higher flow rates.




When the flow rate enters the normal measurement range again the meter again registers correct.

*Note:*

It is not possible to damage the Flow Sensor by overload!

## 4.10 Flow rates below Q1

At very low flow rates

$$0{,}25\ Q1 < Q < Q1$$

a special signal validation technique is used in order to eliminate errors occur due to the unavoidable noise of the very weak flow signal. Every sample is compared to the previous one and only if there are 5 successive validated sample signals the 5 measurements will be used for further processing and registered as valid signals. This means that the meter does not register faulty signals.

## 4.11 Back-up battery

### 4.11.1 Battery Function

The meter is provided with a back up battery Lithium 3 V type CR 2032 for:

- Date and time
- Data and meter set up

The meters microcontroller and its memory is supplied either from the internal power supply (as long as the mains is supplied) or the battery via couple of diodes.

In case of low battery a warning battery icon and an ErrorCode #5 is displayed. It is recommended to change the battery soonest possible. The battery is in function only during times, when the meter is NOT mains operated and has an expected live time of at least 10 years.

Whenever the mains supply is connected (or in connection with a battery renewal after a low battery state) a self-start automatic data and set up recovery from EEPROM is established. The ErrorCode #9 indicates the date and time failure. In order to set the date and time a PC and a the HGQ/HGS service program is needed.

The internal data back up to the EEPROM is accomplished daily at 00:01. Refer to chapter 11 HGQ/HGS Service Program.

### 4.11.2 Change of battery

The Lithium battery may be changed by qualified personnel only!

The battery MUST ALWAYS be changed with the mains connected – otherwise the microcontroller reset will not function properly, the meter will not work correct and the battery will discharge very fast afterwards.

In order to get access to the battery the PCB has to be unscrewed from the case and lifted up. With the mains supplied (!) and the meter running, the battery can be pulled out of the battery holder and can be replaced by a new one.

Do NOT use metallic tools in order to avoid short-circuiting the battery during this process.

## 4.12 Info and error codes

Error handler: Running once every minute. Up to one minute to clear the error code.

The last ten error events are accessible on the display.

Remote reading:

- HGW Versions from EG: Remote reading: Via M-Bus (EC) or LON (nvoErrorCode) the meter can transmit two ErrorCode bytes showing the current ErrorCode. The current error also can be shown in the meter display together with its date and time stamp. Be aware of the different ways these codes appear, depending upon the mode of representation.

The error code can be compounded of more than one element, meaning that it is possible to display several simultaneous errors.

*Example 1:*

Display shows: ERROR 56

Current error with the following meaning: Error #5 and error #6

Error codes:

0. No current errors
1. Interruption of Power Supply
2. No water pulses were detected within the last 24 hours while the temperature difference was more than 20 °C
3. $t_H$ temperature sensor failure
4. $t_L$ temperature sensor failure
5. Low voltage of back-up battery
6. *Flow sensors magnet coil short circuit to ground or disconnected
7. *Error in the meter configuration
8. *Negative Ät. Heat meter temperature sensors are swapped (This error does not occur in cooling meters)
9. The clock has not been set

* Error 6 does not occur when the H/W lock is open!

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The 9 bits interpretation of the 2 byte error code:

*Example 2:*

Read out via M-Bus (EC) or LON (nvoErrorCode): 33

This current error means: The decimal value 33 is the sum of 32 + 1, corresponding to the error codes 6 and 1. This is an indication of the errors #6 and #1.

Some other examples of possible error codes presentation:

Error examples

| Decimal value | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|
| Errorcode element | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

Eksample:
Error #6 and #1

Display: 61

SUM / LON: 33

Error codes 0 and 1 are not shown in the display.

Whenever an ErrorCode is displayed the back-light will flash simultaneously.

| Register Bank 8 | HGW Display | Errors | M-Bus telegram | Decimal values |
|---|---|---|---|---|
| 0 | - | - | - | 0 |
| 80 | Error 8 | 8 | 128 | 128 |
| 100 | Error 9 | 9 | 256 | 256 |
| 110 | Error 95 | 9 & 5 | 272 | 256+16 |
| 190 | Error 985 | 9 & 8 & 5 | 400 | 256+128+16 |
| A0 | Error 86 | 8 & 6 | 160 | 128+32 |

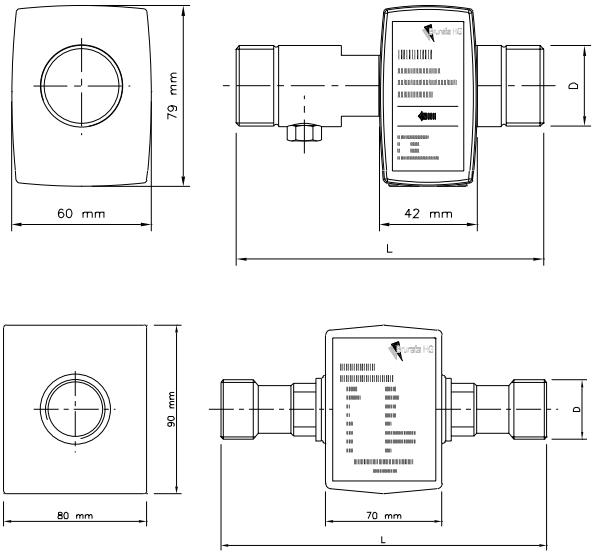
## 4.13 Stored data and recovery

Whenever the mains supply is connected (or in connection with a battery renewal after a low battery state) a self-start automatic data and set up recovery from EEPROM is established. The ErrorCode #9 indicates the date and time failure. In order to set the date and clock a PC and a dedicated service program is needed.

The internal data back up to the EEPROM is accomplished daily at 00:01.

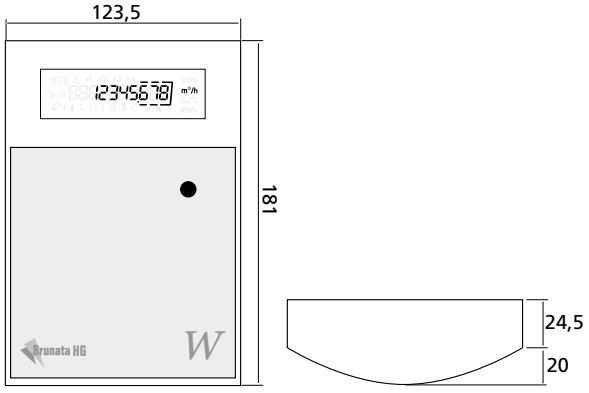
# 5. Dimensions

## 5.1 Flow sensor




| Type | Max flow m³/h | Connection D | Lenght without coupling L | DN x lenght using loose flanges |
|---|---|---|---|---|
| HGW2-R0-77x | 2.4 | G¾B | 110 | |
| HGW2-R2-77x | 2.4 | G1B | 105 | |
| HGW2-R3-77x | 2.4 | G1B | 130 | |
| HGW2-R4-77x | 2.4 | G1B | 190 | DN32 x 260/ DN40 x 300 |
| HGW6-R4-77x | 9.5 | G1B | 190 | DN32 x 260 / DN40 x 300 |
| HGW6-R6-77x | 9.5 | G1¼B | 260 | |
| HGW10-R4-77x | 15 | G1B | 190 | DN40 x 300 / DN50 x 270 |
| HGW10-R6-77x | 15 | G1¼B | 260 | |
| HGW16-R4-77x | 24 | G1B | 190 | DN40 x 300 / DN50 x 270 |
| HGW16-R6-77x | 24 | G1¼B | 260 | |
| HGW16-R8-77x | 24 | G2B | 300 *) | |

## 5.2 Electronics





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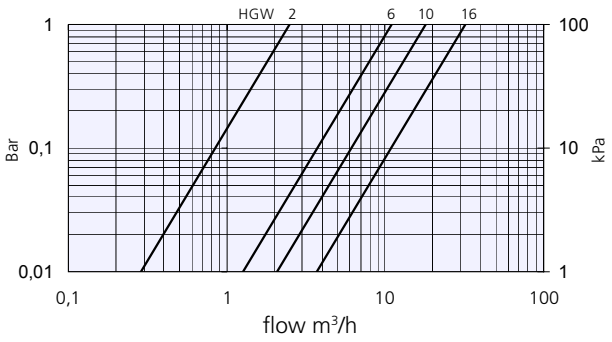
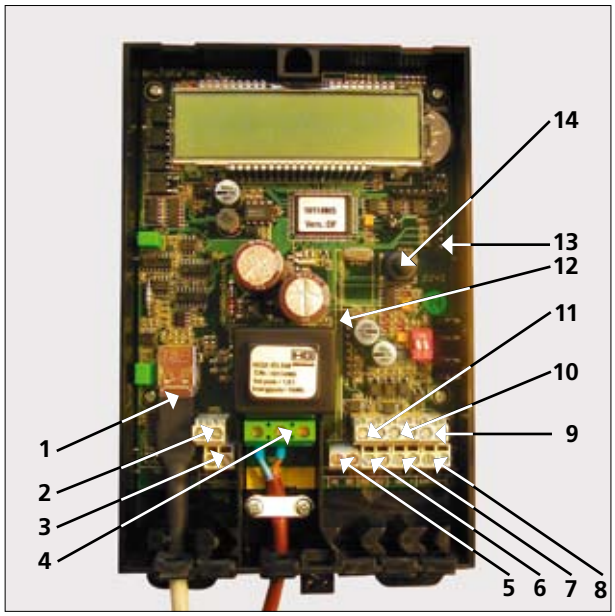
# 6. Pressure ratings and flow ranges




The volume flow rate is a function of the flow velocity and the size of the liner. That's why the pressure losses for all e.g. HGW2 flow sensors are the same, regardless of the physical meter versions (see chapter 5.1 Flow sensors).

# 7. Input / Output

## 7.1 HGW Standard electronics




*Note*:

The sensor cable must not be modified by any means. The sensor with its cable is calibrated together with the meter electronics. They share identical serial numbers.

| Nr. | Name | Function / Specification |
|---|---|---|
| 1 | Flow Sensor | Flow Sensor input |
| 2 [1) 2)] | Pt. Forward (High) | The connection of Pt100/Pt500 temperature sensor in the Flow pipe |
| 3 [1) 2)] | Pt. Return (Low) | The connection of Pt100/Pt500 temperature sensor in the Return pipe |
| 4 | Mains | 230 Volt +10 % -15 % 50 Hz |
| 5 | A1, B1 | 1. Serial communication connection MBus |
| 6 | A2, B2 | 2. Serial communication connection MBus parallel to A1, B1 |
| 7 | Volume pulse output | Darlington opto coupler pulse output max. 20 mA 28 Volt. (Refer to 6.4) |
| 8 [1) 2)] | Energy pulse output | Darlington opto coupler pulse output max. 20 mA 28 Volt. (Refer to 6.4) |
| 9 | 1. Extern. pulse input | 1. Pulse input from external meter / counter. (Refer to 6.5) |
| 10 | 2. Extern. pulse input | 2. Pulse input from external meter / counter. (Refer to 6.5) |
| 11 | +5V | +5 Volt max. 5mA (for ext. calculator) |
| 12 | M52 | Serial communication in use for configuration and test |
| 13 | M57 | High resolution volume output (see test and adjustment) |
| 14 [2)] | Push button | To step through the menus. |

1) Only in use when configured as energy meters

2) Not available in -07 version

This also apply for the energy integrator HGS-IV

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## 7.2 HGW – 107 electronics

Same as above but without display, and pushbutton.

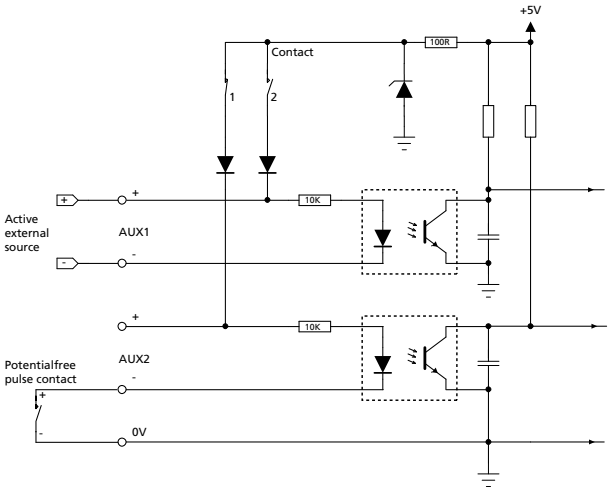
Note: This version is not approved according to OIML-R49.

## 7.3 Pulse input specifications

### 7.3.1 Pulse Input (AUX1 & AUX2) - Connection

HGW has two (galvanic separated) opto coupler inputs: +AUX1- and +AUX2-.

These are (opto coupler) diode inputs and the polarity of the connections has to be observed.




*AUX1 galvanic isolated. AUX2 not isolated*


*AUX inputs galvanic isolated*


*AUX inputs not isolated*


*AUX1 galvanic isolated - AUX2 not isolated*

| | |
|---|---|
| $V_{on}$ | > 2,5 Volt |
| $V_{off}$ | < 0,9 Volt |
| $+V_{max}$ | < 48 Volt |
| $t_{on}$ | > 50 ms |
| $t_{off}$ | > 50 ms |

*Input specification*

### 7.3.2 Description of the AUX input

The AUX1 & AUX2 inputs permit the registration of pulse-based inputs from various signal sources such as volume, flow, energy, time and others. The internal sampling timing is 20 ms and pulses ($t_{on}$ and $t_{off}$) as short as of 30 ms can be registered.

These pulse count registrations are completely independent of the normal registration from the flow sensor and are visible on the display as AC1 and AC2 with 6 digits*) with appropriate units or a non-unit »BLANK«.



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### 7.3.3 Prescaler

The prescalers of the AUX inputs are programmable according to the different input source scale factors and the desired display resolution. The prescaler setting is not available from the display.

The prescaler (divider) setting determines how many input pulses are necessary for a correct change of the last display digit (LSD):

As an example you may have a volume signal source with 2.5 litre/pulse and you may wish to display the $m^3$ display with 3 decimals. This is not possible, because the last digit of a 3 decimal display represents 1 litre. With the appropriate choice of 2 decimals the last digit displays 10 litres and will change for every 4 pulses at the input, i.e. the prescaler has to be 4.

The AUX registrations are also readable (rounded to 6 digits*) via the communication port (M-Bus, LON etc), and will be stored in the file menu.

| | |
|---|---|
| Number of decimals: | 0, 1, 2 and 3 |
| Volume units: | $m^3$ |
| Flow units: | $m^3/h$ |
| Energy units: | GJ, MWh and kWh |
| Time units: | hours |

Prescaler input divider:
1 to 30,000 (Integers only).

0 = disabled

*) 999999 or 99999.9 or 9999.99 or 999.999. The position of the decimal point can be chosen to be 1 2 or 3, where the pulse-factor (unit/pulse) has to be considered. You may not choose 3 decimals at 0.25 litre/pulse, because the last digit position correspondences to 0.1 litre/pulse. 0.25 litre/pulse requires max. 2 decimals.

The normal display for energy and volume shows up to 9 digits [999999999]. The following count will reset the internal register and display to 0.

*Prescaler examples:*

In order to illustrate the prescaler function, let's assume the display is set to $m^3$ with 1 decimal and shows 102.4 $m^3$.

The input pulse represents 0.01 litre/pulse.

The last decimal indicates 0.1 $m^3$ = 100 litres

To increment the display unit (= 1 $m^3$) there must appear (1,000 litre) / (0.01 litre/pulse) = 100,000 pulses at the AUX terminals.

However, the resolution of the display is 100 litres. Hence the prescaler has to be: 100 litre / 0.01 litre/pulse = 10,000.

| Number of pulses to increment the display unit | Pulse factor | Display unit | Number of decimals on display | Choice of pres-caler |
|---|---|---|---|---|
| 100,000 | 0.01 l | $m^3$ | 1 | 10,000 |
| 100,000 | 0.01 l | $m^3$ | 2 | 1,000 |
| 100,000 | 0.01 l | $m^3$ | 3 | 100 |
| 40,000 | 0.025 l | $m^3$ | 1 | 4,000 |
| 40,000 | 0.025 l | $m^3$ | 2 | 400 |
| 40,000 | 0.025 l | $m^3$ | 3 | 40 |
| 100,000 | 0.01 Wh | kWh | 1 | 10,000 |
| 100,000 | 0.01 Wh | kWh | 2 | 1,000 |
| 100,000 | 0.01 Wh | kWh | 3 | 100 |
| 10,000,000 | 0.1 Wh | MWh | 3 | 10,000 |
| 4,000,000 | 0.25 Wh | MWh | 3 | 4,000 |
| 100,000 | 0.01 kWh | MWh | 1 | 10,000 |
| 100,000 | 0.01 kWh | MWh | 2 | 1,000 |
| 100,000 | 0.01 kWh | MWh | 3 | 100 |
| 40,000 | 0.025 kWh | MWh | 1 | 4,000 |
| 100 | 0.01 kWh | kWh | 0 | 100 |
| 100 | 0.01 kWh | kWh | 1 | 10 |
| 40 | 0.025 kWh | kWh | 0 | 40 |
| 40 | 0.025 kWh | kWh | 1 | 4 |
| 10 | 0.1 kWh | kWh | 0 | 10 |
| 10 | 0.1 kWh | kWh | 1 | 1 |

*Prescaler examples*

## 7.4 Pulse output specifications

For volume consumption there are to types of pulses inherent in the meter:

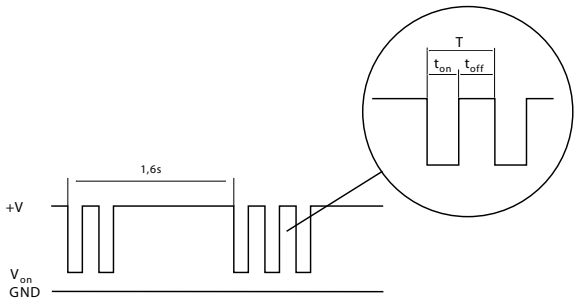
- High resolution pulses
- Low resolution pulses

The low-resolution pulses are directly accessible by the user, while the high-resolution pulses appear as an serial data stream at the M57 connector. Refer to the chapter 9 Test and adjustment for details. The accumulated high-resolution pulses can be displayed.

HGW Meter has one (galvanic separated) opto coupler output: -VOL+ .

These are (opto coupler) transistor switch outputs and the polarity of the connections must be observed. The standard version has a Darlington phototransistor output.

ON is defined to be a conducting transistor with a LOW output.




*Output pulse timing*

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| | STD | OEM |
|---|---|---|
| $+V_{max}$ | 28 Volt | |
| $I_{max}$ | 20 mA | 0.8mA |
| $V_{on\ max}$ | 1,5 Volt | 0.6V |

*Output specification*

1. Tolerance of $t_{on}$ : ± 5ms
2. $t_{off} \geq t_{on}$
3. Pulse period $T = t_{on} + t_{off}$
4. $t_{on\ min}$ = 20 ms (with increments of 20 ms)

$T_{min}$ = 40 ms (with increments of 40 ms)

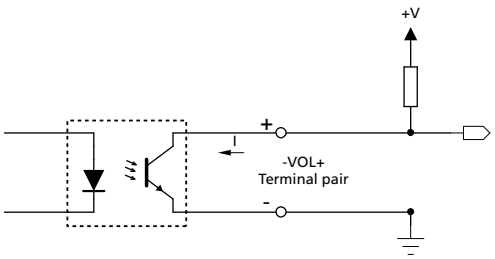
*Output pulse timing*

| | Standard & 07 | OEM |
|---|---|---|
| | $R = \frac{+V - 1.5}{5\ mA}$ | $R = \frac{-V - 0.6}{0.8\ mA}$ |
| **+V** | **Approx. R for I = 5mA** | **Approx. R for I = 0.8 mA** |
| 3V | - | 3 kΩ |
| 5V | 700 Ω | 5.5 kΩ |
| 10V | 1.7 kΩ | 11 kΩ |
| 15V | 2.7 kΩ | 18 kΩ |
| 20V | 3.7 kΩ | 25 kΩ |
| 24V | 4.5 kΩ | 30 kΩ |
| 28V | 5.3 kΩ | 35 kΩ |

$t_{on}$ and $t_{off}$ are programmable in increments of 20 ms, i.e. increments of T = 40 ms.

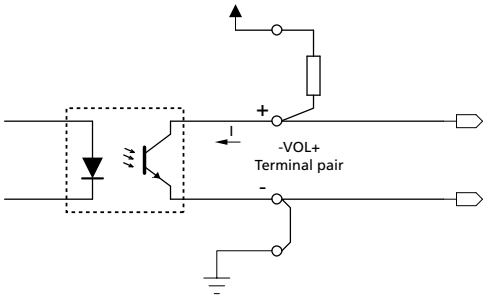
The volume/pulse factor $V_p$ has to be set accordingly. Refer to the following pages.

### 7.4.1 Pulse Output - Connection (Galvanic separated)




*Output galvanic isolated*

### 7.4.2 Pulse Output - Connection (NOT galvanic separated)




*Output NOT isolated*

*Connection of pulse output*





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### 7.4.3 Minimum Volume/Pulse value $V_p$ for Q4

| | HGW2 | HGW6 | HGW10 | HGW16 |
|---|---|---|---|---|
| **Q3 m³/h** | **1.6** | **6.3** | **10** | **16** |
| **Q4 litre/h** | **2,000** | **7,875** | **12,500** | **20,000** |
| **$T = t_{on}+t_{off}$ Pulse period [ms]** | **Minimum volume/pulse value $V_p$ (litre/pulse) For 1.25 · Q3 at a given pulse period** | | | |
| 40 | 0.025 | 0.1 | 0.25 | 0.25 |
| 80 | 0.1 | 0.25 | 0.25 | 1 |
| 120 | 0.1 | 0.25 | 1 | 1 |
| 160 | 0.1 | 1 | 1 | 1 |
| 200 | 0.1 | 1 | 1 | 2.5 |
| 240 | 0.25 | 1 | 1 | 2.5 |
| 280 | 0.25 | 1 | 1 | 2.5 |
| 320 | 0.25 | 1 | 1 | 2.5 |
| 360 | 0.25 | 1 | 2.5 | 2.5 |
| 400 | 0.25 | 1 | 2.5 | 2.5 |
| 440 | 0.25 | 1 | 2.5 | 10 |
| 480 | 0.25 | 1 | 2.5 | 10 |
| 520 | 0.25 | 1 | 2.5 | 10 |
| 560 | 1 | 2.5 | 2.5 | 10 |
| 600 | 1 | 2.5 | 2.5 | 10 |
| 640 | 1 | 2.5 | 2.5 | 10 |
| 680 | 1 | 2.5 | 2.5 | 10 |
| 720 | 1 | 2.5 | 2.5 | 10 |
| 760 | 1 | 2.5 | 2.5 | 10 |
| 800 | 1 | 2.5 | 2.5 | 10 |
| 840 to 1,560 | 1 | 10 | 10 | 10 |

### 7.4.4 Volume/flow pulse value

For other flow values - not covered by the table above - the volume/pulse value $V_p$ can be calculated:

- Choose a pulse length ton (20 ms ≤ $t_{on}$ < 800 ms) resulting in a pulse period of $T = 2t_{on} = t_{on} + t_{off}$ (40 ms ≤ T < 1.6 s)
- Maximum number of complete output pulse periods T during the measurement period of 1.6s:

  $$N=1.6\ s/T$$

  Get the integer N from this.
- Divide this integer N by 1.6 s and multiply by 3,600 s in order to obtain the maximum number of complete output pulse periods per hour:

  $$M=3{,}600*N/1.6$$
- Now the minimum volume/pulse value $V_p$ for a given max. flow Qmax can be calculated:

  $$V_p = Qmax/M$$
- Choose the next possible higher volume/pulse value.

*Example:*

HGW16 (with a max. measurable flow of $q_{max}$ = 1,5 * 16 m³/h = 24 m³/h)

If you want to measure a max. flow of $q_{max}$=15 m³/h:

T = 280 ms

n = (1.6/0.28) = 5.7 pulses/measurement period

The integer of this is:

N = 5 and M = (5*3,600/1,6) = 11,250 complete pulse periods per hour

$V_p$ = (15,000/11,250) = 1.33 litre/pulse

The next possible higher value is $V_{p\ act}$ = 2.5 litre/pulse has to be chosen in order not to exceed the maximum possible pulses/ hour of 11,250.

Recalculation of the actual pulse periods/hour:

$M_{act} = (q_{max} / V_p)$ = 15,000 litre/h /2.5 litre/pulse = 6,000 complete pulse periods per hour

which (of course) is less than 11,250.

### 7.4.5 Max. measurable flow before limit

Refer to tables on following pages showing the dependency of pulse period T, pulse value Vp and the associated maximum flow where a limitation occurs.

During the measuring period of 1.6s a pulse train appears with a pulse period T and a pulse value Vp (litre/pulse). Whenever the pulse count times the pulse period time T exceeds the measuring period, the maximum measurable flow is exceeded and limited according to the table values. Bold numbers indicate the absolute maximum flow of the meter itself; the other ones show the limited flow due to the choice of pulse period T and the litre/pulse scaling.

Example: HGW2: 0.25 litre/pulse. Up to 520 ms the maximum flow is the meters inherent maximum of 1440 litre/h. For T>520 ms the max. measurable flow is limited to 563 litre/h.

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# 8. Data communication

## 8.1 Data protocol

### 8.1.1 M-Bus protocol

**Remote reading of the meter data requires an appropriate program, such as MCOM from SVM North Node AB (former ABB Metering) in Sweden.**

When using RS232 and M-Bus automatic remote reading time can be programmed, while The LON- module has a fixed readout interval of 20 seconds and cannot be altered.

In connection with the automatic remote readout the peak values and mean temperature values in user menu#2 are reset.

Communication modules within the calculator unit handle the serial data communication with its hardware modules M-Bus, RS232 and LON.

The available modules are small plug-in circuits on a pin strip. The modules can be used in all Brunata volume and energy meters. The modules are powered from the meter. Essential registers within the calculator unit can be accessed via standard M-Bus protocol, as specified in the European standard EN 1434, part 3.

When reading the meter remote using RS232 or M-Bus the exact time for the remote reading is registered and is readable on the display.

### 8.1.2 M-Bus telegram

Example from HGQ acquired by the MCOM software version 2.91

| | | | |
|---|---|---|---|
| 14:21 22-05-2003: | | | |
| Copenhagen Road 69 | Bill Haley | | |
| Aux1 | Hot Water | 64 | $m^3$ |
| Aux2 | Meter | 725 | KW/h |
| Average | High Temperature | 111.84 | °C |
| | Low Temperature | 74.81 | °C |
| 36,98 | Temperature Difference | K | |
| Errors | Error | None | |
| | Error Code | 0 | |
| | Error Time | 32,955 | h |
| | Error, Date | 22-05-2003 | |
| | Error, Time | 11:24:00 | |
| Identification | Address | 110 | |
| | Customer Data | AVEDØRE | |
| | Hardware Version | 8 | |
| | ID | Copenhagen Road 69 | |
| | Manufacturer ID | BHG | |
| | Meter ID | 30000001 | |
| | Name | Bill Haley | |
| | Software Version | 58 | |
| | Version | 5 | |
| Peak | Flow | 2.092 | $m^3/h$ |
| | Flow, Date | 07-03-2003 | |
| | Flow, Time | 15:13:00 | |
| Low Temp, Crsp. High Temp | 86,23 °C | | |
| | Low Temp, Date | 14-03-2003 | |
| | Low Temp, Time | 09:34:00 | |
| | Low Temperature | 129.50 | °C |
| | Power | 340.229 | kW |
| | Power, Date | 14-03-2003 | |
| | Power, Time | 09:57:00 | |
| | Temp Diff | 139.43 | K |
| | Temp Diff, Date | 14-03-2003 | |
| | Temp Diff, Time | 09:37:00 | |
| Readout | Energy | 3.176 | GJ |
| | Flow | 0.838 | $m^3/h$ |
| | Power | 35.356 | kW |
| | Volume | 100,011.592 | $m^3$ |
| | Volume (Flow Sensor) | 11,767 | $m^3$ |
| Status | Access Number | 20 | |
| | Position | Heat: outlet | |
| Tariff | Energy | 3.588 | GJ |
| | Tariff Criterium 1 | 2,500 | |
| | Tariff Criterium 2 | 0 | |
| | Tariff Type | 1 | |
| | Volume | 161.316 | $m^3$ |
| Temperature | Difference | 37.01 | K |
| | High | 111.80 | °C |
| | Low | 74.76 | °C |
| Time | Date | 22-05-2003 | |
| | PC Date | 22-05-2003 | |
| | PC Time | 14:20:25 | |
| | Runtime | 65,607 | h |
| | Time | 14:13:00 | |

## 8.2 Addressing of communication modules

M-Bus primary and secondary addresses are programmed according the M-Bus standard.

Primary M-Bus address is a numeric value between 1 and 250, default programmed as the last two digits in the serial number (can be read on the side of the meter). If the serial number ends with 00, the M-Bus primary address is 100.

On request the meter will be delivered with custom specified primary M-Bus address. The user can not change the primary M-Bus address. On meters with custom primary M-Bus address the address will be displayed in menu 4.

Secondary M-Bus address is the 8-digit serial number, and is factory programmed. The number can be read on the side of the meter.



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## 8.3 RS232 module

The Brunata RS232 module is designed according to RS232 standard, thus a d-sub plug can be connected directly into a PC and the cable terminated to the meter.

*RS232 Module*

## 8.4 M-Bus module

The Mbus communication module is a small Plug In module, which is to be mounted on a pin strip in all Brunata volume and energy meters. It is powered from the meter.

*Mbus module*

## 8.5 LON module

Refer to Appendix A.4 HGLON. Using LON module the meter can communicate according to FTT10A standard used in for example building automation systems.

Using the LON-module for communication the remote reading occurs every 20 second and the display will be updated accordingly each 20 second.

*LON module*

## 8.6 Analogue output device

For regulation purpose the HG-F/I-420SD flow-to-current converter can be used. This converter uses a data output in the flowmeter, and therefore updates every 1.6 s.

The converter are galvanic isolated, and contains an active current source. Further information in appendix 3.

*HG Analogue Box*

## 8.7 Communication modem

To communicate using a modem, the meter needs the RS232 module installed. Modems can be either for PSTN, GSM, GPRS and IP-modem. The modem shall have support for 11-bit communication.

Several modems can provide support for either 10-bit or 11-bit communication. Each of these modems is factory configured for default 10-bit communication. To configure a local modem for 11-bit communication, consult the manual for the modem.

The baudrate used in the meter is 2400 baud.

*GSM Modem*

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# 9. Test and adjustment

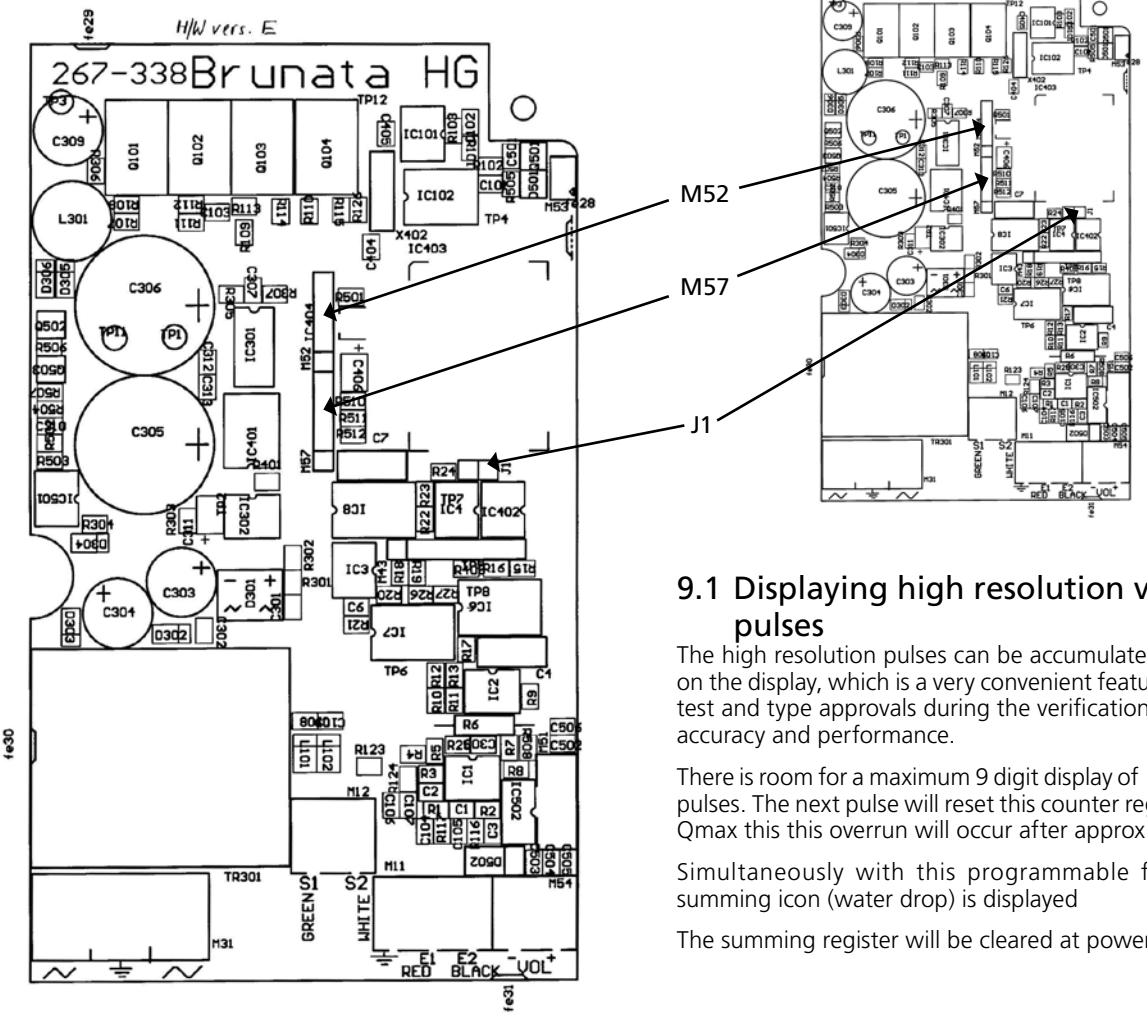
Reference conditions:

Fluid temperature: 20 °C ± 5 K

Ambient temperature: 20 °C ± 5 K

Warm Up time: 30 Minutes

High-resolution volume pulses:




| | HGQ1 | HGQ3 | HGS5 | HGS9 | HGS16 |
|---|---|---|---|---|---|
| Pulses / litre | 46875 | 18750 | 11250 | 6250 | 3516,63 |

The five-pin connector M57 is a data output for high-resolution volume pulses, which can be converted into real pulses by means of the external HG High frequency Pulse converter. The HF-Pulses have the following values:

These pulses trains are transmitted once every 1.60 seconds.

Adjustment of water flow:

- The flow is set to maximum permanent flow (Q3). This makes the meter generate 25,000 pulses per 1.60 s.
- The GAIN factor is adjusted with the HG-STOOL*) program so that the number of pulses is within the wanted accuracy. E.g. ±0.5 % equals 25,000 ± 125 pulses per 1.6 s.
- The flow is set to minimum flow (Q1). This makes the meter generate 100 pulses per 1.60 s.
- After a suitable volume e.g. 1. 5 or 10 litre's, the accumulated pulses is compared to the wanted number of pulses. The OFFSET factor is adjusted with the HG-STOOL*) program so that the number of pulses is within the wanted accuracy. E.g. ±0.5 % equals 100 ± 0.5 pulses every 1.6 s.




## 9.1 Displaying high resolution volume pulses

The high resolution pulses can be accumulated and shown on the display, which is a very convenient feature during the test and type approvals during the verification of the Qmin accuracy and performance.

There is room for a maximum 9 digit display of 999.999.999 pulses. The next pulse will reset this counter register to 0. At Qmax this this overrun will occur after approx. 14 hours.

Simultaneously with this programmable function the summing icon (water drop) is displayed

The summing register will be cleared at power on.

## 9.2 Verification

Verification sealing:

Programming and communication terminal M52 or jumper J1 is sealed with VOID -label.

After installation the meters in casing can be sealed through the holes in the transparent lid and bottom. However, meters delivered after June 2000 can be sealed and locked at the same time using a special plastic seal, which will brake when the meter is opened.

## 9.3 Zeroing of peak values

Refer to chapter 4.8 Reset function





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# 10.Installation requirements

## 10.1 Installing the Flow Sensor

The arrow on the flow sensor label must point in the flow direction. There are no requirements regarding straight pipe sections before or after the flow sensor, only the meter must always be filled with water. Never insulate the housing of the flow sensor

## 10.2 Mounting and connections of the electronic unit

The HGW is a wall mounted piece of equipment, which should be installed in suitable distance from the flow sensor and in an indoor environment. Mount the unit on an even surface with 3 screws.

*All connections to the meter must be installed before connecting with power.*

## 10.3 Security seals

The electronic unit is sealed with VOID labels when delivered. The box is closed and sealed with Brunata HG special seal made of plastic, which is pushed into the narrow hole on the bottom of the box. The seal can be removed with a screwdriver. The broken piece of the seal is to be pushed into the box with the screwdriver and hereafter the box can be opened. Alternatively the box can be closed with the enclosed screw and sealed with thread through the hole next to the screw for the lid.

The flow sensor is sealed with thread through the hole in the screwed connections and the same method is used for the temperature sensors.

## 10.4 Starting up the meter

When the meter is connected to the mains for the first time the display will always show "Error 1", as the meter has been powerless during transportation. By pushing the button once the error sign will disappear, and the meter is then ready. If there is no water in the system the meter will not be damaged, however it meter will register a random flow.

UK-QB 10.1482/25.04.2006

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