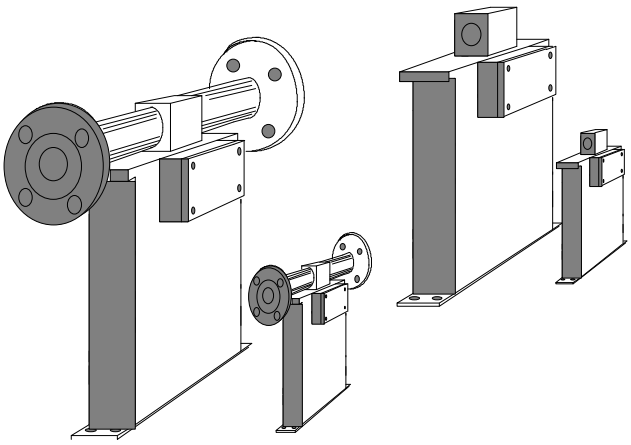

OPERATION MANUAL

RHEONIK

MASS FLOW METER

March 1999, REV. F

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1. MOUNTING AND INSTALLATION INSTRUCTIONS

1.1. GENERAL SYSTEM DESCRIPTION

The RHEONIK massflowmeter consists of one of the RHM .. series flow sensors and one RHE series transmitter. The remote unit RHE is for installation in the safe area and is connected to the transmitter via a single multi-conductor cable. Ex-series sensors RHM .. are for installation inside hazardous areas.
The transmitter RHE .. includes seven printed boards which can be replaced during servicing.

1) Power Supply

The power supply converts 115/230 VAC or 20..30 VDC input to some DC voltage outputs. The power supply generates regulated 6 Volt power to the digital circuits, +/- 15 Volt outputs to the amplifier board and an isolated 30 Volt output for the 0/4 - 20 mA current loops of the output board.

2) Amplifier Board

This board amplifies and filters the flow and temperature output signals of the sensor RHM .. and converts them into digital signals for the microprocessor reading.
Also this board provides drive excitation to the RHM .. series flow sensor.

3) Processor Board

Heart of this board is a high speed microcontroller. It converts the digital signals from the amplifier board into massflow, volumetric, density or temperature information to be output on different digital and analog outputs (LCD display, frequency output, 0/4 - 20 mA output, limit outputs, serial communication ports).

4) I/O Board

All input and output signals to external devices (PLC, recorders,..) go through this board. All inputs and outputs, also the current loop outputs, are galvanically isolated.

5) Safety Board

This board is included in Ex-series transmitters RHM .. and provides an intrinsically safe design, so permitting the sensor RHM .. to be installed in certain hazardous areas.

6) Display Board

The display board provides a digital indication of different measurement data displays as flow rate, flow totalization, temperature, density.
It is a dual line LCD display with 16 characters per line. The character height is 8 mm.
Also all digital programming can be done using the display menu system in combination with 3 push-button keys.

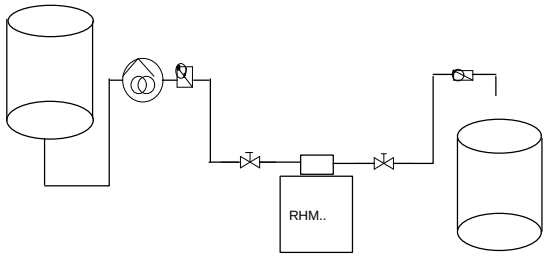
7) Motherboard

This board is mounted inside the transmitter housing and is the interface board between the single boards mentioned above. All single boards are plugged to the motherboard by using DIN connectors and can be easily replaced therefore.

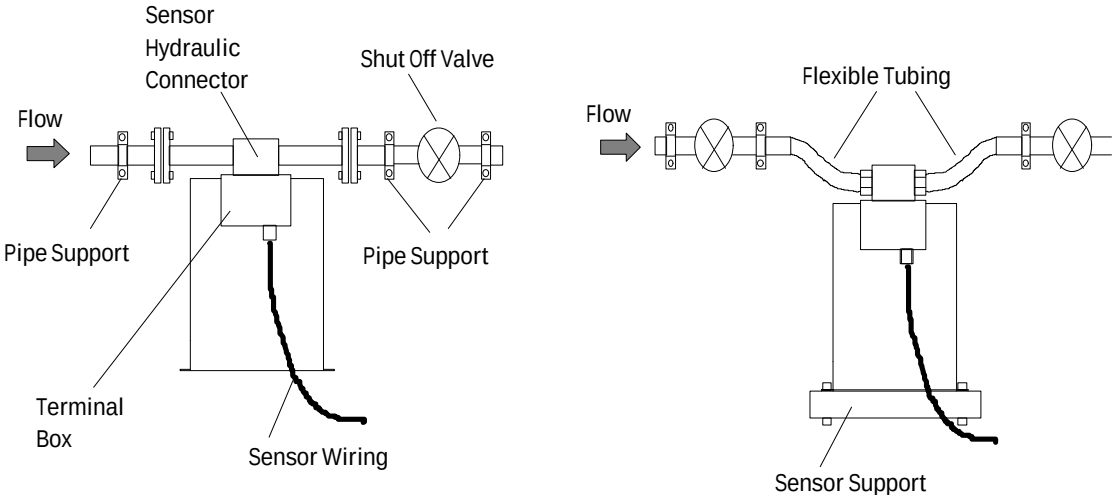
1.2 MOUNTING INSTRUCTIONS SENSOR RHM ..

For liquids locate the sensor RHM .. at lowest practical level in your pipe line system. The sensor must be filled with liquid all the time while operating.
Sensor and cable must be located as far as possible from sources of electrical noise (transformers, high voltage power switches, large electrical motors).

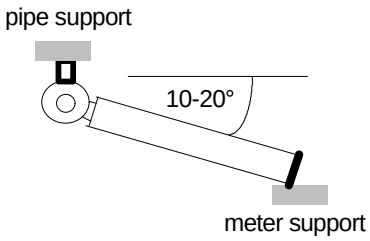
Installation example:



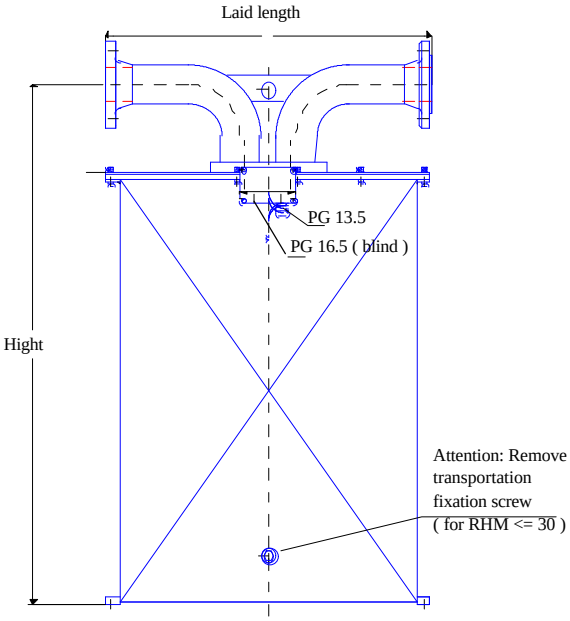
Avoid connecting the sensor directly to the process pump. The piping system must be as free of vibration as possible. Normal plant vibration has no effect on meter performance. However do not mount the sensor in areas having abnormally high vibration.
Install the sensor in horizontal position with hanging twin loops for liquid measurement (see the following sketch) and opposite for gas measurement.



The first position helps to remove gas bubbles out from the meter tubes, the second prevents condensate collection. In order to remove gas bubbles during start-up, flushing with relatively high flow rate for some minutes is recommended.
Do install the piping close to the hydraulic meter connector in between two supports according to above sketch. Preferably use only rigid pipes in the system.
Avoid abrupt pipeline reducers. They can cause cavitation or flashing inside the meter tubes. Mount reducers outside the rigid pipe supports.
For sensor sizes **RHM 30, 40, 60, 80** straight pipe running before and after the sensor are required. There should be no valves, reducers or pipe unions inbetween the pipe supports and the sensor.
For liquids in a low flow range of 5 - 30 % of meter full scale, install **sensors RHM 40, 60, and 80** or bigger in almost horizontal position (housing almost parallel to bottom). For this installation, the housing flanges can be used for connection to housing supports.

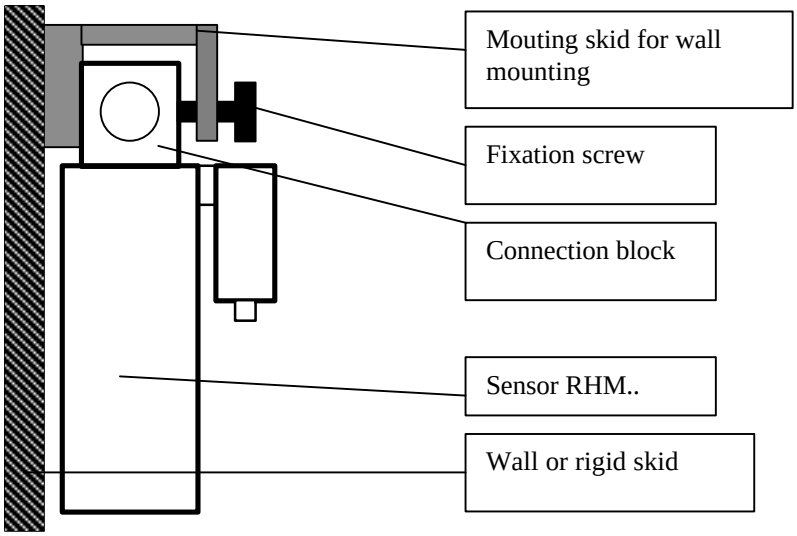


Please remove the transportation fixation screw before start-up. Please find enclosed a drawing of a RHM.. (dimensions can be found in our datasheets).



If you are connecting flexible tubing or hose directly to the sensor please use sensor housing flanges for rigid sensor mounting.
Use a high quality valve downstream from the sensor for proper zero point calibration. For sensor sizes RHM 007, 01 and 03 two valves, upstream and downstream, are recommended.
For **RHM 007, 015, 01, 03, 04** G (R 1/4") the tubing has to be considered as flexible, because the tube diameter is relatively low, and therefore this meter sizes have to be fixed at the connection block in addition. For this reason we can supply a mounting skid made of aluminium, in order to achieve an optimum of stability with low installation time and costs.

For best performance please use metal installation supports for the tubing or two plastic supports at each side of the sensor for tube mounting.



NOTES FOR HIGH TEMPERATURE USE (RHM ET and .. HT TYPE)

Installation: Avoid in any case heavy accelerations or mechanical shocks on the instrument. The instrument has to be isolated in such manner, that levels of different temperature within the instrument can be avoided. Use exclusively cables corresponding to the temperature range of sensor terminal box and surroundings (terminal box is extended).
Heat up: The instrument has to be heated up slowly, that in any case the temperature difference within the instrument cannot surpass a delta of about 50°C. Heating up with constantly 1°C per second is the maximum that is permitted. This means that if you are able to heat up with constant velocity, it would take **at least** 1 minute to heat up from f.e. 30°C to 90°C. It is recommended for a long lifetime of the meter to minimize the heating up cycles by keeping the meter always at high temperature (with a heating system) as good as possible. For meter sizes <= RHM08 it is recommended not to have more than about 50 heating up or down cycles in total, for bigger meter sizes the number of cycles may be higher !!
Filling with medium: Before it can be filled with the hot medium, the instrument must have a minimum temperature of 50°C below the temperature of the medium. The temperature of the instrument can easily be checked at the RHE.. temperature indication. Please note: Heavy temperature shocks may damage the instrument totally !!
Example: medium 350°C - instrument 310°C is o.k..
Cleaning: For cleaning purposes temperature shocks have to be avoided in any case. Please work within the limits as above described.

NOTES FOR LOW TEMPERATURE USE (BELOW 0°C)

All the recommendations regarding temperature shock are valid as well as for high temperatures.
After using a meter (with sealing) the first time at low temperature, you have to tighten again the connector screws in order to prevent any leakage !
Please note: If you do not tighten the screws, the leaking meter can cause a big damage !
After the first shrinking and you tightened the screws, no further precautions are necessary.

1.3. SENSOR RHM.. WIRING

The sensor RHM .. is connected to a RHM.. transmitter using a cable having four pair of shielded wires plus 1 wire (9 wires).
The normal distance between sensor and transmitter is up to 200 m. For distances up to 500 meters please ask the manufacturer.
Use cable supplied by RHEONIK being suitable for the sensor terminal box temperature range.
Use instrumentation cable channels for cable installation to the remote electronic unit far from high current motor cables. Avoid routing wiring to external customer equipment, motors, strong magnetic fields or sources of electrical noise.
Make sure that the bare cable shields have insulation preventing them from shorting out from contact with the transmitter housing, sensor enclosure, conduit or other parts.
One shield wire has to be used for connection of RHM terminal #3 (see attached wiring diagram).
A ground screw is provided inside the sensor terminal box and should be connected to a known earth ground, if there is no other ground connection outside on the meter housing.

Specifications of the RHEONIK furnished cable:

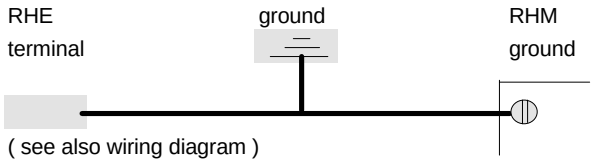
- Normal temperature range (static: -20°C .. + 70°C):
  SLI2Y (ST) Y (4 * (2 * (2 * 0,5mm²) + 1 * 0,5mm²)

4 pairs, each pair individually shielded, plus 1 wire and 1 overall shield (wire tinned copper (7*0,3mm).Twisted pairs covered by aluminium polyester foil insulation. Wire colors white-brown, green-yellow, grey-pink, blue-red and orange. Outside jacket color light blue (AD 10,2 +- 0,4 mm).

- Extended temperature range (- 20 °C .. +210°C):

Almost same specifications as normal temperature cable except insulation material: TEFLON (only 8 wires - shield has to be used as 1 wire). Outside jacket color blue.

NOTES FOR RHM TYPE ..HT
For all RHM type HT (with ceramic isolated wire) an additional connection wire has to be installed between ground of sensor RHM .. HT and remote unit RHE.. and set to known ground in order to assure the same ground level for RHM HT and RHE.. .



NOTES FOR INTRINSICALLY SAFE INSTALLATION:

Only equipment with safety agency labels attatched to the sensor and transmitter meet the agency approval requirements.
Intrinsically safe flowmeters must be installed according to the wiring diagram, supplied with the meter.
Consider proper earth ground wiring according to this diagram.
Sensor cable must be suitable for the sensor operating temperature range.

All intrinsically safe cables must be separated from all other cables.
Consider temperature class and maximum allowable sensor temperature, indicated on sensor type label, for safe operation.
All electrical installations must comply with national and local codes.

1.4. MOUNTING INSTRUCTIONS RHE FLOW TRANSMITTER

Mount the RHE unit in an area where the ambient temperature falls within the range -10°C .. +40°C. For installations outside this range please consult factory.
Locations with extreme vibrations must be avoided.
Do not locate the flow transmitter in direct sunlight.

Sensor RHM and transmitter RHE were calibrated together at the factory.
Therefore make sure that the serial numbers of connected systems comply with serial numbers indicated on instrument type labels.

1.5. POWER SUPPLY WIRING

The transmitter is delivered set up for 220/230 VAC, 100/115 VAC, 20 to 30 VDC power input.
The power supply must be turned off while wiring to the remote unit RHE ...
Power supply voltage must agree with the voltage indicated on electronic type label or in the power supply wiring compartment.
Power supply earth ground must be connected to the RHE .. power supply wiring section.
Failure to connect earth ground will nullify the intrinsic safety.

2. PROGRAMMING AND OPERATING

This section covers the operation and parameter setup of RHEONIK RHE .. transmitters and model RHM .. massflow sensor.

The subjects are:

1. Display and keyboard handler
2. Basic transmitter setup (inputs,outputs, zeroing)
3. High level setup (sensor setup, passwords, diagnostics)

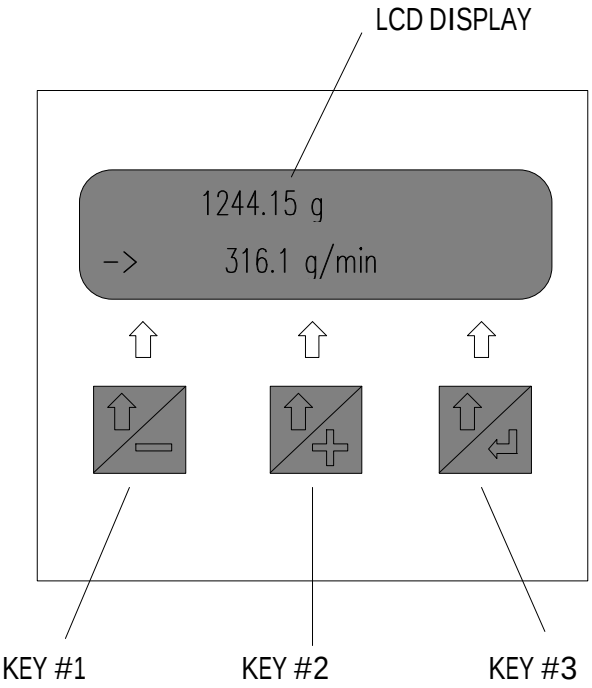
2.1. GENERAL INTRODUCTION

When turning on the remote unit RHE or when causing a system reset the display will show the software version number. The unit runs an automatic diagnostic program to determine if both sensor and electronics are free of malfunctions. After the diagnostics have been completed satisfactorily or if the flowmeter is in operation, the LCD-display will show a measurement display.

2.1.1. KEYBOARD AND DISPLAY

The display is a dual line 16 character liquid crystal display (LCD). The keyboard consists of 3 keys.
For LCD contrast adjustment a 270° angle trimpot is installed on the back side of the 19" housing.
If the display characters do not appear or there is poor readibility, turn this trimpot slowly from the factory set position until chracters just start to appear on display.
Display symbols in the measuring mode with explanation:

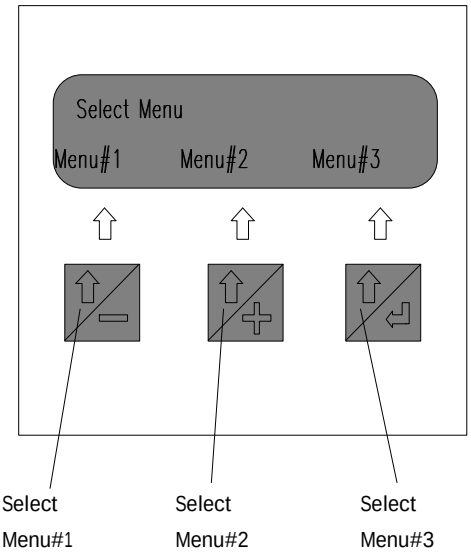
← →	:	Flow direction (direction not fixed, forward / backward)
A	:	Flow rate > recommended range
v	:	Flow rate < recommended range
*	:	Flow rate < low flow cutoff limit



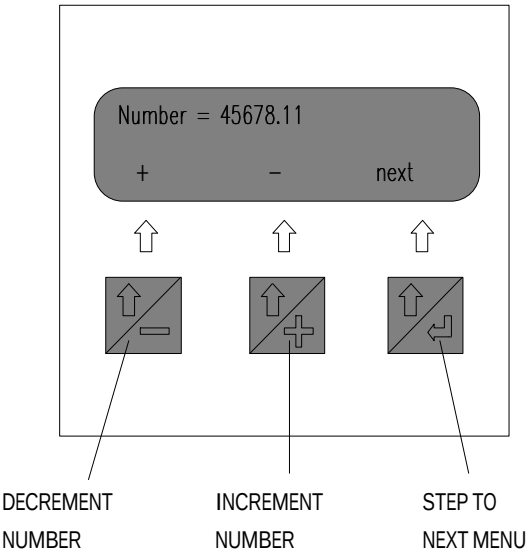
If no button is touched the unit will sequence into the measurement data display. The current mass totalizer and flow rate will appear.
Pressing key #3 scrolls you through the measurement data display.

2.1.2. BASIC OPERATING AND PROGRAMMING PRINCIPLE

The display gives the guideline by itself. If you want to enter any menu you have to press the button below the displayed menu point.



For programming numbers you have to press **+** and **-** buttons to increment or decrement the displayed number. With ***NEXT*** you will enter the next menu point. Following the ***NEXT***-function you will be guided back into the measurement data display.



For complete menu system please have a look at the menu flow chart.

2.1.3. BASIC LEVEL USER MENUS

This section gives a short description of all functions of programming the user needs in order to setup all inputs and outputs according to his demands.

2.1.3.1. ZERO CALIBRATION

Zero calibration is done when:

1) the meter has just been installed, or

2) drastic piping or fluid changes have occurred, or

3) meter operating temperature has changed to a much higher or lower new level.

Before starting a zero calibration, make sure that the sensor RHM .. is installed and wired correctly according to the wiring section of your installation manual. Follow these steps to calibrate meter zero point:

1) Power the remote unit RHE at least half an hour after initial installation and prior the zeroing.

2) If possible run the fluid through the sensor RHM.. for about 10 minutes to establish normal operating conditions.

3) Stop the fluid flow through the sensor with a downstream valve. Meter tubes must remain full of fluid and contain no air or entrapped gas. Even small amounts of flow will cause an inaccurate zero point calibration.

4) Step through the measurement data display by pressing key #3 until you can enter the zeroing menu.

5) Start the zero calibration process by pressing the zero key.

While the unit is zeroing for about 20 seconds ***ZEROING ACTIVE*** is being displayed. After the zeroing, **EXIT** is displayed.

NOTE: If you want to recover the zeropoint before the new zero calibration (for example wrong zeroing) you just have to activate the ***UNDO*** key before leaving the zero calibration menu. After this, the old zeropoint will be valid again.

2.1.3.2 RESET TOTALIZER

This menu point is enterred similarly to zero calibration. By pressing the ***RESET*** key the current totalizer is set to zero. Activating the ***UNDO*** function before leaving the ***RESET*** menu will give back the old totalizer value before ***RESET***.

2.1.3.3. DISPLAY UNITS

You can choose between ***SI***-units (European standard) or ***ANSI*** units (US-standard).

NOTE: With ordered option density measurement you can select volumetric units instead of gravimetric.

Units for each parameter will rotate through the available options depending the selected **+** or **-** key. Standard units for each parameter are:

Total mass:	***t, kg, g***	***tn, lb, oz***
Mass flow :	***t,kg,g / h, min, sec***	***tn, lb, oz / h, min, sec***

Density:	***kg/l*** (=kg/dm³)	***lb/ga, BaumeL, BaumeH, kg/l a *)***
Temperature:	***°C***	***°F***
Total volumetric:	***m³, l, ml***	***ga, ba, in³***

The selection may be changed as often as desired and will be held in non volatile EEPROM memory.

NOTE: *) This density unit is referenced to a specific temperature (density at reference temperature).

2.1.3.4. DISPLAY SEQUENCE AND FORMAT

In order to determine the sequence of different measurement data displays you have to program first, second , .. display function (***1.Disp = XXXXX***).

In ***TOGGLE*** mode the LCD display is being switched every 10 seconds to another possible measurement data display (***Disp = Toggle***).

Totalizer increment resolution is selected in total format display (***TotalForm=X.XX***). Consider the maximum totalizer of 8 digits! Totalizer overflow will be indicated.

With ***Show Errors=off*** no error messages will be indicated on display.

After ***Lock Keys=on*** the keyboard will be blocked until next power OFF and ON.

2.1.3.5. INPUTS AND OUTPUTS

2.1.3.5.1. CURRENT #1 and #2 OUTPUT

First select the variable to be output on channel #1 or #2 from among the following (press **+** or **-** button):

20mA OutX1=XXXX

- Flow
- Temperature
- Density *)
- % Solids *)
- % Concentration *)

Second select life zero (4 mA) or not for selected channel.
There are 3 modes for 4 - 20 mA output (***20mAOut1=4-20mA***):

1) ***4 - 20 mA:*** The output signal range is in between 4 - 20 mA. Output error status is 2 mA.

2) ***3.7-20 mA:*** Output signal range is in between 3.7 - 20 mA. Output error status is less than 3.7 mA.

3) ***4 - 22 mA:*** Output signal range is in between 4 - 22 mA. Output error status is above 22 mA.
After this you are shown the first of two displays to scale the output. The first display enables you to select the high numerical value of the variable that will be represented by 20 mA of current (***20mA=XXXXX***).

Change that value by pressing + or **-** push-buttons.

After the 20 mA value, you are shown a display to select the low value of the variable to correspond to either 0 or 4 mA of current, depending on the option you selected previously. Scale the output similarily to the 20 mA value (***0 mA = XXXX***).

After pressing the ***next*** button the analog output display is shown to enable you to configure the channel #2 output. All setting procedures are the same as for channel #1.

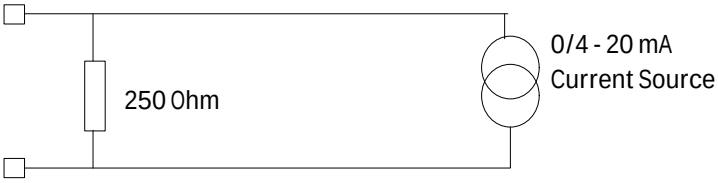
2.1.3.5.2. ANALOG INPUT

The next menu points after the 20 mA output scaling are the analog input configurations. First you have to select the variable units to be input at voltage input (0/1- 5 Volt).
You can choose from among the following:

V, mA, kg/l, °C, ml/min, m3/min, bar, bara, psi, mPas.

After ***next*** you have to determine the input signal range 1- 5 Volts or 0 - 5 Volts. Next you have to input the high and low numerical values of the variable that will be represented by either 5 or 0/1 V.

NOTE: For use as current loop input you have to connect a resistor of 250 Ohm.



2.1.3.6. DIGITAL INPUTS AND OUTPUTS

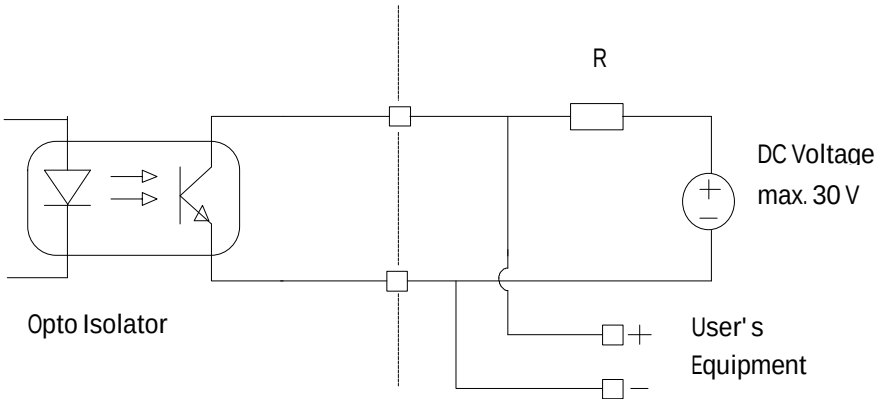
2.1.3.6.1. FREQUENCY OUTPUT

In the first display you have to choose the technique that will be used to scale the frequency output.

Mode 1: Pulse Output. If you choose ***FreqOut = Pulse*** the next display will show the current number of pulse per volumetric or mass units. If you wish to change this you can enter the number of pulses in power of 10 by using the **+** or - push-buttons (1, 10, 100 .. pulses / g or kg or t).

Mode2: Frequency Output. In this mode the display will show the flow proportional frequency of ***5 kHz***. The numerical value of flow rate that will be represented by a frequency of 5 kHz will be changed by using the **+** and **-** function. The whole output frequency range is ***0 to 10 kHz***.

The frequency output is available from an opto isolated open collector driver. For wiring see attached RHM-RHE-wiring diagram.



NOTE: The open collector output can sink up to 50 mA of current. Typical supply voltage 5 .. 30 VDC.

2.1.3.6.2. SERIAL COMMUNICATION

The RHE remote electronic unit supports either ***RS422 / 485 full duplex*** (4 wire system) interface. TTL level serial can also be used. Transmission baudrate can be set in baudrate menu (300, 600, 1200, 2400, 4800, 9600, 19200 bits/second).
The serial interface can be used in a bus (4 wire). For this purpose each remote unite has to be adressed separately.

For RS422/485 connect communications wiring pairs to the TX+/TX- pair terminals and to RX+ /RX- receive air terminals for 4 wire installations (see attatched wiring diagram).

Standard character format is:

7 bit ASCII, 1 start bit, 1 stop bit, parity bit EVEN.

For network communication each transmitter RHE has to have its own ***network address from A to Z***.

Basic Command Format:

Commands are sent by the computer to the transmitter. The message protocol uses only ASCII characters as follows:

- Commandhead: <7F><7F><#>[<address>]

Address is any character ´**A**´ to ´**Z**´. If the transmitter has no address, no address character must be transmitted. If ´**$**´ is transmitted as an address this character is valid as master address. All transmitters of a network are reacting on this request.

- Request Instruction:

If there is any of below listed request instruction transmitted after the command head, the transmitter will send the requested information.

request for	command	transmitter RHE reply	example

flow rate	f?	f=...	f=_1.987kg/min
totalizer	q?	q=...	q=____413.4lb
temperature	t?	t=...	t=-_12.4C
density*)	d?	d=...	d= 16.435lb/gal
non res. total.	m?	m=...	m=___36782kg
analog input	a?	a=...	a=_10.16bar
error message **)	e?	e=...	se=3F
warning **)	w?	w=...	ws=5

*) Only with option density measurement.
**) error and warning code in HEX

- Command Termination: <CR><LF><7F><7F>

CR: carriage return
LF: line feed

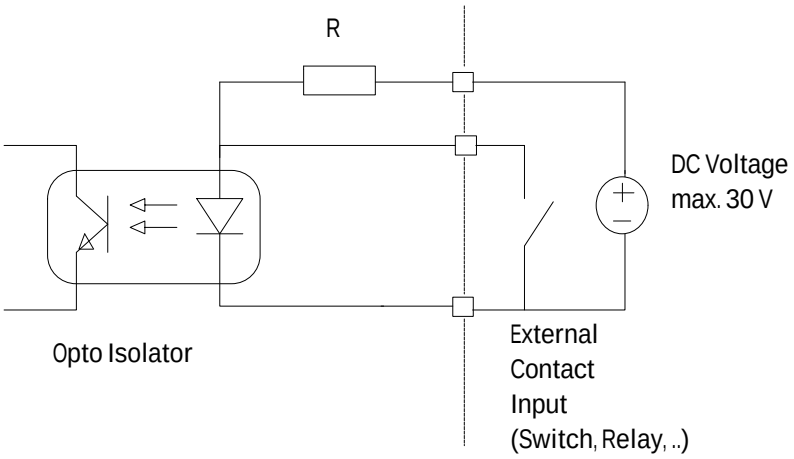
- Commands without measurement data request:

There are also some commands to be sent to the transmitter without request for special measurement data.
These commands must be sent like the request instructions within the comand head and command termination:

instruction	command	transmitter reply message
RESET totalizer	r	r
HOLD ON totalizer	hon	hon
HOLD OFF totalizer	hoff	hoff
CLEAR ERROR	c	c

2.1.3.6.3. INPUTS FROM EXTERNAL CONTACT CLOSURES

The RHE electronic offers two possible inputs. Both are galvanically isolated and are passive, this means to activate the inputs the opto isolators LED´s have to be driven by an external support voltage of maximum 30 VDC (R = 2700 Ohm).



Both inputs can be programmed by software keys as:

- ***RESET*** totalizer (set totalizer to zero)
- ***HOLD*** totalizer (block totalizer counting during flow)
- ***ZERO*** calibration (start zero calibration procedure)
- ***QUIT*** error (quit error message)
- ***NOT USED*** (switch OFF, input not used)

NOTE:

- Care should be taken to ensure that the flow has been stopped before using the input as remote zeroing input.

- Using the ***RESET*** function the input can be used to start a batching process in combination with totalizer limit outputs.

- Without installed I/O board inside the transmitter RHM the input function has to be programmed as ***NOT USED***.

2.1.3.6.4. CONTACT OUTPUTS

The output hardware is the same as for frequency output (see section 2.1.3.6.1.). All outputs can be programmed to one function as follows:

-LIMIT FLOW, TEMP, DENS:

Flow rate, temperature or density limit. The output is active below the adjusted setting.

-LIMIT MASS:

Mass totalizer limit. The output is active below the adjusted totalizer value.

-ERROR:

Output is activated when a malfunction in the flowmeter is detected.

-FLOW DIREC:

Flow direction output. Output is active in one flow direction and passive in the opposite.
-EMPTY TUBE:

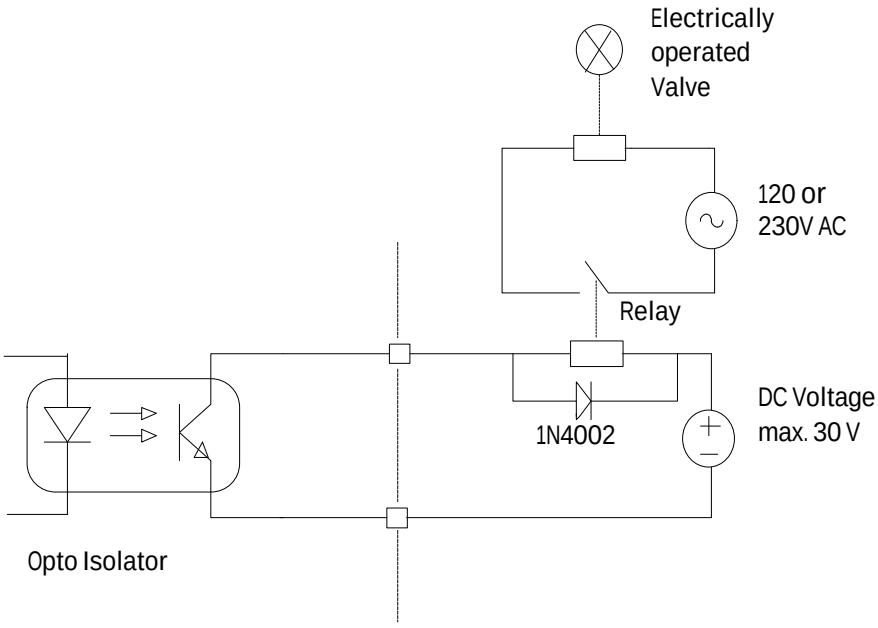
Empty tube signal active with no liquid inside the meter tubes.

Attention: In all cases, the maximum current sinking capability of each output line is 50 mA of current.

Configuration of the digital outputs:

Output	*Status*	*active open*	*active clsd*	*selectable**
limit flow	> value	closed.	open	yes
limit temp	> value	closed	open	yes
limit dens	> value	closed	open	yes
limit mass	> value	closed	open	yes
Error Indication	open at error- at normal operation closed			no
Flow direction	< >	flowdirection	+/-	no
Emty tube indic. (only active with option density measurement !)	> 300 kg/m³	closed	open	yes

* if yes is shown under selectable, you can choose in a separate menu point between out **active open** or out **active clsd** (closed).
All outputs can be selected in one in the same direction only !
digital output circuit switching valves (example):



2.1.4. HIGH LEVEL SETUP, PARAMETER SETUP, DIAGNOSTICS

This menu will only be displayed after key #2 and #3 have been pressed simultaneously. The menu has two options:

- Diagnostics (sensor, I/O hardware)

- Basic level parameter setup (sensor parameters, digital filtering, calibration settings, corrections)

It contains items that alter calibration parameters and items that reconfigure the electronics to perform different functions.

2.1.4.1. DIAGNOSTICS MENU

This menu has two options:

1) ***Set*** I/O to a certain status or level.

2) ***Show*** current I/O status.

For example in ***SET*** mode you can set the mA output to a certain current to compare the setpoint with a digital mA meter connected to the output terminals.

In ***SHOW*** mode you can see the actual mA value the output should have at a certain flow rate, temperature or density indication.

2.1.4.1.2. SENSOR DIAGNOSTICS

This function is helpful for start-up checking or for testing sensor malfunctions.

The single diagnostic displays are:

- FREQ:
Sensor oscillation frequency in XXX.XXX Hz. With proper installation, constant fluid density and no electrical interference this value should vary only at the second decimal after the point.

- GATE 1:
Phase shift timer #1 counts.

- GATE 2:
Phase shift timer #2 counts. The actual phase shift corresponding to massflow rate is calculated from the difference of GATE #1 and #2 value.

- DIFF:
Difference: GATE # 1 - GATE # 2

- d:
Zero phase shift (zero point) and actual phase shift.

- AD-Channel1 #1:
Analog input channel #1 value (12 bit, 0 - 1023).

- AD-Channel #2:

- Run Time:
Electronic run time counter in days and hours.

- Mass:
Second, non resettable totalizer.

2.1.4.1.3. SENSOR BASIC LEVEL PROGRAMMING

To enter this menu you have to input the password.

The password is:

- Press 3 times key #1
- Press 2 times key #2
- Press 1 time key #3

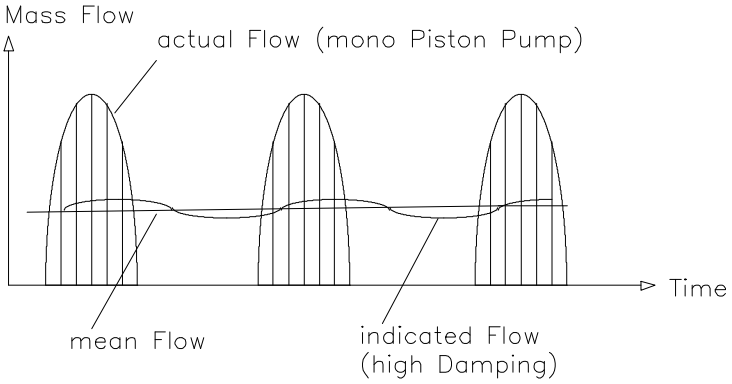
After pressing a key an asterisk ***** is being displayed.

Inside this menu you have to enter sensor specific data like meter size, meter twin loop connection (serial or parallel) and maximum sensor operating temperature.

Next there are settings for special operating conditions like:

- Filt Array:

Digital low pass filter for phase shift measurement. Filt Array number is equal to number of filtered measurement cycles. Shortest measurement cycle time is two sensor oscillations. This filter is very usefull for applications with pulsating flow rates (piston pumps).

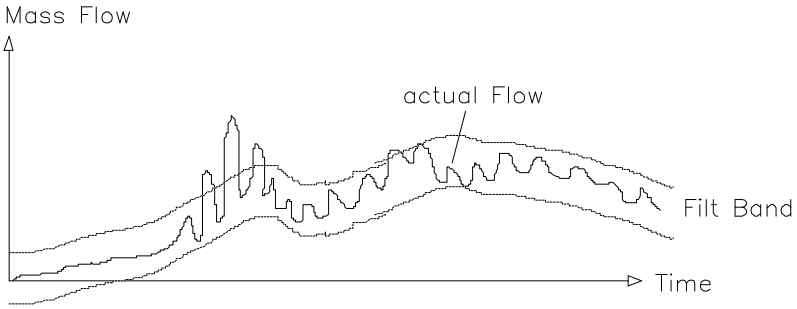


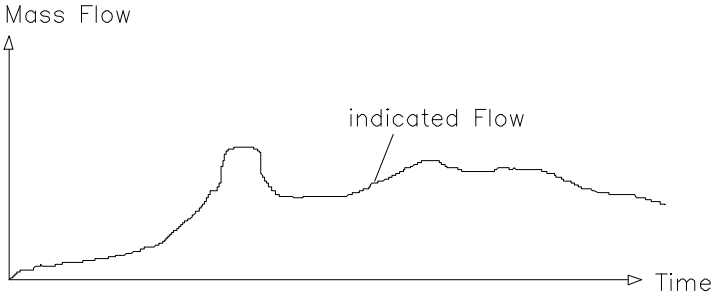
- TFlow:

Digital damping value for display and analog outputs (flow rate). TFlow is response time in X.XX seconds.

- FiltBand:

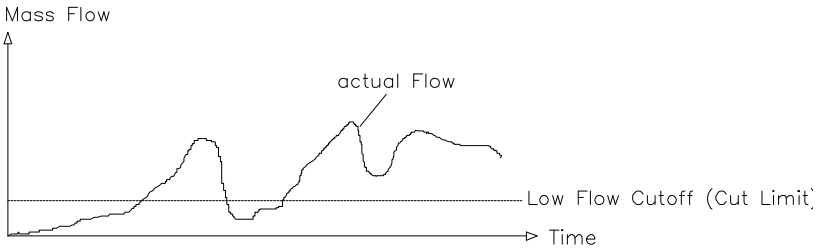
Flow rate filter band in percentage of maximum sensor flow rate (range 1: 20). Response time outside filter band is shortest. Inside adjusted response time TFlow is active.

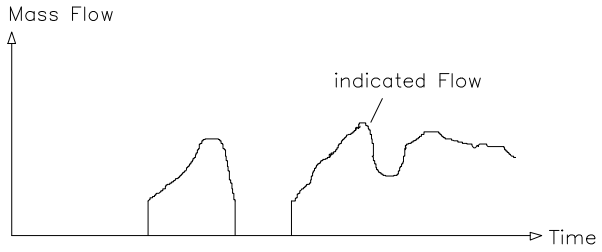




- CutLimit:

Low flow indication cutoff in percentage of max. flow rate. Valid for digital flow rate display and totalization.





- DensCutoff:

Density cutoff for flow rate indication and totalization. For applications where the liquid is removed by gas stream out of the pipeline but the meter should not count the gas stream.

3. ERROR CODES

The internal microcontroller continually monitors several voltages, signals and functions and checks proper operation of the sensor-transmitter system.
If an error occurs, a fault code is being displayed on the transmitter display. Error codes following to the power-up, after initial installation are usually caused by incorrect electrical wiring or inproper flow sensor installation (f. e. sensor tubes not totally filled with liquid).
A transmitter working with no flow sensor will indicate error code nuber 2 (ERR 2).

Possible error codes are:

Code	Display	Description
Err 1	**Drive**	Drive signal error. Drive gain amplifier gives maximum possible power. Possible reasons: - drive coil (term 1 - 2) defective -extreme unbalanced vibrating sensor system (big gas bubbles) Drive level is compared with level adjusted by ***trimpot P3*** on amplifier board.
Err 2	**Pickup**	No sensor coil1 or 2 signal is detected. Possible reasons: - the wiring is incorrect - one or both coils defective - defective component on safety or amplifier board Check sensor and wiring according trouble-shooting section.
Err 3	**Temperature**	The temperature detected by the RTD inside the sensor RHM is out of range (-154 .. 360 °C) or temperature is above maximum allowable operating temperature, adjusted in ***MaxTemp*** menu. Possible reasons: - RTD defective or circuit open or shortened - defective component on safety or amplifier board - defective analog to digital converter inside - microcontroller or defective voltage - reference (***component U7 or U9***). - temperature measurement not properly calibrated, For calibration see next section.
Err 4	**Parameter**	Error on parameter ckeck. Error occurred during parameter transfer from EEProm to RAM memory. Calculated checksum is different from backuped checksum. Replace EEProm on microprocessor board (***component U3***).
Err 5	**RAM**	Error on RAM check. Defective storage cell detected. Replace RAM memory on microcontroller board (***component U4***).
Err 6	**ROM**	Error on ROM check. Calculated checksum is different from programmed checksum. Defective EPROM storage cell. Replace EPROM. Replace EPROM on microcontroller board (***component U6***).
Err 7	**EEProm**	No EEProm reading or writing possible. Replace defective EEProm on microcontroller board (***component U3***).
Err 8	**Division**	Calibration error. Internal calculation overflow. Verify proper

calibration parameter setting.

Err 9	**Stack**	Stack memory too small. Reduce number of measurement gates in calibration parameter setup (***IntGates)***.
Err 10	**A/DChan2**	Defective analog input, or input voltage outside range (0 - 5 Volt). Check input voltage or replace defective microcontroller (analog to digital converter defective, ***component U7***) .

4. WARNINGS

The microprocessor is also indicating warnings. The difference to errors is that warnings are less dangerous than errors. For example there will be a warning when flow rate is above 100 % sensor flow rate. But it is just a warning that tells you that meter performance could be reduced in this range, yet hardware and software are working properly.

Code	**Display**	**Description**
Warn1	Reset	Power failure occurred, there was a processor reset.
Warn2	FlowRange	Flow rate is above maximum flow rate for this sensor size. Reduce flow rate to have optimum accuracy.
Warn3	TempRange	Sensor temperature is more than allowable sensor temperature adjusted in MaxTemp menu. Reduce sensor temperature, or else the electrical installations inside the sensor will be damaged.
Warn4	Drive	For a short time there was a lot of damping of the meter oscillation (may be big gas bubbles).
Warn5	OverflTot	There was a totalizer maximum count overflow, the totalizer started again at zero.

5. TROUBLE-SHOOTING GUIDE

5.1. SENSOR VOLTAGES AND RESISTANCES

There are four electrical circuits connected to the transmitter RHE .. . The sensor receives drive excitation from the transmitter and returns two AC Voltage signals back to the electronics, along with the temperature signal from a RTD temperature sensor.

Using a digital voltmeter the voltages can be checked:

Terminal	Circuit	Voltage
1	Drive +	0.3 - 7 V AC (term. 1 - 2)
2	Drive	
3	RTD	130 mV DC at 20 °C (term. 3 - 4)
4	RTD	
5	RTD	130 mV DC at 20°C (term. 3 - 5)
6	Coil 1 +	10 - 150 mV AC (term. 6 - 7)
7	Coil 1	
8	Coil 2 -	
9	Coil 2 +	10 - 150 mV AC (term. 8 - 9)

If the values are within the above limits, the meter is oscillating.
If the measured voltages are not within the ranges shown in the table, disconnect the transmitter and check the resistances at the sensor RHM .. terminals.

Terminal	Circuit	Resistance
1	Drive +	5 - 170 Ohm (term. 1 - 2)
2	Drive -	
3	RTD	107 - 109 Ohm at 20 °C (term. 3 - 4)
4	RTD	
5	RTD	0 Ohm (short circuit) (term. 4 - 5)
6	Coil 1 +	30 - 150 Ohm (term. 6 - 7)
7	Coil 1 -	
8	Coil 2 -	
9	Coil 2 +	30 - 150 Ohm (term. 8 - 9)

If one of these values is infinite, the sensor RHM .. is defective.

Check insulation resistance to earth ground (sensor RHM .. housing).
If a short circuit between any sensor terminal and sensor housing is measured, the sensor RHM .. is defective.

If no problems are located at the sensor resistance check Sensor-to-Transmitter wiring for correct connections and for no shorts or opens, loose conductors or poorly dressed wiring.

NOTE:

- High temperature sensors RHM .. HT need special grounding. Check ground wiring according to diagram.
- Insulation resistance to earth ground for high temperature sensors is in the range 10^3 - 10^6 Ohm.

5.2. TEMPERATURE CALIBRATION

Temperature measurement is already factory calibrated. Normally a new temperature adjust or new recalibration is not necessary. The RTD is connected by 3 wires, so that the measurement is just influenced by one wire resistance.
For extreme long cable length there is a software adjust function for compensating the wire resistance.

This can be done in the adjust menu. For this the actual temperature must be well known, or a resistor simulating a certain temperature has to be connected instead of the meter RTD. Enter the correct temperature and press the adjust push-button. After this procedure the temperature reading will be ok.

A complete new temperature calibration is performed by:

1) Connect a resistor of 38.0 Ohm, simulating a temperature of -154°C instead of sensor RTD.

2) Open the front panel of the transmitter.

3) Turn trimpot ***P1*** on amplifier board until the temperature reading is -154 °C. Now the analog to digital converter must show 0 (sensor diagnostics menu- ***AD Channel1 0***).

4) Connect a resistor of 138.5 Ohm, simulating a temperature of 100 °C.

5) Turn trimpot ***P4*** on amplifier board until the temperature reading is showing 100°C (the corresponding ADC reading must be: ***AD Channel1 524***).

6) Close the front panel, the calibration is finished, temperature reading by connection of RTD sensor must be ok within absolute error of temperature mesurement of +-2°C.

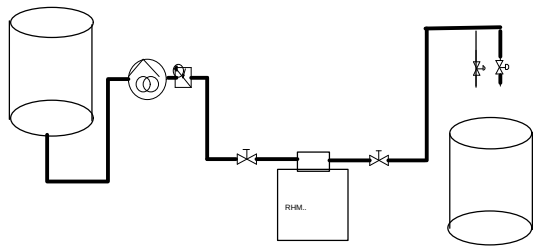
6. REPLACEMENT PARTS

Part Number	Description
NT06	Power Supply (115/230 VAC)
NT07	Power Supply (20.. 30 VDC)
MZ03	Safety Board - Intrinsically Safe
MV03	Amplifier and Signal Conditioning Board
MM03	Processor Board
MIO03	I/O Board
Display	LCD Board
MB07/08	Motherboard RHE 07/08
TR50.2	Fuse 0.2 A
TR51.0	Fuse 1 A
DINCON	Sensor/IO DIN - connector with housing for RHE07

Attention:
For sensor RHM.. for technical reasons only complete RHM can be offered as spare parts. If you have a sensor RHM.. standard with sealing, the sensor however could be offered without connector block or flange as spare part.

7. ADDER FOR OPTION CODE BATCH

(off software version M300998 ver. 1.19)



1. Introduction

With option batch a 1 stage batch process with automatic overflow control, or a 2 stage batch process without automatic overflow control can be performed. The limit outputs of the RHE07/08 unit can be used via relais to drive one or two valves. The preset value and the prewarn value can be set via the menue of the remote unit or via serial interface (option). If automatic overflow control is activated it will automatically after a few batches set the **PWARN** value to the correct value in order to have exactly the required batch value (**PSET**). If you stop during a batch you can decide afterwards to continue (**GoOn**) or to stop the batch and start a new one (**Clear**). If the power supply is disconnected during a batch, this batch is stopped and cannot be continued from the last value anymore - a new batch has to be started.

2. Settings in the RHE07/08 software menu (see also batch menu diagram)

To enter the batch menu the left button has to be pressed, then

BATCH **SETUP** **NEXT**

appears, if you press **BATCH** you can use the left and middle pushbutton as

START **STOP**

if you press **SETUP** you can configurate the

PSET value in mass units

and after passing the password the **PWARN** value as well.

The configuration of the digital outputs and inputs has to be done in the standard menu under

SETUP I/O =>> **DIG**

IN1 (input 1) can be configurated as **BATCH START** or **BATCH STOP**

IN2 (input 2) can be configurated as **BATCH START** or **BATCH STOP**

The function of **OUT ACTIVE clsd** or **open** has no effect for the batch functions (always active clsd; the valve has to be closed if there is a power failure on the batch system -

PRESET and **PREWARN** outputs have the status **off**, if the valves are open, as well as the **ERROR** output has the status **off**, if there is no error !)

OUT1 (output 1) can be configurated **PRESET** or **PREWARN** (+ standard funct.)

OUT2 (output 2) can be configurated **PRESET** or **PREWARN** (+ standard funct.)

OUT3 (output 3) can be configurated **PRESET** or **PREWARN** (+ standard funct.)

Selection in the options code:

→ calibration menu

→ <press all 3 pushbuttons>

→ display will show **"Pass = 0.00000"**

1. Switch off batch function with code "**Pass = 0.000005**" (if activated !!)
2. Go out of the menu and start the same procedure with code **"Pass = 0.002808"** for
   TWO STAGE BATCH function with **PRESET** and **PREWARN** without **"aoc"**
   As an alternative you can also:
   Go out of the menu and start the same procedure with code **"Pass = 0.002809"** for
   SINGLE STAGE BATCH function with just **PRESET** and **"aoc"** (**PREWARN** automatically set).

3. Examples with explanation

Example 1: We have a 1 stage batch process (1 batch valve) and want to batch a quantity of 100 kg:

PSET	to be set on	100 kg
PWARN	to be set on an estimated value depending on the delay time f.e:	2 kg

If the option aoc (automatic overflow control) is not activated the **PWARN** value will always be activated at 98 kg and will close the valve. The **PSET** output will not be connected to any valve in this configuration.
If "**aoc"** will be active the **PWARN** value will be controlled or optimized automatically in that way that after some batches the **PSET** value will be reached.
Example 2: We have a 2 stage batch process with one valve for the main flow and 1 valve for the small flow. The output for **PSET** will be connected to the small flow valve and the output for **PWARN** to the main flow valve.

PSET	to be set on	100 kg
PWARN	to be set on an estimated value depending on the delay time f.e:	2 kg

The "**aoc"** can not be activated now !
The main flow valve will close at 98 kg and the small flow valve will close at 100 kg. This means that still a very small overflow will appear. This can be eliminated by changing the **PSET** value to a smaller corresponding value.

3. SERIAL INTERFACE

In addition to the standard serial interface requests and actions there are additional codes that can be used with option code „batch“ active only.

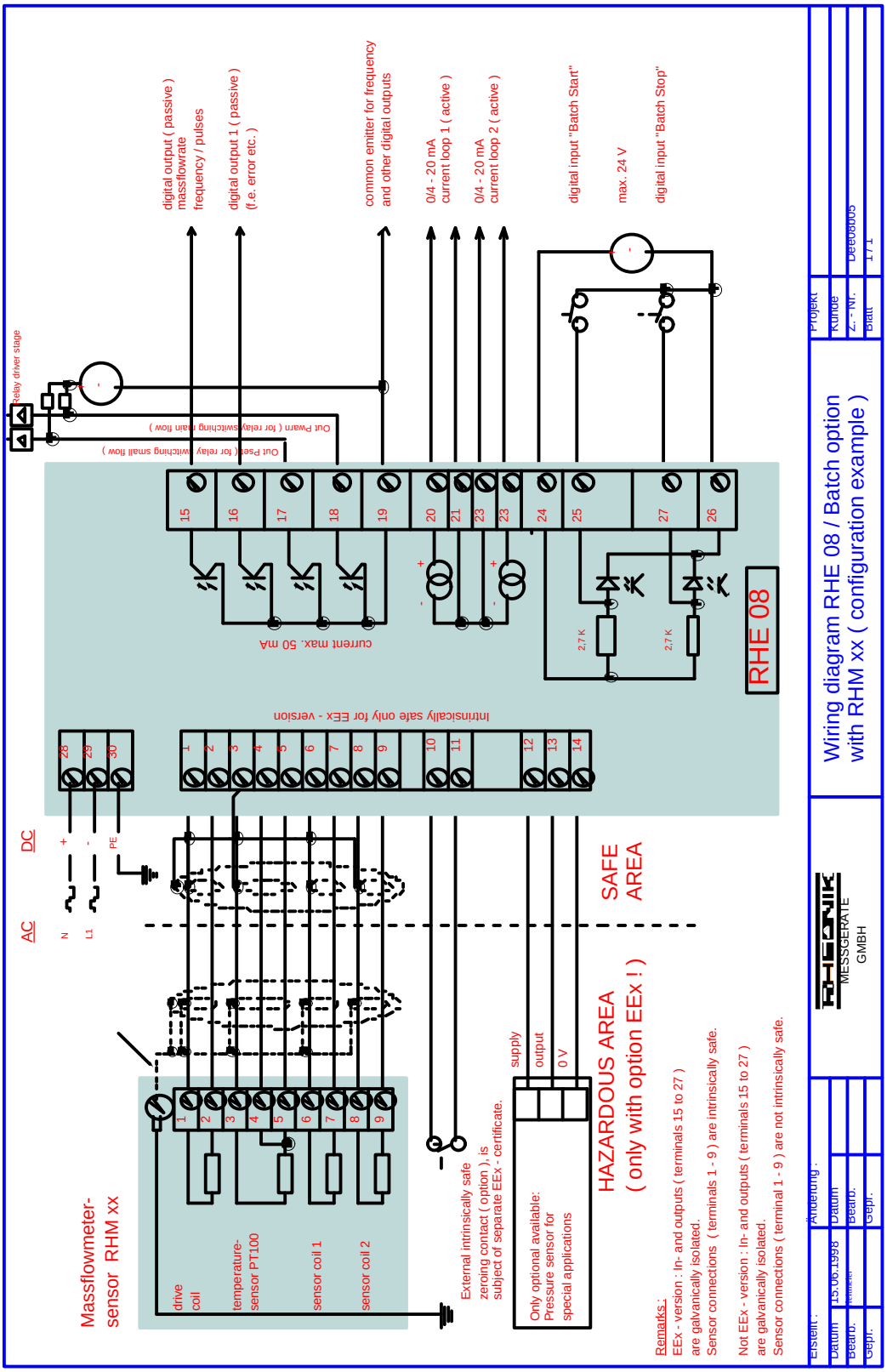
3.1. Requests

print **PRESET** value:	7F,7F, ’#’ , <A> , ’BRs’ , ’?’ ,0D,0A,7F,7F
print **PREWARN** value:	7F,7F, ’#’ , <A> , ’BRw’ , ’?’ ,0D,0A,7F,7F
write **PRESET** value:	7F,7F, ’#’ , <A> , ’BRsXXXXXXXEE’ , ’?’ ,0D,0A,7F,7F
write **PREWARN** value:	7F,7F, ’#’ , <A> , ’BRwXXXXXXXEE’ , ’?’ ,0D,0A,7F,7F

X: ‘0’ , ‘1’ ,...’9’ or ‘.’
EE: mass unit characters f.e. ‘kg’

3.1. Actions

batch **START**:	7F,7F, ’#’ , <A> , ’Bst’ , ’?’ ,0D,0A,7F,7F
batch **STOP**:	7F,7F, ’#’ , <A> , ’Bsp’ , ’?’ ,0D,0A,7F,7F


Wiring diagram RHE 08 / Batch option
with RHM xx (configuration example)
RHEONIK MESSGERÄTE GMBH
RHE 08
Massflowmeter-
sensor RHM xx
drive coil
temperature-sensor PT100
sensor coil 1
sensor coil 2
intrinsically safe only for EEx - version
current max. 50 mA
digital output (passive)
massflowrate
frequency / pulses
digital output 1 (passive)
(f.e. error etc.)
common emitter for frequency
and other digital outputs
0/4 - 20 mA
current loop 1 (active)
0/4 - 20 mA
current loop 2 (active)
digital input "Batch Start"
max. 24 V
digital input "Batch Stop"
Out Pwarn (for relay switching main flow)
Out Psens (for relay switching small flow)
relay driver stage
AC
DC
N
L1
PE
External intrinsically safe
zeroing contact (option), is
subject of separate EEx - certificate.
supply
output
0 V
Only optional available:
Pressure sensor for
special applications
HAZARDOUS AREA
(only with option EEx !)
SAFE
AREA
Remarks :
EEx - version : In- and outputs (terminals 15 to 27)
are galvanically isolated.
Sensor connections (terminals 1 - 9) are intrinsically safe.
Not EEx - version : In- and outputs (terminals 15 to 27)
are galvanically isolated.
Sensor connections (terminal 1 - 9) are not intrinsically safe.
Erstellt :
Datum 15.06.1998
Bearb.
Gepr.
Änderung
Datum
Bearb.
Gepr.
Projekt
Kunde
Z. - Nr.
Blatt
Datum
1 / 1