TGM

Thermal Mass Flow Meter for Gases

TRICOR
Coriolis Technology

Manual-Version

TGM_M_EN_160429_E006

SW-Version

This manual is valid for TGM-S05

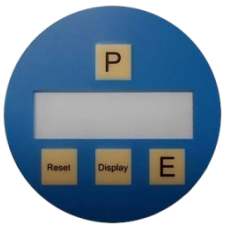
Index

1. General

The electronic of the TGM is used to measure, scale and transform the signal of the integral mass sensor. Measuring values and operational parameters are shown in the display while operation and parameter settings are effected via the foil touch keyboard.

In this manual the keys are referred to as follows:

Reset	Reset	E	key right-hand top
Display	Display	P	key right-hand bottom



Special features of the TGM are fast response time and high accuracy as well as simple and safe programming of all parameters.

The following features are available for evaluation:

- Analogue output, galvanically free (0/4 … 20 mA), 12 bit resolution
- Divider output

1.1. Safety Instructions

Applications with flammable or explosive media require the user to ensure that no explosive gas mixture appears in the tube, TGM or environment. If necessary the tube should be purged with nitrogen or noble gas.

The TGM must not be used in hazardous areas or any environment which requires an EX-approval or explosion-proof design.

KEM Küppers Elektromechanik GmbH does not assume liability for any damage caused by inappropriate use.

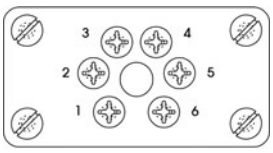
2. Specifications

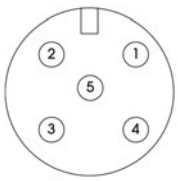
2.1. Technical Data

Application	Compressed air, nitrogen and non-aggressive gases
Measuring ranges	TGM 025: 0.10 up to 60 kg/h TGM 040: 0.25 up to 150 kg/h TGM 065: 4.00 up to 250 kg/h
Linearity	2.0 % of actual flow
Pressure drop	< 50 mbar [725 psi]
Housing	Aluminum
Protection class	Standard housing: IP60 with protective cover and junction boy: IP65 with protective cover and plug: IP67
Connections	TGM 025: Ermeto threads GE 28-PLM-ED TGM 040: Ermeto-threads GE 42-PLM-ED TGM 065: Wafer ends for installation between flanges as per DIN 2632, DN 65, PN 16
Pressure	$P_{max.}$ 10 bar [145 psi]
Medium temperature	-30 °C … +70 °C [-22 °F ... +158 °F]

Electrical Data

Supply voltage	24 V DC controlled, ±15 %/I_{max} < 200 mA
Analogue output	0/4 up to 20 mA, 2-wire active, potential free, free scalable
Max. load	800 Ω
Pulse/divider output	Push pull or open collector: 0.001 - 0.01 - 0.1 - 1 kg, f_{out} max = 10 Hz
Adjustable pulse width	1 ms/20 ms/50 ms
Response time of sensor	≤50 ms
Electrical connection	unction box (cable sleeve: 7 - 13 mm) or 5-pin plain plug M12 1 = U_B +24 V DC, ±15% 2 = pulse/divider output 3 = GND 4 = -I 5 = +I 6 = shield (junction box only)





2.2. Dimensional drawings (mm)

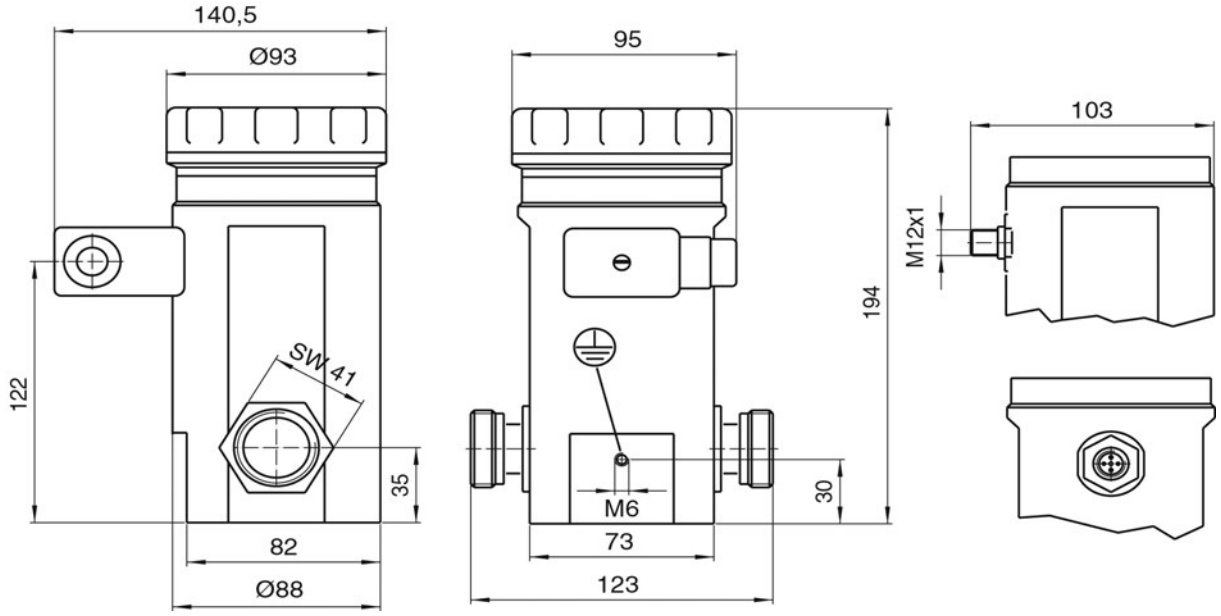


Fig. 1: TGM 025 with junction box *with plug*

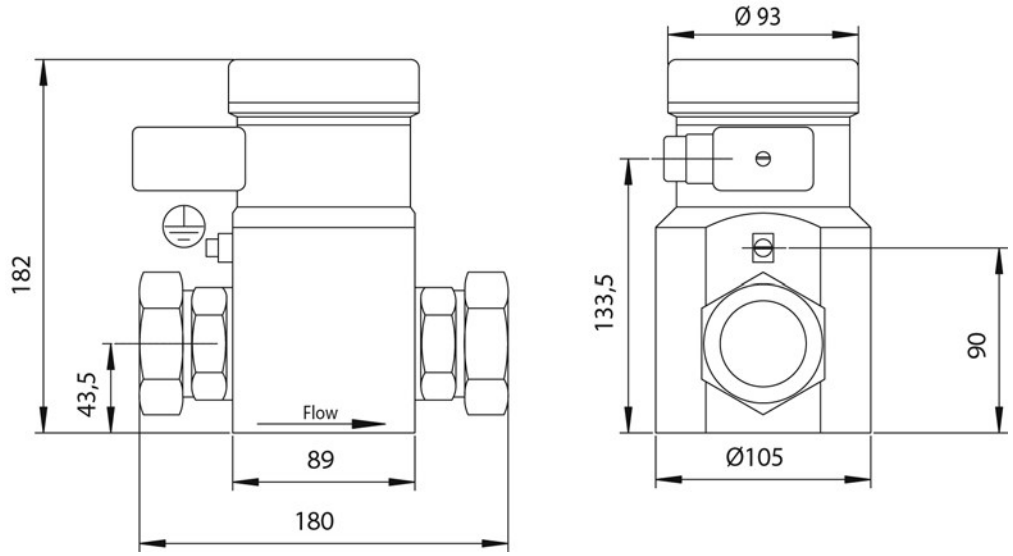


Fig. 2: TGM 040 with junction box

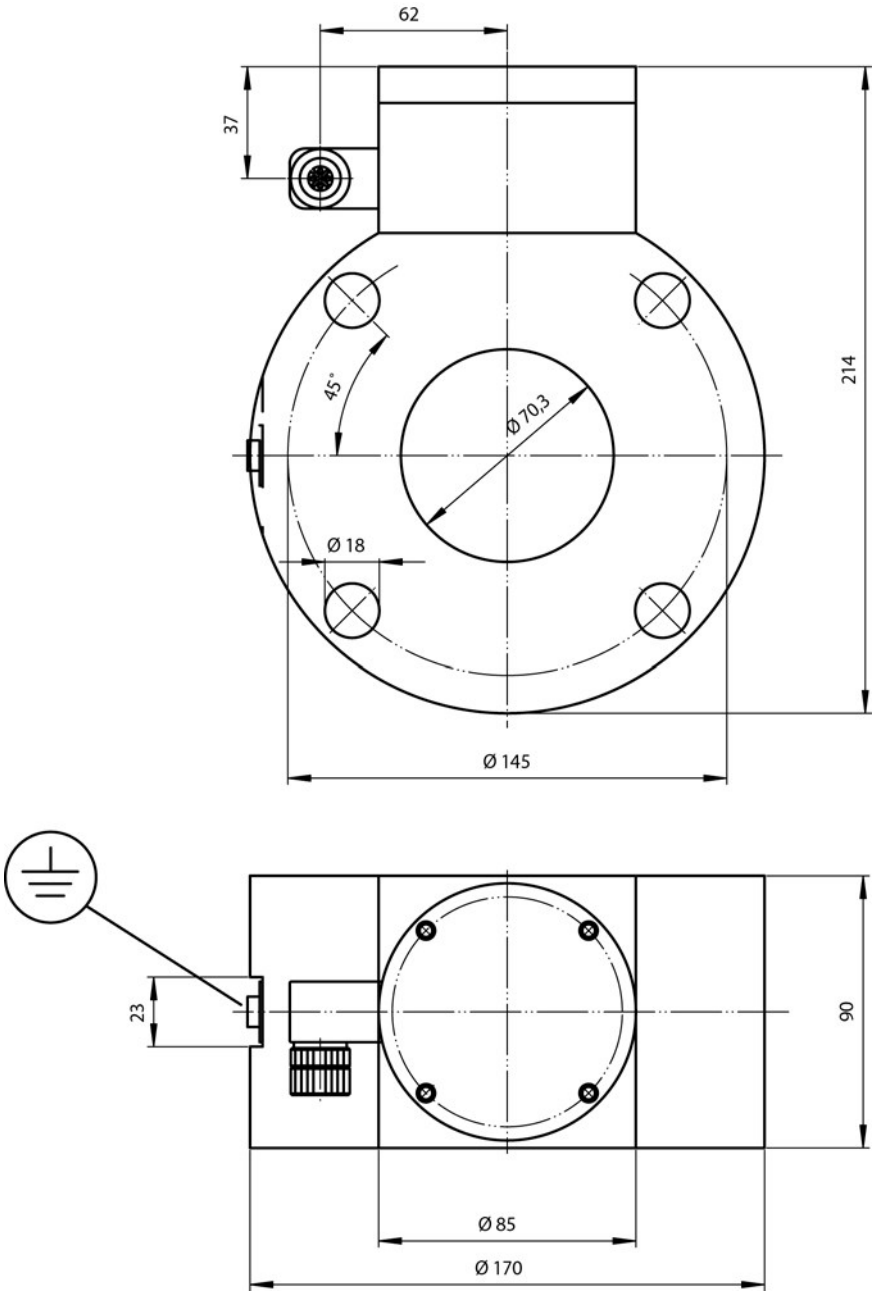


Fig. 3: TGM 065

2.3. Analogue output

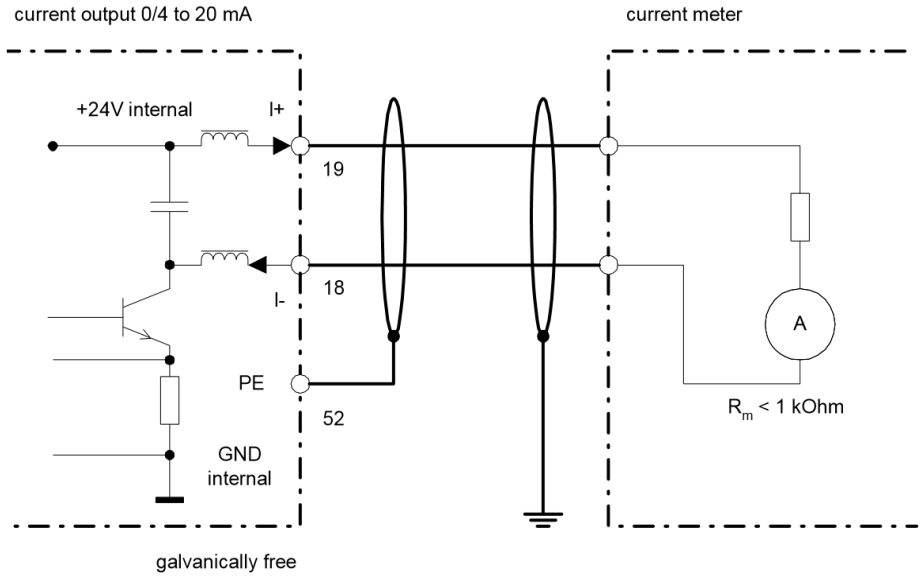


Fig. 4: Analogue output

2.4. Pulse output

The TGM has a pulse output to provide a divided mass signal of 1.0 kg/0.1 kg/0.01 kg in accordance with programming. You may select from two signal modes, see next page for adjustment.

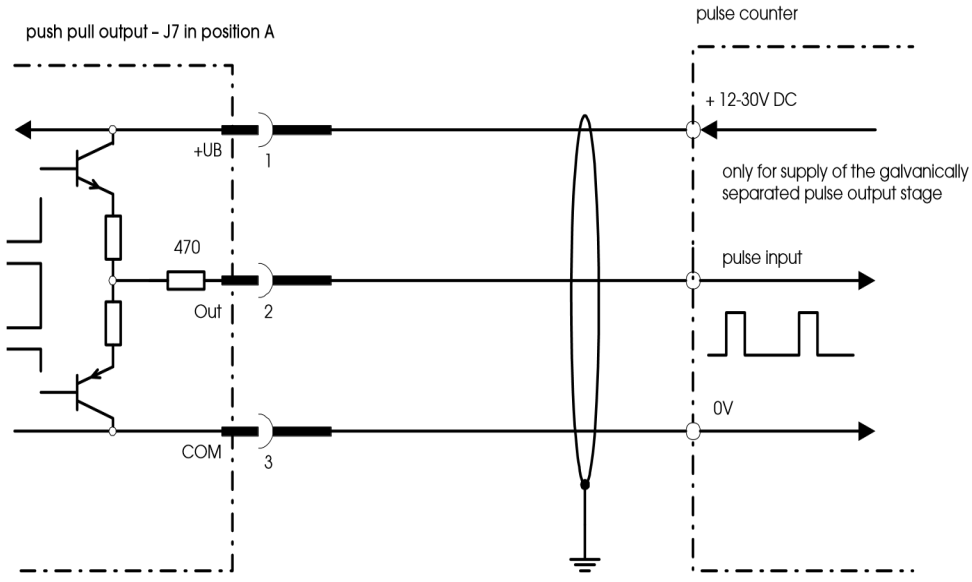


Fig. 5: Pulse output: push pull

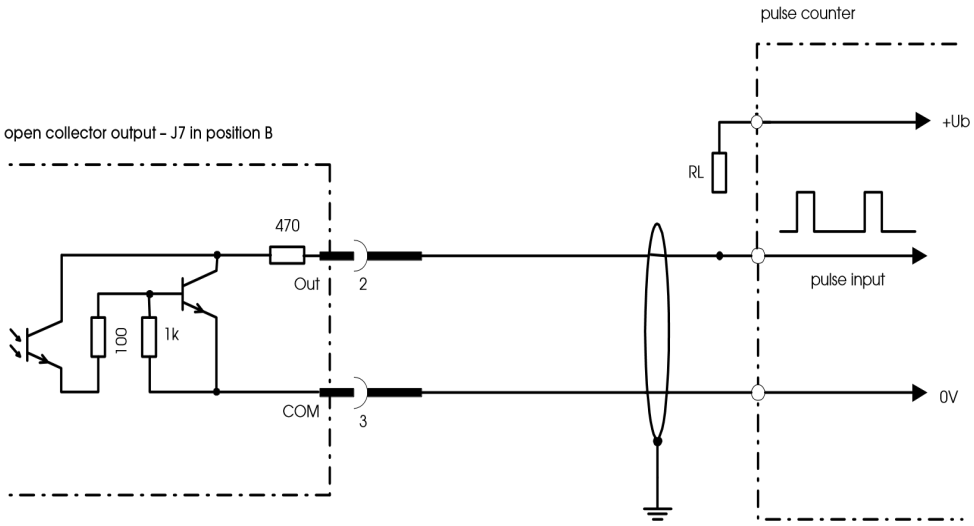
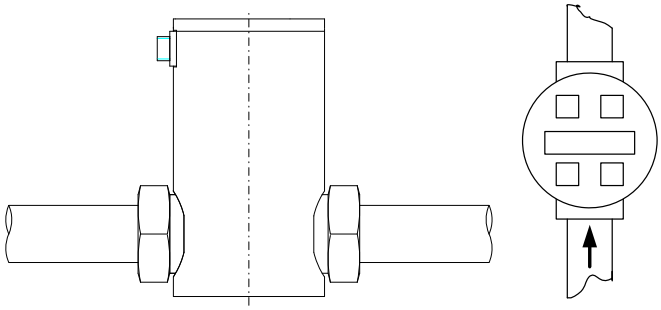


Fig. 6: Pulse output: open collector

2.5. Notes on installation



Mounting position

Install the TGM in a horizontal pipe with top up as shown in the left part of the drawing. This way the TGM may be operated at pressure rates of up to 10 bar [145 psi]. For any other positions,

e.g. face down or in a vertical pipe, the max pressure has to be limited to 4 bar [58 psi].

Fig. 7: Mounting position

In- and outlet sections

Upstream at least 10 x TGM dia
Downstream at least 5 x TGM dia

Important note

The TGM is fitted with screwed connections which may only be replaced by the manufacturer.

Connect metal housing with PE

Built-in devices have to be installed in a metal housing connected with protected earth. Observe a low impedance connection of PE and a measurement of the PE resistor according to VDE 0701. Also observe a sufficient shielding for the employed cabinet.

Keep distance

Keep current-carrying cables at least 30 cm away from the TGM. Only shall indicated terminals and contacts be used for power supply. Keep mobiles, ISM-units or switching inductivities like engines or solenoid valves at least 2 meters away from the digital measuring and control electronics. Avoid sources of electrostatic charges in the closer environment of the TGM. Operators should also consider appropriate clothing and wear of shoes with discharging ability.

Avoid parallel arrangement of current-carrying cables.

3. Start up

After connecting the power supply the following messages will appear in the display:

VER:SO5	Software version
READ-DAT	All outputs take a neutral state. Parameters in the Fare being read
-DN25-	Software version
AIR	Gas type
TEST REG	Calculation of all working parameters
OKAY	On successful check of all data and the unit's operation the TGM will automatically activate the measuring mode and display the current operational parameters in accordance with the selected measuring mask.

NOTE:

P-ERROR Parameter are saved twice in different banks of the EEPROM. In case of deviations between both parameter banks the display will show an error message. Press [E] to restore all defaults and reset the totalizer to 0000. Afterwards the operation software will start the programming mode and parameter settings may be repeated.

NOTE:

The restoring of defaults may be started manually at any time (cf. programming of parameter CLEAR).

3.1. Error and status messages

During the measuring mode of after programming the following messages may appear in the display:

Message	Description
CLEAR	erasing EEPROM/data memory
P-ERROR	parameter error in EEPROM, proceed with [E]
OVERFLOW	display range exceeded, measuring value cannot be indicated
SET-DEF	set defaults in MEMORY
*	no flow
READ-DAT	copying data to MEMORY
TEST-REG	calculating operational parameter
WRITE	writing data in EEPROM

3.2. Program flow chart

The scheme shows the job stream of the MPU unit and the operation facilities during the measuring mode considering the parameters KEY-RES and DIS-MODE.

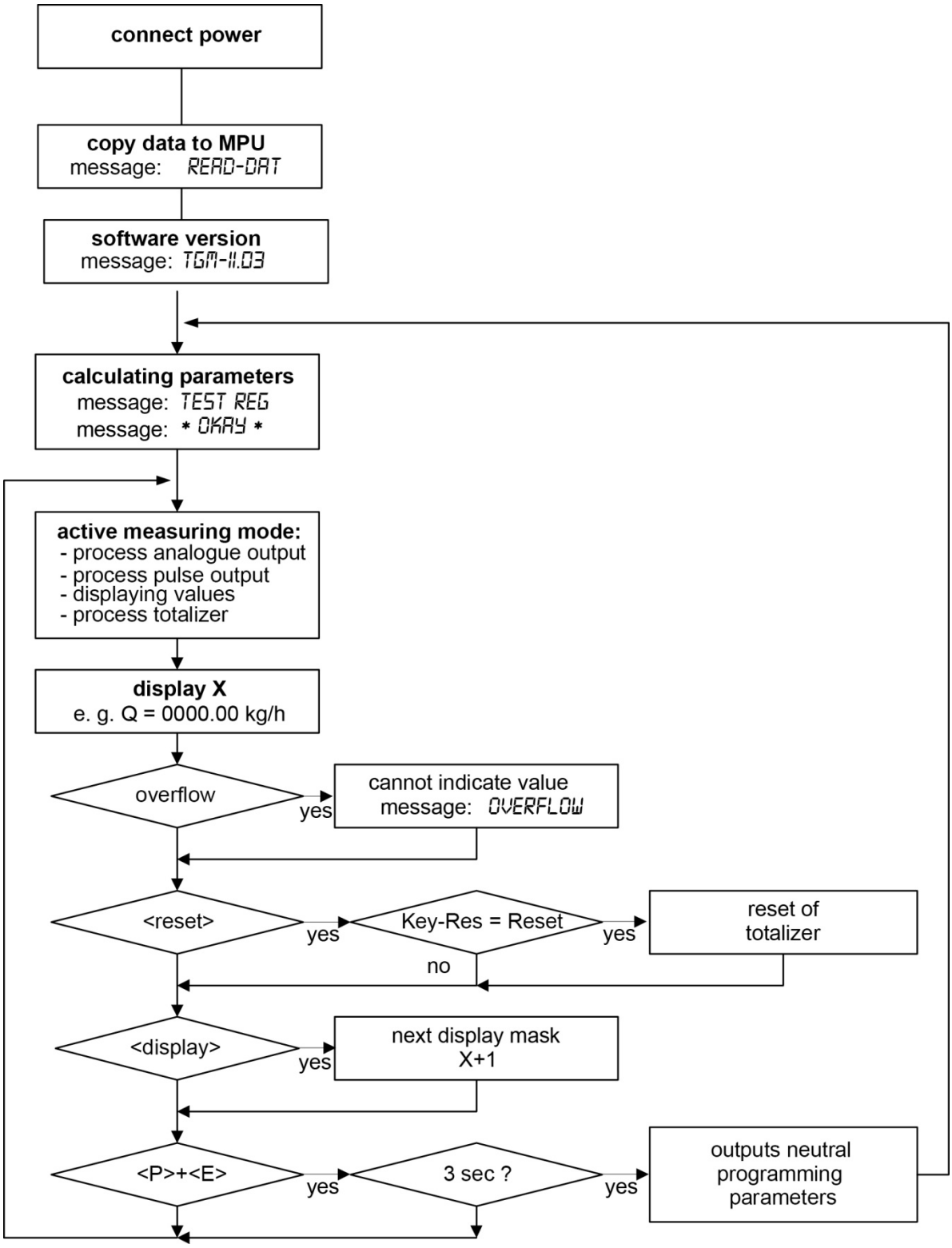


Fig. 8: Flow chart measuring mode

4. Measuring mode

The measuring mode allows for either indicating real-time values or totals. Press Display to select the desired measuring mask. The way of indication (resolution, unit etc.) depends on the adjustments in level »PARAMET.«.

4.1. Measuring masks

Meas. mask	Display	Unit
RATE	real-time value	flow rate unit
TOTAL	totals	total unit

4.1.1. Real-time value (measuring mask RATE)

The real-time value is indicated in accordance with the adjusted flow rate unit FLOW-UNITS and decimal point set-ting FLOW-DP. The calculation is based on the currently measured sensor voltage and the K-factor of the flow meter. The upgrading interval of the display is approx. 0.6 Hz. The internal upgrading and resultant response time of the analogue output depends on the parameter A-TIME.

4.1.2. Totals (measuring mask TOTAL)

The integral tantalizer adds the measured mass signal over a defined time interval (FLOW-UNITS). Thus long-term flow rates may be detected. The decimal point position depends on the adjusted flow rate unit, it begins with 3 decimal digits.

Example: Flow rate unit = kg/h. The consumption is indicated in kg: 12.345 kg

If the measuring value exceeds the display range, it will be assigned accordingly (e. g. 1234.567 kg will be displayed as 1234.56 kg). If the measuring value is too high to be shown by fading out digits, it will be displayed using exponential notation (e. g. 1234567.89 kg → 1.23E06).

In the measuring mode the tantalizer may be reset via key provided that the parameter KEY-RES was programmed accordingly.

5. Programming

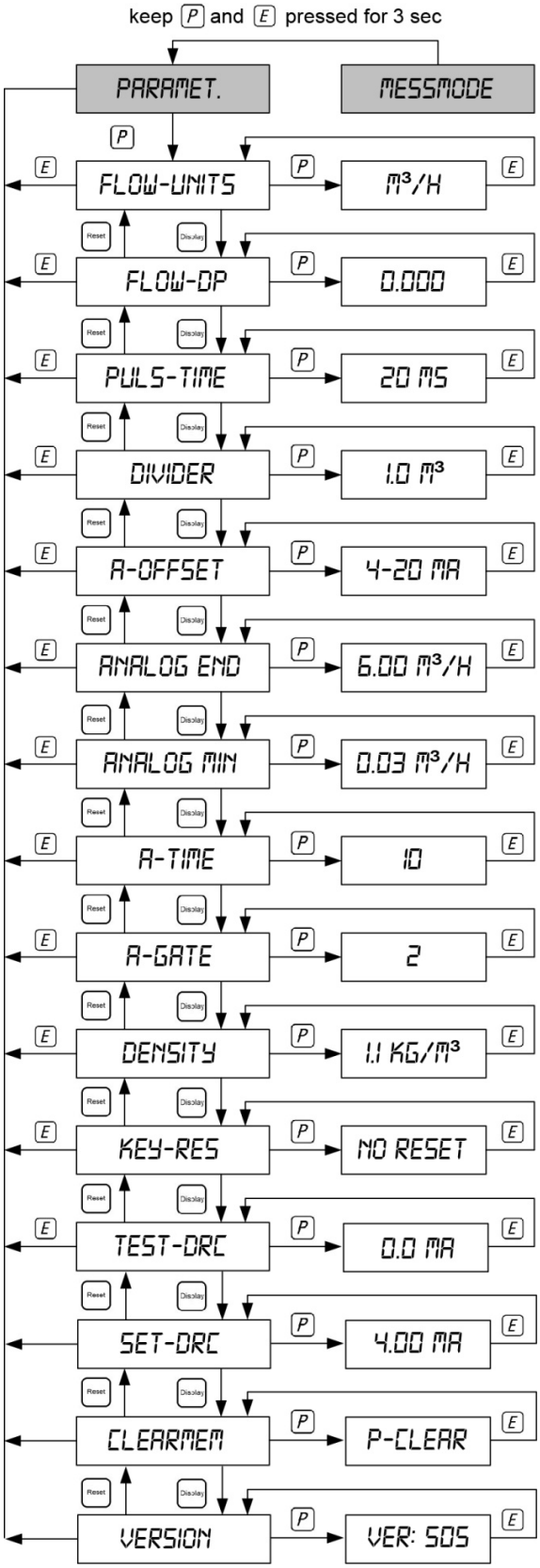


Fig. 9: Flow chart programming

5.1. Starting the programming mode

Simultaneously press [P] and [E] for 3 seconds to start the programming mode. The measuring mode will be interrupted and all outputs take a neutral state. The display shows the first parameter:

FLOW-UNITs..

Press [Display] to select a parameter.

Press [P] to start programming.

Having started the programming, the display shows the current value of the parameter. It may be adjusted either by entering a numerical value or selecting from presets.

5.2. Entering numerical parameters

When a numerical parameter is to be programmed the up right-hand digit will be flashing asking you to enter a value. This value may be entered and saved as follows:

[Reset] to select the decimal position. The present position is flashing.

[Display] each pressing will increase the value by 1 (0, 1, 2, 3, …, 9, 0, 1,…).

[E] to save. Afterwards the display returns to the parameter description.

[Display] to select the next parameter.

[E] to quit programming

5.3. Parameters

5.3.1. FLOW-UNITS: flow rate unit

Your selection will apply for the real-time value and totals as well as the scaling of the display and analogue output. The unit itself is not indicated in the display. You may select from the units below. Press [Display] to scroll and [E] to save.

Presets	g/min	g/s	kg/min	kg/h	Nm^3/h	Nm^3/min	Nl/h	Nl/min
Operation	[Display]	[Display]	[Display]	[Display]	[Display]	[Display]	[Display]	[Display]

Example:

With the flow dimension is kg/h, the analogue full scale is entered as kg/h and the pulse divider as kilograms. Real-time values are indicated in kg/h, totals in kg.

5.3.2. FLOW-DP: flow decimal point

The position of the decimal points determines the display resolution for the real-time value.

Presets	0000.	000.0	00.00	0.000
Meaning	1/1	1/10	1/100	1/1000
Operation	Reset	Reset	Reset	Reset

Example:

When the flow rate is supposed to be indicated in kg/h with two decimal digits, select kg/h as flow dimension and decimal point position 00.00.

5.3.3. PULS-TIME: pulse time of divider output

In order to further process the divider output signal by additional units (preset counters, PLC etc.) 3 different the pulse time adjustments are available:

Presets	1	20	50
Meaning	ms	ms	ms
Operation	Display	Display	Display

5.3.4. DIVIDER: divider pulse output

In order to detect the flow rate with an external counter, the TGM divides the mass signal of the sensor and the pulse output generates a mass-proportional pulse. You may now program the dividing factor with a value that shall correspond to one output pulse. The unit is »kg«.

Presets for flow dimensions:
kg/min – kg/h – Nm³/h – Nm³/min

Preset for flow dimensions:
g/min – Nl/h – Nl/min – g/s

Presets	1.0	0.1	0.01	Presets	1000	100	10
Operation	Display	Display	Display	Operation	Display	Display	Display

5.3.5. A-OFFSET: analogue output

You may select from two presets: 0 mA (current loop 0 … 20) and 4 mA (current loop 4 … 20 mA). Press Display to select and E to confirm.

5.3.6. ANALOG END: analogue full scale

The TGM may provide a flow proportional current signal of 0/4 … 20 mA. You may program the instant flow value, which shall correspond to 20 mA (unit in accordance with parameter (FLOW-UNITS). In order to reach a maximum accuracy, you may shift the decimal poir[P]sing . This adjustment is not affected by the general decimal point position as programmed under FLOW-DP. Finally save your adjustn[E]t via .

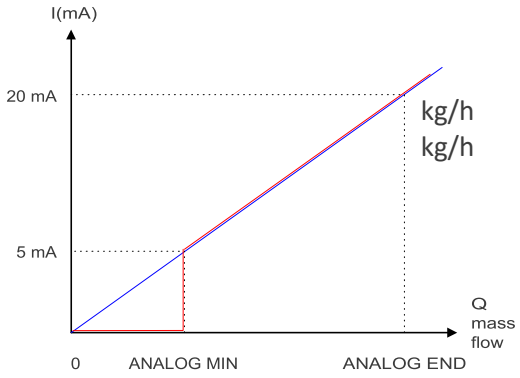
5.3.7. ANALOG-MIN: minimum working range

This value marks the minimum working range to fade out zero point variations. In order to reach a maximum accuracy, you may shift the decimal point using [P]. This adjustment is not affected by the general decimal point position as programmed under FLOW-DP. Finally save your adjustment via [E].

Example:

ANALOG MIN = 1.00
ANALOG END = 16.00
A-OFFSET = 0 - 20 mA

When the measuring value falls below 1.00 kg/h the analogue output provides only the offset (0 mA), the current flow is displayed 000 and the internal totalizer is stopped.



5.3.8. A-TIME: response time of the analogue output

Press [Display], to select OUT FAST for the fastest response time available or (OUT SLOW) for a constant response time of 0.8 seconds. [E]e with .

Presets	Out-Fast	Out-Slow
Meaning	fast	slow
Operation	[Display]	[Display]

5.3.9. A-GATE: gate time of the analogue output

This parameter determines the number of measurements, which will be considered for calculating the actual measuring value (the response time of the measuring results depends on the A-TIME setting). With n > 0, the TGM calculates an average value considering the last n measurements and the actual measurement. The influence of the actual measurement can be determined as follows:

$$100\ \% * \frac{1}{n+1}$$

5.3.10. DENSITY: density of the measuring medium

The calculation of the flow volume is based on the density of the gas to be measured. As the sensor supplies a signal proportional with the gas mass flow, the volume flow under standard conditions may be measured with-out pressure or temperature compensation.

You are required to enter the density of the gas under standard conditions (e.g. air: ρ = 1,293 kg/m³ at 0 °C and 1,013.2 mbar). If you wish to calculate the volume under different pressure and temperature conditions you must enter the density corresponding to these conditions. The unit of the density is always kg/m³.

5.3.11. KEY-RESET: reset via keyboard

The totalizer of the TGM can be reset via keyboard when KEY-RESET is selected. The reset function is only available in display mode »TOTALS«. Select wi Display and save wi E .

Presets	No-Reset	Reset
Meaning	block	allow
Operation	Display	Display

5.3.12. TEST-DAC: check of the analogue output

The analogue output may be checked with respect to performance and linearity. Four preset output values are available via keyboard. Press Display to select from the presets and E to quit the test mode.

5.3.13. CLEARMEM: restoring defaults

This function will restore the defaults erasing all parameter adjustments and counts. Having selected this function via P the display shows P-CLEAR. If you should have selected this function by mistake, you may quit pres E .To restore defaults pre P . Afterwards the EEEPROM with all operational parameters and counts will be erased. During this process the message *CLEAR* will appear in the display.

6. Service

The service menu must only be used by trained personal.

6.1. Starting the service mode

Simultaneously press [P] and [E] for 3 seconds to start the programming mode. The measuring mode will be interrupted and all outputs take a neutral state. The display shows the first parameter:

FLOW-UNITs..

Now simultaneously press [Reset] and [Display] for 3 seconds to start the service mode. You will be asked to enter the service code. The service code is available on request by KEM Küppers Elektromechanik GmbH directly or by our local sales partner.

6.2. Service parameters

Parameter	Description/Function	Unit	Default	Range/Modes
GAS TYPE	measured gas	enum	Air	Air, Oxygen, Nitrogen, 100-H2, Helium
CALIB.FACTOR	calibration factor	%	0.0	0 - 100
MEAS. GATE TIME	1 meas. period = 35 ms	periods	10	10 - 99
DISP. UPDATE TIME	display refresh rate	ms	3500	500 – 10,000
HYSTERESIS	sensor hysteresis	mV	10	5 - 50

7. Listings

7.1. List of Figures

NORTH & SOUTH AMERICA

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