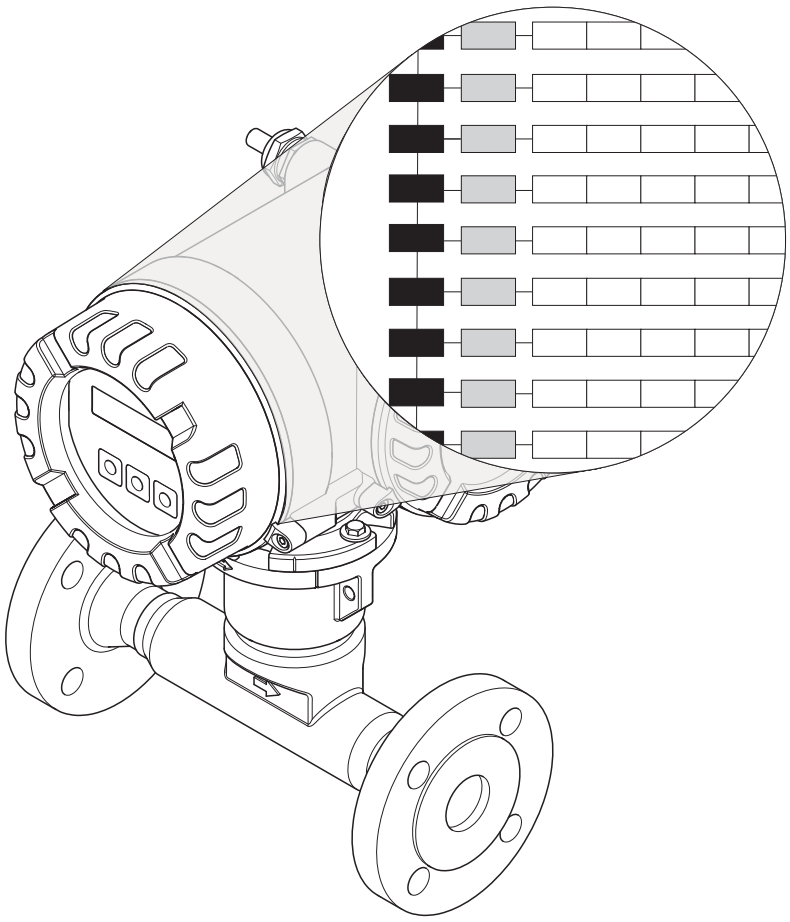
BA00135D/6/EN/14.14
71261915

Valid as of version
V 3.00.XX (Device software)

Description of device functions
Proline t-mass 65
FOUNDATION Fieldbus

Thermal Mass Flowmeter

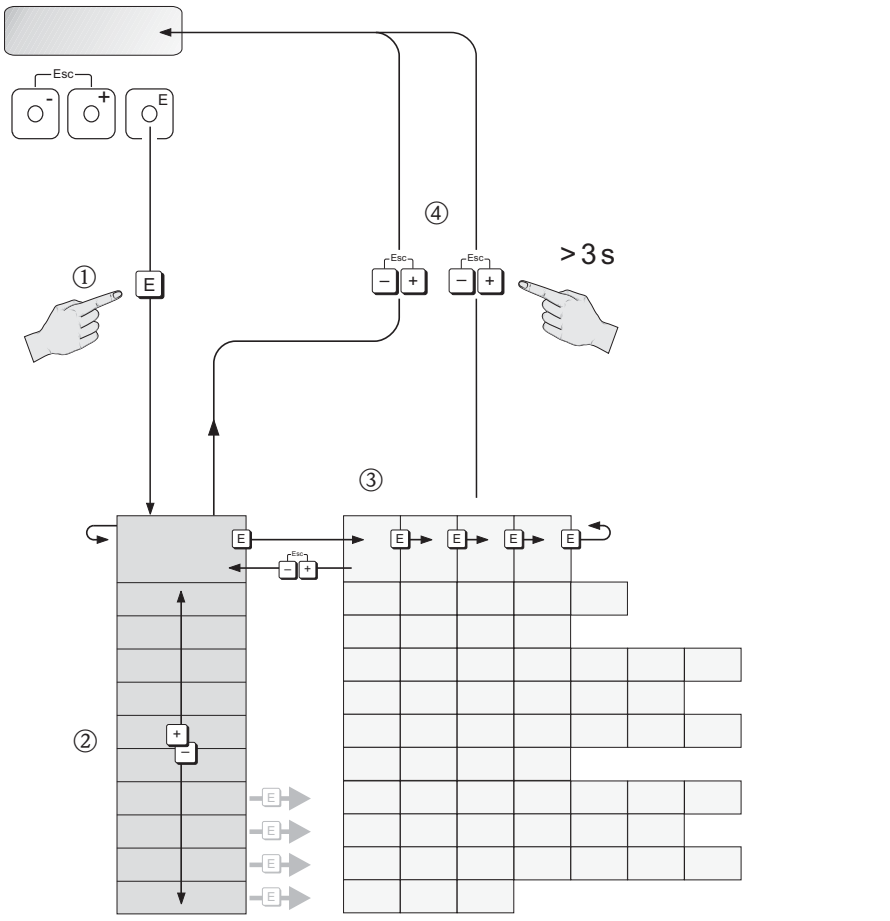


Endress+Hauser
People for Process Automation

Table of contents for local operation

1 The function matrix: layout and use

The function matrix is a two-level construction: the groups form one level and the groups' functions the other. The groups are the highest-level grouping of the control options for the measuring device. A number of functions is assigned to each group. You select a group in order to access the individual functions for operating and configuring the measuring device. You can find an overview of all the groups available in the table of contents on page 3 and in the graphic representation of the function matrix on page 6. On page 6 you can also find an overview of all the functions available with the page references to the specific function description. A description of the individual functions is provided on page 7 and onwards.



2 Illustration of the function matrix

Groups/function groups		Functions			
MEASURING VALUES	→ 🖹 7	MASS FLOW	CORRECTED VOLUME FLOW	HEAT FLOW	TEMPERATURE
↓					
SYSTEM UNITS	→ 🖹 8	UNIT MASS FLOW	UNIT MASS	UNIT CORRECTED VOLUME FLOW	UNIT CORRECTED VOLUME
↓		UNIT CALORIFIC VALUE MASS	UNIT CALORIFIC VALUE CORRECTED VOLUME	UNIT HEAT FLOW	UNIT HEAT
		UNIT PRESSURE	UNIT TEMPERATURE	UNIT DENSITY	UNIT LENGTH
Quick Setup	→ 🖹 12	QUICK SETUP COMMISSIONING	QUICK SETUP SENSOR	QUICK SETUP GAS	QUICK SETUP PRESSURE
↓		QUICK SETUP HEAT FLOW	T-DAT SAVE/LOAD		
OPERATION	→ 🖹 22	LANGUAGE	ACCESS CODE	DEFINE PRIVATE CODE	STATUS ACCESS
↓		ACCESS CODE COUNTER			
USER INTERFACE	→ 🖹 24	ASSIGN LINE 1	ASSIGN LINE 2	100% VALUE LINE 1	100% VALUE LINE 2
↓		FORMAT	DISPLAY DAMPING	CONTRAST LCD	BACKLIGHT
↓		TEST DISPLAY			
TOTALIZER 1/2	→ 🖹 27	ASSIGN TOTALIZER	ASSIGN GAS GROUP	SUM	OVERFLOW
↓		UNIT TOTALIZER	RESET TOTALIZER		
HANDLING TOTALIZER	→ 🖹 29	RESET ALL TOTALIZERS	FAILSAFE MODE		
↓					
COMMUNICATION	→ 🖹 30	WRITE PROTECTION	SIMULATION	DEVICE PD-TAG	MANUFACTURER ID
↓		DEVICE TYPE	SERIAL NUMBER	DEVICE REVISION	DD REVISION
		BLOCK SELECTION	OUT VALUE	IN VALUE	CASCADE_IN VALUE
PROCESS PARAMETER	→ 🖹 33	PROCESS PRESSURE 1	PROCESS PRESSURE 2	PROCESS PRESSURE	REFERENCE PRESSURE
		REFERENCE TEMPERATURE	REFERENCE DENSITY	NET CALORIFIC VALUE	GROSS CALORIFIC VALUE
↓		MOLE % GAS 1	ASSIGN LOW FLOW CUT OFF	ON-VALUE LOW FLOW CUT OFF	OFF-VALUE LOW FLOW CUT OFF
		ZERO POINT ADJUST	INSTALLATION FACTOR		
GAS	→ 🖹 37	SELECT GROUP	ANALYZER INPUT	NUMBER OF GASES	GAS TYPE 1
↓		MOLE % GAS 1	DESCRIPTION	CORRECTION FACTOR	REFERENCE DENSITY
		GAS TYPE 2 to 8	MOLE % GAS 2 to 8	CHECK VALUES	SAVE CHANGES
HEAT FLOW	→ 🖹 42	CALORIFIC VALUE TYPE	MODE 1	HEATING VALUE 1	MODE 2

Groups/function groups		Functions			
↓		HEATING VALUE 2	REFERENCE COMBUSTION TEMPERATURE		
SYSTEM PARAMETER	→ 🖹 44	POSITIVE ZERO RETURN	FLOW DAMPING		
↓					
SENSOR DATA	→ 🖹 45	PIPE TYPE	PIPE STANDARD	NOMINAL DIAMETER	OUTER DIAMETER
↓		WALL THICKNESS	INTERNAL DIAMETER	INTERNAL HEIGHT	INTERNAL WIDTH
		MOUNTING	MOUNTING SET LENGTH	INSERTION DEPTH	ZERO POINT
		FLOW CONDITIONER	CALIBRATION DATE		
SUPERVISION	→ 🖹 49	ACTUAL SYSTEM CONDITION	PREVIOUS SYSTEM CONDITION	ALARM DELAY	SYSTEM RESET
↓		OPERATION HOURS	HOURS SINCE RESET		
SIMULATION SYSTEM	→ 🖹 50	SIMULATION FAILSAFE MODE	SIMULATION MEASURAND	VALUE SIMULATION MEASURAND	
↓					
SENSOR VERSION	→ 🖹 51	SENSOR TYPE	SERIAL NUMBER	TRANSDUCER SERIAL NUMBER	SOFTWARE REVISION NUMBER S-DAT
↓		PRE-AMPLIFIER SOFTWARE REVISION NUMBER	PRE-AMPLIFIER HARDWARE REVISION NUMBER		
AMPLIFIER VERSION	→ 🖹 52	DEVICE SOFTWARE	HARDWARE REVISION NUMBER AMPLIFIER	SOFTWARE REVISION NUMBER AMPLIFIER	SOFTWARE REVISION NUMBER T-DAT
		I/O MODULE TYPE	SOFTWARE REVISION NUMBER I/O MODULE		

3 MEASURING VALUES

Function description, MEASURING VALUES group	
✎ Note! The engineering unit of the measured variable displayed here is configured in the SYSTEM UNITS group (→ 🖹 8)	
MASS FLOW	**Description** The currently measured mass flow appears on the display. **Display** 5-digit floating-point number, including unit e.g. 462.87 kg/h; 731.63 lb/min
CORRECTED VOLUME FLOW	**Description** The calculated corrected volume flow appears on the display. The corrected volume flow is calculated from the measured mass flow and the reference density of the gas. **Display** 5-digit floating-point number, including unit e.g. 104.97 Nm3/h; 110.73 Sm3/h; etc.
HEAT FLOW	**Description** The calculated heat flow appears on the display. **Display** 5-digit floating-point number, including unit, (e.g. 175.00 kJ/h; 50.000 kBtu/h; etc.)
TEMPERATURE	**Description** The currently measured temperature appears on the display. **Display** 5-digit fixed-point number, incl. unit and sign e.g. –23.4 °C, 160.0 °F, 295.4 K

4 SYSTEM UNITS

Function description, SYSTEM UNITS group	
UNIT MASS FLOW	**Description** For selecting the unit required and displayed for the mass flow. The unit you select here is also valid for: ▪ Low flow cut off The following time units can be selected: s = second, m = minute, h = hour, d = day **Options** SI: Gram → g/time unit Kilogram → kg/time unit Metric ton → t/time unit US: Ounce → oz/time unit Pound → lb/time unit Ton → ton/time unit **Factory setting** kg/h or lb/h (country dependent → 🖹 53)
UNIT MASS	**Description** For selecting the unit required and displayed for the mass. **Options** SI: Gram → g Kilogram → kg Metric ton → t US: Ounce → oz Pound → lb Ton → ton **Factory setting** kg or lb (country dependent → 🖹 53)
UNIT CORRECTED VOLUME FLOW	**Description** For selecting the unit required and displayed for the corrected volume flow.The unit you select here is also valid for: ▪ Low flow cut off The following time units can be selected: s = second, m = minute, h = hour, d = day **Options** SI: Norm cubic meter → Nm^3/time unit Norm liter → Nl/time unit US: Standard cubic meter → Sm^3/time unit Standard cubic feet → Sft^3/time unit **Factory setting** Nm^3/h or Sm^3/h (country dependent → 🖹 53)

Function description, SYSTEM UNITS group	
UNIT CORRECTED VOLUME	**Description** For selecting the unit required and displayed for the corrected volume. **Options** SI: Norm cubic meter → Nm^3 Norm liter → Nl US: Standard cubic meter → Sm^3 Standard cubic feet → Sft^3 **Factory setting** Nm^3 or Sm^3 (country dependent → 🖹 53)
UNIT CALORIFIC VALUE MASS	**Description** For selecting the unit required and displayed for the gross/net calorific value. **Options (SI units)** kJ/kg MJ/kg kWh/kg MWh/kg kcal/kg Mcal/kg **Options (US units)** Btu/lb kBtu/lb **Factory setting** MJ/kg or kBtu/lb (country dependent → 🖹 53)
UNIT CALORIFIC VALUE CORRECTED VOLUME	**Description** For selecting the unit required and displayed for the calorific value based on the corrected volume. **Options (SI units)** kJ/Nm^3 MJ/Nm^3 kWh/Nm^3 MWh/Nm^3 $kcal/Nm^3$ $Mcal/Nm^3$ **Options (US units)** kJ/Sm^3 MJ/Sm^3 kWh/Sm^3 MWh/Sm^3 $kcal/Sm^3$ $Mcal/Sm^3$ Btu/Sft^3 $kBtu/Sft^3$ **Factory setting** MJ/Nm^3 or $kBtu/Sft^3$ (country dependent → 🖹 53)

Function description, SYSTEM UNITS group	
UNIT HEAT FLOW	**Description** For selecting the unit required and displayed for the heat flow. The following time units can be selected: s = second, m = minute, h = hour, d = day **Options (SI unit)** kW MW kJ/time unit MJ/time unit GJ/time unit kcal/time unit Mcal/time unit Gcal/time unit **Options (US unit)** tons kBtu/time unit MBtu/time unit GBtu/time unit **Factory setting** kW or kBtu/h (country dependent → 🖹 53)
UNIT HEAT	**Description** For selecting the unit required and displayed for the heat. The following time units can be selected: s = second, m = minute, h = hour, d = day **Options (SI units)** kWh MWh kJ MJ GJ kcal Mcal Gcal **Options (US units)** tonh kBtu MBtu GBtu **Factory setting** kWh or kBtu (country dependent → 🖹 53)
UNIT PRESSURE	**Description** Use this function to select the unit for pressure. The unit you select here is also valid for: ▪ Process pressure (see PROCESS PARAMETER group, → 🖹 33) ▪ Reference pressure (see PROCESS PARAMETER group, → 🖹 33) **Options** bar a (bar absolute) psi a (pound per square inch absolute) kPa a (kilopascal absolute) mmHg 0°C a (millimeter mercury absolute) inHg 32°F a (inch mercury absolute) mmH2O 4°C a (millimeter water absolute) inH2O 39°F a (inch water absolute) kg/cm2 a (kilogram per centimeter squared absolute) **Factory setting** bar a or psi a (country dependent → 🖹 53)

Function description, SYSTEM UNITS group	
UNIT TEMPERATURE	**Description** For selecting the unit required and displayed for the temperature. **Options** °C (CELSIUS) K (KELVIN) °F (FAHRENHEIT) R (RANKINE) **Factory setting** °C or °F (country dependent → 🖹 53)
UNIT DENSITY	**Description** For selecting the unit required and displayed for the calculated gas density at process conditions. The unit you select here is also valid for: ▪ Reference density (see PROCESS PARAMETER group, → 🖹 33) **Options** SI: g/cm^3 g/cc kg/dm^3 kg/l kg/m^3 US: lb/ft^3 **Factory setting** kg/m^3 or lb/ft^3 (country dependent → 🖹 53)
UNIT LENGTH	**Prerequisite** This function is **only** available for the insertion sensor (t-mass 65I) **Description** For selecting the unit of length required and displayed for the pipe internal diameter or the inner dimensions of rectangular ducts (see SENSOR DATA function group → 🖹 45). **Options** MILLIMETER INCH **Factory setting** MILLIMETER or INCH (country dependent → 🖹 53)

5 Quick Setup

Function description, Quick Setup group	
QUICK SETUP COMMISSIONING	**Description** Starts the Quick Setup menu for commissioning. For a flowchart of the QUICK SETUP COMMISSIONING: → 🖹 13. **Options** NO YES **Factory setting** NO
QUICK SETUP SENSOR	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). **Description** Use this function to start the application-specific setup to calculate the insertion depth for the insertion sensor. For a flowchart of the QUICK SETUP SENSOR: → 🖹 15. **Options** NO YES **Factory setting** NO
QUICK SETUP GAS	**Description** Use this function to start the application-specific setup for programming the gas or gas mixture. For a flowchart of the QUICK SETUP GAS: → 🖹 16. **Options** NO YES **Factory setting** NO
QUICK SETUP PRESSURE	**Description** Use this function to start the application-specific setup for programming the process pressure for each gas group.For a flowchart of the QUICK SETUP PRESSURE: → 🖹 18 **Options** NO YES **Factory setting** NO
QUICK SETUP HEAT FLOW	**Description** Use this function to start the application-specific setup for heat flow. For a flowchart of the QUICK SETUP HEAT FLOW: → 🖹 19. **Options** NO YES **Factory setting** NO

Function description, Quick Setup group	
T-DAT SAVE/LOAD	**Description** Use this function to save the configuration/settings of the **transmitter** to a transmitter-DAT (T-DAT), or to load a configuration from the T-DAT to the EEPROM (**manual** backup function). Application examples: ▪ After commissioning, the current measuring point parameters can be saved to the T-DAT as a backup. ▪ If the transmitter is replaced for some reason, the data from the T-DAT can be loaded into the new transmitter (EEPROM). **Options** CANCEL SAVE (from the EEPROM to the T-DAT) LOAD (from the T-DAT to the EEPROM) Note! ▪ If the target device has an older software version, the message "TRANSM. SW-DAT" is displayed during startup. Then only the "SAVE" option is available. ▪ LOAD This option is only possible: – if the target device has the same software version as, or a more recent software version than, the source device or – if the T-DAT contains valid data that can be called up ▪ SAVE This function is always available. **Factory setting** CANCEL

5.1 Quick Setup "Commissioning"

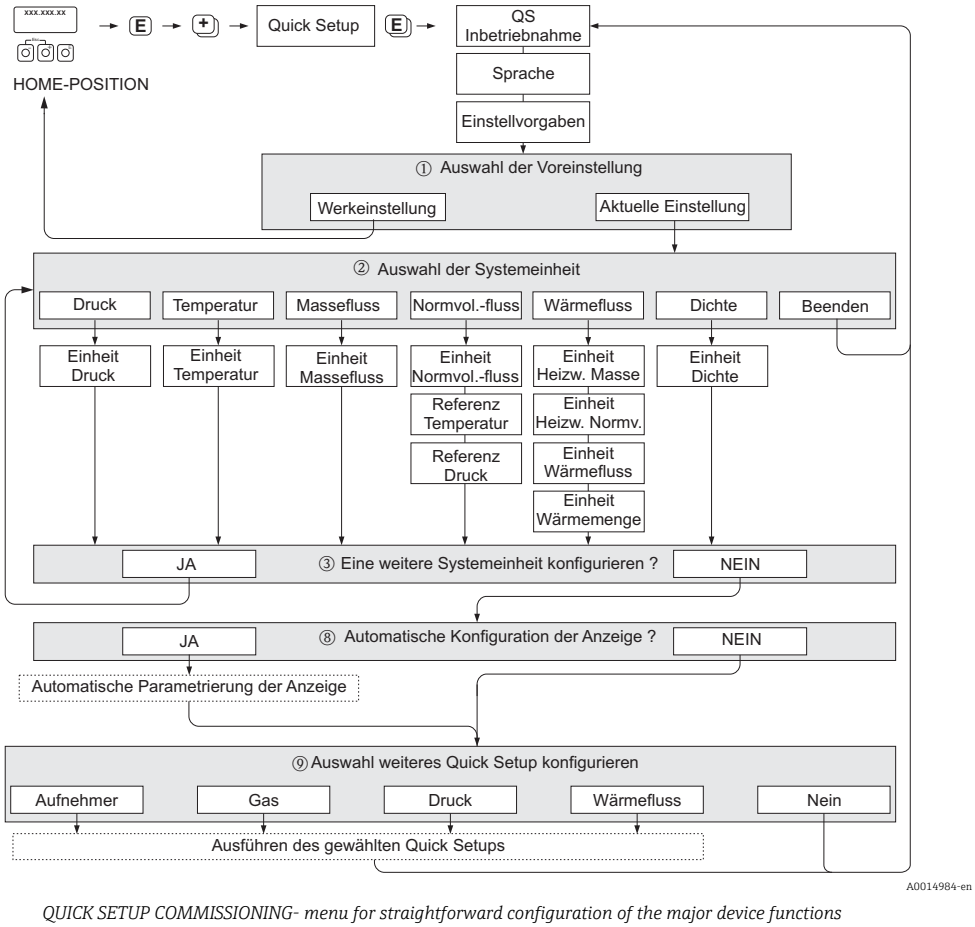


Fig. 1: QUICK SETUP COMMISSIONING- menu for straightforward configuration of the major device functions

Note!
The display returns to the QUICK SETUP cell if you press the ESC key combination ( ) during programming of a parameter anywhere in the menu. The configuration settings already made remain valid, however.

QUICK SETUP - COMMISSION

Use the + or − key at the prompt "QS-COMMISSION NO" and the device access code entry appears. Enter the device access code "65" and press E; programming is enabled. The prompt "QS-COMMISSION NO" appears. Use the + or − key to change NO to YES and press E.

LANGUAGE

Use the + or − key to select the required language and continue with E.

PRE-SETTING.

① Select ACTUAL SETTINGS to continue programming the device and go to the next level or select DELIVERY SETTINGS to reset the device. The device restarts and returns to the Home position.

- ACTUAL SETTINGS are the actual programmed parameters in the device

- DELIVERY SETTINGS are the programmed parameters (factory settings plus customer specific settings) originally delivered with the device

SYSTEM UNITS

Select required system unit function and carry out parameterization or select QUIT to return to the QUICK SETUP function if no further programming is required.

② Only units not yet configured in the current setup are available for selection in each cycle.

③ The YES option remains visible until all the units have been configured.
NO is the only option displayed when no further units are available.

Automatic configuration of the display

⑧ The "automatic parameterization of the display" option contains the following basic settings/factory settings:

- YES: main line = MASS FLOW, additional line = TOTALIZER 1

- NO: The existing (selected) settings remain.

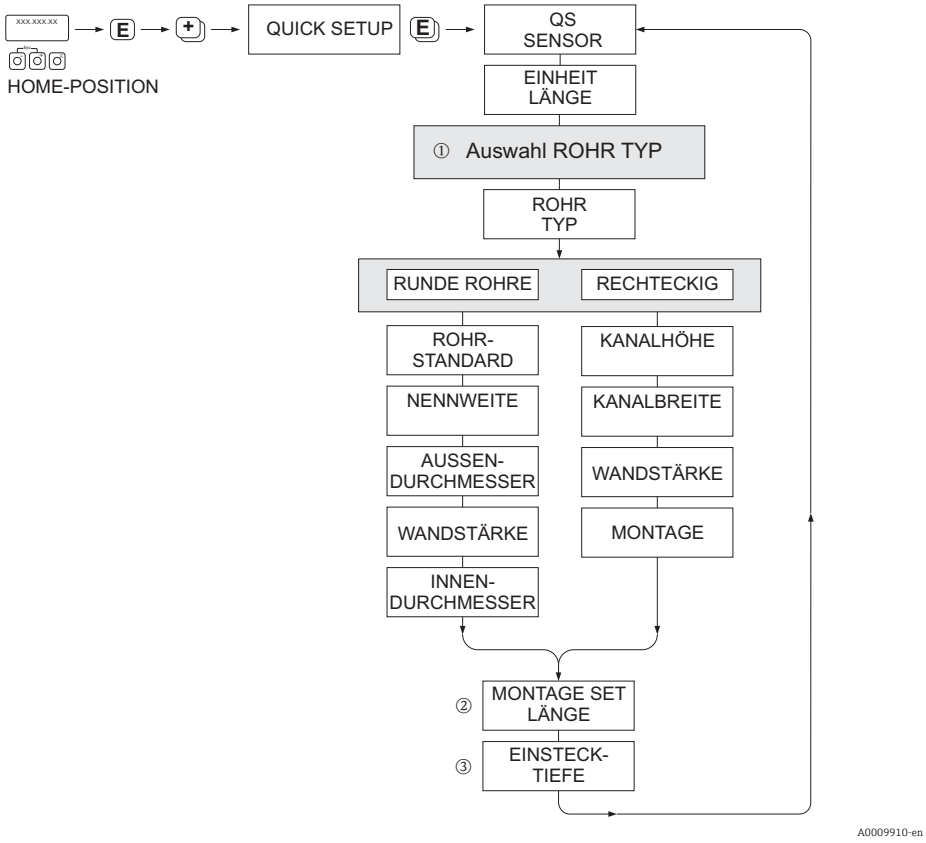
Carry out another Quick Setup?

⑨ Select additional Quick Setups to complete commissioning or select NO to exit.

5.2 Quick Setup "Sensor"

It is essential that the insertion sensor is setup according to the actual pipe or duct and then installed at the calculated insertion depth. This Quick Setup guides you systematically through the procedure to setup the sensor.

Note!
The QUICK SETUP SENSOR function is not available for flanged type sensors.



PIPE TYPE

① ▪ CIRCULAR
- in case that the pipe is of a standard type, then parameterize functions PIPE STANDARD and NOMINAL DIAMETER
- In case that the pipe is a non-standard type, then select OTHERS in the function PIPE STANDARD and parameterize the functions WALL THICKNESS and OUTER DIAMETER.
- The function INTERNAL DIAMETER displays the calculated internal diameter and is read only.

▪ RECTANGULAR
- Enter the INTERNAL HEIGHT, INTERNAL WIDTH and WALL THICKNESS of the duct
- Select the MOUNTING orientation of the sensor: HORIZONTAL or VERTICAL

MOUNTING SET LENGTH

② Enter the measured length of the mounting set (including the compression fitting).

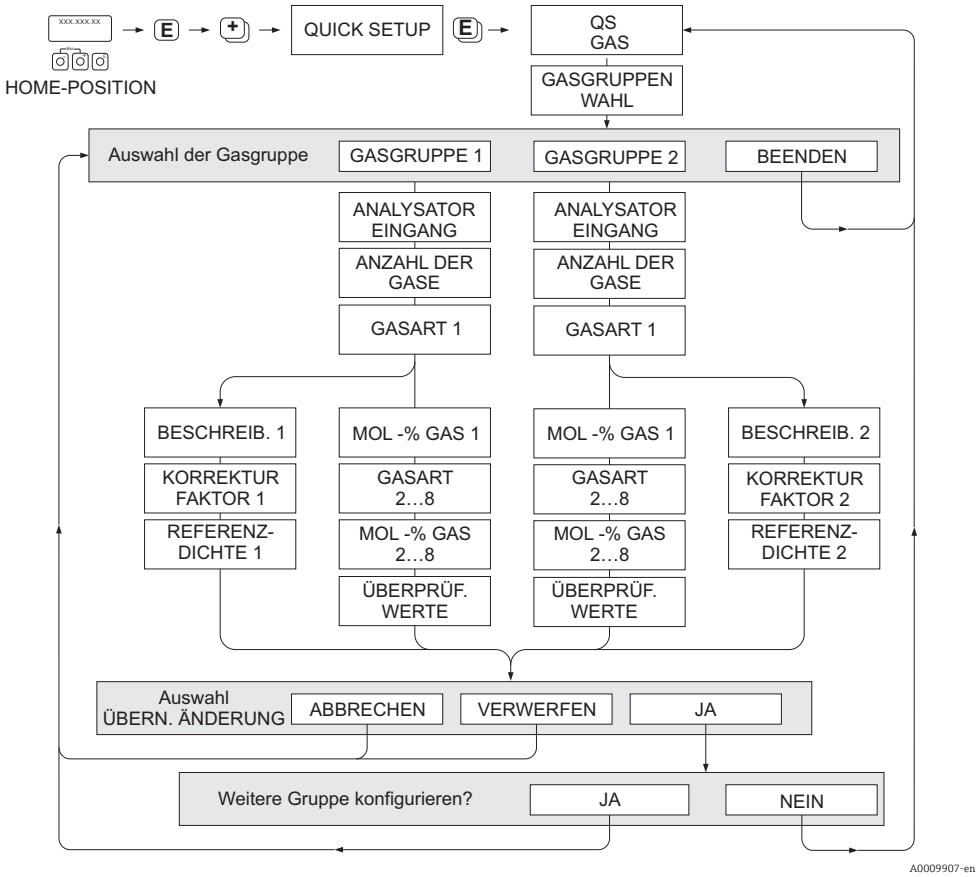
INSERTION DEPTH

③ This function calculates the insertion depth value for the mounting of the sensor.

Press E to save settings and return to QUICK SETUP SENSOR group.

5.3 "Gas" Quick Setup menu

The device can be setup with 1 or 2 individual gas groups in memory. This means that up to 2 different gas flow streams (e.g. nitrogen and argon) can be measured in a single pipe with one flowmeter.
In the case of 2 gas groups being used, a digital input can be assigned to switch between the gas groups or, alternatively, the switch can be done manually via a function in the device software.



Programming a gas group
The device allows flexible change of the gas group parameters, independent of the original factory setup and calibration
A gas group can be programmed as:
– one single gas or
– one gas mixture (of up to 8 components)
A single gas can be:
– selected from a list of standard gases or
– setup for other suitable types of gases, such as Ozone, using manual correction factors and the option called SPECIAL GAS. This requires application evaluation at the factory - consult your Endress+Hauser sales center prior to using this function.

Setting or viewing the active gas group

Go to the function SELECT GROUP (→ 📖 38) and simply select 1 or 2 and then exit using ESC (⊡ keys simultaneously). No save function is necessary.

Note!
This Quick Setup Gas function is not available if an in-situ calibration function has been performed on the device as the in-situ calibration curve refers to the sensor power at each recorded flow point. Therefore, the programmed gas settings become redundant.

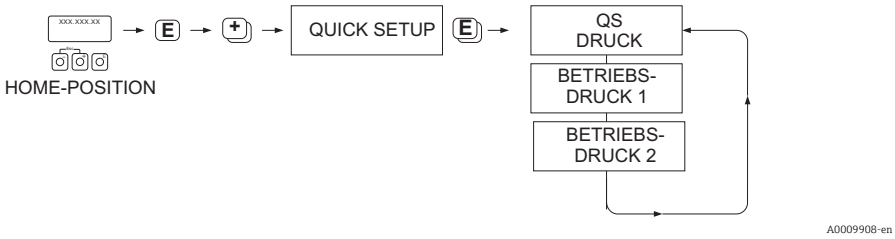
Performing the Quick Setup

1. GAS GROUP
   Use the ⊞ or ⊟ key to select the required GAS GROUP and continue with ⓔ.
   - select the NUMBER OF GASES in the group from 1 to 8
   - select the GAS TYPE from the choose list.
   - enter the MOLE % for each GAS TYPE (only if NUMBER OF GASES is 2 and more).
   - The error message CHECK VALUES appears if the total mixture % does not equal 100%. → Go back and check the mixture settings.
2. SAVE CHANGES?
   - Select YES to save the settings in GAS GROUP 1 or 2 and activate the last gas group selected. Press ⓔ to continue or
   - Select CANCEL to save the entered settings in buffer memory but not activate them for measurement. If this function is selected, then it will be necessary to come back to this gas group and save it at a later stage.
   - Select DISCARD to clear the last changes and return to CONFIGURE GROUP to make new settings.
3. ANOTHER GAS GROUP?
   - Select YES to continue to the CONFIGURE GROUP function. Use the ⊞ or ⊟ key to select the desired GAS GROUP and proceed as per the above instructions.
   - Select NO to exit to the Quick Setup.

Note!
You can find more detailed information on the GAS GROUP in chapter GAS → 📖 38

5.4 "Pressure" Quick Setup menu

Use this Quick Setup to program the individual process pressure for each gas group. If only one gas group is being used, then only the function PROCESS PRESSURE 1 needs to be programmed, PROCESS PRESSURE 2 can remain with default settings.

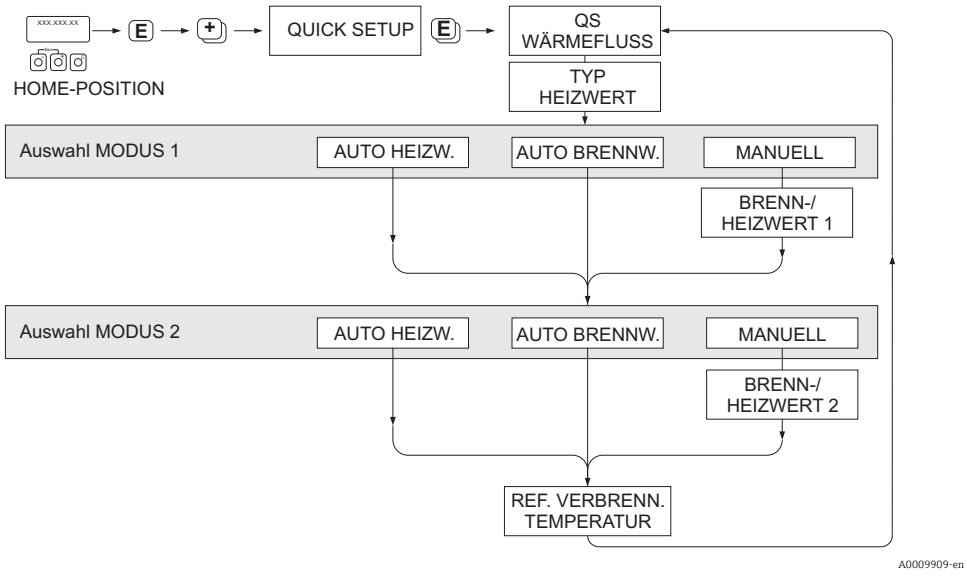


Note!

- The device operates with absolute pressure only. Convert any gauge pressures to absolute pressure.
- If a pressure compensating input is being used, then the input signal value overrides the manually programmed value. The pressure input value applies to both gas groups. i.e. 2 independent pressure values are no longer possible.
- This Quick Setup Gas function is not available if an in-situ calibration function has been performed on the device as the in-situ calibration curve refers to the sensor power at each recorded flow point. Therefore, the programmed pressure settings become redundant.

5.5 "Heat Flow" Quick Setup menu

The device can calculate and output the heat of combustion of common fuel gases such as methane, natural gas, propane, butane, ethane and hydrogen.
Use this Quick Setup menu to program the method used to calculate the heating value or calorific value (CV). The device can be configured to give two independent heating value outputs and totalized values. For example, the pipeline has either natural gas or propane running at separate times and the heating value is required for both gases.



Calculation mode 1 and 2

- The heating value for CALCULATION MODE 1 corresponds to the settings in the function GAS GROUP 1.
- The heating value for CALCULATION MODE 2 corresponds to the settings in the function GAS GROUP 2.

Note!
- If only one gas group is used, then leave mode 2 as default settings.
- The units of measure are selected in the SYSTEM UNITS section → 8.

Auto Gross

The gross heating value (or higher heating value) is the total heat obtained by complete combustion at constant pressure of a volume of gas in air, including the heat released by the water vapor in the combustion products (gas, air and combustion products taken at reference combustion temperature and standard pressure).

Auto Net

The net heating value (or lower heating value) is determined by subtracting the heat of vaporization of the water vapor from the higher heating value. This treats any water formed as water vapor. The energy required to vaporize the water therefore is not realized as heat.

Manual

This function allows entry of a user-specific heating value if the required value is different from the value in the following table.

Gas	Formula	Net/lower heating value		Gross/upper heating value	
		[Mj/kg]	Btu/lb	[Mj/kg]	Btu/lb
Hydrogen	H_2	119.91	51.56	141.78	60.97
Ammonia	NH_3	18.59	7.99	22.48	9.67
Carbon Monoxide	CO	10.1	4.34	10.1	4.34
Hydrogen Sulphide	H_2S	15.2	6.54	19.49	8.38
Methane	CH_4	50.02	21.51	55.52	23.87
Ethane	C_2H_6	47.5	20.43	51.93	22.33
Propane	C_3H_8	46.32	19.92	50.32	21.64
Butane	C_4H_{10}	45.71	19.66	49.51	21.29
Ethylene	C_2H_4	47.16	20.28	50.31	21.63

* According to ISO 6976:1995(E) and GPA Standard 2172-96

reference combustion temperature

The following reference temperatures are used:

Country	reference combustion temperature
Austria, Belgium, Denmark, Germany, Italy, Luxembourg, The Netherlands, Poland, Russia, Sweden, Switzerland	25 °C
Brazil, China	20 °C
France, Japan	0 °C
Australia, Canada, Czech Republic, Hungary, India, Ireland, Malaysia, Mexico, South Africa, Great Britain	15 °C
Slovakia	25 °C
USA, Venezuela	60 °F

5.6 Data backup/transmission

Using the T-DAT SAVE/LOAD function, you can transfer data (device parameters and settings) between the T-DAT (exchangeable memory) and the EEPROM (device storage unit).

This is required in the following instances:
- Creating a backup: current data are transferred from an EEPROM to the T-DAT.
- Replacing a transmitter: current data are copied from an EEPROM to the T-DAT and then transferred to the EEPROM of the new transmitter.
- Duplicating data: current data are copied from an EEPROM to the T-DAT and then transferred to EEPROMs of identical measuring points.

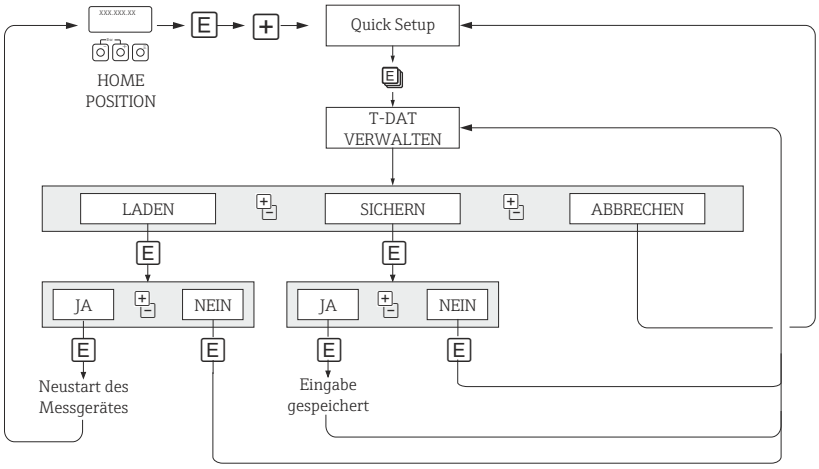


Fig. 2: Data backup/transmission with T-DAT SAVE/LOAD function

5.6.1 Information on the LOAD and SAVE options available

LOAD
Data are transferred from the T-DAT to the EEPROM.

Note!
- Any settings already saved on the EEPROM are deleted.
- This option is only available, if the T-DAT contains valid data.
- This option can only be executed if the software version of the T-DAT is the same or newer than that of the EEPROM. Otherwise, the error message "TRANSM. SW-DAT" appears after restarting and the LOAD function is then no longer available.

SAVE
Data are transferred from the EEPROM to the T-DAT

6 OPERATION

Function description, OPERATION group	
LANGUAGE	**Description** For selecting the language in which all messages are shown on the local display. If you press the ⊡ keys simultaneously at startup, the language defaults to "ENGLISH". **Options** ENGLISH DEUTSCH FRANCAIS ESPANOL ITALIANO NEDERLANDS NORSK SVENSKA SUOMI PORTUGUES POLSKI CESKI **Factory setting** country dependent → 🖹 53
ACCESS CODE	**Description** All data of the measuring device are protected against inadvertent change. Programming is disabled and the settings cannot be changed until a code is entered. If you press the ⊡ operating elements in any function, the measuring device automatically goes to this function and the prompt to enter the code appears on the display (programming disabled). You can enable programming by entering the private code (factory setting = 65, see DEFINE PRIVATE CODE function (→ 🖹 22). ▪ The programming levels are disabled if you do not press the operating elements within 60 seconds following a return to the HOME position. ▪ Programming can also be disabled by entering any number (other than the private code). ▪ Your Endress+Hauser sales center can be of assistance if you mislay your private code. **User input** Max. 4-digit number: 0 to 9999
DEFINE PRIVATE CODE	**Description** Use this function to specify the private code for enabling programming. ▪ Programming is always enabled if the code defined = 0. ▪ Programming has to be enabled before the code can be changed. When programming is disabled this function cannot be edited, thus preventing others from accessing your personal code. **User input** Max. 4-digit number: 0 to 9999 **Factory setting** 65
STATUS ACCESS	**Description** The access status for this function matrix appears on the display. **Display** ACCESS CUSTOMER (parameters can be modified) LOCKED (parameters cannot be modified)

Function description, OPERATION group	
ACCESS CODE COUNTER	**Description** The number of times the private and service code was entered to access the device appears on the display. **Display** Integer **Factory setting** 0

7 USER INTERFACE

Function description, USER INTERFACE group	
ASSIGN LINE 1	**Description** For assigning a display value to the main line (top line of the local display). This value is displayed during normal operation. **Options** OFF MASS FLOW MASS FLOW IN % TEMPERATURE TOTALIZER 1 TOTALIZER 2 AI(1 to 5) - OUT VALUE CORRECTED VOLUME FLOW CORRECTED VOLUME FLOW IN % HEAT FLOW HEAT FLOW IN % AO-VALUE **Factory setting** MASS FLOW
ASSIGN LINE 2	**Description** For assigning a display value to the additional line (bottom line of the local display). This value is displayed during normal operation. **Options** OFF MASS FLOW MASS FLOW IN % MASS FLOW BARGRAPH IN % TEMPERATURE TOTALIZER 1 TAG NAME OPERATING/SYSTEM CONDITIONS TOTALIZER 2 CORRECTED VOLUME FLOW CORRECTED VOLUME FLOW IN % CORRECTED VOLUME FLOW BARGRAPH IN % AI(1 to 5) - OUT VALUE HEAT FLOW HEAT FLOW IN % HEAT FLOW BARGRAPH IN % AO-VALUE **Factory setting** TOTALIZER 1

Function description, USER INTERFACE group	
100% VALUE LINE 1	**Prerequisite** This function is **only** available if one of the following options was selected in the ASSIGN LINE 1 function (→ 🖹 24): ▪ MASS FLOW IN % ▪ CORRECTED VOLUME FLOW IN % ▪ HEAT FLOW IN % **Description** Use this function to enter the flow value which should be shown on the display as the 100% value. **User input** 5-digit floating-point number **Factory setting** 10 kg/h (with mass flow) 10 Nm^3/h (with corrected volume flow) 10 kW (with heat flow)
100% VALUE LINE 2	**Prerequisite** This function is **only** available if one of the following options was selected in the ASSIGN LINE 2 function (→ 🖹 24): ▪ MASS FLOW IN % ▪ CORRECTED VOLUME FLOW IN % ▪ HEAT FLOW IN % ▪ MASS FLOW BARGRAPH IN % ▪ CORRECTED VOLUME FLOW BARGRAPH IN % ▪ HEAT FLOW BARGRAPH IN % **Description** Use this function to enter the flow value which should be shown on the display as the 100% value. **User input** 5-digit floating-point number **Factory setting** 10 kg/h (with mass flow) 10 Nm^3/h (with corrected volume flow) 10 kW (with heat flow)
FORMAT	**Description** For selecting the number of decimal places for the display value in the main line. ▪ Note that this setting only affects the reading as it appears on the display, it has no influence on the accuracy of the system's calculations. ▪ The places after the decimal point as computed by the measuring device cannot always be displayed, depending on this setting and the engineering unit. In these instances an arrow appears on the display between the measured value and the engineering unit (e.g. 1.2 → kg/h), indicating that the measuring device is computing with more decimal places than can be shown on the display. **Options** XXXXX. - XXXX.X - XXX.XX - XX.XXX -X.XXXX **Factory setting** X.XXXX
DISPLAY DAMPING	**Description** For entering a time constant defining how the display reacts to severely fluctuating flow variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). The setting 0 seconds switches off damping. **User input** 0 to 100 seconds **Factory setting** 3 seconds

Function description, USER INTERFACE group	
CONTRAST LCD	**Description** For adjusting the display contrast to suit local operating conditions. **User input** 10 to 100% **Factory setting** 50%
BACKLIGHT	**Description** For adjusting the background lighting to suit local operating conditions. Entering the value “0” means that the backlight is “switched off”. The display then no longer emits any light, i.e. the display texts can no longer be read in the dark. **User input** 0 to 100% **Factory setting** 50%
TEST DISPLAY	**Description** Use this function to test the operability of the local display and its pixels. Test sequence: 1. Start the test by selecting ON. 2. All pixels of the main line and additional line are darkened for minimum 0.75 seconds. 3. The main line and additional line show an "8" in each field for minimum 0.75 seconds. 4. The main line and additional line show a "0" in each field for minimum 0.75 seconds. 5. The main line and additional line show nothing (blank display) for minimum 0.75 seconds. 6. When the test is completed, the local display returns to its initial state and displays the option OFF. **Options** OFF ON **Factory setting** OFF

8 TOTALIZER 1/2

Function description, TOTALIZER 1/2 group	
ASSIGN TOTALIZER	**Description** Use this function to assign a measured variable to the totalizer. ▪ The totalizer is reset to "0" as soon as the option selected is changed. ▪ If you select OFF, only the ASSIGN TOTALIZER function is displayed in the Totalizer 1 or 2 group. **Options** OFF MASS FLOW CORRECTED VOLUME FLOW HEAT FLOW **Factory setting** MASS FLOW
ASSIGN GAS GROUP	**Description** Use this function to assign a gas group to a totalizer. If GAS GROUP 1&2 is selected, the individual values of each gas group are totaled on one totalizer. **Options** GAS GROUP 1 GAS GROUP 2 GAS GROUP 1&2 **Factory setting** GAS GROUP 1
SUM	**Description** The total for the totalizer's measured variable aggregated since measuring commenced appears on the display. The value is positive. The totalizers' response to errors is defined in the FAILSAFE MODE function (→ 🖹 29). **Display** Max. 7-digit floating-point number, including unit (e.g. 15467.04 kg)
OVERFLOW	**Description** The total for the totalizer's overflow aggregated since measuring commenced appears on the display. Total flow is represented by a floating-point number consisting of max. 7 digits. Higher numerical values (>9,999,999) can be viewed as overflows. The effective quantity is thus the total of the SUM function (→ 🖹 27) plus the value displayed in the OVERFLOW function. Example: Reading after 2 overflows: 2 E7 kg (= 20000000 kg) The value displayed in the SUM function = 196845.7 kg Effective total quantity = 20196845.7 kg **Display** Integer with exponent, including unit, e.g. 2 E7 kg

Function description, TOTALIZER 1/2 group	
UNIT TOTALIZER	**Description** For selecting the unit for the measured variable assigned to the totalizer. **Options (ASSIGN TOTALIZER = MASS FLOW)** SI → g , kg, t US → oz, lb, ton **Factory setting** Depends on the nominal diameter and the country → 🖹 53 **Options (ASSIGN TOTALIZER = CORRECTED VOLUME FLOW)** SI → Nl, Nm^3 US → Sm^3, Sft^3 **Factory setting** Depends on the nominal diameter and the country → 🖹 53 **Options (ASSIGN TOTALIZER = HEAT FLOW)** SI → kWh, MWh, kJ, MJ, GJ, kcal, Mcal, Gcal US → kBtu, MBtu, GBtu, tonh **Factory setting** MWh or kBtu (country dependent → 🖹 53)
RESET TOTALIZER	**Description** Resets the sum and overflow in the totalizer selected. **Options** NO YES **Factory setting** NO

9 HANDLING TOTALIZER

Function description, HANDLING TOTALIZER group	
RESET ALL TOTALIZERS	**Description** Resets the sums and overflows of both totalizers to "zero" (=RESET). **Options** NO YES **Factory setting** NO
FAILSAFE MODE	**Description** For selecting the behavior of the totalizer in an alarm condition. **Options** STOP The totalizer does not continue to count the flow if a fault is present. The totalizer stops at the last value before the alarm condition occurred. HOLD VALUE The totalizer continues to count the flow on the basis of the last valid flow data (before the fault occurred). ACTUAL VALUE The totalizers continue to count on the basis of the current flow data. The fault is ignored. **Factory setting** STOP

10 COMMUNICATION

Function description, COMMUNICATION group	
WRITE PROTECTION	**Description** Use this function to check whether the measuring device can be write-accessed. Write protection is activated and deactivated by means of a jumper on the I/O module (see Operating Instructions BA00134D/06). **Display** OFF = Data exchange is possible ON = Data exchange disabled **Factory setting** OFF
SIMULATION	**Description** Use this function to check whether a simulation in the Analog Input or Discrete Output function block is possible. ▪ Write protection is activated and deactivated by means of a jumper on the I/O module (see Operating Instructions BA00134D/06). ▪ The status of the simulation mode is also shown in the parameter BLOCK_ERR of the Resource Block. **Display** OFF Simulation in the Analog Input and Discrete Output function block is **not** possible. ON Simulation in the Analog Input and Discrete Output function block is possible. **Factory setting** ON
DEVICE PD-TAG	**Description** Use this function to enter a tag name for the measuring device. **User input** Max. 32-character text, permissible: A-Z, 0-9, +,-, punctuation marks **Factory setting** E+H_TMASS_65_XXXXXXXXXXX)
MANUFACTURER ID	**Description** Use this function to view the manufacturer ID in decimal numerical format. **Display** 452B48 (hex) for Endress+Hauser
DEVICE TYPE	**Description** Use this function to view the device ID in hexadecimal numerical format. **Display** 1065 (hex) for t-mass 65 FOUNDATION Fieldbus

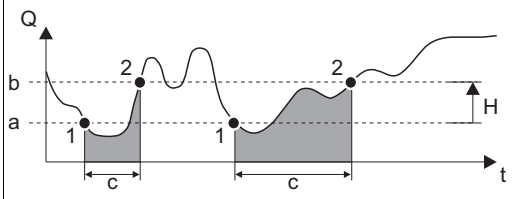
Function description, COMMUNICATION group	
SERIAL NUMBER	**Description** Use this function to view the serial number. **Display** 11-digit number
DEVICE REVISION	**Description** Use this function to view the device revision number. ✎ Note! The information displayed here helps ensure that the correct system files (DD = Device Description) are used for integration into the host system. The system files can be downloaded from the Internet free of charge (www.endress.com). Example: Information displayed in the DEVICE REVISION function → 01 Information displayed in the DD REVISION function → 01 Device description files required (DD)) → 0101.sym / 0101.ffo **Display** 1
DD REVISION	**Description** Use this function to view the revision number of the Device Description. ✎ Note! The information displayed here helps ensure that the correct system files (DD = Device Description) are used for integration into the host system. The system files can be downloaded from the Internet free of charge (www.endress.com). Example: Information displayed in the DEVICE REVISION function → 01 Information displayed in the DD REVISION function → 01 Device description files required (DD)) → 0101.sym / 0101.ffo **Display** 1
BLOCK SELECTION	**Description** In this function, a function block can be selected, whose value and status is shown in the following functions. **Display** ANALOG INPUT 1 to 5 ANALOG OUTPUT PID **Factory setting** ANALOG INPUT 1
OUT VALUE	**Description** Displays the output value OUT, incl. unit and status, of the Analog Input or PID function block selected in the function BLOCK SELECTION.
IN VALUE	**Prerequisite** This function is not available unless the PID option was selected in the BLOCK SELECTION function. **Display** Displays the controlled variable IN, incl. unit and status of the Analog Input or PID function block selected in the function BLOCK SELECTION.

Function description, COMMUNICATION group	
CASCADE_IN VALUE	**Prerequisite** This function is not available unless the PID option was selected in the BLOCK SELECTION function. **Display** Displays an analog set value, incl. unit and status, taken over from an external function block.

11 PROCESS PARAMETER

Function description, PROCESS PARAMETER group	
PROCESS PRESSURE 1	**Prerequisite** This function is **not** available if the IN-SITU CALIBRATION function has been enabled. Refer to your Endress+Hauser sales center for more information. **Description** Use this function to enter the process pressure for GAS GROUP 1. (Selection and composition via the functions in the GAS 1/2 group) The unit is taken from the function UNIT PRESSURE (→ 🖹 10). **Input/display** 5-digit floating-point number **Factory setting** 1.0130 [bar a] or 14.692 [psi a] (country dependent → 🖹 53)
PROCESS PRESSURE 2	**Prerequisite** This function is **not** available if the IN-SITU CALIBRATION function has been enabled. Refer to your Endress+Hauser sales center for more information. **Description** Use this function to enter the process pressure for GAS GROUP 2. (Selection and composition via the functions in the GAS 1/2 group) The unit is taken from the function UNIT PRESSURE (→ 🖹 10). **Input/display** 5-digit floating-point number **Factory setting** 1.0130 [bar a] or 14.692 [psi a] (country dependent → 🖹 53)
PROCESS PRESSURE	**Description** Use this function to display the pressure value which is used for the flow calculation. The value is read from the following function: ▪ PROCESS PRESSURE 1 or 2 (depending on which gas group is active) The unit is taken from the function UNIT PRESSURE (→ 🖹 10). **Display** 5-digit floating-point number **Factory setting** 1.0130 [bar a] or 14.692 [psi a] (country dependent → 🖹 53)
REFERENCE PRESSURE	**Description** Use this function to enter the reference pressure for calculating the reference density (for corrected volume flow measurement). The unit is taken from the function UNIT PRESSURE (→ 🖹 10). **User input** 5-digit floating-point number **Factory setting** 1.0130 [bar a] or 14.692 [psi a] (country dependent → 🖹 53)
REFERENCE TEMPERATURE	**Description** Use this function to enter the reference temperature for calculating the reference density (for corrected volume flow measurement). The unit is taken from the function UNIT TEMPERATURE (→ 🖹 11). **User input** 5-digit floating-point number **Factory setting** 0.0 [°C] or +32.0 [°F] (country dependent → 🖹 53.)

Function description, PROCESS PARAMETER group	
REFERENCE DENSITY	**Prerequisite** This function is **not** available if the IN-SITU CALIBRATION function has been enabled. Refer to your Endress+Hauser sales center for more information. **Description** Use this function to display the calculated reference density (for corrected volume flow measurement). The unit is taken from the function UNIT DENSITY (→ 🖹 11). **Display** 5-digit floating-point number
NET CALORIFIC VALUE	**Prerequisite** This function is **only** available if AUTO NET or MANUAL was selected in the MODE 1 or 2 function (→ 🖹 42) **Description** Use this function to display the current net calorific value of the gas. The unit is taken from the function UNIT CALORIFIC VALUE MASS (→ 🖹 9) or UNIT CALORIFIC VALUE CORRECTED VOLUME (→ 🖹 9). **Display** 5-digit floating-point number
GROSS CALORIFIC VALUE	**Prerequisite** This function is **only** available if AUTO GROSS was selected in the MODE 1 or 2 function (→ 🖹 42). **Description** Use this function to display the current gross calorific value of the gas. The unit is taken from the function UNIT CALORIFIC VALUE MASS (→ 🖹 9) or UNIT CALORIFIC VALUE CORRECTED VOLUME (→ 🖹 9). **Display** 5-digit floating-point number
MOLE % GAS 1	**Prerequisite** This function is **not** available if OFF was selected in the ANALYZER INPUT function (→ 🖹 38) of the active gas group. **Description** Use this function to display the mole % of GAS TYPE 1 (→ 🖹 38) in accordance with the input signal of the gas analyzer. **Display** 0.0 % to 100.0 %
ASSIGN LOW FLOW CUT OFF	**Description** For selecting the process variable on which low flow cut off should act. **Options** OFF MASS FLOW CORRECTED VOLUME FLOW **Factory setting** MASS FLOW

Function description, PROCESS PARAMETER group	
ON-VALUE LOW FLOW CUT OFF	**Prerequisite** This function is **not** available if OFF was selected in the ASSIGN LOW FLOW CUT OFF function (→ 🖹 34). **Description** Use this function to enter the on-value for low flow cut off. The unit is taken from the SYSTEM UNITS group (→ 🖹 8). Low flow cut off is switched on if the value entered is not equal to 0. An inverted plus sign is shown on the local display of the flow value as soon as the low flow cut off is active. **User input** 5-digit floating-point number **Factory setting** 1% of calibrated full scale value
OFF-VALUE LOW FLOW CUT OFF	**Description** Use this function to enter the off-value for low flow cut off. Enter the off-value as a positive hysteresis from the on-value.  A0001245 *Fig. 3: Example for the behavior of low flow cutoff* *Q Flow rate [volume/time]* *t Time* *H Hysteresis* *a ON VALUE LOW FLOW CUT OFF = 20 kg/h* *b OFF-VALUE LOW FLOW CUTOFF = 10%* *c Low flow cutoff active* *1 Low flow cut off is switched on at 20 kg/h* *2 Low flow cut off is switched off at 22 kg/h* **User input** Integer 0 to 100% **Factory setting** 50%
ZERO POINT ADJUST	**Description** Use this function to start automatic zero point adjustment. Caution! Prior to performing zero point adjustment, observe the exact procedure for zero point adjustment as specified in Operating Instructions BA00113D/06. Note! ▪ If zero point adjustment is not possible due to unstable flow conditions, alarm #451 "ADJUST ZERO FAIL" appears on the display. ▪ RESET: reset to factory calibration. **Options** START CANCEL RESET **Factory setting** CANCEL

Function description, PROCESS PARAMETER group	
INSTALLATION FACTOR	**Description** Disturbances in the flow may arise due to the design of the system, such as pipe bends, reducers, etc. The flow value measured is scaled by entering a constant factor. The flow disturbance can thus be compensated using the calculated flow signal: Flow output = measured flow × installation factor Enter a higher value: flow value output is increased. Enter a lower value: flow value output is decreased. **User input** 5-digit floating-point number 0.0000 to 99999 **Factory setting** 1.0000

12 GAS

Function description, GAS group

Prerequisite
This function is **not** available if the IN-SITU CALIBRATION function is enabled. This function is available again if the in-situ calibration is reset to the factory setting. Contact your Endress+Hauser service organization for more information.

Description
Use this function to view or change the gas configuration
- The device can be configured with one or two independent gas groups.
- Switching between two groups can be performed manually (function SELECT GROUP → 🖹 38)

General programming rules:
- A gas group can be configured with 1 single gas or a gas mixture (max. 8 gas constituents).
- The sum of the gas mixture constituents entered must total 100.0 Mole %.
- A gas constituent and its corresponding Mole % can be entered in any order within the mixture.
- A gas constituent may have a value of 0.0 Mole % within the mixture.
- The option NOT USED in the GAS TYPE 1 and GAS TYPE 2 to 8 functions is a place holder where no gas is assigned. The program does not use this option for calculations.
- The option SPECIAL GAS is a substitute for other gases. The Mole % value is always 100.0%

✎ Note!
For a flowchart of the GAS QUICK SETUP, see Operating Instructions BA00134D/06.

Programming examples

a. 1 gas group: 1 standard gas

SELECT GROUP	GAS GROUP 1
ANALYZER INPUT	OFF
NUMBER OF GASES	1
GAS TYPE 1	AIR
MOLE % GAS 1	100.0 %

b. 2 gas groups: 2 standard gases

SELECT GROUP	GAS GROUP 1	GAS GROUP 2
ANALYZER INPUT	OFF	OFF
NUMBER OF GASES	1	1
GAS TYPE 1	ARGON	NITROGEN
MOLE % GAS 1	100.0 %	100.0 %

c. 2 gas groups: 1 standard gas, 1 special gas

SELECT GROUP	GAS GROUP 1	GAS GROUP 2
ANALYZER INPUT	OFF	OFF
NUMBER OF GASES	1	1
GAS TYPE 1	OXYGEN	SPECIAL GAS
MOLE % GAS 1	100.0 %	100.0 %
DESCRIPTION	–	O2 90% OZONE 10%
CORRECTION FACTOR	–	1.2009
REFERENCE DENSITY	–	1.5005 kg/m3

d. 1 gas groups: 1 gas mixture (with gas analyzer input compensation)

SELECT GROUP	GAS GROUP 1
ANALYZER INPUT	ON
NUMBER OF GASES	1
GAS TYPE 1	METHANE
MOLE % GAS 1	50.0 %
GAS TYPE 2	CARBON DIOXIDE
MOLE % GAS 2	40.0 %
GAS TYPE 3	NITROGEN
MOLE % GAS 3	10.0 %

Function description, GAS group	
SELECT GROUP	**Description** ▪ select a gas group for editing ▪ set the active gas group manually Setting the active gas group: ▪ Once all the necessary settings have been programmed in the gas group, select YES in the SAVE CHANGES function (→ 🖹 38), or ▪ If the gas group is already programmed as required, simply select the required gas group and then exit using the ESC keys (⊡+⊡). **Options** GAS GROUP 1 GAS GROUP 2 **Factory setting** GAS GROUP 1
ANALYZER INPUT	**Description** Use this function to activate/deactivate automatic updating of gas mixtures (via a gas analyzer signal). A gas group must contain at least 2 gas types (e.g. Methane 60%, Carbon Dioxide 40%). **User input** OFF ON **Factory setting** OFF
NUMBER OF GASES	**Description** Use this function to enter the number of gases that are used in the gas group. **User input** 1 to 8 **Factory setting** 1
GAS TYPE 1	**Description** Use this function to select gas type 1. **Options** AIR AMMONIA ARGON BUTANE CARBON DIOXIDE CARBON MONOXIDE CHLORINE ETHANE ETHYLENE HELIUM 4 HYDROGEN NORMAL HYDROGEN CHLORIDE HYDROGEN SULFIDE KRYPTON METHANE NEON NITROGEN OXYGEN PROPANE XENON NOT USED SPECIAL GAS **Factory setting** AIR

Function description, GAS group	
MOLE % GAS 1	**Prerequisite** This function is **not** available if the setting in NUMBER OF GASES (→ 🖹 38) is 1. (The factory setting 100% is automatically used) **Description** Use this function to enter the Mole % of the gas selected in GAS TYPE 1. **User input** 000.00 % to 100.00 % **Factory setting** 100.00 %
DESCRIPTION	**Prerequisite** This function is **only** available if the option SPECIAL GAS is selected in the function GAS TYPE 1 (→ 🖹 38). **Description** Use this function to enter a description for a special gas configuration. Example A special composition consisting of 93% oxygen and 7% ozone. User input: O2 93% OZONE 7% **User input** xxxx (max. 16 characters) Valid characters are A-Z, 0-9, +, -, decimal point, blank space or underscore **Factory setting** "– – – – – – – – – – – – – – – –" (no text)
CORRECTION FACTOR	**Prerequisite** This function is **only** available if the option SPECIAL GAS is selected in the function GAS TYPE 1 (→ 🖹 38). **Description** Use this function to enter a manual correction factor for a special gas configuration. The correction factor is normally based on air and at the specified process conditions. The correction factor is determined by the factory. If the gas or process conditions change from the initial setting, then the correction factor value will also need updating. **User input** 5-digit floating-point number **Factory setting** 1.0

Function description, GAS group	
REFERENCE DENSITY	**Prerequisite** This function is **only** available if the option SPECIAL GAS is selected in the function GAS TYPE 1 (→ 🖹 38). **Description** Use this function to enter a reference density for a special gas configuration when corrected volume flow is required, e.g. Nm^3 (Sft^3) The unit is taken from the function UNIT DENSITY (→ 🖹 11). The reference density is determined by the factory. If the gas or reference conditions change from the initial setting, then the reference density value will also need updating. **User input** 5-digit floating-point number, with unit **Factory setting** 1.2930 [kg/m^3] or 0.0807 [lb/ft^3] (country dependent → 🖹 53)
GAS TYPE 2 to 8	**Prerequisite** The number of functions available here is dependent upon the setting in the function NUMBER OF GASES (→ 🖹 38). **Description** Use this function to select the gas type. **Options** AIR AMMONIA ARGON BUTANE CARBON DIOXIDE CARBON MONOXIDE CHLORINE ETHANE ETHYLENE HELIUM 4 HYDROGEN NORMAL HYDROGEN CHLORIDE HYDROGEN SULFIDE KRYPTON METHANE NEON NITROGEN OXYGEN PROPANE XENON NOT USED **Factory setting** NOT USED
MOLE % GAS 2 to 8	**Prerequisite** The number of functions available here is dependent upon the setting in the function NUMBER OF GASES (→ 🖹 38). **Description** Use this function to enter the Mole % of the gas selected in GAS TYPE 2 to 8. **User input** 000.00 % to 100.00 % **Factory setting** 100.00 %

Function description, GAS group	
CHECK VALUES	**Prerequisite** This function is only available if there is an error in the Mole % values. **Description** The error message MIXTURE NOT 100% appears if the entered values do not add up to 100%. The entries have to be checked and corrected before the gas group can be saved and used for flow measurement (see option YES ® function SAVE CHANGES (→ 🖹 41). **Display** MIXTURE NOT 100%
SAVE CHANGES	**Description** Use this function to control the way entries are saved in the gas group and utilized for flow measurement. **Options** CANCEL The entered parameters are saved in the gas group but they are **not** used for flow measurement. The gas group can be activated, at a later time, by returning to the group, checking the parameters and then selecting the option YES in this function. YES The entered parameters are saved in the gas group and are used for flow measurement. DISCARD The entered parameters are not saved. The previous parameters remain valid and are used for flow measurement.

13 HEAT FLOW

Function description, HEAT FLOW group	
CALORIFIC VALUE TYPE	**Description** Use this function to select the measured variable on which the combustion value is based. **Options** ▪ MASS ▪ CORRECTED VOLUME **Factory setting** MASS
MODE 1	**Description** Use this function to select a mode for calculating the heat flow (GAS GROUP 1). **Options** ▪ AUTO NET ▪ AUTO GROSS ▪ MANUAL **Factory setting** AUTO NET
HEATING VALUE 1	**Prerequisite** This function is **only** available if MANUAL was selected in the MODE 1 function (→ 🖹 42). **Description** Use this function to enter a user-specific calorific value. **Input/display** 5-digit floating-point number **Factory setting** 0.0 The corresponding unit is taken from the UNIT CALORIFIC VALUE MASS (→ 🖹 9) or UNIT CALORIFIC VALUE CORRECTED VOLUME function (→ 🖹 9).
MODE 2	**Description** Use this function to select a mode for calculating the heat flow (GAS GROUP 2). **Options** ▪ AUTO NET ▪ AUTO GROSS ▪ MANUAL **Factory setting** AUTO NET
HEATING VALUE 2	**Prerequisite** This function is **only** available if MANUAL was selected in the MODE 2 function (→ 🖹 42). **Description** Use this function to enter a user-specific calorific value. **Input/display** 5-digit floating-point number **Factory setting** 0.0 The corresponding unit is taken from the UNIT CALORIFIC VALUE MASS (→ 🖹 9) or UNIT CALORIFIC VALUE CORRECTED VOLUME function (→ 🖹 9).

Function description, HEAT FLOW group	
REFERENCE COMBUSTION TEMPERATURE	**Prerequisite** This function is **not** available if the option MANUAL is selected in MODE 1 oder 2 (→ 🖹 42). **Description** Use this function to enter the reference combustion temperature of the gas. This function is used to calculate the calorific value of the gas. The unit is taken from the function UNIT TEMPERATURE (→ 🖹 11). **User input** 5-digit floating-point number **Factory setting** 25.0 °C or 60.0 °F (country dependent → 🖹 53)

14 SYSTEM PARAMETER

Function description, SYSTEM PARAMETER group	
POSITIVE ZERO RETURN	**Description** Use this function to interrupt evaluation of measured variables. For example, the output signal should be set to zero flow during operations such as pipe cleaning. The setting acts on all functions and outputs of the measuring device. If the positive zero return is active, the notice message #601 "POSITIVE ZERO-RET" is displayed. **Options** OFF ON (signal output is set to zero flow value, temperature is as normal) **Factory setting** OFF
FLOW DAMPING	**Description** For setting the filter depth. The sensitivity of the flow measurement signal can be reduced with respect to transient flows and interference peaks. The response time of the measuring device increases with every increase in the filter setting. The damping acts prior to other damping functions (e. g. display, time constant). **User input** 0 to 100 s **Factory setting** 1 s

15 SENSOR DATA

Function description, SENSOR DATA group	
This group of functions contains the essential data relating to the sensor geometry and calibration. Flange version (t-mass 65 F): The sensor data cannot be changed and is read only. Insertion version (t-mass 65 I): The sensor data can be changed to suit the application pipe. The pipe or duct dimensions are essential for calculating the correct insertion depth. ✎ Note! To record the sensor data for the insertion sensor (t-mass 65I), see the flowchart of the Quick Setup "Sensor" → 🖹 15. Refer to your Endress+Hauser sales center for more information.	
PIPE TYPE	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). **Description** Use this function to select the type of pipe. **Options** CIRCULAR RECTANGULAR **Factory setting** CIRCULAR
PIPE STANDARD	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **not** available if RECTANGULAR is selected in the PIPE TYPE function (→ 🖹 45). **Description** Use this function to select a pipe standard. If the option OTHERS is selected here, then values need to be entered in the functions OUTER DIAMETEROUTER DIAMETER and WALL THICKNESSWALL THICKNESS. **Options** DIN: PN6, PN10, PN25, PN40 ANSI: B36.10 SCHEDULE 10, 20, 30, 40, 60, 80 B36.19 SCHEDULE 10, 40, 80 OTHERS **Factory setting** PN10 or B36.10 SCHEDULE 10 (country dependent → 🖹 53)

Function description, SENSOR DATA group	
NOMINAL DIAMETER	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **not** available if OTHER was selected in the PIPE STANDARD function (→ 🖹 45) or RECTANGULAR in the PIPE TYPE function (→ 🖹 45). **Description** Use this function to select the nominal diameter of the pipe. **Options** 80/3", 100/4", 150/6", 200/8", 250/10", 300/12", 350/14", 400/16", 450/18", 500/20", 600/24", 700/28", 800/32", 900/36", 1000/40" **Factory setting** 150/6"
OUTER DIAMETER	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if CIRCULAR is selected in the function PIPE TYPE (→ 🖹 45) and OTHER was selected in the function PIPE STANDARD (→ 🖹 45). **Description** Use this function to enter a value for the outer diameter. The unit is taken from the function UNIT LENGTH (→ 🖹 11). **User input** 5-digit floating-point number 60 to 99999 (mm) or 2.362 to 3937 (inch) (country dependent → 🖹 53) **Factory setting** 168.3 (mm) or 6.0 (inch) (country dependent → 🖹 53)
WALL THICKNESS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if OTHER was selected in the PIPE STANDARD function (→ 🖹 45). **Description** Use this function to enter the wall thickness of a circular or rectangular duct. The unit is taken from the function UNIT LENGTH (→ 🖹 11). **User input** 5-digit floating-point number 2.0 to 40.0 (mm) or 0.08 to 1.57 (inch) (country dependent → 🖹 53) **Factory setting** 4.5 (mm) or 0.1771 (inch) (country dependent → 🖹 53)
INTERNAL DIAMETER	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if OTHER is selected in the PIPE STANDARD function (→ 🖹 45) and CIRCULAR was selected in the PIPE TYPE function (→ 🖹 45). **Description** Use this function to view the internal diameter of a circular pipe. The unit is taken from the function UNIT LENGTH (→ 🖹 11). **Display** 5-digit floating-point number **Factory setting** Depends on the sensor size (country dependent → 🖹 53)

Function description, SENSOR DATA group	
INTERNAL HEIGHT	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if RECTANGULAR was selected in the PIPE TYPE function (→ 🖹 45). **Description** Use this function to enter the internal height of a rectangular duct. The unit is taken from the function UNIT LENGTH (→ 🖹 11). **User input** 5-digit floating-point number 45 to 99999 (mm) or 1.771 to 3937 (inch) (country dependent → 🖹 53) **Factory setting** 150.0 (mm) or 6.0 (inch) (country dependent → 🖹 53)
INTERNAL WIDTH	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if RECTANGULAR was selected in the PIPE TYPE function (→ 🖹 45). **Description** Use this function to enter the internal width of a rectangular duct. The unit is taken from the function UNIT LENGTH (→ 🖹 11). **User input** 5-digit floating-point number 45 to 99999 (mm) or 1.771 to 3937 (inch) (country dependent → 🖹 53) **Factory setting** 150.0 (mm) or 6.0 (inch) (country dependent → 🖹 53)
MOUNTING	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if RECTANGULAR was selected in the PIPE TYPE function (→ 🖹 45). **Description** Use this function to select the installation direction of the insertion sensor in the rectangular duct. – If the VERTICAL option is selected, the value from the function INTERNAL HEIGHT (→ 🖹 47) is used to calculate the insertion depth – If the HORIZONTAL option is selected, the value from the function INTERNAL WIDTH (→ 🖹 47) is used to calculate the insertion depth **Options** HORIZONTAL VERTICAL **Factory setting** VERTICAL

Function description, SENSOR DATA group	
MOUNTING SET LENGTH	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). **Description** Use this function to enter a value for the length of the mounting set (including the sensor compression fitting). The unit is taken from the function UNIT LENGTH (→ 🖹 11). **User input** 5-digit floating-point number 75 to 900 (mm) or 2.953 to 35.433 (inch) (country dependent → 🖹 53) **Factory setting** 106.0 (mm) or 4.173 (inch) (country dependent → 🖹 53) The factory setting value is the length of the G1A compression fitting and standard Endress+Hauser mounting boss.
INSERTION DEPTH	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). **Description** This function displays the calculated insertion depth for mounting the sensor. The unit is taken from the function UNIT LENGTH (→ 🖹 11). For more information on insertion depth calculation, please refer to the Operating Instructions BA00134D/06. **Display** 5-digit floating-point number
ZERO POINT	**Description** This function shows the current zero point correction value for the sensor. The zero point is determined by the ZERO POINT ADJUST (→ 🖹 35) function. **User input** 5-digit floating-point number –20.000 to +20.000 **Factory setting** Depends on calibration.
FLOW CONDITIONER	**Description** Use this function to indicate if the t-mass 65F sensor has been calibrated with or without a flow conditioner. **Display** WITH WITHOUT **Factory setting** WITHOUT
CALIBRATION DATE	**Description** Use this function to display the date of the last factory calibration of the measuring device. This date is not updated by the IN-SITU CALIBRATION function. **Options** DD.MM.YYYY

16 SUPERVISION

Function description, SUPERVISION group	
ACTUAL SYSTEM CONDITION	**Description** The current system status appears on the display. **Display** SYSTEM OK or The fault/notice message with the highest priority.
PREVIOUS SYSTEM CONDITION	**Description** The last 16 fault and notice messages appear on the display.
ALARM DELAY	**Description** Use this function to enter a time delay for which the criteria for an error always has to be satisfied before a fault or notice message is generated. Depending on the setting and the type of error, this suppression acts on the display. ✎ Note! If this function is used, fault and notice messages are delayed by the time corresponding to the setting before being forwarded to the higher-level controller (PLC, DCS, etc.). Therefore, check in advance whether a delay of this nature could affect the safety requirements of the process. If fault and notice messages are not be suppressed, than a value of 0 seconds must be entered here. **User input** 0 to 100 s (in steps of one second) **Factory setting** 0 s
SYSTEM RESET	**Description** Use this function to restart (reset) the measuring device. **Options** NO The device is not restarted. RESTART SYSTEM Restart without disconnecting main power. In doing so, all the data (functions) are accepted unchanged. **Factory setting** NO
OPERATION HOURS	**Description** The hours of operation of the device appear on the display. **Display** Depends on the number of hours of operation elapsed: Hours of operation < 10 hours → display format = 0:00:00 (hr:min:sec) Hours of operation 10 to 10 000 hours → display format = 0000:00 (hr:min) Hours of operation >10 000 hours → display format = 000000 (hr)
HOURS SINCE RESET	**Description** The hours of operation since the last reset of the device appear on the display. **Display** Depends on the number of hours of operation elapsed: Hours of operation < 10 hours → display format = 0:00:00 (hr:min:sec) Hours of operation 10 to 10 000 hours → display format = 0000:00 (hr:min) Hours of operation >10 000 hours → display format = 000000 (hr)

17 SIMULATION SYSTEM

Function description, SIMULATION SYSTEM group	
SIMULATION FAIL-SAFE MODE	**Description** Use this function to set all inputs, outputs and the totalizer to their error-response modes, in order to check whether they respond correctly. During this time, the message #691 "SIMULATION FAILSAFE" appears on the display. **Options** OFF ON **Factory setting** OFF
SIMULATION MEASURAND	**Description** Use this function to set all the inputs, outputs and the totalizer to their flow-response modes, in order to check whether they respond correctly. During this time, the message #692 "SIMULATION MEASURAND" appears on the display. Note! ▪ The measuring device can only be used for measuring to a certain extent while the simulation is in progress. ▪ The setting is not saved if the power supply fails. **Options** OFF MASS FLOW CORRECTED VOLUME FLOW TEMPERATURE HEAT FLOW **Factory setting** OFF
VALUE SIMULATION MEASURAND	**Prerequisite** Function is **only** available if the SIMULATION MEASURAND function (→ 🖹 50) is active. **Description** Use this function to specify an arbitrary value (e.g. 12 kg/s) to check the assigned functions in the device itself and downstream signal circuits. The unit depends on the option selected in the SIMULATION MEASURAND function and is taken from the SYSTEM UNITS group (→ 🖹 8). Note! The setting is not saved if the power supply fails. **User input** 5-digit floating-point number **Factory setting** (country dependent → 🖹 53) ▪ 0 kg/h; 0 lb/h (MASS FLOW) ▪ 0 Nm^3/h; 0 Sm^3/h (CORRECTED VOLUME FLOW) ▪ 0 kW; 0 kBtu (HEAT FLOW) ▪ 0 °C; +32 °F (TEMPERATURE)

18 SENSOR VERSION

Function description, SENSOR VERSION group	
SENSOR TYPE	**Description** Use this function to view the sensor type. **Display** FLOWCELL (t-mass 65F flange sensor) INSERTION (t-mass 65I insertion sensor)
SERIAL NUMBER	**Description** The serial number of the sensor appears on the display.
TRANSDUCER SERIAL NUMBER	**Description** The serial number of the transducer appears on the display.
SOFTWARE REVISION NUMBER S-DAT	**Description** Use this function to view the software revision number of the S-DAT.
PRE-AMPLIFIER SOFTWARE REVISION NUMBER	**Description** Use this function to view the software revision number of the preamplifier.
PRE-AMPLIFIER HARDWARE REVISION NUMBER	**Description** Use this function to view the hardware revision number of the preamplifier.

19 AMPLIFIER VERSION

Function description, AMPLIFIER VERSION group	
DEVICE SOFTWARE	**Description** Use this function to display the current device software version.
HARDWARE REVISION NUMBER AMPLIFIER	**Description** Use this function to view the hardware revision number of the amplifier board.
SOFTWARE REVISION NUMBER AMPLIFIER	**Description** Use this function to view the software revision number of the amplifier board.
SOFTWARE REVISION NUMBER T-DAT	**Description** Use this function to view the software revision number of the T-DAT.
I/O MODULE TYPE	**Description** Use this function to view the configuration of the I/O module.
SOFTWARE REVISION NUMBER I/O MODULE	**Description** Use this function to view the software revision number of the I/O module.

20 Factory settings

20.1 Language

Country	Language	Country	Language
Australia	English	Norway	Norwegian
Belgium	English	Austria	German
Denmark	English	Poland	Polish
Germany	German	Portugal	Portuguese
England	English	Sweden	Swedish
Finland	Finnish	Switzerland	German
France	French	Singapore	English
The Netherlands	Dutch	Spain	Spanish
Hong Kong	English	South Africa	English
India	English	Thailand	English
Italy	Italian	Czechia	Czech
Luxembourg	French	Hungary	English
Malaysia	English	Other countries	English

20.2 SI units (not for USA and Canada)

20.2.1 Low flow cut off, full scale value, pulse value

t-mass F sensor
With air at ambient conditions (without a flow conditioner)

Nominal diameter [mm]	Low flow cut off [kg/h]	Full scale value [kg/h]	Pulse value [kg/p]
15	0.53	53	0.10
25	2.00	200	1.00
40	5.55	555	1.00
50	9.10	910	10.00
80	20.30	2030	10.00
100	37.50	3750	10.00

t-mass I sensor
With air at ambient conditions (without a flow conditioner)

Nominal diameter [mm]	Low flow cut off [kg/h]	Full scale value [kg/h]	Pulse value [kg/p]
80	20.30	2030	10.0
100	37.50	3750	10.0
150	75.00	7500	100.0
200	125.00	12500	100.0

Nominal diameter [mm]	Low flow cut off [kg/h]	Full scale value [kg/h]	Pulse value [kg/p]
250	200.00	20000	100.0
300	280.00	28000	100.0
400	500.00	50000	100.0
500	800.00	80000	100.0
600	1150.00	115000	100.0
700	1590.00	159000	100.0
1000	3200.00	320000	100.0
1500	7200.00	720000	100.0

20.2.2 System units

	Unit
Temperature	°C
Density	kg/m³
Reference density	kg/m³
Calorific Value Mass	MJ/kg
Heat	kWh

	Unit
Length	mm
Pressure	bar a
Reference Pressure	bar a
Calorific Value Corr. Vol.	MJ/m³
Reference temperature	°C

20.2.3 Unit totalizer 1 and 2

	Unit
Mass flow	kg
Heat flow	MWh

	Unit
Corrected volume flow	Nm³

20.2.4 Other Units

	Unit	
Ref. combustion temp.	°C	→ 🖹 43
Pipe standard	according to DIN	→ 🖹 45

20.3 US units (only for USA and Canada)

20.3.1 Low flow cut off, full scale value, pulse value

t-mass F sensor
With air at ambient conditions; (without a flow conditioner)

Nominal diameter [mm]	Low flow cut off [lb/hr]	Full scale value [lb/hr]	Pulse value [lb/p]
½"	1.16	116	0.20
1"	4.40	440	2.00
1½"	12.20	1220	2.00
2"	20.02	2002	20.00
3"	44.66	4466	20.00
4"	82.50	8250	20.00

t-mass I sensor
With air at ambient conditions; (without a flow conditioner)

Nominal diameter [mm]	Low flow cut off [lb/hr]	Full scale value [lb/hr]	Pulse value [lb/p]
3"	44.66	4466	20.00
4"	82.50	8250	20.00
6"	165.00	16500	200.00
8"	275.00	27500	200.00
10"	440.00	44000	200.00
12"	610.00	61000	200.00
16"	1100.00	110000	200.00
20"	1760.00	176000	200.00
24"	2530.00	253000	200.00
28"	3498.00	349800	200.00
40"	7040.00	704000	200.00
60"	15840.00	1584000	200.00

20.3.2 System units

	Unit
Temperature	°F
Density	lb/ft³
Reference density	lb/ft³
Calorific Value Mass	kBtu/lb
Heat	kBtu

	Unit
Length	inch
Pressure	psi a
Reference Pressure	psi a
Calorific Value Corr. Vol.	kBtu/Sft³
Reference temperature	°F

20.3.3 Unit totalizer 1 and 2

	Unit
Mass flow	lb
Heat flow	kBtu

	Unit
Corrected volume flow	Sm^3

20.3.4 Other Units

	Unit	
Ref. combustion temp.	°F	→ 🖹 43
Pipe standard	according to ANSI	→ 🖹 45

Index function matrix

Operation via FOUNDATION Field-bus

Endress+Hauser
People for Process Automation

Table of contents for FOUNDATION Fieldbus

1 Block model

In the FOUNDATION Fieldbus all the device parameters are categorized according to their functional properties and task and are generally assigned to three different blocks. A block may be regarded as a container in which parameters and the associated functionalities are contained.

A FOUNDATION Fieldbus device has the following block types.
- A Resource Block
  The Resource Block contains all the device-specific characteristics of the device.
- One or more Transducer Blocks (transmission blocks)
  The Transducer Block contains all the measuring technology and device-specific parameters of the device. The measurement principles (e.g. flow, temperature) are depicted in the Transducer Blocks in accordance with the FOUNDATION Fieldbus specification.
- One or more function blocks
  Function blocks contain the automation functions of the device. We distinguish between different function blocks, e.g. Analog Input function block, Analog Output function block, PID function block (PID controller), etc. Each of these function blocks is used to process different application functions.

Different automation tasks can be realized depending on the arrangement and connection of the individual blocks. In addition to these blocks, a field device may have any number of further blocks, e.g. several Analog Input function blocks if more than one process variable is available from the field device.

The t-mass 65 FOUNDATION Fieldbus has the following blocks:
- 1 Resource Block
- 5 Transducer Blocks
- 12 function blocks consisting of:
  - 5 Analog Input function blocks
  - 1 Analog Output function blocks
  - 1 Discrete Output function block
  - 1 PID function block
  - 1 Arithmetic function block
  - 1 Input Selector function block
  - 1 Signal Characterizer function block
  - 1 Integrator function block

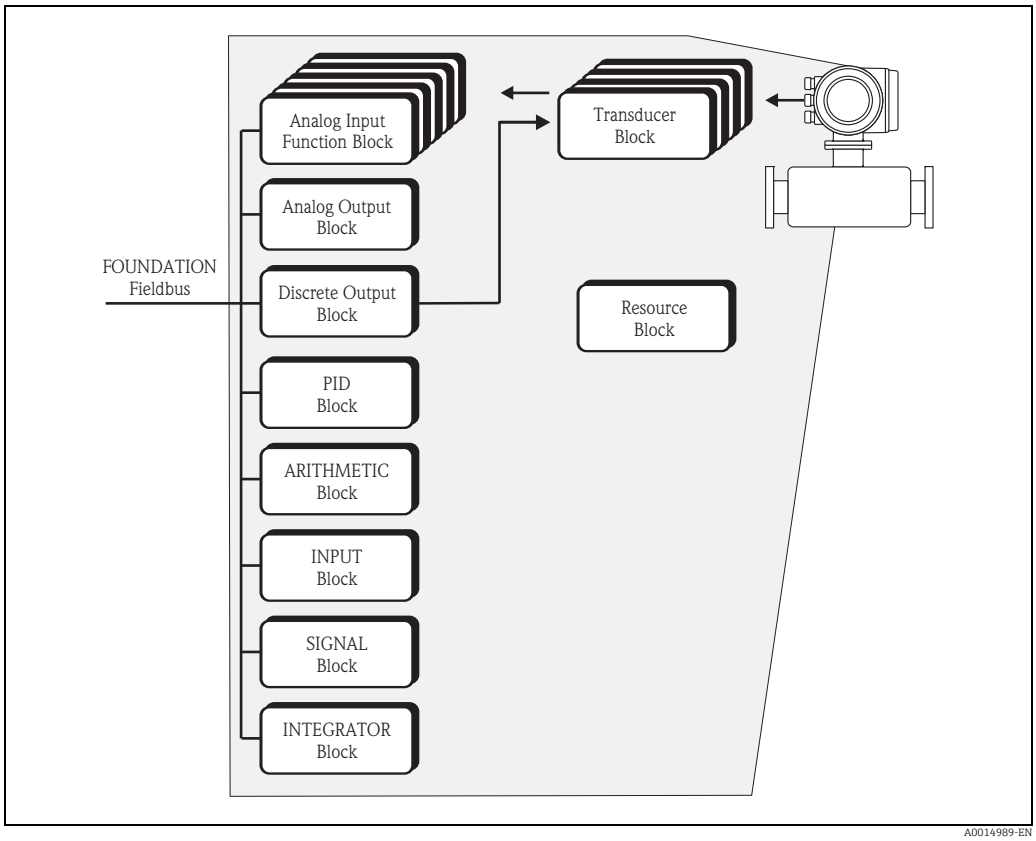


Fig. 1: t-mass 65 FOUNDATION Fieldbus blocks

The sensor signal is first prepared specifically for the flow in the measuring block **(the Transducer Block)**. The process variables are then passed to the **Analog Input function blocks** for technical processing (e.g. scaling, limit value processing).

The process variables go through the complete function block algorithm and are available to other function blocks, e.g. the PID block, as a starting variable for connecting the desired application function.

Using the **Discrete Output function block (DO)**, various actions and functions in the t-mass 65 can be initiated and controlled via FOUNDATION Fieldbus.

Note!
Additional function blocks such as the PID, Arithmetic, Input Selector, Signal Characterizer and Integrator function block are described in the "FOUNDATION Fieldbus Overview" (BA00013S) Operating Instructions (available at: ® www.endress.com ® download).

2 Resource Block

A Resource Block contains all the data that uniquely identifies and characterizes the field device. It is an electronic version of a nameplate on the field device. Parameters of the Resource Block include device type, device name, manufacturer ID, serial number, etc.

A further task of the Resource Blocks is the management of overall parameters and functions that have an influence on the execution of the remaining blocks in the field device. The Resource Block is thus the central unit that also checks the device status and thereby influences or controls the operability of the other blocks and thus also of the device. Since the Resource Block has no block input and block output data, it cannot be linked with other blocks.

The most important functions and parameters of the Resource Block are listed below; you will find an overview of all the available parameters starting on → 8

2.1 Selecting the operating mode

The operating mode is configured via the MODE_BLK parameter group.

The Resource Block supports the following operating modes:
- AUTO (automatic mode)
- OOS (out of service)

Note!
The block status OOS is also shown via the parameter BLOCK_ERR. In operating mode OOS, if write protection is not enabled, you can access all the write parameters without restriction.

2.2 Block status

The current operating status of the Resource Block is shown in the parameter RS_STATE.

The Resource Block can take on the following states:
- STANDBY
  The Resource Block is in the OOS mode.
  It is not possible to execute the remaining blocks.
- ONLINE LINKING
  The connections configured between the function blocks have not yet been linked.
- ONLINE
  Normal operating status, the Resource Block is in the AUTO operating mode. The configured connections between the function blocks have been established.

2.3 Write protection and simulation

Write protection of the device parameters and simulation in the Analog Input and Discrete Output Function Block can be locked or unlocked via a jumper setting on the FOUNDATION Fieldbus
I/O board (Operating Instructions BA00134D/06).

The parameter WRITE_LOCK shows the status of the hardware write protection.
The following statuses are possible:
- LOCKED
  Device data cannot be modified via the FOUNDATION Fieldbus interface.
- NOT LOCKED
  Device data can be modified via the FOUNDATION Fieldbus interface.

The parameter BLOCK_ERR indicates whether a simulation is possible in the Analog Input and Discrete Output function block:
- Simulation Active
  Simulation possible in the Analog Input function block via the SIMULATE parameter and in the Discrete Output function block via the SIMULATE_D parameter.

2.4 Alarm detection and processing

Process alarms provide information on particular block statuses and block events. The status of the process alarms is communicated to the fieldbus host system via the parameter BLOCK_ALM. The parameter ACK_OPTION specifies whether an alarm must be acknowledged via the fieldbus host system.

The following process alarms are generated by the Resource Block:

Block process alarms
The following block process alarms of the Resource Block are shown via the parameter:
- OUT OF SERVICE
- SIMULATE ACTVE

Write protection process alarm
If write protection is disabled on the FOUNDATION Fieldbus I/O board, then prior to communicating the change of status to the fieldbus host system the alarm priority specified in the parameter WRITE_PRI is checked. The alarm priority specifies the action taken when the write protection alarm WRITE_ALM is enabled.

Note!
- If the option of a process alarm has **not** been enabled in the parameter ACK_OPTION, this process alarm only has to be acknowledged in the parameter BLOCK_ALM.
- The parameter ALARM_SUM shows the current status of all the process alarms.

2.5 Resource Block parameters

The following table shows the Endress+Hauser-specific parameters of the Resource Block.

Note!
FOUNDATION Fieldbus parameters are described in the Operating Instructions "FOUNDATION Fieldbus Overview" (BA00013S) (available at: ® www.endress.com ® download).

Resource Block		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Sensor - Serial Number	read only	Use this function to view the sensor serial number.
Amp. - HW Rev.Number	read only	Use this parameter to view the hardware revision number of the amplifier.
Amp. - HW Identification	read only	Use this parameter to view the hardware ID number of the amplifier.
Amp. - SW Rev.Number	read only	Use this function to view the software revision number of the amplifier.
Amp. - SW Identification	read only	Use this function to view the software ID number of the amplifier.
Amp. - Prod.Number	read only	Use this function to view the production number of the amplifier.
Amp. - SW Rev.No. T-DAT	read only	Use this parameter to view the software revision number of the software used to create the content of the T-DAT.
I/O - Type	read only	Use this function to view the I/O module type.
I/O - HW Rev. Number	read only	Use this function to view the hardware revision number of the I/O module.
I/O - HW Identification	read only	Use this parameter to view the hardware ID number of the I/O module.
I/O - SW Rev. Number	read only	Use this function to view the software revision number of the I/O module.
I/O - SW Identification	read only	Use this parameter to view the software ID number of the I/O module.
I/O - Prod.Number	read only	Use this function to view the production number of the I/O module.
Device-Software	read only	Use this function to view the device software version.

3 Transducer Block

The Transducer Blocks contain all the measurement- and device-specific parameters of the flowmeter. All the settings directly connected with the flow measurement/application are made here. They form the interface between the sensor-specific measured value preprocessing and the Analog Input function blocks required for automation.

A Transducer Block allows you to influence the input and output values of a function block. The parameters of a Transducer Block include information on the sensor type, sensor configuration, physical units, calibration, damping, diagnosis, etc. as well as the device-specific parameters. The device-specific parameters and functions are split into several Transducer Blocks, each covering different task areas.

"Flow" Transducer Block / base index 1400:
This block contains all the flow-specific parameters and functions, e.g. calibration functions, sensor data, etc.→ 🖹 13

"Diagnosis" Transducer Block / base index 1600:
This block contains all the parameters for system diagnosis, e.g. current system status etc usw.→ 🖹 27

"Display" Transducer Block / base index 1800:
This block contains all the parameters for configuring the local display
→ 🖹 30

"Totalizer" Transducer Block / base index 1900:
This block contains all the parameters for configuring the totalizers
→ 🖹 35

"Heat Flow" Transducer Block / base index 2700:
This block contains all the parameters for configuring gas measurement
→ 🖹 39

3.1 Signal processing

The following figure shows the internal structure of the individual Transducer Blocks:

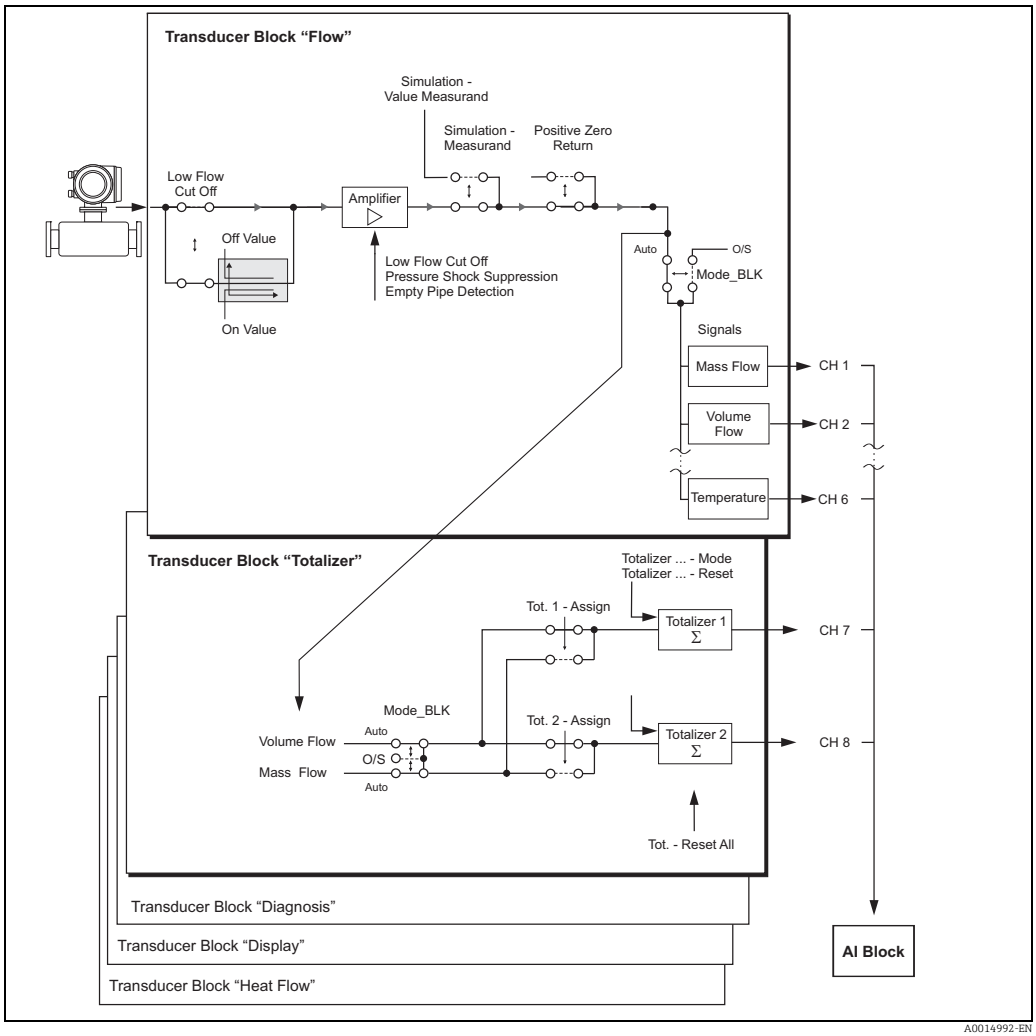


Fig. 2: Internal structure of the individual Transducer Blocks

The Transducer Block receives several signals from the sensor as input values (mass, density, temperature). Other process variables (volume, standard volume) are derived from these signals. The input signals further processed via an amplifier. A low flow cut off allows you to hide measurement inaccuracies in the low-flow sector. The parameter "Low Flow Cut Off - On-Value" (→ 🖹 18) allows you to define a limit value. If the measured flow value is below this limit value then the output value of 0 is output.
The parameter "Simulation - Value Measurand" (→ 🖹 26) allows you to specify a simulation value for the Transducer Block in order to test assigned parameters in the device and subsequent function blocks. In addition, the parameter "System Parameter - Positive Zero Return" (→ 🖹 22) allows you to switch the measured value to "Zero Flow". This is necessary when a piping system is being cleaned, for example.
Output variables (process variables) that are made available by the Transducer Blocks → 🖹 11, Output Variable Block.
A process variable, e.g. mass flow, volume flow, etc., can be assigned to the individual totalizers. Each totalizer can be manually reset using the parameter Totalizer (1 - 3) Reset. The most important functions and parameters of the Transducer Blocks are listed below. You will find an overview of all the available parameters starting on → 🖹 13.

3.2 Important functions and parameters of the Transducer Blocks

3.2.1 Block output values

The Transducer Blocks make the following output variables (process variables) available. The CHANNEL parameter in the Analog Input function block is used to assign which process variable is read in and processed in the downstream Analog Input function block.

Note!
The "Diagnosis" and "Display" Transducer Blocks do not have any output variables.

Block	Process variable	Channel parameter (AI Block)
"Flow" Transducer Block	Mass flow	1
	Volume flow	2
	Temperature	6
"Totalizer" Transducer Block	Totalizer 1	7
	Totalizer 2	8
"Heat Flow" Transducer Block	Gas analyzer and Heat flow measurement	53

3.2.2 Selecting the operating mode

The operating mode is configured via the MODE_BLK parameter group.

The Transducer Blocks support the following operating modes:
- AUTO (automatic mode)
- OOS (out of service)

Note!
- The block status OOS is also shown via the parameter BLOCK_ERR. In operating mode OOS, if write protection is not enabled and the release code is entered, you can access all the write parameters without restriction.
- The following applies for the "Flow" and "Totalizer" Transducer Blocks: In the "OOS" operating mode, the process variables are updated but the status of the output value OUT (AI Block) changes to "BAD".
- If problems occur during the configuration of the function blocks → See Operating Instructions BA00135D/06, "Troubleshooting" section.

3.2.3 Alarm detection and processing

The Transducer Blocks do not generate any process alarms. The status of the process variables is evaluated in the subsequent Analog Input function blocks. If the Analog Input function block does not receive an input value that can be evaluated from the Transducer Blocks, then a process alarm is generated. This process alarm is displayed in the BLOCK_ERR parameter of the Analog Input function block (BLOCK_ERR = Input Failure).
The parameter BLOCK_ERR of the "Diagnosis" Transducer Block displays the device error that produced the input value that could not be evaluated and thus triggered the process alarm in the Analog Input function block.
In addition, the active device error is displayed via the "Diagnosis" Transducer Block in the "Diag. - Act.Sys.Condition" parameter (→ 27).
For more information on rectifying errors → See Operating Instructions BA00135D/06, "Troubleshooting" section.

3.2.4 Diagnosis

The status of the device is displayed via the following parameters specified in the FOUNDATION Fieldbus specification:
- BLOCK_ERR
- Transducer Error

Detailed information on the current device status is displayed via the "Diagnosis" Transducer Block in the manufacturer-specific parameter "Diag. - Act.Sys.Condition" (→ 🖹 27).
For more information on rectifying errors → See Operating Instructions BA00135D/06, "Troubleshooting" section.

3.2.5 Accessing the device-specific parameters

To access the device-specific parameters the following requirements must be met:

1. Hardware write protection must be deactivated → See Operating Instructions BA00135D/06.
2. The correct code must be entered in the parameter "Access - Code" via the corresponding Transducer Block.

3.3 "Flow" Transducer Block parameters

The following table shows the Endress+Hauser-specific parameters of the "Flow" Transducer Block. These can only be changed after entering a release code in the "Access - Code" parameter.

Note!
FOUNDATION Fieldbus parameters are described in the Operating Instructions "FOUNDATION Fieldbus Overview" (BA00013S) (available at: ® www.endress.com ® download).

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Access - Code	AUTO - OOS	**Description** All data of the measuring device are protected against inadvertent change. Only when the code has been entered in this parameter can the manufacturer-specific parameters be programmed and the device configuration modified. You can enable programming by entering: ▪ Code 65(factory setting) ▪ Personal code (Access Def.Private Code parameter → 31) Note! ▪ If the hardware write protection is enabled then access to the manufacturer-specific parameters is blocked even if the right code is entered. ▪ You can disable programming again by entering any number (other than the release code) in this parameter. ▪ The Endress+Hauser sales center can be of assistance if you mislay your personal code. ▪ Certain parameters are not accessible unless a special service code is entered. This service code is known only to the Endress+Hauser sales center. Please contact your Endress+Hauser sales center if you require clarification. **User input** Max. 4-digit number: 0 to 9999
Access - Status	read only	**Description** Use this parameter to check the access status for the parameter matrix. **Display** LOCKED (parameterization disabled) ACCESS CUSTOMER (parameterization enabled) ACCESS SERVICE (parameterization enabled)

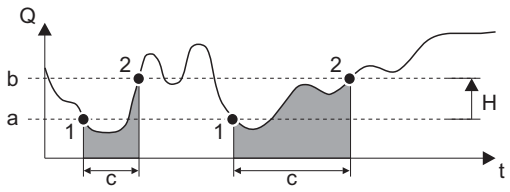
"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
System Value - Mass Flow	read only	**Description** The currently measured mass flow appears on the display. **Display** 5-digit floating-point number, including unit e.g. 462.87 kg/h; 731.63 lb/min
System Unit - Mass Flow	AUTO - OOS	**Description** For selecting the unit required and displayed for the mass flow. The unit you select here is also valid for: ▪ Low flow cut off The following time units can be selected: s = second, m = minute, h = hour, d = day **Options** SI: Gram → g/time unit Kilogram → kg/time unit Metric ton → t/time unit US: Ounce → oz/time unit Pound → lb/time unit Ton → ton/time unit **Factory setting** kg/h or lb/h (country dependent → 🖹 58)
System Value - Corr.Volume Flow	read only	**Description** The calculated corrected volume flow appears on the display. The corrected volume flow is calculated from the measured mass flow and the reference density of the gas. **Display** 5-digit floating-point number, including unit e.g. 104.97 Nm3/h; 110.73 Sm3/h; etc.

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
System Unit - Corr.Volume Flow	AUTO - OOS	**Description** For selecting the unit required and displayed for the corrected volume flow. The unit you select here is also valid for: ▪ Low flow cut off The following time units can be selected: s = second, m = minute, h = hour, d = day **Options** SI: Norm cubic meter → Nm^3/time unit Norm liter → Nl/time unit US: Standard cubic meter → Sm^3/time unit Standard cubic feet → Sft^3/time unit **Factory setting** Nm^3/h or Sm^3/h (country dependent → 🖹 58)
System Unit - Calorific Value Mass	AUTO - OOS	**Description** For selecting the unit required and displayed for the gross/net calorific value. **Options (SI units)** kJ/kg MJ/kg kWh/kg MWh/kg kcal/kg Mcal/kg **Options (US units)** Btu/lb kBtu/lb **Factory setting** MJ/kg or kBtu/lb (country dependent → 🖹 58)
System Unit- Calorific Value Corrected Volume	AUTO - OOS	**Description** For selecting the unit required and displayed for the calorific value based on the corrected volume. **Options (SI units):** kJ/Nm^3 MJ/Nm^3 kWh/Nm^3 MWh/Nm^3 $kcal/Nm^3$ $Mcal/Nm^3$ **Options (US units):** kJ/Sm^3 MJ/Sm^3 kWh/Sm^3 MWh/Sm^3 $kcal/Sm^3$ $Mcal/Sm^3$ Btu/Sft^3 $kBtu/Sft^3$ **Factory setting** MJ/Nm^3 or $kBtu/Sft^3$ (country dependent → 🖹 58)

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
System Value - Heat Flow	read only	**Description** The calculated heat flow appears on the display. **Display** 5-digit floating-point number, including unit, (e.g. 175.00 kJ/h; 50.000 kBtu/h; etc.)
System Unit - Heat Flow	AUTO - OOS	**Description** For selecting the unit required and displayed for the heat flow. The following time units can be selected: s = second, m = minute, h = hour, d = day **Options (SI unit)** kW MW kJ/time unit MJ/time unit GJ/time unit kcal/time unit Mcal/time unit Gcal/time unit **Options (US unit)** tons kBtu/time unit MBtu/time unit GBtu/time unit **Factory setting** kW or kBtu/h (country dependent → 🖹 58)
System Unit - Heat	AUTO - OOS	**Description** For selecting the unit required and displayed for the heat. The following time units can be selected: s = second, m = minute, h = hour, d = day **Options (SI units)** kWh MWh kJ MJ GJ kcal Mcal Gcal **Options (US units)** tonh kBtu MBtu GBtu **Factory setting** kWh or kBtu (country dependent → 🖹 58)

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
System Unit - Pressure	AUTO - OOS	**Description** Use this function to select the unit for pressure. The unit you select here is also valid for: ▪ Process pressure (Process Pressure 1 und 2, → 🖹 20) ▪ Reference pressure (Reference Pressure, → 🖹 20) **Options** bar a (bar absolute) psi a (pound per square inch absolute) kPa a (kilopascal absolute) mmHg 0°C a (millimeter mercury absolute) inHg 32°F a (inch mercury absolute) mmH2O 4°C a (millimeter water absolute) inH2O 39°F a (inch water absolute) kg/cm2 a (kilogram per centimeter squared absolute) **Factory setting** bar a or psi a (country dependent → 🖹 58)
System Value - Temperature	read only	**Description** The currently measured temperature appears on the display. **Display** 5-digit fixed-point number, incl. unit and sign e.g. –23.4 °C, 160.0 °F, 295.4 K
System Unit - Temperature	AUTO - OOS	**Description** For selecting the unit required and displayed for the temperature. **Options** °C (CELSIUS) K (KELVIN) °F (FAHRENHEIT) R (RANKINE) **Factory setting** °C or °F (country dependent → 🖹 58)
System Unit - Density	AUTO - OOS	**Description** For selecting the unit required and displayed for the calculated gas density at process conditions. The unit you select here is also valid for: ▪ Reference density (Process Pressure 1 und 2, → 🖹 20) **Options** SI: g/cm^3 g/cc kg/dm^3 kg/l kg/m^3 US: lb/ft^3 **Factory setting** kg/m^3 or lb/ft^3 (country dependent → 🖹 58)

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
System Unit - Length	AUTO - OOS	**Prerequisite** This function is **only** available for the insertion sensor (t-mass 65I) **Description** For selecting the unit of length required and displayed for the pipe internal diameter or the inner dimensions of rectangular ducts. **Options** MILLIMETER INCH **Factory setting** MILLIMETER or INCH (country dependent → 58)
Low Flow Cut Off - Assign	AUTO - OOS	**Description** For selecting the process variable on which low flow cut off should act. **Options** OFF MASS FLOW CORRECTED VOLUME FLOW **Factory setting** MASS FLOW
Low Flow Cut Off -On Value	AUTO - OOS	**Prerequisite** This function is **not** available if OFF was selected in the Low Flow Cut Off -Assign (→ 18). **Description** Use this function to enter the on-value for low flow cut off. Low flow cut off is switched on if the value entered is not equal to 0. An inverted plus sign is shown on the local display of the flow value as soon as the low flow cut off is active. **User input** 5-digit floating-point number **Factory setting** 1 % of 20 mA value
Low Flow Cut Off - Unit	read only	**Description** Displays the unit of the low flow cut off. Note! Depending on the process variable selected, the unit is taken from the corresponding parameter "System Unit - Mass Flow", "System Unit - Volume Flow" or "System Unit - Corr.Volume Flow".

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Low Flow Cut Off - Off Value	AUTO - OOS	**Description** Use this function to enter the off-value for low flow cut off. Enter the off-value as a positive hysteresis from the on-value.  A0001245 *Fig. 3: Example for the behavior of low flow cutoff* *Q Flow rate [volume/time]* *t Time* *H Hysteresis* *a ON VALUE LOW FLOW CUT OFF = 20 kg/h* *b OFF-VALUE LOW FLOW CUTOFF = 10%* *c Low flow cutoff active* *1 Low flow cut off is switched on at 20 kg/h* *2 Low flow cut off is switched off at 22 kg/h* **User input** Integer 0 to 100% **Factory setting** 50%
Adj. - Zeropoint Adjustment	AUTO - OOS	**Description** Use this function to start automatic zero point adjustment. Caution! Prior to performing zero point adjustment, observe the exact procedure for zero point adjustment as specified in Operating Instructions BA00135D/06. Note! ▪ If zero point adjustment is not possible due to unstable flow conditions, alarm #451 "ADJUST ZERO FAIL" appears on the display. ▪ RESET: reset to factory calibration. **Options** START CANCEL RESET **Factory setting** CANCEL
Installation Factor	AUTO - OOS	**Description** Disturbances in the flow may arise due to the design of the system, such as pipe bends, reducers, etc. The flow value measured is scaled by entering a constant factor. The flow disturbance can thus be compensated using the calculated flow signal: Flow output = measured flow × installation factor Enter a higher value: flow value output is increased. Enter a lower value: flow value output is decreased. **User input** 5-digit floating-point number 0.0000 to 99999 **Factory setting** 1.0000

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Process Pressure 1	AUTO - OOS	**Prerequisite** This function is **not** available if the IN-SITU CALIBRATION function has been enabled. Refer to your Endress+Hauser sales center for more information. **Description** Use this function to enter the process pressure for Gas Group 1. The unit is taken from the function System Unit - Pressure (→ 🖹 17). **Input/display** 5-digit floating-point number **Factory setting** 1.0130 [bar a] or 14.692 [psi a] (country dependent → 🖹 58)
Process Pressure 2	AUTO - OOS	**Prerequisite** This function is **not** available if the IN-SITU CALIBRATION function has been enabled. Refer to your Endress+Hauser sales center for more information. **Description** Use this function to enter the process pressure for Gas Group 2. The unit is taken from the function System Unit - Pressure (→ 🖹 17). **Input/display** 5-digit floating-point number **Factory setting** 1.0130 [bar a] or 14.692 [psi a] (country dependent → 🖹 58)
Press.Corr. - Pressure	AUTO - OOS	**Description** Use this function to display the pressure value which is used for the flow calculation. The value is read from the following function: ▪ Process Pressure 1 or 2 (depending on which gas group is active) The unit is taken from the function System Unit - Pressure (→ 🖹 17). **Display** 5-digit floating-point number **Factory setting** 1.0130 [bar a] or 14.692 [psi a] (country dependent → 🖹 58)
Ref.Param. - Ref. Temperature	AUTO - OOS	**Description** Use this function to enter the reference temperature for calculating the reference density (for corrected volume flow measurement). The unit is taken from the function System Unit - Temperature (→ 🖹 17). **User input** 5-digit floating-point number **Factory setting** 0.0 [°C] or +32.0 [°F] (country dependent → 🖹 58.)
Reference Pressure	AUTO - OOS	**Description** Use this function to enter the reference pressure for calculating the reference density (for corrected volume flow measurement). The unit is taken from the function System Unit - Pressure (→ 🖹 17). **User input** 5-digit floating-point number **Factory setting** 1.0130 [bar a] or 14.692 [psi a] (country dependent → 🖹 58)

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Reference Density	read only	**Prerequisite** This function is **not** available if the IN-SITU CALIBRATION function has been enabled. Refer to your Endress+Hauser sales center for more information. **Description** Use this function to display the calculated reference density (for corrected volume flow measurement). The unit is taken from the function System Unit - Density (→ 🖹 17). **Display** 5-digit floating-point number
Net Calorific Value	read only	**Prerequisite** This function is **only** available if AUTO NET or MANUAL was selected in the Group 1 to 2 - Mode 1 to 2 (→ 🖹 44). **Description** Use this function to display the current net calorific value of the gas. The unit is taken from the function System Unit - Calorific Value Mass (→ 🖹 15) or System Unit- Calorific Value Corrected Volume (→ 🖹 15). **Display** 5-digit floating-point number
Gross Calorific Value	read only	**Prerequisite** This function is **only** available if AUTO GROSS or MANUAL was selected in the Group 1 to 2 - Mode 1 to 2 (→ 🖹 44). **Description** Use this function to display the current net calorific value of the gas. The unit is taken from the function System Unit - Calorific Value Mass (→ 🖹 15) or System Unit- Calorific Value Corrected Volume (→ 🖹 15). **Display** 5-digit floating-point number
Mole % Gas 1	read only	**Prerequisite** This function is **not** available if OFF was selected in the Group 1 to 2 - Analyzer Input (→ 🖹 40). **Description** Use this function to display the Mole % of Group 1 to 2 - Gas Type 1 → 🖹 41 in accordance with the input signal of the gas analyzer. **Display** 0.0 % to 100.0 %
Sys. - Flow Damping	AUTO - OOS	**Description** For setting the filter depth. The sensitivity of the flow measurement signal can be reduced with respect to transient flows and interference peaks. The response time of the measuring device increases with every increase in the filter setting. The damping acts prior to other damping functions (e. g. display, time constant). **User input** 0 to 100 s **Factory setting** 1 s

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Sys. - Positive Zero Return	AUTO - OOS	**Description** Use this function to interrupt evaluation of measured variables. For example, the output signal should be set to zero flow during operations such as pipe cleaning. The setting acts on all functions and outputs of the measuring device. If the positive zero return is active, the notice message #601 "POSITIVE ZERO-RET" is displayed. **Options** OFF ON (signal output is set to zero flow value, temperature is as normal) **Factory setting** OFF
Sensor Data - Pipe Type	AUTO - OOS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). **Description** Use this function to select the type of pipe. **Options** CIRCULAR RECTANGULAR **Factory setting** CIRCULAR
Sensor Data - Pipe Standard	AUTO - OOS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **not** available if RECTANGULAR is selected in the Sensor Data - Pipe Type (→ 🖹 22) function. **Description** Use this function to select a pipe standard. If the option OTHERS is selected here, then values need to be entered in the functions Sensor Data - Outer Pipe Diameter and Sensor Data - Wall Thickness. **Options** DIN: PN6, PN10, PN25, PN40 ANSI: B36.10 SCHEDULE 10, 20, 30, 40, 60, 80 B36.19 SCHEDULE 10, 40, 80 OTHERS **Factory setting** PN10 or B36.10 SCHEDULE 10 (country dependent → 🖹 58)
Sensor Data - Nominal Diameter	AUTO - OOS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **not** available if OTHER was selected in the function Sensor Data - Pipe Standard (→ 🖹 22) or RECTANGULAR in the Sensor Data - Pipe Type (→ 🖹 22). **Description** Use this function to select the nominal diameter of the pipe. **Options** 80/3", 100/4", 150/6", 200/8", 250/10", 300/12", 350/14", 400/16", 450/18", 500/20", 600/24", 700/28", 800/32", 900/36", 1000/40" **Factory setting** 150/6"

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Sensor Data - Outer Pipe Diameter	AUTO - OOS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if CIRCULAR is selected in the function Sensor Data - Pipe Type (→ 🖹 22) and OTHER was selected in the function Sensor Data - Pipe Standard (→ 🖹 22). **Description** Use this function to enter a value for the outer diameter. The unit is taken from the function System Unit - Length (→ 🖹 18). **User input** 5-digit floating-point number 60 to 99999 (mm) or 2.362 to 3937 (inch) (country dependent → 🖹 58) **Factory setting** 168.3 (mm) or 6.0 (inch) (country dependent → 🖹 58)
Sensor Data - Internal Diameter	read only	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if OTHER is selected in the function Sensor Data - Pipe Standard (→ 🖹 22) and CIRCULAR was selected in the function Sensor Data - Pipe Type (→ 🖹 22) . **Description** Use this function to view the internal diameter of a circular pipe. The unit is taken from the function System Unit - Length (→ 🖹 18). **Display** 5-digit floating-point number
Sensor Data - Internal Height	AUTO - OOS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if RECTANGULAR is selected in the function Sensor Data - Pipe Type (→ 🖹 22). **Description** Use this function to enter the internal height of a rectangular duct. The unit is taken from the function System Unit - Length (→ 🖹 18). **User input** 5-digit floating-point number 45 to 99999 (mm) or 1.771 to 3937 (inch) (country dependent → 🖹 58) **Factory setting** 150.0 (mm) or 6.0 (inch) (country dependent → 🖹 58)

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Sensor Data - Internal Width	AUTO - OOS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if RECTANGULAR is selected in the function Sensor Data - Pipe Type (→ 🖹 22). **Description** Use this function to enter the internal width of a rectangular duct. The unit is taken from the function System Unit - Length (→ 🖹 18). **User input** 5-digit floating-point number 45 to 99999 (mm) or 1.771 to 3937 (inch) (country dependent → 🖹 58) **Factory setting** 150.0 (mm) or 6.0 (inch) (country dependent → 🖹 58)
Sensor Data - Wall Thickness	AUTO - OOS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if OTHER was selected in the function Sensor Data - Pipe Standard (→ 🖹 22). **Description** Use this function to enter the wall thickness of a circular or rectangular duct. The unit is taken from the function System Unit - Length (→ 🖹 18). **User input** 5-digit floating-point number 2.0 to 40.0 (mm) or 0.08 to 1.57 (inch) (country dependent → 🖹 58) **Factory setting** 4.5 (mm) or 0.1771 (inch) (country dependent → 🖹 58)
Sensor Data - Mounting	AUTO - OOS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). This function is **only** available if RECTANGULAR is selected in the function Sensor Data - Pipe Type (→ 🖹 22). **Description** Use this function to select the installation direction of the insertion sensor in the rectangular duct. – If the VERTICAL option is selected, the value from the function Sensor Data - Internal Height (→ 🖹 23) is used to calculate the insertion depth. – If the HORIZONTAL option is selected, the value from the function Sensor Data - Internal Width (→ 🖹 24) is used to calculate the insertion depth **Options** HORIZONTAL VERTICAL **Factory setting** VERTICAL

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Sensor Data - Mounting Set Length	AUTO - OOS	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). **Description** Use this function to enter a value for the length of the mounting set (including the sensor compression fitting). The unit is taken from the function System Unit - Length (→ 🖹 18). **User input** 5-digit floating-point number 75 to 900 (mm) or 2.953 to 35.433 (inch) (country dependent → 🖹 58) **Factory setting** 106.0 (mm) or 4.173 (inch) (country dependent → 🖹 58) The factory setting value is the length of the G1A compression fitting and standard Endress+Hauser mounting boss.
Sensor Data - Insertion Depth	read only	**Prerequisite** This function is **only** available for insertion sensors (t-mass 65I). **Description** This function displays the calculated insertion depth for mounting the sensor. The unit is taken from the function System Unit - Length (→ 🖹 18). For more information on insertion depth calculation, please refer to the Operating Instructions BA00134D/06. **Display** 5-digit floating-point number
Sensor Data - Zeropoint	AUTO - OOS	**Description** This function shows the current zero point correction value for the sensor. The zero point is determined by the Adj. - Zeropoint Adjustment (→ 🖹 19) function. **User input** 5-digit floating-point number −20.000 to +20.000 **Factory setting** Depends on calibration.
Sensor Data - Flow Conditioner	read only	**Description** Use this function to indicate if the t-mass 65F sensor has been calibrated with or without a flow conditioner. **Display** WITH WITHOUT **Factory setting** WITHOUT
Sensor Data - Calibration Date	read only	**Description** Use this function to display the date of the last factory calibration of the measuring device. This date is not updated by the IN-SITU CALIBRATION function. **Options** DD.MM.YYYY

"Flow" Transducer Block / base index 1400		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Simulation - Measurand	AUTO - OOS	**Description** Use this function to set all the inputs, outputs and the totalizer to their flow-response modes, in order to check whether they respond correctly. During this time, the message #692 "SIMULATION MEASURAND" appears on the display. ✎ Note! ▪ The measuring device can only be used for measuring to a certain extent while the simulation is in progress. ▪ The setting is not saved if the power supply fails. **Options** OFF MASS FLOW CORRECTED VOLUME FLOW TEMPERATURE HEAT FLOW **Factory setting** OFF
Simulation - Value Measurand	AUTO - OOS	**Prerequisite** Function is **only** available if the Simulation - Measurand function (→ 🖹 26) is active. **Description** Use this function to specify an arbitrary value (e.g. 12 kg/s) to check the assigned functions in the device itself and downstream signal circuits. ✎ Note! The setting is not saved if the power supply fails. **User input** 5-digit floating-point number **Factory setting** (country dependent → 🖹 58) ▪ 0 kg/h; 0 lb/h (MASS FLOW) ▪ 0 Nm^3/h; 0 Sm^3/h (CORRECTED VOLUME FLOW) ▪ 0 MWh; 0 kBtu (HEAT FLOW) ▪ 0 °C; +32 °F (TEMPERATURE)
Sensor Version - Sensor Type	read only	**Description** Use this function to view the sensor type. **Display** FLOWCELL (t-mass 65F flange sensor) INSERTION (t-mass 65I insertion sensor)
Sensor - Prod.Number	read only	**Description** The serial number of the sensor appears on the display.
Sensor Version - Tra.Ser.No	read only	**Description** The serial number of the transducer appears on the display.
Sensor Version - SW-Rev.No.S-DAT	read only	**Description** Use this function to view the software revision number of the S-DAT.
Sensor Version - SW-Rev.No.Pre-Amp.	read only	**Description** Use this function to view the software revision number of the preamplifier.
Sensor Version - HW-Rev.No.Pre-Amp.	read only	**Description** Use this function to view the hardware revision number of the preamplifier.

3.4 "Diagnosis" Transducer Block parameters

The following table shows the Endress+Hauser-specific parameters of the "Flow" Transducer Block. These can only be changed after entering a release code in the "Access - Code" parameter.

Note!
FOUNDATION Fieldbus parameters are described in the Operating Instructions "FOUNDATION Fieldbus Overview" (BA00013S) (available at: ® www.endress.com ® download).

"Diagnosis" Transducer Block / base index 1600		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Diag. - Act. Sys. Condition	read only	The current system status appears on the display. Note! A precise error description as well as notes on remedying errors can be found in the Operating Instructions BA00135D.
Diag. - Prev. ?Sys. ?Conditio n	read only	Displays the last error message that occurred.
Access - Code	AUTO - OOS	**Description** All data of the measuring device are protected against inadvertent change. Only when the code has been entered in this parameter can the manufacturer-specific parameters be programmed and the device configuration modified. You can enable programming by entering: ▪ Code 65(factory setting) ▪ Personal code (Access Def.Private Code parameter → 31) Note! ▪ If the hardware write protection is enabled then access to the manufacturer-specific parameters is blocked even if the right code is entered. ▪ You can disable programming again by entering any number (other than the release code) in this parameter. ▪ The Endress+Hauser sales center can be of assistance if you mislay your personal code. ▪ Certain parameters are not accessible unless a special service code is entered. This service code is known only to the Endress+Hauser sales center. Please contact your Endress+Hauser sales center if you require clarification. **User input** Max. 4-digit number: 0 to 9999

"Diagnosis" Transducer Block / base index 1600		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Access - Status	read only	**Description** Use this parameter to check the access status for the parameter matrix. **Display** LOCKED (parameterization disabled) ACCESS CUSTOMER (parameterization enabled) ACCESS SERVICE (parameterization enabled)
Sys.- Alarm Delay	AUTO - OOS	**Description** Use this function to define a time span for which the criteria for an error have to be satisfied without interruption before a fault or notice message is generated. Depending on the setting and the type of error, this suppression acts on: ▪ Display ▪ Output Blocks (AI Blocks), FOUNDATION Fieldbus interface ✎ Note! If this parameter is used, fault and notice messages are delayed by the time corresponding to the setting before being forwarded to the downstream function blocks or the fieldbus host system. Therefore, check in advance whether a delay of this nature could affect the safety requirements of the process. If fault and notice messages are not be suppressed, than a value of 0 seconds must be entered here. **User input** 0 to 100 s (in steps of one second) **Factory setting** 0 s
Sys.- Sim. Failsafe Mode	AUTO - OOS	**Description** Use this parameter to set the Analog Input and Totalizer function blocks to their defined failsafe modes, in order to check whether they respond correctly. The failsafe mode of the totalizers is defined via the Tot. - Failsafe All parameter (→ 🖹 38). ✎ Note! Active simulation mode is relayed to downstream function blocks or higher level process control systems by means of the status "UNCERTAIN" of the output value OUT (AI Block). **Options** OFF ON **Factory setting** OFF

"Diagnosis" Transducer Block / base index 1600		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Sys.- Reset	AUTO - OOS	**Description** Use this function to restart (reset) the measuring device. **Options** NO The device is not restarted. RESTART SYSTEM Restart without disconnecting main power. In doing so, all the data (functions) are accepted unchanged. **Factory setting** NO
Sys.- Operation Time	read only	**Description** The hours of operation of the device appear on the display. **Display** Depends on the number of hours of operation elapsed: Hours of operation < 10 hours → display format = 0:00:00 (hr:min:sec) Hours of operation 10 to 10 000 hours → display format = 0000:00 (hr:min) Hours of operation >10 000 hours → display format = 000000 (hr)
Sys.- Time Since Reset	read only	**Description** This parameter is only used for service purposes
Sys.- T-DAT Save/ Load	AUTO - OOS	**Description** Use this function to save the configuration/settings of the **transmitter** to a transmitter-DAT (T-DAT), or to load a configuration from the T-DAT to the EEPROM (**manual** backup function). Application examples: ▪ After commissioning, the current measuring point parameters can be saved to the T-DAT as a backup. ▪ If the transmitter is replaced for some reason, the data from the T-DAT can be loaded into the new transmitter (EEPROM). **Options** CANCEL SAVE (from the EEPROM to the T-DAT) LOAD (from the T-DAT to the EEPROM) ✎ Note! ▪ If the target device has an older software version, the message "TRANSM. SW-DAT" is displayed during startup. Then only the "SAVE" option is available. ▪ LOAD This option is only possible: – if the target device has the same software version as, or a more recent software version than, the source device or – if the T-DAT contains valid data that can be called up ▪ SAVE This function is always available. **Factory setting** CANCEL
Sys.- Amp.Device Type	read only	**Description** This parameter is only used for service purposes

3.5 "Display" Transducer Block parameters

The following table shows the Endress+Hauser-specific parameters of the "Display" Transducer Block. These can only be changed after entering a release code in the "Access - Code" parameter.

Note!
FOUNDATION Fieldbus parameters are described in the Operating Instructions "FOUNDATION Fieldbus Overview" (BA00013S) (available at: ® www.endress.com ® download).

"Display" Transducer Block / base index 1800		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Access - Code	AUTO - OOS	**Description** All data of the measuring device are protected against inadvertent change. Only when the code has been entered in this parameter can the manufacturer-specific parameters be programmed and the device configuration modified. You can enable programming by entering: ▪ Code 65(factory setting) ▪ Personal code (Access Def.Private Code parameter → 🖹 31) Note! ▪ If the hardware write protection is enabled then access to the manufacturer-specific parameters is blocked even if the right code is entered. ▪ You can disable programming again by entering any number (other than the release code) in this parameter. ▪ The Endress+Hauser sales center can be of assistance if you mislay your personal code. ▪ Certain parameters are not accessible unless a special service code is entered. This service code is known only to the Endress+Hauser sales center. Please contact your Endress+Hauser sales center if you require clarification. **User input** Max. 4-digit number: 0 to 9999
Access - Status	read only	**Description** Use this parameter to check the access status for the parameter matrix. **Display** LOCKED (parameterization disabled) ACCESS CUSTOMER (parameterization enabled) ACCESS SERVICE (parameterization enabled)

"Display" Transducer Block / base index 1800		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Access Def.Private Code	AUTO - OOS	**Description** Use this function to specify the private code for enabling programming. This applies both to manufacturer-specific parameters in the Transducer Blocks and to operating via the local display ▪ Programming is always enabled if the code defined = 0. ▪ Programming has to be enabled before the code can be changed. When programming is disabled this function cannot be edited, thus preventing others from accessing your personal code. **User input** Max. 4-digit number: 0 to 9999 **Factory setting** 65
Access Code Counter	read only	**Description** The number of times the private and service code was entered to access the device appears on the display. **Display** Integer **Factory setting** 0
Display - Language	AUTO - OOS	**Description** For selecting the language in which all messages are shown on the local display. **Options** ENGLISH DEUTSCH FRANCAIS ESPANOL ITALIANO NEDERLANDS NORSK SVENSKA SUOMI PORTUGUES POLSKI CESKI **Factory setting** country dependent → 🖹 58
Display - Damping	AUTO - OOS	**Description** For entering a time constant defining how the display reacts to severely fluctuating flow variables, either very quickly (enter a low time constant) or with damping (enter a high time constant). The setting 0 seconds switches off damping. **User input** 0 to 100 seconds **Factory setting** 3 seconds

"Display" Transducer Block / base index 1800		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Display - Contrast LCD	AUTO - OOS	**Description** For adjusting the display contrast to suit local operating conditions. **User input** 10 to 100% **Factory setting** 50%
Display - Backlight	AUTO - OOS	**Description** For adjusting the background lighting to suit local operating conditions. Entering the value “0” means that the backlight is “switched off”. The display then no longer emits any light, i.e. the display texts can no longer be read in the dark. **User input** 0 to 100% **Factory setting** 50%
Display - Test	AUTO - OOS	**Description** Use this function to test the operability of the local display and its pixels. Test sequence: 1. Start the test by selecting ON. 2. All pixels of the main line and additional line are darkened for minimum 0.75 seconds. 3. The main line and additional line show an "8" in each field for minimum 0.75 seconds. 4. The main line and additional line show a "0" in each field for minimum 0.75 seconds. 5. The main line and additional line show nothing (blank display) for minimum 0.75 seconds. 6. When the test is completed, the local display returns to its initial state and displays the option OFF. **Options** OFF ON **Factory setting** OFF

"Display" Transducer Block / base index 1800		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Display - Format	AUTO - OOS	**Description** For selecting the number of decimal places for the display value in the main line. ▪ Note that this setting only affects the reading as it appears on the display, it has no influence on the accuracy of the system's calculations. ▪ The places after the decimal point as computed by the measuring device cannot always be displayed, depending on this setting and the engineering unit. In these instances an arrow appears on the display between the measured value and the engineering unit (e.g. 1.2 → kg/h), indicating that the measuring device is computing with more decimal places than can be shown on the display. **Options** XXXXX. - XXXX.X - XXX.XX - XX.XXX -X.XXXX **Factory setting** X.XXXX
Line 1 - Assign	AUTO - OOS	**Description** For assigning a display value to the main line (top line of the local display). This value is displayed during normal operation. **Options** OFF MASS FLOW MASS FLOW IN % TEMPERATURE TOTALIZER 1 TOTALIZER 2 AI(1 to 5) - OUT VALUE CORRECTED VOLUME FLOW CORRECTED VOLUME FLOW IN % HEAT FLOW HEAT FLOW IN % AO - VALUE **Factory setting** MASS FLOW
Line 2 - Assign	AUTO - OOS	**Description** For assigning a display value to the additional line (bottom line of the local display). This value is displayed during normal operation. **Options** OFF MASS FLOW MASS FLOW IN % MASS FLOW BARGRAPH IN % TEMPERATURE TOTALIZER 1 TOTALIZER 2 TAG NAME OPERATING/SYSTEM CONDITIONS CORRECTED VOLUME FLOW CORRECTED VOLUME FLOW IN % CORRECTED VOLUME FLOW BARGRAPH IN % AI(1 to 5) - OUT VALUE HEAT FLOW HEAT FLOW IN % HEAT FLOW BARGRAPH IN % AO - VALUE **Factory setting** TOTALIZER 1

"Display" Transducer Block / base index 1800		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Line 1 - 100% Value	AUTO - OOS	**Prerequisite** This function is **only** available if one of the following options was selected in the Line 1 - Assign function (→ 🖹 33): ▪ MASS FLOW IN % ▪ CORRECTED VOLUME FLOW IN % ▪ HEAT FLOW IN % **Description** Use this function to enter the flow value which should be shown on the display as the 100% value. **User input** 5-digit floating-point number **Factory setting** 10 kg/h (with mass flow) 10 Nm^3/h (with corrected volume flow) 10 kW (with heat flow)
Line 2 - 100% Value	AUTO - OOS	**Prerequisite** This function is **only** available if one of the following options was selected in the Line 2 - Assign function (→ 🖹 33): ▪ MASS FLOW IN % ▪ CORRECTED VOLUME FLOW IN % ▪ HEAT FLOW IN % ▪ MASS FLOW BARGRAPH IN % ▪ CORRECTED VOLUME FLOW BARGRAPH IN % ▪ HEAT FLOW BARGRAPH IN % **Description** Use this function to enter the flow value which should be shown on the display as the 100% value. **User input** 5-digit floating-point number **Factory setting** 10 kg/h (with mass flow) 10 Nm^3/h (with corrected volume flow) 10 kW (with heat flow)

3.6 "Totalizer" Transducer Block parameters

The following table shows the Endress+Hauser-specific parameters of the "Totalizer" Transducer Block. These can only be changed after entering a release code in the "Access - Code" parameter.

Note!
FOUNDATION Fieldbus parameters are described in the Operating Instructions "FOUNDATION Fieldbus Overview" (BA00013S) (available at: ® www.endress.com ® download).

"Totalizer" Transducer Block / base index 1800		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Access - Code	AUTO - OOS	**Description** All data of the measuring device are protected against inadvertent change. Only when the code has been entered in this parameter can the manufacturer-specific parameters be programmed and the device configuration modified. You can enable programming by entering: ▪ Code 65(factory setting) ▪ Personal code (Access Def.Private Code parameter → 🖹 31) Note! ▪ If the hardware write protection is enabled then access to the manufacturer-specific parameters is blocked even if the right code is entered. ▪ You can disable programming again by entering any number (other than the release code) in this parameter. ▪ The Endress+Hauser sales center can be of assistance if you mislay your personal code. ▪ Certain parameters are not accessible unless a special service code is entered. This service code is known only to the Endress+Hauser sales center. Please contact your Endress+Hauser sales center if you require clarification. **User input** Max. 4-digit number: 0 to 9999
Access - Status	read only	**Description** Use this parameter to check the access status for the parameter matrix. **Display** LOCKED (parameterization disabled) ACCESS CUSTOMER (parameterization enabled) ACCESS SERVICE (parameterization enabled)

"Totalizer" Transducer Block / base index 1800		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Tot. 1 to 2 - Sum	AUTO - OOS	**Description** Use this parameter to view the total for the totalizer's measured variable aggregated since measuring commenced. The value can be positive or negative, depending on the setting selected in the parameter Tot. 1 to 2 - Mode (→ 🖹 37) and the direction of flow. ✎ Note! ▪ The effect of the setting in the parameter Tot. 1 to 2 - Mode is as follows: – If the setting is BALANCE, the totalizer balances flow in the positive and negative directions. – If the setting is FORWARD, the totalizer registers only flow in the positive direction. – If the setting is REVERSE, the totalizer registers only flow in the negative direction. ▪ The totalizers' response to faults is defined in the parameter "Tot. - Failsafe All". **Display** Max. 7-digit floating-point number, including unit (e.g. 15467.04 kg)
Tot. 1 to 2 - Unit	AUTO - OOS	**Description** For selecting the unit for the measured variable assigned to the totalizer. The unit selected here does not have any effect on the desired volume unit which should be transmitted by means of the FOUNDATION Fieldbus interface. This setting is made separately by means of the corresponding AI Block in the XD_SCALE parameter group. **Options (Tot. 1 to 2 - Assign = MASS FLOW):** SI → g , kg, t US → oz, lb, ton **Factory setting** kg or lb (country dependent → 🖹 58) **Options (Tot. 1 to 2 - Assign = CORRECTED VOLUME FLOW):** SI → Nl, Nm^3 US → Sm^3, Sft^3 **Factory setting** Nm^3 or Sm^3 (country dependent → 🖹 58) **Options (Tot. 1 to 2 - Assign = HEAT FLOW):** SI → kWh, MWh, kJ, MJ, GJ, kcal, Mcal, Gcal US → kBtu, MBtu, GBtu, tonh **Factory setting** MWh or kBtu (country dependent → 🖹 58)
Tot. 1 to 2 - Assign	AUTO - OOS	**Description** Use this function to assign a measured variable to the totalizer. ▪ The totalizer is reset to "0" as soon as the option selected is changed. ▪ If you select OFF, only the Tot. 1 to 2 - Assign function is displayed in the Totalizer 1 or 2 group.. **Options** OFF MASS FLOW CORRECTED VOLUME FLOW HEAT FLOW **Factory setting** MASS FLOW

"Totalizer" Transducer Block / base index 1800		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Tot. 1 to 2 - Assign Gas Group	AUTO - OOS	**Description** Use this function to assign a gas group to a totalizer. If GAS GROUP 1&2 is selected, the individual values of each gas group are totaled on one totalizer. **Options** GAS GROUP 1 GAS GROUP 2 GAS GROUP 1&2 **Factory setting** GAS GROUP 1
Tot. 1 to 2 - Mode	AUTO - OOS	**Description** Use this parameter to define how the flow components are to be totaled by the totalizer. **Options** BALANCE Positive and negative flow components. The positive and negative flow components are balanced. In other words, net flow in the flow direction is registered. FORWARD Positive flow components only. REVERSE Negative flow components only. **Factory setting** Totalizer 1 = BALANCE Totalizer 2 = FORWARD
Tot. 1 to 2 - Reset	AUTO - OOS	**Description** Resets the sum and overflow in the totalizer selected. **Options** NO YES **Factory setting** NO
Tot. - Reset All	AUTO - OOS	**Description** Reset all totalizers simultaneously to zero (Tot. 1 to 2 - Sum parameter). **Options** NO YES **Factory setting** NO

"Totalizer" Transducer Block / base index 1800		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Tot. - Failsafe All	AUTO - OOS	**Description** For selecting the behavior of the totalizer in an alarm condition. **Options** STOP The totalizer does not continue to count the flow if a fault is present. The totalizer stops at the last value before the alarm condition occurred. HOLD VALUE The totalizer continues to count the flow on the basis of the last valid flow data (before the fault occurred). ACTUAL VALUE The totalizers continue to count on the basis of the current flow data. The fault is ignored. **Factory setting** STOP
Amp.Device Type	read only	**Description** This parameter is only used for service purposes

3.7 "Heat Flow"Transducer Block parameters

The following table shows the Endress+Hauser-specific parameters of the "Totalizer" Transducer Block. These can only be changed after entering a release code in the "Access - Code" parameter.

Note!
FOUNDATION Fieldbus parameters are described in the Operating Instructions "FOUNDATION Fieldbus Overview" (BA00013S) (available at: ® www.endress.com ® download).

"Heat Flow" Transducer Block / base index 2700		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Access - Code	AUTO - OOS	**Description** All data of the measuring device are protected against inadvertent change. Only when the code has been entered in this parameter can the manufacturer-specific parameters be programmed and the device configuration modified. You can enable programming by entering: ▪ Code 65 (factory setting) ▪ Personal code (Access Def.Private Code parameter → 🖹 31) Note! ▪ If the hardware write protection is enabled then access to the manufacturer-specific parameters is blocked even if the right code is entered. ▪ You can disable programming again by entering any number (other than the release code) in this parameter. ▪ The Endress+Hauser sales center can be of assistance if you mislay your personal code. ▪ Certain parameters are not accessible unless a special service code is entered. This service code is known only to the Endress+Hauser sales center. Please contact your Endress+Hauser sales center if you require clarification. **User input** Max. 4-digit number: 0 to 9999
Access - Status "Heat Flow" Transducer Block	read only	**Description** Use this parameter to check the access status for the parameter matrix. **Display** LOCKED (parameterization disabled) ACCESS CUSTOMER (parameterization enabled) ACCESS SERVICE (parameterization enabled)
Gas - Select Group	AUTO - OOS	**Description** ▪ select a gas group for editing ▪ set the active gas group manually Setting the active gas group: ▪ On completion of programming all the necessary functions in the gas group, select YES in the Group 1 to 2 - Save Changes (→ 🖹 44) function, or ▪ If the gas group is already programmed as required, simply select the required gas group and then exit using the ESC keys (□+□). **Options** GAS GROUP 1 GAS GROUP 2 **Factory setting** GAS GROUP 1

"Heat Flow" Transducer Block / base index 2700		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Group 1 to 2 - Analyzer Input	AUTO - OOS	**Description** Use this function to assign automatic updating of a gas group (via a gas analyzer signal and the current input function). A gas group must contain at least 2 gas types (e.g. Methane 60%, Carbon Dioxide 40%). **User input** OFF ON **Factory setting** OFF
Group 1 to 2 - Number Of Gases	AUTO - OOS	**Description** Use this function to enter the number of gases that are used in the gas group. **User input** 1 to 8 **Factory setting** 1

"Heat Flow" Transducer Block / base index 2700		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Group 1 to 2 - Gas Type 1	AUTO - OOS	**Description** Use this function to select gas type 1. **Options** AIR AMMONIA ARGON BUTANE CARBON DIOXIDE CARBON MONOXIDE CHLORINE ETHANE ETHYLENE HELIUM 4 HYDROGEN NORMAL HYDROGEN CHLORIDE HYDROGEN SULFIDE KRYPTON METHANE NEON NITROGEN OXYGEN PROPANE XENON NOT USED SPECIAL GAS **Factory setting** AIR

"Heat Flow" Transducer Block / base index 2700		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Group 1 to 2 - Gas Type 2 To 8	AUTO - OOS	**Prerequisite** The number of functions available here is dependent upon the setting in the function Group 1 to 2 - Number Of Gases (→ 🖹 40). **Description** Use this function to select the gas type. **Options** AIR AMMONIA ARGON BUTANE CARBON DIOXIDE CARBON MONOXIDE CHLORINE ETHANE ETHYLENE HELIUM 4 HYDROGEN NORMAL HYDROGEN CHLORIDE HYDROGEN SULFIDE KRYPTON METHANE NEON NITROGEN OXYGEN PROPANE XENON NOT USED **Factory setting** NOT USED
Group 1 to 2 - Correction Factor	AUTO - OOS	**Prerequisite** This function is **only** available if the option SPECIAL GAS is selected in the function Group 1 to 2 - Gas Type 1 (→ 🖹 41). **Description** Use this function to enter a manual correction factor for a special gas configuration. The correction factor is normally based on air and at the specified process conditions. The correction factor is determined by the factory. If the gas or process conditions change from the initial setting, then the correction factor value will also need updating. **User input** 5-digit floating-point number **Factory setting** 1.0
Group 1 to 2 - Reference Density	AUTO - OOS	**Prerequisite** This function is **only** available if the option SPECIAL GAS is selected in the function Group 1 to 2 - Gas Type 1 (→ 🖹 41). **Description** Use this function to enter a reference density for a special gas configuration when corrected volume flow is required, e.g. Nm^3 (Sft^3). The unit is taken from the function System Unit - Density (→ 🖹 17). The reference density is determined by the factory. If the gas or reference conditions change from the initial setting, then the reference density value will also need updating. **User input** 5-digit floating-point number, with unit **Factory setting** 1.2930 [kg/m^3] or 0.0807 [lb/ft^3] (country dependent → 🖹 58)

"Heat Flow" Transducer Block / base index 2700		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Group 1 to 2 - Mole % Gas 1	AUTO - OOS	**Prerequisite** This function is **not** available if the setting in Group 1 to 2 - Number Of Gases (→ 🖹 40) is 1. (The factory setting 100% is automatically used) **Description** Use this function to enter the Mole % of the gas selected in Group 1 to 2 - Gas Type 1. **User input** 000.00 % to 100.00 % **Factory setting** 100.00 %
Group 1 to 2 - Mole % Gas 2 To 8	AUTO - OOS	**Prerequisite** The number of functions available here is dependent upon the setting in the function Group 1 to 2 - Number Of Gases (→ 🖹 40). **Description** Use this function to enter the Mole % of the gas selected in Group 1 to 2 - Gas Type 2 To 8. **User input** 000.00 % to 100.00 % **Factory setting** 100.00 %
Group 1 to 2 - Description	AUTO - OOS	**Prerequisite** This function is **only** available if the option SPECIAL GAS is selected in the function Group 1 to 2 - Gas Type 1 (→ 🖹 41). **Description** Use this function to enter a description for a special gas configuration. Example A special composition consisting of 93% oxygen and 7% ozone. User input: O2 93% OZONE 7% **User input** xxxx (max. 16 characters) Valid characters are A-Z, 0-9, +, -, decimal point, blank space or underscore **Factory setting** "– – – – – – – – – – – – – – – –" (no text)
Group 1 to 2 - Check Values	AUTO - OOS	**Prerequisite** This function is only available if there is an error in the Mole % values. **Description** The error message MIXTURE NOT 100% appears if the entered values do not add up to 100%. The entries have to be checked and corrected before the gas group can be saved and used for flow measurement (see option YES ® function Group 1 to 2 - Save Changes (→ 🖹 44). **Display** MIXTURE NOT 100%

"Heat Flow" Transducer Block / base index 2700		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Group 1 to 2 - Save Changes	AUTO - OOS	**Description** Use this function to control the way entries are saved in the gas group and utilized for flow measurement. **Options** CANCEL The entered parameters are saved in the gas group but they are **not** used for flow measurement. The gas group can be activated, at a later time, by returning to the group, checking the parameters and then selecting the option YES in this function. YES The entered parameters are saved in the gas group and are used for flow measurement. DISCARD The entered parameters are not saved. The previous parameters remain valid and are used for flow measurement.
Gas - Calorific Value Type	AUTO - OOS	**Description** Use this function to select the measured variable on which the combustion value is based. **Options** ▪ MASS ▪ CORRECTED VOLUME **Factory setting** MASS
Group 1 to 2 - Mode 1 to 2	AUTO - OOS	**Description** Use this function to select a mode for calculating the heat flow (GAS GROUP 1). **Options** ▪ AUTO NET ▪ AUTO GROSS ▪ MANUAL **Factory setting** AUTO NET

"Heat Flow" Transducer Block / base index 2700		
Parameter	**Write access with operating mode (MODE_BLK**	**Description**
Group 1 to 2 - Heating Value 2	AUTO - OOS	**Prerequisite** This function is **only** available if MANUAL was selected in the Group 1 to 2 - Mode 1 to 2 (→ 🖹 44) function. **Description** Use this function to enter a user-specific calorific value. **Input/display** 5-digit floating-point number **Factory setting** 0.0 The corresponding unit is taken from the System Unit - Calorific Value Mass (→ 🖹 15) or System Unit- Calorific Value Corrected Volume function (→ 🖹 15).
Gas - Reference Combustion Temperature	AUTO - OOS	**Prerequisite** This function is **not** available if the option MANUAL is selected in Group 1 to 2 - Mode 1 to 2 (→ 🖹 44). **Description** Use this function to enter the reference combustion temperature of the gas. This function is used to calculate the calorific value of the gas. The unit is taken from the function System Unit - Temperature (→ 🖹 17). **User input** 5-digit floating-point number **Factory setting** 25.0 °C or 60.0 °F (country dependent → 🖹 58)

4 Function blocks

The function blocks contain the basic automation functions of the field device. We distinguish between different function blocks, e.g. Analog Input function block, PID function block (PID controller), etc.

Each of these function blocks is used to execute different application functions. This means that local control functions, for example, can be carried out directly in the field, and device errors such as amplifier errors are reported to the automation system automatically.

The function blocks process the input values in accordance with their specific algorithm and their internally available parameters. They generate output values that are made available to other function blocks for further processing by linking the individual function blocks with each other.

5 Analog Input function block

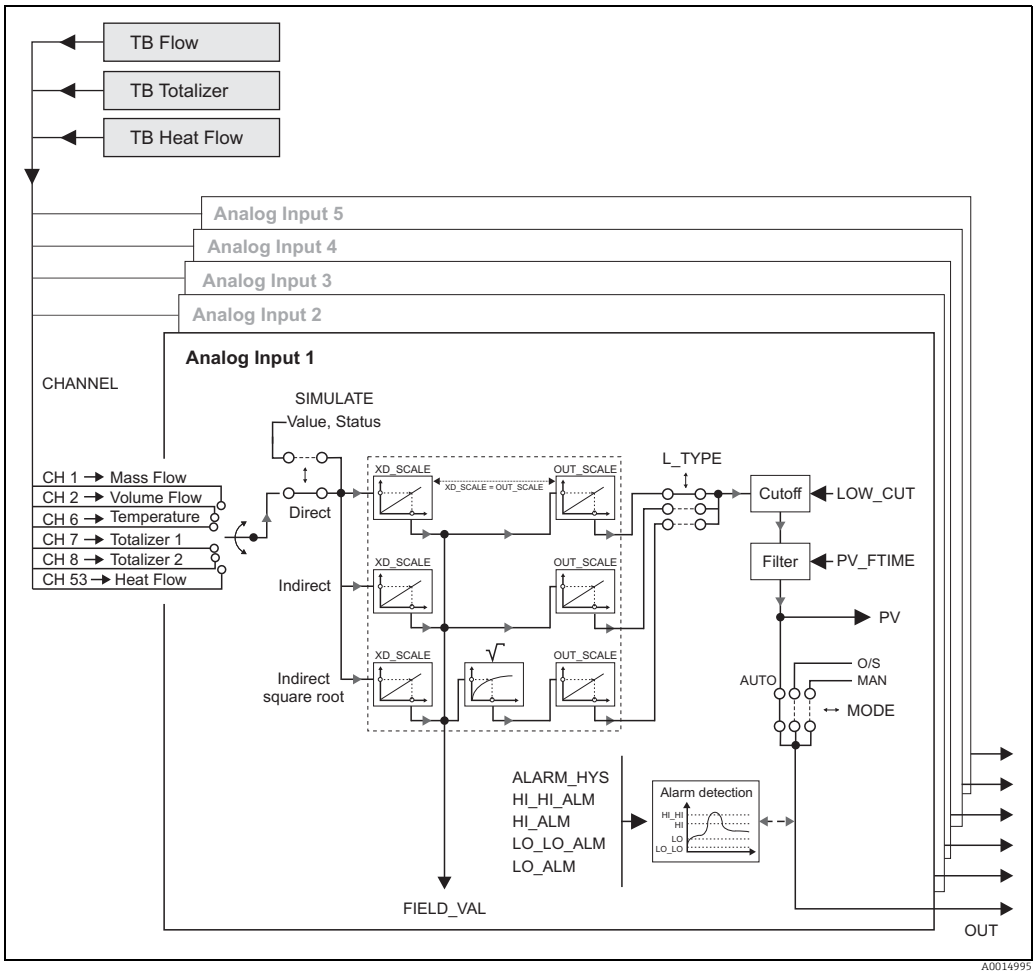
In the Analog Input function block (AI) the process variables from the Transducer Block are prepared for the subsequent automation functions (e.g. scaling, limit value processing). The automation function is defined by the connections of the outputs.

A0003800

OUT = output value and output status of the Analog Input function block

5.1 Signal processing

The figure shows the internal structure of the Analog Input function blocks available:



A0014995

Fig. 4: Internal structure of the individual Analog Input function blocks

The Analog Input function blocks receive their input values from the **Transducer Blocks**. The parameter CHANNEL is used to select which input value is to be processed in an **Analog Input function block**.

Factory-based configuration of the Transducer Blocks → 🖹 11

The parameter group SIMULATE allows you to replace the input value with a simulation value and to activate simulation. By specifying the status and the simulation value the reaction of the complete Analog Input function block can be tested.

Note!
The simulation mode is activated by means of jumpers on the I/O board (→ See Operating Instructions BA00134D)

The parameter L_TYPE is used to select the linearization type of the input or simulation value:
- Direct signal conversion
  The value is forwarded without conversion (XD_SCALE = OUT_SCALE). Select this option if the input value is already in the physical unit you want
- Indirect signal conversion
  With this setting the measured value from the Transducer Block (input value) is re-scaled linearly via the input scaling XD_SCALE to the desired output range OUT_SCALE (further information on rescaling of the input value can be found on
  → 51).
- Indirect signal conversion with square root
  With this setting the measured value from the Transducer Block (input value) is re-scaled via the parameter group XD_SCALE and recalculated using a square root function. It is then rescaled again to the desired output range via the parameter group OUT_SCALE

The parameter LOW_CUT allows a limit value to be specified for the low flow cut off. The low flow cut off is activated via the parameter IO_OPTS. If the converted primary value (PV) is below the limit value then it is set to a value of "Zero".

In the parameter PV_FTIME a filter time can be specified for filtering the converted primary value (PV). If a time of 0 seconds is specified then no filtration takes place.

The parameter group MODE_BLK is used to select the operating mode of the Analog Input function block. If the operating mode MAN (manual) is selected then the output value OUT can be specified directly.

The output value OUT is compared with warning and alarm limits (e.g. HI_LIM, LO_LO_LIM, etc.) that can be entered via various parameters. If one of these limit values is violated then a limit value process alarm (e.g. HI_ALM, LO_LO_ALM, etc.) is triggered.

5.2 Important functions and parameters of the Analog Input function blocks

The most important functions and parameters of the Analog Input function blocks are listed below.

Note!
All the FOUNDATION Fieldbus parameters available are described in the Operating Instructions "FOUNDATION Fieldbus Overview" (BA00013S) (available at: ® www.endress.com ® download).

5.2.1 Selecting the operating mode

The operating mode is configured via the MODE_BLK parameter group. The Analog Input function block supports the following operating modes:
- AUTO (automatic mode)
- MAN (manual mode)
- OOS (out of service)

Note!
The block status OOS is also shown via the parameter BLOCK_ERR. In operating mode OOS, if write protection is not enabled, you can access all the write parameters without restriction.

5.2.2 Assignment of the process variable

The t-mass 65 FOUNDATION Fieldbus has five Analog Input function blocks. The process variables of the Transducer Block that are to be processed are assigned via the parameter CHANNEL.

Factory-based configuration of the Transducer Blocks → 🖹 11

5.2.3 Linearization types

In an Analog Input function block, the input value of a Transducer Block can be linearized using the parameter L_TYPE. The following types of linearization are available:
- Direct
  With this setting the measured value from the Transducer Block (input value) bypasses the linearization function and is looped unchanged with the same unit through the Analog Input function block.
- Indirect
  With this setting the measured value from the Transducer Block (input value) is re-scaled linearly via the input scaling XD_SCALE to the desired output range OUT_SCALE.
- Indirect Square Root
  With this setting the measured value from the Transducer Block (input value) is re-scaled via the parameter group XD_SCALE and recalculated using a square root function. It is then rescaled again to the desired output range via the parameter group OUT_SCALE.

5.2.4 Selection of units

A change in the unit for a process variable is defined in the relevant Analog Input function block, in the parameter group XD_SCALE via the element UNIT.

If an unsuitable unit is selected, the function block changes to the OOS mode (out of service).

Note!
- If the "Direct" type of linearization was selected via the L_TYPE parameter, the setting of the XD_SCALE and OUT_SCALE parameter groups must be identical; otherwise, the function block remains in the OOS operating mode and the "BLOCK CONFIG ERROR" block error is displayed in the BLOCK_ERROR parameter.
- The system units selected in the Transducer Blocks in question do not have any effect on the setting of the system units in the Analog Input function block. The units are specified independently of one another and must be configured separately. The unit selected in the Transducer Blocks is only used for the local display, EPD adjustment, low flow cut off and for simulation.

5.2.5 Status of the output value OUT

The status of the parameter group OUT communicates to the subsequent function blocks the status of the Analog Input function block and the validity of the output value OUT. The following status values can be displayed:
- GOOD_NON_CASCADE
  The output value OUT is valid and can be used for further processing.
- UNCERTAIN
  The output value OUT can only be used for further processing to a limited extent. The status tells the downstream function blocks that a "notice message" is present in the device, e.g. arising from active positive zero return or simulation.
- BAD
  The output value OUT is invalid. The following causes are possible:
  – The Analog Input function block is in the OOS operating mode.
  – The Resource Block is in the OOS mode.
  – The "Flow" or "Totalizer" Transducer Block is in the OOS operating mode. The Analog Input function block can only process the input value of the Transducer Block in question if the operating mode is set to AUTO.
  – A "fault message" is present in the device arising from a critical device error, e.g. an electronics module defect.

Note!
- The status of the device (block error) is displayed by means of the BLOCK_ERR parameter.
- Detailed information on the current device status is displayed via the "Diagnosis" Transducer Block in the parameter "Diag. - Act.Sys.Condition". A list of all the error messages, including remedial measures, can be found in the Operating Instructions ? BA00135D.

5.2.6 Simulation of input/output

Parameters of the Analog Input function block allow simulation of the input and output of the function block:

1. Simulation of the input of the Analog Input function block:
   The parameter group SIMULATE can be used to specify the input value (measured value and status). Since the simulation value runs through the entire function block, all the parameter settings of the block can be checked.

   ✎ Note!
   If simulation is blocked by the jumper on the I/O board then simulation mode cannot be activated in the parameter SIMULATE. In the Resource Block, the parameter BLOCK_ERROR shows whether simulation of the Analog Input function block is possible.

2. Simulation of the output of the Analog Input function block:
   Set the operating mode in the parameter group MODE_BLK to MAN and specify the desired output value directly in the parameter OUT.

5.2.7 Diagnosis

The status of the device is displayed via the BLOCK_ERR parameter specified in the FOUNDATION Fieldbus specification.

Detailed information on the current device status is displayed via the "Diagnosis" Transducer Block in the manufacturer-specific parameter "Diag. - Act.Sys.Condition" (→ 🖹 27).

For more information on rectifying errors → See Operating Instructions BA00135D, "Troubleshooting" section.

5.2.8 Rescaling the input value

In the Analog Input function block the input value or input range can be scaled in accordance with the automation requirements.

Example:
- The system unit in the Transducer Block is kg/h.
- The measurement range of the sensor is 0 to 30 kg/h.
- The output range to the process control system should be 0 to 100%.

The Analog Input function block must be configured as follows:
- Parameter CHANNEL
  Select: CHANNEL → 1 = Mass Flow
- Parameter L_TYPE
  Select: L_TYPE = Indirect
  The process variable "Volume flow" from the "Flow" Transducer Block is rescaled linearly in the AI Parameter group via input scaling XD_SCALE to the desired output range OUT_SCALE.
- Parameter group XD_SCALE
  XD_SCALE 0 % = 0
  XD_SCALE 100 % = 30
  XD_SCALE UNIT = kg/h

- Parameter group OUT_SCALE
  OUT_SCALE 0 % = 0
  OUT_SCALE 100 % = 100
  OUT_SCALE UNIT = %

The result is that with an input value of, for example, 15 kg/h a value of 50% is output via the parameter OUT.

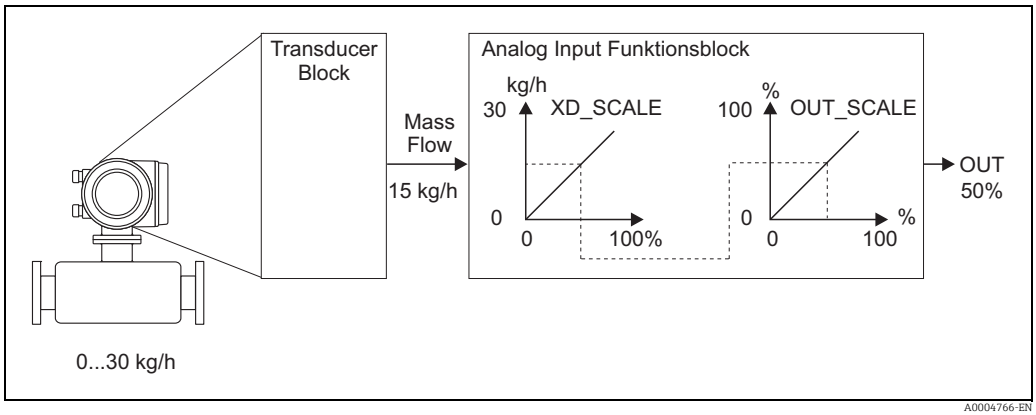


Fig. 5: Rescaling the input value (example)

5.2.9 Limit values

The limit values are based on the output value OUT. If the output value OUT exceeds or does not reach the defined limit values then an alarm is sent to the fieldbus host system via the limit value process alarms. The following limit values can be defined:
- HI_HI_LIM (upper alarm limit)
- HI_LIM (upper pre-warning limit)
- LO_LO_LIM (lower alarm limit)
- LO_LIM (lower pre-warning limit)

5.2.10 Alarm detection and processing

Process alarms provide information on particular block statuses and block events. The status of the process alarms is communicated to the fieldbus host system via the parameter BLOCK_ALM. The parameter ACK_OPTION specifies whether an alarm must be acknowledged via the fieldbus host system.

The following process alarms are generated by the Analog Input function block:

Block process alarms

A block process alarm is triggered via the BLOCK_ERR parameter. The parameter BLOCK_ALM is used to show the block process alarms and communicate them to the fieldbus host system. The following process alarms can be generated by the Analog Input function block:
- SIMULATE ACTIVE
- INPUT FAILURE
- OUT OF SERVICE
- BLOCK CONFIG ERROR

If the option of the process alarm (BLOCK ALM) has not been enabled in the parameter ACK_OPTION, the process alarms must be acknowledged in the parameter BLOCK_ALM.

Limit value process alarms

If a limit value is infringed then the priority specified for the limit value alarm will be checked before the limit value violation is communicated to the fieldbus host system. The priority that specifies the action in the event of an active limit value violation is determined by the following parameters:
- HI_HI_PRI (upper alarm limit)
- HI_PRI (upper pre-warning limit)
- LO_LO_PRI (lower alarm limit)
- LO_PRI (lower pre-warning limit)

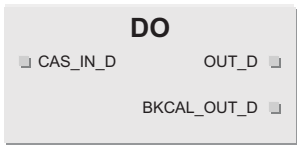
The status of the limit value process alarms is communicated to the fieldbus host system via the following parameters:
- HI_HI_ALM (upper alarm limit)
- HI_ALM (upper pre-warning limit)
- LO_LO_ALMI (lower alarm limit)
- LO_ALM (lower pre-warning limit)

If the option of a limit value process alarm has not been enabled in the parameter ACK_OPTION then this must be acknowledged directly in its parameter (see list.

Note!
The parameter ALARM_SUM shows the current status of all the process alarms.

6 Discrete Output function block

The Discrete Output function block (DO, Discrete Output) processes a discrete setpoint value received from an upstream function block or higher level process control system, with which various instrument functions (e.g. zero point adjustment or totalizer reset) can be initiated in the subsequent Transducer Block.



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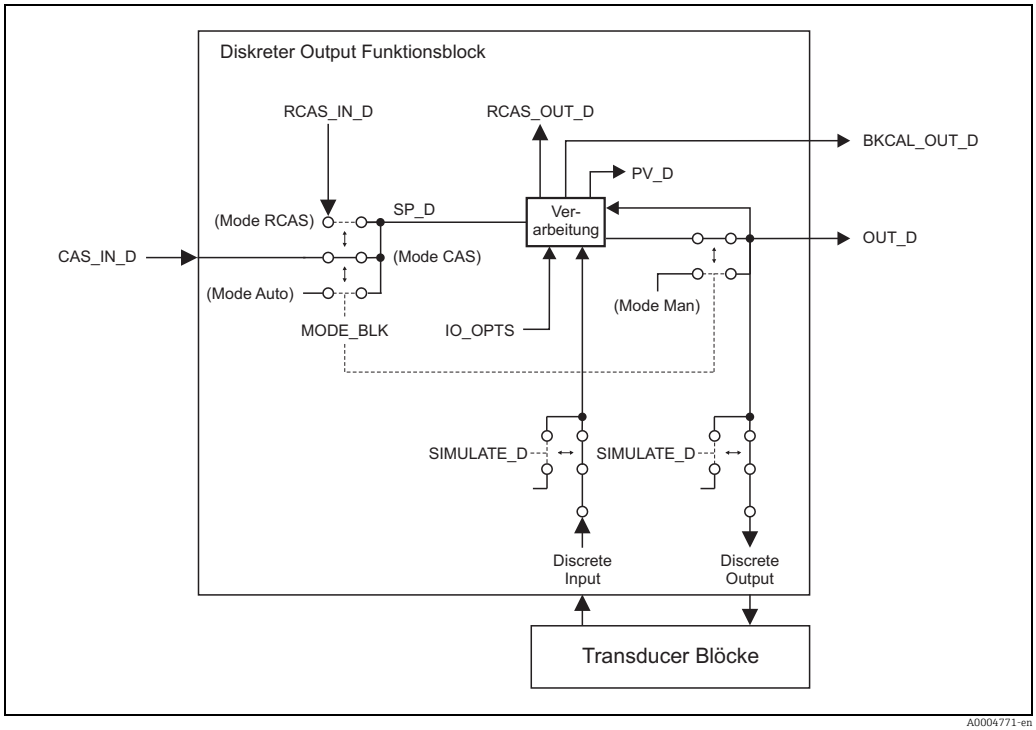
CAS_IN _D = Remote setpoint value from another function block

OUT_D = Discrete output value and status

BKCAL_OUT_D = Discrete output value and status required by BKCAL_IN_D input of another block for

6.1 Signal processing

The figure shows the internal structure of the Discrete Output function blocks t-mass 65 FOUNDATION Fieldbus:



A0004771-en

Fig. 6: Signal processing in the Discrete Output function block

In the CAS operating mode (cascade operation), the **Discrete Output function block** receives, via the function block input CAS_IN_D, a discrete signal from an upstream function block. This signal controls the setpoint value (parameter SP_D) of the function block, and after internal calculation is sent as an output signal (parameter OUT_D) to the Transducer Block for control of instrument functions (e.g. zero point adjustment). The output value and status of the **Discrete Output function block** is communicated to the upstream block via the output BKCAL_OUT_D.

Signal processing in the RCAS operating mode (remote cascade operation) is largely identical to the CAS operating mode. However, in this operating mode, control of the parameter SP_D does not take place via an upstream function block but through a fieldbus host system.

The output value and status of the Discrete Output function block is communicated to the process control system as an answer message via parameter RCAS_OUT_D.

In the AUTO operating mode (automatic operation), the set point value (parameter SP_D) is prescribed directly in the Discrete Output function block. In this case, the parameter CAS_IN_D is not taken into consideration in the internal calculation.

In the MAN operating mode (HAND), the output value (parameter OUT_D) can be prescribed directly in the Discrete Output function block. No internal calculation takes place.

6.2 Important functions and parameters of the Discrete Output function block

The most important functions and parameters of the Discrete Output function block are listed below.

Note!
All the FOUNDATION Fieldbus parameters available are described in the Operating Instructions "FOUNDATION Fieldbus Overview" (BA00013S) (available at: ® www.endress.com ® download).

6.2.1 Selecting the operating mode

The operating mode is configured via the MODE_BLK parameter group. The Discrete Output function block supports the following operating modes:
- AUTO
- MAN
- CAS
- RCAS
- OOS

6.2.2 Safety behavior

There is a safety default available (fault state) for the Discrete Output function block. This is activated when a fault condition (of the corresponding valid set point value) exists longer than defined in the parameter FSTATE_TIME, or when the parameter SET_FSTATE in the Resource Block is activated. The safety operation is determined via the parameters FSTATE_TIME, FSTATE_VAL_D, and IO_OPTS.

6.2.3 Assignment between the Discrete Output function block and the Transducer Block

The assignment or connection between the Discrete Output function block and the Transducer Block takes place in the Discrete Output function block via the parameter CHANNEL.
→ Parameter CHANNEL → 16 (= Discrete Output function block)

6.2.4 Values for the parameters CAS_IN_D, RCAS_IN_D, OUT_D, and SP_D

Via the Discrete Output function block, different instrument functions in the Transducer Block can be initiated via manufacturer-specific, fixed set point values from an upstream function block.

Here it must be observed that the desired function is only then executed when a status change from the value 0 (Discrete state 0) to the corresponding function value (following table) takes place. The value 0 always serves as the starting point for the corresponding control of instrument functions. A status change from a value not equal to zero to another value has no effect.

Input assignment of the CAS_IN_D, RCAS_IN_D, OUT_D, SP_D parameters

Status changes			Action
Discrete state 0	→	Discrete state 1	Reserved
Discrete state 0	→	Discrete state 2	Positive zero return: ON
Discrete state 0	→	Discrete state 3	Positive zero return: OFF
Discrete state 0	→	Discrete state 4	Zero adjustements
Discrete state 0	→	Discrete state 5	Reserved
Discrete state 0	→	Discrete state 6	Reserved
Discrete state 0	→	Discrete state 7	Reset totalizers 1, 2
Discrete state 0	→	Discrete state 8	Reset totalizers 1
Discrete state 0	→	Discrete state 9	Reset totalizers 2

Example for controlling positive zero return via the Discrete Output function block.

The following example shows how positive zero return can be activated or deactivated via the Discrete Output function block during a cleaning procedure.

1. In the first step, the connection between the Discrete Output function block and the Transducer Block must be established. Here, the value 16 must be assigned to the parameter CHANNEL in the Discrete Output function block
   → Parameter CHANNEL → 16 (= Discrete Output function block)
2. In the CAS operating mode, the Discrete Output function block processes the set point value specified at the input CAS_IN_D by the upstream function block and transfers it to the Transducer Block

   Activating positive zero return
   With a starting value of 0 (Discrete state 0), positive zero return is activated by a status change from 0 to 2 at input CAS_IN_D.

   Deactivating the positive zero return
   Positive zero return can only then be deactivated when the input value at CAS_IN_D has first been set to output value 0 (Discrete state 0). Only then can positive zero return be deactivated through a status change from 0 to 2 at input CAS_IN_D.

7 Additional function blocks

Note!
Additional function blocks such as the PID, Arithmetic, Input Selector, Signal Characterizer and Integrator function block are described in the "FOUNDATION Fieldbus Overview" (BA00013S) Operating Instructions (available at: ® www.endress.com ® download).

8 Factory settings

8.1 Language

Country	Language	Country	Language
Australia	English	Norway	Norwegian
Belgium	English	Austria	German
Denmark	English	Poland	Polish
Germany	German	Portugal	Portuguese
England	English	Sweden	Swedish
Finland	Finnish	Switzerland	German
France	French	Singapore	English
The Netherlands	Dutch	Spain	Spanish
Hong Kong	English	South Africa	English
India	English	Thailand	English
Italy	Italian	Czechia	Czech
Luxembourg	French	Hungary	English
Malaysia	English	Other countries	English

8.2 SI units (not for USA and Canada)

8.2.1 Low flow cut off, full scale value, pulse value

t-mass F sensor
With air at ambient conditions (without a flow conditioner)

Nominal diameter [mm]	Low flow cut off [kg/h]	Full scale value [kg/h]	Pulse value [kg/p]
15	0.53	53	0.10
25	2.00	200	1.00
40	5.55	555	1.00
50	9.10	910	10.00
80	20.30	2030	10.00
100	37.50	3750	10.00

t-mass I sensor
With air at ambient conditions (without a flow conditioner)

Nominal diameter [mm]	Low flow cut off [kg/h]	Full scale value [kg/h]	Pulse value [kg/p]
80	20.30	2030	10.0
100	37.50	3750	10.0
150	75.00	7500	100.0
200	125.00	12500	100.0

Nominal diameter [mm]	Low flow cut off [kg/h]	Full scale value [kg/h]	Pulse value [kg/p]
250	200.00	20000	100.0
300	280.00	28000	100.0
400	500.00	50000	100.0
500	800.00	80000	100.0
600	1150.00	115000	100.0
700	1590.00	159000	100.0
1000	3200.00	320000	100.0
1500	7200.00	720000	100.0

8.2.2 System units

	Unit
Temperature	°C
Density	kg/m³
Reference density	kg/m³
Calorific Value Mass	MJ/kg
Heat	kWh

	Unit
Length	mm
Pressure	bar a
Reference Pressure	bar a
Calorific Value Corr. Vol.	MJ/m³
Reference temperature	°C

8.2.3 Unit totalizer 1 and 2

	Unit
Mass flow	kg
Heat flow	MWh

	Unit
Corrected volume flow	Nm³

8.2.4 Other Units

	Unit	
Ref. combustion temp.	°C	→ 🖹 45
Pipe standard	according to DIN	→ 🖹 22

8.3 US units (only for USA and Canada)

8.3.1 Low flow cut off, full scale value, pulse value

t-mass F sensor
With air at ambient conditions; (without a flow conditioner)

Nominal diameter [mm]	Low flow cut off [lb/hr]	Full scale value [lb/hr]	Pulse value [lb/p]
½"	1.16	116	0.20
1"	4.40	440	2.00
1½"	12.20	1220	2.00
2"	20.02	2002	20.00
3"	44.66	4466	20.00
4"	82.50	8250	20.00

t-mass I sensor
With air at ambient conditions; (without a flow conditioner)

Nominal diameter [mm]	Low flow cut off [lb/hr]	Full scale value [lb/hr]	Pulse value [lb/p]
3"	44.66	4466	20.00
4"	82.50	8250	20.00
6"	165.00	16500	200.00
8"	275.00	27500	200.00
10"	440.00	44000	200.00
12"	610.00	61000	200.00
16"	1100.00	110000	200.00
20"	1760.00	176000	200.00
24"	2530.00	253000	200.00
28"	3498.00	349800	200.00
40"	7040.00	704000	200.00
60"	15840.00	1584000	200.00

8.3.2 System units

	Unit
Temperature	°F
Density	lb/ft³
Reference density	lb/ft³
Calorific Value Mass	kBtu/lb
Heat	kBtu

	Unit
Length	inch
Pressure	psi a
Reference Pressure	psi a
Calorific Value Corr. Vol.	kBtu/Sft³
Reference temperature	°F

8.3.3 Unit totalizer 1 and 2

	Unit
Mass flow	lb
Heat flow	kBtu

	Unit
Corrected volume flow	Sm^3

8.3.4 Other Units

	Unit	
Ref. combustion temp.	°F	→ 🖹 45
Pipe standard	according to ANSI	→ 🖹 22

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Symbols

A

B

C

D

E

G

I

L

M

N

O

P

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