Data Sheet 10/18-5.22-EN Rev. I

SensyCal FCU200, SensyCal FCU400
Universal Measuring Computer

Multifunctional
Precise
Compact

Measurement made easy

- Data logger function and billing date recording
- Electrical isolation of inputs and outputs
- Up to 4 active current outputs
- Up to 6 current inputs with transmitter supply
- Up to 12 voltage / current inputs without supply
- Pulse and frequency inputs
- Communication via M-Bus, MODBUS, and PROFIBUS (via converter)
- For liquids, steam, gases, and compressed air
- Quantity, volume, and energy meter
- Highly-precise differential temperature measurement (chemical processes, brine, and temperature monitoring)
- Mathematical linking and implementation of all input and output signals as well as calculation results on M-Bus, MODBUS, PROFIBUS (via converter)
- Universal use for field applications and control rooms
- International approvals

SensyCal FCU200, SensyCal FCU400
Universal Measuring Computer

General description

The FCU is a universal measurement computer that supports a whole host of process signal processing applications. It combines the very latest communication methods with many years of expertise in the field of measurement technology. All physical and electrical process variables, as well as device data, data logger data, and billing dates, can be displayed on a high-resolution, multi-line LCD display.
The following device models are available:

Type	Function
FCU200-W	Heat quantity, cold quantity computer for water and brine
FCU400-S	Steam, saturated steam computer (flow, heat)
FCU400-G	Gas flow computer, gas translator
FCU200-T	2-channel current-pulse converter
FCU400-P	Signal combination, highly-precise ΔT measurement, totalizing, leakage measurement, boiler water-level measurement, etc.
FCU400-IR	Contactless temperature monitoring

SensyCal FCU200-W – Heat quantity computer

Description

The FCU200-W is a heat quantity computer for determining industrial thermal balances. It is used to calculate heat quantities, cold quantities and flow rates in liquids within heat supplies.
Reliable microelectronics, developed in accordance with standards DIN EN ISO 1434-1 ... 6 and OIML75.
The heat quantity computer can be used in conjunction with all standard flowmeters that provide a pulse signal, frequency signal or mA signal, such as orifice plates, ultrasound flowmeters, swirl flowmeters or vortex flowmeters.
Connecting Pt100 temperature sensors in a four-wire circuit enables precise temperature measurement.
Microprocessor technology and the integrated data logger allow for reliable, traceable acquisition of operating values.

Operating principle

The heat quantity is calculated from the volume flow or mass flow and the temperatures of the heat flow T_w and the cold flow T_k at a given pressure level, using the formulae below.

$$q_m = q_v \times \rho(T,p)$$

$$P = q_m \times [h_w(T_w,p) - h_k(T_k,p)]$$

$$V = \int_0^t q_v dt$$

$$E = V \times \rho(T,p) \times [h_w(T_w,p) - h_k(T_k,p)]$$

Element in formula	Description
E	Heat energy
V	Volume
P	Power
q_v	Volume flow
q_m	Mass flow
ρ	Current operating density
h_w	Enthalpy in heat flow
h_k	Enthalpy in cold flow
T_w	Temperature of heat flow
T_k	Temperature of cold flow
p	Pressure

Temperatures T_w and T_k can be measured using either Pt100 resistance thermometers or temperature transmitters.

IMPORTANT (NOTE)
The type of connection required (Pt100 or transmitter) for the temperature inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

Calibratable measurement for billing purposes

All devices in the circuit must be approved by the German national metrology institute (PTB) to meet the requirements of calibratable measurements for billing purposes (for water only).
Arithmetic logic unit:

— FCU200-W

Flow counter:

— Swirl flowmeter, ultrasound flowmeter, electromagnetic flowmeter, Woltmann meter, orifice plate

Temperature sensors:

— Pt100, coupled

Before the measurement process begins, acceptance by the relevant board of weights and measures is carried out if required. There is no longer a requirement for calibration in the case of rated power levels of 10 MW and up.

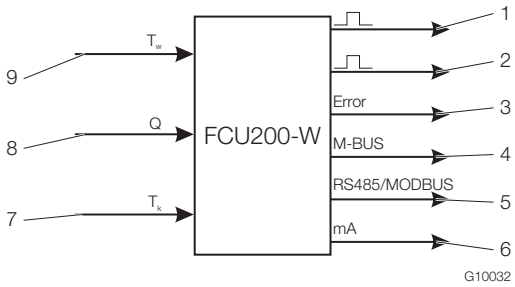

Fig. 1
1 Pulse output for heat quantity | 2 Pulse output for quantity/volume | 3 Error output | 4 Interface (M-BUS) | 5 Interface (optional, RS485 / MODBUS) | 6 Current output (optional) | 7 Temperature of cold flow | 8 Flowmeter | 9 Temperature of heat flow

Recording of billing date

Two billing dates for storing all meter readings. Date and time parameters can be adjusted.

Data logger

For storing multiple operating variables over 128 periods:

— Power
— Flow rate
— Temperature of heat flow
— Temperature of cold flow
— Temperature difference

Instantaneous values, minimum values and maximum values are all stored for the operating variables. In some cases, an average value is stored as well.

Meters and storage

Energy counter standstill in the event of:

— Flow rate = zero
— PT100 sensor break or
— Short-circuit in heat flow or cold flow
— Temperature in heat flow lower than in cold flow

Meter readings saved in the event of a power failure

Pulse output

Two pulse outputs.

Device parameterization

The device is parameterized using the FCOM200 parameterization software (ParaTool).
Parameterization can be performed at the factory or the customer's site. If parameterization is carried out at the factory, a questionnaire must be completed at the customer's site. Default values are loaded in the case of standard parameterization.

SensyCal FCU400-S – Steam computer

Description

The FCU400-S is a steam, flow, and thermal output computer designed for industrial quantity measurements, thermal balances, and measurements for accounting purposes. It is used for superheated steam or saturated steam with or without condensate reverse flow, as a flowmeter and / or a heat quantity computer.

The measurement computer can be used in conjunction with all standard flowmeters that provide a pulse signal, frequency signal, or mA signal, such as orifices, ultrasound flowmeters, swirl flowmeters, or vortex flowmeters.

The split-range procedure, flow coefficient correction, and expansion rate correction are possible in the standard program in the case of flow measurement involving orifices.

With the standard program, process signals from the following measuring devices can be processed:

- Flowmeters in steam forward flow
- Pressure transmitters in steam forward flow
- Temperature sensors (Pt100 or via transmitters) in steam forward flow
- Flowmeters in condensate reverse flow
- Temperature sensors (Pt100 or via transmitters) in condensate reverse flow

Up to 5 counter are provided in the standard program. The following applications can be realized.

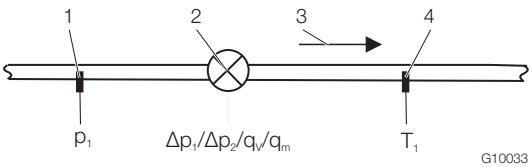

Fig. 2: Steam: flow, thermal output calculation

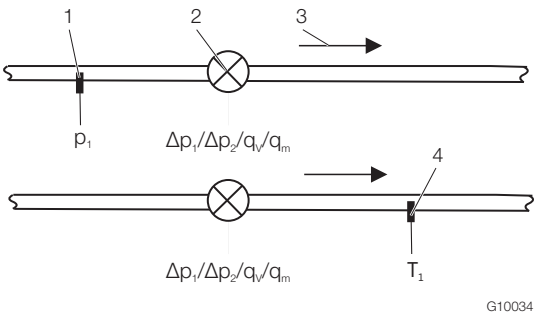

Fig. 3: Saturated steam: flow, thermal output calculation
1 Pressure transmitter | 2 Flowmeter | 3 Flow direction | 4 Temperature sensor

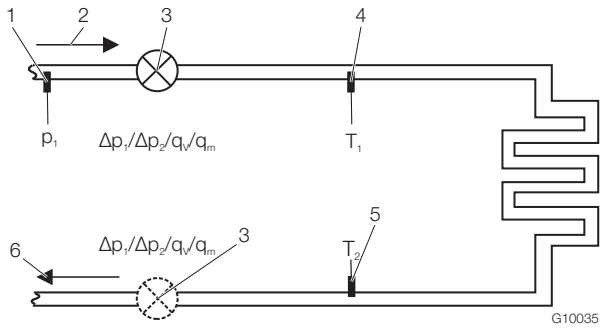

Fig. 4: Forward flow: steam / saturated steam; reverse flow: condensate
1 Pressure transmitter | 2 Forward flow | 3 Flowmeter (alternatively in condensate reverse flow) | 4 Temperature sensor (steam) | 5 Temperature sensor (condensate) | 6 Reverse flow

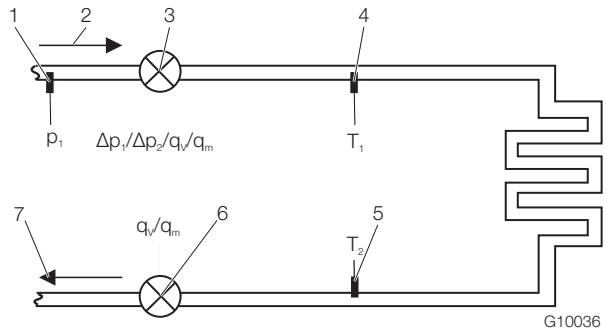

Fig. 5: Open systems
1 Pressure transmitter | 2 Forward flow | 3 Flowmeter (steam) | 4 Temperature sensor (steam) | 5 Temperature sensor (condensate) | 6 Flowmeter (condensate) | 7 Reverse flow

The physical "density" and "enthalpy" values of steam and water are calculated in accordance with the latest version of industry standard IAPWS-IF 97.

Connecting Pt100 temperature sensors in a four-wire circuit enables precise temperature measurement. Microprocessor technology and the integrated data logger allow for reliable, traceable acquisition of operating values.

Operating principle

The mass flow is calculated from the volume flow and density. When the flow is measured by means of differential pressure measurement, the mass flow is corrected on the basis of the reference density, i.e., the operating density in relation to the density for which the measurement was designed.
The heat quantity is calculated from the mass flow and enthalpy (internal energy of steam or water).
In the case of steam and water, the density and enthalpy are a function of pressure and temperature. In the case of saturated steam, they are a function of pressure or temperature.

$$q_m = q_v \times \rho(T_d, p_d)$$

$$P = q_m \times h_d(T_d, p_d)$$

$$E = \int_0^t P dt$$

For steam in the forward flow and condensate in the reverse flow, the following applies:

$$P_{Steam} = q_m \times h_d(T_d, p_d)$$

$$P_{Condensate} = q_m \times h_w(T_w, p_w = Const)$$

$$P_{Balance} = P_{Steam} - P_{Condensate}$$

Element in formula	Description
E	Heat energy
P	Power
q_v	Volume flow
q_m	Mass flow
ρ	Current operating density
h_d	Steam enthalpy
h_w	Condensate enthalpy
T_d	Steam temperature
T_w	Condensate temperature
p	Pressure

Temperatures T_d and T_w can be measured using either Pt100 resistance thermometers or temperature transmitters.

IMPORTANT (NOTE)

The type of connection required (Pt100, transmitter) for the temperature inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

Calibrated measurement for accounting purposes

In Germany, there is no requirement for calibration in the case of measurement for accounting purposes involving steam. If requested by the customer, all the devices in the circuit may be supplied as calibrated devices in order to meet the requirements of calibrated measurement for accounting purposes.
For this purpose, a calibration request for the FCU400-S measurement computer is submitted to the relevant board of weights and measures (based on the approval for official calibration for water).

Billing date recording

Two billing dates for storing up to 5 counter readings. Date and time parameters can be adjusted.

Data logger

For storing up to 27 operating variables over 128 periods.

- 5 counters (E1 energy (steam), M1 quantity (steam), EΔ energy balance (steam condensate), E2 energy (condensate), M2 quantity (condensate))
- Instantaneous values of all process variables
- Determining minimum and maximum values (over parameterizable time) and mean values for 4 process variables (parameterizable)

Counters, storage

Energy counter standstill in the event of:

- Flow = zero

Counter readings saved in the event of a power failure

Pulse output

2 pulse outputs.

Device parameterization

The device is parameterized using the FCOM200 parameterization software (ParaTool).
Parameterization can be performed at the factory or the customer's site. If parameterization is carried out at the factory, a questionnaire must be completed at the customer's site. Default values are loaded in the case of standard parameterization.

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SensyCal FCU400-G – Gas flow computer, gas translator

Description

The FCU400-G is a gas flow computer and translator designed for industrial gas flow calculations and gas measurements for accounting purposes.
The measurement computer can be used in conjunction with all standard flowmeters that provide a pulse signal, frequency signal, or mA signal, such as orifices, ultrasound flowmeters, swirl flowmeters, or vortex flowmeters.
The split-range procedure, compressibility factor, flow coefficient correction, and expansion rate correction are possible in the standard program in the case of flow measurement involving orifices.
With the standard program, process signals from the following measuring devices can be processed:

— Flowmeters
— Pressure transmitters
— Temperature sensor (Pt100 or via transmitter)

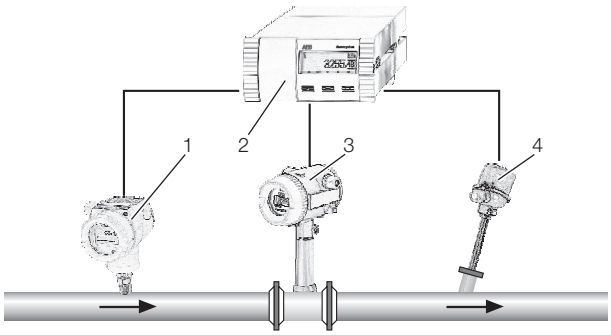

Fig. 6
1 Pressure transmitter | 2 Measurement computer | 3 Flowmeter | 4 Temperature sensor (Pt100 or via transmitter)

The physical compensation and conversion of the flow are calculated in accordance with EN ISO 5167-1 and VDI/VDO 2040.

Operating principle

The standard volume flow is calculated from the volume flow, operating density, and standard density. The operating density can be calculated from the operating pressure, operating temperature, and standard density in the standard condition. When the flow is measured by means of differential pressure measurement, the standard volume flow is corrected on the basis of the reference density, i.e., the operating density in relation to the density for which the measurement was designed.

$$Q_n = Q_V \times \frac{\rho}{\rho_n}$$

$$\rho = \rho_n \times \frac{p}{p_n} \times \frac{T_n}{T} \times \frac{Z_n}{Z}$$

In the case of differential pressure measurement:

$$Q_n = Q_{n,measured} \times \sqrt{(\rho / \rho, A)} \times \frac{C}{C, A} \times \frac{\varepsilon}{\varepsilon, A}$$

$$\rho = f(p, T, Z)$$

Element in formula	Description
Q_n	Standard volume flow
Q_v	Operating volume flow
ρ	Operating density
ρ_n	Standard density
T	Temperature
p	Pressure
Z	Compressibility factor
C	Flow coefficient
ε	Expansion rate
p_n	Pressure in standard condition (1.01325 bar)
T_n	Temperature in standard condition (273.15 K)
Z_n	Flow coefficient in standard condition
A	Design specifications for orifice

The temperature T is measured using either Pt100 resistance thermometers or temperature transmitters.

IMPORTANT (NOTE)
The type of connection required (Pt100, transmitter) for the temperature inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

Data logger
For storing up to 20 operating variables over 200 periods:
- 1 counter
- Instantaneous values, mean values, and minimum and maximum values of all process variables

Counters, storage
Counter standstill in the event of:
- Flow = zero

Counter readings saved in the event of a power failure.

Pulse output
2 pulse outputs.

Device parameterization
The device is parameterized using the FCOM200 parameterization software (ParaTool).
Parameterization can be performed at the factory or the customer's site. If parameterization is carried out at the factory, a questionnaire must be completed at the customer's site. Default values are loaded in the case of standard parameterization.

SensyCal FCU200-T – Current-pulse converter
Description
The FCU200-T is a two-channel
- energy, quantity, and volume counter
- current-pulse converter
- pulse-current converter

Operating principle
The device converts either direct current into a proportional pulse frequency or a proportional pulse frequency into direct current.
With the standard program, the following process signals can be processed:
- 2 active mA signals or 2 active pulse / frequency signals
- 2 pulse output signals

The mA output card, power supply card, and RS485 / RS232 card can be supplied as an option.

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The following applications can be realized with the standard program:

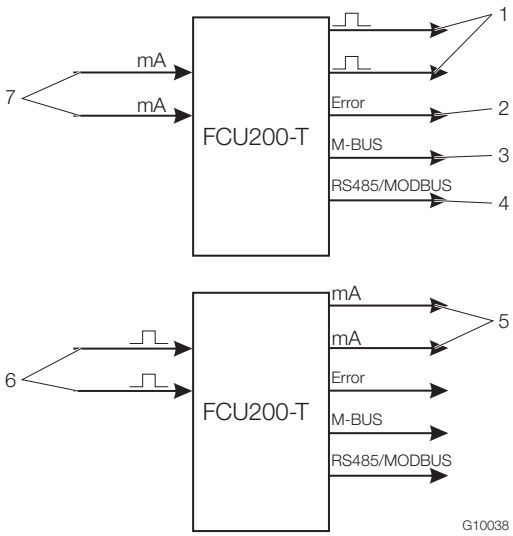

Fig. 7
1 Pulse outputs | 2 Error output | 3 Interface (M-Bus) | 4 Interface (optional, RS485 / MODBUS) | 5 Current outputs (optional) | 6 Pulse inputs | 7 Current inputs

Device parameterization

The device is parameterized using the FCOM200 parameterization software (ParaTool).
Parameterization can be performed at the factory or the customer's site. If parameterization is carried out at the factory, a questionnaire must be completed at the customer's site. Default values are loaded in the case of standard parameterization.

Pulse output

2 pulse outputs.

SensyCal FCU400-P – Signal combination, highly-precise ΔT measurement, totalizing, etc.

Description

Precise differential temperature measurement is a must wherever thermal balancing is required for additional process optimization.
The FCU400-P for highly-precise differential temperature measurement is a system consisting of a measurement computer (which serves as an evaluation unit) and 2 high-quality, precise, paired, and carefully-selected Pt100 sensors. In the lower measuring range (ΔT = 1 ... 5 K), the system also offers a measuring error of < 100 mK. If required, it can be calibrated and certified at a German Calibration Service (DKD) calibration lab.

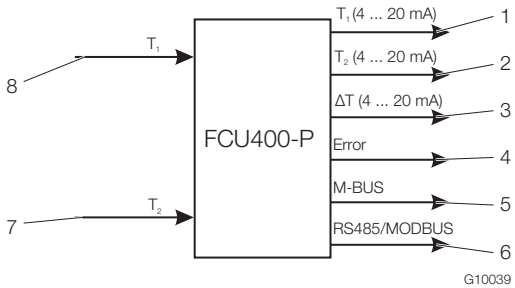

Fig. 8
1 Analog output T1 (optional) | 2 Analog output T2 (optional) | 3 Analog output ΔT (optional) | 4 Error output | 5 Interface (M-Bus) | 6 Interface (optional, RS485 / MODBUS) | 7 Input for temperature sensor T1 (forward flow) | 8 Input for temperature sensor T2 (reverse flow) |

Inputs
2 x Pt100 temperature sensors in a four-wire circuit

Either Pt100 resistance thermometers or temperature transmitters can be connected to the temperature sensor inputs.

IMPORTANT (NOTE)
The type of connection required (Pt100, transmitter) for the temperature sensor inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

Output
M-Bus, optional analog outputs and RS485 / RS232 for MODBUS protocol.

Additional applications (e.g., totalizing) and technical details for the FCU400-P available on request.

Data logger
1 or 2 counters.
Storage of process variables over 200 periods; programmable time window:
- Instantaneous values
- Minimum and maximum values
- Mean values

Saving
Counter readings saved in the event of a power failure.

Pulse output
2 pulse outputs.

SensyCal FCU400-IR – Contactless temperature monitoring
Description
The FCU400-IR is a complete system for contactless temperature monitoring at contact points and circuit breakers on MV switchgear. Loose screw connections and oxidation at the contact points between the busbars and at the circuit breakers lead to an increase in contact resistance. This causes power to be converted into heat energy, which in turn damages the system.

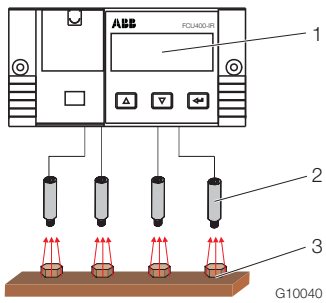

Fig. 9
1 FCU400-IR | 2 Pyrometer | 3 Measuring points

Properties
- Continuous temperature monitoring on live components
- Monitoring of up to 12 hotspots in switchgear using one system
- Freely-adjustable limit values for the pre-alarm and main alarm
- Analog output for maximum temperature value (optional)
- MODBUS output (optional)
- No PVC cables
- Full shielding of all components against electromagnetic disturbances
- Option of connecting a Pt100 temperature sensor for the purpose of measuring the ambient temperature

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— M-Bus and optical interfaces (IRDA, ZVEI) for reading out data and configuration
— All necessary parameters displayed on a multi-line LCD display on site
— All measuring points and maximum temperatures displayed with measuring point identification in each case
— Data logger function with real-time clock for all temperatures and limit values
— If a limit value is exceeded, the error is stored together with the date and time
— Minimum adjustment work on site, plus excellent upgradeability (modular structure)

How you can benefit from using the FCU400-IR:
— Lower costs
— No expensive routine checks of contact points required
— No measuring system maintenance required
— Improved system safety
— No malfunctions thanks to fast online detection of hotspots and shutdown of switchgear
— Measuring system does not come into contact with live components

The system principally consists of the following components:
— Infrared pyrometer for hotspot monitoring in the busbar area
— Pt100 temperature sensor (optional) for measuring the ambient temperature in the busbar area
— Measurement computer for signal processing, evaluation, and display in secondary equipment area

Inputs	Maximal 12 x pyrometer
	1 x Pt100, measuring range 0 … 200 °C (32 … 392 °F)
Outputs	3 binary switching outputs (pre-alarm, alarm, and device error)
	1 MODBUS output (optional)
or alternatively	1 analog output (optional), 4 … 20 mA signal for maximum pyrometer temperature
Optical resolution of sensors	15:1
Length of sensor-measurement computer connecting cable	10 m (standard)
Response time of entire system	< 1 s
Reproducibility of temperature measurement	±0.75 °C or ±0.75 % of measured value (the larger value in each case applies)
Degree of protection	IP 40
Power supply	24 V DC ± 5 %
Maximum power consumption	10 VA
Maximum ambient temperature	Measurement computer: 55 °C (131 °F) Pyrometer: 70 °C (158 °F)

Additional technical details for the FCU400-IR available on request.

Specifications

System structure

The measurement computer consists of a basic device with four slots for extension modules.
The basic device contains:

- Power supply unit
- LCD display with backlighting
- Processing electronics
- 2 analog inputs for Pt100 temperature sensors with constant power source for four-wire circuit or 2 analog 0 / 4 … 20 mA inputs for transmitters
- 2 digital, electrically isolated inputs for pulse or frequency signals; can also be used for logic signals for control purposes
- 3 digital, electrically isolated outputs for pulse output and error signaling
- M-Bus interface
- Optical interface on front, which can also be operated in accordance with the IRDA or ZVEI standard, depending on the parameterization

IMPORTANT (NOTE)

The type of connection required (Pt100, transmitter) for the analog inputs must be specified when ordering the device. It is not possible to change the type of connection at the actual site.

The four slots are designed to accommodate extension modules. You have the option of combining the following modules:

- Current input module, 2 inputs with transmitter supply
- Current input module, 4 inputs without transmitter supply
- Voltage input module, 4 inputs
- Current output module with limit monitors
- RS485 / RS232 module for MODBUS communication
- Supply for transmitters in two-wire technology

Electrical connections

Analog inputs

2 x Pt100 IEC or 2 x 0 / 4 … 20 mA,
measuring range -200 … 850 °C,
resolution 20 bits ≈ 0.0012 K

Digital inputs EB1, EB2

2 x electrically isolated, 24 V passive (optocoupler), can be configured in acc. with DIN 19240 as:

- Pulse input 0.001 s^{-1} ... 3000 s^{-1}
- Frequency input 0.001 Hz ... 10 kHz
- Logic signal (hi / low)

Digital outputs AB1, AB2, and Err

3 x open collector, passive. Electrically isolated via optocoupler.

External supply	In acc. with VDE 2188, Category 2
Maximum load	24 VDC (± 25 %), < 100 mA
Maximum insulation voltage	500 V_{SS} (peak-to-peak)
Internal resistance R_i in conductive state	< 20 Ω
Function	AB1: Pulse output AB2: Pulse output Err: Error output

Communication interfaces

Communication takes place via the M-Bus protocol in acc. with EN 1434-3, IEC 870-5.

Optical interface on the front of the device	Electrical interface via terminal strip of device
Operating mode can be parameterized, optical head (ZVEI) standard in acc. with IEC EN 61107 (300 ... 400 (9600) baud).	— 2-wire M-Bus interface (300 … 38,400 baud) — RS232 / RS485 (300 ... 38,400 baud)

The device is parameterized using the FCOM200 parameterization software (ParaTool).
Data (operating variables, data logger, etc.) is read out via M-Bus or MODBUS.

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Power supply

DC voltage	24 V DC ± 20 % (FCU400-IR ± 5 %)
AC voltage (not in the case of FCU400-IR)	24 V AC, 110 V AC, 230 V AC, -15 ... +10 %, 48 ... 62 Hz
Power consumption 24 V AC 115 V AC 230 V AC	 1 ... 10 VA depending on extension 2 ... 10 VA depending on extension 3 ... 10 VA depending on extension

Extension modules

The extension modules are inserted in the slots on the basic device.

Module designation	Description
101 2 x current inputs (EX1, EX2) 2 x transmitter supplies (Us1, Us2)	0 / 4 ... 20 mA, R_E = 50 Ω; resolution 16 bits ≈ 0.3 µA max. permissible input current 40 mA, electrically isolated each 16 V, 25 mA, short circuit-proof, electrically isolated
107 4 x voltage inputs (EX1 … EX4)	0 ... 2,500 mV, R_E > 1 MΩ, resolution 16 bits, max. permissible input voltage + 5 V
108 4 x current inputs (EX1 … EX4)	0 / 4 ... 20 mA, R_E = 50 Ω; resolution 16 bits ≈ 0.3 µA max. permissible input current ± 40 mA
102 2 x analog outputs (AX1, AX2) 2 x limit monitors (ABX1, ABX2)	Signal range 0 / 4 ... 20 mA, load max. 500 Ω, open permitted, short circuit-proof Open collector, passive Electrical isolation via optocoupler. External supply VDE 2188, Category 2. Maximum load 24 V (+ 25 %), < 100 mA. Max. insulation voltage 500 V (peak-to-peak).
105 RS485 / RS232 card	For MODBUS communication
106 2 x transmitter supplies (Us1, Us2)	each 20 V, 25 mA, short circuit-proof, electrically isolated

Characteristic values

Temperature inputs	
Temperature measuring error	0.3 % of measuring range end value
Measuring error for differential temperature	3 … 20 K, < 1.0 % of measured value 20 … 250 K, < 0.5 % of measured value

Current outputs	
Effect of ambient temperature	< 0.01 %/K
Calibration error	< 0.2 % of end value
Maximum linearity error	< 0.005 % FSR
Accuracy class of calculator	EN 1434-1 / OIML 75 Class 2

Ambient conditions

Ambient temperature	-5 … 55 °C (23 … 131 °F)
Storage temperature	-25 … 70 °C (-13 … 158 °F)
Climate class	Ambient temperature class C acc. to EN 1434-1
Relative humidity	Checked in acc. with EN 1434-4, IEC 62-2-30
Condensation	Permissible
Degree of protection	IP 65 IP 40 (only in the case of FC400-IR)
Shock resistance during operation (at 20 °C) in acc. with IEC 68-2-6 or 68-2-27	Vibration: 2 g / 10 ... 150 Hz Shock: 30 g / 11 ms / 3 shocks

Electromagnetic compatibility (EMC)

Interference immunity in acc. with EN 50082-2 (EN 6100-4-2, -3, -4, -5, 6); also in acc. with EN 1434-4 (Class C), RFI suppression in acc. with EN 50081-2 (EN 55011 Class A)

Type of test	Standard	Testing accuracy	Effect
Surge on power supply (AC) com diff.	EN 61000-4-5	 2 kV 1 kV	 No effect No effect
Burst on supply lines	EN 61000-4-4	2 kV	< 0.2 %
Burst on signal lines	EN 61000-4-4	1 kV	< 0.2 %
Discharge of static electricity (contact discharge)	EN 61000-4-2	6 kV	< 0.2 %
Radiated field (80 … 1,000 MHz)	EN 61000-4-3	10 V/m	< 0.2 %
Cable-guided radiation (150 kHz … 80 MHz)	EN 61000-4-6	10 V	Requirements met
Line interruptions and fluctuations	EN 61000-4-411	-	-
RFI suppression	Limit value class adhered to		
Interference voltage on supply line	EN 55022	A	
Interference field strength	EN 55022	B	

Operation

Display

LCD display, 120 x 32 pixels, multi-line, with backlighting.

Billing date recording

Two billing dates can be determined for the purpose of storing all counter readings. The date and time parameters can be adjusted independently for each billing date.

Data logger

The integrated data logger features 128 or 200 slots and has a ring buffer design. The data logger stores the process variables (counter readings, instantaneous values, min. / max. and mean values).
Depending on the application concerned, the number of operating variables and slots may vary.

Error messages

The measurement computer enables internal errors to be detected thanks to regular self-diagnostics.

— Critical device errors; e.g., storage failure, process errors
— Power supply failures; meter standstill.

The 10 most recent process errors are stored and can be called up as plain text with a time stamp via the LCD display.

Err error output

Open collector, passive

SensyCal FCU200, SensyCal FCU400
Universal Measuring Computer

Mounting dimensions

DIN rail mounting and wall mounting	
Dimensions (width x height x depth)	144 mm x 72 mm x 183 mm (5.67 inch x 2.83 inch x 7.2 inch)
Housing material	Polycarbonate
Weight	Approx. 0.7 kg (1.54 lb)

Panel mounting	
Dimensions (width x height x depth)	144 mm x 72 mm x 117 mm (5.67 inch x 2.83 inch x 4.61 inch)
Panel cutout (width x height)	139 mm x 69 mm (5.47 inch x 2.72 inch)
Housing material	Polycarbonate
Weight	Approx. 0.5 kg (1.1 lb)

Approvals and certifications

— VDE certification (electrical safety)
— CSA-NRTL-C approval
— GOST approval (Russia)

Parameterization software

The FCOM200 PC parameterization software (ParaTool) is used for setting parameters in standard applications.
The software can be installed and used on standard PCs.
Two options are available for the connection between the PC and measurement computer:

— Via the infrared interface on the front (with optical head)
— Via the M-Bus interface (with M-Bus repeater)

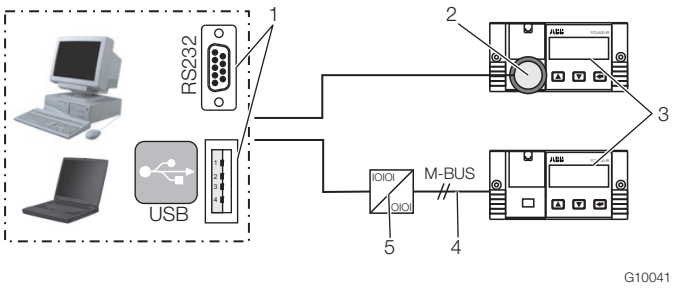

Fig. 10
1 RS232 / USB interface | 2 Optical head | 3 Measurement computer | 4 M-BUS connection (2-wire) | 5 M-BUS repeater

Note on communication:
The following settings must match on the PC and on the device (under "Device data"):
Bus address, baud rate, interface.

Interface	Setting
With optical head	Optical head / automatic
With M-Bus repeater	M-Bus repeater

Infrared printer

The infrared interface can be used to print out measurement computer data on the portable "HP82240B Infrared Printer".

Electrical connections

Basic device

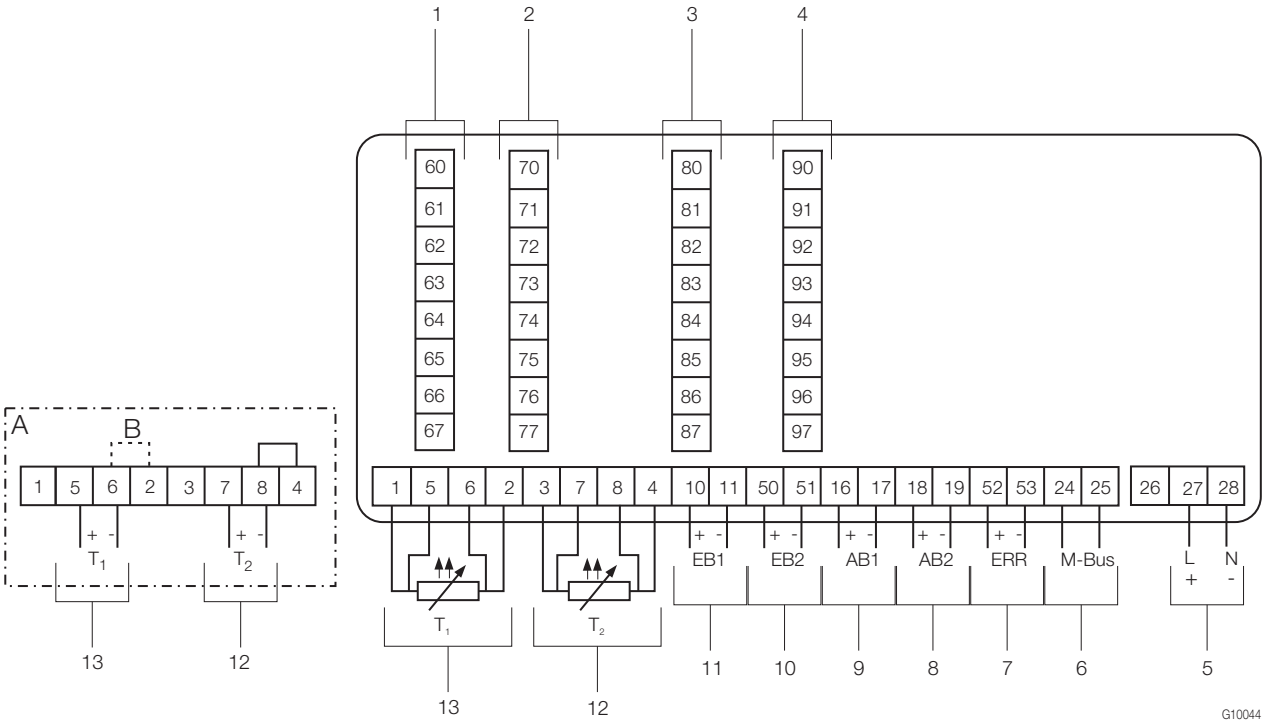

Fig. 11
A Alternative connection for temperature transmitters with active current output | B Jumper
1 Slot 1 | 2 Slot 2 | 3 Slot 3 | 4 Slot 4 | 5 Power supply | 6 Interface (M-Bus) | 7 Error output | 8 Pulse output AB2 |
9 Pulse output AB1 | 10 Pulse / frequency input EB2 | 11 Pulse / frequency input EB1 |
12 Temperature sensor input T2 (Pt100 or 0 / 4 ... 20 mA) | 13 Temperature sensor input T1 (Pt100 or 0 / 4 ... 20 mA)

IMPORTANT (NOTE)

If the temperature transmitters are electrically connected, there is no jumper B (between terminals 6 and 2).
The type of connection required (Pt100 or transmitter) for the temperature sensor inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

Supply and interface card (FCU200-W, FCU200-T, FCU400-S, FCU400-G, FCU400-P)

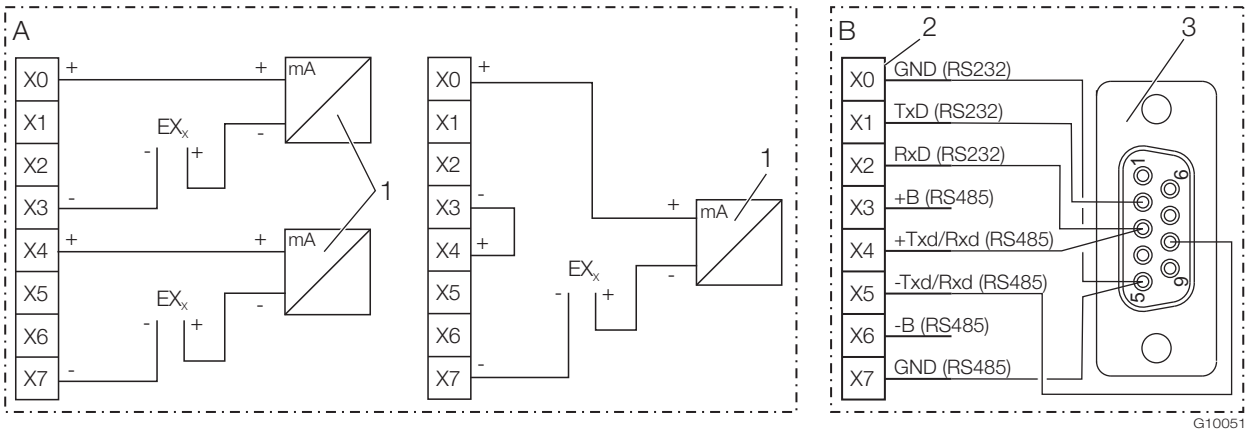

Fig. 12
A Power supply card | B Interface card RS232 / RS485
1 Transmitter in two-wire technology with current output | 2 Terminal strip for interfaces | 3 D-sub female connector, 9-pin

IMPORTANT (NOTE)

A power supply card can supply either two transmitters with 20 V or one transmitter with 40 V (jumper between X3/X4).
The X in the terminal designation of the extension cards must be replaced with 7, 8, or 9 (depending on the selected slot; see also "Electrical connections / Basic device").

FCU200-W

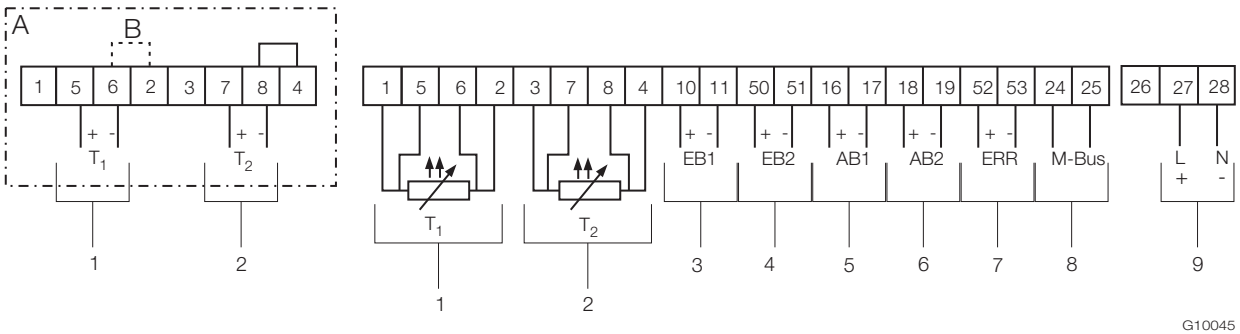

Fig. 13: Connection diagram, FCU200-W basic device
A Alternative connection for temperature transmitters with active current output | B Jumper
1 Input for temperature sensor in forward flow (heat) | 2 Input for temperature sensor in reverse flow (cold) | 3 Input for flowmeter Q_V | 4 Input for second flowmeter (DTF signal) | 5 Pulse output AB1 (energy) | 6 Pulse output AB2 (flow) | 7 Error output | 8 Interface (M-Bus) | 9 Power supply

IMPORTANT (NOTE)

If the temperature transmitters are electrically connected, there is no jumper B (between terminals 6 and 2).
The type of connection required (Pt100 or transmitter) for the temperature sensor inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

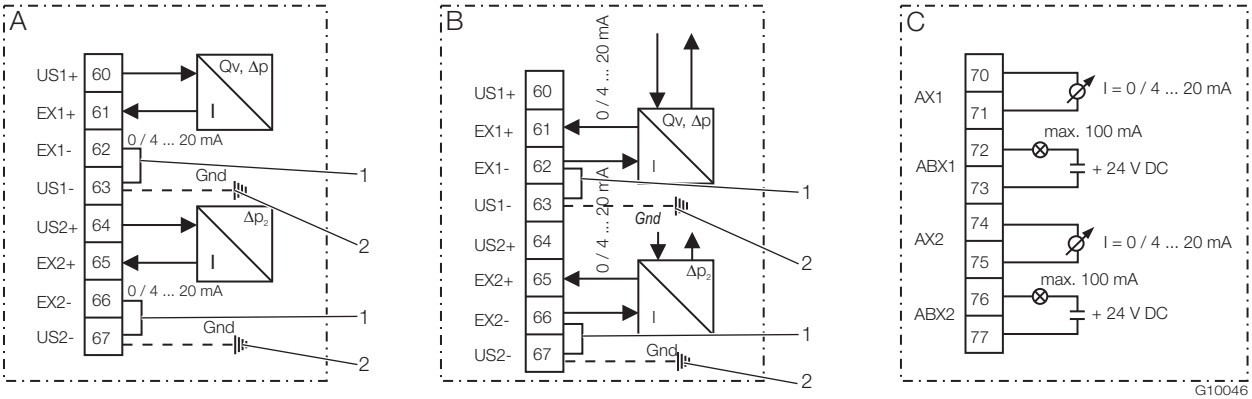

Fig. 14: Connection diagram for extension modules FCU200-W (example)
A Current input module for transmitters in two-wire technology; 16 V, 23 mA supply | B Current input module for transmitters in four-wire technology, external supply | C Current output module
1 External jumper | 2 Optional ground connection for potential equalization rail (Gnd)

FCU400-S

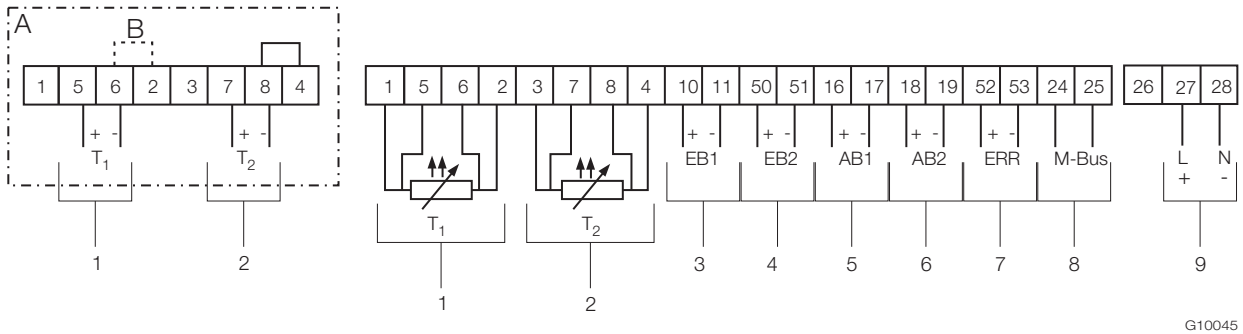

Fig. 15: Connection diagram, FCU400-S basic device
A Alternative connection for temperature transmitters with active current output | B Jumper
1 Input for temperature sensor in steam forward flow | 2 Input for temperature sensor in condensate reverse flow |
3 Pulse / frequency input EB1 (flow) | 4 Pulse / frequency input EB2 (flow) | 5 Pulse output AB1 | 6 Pulse output AB2 | 7 Error output |
8 Interface (M-Bus) | 9 Power supply

IMPORTANT (NOTE)

If the temperature transmitters are electrically connected, there is no jumper B (between terminals 6 and 2).
The type of connection required (Pt100 or transmitter) for the temperature sensor inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

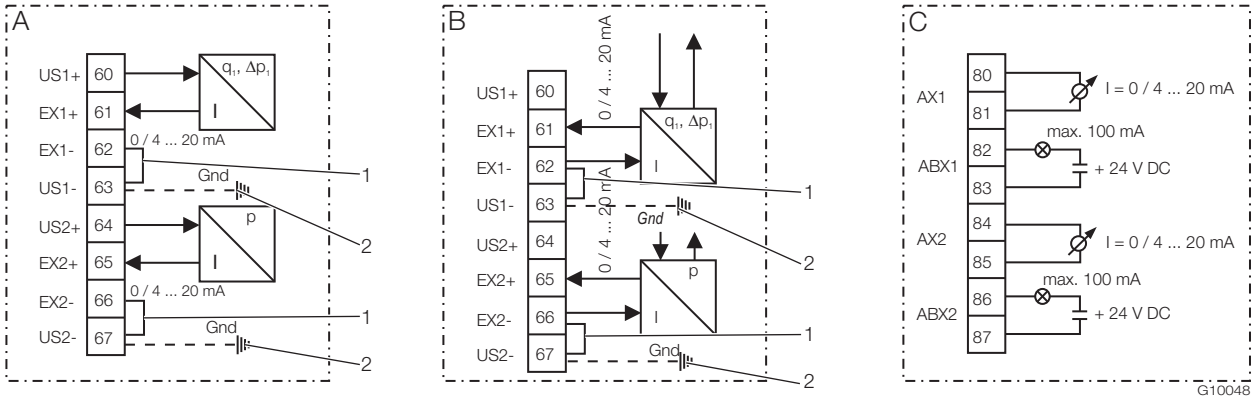

Fig. 16: Connection diagram for FCU400-S extension modules (pressure and flow transmitters)
A Current input module for transmitters in two-wire technology; 16 V, 23 mA supply | B Current input module for transmitters in four-wire technology, external supply | C Current output module
1 External jumper | 2 Optional ground connection for potential equalization rail (Gnd)

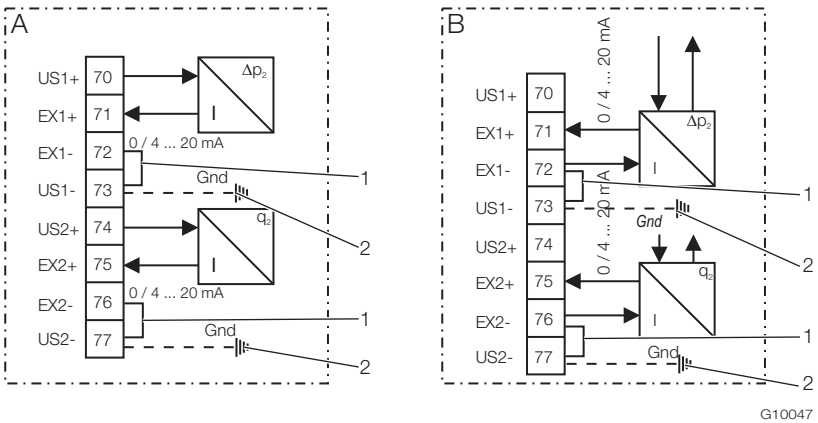

Fig. 17: Connection diagram for FCU400-S extension modules (Δp_2, condensate flow)
A Current input module for transmitters in two-wire technology; 16 V, 23 mA supply | B Current input module for transmitters in four-wire technology, external supply | C Current output module
1 External jumper | 2 Optional ground connection for potential equalization rail (Gnd)

FCU400-G

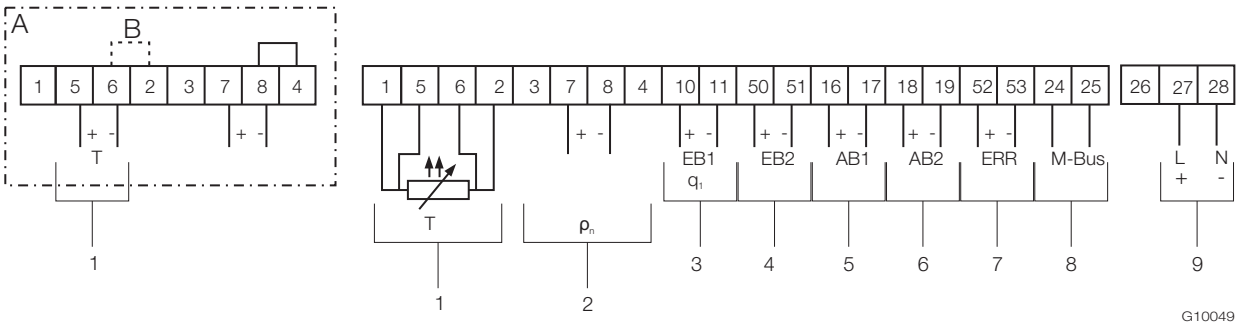

Fig. 18: Connection diagram, FCU400-G basic device
A Alternative connection for temperature transmitters with active current output | B Jumper
1 Input for temperature sensor | 2 Transmitter input for standard gas density | 3 Pulse / frequency input EB1 (flow) |
4 Pulse / frequency input EB2 | 5 Pulse output AB1 | 6 Pulse output AB2 | 7 Error output | 8 Interface (M-Bus) | 9 Power supply

IMPORTANT (NOTE)

If the temperature transmitters are electrically connected, there is no jumper B (between terminals 6 and 2).
The type of connection required (Pt100 or transmitter) for the temperature sensor inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

FCU200T

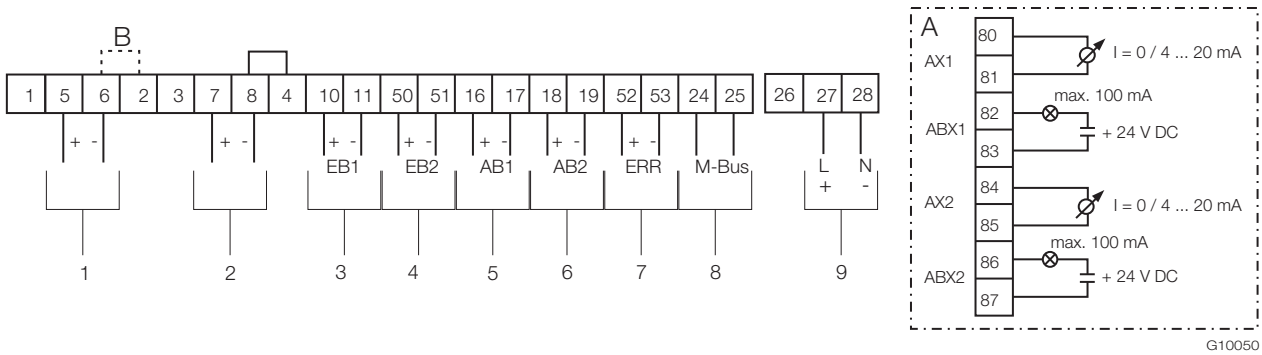

Fig. 19: Connection diagram, FCU200-T basic device
A Current output module (optional) | B Jumper
1 Input 1 for transmitters with active current output | 2 Input 2 for transmitters with active current output | 3 Pulse / frequency input EB1 |
4 Pulse / frequency input EB2 | 5 Pulse output AB1 | 6 Pulse output AB2 | 7 Error output | 8 Interface (M-Bus) | 9 Power supply

IMPORTANT (NOTE)

If the transmitters are electrically connected, there is no jumper B (between terminals 6 and 2).

FCU400-IR

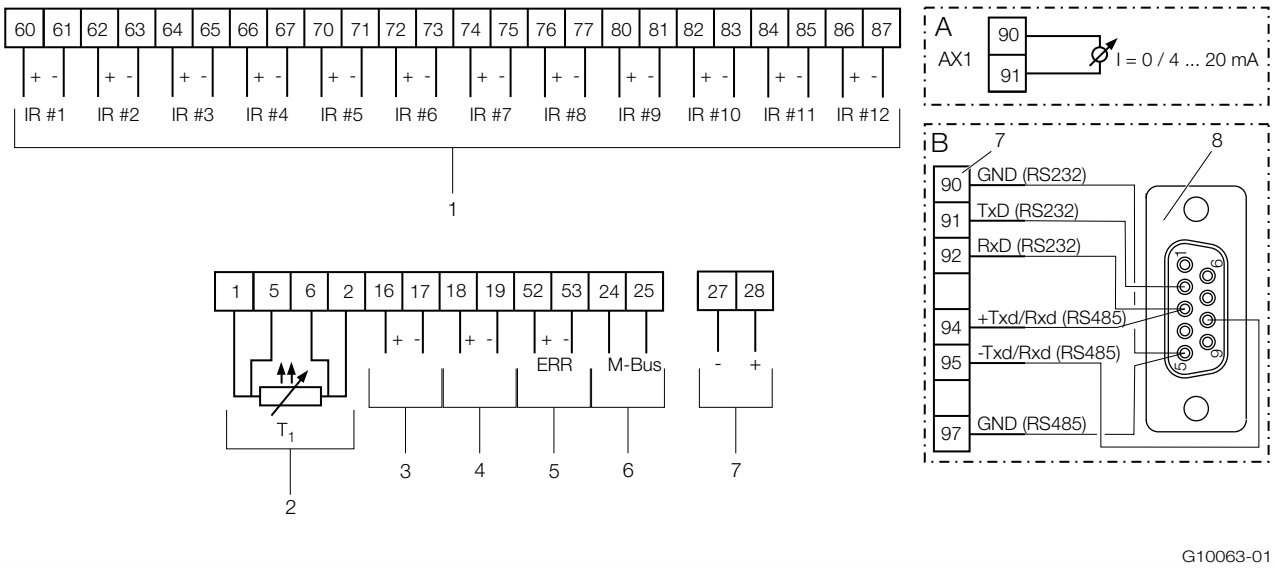

Fig. 20: FCU400-IR connection diagram
A Current output extension module | B RS232 / RS485 (Modbus) interface extension module
1 Inputs for infrared sensors (1 ... 12) | 2 Input for ambient temperature sensor | 3 Alarm output | 4 Alarm output (pre-alarm) | 5 Error output | 6 Interface (M-Bus) | 7 Power supply

IMPORTANT (NOTE)

Extension slots 1, 2, and 3 are already occupied by the IR sensor inputs. The current output and interface extension modules are installed in slot 4. Only one extension module can be installed at any given time (i.e., either the current output or the interface extension module).

Dimensions

Panel mounting

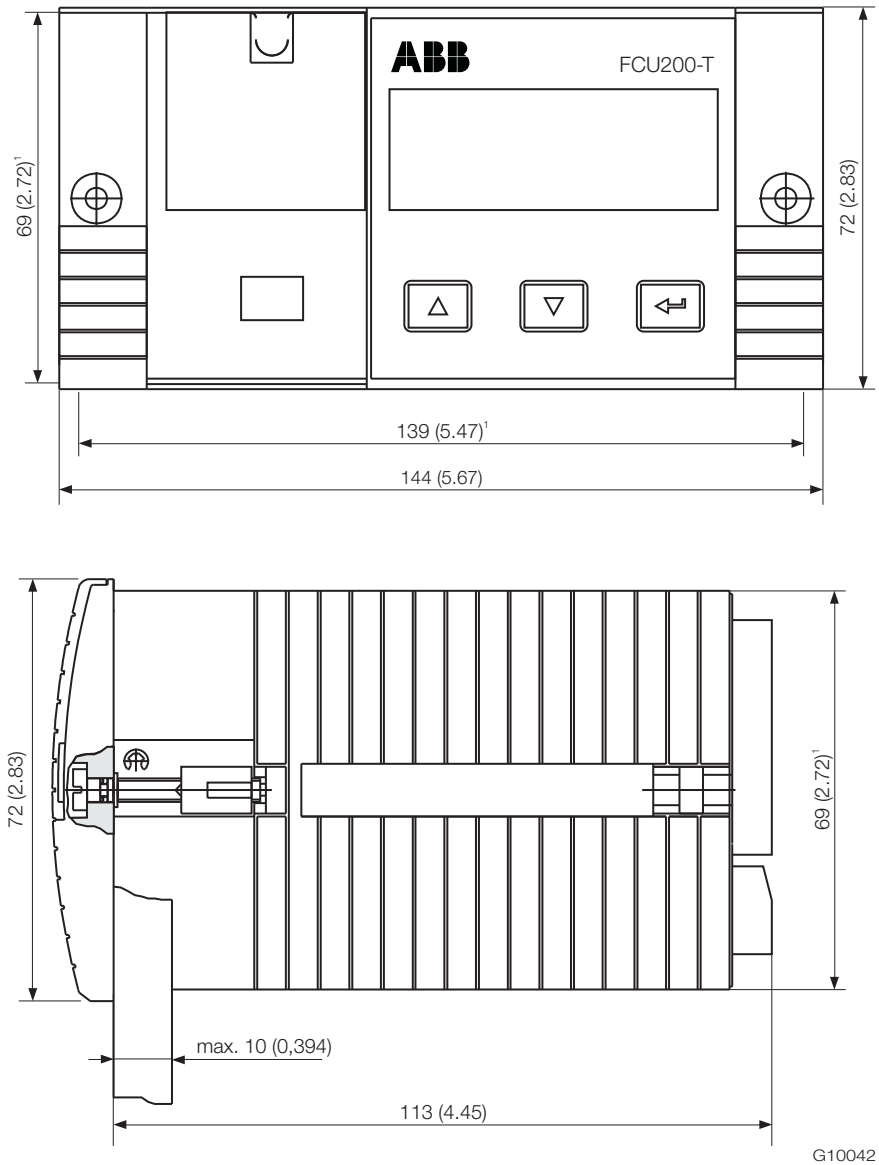

Fig. 21: All dimensions in mm (inch)

1 Panel cutout

Wall mounting (35 mm top-hat rail)

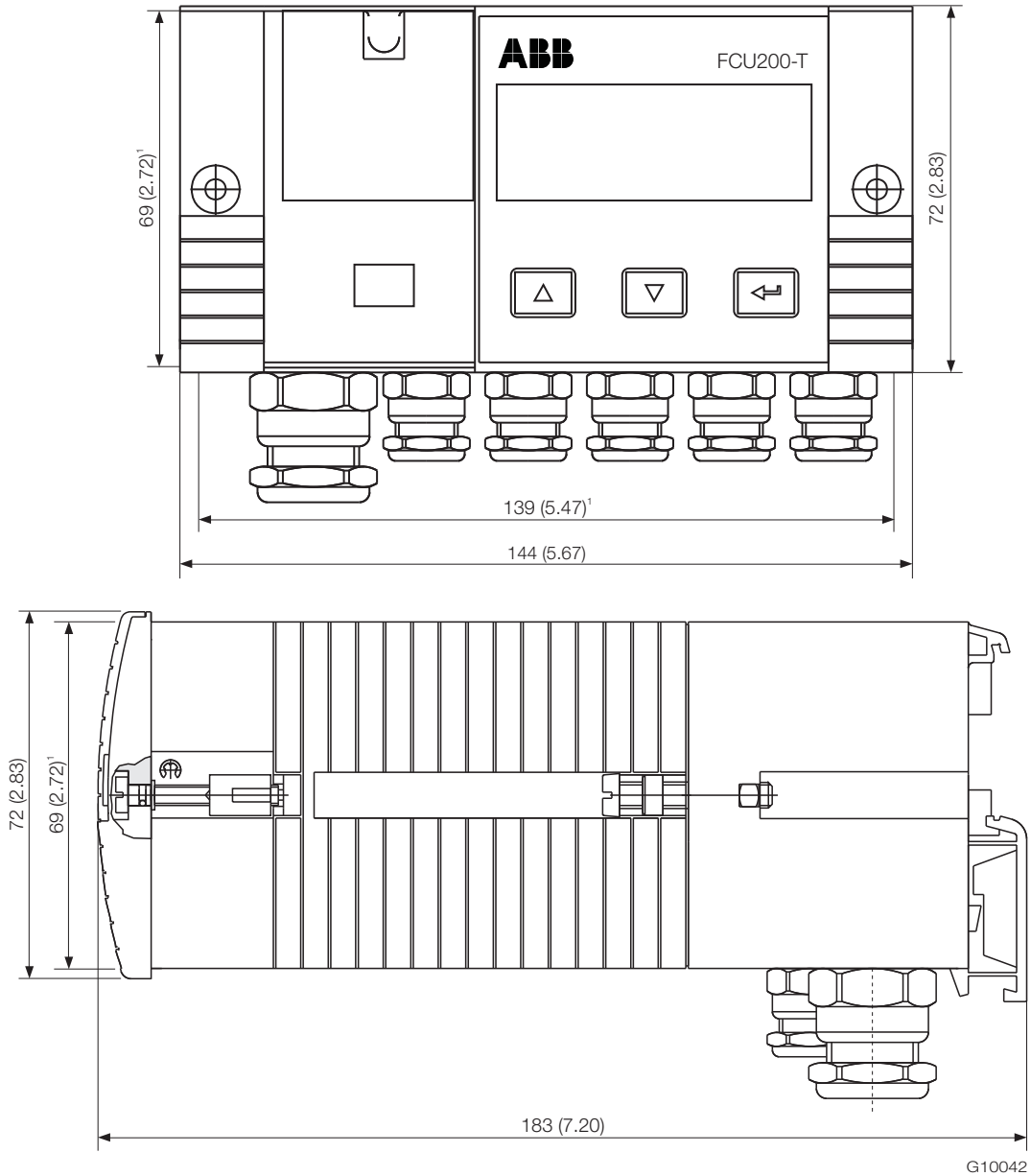

Fig. 22: All dimensions in mm (inch)

1 Panel cutout

Ordering Information

IMPORTANT (NOTE)

The type of connection required (Pt100 or transmitter) for the temperature sensor inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

Main ordering information

Base model		V18022	XX	X	X	X	X
Universal Measurement Computer							
Application							
FCU200-W (SensyCal W), caloric energy computer, standard, water, cooling water, brine, oil	(Note: 1)		10				
FCU200-W (SensyCal W), caloric energy computer, others	(Note: 1)		19				
FCU400-S (SensyCal S), steam / saturated steam, standard, thermal output / flow correction	(Note: 1)		25				
FCU400-S (SensyCal S), steam / saturated steam, standard, flow correction	(Note: 1)		2A				
FCU400-S (SensyCal S), steam / saturated steam, others (special applications)	(Note: 1)		29				
FCU400-G (SensyCal G), gas, standard, flow correction (Qv, p, T)	(Note: 1)		3C				
FCU400-G (SensyCal G), gas, standard, flow correction (Δp, p, T)	(Note: 1)		3D				
FCU400-G (SensyCal G), gas, others (special applications)	(Note: 1)		39				
FCU400-P (SensyCal P), process applications, summation and subtraction (max. 6 inputs)	(Note: 2)		46				
FCU400-P (SensyCal P), process applications, high-precision differential temperature measurement	(Note: 2)		4B				
FCU400-P (SensyCal P), process applications, others	(Note: 2)		49				
FCU200-T (SensyCal T), counting / accounting, current-to-pulse converter	(Note: 3)		57				
FCU200-T (SensyCal T), counting / accounting, pulse-to-current converter	(Note: 3)		58				
FCU200-T (SensyCal T), counting / accounting, others	(Note: 3)		59				
FCU400-IR (SensyCal IR), temperature monitoring, Infrared temperature monitoring	(Note: 4)		60				
(IR temp. sensor available on request)							
Power Supply							
230 V AC				1			
115 V AC				2			
24 V AC / DC (Not with FCU400-IR)				3			
24 V DC (Only with FCU400-IR)				3			
Approvals							
Without calibration					0		
Special test certified (Witness Calibration) for FCU200-W (SensyCal W)					1		
Special certificate for FCU400-S, FCU400-G (SensyCal S, SensyCal G)					2		
Calibration for high-precision differential temperature measurement					4		
Others (special applications)					9		
Configuration							
Without configuration						0	
With customer-specific configuration						1	
Housing							
Housing for panel mounting and wall mounting, 144 mm x 72 mm (5.67 x 2.83 in.)	(Note: 5)						0

SensyCal FCU200, SensyCal FCU400
Universal Measuring Computer

Additional ordering information

	XXX	XXX	XXX	XXX
Optional Extension Module no. 1				
2 x mA inputs and 2 x transmitter supplies (2 x 16 V, 25 mA)	101			
2 x mA outputs and 2 x alarm contacts	102			
RS 485 / RS 232 card for MODBUS communication	105			
2 x transmitter supplies (2 x 20 V, 25 mA)	106			
4 x mV inputs (special application)	107			
4 x mA inputs (summation, special application)	108			
Optional Extension Module no. 2				
2 x mA inputs and 2 x transmitter supplies (2 x 16 V, 25 mA)		101		
2 x mA outputs and 2 x alarm contacts		102		
RS 485 / RS 232 card for MODBUS communication		105		
2 x transmitter supplies (2 x 20 V, 25 mA)		106		
4 x mV inputs (special application)		107		
4 x mA inputs (summation, special application)		108		
Optional Extension Module no. 3				
2 x mA inputs and 2 x transmitter supplies (2 x 16 V, 25 mA)			101	
2 x mA outputs and 2 x alarm contacts			102	
RS 485 / RS 232 card for MODBUS communication			105	
2 x transmitter supplies (2 x 20 V, 25 mA)			106	
4 x mV inputs (special application)			107	
4 x mA inputs (summation, special application)			108	
Optional Extension Module no. 4				
2 x mA inputs and 2 x transmitter supplies (2 x 16 V, 25 mA)				101
2 x mA outputs and 2 x alarm contacts				102
RS 485 / RS 232 card for MODBUS communication				105
2 x transmitter supplies (2 x 20 V, 25 mA)				106
4 x mV inputs (special application)				107
4 x mA inputs (summation, special application)				108

Note 1: Select code 101 for mA inputs and code 102 for mA outputs. Select code 106 for supply of passive pulse / frequency input or temperature transmitter
Note 2: 2 inputs are available for mA signals. Select code 108 for more inputs. Select code 106 for power supply
Note 3: 2 inputs are available for active mA or pulse / frequency signals. Select code 106 for supply of the signals
Note 4: Only with Power Supply 24 V DC
Note 5: 19 in. cartridge see accessories

Accessories

Designation	Order number
FCU RS 232 cable (SUB-D 1:1 9-pole socket / plug), length 3 m, for M-Bus level transformer	7962895
FCU PC configuration program FCOM200, for FCU200-W, FCU400-S, FCU400-G, FCU200-T	7962875
FCU Optohead for connection to a PC via USB-Interface	7962897
FCU Optohead, for connection to a PC via RS 232 interface	7962876
FCU M-Bus micro-master with laptop adapter cable via RS 232 interface, for 10 terminal units (MR 003)	7962877
FCU M-Bus level transformer with RS 232 C interface for 3 terminal units, housing for Z rails or wall mounting PW3	7962878
FCU M-Bus level transformer with RS 232 C interface for 20 terminal units, housing for Z rails or wall mounting PW20	7962879
FCU M-Bus level transformer with RS 232 C interface for 60 terminal units, housing for Z rails or wall mounting PW60	7962880
FCU M-Bus level transformer with RS 232 C interface for 250 terminal units, housing for Z rails or wall mounting PW250	7962891
FCU Handheld printer for infrared communication	7962882
FCU Extension module 2 x mA inputs and 2 x transmitter supplies (2 x 16 V, 25 mA)	7962870
FCU Extension module 2 x mA outputs and 2 x alarm contacts	7962871
FCU Extension module RS 485 / RS 232 card for MODBUS communication	7962874
FCU Extension module 2 x transmitter supplies (2 x 20 V, 25 mA)	7962869
FCU Extension module 4 x mV inputs (special application)	7962881
FCU Extension module 4 x mA inputs (special application)	7962868
FCU400-IR Infra-red Thermometer (Sensytherm IR-CS), Temperature Range 0 ... 250 °C, Spectral Sensitivity 8 ... 14 µm, Optical Resolution 15:1, Response Time 200 ms, Measurement Deviation 1.5 % of Reading, Power Supply 12 ... 28 V DC, Connecting Cable 10 m	7962997
FCU400-IR Accessory for SensyCal IR with Sensytherm, protection housing against electromagnetic interferences	7962998
FCU Front Plate 19 in. Cover for SensyCal	7962896

SensyCal FCU200, SensyCal FCU400
Universal Measuring Computer

Parameterization questionnaire

IMPORTANT (NOTE)
The type of connection required (Pt100 or transmitter) for the temperature sensor inputs must be specified when ordering the device. It is not possible to change the type of connection on site.

FCU200-W

Technical contact person

Tel. / Fax

Person responsible

Tel. / Fax

Tag name (2 x 20 characters) **Language**

Flow transmitter inputs

Pulse **Frequency** **mA**

Pulse value | F min [Hz] | F max [Hz] | 0 ... 20 mA | 4 ... 20 mA

qv-max | qv-min | qv-max | qv-min | qv-max

Absolute pressure [bar] (operating pressure) | Δp-min | Δp-max

Flow sensor placed in | Warm flow | For Δp measurem.: Δp transm. | Linear

Cold flow | Root extracting

For differential pressure measurement (orifice, nozzle, venturi, pitot tube flow meter) please add calculation.

Temperature inputs Pt100 direct | Transmitter 0 … 20 mA | 4 ... 20 mA

Tw min | Tw max | Tc min | Tc max

Pulse output 1

Pulse value

Puls width [ms]

Pulse output 2

Pulse value

Puls width [ms]

Outputs
(Specify physical measuring ranges with units.)

Outputs (select signal)

0 ... 20 mA | 4 ... 20 mA (for all outputs)

	A1	A2	A3	A4
Physical value, start value				
Physical value, final value				

FCU400-S

Technical contact person

Tel. / Fax

Person responsible

Tel. / Fax

Tag name (2 x 20 characters) **Language**

Flow transmitter inputs for steam flow

Pulse **Frequency** **mA**

Pulse value | F min [Hz] | F max [Hz] | 0 ... 20 mA | 4 ... 20 mA

qv-max | qv-min | qv-max | qv-min | qv-max

For Δp measur.: Δp transm. Linear Root extracting Δp-min Δp-max

For differential pressure measurement (orifice, nozzle, venturi, pitot tube flow meter) please add calculation.

Flow transmitter inputs for condensate flow

Pulse **Frequency** **mA**

Pulse | F min [Hz] | F max [Hz] | 0 ... 20 mA | 4 ... 20 mA

qv-max | qv-max | qv-min | qv-max

Absolute pressure (bar) (Operating pressure in the condensate)

Pressure transmitter

0 ... 20 mA 4 ... 20 mA

Over / Abs.

bar / MPA

Steam temperature

0 ... 20 mA 4 ... 20 mA

Pt100 direct

°C

Condensate temperature

0 ... 20 mA 4 ... 20 mA

Pt100 direct

°C

Pulse output 1

Counter

Pulse value

Pulse width (ms)

Pulse output 2

Counter

Pulse value

Pulse width (ms)

Counter

3 Energy (steam condensate)

1 Energy steam

2 Mass steam

4 Energy condensate

5 Mass condensate

Outputs (standard: 2 outputs)
(Specify physical measuring ranges with units.)

Outputs (select signal)

0 ... 20 mA 4 ... 20 mA (for all outputs)

	A1	A2	A3	A4
Physical value, start value				
Physical value, final value				

Zero point suppression for flow m³/h kg/h t/h

(applicable for calculating the flow, power, mass, volume, energy)

SensyCal FCU200, SensyCal FCU400
Universal Measuring Computer

FCU400-G

Technical contact person

Tel. / Fax

Person responsible

Tel. / Fax

Tag name (2 x 20 characters) **Language**

Flow transmitter inputs

Pulse **Frequency** **mA**

Pulse value F min [Hz] F max [Hz] 0 ... 20 mA 4 ... 20 mA

qv-max qv-min qv-max qv-min qv-max

Δp-min Δp-max

For Δp measur.: Δp transm. Linear Root extracting

For differential pressure measurement (orifice, nozzle, venturi, pitot tube flow meter) please add calculation.

Pressure transmitter

0 ... 20 mA 4 ... 20 mA

Over / Abs.

bar / MPA

Gas temperature

0 ... 20 mA 4 ... 20 mA

Pt100 direct

°C

Pulse output 1

Counter

Pulse value

Pulse width (ms)

Counter

1 Nm3

Outputs (optional)
(Specify physical measuring ranges with units.)

Outputs (select signal)

0 ... 20 mA 4 ... 20 mA (for all outputs)

	A1	A2	A3	A4
Physical value, start value				
Physical value, final value				

FCU200-T

Technical contact person

Tel. / Fax

Person responsible

Tel. / Fax

Tag name (2 x 20 characters) **Language**

Inputs

Channel 1

Pulse 1 **Frequency 1** **mA, 1**

Pulse value | F min [Hz] | F max [Hz] | 0 ... 20 mA | 4 ... 20 mA

Max. value | Min. value | Max. value | Min. value | Max. value

Channel 2

Pulse 2 **Frequency 2** **mA, 2**

Pulse value | F min [Hz] | F max [Hz] | 0 ... 20 mA | 4 ... 20 mA

Max. value | Min. value | Max. value | Min. value | Max. value

Pulse output 1

Pulse value

Pulse width (ms)

Pulse output 2

Pulse value

Pulse width (ms)

Outputs (optional)
(Specify physical measuring ranges with units.)

Outputs (select signal)

0 ... 20 mA 4 ... 20 mA (for all outputs)

	A1	A2	A3	A4
Physical value, start value				
Physical value, final value				

An extension board (Code No. 106 with 2 x 20 V supply) is available for power supply of the inputs (pulse, frequency or mA).

Notes

Notes

Contact us

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