

Technical Information

RMC621

Flow and Energy Manager



Universal flow and energy computer for gases, liquids and steam

Application

- Energy management
- Chemical industry
- Heating and air conditioning
- Pharmaceutical industry
- Food and beverage
- Plant and panel manufacture
- Oil + petrochemicals

Your benefits

- Suitable for applications with gas, liquid, steam and water
- Intrinsically safe input (optional)
- Simultaneous calculation of up to 3 measuring applications, even if different fluids are used
- Very precise process calculations (density, enthalpy, compressibility) on the basis of equations and/or storable tables with material data
- Calculation standards according to IAPWS-IF 97, SGERG88, AGA8, real gas equations (SRK, RK), ISO 5167, tables
- Can be used with all common flow measuring systems (vortex, turbine, MID, orifice plate, differential pressure, etc.)
- Profibus interface (optional)
- Compensation input for density signal
- Logbook function for error messages and parameter changes with date and time
- Configuration and operation using the PC software ReadWin 2000
- Modular expansion of inputs and outputs
- Large back-lit LCD with color change in the event of an error

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Function and system design

Measuring principle

The RMC621 is a multifunctional flow and energy computer. It calculates standard & volumetric flow, mass flow and energy (heat) flow using input signals of flow, differential pressure, pressure, temperature and density. It satisfies requirements for gas (e.g. natural gas, air, steam, etc.) and liquid (e.g. heat transfer liquid, water, etc.) applications.

Calculation

- volumetric flow
- standard (corrected) flow
- mass flow
- heat flow
- energy differential (energy balance)

Input

- Current (0/4 to 20 mA)
- PFM
- Pulse
- Temperature Pt100, PT500 and Pt1000 in 3- or wire connection, directly or via temperature transmitter (e.g. TMT181) as 4 to 20 mA signal

Sums (counters)

- volumetric flow
- standard (corrected) flow
- mass
- heat
- bidirectional volumetric/mass/energy flow

Output

- Current (0/4 to 20 mA)
- Pulse
- Digital (passive)
- Relay
- Transmitter power supply (TPS) per analog / pulse input



The number of inputs, outputs, relays and transmitter power supplies contained in the basic device can be individually increased using a maximum of three plug-in cards.

Calculation methods

The flow & energy calculator RMC621 incorporates compensation for flow, gas and fluid measurement according the following equations:

Gases:

- Improved ideal gas law: flow correction in consideration of temperature, pressure and the mean value for compressibility.
- Real gas equation (SRK, RK) and possibility to edit tables for the calculation of compressibility and density of technical gases or density input.
- Natural gas using international standards NX19, SGERG88 and AGA8 (optional).

Liquids:

- Density calculation with algorithms and tables.
- Constant heat capacity or table (heating value as a constant).
- Mineral oil density according to standards ASTM 1250, API 2540, OIML R63 (optional).

Steam/water:

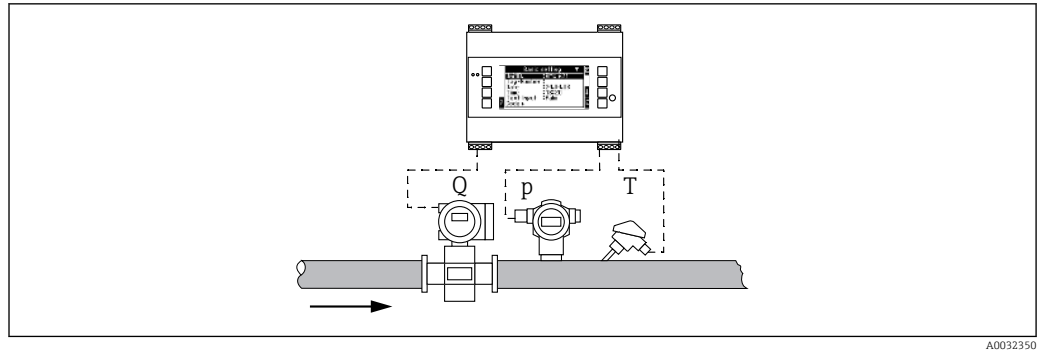
International calculation standard IAPWS IF-97 (ASME tables).

Applications

Gas (standard volume/mass/combustion heat)

Calculation of the gas standard volume and the gas mass with the aid of the gas properties stored in the flow computer. The gas standard volume is determined by taking into account the pressure and temperature effect and the compressibility of the gas which describes the deviation of a gas from an ideal gas. The compressibility of the gas (z-factor) is determined using calculation standards or stored tables depending on the type of gas. As an option there is an input to measure the density directly.

For combustibles the potential combustion heat is calculated using the mean heating value.

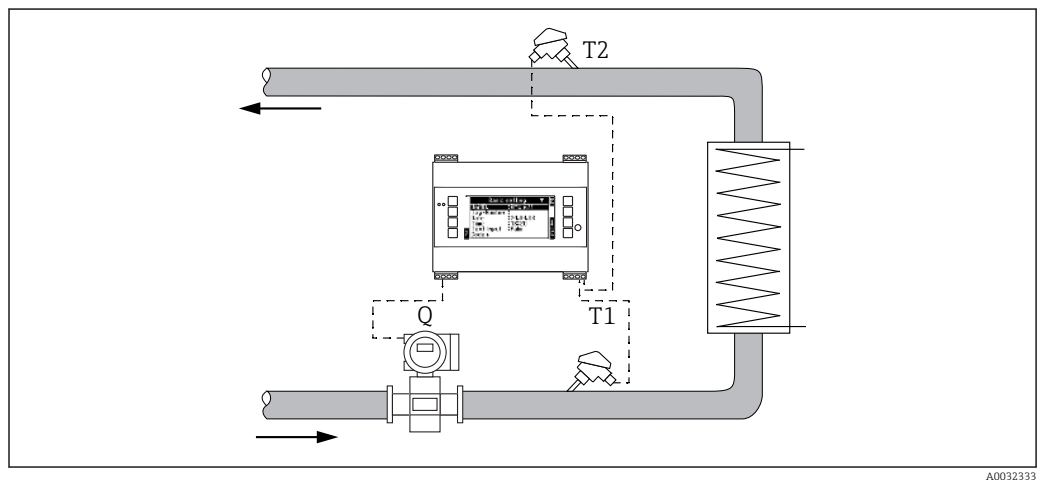


1 Calculation of the gas standard volume/mass from the input variables flow (Q), pressure (p) and temperature (T) and/or density (ρ)

Liquid (heat quantity/heat-differential)

Calculation of the quantity of heat that is emitted or absorbed by a liquid flow in a heating or cooling system. The quantity of heat is calculated from the process variable for flow and the differential from the flow and return temperature. Bidirectional energy calculations, such as balancing systems with changing flow direction (charging/discharging the heat accumulator) are also possible. As an option there is an input to measure the liquid density directly.

For combustibles the potential combustion heat is calculated using the mean heating value.

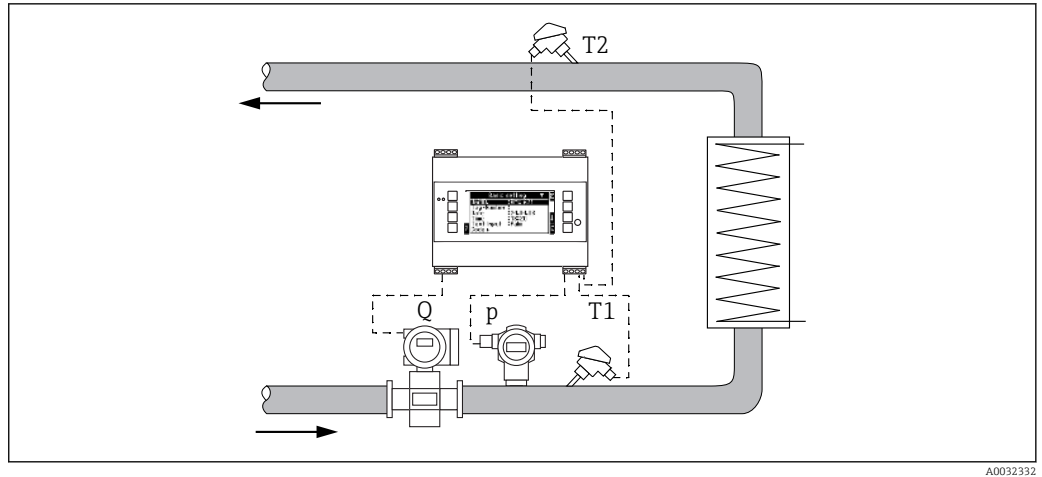


2 Calculation of the water-quantity of heat and water-heat differential from the input variables flow (Q) and the temperature differential ($T1 - T2$) and/or density (ρ)

Steam (mass/heat quantity/heat-differential)

Calculation of the mass flow and its quantity of heat (energy) in a steam line from the process variables i. e. flow, pressure and temperature. In saturated steam operation, the mass flow is calculated from two input variables (pressure-compensated or temperature-compensated).

In addition the balancing of a steam generation process (phase transition: water $\rightarrow$ steam) or a steam heating process (phase transition: steam $\rightarrow$ water) is possible.



3 Calculation of steam-heat differential from the input variables for flow (Q), pressure (p) and temperature differential ($T1 - T2$)

Measuring system

The analog input variables are digitized, the pulse and PFM signals recorded using period length/frequency measurement and processed further in the arithmetic unit controlled by the microcontroller. The energy values are calculated depending on the medium and configuration using international standards (IAPWS-IF97, SGERG88), state equations (SRK) or specific tables. This guarantees maximum precision in all temperature ranges. The internal real time clock with back up power is used to integrate the flow values. Both the input variables and the results can be given out via the outputs.

With differential pressure measurement, the coefficients for flow compensation are calculated over the entire working range of the flow sensor.

Configuration of the inputs, outputs, limit values, the display as well as commissioning and maintenance of the device can be performed via 8 soft keys with the back-lit dot matrix display, using RS232/RS485 interface, ReadWin 2000 PC software and an external control unit.

Online help makes on-site operation easier. The color change of the background lighting visualizes alarm value violations or faults. A functional expansion of the device by means of expansion cards can be made at any time.

Input

Measured variable	Current, PFM, pulse, temperature		
Input signal	Flow, differential pressure, pressure, temperature		
Measuring range	Measured variable	Input	
	Current	0/4 to 20 mA +10% overrange - Maximum input current 150 mA - Input impedance < 10 Ω - Signal attenuation low-pass filter 1st order, filter constants 0 to 99 s configurable - Fault recognition 3.6 mA and 21 mA limit as per NAMUR NE43	
	PFM	- Frequency range when using an input on the mainboard (Slot A): 0.25 Hz to 12.5 kHz - Frequency range when using an input on an extension board (Slot B, C, D): 0.01 Hz to 12.5 kHz - Signal level 2 to 7 mA low; 13 to 19 mA high - Measurement method: period length/frequency measurement	
	Pulse	- Frequency range when using an input on the mainboard (Slot A): 0.25 Hz to 12.5 kHz - Frequency range when using an input on an extension board (Slot B, C, D): 0.01 Hz to 12.5 kHz - Signal level 2 to 7 mA low; 13 to 19 mA high with approximately 1.3 kΩ dropping resistor at 24 V voltage level	
	Temperature	Resistance thermometer (RTD) according to ITS 90:	
		Designation	Measuring range
		Pt100	–200 to 800 °C (–328 to 1 472 °F)
		Pt500	–200 to 250 °C (–328 to 482 °F)
		Pt1000	–200 to 250 °C (–328 to 482 °F)
		- Type of connection: 3- or 4-wire system - Measuring current 500 µA	
Number: 2 x 0/4 to 20 mA/PFM/pulse 2 x Pt100/500/1000 (in basic device)			
Maximum number: 10 (depends on the number and type of expansion cards)			
Galvanic isolation	The inputs are galvanically isolated between the individual expansion cards and the basic device (see also 'Galvanic isolation' under Output).		

Ouput

Output signal Current, pulse, transmitter power supply (TPS) and switching output

Galvanic isolation Basic device:

Connection with terminal designation	Supply (L/N)	Input 1/2 0/4 to 20 mA/ PFM/ pulse (10/11) or (110/11)	Input 1/2 TPS (82/81) or (83/81)	Temperature input 1/2 (1/5/ 6/2) or (3/7/8/4)	Output 1/2 0 to 20 mA/ pulse (132/131) or (134/133)	Interface RS232/485 housing front or (102/101)	TPS external (92/ 91)
Power supply		2 300 V	2 300 V	2 300 V	2 300 V	2 300 V	2 300 V
Input 1/2 0/4 to 20 mA/ PFM/ pulse	2 300 V			500 V	500 V	500 V	500 V
Input 1/2 TPS	2 300 V			500 V	500 V	500 V	500 V
Temperature input 1/2	2 300 V	500 V	500 V		500 V	500 V	500 V
Output 1/2 0 to 20 mA/ pulse	2 300 V	500 V	500 V	500 V		500 V	500 V
Interface RS232/RS485	2 300 V	500 V	500 V	500 V	500 V		500 V
TPS external	2 300 V	500 V	500 V	500 V	500 V	500 V	



The specified insulation voltage is the AC testing voltage U_{eff} , which is applied between the connections.

Basis for assessment: IEC 61010-1 (EN 61010-1), protection class II, overvoltage category II.

Current - pulse output variable

Current

- 0/4 to 20 mA +10% overrange, invertible
- maximum loop current 22 mA (short-circuit current)
- Load maximum 750 Ω at 20 mA
- Accuracy 0.1% of full scale value
- Temperature drift: 0.1% / 10 K (18 °F) ambient temperature change
- Output Ripple < 10 mV at 500 Ω for frequencies < 50 kHz
- Resolution 13 Bit
- Error signals 3.6 mA and 21 mA limits as per NAMUR NE43 adjustable

Pulse

Basic device:

- Frequency range to 2 kHz
- Voltage level 0 to 1 V low, 24 V high $\pm 15\%$
- Load minimum 1 k Ω
- Pulse width 0.25 to 1000 ms

Expansion cards (digital passive, open collector):

- Frequency range to 2 kHz
- $I_{\text{max}} = 200 \text{ mA}$
- $U_{\text{max}} = 24 \text{ V} \pm 15\%$
- $U_{\text{low/max}} = 1.3 \text{ V}$ bei 200 mA
- Pulse width 0.25 to 1000 ms

Number

Number:

2 x 0/4 to 20 mA/pulse (in basic device)

maximum number

- 8 x 0/4 to 20 mA/pulse (depends on the number of expansion cards)
- 6 x digital passive (depends on the number of expansion cards)

Signal sources

All available multifunctional inputs (current, PFM or pulse inputs) and results can be freely allocated to the outputs.

Switching output

Function

Limit relay switches in these operating modes: minimum, maximum safety, gradient, alarm, saturated steam alarm, frequency/pulse, device error

Switch behavior

Binary, switches when the alarm value is reached (potential-free NO contact)

Relay switching capacity

maximum 250 V_{AC}, 3 A / 30 V_{DC}, 3 A



When using relays on expansion cards, a mixture of low voltage and extra-low voltage is not permitted.

Switching frequency

maximum 5 Hz

Switching threshold

Programmable (wet steam alarm is preset at 2 °C (3.6 °F) at the factory)

Hysteresis

0 to 99%

Signal source

All available inputs and calculated variables can be allocated freely to the switching outputs.

Number

- 1 (in basic device)
- Maximum number: 7 (depends on the number and type of expansion cards)

Number of output states

100 000

Scan rate

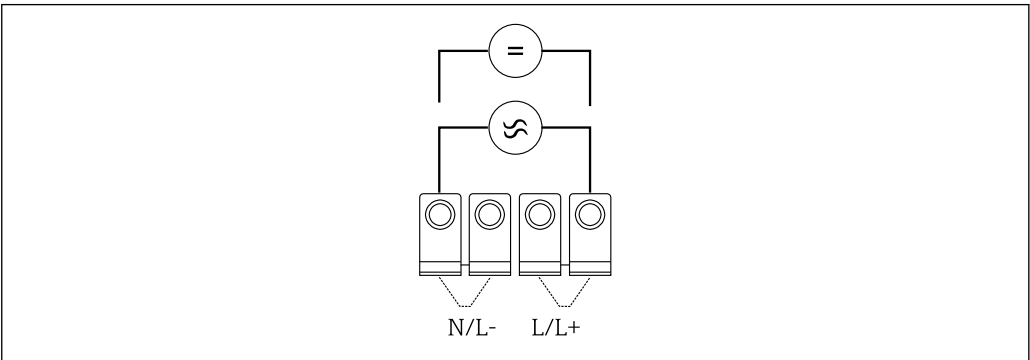
500 ms

Transmitter power supply and external power supply

- Transmitter power supply unit, terminals 81/82 or 81/83 (optional universal expansion cards 181/182 or 181/183):
 - Maximum supply voltage 24 V_{DC} ±15%
 - Impedance < 345 Ω
 - Maximum output current 22 mA (for U_{out} > 16 V)
 - HART® communication is not impaired
 - Number: 2 (in basic device)
 - maximum number: 8 (depending on the number and type of expansion cards)
- Additional power supply (e.g. external display), terminals 91/92:
 - Supply voltage 24 V_{DC} ±5%
 - Maximum current 80 mA, short-circuit proof
 - Number: 1
 - Source resistance < 10 Ω

Power supply

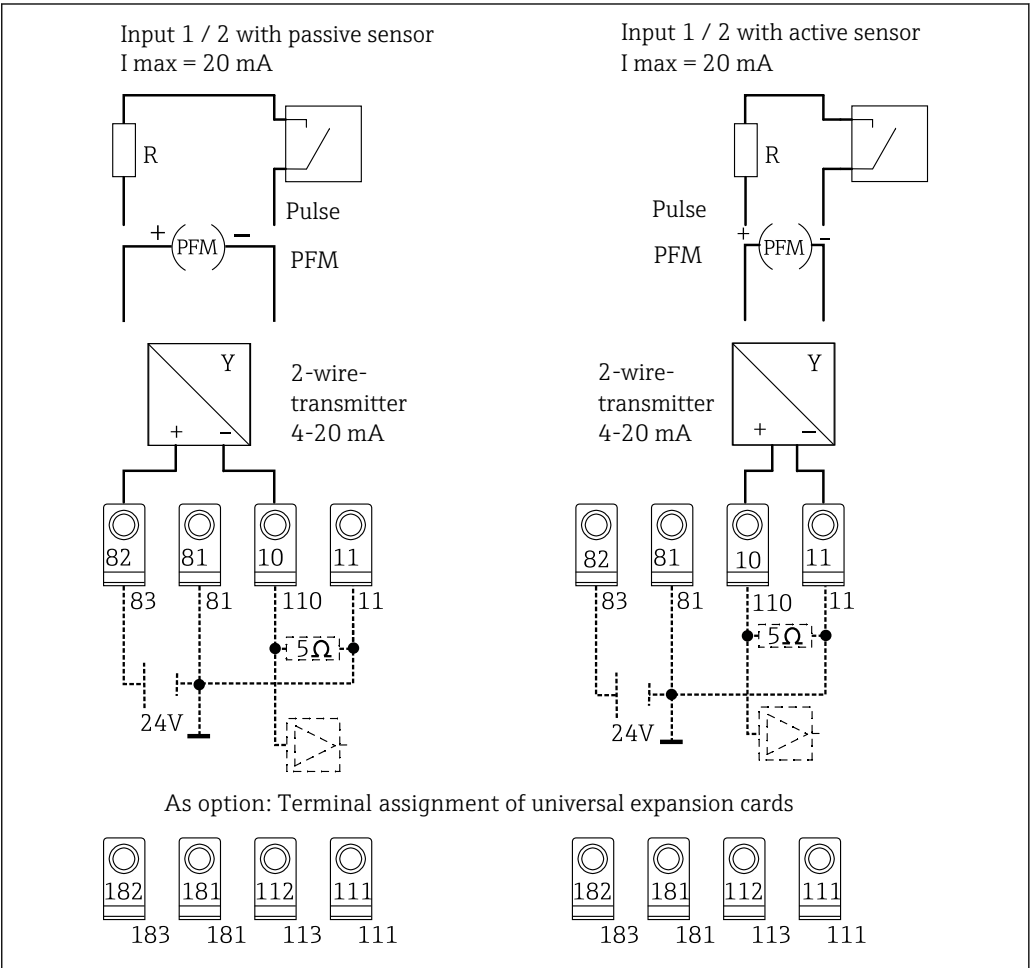
Terminal assignment



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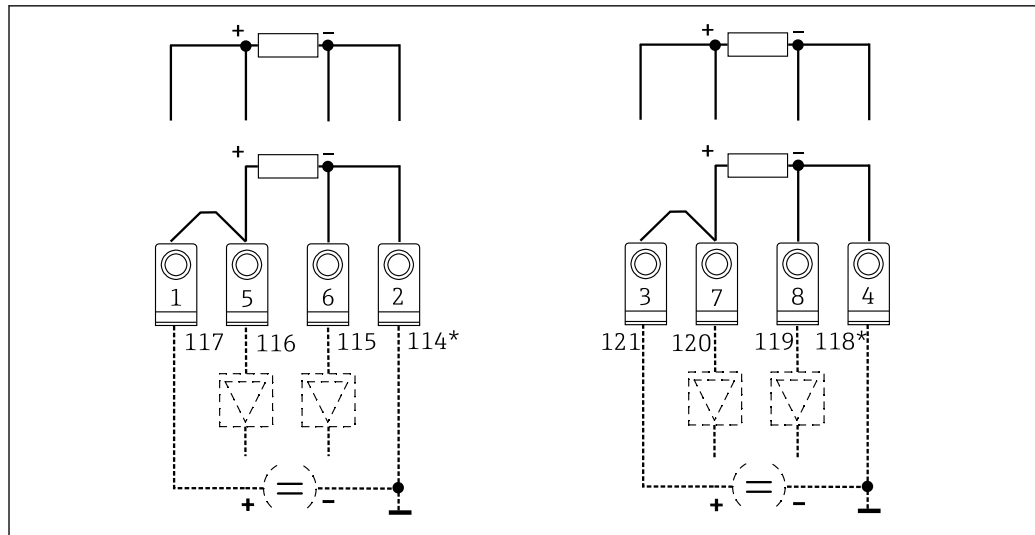
4 Power supply; 90 to 250 V_{AC} 50/60 Hz, 20 to 36 V_{DC}, 20 to 28 V_{AC} 50/60 Hz

 The terminals are bridged internally and can be used as support points for series wiring.



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5 PFM, current and pulse inputs of the energy manager

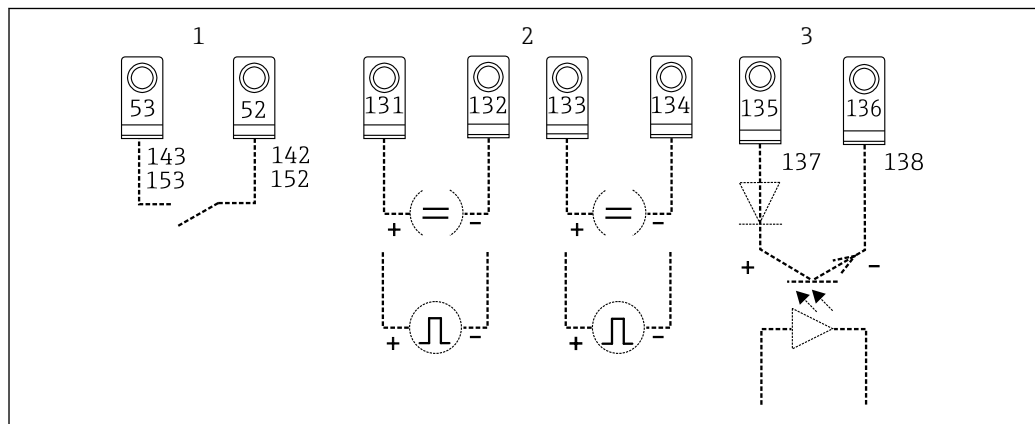


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6 Temperature inputs of the energy manager; terminals 1, 2, 5, 6: input 1; terminals 3, 4, 7, 8: input 2

* Optional: Terminal assignment temperature expansion card

i The terminals 1 and 5 or 3 and 7 respectively must be bridged for 3-wire connection.



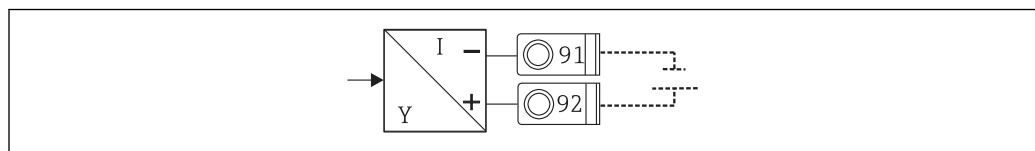
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7 Outputs of the energy managers

1 Relay 1; terminal 142, 143 (relay 1) and 152, 153 (relay 2) as an option in expansion card

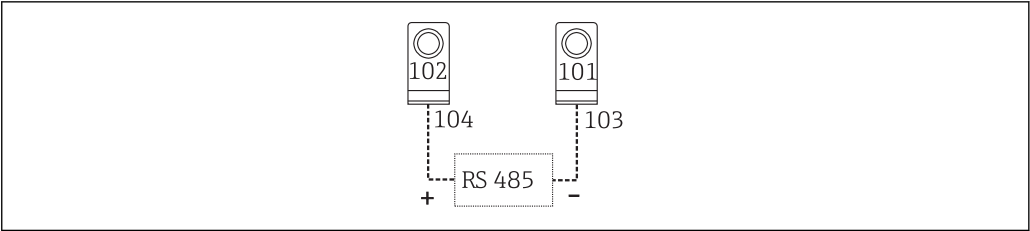
2 Pulse and current outputs

3 Pulse outputs (Open Collector) as an option in expansion card



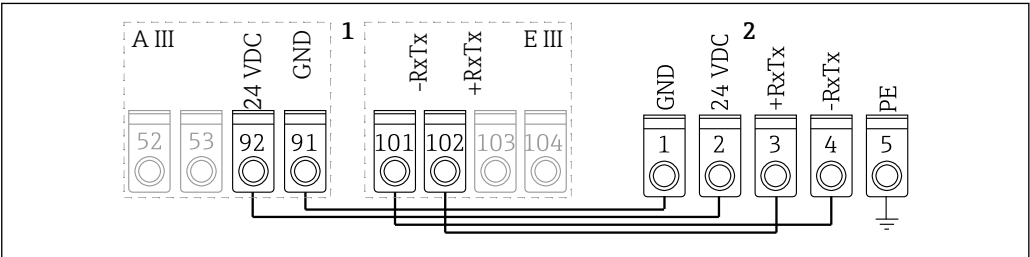
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8 Transmitter power supply



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9 Interfaces RS485



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10 Connection of remote display and operating unit (option)

- 1 Energy manager
2 Display and operating unit

Supply voltage	- Low voltage power unit: 90 to 250 V_{AC} 50/60 Hz - Extra-low voltage power unit: 20 to 36 V_{DC}, 20 to 28 V_{AC} 50/60 Hz
Power consumption	8 to 26 VA (depending on the configuration)
Connection data interface	RS232 - Connection: 3.5 mm jack plug on front panel - Transmission protocol: ReadWin 2000 - Transmission rate: maximum 57600 Baud RS485 - Connection: plug-in terminals 101/102 (in basic device) - Transmission protocol: (serial: ReadWin 2000; parallel: open standard) - Transmission rate: maximum 57600 Baud Optional: additional RS485 interface - Connection: plug-in terminals 103/104 - Transmission protocol and transmission rate same as standard RS485 interface

Performance characteristics

Reference operating conditions	- Power supply 230 V_{AC} ±10%; 50 Hz ±0.5 Hz - Warm-up period > 30 min - Ambient temperature range 25 °C (77 °F) ±5 K (±9 °F) - Air humidity 39% ± 10% relative humidity
Maximum measured error	- Current: 0.1% of full scale value - PFM: 0.01% of full scale value - Temperature (4-wire connection): - Pt100: 0.03% of full scale value - Pt500: 0.1% of full scale value - Pt1000: 0.08% of full scale value
Resolution	- Current: 13 Bit - Temperature: 16 Bit

Influence of ambient temperature	■ Current: 0.4% / 10 K (18 °F) ambient temperature change ■ PFM: 0.1% / 10 K (18 °F) ambient temperature change ■ Temperature: 0.01%/ 10 K (18 °F) ambient temperature change
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Installation

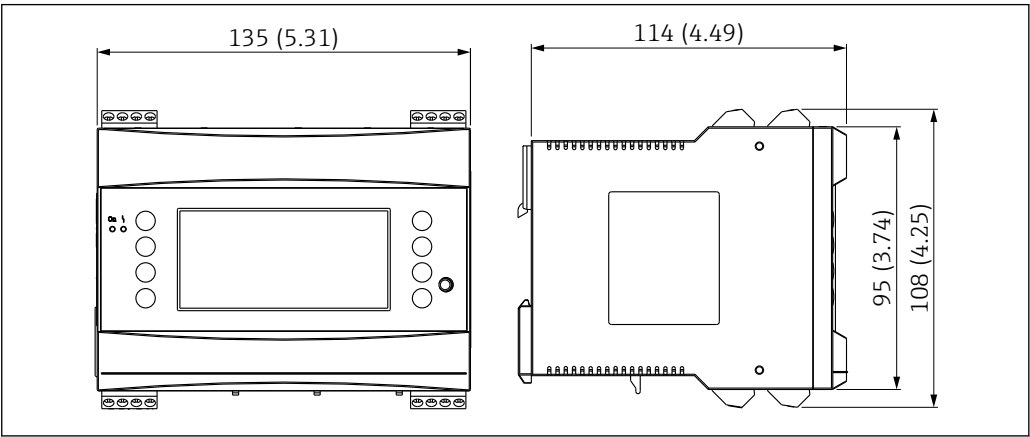
Mounting location	In the cabinet on DIN rail according to IEC 60715 TH 35
	NOTICE Device overheating when using expansion cards ► When using extension cards, venting with an air current of at least 0.5 m/s is necessary.
Orientation	No restrictions.

Environment

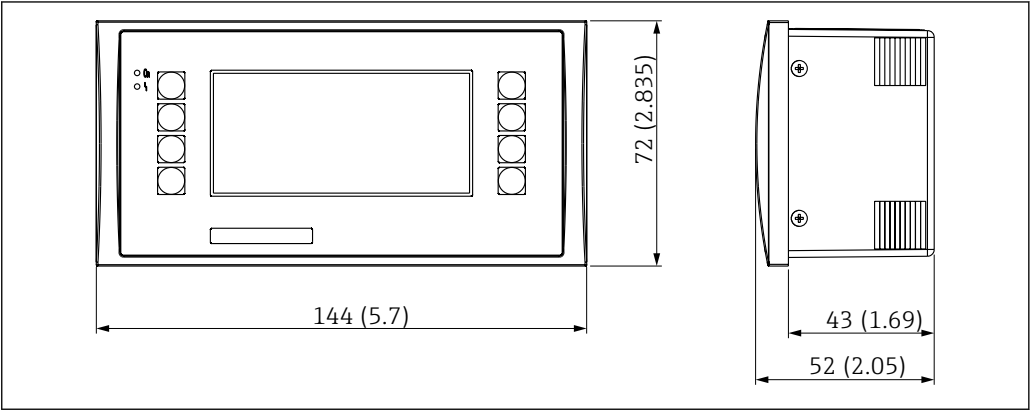
Ambient temperature range	–20 to 60 °C (–4 to 140 °F)
Storage temperature	–30 to 70 °C (–22 to 158 °F)
Climate class	As per IEC 60 654-1 Class B2 / EN 1434 Klasse 'C' (no condensation permitted)
Electrical safety	As per IEC 61010-1: ambient < 2 000 m (6 560 ft) above sea level
Degree of protection	■ Basic device: IP 20 ■ External display: IP 65
Electromagnetic compatibility	■ Interference emission: IEC 61326 Class A ■ Interference immunity: – Power failure: 20 ms, no influence – Starting current limitation: $I_{\max}/I_n \leq 50\%$ ($T_{50\%} \leq 50$ ms) – Electromagnetic fields: 10 V/m as per IEC 61000-4-3 – Conducted HF: 0.15 to 80 MHz, 10 V as per IEC 61000-4-3 – Electrostatic discharge: 6 000 V contact, indirect as per IEC 61000-4-2 – Burst (power supply): 2 000 V as per IEC 61000-4-4 – Burst (signal): 1 000 V/2 000 V as per IEC 61000-4-4 – Surge (AC power supply): 1 000 V/2 000 V as per IEC 61000-4-5 – Surge (DC power supply): 1 000 V/2 000 V as per IEC 61000-4-5 – Surge (signal): 500 V/1 000 V as per IEC 61000-4-5

Mechanical construction

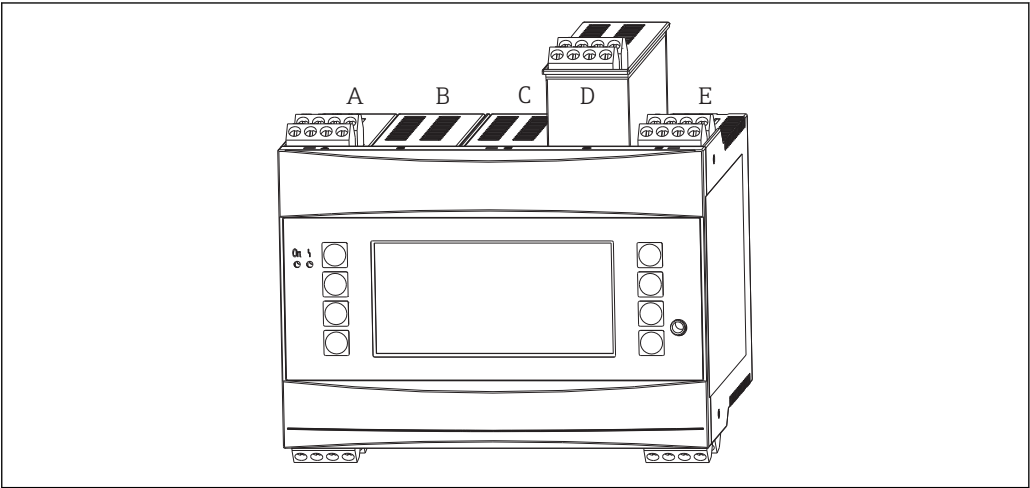
Design, dimensions



11 Housing for DIN rail as per IEC 60751 TH35; dimensions in mm (in)



12 Display and operating unit for panel mounting (available as an option or as an accessory); dimensions in mm (in)



13 Unit upgrade with expansion cards (optional or available as accessories)

A, E Slots A and E equipped in the basic device
B, C, Slots B, C and D can be upgraded with expansion cards
D

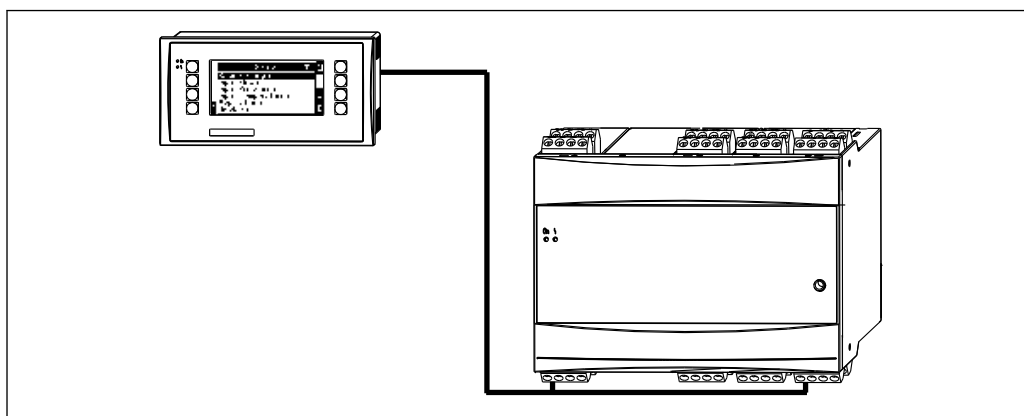
Weight

- Basic device: 500 g (17.6 oz) (in maximum configuration with expansion cards)
- Remote control unit: 300 g (10.6 oz)

Material	Housing: polycarbonate plastic, UL 94V0
Terminals	Coded, pluggable screw terminals; Clamping area 1.5 mm ² (16 AWG) solid, 1.0 mm ² (18 AWG) flexible with wire end ferrule (applies to all connections).

Operability

Operating concept	■ Display (optional): 160 x 80 Dot-matrix LCD with blue background lighting Color changes to red in the event of an error (adjustable) ■ LED status display: Operation: 1 x green Fault message: 1 x red ■ External display and operating unit (optional or as accessory): A display and operating unit can also be connected to the energy manager in the panel mounted housing, dimensions (WxHxT) 144 (5.67) x 72 (2.83) x 43 (1.69) mm (in)) The connection to the integrated RS485 interface is made using the connecting cable (l = 3 m (9.84 ft)) which is included in the accessories set. Parallel operation of the external display unit with a device-internal display in the RMS621 is possible.
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14 External display and operating unit in the panel mounted housing

Operating elements	Eight front-panel soft keys interact with the display (function of the keys is shown in the display).
Remote operation	RS232 interface (3.5 mm (0.14 in)): jack plug on front panel): configuration via PC operating software.
Real time clock	■ Deviation: 2.6 min per year ■ Power reserve: 14 days
Mathematical functions	■ Flow, difference pressure calculation: EN ISO 5167 ■ Continuous calculation of mass, density, enthalpy, heat quantity using stored algorithms and tables ■ Water / steam calculation as per IAPWS-IF97 ■ Liquids: linear density function and tables for density and heat capacity Mineral oil: API 2540, ASTM 1250, OIIML R63 ■ Technical gases: real gas equations (Soave Redlich Kwong), compressibility tables as well as improved ideal gas equation ■ Natural gas: NX19, as option: SGERG88, AGA8 (gross-method) Tables for density, heat value and compressibility can be edited freely or saved.

Certificates and approvals

CE mark	The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE-mark.
EAC mark	The product meets the legal requirements of the EEU guidelines. The manufacturer confirms the successful testing of the product by affixing the EAC mark.
Ex approvals	For further details on the available Ex versions (ATEX, CSA, FM, etc.), please contact your Endress+Hauser sales organization. All relevant data for hazardous areas can be found in separate Ex documentation. If required, please request copies.
Other standards and guidelines	■ IEC 60529: Degrees of protection by housing (IP code) ■ IEC 61010-1: Safety requirements for electrical measurement, control and laboratory instrumentation. ■ IEC 61326-Serie: Electromagnetic compatibility (EMC requirements). ■ NAMUR NE21, NE43: Standardization association for measurement and control in chemical and pharmaceutical industries (www.namur.com). ■ IAPWS-IF 97: International applicable and recognized calculation standard (since 1997) for steam and water. Issued by the International Association for the Properties of Water and Steam (IAPWS). ■ OIML R75: International construction regulation and test specification for water energy managers from the Organisation Internationale de Métrologie Légale. ■ EN 1434 1, 2, 5 und 6 ■ EN ISO 5167: Flow measurement of fluids with throttle devices.

Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.
- From your Endress+Hauser Sales Center: www.addresses.endress.com



Product Configurator - the tool for individual product configuration

- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Application packages

The following table contains an overview of the order codes for the expansion cards with the possible applications.

Applications in a device	Number of inputs	Product structure (expansion cards)
1 x saturated steam measurement	1 x pulse flow 1 x 4 to 20 mA pressure	RMC621-xxxAAxxxx
1 x gas standard volume	1 x 4 to 20 mA flow 1 x 4 to 20 mA pressure 1 x Pt100 temperature	
1 x liquid-heat differential	1 x 4 to 20 mA pressure 2 x Pt100 temperature	
2 x saturated steam	2 x flow pulse 2 x 4 to 20 mA pressure	RMC621-xxBAxxxx
1 x gas standard volume 1 x steam heat differential	2 x PFM flow 2 x 4 to 20 mA pressure 2 x Pt500 temperature	
1 x saturated steam measurement 1 x water heat quantity	2 x pulse flow 1 x 4 to 20 mA pressure 2 x Pt100 temperature	
2 x liquid heat quantity	2 x 4 to 20 mA flow 4 x Pt100 temperature	RMC621-xxCAxxxx
1 x gas standard volume 1 x liquid heat differential	2 x 4 to 20 mA flow 4 x Pt100 temperature	
3 x saturated steam measurement	3 x pulse flow 3 x 4 to 20 mA pressure	RMC621-xxBAxxxx
1 x steam heat quantity 1 x water heat differential	1 x PFM flow 1 x pulse flow 1 x 4 to 20 mA pressure 3 x Pt100 temperature	RMC621-xxBCAxxxx
1 x steam heat differential 1 x water heat differential	2 x PFM flow 1 x 4 to 20 mA pressure 4 x Pt100 temperature	
1 x gas standard volume 1 x steam net heat quantity 1 x liquid heat quantity	3 x PFM flow 2 x 4 to 20 mA pressure 4 x Pt100 temperature	RMC621-xxBBCxxxx
3 x gas standard volume	3 x 4 to 20 mA flow 3 x 4 to 20 mA pressure 3 x Pt500 temperature	
1 x steam mass 2 x water heat differential	3 x PFM flow 1 x 4 to 20 mA pressure 5 x Pt100 temperature	RMC621-xxBCCxxxx
3 x water heat differential	3 x pulse flow 6 x Pt100 temperature	

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website:

www.endress.com.

Device-specific accessories

- Display and operating unit (optional or as an accessory):
Remote display for panel mounting (dimensions (WxHxD) 144 (5.67) x 72 (2.83) x 43 (1.69) mm (in))
- IP 66 protective housing for field mounting DIN rail instrumentation

Expansion cards

A function expansion of the device by means of max. 3 extension cards (universal and/or temperature cards) is possible.

- Extension card temperature
Inputs: 2 x Pt100/500/1000
Outputs: 2 x 0/4 to 20 mA/pulse, 2 x digital, 2 x relay
- Extension card universal
Inputs: 2 x 0/4 to 20 mA/PFM/pulse with TPS
Outputs: 2 x 0/4 to 20 mA/pulse, 2 x digital, 2 x relay
- PC configuration software ReadWin 2000 and serial configuration cable with jack plug 3.5 mm (0.14 in).

Communication-specific accessories

PROFIBUS interface

Documentation

- System components and data managers - Solutions for the loop: FA00016K
- Operating instructions RMC621: BA00144R
- Appendix to the Operating Instructions M-Bus interface RMC621/RMS621: BA00216R
- Brief Operating Instructions RMC621/RMS621: KA01321K

www.addresses.endress.com
