

# MPR316 / 08 / 04 Compact Controller with program function

## Brief description

The series of controllers includes four freely programmable instruments in different DIN formats for controlling temperature, pressure and other process variables. The high-contrast, multicolor LC display for process value, setpoint and operator prompting contains two four-digit 7-segment displays, two single-character 16-segment displays, display of the active setpoints, six switch position indicators, and displays for the dimensional unit, ramp function and manual operation.

Simple operation through 4 keys. The instruments can be used as 2-state, 3-state, modulating or continuous controllers. The controller software includes a program or ramp function, parameter set changeover, two autotuning (self-optimization) procedures, a math and logic module, as well as 4 limit comparators.

Linearizations for the usual transducers are stored, and a customer-specific linearization table can be programmed.

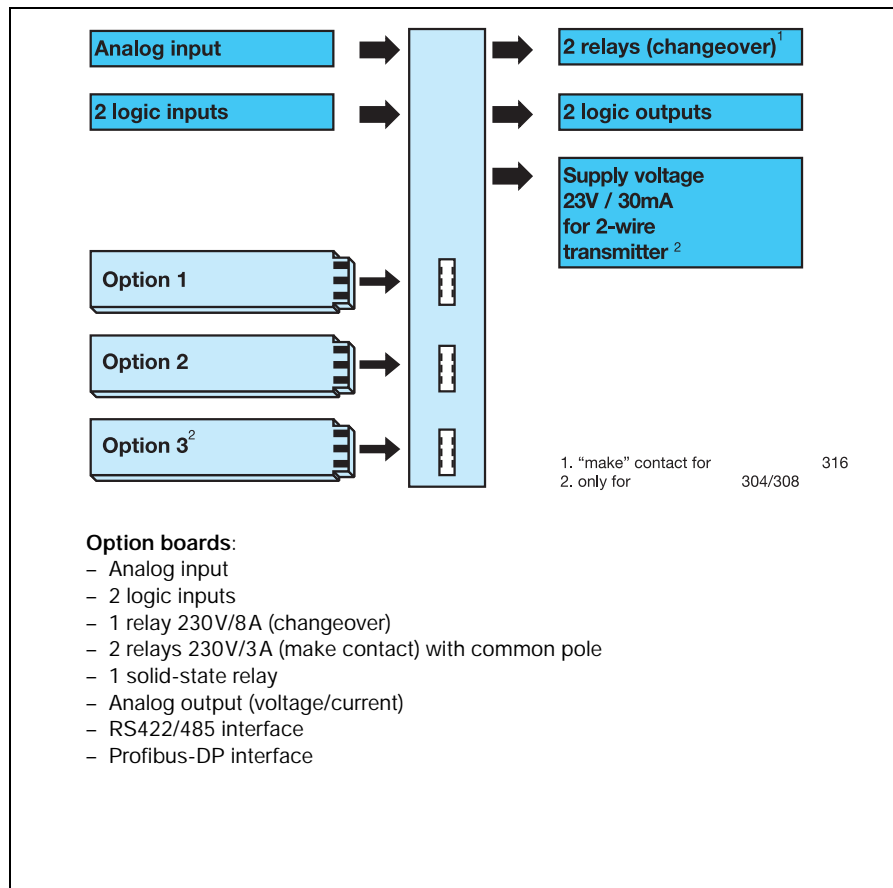
A setup program is available for user-friendly configuration from a PC.

A serial interface for RS422/485 or Profibus-DP can be used to integrate the instruments into a data network.

The electrical connection is made at the back, via screw terminals.

The possible input and output configurations are shown in the following block diagram. The option boards are universally applicable for all instruments in the series.

## Block structure



Type 316



Type 308H



Type 308Q



Type 304

## Key features

- Max. two programmable analog inputs
- Four programmable setpoints, two parameter sets
- Program function with 8 segments, or ramp function
- Math and logic module
- 4 limit comparators
- Two timer functions
- Two self-optimization procedures
- Fast, user-friendly configuration through the setup program with program editor
- RS422/485 interface
- Profibus-DP interface

## Self-optimization

Standard features include the tried and tested self-optimization, which makes it possible for the controller to be matched to the control loop by a user who is not a control technology expert.

This functions by evaluating the response of the control loop to specific changes in the manipulating variable. Either an oscillatory method or a step-response test can be selected. The step-response test is used, for example, in the plastics industry or in processes where the oscillatory method cannot be employed. The controller parameters that are calculated are: proportional band, reset time, derivative time, cycle time and filter time constant.

## Customer-specific linearization

In addition to the linearizations for the usual transducers, a customer-specific linearization can also be created. The programming is carried out in the setup program, in the form of a table of values or a formula.

## User level

Parameters which frequently have to be changed by the user, can be combined in the instrument and displayed at the user level (only through the setup program).

## Math and logic module<sup>1</sup>

The math module makes it possible to combine values such as the setpoints, output levels and measurements from the analog inputs into a mathematical formula.

The logic module can be used, for instance, to make a logical combination of logic inputs and limit comparator states.

Up to two math or logic formulae can be entered through the setup program, and the results of the calculations can be presented at the outputs or used for internal purposes.

## Special types of controller<sup>1</sup>

The instrument can be operated as a differential, humidity or ratio controller.

## Logic functions

- Start/cancel self-optimization
- Change to manual mode
- Hold/cancel ramp
- Controller off
- Setpoint changeover
- Parameter set switching
- Key/level inhibit
- Text display
- Display off
- Acknowledge limit comparators
- Program start/hold/cancel
- Timer start/stop

The logic functions can be combined with one another (only through the setup program).

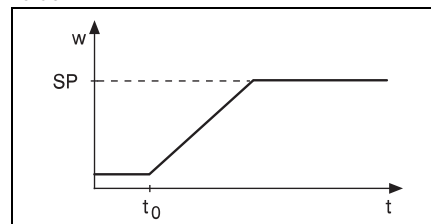
1. Extra code

## Functions of the outputs

- Analog input variables
- Math
- Process value
- Setpoint
- Ramp end value
- Control deviation
- Output level
- Controller outputs
- Limit comparators
- Control contacts
- Logic inputs
- Logic formula
- Program end
- Timer signals
- Program/automatic signal

## Ramp function

Either a rising or a falling ramp function can be used (increase or decrease in the setpoint). The change in setpoint value SP at  $t_0$  is the final value for the ramp. The ramp starts with the setpoint at time  $t_0$ . The slope of the ramp can be programmed; the sign (direction) of the slope is given by the relationship between the setpoint at time  $t_0$  and the SP value. When the supply voltage is switched on, the ramp function starts with the momentary process value.



## Timers

Two timers are available for time-dependent control. The status of the timers can be switched through to the logic outputs or internally processed for the activation or de-activation of time-dependent processes.

## Setup program (accessory)

The setup program for configuring the instrument is available in English, French and German. Using a PC, you can create and edit sets of data, and transfer them to the controller or read them out from the instrument. The data sets are stored and managed.

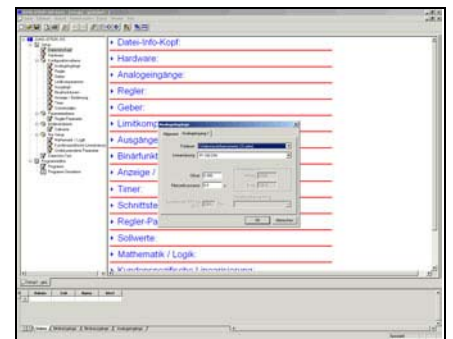
The setup program can be expanded through additional program modules.

### Program editor

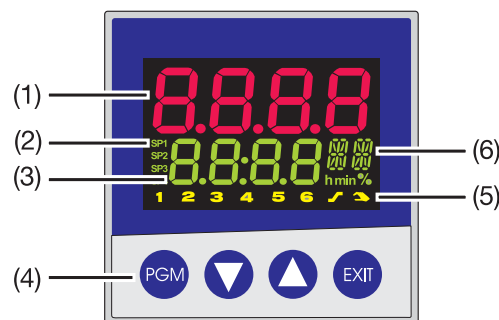
For the easy creation of programs.

### Startup

To check the control-loop behavior.

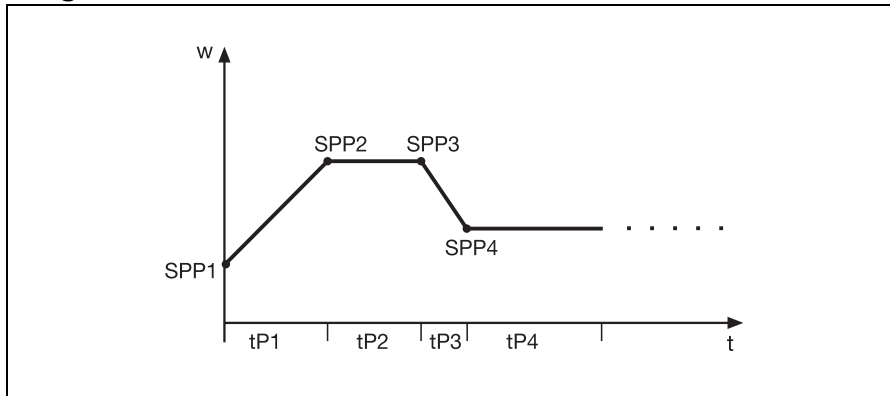


## Displays and controls



|     |   |
|-----|---|
| (1) | <b>7-segment display</b> (factory setting: process value)<br>four-digit, red, decimal place is configurable (automatic adjustment on display overflow)                              |
| (2) | <b>Active setpoint</b> (factory setting: SP1)<br>SP1, SP2, SP3, SP4 (SP=setpoint); green;   |
| (3) | <b>7-segment display</b> (factory setting: setpoint)<br>four-digit, green, decimal place is configurable, also used for operator prompting (display of parameter and level symbols) |
| (4) | <b>Keys</b>   |
| (5) | <b>Indication</b><br>yellow, for<br>- switch status of logic outputs 1—6<br>- ramp/program function<br>- active manual operation  |
| (6) | <b>16-segment display + dim. units</b><br>two-digit, green, with symbols for °C, °F, h, min, %  |

## Program function



A setpoint profile can be implemented with a maximum of 8 program segments. The settings for the segment setpoints (SPP1 — SPP8) and segment times (tP1 — tP8) are carried out at the user level. The time scale can be configured as mm:ss or hh:mm (s = seconds, h = hours).

A program-end signal can be generated, and the program can be halted or canceled. Further functions can be defined through the setup program (start at process value, cyclical program handling, segment-by-segment assignment of parameter sets and four control contacts). The program profile can also be visualized.

### Warm-up ramp for hot-channel controller

The warm-up ramp for hot-channel equipment is used, for example, for the gentle operation of ceramic heater elements. Damage can be avoided by allowing moisture to evaporate slowly from the hygroscopic heater elements during the warm-up phase.

## Interfaces

### RS422/RS485 interface

The serial interface is used for communication with higher-level (supervisory) systems. The Modbus protocol is used for transmission.

### PROFIBUS-DP

The Profibus-DP interface can be used to integrate the controller into a fieldbus system operating according to the Profibus-DP standard. This Profibus version is especially designed for communication between automation systems and decentralized peripheral devices at the field level, and optimized for speed.

Data transmission is made serially, using the RS485 standard.

GSD generator, the project-planning tool that is supplied with the package (GSD = Gerätestammdaten, i.e. device data), is used to make a selection of device characteristics for the controller to create a standardized GSD file that is used to integrate the controller into the fieldbus system.

## Parameter level

All the parameters and their meanings are included in the table. Some parameters may be missing or meaningless for a particular type of controller. Two parameter sets can be stored, to handle special applications.

| Parameter              | Value range      | Factory setting | Meaning   |
|------------------------|------------------|-----------------|---|
| Proportional band      | 0 — 9999 digits  | 0 digits        | Size of the proportional band<br>0 means that the controller structure is out of action!  |
| Derivative time        | 0 to 9999 sec    | 80 sec          | Influences the differential component of the controller output signal   |
| Reset time             | 0 to 9999 sec    | 350 sec         | Influences the integral component of the controller output signal   |
| Cycle time             | 0 to 999.9 sec   | 20.0 sec        | When using a switched output, the cycle time should be chosen so that the energy flow to the process is as continuous as is practicable without overloading the switching elements. |
| Contact spacing        | 0 to 999.9 sec   | 0.0 digits      | The spacing between the two control contacts for 3-state or modulating controllers  |
| Switching differential | 0 — 999.9 digits | 1.0 digits      | Hysteresis for switching controllers with proportional band = 0   |
| Actuator time          | 5 to 3000 sec    | 60 sec          | Actuator time range used by the control valve for modulating controllers  |
| Working point          | -100 to +100%    | 0%              | The output level for P and PD controllers (if $x = w$ then $y = Y0$ )   |
| Output level limiting  | 0 — 100%         | 100%            | The maximum limit for the output level  |
|                        | -100 to +100 %   | -100%           | The minimum limit for the output level  |

## Technical data

### Thermocouple input

| Designation              | Measuring range | Measuring accuracy  | Ambient temperature error |
|--------------------------|-----------------|---------------------|---------------------------|
| Fe-Con L                 | -200 to + 900°C | ≤0.25%              | 100 ppm / °C              |
| Fe-Con J EN 60 584       | -200 to +1200°C | ≤0.25%              | 100 ppm / °C              |
| Fe-Con U                 | -200 to + 600°C | ≤0.25%              | 100 ppm / °C              |
| Cu-Con T EN 60 584       | -200 to + 400°C | ≤0.25%              | 100 ppm / °C              |
| NiCr-Ni K EN 60 584      | -200 to +1372°C | ≤0.25%              | 100 ppm / °C              |
| NiCr-Con E EN 60 584     | -200 to +1000°C | ≤0.25%              | 100 ppm / °C              |
| NiCrSi-NiSi N EN 60 584  | -100 to +1300°C | ≤0.25%              | 100 ppm / °C              |
| Pt10Rh-Pt S EN 60 584    | 0 to 1768°C     | ≤0.25%              | 100 ppm / °C              |
| Pt13Rh-Pt R EN 60 584    | 0 to 1768°C     | ≤0.25%              | 100 ppm / °C              |
| Pt30Rh-Pt6Rh B EN 60 584 | 0 to 1820°C     | ≤0.25% <sup>1</sup> | 100 ppm / °C              |
| W5Re-W26Re C             | 0 to 2320 °C    | ≤0.25%              | 100 ppm / °C              |
| W3Re-W25Re D             | 0 to 2495 °C    | ≤0.25%              | 100 ppm / °C              |
| W3Re-W26Re               | 0 to 2400 °C    | ≤0.25%              | 100 ppm / °C              |
| Cold junction            | Pt100, internal |                     |                           |

1. in the range 300 to 1820 °C

### Input for resistance thermometer

| Designation            | Connection   | Measuring range | Measuring accuracy |        | Ambient temperature error |
|------------------------|--|-----------------|--------------------|--------|---------------------------|
|                        |  |                 | 3-/4-wire          | 2-wire |                           |
| Pt100 EN 60 751        | 2-wire / 3-wire / 4-wire   | -200 to +850°C  | ≤0.05%             | ≤0.4%  | 50 ppm / °C               |
| Pt500 EN 60 751        | 2-wire / 3-wire / 4-wire   | -200 to +850°C  | ≤0.2%              | ≤0.4%  | 100 ppm / °C              |
| Pt1000 EN 60 751       | 2-wire / 3-wire / 4-wire   | -200 to +850°C  | ≤0.1%              | ≤0.2%  | 50 ppm / °C               |
| KTY11-6                | 2-wire   | -50 to +150°C   | ≤1.0%              | ≤2.0%  | 50 ppm / °C               |
| Sensor lead resistance | max. 30Ω per lead for 3-wire or 4-wire circuit   |                 |                    |        |                           |
| Measuring current      | approx. 250µA  |                 |                    |        |                           |
| Lead compensation      | Not required for 3-wire or 4-wire circuit. With a 2-wire circuit, the lead resistance can be compensated in software by a correction of the process value. |                 |                    |        |                           |

### Input for standard signals

| Designation            | Measuring range  | Measuring accuracy | Ambient temperature error    |
|------------------------|--|--------------------|------------------------------|
| Voltage                | 0(2) — 10V<br>0 — 1V<br>Input resistance $R_{IN} > 100k\Omega$ | ≤0.05%<br>≤0.05%   | 100 ppm / °C<br>100 ppm / °C |
| Current                | 0(4) — 20mA, voltage drop ≤ 1.5V                               | ≤0.05%             | 100 ppm / °C                 |
| Heating current        | 0 — 50mA AC  | ≤1%                | 100 ppm / °C                 |
| Resistance transmitter | min. 100Ω, max. 4kΩ  | ≤0.5%              | 100 ppm / °C                 |

### Logic inputs

|                   |  |
|-------------------|--|
| Floating contacts |  |
|-------------------|--|

■ Standard version

### Measuring circuit monitoring

In the event of a fault, the outputs move to a defined (configurable) status.

| Sensor                       | Overrange / underrange | Probe or lead short-circuit | Probe or lead break |
|------------------------------|------------------------|-----------------------------|---------------------|
| Thermocouple                 | •                      | -                           | •                   |
| Resistance thermometer       | •                      | •                           | •                   |
| Voltage 2 — 10V<br>0 — 10V   | •<br>•                 | •<br>-                      | •<br>-              |
| Current 4 — 20mA<br>0 — 20mA | •<br>•                 | •<br>-                      | •<br>-              |

• = recognized - = not recognized

**Outputs**

|   |   |
|---|---|
| Relay (changeover)<br>for type 703042/43/44<br>contact rating<br>contact life | 3A at 230V AC resistive load<br>350,000 operations at rated load / 750,000 operations at 1A         |
| Relay (changeover) (option)<br>contact rating<br>contact life                 | 8A at 230V AC resistive load<br>100,000 operations at rated load / 350,000 operations at 3A         |
| Relay (make)<br>for type 703041<br>contact rating<br>contact life             | 3A at 230V AC resistive load<br>150,000 operations at rated load / 350,000 at 1A                    |
| Relay (changeover) (option)<br>contact rating<br>contact life                 | 3A at 230VAC resistive load<br>350,000 operations at rated load / 900,000 operations at 1A          |
| Logic output  | 0/12V / 30mA max. (sum of all output currents) or<br>0/18V / 25mA max. (sum of all output currents) |
| Solid-state relay (option)<br>contact rating<br>protection circuitry          | 1A at 230V<br>varistor  |
| Voltage (option)<br>output signals<br>load resistance                         | 0 — 10V / 2 — 10V<br>$R_{load} \geq 500\Omega$  |
| Current (option)<br>output signals<br>load resistance                         | 0 — 20mA / 4 — 20mA<br>$R_{load} \leq 500\Omega$  |
| Supply voltage for<br>2-wire transmitter<br>voltage                           | electrically isolated, not stabilized<br>30V DC with no load<br>23V at 30mA load                    |

**Controller**

|                       |   |
|-----------------------|---|
| Controller type       | 2-state controller,<br>3-state controller, modulating controller, continuous controller |
| Controller structures | P, PD, PI, PID  |
| A/D converter         | dynamic resolution up to 16-bit   |
| Sampling time         | 250msec   |
|                       | 50msec, 90msec, 150msec, 250msec  |

**Electrical data**

|   |  |
|---|--|
| Supply voltage (switchmode PSU)   | 110 — 240V AC -15/+10%, 48 — 63Hz<br>20—53V AC/DC, 48—63Hz   |
| Electrical safety   | to EN 61 010, Part 1<br>overvoltage category II, pollution degree 2<br>for type 703041 with power supply AC/DC connect to SELV and PELV only |
| Power consumption   | max. 7VA   |
| Data backup   | EEPROM   |
| Electrical connection   | at the back, via screw terminals,<br>conductor cross-section up to 1.5mm <sup>2</sup><br>with core ferrules (length: 10mm)                   |
| Electromagnetic compatibility<br>Interference emission<br>Interference immunity | EN 61 326<br>Class B<br>to industrial requirements   |

■ Standard version

**Housing**

|                                   |  |
|-----------------------------------|--|
| Housing type                      | plastic housing for panel mounting to DIN 43 700                           |
| Depth behind panel                | 90 mm  |
| Ambient/storage temperature range | 0 to 55 °C / -40 to +70 °C   |
| Climatic conditions               | rel. humidity ≤90% annual mean, no condensation                            |
| Operating position                | horizontal   |
| Protection                        | to EN 60 529, front IP65 / back IP20                                       |
| Weight (fully fitted)             | dTRON316: approx. 220g<br>dTRON308: approx. 380g<br>dTRON304: approx. 490g |

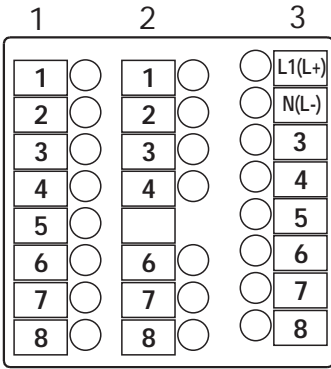
**Interface****MODbus**

|                      |                        |
|----------------------|------------------------|
| Interface type       | RS422/485              |
| Protocol             | Modbus, Modbus-integer |
| Baud rate            | 9600, 19200, 38400     |
| Device address       | 0 — 255                |
| Max. number of nodes | 32                     |

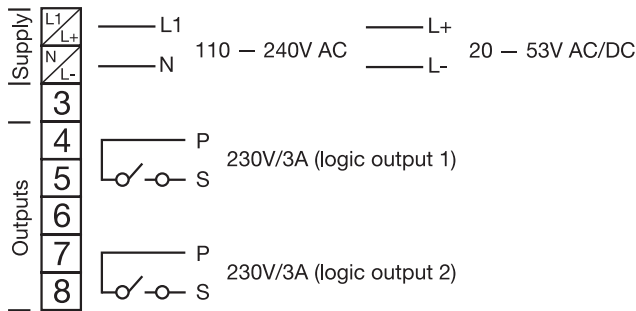
**Profibus**

|                |         |
|----------------|---------|
| Device address | 0 — 255 |
|----------------|---------|

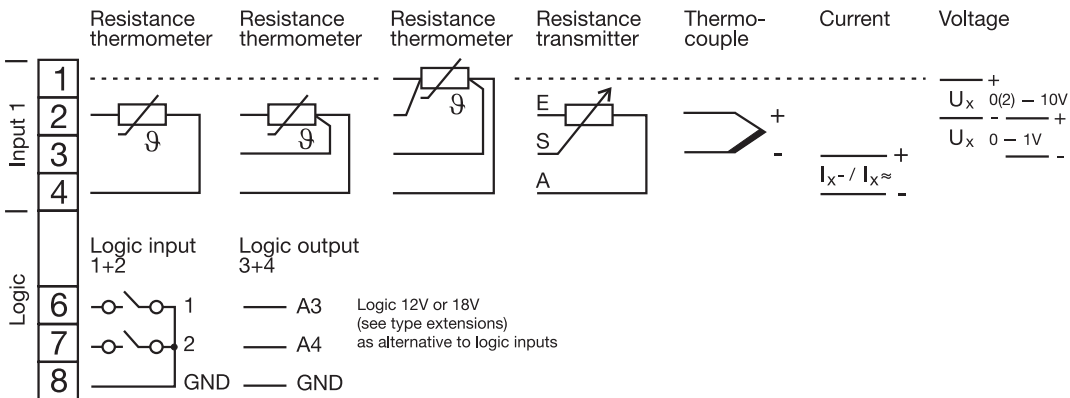
### Connection diagram, type 703041



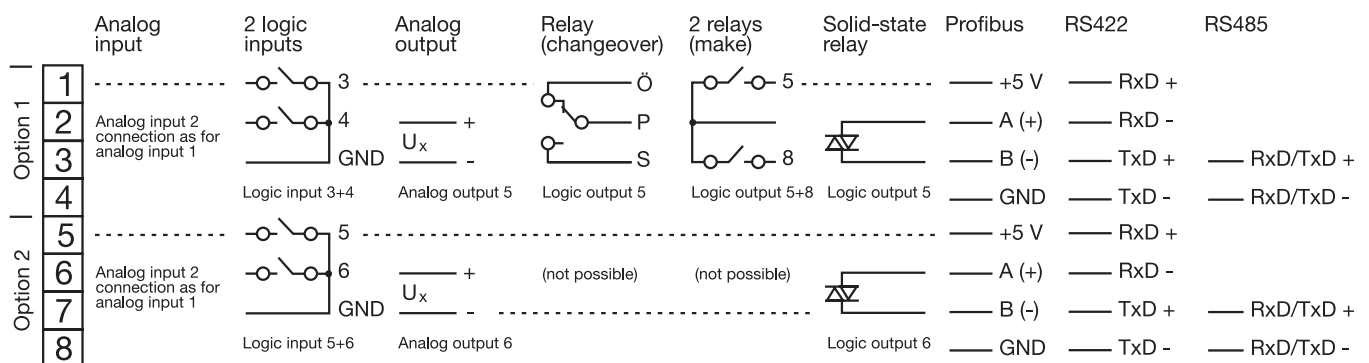
#### Terminal strip 3



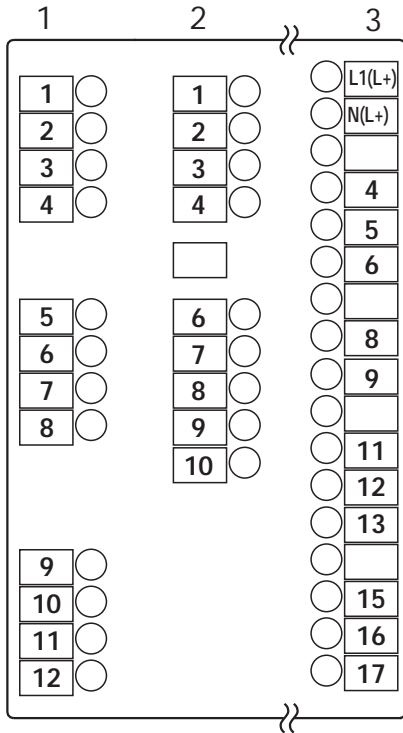
#### Terminal strip 2



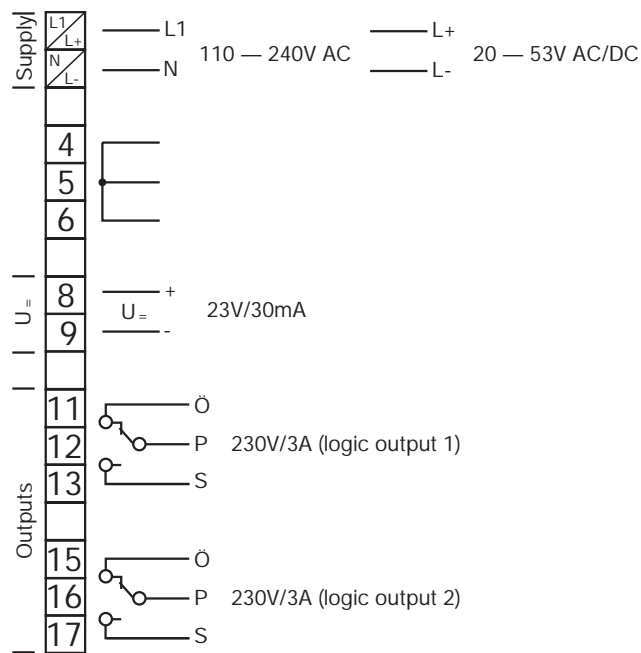
#### Terminal strip 1



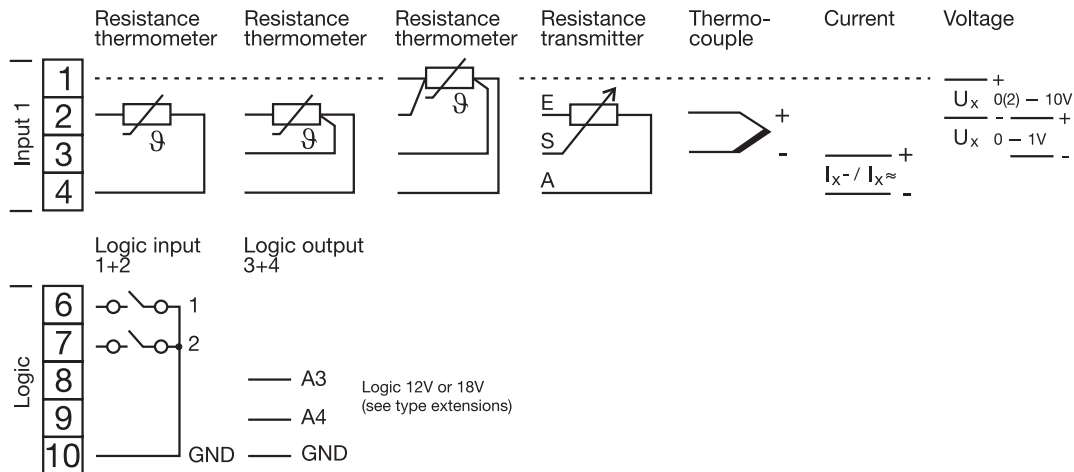
### Connection diagram, type 703042/43/44



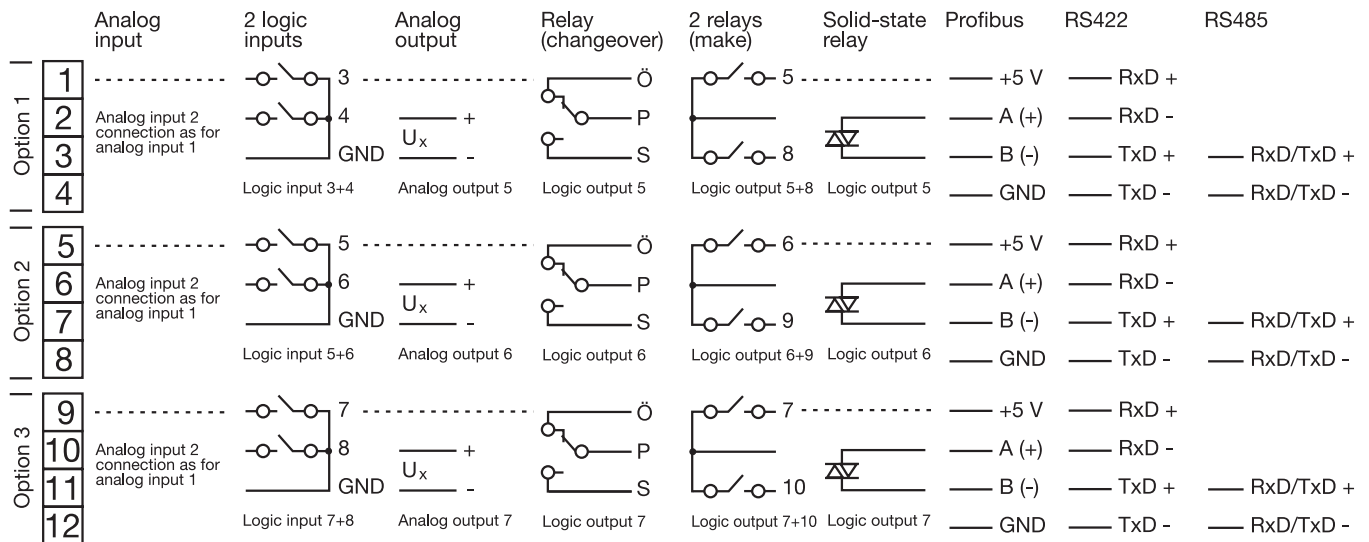
#### Terminal strip 3



#### Terminal strip 2



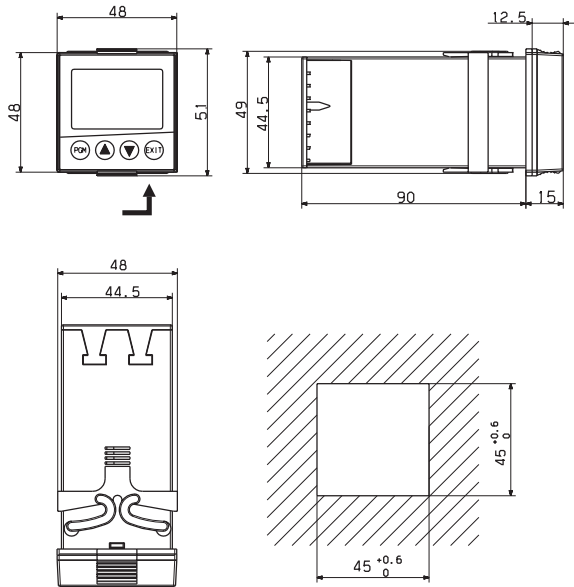
#### Terminal strip 1



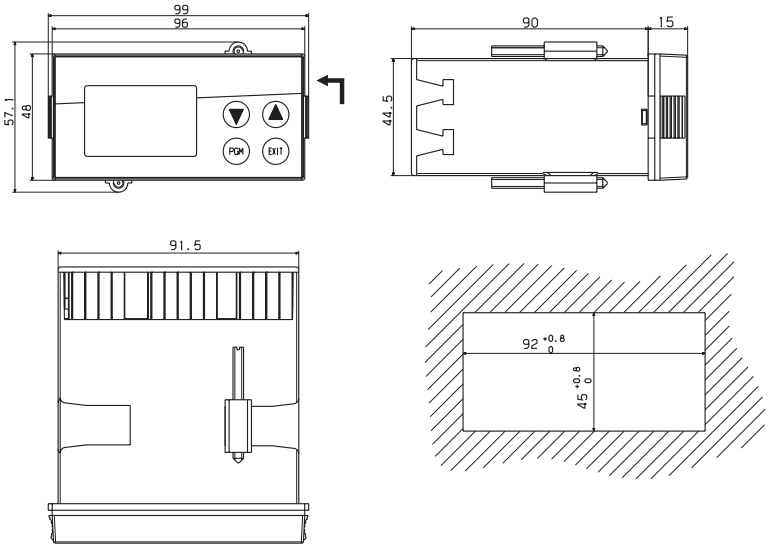


## Dimensions

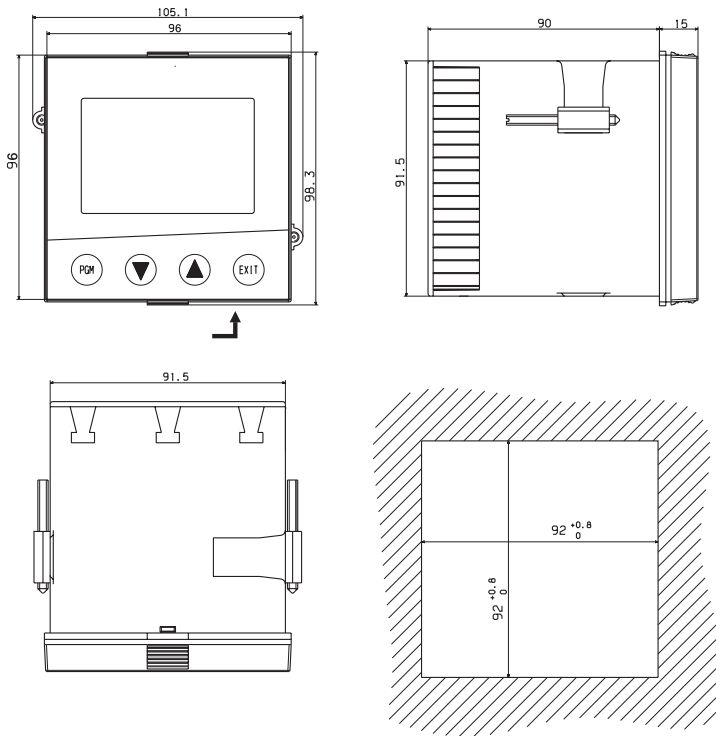
Type 316



Type 308



Type 304



| Close mounting                    |            |          |
|-----------------------------------|------------|----------|
| Minimum spacing of panel cut-outs |            |          |
| Type                              | horizontal | vertical |
| without setup connector:          |            |          |
| 703041                            | 11 mm      | 30 mm    |
| 703042 (portrait format)          | 11 mm      | 30 mm    |
| 703043 (landscape fmt.)           | 30 mm      | 11 mm    |
| 703044                            | 11 mm      | 30 mm    |
| with setup connector (see arrow): |            |          |
| 703041                            | 11 mm      | 65 mm    |
| 703042 (portrait format)          | 11 mm      | 65 mm    |
| 703043 (landscape fmt.)           | 65 mm      | 11 mm    |
| 703044                            | 11 mm      | 65 mm    |

### Order details

| Basic type |  |
|------------|--|
| MPR316     | format 48mm x 48mm<br>incl. 1 analog input, 2 relay outputs and 2 logic inputs or 2 logic outputs        |
| MPR308Q    | format 48mm x 96mm (portrait format)<br>incl. 1 analog and 2 logic inputs, 2 relays and 2 logic outputs  |
| MPR308H    | format 96mm x 96mm (landscape format)<br>incl. 1 analog and 2 logic inputs, 2 relays and 2 logic outputs |
| MPR304     | format 96mm x 96mm<br>incl. 1 analog and 2 logic inputs, 2 relays and 2 logic outputs                    |

| Basic type extensions |   |  |   |
|-----------------------|---|--|---|
| 1                     |   |  | Basic type 1                            |
|                       |   |  | Version                                 |
| 8                     |   |  | Standard, with factory settings         |
| 9                     |   |  | Programming to customer specification   |
|                       |   |  | Logic outputs (2 available as standard) |
|                       | 1 |  | 0 / 12V                                 |
|                       | 2 |  | 0 / 18V                                 |

|   |   |   |                            | Type 703042/43/44 | Type 703041 (no option 3) |          |          |
|---|---|---|----------------------------|-------------------|---------------------------|----------|----------|
| 1 | 2 | 3 | Option slots               | Max. number       | Max. number               | Option 1 | Option 2 |
| 0 | 0 | 0 | not used                   |                   |                           | X        | X        |
| 1 | 1 | 1 | Analog input 2 (universal) | 1                 | 1                         | X        | X        |
| 2 | 2 | 2 | Relay (changeover)         | 2                 | 1                         | X        | -        |
| 3 | 3 | 3 | 2 relays (make contact)    | 2                 | 1                         | X        | -        |
| 4 | 4 | 4 | Analog output              | 2                 | 2                         | X        | X        |
| 5 | 5 | 5 | 2 logic inputs             | 2                 | 1                         | X        | X        |
| 6 | 6 | 6 | Solid-state relay 1A       | 2                 | 2                         | X        | X        |
| 7 | 7 | 7 | RS422/485 interface        | 1                 | 1                         | X        | X        |
| 8 | 8 | 8 | Profibus-DP interface      | 1                 | 1                         | X        | X        |

X = available in this option slot, - = not available in this option slot

| Supply voltage |   |  |                                   |
|----------------|---|--|-----------------------------------|
| 2              | 3 |  | 110 — 240V AC -15/+10%, 48 — 63Hz |
| 2              | 5 |  | 20 — 53V AC/DC, 48 — 63Hz         |

| Extra codes |   |   |  |
|-------------|---|---|--|
| 0           | 0 | 0 | none   |
| 2           | 1 | 4 | Math and logic module                                  |
| 2           | 1 | 7 | Ratio controller (requirement: 2 analog inputs)        |
| 2           | 1 | 8 | Differential controller (requirement: 2 analog inputs) |
| 2           | 1 | 9 | Humidity controller (requirement: 2 analog inputs)     |

| Approvals |   |   |      |
|-----------|---|---|------|
| 0         | 0 | 0 | none |

703041 / 1 8 1 - 1 4 0 - 2 3 / 0 0 0 , 0 0 0

■ = stock versions

- Scope of delivery:
- 1 controller
  - 1 seal
  - mounting brackets
  - brief operating instructions
  - 1 mini-CD including DEMO-software & operating manuals as pdf-file