



Multivariable Measurement Transducer Multivariable Temperature Controller RTI 16

■ Brief description

The first function of the RTI 16 is as a precise and economical microcomputer-based multivariable controller with CANbus interface. It can also be deployed as a freely configurable universal measurement transducer for standard signals and thermocouple and/or PT100 readings.

With functions such as "setpoint decrease" and "heating/cooling with four alarms" it is especially suitable for controlling temperature regulation in plastics processing machines, machine tools, packing machines, temperature stabilisers and similar thermal processes.

The selectable functions starting circuit and manipulated variable take-over on sensor failure increase the operational life of high-capacity electrical heating elements (e.g. hot runner moulds) and can prevent production being interrupted. The self-optimisation function guarantees the shortest possible start-up times.

- 16-channel measurement transducer and controller in modular terminal casing
- CAN/CANopen
- 16 individually configurable universal inputs: +/-10V/20mA, thermocouple/PT100
- Extensive SW function: self-optimisation, starting circuit, gradients, etc.
- Controller manipulated variables via CANbus
- Connection to engineering tool or local operation

The RTI 16 does not have its own manipulated variable outputs. These are made available via CANbus as a manipulated variable in % and digital information (on/off). Digital input/output modules from Berghof's CANtrol product range may also be used for heating control.

■ Description of controller

For each of the functions mentioned in the following, all 16 channels can be considered

as separate controllers and/or measurement transducers.

Measuring circuit monitoring

When measuring circuits are defective, the in-built measuring circuit monitoring component increases plant operational safety. The reaction of the controller output (manipulated variable via bus) after response of the monitoring component can be selected at will:

- max. manipulated variable (upscale)
- min. manipulated variable (downscale)
- outputs switched off
- assume average manipulated variable

Monitoring checks for failure and/or polarity reversal at thermocouple connections and for failure and/or short circuiting at PT100 sensor connections.



Regulator and control functions

In addition to the basic measurement and monitoring functions, the RTI 16 device is also configurable as a signalling device, a two-point controller, a three-point controller, a cascade controller or a motor step controller.

Bumpless automatic-to-manual switchover is also possible. In manual mode, the controller output signalled by bus can be set to any relative ON period. In cascade control mode, the follower "controllers" can also be run as controllers. The manipulated variable outputs of the follower "controllers" are discharged from the manipulated variable output of the master controller (Y follower controller = m * Y master controller).

Alarm functions

Triggered alarms can be polled via CANbus. The actual value, system deviation (actual value/setpoint) as well as manipulated variable or setpoint are monitored. Four limiting values (2 low alarms and 2 high alarms) can be set for each control channel. In addition to channel-oriented alarm status bytes, 3 centralised alarm bits are available, via which the following alarm messages for any number of control channels may be output:

Relative measured value alarm for monitoring the system deviation (actual value/setpoint).

Measured value correction for all inputs

The measured value correction facility corrects and/or scales the measurement and is designed for zero shift, gain adjustment (pitch), or both together. It corresponds to $mx + b$ scaling, with the difference that the controller calculates the gain m and zero point b itself from the given value pairs for the actual value (X1in, X2in) and corrected value (X1out, X2out) of two reference points.

Absolute measured value alarm for monitoring the limiting values, irrespective of the setpoint setting.

Relative measured value alarm with alarm suppression. The alarm is not effective at start-up and on changing the setpoints.

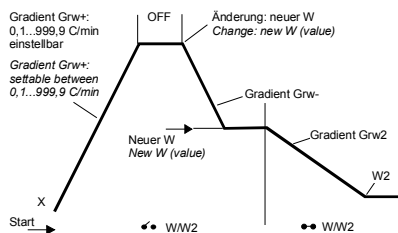
Sensor fault alarm: the 3 centralised alarms are also signalled via 3 LEDs.

Second setpoint with ramp function

A second setpoint may be activated using external control signal W/W2 (e.g. lower setpoint, which may be used for start-up even after auxiliary power restart). The setpoint which has then become effective is then reached via a GRW2 gradient (disconnectable).

Setpoint gradient function

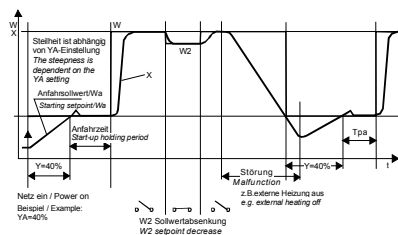
The setpoint gradient function is settable with the Gr+ (positive gradient) and Gr- (negative gradient) parameters. For each setpoint adjustment and each cold restart, the function starts at the actual value X and continues along the gradient set (e.g. 5°C/min) to the new setpoint. When the setpoint is reset, the function starts at the current setpoint.



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Starting circuit

For temperature regulation, e.g. hot runner control. On firing, high-capacity heating cartridges with magnesium oxide insulation must be heated up slowly, in order to disperse moisture and avoid damage. When the starting circuit function is selected, the controller moves first at the starting rate set (e.g. 40%) to the starting setpoint (e.g. 95°C). In order to preserve the heating cartridges, the switching period may be reduced to 25% during start-up. The starting setpoint (e.g. 95°C) is maintained for the selected start-up holding period. After this, the controller progresses to the main setpoint W.



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Manipulated variable takeover on sensor failure

In order to continue production in a plant in the event of sensor failure in a controller, the temperature must be maintained at the last average manipulated variable. The RTI 16 provides a visible notification via CANbus of the sensor failure, so that the sensor can be replaced. If this happens and the RTI 16 recognises a valid measured value, controller operation is resumed automatically. The average manipulated variable is constantly calculated if the actual value lies within a particular operating limit (e.g. $X_w = \pm 2K$). When the power supply is restarted or after reconfiguration, the average manipulated variable is set to 0%. The average manipulated variable can be limited in order to avoid manipulated variable values that are too high and consequently to avoid overheating upon failure of a thermocouple.

Self-optimisation

Self-optimisation for the automatic determination of control parameters is installed as a standard feature. The process is activated at will (via CANbus) and calculates the optimum parameters for quick, dead-beat adjustment to the setpoint from the delay time T_u and rate of change V_{max} of the temperature-controlled system. When the RTI 16 is configured as a three-step controller, "cooling" parameters are determined separately. Self-optimisation also works when the starting circuit is selected. In order to determine the optimal parameters for heavily coupled temperature-controlled systems, self-optimisation can be started synchronously for all selected channels. Each control loop may be configured for this purpose.

Engineering tool connection, operation

The PC-compatible engineering tool, which is used to configure, parameterise and operate the RTI 16 can be connected via an additional serial terminal. A simple operator panel/line display can be connected via the same (UART) interface for local operation.

Watchdog

The RTI 16 includes a hardware watchdog which is triggered internally at least every 1.6 seconds.

Technical Data

Inputs

Thermocouples

Types L, J, K, N, S, R in accordance with DIN IEC 584

Type	Measurement range	Failure
L	0... 900 °C	≤ 2 K
J	0... 900 °C	≤ 2 K
K	0...1350 °C	≤ 2 K
N	0...1300 °C	≤ 2 K
S	0...1760 °C	≤ 3 K
R	0...1760 °C	≤ 3 K

Display in °C or °F; input resistance: ≤1MΩ, disruption monitoring: power through sensor ≤1μA, operation mode configurable, polarity reversal monitoring: responds at 30K under start of scale.

Temperature compensation built-in. Route sensor and/or compensation lines to the controller.

Additional error: ≤1K per 10K terminal temperature change; permissible direct voltage between inputs: 1V; permissible alternating voltage between inputs: 2V; between inputs and measuring earth: 5V.

Resistance thermometer

Pt 100Ω in accordance with DIN IEC 751.

Range: -100.0...850.0°C. With linearisation (temperature linear), indication error: ≤2K. Connection to three-wire circuit without adjustment. For two-wire circuitry, insert trimming resistor in the same way as conductor resistance. Conductor resistance: ≤30Ω, measured current: ≤0.3mA, measuring circuit monitoring for sensor or conductor failure and/or short circuiting. Mode of operation configurable.

Direct voltage

0...100mV linear, input resistance: ≤1MΩ, error: ≤0.1%, scalable via measured value correction facility.

Direct voltage

Measuring range: +/-10V, error: ≤0.1%, resolution: ≤0.8mV, input resistance: ≥20 kΩ, scalable via measured value correction facility

Direct current

0...20mA or 4...20mA configurable, error: $\leq 0.1\%$, resolution: $\leq 0.8\text{mA}$, input resistance: $\leq 50\Omega$, scalable via measured value correction facility, measuring circuit monitoring at 4...20mA, responds when $I \leq 2\text{mA}$.

Sampling rate

The sampling rate for all inputs is approx. 1 sec.

Digital interfaces

CANbus interface

RTI 16 temperature controller/measurement transducer with integrated CANbus interface and CAN-open protocol.

Interface for PC and/or operation

The engineering tool used to configure, parameterise and operate the RTI 16 can be connected via an additional serial interface.

Auxiliary power

24VDC (+24V, gnd) voltage range 18V to 30VDC, wattage: approx. 5W, protection category III (safety extra-low voltage).

Control performance

Control operation with 0...100% cyclic duration factor, configurable as a signalling device with one or two outputs. Two-point controllers with DPID performance, three-point controllers with DPID/DPID performance, control function via manual operation of three-point controller, motor step controller.

Cascade controller

Control parameters: self-tuning/settable parameters. Signalling device differential: 0.2%.

Alarm functions

Output of the following alarm messages from any controller channels:

- relative or absolute measured value alarm
- relative measured value alarm with alarm suppression
- sensor failure alarm
- heating current alarm
- output signal alarm

Setpoint

The lower and upper limit of the setpoint setting range can be freely selected within the measuring range limits.

Displays

- LED status displays:
- for device ok
- for communication ok
- 3 x for centralised alarm messages

Program memory

EPROM

Environmental conditions

Permissible temperatures: operating temperature 0...55°C, limit of operation 0...66°C, storage/transport -20...60°C, climatic category: KUF in accordance with DIN 40040, relative humidity: $\leq 75\%$ annual mean, non-condensing.

Influencing variables

Auxiliary power without influence. The configuration data are not lost in the event of an auxiliary power failure (EEPROM memory).

Vibration and shock: vibration test Fc in accordance with DIN 68-2-6.

10...150Hz, device in operation: 1g and/or 0.075mm, device not in operation: 2g and/or 0.15mm shock test Ea in accordance with DIN IEC 68-2-27. 15g, 11ms.

Electromagnetic compatibility

Interference immunity EN 50082-2, measurement inputs to be shielded, electrostatic discharge IEC 801-2 8kV air discharge, 4kV contact discharge.

Electromagnetic RF field:

ENV 50 140 (IEC 801-3) 80...1000MHz, 10V/m.

Conducted radio frequency:

ENV 50 141 (IEC 801-6) 0.15...80MHz, 10V influence $\leq 13\text{K}$ with shielding no influence.

Fast transient (burst):

IEC 801-4 with auxiliary power and signal lines 2kV.

Noise emission: complies with EN 50081-2.

General notes

Casing: dimensions (b×l×h): 124 × 170 × 85 [mm], degree of protection in accordance with DIN 40 050/IEC 529

CE mark: complies with electromagnetic compatibility and low voltage directives

Electrical safety level: in accordance with VDE 0411 protection category III (safety extra-low voltage)

Electrical connections: Phoenix type: FRONT MSTB, 2.5/18-ST-5.08

Installation type: can be clipped on to top-hat rail (DIN EN 50022)

Weight: approx. 0.65kg

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