GOSSEN METRAWATT

R6000
8-Channel Controller

3-349-157-03
12/8.14

- freely configurable control channels
- Software tool for complete configuration and parameter setting
- Sampling cycle – 10 ms per channel
- PDPI control without overshooting
- Control parameters adaptation can be started at any time for each channel
- Functions: limit transducer / 2 and 3-step, continuous and step-action controller
- Ratio, cascade, differential and switch control
- Hot runner control with actuating circuit and booster circuit
- Assignment to groups for control zones for synchronous heating
- Algorithms for water cooling
- 16 binary inputs/outputs with short-circuit detection – can be freely assigned to controller states, functions and channels
- 4 additional continuous outputs or 4 additional binary I/Os as option
- Fieldbus options: Profibus-DP, CAN-Bus, Modbus (RS 485)
- Handling modules for SIMATIC Manager
- Power limitation
- Data logger for all actual values and setpoints
- Alarm history with time stamp
- Several measuring inputs are taken into account to determine the controlled variable
- In the SIMATIC project, not assigned I/Os are freely available to the CPU

New
20 mA
Measuring Input

CE

Features

- 8 sensor inputs – can be switched individually with software to thermocouple, Pt100 or 50 mV linear
- Thermocouple inputs immune to interference due to leakage current (up to 230 V)
- Removable cold junction
- Suitable for zones with temperature rises of approximately 100 K/s to less than 100 K/h
- Direct connection of melt pressure transducers
- Monitoring for sensor breakage, polarity reversal and short-circuiting
- Regulated value is active in the event of sensor breakage
- Actual value correction for periodic measured-value fluctuation
- Deactivate zones as desired with internal or external signal
- Setpoint ramps (up-down), 2nd setpoint, setpoint limiting
- Feed-forward control for the avoidance of overshooting and undershooting during load changes
- Heating circuit monitoring without additional transformer
- Heating current monitoring with single-phase/three-phase external current transformers, and an optional voltage transformer for compensation of voltage fluctuation
- Remote diagnosis supported with numerous monitoring functions
- 2^{nd} set of parameters
- Short-circuit detection at the binary outputs
- Integrated self-restoring overload protection for binary outputs
- 24 V DC auxiliary power supply

Filter and Functions with Distorted Controlled Variable

Designation / Parameter	Function	Limitation
Peak filter	Individual erroneous measurements caused by, for example, electrostatic discharge to the sensor, are suppressed.	---
Smoothing filter	In accordance with controlled system dynamics, several measured values are combined for control purposes to avoid an unsteady controlled variable.	---
Actual value correction, actual value factor	Linear correction of measured values, if, amongst other factors, measured temperature deviates from the temperature to be measured / to be displayed due to a temperature gradient.	---
Adaptive measured value correction	Suppression of constant periodic, or slowly changing oscillation.	Not active if period is > ½ Tu*
Oscillation disabling (oscillation period: 0.3 to 20 s)	Suppression of oscillation with a constant period, if the period is longer than ½ Tu.	---
Feed-forward control	Suppression of controlled variable swells and dips in the event of load fluctuations, e.g. caused by operation/standstill of a machine/system	Load fluctuation interval much greater than Tu*
Response in event of sensor failure, sensor error manipulating factor	If operation must be continued with a defective sensor, the controller reads out a plausible manipulated variable in order to maintain the working level.	---

* Tu = delay time
Detailed information is included in the operating instructions.

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Applications

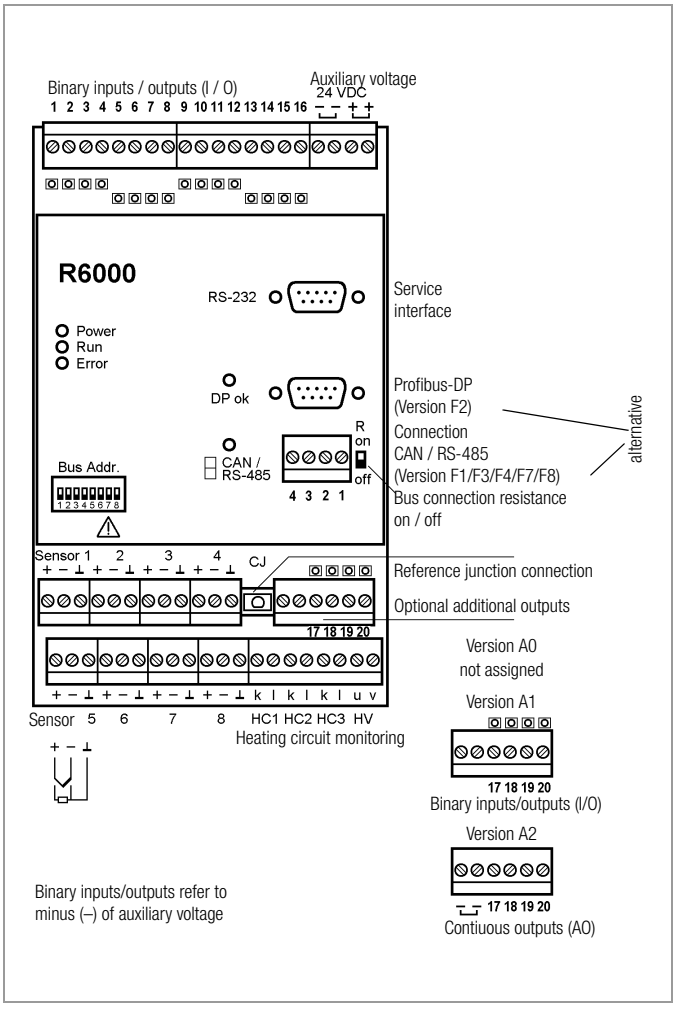
The R6000 compact 8-channel temperature controller offers concentrated control technology know-how in a rail mount housing. The autonomous controller can be very quickly configured and adapted to control systems by means of self-tuning. Outstanding control performance is achieved by means of GOSSEN METRAWATT's own dead-beat PDPI algorithm, which even assures outstanding results for critical applications. Communications are possible via a number of standardized fieldbus interfaces, or by means of the integrated service interface.

Advantages for your quality management system include the integrated data logger for all actual values and setpoints, an alarm history for error status entries with time stamp, and alarm value reports.

The controller's range of applications includes multi-channel temperature control for plastics processing machines (injection molding, extrusion, blow molding and hot runner technology), semiconductor manufacturing processes, industrial and laboratory ovens, textile machinery, climatic test cabinets, environmental simulation chambers, pharmaceuticals, food and beverage vending machines, packaging and printing machinery, temperature stabilizers and similar thermal processes.

The specially developed control algorithm (compensation for non-linear water evaporation characteristics) allows for water-cooled extruder zone applications.

Terminal Assignment



Applicable Regulations and Standards

IEC 61010-1 / EN 61010-1 / VDE 0411, part 1	Safety requirements for electrical equipment for measurement, control and laboratory use
IEC 60529 / EN 60529 DIN VDE 0470, part 1	Protection provided by enclosures for electrical equipment (IP code)
DIN EN 60204-1 / VDE 0113, part 1	Machine safety
IEC 61326/ EN 61326	Electromagnetic compatibility (EMC)
IEC 60584 / EN 60584 (DIN 43710)	Thermocouples
IEC 60751 / DIN EN 60751	Industrial platinum resistance thermometers and platinum resistance elements, Pt100 sensors
DIN EN 50022	Mounting rails, top-hat rail with 35 mm width for snap mounting devices

Characteristic Values

Inputs / Outputs

Sampling Rates 10 ms per channel

Thermocouple Measurement Input / Linear 50 mV

Thermocouples	per IEC 60584 / EN 60584 / DIN 43710 type J, L, K, R, S, B and N, C
Measuring Range	linear 0 ... 50 mV
Nominal Input Range for Type	J, L 0 ... 900 °C K –100 ... 1300 °C R, S 0 ... 1750 °C B 0 ... 1800 °C N 0 ... 1300 °C C 0 ... 2300 °C
Accuracy / Error	< 0.7% of measuring range span for types J, L, K, N < 2.0 % of measuring range span for types R, S, for type B from 600 °C and greater
Resolution	0.1 K
Cont. AC Overload	50 / 60 Hz / 50 V AC, sinusoidal
DC	1 V DC
Input Impedance	> 50 kΩ
Error Messages	for sensor breakage or polarity reversal, or temperature outside of measuring range

Reference Junction Measurement Input

Nominal Input Range	0 ... 70 °C
Accuracy	± 2 K
Reference Junction	two-step

Pt100 Resistance Thermometer Measurement Input, 2 or 3-Wire Connection

Pt100	per IEC 60751 / DIN EN 60751
Measuring Range	18 ... 320 Ω
Nominal Input Range	–200 ...850 °C
Sensor Current	< 0.2 mA
Offset Compensation	possible by means of parameter entry
Accuracy / Error	< 0.5 % of measuring range
Resolution	0.1 K
Cont. AC Overload	50 / 60 Hz / 50 V AC, sinusoidal
DC	1 V DC
Input Impedance	13 kΩ
Cable Resistance (both directions)	2-wire connection: 0 ... 30 Ω, adjustable 3-wire connection: 0 ... 30 Ω, compensated
Error Messages	for sensor breakage or short-circuit, or temperature outside of measuring range

Sensor Input Configuration

Sensor type is selected separately for each input via the interface. Switching between thermocouple and Pt100 is accomplished with the DIP switch at the left-hand side of the housing.

Heating Current Monitoring Input

Measuring Range	1 A AC (direct connection of a commercially available measuring transducer)
Resolution	< 0.1% of upper range value
Accuracy	typically < 5% of upper range value
Reproducibility	< 1% of measurement value + 0.5% of upper range value

Heating Voltage Monitoring Input

Measuring Range	10 ... 50 A AC (direct connection of a commercially available measuring transducer)
Resolution	< 0.1% of upper range value
Accuracy	typically < 5% of upper range value
Reproducibility	< 1% of measurement value + 0.5% of upper range value

Binary Inputs / Outputs

Output Function	Active switching outputs, supplied directly from auxiliary voltage
Function	Switching output (heating/cooling, or more/less for step-action controllers) Alarm output
Read-Out Cycle	Adjustable within a range of 0.1 ... 300 s
Nominal Range of Use	H signal: U ≥ auxiliary voltage, – 0.5 V I ≤ 500 mA Total current ≤ 3 A per device L signal: < 0.1 mA e.g. for driving up to 3 commercially available semiconductor relays (SSR) in series
Input Function	Read back output status, external control of PLC etc.
Nominal Range of Use	H signal: > 14 V 8 ... 16 mA at 24 V L signal: < 7 V / < 0.2 mA
Overrange Limit H, L Signal	Continuous short-circuit, interruption

Continuous Outputs

Output Function	Actuator Output for Proportional Actuator
Output Quantity	0 (2) ...10 V at > 1 kΩ load, 0 (4) ... 20 mA at < 300 Ω load
Resolution	0.1% of upper range value
Accuracy	< 3% of upper range value

Status Displays

Power on	green	3 mm dia. LEDs on metal housing
Run	green	
Bus communication active	yellow	
Error	red	
Binary Inputs / Outputs Active	yellow	SMD LEDs at clamp-type terminal blocks

Control Performance

Setpoints

Setpoint limiting	Adjustable upper and lower setting limits
Proxy setpoint	Activated via binary input or bus, adjustable value
Setpoint increase (boost)	Activated via binary input or bus, value and maximum duration can be configured
Ramp function (separate for rise and fall)	Specification of a gradual temperature change in degrees per minute Activated by means of: – Turn on auxiliary voltage – Change current setpoint value – Activate proxy setpoint – Switch from manual to automatic operation

Configurable Control Modes

Not in use	No error monitoring	
Measuring	With limit value monitoring	
Actuator		
Limit transducer	Two / three position controller without time response	
PDPI controller	Heating	Cooling
	Can be combined as desired	
	Switching	Switching
	Hot-runner	Water cooling
	Continuous	Continuous
	Step	Step
	No heating	No cooling
Proportional actuator	Two / three position controller without time response	

In addition to fixed value control, the PDPI controller also includes differential, cascade and switching controller functions.

Control Channel Combinations

Differential controller	The temperature difference is corrected.
Cascade controller	The setpoint from one or more control channels is manipulated dynamically.
Switching controller	Depending upon operating state, a control loop with only one actuator can be controlled at two different (temperature) measuring points.
Ratio controller	2 controlled variables are controlled at a ratio that is fixed by a setpoint value. To this end, the master variable is determined from the product of the setpoint value divided by a thousandth and the actual value of the partner channel. An activated setpoint ramp influences the master variable. The controller type of the partner channel can be selected independently, e.g. fixed-value control.

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Self-Optimization

Can be activated from any operating state.
Control parameters can be changed.

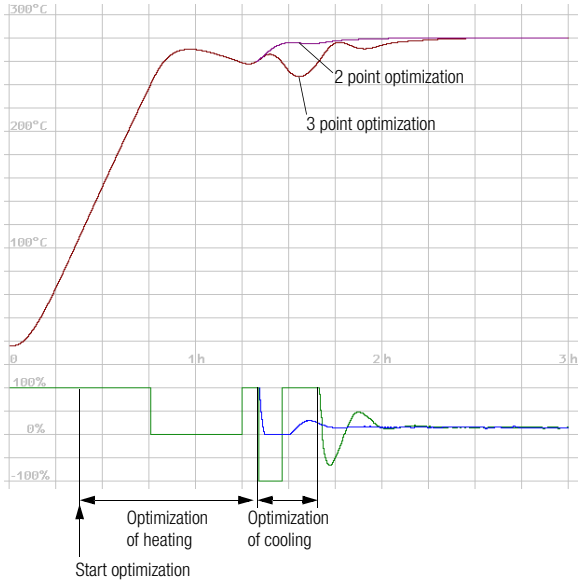


Fig. 1 Control Performance with Self-Optimization

Alarms

All errors and alarms for all channels, I/Os and functions can be accessed separately via the bus or the service interface.

Selected errors and alarms can be read out to binary outputs. Selection and assignment to a specific output can be configured as desired.

Channel-Specific Alarms

- Broken sensor, reversed polarity
- Two upper and two lower limit values, relative and absolute
- Heating current / heating circuit errors
- Adaptation errors

Device-Specific Alarms

- Hardware errors
- Overloading of the measurement inputs
- Reference junction errors
- I/O errors
- Mapping errors
- Parameter errors

Alarm History

The alarm history includes 100 error status entries with the respective time stamps. Recording is started over each time the device is reset, and data are lost if auxiliary power fails.

After memory has been filled to capacity with 100 entries, the oldest entry is deleted each time a new one is recorded.

Data can be accessed via the RS 232 service interface and via bus (CAN-Bus, Profibus-DP, RS485-Modbus).

Monitoring Functions

Limit Value Monitoring

Two upper and two lower limit values can be configured per channel.

Alarm memory and actuation suppression can be set up.

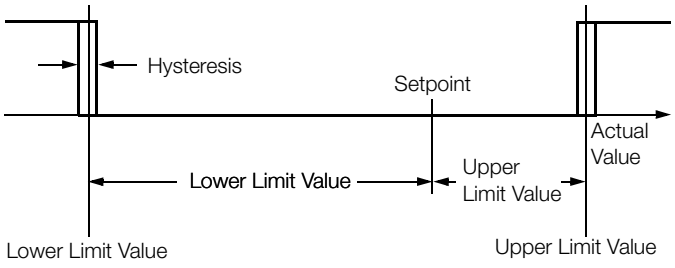


Fig. 2 Schematic Representation of Relative Limit Value Monitoring

Heating Current Monitoring

Heating Current Monitoring	Permanently installed
Heating Current Acquisition	With external, commercially available current transformer measurement of the total current of all 8 channels measurement of the total current of up to 24 channels possible with a transformer
Nominal value transfer	To be initiated automatically via the bus
Compensation of current fluctuation	By measuring heating voltage

Error messages for	
– Antivalence	Actuator signal OFF + heating current ON Actuator signal ON + heating current OFF
– Actual current value less than nominal value	Dip below nominal heating current value by more than 5% + 0.1 A with actuator signal ON

Heating Circuit Monitoring

Without external transformer, without additional parameters

Configurable	Heating circuit monitoring active / inactive
Error messages for	100% heat without rising temperature, i.e. short-circuited thermocouple, interrupted heating, no sensor in heating circuit

Hot Runner Control Functions

Actuating Circuit

Actuation with a reduced manipulating factor and dwelling at a specific actuation setpoint serves to dry out hygroscopic heating elements.

Group Actual Value Control – Synchronous Heat-Up

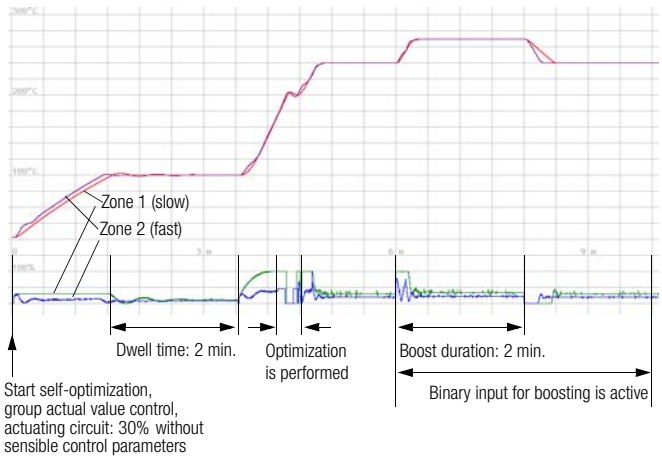
Synchronous heat-up prevents thermal stress by minimizing actual value differences.

If self-optimization has been started, it takes actual value management into consideration, as well as the actuating circuit.

Synchronous heat-up is also possible via several control modules.

Boosting – Temporarily Increased Setpoint

Temporarily increasing the setpoint frees clogged mould nozzles of “frozen” material remnants.



Mapping for Checking Sensor and Heater Assignments

This function is used to test for correct wiring of the heater and the sensors. Assignments can be checked when the machine is started up before initial heat-up. Testing is conducted in several phases in order to determine whether or not the temperature changes at the individual channels coincide with the actuating signals. If an error is detected, all actuating outputs remain inactive until the error has been acknowledged.

Data Logger

The data logger has enough capacity for 3600 sampled value pairs including actual values and manipulated variables for all 8 channels.

Recording is started over each time the device is reset, and data are lost if auxiliary power fails.

After memory has been filled to capacity with 3600 entries, the oldest values are deleted as new ones are recorded.

Data can be accessed via the RS 232 service interface and via bus (CAN-Bus, Profibus-DP, RS485-Modbus).

Power Limitation

With this function it is possible to prevent peaks in the power consumption of the heaters and/or to limit the total current consumption.

The positioning output of the heaters of all 4/8 channels is synchronized and the heaters are activated in a staggered pattern to ensure that only a minimum number of heaters are active at the same time.

Settings

0% function inactive, power peaks possible in regular operating mode

100% Avoidance of power peaks, actuation at full throttle; Advantage: This function is also active when power limitation has been set to 100% so that all 4/8 channels produce full heat during actuation. However, current loading is more evenly spread at the operating point, thus avoiding power peaks.

X% Current limitation, a maximum number of 1 to 7 heaters of a total of 8 is simultaneously activated, i.e. avoidance of power peaks during regular operation; power is limited during actuation.

Data Interfaces

Type	Service Interface	Fieldbus Interface		
Interface	RS 232	Profibus DP	CAN / CANOpen	RS 485
Maximum number of devices	1	32	100	32
Range of addresses	–	0 ... 126	0 ... 127	0 ... 254
Transmission speed	9.6 or 19.2 kBaud	9.6 kBaud ... 12 MBaud	10 kBaud ... 1 MBaud	9.6 or 19.2 kBaud
Protocol per	EN 60870	EN 50170	IEC 1131 CANOpen	EN 60870 Modbus/ HB-Therm/ DIN 19244
Connection	9-pin D sub	9-pin D sub	4-pole screw terminal	

Bus Address Selection

The bus address is selected with the DIP switch at the front panel.

Service Interface

A laptop or a notebook can be connected to the RS 232 interface for service purposes.

Profibus DP Interface with Protocol per EN 50170

The R6000 is equipped with a Profibus DP interface for communication with a master computer or a PLC. Baud rates of up to 12 Mbit per second are supported.

Device Database File (DDBF)

The file required for configuring the Profibus DP (DDBF, multi-channel Profibus DP) can be downloaded free of charge from the GMC-I Messtechnik GmbH website (http://www.gossenmetrawatt.com).

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CAN Bus

The CANopen protocol is used for communication.

ESD File

The ESD file which is required for project engineering can be downloaded from the Internet at: http://www.gossenmetrawatt.com.

RS 232 / RS 485 Interface, Modbus Protocol

The Modbus protocol is used for communication with control terminals or a PLC.
The RTU mode and conformity class 0 (read and write words) are utilized by the R6000.

Auxiliary Power

A completely separate safety power supply unit is to be used for operating the controller.

Nominal Value	24 V DC
Nominal Range of Use	18 V ... 30 V DC
Power Consumption	Max. 10 VA, typically 6 W (without load)

Reference Conditions

Reference Quantity	Reference Condition
Auxiliary voltage	24 V DC ± 1 V
Superimposed alternating voltage	sinusoidal, or sinusoidal half-waves: 0.1 V AC
Allowable common-mode voltage	to electrically connected inputs: 0 V DC / AC
Ambient temperature	23 °C ± 2 K
Reference junction temperature	23 °C ± 2 K
Warm-up time	3 minutes
Measuring inputs	Thermocouple, low-resistance termination: ≤ 10 Ω Pt100: 110 ± 10 Ω

Influencing Quantities and Influence Error

Influencing Quantity	Nominal Range of Use	Maximum Influence Error
Ambient temperature – Thermocouple / Pt100 – Reference junction	 0 °C ... + 50 °C 0 °C ... + 50 °C	 ± 0.05% MRS [1] / K 0.1 K / K
Cable resistance – Thermocouple – Pt100, 2-wire – Pt100, 3-wire	 R = 0 ... 200 Ω R = 0 ... 30 Ω R = 0 ... 30 Ω	 ± 0.1% MRS [1] / 10 Ω approx. 3 K / Ω (adjustable) ± 2 K / 10 Ω
Warm-up influence	≤ 3 minutes	± 1 %

[1] MRS = measuring range span

Electrical Safety

Standard	IEC 61010-1 / EN 61010-1 / VDE 0411, part 1
Safety class	II
Overvoltage category	CAT II
Fouling factor	2
Protection	IEC 60529 / EN 60529 / VDE 0470, part 1
Housing	IP 20
PCB	IP 10
Terminals	IP 20

Attention: The instrument is not equipped with an integrated circuit breaker.

Electromagnetic Compatibility

Interference Emission		IEC 61326/EN 61326		
Interference Immunity		IEC 61326/EN 61326		
Test type	Standard	Test Severity		Criterion
ESD	EN 61000-4-2	4 kV 8 kV	contact discharge atmospheric discharge	B B
E field	EN 61000-4-3	10 V / m	80 ... 1000 MHz	A
Burst	EN 61000-4-4	2 kV	at all connector cables	B
Surge	EN 61000-4-5	1 kV 2 kV	symmetrical asymmetrical	A A
HF	EN 61000-4-6	3 V	0.15 ... 80 MHz, all terminals	A

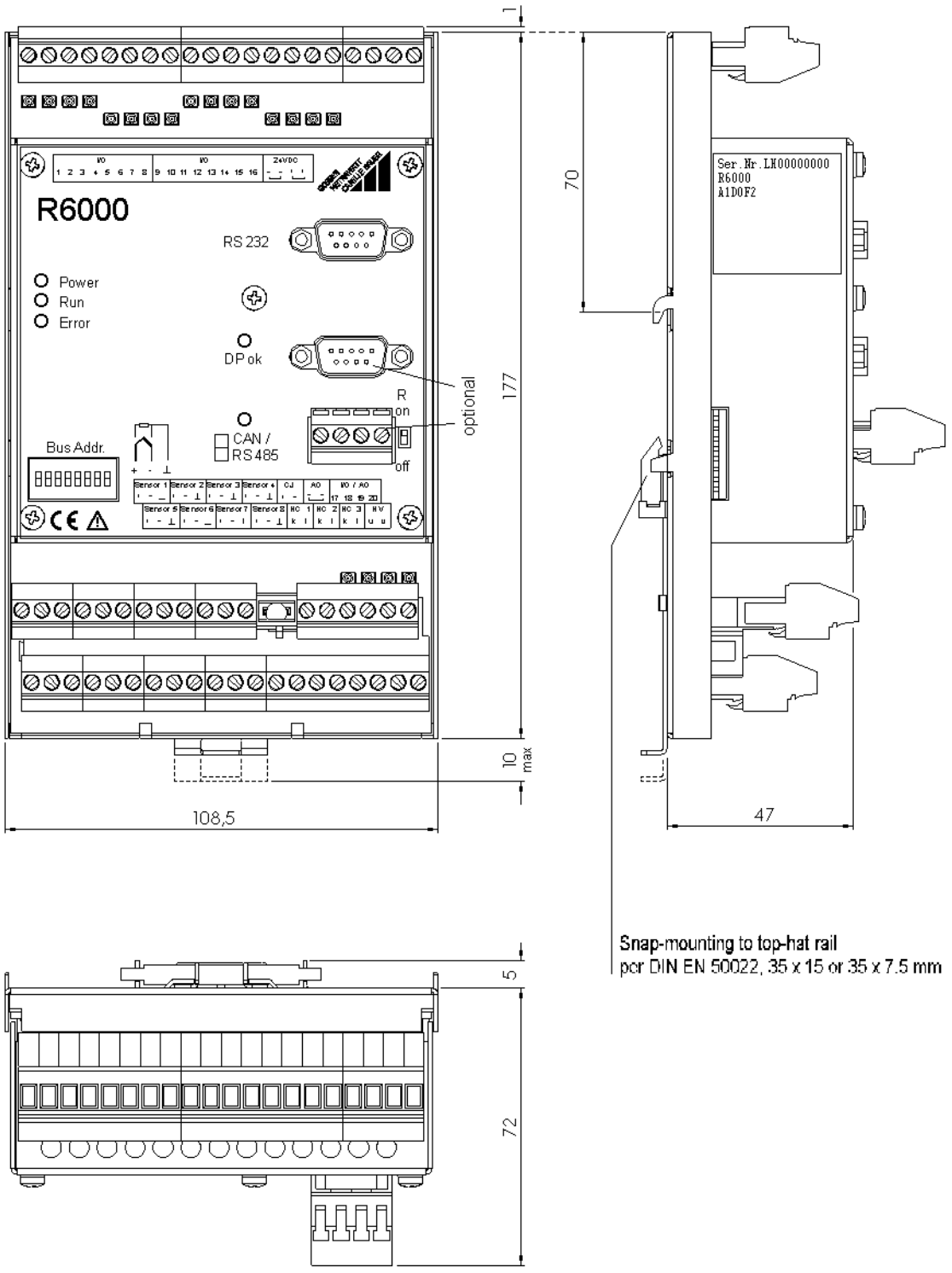
Ambient Conditions

Annual mean relative humidity, no condensation	75%
Ambient temperature – Nominal range of use – Operating range – Storage range	 0 °C ... + 50 °C 0 °C ... + 50 °C – 25 °C ... + 70 °C

Mechanical Design

Housing	Sheet metal / plastic per UL-V0
Dimensions Including Terminal Blocks	H x W x D: max. 182 x 109 x 78 mm
Weight	Approx. 0.6 kg including terminal blocks
Connectors	Terminal blocks for wire cross-sections to 2.5 mm^2 or double wire-end ferrules for 2 x 1.0 mm^2
Mounting	Integrated for top-hat rails per DIN EN 50022, 35 x 7.5 mm or 35 x 15 mm

Dimensional Drawing



All dimensions in mm

R6000
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Order Information

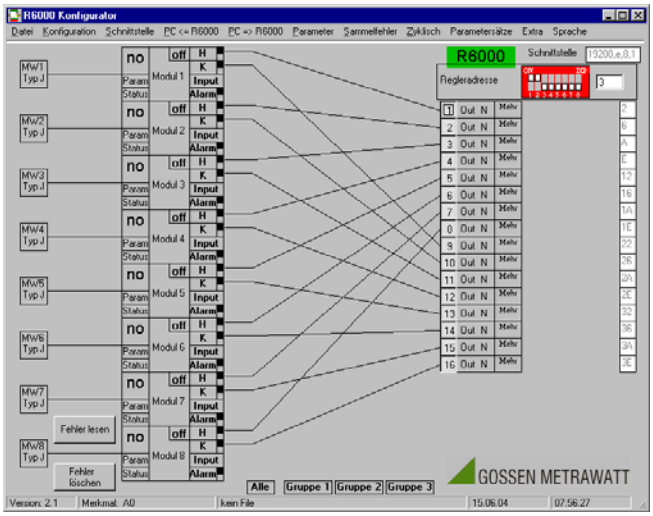
Description	Article Number / Feature
8-channel controller with installation instructions	**R6000**
Inputs / Outputs	
16 binary inputs / outputs	A0
20 binary inputs / outputs	A1
16 binary inputs / outputs, 4 continuous outputs	A2
Connectors	
Screw terminal blocks	D0
Bus Interface	
CAN / CANOpen	F1
Profibus DP	F2
RS-485 / Modbus protocol	F3
RS 485 / EN 60870 protocol	F4
RS 485 / HB-Therm protocol	F7
RS 485 / DIN 19244 protocol as R7000	F8

Accessories

Description		Article Number
Two-step reference junction		**Z306A**
Operating instructions	German	**Z307A**
	English	**Z307B**
	French	**Z307C**
	Italian	**Z307D**
Modem cable for connection of service interface		**GTZ3241000R0001**

R6KONFIG Configuration Tool

The R6000 can be fully configured with this tool. All values are uploaded and downloaded via the serial interface. Cyclically occurring values such as actual values, control variables, heating current and alarms can be visualized, recorded and documented online.



GOSSEN METRAWATT
GMC-I Messtechnik GmbH
Südwestpark 15
90449 Nürnberg • Germany

Phone +49 911 8602-111
Fax +49 911 8602-777
E-Mail info@gossenmetrawatt.com
www.gossenmetrawatt.com