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The Hengstler headquarters are located in Aldingen, in South-West Germany, on the edge of the Black Forest – a region famous for its industrial pioneers and inventors. The foundations for the Hengstler company were laid by one of these inventors, Johannes Hengstler, who, in 1846, set up a workshop which was later to become the center of the worldwide Hengstler group. The workshop was started for the manufacture of clock springs; today, Hengstler products range from miniature counters to length measuring systems.

All technical data and information contained in this catalog, including the graphics, were collected and compiled with the utmost care. This catalog provides information on products and accessories, which, however, does not constitute any guarantee for technical data or features. The user of these products must determine himself the suitability of the product for the intended use.

All technical data is subject to alterations. For questions of technical nature or regarding prices and delivery, please contact our company headquarters or field service employees.

Better by competence

This catalogue provides proof of our competence for industrial and temperature controllers – a comprehensive program characterized (as are all Hengstler products) by state-of-the-art technology, excellent design and the highest standards of quality and reliability.

Hengstler – you can count on us.
Innovation at an international level

Our numerous branches and representatives in Europe, America and Asia have made us a truly international enterprise. Our availability around the globe is, of course, a great benefit for our customers – the next Hengstler contact is never far away.

Our sound footing in all parts of the world also has a positive effect on our product know-how. Findings from worldwide research programs provide a pool of information from which, in turn, the material for the carefully directed, overall technological concept is won. These findings form the practice-oriented basis for ongoing innovation and efficiency in all corporate sectors.

The pace of innovation is getting faster and faster in all sectors of technology. Only those who are able to follow or even set this pace will continue to be competitive. Strong, reliable partners are needed to help you cope with these new demands. You need partners whose top priority is added product value/customer value, customer-orientation and high quality.

And taking all this into account, Hengstler is your partner of choice.

Hengstler is a leading European manufacturer in the field of industrial counting and control components, e.g. counters, encoders, industrial and temperature controllers, as well as relays.

Hengstler's product range is completed by printers and cutters, with Hengstler being the greatest manufacturer in Europe.

Successful with Hengstler

One of our particular strengths is the project management of custom applications. The basis for this is our wide experience gained over many years in the fields of electromechanics, mechanics, pneumatics and electronics which, of course, mirrored in our product program. Hengstler offers its customers complete support starting at the project planning and development right through to the final product. At present we are handling complex projects in the field of pneumatics and printers for well-known companies, such as Bosch, Festo, IBM and Siemens.

Talk to Hengstler. We can offer solutions.

Hengstler: Your Technology Partner
Hengstler's new products – powerful and versatile

Adaptive Sine-wave Encoder RIS 58
The latest High-Tech generation
This new type of incremental encoders features a universal top-of-the line industrial encoder for a wide range of applications. It uses a second generation Hengstler sine optoasic, which ensures enhanced reliability and prolonged product life.
- Full shaft
- Open hollow-shaft on one side

Hollow-Shaft Encoder RI36H with clamping shaft
Hengstler has expanded its product range by this small, powerful hollow-shaft encoder, which offers a resolution of up to 3600 pulses/rev. at an outer diameter of only 36 mm. The use of an Optoasic makes this encoder particularly reliable and immune to interference. A coupling is not necessary and, therefore, space and costs are saved due to the fact that this encoder is mounted directly on the motor shaft.

Integrated Sine-wave Encoder S21
Motor feedback meeting the most stringent demands
The S21 integrated sine-wave encoder was specially developed for use in brushless servo motors and for demanding applications, such as for CNC or printing machines. High sine signal quality (distortion factor better than 1%) and interpolation of 2048 signal periods allow resolutions of more than 4 million measuring increments. One sine-cosine signal period per turn is used for electronic commutation of the synchronous motors, which are energized by permanent magnets.

RA 58 Absolute Encoder with hollow shaft
This encoder is very short as compared to full shaft encoders and, therefore, is particularly easy to mount. It features an open hollow shaft on one side (inside diameter 10 or 12 mm). It ensures safe and secure mounting on the drive shaft by means of a clamping ring. The supplied mounting plate is used to protect against torsion and compensate for axial and radial offset of the drive shaft.

Special advantages:
- Enhanced dynamic behavior
- Reduced mounting times
- Fewer mounting parts required
- Reduced mounting depth
Inductive Linear Encoders LI
Hengstler offers the only linear measurement system to combine the high accuracy of optical encoders with the ruggedness and low cost of the previous magnetic systems.

Decisive benefits are:
- **Speed:** real-time signals up to 20 m/s travel speed
- **Ruggedness:** immune to dirt, vibrations and magnetic fields (non-contact principle)
- **Precision:** allowing resolutions up to 0.25 µm, reference signal output
- **Time and Cost-Saving:** even more cost-effective with increased travel lengths.

AI Inductive Angle Measuring System modular and rugged
The inductive angle encoder exhibits the same system characteristics as the linear encoder system described above. It is immune against dirt and mechanical impact, and excels by extremely high measuring accuracy. Its flexible, modular design makes it suitable for a multitude of applications, which were previously either not possible or required a high degree of mechanical effort.

MLC 9000 Multi-Channel Control System with Bus Integration
The new “grado” multi-channel controller system is a modular control system that is extremely well-suited for DIN C-rail mounting in switching cabinets. It is particularly space-saving due to its very compact design - i.e. the width of the system corresponding exactly to the number of modules used. Further benefits: the system is operated independently of the PLC, with accordingly reduced effort for parameterization, programming and control and significantly higher performance and precision values.

H-472 ... H-472 Safety Relays
The new range of safety relays, H-472 to H-475, with force guided contact sets, features extremely flat relays (only 15.7 mm). Despite their small dimensions these relays offer up to 7 contacts and allow safe electrical isolation (reinforced/double insulation) for overvoltage category U=III and a degree of pollution of V=2. Hengstler’s twin relays H-474 and H-475 are worldwide innovation: two safety relays are located in one housing.
Hengstler's Product Range: Competence and Variety

Get it all from one source: a requirement that is more important than ever for many customers, since a close partnership contributes significantly to saving time and money and to facilitate processes. Moreover, intensive contacts between users and manufacturers at the early stage of the product design are the basis of common success.

Hengstler offers versatile components for the following fields of applications:
- Counting
- Controlling
- Regulating
- Indicating
- Measuring
- Positioning
- Switching
- Printing
- Cutting

Indicating, counting, control
Whether you use electronic, electro-mechanical, mechanical or pneumatic counters, your selection is always ruled by your specific requirements.

Our program ranges from miniature counters to sophisticated programmable control counters, multi-function counters, positioning counters, indicators, tachometers, time counters and timers.

As for all our products, the standard features of this versatile portfolio are state-of-the-art technique, attractive design, high quality and reliability as well as a customer-friendly price/performance ratio.

More information
Please order our Counter Catalog.
Please contact your local distributor, addresses see from page 10.

Controllers and Indicators
Our industrial and temperature controllers demonstrate their qualities - even under extreme conditions. Moreover, they excel by extremely easy operation, safety due to self-optimization features, state-of-the-art technology and compact DIN sizes.

NEW: the MLC 9000 multi-channel control system with bus integration. It can be operated independently of the PLC and features a modular, very compact design with particularly high performance and accuracy.

More information
Please order our Controller Catalog.
Please contact your local distributor, addresses see from page 10.
Measuring and Positioning
Continuously increasing demands with regard to precision and productivity, combined with cost reductions due to automation, make the use of encoders indispensable in numerous industrial sectors.
Hengstler’s overall product range offers:
- Incremental/absolute encoders
- Hollow shaft encoders
- Ex-protection versions
- Stainless-steel versions
- Field-bus encoders
- Sine-wave encoders, motor encoders
- Inductive linear and rotary measuring systems

Printing and Cutting Applications
Innovative solutions in the field of printers and cutters are further assets offered by Hengstler. Hengstler components offer special benefits: they are highly reliable, maintenance-free and easy to handle, even when it gets down to changing paper.

Our thermal printers and impact printers are used as voucher or receipt printers, e.g. for cash dispensers (ATM), Kiosk systems and all other types of automatic dispensers.
Powerful cutters exhibiting different cutting widths ensure clean cuts for a great variety of applications and under extreme climatic conditions.

Switching Applications
Cutting-edge relay technology is a key characteristic of our relay product range. Our particular strength lies in the field of safety relays where we have traditionally been assuming a pioneer role. Some of these “firsts” are listed below:
- Reinforced insulation, also between contacts
- Failure-tolerant contact sets
- Extremely flat, with reinforced insulation
- Twin relays

More information
Please order our Encoder Catalog and Inductive Measuring Systems brochure. Please contact your local distributor, addresses see from page 10.

Please order our Relay Catalog on CD-ROM and brochures. Please contact your local distributor, addresses see from page 10.

More information
Please order our Printers and Cutters Catalog. Please contact your local distributor, addresses see from page 10.
Our Top Service for You

1. Customer service
   – always remains close to you – thanks to our extensive sales and distribution network. Please contact your local Hengstler distributor, addresses on following pages.

   Customer Advantages
   - Personal customer service
   - Many years of experience

Talk to Hengstler.
We offer solutions.

2. World-wide representation
You will always find a friendly contact at Hengstler – wherever you are in the world. Our experienced, competent partners are familiar with your branch – just get in touch.

   Customer Advantages
   - We’re there for you — wherever you are — worldwide

Please contact your local Hengstler distributor, addresses on following pages.

3. Always on the safe side
Quality and reliability of our products are our top priority. Our quality management system is DQS-certified to DIN EN ISO 9001. Reg. No. 1540-01.

4. Delivery
Your orders are shipped on time, at the delivery dates requested by you and also as part shipments, if required. Customer orders are always entered directly, which ensures high flexibility and short delivery times despite our wide range of different products. And – if there should be an emergency despite all careful planning – we’ll be prepared to ship at once.

   Customer Advantages
   - Overnight
     If you order a product from our main product list before 10.00 a.m., your order will be shipped on the same day.

5. Repair Service
Customer complaints
We are always there for you if there should be any problems. Please contact your local Hengstler distributor, addresses on following pages.

   Customer Advantages
   - Emergency Service
   - Repair/Customer Complaint Report

Our Repair Team at Hengstler

6. Technical Support
If you should have any technical questions concerning your product selection or specific application – get fast and competent help from your local Hengstler distributor or from our Technical Support Center in Aldingen: Tel.: +49 7424-89 539 or 462 Or by e-mail:
   For encoders: claus.grimm@hengstler.de
   For counters: claus.grimm@hengstler.de
   For controllers: norbert.weber@hengstler.de

   Customer Advantages
   - Quick response to your technical queries.

Customer Advantages

We’re there for you – wherever you are
Technical Information

The principles of control engineering

An industrial controller is used to set a physical process variable to a desired value (set value) and hold it there. For this purpose, there are various designs of controllers which can be classified as follows:
- by the prerequisites posed by the task (controlled system);
- by the required measuring method for determining the controlled variable; and
- by their influence on the process.

The controlled system is that part of an installation whose process variable is to be kept constant. It is here that the measurements are taken and any necessary adjustments are made to counter the effect of disturbance variables.

Familiarity with the controlled system is necessary to select the correct control unit (controller). We distinguish the type of controlled system on the basis of the controlled variable. In the case of a heated tool or an industrial furnace, the temperature is the controlled variable. Consequently, we are dealing with a controlled temperature system. When a container needs to be filled, we may be talking about a controlled pressure system or a controlled liquid level system. Other controlled systems may refer to revolutions, current, voltage, mixing ratios, humidity, speed, etc.

When the controlled system exhibits a state of equilibrium and an influencing variable is changed by a constant amount, a new state of equilibrium will be reached in most controlled systems after a certain period of time. These types of controlled systems are called controlled systems with equalization.

The dynamics of the controlled system are defined by the time response exhibited when abrupt changes are made in an influencing variable. This can be shown in characteristic curves. When sinusoidal changes are implemented in the influencing variables, frequency response diagrams or circle diagrams may become necessary. Nevertheless, the best evaluation is that based on the step response process.
The step response of a controlled system is determined by abruptly changing the system’s input variable at the specified operating point by a safe amount (e.g. 10%). The ensuing reaction is recorded and evaluated.

In the above diagram the upper graph shows the step change in the control output and the lower graph shows the change in the progress variable (from X1 to X2) with respect to time. If a tangent to the process variable curve is drawn at the point where $\Delta x / \Delta t$ is a maximum, the points of interaction of that tangent with the lines representing $X = X_1$ and $X = X_2$ determine the times $T_u$ and $T_g$. Delay time $T_u$ refers to the time lag exhibited by the system, and depending on the amount of the delay one speaks of 1st order controlled systems, 2nd order controlled systems, ...nth order controlled systems, and so on. The variables $T_u$ and $T_g$ are determined by applying the tangent at the reversal point with the points of intersection as shown in the diagram. The controllability can be estimated on the basis of the ratio between $T_u$ and $T_g$.

\[
\frac{T_u}{T_g} = \begin{align*}
1:10 & = 0.1 & \text{good controllability} \\
1:5 & = 0.2 & \text{still controllable} \\
1:3 & = 0.33 & \text{hard to control}
\end{align*}
\]

In addition, the controlled system can also be classified as a fast or slow controlled system. Another important criterion is the transfer coefficient of the system $K_s$. It is the proportional action factor between the control output and controlled variable $K_s = y/x$. 
Control units can be classified as continuous-action (linear) or discontinuous-action (non-linear) controllers. Amongst the linear controllers, a distinction is made between two-point controllers, three-point controllers, three-point-step controllers, multi-controllers, which, in turn, can be divided into controllers with or without auxiliary power. Depending on the demands set in connection with the controlling task, one further distinguishes between mechanical and constructional aspects. Single-loop and dual-loop controllers are differentiated as well as system controllers, compact controllers and programmed controllers. Another differentiation is based on control response.

Regulating and controlling are two concepts that are often confused. The term „regulating“ refers to the continuous measurement of the controlled variable (actual value) and its being compared to another variable (reference variable = setpoint). Depending on the result of this comparison, it is then brought into line with the reference variable. This type of control loop is called a closed loop. A control system does not exhibit this kind of independent action. The influence of variables, also by disturbance variables, on the controlled variable is not measured and, hence, not compared. The loop is not closed. The compact controllers included in this catalog are designed for industrial applications and are available in different sizes. All devices are high-quality measuring instruments and incorporate state-of-the-art technology. Our R+D and production processes have been certified according to ISO 9000. The CE regulations are observed, and usually the devices are also UL-approved.
The controllers allow direct connection of thermocouples and resistance thermometers. Moreover, most models can also be connected to standardized signals such as 0 (4)...20 mA or 0 (2)...10 V. Due to their adjustable scaling function the devices can also control pressure, flow rates, humidity, speed, position, length changes, angles of rotation, etc. as well as temperature values. Up to four outputs can be provided for system control.

The outstanding control response exhibited by the devices is ideal for use in the production of plastics or rubber, for lithographic processes used in the production of semiconductors, for surface treatment processes in all kinds of areas, for drying processes, in the refinement of steel and other materials, for baking clay, ceramics, porcelain, enamel, etc., as well as in packaging technology, for cooling and freezing, and many other applications.

![Figure 5: Types of inputs of compact controllers](image-url)
Technical Information

Two-point controllers are classified as non-linear controllers. They only have two output states: On or Off. The simplest variant, also called On-Off controller or Black-White controller, switches on the control output $y$ as long as the process variable $x$ is below the reference variable $w$, and switches off when $x$ is greater than $w$. These types of controllers are used as limit controllers or in simple temperature control systems with oil burners (see Fig. 6).

A smaller oscillation $x$ can be obtained by reducing the delay time $T_u$ and hysteresis $x_{sd}$ as well as by increasing the recovery time. All switching controllers described in this catalog can be configured for On-Off behavior. Insofar as the intended application permits, the two-step controller with time response should be used because it provides a significantly better control response (see Fig. 7).

Figure 6: Characteristic curve of a two-point controller

Figure 7: Control response of a two-point controller with On-Off response
Technical Information

In most cases, temperature control systems are slow systems. For example, when an oven has to be heated up to a temperature of 500°, high energy supply can lead to fast heating, whereas less energy is needed to hold this temperature value. The regenerative capacity of the oven will result in a gradual adaptation of the temperature value to the set value. For an On/Off controller, sudden switching ON or OFF the energy supply will result in significant fluctuations, which can be compensated by increasing the switching frequency. To do this, the On/Off switching response within a defined range (proportional band xp) is set to cyclic action. This cyclic On/Off switching phase is combined with a fixed pulse repetition period, which is determined according to the switching elements being used and the moment of inertia of the controlled system.

With slow controlled systems, a pulse repetition period Ty of 30 seconds constitutes a good time value. Pulse repetition periods of 1 second can be selected for faster controlled systems or if you are independent of mechanical constraints, e.g. by using semiconductor elements (solid-state relays) or thyristors. At a line frequency of 50 Hz, control output resolution comes to 1 %.

Within the proportional band there is a proportional correlation between the deviation and the controller output. This enables quasi-continuous action by means of a two-term controller. A steady condition has been reached when the amount of supplied energy equals the amount of energy taken up or dissipated. If such equalization is not reached at an energy supply of 50 %, this will result in a permanent deviation from setpoint value Xpa. The deviation can be compensated by shifting the operating point towards the setpoint value. Any disturbances will not be controlled but will be transferred in proportion to their magnitude.

![Energy curve of a temperature controlled system](figure8)
Technical Information

Figure 9: Control characteristics of a two-point controller with P-behavior

Figure 10: Pulse-width modulation
The basic structure of a two-term controller with PID behavior exhibits the functions described in the previous section. In addition to its proportional behavior, an integrating and differentiating component are active. Proportional effects are added to these components.

Adding an integral time constant establishes a proportional correlation between the control rate and control difference. The ruling parameter \( T_n \) is the time required by the integral proportion to reach the changed setting effected by the proportional part, or the time value upon expiration of which the proportional effect has doubled at a constant controlled variable/condition.

The I-proportion compensates for the deviation which usually occurs during P (proportional) control behavior. A slight hysteresis results in a gradual change of the control output. The direct proportional adjustment becomes effective immediately, followed by a slight readjustment by the integral proportion which is performed until the deviation is balanced out. This behavior is also advantageous for controlled systems exhibiting dead times, but is disadvantageous for very slow controlled systems.

Rate time constant \( T_v \) is the D-response parameter, which is defined as the time value by which the rise response of a PD control unit reaches a defined value of the control parameter sooner than a simple P-control system. The D component effects a change in the output signal which is proportional to the rate of the input signal.

The amount of \( Y_d \) (Fig. 12) is ruled by the change rate of the input signal of a PD-control unit. The D-proportion effects an immediate change in the control signal due to a fast change of the input signal. Hence, the PD controller responds directly to disturbances by changing the control signal. However, the permanent deviation of the P-proportion is not balanced.
PID control response

A combination of these three response types gives optimal control response, provided that the parameters \( x_p, T_n \) and \( T_v \) are set correctly. The controlled system parameters can be determined from the characteristic curve of the controlled system, and the adjusting values can be calculated on the basis of known procedures. Using modern microcontroller techniques, these calculations can be performed by integrated optimization (self-tuning) functions.

![Characterstic curve of a PID controller](image)

**Figure 13: Characteristic curve of a PID controller**
Technical Information

In contrast to two-point controllers, dual output controllers exhibit three output states On-Off-On or High-Low-High, and also enable base load - controlled load applications. The characteristic curve shown in Figure 14 allows the following conclusion:

If the controlled variable exceeds the set value $w_1$, the control output is reset to $y_a$. If the controlled variable continues to rise and exceeds the set value of $w_2$, it is reset to the lowest control output, $y_k$. If the controlled variable falls again, the control output is reset to max. output. It must be noted that the differential gap $x_{sd}$ (hysteresis), which is allocated to each switching point, has to be overcome.

Nevertheless, a time-proportional pulse width modulation is also required for improved control characteristics (see two-point controllers with P-response). Typical applications are heating–cooling control systems in machines used in the production of plastic or climatic chambers. The control response is configured for PID control response.

In addition to the parameters already described for two-term controllers, a dead band zone (OL) or overlap zone (-OL) can be set between both outputs. This enables continuous transition between the heating and cooling processes. The different transmitting properties of the controlled heating and cooling system are compensated by adjusting the output power limitation $y_{max}$ together with the $x_p$-setting. As long as there is no proportional time response required for the cooling output, this output can be configured for ON-OFF-behavior. Figure 15 shows the effects of these parameter settings.

Three-point-step controllers are a variant of three-point controllers. They exhibit specific control response for triggering control elements with motor-driven adjustment. The respective outputs effect clockwise rotation, standstill, and counterclockwise rotation of a motor-driven control element.

These types of controllers exhibit linear mA or V-outputs instead of switching outputs and supply a continuous output signal corresponding to their control response. The control output can assume any value between 0 – 100 % within the adjusting range (extending from 0 (4)…20 mA or 0…10 V).
OPTIMIZING THE CONTROL PARAMETERS

Pre-tuning of parameters

Most HENGSTLER control units are equipped with an automatic parameter adjustment feature with two processes, which considerably simplifies the time-consuming optimization of PID control parameters when starting up or when the control system of a process has been changed. Consequently, a manual adjustment usually will not be necessary anymore.

Pre-tuning of parameters is carried out when the controlled variable has reached about 50% of the setpoint. Such an adjustment procedure is initialized during start-up and executes a step response. At the time value to the control action of the control output is changed over. The ensuing step response serves as the basis for calculating the control parameters P, I and D, as well as P2 in three-term controllers. In open-loop valve-motor-drive controllers this serves to determine the settings for parameters P and I. Subsequently, the optimization function switches off and the controller starts approaching its set value. Before activating the pre-tuning function, the proportional time has to be set according to the type of controlled system and, if necessary, other parameters that vary with time.

The parameters are adjusted once during the pre-tuning. The self-tuning function, however, can be activated permanently. It is carried out directly at the set value and can be executed instead of a preliminary adjustment, if the controlled system will not suffer any detrimental effects when the process variable is overshot beyond the set value. Nonetheless, it is recommended that the adjustment include both a preliminary adjustment and automatic self-tuning function. In this case a rough adjustment is carried out first, followed by fine-tuning when the system has settled at the set value. Due to the non-linearity of the controlled system a preliminary adjustment alone would not be optimal. An adjustment to the setpoint is not recommendable because of the preceding overshooting. Preliminary adjustment together with automatic self-tuning provides the optimal solution for determining the correct parameter settings.

Automatic self-tuning

**Figure 16: Self-tuning/Pretuning**
Imagine a temperature controller – when started up the first time – already familiar with the properties of the controlled system and which would react to its special characteristics. In other words, that it would be better than a well-adjusted PID controller. Surely you would be happy if any disturbance of the controlled system could be corrected quickly and optimally. HENGSTLER’s control units with RaPID control response offer such properties. No adjustments need to be made for optimizing and setting the controllers to the controlled system. The control unit works like a control engineer with many years of experience, and adjusts the parameters while observing the process and control system. Hence, it provides better control features than would be possible with a PID system alone.

RaPID control stands for ‘Response-Assisted PID Behavior’. The centerpiece of this behavior is a fuzzy-logic software that dynamically executes the parameter settings of the PID parts. Contrary to the adjustment methods generally applied up to now, such as pre-tuning, self-tuning, auto-tuning, etc., the system is controlled effectively before an oscillation needed to calculate the parameters is completely applied. Any disturbance is optimally counteracted by immediately changing the parameter settings.
Use in a multitude of branches

- Thermal treatment, environment simulation
- Packaging machines
- Tool heating and plastics processing machines
- Food and beverages industry
- Glass industry
- Paper industry
- Energy supply and climate control
- Chemistry and pharmaceutical industry
- Semi-conductor industry
- Rubber products
- Building materials and ceramics industry
- Motor vehicle industry
- Desiccation installations
- Bakery installations

Key advantages of our controllers:

- Easy operation
- State-of-the-art technology
- Versatility
- Reliability due to self-tuning functions
- Compact DIN dimensions and attractive design
- Low prices and short delivery times
1. Industrial and Temperature Controllers
2. Open-Loop Valve-Motor-Drive-Controllers

<table>
<thead>
<tr>
<th>Type</th>
<th>grado 901, 911, 921</th>
<th>grado 902, 912, 922</th>
</tr>
</thead>
</table>
| Dimensions (width x height x depth) | 901: 48 mm x 48 mm x 110 mm  
911: 48 mm x 96 mm x 100 mm  
921: 96 mm x 96 mm x 100 mm | 902: 48 mm x 48 mm x 110 mm  
912: 48 mm x 96 mm x 100 mm  
922: 96 mm x 96 mm x 100 mm |
| Display                   | Two-line, four-digit display  
Actual value = red  
Setpoint = green | Two-line, four-digit display  
Actual value = red  
Setpoint = green |
| Inputs                    | Thermocouple  
RTD: Pt 100, 3 wire  
Linear DC mV, V, mA | Thermocouple  
RTD: Pt 100, 3 wire  
Linear DC mV, V, mA |
| Auxiliary inputs          | Dual setpoint selection | Dual setpoint selection |
| Accuracy                  | ± 0.25 %, ± 1 LSD | ± 0.25 %, ± 1 LSD |
| Measuring rate            | 4 measurements per second | 4 measurements per second |
| Output 1                  | Control-output 1 (e.g. heat)  
Relay or Logic for SSR drive  
Linear mA or Volt | Control-output OPEN Relay |
| Output 2                  | Control-output 2 (e.g. cool)  
Relay or Logic for SSR drive  
Linear mA or Volt | Control-output CLOSE Relay |
|                          | or Alarm output  
Relay or Logic for SSR drive | |
| Output 3                  | Alarm output  
Relay or Logic for SSR drive | Alarm output  
Relay or Logic for SSR drive |
|                          | Recorder output  
Linear: mA or Volt | Recorder output  
Linear: mA or Volt |
| Output 4                  | not available | not available |
| Alarm function            | 1 Loop alarm and  
2 Software alarms (standard), selectable as Process alarm high or low,  
band alarm, deviation alarm.  
Alarms can be allocated to output 2 and/or 3 | 1 Loop alarm and  
2 Software alarms (standard), selectable as Process alarm high or low,  
band alarm, deviation alarm.  
Alarms can be allocated to output 3 |
| Digital interface         | RS 485, ASCII protocol | RS 485, ASCII protocol |
| Supply voltage            | 90–264 V AC 50/60 Hz (standard)  
20–50 V AC or 22–65 V DC (option) | 90–264 V AC 50/60 Hz (standard)  
20–50 V AC or 22–65 V DC (option) |
| Features                  | one control output (Heat) or  
two control outputs (Heat / Cool)  
control as ON/OFF, PID switching or linear  
Setpoint ramping selectable  
Parameter tuning manual, pre-tune, self-tune, RaPID, easy tune  
2 Alarms and Loop-alarm | one control loop with two outputs for  
motor drive OPEN / CLOSE  
control as ON/OFF, PID switching  
Setpoint ramping selectable  
Parameter tuning manual, pre-tune, self-tune  
2 Alarms and Loop-alarm |
# 1. Limit Controllers

## 2. Temperature Controller

<table>
<thead>
<tr>
<th>Type</th>
<th>grado 904, 924</th>
<th>grado 905</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong>&lt;br&gt;(width x height x depth)</td>
<td>904: 48 mm x 48 mm x 110 mm 924: 96 mm x 96 mm x 100 mm</td>
<td>905: 48 mm x 48 mm x 110 mm</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>Two-line, four-digit display&lt;br&gt;Actual value = red&lt;br&gt;Setpoint = green</td>
<td>Two-line, four-digit display&lt;br&gt;Actual value = red&lt;br&gt;Setpoint = green</td>
</tr>
<tr>
<td><strong>Inputs</strong></td>
<td>Thermocouple&lt;br&gt;RTD: Pt 100, 3 wire&lt;br&gt;Linear DC mV, V, mA</td>
<td>Thermocouple&lt;br&gt;RTD: Pt 100, 3 wire</td>
</tr>
<tr>
<td><strong>Auxiliary inputs</strong></td>
<td>External reset</td>
<td>not available</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>± 0.25 %, ± 1 LSD</td>
<td>± 0.25 %, ± 1 LSD</td>
</tr>
<tr>
<td><strong>Measuring rate</strong></td>
<td>4 measurements per second</td>
<td>4 measurements per second</td>
</tr>
<tr>
<td><strong>Output 1</strong></td>
<td>Limit-output, latched&lt;br&gt;Relay</td>
<td>Control-output 1 (e.g. heat)</td>
</tr>
<tr>
<td><strong>Output 2</strong></td>
<td>Alarm output&lt;br&gt;Relay or Logic for SSR drive</td>
<td>not available</td>
</tr>
<tr>
<td><strong>Output 3</strong></td>
<td>Alarm output&lt;br&gt;Relay or Logic for SSR drive</td>
<td>not available</td>
</tr>
<tr>
<td><strong>Output 4</strong></td>
<td>not available</td>
<td>not available</td>
</tr>
<tr>
<td><strong>Alarm function</strong></td>
<td>1 Loop alarm and&lt;br&gt;2 Software alarms (standard), selectable as Process alarm high or low, band alarm, deviation alarm. Alarms can be allocated to output 2 and/or 3</td>
<td>1 alarm on output 2 selectable as Process alarm high or low, band alarm, deviation alarm</td>
</tr>
<tr>
<td><strong>Digital interface</strong></td>
<td>RS 485, ASCII protocol</td>
<td>RS 485, ASCII protocol</td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>90-264 V AC 50/60 Hz (standard)&lt;br&gt;20-50 V AC or 22-65 V DC (option)</td>
<td>90-264 V AC 50/60 Hz (standard)&lt;br&gt;20-50 V AC or 22-65 V DC (option)</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>Limit control as HIGH or LOW&lt;br&gt;2 Alarms control as ON/OFF, PID switching or linear&lt;br&gt;Setpoint ramping selectable&lt;br&gt;Parameter tuning manual, pre-tune,</td>
<td>one control output (Heat)&lt;br&gt;control as ON/OFF, PID switching&lt;br&gt;Parameter tuning manual, easy-tune&lt;br&gt;1 Alarm</td>
</tr>
</tbody>
</table>

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Page

| 40 | 43 |
1. Temperature controllers for the plastics industry

2. RaPID – Industrial Controllers

<table>
<thead>
<tr>
<th>Type</th>
<th>grade 906, 916</th>
<th>grade 913, 923</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(width x height x depth)</td>
<td>906: 48 mm x 48 mm x 110 mm</td>
<td>913: 48 mm x 96 mm x 100 mm</td>
</tr>
<tr>
<td></td>
<td>916: 48 mm x 96 mm x 100 mm</td>
<td>923: 96 mm x 96 mm x 100 mm</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>Two-line, four-digit display</td>
<td>Two-line, four-digit display</td>
</tr>
<tr>
<td></td>
<td>Actual value = red</td>
<td>Actual value = red</td>
</tr>
<tr>
<td></td>
<td>Setpoint = green</td>
<td>Setpoint = green</td>
</tr>
<tr>
<td><strong>Inputs</strong></td>
<td>Thermocouple</td>
<td>Thermocouple</td>
</tr>
<tr>
<td></td>
<td>RTD: Pt 100, 3 wire</td>
<td>RTD: Pt 100, 3 wire</td>
</tr>
<tr>
<td></td>
<td>Linear DC mV, V, mA</td>
<td>Linear DC mV, V, mA</td>
</tr>
<tr>
<td><strong>Auxiliary inputs</strong></td>
<td>Currant transformer input</td>
<td>External setpoint</td>
</tr>
<tr>
<td></td>
<td>Dual setpoint selection</td>
<td>Dual setpoint selection</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>± 0.25 %, ± 1 LSD</td>
<td>± 0.25 %, ± 1 LSD</td>
</tr>
<tr>
<td><strong>Measuring rate</strong></td>
<td>4 measurements per second</td>
<td>4 measurements per second</td>
</tr>
<tr>
<td><strong>Output 1</strong></td>
<td>Control-output 1 (e.g. heat)</td>
<td>Control-output 1 (e.g. heat)</td>
</tr>
<tr>
<td></td>
<td>Relay or Logic for SSR drive</td>
<td>Relay or Logic for SSR drive</td>
</tr>
<tr>
<td></td>
<td>Linear mA or Volt</td>
<td>Linear mA or Volt</td>
</tr>
<tr>
<td><strong>Output 2</strong></td>
<td>Control-output 2 (e.g. cool)</td>
<td>Control-output 2 (e.g. cool)</td>
</tr>
<tr>
<td></td>
<td>Relay or Logic for SSR drive</td>
<td>Relay or Logic for SSR drive</td>
</tr>
<tr>
<td></td>
<td>or Alarm output</td>
<td>or Alarm output</td>
</tr>
<tr>
<td></td>
<td>Relay or Logic for SSR drive</td>
<td>Relay or Logic for SSR drive</td>
</tr>
<tr>
<td><strong>Output 3</strong></td>
<td>Alarm output</td>
<td>Alarm output</td>
</tr>
<tr>
<td></td>
<td>Relay or Logic for SSR drive</td>
<td>Relay or Logic for SSR drive</td>
</tr>
<tr>
<td></td>
<td>Recorder output</td>
<td>Recorder output</td>
</tr>
<tr>
<td></td>
<td>Linear: mA or Volt</td>
<td>Linear: mA or Volt</td>
</tr>
<tr>
<td><strong>Output 4</strong></td>
<td>Alarm output</td>
<td>not available</td>
</tr>
<tr>
<td></td>
<td>Relay</td>
<td></td>
</tr>
<tr>
<td><strong>Alarm function</strong></td>
<td>3 alarms</td>
<td>1 Loop alarm and</td>
</tr>
<tr>
<td></td>
<td>selectable as Process alarm high or low,</td>
<td>2 Software alarms (standard),</td>
</tr>
<tr>
<td></td>
<td>band alarm, deviation alarm, heater break</td>
<td>selectable as Process alarm high or low,</td>
</tr>
<tr>
<td></td>
<td>Alarms can be allocated to output</td>
<td>band alarm, deviation alarm.</td>
</tr>
<tr>
<td></td>
<td>2, 3 and/or 4</td>
<td>Alarms can be allocated to output</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 and/or 3</td>
</tr>
<tr>
<td><strong>Digital interface</strong></td>
<td>RS 485, ASCII protocol</td>
<td>RS 485, ASCII protocol</td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>90-264 V AC 50/60 Hz (standard)</td>
<td>90-264 V AC 50/60 Hz (standard)</td>
</tr>
<tr>
<td></td>
<td>20-50 V AC or 22-65 V DC (option)</td>
<td>20-50 V AC or 22-65 V DC (option)</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>one control output (Heat) or two control outputs (Heat / Cool) control as ON/OFF, PID switching soft-start function heater break alarm Parameter tuning manual, pre-tune, self-tune 3 Alarms</td>
<td>one control output (Heat) or two control outputs (Heat / Cool) control as ON/OFF, PID switching or linear Setpoint ramping selectable external setpoint input Parameter tuning manual, pre-tune, RaPID 2 Alarms and Loop-alarm</td>
</tr>
</tbody>
</table>

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1. Digital indicator
2. Industrial mini-controller and indicator

<table>
<thead>
<tr>
<th>Type</th>
<th>grado 918</th>
<th>grado 932</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong>&lt;br&gt;(width x height x depth)</td>
<td>918: 96 mm x 48 mm x 100 mm</td>
<td>906: 48 mm x 24 mm x 100 mm</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>One-line, four-digit display&lt;br&gt;Actual value = red or green</td>
<td>Two-line, four-digit display&lt;br&gt;Actual value = red or green</td>
</tr>
<tr>
<td><strong>Inputs</strong></td>
<td>Thermocouple&lt;br&gt;RTD: Pt 100, 3 wire&lt;br&gt;Linear DC mV, V, mA</td>
<td>Thermocouple&lt;br&gt;RTD: Pt 100, 3 wire&lt;br&gt;Linear DC mV, V, mA</td>
</tr>
<tr>
<td><strong>Auxiliary inputs</strong></td>
<td>External reset</td>
<td>Not available</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>± 0.25 %, ± 1 LSD</td>
<td>± 0.25 %, ± 1 LSD</td>
</tr>
<tr>
<td><strong>Measuring rate</strong></td>
<td>4 measurements per second</td>
<td>4 measurements per second</td>
</tr>
<tr>
<td><strong>Output 1</strong></td>
<td>Alarm output 1&lt;br&gt;Relay&lt;br&gt;Latched function selectable</td>
<td>Alarm or Control-output 1 (e.g. heat&lt;br&gt;Logic for SSR drive</td>
</tr>
<tr>
<td><strong>Output 2</strong></td>
<td>Alarm output 2&lt;br&gt;Relay&lt;br&gt;or&lt;br&gt;Recorder output&lt;br&gt;Linear: mA or Volt</td>
<td>Alarm or Control-output 1 (e.g. heat&lt;br&gt;Relay</td>
</tr>
<tr>
<td><strong>Output 3</strong></td>
<td>Alarm output 3&lt;br&gt;Relay&lt;br&gt;or&lt;br&gt;Transmitter power supply&lt;br&gt;24 V DC</td>
<td>Alarm output&lt;br&gt;Relay</td>
</tr>
<tr>
<td><strong>Output 4</strong></td>
<td>Not available</td>
<td>Not available</td>
</tr>
<tr>
<td><strong>Alarm function</strong></td>
<td>2 Software alarms (standard), selectable as Process alarm high or low, band alarm, deviation alarm.&lt;br&gt;Alarms can be allocated to output 2 and/or 3</td>
<td>2 alarms selectable as Process alarm high or low, band alarm, deviation alarm.</td>
</tr>
<tr>
<td><strong>Digital interface</strong></td>
<td>RS 485, ASCII and ModBus protocol</td>
<td>RS 485, ModBus protocol</td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>90-264 V AC 50/60 Hz (standard)&lt;br&gt;20-50 V AC or 22-65 V DC (option)</td>
<td>90-264 V AC 50/60 Hz (standard)&lt;br&gt;20-50 V AC or 22-65 V DC (option)</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>3 Alarms, alarm 1 can be latched&lt;br&gt;Transmitter power supply</td>
<td>One control output (Heat)&lt;br&gt;Control as ON/OFF,&lt;br&gt;PID switching&lt;br&gt;Parameter tuning manual, easy-tune&lt;br&gt;2 Alarms</td>
</tr>
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## Setpoint Profile Controller

<table>
<thead>
<tr>
<th>Type</th>
<th>grade 964</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td>964: 48 mm x 48 mm x 110 mm</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>One-line, four-digit display</td>
</tr>
<tr>
<td></td>
<td>Actual value = red</td>
</tr>
<tr>
<td></td>
<td>Setpoint = green</td>
</tr>
<tr>
<td><strong>Inputs</strong></td>
<td>Thermocouple</td>
</tr>
<tr>
<td></td>
<td>RTD: Pt 100, 3 wire</td>
</tr>
<tr>
<td></td>
<td>Linear DC mV, V, mA</td>
</tr>
<tr>
<td><strong>Auxiliary inputs</strong></td>
<td>remote RUN / HOLD</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>± 0.25 %, ± 1 LSD</td>
</tr>
<tr>
<td><strong>Measuring rate</strong></td>
<td>4 measurements per second</td>
</tr>
<tr>
<td><strong>Output 1</strong></td>
<td>Control-output 1 (e.g. heat)</td>
</tr>
<tr>
<td></td>
<td>Relay or Logic for SSR drive</td>
</tr>
<tr>
<td></td>
<td>Linear mA or Volt</td>
</tr>
<tr>
<td><strong>Output 2</strong></td>
<td>Control-output 2 (e.g. cool)</td>
</tr>
<tr>
<td></td>
<td>Relay or Logic for SSR drive</td>
</tr>
<tr>
<td></td>
<td>Linear mA or Volt</td>
</tr>
<tr>
<td></td>
<td>or Alarm or Event output</td>
</tr>
<tr>
<td></td>
<td>Relay or Logic for SSR drive</td>
</tr>
<tr>
<td><strong>Output 3</strong></td>
<td>Alarm or Event output</td>
</tr>
<tr>
<td></td>
<td>Relay or Logic for SSR drive</td>
</tr>
<tr>
<td></td>
<td>Recorder output</td>
</tr>
<tr>
<td></td>
<td>Linear: mA or Volt</td>
</tr>
<tr>
<td><strong>Output 4</strong></td>
<td>not available</td>
</tr>
<tr>
<td><strong>Alarm function</strong></td>
<td>1 Loop alarm and</td>
</tr>
<tr>
<td></td>
<td>2 Software alarms (standard), selectable as Process alarm high or low,</td>
</tr>
<tr>
<td></td>
<td>band alarm, deviation alarm</td>
</tr>
<tr>
<td></td>
<td>Alarms can be allocated to output</td>
</tr>
<tr>
<td></td>
<td>2 and/or 3</td>
</tr>
<tr>
<td><strong>Digital interface</strong></td>
<td>RS 485, ModBus protocol</td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>90–264 V AC 50/60 Hz (standard)</td>
</tr>
<tr>
<td></td>
<td>20–50 V AC or 22–65 V DC (option)</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>one control output (Heat) or two control outputs (Heat / Cool)</td>
</tr>
<tr>
<td></td>
<td>control as ON/OFF, PID switching or linear</td>
</tr>
<tr>
<td></td>
<td>Parameter tuning manual, pre-tune, easy-tune</td>
</tr>
<tr>
<td></td>
<td>2 Alarms, 1 Event output</td>
</tr>
<tr>
<td></td>
<td>4 profile programs, each up to 16 segments</td>
</tr>
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</table>

**Page**: 59
<table>
<thead>
<tr>
<th>TYPES</th>
<th>Front</th>
<th>Cut Out</th>
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<tbody>
<tr>
<td>grado 932</td>
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<td>grado 902</td>
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<td>grado 904</td>
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<td>grado 905</td>
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<td>grado 906</td>
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<td>grado 907</td>
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<td>grado 912</td>
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<td>grado 922</td>
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<td>grado 923</td>
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<td>grado 924</td>
<td><img src="image" alt="Dimensions" /></td>
<td><img src="image" alt="Dimensions" /></td>
</tr>
</tbody>
</table>

**Dimensions Front and Cut Out**
Features and advantages of HENGSTLER controllers

- **Trouble-free communication**
  System compatibility via optional RS 485 interface; configuration values adjustable by means of a convenient PC program.

- **Reliability:**
  High scanning rate (4 x /s) ensures fast response in the event of disturbances.

- **Flexibility:**
  Enhanced flexibility by means of a second setpoint value which makes it possible to change between both setpoint values.
  Free configuration is offered for a universal input for the resistance thermometer (Pt 100), Thermocouples (all common types) or analog signals (V, mV, mA).
  Wide selection of output types (relay, logic or DC linear).

Automatic self-tuning for enhanced user convenience

Adjusting controllers for specific applications in an optimal way is usually a time-consuming process which calls for special knowledge and expertise.

HENGSTLER controllers offer an automatic self-tuning function which facilitates application-specific adjustments by setting all parameters automatically.

A pre-adjustment safely approximates your process to the set value during the starting-up sequence and without the risk of overshooting.

Subsequently, the automatic self-tuning function performs an in-process adjustment of all parameters for you.
Industrial and Temperature Controllers

**grado 901, 911, 921**

- Available as two-point, three-point, or continuous controller
- Easy adjustment of the PID control parameters through preliminary adjustment (pre-tune) and self-adjustment (self-tuned facilities).
- Very easy setpoint adjustment directly through front panel keys
- Configurable universal input for thermocouples, resistance thermometer PT 100, or freely scaleable analogue input (current/voltage)
- 3 outputs (discontinuous or continuous) for control, as linear output for measured or setpoint value, or as alarm output
- Two-line high-luminosity LED display
- Permanent setpoint and actual value display
- 2 software alarms which can be allocated to the outputs
- 4 types of alarm: closed loop alarm, deviation alarm, band alarm, absolute alarm
- Adjustable digital input filter
- 2 externally selectable setpoint values
- Easy adjustment of control parameters with interface through PC
- Adjustable actual value offset for the correction of the measured value
- IP 65 system of protection

High-luminosity two-line LED display (red/green) for set and actual value.

4 LED indicators:
- SET: Unit in parameter mode of operation (blinks)
- AT: Self-optimisation of the control parameters is active (auto-tuning)
- AL: Alarm pending
- 1 and 2: Output 1 and 2, respectively, active

**Keys:**
- Change-over from automatic to manual mode of operation for adjustment of the output power
- Up and down for adjustment of values
- Function key for entering the various programming levels
**Technical data**

**Dimensions**
- **Case size (WxHxD)**
  - 901: 48 mm x 48 mm x 110 mm
  - 911: 48 mm x 96 mm x 100 mm
  - 921: 96 mm x 96 mm x 100 mm
- **Panel cutout (WxH)**
  - 45 mm x 45 mm
  - 45 mm x 92 mm

**Mounting**
- with clamping frame

**Electrical connection**
- terminal screws

**Ambient temperature**
- operating: 0 °C to 50 °C, storage: -20 °C to 80 °C

**Data retention**
- > 10 years with EEPROM

**Accuracy**
- ± 0.25%, ± 1 LSD

**Measuring rate**
- 4 per second

**Display**
- Two-line, four-digit display
- Actual value = red, Setpoint = green

**Alarm function**
- 1 Loop alarm and 2 Software alarms (standard), selectable as Process alarm, high or low, band, deviation alarm
- Alarms can be allocated to output 2 and/or 3

**Digital interface**
- RS 485, 2 – wire, Baud rate 9600, 4800, 2400, 1200, ASCII protocol

**Supply voltage**
- 90 – 264 V AC 50/60 Hz (standard)
- 20 – 50 V AC or 22 – 65 V DC (option)

**Power consumption**
- 4 watts approximately

**Thermocouple**
- J + L: 0.0 – 205.4 °C, 0 – 450 °C, 0 – 760 °C
- K: - 200 – 760 °C, -200 – 1373 °C
- R + S: 0 – 1650 °C
- T: - 200 – 262 °C, 0.0 – 260.6 °C
- B: 100 – 1824 °C
- N: 0 – 1399 °C

**RTD**
- Pt 100: 0 – 300 °C, 0 – 800 °C
- - 200 – 206 °C, 0.0 – 100.9 °C,
- - 100.9 – 100.0 °C, -100.9 – 537.3 °C

**Linear DC**
- 0–20 mA, 4–20 mA,
- 0–50 mV, 10–50 mV, 0–5 V, 1–5 V, 0–10 V, 2–10 V
- decimal point selection, free scaleable in the range –1999 to 9999

**Control function**
- Dual setpoint selection by voltage free contact or TTL logic signal
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V

**Control (e.g. heat)**
- Relay: 2A resistive at 120/240 V AC,
- contact single pole double throw
- Logic: > 4.2 V DC for SSR
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V

**Control (e.g. cool)**
- Relay: 2A resistive at 120/240 V AC,
- contact single pole double throw
- Logic: > 4.2 V DC for SSR
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V

**Alarm output**
- Relay: 2A resistive at 120/240 V AC,
- contact single pole double throw
- Logic: > 4.2 V DC for SSR
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V

**Recorder output**
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V
- Not available

**Control function**
- ON/OFF, PID two point (heat), PID three point (heat/cool)

**Tuning**
- Manual, pre-tune, auto pre-tune

**Set-up / configuration**
- from front keys or via configuration socket from PC
The clear division of parameters into 3 operating levels (operator, set up, and configuration mode of operation) allows for easy operation and setting of the controller. In standard mode of operation, the setpoint is adjusted by simply pressing the arrow keys.

On the parameter level, numerous control parameters can be adjusted to the control task. The adjustment of the PID control parameters is possible in an even easier way by automatic preliminary and self-adjustment.

The configuration level comprises parameters for adjustment of the inputs and outputs as well as the hardware.
### Technical data

**Connection Diagram**

**Type 901**

**Type 911/921**

### Ordering Code

<table>
<thead>
<tr>
<th>Type</th>
<th>Option</th>
<th>Input</th>
<th>Output 1, 2, 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0901</td>
<td>None</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0911</td>
<td>Interface RS 485</td>
<td>2</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>0921</td>
<td>Set value change-over</td>
<td>3</td>
<td>DC 0-20 mA</td>
</tr>
</tbody>
</table>

**Input**
- 1. Resistance thermometer
- 2. Thermocouple
- 3. mA input
- 4. V input

**Output 1, 2, 3**
- 0. none
- 1. Relay
- 2. Logic
- 3. DC 0-10 V
- 4. DC 0-20 mA
- 5. DC 0-5 V
- 7. DC 4-20 mA

**Option**
- 12. Interface RS 485 and power supply 22-50 V DC/AC
- 32. Set value change-over and power supply 22-50 V DC/AC
Open-Loop Valve-Motor-Drive-Controllers

The dual display is also user-programmable to enable the operator to display the information which is most relevant to the application. You may choose to display the process variable plus the setpoint (in either "read only" or "changeable" mode), the process variable plus the ramping setpoint, or the process variable or setpoint values as single displays.

- Dual four digit red and green display for measured variable and setpoint.
- Easy setpoint adjustment and parameter setup via microswitches behind front membrane.
- Universal sensor input. Thermocouples, three wire RTD, DC linear mA or mV, V
- Input ranges selectable from the front panel
- Universal power supply 90 to 264 V AC or optional 24 V AC/DC
- IP 65 sealed front panel
- Auto / Manual control (selectable)
- Pre-tune and self-tune functions
- Output 3 can be used as alarm 1 or as linear output for measured variable or setpoint
- Optional RS 485 comms port
- Dual setpoint
- CE marked to comply with EN 50081 and EN 50082 EMC specifications

 grado 902, 912, 922
Technical data

Dimensions

<table>
<thead>
<tr>
<th></th>
<th>Case size (WxHxD)</th>
<th>Panel cutout (WxH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>902</td>
<td>48 mm x 48 mm x 110 mm</td>
<td>45 mm x 45 mm</td>
</tr>
<tr>
<td>912</td>
<td>48 mm x 96 mm x 100 mm</td>
<td>45 mm x 92 mm</td>
</tr>
<tr>
<td>922</td>
<td>96 mm x 96 mm x 100 mm</td>
<td>92 mm x 92 mm</td>
</tr>
</tbody>
</table>

Mounting

- with clamping frame

Electrical connection

- terminal screws

Ambient temperature

- operating 0 °C to 50 °C, storage –20 °C to 80 °C

Data retention

- > 10 years with EEPROM

Accuracy

- ± 0.25%, ± 1 LSD

Measuring rate

- 4 per second

Display

- Two-line, four-digit display
- Actual value = red, Setpoint = green

Alarm function

- 1 Loop alarm and 2 Software alarms (standard), selectable as Process alarm high or low, band alarm, deviation alarm
- Alarms can be allocated to output 3

Digital interface

- RS 485, 2 – wire, Baud rate 9600, 4800, 2400, 1200, ASCII protocol

Supply voltage

- 90 – 264 V AC 50/60 Hz (standard)
- 20 – 50 V AC or 22 – 65 V DC (option)

Power consumption

- 4 watts approximately

Thermocouple

- J + L: 0.0 – 205.4 °C, 0 – 450 °C, 0 – 760 °C
- K: 0 – 1650 °C
- T: 0 – 262 °C, 0.0 – 260.6 °C
- B: 100 – 1824 °C
- N: 0 – 1399 °C

RTD

- Pt 100: 0 – 300 °C, 0 – 800 °C, -200 – 206 °C, 0.0 – 100.9 °C, -100.9 – 100.9 °C, -537.3 °C

Linear DC

- 0-20 mA, 4-20 mA,
- 0-50 mV, 10-50 mV, 0-10 V, 1-5 V, 2-10 V
- decimal point selection, free scaleable in the range –1999 to 9999
- Dual setpoint selection by voltage free contact or TTL logic signal

Control OPEN

- Relay: 2A resistive at 120/240 V AC, contact single pole double throw

Control CLOSE

- Relay: 2A resistive at 120/240 V AC, contact single pole double throw

Alarm output

- Relay: 2A resistive at 120/240 V AC, contact single pole double throw

Logic: > 4.2 V DC for SSR

Recorder output

- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V
- Not available

Control function

- ON/OFF, PID for open-loop valve-motor-drive

Tuning

- Manual, pre-tune, auto pre-tune

Set-up / configuration

- from front keys or via configuration socket from PC

TECHNICAL DATA

General

- Input and ranges
  - Auxiliary inputs
    - Output 1
    - Output 2
    - Output 3

Control Performance

- Output 4
Technical data

DIMENSIONS

CONNECTIONS DIAGRAM
Type 902, 912, 922

ORDERING CODE

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>0902</td>
<td>48 x 48 mm</td>
<td>00 Not fitted (90...264 V 50/60 Hz)</td>
</tr>
<tr>
<td>0912</td>
<td>48 x 96 mm</td>
<td>02 Line Supply 24 V AC/DC</td>
</tr>
<tr>
<td>0922</td>
<td>96 x 96 mm</td>
<td>10 RS 485 Communications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12 RS 485 Communications and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Line Supply 24 V DC/AC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 Dual Setpoint</td>
</tr>
<tr>
<td></td>
<td></td>
<td>32 Dual Setpoint and Line Supply 24 V DC/AC</td>
</tr>
</tbody>
</table>

Input
1 Resistance thermometer
2 Thermocouple
3 Linear mV
4 Linear mA

Output 1
1 Relay
Output 2
1 Relay
Output 3
0 none
1 Relay
2 SSR/DC
3 Linear 0-10 V
4 Linear 0-20 mA
5 Linear 0-5 V
6 Linear 4-20 mA
Limit Controllers

The instrument can be configured to act as either a "high limit" unit, where the relay will de-energise when the PV is above the limit setpoint, or a "low limit" where the relay will de-energise when the PV falls below the setpoint. LED indicators show when limits have been exceeded and when the relay is latched.

- Dual four digit red and green display for measured variable and setpoint
- Simple setup with password protection
- Universal sensor input. Thermocouples, three wire RTD, DC linear mA or mV, V
- Input ranges selectable from the front panel
- Universal power supply 90 to 264 V AC or optional 24 V AC/DC
- IP 65 sealed front panel
- Front or remote reset (selectable)
- Limit relay output
- Optional annunciator output second alarm or linear output for measured variable or setpoint
- Optional RS 485 comms port
- CE marked to comply with EN 50081 and EN 50082 EMC specifications
**Technical data**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Case size (WxHxD)</th>
<th>Panel cutout (WxH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>904</td>
<td>48 mm x 48 mm x 110 mm</td>
<td>45 mm x 45 mm</td>
</tr>
<tr>
<td>924</td>
<td>96 mm x 96 mm x 100 mm</td>
<td>92 mm x 92 mm</td>
</tr>
</tbody>
</table>

**Mounting**
- with clamping frame

**Electrical connection**
- terminal screws

**Ambient temperature**
- operating: 0 °C to 50 °C, storage: -20 °C to 80 °C

**Data retention**
- > 10 years with EEPROM

**Accuracy**
- ± 0.25 %, ± 1 LSD

**Measuring rate**
- 4 per second

**Display**
- Two-line, four-digit display
- Actual value = red, Setpoint = green

**Alarm function**
- 2 Software alarms (standard), selectable as
- Process alarm high or low, band alarm, deviation alarm
- Alarms can be allocated to output 2 and/or 3

**Digital interface**
- RS 485, 2 – wire, Baud rate 9600, 4800, 2400, 1200, ASCII protocol

**Supply voltage**
- 90 – 264 V AC 50/60 Hz (standard)
- 20 – 50 V AC or 22 – 65 V DC (option)

**Power consumption**
- 4 watts approximately

**Thermocouple**
- J + L: 0.0 – 205.4 °C, 0 – 450 °C, 0 – 760 °C
- K: - 200 – 760 °C, -200 – 1373 °C
- R + S: 0 – 1650 °C
- T: - 200 – 262 °C, 0.0 – 260.6 °C
- B: 100 – 1824 °C
- N: 0 – 1399 °C

**RTD**
- Pt 100: 0 – 300 °C, 0 – 800 °C,
- 200 – 206 °C, 0.0 – 100.9 °C,
- 100.9 – 100.0 °C, -100.9 – 537.3 °C

**Linear DC**
- 0–20 mA, 4–20 mA,
- 0–50 mV, 10–50 mV, 0–5 V, 1–5 V, 0–10 V, 2–10 V
- decimal point selection, free scaleable in the range –1999 to 9999

**External reset**
- by voltage free contact or TTL logic signal

**Limit output (latched)**
- Relay: 2A resistive at 120/240 V AC, contact single pole double throw

**Alarm**
- Relay: 2A resistive at 120/240 V AC, contact single pole double throw
- Logic: > 4.2 V DC for SSR

**Alarm**
- Relay: 2A resistive at 120/240 V AC, contact single pole double throw
- Logic: > 4.2 V DC for SSR

**Recorder output**
- Linear: 0 – 20 mA, 4 – 20 mA,
- 0 – 5 V, 0 – 10 V
- Not available

**Control function**
- not available

**Tuning**
- not available

**Set-up / configuration**
- from front keys or via configuration socket from PC
### Technical data

**DIMENSIONS**

![Dimensions in mm](image)

**CONNECTIONS DIAGRAM**

Type 904, 924

**ORDERING CODE**

<table>
<thead>
<tr>
<th>Type</th>
<th>0904 48 x 48 mm</th>
<th>0924 96 x 96 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option</td>
<td>00 Not fitted (90...264 V 50/60 Hz)</td>
<td>30 Remote Reset Input</td>
</tr>
<tr>
<td></td>
<td>02 Line Supply 24 V AC/DC</td>
<td>32 Remote Reset Input and Line Supply 24 V DC/AC</td>
</tr>
<tr>
<td></td>
<td>10 RS 485 Communications</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 RS 485 Communications and Line Supply 24 V DC/AC</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Input</th>
<th>Output 1</th>
<th>Output 2</th>
<th>Output 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Resistance thermometer</td>
<td>1 Relay Limit</td>
<td>1 Relay</td>
<td>none</td>
</tr>
<tr>
<td>2 Thermocouple</td>
<td>3 Linear 0-10 V</td>
<td>4 Linear 0-20 mA</td>
<td>5 Linear 0-5 V</td>
</tr>
<tr>
<td>3 Linear mV</td>
<td>6 Linear 4-20 mA</td>
<td>7 Linear 0-10 V</td>
<td>8 Linear 0-20 mA</td>
</tr>
<tr>
<td>4 Linear mA</td>
<td>9 Linear 0-5 V</td>
<td>10 Linear 0-10 V</td>
<td>11 Linear 0-20 mA</td>
</tr>
</tbody>
</table>

---

[ENCODERS COUNTERS CONTROLLERS INDICATORS RELAYS PRINTERS CUTTERS]
Temperature Controller

Versatility

Typical applications are in the fields of packaging machines, tool heating, plastics processing machines, soldering units, food preparation, furnace construction, distilling and desiccation installations, and bakery machines, among other things.

FEATURES

- Easy operation
- Large degree-precision (3 digits) display of the actual or setpoint
- Immediate optimal control through special automatic adjustment of the PID control parameters
- Controls heating processes, e.g. of packaging machines
- Ideal under wet conditions (food preparation) due to the slick face and protection class IP 66
- For thermocouples or Pt 100 sensors
- Relay or logical output deliverable
- With and without relay output for alarm
- (Configurable: maximum, minimum, deviation, and band alarms)
- Deliverable for operating voltages in the range 90-264 V AC or 22-50 V AC/DC
- PID or On/Off control
- In accordance with CE, UL and IP66 / NEMA4
- Adjustable digital input filter

DISPLAY

High luminosity red LED-display for set and actual value

4 LED indicators:
- SP: Setpoint is displayed
- AL: Alarm pending (blinks) or Alarm set value is displayed
- ON CONTROL: Actual and set values correspond (to +/- 0.5%)

Up and down keys for value adjustment

Function key for switching to set value
## Technical data

<table>
<thead>
<tr>
<th></th>
<th>905</th>
<th>Panel cutout (WxH)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td><strong>Case size (WxHxD)</strong></td>
<td><strong>Panel cutout (WxH)</strong></td>
</tr>
<tr>
<td></td>
<td>48 mm x 48 mm x 110 mm</td>
<td>45 mm x 45 mm</td>
</tr>
</tbody>
</table>

### General
- **Mounting**: with clamping frame
- **Electrical connection**: terminal screws
- **Ambient temperature**: operating 0 °C to 50 °C, storage –20 °C to 80 °C
- **Data retention**: > 10 years with EEPROM
- **Accuracy**: ± 0.25 %, ± 1 LSD
- **Measuring rate**: 4 per second
- **Display**: Three-digit display
  - Actual value = red
- **Alarm function**: 1 alarm (Optional) on output 2 selectable as Process alarm high or low, band alarm, deviation alarm
- **Digital interface**: Not available
- **Supply voltage**: 90 – 264 V AC 50/60 Hz (standard)
- **Power consumption**: 4 watts approximately
- **Thermocouple**:
  - J + L: 0.0 – 205.4 °C, 0 – 450 °C, 0 – 760 °C
  - K: - 200 – 760 °C, -200 – 1373 °C
  - R + S: 0 – 1650 °C
  - T: - 200 – 262 °C, 0.0 – 260.6 °C
  - B: 100 – 1824 °C
  - N: 0 – 1399 °C
- **RTD**:
  - Pt 100: 0 – 300 °C, 0 – 800 °C,
    - - 200 – 206 °C, 0.0 – 100.9 °C,
    - - 100.9 – 100.0 °C, -100.9 – 537.3 °C
- **Linear DC**: Not available
- **Control 1**:
  - Relay: 2A resistive at 120/240 V AC, contact single pole double throw
  - Logic: > 4.2 V DC for SSR
- **Alarm**:
  - Relay: 2A resistive at 120/240 V AC, contact single pole double throw
  - Not available
- **Control function**: ON/OFF, PID two point (heat)
- **Tuning**: easy-tune
- **Set-up / configuration**: from front keys

### Input and ranges
- **Output 1**: Not available
- **Output 2**: Not available
- **Output 3**: Not available
- **Output 4**: Not available

### DIMENSIONS

![Dimensions in mm](image-url)

**Dimensions in mm**
Technical data

The clear division of parameters into 3 operating levels (normal, set up and configuration modes of operation) allows for easy operation and setting of the controller.

In normal operation mode the setpoint is adjusted by simply pressing the arrow keys.

On the parameter level only a few settings are necessary since the PID control parameter setting occurs automatically.

The configuration level comprises the setting of the measurement range and of the type of alarm.

PROGRAMMING

In normal operation mode the setpoint is adjusted by simply pressing the arrow keys.

On the parameter level only a few settings are necessary since the PID control parameter setting occurs automatically.

The configuration level comprises the setting of the measurement range and of the type of alarm.

CONNÖCTIOÀ DIAGRAM
Type 905

ORDERING CODE

Type 0905
Temperature controller
(48 mm x 48 mm)

Alarm
0 None
1 Relay

Operating manual
0 None
1 English
2 French
3 German

Operating voltage
0 90 - 264 V AC
2 24 V AC/DC nominal

Input
1 Resistance thermometer
PT 100 (mV)
2 Thermocouple

Output
1 Relay
2 Logic
Temperature Controllers
for the plastic industry

Grado 906 controllers are designed for applications in the plastics processing industry and equipped with a multitude of special functions.

- DIN-dimensions: 48 x 48 mm, 48 x 96 mm
- Monitors the heating current of machines and tools and thus prevents production losses caused by breakdown of heating elements
- Increases the life of heating elements by means of a "soft" start-up circuit
- Easy adjustment of PID control parameters by automatic pre-tuning and self-tuning functions
- Universal input can be configured for thermocouples and resistance thermometer Pt 100
- Simultaneous display of setpoint and actual values
- Two linkable software alarms which can be assigned to the respective outputs
- Four different types of alarm: process high alarm, process low alarm, deviation alarm, band alarm, absolute alarm
- Two optional setpoint which can be changed-over externally
- Easy interfacing to SCADA systems via standard MODbus protocol
- Adjustable actual value - offset for compensating the measured values
- Display of all relevant information, e. g. actual temperature/setpoint temperature, current monitoring status (heating current) on a dual, four-line display
- Four outputs for extensive signaling – also when used as controller for heating or cooling
- The proper solution for numerous requirements
- Protection class IP 65

Soft Start

![Diagram of Soft Start](image)

- Ramp rate depends on the power limitation
- Starting time
### Technical data

#### Dimensions

<table>
<thead>
<tr>
<th>Model</th>
<th>Case size (WxHxD)</th>
<th>Panel cutout (WxH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>906</td>
<td>48 mm x 48 mm x 110 mm</td>
<td>45 mm x 45 mm</td>
</tr>
<tr>
<td>916</td>
<td>48 mm x 96 mm x 100 mm</td>
<td>45 mm x 92 mm</td>
</tr>
</tbody>
</table>

#### Mounting
- with clamping frame

#### Electrical connection
- terminal screws

#### Ambient temperature
- operating: 0 °C to 50 °C, storage: -20 °C to 80 °C

#### Data retention
- > 10 years with EEPROM

#### Accuracy
- ± 0.25 %, ± 1 LSD

#### Measuring rate
- 4 per second

#### Display
- Two-line, four-digit display
- Actual value = red, Setpoint = green

#### Alarm function
- 2 Software alarms (standard), selectable as Process alarm high or low, band alarm, deviation alarm
- Alarms can be allocated to output 2, 3 and/or 4
- 1 heater break alarm

#### Digital interface
- RS 485, 2 – wire, Baud rate 9600, 4800, 2400, 1200, ModBus and ASCII protocol

#### Supply voltage
- 90 – 264 V AC 50/60 Hz (standard)
- 20 – 50 V AC or 22 – 65 V DC (option)

#### Power consumption
- 4 watts approximately

#### Thermocouple
- J + L: 0.0 – 205.4 °C, 0 – 450 °C, 0 – 760 °C
- K: -200 – 760 °C, -200 – 1373 °C
- R + S: 0 – 1650 °C
- T: -200 – 262 °C, 0.0 – 260.6 °C
- B: 100 – 1824 °C
- N: 0 – 1399 °C
- RTD Pt 100: 0 – 300 °C, 0 – 800 °C, -200 – 206 °C, 0.0 – 100.9 °C, -100.9 – 100.0 °C, -100.9 – 537.3 °C

#### Linear DC
- not available

#### Current transformer input
- 0 – 50 mA

#### Control 1 (e.g. heat)
- Dual setpoint selection by voltage free contact or TTL logic signal
- Relay: 2A resistive at 120/240 V AC, contact single pole double throw
- Logic: > 4.2 V DC for SSR

#### Control 2 (e.g. cool)
- Relay: 2A resistive at 120/240 V AC, contact single pole double throw
- Logic: > 4.2 V DC for SSR

#### Alarm output
- Relay: 2A resistive at 120/240 V AC, contact single pole double throw
- Logic: > 4.2 V DC for SSR

#### Recorder output
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V
- Alarm output: if fitted then shared on output 2 as
- 2 Relay: 2A resistive at 120/240 V AC, contact single pole single throw

#### Control function
- ON/OFF, PID two point (heat), PID three point (heat/cool)

#### Tuning
- Manual, pre-tune, auto pre-tune, self-tune

#### Set-up / configuration
- from front keys or via configuration socket from PC

#### Heater break alarm
- high, low, short circuit
**Technical data**

**Connections Diagram**
Type 906, 916

Output 3
- RELAY
- N/C C N/O

Output 1
- RELAY
- N/O C N/C

Input – heat-current monitoring

PT100

Optional: Dual-relay output

Output 2
- PT100

Input – heat-current monitoring

Optional: Dual setpoint or Quick transfer

Output 4

Optional: Dual-Relay

- ~ 96...364 V AC (Standard)
- 20...50 V AC
- 22...65 V DC

- Optional

- Optional: Dual setpoint or Quick transfer
Technical data

DIMENSIONS

ORDERING CODE

Type 0906  (48 x 48 mm)
Type 0916  (48 x 96 mm)

Options
10 RS 485 interface
30 Alternating set value/quick start
02 Power supply 24 V AC/DC
12 RS 485 interface and power supply 24 V DC/AC
32 Alternating set value/quick start and power supply 24 V DC/AC

Input
1 Pt 100 linear mV
2 Thermocouple

Output 1
1 Relay
2 SSR

Output 2 (and output 4)
0 None
1 Relay
3 SSR
9 Dual relay

Output 3
0 None
2 Relay (alarm 1 or heat-current alarm)
3 Linear 0 – 10 V
4 Linear 0 – 20 mA
5 Linear 0 – 5 V
7 Linear 4 – 20 mA

Options
10 RS 485 interface
30 Alternating set value/quick start
02 Power supply 24 V AC/DC
12 RS 485 interface and power supply 24 V DC/AC
32 Alternating set value/quick start and power supply 24 V DC/AC

Dimensions in mm
The new grado RaPID temperature controllers were specifically designed to improve the settling response during start-up and in the event of process malfunctions. These controllers minimize overshooting and significantly reduce start-up times.

RaPID controllers are PID controllers supported by fuzzy logic. To achieve optimal control characteristics, you simply start up the system using the usual automatic parameter checking found throughout the “grado” family and then switch on the RaPID function with a simple key stroke.

RaPID (Response-assisted PID) is a unique function based on fuzzy logic. In an on-line process, the traditional PID parameters are continuously compiled by a fuzzy logic according to their P, I and D proportions. Instead of providing computing functions, such as self-tuning, auto-tuning, which await the end of the previous function, RaPID responds immediately, which makes controlling significantly faster and prevents expansion of the interference amplitude. The RaPID function allows non-linear response of the controller. Such linguistic descriptions as “warmer” or “faster” are recognized and applied correctly.

Our illustration below shows a comparison of a standard PID controller in a load simulation of 1st order, a time constant of 80 and 30 seconds and a delay time of 7 seconds.
## Technical data

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Case size (WxHxD)</th>
<th>Panel cutout (WxH)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>913</strong></td>
<td>48 mm x 96 mm x 100 mm</td>
<td>45 mm x 92 mm</td>
</tr>
<tr>
<td><strong>923</strong></td>
<td>96 mm x 96 mm x 100 mm</td>
<td>92 mm x 92 mm</td>
</tr>
</tbody>
</table>

### Mounting
- with clamping frame

### Electrical connection
- terminal screws

### Ambient temperature
- operating 0 °C to 50 °C, storage –20 °C to 80 °C

### Data retention
- > 10 years with EEPROM

### Accuracy
- ± 0.25 %, ± 1 LSD

### Measuring rate
- 4 per second

### Display
- Two-line, four-digit display
- Actual value = red, Setpoint = green

### Alarm function
- 1 Loop alarm and 2 Software alarms (standard), selectable as Process alarm high or low, band alarm, deviation alarm
- Alarms can be allocated to output 2 and/or 3

### Digital interface
- RS 485, 2 – wire, Baud rate 9600, 4800, 2400, 1200, ASCII protocol

### Supply voltage
- 90 – 264 V AC 50/60 Hz (standard)
- 20 – 50 V AC or 22 – 65 V DC (option)

### Power consumption
- 4 watts approximately

### Thermocouple
- J + L: 0.0 – 205.4 °C, 0 – 450 °C, 0 – 760 °C
- K: - 200 – 760 °C, -200 – 1373 °C
- R + S: 0 – 1650 °C
- T: - 200 – 262 °C, 0.0 – 260.6 °C
- B: 100 – 1824 °C
- N: 0 – 1399 °C

### RTD
- Pt 100: 0 – 300 °C, 0 – 800 °C, - 200 – 206 °C, 0.0 – 100.9 °C, - 100.9 – 100.0 °C, + 100.9 – 537.3 °C

### Linear DC
- 0-20 mA, 4-20 mA
- 0-50 mV, 0-500 mV, 0-5 V, 1-5 V, 0-10 V, 2-10 V
decimal point selection, free scalable in the range –1999 to 9999
External Setpoint: mV / V / mA / Potentiometer
Dual setpoint selection by voltage free contact or TTL logic signal

### Control 1 (e.g. heat)
- Relay: 2A resistive at 120/240 V AC,
  contact single pole double throw
- Logic: > 4.2 V DC for SSR
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V

### Alarm or Control 2 (e.g. cool)
- Relay: 2A resistive at 120/240 V AC,
  contact single pole double throw
- Logic: > 4.2 V DC for SSR
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V

### Control function
- ON/OFF, PID two point (heat), PID three point (heat/cool)

### Tuning
- Manual, pre-tune, auto pre-tune, self-tune, RaPID

### Set-up / configuration
- from front keys or via configuration socket from PC
Technical data

DIMENSIONS

[Dimensions diagram]

CONNECTIONS DIAGRAM
Type 913, 923

[Connection diagram]

ORDERING CODE

<table>
<thead>
<tr>
<th>Type 0913 (48 mm x 96 mm)</th>
<th>Type 0923 (96 mm x 96 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input:</td>
<td></td>
</tr>
<tr>
<td>1 Pt 100 linear mV</td>
<td></td>
</tr>
<tr>
<td>2 Thermocouple</td>
<td></td>
</tr>
<tr>
<td>3 Linear mA</td>
<td></td>
</tr>
<tr>
<td>4 Linear V</td>
<td></td>
</tr>
<tr>
<td>Output 1:</td>
<td></td>
</tr>
<tr>
<td>0 None</td>
<td></td>
</tr>
<tr>
<td>1 Relay</td>
<td></td>
</tr>
<tr>
<td>2 DC SSR</td>
<td></td>
</tr>
<tr>
<td>3 Linear 0 - 10 V</td>
<td></td>
</tr>
<tr>
<td>4 Linear 0 - 20 mA</td>
<td></td>
</tr>
<tr>
<td>5 Linear 0 - 5 V</td>
<td></td>
</tr>
<tr>
<td>7 Linear 4 - 20 mA</td>
<td></td>
</tr>
<tr>
<td>Output 2:</td>
<td></td>
</tr>
<tr>
<td>0 None</td>
<td></td>
</tr>
<tr>
<td>1 Relay</td>
<td></td>
</tr>
<tr>
<td>2 DC SSR</td>
<td></td>
</tr>
<tr>
<td>3 Linear 0 - 10 V</td>
<td></td>
</tr>
<tr>
<td>4 Linear 0 - 20 mA</td>
<td></td>
</tr>
<tr>
<td>5 Linear 0 - 5 V</td>
<td></td>
</tr>
<tr>
<td>7 Linear 4 - 20 mA</td>
<td></td>
</tr>
<tr>
<td>Output 3:</td>
<td></td>
</tr>
<tr>
<td>0 None</td>
<td></td>
</tr>
<tr>
<td>1 Relay</td>
<td></td>
</tr>
<tr>
<td>2 DC SSR</td>
<td></td>
</tr>
<tr>
<td>3 Linear 0 - 10 V</td>
<td></td>
</tr>
<tr>
<td>4 Linear 0 - 20 mA</td>
<td></td>
</tr>
<tr>
<td>5 Linear 0 - 5 V</td>
<td></td>
</tr>
<tr>
<td>7 Linear 4 - 20 mA</td>
<td></td>
</tr>
<tr>
<td>2nd Analog input:</td>
<td></td>
</tr>
<tr>
<td>0 None</td>
<td></td>
</tr>
<tr>
<td>1 Relay</td>
<td></td>
</tr>
<tr>
<td>2 DC SSR</td>
<td></td>
</tr>
<tr>
<td>3 Linear 0 - 10 V</td>
<td></td>
</tr>
<tr>
<td>4 Linear 0 - 20 mA</td>
<td></td>
</tr>
<tr>
<td>5 Linear 0 - 5 V</td>
<td></td>
</tr>
<tr>
<td>7 Linear 4 - 20 mA</td>
<td></td>
</tr>
<tr>
<td>Options:</td>
<td></td>
</tr>
<tr>
<td>10 RS 485 interface</td>
<td></td>
</tr>
<tr>
<td>30 Alternating setpoint</td>
<td></td>
</tr>
<tr>
<td>02 Power supply 24 V AC/DC</td>
<td></td>
</tr>
<tr>
<td>12 RS 485 interface and power supply 24 V DC/AC</td>
<td></td>
</tr>
<tr>
<td>32 Alternating setpoint and power supply 24 V DC/AC</td>
<td></td>
</tr>
</tbody>
</table>

[Options diagram]
Digital Indicator

**Versatile and Visible**

Grado indicators are ideal if you wish to indicate temperature, pressure or other analog measuring values. They offer universal measuring inputs combined with low costs and excellent readability.

Enhanced flexibility is ensured by a multitude of different options.

A plug-type modular design allows customized use, i.e. costs depend on application-specific requirements. Grado can be operated and configured from the front panel or by means of the configuration software (via the standard socket at the PC).

**SPECIAL FEATURES**

- Large four-digit display, green or red, height: 13 mm
- Display elements protected behind the front panel (plug-type)
- CE conformity and UL approval
- Universal input for thermocouple, resistance thermometer and linear input (mA, mV or V)
- Adjustable measured value correction
- Adjustable digital filter
- Selectable input range/freely scaleable display range with selectable decimal point
- Measuring range can be calibrated
- High resolution (at least four times better than display range, 14-bit)
- Monitoring of measuring input
- Selectable operating access
- Display and storage of the max. and min. readings
- Optional output for transmitter supply (24 V nominal)
- 3 alarm values with adjustable and configurable functions; adjustable hysteresis
- 1 relay output (standard), e.g. selectable as latching alarm output with time elapsed features
- Optional external reset of latched alarm
- Optional outputs 2 and 3, selectable as relay or output 2 (linear output mA or V (10-bit) with scaleable starting and final value).
- Serial interface, optional RS 485 with ASCII and MODbus protocol
- Universal power supply 90–264 V AC (also a 24 V AC/DC version)
- IP 65/NEMA 4 rated front panel
- Connections by means of terminal screws

**DISPLAY**

- Up and Down keys for value adjustment
- Function switch for selection of displayed parameter
- Alarm status indicators
## Technical data

### Dimensions

**Case size (WxHxD)**
- 96 mm x 48 mm x 100 mm

**Panel cutout (WxH)**
- 45 mm x 92 mm

### Mounting

- with clamping frame

### Electrical connection

- terminal screws

### Ambient temperature

- operating: 0 °C to 50 °C, storage: -20 °C to 80 °C

### Data retention

- > 10 years with EEPROM

### Accuracy

- ± 0.25 %, ± 1 LSD

### Measuring rate

- 4 per second

### Display

- Four Digit display, 13 mm Height, red or green

### Alarm function

- 2 Software alarms (standard), selectable as Process alarm high or low
- Alarms can be allocated to output 2 and/or 3

### Digital interface

- RS 485, 2 – wire, Baud rate 9600, 4800, 2400, 1200, ModBus or ASCII protocol

### Supply voltage

- 90 – 264 V AC 50/60 Hz (standard)
- 20 – 50 V AC or 22 – 65 V DC (option)

### Power consumption

- 4 watts approximately

### Thermocouple

- J + L: 0.0 – 205.4 °C, 0 – 450 °C, 0 – 760 °C
- K: -200 – 760 °C, -200 – 1373 °C
- R + S: 0 – 1650 °C
- T: -200 – 262 °C, 0.0 – 260.6 °C
- B: 100 – 1824 °C
- N: 0 – 1399 °C

### RTD

- Pt 100: 0 – 300 °C, 0 – 800 °C, 200 – 206 °C, 0.0 – 100.9 °C, 100.9 – 100.0 °C, 100.9 – 537.3 °C

### Linear DC

- 0-20 mA, 4-20 mA, 0-50 mV, 10-50 mV, 0-5 V, 1-5 V, 0-10 V, 2-10 V
- decimal point selection, free scaleable in the range –1999 to 9999
- External reset by voltage free contact or TTL logic signal

### Output 1

- Relay: 2A resistive at 120/240 V AC
- contact single pole double throw
- Latched function selectable

### Output 2

- Relay: 2A resistive at 120/240 V AC
- contact single pole double throw

### Output 3

- Relay: 2A resistive at 120/240 V AC
- contact single pole double throw
- Logic: > 4.2 V DC for SSR

### Output 4

- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V
- Relay: 2A resistive at 120/240 V AC
- contact single pole double throw

### Control function

- not available

### Tuning

- not available

### Set-up / configuration

- from front keys or via configuration socket from PC

---

**TECHNICAL DATA**

**General**

- Input and ranges
- Auxiliary inputs
  - Output 1
  - Output 2
  - Output 3
  - Output 4
- Control Performance

**ENCODERS COUNTERS**

**CONTROLLERS**

**INDICATORS RELAYS PRINTERS CUTTERS**
**Technical data**

**DIMENSIONS**

![Dimensions in mm](image)

**CONNECTION DIAGRAM**

Type 918

![Connection Diagram](image)

**ORDERING CODE**

Type grado 918

<table>
<thead>
<tr>
<th>Options</th>
<th>0918-Z</th>
<th>1</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>0</td>
<td>Pt 100 linear mV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Thermocouple</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Linear (mA)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Linear (V)</td>
<td></td>
</tr>
<tr>
<td>Output 1</td>
<td>0</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Relay</td>
<td></td>
</tr>
<tr>
<td>Output 2</td>
<td>0</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Relay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Ext. transmitter power supply</td>
<td></td>
</tr>
<tr>
<td>Output 3</td>
<td>0</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Relay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Linear 4 - 20 mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Linear 0 - 20 mA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Linear 0 - 5 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Linear 0 - 10 V</td>
<td></td>
</tr>
<tr>
<td>Options</td>
<td>10 RS 485 interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>02 Power supply 22-50 V DC/AC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 RS 485 and 24 V DC/AC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30 External (remote) reset and 24 V DC/AC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LED colors**

- 0 Red LEDs
- 1 Green LEDs

**Transmitter power supply**

- N/C C N/O

**Relay**

- OUTPUT 1
- OUTPUT 2
- OUTPUT 3
The digital temperature controller grado 932 exhibits all essential features and advantages of our grado family. Due to its versatility it can also be used as an indicator. The universal power supply allows direct connection to line voltage in the range of 90-264 V AC, 50/60 Hz.

### SPECIAL FEATURES

- Controller format DIN 48 x 24 mm
- Large, easy-to-read four-digit display, red or green, available as two-point controllers
- Easy adjustment of the PID control parameters by means of automatic parameter setting (easy-tune operation)
- Adjustable offset for the correction of measured values
- Universal input for thermocouples, Pt100, current (mA) and voltage (mV). Linear input with freely scalable display range and selectable decimal point
- Easy operation via 3 keys
- Inputs calibrated according to BS 4937, BS 1904, NBS 125, DIN 43760, IEC 584
- 2 setpoints
- 3 outputs are available
- Alarms: (process high alarm, process low alarm, deviation, band alarm)
- Optional: RS 485 interface (2-wire) with MODBUS-RTU protocol
- Optional: 24 V AC 50/60 Hz or 12-30 V DC
- CE, UL and IP 65 (front side)
### Technical data

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Case size (WxHxD)</th>
<th>Panel cutout (WxH)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>932</strong></td>
<td>25 mm x 49 mm x 100 mm</td>
<td>22 mm x 45 mm</td>
</tr>
</tbody>
</table>

- **Mounting**: with clamping frame
- **Electrical connection**: terminal screws
- **Ambient temperature**: operating 0 °C to 50 °C, storage −20 °C to 80 °C
- **Data retention**: > 10 years with EEPROM
- **Accuracy**: ± 0.25 %, ± 1 LSD
- **Measuring rate**: 4 per second
- **Display**: Four Digit display, 10 mm Height, red or green
- **Alarm function**: max 2 alarms, selectable as Process alarm high or low, band alarm, deviation alarm
- **Digital interface**: RS 485, 2 – wire, Baud rate 9600, 4800, 2400, 1200, ModBus protocol
- **Supply voltage**: 90 – 264 V AC 50/60 Hz (standard)
- **Power consumption**: 4 watts approximately
- **Thermocouple**: J: - 128.0 – 537.0 °C, -200 – 1200 °C
  - K: - 128.0 – 537.0 °C, -240 – 1371 °C
  - R + S: 0 – 1770 °C
  - T: - 128.0 – 400.6 °C, -240 – 401 °C
  - B: 100 – 1824 °C
  - N: 0 – 1399 °C
- **RTD**: Pt 100: -199 °C – 802 °C
  - -127.9 – 573.0 °C
- **Linear DC**: 0–20 mA, 4–20 mA, 0–50 mV, 10 – 50 mV decimal point selection, free scaleable in the range –1999 to 9999
- **Alarm or Logic**: > 10 V DC for SSR
- **Control 1 (e.g. heat)**: 2A resistive at 120/240 V AC, contact single pole double throw
- **Control 1 (e.g. cool)**: 2A resistive at 120/240 V AC, contact single pole double throw (if digital interface is fitted then contact single pole single throw)
- **Control 2 output**: Not available
- **Control function**: ON/OFF, PID two point (heat)
- **Tuning**: Manual, pre-tune, easy-tune
- **Set-up / configuration**: from front keys
**Technical data**

**DIMENSIONS**

- Dimensions in mm

**CONNECTION DIAGRAM**

*Type 932*

- Resistance thermometer (Pt100)
- Thermocouple and DC (mV)
- DC (mA)
- RS 485 serial interface
- Relay

Output 1: SSR drive output
Output 2a: Relay
Output 2b: SSR drive output
Output 3

**Note**
1. If the DC (mA) input is used, terminals 2 and 4 must be linked.
2. Output 2a is only available if output 3 is not configured.

**ORDERING CODE**

**Display and supply voltage**
- 0 Green display
- 1 Red display
- 2 Green display
- 3 Red display

**Line voltage**
- 230 V AC
- 230 V AC
- Electrical supply 24 V AC/DC
- Electrical supply 24 V AC/DC

**Manual**
- 0 None
- 1 Operating and installation instructions (3 languages)
- 2 Operating instructions (3 languages)

**Control output and alarm output 1**
- 00 Undefined (indicator)
- 12 Control output: Relay
- 21 Control output: SSR drive output
- 00 Alarm output 1: SSR drive output
- 12 Alarm output 1: Relay

**Universal input**
- Input: Thermocouple
- Input: Pt 100
- Input: DC linear voltage or current

**Type 0932 (48 mm x 24 mm)**

**Option**
- 0 None
- 1 Alarm output 2: relay
- 2 RS 485 interface Modbus protocol
Setpoint Profile Controller  grado 964

The grado 964 is one of the most powerful profile controllers for its size available anywhere, offering unrivalled ease-of-use. In addition to a 4 program, 16 free-form segment profiling capability, it also features the proven RaPID (Response assisted PID) fuzzy based control algorithm, which provides faster and more accurate control, with simple set-up and use.

ADVANTAGES

- Process profile controller in DIN format 48 x 48 mm
- 4 programmes with 16 free-form segments
- PC programming
- For temperature and time control
- Excellent price-performance ratio
- RaPID fuzzy logic
- Time controlled event contact for outputs 2 or 3
- Profile cycling from 1-9999 and infinite cycles
- Programmable delayed start feature to max. 99 hours 59 minutes
- Time mode in hours/minutes or minutes/seconds for all programs
- External START/HOLD function
- Own locking code (for program and control parameters)

PROGRAM SOFTWARE
The PC software is installed under Windows. The connection from the PC to the process controller is made with a special RS232/485 adapter cable. The parameter values can be confirmed by clicking them or tipped in directly through the push buttons. It is possible to jump from the programme level to the configuration level. Both windows can remain open on screen to have a constant overview of the controller configuration.
## Technical data

### Dimensions

<table>
<thead>
<tr>
<th>Controller</th>
<th>Case size (WxHxD)</th>
<th>Panel cutout (WxH)</th>
</tr>
</thead>
<tbody>
<tr>
<td>964</td>
<td>48 mm x 48 mm x 110 mm</td>
<td>45 mm x 45 mm</td>
</tr>
</tbody>
</table>

### Mounting

- with clamping frame
- terminal screws

### Ambient temperature

- operating: 0 °C to 50 °C, storage: -20 °C to 80 °C

### Data retention

- > 10 years with EEPROM

### Accuracy

- ± 0.25 %, ± 1 LSD

### Measuring rate

- 4 per second

### Display

- Two-line, four-digit display
- Actual value = red, Setpoint = green

### Alarm function

- 2 Software alarms (standard), selectable as Process alarm high or low, band alarm, deviation alarm
- Alarms can be allocated to output 2 and/or 3 1 event alarm

### Digital interface

- RS 485, 2 – wire, Baud rate 9600, 4800, 2400, 1200, ModBus protocol

### Supply voltage

- 90 – 264 V AC 50/60 Hz (standard)
- 20 – 50 V AC or 22 – 65 V DC (option)

### Power consumption

- 4 watts approximately

### Thermocouple

- J + L: 0.0 – 205.4 °C, 0 – 450 °C, 0 – 760 °C
- K: - 200 – 760 °C, -200 – 1373 °C
- R + S: 0 – 1650 °C
- T: - 200 – 262 °C, 0.0 – 260.6 °C
- B: 100 – 1824 °C
- N: 0 – 1399 °C

### RTD

- Pt 100: 0 – 300 °C, 0 – 800 °C,
  - 200 – 206 °C, 0.0 – 100.9 °C,
  - 100.9 – 100.0 °C, -100.9 – 537.3 °C

### Linear DC

- 0–20 mA, 4–20 mA,
- 0–50 mV, 10–50 mV, 0–5 V, 1–5 V, 0–10 V
- decimal point selection, free scaleable in the range –1999 to 9999

### Control 1 (e.g. heat)

- Remote RUN/HOLD by voltage free contact or TTL logic signal
- Relay: 2A resistive at 120/240 V AC,
  - contact single pole double throw
- Logic: > 4.2 V DC for SSR
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V

### Alarm or Event or Relay: 2A resistive at 120/240 V AC,
- contact single pole double throw
- Logic: > 4.2 V DC for SSR
- Linear: 0 – 20 mA, 4 – 20 mA, 0 – 5 V, 0 – 10 V

### Control Performance

- ON/OFF, PID two point (heat), PID three point (heat/cool)
- Manual, pre-tune, RaPID
- from front keys or via configuration socket from PC
- 4

### Profile Performance

- 16, each segment can be programmed as RAMP or Dwell
- 1, can be set ON or OFF in each segment
Technical data

**DIMENSIONS**

Dimensions in mm

**CONNECTION DIAGRAM**

Type 964

**ORDERING CODE**

**Input**

1. Pt 100 linear mV
2. Thermocouple
3. linear mA
4. linear V

**Output 1**

1. Relay
2. DC for SSR
3. linear 0...10 V
4. linear 0...20 mA
5. linear 0...5 V
6. linear 4...20 mA
7. Triac

**Output 2**

1. Relay
2. DC for SSR
3. linear 0...10 V
4. linear 0...20 mA
5. linear 0...5 V
6. linear 4...20 mA

**Output 3**

0. not fitted
1. Relay
2. DC for SSR
3. linear 0...10 V
4. linear 0...20 mA
5. linear 0...5 V
6. linear 4...20 mA

**Options**

00 90...264 V 50/60 Hz
10 RS 485 interface
30 External input Run/Hold
02 line voltage 24 VAC/DC
12 RS 485 interface and line voltage 24 VDC/DC
32 External input Run/Hold and line voltage 24 VDC/DC

**Type 0 964**

(48 mm x 48 mm)

**Output 2**

0. not fitted
1. Relay
2. DC for SSR
3. linear 0...10 V
4. linear 0...20 mA
5. linear 0...5 V
6. linear 4...20 mA
8. Triac

**Output 3**

0. not fitted
1. Relay
3. linear 0...10 V
4. linear 0...20 mA
5. linear 0...5 V
7. linear 4...20 mA
Accessories

Solid state relays

Solid state relays (SSRs) are suitable for frequent switching of resistive loads (thermal loads). In order to achieve reliable and constant switching properties of the indicated load current, the relays must be fitted with appropriately dimensioned heat sinks. To protect them against short-circuits within the load circuit, they must be equipped with super-fast-blo fuses. Ordinary automatic fuses are totally unsuitable and much too slow to protect SSRs. Therefore, we strongly recommend that you use the fuses and fuse holders for C-rail mounting listed below.

Design:

All SSRs listed below are supplied complete with:
- Sufficiently dimensioned heat sink
- Snap-in mount for C-rail according to DIN EN 50022
- Touch protection according to VBG 4 and VDE 106 Part 100
- Varistor overvoltage protection

<table>
<thead>
<tr>
<th>Control voltage</th>
<th>Load voltage</th>
<th>Operating temperature range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 32 V DC</td>
<td>42 to 440 V - 45-65 Hz</td>
<td>0 to 50°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SSR relays up to 16 A</th>
<th>Dimensions</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>46 x 82 x 80 mm (width x height x depth)</td>
<td>RA4425-D08HK-RV04</td>
</tr>
<tr>
<td>Fuse holder</td>
<td>17.5 x 81 x 68 mm (width x height x depth)</td>
<td>ST10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>A070GRB016T13</td>
</tr>
<tr>
<td>RA4425-D08K3-RV04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SSR relays up to 25 A</th>
<th>Dimensions</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.3 x 38 mm</td>
<td>80 x 100 x 125 mm (width x height x depth)</td>
<td>RA4450-D08K3-RV04</td>
</tr>
<tr>
<td>Fuse holder</td>
<td>17.5 x 81 x 68 mm (width x height x depth)</td>
<td>ST10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>A070GRB016T13</td>
</tr>
<tr>
<td>RA4450-D08K3-RV04</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SSR relays up to 40 A</th>
<th>Dimensions</th>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.3 x 38 mm</td>
<td>80 x 100 x 125 mm (width x height x depth)</td>
<td>RA4450-D08K3-RV04</td>
</tr>
<tr>
<td>Fuse holder</td>
<td>35 x 85 x 129 mm (width x height x depth)</td>
<td>ST22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuse</th>
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</thead>
<tbody>
<tr>
<td>22 x 58 mm</td>
</tr>
<tr>
<td>6621CPURD22.58/50</td>
</tr>
</tbody>
</table>

The SCIA 485 interface converter can be used to connect one or more controllers with RS 485/RS 422 interface to a system with an RS 232 interface (e.g., PC, PLC, etc.). The required direction control is effected automatically.

<table>
<thead>
<tr>
<th>Bench case</th>
<th>Voltage supply</th>
<th>Line connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light-gray, approx. 95 x 45 x 160 cm (width x height x depth)</td>
<td>90 to 260 V, 50/60 Hz, max. 3 VA</td>
<td>Line power cord, approx. 1.4 m, with Euro-plug</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RS 232</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-pin D-sub socket</td>
</tr>
<tr>
<td>9-pin extension (to approx. 2 m)</td>
</tr>
<tr>
<td>9-pin adapter plug (for 25-pin socket)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RS 485/RS422</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-pin socket and matching plug with screw-type fitting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ordering code</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIA 485</td>
</tr>
</tbody>
</table>

INTERFACE CONVERTERS

Bench case Light-gray, approx. 95 x 45 x 160 cm (width x height x depth)

Voltage supply 90 to 260 V, 50/60 Hz, max. 3 VA

Line connection Line power cord, approx. 1.4 m, with Euro-plug

RS 232 9-pin D-sub socket
RS 232 9-pin extension (to approx. 2 m)
RS 232 9-pin adapter plug (for 25-pin socket)

RS 485/RS422 8-pin socket and matching plug with screw-type fitting

Ordering code SCIA 485
Accessories

BLIND PLATES

Blind plates are used to cover vacant panel cutouts or any cutouts that remain after inserting a smaller controller type into a given aperture.

Description:
The cover plate and spring-type clamps are made of black plastic. The spring-type clamps are pressed onto the adjusting pins in the cover plate.

<table>
<thead>
<tr>
<th>Order number</th>
<th>Dimensions</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>445-317</td>
<td>Front dimension 96 x 96 mm</td>
<td>Covers a cutout according to DIN 96 x 96 mm</td>
</tr>
<tr>
<td>445-177</td>
<td>Front dimension 48 x 96 mm</td>
<td>Covers a cutout according to DIN 48 x 96 mm or a remaining aperture after inserting a controller (DIN 48 x 96 mm) into a cutout of DIN 96 x 96 mm.</td>
</tr>
<tr>
<td>445-137</td>
<td>Front dimension 48 x 48 mm</td>
<td>Covers a cutout according to DIN 48 x 48 mm or a remaining aperture after inserting a controller (DIN 48 x 48 mm) into a cutout of DIN 48 x 96 mm.</td>
</tr>
</tbody>
</table>

AUXILIARY CONTROLLER BOARDS

Further technical information can be obtained from the ordering information of the requested controller type.

<table>
<thead>
<tr>
<th>Order number</th>
<th>Dimensions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 901 001</td>
<td>35 x 34 x 13 mm</td>
<td>Relay board</td>
</tr>
<tr>
<td>1 901 002</td>
<td>35 x 34 x 11 mm</td>
<td>Logic output board</td>
</tr>
<tr>
<td>1 901 003</td>
<td>35 x 34 x 11 mm</td>
<td>Linear output board</td>
</tr>
<tr>
<td>1 901 004</td>
<td>37 x 20 x 19 mm</td>
<td>RS 485 interface board</td>
</tr>
<tr>
<td>1 901 005</td>
<td>37 x 20 x 19 mm</td>
<td>Board for digital input</td>
</tr>
<tr>
<td>1 901 007</td>
<td>35 x 34 x 13 mm</td>
<td>Dual relay board (for grado 906, 916)</td>
</tr>
<tr>
<td>1 901 008</td>
<td>35 x 34 x 11 mm</td>
<td>Transmitter power supply (for grado 918)</td>
</tr>
</tbody>
</table>

CURRENT TRANSFORMERS

Current transformers are to be connected directly to grado type 906 controllers.

Single-phase current transformers

<table>
<thead>
<tr>
<th>Order number</th>
<th>Dimensions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M9610A25</td>
<td>37 x 50 x 20 mm</td>
<td>Current transformer 25 A, also available for DIN-rail mounting</td>
</tr>
<tr>
<td>M9610A50</td>
<td>37 x 50 x 20 mm</td>
<td>Current transformer 50 A, also available for DIN-rail mounting</td>
</tr>
<tr>
<td>M9610A100</td>
<td>37 x 50 x 20 mm</td>
<td>Current transformer 100 A, also available for DIN-rail mounting</td>
</tr>
<tr>
<td>1 901 009</td>
<td>70 x 22 x 10 mm</td>
<td>DIN-rail mounting</td>
</tr>
</tbody>
</table>

Three-phase current transformers

<table>
<thead>
<tr>
<th>Order number</th>
<th>Dimensions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 901 210</td>
<td>140 x 80 x 95 mm</td>
<td>Three-phase current transformer 25 A</td>
</tr>
<tr>
<td>1 901 211</td>
<td>140 x 80 x 95 mm</td>
<td>Three-phase current transformer 50 A</td>
</tr>
<tr>
<td>1 901 212</td>
<td>140 x 80 x 95 mm</td>
<td>Three-phase current transformer 100 A</td>
</tr>
</tbody>
</table>

CONFIGURATOR SOFTWARE

<table>
<thead>
<tr>
<th>Order number</th>
<th>Dimensions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M9997A05016</td>
<td></td>
<td>Configurator software grado</td>
</tr>
</tbody>
</table>
Glossary

Accuracy

The controllers have a measuring accuracy of 0.25% (always related to the span of the measuring range).

→ Input span

Actual value

Display of the measured signal after digital filtering and offset. This displayed actual value rules all related parameters, e.g. PID parameters, alarm parameters, etc.

Actual value – offset

→ see Offset

Alarm hysteresis

The smallest adjustable hysteresis is one digit

Alarm status

Reporting of alarm statuses during normal operation

Alarms

→ see process alarm, band alarm, deviation alarm

Analog interface

If output 3 is a linear output, it can be allocated an actual value or setpoint. This signal can then be processed by other systems (e.g. PC, recorder, etc.).

Automatic mode

→ see modes of operation

Band alarm

Dependent on the setpoint value. Becomes active if the process variable exceeds the set value plus alarm value, or if the process variable is less than the setpoint minus alarm value. Can be configured as an ON or OFF function in the event of an alarm.

Cold junction compensation

Only effective for a thermocouple input. The values indicated in the thermoelectric power tables always refer to a reference point temperature of 0°C. Being connected to the controller input either directly or via the compensating cable, the thermocouples form the cold junction which can assume temperatures between 0 °C and 50 °C. By measuring these temperatures with a sensor inside the controller it is now possible to perform a cold junction compensation by means of the software.

Compensating cable

Extension cable for thermocouple connections, consisting of a material that exhibits the same properties as the thermocouple up to a temperature of 200 °C. Compensating cables are less expensive than comparable thermocouple cables.

Configuration

Hardware adjustments and parameter settings for the desired application

Continuous-action controller

The control output of the linear controller is a current or voltage signal that can assume any value between 0 - 100 %.

Continuous-action output

Also described as analog or linear output. Current or voltage output which can assume any value between 0 - 100 %.

Control

The control function is used to monitor the production process as compared to a predefined value (setpoint value) and to automatically eliminate any deviations or malfunctions.

Control loop

Controllers can only fulfill their tasks in a closed control loop. The sensor acquires the process temperature and transmits it to the controller input. The controller compares this actual value to the adjusted setpoint value and, by means of the adjusted PID-parameters, calculates the control variable. This control variable determines the power supplied to the process via an actuator. The process response is recorded by the sensor and the control loop is thus closed.

Control loop alarm

Special alarm which detects errors in the control loop by continuously checking the influence of the actual value on signal changes at the outputs. The loop alarm time is twice the value of the integral time constant (for PID control), or is set as a parameter value (for ON/OFF control).
Controller

Instrument which compares an input signal (actual value) to a predefined setting (setpoint value) and adjusts the control output (control variable) after performing a calculation (PID algorithm).

Dead band

→ see overlap

Definition code

Reports the controller hardware to the controller processor. In the event of changes to the hardware or type of input, this code must be adjusted correctly in the configuration software.

Deviation alarm

This alarm is dependent on the setpoint value and becomes active if the alarm value has been exceeded (positive prefix) or fallen below (negative prefix). It can be configured as an ON or OFF function in the event of an alarm.

Differential time

→ see PID controller

Digital interface

Bus-compatible RS485 interface. A simple ASCII protocol allows reading and/or writing all control parameters.

Dual setpoint

This option allows setting two setpoints and to change over between these values externally by means of a potential-isolated contact.

Dual setpoint

This option allows the setting of two setpoints values and then can be selected by an external potential free contact.

External setpoint

The external setpoint is a current signal or voltage signal which is externally transmitted to the controller. Changeover between internal or external setpoint is possible.

Filter

Digital filter for the suppression of interference pulses and/or for smoothing the measuring signal.

Initial setting

Factory-adjusted parameters or settings adjusted after a change in the controller configuration or after strong impact of disturbances.

Input

→ see measuring input

Input code

Four-digit code for selecting the desired measuring range.
Entry via the configuration menu.

Input filter

→ see filter

Input offset

→ see offset

Input span

Span extending from the lowest to the highest input value.
Example:
Input span for Ni-CrNi thermocouple (measuring range from -200 °C to +1373 °C) = 1573 K.
This value rules the accuracy and proportional band parameters.

Input type

Four different input types are available for configuration:
Thermocouples
Resistance thermometer Pt 100 (or mV signal)
Measuring transmitter with voltage output
Measuring transmitter with current output

Integral time

→ see PID controller

Linearization

Thermocouple sensor signals or resistance thermometer signals are non-linear to "temperature values; therefore the controller software includes a linearization" function.
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Locking</strong></td>
<td>The parameter setting environment [menu] is protected against unauthorized access by means of a four-digit, variable code number.</td>
</tr>
<tr>
<td><strong>Manual parameter setting</strong></td>
<td>Control parameters (PID and others) are figured out and adjusted by the user.</td>
</tr>
<tr>
<td><strong>Measuring input</strong></td>
<td>Terminals for the measuring input</td>
</tr>
<tr>
<td><strong>Measuring signal</strong></td>
<td>Sensor signal connected to the measuring input</td>
</tr>
</tbody>
</table>
| **Modes of operation**        | *Manual operation: The control loop is opened; the user selects the output* power manually by means of the arrow keys.  
                                           *Automatic operation: The control loop is closed; the output power is* calculated by the controller. |
| **Normal mode of operation**  | → see modes of operation                                                                                                                  |
| **Offset**                    | Offset of the displayed reading vs. actual reading. Displayed reading = actual reading + input offset                                       |
| **ON/OFF Controller**         | Switches off when the setpoint value is exceeded and switches ON again when the setpoint value has been fallen below.  
                                           *Adjustable ON- OFF hysteresis. Fluctuations of the actual value in the range of* the setpoint value are normal and function-dependent. |
| **Operating elements**        | Front panel keys for selecting functions and adjusting parameter values.                                                                      |
| **Operating strategy**        | Determines the type of information and adjusting options available to the user during normal operation.                                      |
| **Optional boards**           | Small boards (or modules) by means of which the controller hardware can be upgraded or converted within its technical specification           |
| **Output**                    | One distinguishes between the output function (control output, alarm output) and output type (relay contacts, SSR control, continuous current/voltage, etc.) |
| **Output power**              | The output signal calculated by the controller is the output power variable. It can assume values in the range of 0 –to +100 % (two-point controllers) or -100 to +100 % (three point controllers).  
                                           The value of the control variable currently returned by the continuous-action or quasi-continuous-action controller is the output power in %.  
                                           The max. value of the control variable can be set by means of the output power limit parameter. |
| **Output power limit**        | → see output power                                                                                                                          |
| **Overlap**                   | This parameter can be used to influence the transition of the control outputs of a three-point controller (heating/cooling). Positive values lead to overlapping, which means, heating is still ON and cooling starts at the same time.  
                                           Negative values result in a dead band zone, which means that the heating process is stopped and a "dead band zone" follows before cooling is started. |
<p>| <strong>Parameter setting</strong>         | Parameters are set in a protected parameter software menu (protection by means of code number) in order to adapt the controller to its specific control application. |
| <strong>PID controller</strong>            | Controller which enables wide-scale adjustment of the control parameters proportional band (P), integral time (I) and differential time (D). The PID control algorithm is suitable for a multitude of processes. |
| <strong>Pre-tune</strong>                  | Determines and adjusts the control parameters (PID)                                                                                         |</p>
<table>
<thead>
<tr>
<th><strong>Glossary</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process alarm</strong></td>
</tr>
<tr>
<td>This alarm is independent of the setpoint value and adjustable within the entire input span. It can be configured for deviation high alarm or deviation low alarm and can also be configured to include an ON or OFF function in the event of an alarm.</td>
</tr>
<tr>
<td><strong>Product code</strong></td>
</tr>
<tr>
<td>Composed of the model description and Z-number. The model description defines the instrument size and function, e.g. grado 911 industrial controller in an 48 x 96 DIN case (the Z-number defines the hardware version), e.g. Z1234/10 input Pt 100, output 1 SSR, output 2 0-10 V output 3 0-20 mA, interface RS 485</td>
</tr>
<tr>
<td><strong>Programming operation</strong></td>
</tr>
<tr>
<td>→ see parameter setting</td>
</tr>
<tr>
<td><strong>Proportional band</strong></td>
</tr>
<tr>
<td>→ see PID controller</td>
</tr>
<tr>
<td><strong>Proportional time</strong></td>
</tr>
<tr>
<td>Time required by an active output for one switching-On and one switching-Off cycle</td>
</tr>
<tr>
<td><strong>Ramp function</strong></td>
</tr>
<tr>
<td>This function can be activated in order to prevent temperature shocks. The ramp rate is an adjustable value per hour (°C/h). The setpoint value changes internally at the adjusted ramp rate.</td>
</tr>
<tr>
<td><strong>Scaling</strong></td>
</tr>
<tr>
<td>Adapts the display of controllers with standard signal input to the actual physical magnitude by means of a starting value, end value and decimal point parameters.</td>
</tr>
<tr>
<td><strong>Self-tuning</strong></td>
</tr>
<tr>
<td>The control parameters (PID) are monitored by the self-tuning function and readjusted as necessary.</td>
</tr>
<tr>
<td><strong>Setpoint</strong></td>
</tr>
<tr>
<td>This is the parameter to which the application process should be controlled</td>
</tr>
<tr>
<td><strong>Setpoint limits</strong></td>
</tr>
<tr>
<td>This parameters limits the range of setpoint adjustments in normal user operation</td>
</tr>
<tr>
<td><strong>Three point controller</strong></td>
</tr>
<tr>
<td>The controller has two control outputs and can have three conditions e.g. Heat - OFF - Cool</td>
</tr>
<tr>
<td><strong>Two point controller</strong></td>
</tr>
<tr>
<td>The controller has one control output and can have two conditions e.g. Heat - OFF</td>
</tr>
</tbody>
</table>
Sales International: Controllers

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tel. kom. 02 060 728 557

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28028 Madrid
Tel. (91) 658 8800
Fax (91) 651 0939
<table>
<thead>
<tr>
<th>Area</th>
<th>Counters / Encoders</th>
<th>Printers</th>
<th>Controllers</th>
</tr>
</thead>
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<td>K 02</td>
<td>W. Weser GmbH</td>
<td>W. Weser GmbH</td>
<td></td>
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<tr>
<td></td>
<td>Hartstr. 104</td>
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<td>W. Weser GmbH</td>
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<td>82110 Gemering</td>
<td>82110 Gemering</td>
<td>Hartstr. 104</td>
</tr>
<tr>
<td></td>
<td>Tel. (089) 84 22 97</td>
<td>Tel. (089) 84 22 97</td>
<td>82110 Gemering</td>
</tr>
<tr>
<td></td>
<td>Fax (089) 8 41 23 31</td>
<td>Fax (089) 8 41 23 31</td>
<td>Tel. (089) 84 22 97</td>
</tr>
<tr>
<td></td>
<td>Mail: <a href="mailto:WweserGmbH@t-online.de">WweserGmbH@t-online.de</a></td>
<td>Mail: <a href="mailto:WweserGmbH@t-online.de">WweserGmbH@t-online.de</a></td>
<td>Fax (089) 8 41 23 31</td>
</tr>
<tr>
<td>K 05</td>
<td>Huber GmbH + Co</td>
<td>Hengstler GmbH</td>
<td>Heiden Elektronik GmbH</td>
</tr>
<tr>
<td></td>
<td>Am Heilbrunnen 115</td>
<td>Peter König</td>
<td>Lichtensteinweg 3</td>
</tr>
<tr>
<td></td>
<td>72766 Reutlingen</td>
<td>Postfach 1151</td>
<td>73268 Erkenbrechtsweiler</td>
</tr>
<tr>
<td></td>
<td>Tel. (07121) 14 83-0</td>
<td>Tel. (07424) 89 571</td>
<td>Tel. (07026) 22 11</td>
</tr>
<tr>
<td></td>
<td>Fax (07121) 14 83 20</td>
<td>Fax (07424) 89 210</td>
<td>Fax (07026) 44 99</td>
</tr>
<tr>
<td></td>
<td>Mail: <a href="mailto:Huber@acco.net">Huber@acco.net</a></td>
<td>Mail: <a href="mailto:peterkoeing@hengstler.de">peterkoeing@hengstler.de</a></td>
<td>Mail: <a href="mailto:Heiden_Elektronik_GmbH@t-online.de">Heiden_Elektronik_GmbH@t-online.de</a></td>
</tr>
<tr>
<td>K 06</td>
<td>IBH Elektrotechnik GmbH</td>
<td>IBH Elektrotechnik GmbH</td>
<td>OPTRON</td>
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<tr>
<td></td>
<td>Gutenbergring 35</td>
<td>Gutenbergring 35</td>
<td>Meßtechnik GmbH</td>
</tr>
<tr>
<td></td>
<td>22848 Norderstedt</td>
<td>22848 Norderstedt</td>
<td>Steinriede 12</td>
</tr>
<tr>
<td></td>
<td>Tel. (040) 52 30 52 22</td>
<td>Tel. (040) 52 30 52 22</td>
<td>30827 Garbsen</td>
</tr>
<tr>
<td></td>
<td>Fax (040) 5 23 97 09</td>
<td>Fax (040) 5 23 97 09</td>
<td>Tel. (05131) 70 83-0</td>
</tr>
<tr>
<td></td>
<td>Mail: <a href="mailto:Info@IBH-Elektrotechnik.de">Info@IBH-Elektrotechnik.de</a></td>
<td>Mail: <a href="mailto:Info@IBH-Elektrotechnik.de">Info@IBH-Elektrotechnik.de</a></td>
<td>Fax (05131) 70 83-25</td>
</tr>
<tr>
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