INSTRUCTION MANUAL

Temperature Controller N1040

Description

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INSTRUCTION MANUAL

Foreword

Dear customer,

We thank you for having purchased the Controller N1040 and we are very glad that you decided a product of **B+B Thermo-Technik GmbH**. We hope this product will fully satisfy you and will assist you effectively in your work.

This Device has been developed to be technically highly up-to-date and has been designed in accordance with the regnant European and German national directives and rules. For a proper and effective usage of the product the customer shall observe the following Operating Instructions. In the case that against one's expectations any trouble occurs which you can not resolve yourself, please contact our service centers or our authorized dealer. We will provide you rapid and competent help to minimize the risk of long time outfalls.

The following operating Instruction is an indispensable part of this Product. It contains important advices for the starting up and further use of the device.

General Information

This Operation Manual is intended to serve as an aid in the proper setup, installation and operating of the B+B product.

All essential details of the equipment and all actions required on the part are clearly presented and explained. We thus ask that you read this manual carefully before proceeding to work with the equipment. Keep this manual available for ready reference in a convenient and conspicuous location near the equipment.

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Content

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Symbols Employed

Sign	Meaning	Notice
	**Advice**	It is necessary to read the following advices before using the product. The used symbols in the manual acts first of all as eye catcher for security risks. The symbols do not replace the security advices. The text must be read completely.
	**Necessarily to observe**	This symbol designates important advices and tips which are necessary for the success of a procedure. They have to be followed in order to get good results.

Warning Signs

Warning Signs	Meaning
	This symbol advises the user of danger for persons, material or environment. The text gives information that must be necessarily followed to avoid any risks
	Caution against hot surfaces (BGV A8, GUV-V A8/W26) and hot liquids or substances
	Caution against liquids and hot substances
	Caution against dangerous explosive substances (BGV A8, GUV-V A8/W02)
	Caution against moving maschines (W29) Caution against moving parts
	Caution against electromagnetic fields (BGV A8, GUV-V A8/W12)
	Caution against severe cold (BGV A8, GUV-V A8/W17)
	Caution against dangerous high electrical voltage (BGV A8, GUV-V A8/W08)
	Caution against dangerous explosive atmosphere (BGV A8, GUV-V A8/W21)
	Electronic waste

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Safety Instructions

For damages caused by failure to observe these safety and operating instructions, takes over the B + B Thermo-Technik GmbH is not liable.

This device has been designed and tested in accordance to the safety regulations for electronic devices.
However, its trouble-free operation and reliability cannot be guaranteed unless the standard safety measures and special safety advises given in this manual will be adhered to when using it.

Trouble-free operation and reliability of the device can only be guaranteed if it is not subjected to any other climatic conditions than those stated under “Specification”.

If the device is transported from a cold to a warm environment condensation may result in a failure of the function. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.

If device is to be connected to other devices the circuitry has to be designed most carefully. Internal connection in third party devices (e.g. connection GND and earth) may result in not-permissible voltages impairing or destroying the device or another device connected.

Warning:

Only devices with mains input: If device is operated with a defective mains power supply (e.g. short circuit from mains voltage to output voltage) this may result in hazardous voltages at the device (e.g. at sensor socket)

If there is a risk whatsoever involved in running it, the device has to be switched off immediately and to be marked accordingly to avoid re-starting. Operator safety may be at risk if:

- there is visible damage to the device
- the device is not working as specified
- the device has been stored under unsuitable conditions for a longer time

In case of doubt, please return device to manufacturer for repair or maintenance.

Caution:

Do not use these product as safety or emergency stop devices, or in any other application where failure of the product could result in personal injury or material damage. Failure to comply with these instructions could result in death or serious injury and material damage.

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Intended Use

The use of the unit in fields other than those indicated under “SAFETY INSTRUCTIONS” is not allowed for safety reasons.

This instruction manual does not at all substitute any additional instruction manual of connected accessoriy!

Disposal

This unit has been marked in accordance with the European Device 2002/96/EC on waste electrical and electronic equipment (WEEE)
At the end of its operating life-time, dispose of the unit as electrical scrap.
Please ask either **B+B Thermo-Technik GmbH** or your specialist dealer for information on your local collection point.
Within the scope of application of this Directive, **B+B Thermo-Technik GmbH** is responsible for proper disposal of this unit.

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1. Product Description

The microprocessor based N1040 is conceived for low cost applications and yet achieving high degree of accuracy. It features a short depth enclosure of only 70 mm thus reducing panel space considerably. Another important innovation is the exclusive removable wiring connection block which translates into ease of use during installation process. It accepts Pt100 RTD´s and thermocouples types J, K and T and features two outputs for control and alarm, universal power supply and automatic tuning of the PID parameters. The N1040 is set to be the lowest cost temperature controller in the market while keeping high performance standards.

- Accepts thermocouples J, K, T and Pt100 RTD without any hardware change or recalibration
- Auto tuning PID
- Outputs: logic pulse (ideal for driving solid state relays) and 1 SPST relay
- The outputs are programmable for main control or alarm.
- Two alarm functions can be directed to one single output
- A very efficient universal switching power supply provides high accuracy conditions even during mains voltage fluctuations
- Safe output function allows the user to set control output conditions in case of sensor break or failure
- LBD (Loop Break Detection) function detects failures in the control loop
- Simplified programming menu makes operator programming very easy
- Indelible electronic serial number with 8 digits can be accessed from the display
- Keypad protection prevents unauthorized programming changes
- Silicone rubber frontal keypad
- Front panel protecion: IP65

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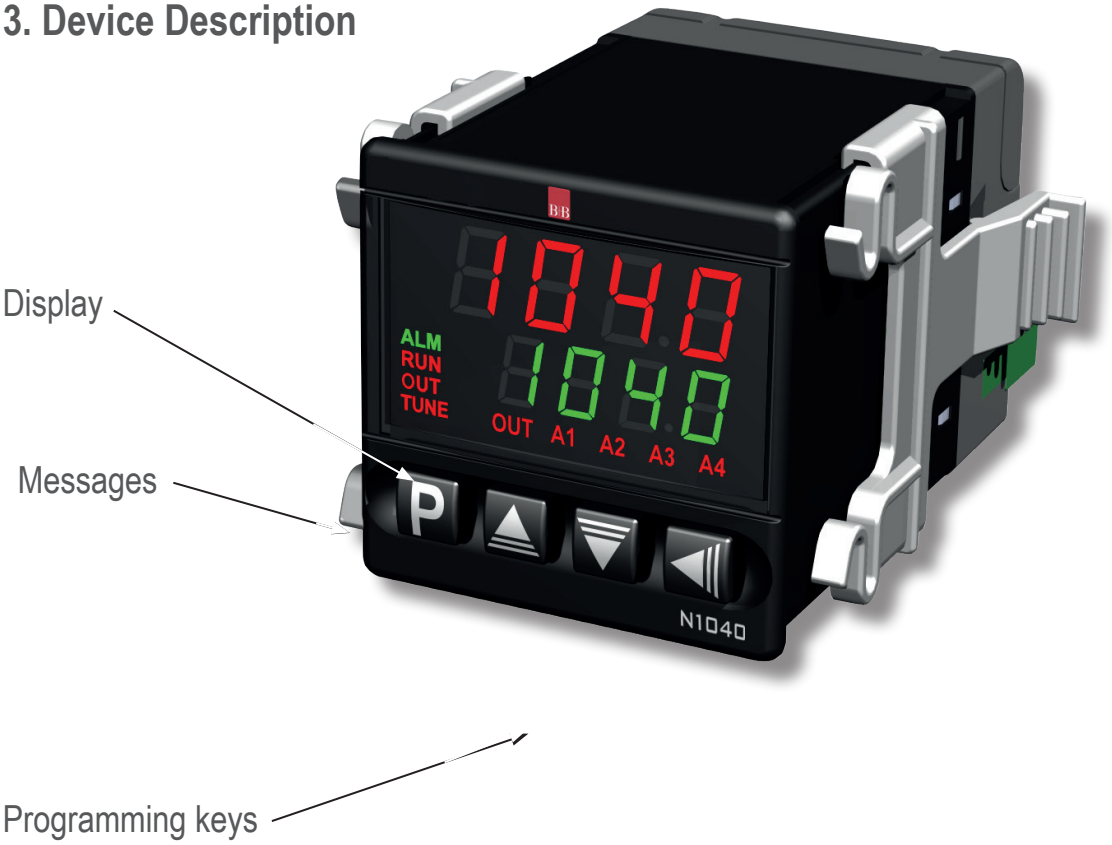
2. Scope of Delivery

Article Name	Article Number	Description
Temperature Controller N1040	0556 0112	1 x Controller N1040, 1 x User manual on CD

An identification label is on the side of the controller with wiring instructions. Check if the features described are in accordance with your order.

3. Device Description



3.1. DESCRIPTION OF THE BUTTONS ON THE FRONT OF THE INDICATOR

- P Program-key (P)
- Up-key
- Down-key
- Back-key

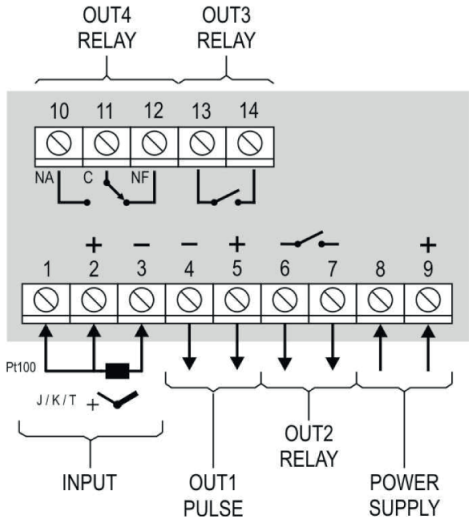
4. Installation / Connection

The controller must be fastened on a panel, following the sequence of steps described below:

- Prepare a panel cut-out 45,5 x 45,5 mm
- Remove the mounting clamps from the controller
- Insert the controller into the panel cut-out
- Slide the mounting clamp from the rear to a firm grip at the panel

4.1. Electrical connections

The features loaded in a particular unit are shown on its label:



4.2. Reccommendations for the installation

- All electrical connections are made to the screw terminals at the rear of the controller. They accept wire sizes from 0.5 to 1.5 mm^2 (16 to 22 AWG). The terminals should be tightened to a torque of 0.4 Nm (3.5 lb in).
- To minimize the pick-up of electrical noise, the low voltage DC connections and the sensor input wiring should be routed away from high-current power conductors. If this is impractical, use shielded cables. In general, keep cable lengths to a minimum.
- All electronic instruments must be powered by a clean mains supply, proper for instrumentation.
- It is strongly recommended to apply RC'S FILTERS (noise suppressor) to contactor coils, solenoids, etc.
- In any application it is essential to consider what can happen when any part of the system fails. The controller features by themselves can not assure total protection.

5. Features

5.1. Input type selection

Select the input type (in parameter tYPE) from Table below:

TYPE	CODE	RANGE OF MEASUREMENT
J	tcJ	Range: -110...+950°C (-166...+1742°F)
K	tcK	Range: -150...+1370°C (-238...+2498°F)
T	tcT	Range: -160...+400°C (-256...+752°F)
Pt100	Pt	Range: -200...+850°C (-328...+1562°F)

5.2. Outputs

The controller offers four output channels. The output channels are user configurable as Control Output, Alarm 1 Output, Alarm 2 Output, Alarm 1 or Alarm 2 Output and LBD (Loop Break Detect) Output.

OUT 1 - Logical pulse, 5V DC / 20 mA, available at terminals 4 and 5
OUT 2 - Relay SPST-NA, 3 A / 250V AC, available at terminals 6 and 7
OUT 3 - Relay SPST-NA, 3 A / 240V AC, available at terminals 13 and 14
OUT 4 - Relay SPDT, available at terminals 10, 11 and 12

Control output

The control strategy can be ON / OFF (when Pb = 0.0) or PID. The PID parameters can be automatically determined enabling the autotuning function (AtUn).

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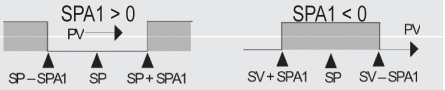
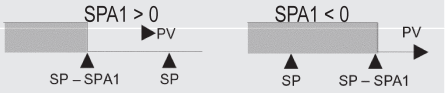
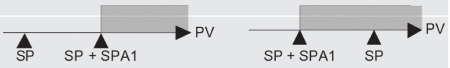
5.3. Table alarm output

Alarm	Function	Grafic
oFF	Alarm turned off	
Lo	Low Alarm: Triggers when the value of measured PV is below the value defined for alarm setpoint. (SPA 1 or SPA 2)	
HI	High Alarm: Triggers when the value of measured PV is above the value defined for alarm setpoint. (SPA 1 or SPA 2)	
dIF	Bandwidth Alarm: In this function the parameters SPA1 and SPA2 represent the deviation of PV in relation to the SP of control	
dIFL	Differential Low Alarm: Triggers when the value of measured PV is below the value defined for alarm setpoint.	
dIFh	Differential High Alarm: Triggers when the value of measured PV is above the value defined for alarm setpoint.	
IErr	Sensor break alarm. Activated when the input signal of PV is interrupted, out of the range or when Pt100 in short-circuit	

Note: Alarm functions on the table above are also valid for Alarm 2 (SPA2).

Initial Blocking of Alarm

The initial blocking option inhibits the alarm from being recognized if an alarm condition is present when the controller is first energized (or after a transition from run YES NO). The alarm will be enabled only after the occurrence of a non alarm condition followed by a new occurrence for the alarm.

The initial blocking is useful, for instance, when one of the alarms is configured as a minimum value alarm, causing the activation of the alarm soon upon the process start-up, an occurrence that may be undesirable.

The initial blocking is disabled for the sensor break alarm function.

Offset

Allows fine adjustments to the PV reading for compensation of sensor error.

LBD - LOOP BREAK Detection

The parameter defines a time interval, in minutes, within which the PV is expect to react to a control output signal. If the PV does not react properly within the time interval configured in Lbdt, the controller interprets this as a control loop break and signals this occurrence in the display.

A LBD event may be sent to any output channel. Simply configure the LDB function to the desired output channel (OUT1 or OUT2): the selected output will be activated when a LDB condition is detected. When the Lbd.t parameter is programmed with 0 (zero), the LDB function is disabled.

The LBD is useful in detecting system failures, such us defective sensors or actuators, loads and power supply, among others.

Safe Output value with Sensor Failure

This function defines an output value (user defined) to be assigned to the control output in the event of a sensor failure.

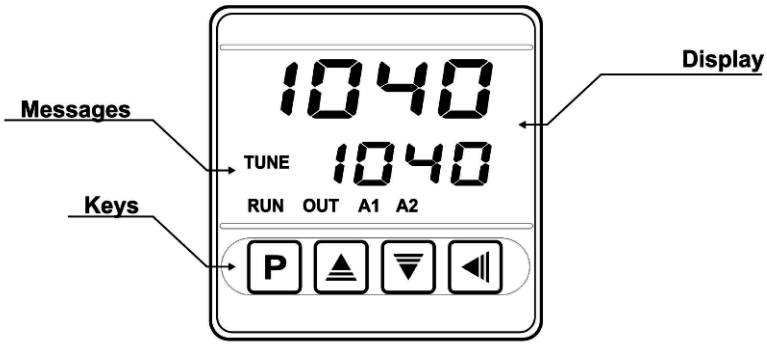
When the input sensor is identified as broken, the controller switches the control mode to MANUAL while forcing MV to assume the user configured value in the iEoU parameter. This function requires that one of the alarms be configured as iErr and the iEoU parameter (control output percentage) programmed with a value other then 0 (zero).

Once this function is triggered, the controller remains in SAFE mode (MANUAL control output) even after the sensor failure appears to be fixed. The operator intervention is required for switching back to AUTO mode.

iEoU values are only 0 and 100 % when in ON/OFF control mode. For PID control mode any value in the range from 0 to 100 % is accepted.

6. Operation

The controller´s front panel, with its parts, can be seen in the figure below.



Display of PV / Programming (top display, red color): Displays the current value of PV (Process Variable). When in configuration mode, it shows the parameters names.

Display of SP / Parameters (bottom display, green color): Displays the value of SP (Setpoint). When in configuration mode, it shows the parameters values.

TUNE Indicator: Stays ON while the controller is in tuning process.

OUT Indicator: For relay or pulse control output; it reflects the actual state of the output.

A1 and A2 Indicators: signalize the occurrence of alarm situation.

P Key: used to walk through the menu parameters.
Increment key and - Decrement key: allow altering the values of the parameters.
Back key: used to retrocede parameters.

6.1. Operation

When the controller is powered up, it displays its firmware version for 3 seconds, after which the controller starts normal operation. The value of PV and SP is then displayed and the outputs are enabled.

In order for the controller to operate properly in a process, its parameters need to be configured first, such that it can perform accordingly to the system requirements. The user must be aware of the importance of each parameter and for each one determine a valid condition.

The parameters are grouped in levels according to their functionality and operation easiness. The 5 levels of parameters are: 1 – Operation / 2 – Tuning / 3 – Alarms / 4 – Input / 5 – Calibration

The  key is used for accessing the parameters within a level.

Keeping the “P” key pressed, at every 2 seconds the controller jumps to the next level of parameters, showing the first parameter of each level:

PV >> AtUn >> FUA 1 >> tYPE >> PASS >> PV …

To enter a particular level, simply release the “P” key when the first parameter in that level is displayed. To walk through the parameters in a level, press the “P” key with short strokes. To go back to the previous parameter in a cycle, press :

Each parameter is displayed with its prompt in the upper display and value/condition in the lower display. Depending on the level of parameter protection adopted, the parameter PASS precedes the first parameter in the level where the protection becomes active. See section Configuration Protection.

7. Description of the Parameters

7.1. Operating Level

Parameter	Function
PV + SP	PV and SP indication – The upper display shows the current value of PV. The lower display shows the control SP value.
SPA1 SPA2	ALARM SETPOINT: Tripping point for alarm 1 and 2. Value that defines the point of activation for the programmed alarms with the functions Lo or hi. For the alarms configured with Differential type functions, this parameter defines deviation (band). Not used for the other alarm functions.

7.2. Tuning Level

Parameter	Function
AtUn	AUTO-TUNE: enables the auto-tuning function for the PID parameters (Pb, Ir, dt). Defines the control strategy to be taken: oFF - Turned off (no PID tuning) FASt - Fast automatic tuning FULL - More accurate automatic tuning Refer to the section DETERMINATION OF PID PARAMETERS for more details.
Pb	PROPORTIONAL BAND - Value of the term **P** of the control mode PID, in percentage of the maximum span of the input type. Adjust of between 0 and 500.0 %. When set to zero (0), control action is ON/OFF.
Ir	INTEGRAL RATE - Value of the term I of the PID algorithm, in repetitions per minute (Reset). Adjustable between 0 and 99.99. Displayed only if proportional band ≠ 0.
dt	DERIVATIVE TIME – Value of the term D of the control mode PID, in seconds. Adjustable between 0 an 300.0 seconds. Displayed only if proportional band ≠ 0.
ct	CYCLE TIME - Pulse Width Modulation (PWM) period in seconds. This term is not used when controller is set to ON/OFF action (Pb=0).
HySt	CONTROL HYSTERESIS - Is the hysteresis for ON/OFF control (set in temperature units). This parameter is only used when the controller is in ON/OFF mode (Pb=0).
Act	ACTION CONTROL: rE: Control with Reverse Action. Appropriate heating. Turns control output on when PV is below SP. d Ir: Control with Direct Action. Appropriate for cooling. Turns control output on when PV is above SP.
SFSt	Soft-Start Function: Time in seconds during which the controller limits the MV value progressively from 0 to 100 %. It is enabled at power-up or when the control output is activated. If in doubt, set SFSt = 0 (the zero value disables the Soft-Start function).,
oUt1 oUt2 oUt3 oUt4	Assign functions to the Output channels OUT1, OUT2, OUT3 and OUT4: oFF - Not used. ctrL - control output. A1 - alarm 1 output. A2 - alarm 2 output. A1A2 - Alarm 1 + Alarm2 (OR logic). Lbd - Loop Break Detect Alarm.

7.3. Alarm Level

Parameter	Function
FUA 1 FUA2	FUNCTIONS OF ALARMS. Defines the functions for the alarms among the options of the Table on page 12.
SPA 1 SPA2	ALARM SETPOINT: Tripping points for alarms 1 and 2. Value that defines the point of activation for the programmed alarms with the functions Lo or h 1. For the alarms configured with Differential type functions, this parameter defines deviation (band). Not used for the other alarm functions.
SP 1E SP2E	Configures display of SPA 1 and SPA2 also in the Operation Cycle. YES - SPA 1/SPA2 are displayed in the Operation Cycle no - SPA 1/SPA2 are not displayed in the Operation Cycle
bLA 1 bLA2	BLOCKING ALARMS: YES - enables initial blocking no - inhibits initial blocking
HYA 1 HYA2	ALARM HYSTERESIS. Defines the difference between the value of PV at which the alarm is triggered and the value at which it is turned off.
FLSh	Allows visual signalization of an alarm occurrence by flashing the indication of PV in the operation level. YES - enables alarm signaling flashing PV no - disables alarm signaling flashing PV

7.4. Input LevelL

Parameter	Function
tYPE	INPUT TYPE: Selects the input signal type to be connected to the process variable input. Refer to Table 01 for the available options.
FLtr	Digital Input Filter - Used to improve the stability of the measured signal (PV). Adjustable between 0 and 20. 0 (zero) means filter turned off and 20 means maximum filter. The higher the filter value, the slower is the response of the measured value.
dPPo	Selects the decimal point position to be viewed in both PV and SP.
Un it	Selects display indication for degrees Celsius or Fahrenheit: C - Indication in Celsius. F - Indication in Fahrenheit.
OFFS	SENSOR OFFSET: Offset value to be added to the PV reading to compensate sensor error. Default value: zero.
SPLL	Defines the SP lower limit.
SPhL	Defines the upper limit for adjustment of SP.
Lbdt	Time interval for the LBD function. Defines the maximum interval of time for the PV to react to a control command. In minutes.
iEoU	Percentage output value that will be transfered to MV when the SAFE output function is enabled. If iEoU = 0, the SAFE output function is disabled and the outputs are turned off in the occurrence of a sensor fail.

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7.5. Calibration Level

All of the input and output types are calibrated in the factory. If a recalibration is required, this should be carried out by a experienced personnel. If this cycle is accidentally accessed, pass through all the parameters without pressing the ▼ or ▲ keys.

Parameter	Function
PASS	Password. This parameter is presented before the protected cycles. See item Protection of Configuration.
cALb	Enables or disables instrument calibration by the user, YES: shows calibration parameters no: Hides the calibration parameters.
InLc	Input Low Calibration. Enter the value corresponding to the low scale signal applied to the analog input.
Inhc	Input High Calibration. Enter the value corresponding to the full scale signal applied to the analog input.
rStr	Restore. Restores the factory calibration for all inputs and outputs, disregarding modifications carried out by the user.
cJ	Cold Junction. This screen is for information purpose only..
PASc	Password Change. Allows defining a new access password, always different from zero.
Prot	Protection. Sets up the Level of Protection. See Table Parameter next page..
FrEQ	Mains frequency. This parameter is important for proper noise filtering.

8. Configuration Protection

The controller provides means for protecting the parameters configurations, not allowing modifications to the parameters values, avoiding tampering or improper manipulation. The parameter Protection (*Prot*), in the Calibration level, determines the protection strategy, limiting the access to particular levels, as shown by the Table below.

Protection Level	Protection Levels
1	Only the Calibration level is protected
2	Calibration and Input levels
3	Calibration, Input and Alarms levels
4	Calibration, Input, Alarms and Tuning levels
5	All levels are protected, but the SP screen in the operation level.
6	All levels are protected, including SP

8.1. Access Password

The protected levels, when accessed, request the user to provide the Access Password for granting permission to change the configuration of the parameters on these levels.

The prompt *PASS* precedes the parameters on the protected levels.
If no password is entered, the parameters of the protected levels can only be visualized.

The Access Password is defined by the user in the parameter Password Change (*PAS.c*), present in the Calibration Level. The factory default for the password code is 1111.

8.2. Protection Access Password

The protection system built into the controller blocks for 10 minutes the access to protected parameters after 5 consecutive frustrated attempts of guessing the correct password.

8.3. Master Password

The Master Password is intended for allowing the user to define a new password in the event of it being forgotten. The Master Password doesn't grant access to all parameters, only to the Password Change parameter (*PAS.c*). After defining the new password, the protected parameters may be accessed (and modified) using this new password.

The master password is made up by the last three digits of the serial number of the controller added to the number 9000.

As an example, for the equipment with serial number 07154321, the master password is 9 3 2 1.

Controller serial number is displayed by pressing ◀| for 3 seconds.

9. Determination of PID-Parameters

During the process of determining automatically the PID parameters,the system is controlled in ON/OFF in the programmed Setpoint. The auto-tuning process may take several minutes to be completed, depending on the system. The steps for executing the PID autotuning are:

- Select the process Setpoint.
- Enable auto-tuning at the parameter AtUn, selecting FASt or FULL.
-

The option FAST performs the tuning in the minimum possible time, while the option FULL gives priority to accuracy over the speed. The sign TUNE remains lit during the whole tuning phase. The user must wait for the tuning to be completed before using the controller.

During auto tuning period the controller will impose oscillations to the process. PV will oscillate around the programmed set point and controller output will switch on and off many times.

If the tuning does not result in a satisfactory control, refer to Table below for guidelines on how to correct the behavior of the process.

Parameter	Verified Problem	Solution
Band Proportional	Slow answer	Decrease
	Great oscillation	Increase
Rate Integration	Slow answer	Increase
	Great oscillation	Decrease
Derivative Time	Slow answer or instability	Decrease
	Great oscillation	Increase

10. Maintenance

10.1. PROBLEMS WITH THE CONTROLLER

Connection errors and inadequate programming are the most common errors found during the controller operation. A final revision may avoid loss of time and damages.
The controller displays some messages to help the user identify problems.

Message	Description of the Problem
----	Open input. No sensor or signal
Err 1 Err6	Connection and/or configuration errors. Check the wiring and the configuration.

Other error messages may indicate hardware problems requiring maintenance service. When contacting the manufacturer, inform the instrument serial number, obtained by pressing the key for more than 3 seconds.

10.2. CALIBRATION OF THE INPUT

All inputs are factory calibrated and a recalibration should only be done by qualified personnel. If you are not familiar with these procedures do not attempt to calibrate this instrument.

The calibration steps are:

1. Configure the type of input to be calibrated.
2. Configure the lower and upper limits of indication for the maximum span of the selected input type.
3. At the input terminals inject a signal corresponding to a known indication value a little above the lower display limit.
4. Access the parameter InLc. With the keys and adjust the display reading such as to match the applied signal. Then press the key
5. Inject a signal that corresponds to a value a little lower than the upper limit of indication.

Note: When checking the controller calibration with a Pt100 simulator, pay attention to the simulator minimum excitation current requirement, which may not be compatible with the 0.170 mA excitation current provided by the controller.

11. Technical data

Features	Values
Inputs	Thermocouples type J, K, T, Pt100 3-wire connection
Internal Resolution	32767 levels (15 bits)
Sample rate	up 55 per sec.
Output 1	Voltage pulse, 5V / 25 mA
Output 2	Relay SPST, 1.5 A / 240V AC
Output 3	Relay SPST, 1.5 A / 240V AC
Output 4	Relay SPDT 3 A / 240V AC
Operating temperature	0...+60°C
Measuring range	J -110...+950°C (-166...+1742°F)
	K -150...+1370°C (-238...+2498°F)
	T -160...+400°C (-256...+752°F)
	PT100 -200...+850°C (-328...+1562°F)
Accuracy	Thermocouples J, K, T and E: ±0,25% of the max. range ±1 °C
	Pt 100: ±0.2% of the max. range
Power Supply	100...240 V AC (± 10 %), 50/60 Hz or 24...300 V DC (± 10 %)
Ingress Protection	IP65 on the front panel
Dimensions (W x H x D)	48 x 48 x 80 mm
Weight	75 g
CE-conformance	2014/30/EU
Electromagnetic conductivity	EN 61326-1

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12. Order Information

Article No.	Description
0556 0112	Controller N1040

General Questions

If you still have questions concerning this product of B+B Thermo-Technik GmbH, please do not hesitate to contact us at:

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We wish you a successful measuring!

Your Temperature-Partner
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