N1030
TEMPERATURE CONTROLLER

USER GUIDE — V1.1x / V2.0x B

1. SAFETY ALERTS

The symbols below are used on the equipment and throughout this document to draw the user's attention to important operational and safety information.

		
CAUTION Read the manual fully before installing and operating the device.	**CAUTION OR HAZARD** Risk of electric shock.	**ATTENTION** Material sensitive to static charge. Check precautions before handling it.

All safety related instructions that appear in the manual must be observed to ensure personal safety and to prevent damage to either the instrument or the system. If the instrument is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

2. INSTALLATION / CONNECTIONS

The equipment should be fixed to a panel, following the sequence of steps below:

- Make a cutout in the panel according to SPECIFICATIONS.
- Remove the fixing clip.
- Insert the equipment into the cutout from the front of the panel.
- Replace the clip on the equipment, pressing until it is well fixed.

2.1 INSTALLATION RECOMMENDATIONS

- Input signal conductors should run through the plant separately from output and supply conductors. If possible, in grounded conduits.
- The power supply for electronic instruments must come from a network dedicated to the instrumentation.
- The use of RC FILTERS (noise suppressors) in contactor coils, solenoids, etc. is recommended.
- In control applications, it is essential to consider what can happen when any part of the system fails. The controller's internal devices do not provide full protection.

2.2 ELECTRICAL CONNECTIONS

The figure below shows the connections on the back panel of the controller:

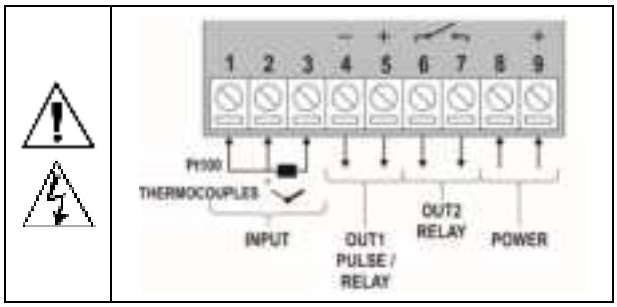


Figure 1

3. FEATURES

3.1 TEMPERATURE SENSOR (INPUT)

The temperature sensor or input type to be used by the controller is defined during equipment configuration. The table below shows the available options:

TYPE	CODE	MEASUREMENT RANGE
Thermocouple **J**	tc J	Range: -110 to 950 °C (-166 to 1742 °F)
Thermocouple **K**	tc K	Range: -150 to 1370 °C (-238 to 2498 °F)
Thermocouple **T**	tc t	Range: -160 to 400 °C (-256 to 752 °F)
Pt100	Pt	Range: -200 to 850 °C (-328 to 1562 °F)

Table 1

The input type should be the first parameter to be configured. Any modifications on the input type will automatically change other related parameters. When changing the sensor type, you should check the overall condition of the configuration.

3.2 OUTPUTS

The controller has 2 outputs. You can configure these outputs to operate as **Control Output (CtrL)** or **Alarm Output (AL1)**.

OUT1:

- **N1030-PR**: Output voltage pulse, 5 Vdc / 25 mA
- **N1030-RR**: Output Relay SPST-NO

OUT2:

- Output Relay SPST-NO

3.3 CONTROL OUTPUT (CtrL)

The process control output can operate in **ON/OFF** mode or in **PID** mode.

To operate in **ON/OFF** mode, the value set in parameter **Pb** must be 0.0.

When configuring the parameter **Pb** with values other than 0, the controller operates in **PID** mode. The values for the PID parameters can be set automatically with the help of Auto Tune (**AtUn**).

3.4 ALARM OUTPUT (AL1)

The controller has an alarm that can be directed to any of the outputs. When enabled, you can configure the alarm to operate with one of the functions described in the table below:

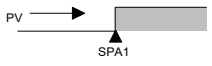
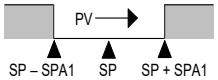
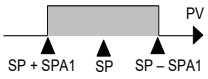
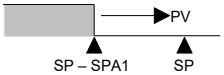
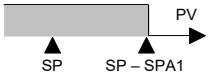
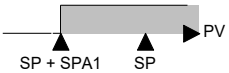
<table>
<tr><td>oFF</td><td colspan="2">Alarm off.</td></tr>
<tr><td>Lo</td><td>Alarm of absolute minimum value. It triggers when the value of measured PV is below the value defined for alarm Setpoint (SPA1).</td><td> 
</td></tr>
<tr><td>HI</td><td>Alarm of absolute maximum value. It triggers when the value of measured PV is above the value defined for alarm Setpoint (SPA1).</td><td> 
</td></tr>
<tr><td rowspan="3">dIF</td><td colspan="2">Differential alarm. In this function, SPA1 represents an error (difference) between control PV and SP.</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Positive SPA1</td><td>Negative SPA1</td></tr>
<tr><td rowspan="3">dIFL</td><td colspan="2">Alarm of minimum differential value. It triggers when the PV value is below the defined point by SP-SPA1.</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Positive SPA1</td><td>Negative SPA1</td></tr>
<tr><td rowspan="3">dIFH</td><td colspan="2">Alarm of maximum differential. It triggers when the PV value is above the defined point by SP+SPA1.</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Positive SPA1</td><td>Negative SPA1</td></tr>
<tr><td>IErr</td><td colspan="2">Open sensor alarm. It triggers when the input presents problems such as a broken sensor, poorly connected sensor etc.</td></tr>
</table>

Table 2

Important note: Alarms configured with the **HI**, **dIF**, and **dIFH** functions also trigger their associated output when the controller identifies and signals a sensor failure. A relay output, for example, configured to function as a Higher Alarm (**HI**), will operate when the SPA1 value is exceeded and when the sensor connected to the controller input is broken.

3.5 ALARM INITIAL BLOCKING

The **Initial Blocking** option inhibits the alarm from being triggered if an alarm condition exists when the controller is turned on. The alarm is triggered only after the process goes through a non-alarm condition.

The initial blocking is useful, for example, when one of the alarms is configured as a minimum value alarm, which can cause the alarm to be triggered as soon as the process is started (a behavior that is often undesired).

The initial block is not valid for the **tErr** function.

3.6 OFFSET

Function that allows you to make a small adjustment to the PV indication. Allows you to correct measurement errors that appear, for example, when replacing the temperature sensor.

4. OPERATION

The front panel of the controller can be seen in the figure below:

Figure 2

Display: Displays the measured variable, configuration parameter symbols and their respective values or conditions.

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

OUT Indicator: Signals the control output(s) status.

A1 and A2 Indicators: Signal the occurrence of an alarm condition.

[P] **Key**: Key used to advance the successive parameters and parameter cycles.

[▲] **Increment key and** [▼] **Decrement key**: Keys used to change parameter values.

[◀] **Back key**: Key used to move back parameters during configuration.

4.1 OPERATION

When turned on, the controller shows the software version for the first 3 seconds, then it shows the value of the measured process variable (PV) in the upper display. In the lower display, it shows the SP value. This is the **Indication Screen**.

To be used in a process, the controller must be previously configured. To configure it, each of the various parameters presented must be defined. You must understand the importance of each parameter and determine a valid condition or value.

The configuration parameters are gathered in affinity groups, called parameter cycles. The 3 parameter cycles are:

1 – Tuning / 2 – Input / 3 – Calibration

The [P] key gives access to the cycles and their parameters.

By keeping the [P] key pressed, every 2 seconds the controller jumps from one cycle to another, presenting the first parameter of each cycle:

PV >> AtUn >> tYPE >> PASS >> PV ...

To enter the desired cycle, simply release the [P] key when the first parameter is displayed. To move forward through the parameters of that cycle, use the [P] key. To go backwards through the parameters, use the [◀] key.

The symbol of each parameter is shown in the upper display. Its respective value/condition is shown in the lower display.

Depending on the configuration protection that you have adopted, the **PASS** parameter is shown as the first parameter of the cycle where the protection starts (see CONFIGURATION PROTECTION chapter).

5. PARAMETERS DESCRIPTION

5.1 INDICATION SCREEN

PV **SP**	**Temperature indication screen**. The upper (red) display shows the value of the measured variable (**PV**) temperature. The lower display (green) shows the control setpoint value (**SP**), which is the desired value for the process temperature.
SPA1	Alarm SP. Value that defines the alarm actuation point. For **Differential** functions, this parameter specifies error (*).

5.2 TUNING CYCLE

AtUn *Auto-tune*	**AUTO-TUNE**. Allows you to enable the automatic tuning of the PID parameters (**Pb**, **Ir**, **dt**). See PID PARAMETERS DEFINITION chapter. **oFF** Auto-tune off **FASt** Perform tuning in fast mode **FULL** Perform tuning in precise mode
Pb *Proportional Band*	Allows you to set the value of the term **P** of the control mode PID, in percentage of the maximum span of the input type. Adjustable between 0 and 500.0 %. **When set to zero (0), control action is ON/OFF.**
Ir *Integral Rate*	Allows you to set the value of the term **I** of the PID algorithm. In repetitions per minute (Reset). Adjustable between 0 and 24.00. Displayed only if proportional band ≠ 0.
dt *Derivative Time*	Allows you to set the value of the term **D** of the control mode PID. In seconds. Adjustable between 0 and 250 seconds. Displayed only if proportional band ≠ 0.
Ct *Cycle Time*	Pulse Width Modulation (PWM) period in seconds. Adjustable between 0.5 and 100.0 seconds. Displayed only if proportional band ≠ 0.
HYSt *Hysteresis*	Allows you to set the hysteresis value for ON/OFF control. In degrees. Adjustable between 0 and the measurement range width of the selected input type.
ACt *Action control*	Allows you to set the action control: **rE** Control with **Reverse Action**. Appropriate for **heating**. It 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.
Out1 *Output 1* **Out2** *Output 2*	Allows you to set the operation mode of OUT1 and OUT2 outputs: **oFF** Not used. **A1** Alarm output. **CtrL** Control output.

5.3 INPUT CYCLE

tYPE *Type*	Input type. Allows you to set the input type used by the controller. See TEMPERATURE SENSOR section.
dPPo *Decimal Point*	Decimal point. Allows you to define the display of the decimal point. When configuring the input (**tYPE**) with temperature sensors (J, K, Pt100, etc), in addition to the integer part of the measurement, the **dPPo** parameter will only display decimal values (XXX.X). When configuring the input (**tYPE**) with linear signals (mA, mV, V), the **dPPo** parameter determines the position of the decimal point of the measured value (XXXX, XXX.X, XX.XX, X.XXX).
unit *Unit*	Allows you to set the temperature unit to be used: **C** Indication in Celsius. **F** Indication in Fahrenheit.
OFFS *Offset*	Allows you to make corrections to the indicated PV value.
SPLL *SP Low Limit* **SPHL** *SP High Limit*	Allows you to set the lower/upper limits for adjustments to the control SP value. Does not limit the setting of the Alarm SP value.

FuA1 *Alarm functions*	Allows you to set the alarm functions. See ALARM OUTPUT section.
SPA1 *Alarm Setpoint*	Alarm SP. Allows you to set the alarm actuation point. For **Differential** type functions, this parameter defines the error (*).
bLA1 *Blocking Alarm*	Allows you to enable the function to block the alarms (*). See ALARM INITIAL BLOCKING. **YES** Enables initial blocking. **no** Inhibits initial blocking.
HYA1 *Alarm hysteresis*	Alarm hysteresis. Allows you to set the difference between the PV value at which the alarm is turned on and the value at which it is turned off (*).
SP iE	Allows to display **SPA1** parameter in the controller Operation Cycle (*). **YES** Displays **SPA1** parameter in the Operation Cycle. **no** Does not display **SPA1** parameter in the Operation Cycle.

(*) This parameter is not displayed when the alarm function is set to **oFF** or **iErr**.

5.4 CALIBRATION CYCLE

All input types are calibrated at the factory. If a recalibration is necessary, it must be performed by a specialized professional. If this cycle is accessed accidentally, do not promote changes in its parameters.

PASS *Password*	Allows you to enter the password. This parameter is shown before the protected cycles. See CONFIGURATION PROTECTION chapter.
CAL *Calibration*	Allows you to enable the function to calibrate the controller. When the function is not enabled, the calibration of the related parameters will remain hidden.
InLC *Input Low Calibration*	Allows you to enter the value corresponding to the low scale signal applied to the analog input.
InHC *Input High Calibration*	Allows you to enter the value corresponding to the full-scale signal applied to the analog input.
rStr *Restore*	Allows you to reset the input factory calibrations, disregarding all changes made.
PASC *Password Change*	Allows you to set a new access password, always different from 0.
Prot *Protection*	Allows you to define the protection level.

6. CONFIGURATION PROTECTION

The controller allows you to protect its configuration, preventing undue changes.

In the Calibration cycle, the *Protection* parameter (**Prot**) determines the protection cycle to be adopted, limiting access to the cycles, as shown in the table below:

PROTECTION CYCLE	PROTECTION CYCLE
1	Only Calibration cycle is protected.
2	Calibration and Input cycles are protected.
3	Calibration, Input, and Tuning cycles are protected.
4	All cycles (including SP) are protected.

Table 3

6.1 ACCESS PASSWORD

To access the Calibration cycle, a password is required. If entered correctly, it allows changing the configuration of the parameters of these cycles, including the *Protection* parameter (**Prot**).

You can set the password in the *Password Change* parameter (**PASC**), which is also present in the Calibration cycle. **The controllers leave the factory with the password set to 1111**.

6.2 PROTECTION ACCESS PASSWORD

The controller has a security system that helps prevent the entry of numerous passwords to guess the correct password. Once 5 consecutive invalid passwords are identified, the controller stops accepting passwords for 10 minutes.

6.3 MASTER PASSWORD

If you forget the password, you can use the Master Password feature. When entered, this password gives access and allows changing the *Password Change* parameter (**PASC**). This makes it possible to set a new password for the controller.

The master password is formed by the last 3 digits of the controller serial number **plus** the number 9000.

Example: For a device with serial number 07154321, the master password is 9321.

You can get the serial number of the controller by pressing ◀ key for 5 seconds.

7. PID PARAMETERS DEFINITION

During auto-tuning, the process is controlled in ON/OFF mode at the programmed setpoint (SP). In some processes, the auto-tuning can take many minutes to complete. The recommended procedure for its execution is:

- Set the desired SP value for the process.
- On the **AtUn** screen, enable automatic tuning by selecting **FASt** or **FULL**.

The **FASt** option performs the tuning in the minimum possible time. The **FULL** option prioritizes a more precise tuning.

During automatic tuning, the **TUNE** indicator remains lit on the front of the controller. You must wait until the tuning is finished before you can use the controller.

During the execution of the automatic tuning, there will be PV oscillations in the process around the Setpoint.

If the tuning does not result in satisfactory control, the table below presents guidelines on how to correct the process behavior:

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

Table 4

8. MAINTENANCE

8.1 PROBLEMS WITH THE CONTROLLER

Wiring errors and improper programming represent most of the problems that can occur when using the controller. A final review can avoid wasted time and losses.

The controller presents some messages that are intended to help you identify problems:

MESSAGE	PROBLEM DESCRIPTION
----	Open input. No sensor or signal.
Err 1	Error in the Pt100 sensor connections.
Err2	Internal error in the analog input (*).
Err4	The equipment has rebooted due to an internal error.
Err7	Error in the retentive memory.
Err8	Error when reading Cold Junction.

Table 5

(*) Error 2 can combine with errors 1 and 8, producing errors 3 and 10, respectively.

Other error messages displayed by the controller represent internal damages that necessarily imply sending the equipment for maintenance.

8.2 INPUT CALIBRATION

All controller input types leave the factory already calibrated. Recalibration is not recommended for inexperienced operators. If it is necessary to recalibrate an input, proceed as follows:

a) In the **tYPE** parameter, set the input type to be calibrated.

b) Program the lower and upper SP limits for the extremes of the input type.

c) Access the Calibration cycle.

d) Enter the access password.

e) In parameter **CAL Ib**, enable the calibration by setting **YES**.

f) With an electrical signal simulator, apply to the input terminals a signal near the lower limit of the configured input measurement range.

g) In the **nLC** parameter, use the ▲ and ▼ keys to make the display indicate the expected value for the applied signal. Then press the P key.

h) Apply a signal near the **upper** limit of the configured input measurement range to the input terminals.

i) In the **InHC** parameter, use the ▲ and ▼ keys to make the display indicate the expected value for the applied signal. Then, press the P key until returning to the **Temperature Indication Screen**.

j) Validate the calibration.

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.

9. SPECIFICATIONS

DIMENSIONS: ..... 48 x 48 x 35 mm (1/16 DIN)
Panel cutout: ..... 45.5 x 45.5 mm (+0.5 -0.0 mm)
N1030-PR model: ..... Approximate weight: 60 g
N1030-RR model: ..... Approximate weight: 75 g

POWER SUPPLY: ..... 100 to 240 Vac (±10 %), 50/60 Hz
..... 48 to 240 Vdc (±10 %)
Optional 24 V: ..... 12 to 24 Vdc / 24 Vac (-10 % / +20 %)
Maximum consumption: ..... 5 VA

ENVIRONMENTAL CONDITIONS:
Operation temperature: ..... 0 to 50 °C
Relative humidity: ..... 80 % @ 30 °C
For temperatures above 30 °C, reduce 3 % for each °C.
Internal use; Category of installation II, Degree of pollution 2; altitude < 2000 meters.

INPUT ..... Thermocouples **J**; **K**; **T** and **Pt100** (according of **Table 1**)
Internal resolution: ..... 32767 levels (15 bits)
Display resolution: ..... 12000 levels (from -1999 up to 9999)
Rate of input reading: ..... up 10x per second
Accuracy: Thermocouples **J**, **K**, **T**: 0.25 % of the span ±1 °C (*)
..... Pt100: 0.2 % of the span
Input impedance: ..... Pt100 and thermocouples: > 10 MΩ
Pt100 measurement: ..... 3-wire type, (α = 0.00385)
With compensation for cable length, excitation current of 0.120 mA.
(*) The use of thermocouples requires a minimum time interval of 15 minutes for stabilization.

OUTPUTS: OUT1: ..... Voltage pulse, 5 Vdc / 25 mA
..... SPST relay; 1.5 A / 240 Vac / 30 Vdc
OUT2: ..... SPST relay; 1.5 A / 240 Vac / 30 Vdc

FRONT PANEL: ..... IP65, Polycarbonate (PC) UL94 V-2

HOUSING: ..... IP20, ABS+PC UL94 V-0

ELECTROMAGNETIC COMPATIBILITY: ..... EN 61326-1:1997 and EN 61326-1/A1:1998

EMISSION: CISPR11/EN55011

IMMUNITY: ..... EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6, EN61000-4-8, and EN61000-4-11

SAFETY: ..... EN61010-1:1993 and EN61010-1/A2:1995

SPECIFIC CONNECTIONS FOR PIN TERMINALS.

PWM PROGRAMABLE LEVEL: From 0.5 up 100 seconds.

START-UP: After 3 seconds connected to the power supply.

CERTIFICATIONS: CE, UKCA, UL.

10. IDENTIFICATION

N1030 -	A -	B

A: Output Features

PR: OUT1 = Pulse / OUT2 = Relay

RR: OUT1 = Relay / OUT2 = Relay

B: Power Supply

(Blank): .....Standard model

.....100~240 Vac / 48~240 Vdc; 50~60 Hz

24V: .....24V Model

.....12~24 Vdc / 24 Vac

11. WARRANTY

Warranty conditions are available on our website www.novusautomation.com/warranty.