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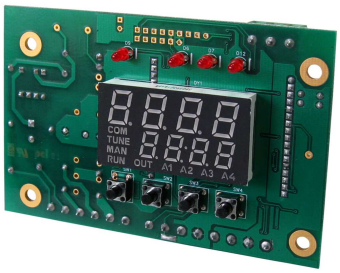


Controller N120

INSTRUCTIONS MANUAL – V1.0C

INTRODUCTION

The N120 is an extraordinarily versatile process controller. It holds in one single instrument all the main features needed for the vast majority of industrial processes. It accepts in a single model the majority of the sensors and signals used in the industry and provides the main output types required by usual applications.

The instrument setup is carried out through its frontal keypad without any hardware change.

It is important that the users read carefully this manual before using the controller. Verify if the release of this manual matches the instrument version (the firmware version is shown when the controller is energized). The N120 main characteristics are:

- Multi-sensor universal input;
- Protection for open sensor in any condition;
- Relay and logic pulse control outputs available in the standard model;
- 4-20 mA output (optional)
- Self-tuning of PID parameters;
- Up to two alarm outputs, with functions of minimum, maximum, differential (deviation), open sensor and event;
- Timer functions that can be associated to the alarms;
- Retransmission of PV or SP in 0-20 mA or 4-20 mA (optional);
- Digital input with 2 functions;
- Programmable *soft-start*;
- 20 setpoint profile programs with 9 segments each, with the ability to be linked together for a total of 180 segments;
- Password for parameters protection;
- Universal power supply: 100-240 Vac, ±10%..

CONFIGURATION / FEATURES

INPUT TYPE SELECTION

Select the input type (in parameter "tYPE") from **Table 1** below.

TYPE	CODE	RANGE OF MEASUREMENT
J	tc J	Range: -110 to 950 °C (-166 to 1742 °F)
K	tc K	Range: -150 to 1370 °C (-238 to 2498 °F)
T	tc t	Range: -160 to 400 °C (-256 to 752 °F)
N	tc n	Range: -270 to 1300 °C (-454 to 2372 °F)
R	tc r	Range: -50 to 1760 °C (-58 to 3200 °F)
S	tc S	Range: -50 to 1760 °C (-58 to 3200 °F)
B	tc b	Range: 400 to 1800 °C (752 to 3272 °F)
E	tc E	Range:-90 to 730 °C (-130 to 1346 °F)
Pt100	Pt	Range: -200 to 850 °C (-328 to 1562 °F)
0–50 mV	L0.50	Linear Signals Programmable indication from -1999 to 9999.
0-5 Vdc	L0.5	
0-10 Vdc	L0.10	

Table 1 - Input types

CONTROL OUTPUT

Either logic pulse (5 Vdc / 20 mA) or relay, software selectable.

ALARM OUTPUTS

The N120 has two independent alarm outputs. They can be configured to operate in nine distinct modes, as shown in **Table 2.**

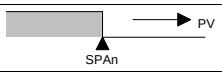
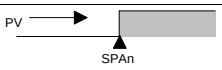
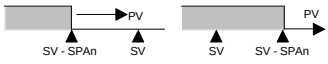
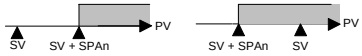
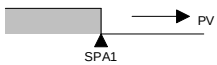
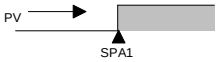
SCREEN	TYPE	ACTUATION
oFF	Inoperative	Output is not used as alarm.
iErr	Open sensor (input **Err**or)	Activated when the input signal of PV is interrupted, out of the range limits or Pt100 in short-circuit.
rS	Event (**r**amp and **S**oak)	Activated in a specific segment of program.
t.End	Timer alarm	Signals when the timer expires.
Lo	Minimum value (**Lo**w)	
HI	Maximum value (**Hi**gh)	
diF	Differential (**di**Ferential)	 Positive SPAn Negative SPAn
diFL	Minimum Differential (**di**Ferential **L**ow)	Positive SPAn Negative SPAn 
diFH	Maximum differential (**di**Ferential **H**igh)	 Positive SPAn Negative SPAn

Table 2 – Alarm Functions

oFF	Inoperative
iErr	(input **Err**or). Activated when the input signal of PV is interrupted, out of the range limits or Pt100 in short-circuit.
rS	Event (**r**amp and **S**oak). Activated in a specific segment of program. .
t.End	Timer end. Signals when the timer expires.
Lo	Minimum value (**Lo**w). 
HI	Maximum value (**Hi**gh). 
diF	Differential (**di**Ferential)  positive SPAx negative SPAx

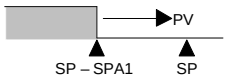
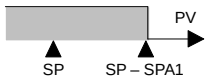
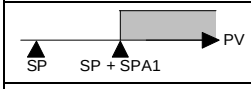
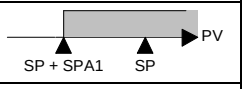
d iFL	Minimum Differential (**diF**erential **L**ow)	
		
	positive SPAx	negative SPAx
d iFH	Maximum differential (**diF**erential **H**igh)	
		
	positive SPAx	negative SPAx

Table 2 – Alarm functions

Where SPAn refers to Setpoints of Alarm "**SPA 1**", "**SPA2**", "**SPA3**" **and** "**SPA4**".

ALARM TIMER MODES

The controller alarms can be configured to perform 3 timer modes:

- One pulse with defined duration;
- Delayed activation;
- Repetitive pulses;

The illustrations in **Table 4** show the behavior of the alarm output for various combinations of times t1 and t2. The timer functions can be configured in parameters **A 1t 1**, **A 1t2**, **A2t 1**, **A2t2**, **A3t 1**, **A3t2**, **A4t 1** and **A4t2**.

OPERATION	T 1	T 2	ACTION
Normal Operation	0	0	
Activation for a defined time	1 to 6500 s	0	
Activation with delay	0	1 to 6500 s	
Intermittent Activation	1 to 6500 s	1 to 6500 s	

Table 4 – Temporization Functions for the Alarms

The signs associated to the alarms will light when the alarm condition is recognized, not following the actual state of the output, which may be temporarily OFF because of the temporization.

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.

RATE FUNCTION

Defines a setpoint increase/decrease rate of change. The rate unit can be either degrees/second or degrees/minute. The time unit is configured in the **Prtb** parameter. The rate starts when the **run** parameter is set to **YES**.

When the SP is reached the temperature is leveled at this point for the amount of time configured in the **t imE** parameter.

TIMER

The N120 has a timer feature. It starts automatically when the PV reaches the SP value. The "time to go" value is presented in decreasing way at the PV+Timer screen.

The alarms configured as **tEnd** will activate when the timer expires.

The timer restart is possible through the digital input or by pressing the ▲ and ▼ Keys simultaneously.

DIGITAL INPUT

The dry-contact digital input can perform the special functions, as shown below:

Code	Description
r.tim	Timer Reset. When the digital input is closed (short circuited), the timer counting restarts.
run	Start/Stop the control. And alarm outputs. **Closed** = outputs enabledSaídas habilitadas a operar **Opened** = outputs disabled

Table 4 – Digital input modes

SOFT-START

The soft-start feature avoids abrupt variations in the power delivered to the load regardless of the system power demand. .

This is accomplished by defining a limiting ramp for the control output. The output is allowed to reach maximum value (100 %) only after the time programmed in the soft-start parameter has elapsed. The Soft-start function is generally used in processes that require slow start-up, where the instantaneous application of 100% of the available power to the load may cause damages to parts of the system.

In order to disable this function, the soft-start parameter must be configured with 0 (zero).

CONTROL MODE

The controller can operate in two different manners: Automatic mode or Manual mode. In automatic mode the controller defines the amount of power to be applied on the process, based on defined parameters (SP, PID, etc.).

In the manual mode the user himself defines this amount of power. The parameter "**CtrL**" defines the control mode to be adopted.

PID AUTOMATIC MODE

For the Automatic mode, there are two different strategies of control: PID control and ON/OFF control.

PID control has its action based on a control algorithm that takes into account the deviation of PV with respect to SP, the rate of change of PV and the steady state error.

On the other hand, the ON/OFF control (obtained when Pb=0) operates with 0% or 100% of power, when PV deviates from SP.

The determination of the PID parameters (Pb, Ir and Dt) is described in the item DETERMINATION OF PID PARAMETERS of this manual.

CUSTOM INPUT LINEARIZATION

The input types listed in Table 1 can be submitted to a second linearization (or correction) curve with up to 15 points within the input range. This second linearization does not modify the original factory calibration; it redefines indication values for particular measurement points in the input range.

For each point, the custom linearization assigns 2 values, one representing the actual reading and the other, the desired value. The

custom linearization works such as to bend the original linearization curve forcing it to coincide with the entered points.

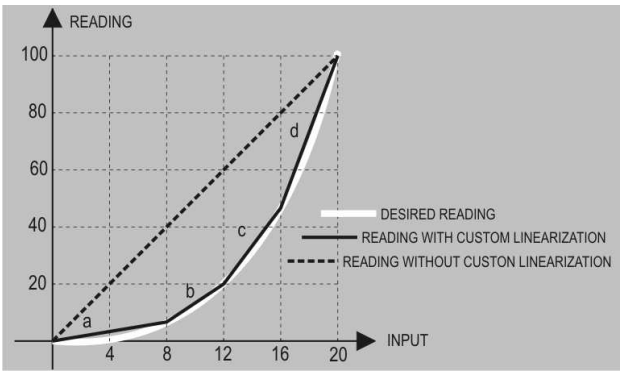


Figure 1 – Non-linear signal submitted to the custom linearization.

Note: the input signal must always have a positive slope.

INSTALATION

The N120 was designed to be mounted with screws behind a metal panel with appropriate openings to allow for the display, keypad and leds.

NOTE: The leds are optional, since the display contains all the relevant indications.

The figures below show the mechanical characteristics..

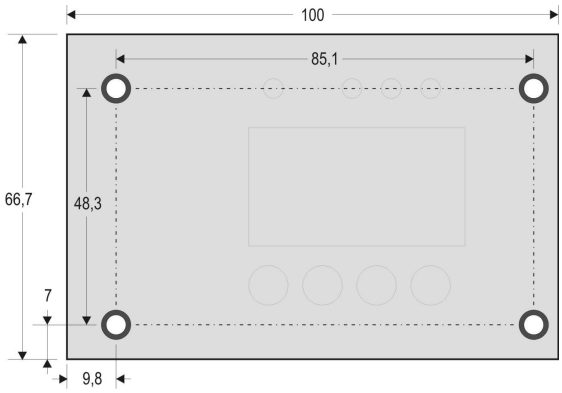


Figura 2a – Screws mounting holes. Frontal view

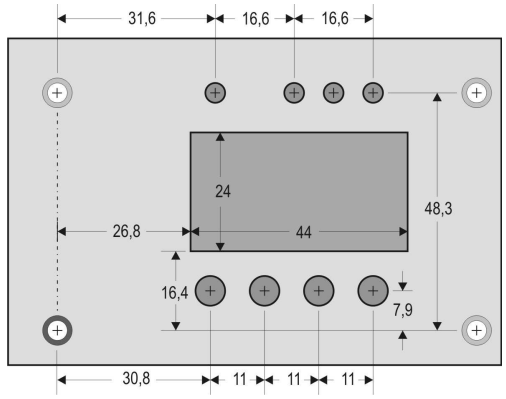


Figura 2b – Keypad, display and leds distances. Front view.

RECOMENDAÇÕES PARA A INSTALAÇÃO

- Condutores de sinais de entrada devem percorrer a planta separados dos condutores de saída e de alimentação, se possível em eletrodutos aterrados.
- A alimentação dos instrumentos eletrônicos deve vir de uma rede própria para instrumentação.
- É recomendável o uso de FILTROS RC (supressor de ruído) em bobinas de contactoras, solenóides, etc.
- Em aplicações de controle é essencial considerar o que pode acontecer quando qualquer parte do sistema falhar. Os dispositivos internos do controlador não garantem proteção total.

ELECTRICAL WIRING

Figure 3 shows the electrical connections.

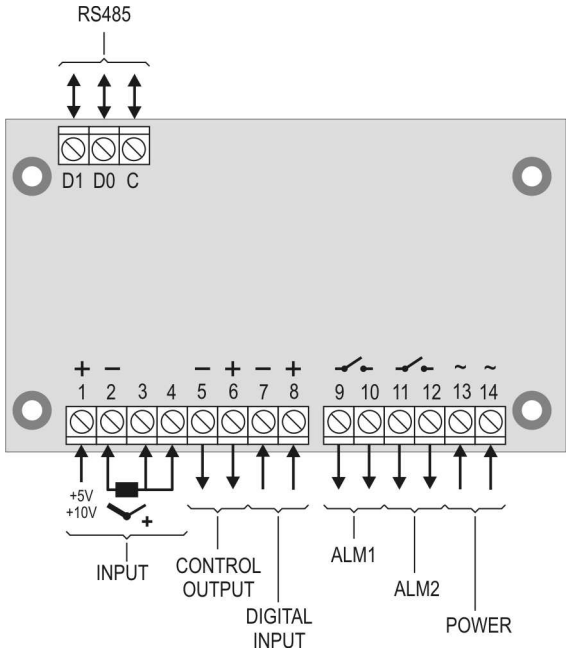


Figure 3 – Input, outputs, mains supply and RS485 interface.

OPERATION

The controller front panel is shown in Figure 4.

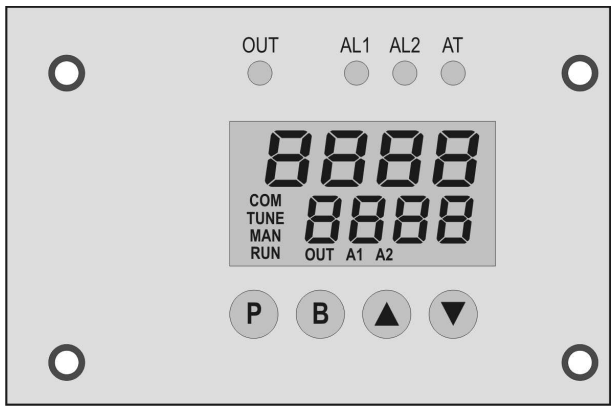


Figura 4 – Front panel elements.

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.

COM indicator: Flashes to indicate communication activity in the RS485 interface.

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

MAN indicator: Signals that the controller is in the manual control mode.

RUN indicator: Indicates that the controller is active, with the control output and alarms enabled.

OUT indicator: For relay or pulse control output; it reflects the actual state of the output. If an analog output is assigned for control, the OUT indicator lights continuously.

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

[P] **P Key (Program key):** used to walk through the menu parameters.

[◀] **Back Key**: used to retrocede parameters.

[▲] **Increment key and** [▼] - **Decrement key:** allow altering the values of the parameters.

When the controller is turned on, its firmware version is delayed for 3 seconds, after which the controller starts normal operation. The values of PV and SP are displayed and the outputs are enabled

In order to operate appropriately, the controller needs a configuration that is the definition of each one of the several parameters presented by the controller. The user must be aware of the importance of each parameter and for each one determine a valid condition or a valid value.

Note: Since many parameters depend on the input type chosen, it is recommended that the parameter **tYPE** be the first one to be configured.

The parameters are grouped in levels according to their functionality and operation easiness. The 7 levels of parameters are:

LEVEL	ACCESS
1 - Operation	Free access
2 - Tuning	Reserved access
3- R&S Programs	
4- Alarms	
5- Scale	
6- I/Os	
7- Calibration	

Table 5 – Cycles of Parameters

The parameters in the operation level have easy access through the key [P]. The access deeper levels use the combination of keys:

P and B pressed simultaneously

Press **P** to advance or **B** to retrocede parameters within a level. At the end of each level, the controller returns to the operation level. Keep pressing the **P** key to move fast forward in the level.

Alternatively, the controller returns to the operation level after pressing the **B** key for 3 seconds

All configuration parameters are stored in protected memory. The values are saved when the Keys **P** or **B** are pressed after changing a parameter value. The value of SP is saved upon pressing the **P** key or every 25 seconds.

DESCRIPTION OF THE PARAMETERS

OPERATION LEVEL

TO ACCESS THE OPERATION LEVEL PARAMETERS, PRESS THE **P** KEY UNTIL THE DESIRED PARAMETER IS DISPLAYS.

PV + SP	**IPV and SP indication** – The upper display shows the current value of PV. The lower display shows the control SP value.
PV + *timer*	**PV and Timer** indication – the upper display indicates the PV value and the lower display indicates the amount of time left to the end of program.
SP	**SP adjustment**
t iME	**Timer adjustment** (in seconds or minutes)
rAtE	**RATE OF PV RISE** from the current PV to the SP value. In degrees/second or degrees/minute.:
E Pr *Enable Program*	**Enable Program** - Selects the ramp and soak profile program to be executed. **0** - does not execute program **1 to 20** number of the program to be executed With enabled outputs (RUN = YES), the program starts right after the program is selected. **Note**: When a program is selected, the **rAtE** and **t iME** parameters are disregarded.
P.SEG	Screen for indication only. When a ramp and soak program is active, this parameter shows the number of the segment under execution, from 1 to 9.
t.SEG	Screen for indication only. When a ramp and soak program is in execution, it shows the remaining time to the end of the current segment, in units of time configured in the **PrtB** parameter.
run	Enables control outputs and alarms. **YES** - Outputs enables. **no** - Outputs not enabled.

TUNING LEVEL

AtUn *Auto-tune*	Defines the control strategy to be taken: **oFF** – Turned off. (no PID tuning) **FASt** – **FASt** automatic tuning. **FULL** –More accurate automatic tuning. **SELF** – Precise + auto - adaptative tuning **rSLF** –Forces <u>one</u> new precise automatic precise + auto - adaptative tuning. **tUnt** - Forces <u>one</u> new precise automatic + auto - adaptative tuning when Run = YES or controller is turned on. Refer to the "DETERMINING PID PARAMETERS" section for further details on tuning strategies.
Pb *Proportional Band*	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 %. Select zero for ON/OFF control.
Ir *Integral Rate*	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*	DERIVATIVE TIME - Value of the term **D** of the control mode PID, in seconds. Adjustable between 0 and 300.0 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*	CONTROL HYSTERESIS (in engineering. units): This parameter is only shown for ON / OFF control (Pb=0). Adjustable between **0** and the measurement input type span.

Act *Action*	CONTROL ACTION: For Auto Mode only. **rE** Control with reverse Action. Appropriate for **heating**. Turns control output on when PV is below SP. **dIr** Control with direct Action. Appropriate for **cooling**. Turns control output on when PV is above SP.
bIAS	BIAS: Offset for MV (manual reset). Range: -100 % to +100 %. Allows adding a percentage value between -100% and +100 %. to the MV control output The value 0 (zero) disables the function.
ouLL *Output Low Limit*	Lower limit for the control output - Minimum percentage value assumed by the control output when in automatic mode and in PID. Typically configured with **0 %**. Default value: 0 %
ouHL *Output High Limit*	Upper limit for the control output - Maximum percentage for the control output when in automatic mode and in PID. Typically configured with **100 %**. Default value: 100 %
SFSt *Softstart*	*SoftStart* 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 zero (zero value disables the Soft start function).
SPA1 **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 "**HI**". For the alarms configured with **Differential** type functions, this parameter defines deviation (band). Not used for the other alarm functions.

PROGRAM LEVEL

Prtb *Program time base*	Defines the time base that will be used by all Ramp & Soak programs. **SEC** - Time basis in seconds; **Min** - Time basis in minutes;
Pr n *Program number*	Selects the ramp and soak profile program to be edited/viewed. The sequence of parameters that follows refer to this selected program. Total of 20 programs possible.
PtoL *Program Tolerance*	Maximum admitted deviation of PV with respect to SP. If exceeded, the program execution is suspended (the internal timer freezes) until the deviation be returns back within the defined tolerance. The value 0 (zero) disables the function (the program progresses regardless of the difference between PV and SP).
PSP0 **PSP9**	Program SP's, 0 to 9: Group of 10 values of SP that define the Ramp and Soak profile segments.
Pt1 **Pt9**	Segments durations, 1 to 9: Defines the time of duration, in second or minutes, of the segments of the program being edited.
PE1 **PE9** *Program event*	Alarms of Event, 1 to 9: Parameters that define which alarms are to be activated during the execution of a certain program segment. The alarms chosen must have its function configured as "**rS**." (See **Table 3**)
LP *Link Program*	Link Programs: Number of the next profile program to be linked following the current program. Profiles can be linked together to produce larger programs of up to 180 segments. **0** – do not link to any other program.

CYCLE of alarms:

FuA1 **FuA2**	FUNCTIONS OF ALARMS 1 and 2. Defines the functions for the alarms among the options of the **Table 3**. **oFF, tErr, Lo, HI, dIFL, dIFH, dIF**
bLA1 **bLA2**	BLOCK ALARM 1 and 2: This function blocks the alarms when the controller is energized. **YES** - enables initial blocking **no** - inhibits initial blocking When enabled, the alarm will not be active at power-up, waiting for PV (Process Variable) to reach a non-alarm situation. From this point on the alarm will be free to actuate should a new alarm situation occur.
HyA1 **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 (in engineering units).
A1t1 **A2t1** *Alarm Time* **t1**	Defines the temporization time **t1**, in seconds, for the alarms. Defines the temporization time **t1**, in seconds, for the alarms time functions. The value 0 (zero) disables the function. Refer to Table 4 for configuring this parameter timed functions. The value 0 (zero) disables the function. Refer to Table 4 for configuring this parameter.
A1t2 **A2t2**	Alarm Time **t2.** Defines the temporization time **t2**, in seconds, for the alarms time functions. The value 0 (zero) disables the function. Refer to Table 4 for configuring this parameter
FLSh *Flash*	Allows visual signalization of an alarm occurrence by flashing the indication of PV in the operation level. The user chooses which alarms are to be associated with this feature.
FLSh *Flash*	Allows visual signalization of an alarm occurrence by flashing the indication of PV in the operation level. The user chooses which alarms are to be associated with this feature.

SCALE LEVEL

tYPE *Type*	INPUT TYPE: Selects the input signal type to be connected to the process variable input. Refer to **Table 1** for the available options.
FLtr *Filter*	Digital Input Filter - Used to improve the stability of the measured signal (PV). Adjustable between 0 and 20. In 0 (zero) it means filter turned off and 20 means maximum filter. The higher the filter value, the slower is the response of the measured value.
dPPo *Decimal Point*	Selects the decimal point position to be viewed in both PV and SP.
unIt	*Unit.* Temperature indication in ºC or ºF. Not shown for linear inputs.
Fu.d1 *Digital Input function*	Digital input function **rtMr** – timer reset **run** – enable/disable outputs

PrtB *Program time base*	Defines the time base that will be used by all Ramp & Soak programs. **SEC** - Time basis in seconds; **Min** - Time basis in minutes;
OFFS *Offset*	SENSOR OFFSET: Offset value to be added to the PV reading to compensate sensor error. Default value: zero.
SPLL *Setpoint Low Limit*	Defines the SP lower limit of. - Linear inputs: Sets the lower range for SP and PV indication. - T/C and Pt100 inputs: sets the lower range for SP only.
SPHL *Setpoint High Limit*	Defines the upper limit for adjustment of SP. - Linear inputs: Sets the upper range for SP and PV indication. - T/C and Pt100 inputs: sets the upper range for SP only.
bAud *Baud Rate*	Digital communication *Baud Rate* selection, in kbps: 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6 and 115.2
PrtY *Parity*	Parity of the serial communication. **nonE** Without parity **EUEn** Even parity **Odd** Odd parity
Addr *Address*	SLAVE ADDRESS SELECTION: Identifies the controller in the network. The possible address numbers are from 1 to 247.

CALIBRATION cycle

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

PASS *Password*	Input of the Access Password. This parameter is presented before the protected cycles. See item **Protection of Configuration**.
InHC *Input High Calibration*	See section MAINTENANCE / Input Calibration. Enter the value corresponding to the full scale signal applied to the analog input.
rSLC *Remote SP Low Calibration*	See section: MAINTENANCE / Input Calibration Enter the value corresponding to the low scale signal applied to the remote SP input.
rSHC *Remote SP High Calibration*	See section: MAINTENANCE / Input Calibration. Enter the value corresponding to the full scale signal applied to the remote SP input.
OuLC *Output Low Calibration*	See section MAINTENANCE / Analog output Calibration. Enter the analog value as measured at the analog ouput.
OuHC *Output High Calibration*	See section MAINTENANCE / Analog output Calibration. Enter the analog value as measured at the analog output.
CJ	Adjusts the of cold junction temperature value.

InLC *Input Low Calibration*	See section MAINTENANCE / Input Calibration. Enter the value corresponding to the low scale signal applied to the analog input.
InHC *Input High Calibration*	See section MAINTENANCE / Input Calibration. Enter the value corresponding to the full scale signal applied to the analog input.
OuLC *Output Low Calibration*	See section MAINTENANCE / Analog output Calibration. Enter the analog value as measured at the analog ouput.
OuHC *Output High Calibration*	See section MAINTENANCE / Analog output Calibration. Enter the analog value as measured at the analog output.
CJ	Adjusts the of cold junction temperature value.
HtyP *Hardware Type*	Parameter that informs the controller about the hardware optionals installed. It should not be altered by the user, except when an accessory is introduced or removed. **0** – Basic model. Without optional items **1** – 485 **2** – 3R **3** – 3R + 485 **4** – DIO **5** – DIO + 485 **8** – HBD **9** – HDB + 485
PASC	Allows defining a new access password, always different from zero.
Prot	Sets up the Level of Protection. See **Table 6.**
FrEQ	Mains frequency. This parameter is important for proper noise filtering.
rStr *Restore*	Restores the factory calibration for all inputs and outputs, disregarding modifications carried out by the user.

HtyP *Hardware Type*	Parameter that informs the controller about the hardware optionals installed. It should not be altered by the user, except when an accessory is introduced or removed. **0** – Basic model. Without optional items **1** – 485 **2** – 3R **3** – 3R + 485 **4** – DIO **5** – DIO + 485 **8** – HBD **9** – HDB + 485
PASC	Allows defining a new access password, always different from zero.
Prot	Sets up the Level of Protection. See **Table 6.**
FrEQ	Mains frequency. This parameter is important for proper noise filtering.

PROTECTION OF CONFIGURATION

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	Protected cycles
1	Only the Calibration level is protected.
2	I/Os and Calibration levels.
3	Tuning, I/Os and Calibration levels.
4	Alarm, Tuning, I/Os and Calibration levels.
5	Programs, Alarm, Tuning, I/Os and Calibration levels.
6	Tuning, Programs, Alarm, Input, I/Os and Calibration levels.
7	Operation (except SP), Tuning, Programs, Alarm, input, I/Os and Calibration levels.
8	Operation (except SP), Tuning, Programs, Alarm, Input, I/Os and Calibration levels.

Table 7 – Levels of Protection for the Configuration

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 cycles.

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

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

Protection of the access code

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.

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 (**PASC**). 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.

DETERMINATION OF PID PARAMETERS

The determination (or tuning) of the PID control parameters in the controller can be carried out in an automatic way and auto-adaptative mode. The **automatic tuning** is always initiated under request of the operator, while the **auto-adaptive tuning** is initiated by the controller itself whenever the control performance becomes poor.

Automatic tuning: In the beginning of the **automatic tuning** the controller has the same behavior of an ON/OFF controller, applying minimum and maximum performance to the process. Along the tuning process the controller's performance is refined until its conclusion, already under optimized PID control. It begins immediately after the selection of the options FAST, FULL, RSLF or TGHT, defined by the operator in the parameter ATUN.

Auto-adaptive tuning: Is initiated by the controller whenever the control performance is worse than the one found after the previous tuning. In order to activate the performance supervision and **auto-adaptative tuning**, the parameter ATUN must be adjusted for SELF, RSLF or TGHT. The controller's behavior during the **auto-adaptative tuning** will depend on the worsening of the present performance. If the maladjustment is small, the tuning is practically imperceptible for the user. If the maladjustment is big, the **auto-adaptive tuning** is similar to the method of **automatic tuning**, applying minimum and maximum performance to the process in ON/OFF control.

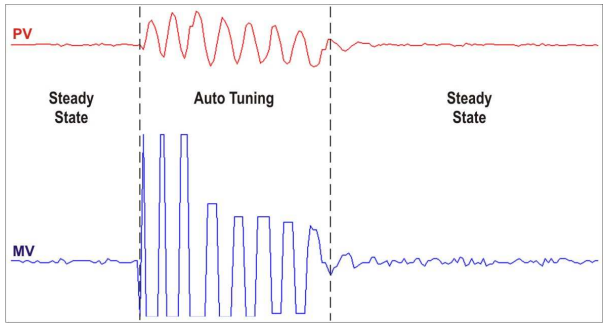


Figure 11 – Example of auto tuning

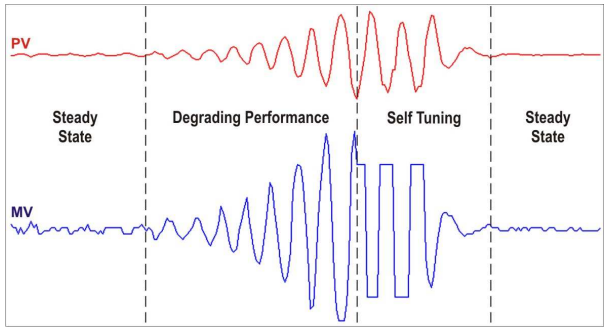


Figure 12 - Example of auto-adaptative tuning

The operator may select, through the ATUN parameter, the desired tuning type among the following options:

- OFF: The controller does not carry through **automatic tuning** or **auto-adaptative tuning**. The PID parameters will **not** be automatically determined **nor** optimized by the controller.
- FAST: The controller will accomplish the process of **automatic tuning** one single time, returning to the OFF mode after finishing. The tuning in this mode is completed in less time, but not as precise as in the FULL mode.
- FULL: The same as the FAST mode, but the tuning is more precise and slower, resulting in better performance of the P.I.D. control.
- SELF: The performance of the process is monitored and the **auto-adaptative tuning** is automatically initiated by the controller whenever the performance becomes poorer.

  After the tuning process, the controller enters a learning phase when it collects data relative to the process performance. This phase, which is dependent of the response time of the process, is indicated by a flashing TUNE indicator. Once this learning is completed, the controller is able to decide whether of not a new tuning is required to improve system response.

  It is recommended not to turn the controller off neither change the SP value during this phase.
- rSLF: Accomplishes the **automatic tuning** and returns into the SELF mode. Typically used to force an immediate **automatic tuning** of a controller that was operating in the SELF mode, returning to this mode at the end.
- TGHT: Similar to the SELF mode, but in addition to the **auto-adaptative tuning** it also executes the **automatic tuning** whenever the controller is set in RUN=YES or when the controller is turned on.

Whenever the parameter ATUN is altered by the operator into a value different from OFF, an automatic tuning is immediately initiated by the controller (if the controller is not in RUN=YES, the tuning will begin when it passes into this condition). The accomplishment of this

automatic tuning is essential for the correct operation of the auto-adaptative tuning.

The methods of **automatic tuning** and **auto-adaptative tuning** are appropriate for most of the industrial processes. However, there may be processes or even specific situations where the methods are not capable to determine the controller's parameters in a satisfactory way, resulting in undesired oscillations or even taking the process to extreme conditions. The oscillations themselves imposed by the tuning methods may be intolerable for certain processes. These possible undesirable effects must be considered before beginning the controller's use, and preventive measures must be adopted in order to assure the integrity of the process and users.

The "**TUNE**" signaling device will stay on during the tuning process.

In the case of PWM or pulse output, the quality of tuning will also depend on the cycle time adjusted previously by the user.

If the tuning does not result in a satisfactory control, refer to **Table 7** for guidelines on how to correct the behavior of the process.

PARAMETER	VERIFIED PROBLEM	SOLUTION
Proportional Band	Slow answer	Decrease
	Great oscillation	Increase
Rate of Integration	Slow answer	Increase
	Great oscillation	Decrease
Derivative Time	Slow answer or instability	Decrease
	Great oscillation	Increase

Table 7 - Guidance for manual adjustment of the PID parameters

PROGRAMS OF RAMP AND SOAK

This feature allows the creation of Ramp and Soak Setpoint Profiles (Programs). Up to **20 different profiles** with **9 segments** each can be programmed. Longer profiles of up to 180 segments can be created by linking 2 or more profiles together.

The figure below displays a profile model:

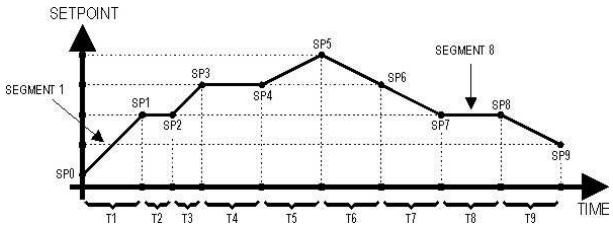


Figure 8 - Example of a Ramp and Roak.

Once a profile is defined and selected for execution (parameter **EPr** in the operating level), the controller starts to generate the SP profile automatically in accordance with the elaborated program.

To execute a profile with fewer segments just program 0 (zero) for the time intervals that follow the last segment to be executed.

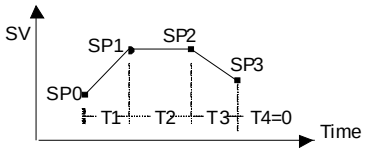


Figure 9 - Program example with few segments

The program tolerance defines the maximum deviation between PV and SP for the execution of the profile. If this deviation is exceeded, the program will be halted until the deviation falls to within the tolerance band.

Programming 0 (zero) in the "**PtoL**" parameter disables the program tolerance and the profile execution will continue regardless of the PV value (time priority as opposed to SP priority).

link OF PROGRAMS

It is possible to create a more complex program, with up to 180 segments, joining the 20 programs. This way, at the end of a program execution the controller immediately starts to run the next one, as indicated in the "**LP**".

To force the controller to run a given program or many programs continuously, it is only necessary to link a program to itself or the last program to the first.

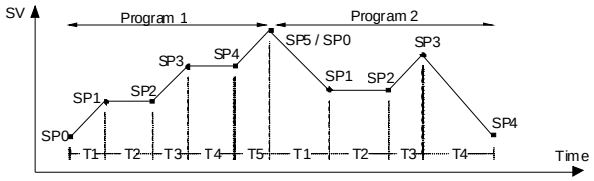


Figure 10 - Example of interlinked programs

EVENT ALARM

The Event Alarm function associates the alarms to specific segments of a program. The information of which alarms are to be activated or deactivated is given in parameters "**PE 1**" to "**PE9**. Press the ▲ and ▼ keys until the desired alarm numbers are displayed.

The Event Alarm requires that the Alarm function be configured as "**rS**".

Notes:

1. If **PtoL** is different than zero, the controller will wait for the PV to reach the first program set point SP0 in order to start the program execution. Otherwise, it will start promptly.
2. Should any power failure occur, the controller resumes the program execution at the beginning of the segment that was interrupted.

MAINTENANCE

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.

CALIBRATION OF THE INPUT

All inputs are factory calibrated and 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:

a) Configure the type of input to be calibrated.

b) Configure the lower and upper limits of indication for the maximum span of the selected input type.

c) At the input terminals inject a signal corresponding to a known indication value a little above the lower display limit.

d) Access the parameter "**InLc**". With the keys ▲ and ▼ adjust the display reading such as to match the applied signal. Then press the P key.

e) Inject a signal that corresponds to a value a little lower than the upper limit of indication.

f) Access the parameter "**InLc**". With the keys ▲ and ▼ adjust the display reading such as to match the applied signal. Then press the P key.

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 N1200.

CALIBRATION OF THE ANALOGICAL OUTPUT

- Configure I/O 5 for the current output to be calibrated, be it control or retransmission.
- In the screen "**ctrL**", program manual mode (**mAn**).
- Connect a current meter at the analog output.
- Enter the calibration cycle with the correct password.
- Select the screen "**ouLc**". Press the keys ▲ and ▼ for the controller to recognize the calibration process of the current output.
- Read the current indicated on the current meter and adjust the parameter "**ouLc**" to indicate this current value (use the keys ▲ and ▼)
- Select the screen "**ouHc**". Press the keys ▲ and ▼ for the controller to recognize the calibration process of the current output.
- Read the current indicated on the current meter and adjust the parameter "**ouHc**" to indicate this current value
- The key P or ◄ in order to leave the screen confirm the calibration.

SERIAL COMMUNICATION

The controller can be supplied with an asynchronous RS-485 digital communication interface for master-slave connection to a host computer (master).

The controller works as a slave only and all commands are started by the computer which sends a request to the slave address. The addressed unit sends back the requested reply.

Broadcast commands (addressed to all indicator units in a multidrop network) are accepted but no reply is sent back in this case.

CHARACTERISTICS

- Signals compatible with RS-485 standard. MODBUS (RTU) Protocol. Two wire connection between 1 master and up to 31 (addressing up to 247 possible) instruments in bus topology. The communication signals are electrically insulated from the rest of the device;
- Maximum connection distance: 1000 meters.
- Time of disconnection for the controller: Maximum 2 ms after last *byte*.
- Selectable speed; 8 data bits; 1 *stop* bit; selectable parity (no parity, pair or odd);
- Time at the beginning of response transmission: maximum 100 ms after receiving the command.

The RS-485 signals are:

D1	**D**	**D +**	**B**	Bi-directional data line. Terminal 16
D0	$\overline{D}$:	**D -**	**A**	Bi-directional inverted data line. Terminal 17
		C		Optional connection that improves the performance of the communication. Terminal 18
		GND		

CONFIGURATION OF PARAMETERS FOR SERIAL COMMUNICATION

Two parameters must be configured for using the serial type:

bAud: Communication speed.

PrtY: Parity of the communication.

Addr: Communication address for the controller.

REDUCED REGISTERS TABLE FOR SERIAL COMMUNICATION

COMMUNICATION PROTOCOL

The MOSBUS RTU slave is implemented. All configurable parameters can be accessed for reading or writing through the communication port. Broadcast commands are supported as well (address 0).

The available Modbus commands are:

03 - *Read Holding Register*	06 - *Preset Single Register*
05 - *Force Single Coil*	16 - *Preset Multiple Register*

HOLDING REGISTERS TABLE

Follows a description of the usual communication registers. For full documentation download the Registers Table for Serial Communication in the N1200 section of our web site – www.novusautomation.com.

All registers are 16 bit signed integers.

Address	Parameter	Register Description
0000	Active SP	Read: Active control SP (main SP, from ramp and soak or from remote SP). Write: to main SP. Range: from **SPLL** to **SPHL**.
0001	PV	Read: Process Variable. Write: Not allowed. Range: Minimum value is the one configured in **SPLL** and the maximum value is the one configured in **SPHL**. Decimal point position depends on **dPPo** value. In case of temperature reading, the value read is always multiplied by 10, independently of **dPPo** value.

SPECIFICATIONS

DIMENSIONS:.....100 x 67 mm

.....Peso Aproximado: 80 g

POWER SUPPLY:..... 100 a 240 Vac/dc (±10 %), 50/60 Hz

Consumo máximo:..... 5 VA

ENVIRONMENTAL CONDITIONS:

Operation Temperature: ..... 5 to 60 °C

Relative Humidity: .....80% max. 30 ºC

For temperatures above 30 ºC, reduce 3% for each ºC

INPUT..... T/C, Pt100, voltage and current (according to **Table 1**)

Internal Resolution: ..... 32767 levels (15 bits)

Resolution of Display: .....12000 levels (from - 1999 up to 9999)

Rate of input reading: .....up to 55 per second

Precision: ..Thermocouples **J**, **K**, **T**, **E:** 0.25% of the *span* ±1 ºC

..... Thermocouples **N**, **R**, **S**, **B**: 0.25% of the *span* ±3 ºC

..... Pt100: 0.2% of the *span*

.....0-50 mV, 0-5 Vdc: 0.2% of the *span*

Input Impedance: 0-50 mV, Pt100 and Thermocouples: >10 MΩ

..... 0-5 V: >1 MΩ

Measurement of Pt100: .....Three wire type, (α=0.00385) with compensation for cable length, excitation current of 0.170 mA.

All input and output types are factory-calibrated. Thermocouples according to standard NBR 12771 / 99, RTD's NBR 13773 / 97;

ANALOGICAL OUTPUT: .....0-20 mA or 4-20 mA, 550Ω max. 31000 levels, isolated, for control or retransmission of PV and SP

CONTROL OUTPUT:

... 2 Relays SPST-NA (I/O1 and I/O2): 3 A / 240 Vac, general use ..... Voltage pulse for SSR: 5 V max. / 20 mA

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

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

STARTS UP OPERATION AFTER 3 SECONDS CONNECTED TO THE POWER SUPPLY;

TABELA DE PARÂMETROS

OPERATION LEVEL	TUNING LEVEL	SP PROFILE LEVEL	ALARM LEVEL	INPUTS LEVEL	CUSTON LINEARIZATION LEVEL	CALIBRATION LEVEL
PV + SP Indica PV+SP	**AtUn** Executa sintonia automática	**Prtb** Base de tempo para programas, rampa e timer	**FuA1** **FuA2** Funções de Alarmes	**tYPE** Tipo de Entrada	**ctYP** Tipo de Entrada	**PASS** Senha
PV + timer Indica PV+timer	**Pb** Proporcional (P)	**Pr n** Número do programa	**bLA1 bLA2** Bloqueio de Alarme	**FLtr** Filtro	**In.01** **In.15**	**CAL Ib** Calibrar ? sim ou não
SP Ajuste de Setpoint	**Ir** Integral (I)	**PtoL** Tolerância	**HYA1 HYA2** Histeres de Alarme	**dPPo** Ponto Decimal	**ou.01** **ou.15**	**InLC** Input Low Calibration
tIME Ajuste do Timer	**dt** Derivativo (D)	**PSP0** **PSP9** SPs do Programa	**A1t1** **A2t1** Temporização de alarme T1	**unIt** Unidade de Temperatura		**InHC** Input High Calibration
rAtE Ajuste do Rate (rampa)	**Ct** Período PWM	**Pt1** **Pt9** Tempos do Programa	**A1t2** **A2t2** Temporização de alarme T2	**Fu.d1** Função de ED		**CJ** Junta fria (não alterar)
E Pr Seleciona Programa	**HYSt** Hysterese	**PE1** **PE9** Alarmes Associados	**FLSh** Pisca PV quando em alarme	**Prtb** Base de tempo para programas, rampa e *timer*		**PASC** Nova Senha
run Liga/Desliga saídas	**Act** Ação de Controle	**LP** Interligar Programas		**OFFS** Offset de PV		**Prot** Proteção
	bIAS Bias			**SPLL** Limite para SP		**FrE9** Freqüência da rede elétrica
	ouLL Limite de saída			**SPHL** Limite para SP		**rStr** Resgata calibração de fábrica
	ouHL Limite de saída			**bAud** *Baud Rate*		
	SFSt Softstart			**PrtY** Paridade		
	SPA1 **SPA2** SPs dos alarmes			**Addr** Endereço		