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.

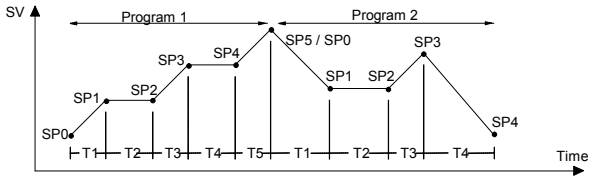

Figure 10 - Example of interlinked programs

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.

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.

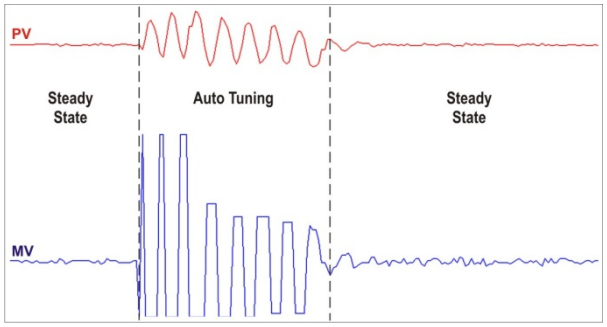

Figure 11 – Example of auto tuning

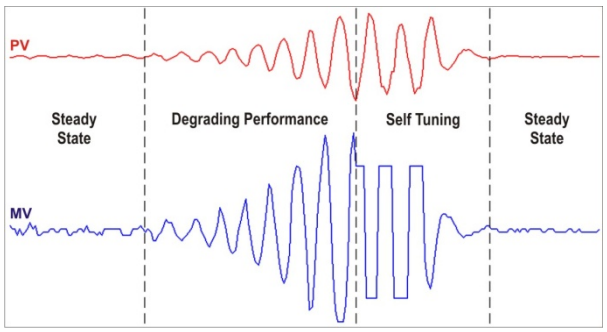

Figure 12 - Example of auto-adaptative tuning

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 a tuning cycle, the controller starts collecting data from the process for determining the performance benchmark that will allow evaluate the need for future tunings. This phase is proportional to the process response time and is signaled by the flashing TUNE indication on the display. It is recommended not to turn the controller off neither change the SP during this learning period.
- 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 8** 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 8 - Guidance for manual adjustment of the PID parameters

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 controller.

ANALOG OUTPUT CALIBRATION

- 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 to 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
- Press the key P in order to confirm the calibration procedure and return to the operating level.

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.
- There is **no electrical isolation** between serial communication (RS485) and channel I/O5.

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 website – 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.
0002	MV	Read: Output Power in automatic or manual mode. Write: Not allowed. See address 28. Range: 0 to 1000 (0.0 to 100.0 %).

SPECIFICATIONS

DIMENSIONS:.....48 x 48 x 110 mm (1/16 DIN)
Cutout in the Panel: .....45.5 x 45.5 mm (+0.5 -0.0 mm)
Approximate Weight: ..... 150 g

POWER SUPPLY.....100 to 240 Vac/dc (±10 %), 50 / 60 Hz
Optionally 24V: .....12 to 24 Vdc / 24 Vac (-10 % / +20 %)
Maximum consumption:..... 9 VA

ENVIRONMENTAL CONDITIONS:
Operation Temperature: ..... 5 to 50 °C
Relative Humidity: .....80 % max. @ 30 ºC
For temperatures above 30 ºC, reduce 3 % for each ºC
Internal Use; Category of installation II, Degree of pollution 2; altitude < 2000 m

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*
.....4-20 mA, 0-50 mV, 0-5 Vdc, 0-10 Vdc: 0.2 % of the *span*
Input Impedance: 0-50 mV, Pt100 and Thermocouples: >10 MΩ
..... 0-5 V: >1 MΩ
..... 4-20 mA: 15 Ω (+2 Vdc @ 20 mA)
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 (I/O5): .....0-20 mA or 4-20 mA, 550Ω max. 31000 levels, insulated, for control or retransmission of PV and SP

CONTROL OUTPUT:
2 Relays SPST-NA (I/O1 and I/O2): 1.5 A / 240 Vac, general use
.....1 Relay SPDT (I/O3): 3 A / 250 Vac, general use
.....Voltage pulse for SSR (I/O5): 10 V max. / 20 mA
..... Voltage pulse for SSR (I/O3 and I/O4): 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

USB INTERFACE 2.0, CDC CLASS (VIRTUAL COMMUNICATIONS PORT), MODBUS RTU PROTOCOL.

SPECIFIC CONNECTIONS FOR TYPE FORK TERMINALS OF 6.3 MM;

FRONT PANEL: IP65, polycarbonate - UL94 V-2;

CASE: IP30, ABS+PC UL94 V-0;

STARTS UP OPERATION: after 3 seconds connected to the power supply;

CERTIFICATIONS: .....CE / UL (FILE: 300526)

IDENTIFICATION

N1200 -	3R -	485 -	24V
A	B	C	D

A: Controller Model:
N1200;

B: Optional I/Os:
Blank (basic version, without **I/O3** nor **I/O4**);
3R (SPDT Relay in **I/O3**);
DIO (Digital I/Os in **I/O3** and **I/O4**);
HBD (Burnt-Out Resistance detection);

C: Digital Communication:
Blank (basic version, without serial communication);
485 (RS485, Modbus protocol)

D: Power Supply:
Blank (basic version, 100 to 240 Vac/dc input);
24V (12 to 24 Vdc / 24 Vac input voltage);

WARRANTY

Warranty conditions are available on our website