N1200 CONTROLLER

USER GUIDE V2.0x O

We Measure, We Control, We Record

1. SAFETY ALERTS

The symbols below are used in the device and throughout this manual to draw the user's attention to important information related to device safety and use.

		
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.

All safety recommendations appearing in this manual must be followed to ensure personal safety and prevent damage to the instrument or system. If the instrument is used in a manner other than that specified in this manual, the device's safety protections may not be effective.

2. INTRODUCTION

N1200 is an extraordinarily versatile process controller. It accepts in a single model all the sensors and signals used in the industry and provides the main output types required for the operation of diverse processes.

Configuration can be performed either directly on the controller or via the USB interface once **QuickTune** software has been installed on the computer to be used. Once connected to USB, the device will be recognized as a serial communication (COM) port operating with Modbus RTU protocol.

Through the USB interface, even if disconnected from the power supply, the configuration performed in a piece of equipment can be saved in a file and repeated in other pieces of equipment that require the same configuration.

It is important that the users carefully read 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).

N1200 main characteristics are:

- Multi-sensor universal input
- Protection for open sensor in any condition
- Relay, 4-20 mA and logic pulse control outputs all available in the standard model
- Self-tuning of PID parameters
- Automatic / Manual function with Bumpless transfer
- Four modes of independents alarms, 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
- Input for remote Setpoint
- Digital input with 5 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.

3. CONFIGURATION / FEATURES

3.1 INPUT TYPE SELECTION

During equipment configuration, you must set the input type to be used. The table below shows the available options:

TYPE	CODE	MEASUREMENT RANGE
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)
0-20 mA	L0.20	Linear Signals Programmable indication from -1999 to 9999.
4-20 mA	L4.20	
0-50 mV	L0.50	
0-5 Vdc	L0.5	
0-10 Vdc	L0.10	
4-20 mA NON-LINEAR	Ln J	Non-Linear Analog Signals Indication range depends on the selected sensor.
	Ln K	
	Ln t	
	Ln n	
	Ln r	
	Ln S	
	Ln b	
	Ln E	
	LnPt	

Table 1

Note: All input types are factory calibrated.

3.2 CONFIGURATION OF OUTPUTS, ALARMS AND DIGITAL INPUTS

The controller has input and output channels (I/O) that can assume multiple functions: control output, digital input, digital output, alarm output, and PV and SP retransmission. These channels are identified as **I/O1**, **I/O2**, **I/O3**, **I/O4**, and **I/O5**.

The basic controller model has the following features:

- I/O1 Relay Output SPST-NO
- I/O2 Relay Output SPST-NO
- I/O5 Current output, digital output, digital input

Optionally, other features can be added, as shown under the item IDENTIFICATION in this manual:

- **3R** I/O3 with SPDT relay output
- **DIO** I/O3 and I/O4 as digital input and output channels
- **HBD** Heater break detect
- **485** Serial Communication

The function to be used in each channel of I/O is defined in accordance with the options shown in the table below:

I/O FUNCTION	CODE	I/O TYPE
Without Function	oFF	Output
Alarm 1 Output	A1	Output
Alarm 2 Output	A2	Output
Alarm 3 Output	A3	Output
Alarm 4 Output	A4	Output
LBD (Loop Break Detection)	Lbd	Output
Control Output (Relay or Digital Pulse)	ctrL	Output
Automatic / Manual mode selection	iMAn	Digital Input
Run / Stop mode selection	run	Digital Input
Remote SP selection	rSP	Digital Input
Setpoint profile program HOLD (Freezes program execution)	HPrG	Digital Input
Setpoint Profile Program 1 selection	Pr 1	Digital Input
0 to 20 mA control output selection	C.0.20	Analogical Output
4 to 20 mA control output selection	C.4.20	Analogical Output
PV Retransmission (0 to 20 mA)	P.0.20	Analogical Output
PV Retransmission (4 to 20 mA)	P.4.20	Analogical Output
SP Retransmission (0 to 20 mA)	S.0.20	Analogical Output
SP Retransmission (4 to 20 mA)	S.4.20	Analogical Output

Table 2

During channel configuration, only the valid options for each channel will be shown on the display. These functions are described below:

oFF – NO FUNCTION

The I/O channel programmed with code **oFF** will not be used by the controller. Although without function, this channel is available through the serial communication as digital I/O (command 5 Modbus).

A1, A2, A3, A4 – ALARM OUTPUTS

The selected channel can be used as output to Alarms 1 to 4. Defines that the programmed I/O channel acts as alarm outputs.

Available to all I/O channels.

Lbd – LOOP BREAK DETECTOR FUNCTION

Assigns the output of the Loop Break Detector alarm to an I/O channel.

Available to all I/O channels.

CtrL – PWM CONTROL OUTPUT

Defines the I/O channel to be used as the PWM control output (relay or digital pulse). The digital pulse is available on I/O5 (standard) or on I/O3 and I/O4 (when the DIO optional is installed). Check the specifications of each channel.

Available to all I/O channels.

iMAn – DIGITAL INPUT WITH AUTO/MANUAL FUNCTION

Defines the I/O channel as Digital Input with the function of switching the control mode between **Automatic and Manual**.

Closed Manual control;

Open Automatic control

Available on I/O5 (standard) or on I/O3 and I/O4 (when the DIO optional is installed).

run – DIGITAL INPUT WITH RUN FUNCTION

Defines channel as Digital Input with the function of enabling/disabling the control and alarm outputs (RUN=YES/NO).

Closed Outputs enabled

Open Control and alarms output shut off

Available for I/O5 or I/O3 and I/O4 (when available).

rSP – DIGITAL INPUT WITH REMOTE SP FUNCTION

Defines channel as Digital Input with the function of selecting the remote SP as the control setpoint.

Closed Remote SP

Open Uses main SP

Available for I/O5 or I/O3 and I/O4 (when available).

HPrG – DIGITAL INPUT WITH HOLD PROGRAM FUNCTION

Defines channel as Digital Input with the function of commanding the execution of the selected setpoint profile **program**.

Closed Enables execution of the program

Open Interrupts (freezes) execution of the program

Available for I/O5 or I/O3 and I/O4 (when available).

Note: Even when the execution of the program is interrupted, the control output remains active and controlling the process at the point (Setpoint) of interruption. The program will resume its normal execution starting from this same point when the digital input is closed.

Pr 1 – DIGITAL INPUT WITH FUNCTION TO EXECUTE PROGRAM 1

Defines the IO channel as Digital Input with the function of commanding the execution of the Setpoint profile **program 1.**

Useful function for switching between the main Setpoint and a secondary one defined by the **program 1**.

Closed Selects program 1

Open Selects main Setpoint

Available for I/O5 or I/O3 and I/O4 (when available).

C.0.20 – 0-20 mA CONTROL OUTPUT

Defines the channel as a 0-20 mA control output.

Available for I/O 5 only.

C.4.20 – 4-20 mA CONTROL OUTPUT

Defines the channel as a 4-20 mA control output.

P.0.20 – 0-20 mA PV RETRANSMISSION

Configures the channel to retransmit the values of PV in 0-20 mA.

Available for I/O 5 only.

P.4.20 – 4-20 mA PV RETRANSMISSION

Configures the channel to retransmit the values of PV in 4-20 mA.

Available for I/O 5 only.

S.0.20 – 0-20 mA SP (SETPOINT) RETRANSMISSION

Configures the channel to retransmit the values of SP in 0-20 mA.

Available for I/O 5 only.

S.4.20 – 4-20 mA SP (SETPOINT) RETRANSMISSION

Configures the channel to retransmit the values of SP in 0-20 mA.

Available for I/O 5 only.

3.3 ALARM CONFIGURATION

The controller has 4 independent alarms. These alarms can be configured to operate with nine functions, as shown in the table below:

- **oFF**: Alarms turned off.
- **lErr**: Open Sensor alarms (Loop Break)

The open sensor alarm acts whenever the input sensor is broken or badly connected.

- **rS**: Program Event Alarm

Configures the alarm to act in (a) specific segment(s) of the programs of ramps and baselines to be created by the user.

- **rFAIL**: Burnt-out Resistance Alarm (Heat Break)

Signals that the heating element has broken up. This alarm function requires the accessory Current transformer CT1.

Details for use of the option "burnt-out resistance" are found in the specific documentation that accompanies the product whenever this option is requested.

- **Lo**: Alarm of Absolute Minimum Value

Triggers when the value of measured PV is **below** the value defined for alarm Setpoint.

- **HI**: Alarm of Absolute Maximum Value

Triggers when the value of measured PV is **above** the value defined for alarm Setpoint.

- **dIF**: Alarm of Differential Value

In this function the parameters **SPA1**, **SPA2**, **SPA3** and **SPA4** represent the Deviation of PV in relation to the SP.

Using the Alarm 1 as example: for Positive SPA1 values, the Differential alarm triggers when the value of PV is **out** of the range defined for:

(SP – SPA1) to (SP + SPA1)

For a negative SPA1 value, the Differential alarm triggers when the value of PV is **within** the range defined above:

- **dIFL**: Alarm of Minimum Differential Value

It triggers when the value of PV is below the defined point by:

(SP – SPA1)

Using the Alarm 1 as example.

- **dIFH :** Alarm of Maximum Differential Value

Triggers when the value of PV is **above** the defined point by:

(SP + SPA1)

Using Alarm 1 as example.

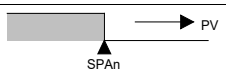
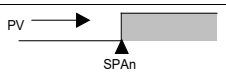
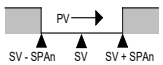
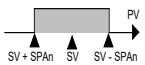
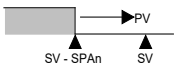
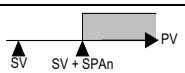
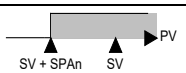
SCREEN	TYPE	ACTION	
oFF	Inoperative	Output is not used as alarm.	
lErr	Open sensor (**i**nput **Err**or)	Activated when the input signal of PV is interrupted, out of the range limits or Pt100 in short-circuit.	
rS	Event (**r**amp and **S**oak)	Activated in a specific segment of program.	
rFAIL	Resistance burnt out (resistance **fail**)	Signals a failure in the heating element.	
Lo	Minimum value (**Lo**w)		
HI	Maximum value (**Hi**gh)		
dIF	Differential (**dif**ferential)		
		Positive SPAn	Negative SPAn
dIFL	Minimum Differential (**dif**ferential **L**ow)		
		Positive SPAn	Negative SPAn
dIFH	Maximum differential (**dif**ferential **H**igh)		
		Positive SPAn	Negative SPAn

Table 3

Where SPAn refers to Setpoints of Alarm **SPA1**, **SPA2**, **SPA3** and **SPA4**.

Important note: Alarms configured with the **H I**, **d IF**, and **d IFH** functions also trigger their associated output when a sensor fault is identified and signaled by the controller. A relay output, for example, configured to function as a High Alarm (**H I**), will operate when the SPAL value is exceeded and when the sensor connected to the controller input is broken.

3.3.1 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 the table below 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**.

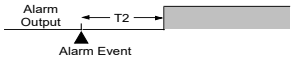
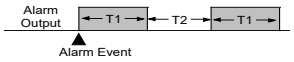
OPERATION	T 1	T 2	ACTION
Normal operation	0	0	
Activation for a defined time	1 to 6500 s	0	
Activation with delay	0	1 to 6500 s	
Intermittent Activation	1 to 6500 s	1 to 6500 s	

Table 4

The LEDs 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.

3.3.2 ALARM INITIAL BLOCKING

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.

3.4 EXTRACTION OF THE SQUARE ROOT

With this feature enabled the controller uses for display and control a value that corresponds to the square root of the applied input signal.

Available only for the inputs belonging to the group of linear analogic signals: 0-20 mA, 4-20 mA, 0-50 mV, 0-5 V, and 0-10 V.

3.5 ANALOG RETRANSMISSION OF PV AND SP

The analog output, when not used for control purposes, is available for retransmitting the PV and SP values in 0-20 or 4-20 mA. This analog output is electrically isolated from other inputs and outputs.

The analog output signal is scalable, with the output range defined by the values programmed in the parameters **rtLL** and **rtHL**.

To obtain a voltage output, the user must install a resistor shunt (550 Ω max.) to the current output terminals (terminals 7 and 8). The actual resistor value depends on the desired output voltage span.

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

3.6 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 used in processes that require slowly start up, where the instantaneous application of 100 % of the available power to the load may cause damages to parts of the system.

Notes:

1. Function only valid when in PID control mode.
2. Setting 0 (zero) in the time interval, the function is disabled.

3.7 REMOTE SETPOINT

The controller can have its Setpoint value defined by an analog, remotely generated signal. This feature is enabled through the channels I/O3, I/O4 or I/O5 when configured as digital inputs and configured with the function **rSP** (Remote SP selection) or through the parameter **E.rSP**. The remote setpoint input accepts the signals 0-20 mA, 4-20 mA, 0-5 V, and 0-10 V.

For the signals of 0-20 and 4-20 mA, a shunt resistor of **100 Ω** is required between terminals 9 and 10, as shown in **Figure 7**.

3.8 CONTROL MODE

The controller can operate in two different manners: **1)** Automatic mode or **2)** 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.

3.9 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 considers 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 PID PARAMETERS DEFINITION of this manual.

3.10 LBD − LOOP BREAK DETECTION ALARM

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

An LBD event may be sent to any I/O channel. Simply configure the **Ldb** function to the desired I/O channel: 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 **Ldb** is useful in system supervision and troubleshooting, allowing early detection of problems in the actuator, power source or load.

3.11 HBD − HEATER BREAK DETECTION

Available in the products identified with the suffix HBD. For further information, visit the link:

www.novusautomation.com/en/N1200HBD_appendix

3.12 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 forcing MV to assume the user configured value in the **IE.ou** parameter.

When the parameter **IE.ou** is configured with 0.0 (zero) value, this function is disabled, and the control output is simply turned off upon input sensor error.

3.13 USB INTERFACE

The USB interface is used to CONFIGURE, MONITOR or UPDATE the controller FIRMWARE. The user should use **QuickTune** software, which offers features to create, view, save and open settings from the device or files on the computer. The tool for saving and opening configurations in files allows the user to transfer settings between devices and perform backup copies.

For specific models, **QuickTune** allows to update the firmware (internal software) of the controller via the USB interface.

For MONITORING purposes, the user can use any supervisory software (SCADA) or laboratory software that supports the MODBUS RTU communication over a serial communication port. When connected to a computer's USB, the controller is recognized as a conventional serial port (COM x).

The user must use **QuickTune** software or consult the DEVICE MANAGER on the Windows Control Panel to identify the COM port assigned to the controller.

The user should consult the mapping of the MODBUS memory in the controller's communication manual and the documentation of the supervision software to start the MONITORING process.

Follow the procedure below to use the USB communication of the device:

1. Download **QuickTune** software from our website and install it on the computer. The USB drivers necessary for operating the communication will be installed with the software.
2. Connect the USB cable between the device and the computer. The controller does not have to be connected to a power supply. The USB will provide enough power to operate the communication (other device functions may not operate).
3. Run the **QuickTune** software, configure the communication and start the device recognition.

The USB interface IS NOT SEPARATE from the signal input (PV) or the controller's/indicator's digital inputs and outputs. It is intended for temporary use during CONFIGURATION and MONITORING periods.

For the safety of people and equipment, it must only be used when the piece of equipment is completely disconnected from the input/output signals.

Using the USB in any other type of connection is possible but requires a careful analysis by the person responsible for installing it.

When MONITORING for prolonged periods of time and with connected inputs and outputs, we recommend using the RS485 interface, which is available or optional in most of our products.

4. INSTALLATION / CONNECTIONS

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

- Prepare a panel cut-out according to Specifications.
- 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 INSTALLATION RECOMMENDATIONS

- 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 cannot assure total protection.

4.2 ELECTRICAL CONNECTIONS

The controller's internal circuits can be removed without undoing the connections on the back panel. The figure below shows the disposition of the features placed on the back panel of the controller:

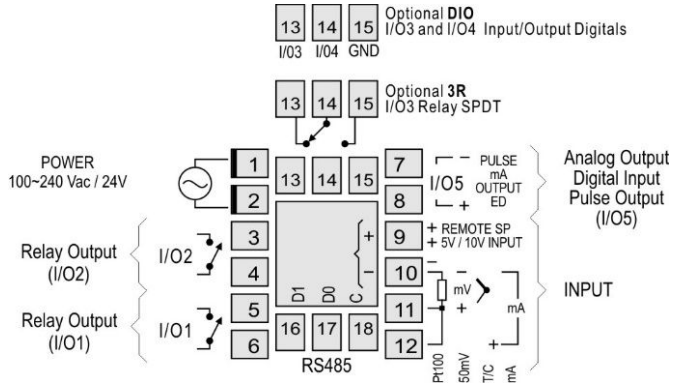
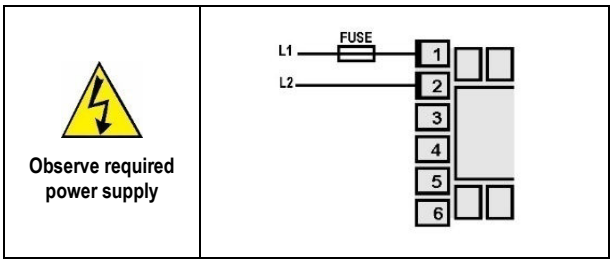


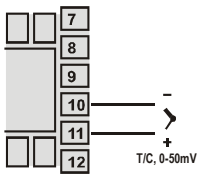
Figure 1

4.2.1 POWER SUPPLY CONNECTIONS



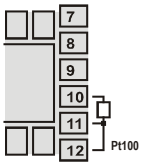
4.2.2 INPUT CONNECTIONS

THERMOCOUPLE (T/C) AND 0-50 mV

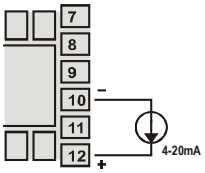


The figure indicates the wiring for the thermocouple and 0-50 mV signals. If the thermocouple wires need to be extended, use appropriate compensation cables.

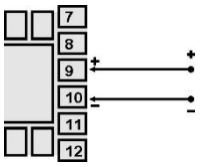
RTD (Pt100)

	The figure shows the Pt100 wiring, for 3 conductors. For proper cable length compensation, use conductors of same gauge and length. For 4-wires Pt100, leave one conductor disconnected at the controller. For 2-wire Pt100, short-circuit terminals 11 and 12.

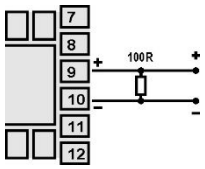
4-20 mA

	The connections for current signals 4-20 mA must be conducted according to the figure.

5 V AND 10 V

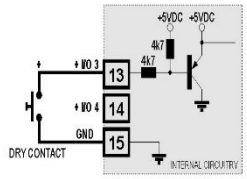
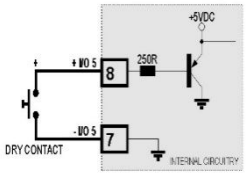
	Refer to the figure for connecting voltage signals.

4.2.3 REMOTE SETPOINT

	Feature available in terminals 9 and 10. When the Remote SP input signal is 0-20 mA or 4-20 mA, an external 100 Ω shunt resistor of must be connected to terminals 9 and 10 as indicated in this figure.

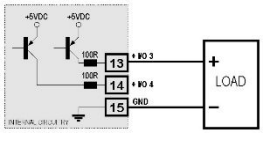
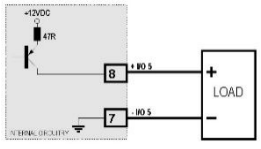
4.2.4 DIGITAL INPUT CONNECTIONS

To trigger I/O3, I/O4, and I/O5 channels as Digital Inputs, connect a key or similar (Dry Contact) to the terminals.

	I/O3 as a Digital Input	I/O5 as a Digital Input
		

4.2.5 ALARMS AND OUTPUTS CONNECTIONS

When configured as outputs, the I/O channels must have their load limit capacities observed, according to the Specifications.

	IO3 or I/O4 with output pulse for SSR	I/O5 with output pulse for SSR
		

5. OPERATION

The front panel can be seen in the figure below:

Figure 2

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

Display of SP / Parameters: 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 indicator lights continuously.

A1, A2, A3, and A4 indicators: signalize the occurrence of alarm situation.

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

◄ **Back Key**: Key used to retrocede parameters.

▲ **Increment key and** ▼ **Decrement key:** Keys used to alter the values of the parameters.

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

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 determines a valid condition or a valid value.

Note:
The **Input Type** must be the first parameter 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/O	
7 − Calibration	

Table 5

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

◄ (BACK) and P (PROG) pressed simultaneously

Press P to advance or ◄ 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 ◄ key for 3 seconds

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

Note: It is recommended to disable/suspend the control (**run** = **no**) whenever it is necessary to change the device settings.

6. DESCRIPTION OF THE PARAMETERS

6.1 OPERATION CYCLE

PV Indication (Red Screen) SP Indication (Green Screen)	PV and SP indication. The upper display shows the current value of PV. The lower display shows the control SP value.
CtrL *Control*	Control Mode: **AuTo** Means automatic control mode. **mAn** Means manual control mode. Bumpless transfer between automatic and manual control modes.
PV Indication (Red Screen) MV Indication (Green Screen)	Manipulated Variable value (MV). The upper display shows PV value. The lower display shows the **percentage** of MV applied to the control output. When in manual control, the MV value can be manually changed by the ▲ and ▼ keys. When in auto mode the MV value can only be viewed. To distinguish the MV display from the SP display, the MV is shown flashing intermittently.
E Pr *Enable Program*	Program execution. 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.
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 **Pr.tb** parameter.
run *Run*	Enables control outputs and alarms. **YES** Outputs enabled. **no** Outputs not enabled.

6.2 TUNING CYCLE

AtUn *Auto-tune*	Defines the control strategy to be taken: **oFF** Turned off. **FASt** Fast automatic tuning. **FULL** More accurate automatic tuning. **SELF** Precise + auto-adaptive tuning **rALF** Forces <u>one</u> new precise automatic precise + auto-adaptive tuning. **tGHt** Forces <u>one</u> new precise automatic + auto-adaptive tuning when **run** = **YES** or the controller is turned on.
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 %. **When set with 0.0, determines ON/OFF control mode.**
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. Hysteresis value for ON/OFF control. Adjustable between **0** and the measurement input type span.

Act *Action*	Control action: **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.
Lbdt *Loop break detection time*	Time interval for the LBD function. Defines the maximum interval of time for the PV to react to a control command. In minutes
bIAS *Bias*	Bias function. 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 %**.
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 %**.
SFSt *Soft Start*	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 zero (zero value disables the Soft start function).
SPA1 **SPA2** **SPA3** **SPA4** *Alarm Setpoint*	Alarm Setpoint. 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.

6.3 PROGRAMS CYCLE

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 within the defined tolerance. The value 0 (zero) disables the function.
PSP0 **PSP9** *Program SP*	Program SP. 0 to 9. Group of 10 values of SP that define the Ramp and Soak profile segments.
Pt 1 **Pt9** *Program Time*	Segment duration. 1 to 9. Defines the time of duration, in second or minutes, of the segments of the program being edited.
PE 1 **PE9** *Program event*	Event alarm. 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**.
LP *Link Program*	Link programs. Number of the next profile program to be linked following the current program. **0** Do not link to any other program.

6.4 ALARM CYCLE

FuA1 FuA2 FuA3 FuA4 *Function Alarm*	Alarm functions. Defines the functions for the alarms: **oFF, lErr, rS, rFAIL, Lo, HI, dIFL, dIFH, dIF**
bLA1 bLA2 bLA3 bLA4 *Blocking Alarm*	Alarm initial blocking. Function used to initially block alarms 1 to 4. **YES** Enables initial blocking. **no** Inhibits initial blocking.
HYA1 HYA2 HYA3 HYA4 *Alarm Hysteresis*	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 A3t1 A4t1 *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.
A1t2 A2t2 A3t2 A4t2 *Alarm Time* **t2**	Alarm Time **t2.** Defines the temporization time **t2**, in seconds, for the alarms time functions. The value 0 (zero) disables the function.
FLSh *Flash*	Allows visual signalization of an alarm occurrence by flashing the indication of **PV** in the operation level. To enable, the user chooses which alarms are to be associated with this feature: 1, 2, 3, 4.

6.5 SCALE CYCLE

tYPE *Type*	Input type. Selects the input signal type to be connected to the process variable input. Refer to **Table 1**. **The first parameter to be configured.**
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*	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 define the temperature unit to be used: Celsius **°C** or Fahrenheit **°F** When using a temperature sensor, this parameter will be shown.
root *Square Root*	Square Root Function. Applies the quadratic function on the input signal, within the limits programmed in **SPLL** and **SPHL**. **YES** Enables the function. **no** Does not enable the function. The indication assumes the lower limit value when the input signal is below 1 % of programmed span. Parameter available for lineal inputs only.
OFFS *Offset*	Offset value to be added to the PV reading to compensate sensor error. Default value: zero.
E.rSP *Enable Remote SP*	Allows you to Enable remote SP. **YES** Enables the function. **no** Does not enable the function. This parameter is not displayed when the remote SP selection is defined by a Digital Input.

rSP *Remote SP type*	Defines the signal type for the remote SP. **0-20** Current of 0-20 mA. **4-20** Current of 4-20 mA. **0-5** Voltage of 0-5 V. **0- 10** Voltage of 0-10 V. Parameter displayed when remote SP is enabled.
rSLL *Remote SP Low Limit*	Remote setpoint low limit. Used in conjunction with the **rSHL**, scales the remote SP input defining the initial value in the remote SP indication range. Parameter displayed when remote SP is enabled.
rSHL *Remote SP High Limit*	Remote Setpoint High Limit. defines the full-scale indication of the Remote Setpoint. Parameter displayed when remote SP is enabled.
SPLL *Setpoint Low Limit*	Defines the SP lower limit of SP. For the linear analog input types available (0-20 mA, 4-20 mA, 0-50 mV, 0-5 V and 0-10 V), defines the minimum PV indication range, besides limiting the SP adjustment.
SPHL *Setpoint High Limit*	Defines the upper limit for adjustment of SP. For the linear analog input types available (0-20 mA, 4-20 mA, 0-50 mV, 0-5 V and 0-10 V), defines the maximum PV indication range, besides limiting the SP adjustment.
rtLL *Retransmission Low Limit*	In association with the **rtHL** parameter, it defines the analog retransmission scale for PV or SP. The **rtLL** represents the. minimum scale value for the analog output This parameter is displayed only if the analog retransmission is selected in the I/O 5 parameter (I/O level).
rtHL *Retransmission High Limit*	Defines the full-scale value for the analog retransmission of PV or SP. This parameter is displayed only when the analog retransmission is selected in the I/O 5 parameter (I/O level).
IEou	Percentage output value that will be transfer 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.
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. **EVEn** 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.

6.6 I/O (INPUTS AND OUTPUTS) CYCLE

io 1	I/O1 channel function. Selection of the function used in the channel I/O1.
io 2	I/O2 channel function. Selection of the function used in the channel I/O2.
io 3	I/O3 channel function. Selection of the function used in the channel I/O3.
io 4	I/O4 channel function. Selection of the function used in the channel I/O4.
io 5	I/O5 channel function. Selection of the function used in the channel I/O5.

6.7 CALIBRATION CYCLE

All the input and output types are calibrated in the factory. If a recalibration is required, this should be conducted by 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 CONFIGURATION PROTECTION section.
InLC *Input Low Calibration*	Enter the value corresponding to the low scale signal applied to the analog input. See INPUT CALIBRATION section.
InHC *Input High Calibration*	Enter the value corresponding to the full-scale signal applied to the analog input. See INPUT CALIBRATION section.

rSLC *Remote SP Low Calibration*	Enter the value corresponding to the low scale signal applied to the remote SP input. See INPUT CALIBRATION section.
rSHC *Remote SP High Calibration*	Enter the value corresponding to the full-scale signal applied to the remote SP input. See INPUT CALIBRATION section.
OuLC *Output Low Calibration*	Enter the analog low value as measured at the analog output. See ANALOG OUTPUT CALIBRATION section.
OuHC *Output High Calibration*	Enter the analog high value as measured at the analog output. See ANALOG OUTPUT CALIBRATION section.
rStr *Restore*	Restores the factory calibration for all inputs and outputs, disregarding modifications conducted by the user.
CJ *Cold Junction*	Adjusts the of cold junction temperature value.
HtYP *Hardware Type*	Parameter that informs the controller about the hardware optional 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** HBD + 485 **Note:** The options **6** and **7** not are used.
PASC *Password*	Allows defining a new access password, always different from zero.
Prot *Protection*	Sets up the Level of Protection. See **Table 8**.
FrE9 *Frequency*	Mains frequency. This parameter is important for proper noise filtering.

6.8 ALL PARAMETERS

OPERATION CYCLE	TUNING CYCLE	PROGRAM CYCLE	ALARM CYCLE	CONFIGURATION CYCLE	I/O CYCLE	CALIBRATION CYCLE
PV and SP	AtUn	Pr.tb	FuA1 - FuA4	tYPE	Io1	PASS
CtrL	Pb	Pr n	bLA1 - bLA4	FLtr	Io2	InLC
PV and MV	Ir	PtoL	HYA1 - HYA4	dPPo	Io3	InHC
EPr	dt	PSP0 – PSP9	A1t1	unit	Io4	rSLC
P.SEG	Ct	Pt1 – Pt9	A1t2	root	Io5	rSHC
t.SEG	HYSt	PE1 – PE9	A2t1	oFFS		OuLC
run	ACt	LP	A2t2	ErSP		OuHC
	Lbdt		FLSh	rSP		rStr
	b1AS			rSLL		CJ
	ouLL			rSHL		HtYP
	ouHL			SPLL		PASC
	SFSt			SPHL		Prot
	SPA1 - SPA4			1Eou		FrE9
				rtLL		
				rtHL		
				bAud		
				PrtY		
				Addr		

Table 6

7. CONFIGURATION PROTECTION

The controller provides means for protecting the parameters configurations, not allowing modifications to the parameter values, avoiding tampering or improper manipulation.

The parameter **Protection** (*Prot*), in the Calibration level, determines the protection strategy, limiting the access to certain levels, as shown by the table below.

PROTECTION LEVEL	PROTECTED CYCLES
1	Only the Calibration level is protected.
2	I/O and Calibration levels.
3	Tuning, I/O, and Calibration levels.
4	Alarm, Tuning, I/O, and Calibration levels.
5	Programs, Alarm, Tuning, I/O, and Calibration levels.
6	Tuning, Programs, Alarm, Input, I/O, and Calibration levels.
7	Operation (except SP), Tuning, Programs, Alarm, input, I/O, and Calibration levels.
8	Operation, Tuning, Programs, Alarm, Input, I/O, and Calibration levels.

Table 7

7.1 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 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.

7.2 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.

7.3 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 does not 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.

8. RAMPS AND SOAKS PROGRAMS

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:

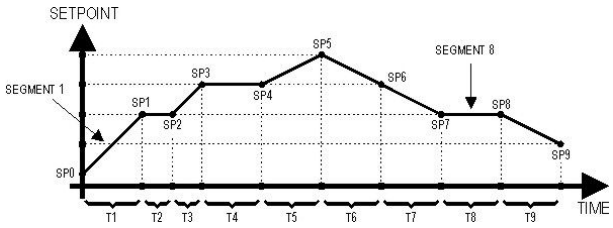


Figure 3

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.

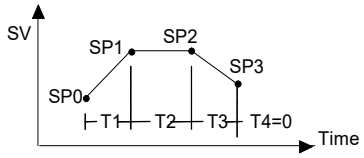


Figure 4

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).

The configured **time limit** for each segment is 9999 and can be displayed in seconds or minutes, depending on the time base configured.

8.1 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.

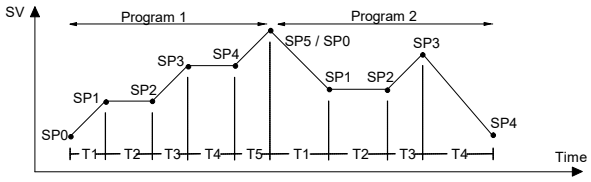


Figure 5

8.2 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** 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.

9. PID PARAMETERS DEFINITION

The determination (or tuning) of the PID control parameters in the controller can be conducted in an automatic way and auto-adaptive 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.

9.1 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.

9.2 AUTO-ADAPTIVE TUNING

Is initiated by the controller whenever the control performance is worse than the one found after the previous tuning.

To activate the performance supervision and **Auto-Adaptive Tuning**, the parameter ATUN must be adjusted for SELF, RSLF or TGHT.

The controller's behavior during the **Auto-Adaptive Tuning** will depend on the worsening of the present performance. If the maladjustment is small, the tuning is almost imperceptible for the user. If the maladjustment is big, the **Auto-Adaptive Tuning** is like the method of **Automatic Tuning**, applying minimum and maximum performance to the process in ON/OFF control.

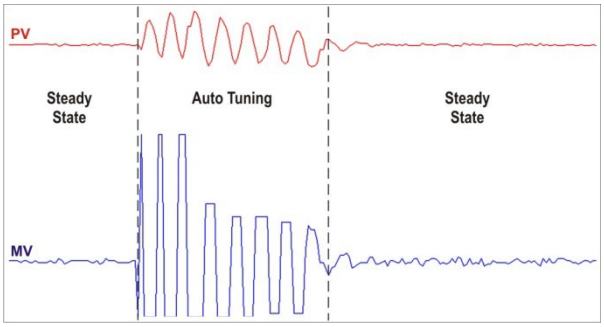


Figure 6

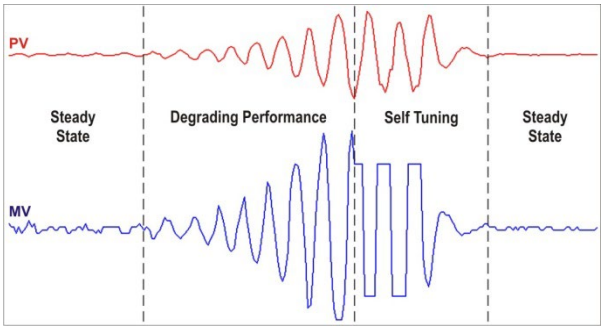


Figure 7

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-Adaptive 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-Adaptive 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:** Like the SELF mode, but in addition to the **Auto-Adaptive 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 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 the table below for guidelines on how to correct the behavior of the process:

PARAMETER	VERIFIED PROBLEM	SOLUTION
Proportional band	Slow answer	Decrease
	Great oscillation	Increase
Integration rate	Slow answer	Increase
	Great oscillation	Decrease
Derivative time	Slow answer or instability	Decrease
	Great oscillation	Increase

Table 8

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	PROBLEM DESCRIPTION
nnnn	Open input. No sensor or signal.
Err 1 Err6	Connection and/or configuration errors. Check the wiring and the configuration.

Table 9

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 INPUT CALIBRATION

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.

10.3 ANALOG OUTPUT CALIBRATION

1) Configure I/O 5 for the current output to be calibrated, be it control or retransmission.

2) In the screen **ctrL**, program manual mode (**iMAn**).

3) Connect a current meter to the analog output.

4) Enter the calibration cycle with the correct password.

5) Select the screen **ouLc**. Press the keys ▲ and ▼ for the controller to recognize the calibration process of the current output.

6) Read the current indicated on the current meter and adjust the parameter **ouLc** to indicate this current value (use the keys ▲ and ▼)

7) Select the screen **ouHc**. Press the keys ▲ and ▼ for the controller to recognize the calibration process of the current output.

8) Read the current indicated on the current meter and adjust the parameter **ouHc** to indicate this current value

9) Press the key P to confirm the calibration procedure and return to the operating level.

11. 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.

11.1 FEATURES

- 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 RS485 signals are:

D1	D	D+	B	Bidirectional data line.	Terminal 16
D0	$\overline{D}$	D-	A	Inverted bidirectional data line.	Terminal 17
C				Optional connection that improves communication performance.	Terminal 18
GND					

Table 10

11.2 CONFIGURATION OF PARAMETERS FOR SERIAL COMMUNICATION

To use the serial, you must set the following parameters:

bAud: Communication speed.

PrtY: Communication parity.

Addr: Communication address for the controller.

11.3 COMMUNICATION PROTOCOL

The Modbus 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*
05	*Force Single Coil*
06	*Preset Single Register*
16	*Preset Multiple Register*

11.4 HOLDING REGISTERS TABLE

Follows a description of the usual communication registers.

For full documentation, see ATTACHMENT 1.

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.

ADDRESS	PARAMETER	REGISTER DESCRIPTION
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 %).

Table 11

12. CONFIGURATION EXAMPLES

On **NOVUS** product page, you can download a file with configuration examples for **N1200**: www.novusautomation.com/en/examples_N1200.

13. SPECIFICATIONS

DIMENSIONS: ..... 48 x 48 x 110 mm (1/16 DIN)

Panel cutout: ..... 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 °C

For temperatures above 30 °C, reduce 3 % for each °C.

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)

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

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

Accuracy: ..... Thermocouples **J**, **K**, **T**, **E:** 0.25 % of the span ±1 °C

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

..... 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, Thermocouples: >10 MΩ

..... 0-5 V: >1 MΩ

..... 4-20 mA: 15 Ω (+2 Vdc @ 20 mA)

Measurement of Pt100: ..... 3-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-NO (I/O1 and I/O2): 1.5 A / 240 Vac, typical use

..... 1 Relay SPDT (I/O3): 3 A / 250 Vac, typical 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

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

START-UP OPERATION: ..... 3 seconds after connecting the device to the power supply.

CERTIFICATIONS: CE, UKCA, UL (FILE: 300526)

14. IDENTIFICATION

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

A: Controller Model:

N1200

B: Optional I/O:

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)

15. WARRANTY

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

16. ATTACHMENT 1 – COMMUNICATION PROTOCOL

16.1 COMMUNICATION INTERFACE

The optional RS485 serial interface allows you to address up to 247 networked controllers, communicating remotely with a computer or master controller.

16.2 RS485 INTERFACE

- Compatible line signals with RS485 standard.
- 3-wire connection between master and up to 31 slaves controllers in a bus topology. With converters with multiples outputs, it is possible to address up to 247 nodes.
- Maximum communication distance: 1000 meters.
- The RS485 signals are:

D1	D	D+	B	Bidirectional data line.	Terminal 16
D0	$\overline{D}$	D-	A	Inverted bidirectional data line.	Terminal 17
C				Optional connection that improves communication performance.	Terminal 18
GND					

Table 12

16.3 GENERAL FEATURES

- Serial interface optical isolation.
- Programmable Baud Rate: 1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200 bps.
- Data Bits: 8
- Parity: None, Even or Odd.
- Stop Bits: 1

16.4 COMMUNICATION PROTOCOL

The device supports slave MODBUS RTU protocol, available in most supervisory software found in the market.

Using the Register Tables, you can access (read and/or write) the controller configurable parameters. By using address **0**, it is possible to write to the registers in Broadcast mode.

The available Modbus commands are the following:

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

The registers are presented in a table, so that it is possible to read several registers with one request.

16.4.1 SETTING THE COMMUNICATION PARAMETERS

To use the serial, you must set 3 parameters:

bAud: Communication baud rate. All devices have the same baud rate.

Addr: Controller communication address. Each controller must have a unique address.

PrtY: Parity.

16.4.2 REGISTER TABLE

Same as the Holding Registers (reference 4X). The registers are the internal parameters of the controller. Most of the registers up to address 12 are read-only. Check each case.

Each parameter in the table is a 16-bit word with sign represented as a 2 complement.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0000	Active SP	Read: Active control Setpoint (from main screen, Ramps and Soaks, or remote Setpoint). Write: Control Setpoint on the main screen. Maximum range: From **SPLL** to the value set in **SPHL**.
0001	PV	Read: Process variable. Write: Not allowed. Maximum range: The minimum value is the value set in **SPLL**. The maximum value is the value set in **SPHL**. The position of the decimal point depends on the **dPPo** screen. When reading the temperature, the value will always be multiplied by 10, regardless of the **dPPo** value.
0002	MV	Read: Power output enabled (manual or automatic). Write: When in manual mode, it allows you to write the MV. When in automatic mode, this register is Read Only. Range: 0 to 1000 (0.0 to 100.0 %).
0003	Remote SP	Read/Write: Input type selected for the remote SP. Range: 0 – 3
0004	Screen value	Read: Value on the current screen. Write: Value on the current screen. Maximum range: -1999 to 9999. The range depends on the screen shown.
0005	Screen number	Read: Number of the current screen. Write: Not allowed. Range: 0000 h a 060 Ch. Screen number formation: XXYYh, where: XX → Number of the screen cycle YY → Screen number
0006	Status Word 1	Read: Controller status Bits. Write: Not allowed. Read value: See STATUS WORDS section.
0007	Software Version	Read: Controller software version. Write: Not allowed. Read values: If the equipment version is V1.00, for example, the read value will be 100.
0008	ID	Read: Device identification number. Write: Not allowed. Read value: 48 (30 h) for **N1200**. Read value: 18 (12 h) for **N1200-HC**.
0009	Status Word 2	Read: Controller status Bits. Write: Not allowed. Read value: See STATUS WORDS section.
0010	Status Word 3	Read: Controller status Bits. Write: Not allowed. Read value: See STATUS WORDS section.
0011	**Ir**	Integral rate (in repetitions/min). Range: 0 to 9999 (0.00 to 99.99).
0012	**dt**	Derivative time (in seconds). Range: 0 to 3000 (0.0 to 300.0).
0013	**Pb**	Proportional band (in percent). Range: 0 to 5000 (0.0 to 500.0).
0014	**Prtb**	Read/Write: Time base for Ramps and Soaks. Range: 0 – 1 (seconds/minutes).

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0015	ct	PWM cycle period (in seconds). Range: 5 to 1000 (0.5 to 100.0).
0016	FrEQ	Read/Write: Power grid frequency. Range: 0 – 1 (60/50 Hz).
0017	HYSt	On/Off control hysteresis (on the engineering unit of the selected type). Range: 0 to SPHL – SPLL
0018	FLtr	Read/Write: Filter strength on PV reading. Range: 0 – 20
0019	ouLL	Lower limit of output power. Range: 0 to 1000 (0.0 to 100.0 %).
0020	ouHL	Upper limit of output power. Range: 0 to 1000 (0.0 to 100.0 %).
0021~0022	Reserved	Internal use.
0023	Serial number high	First four numbers of the serial number. Range: 0 to 9999. Read-only.
0024	Serial number low	Last four numbers of the serial number. Range: 0 to 9999. Read-only.
0025	SV	Control Setpoint (Screen Setpoint). Range: From SPLL to SPHL.
0026	SPLL	Setpoint lower limit. Range: The minimum value depends on the input type set in tYPE (see **Table 1**). The maximum value is the value set in SPHL.
0027	SPHL	Setpoint upper limit. Range: From SPLL to the maximum allowed for the selected input in tYPE (see **Table 1**).
0028	Reserved	Internal use.
0029	oFFS	PV (Process Variable) Offset value. Range: From SPLL to SPHL.
0030	dPPo	PV decimal point position. Range: 0 to 3. 0 → X.XXX 1 → XX.XX 2 → XXX.X 3 → XXXX
0031	SPA1	Alarm Setpoint.
0032	SPA2	
0033	SPA3	
0034	SPA4	
0035	FuA1	Alarm function. Range: 0 to 10. 0 → oFF 1 → lErr 2 → rS 3 → Lo 4 → H I 5 → d IF 6 → d IFL 7 → d IFH 8 → HbL 9 → HbH 10 → HbLH
0036	FuA2	
0037	FuA3	
0038	FuA4	
0039	HYA1	Alarm 1 hysteresis.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0040	HYA2	Range: 0 to 9999 (0.00 to 99.99 %).
0041	HYA3	
0042	HYA4	
0043	tYPE	Type of PV input sensor. Range: 0 to 22.
0044	Addr	Slave address. Range: 1 to 247
0045	bAud	Communication Baud Rate. Range: 0 to 7. 0 → 1200 1 → 2400 2 → 4800 3 → 9600 4 → 19200 5 → 32400 6 → 57600 7 → 115200
0046	Auto	Control mode. Range: 0 → Manual 1 → Automatic
0047	run	Enable control. Range: 0 → No 1 → Yes
0048	Act	Control action. Range: 0 → Direct 1 → Reverse
0049	Atun	Enable Auto-Tuning. Range: 0 → No 1 → Yes
0050	bLA1	Alarm 1 initial blocking. Range: 0 → No 1 → Yes
0051	bLA2	
0052	bLA3	
0053	bLA4	
0054	Tecla	Remote action of the pressed key. Range: 0 to 9. 1 → P key 2 → ∧ key 4 → ∨ key 8 → < key 9 → P and < keys
0055	rSLL	Remote Setpoint lower limit. Range: The minimum value depends on the input type set in tYPE. The maximum value is the value set in rSHL.
0056	rSHL	Remote Setpoint upper limit. Range: The minimum value is the value set in rSLL. The maximum value depends on the input type set in tYPE.
0057	Io 1	I/O channel function.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0058	Io 2	
0059	Io 3	
0060	Io 4	
0061	Io 5	
0062	A1t1	Time 1 of alarm timer 1. Range: 0 to 6500 s.
0063	A1t2	Time 2 of alarm timer 1 (in seconds). Range: Same as in A1t1.
0064	A2t1	Time 1 of alarm timer 2 (in seconds). Range: Same as in A1t1.
0065	A2t2	Time 2 of alarm timer 2 (in seconds). Range: Same as in A1t1.
0066	SFSt	Time de Soft Start (in seconds). Range: 0 to 9999.
0067	unit	Temperature unity. Range: 0 to 1. 0 → °C 1 → °F
0068	bIAS	Bias. Range: -100 to 100 %.
0069	Reserved	Internal use.
0070	R&S Segment	Running Ramps and Soaks segment number (read-only). Range: 0 to 9.
0071	Pr n	Ramps and Soaks program to be viewed (edited). Range: 1 to 20.
0072	E Pr	Ramps and Soaks program being executed. Range: 0 to 20.
0073	R&S Time remaining	Indicates the remaining time of the Ramps and Soaks segment.
0074	SQrt	Square root of a linear input. Range: 0 → Disable 1 → Enable
0075	PV Calibration (Start)	Calibration operator to enter the range start value currently applied to the PV input.
0076	PV Calibration (End)	Calibration operator to enter the end-of-range value currently applied to the PV input.
0077	Remote Setpoint Calibration (Start)	Calibration operator to enter the range start value currently applied to the Remote Setpoint input.
0078	Remote Setpoint Calibration (End)	Calibration operator to enter the end-of-range value currently applied to the Remote Setpoint input.
0079	rtLL	Retransmission lower limit.
0080	rtHL	Retransmission upper limit.
0081	FLSh	Enables the flashing upper display feature depending on the selected alarm. Range: 0 to 15.
0082	A3t1	Time 1 of alarm timer 3 (in seconds). Range: Same as in A1t1.
0083	A3t2	Time 2 of alarm timer 3 (in seconds). Range: Same as in A1t2.
0084	A4t1	Time 1 of alarm timer 4 (in seconds). Range: Same as in A1t1.
0085	A4t2	Time 2 of alarm timer 4 (in seconds). Range: Same as in A1t2.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0086	rStr	Restores factory calibration. Range: 0 to 1 0 → No restore 1 → Restore calibration
0087	PASS	Writes the password. Always reads 0.
0088	Prot	Password protection level used. Range: 1 to 7.
0089	PrtY	Serial channel parity. Range: 0 to 2 0 → No parity 1 → Even 2 → Odd
0090~ 0097	Reserved	Internal use.
0098	ErSP	Enable remote Setpoint. Range: 0 → Remote Setpoint depends on the I/O configuration 1 → Forces remote Setpoint
0099	Reserved	Internal use.
0100	PE 1	Segment 1 event of program 1 (R&S). Range: 0 to 15.
0101	PE2	Segment 2 event of program 1 (R&S). Range: Same as in PE 1.
0102	PE3	Segment 3 event of program 1 (R&S). Range: Same as in PE 1.
0103	PE4	Segment 4 event of program 1 (R&S). Range: Same as in PE 1.
0104	PE5	Segment 5 event of program 1 (R&S). Range: Same as in PE 1.
0105	PE6	Segment 6 event of program 1 (R&S). Range: Same as in PE 1.
0106	PE7	Segment 7 event of program 1 (R&S). Range: Same as in PE 1.
0107	PE8	Segment 8 event of program 1 (R&S). Range: Same as in PE 1.
0108	PE9	Segment 9 event of program 1 (R&S). Range: Same as in PE 1.
0109	PE 1	Segment 1 event of program 2 (R&S). Range: Same as in PE 1 of program 1.
0110	PE2	Segment 2 event of program 2 (R&S). Range: Same as in PE 1.
0111	PE3	Segment 3 event of program 2 (R&S). Range: Same as in PE 1.
0112	PE4	Segment 4 event of program 2 (R&S). Range: Same as in PE 1.
0113	PE5	Segment 5 event of program 2 (R&S). Range: Same as in PE 1.
0114	PE6	Segment 6 event of program 2 (R&S). Range: Same as in PE 1.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0115	PE7	Segment 7 event of program 2 (R&S). Range: Same as in PE 1.
0116	PE8	Segment 8 event of program 2 (R&S). Range: Same as in PE 1.
0117	PE9	Segment 9 event of program 2 (R&S). Range: Same as in PE 1.
0119	PE 1	Segment 1 event of program 3 (R&S). Range: Same as in PE 1 of program 1.
0120	PE2	Segment 2 event of program 3 (R&S). Range: Same as in PE 1.
0118	PE3	Segment 3 event of program 3 (R&S). Range: Same as in PE 1.
0121	PE4	Segment 4 event of program 3 (R&S). Range: Same as in PE 1.
0122	PE5	Segment 5 event of program 3 (R&S). Range: Same as in PE 1.
0123	PE6	Segment 6 event of program 3 (R&S). Range: Same as in PE 1.
0124	PE7	Segment 7 event of program 3 (R&S). Range: Same as in PE 1.
0125	PE8	Segment 8 event of program 3 (R&S). Range: Same as in PE 1.
0126	PE9	Segment 9 event of program 3 (R&S). Range: Same as in PE 1.
0127	PE 1	Segment 1 event of program 4 (R&S). Range: Same as in PE 1 of program 1.
0128	PE2	Segment 2 event of program 4 (R&S). Range: Same as in PE 1.
0129	PE3	Segment 3 event of program 4 (R&S). Range: Same as in PE 1.
0130	PE4	Segment 4 event of program 4 (R&S). Range: Same as in PE 1.
0131	PE5	Segment 5 event of program 4 (R&S). Range: Same as in PE 1.
0132	PE6	Segment 6 event of program 4 (R&S). Range: Same as in PE 1.
0133	PE7	Segment 7 event of program 4 (R&S). Range: Same as in PE 1.
0134	PE8	Segment 8 event of program 4 (R&S). Range: Same as in PE 1.
0135	PE9	Segment 9 event of program 4 (R&S). Range: Same as in PE 1.
0136	PE 1	Segment 1 event of program 5 (R&S). Range: Same as in PE 1 of program 1.
0137	PE2	Segment 2 event of program 5 (R&S). Range: Same as in PE 1.
0138	PE3	Segment 3 event of program 5 (R&S). Range: Same as in PE 1.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0139	PE4	Segment 4 event of program 5 (R&S). Range: Same as in PE 1.
0140	PE5	Segment 5 event of program 5 (R&S). Range: Same as in PE 1.
0141	PE6	Segment 6 event of program 5 (R&S). Range: Same as in PE 1.
0142	PE7	Segment 7 event of program 5 (R&S). Range: Same as in PE 1.
0143	PE8	Segment 8 event of program 5 (R&S). Range: Same as in PE 1.
0144	PE9	Segment 9 event of program 5 (R&S). Range: Same as in PE 1.
0145	PE 1	Segment 1 event of program 6 (R&S). Range: Same as in PE 1 of program 1.
0146	PE2	Segment 2 event of program 6 (R&S). Range: Same as in PE 1.
0147	PE3	Segment 3 event of program 6 (R&S). Range: Same as in PE 1.
0148	PE4	Segment 4 event of program 6 (R&S). Range: Same as in PE 1.
0149	PE5	Segment 5 event of program 6 (R&S). Range: Same as in PE 1.
0150	PE6	Segment 6 event of program 6 (R&S). Range: Same as in PE 1.
0151	PE7	Segment 7 event of program 6 (R&S). Range: Same as in PE 1.
0152	PE8	Segment 8 event of program 6 (R&S). Range: Same as in PE 1.
0153	PE9	Segment 9 event of program 6 (R&S). Range: Same as in PE 1.
0154	PE 1	Segment 1 event of program 7 (R&S). Range: Same as in PE 1 of program 1.
0155	PE2	Segment 2 event of program 7 (R&S). Range: Same as in PE 1.
0156	PE3	Segment 3 event of program 7 (R&S). Range: Same as in PE 1.
0157	PE4	Segment 4 event of program 7 (R&S). Range: Same as in PE 1.
0158	PE5	Segment 5 event of program 7 (R&S). Range: Same as in PE 1.
0159	PE6	Segment 6 event of program 7 (R&S). Range: Same as in PE 1.
0160	PE7	Segment 7 event of program 7 (R&S). Range: Same as in PE 1.
0161	PE8	Segment 8 event of program 7 (R&S). Range: Same as in PE 1.
0162	PE9	Segment 9 event of program 7 (R&S). Range: Same as in PE 1.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0163	PE 1	Segment 1 event of program 8 (R&S). Range: Same as in PE 1 of program 1.
0164	PE2	Segment 2 event of program 8 (R&S). Range: Same as in PE 1.
0165	PE3	Segment 3 event of program 8 (R&S). Range: Same as in PE 1.
0166	PE4	Segment 4 event of program 8 (R&S). Range: Same as in PE 1.
0167	PE5	Segment 5 event of program 8 (R&S). Range: Same as in PE 1.
0168	PE6	Segment 6 event of program 8 (R&S). Range: Same as in PE 1.
0169	PE7	Segment 7 event of program 8 (R&S). Range: Same as in PE 1.
0170	PE8	Segment 8 event of program 8 (R&S). Range: Same as in PE 1.
0171	PE9	Segment 9 event of program 8 (R&S). Range: Same as in PE 1.
0172	PE 1	Segment 1 event of program 9 (R&S). Range: Same as in PE 1 of program 1.
0173	PE2	Segment 2 event of program 9 (R&S). Range: Same as in PE 1.
0174	PE3	Segment 3 event of program 9 (R&S). Range: Same as in PE 1.
0175	PE4	Segment 4 event of program 9 (R&S). Range: Same as in PE 1.
0176	PE5	Segment 5 event of program 9 (R&S). Range: Same as in PE 1.
0177	PE6	Segment 6 event of program 9 (R&S). Range: Same as in PE 1.
0178	PE7	Segment 7 event of program 9 (R&S). Range: Same as in PE 1.
0179	PE8	Segment 8 event of program 9 (R&S). Range: Same as in PE 1.
0180	PE9	Segment 9 event of program 9 (R&S). Range: Same as in PE 1.
0181	PE 1	Segment 1 event of program 10 (R&S). Range: Same as in PE 1 of program 1.
0182	PE2	Segment 2 event of program 10 (R&S). Range: Same as in PE 1.
0183	PE3	Segment 3 event of program 10 (R&S). Range: Same as in PE 1.
0184	PE4	Segment 4 event of program 10 (R&S). Range: Same as in PE 1.
0185	PE5	Segment 5 event of program 10 (R&S). Range: Same as in PE 1.
0186	PE6	Segment 6 event of program 10 (R&S). Range: Same as in PE 1.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0187	PE7	Segment 7 event of program 10 (R&S). Range: Same as in PE 1.
0188	PE8	Segment 8 event of program 10 (R&S). Range: Same as in PE 1.
0189	PE9	Segment 9 event of program 10 (R&S). Range: Same as in PE 1.
0190	PE 1	Segment 1 event of program 11 (R&S). Range: Same as in PE 1 of program 1.
0191	PE2	Segment 2 event of program 11 (R&S). Range: Same as in PE 1.
0192	PE3	Segment 3 event of program 11 (R&S). Range: Same as in PE 1.
0193	PE4	Segment 4 event of program 11 (R&S). Range: Same as in PE 1.
0194	PE5	Segment 5 event of program 11 (R&S). Range: Same as in PE 1.
0195	PE6	Segment 6 event of program 11 (R&S). Range: Same as in PE 1.
0196	PE7	Segment 7 event of program 11 (R&S). Range: Same as in PE 1.
0197	PE8	Segment 8 event of program 11 (R&S). Range: Same as in PE 1.
0198	PE9	Segment 9 event of program 11 (R&S). Range: Same as in PE 1.
0199	PE 1	Segment 1 event of program 12 (R&S). Range: Same as in PE 1 of program 1.
0200	PE2	Segment 2 event of program 12 (R&S). Range: Same as in PE 1.
0201	PE3	Segment 3 event of program 12 (R&S). Range: Same as in PE 1.
0202	PE4	Segment 4 event of program 12 (R&S). Range: Same as in PE 1.
0203	PE5	Segment 5 event of program 12 (R&S). Range: Same as in PE 1.
0204	PE6	Segment 6 event of program 12 (R&S). Range: Same as in PE 1.
0205	PE7	Segment 7 event of program 12 (R&S). Range: Same as in PE 1.
0206	PE8	Segment 8 event of program 12 (R&S). Range: Same as in PE 1.
0207	PE9	Segment 9 event of program 12 (R&S). Range: Same as in PE 1.
0208	PE 1	Segment 1 event of program 13 (R&S). Range: Same as in PE 1 of program 1.
0209	PE2	Segment 2 event of program 13 (R&S). Range: Same as in PE 1.
0210	PE3	Segment 3 event of program 13 (R&S). Range: Same as in PE 1.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0211	PE4	Segment 4 event of program 13 (R&S). Range: Same as in PE 1.
0212	PE5	Segment 5 event of program 13 (R&S). Range: Same as in PE 1.
0213	PE6	Segment 6 event of program 13 (R&S). Range: Same as in PE 1.
0214	PE7	Segment 7 event of program 13 (R&S). Range: Same as in PE 1.
0215	PE8	Segment 8 event of program 13 (R&S). Range: Same as in PE 1.
0216	PE9	Segment 9 event of program 13 (R&S). Range: Same as in PE 1.
0217	PE 1	Segment 1 event of program 14 (R&S). Range: Same as in PE 1 of program 1.
0218	PE2	Segment 2 event of program 14 (R&S). Range: Same as in PE 1.
0219	PE3	Segment 3 event of program 14 (R&S). Range: Same as in PE 1.
0220	PE4	Segment 4 event of program 14 (R&S). Range: Same as in PE 1.
0221	PE5	Segment 5 event of program 14 (R&S). Range: Same as in PE 1.
0222	PE6	Segment 6 event of program 14 (R&S). Range: Same as in PE 1.
0223	PE7	Segment 7 event of program 14 (R&S). Range: Same as in PE 1.
0224	PE8	Segment 8 event of program 14 (R&S). Range: Same as in PE 1.
0225	PE9	Segment 9 event of program 14 (R&S). Range: Same as in PE 1.
0226	PE 1	Segment 1 event of program 15 (R&S). Range: Same as in PE 1 of program 1.
0227	PE2	Segment 2 event of program 15 (R&S). Range: Same as in PE 1.
0228	PE3	Segment 3 event of program 15 (R&S). Range: Same as in PE 1.
0229	PE4	Segment 4 event of program 15 (R&S). Range: Same as in PE 1.
0230	PE5	Segment 5 event of program 15 (R&S). Range: Same as in PE 1.
0231	PE6	Segment 6 event of program 15 (R&S). Range: Same as in PE 1.
0232	PE7	Segment 7 event of program 15 (R&S). Range: Same as in PE 1.
0233	PE8	Segment 8 event of program 15 (R&S). Range: Same as in PE 1.
0234	PE9	Segment 9 event of program 15 (R&S). Range: Same as in PE 1.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0235	PE 1	Segment 1 event of program 16 (R&S). Range: Same as in PE 1 of program 1.
0236	PE2	Segment 2 event of program 16 (R&S). Range: Same as in PE 1.
0237	PE3	Segment 3 event of program 16 (R&S). Range: Same as in PE 1.
0238	PE4	Segment 4 event of program 16 (R&S). Range: Same as in PE 1.
0239	PE5	Segment 5 event of program 16 (R&S). Range: Same as in PE 1.
0240	PE6	Segment 6 event of program 16 (R&S). Range: Same as in PE 1.
0241	PE7	Segment 7 event of program 16 (R&S). Range: Same as in PE 1.
0242	PE8	Segment 8 event of program 16 (R&S). Range: Same as in PE 1.
0243	PE9	Segment 9 event of program 16 (R&S). Range: Same as in PE 1.
0244	PE 1	Segment 1 event of program 17 (R&S). Range: Same as in PE 1 of program 1.
0245	PE2	Segment 2 event of program 17 (R&S). Range: Same as in PE 1.
0246	PE3	Segment 3 event of program 17 (R&S). Range: Same as in PE 1.
0247	PE4	Segment 4 event of program 17 (R&S). Range: Same as in PE 1.
0248	PE5	Segment 5 event of program 17 (R&S). Range: Same as in PE 1.
0249	PE6	Segment 6 event of program 17 (R&S). Range: Same as in PE 1.
0250	PE7	Segment 7 event of program 17 (R&S). Range: Same as in PE 1.
0251	PE8	Segment 8 event of program 17 (R&S). Range: Same as in PE 1.
0252	PE9	Segment 9 event of program 17 (R&S). Range: Same as in PE 1.
0253	PE 1	Segment 1 event of program 18 (R&S). Range: Same as in PE 1 of program 1.
0254	PE2	Segment 2 event of program 18 (R&S). Range: Same as in PE 1.
0255	PE3	Segment 3 event of program 18 (R&S). Range: Same as in PE 1.
0256	PE4	Segment 4 event of program 18 (R&S). Range: Same as in PE 1.
0257	PE5	Segment 5 event of program 18 (R&S). Range: Same as in PE 1.
0258	PE6	Segment 6 event of program 18 (R&S). Range: Same as in PE 1.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0259	PE7	Segment 7 event of program 18 (R&S). Range: Same as in PE 1.
0260	PE8	Segment 8 event of program 18 (R&S). Range: Same as in PE 1.
0261	PE9	Segment 9 event of program 18 (R&S). Range: Same as in PE 1.
0262	PE 1	Segment 1 event of program 19 (R&S). Range: Same as in PE 1 of program 1.
0263	PE2	Segment 2 event of program 19 (R&S). Range: Same as in PE 1.
0264	PE3	Segment 3 event of program 19 (R&S). Range: Same as in PE 1.
0265	PE4	Segment 4 event of program 19 (R&S). Range: Same as in PE 1.
0266	PE5	Segment 5 event of program 19 (R&S). Range: Same as in PE 1.
0267	PE6	Segment 6 event of program 19 (R&S). Range: Same as in PE 1.
0268	PE7	Segment 7 event of program 19 (R&S). Range: Same as in PE 1.
0269	PE8	Segment 8 event of program 19 (R&S). Range: Same as in PE 1.
0270	PE9	Segment 9 event of program 19 (R&S). Range: Same as in PE 1.
0271	PE 1	Segment 1 event of program 20 (R&S). Range: Same as in PE 1 of program 1.
0272	PE2	Segment 2 event of program 20 (R&S). Range: Same as in PE 1.
0273	PE3	Segment 3 event of program 20 (R&S). Range: Same as in PE 1.
0274	PE4	Segment 4 event of program 20 (R&S). Range: Same as in PE 1.
0275	PE5	Segment 5 event of program 20 (R&S). Range: Same as in PE 1.
0276	PE6	Segment 6 event of program 20 (R&S). Range: Same as in PE 1.
0277	PE7	Segment 7 event of program 20 (R&S). Range: Same as in PE 1.
0278	PE8	Segment 8 event of program 20 (R&S). Range: Same as in PE 1.
0279	PE9	Segment 9 event of program 20 (R&S). Range: Same as in PE 1.
0280	PtoL	Program 1 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0281	PtoL	Program 2 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0282	PtoL	Program 3 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0283	PtoL	Program 4 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0284	PtoL	Program 5 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0285	PtoL	Program 6 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0286	PtoL	Program 7 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0287	PtoL	Program 8 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0288	PtoL	Program 9 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0289	PtoL	Program 10 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0290	PtoL	Program 11 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0291	PtoL	Program 12 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0292	PtoL	Program 13 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0293	PtoL	Program 14 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0294	PtoL	Program 15 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0295	PtoL	Program 16 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0296	PtoL	Program 17 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0297	PtoL	Program 18 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0298	PtoL	Program 19 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0299	PtoL	Program 20 tolerance (Ramps and Soaks). Range: 0 to (SPHL - SPLL) value.
0300	LP	Program 1 link (Ramps and Soaks). Range: 0 to 20.
0301	LP	Program 2 link (Ramps and Soaks). Range: 0 to 20.
0302	LP	Program 3 link (Ramps and Soaks). Range: 0 to 20.
0303	LP	Program 4 link (Ramps and Soaks). Range: 0 to 20.
0304	LP	Program 5 link (Ramps and Soaks). Range: 0 to 20.
0305	LP	Program 6 link (Ramps and Soaks). Range: 0 to 20.
0306	LP	Program 7 link (Ramps and Soaks). Range: 0 to 20.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0307	LP	Program 8 link (Ramps and Soaks). Range: 0 to 20.
0308	LP	Program 9 link (Ramps and Soaks). Range: 0 to 20.
0309	LP	Program 10 link (Ramps and Soaks). Range: 0 to 20.
0310	LP	Program 11 link (Ramps and Soaks). Range: 0 to 20.
0311	LP	Program 12 link (Ramps and Soaks). Range: 0 to 20.
0312	LP	Program 13 link (Ramps and Soaks). Range: 0 to 20.
0313	LP	Program 14 link (Ramps and Soaks). Range: 0 to 20.
0314	LP	Program 15 link (Ramps and Soaks). Range: 0 to 20.
0315	LP	Program 16 link (Ramps and Soaks). Range: 0 to 20.
0316	LP	Program 17 link (Ramps and Soaks). Range: 0 to 20.
0317	LP	Program 18 link (Ramps and Soaks). Range: 0 to 20.
0318	LP	Program 19 link (Ramps and Soaks). Range: 0 to 20.
0319	LP	Program 20 link (Ramps and Soaks). Range: 0 to 20.
0320	Pt 1	Time 1 of program 1. Range: 0 to 9999 minutes.
0321	Pt2	Time 2 of program 1. Range: 0 to 9999 minutes.
0322	Pt3	Time 3 of program 1. Range: 0 to 9999 minutes.
0323	Pt4	Time 4 of program 1. Range: 0 to 9999 minutes.
0324	Pt5	Time 5 of program 1. Range: 0 to 9999 minutes.
0325	Pt6	Time 6 of program 1. Range: 0 to 9999 minutes.
0326	Pt7	Time 7 of program 1. Range: 0 to 9999 minutes.
0327	Pt8	Time 8 of program 1. Range: 0 to 9999 minutes.
0328	Pt9	Time 9 of program 1. Range: 0 to 9999 minutes.
0329	Pt 1	Time 1 of program 2. Range: 0 to 9999 minutes.
0330	Pt2	Time 2 of program 2. Range: 0 to 9999 minutes.
0331	Pt3	Time 3 of program 2. Range: 0 to 9999 minutes.
0332	Pt4	Time 4 of program 2. Range: 0 to 9999 minutes.
0333	Pt5	Time 5 of program 2. Range: 0 to 9999 minutes.
0334	Pt6	Time 6 of program 2. Range: 0 to 9999 minutes.
0335	Pt7	Time 7 of program 2. Range: 0 to 9999 minutes.
0336	Pt8	Time 8 of program 2. Range: 0 to 9999 minutes.
0337	Pt9	Time 9 of program 2. Range: 0 to 9999 minutes.
0338	Pt 1	Time 1 of program 3. Range: 0 to 9999 minutes.
0339	Pt2	Time 2 of program 3. Range: 0 to 9999 minutes.
0340	Pt3	Time 3 of program 3. Range: 0 to 9999 minutes.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0341	Pt4	Time 4 of program 3. Range: 0 to 9999 minutes.
0342	Pt5	Time 5 of program 3. Range: 0 to 9999 minutes.
0343	Pt6	Time 6 of program 3. Range: 0 to 9999 minutes.
0344	Pt7	Time 7 of program 3. Range: 0 to 9999 minutes.
0345	Pt8	Time 8 of program 3. Range: 0 to 9999 minutes.
0346	Pt9	Time 9 of program 3. Range: 0 to 9999 minutes.
0347	Pt1	Time 1 of program 4. Range: 0 to 9999 minutes.
0348	Pt2	Time 2 of program 4. Range: 0 to 9999 minutes.
0349	Pt3	Time 3 of program 4. Range: 0 to 9999 minutes.
0350	Pt4	Time 4 of program 4. Range: 0 to 9999 minutes.
0351	Pt5	Time 5 of program 4. Range: 0 to 9999 minutes.
0352	Pt6	Time 6 of program 4. Range: 0 to 9999 minutes.
0353	Pt7	Time 7 of program 4. Range: 0 to 9999 minutes.
0354	Pt8	Time 8 of program 4. Range: 0 to 9999 minutes.
0355	Pt9	Time 9 of program 4. Range: 0 to 9999 minutes.
0356	Pt1	Time 1 of program 5. Range: 0 to 9999 minutes.
0357	Pt2	Time 2 of program 5. Range: 0 to 9999 minutes.
0358	Pt3	Time 3 of program 5. Range: 0 to 9999 minutes.
0359	Pt4	Time 4 of program 5. Range: 0 to 9999 minutes.
0360	Pt5	Time 5 of program 5. Range: 0 to 9999 minutes.
0361	Pt6	Time 6 of program 5. Range: 0 to 9999 minutes.
0362	Pt7	Time 7 of program 5. Range: 0 to 9999 minutes.
0363	Pt8	Time 8 of program 5. Range: 0 to 9999 minutes.
0364	Pt9	Time 9 of program 5. Range: 0 to 9999 minutes.
0365	Pt1	Time 1 of program 6. Range: 0 to 9999 minutes.
0366	Pt2	Time 2 of program 6. Range: 0 to 9999 minutes.
0367	Pt3	Time 3 of program 6. Range: 0 to 9999 minutes.
0368	Pt4	Time 4 of program 6. Range: 0 to 9999 minutes.
0369	Pt5	Time 5 of program 6. Range: 0 to 9999 minutes.
0370	Pt6	Time 6 of program 6. Range: 0 to 9999 minutes.
0371	Pt7	Time 7 of program 6. Range: 0 to 9999 minutes.
0372	Pt8	Time 8 of program 6. Range: 0 to 9999 minutes.
0373	Pt9	Time 9 of program 6. Range: 0 to 9999 minutes.
0374	Pt1	Time 1 of program 7. Range: 0 to 9999 minutes.
0375	Pt2	Time 2 of program 7. Range: 0 to 9999 minutes.
0376	Pt3	Time 3 of program 7. Range: 0 to 9999 minutes.
0377	Pt4	Time 4 of program 7. Range: 0 to 9999 minutes.
0378	Pt5	Time 5 of program 7. Range: 0 to 9999 minutes.
0379	Pt6	Time 6 of program 7. Range: 0 to 9999 minutes.
0380	Pt7	Time 7 of program 7. Range: 0 to 9999 minutes.
0381	Pt8	Time 8 of program 7. Range: 0 to 9999 minutes.
0382	Pt9	Time 9 of program 7. Range: 0 to 9999 minutes.
0383	Pt1	Time 1 of program 8. Range: 0 to 9999 minutes.
0384	Pt2	Time 2 of program 8. Range: 0 to 9999 minutes.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0385	Pt3	Time 3 of program 8. Range: 0 to 9999 minutes.
0386	Pt4	Time 4 of program 8. Range: 0 to 9999 minutes.
0387	Pt5	Time 5 of program 8. Range: 0 to 9999 minutes.
0388	Pt6	Time 6 of program 8. Range: 0 to 9999 minutes.
0389	Pt7	Time 7 of program 8. Range: 0 to 9999 minutes.
0390	Pt8	Time 8 of program 8. Range: 0 to 9999 minutes.
0391	Pt9	Time 9 of program 8. Range: 0 to 9999 minutes.
0392	Pt 1	Time 1 of program 9. Range: 0 to 9999 minutes.
0393	Pt2	Time 2 of program 9. Range: 0 to 9999 minutes.
0394	Pt3	Time 3 of program 9. Range: 0 to 9999 minutes.
0395	Pt4	Time 4 of program 9. Range: 0 to 9999 minutes.
0396	Pt5	Time 5 of program 9. Range: 0 to 9999 minutes.
0397	Pt6	Time 6 of program 9. Range: 0 to 9999 minutes.
0398	Pt7	Time 7 of program 9. Range: 0 to 9999 minutes.
0399	Pt8	Time 8 of program 9. Range: 0 to 9999 minutes.
0400	Pt9	Time 9 of program 9. Range: 0 to 9999 minutes.
0401	Pt 1	Time 1 of program 10. Range: 0 to 9999 minutes.
0402	Pt2	Time 2 of program 10. Range: 0 to 9999 minutes.
0403	Pt3	Time 3 of program 10. Range: 0 to 9999 minutes.
0404	Pt4	Time 4 of program 10. Range: 0 to 9999 minutes.
0405	Pt5	Time 5 of program 10. Range: 0 to 9999 minutes.
0406	Pt6	Time 6 of program 10. Range: 0 to 9999 minutes.
0407	Pt7	Time 7 of program 10. Range: 0 to 9999 minutes.
0408	Pt8	Time 8 of program 10. Range: 0 to 9999 minutes.
0409	Pt9	Time 9 of program 10. Range: 0 to 9999 minutes.
0410	Pt 1	Time 1 of program 11. Range: 0 to 9999 minutes.
0411	Pt2	Time 2 of program 11. Range: 0 to 9999 minutes.
0412	Pt3	Time 3 of program 11. Range: 0 to 9999 minutes.
0413	Pt4	Time 4 of program 11. Range: 0 to 9999 minutes.
0414	Pt5	Time 5 of program 11. Range: 0 to 9999 minutes.
0415	Pt6	Time 6 of program 11. Range: 0 to 9999 minutes.
0416	Pt7	Time 7 of program 11. Range: 0 to 9999 minutes.
0417	Pt8	Time 8 of program 11. Range: 0 to 9999 minutes.
0418	Pt9	Time 9 of program 11. Range: 0 to 9999 minutes.
0419	Pt 1	Time 1 of program 12. Range: 0 to 9999 minutes.
0420	Pt2	Time 2 of program 12. Range: 0 to 9999 minutes.
0421	Pt3	Time 3 of program 12. Range: 0 to 9999 minutes.
0422	Pt4	Time 4 of program 12. Range: 0 to 9999 minutes.
0423	Pt5	Time 5 of program 12. Range: 0 to 9999 minutes.
0424	Pt6	Time 6 of program 12. Range: 0 to 9999 minutes.
0425	Pt7	Time 7 of program 12. Range: 0 to 9999 minutes.
0426	Pt8	Time 8 of program 12. Range: 0 to 9999 minutes.
0427	Pt9	Time 9 of program 12. Range: 0 to 9999 minutes.
0428	Pt 1	Time 1 of program 13. Range: 0 to 9999 minutes.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0429	Pt2	Time 2 of program 13. Range: 0 to 9999 minutes.
0430	Pt3	Time 3 of program 13. Range: 0 to 9999 minutes.
0431	Pt4	Time 4 of program 13. Range: 0 to 9999 minutes.
0432	Pt5	Time 5 of program 13. Range: 0 to 9999 minutes.
0433	Pt6	Time 6 of program 13. Range: 0 to 9999 minutes.
0434	Pt7	Time 7 of program 13. Range: 0 to 9999 minutes.
0435	Pt8	Time 8 of program 13. Range: 0 to 9999 minutes.
0436	Pt9	Time 9 of program 13. Range: 0 to 9999 minutes.
0437	Pt 1	Time 1 of program 14. Range: 0 to 9999 minutes.
0438	Pt2	Time 2 of program 14. Range: 0 to 9999 minutes.
0439	Pt3	Time 3 of program 14. Range: 0 to 9999 minutes.
0440	Pt4	Time 4 of program 14. Range: 0 to 9999 minutes.
0441	Pt5	Time 5 of program 14. Range: 0 to 9999 minutes.
0442	Pt6	Time 6 of program 14. Range: 0 to 9999 minutes.
0443	Pt7	Time 7 of program 14. Range: 0 to 9999 minutes.
0444	Pt8	Time 8 of program 14. Range: 0 to 9999 minutes.
0445	Pt9	Time 9 of program 14. Range: 0 to 9999 minutes.
0446	Pt 1	Time 1 of program 15. Range: 0 to 9999 minutes.
0447	Pt2	Time 2 of program 15. Range: 0 to 9999 minutes.
0448	Pt3	Time 3 of program 15. Range: 0 to 9999 minutes.
0449	Pt4	Time 4 of program 15. Range: 0 to 9999 minutes.
0450	Pt5	Time 5 of program 15. Range: 0 to 9999 minutes.
0451	Pt6	Time 6 of program 15. Range: 0 to 9999 minutes.
0452	Pt7	Time 7 of program 15. Range: 0 to 9999 minutes.
0453	Pt8	Time 8 of program 15. Range: 0 to 9999 minutes.
0454	Pt9	Time 9 of program 15. Range: 0 to 9999 minutes.
0455	Pt 1	Time 1 of program 16. Range: 0 to 9999 minutes.
0456	Pt2	Time 2 of program 16. Range: 0 to 9999 minutes.
0457	Pt3	Time 3 of program 16. Range: 0 to 9999 minutes.
0458	Pt4	Time 4 of program 16. Range: 0 to 9999 minutes.
0459	Pt5	Time 5 of program 16. Range: 0 to 9999 minutes.
0460	Pt6	Time 6 of program 16. Range: 0 to 9999 minutes.
0461	Pt7	Time 7 of program 16. Range: 0 to 9999 minutes.
0462	Pt8	Time 8 of program 16. Range: 0 to 9999 minutes.
0463	Pt9	Time 9 of program 16. Range: 0 to 9999 minutes.
0464	Pt 1	Time 1 of program 17. Range: 0 to 9999 minutes.
0465	Pt2	Time 2 of program 17. Range: 0 to 9999 minutes.
0466	Pt3	Time 3 of program 17. Range: 0 to 9999 minutes.
0467	Pt4	Time 4 of program 17. Range: 0 to 9999 minutes.
0468	Pt5	Time 5 of program 17. Range: 0 to 9999 minutes.
0469	Pt6	Time 6 of program 17. Range: 0 to 9999 minutes.
0470	Pt7	Time 7 of program 17. Range: 0 to 9999 minutes.
0471	Pt8	Time 8 of program 17. Range: 0 to 9999 minutes.
0472	Pt9	Time 9 of program 17. Range: 0 to 9999 minutes.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0473	Pt 1	Time 1 of program 18. Range: 0 to 9999 minutes.
0474	Pt2	Time 2 of program 18. Range: 0 to 9999 minutes.
0475	Pt3	Time 3 of program 18. Range: 0 to 9999 minutes.
0476	Pt4	Time 4 of program 18. Range: 0 to 9999 minutes.
0477	Pt5	Time 5 of program 18. Range: 0 to 9999 minutes.
0478	Pt6	Time 6 of program 18. Range: 0 to 9999 minutes.
0479	Pt7	Time 7 of program 18. Range: 0 to 9999 minutes.
0480	Pt8	Time 8 of program 18. Range: 0 to 9999 minutes.
0481	Pt9	Time 9 of program 18. Range: 0 to 9999 minutes.
0482	Pt 1	Time 1 of program 19. Range: 0 to 9999 minutes.
0483	Pt2	Time 2 of program 19. Range: 0 to 9999 minutes.
0484	Pt3	Time 3 of program 19. Range: 0 to 9999 minutes.
0485	Pt4	Time 4 of program 19. Range: 0 to 9999 minutes.
0486	Pt5	Time 5 of program 19. Range: 0 to 9999 minutes.
0487	Pt6	Time 6 of program 19. Range: 0 to 9999 minutes.
0488	Pt7	Time 7 of program 19. Range: 0 to 9999 minutes.
0489	Pt8	Time 8 of program 19. Range: 0 to 9999 minutes.
0490	Pt9	Time 9 of program 19. Range: 0 to 9999 minutes.
0491	Pt 1	Time 1 of program 20. Range: 0 to 9999 minutes.
0492	Pt2	Time 2 of program 20. Range: 0 to 9999 minutes.
0493	Pt3	Time 3 of program 20. Range: 0 to 9999 minutes.
0494	Pt4	Time 4 of program 20. Range: 0 to 9999 minutes.
0495	Pt5	Time 5 of program 20. Range: 0 to 9999 minutes.
0496	Pt6	Time 6 of program 20. Range: 0 to 9999 minutes.
0497	Pt7	Time 7 of program 20. Range: 0 to 9999 minutes.
0498	Pt8	Time 8 of program 20. Range: 0 to 9999 minutes.
0499	Pt9	Time 9 of program 20. Range: 0 to 9999 minutes.
0500	PSP0	Setpoint 0 of program 1. Range: From SPLL to the value set in SPHL.
0501	PSP 1	Setpoint 1 of program 1 (Ramps and Soaks). Range: Same as in PSP0.
0502	PSP2	Setpoint 2 of program 1 (Ramps and Soaks). Range: Same as in PSP0.
0503	PSP3	Setpoint 3 of program 1 (Ramps and Soaks). Range: Same as in PSP0.
0504	PSP4	Setpoint 4 of program 1 (Ramps and Soaks). Range: Same as in PSP0.
0505	PSP5	Setpoint 5 of program 1 (Ramps and Soaks). Range: Same as in PSP0.
0506	PSP6	Setpoint 6 of program 1 (Ramps and Soaks). Range: Same as in PSP0.
0507	PSP7	Setpoint 7 of program 1 (Ramps and Soaks). Range: Same as in PSP0.
0508	PSP8	Setpoint 8 of program 1 (Ramps and Soaks). Range: Same as in PSP0.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0509	PSP9	Setpoint 9 of program 1 (Ramps and Soaks). Range: Same as in PSP0.
0510	PSP0	Setpoint 0 of program 2. Range: From SPLL to the value set in SPHL.
0511	PSP1	Setpoint 1 of program 2 (Ramps and Soaks). Range: Same as in PSP0.
0512	PSP2	Setpoint 2 of program 2 (Ramps and Soaks). Range: Same as in PSP0.
0513	PSP3	Setpoint 3 of program 2 (Ramps and Soaks). Range: Same as in PSP0.
0514	PSP4	Setpoint 4 of program 2 (Ramps and Soaks). Range: Same as in PSP0.
0515	PSP5	Setpoint 5 of program 2 (Ramps and Soaks). Range: Same as in PSP0.
0516	PSP6	Setpoint 6 of program 2 (Ramps and Soaks). Range: Same as in PSP0.
0517	PSP7	Setpoint 7 of program 2 (Ramps and Soaks). Range: Same as in PSP0.
0518	PSP8	Setpoint 8 of program 2 (Ramps and Soaks). Range: Same as in PSP0.
0519	PSP9	Setpoint 9 of program 2 (Ramps and Soaks). Range: Same as in PSP0.
0520	PSP0	Setpoint 0 of program 3. Range: D From SPLL to the value set in SPHL.
0521	PSP1	Setpoint 1 of program 3 (Ramps and Soaks). Range: Same as in PSP0.
0522	PSP2	Setpoint 2 of program 3 (Ramps and Soaks). Range: Same as in PSP0.
0523	PSP3	Setpoint 3 of program 3 (Ramps and Soaks). Range: Same as in PSP0.
0524	PSP4	Setpoint 4 of program 3 (Ramps and Soaks). Range: Same as in PSP0.
0525	PSP5	Setpoint 5 of program 3 (Ramps and Soaks). Range: Same as in PSP0.
0526	PSP6	Setpoint 6 of program 3 (Ramps and Soaks). Range: Same as in PSP0.
0527	PSP7	Setpoint 7 of program 3 (Ramps and Soaks). Range: Same as in PSP0.
0528	PSP8	Setpoint 8 of program 3 (Ramps and Soaks). Range: Same as in PSP0.
0529	PSP9	Setpoint 9 of program 3 (Ramps and Soaks). Range: Same as in PSP0.
0530	PSP0	Setpoint 0 of program 4. Range: From SPLL to the value set in SPHL.
0531	PSP1	Setpoint 1 of program 4 (Ramps and Soaks). Range: Same as in PSP0.
0532	PSP2	Setpoint 2 of program 4 (Ramps and Soaks). Range: Same as in PSP0.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0533	PSP3	Setpoint 3 of program 4 (Ramps and Soaks). Range: Same as in PSP0.
0534	PSP4	Setpoint 4 of program 4 (Ramps and Soaks). Range: Same as in PSP0.
0535	PSP5	Setpoint 5 of program 4 (Ramps and Soaks). Range: Same as in PSP0.
0536	PSP6	Setpoint 6 of program 4 (Ramps and Soaks). Range: Same as in PSP0.
0537	PSP7	Setpoint 7 of program 4 (Ramps and Soaks). Range: Same as in PSP0.
0538	PSP8	Setpoint *8* of program 4 (Ramps and Soaks). Range: Same as in PSP0.
0539	PSP9	Setpoint 9 of program 4 (Ramps and Soaks). Range: Same as in PSP0.
0540	PSP0	Setpoint 0 of program 5. Range: From SPLL to the value set in SPHL.
0541	PSP1	Setpoint 1 of program 5 (Ramps and Soaks). Range: Same as in PSP0.
0542	PSP2	Setpoint 2 of program 5 (Ramps and Soaks). Range: Same as in PSP0.
0543	PSP3	Setpoint 3 of program 5 (Ramps and Soaks). Range: Same as in PSP0.
0544	PSP4	Setpoint 4 of program 5 (Ramps and Soaks). Range: Same as in PSP0.
0545	PSP5	Setpoint 5 of program 5 (Ramps and Soaks). Range: Same as in PSP0.
0546	PSP6	Setpoint 6 of program 5 (Ramps and Soaks). Range: Same as in PSP0.
0547	PSP7	Setpoint 7 of program 5 (Ramps and Soaks). Range: Same as in PSP0.
0548	PSP8	Setpoint *8* of program 5 (Ramps and Soaks). Range: Same as in PSP0.
0549	PSP9	Setpoint 9 of program 5 (Ramps and Soaks). Range: Same as in PSP0.
0550	PSP0	Setpoint 0 of program 6. Range: From SPLL to the value set in SPHL.
0551	PSP1	Setpoint 1 of program 6 (Ramps and Soaks). Range: Same as in PSP0.
0552	PSP2	Setpoint 2 of program 6 (Ramps and Soaks). Range: Same as in PSP0.
0553	PSP3	Setpoint 3 of program 6 (Ramps and Soaks). Range: Same as in PSP0.
0554	PSP4	Setpoint 4 of program 6 (Ramps and Soaks). Range: Same as in PSP0.
0555	PSP5	Setpoint 5 of program 6 (Ramps and Soaks). Range: Same as in PSP0.
0556	PSP6	Setpoint 6 of program 6 (Ramps and Soaks). Range: Same as in PSP0.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0557	PSP7	Setpoint 7 of program 6 (Ramps and Soaks). Range: Same as in PSP0.
0558	PSP8	Setpoint 8 of program 6 (Ramps and Soaks). Range: Same as in PSP0.
0559	PSP9	Setpoint 9 of program 6 (Ramps and Soaks). Range: Same as in PSP0.
0560	PSP0	Setpoint 0 of program 7. Range: From SPLL to the value set in SPHL.
0561	PSP1	Setpoint 1 of program 7 (Ramps and Soaks). Range: Same as in PSP0.
0562	PSP2	Setpoint 2 of program 7 (Ramps and Soaks). Range: Same as in PSP0.
0563	PSP3	Setpoint 3 of program 7 (Ramps and Soaks). Range: Same as in PSP0.
0564	PSP4	Setpoint 4 of program 7 (Ramps and Soaks). Range: Same as in PSP0.
0565	PSP5	Setpoint 5 of program 7 (Ramps and Soaks). Range: Same as in PSP0.
0566	PSP6	Setpoint 6 of program 7 (Ramps and Soaks). Range: Same as in PSP0.
0567	PSP7	Setpoint 7 of program 7 (Ramps and Soaks). Range: Same as in PSP0.
0568	PSP8	Setpoint 8 of program 7 (Ramps and Soaks). Range: Same as in PSP0.
0569	PSP9	Setpoint 9 of program 7 (Ramps and Soaks). Range: Same as in PSP0.
0570	PSP0	Setpoint 0 of program 8. Range: From SPLL to the value set in SPHL.
0571	PSP1	Setpoint 1 of program 8 (Ramps and Soaks). Range: Same as in PSP0.
0572	PSP2	Setpoint 2 of program 8 (Ramps and Soaks). Range: Same as in PSP0.
0573	PSP3	Setpoint 3 of program 8 (Ramps and Soaks). Range: Same as in PSP0.
0574	PSP4	Setpoint 4 of program 8 (Ramps and Soaks). Range: Same as in PSP0.
0575	PSP5	Setpoint 5 of program 8 (Ramps and Soaks). Range: Same as in PSP0.
0576	PSP6	Setpoint 6 of program 8 (Ramps and Soaks). Range: Same as in PSP0.
0577	PSP7	Setpoint 7 of program 8 (Ramps and Soaks). Range: Same as in PSP0.
0578	PSP8	Setpoint 8 of program 8 (Ramps and Soaks). Range: Same as in PSP0.
0579	PSP9	Setpoint 9 of program 8 (Ramps and Soaks). Range: Same as in PSP0.
0580	PSP0	Setpoint 0 of program 9. Range: From SPLL to the value set in SPHL.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0581	PSP1	Setpoint 1 of program 9 (Ramps and Soaks). Range: Same as in PSP0.
0582	PSP2	Setpoint 2 of program 9 (Ramps and Soaks). Range: Same as in PSP0.
0583	PSP3	Setpoint 3 of program 9 (Ramps and Soaks). Range: Same as in PSP0.
0584	PSP4	Setpoint 4 of program 9 (Ramps and Soaks). Range: Same as in PSP0.
0585	PSP5	Setpoint 5 of program 9 (Ramps and Soaks). Range: Same as in PSP0.
0586	PSP6	Setpoint 6 of program 9 (Ramps and Soaks). Range: Same as in PSP0.
0587	PSP7	Setpoint 7 of program 9 (Ramps and Soaks). Range: Same as in PSP0.
0588	PSP8	Setpoint *8* of program 9 (Ramps and Soaks). Range: Same as in PSP0.
0589	PSP9	Setpoint 9 of program 9 (Ramps and Soaks). Range: Same as in PSP0.
0590	PSP0	Setpoint 0 of program 10. Range: From SPLL to the value set in SPHL.
0591	PSP1	Setpoint 1 of program 10 (Ramps and Soaks). Range: Same as in PSP0.
0592	PSP2	Setpoint 2 of program 10 (Ramps and Soaks). Range: Same as in PSP0.
0593	PSP3	Setpoint 3 of program 10 (Ramps and Soaks). Range: Same as in PSP0.
0594	PSP4	Setpoint 4 of program 10 (Ramps and Soaks). Range: Same as in PSP0.
0595	PSP5	Setpoint 5 of program 10 (Ramps and Soaks). Range: Same as in PSP0.
0596	PSP6	Setpoint 6 of program 10 (Ramps and Soaks). Range: Same as in PSP0.
0597	PSP7	Setpoint 7 of program 10 (Ramps and Soaks). Range: Same as in PSP0.
0598	PSP8	Setpoint *8* of program 10 (Ramps and Soaks). Range: Same as in PSP0.
0599	PSP9	Setpoint 9 of program 10 (Ramps and Soaks). Range: Same as in PSP0.
0600	PSP0	Setpoint 0 of program 11. Range: From SPLL to the value set in SPHL.
0601	PSP1	Setpoint 1 of program 11 (Ramps and Soaks). Range: Same as in PSP0.
0602	PSP2	Setpoint 2 of program 11 (Ramps and Soaks). Range: Same as in PSP0.
0603	PSP3	Setpoint 3 of program 11 (Ramps and Soaks). Range: Same as in PSP0.
0604	PSP4	Setpoint 4 of program 11 (Ramps and Soaks). Range: Same as in PSP0.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0605	PSP5	Setpoint 5 of program 11 (Ramps and Soaks). Range: Same as in PSP0.
0606	PSP6	Setpoint 6 of program 11 (Ramps and Soaks). Range: Same as in PSP0.
0607	PSP7	Setpoint 7 of program 11 (Ramps and Soaks). Range: Same as in PSP0.
0608	PSP8	Setpoint *8* of program 11 (Ramps and Soaks). Range: Same as in PSP0.
0609	PSP9	Setpoint 9 of program 11 (Ramps and Soaks). Range: Same as in PSP0.
0610	PSP0	Setpoint 0 of program 12. Range: From SPLL to the value set in SPHL.
0611	PSP1	Setpoint 1 of program 12 (Ramps and Soaks). Range: Same as in PSP0.
0612	PSP2	Setpoint 2 of program 12 (Ramps and Soaks). Range: Same as in PSP0.
0613	PSP3	Setpoint 3 of program 12 (Ramps and Soaks). Range: Same as in PSP0.
0614	PSP4	Setpoint 4 of program 12 (Ramps and Soaks). Range: Same as in PSP0.
0615	PSP5	Setpoint 5 of program 12 (Ramps and Soaks). Range: Same as in PSP0.
0616	PSP6	Setpoint 6 of program 12 (Ramps and Soaks). Range: Same as in PSP0.
0617	PSP7	Setpoint 7 of program 12 (Ramps and Soaks). Range: Same as in PSP0.
0618	PSP8	Setpoint 8 of program 12 (Ramps and Soaks). Range: Same as in PSP0.
0619	PSP9	Setpoint 9 of program 12 (Ramps and Soaks). Range: Same as in PSP0.
0620	PSP0	Setpoint 0 of program 13. Range: From SPLL to the value set in SPHL.
0621	PSP1	Setpoint 1 of program 13 (Ramps and Soaks). Range: Same as in PSP0.
0622	PSP2	Setpoint 2 of program 13 (Ramps and Soaks). Range: Same as in PSP0.
0623	PSP3	Setpoint 3 of program 13 (Ramps and Soaks). Range: Same as in PSP0.
0624	PSP4	Setpoint 4 of program 13 (Ramps and Soaks). Range: Same as in PSP0.
0625	PSP5	Setpoint 5 of program 13 (Ramps and Soaks). Range: Same as in PSP0.
0626	PSP6	Setpoint 6 of program 13 (Ramps and Soaks). Range: Same as in PSP0.
0627	PSP7	Setpoint 7 of program 13 (Ramps and Soaks). Range: Same as in PSP0.
0628	PSP8	Setpoint 8 of program 13 (Ramps and Soaks). Range: Same as in PSP0.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0629	PSP9	Setpoint 9 of program 13 (Ramps and Soaks). Range: Same as in PSP0.
0630	PSP0	Setpoint 0 of program 14. Range: From SPLL to the value set in SPHL.
0631	PSP1	Setpoint 1 of program 14 (Ramps and Soaks). Range: Same as in PSP0.
0632	PSP2	Setpoint 2 of program 14 (Ramps and Soaks). Range: Same as in PSP0.
0633	PSP3	Setpoint 3 of program 14 (Ramps and Soaks). Range: Same as in PSP0.
0634	PSP4	Setpoint 4 of program 14 (Ramps and Soaks). Range: Same as in PSP0.
0635	PSP5	Setpoint 5 of program 14 (Ramps and Soaks). Range: Same as in PSP0.
0636	PSP6	Setpoint 6 of program 14 (Ramps and Soaks). Range: Same as in PSP0.
0637	PSP7	Setpoint 7 of program 14 (Ramps and Soaks). Range: Same as in PSP0.
0638	PSP8	Setpoint *8* of program 14 (Ramps and Soaks). Range: Same as in PSP0.
0639	PSP9	Setpoint 9 of program 14 (Ramps and Soaks). Range: Same as in PSP0.
0640	PSP0	Setpoint 0 of program 15. Range: From SPLL to the value set in SPHL.
0641	PSP1	Setpoint 1 of program 15 (Ramps and Soaks). Range: Same as in PSP0.
0642	PSP2	Setpoint 2 of program 15 (Ramps and Soaks). Range: Same as in PSP0.
0643	PSP3	Setpoint 3 of program 15 (Ramps and Soaks). Range: Same as in PSP0.
0644	PSP4	Setpoint 4 of program 15 (Ramps and Soaks). Range: Same as in PSP0.
0645	PSP5	Setpoint 5 of program 15 (Ramps and Soaks). Range: Same as in PSP0.
0646	PSP6	Setpoint 6 of program 15 (Ramps and Soaks). Range: Same as in PSP0.
0647	PSP7	Setpoint 7 of program 15 (Ramps and Soaks). Range: Same as in PSP0.
0648	PSP8	Setpoint *8* of program 15 (Ramps and Soaks). Range: Same as in PSP0.
0649	PSP9	Setpoint 9 of program 15 (Ramps and Soaks). Range: Same as in PSP0.
0650	PSP0	Setpoint 0 of program 16. Range: From SPLL to the value set in SPHL.
0651	PSP1	Setpoint 1 of program 16 (Ramps and Soaks). Range: Same as in PSP0.
0652	PSP2	Setpoint 2 of program 16 (Ramps and Soaks). Range: Same as in PSP0.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0653	PSP3	Setpoint 3 of program 16 (Ramps and Soaks). Range: Same as in PSP0.
0654	PSP4	Setpoint 4 of program 16 (Ramps and Soaks). Range: Same as in PSP0.
0655	PSP5	Setpoint 5 of program 16 (Ramps and Soaks). Range: Same as in PSP0.
0656	PSP6	Setpoint 6 of program 16 (Ramps and Soaks). Range: Same as in PSP0.
0657	PSP7	Setpoint 7 of program 16 (Ramps and Soaks). Range: Same as in PSP0.
0658	PSP8	Setpoint 8 of program 16 (Ramps and Soaks). Range: Same as in PSP0.
0659	PSP9	Setpoint 9 of program 16 (Ramps and Soaks). Range: Same as in PSP0.
0660	PSP0	Setpoint 0 of program 17. Range: From SPLL to the value set in SPHL.
0661	PSP1	Setpoint 1 of program 17 (Ramps and Soaks). Range: Same as in PSP0.
0662	PSP2	Setpoint 2 of program 17 (Ramps and Soaks). Range: Same as in PSP0.
0663	PSP3	Setpoint 3 of program 17 (Ramps and Soaks). Range: Same as in PSP0.
0664	PSP4	Setpoint 4 of program 17 (Ramps and Soaks). Range: Same as in PSP0.
0665	PSP5	Setpoint 5 of program 17 (Ramps and Soaks). Range: Same as in PSP0.
0666	PSP6	Setpoint 6 of program 17 (Ramps and Soaks). Range: Same as in PSP0.
0667	PSP7	Setpoint 7 of program 17 (Ramps and Soaks). Range: Same as in PSP0.
0668	PSP8	Setpoint *8* of program 17 (Ramps and Soaks). Range: Same as in PSP0.
0669	PSP9	Setpoint 9 of program 17 (Ramps and Soaks). Range: Same as in PSP0.
0670	PSP0	Setpoint 0 of program 18. Range: From SPLL to the value set in SPHL.
0671	PSP1	Setpoint 1 of program 18 (Ramps and Soaks). Range: Same as in PSP0.
0672	PSP2	Setpoint 2 of program 18 (Ramps and Soaks). Range: Same as in PSP0.
0673	PSP3	Setpoint 3 of program 18 (Ramps and Soaks). Range: Same as in PSP0.
0674	PSP4	Setpoint 4 of program 18 (Ramps and Soaks). Range: Same as in PSP0.
0675	PSP5	Setpoint 5 of program 18 (Ramps and Soaks). Range: Same as in PSP0.
0676	PSP6	Setpoint 6 of program 18 (Ramps and Soaks). Range: Same as in PSP0.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0677	PSP7	Setpoint 7 of program 18 (Ramps and Soaks). Range: Same as in PSP0.
0678	PSP8	Setpoint *8* of program 18 (Ramps and Soaks). Range: Same as in PSP0.
0679	PSP9	Setpoint 9 of program 18 (Ramps and Soaks). Range: Same as in PSP0.
0680	PSP0	Setpoint 0 of program 19. Range: From SPLL to the value set in SPHL.
0681	PSP1	Setpoint 1 of program 19 (Ramps and Soaks). Range: Same as in PSP0.
0682	PSP2	Setpoint 2 of program 19 (Ramps and Soaks). Range: Same as in PSP0.
0683	PSP3	Setpoint 3 of program 19 (Ramps and Soaks). Range: Same as in PSP0.
0684	PSP4	Setpoint 4 of program 19 (Ramps and Soaks). Range: Same as in PSP0.
0685	PSP5	Setpoint 5 of program 19 (Ramps and Soaks). Range: Same as in PSP0.
0686	PSP6	Setpoint 6 of program 19 (Ramps and Soaks). Range: Same as in PSP0.
0687	PSP7	Setpoint 7 of program 19 (Ramps and Soaks). Range: Same as in PSP0.
0688	PSP8	Setpoint *8* of program 19 (Ramps and Soaks). Range: Same as in PSP0.
0689	PSP9	Setpoint 9 of program 19 (Ramps and Soaks). Range: Same as in PSP0.
0690	PSP0	Setpoint 0 of program 20. Range: From SPLL to the value set in SPHL.
0691	PSP1	Setpoint 1 of program 20 (Ramps and Soaks). Range: Same as in PSP0.
0692	PSP2	Setpoint 2 of program 20 (Ramps and Soaks). Range: Same as in PSP0.
0693	PSP3	Setpoint 3 of program 20 (Ramps and Soaks). Range: Same as in PSP0.
0694	PSP4	Setpoint 4 of program 20 (Ramps and Soaks). Range: Same as in PSP0.
0695	PSP5	Setpoint 5 of program 20 (Ramps and Soaks). Range: Same as in PSP0.
0696	PSP6	Setpoint 6 of program 20 (Ramps and Soaks). Range: Same as in PSP0.
0697	PSP7	Setpoint 7 of program 20 (Ramps and Soaks). Range: Same as in PSP0.
0698	PSP8	Setpoint 8 of program 20 (Ramps and Soaks). Range: Same as in PSP0.
0699	PSP9	Setpoint 9 of program 20 (Ramps and Soaks). Range: Same as in PSP0.
0700-0723	Reserved	Internal use.

HOLDING REGISTERS	PARAMETER	REGISTER DESCRIPTION
0724	MV 2	Read: Active output power (manual or automatic) of control output 2. Write: Not allowed. See address 28. Range: 0 to 1000 (0.0 to 100.0 %).
0725	Pb2	Controller 2 proportional band (in percent). Range: 0 to 5000 (0.0 to 500.0 %)
0726	hYt2	On/Off control hysteresis (in the engineering unit of the selected type) of control output 2. Range: 0 to SPHL – SPLL.
0727	ct2	PWM cycle period (in seconds) of control output 2. Range: 5 to 1000 (0.5 to 100.0).
0728	ouLL2	Limite inferior da potência de saída da saída de controle 2. Range: 0 to 1000 (0.0 to 100.0 %).
0729	ouHL2	Limite superior da potência de saída da saída de controle 2. Range: 0 to 1000 (0.0 to 100.0 %).
0730	oLAP	Overlap between heating and cooling in the input type engineering unit.
0731	nAME01	String with the product name.
0732	nAME02	
0733	nAME03	
0734	nAME04	
0735	nAME05	
0736	nAME06	
0737	nAME07	
0738	nAME08	
0739	codE01	String with the product code.
0740	codE02	
0741	codE03	
0742	codE04	
0743	codE05	
0744	LtA1	Enable Latch function for alarm 1. 0 → Latch function disabled 1 → Latch function enabled
0745	LtA2	Enable Latch function for alarm 2. Range: Same as LtA1.
0746	LtA3	Enable Latch function for alarm 3. Range: Same as LtA1.
0747	LtA4	Enable Latch function for alarm 4. Range: Same as LtA1.
0748	rAL	**R**eset **A**larm **L**atch. Bit array for individual reset of alarms that are holding alarms via Latch function. bit 0 – Recognizes alarm 1 retentive bit 1 – Recognizes alarm 2 retentive bit 2 – Recognizes alarm 3 retentive bit 3 – Recognizes alarm 4 retentive

Table 13

16.4.3 STATUS WORDS

REGISTER	VALUE FORMAT
Status Word 1	bit 0 – Alarm 1 (0 → Disabled / 1 → Enabled) bit 1 – Alarm 2 (0 → Disabled / 1 → Enabled) bit 2 – Alarm 3 (0 → Disabled / 1 → Enabled) bit 3 – Alarm 4 (0 → Disabled / 1 → Enabled) bit 4 – Input 0 - I/O 5 (0 → Disabled / 1 → Enabled) bit 5 – Input 1 - I/O 3 (0 → Disabled / 1 → Enabled) bit 6 – Input 2 - I/O 4 (0 → Disabled / 1 → Enabled) bit 7 – Reserved bit 8 – Value to detect hardware bit 9 – Value to detect hardware bit 10 – Value to detect hardware bit 11 – Value to detect hardware bit 12 − Reserved bit 13 − Reserved bit 14 − Reserved bit 15 – Reserved
Status Word 2	bit 0 − Automatic (0 → Manual / 1 → Automatic) bit 1 − Run (0 → Stop / 1 → Run) bit 2 – Control action 1 (0 → Direct / 1 → Reverse) bit 3 – Reserved bit 4 – Auto-tune (0 → No / 1 → Yes) bit 5 – Alarm initial blocking 1 (0 → No / 1 → Yes) bit 6 – Alarm initial blocking 2 (0 → No / 1 → Yes) bit 7 – Alarm initial blocking 3 (0 → No / 1 → Yes) bit 8 – Alarm initial blocking 4 (0 → No / 1 → Yes) bit 9 − Unity (0 → °C / 1 → °F) bit 10 − Reserved bit 11 – Output 1 status bit 12 – Output 2 status bit 13 – Output 3 status bit 14 – Output 4 status bit 15 – Output 5 status
Status Word 3	bit 0 – Very low PV conversion (0 → No / 1 → Yes) bit 1 – Negative conversion after calibration (0 → No / 1 → Yes) bit 2 – Very high PV conversion (0 → No / 1 → Yes) bit 3 – Exceeded linearization limit (0 → No / 1 → Yes) bit 4 – The Pt100 cable resistance is too high (0 → No / 1 → Yes) bit 5 – Auto-Zero conversion out-of-range (0 → No / 1 → Yes) bit 6 – Cold Junction conversion out-of-range (0 → No / 1 → Yes) bit 7 − Reserved bit 8 − Reserved bit 9 − Reserved bit 10 − Reserved bit 11 − Reserved bit 12 − Reserved bit 13 − Reserved bit 14 − Reserved bit 15 − Reserved

Table 14

You can only write to the digital output bits when the outputs are set to **Off** in the controller I/O configuration.

COIL STATUS	OUTPUT DESCRIPTION
0	Output 1 status (I/O1)
1	Output 2 status (I/O2)
2	Output 3 status (I/O3)
3	Output 4 status (I/O4)
4	Output 5 status (I/O5)

Table 15

16.5 EXCEPTION RESPONSES – ERROR CONDITIONS

When receiving a command, the Modbus protocol checks the CRC of the received data block. If there is a CRC error during reception, the master will receive no response.

After receiving an error-free packet, the controller processes the packet and verifies whether the request is valid or not. If invalid, an exception response, containing the corresponding error code, will be sent. In exception responses, the field corresponding to the Modbus command in the response will be added to 80 H.

If a command writing a value to a parameter has a value outside the allowed range, the maximum allowed value for this parameter will be forced, which will return this as the response.

The controller ignores the read commands in Broadcast. That is, there will be no response. You can only write in Broadcast mode.

ERROR CODES	ERROR DESCRIPTION
01	Invalid or non-existent command.
02	Register number invalid or out of range.
03	Number of registers invalid or out of range.

Table 16

16.6 CONFIGURING I/O PARAMETERS

16.6.1 N1200 CONTROLLER

I/O FUNCTION	CODE		I/O TYPE
No function	0	oFF	Output
Alarm output 1	1	A1	Output
Alarm output 2	2	A2	Output
Alarm output 3	3	A3	Output
Alarm output 4	4	A4	Output
Loop Break Detection (LBD) function output	5	Lbd	Output
Control output (Relay or Digital Pulse)	6	ctrL	Output
Switch between Automatic/Manual modes	7	MAn	Digital Input
Switch between Run/Stop modes	8	run	Digital Input
Select remote SP	9	rSP	Digital Input
Freeze the program	10	HPrG	Digital Input
Select program 1	11	Pr 1	Digital Input
Analog control output (0 to 20 mA)	12	C.020	Analog Output
Analog control output (4 to 20mA)	13	C.420	Analog Output
PV retransmission (0 to 20 mA)	14	P.020	Analog Output
PV retransmission (4 to 20 mA)	15	P.420	Analog Output
SP retransmission (0 to 20 mA)	16	S.020	Analog Output
SP retransmission (4 to 20 mA)	17	S.420	Analog Output

Table 17

16.6.2 N1200-HC CONTROLLER

I/O FUNCTION	CODE		I/O TYPE
No function	0	oFF	Output
Alarm output 1	1	A1	Output
Alarm output 2	2	A2	Output
Alarm output 3	3	A3	Output
Alarm output 4	4	A4	Output
Loop Break Detection (LBD) function output	5	Lbd	Output
Control output **1** (Relay or Digital Pulse)	6	Ctr1	Output
Control output **2** (Relay or Digital Pulse)	7	Ctr2	Output
Switch between Automatic/Manual modes	8	MAn	Digital Input
Switch between Run/Stop modes	9	run	Digital Input
Select remote SP	10	rSP	Digital Input
Freeze the program	11	HPrG	Digital Input
Select program 1	12	Pr 1	Digital Input
Analog control output 1 (0 to 20mA)	13	C.0.20	Analog Output
Analog control output 1 (4 to 20mA)	14	C.4.20	Analog Output
Analog control output 2 (0 to 20mA)	15	C.0.20	Analog Output
Analog control output 2 (4 to 20mA)	16	C.4.20	Analog Output
PV retransmission (0 to 20 mA)	17	P.0.20	Analog Output
PV retransmission (4 to 20 mA)	18	P.4.20	Analog Output
SP retransmission (0 to 20 mA)	19	S.0.20	Analog Output
SP retransmission (4 to 20 mA)	20	S.4.20	Analog Output

Table 18