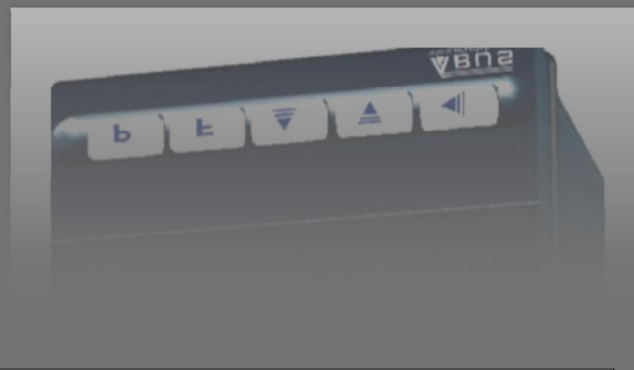


A9696

High End Universal Process Controller User Manual



ABUS TECHNOLOGIES INC.

WARNING

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HEALTH AND SAFETY

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given. Any deviation from these instructions will transfer the complete liability to the user.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

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1. INTRODUCTION

A9696 Big Digit Universal Process Controller is a real breakthrough in versatility for holding in one single instrument for all the major features required in the vast majority of industrial processes. With sophisticated and consistent software and its advanced truly universal circuitry, the A9696 accepts configuration of both input signal and control output through the front keyboard without any internal hardware change.

Power supply for remote loop powered transmitters is standard and is a must for high-end applications. From the very simple applications as a temperature controller to the most complex systems of distributed control with PLC's or SCADA networks, the A9696 is the right answer to your needs for industrial or laboratory automation.

2. PRESENTATION

2.1 Features

1. Universal multi-sensor input without hardware change;
2. Sensor break protection in any condition;
3. Control outputs: relay, linear 4-20 mA, 0-20 mA, logic pulse;
4. Up to 4 alarms. Up to 2 timer relay alarms;
5. PV or SP 4-20mA or 0-20mA analog retransmission;
6. Auto/Manual "bump less" transfer;
7. Up to 2 digital inputs with 5 programmable functions;
8. 4-20 mA Remote Set-point input;
9. Programmable Soft Start (0 to 9999 seconds);
10. RS-485 digital communication; RTU MODBUS Protocol;
11. Firmware version displayed during power up;
12. Keyboard password protection;
13. RS-485, MODBUS RTU protocol, 1200 to 19200 bps;

2.2 Technical Parameters

- **Dimensions:** 96 x 96 x 92 mm. Weight: 330 g
- **Front panel:** IP65, Polycarbonate UL94 V-2.
- **Back panel:** IP30, ABS+PC UL94 V-0
- **Panel cut-out:** 93 x 93 mm (+0.5 -0.0 mm)
- **Terminal connection:** 24 screws accepting 6.3 mm fork lugs
- **Power:** 85 to 265 Vac/dc, 50/60 Hz. Max. Consumption: 3 VA
- **Environmental conditions:** 0 to 55 °C, humidity: 20 to 85 %
Installation category II, pollution degree 2. Altitude < 2000 m

- **Keyboard selection of input type**
- **Internal resolution:** 19500 levels
- **Display resolution:** 12000 levels (from -1999 to 9999)
- **Input sample rate:** 5 per second
- **Accuracy:** Thermocouples **J, K** and **T**: 0.25 % of span ± 1 °C
Thermocouple **N, R, S**: 0.25 % of span ± 3 °C
Pt100, 4-20 mA, 0-50 mV, 0-5 Vdc: 0.2 % of span
- **Input impedance:** 0-50 mV, Pt100 and T/C: >10M Ω
0-5 V: >1 M Ω
4-20 mA: 100 Ω
- **Pt100 measurement: DIN 43760 standard ($\alpha=0.00385$). Excitation current: 170 μ A. 3-wire circuit, cable resistance compensation.**
- **Analog output:** 0-20 mA or 4-20 mA, 1500 levels, 550 Ω max.

- **Two SPDT relays:** 3 A / 250 Vac (3 A / 30 Vdc);
- **Two SPST relays:** 3 A / 250 Vac (3 A / 30 Vdc);
- **Isolated 0-20 mA or 4-20 mA control output or PV or SP retransmission, 1500 level resolution, 550 Ω max. Load;**
- **Logic pulse for SSR drive:** 0 or 20 mA;
- **Any of the above can be selected as the main control output and the remaining outputs can be set as alarms;**
- **Programmable PWM cycle from 0.5 sec. and 100 sec.;**
- **Start up 3 seconds after power up;**

- **Up to 4 alarms can be set with 9 distinct functions for each one.**
- **2 Timing alarms, programmable from 0 to 6500 sec., with advanced functions, ideal for servo-positioning.**
- **Independent power-up inhibition of the 4 alarms.**
- **Programmable hysteresis for the 4 alarms.**

3. DIMENSIONS

| PANEL DIMENSION CODE | PANEL DIMENSION | | CASE DIMENSION | | | HOLE CUTOUT DIMENSION | |
|----------------------|-----------------|----|----------------|----|-----|-----------------------|-----|
| | W | H | W | H | D | W | H |
| A9696 | 96 | 96 | 91 | 91 | 100 | 93 | 923 |

4. ORDERING DETAILS

The basic unit includes one universal input, two SPST relays, two SPDT relays, 24Vdc output for powering remote transmitters, one digital input, a 4-20 mA input for remote set-point and one 4-20 mA output which can also be used as a digital input or output .

Option 1: RS485 digital communication interface with Modbus RTU protocol.

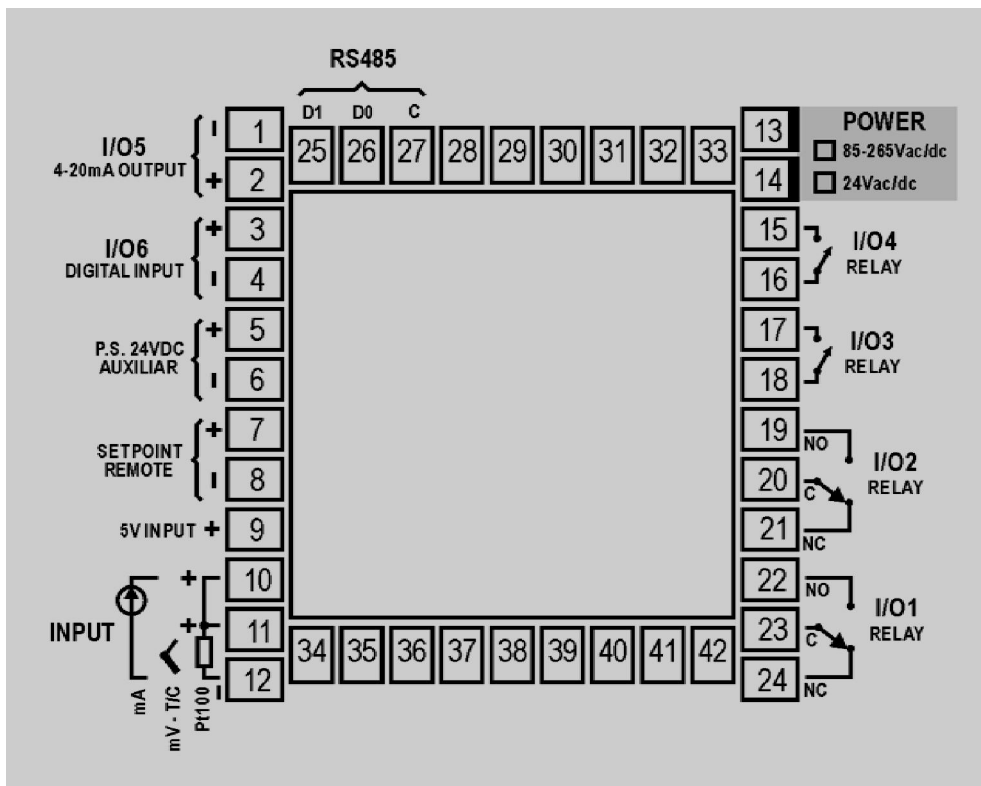
5. CONNECTIONS

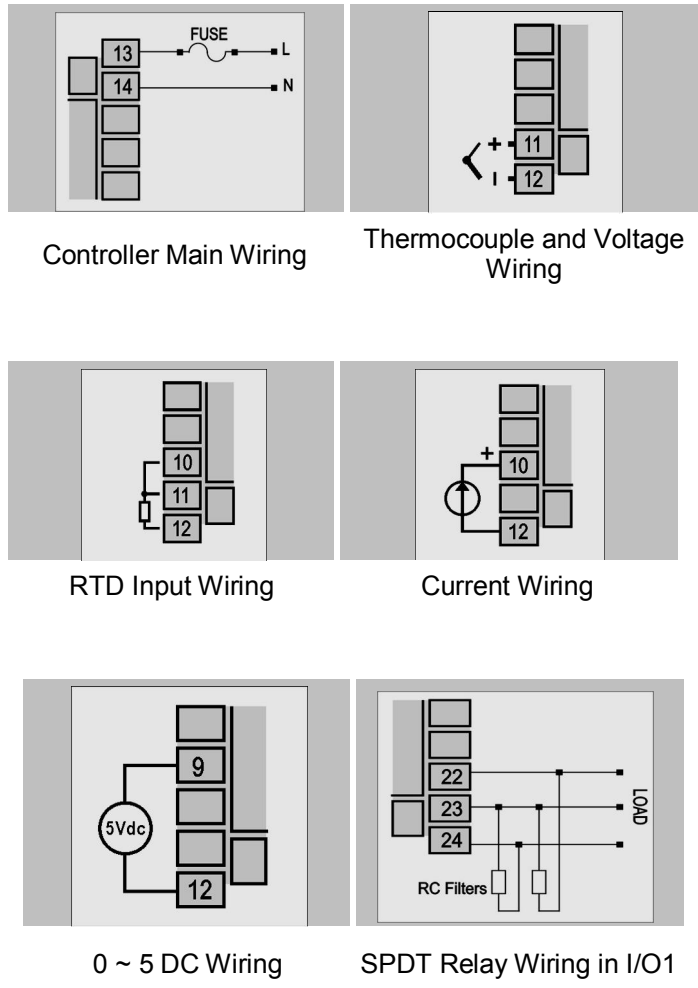
5.1 Electrical Connections

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 mm² (16 to 22 AWG). The terminals should be tightened to a torque of 0.4 Nm (3.5 lb in).

5.2 Routing of Wires

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.





Controller Main Wiring

Thermocouple and Voltage Wiring

RTD Input Wiring

Current Wiring

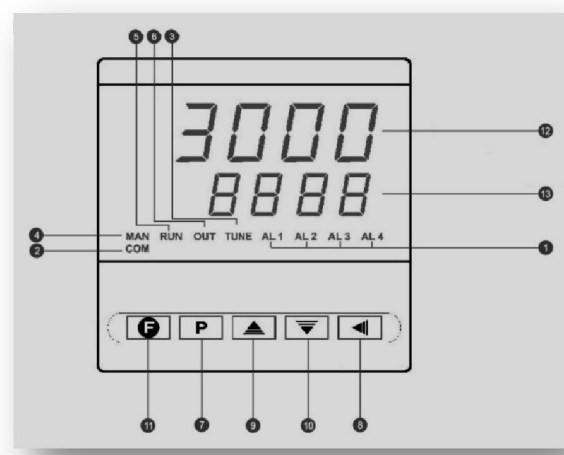
0 ~ 5 DC Wiring

SPDT Relay Wiring in I/O1

6. INSTALLATION

Insert the unit into the panel cutout and slide the mounting clamp from the rear to a firm grip at the panel.

Panel



Panel Attributes

| S.No. | Parameters | Description |
|-------|----------------|---|
| 1 | A1-A4 | Show active alarms. |
| 2 | COM | Flashes when communication messages are sent by the controller. |
| 3 | TUNE | Lights during the execution of PID automatic tuning. |
| 4 | MAN | Lights when the controller is in manual. |
| 5 | RUN | Lights when the controller is active, with control and alarm outputs enabled. |
| 6 | OUT | For relay or pulse control output, reflects the actual state of the output. If an analog output is assigned for control, lights continuously. |
| 7 | P | Program Key: This key is used to access different displays with the programmable parameters of the device. |
| 8 | ◀ | Back Key: This key is used to go back to the previous parameter displayed in the menu cycle. |
| 9 | ▲ | UP / MAX Key: This key is used to increase parameter value, as well as to display maximum values stored in memory. |
| 10 | ▼ | DOWN / MIN Key: This key is used to decrease parameter value, as well as to display minimum values stored in memory. |
| 11 | F | This special function key is used for pre-programmed functions as explained in the table below. |
| 12 | Display | Shows the Process Variable (PV) and the programming prompts. |
| 13 | Display | Shows the Set-Point Variable (SV) and the programming prompts. |

Pre-Programmed Functions

| S.NO. | CYCLE | ACCESS |
|-------|---------------------|-------------------------------|
| 1 | Operation | Free access parameters * |
| 2 | Tuning | |
| 3 | R&S Program | |
| 4 | Alarms | Reserved access parameters ** |
| 5 | Input Configuration | |
| 6 | I/Os | |
| 7 | Calibration | |

* These parameters can be viewed but not changed if the cycle is protected.

** Requires a key combination to access the cycle.

7. CONFIGURATION

7.1 Programming the Indicator

7.1.1 Operation Cycle

| PARAMETER | PROMPT PARAMETER DESCRIPTION |
|--------------------------|--|
| PV Indication (Red) | <i>PV AND SV INDICATION:</i> The status display shows the present value of PV (Process Variable). The parameter display shows SV (Set Variable). The status display shows - - - - whenever PV exceeds the maximum range or there is no signal at the input. In case of hardware error the status display will show Errn , where n is the error code. |
| SV Indication (Green) | |
| Auto | CONTROL MODE: YES indicates automatic control mode (closed loop, PID or ON/OFF). NO indicates manual control mode (open loop). Bumpless transfer from auto ↔ to manual mode is available. If in doubt program YES . |
| PV Indication (Red) | <i>MANIPULATED VARIABLE VALUE (MV):</i> The upper display shows PV value and the lower display shows the percentage of MV applied to the control output. When in manual control the MV value can be manually changed. When in auto mode the MV value can only be viewed. To distinguish the MV display from the SV display, the MV is shown flashing intermittently. |
| MV Indication (Green) | |
| Pr n | <i>RAMP AND SOAK PROGRAM SELECTION:</i> Selects the ramp and soak program to be executed (7 programs possible). |
| run | CONTROL ENABLE: YES means that the control output and alarms are enabled and NO means they are disabled. |

7.1.2 Auto Tuning Cycle

| PARAMETER | PROMPT PARAMETER DESCRIPTION |
|-------------|---|
| Auto | <i>AUTO-TUNE:</i> YES enables the auto tuning of the PID parameters and NO disables it. |
| Pb | <i>PROPORTIONAL BAND:</i> Percentage of maximum input span. Select zero for ON/OFF control. |
| HYS | <i>CONTROL HYSTERESIS (in engineering units):</i> This parameter is only shown for ON/OFF control (Pb=0). |
| Ir | <i>INTEGRAL RATE:</i> Integral time constant in repetitions per minute (Reset). |
| dt | <i>DERIVATIVE TIME:</i> Derivative time constant, in seconds. |
| Ct | <i>CYCLE TIME:</i> PWM period in seconds. Can only be viewed if proportional band is other than zero. |
| bIAS | <i>Offset for MV (manual reset).</i> Range: -100% to +100%. Default value: 0. |
| ouLL | <i>OUTPUT LOW LIMIT:</i> minimum percentage value for MV (Manipulated Variable) when in automatic control and PID. Default value: 0.0% |
| ouHL | <i>OUTPUT HIGH LIMIT:</i> Maximum percentage value for MV when in automatic control and PID. Default value: 100.0% |
| SFSt | <i>SOFT START:</i> 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. |

| | |
|-------------|---|
| SPR1 | <i>ALARM 1 PRESET</i> : Tripping point for alarm 1. |
| SPR2 | <i>ALARM 2 PRESET</i> : Tripping point for alarm 2. |
| SPR3 | <i>ALARM 3 PRESET</i> : Tripping point for alarm 3. |
| SPR4 | <i>ALARM 4 PRESET</i> : Tripping point for alarm 4. |

7.1.3 Ramp and Soak Profile Programming Cycle

| PARAMETER | PROMPT PARAMETER DESCRIPTION |
|----------------------|---|
| tbAS | <i>TIME BASE</i> : Selects the time base for the ramp and soak. Valid for all profile programs. 0 - PT1 to PT7 values are in seconds; 1 - PT1 to PT7 values are in minutes; |
| Pr n | <i>PROGRAM TO BE VIEWED</i> : Selects the ramp and soak profile program to be edited/viewed in the following cycle prompts (7 programs available). |
| PtoL | <i>RAMP AND SOAK TOLERANCE</i> : maximum deviation between PV and SV. Whenever this deviation is exceeded the time counter is halted until deviation lowers to within the tolerance. Set zero to disable this function. |
| PSP0 PSP7 | <i>RAMP AND SOAK SET POINTS (0 to 7)</i> : Set of 8 SV values which define the ramp and soak profile segments. See also PT1 to 7 and PE1 to 7 below. |
| Pt 1 Pt 7 | <i>RAMP AND SOAK SEGMENTS TIME (1 to 7)</i> : Set of 7 time intervals for the 7 segments of the ramp and soak program. Up to 9999 seconds or minutes, according to tbAS parameter. |
| PE 1 PE 7 | <i>RAMP AND SOAK EVENT (1 to 7)</i> : Set of 7 values that define which alarms must be activated during a ramp and soak program segment. Alarm function depends on “ rS ” setting (Table 7.4.2 ALARM FUNCTIONS). |
| LP | <i>LINK TO PROGRAM</i> : Number of the next profile program to be linked to follow the current profile. Profiles can be linked to make larger programs of up to 49 segments. |
| tbAS | <i>TIME BASE</i> : Selects the time base for the ramp and soak. Valid for all profile programs. 0 - PT1 to PT7 values are in seconds; 1 - PT1 to PT7 values are in minutes; |
| Pr n | <i>PROGRAM TO BE VIEWED</i> : Selects the ramp and soak profile program to be edited/viewed in the following cycle prompts (7 programs available). |
| PtoL | <i>RAMP AND SOAK TOLERANCE</i> : maximum deviation between PV and SV. Whenever this deviation is exceeded the time counter is halted until deviation lowers to within the tolerance. Set zero to disable this function. |
| PSP0 PSP7 | <i>RAMP AND SOAK SET POINTS (0 to 7)</i> : Set of 8 SV values which define the ramp and soak profile segments. See also PT1 to 7 and PE1 to 7 below. |
| Pt 1 Pt 7 | <i>RAMP AND SOAK SEGMENTS TIME (1 to 7)</i> : Set of 7 time intervals for the 7 segments of the ramp and soak program. Up to 9999 seconds or minutes, according to tbAS parameter. |
| PE 1 PE 7 | <i>RAMP AND SOAK EVENT (1 to 7)</i> : Set of 7 values that define which alarms must be activated during a ramp and soak program segment. Alarm function depends on “ rS ” setting (Table 7.4.2 ALARM FUNCTIONS). |
| LP | <i>LINK TO PROGRAM</i> : Number of the next profile program to be linked to follow the current profile. Profiles can be linked to make larger programs of up to 49 segments. |

7.1.4 Alarm Cycle

| PARAMETER | PROMPT PARAMETER DESCRIPTION |
|--|--|
| FUR1 | <i>ALARM 1 FUNCTION</i> : Select options from Table 7.4.2 ALARM FUNCTIONS. |
| FUR2 | <i>ALARM 2 FUNCTION</i> : Select options from Table 7.4.2 ALARM FUNCTIONS. |
| FUR3 | <i>ALARM 3 FUNCTION</i> : Select options from Table 7.4.2 ALARM FUNCTIONS. |
| FUR4 | <i>ALARM 4 FUNCTION</i> : Select options from Table 7.4.2 ALARM FUNCTIONS. |
| BLR1 BLR2 BLR3 BLR4 | <i>ALARM BLOCK 1 TO 4</i> : This function blocks the alarm at power-up when the unit is first energized. YES enables and NO inhibits this blocking function. When enabled the alarm will not be active at power-up waiting for PV (Process Variable) to reach a non-alarm situation. From this point on the alarm will be free to actuate should a new alarm situation occur. |
| HYR1 | <i>ALARM 1 HYSTERESIS</i> : Defines the differential range between the PV value at which the alarm is turned on and the value at which it is turned off (in engineering units). |
| HYR2 | <i>ALARM 2 HYSTERESIS</i> : Same as above. |
| HYR3 | <i>ALARM 3 HYSTERESIS</i> : Same as above. |
| HYR4 | <i>ALARM 4 HYSTERESIS</i> : Same as above. |
| RT1 | <i>ALARM 1 TIME 1</i> : Defines the time (6500 sec. max.) during which the alarm 1 output will be ON when alarm 1 is active. Program zero to disable this function. |
| RT2 | <i>ALARM 1 TIME 2</i> : Defines the OFF state time for the alarm 1 output, after being ON during the time selected on ALARM 1 TIME 1. Program zero to disable this function. |
| RT1 | <i>ALARM 2 TIME 1</i> : Defines the time (6500 sec. max.) during which the alarm 1 output will be ON when alarm 1 is active. Program zero to disable this function |
| RT2 | <i>ALARM 2 TIME 2</i> : Defines the time during which the alarm 2 output will be, after being ON during the time selected on ALARM 2 TIME 1. Program zero to disable this function. Table 4 shows the advanced features that can be achieved with these time functions. |



7.1.5 Configuration Cycle





| PARAMETER | PROMPT PARAMETER DESCRIPTION |
|--------------|--|
| TYPE | <i>INPUT TYPE</i> : Selects the input signal type to be connected to the process variable input. Refer to Table 1. This is the first parameter to be set. |
| dPPo | <i>DECIMAL POINT POSITION</i> : For input types 16, 17, 18 or 19 only. Selects the decimal point position to be viewed in both PV and SV. |
| un It | <i>TEMPERATURE INDICATION IN °C OR °F</i> : Selects the display indication to be in °C or °F. Only available if input type is other than 16, 17, 18 or 19. |
| oFFS | <i>SENSOR OFFSET</i> : Offset value to be added to the PV to compensate sensor error. Default value: zero. |
| SPLL | <i>SET POINT LOW LIMIT</i> : <ul style="list-style-type: none"> - Linear inputs: Sets the lower range for SV and PV indication. - T/C and Pt100 inputs: sets the lower range for SV. |
| SPHL | <i>SET POINT HIGH LIMIT</i> : <ul style="list-style-type: none"> - Linear inputs: Sets the upper range for SV and PV indication. - T/C and Pt100 inputs: sets the upper range for SV. |
| rSLL | <i>REMOTE SET POINT LOW LIMIT</i> : Selects the lower range for indication of the Remote Setpoint. |
| rSHL | <i>REMOTE SET POINT HIGH LIMIT</i> : Selects the upper range for indication of the Remote Setpoint. |
| bRud | <i>DIGITAL COMMUNICATON BAUD RATE SELECTION</i> : 0 : 1200bps; 1 : 2400bps; 2 : 4800bps; 3 : 9600bps; 4 : 19200bps. |
| Raddr | <i>SLAVE ADDRESS SELECTION</i> : Identifies a slave in the network. The possible address numbers are from 1 to 247. |

7.1.6 I/O Cycle

| PARAMETER | PROMPT PARAMETER DESCRIPTION |
|--------------|--|
| <i>/ o 1</i> | <i>I/O 1 FUNCTION:</i> Selects the I/O function to be used at I/O 1 (relay 1). Options 0 to 5 are possible for this output. Refer to Table 7.3 I/O channel functions for functions. |
| <i>/ o 2</i> | <i>I/O 2 FUNCTION:</i> Selects the I/O function to be used at I/O 2 (relay 2). Options 0 to 5 are possible for this output. Refer to Table 7.3 I/O channel functions for functions. |
| <i>/ o 3</i> | <i>I/O 3 FUNCTION:</i> Selects the I/O function to be used at I/O 3 (relay 3). Options 0 to 5 are possible for this output. Refer to Table 7.3 I/O channel functions for functions. |
| <i>/ o 4</i> | <i>I/O 4 FUNCTION:</i> Selects the I/O function to be used at I/O 4 (relay 4). Options 0 to 5 are possible for this output. Refer to Table 7.3 I/O channel functions for functions. |
| <i>/ o 5</i> | <i>I/O 5 FUNCTION:</i> Selects the I/O function to be used at I/O 5 (Analog Output). Functions 0 to 15 are available (See Table 7.3 I/O channel functions). This option is normally used for main control output or PV analog retransmission. |
| <i>/ o 6</i> | <i>I/O 6 FUNCTION:</i> Selects the I/O function to be used at I/O 6 (Digital Input). Options 0, 6, 7, 8, 9 and 10 are possible for this input. Refer to Table 7.3 I/O channel functions for functions. |
| <i>FFunc</i> | <p>[F] KEY FUNCTION: Selects the I/O function assigned to the front panel [F] key. Available functions are:</p> <ul style="list-style-type: none"> 0 - Key not used; 6 - Manual/Automatic control selection; 7 - Start/Stop the controller (RUN function); 8 - Select remote setpoint; 9 - Execute/Hold ramp and soak profile; 10 - Enable/Disable ramp and soak profile 1; |

7.1.7 Calibration Cycle

All input and output types are factory calibrated. This cycle should only be accessed by experienced personnel. If in doubt do not press the  or  keys in this cycle.

| PARAMETER | PROMPT PARAMETER DESCRIPTION |
|--------------|---|
| <i>inLC</i> | INPUT LOW CALIBRATION: Sets the Process Variable low calibration (offset). Several keystrokes at  or  might be necessary to increment one digit. |
| <i>inHC</i> | INPUT HIGH CALIBRATION: Sets the Process Variable span calibration (gain). |
| <i>ouLL</i> | OUTPUT LOW CALIBRATION: Sets the analog current output low calibration (offset). |
| <i>ouHC</i> | OUTPUT HIGH CALIBRATION: Sets the analog current output span calibration (gain). |
| <i>[J] L</i> | COLD JUNCTION OFFSET CALIBRATION: Sets the cold junction offset calibration. |
| <i>rSLC</i> | REMOTE SET POINT LOW CALIBRATION: Sets the Remote Set Point low calibration (offset). Several keystrokes at  or  might be necessary to increment one digit. |
| <i>rSHC</i> | REMOTE SET POINT HIGH CALIBRATION: Sets the Remote Set Point span calibration (gain). |

7.2 Input Type Selection

Select the input type (in parameter “**TYPE**”) from Table below.

| TYPE | CODE | CHARACTERISTICS |
|-----------|-----------|---|
| J | 0 | Range: -50 to 760 °C (-58 to 1400 °F) |
| K | 1 | Range: -90 to 1370 °C (-130 to 2498 °F) |
| T | 2 | Range: -100 to 400 °C (-148 to 752 °F) |
| N | 3 | Range: -90 to 1300 °C (-130 to 2372 °F) |
| R | 4 | Range: 0 to 1760 °C (32 to 3200 °F) |
| S | 5 | Range: 0 to 1760 °C (32 to 3200 °F) |
| Pt100 | 6 | Range: -199.9 to 530.0 °C (-328.0 to 986.0 °F) |
| Pt100 | 7 | Range: -200 to 530 °C (-328 to 986 °F) |
| 4-20 mA | 8 | J Linearization Programmable range: -110 to 760 °C |
| 4-20 mA | 9 | K Linearization Programmable range: -150 to 1370 °C |
| 4-20 mA | 10 | T Linearization Programmable range: -160 to 400 °C |
| 4-20 mA | 11 | N Linearization Programmable range: -90 to 1370°C |
| 4-20 mA | 12 | R Linearization. Programmable range: 0 to 1760 °C |
| 4-20 mA | 13 | S Linearization Programmable Range: 0 to 1760 °C |
| 4-20 mA | 14 | Pt100 Linearization Prog. Range: -200.0 to 530.0 °C |
| 4-20 mA | 15 | Pt100 Linearization Prog. Range: -200 to 530 °C |
| 0-50 mV | 16 | Linear. Programmable indication -1999 to 9999 |
| 4-20 mA | 17 | Linear. Programmable indication -1999 to 9999 |
| 0 to 5Vdc | 18 | Linear. Programmable indication -1999 to 9999 |
| 4-20 mA | 19 | Square Root Extraction |

7.3 Output and Digital Inputs Configuration

The controller input/output channels can assume multiple functions, depending on configuration: control output, alarm output, digital output, digital input, and PV or SV analog retransmission. These channels are identified as **I/O1**, **I/O2**, **I/O3**, **I/O4**, **I/O5** and **I/O 6**. The basic controller model comes loaded with:

- I/O1 and I/O2** - Relay output SPDT;
- I/O3 and I/O4** - Relay output SPST;
- I/O5** - Analog output (0-20 or 4-20 mA), pulse, digital I/O;
- I/O6** - Digital Input

The function code of each I/O can be selected among the options on Table 2. Only valid function codes are displayed for each I/O (for example, I/O1, which is a relay, can be configured with

functions 0 to 5 only; on the other hand, I/O5 can perform all 16 functions). The description for the functions follows:

- CODE 0:** *No function* - The I/O channel programmed with code 0 will not be used by the controller. It is available to be used by serial communication as digital output.
- CODES 1 to 4:** *Alarm output* - Available for all I/O channels. The selected channel can be used as output to Alarms 1 to 4.
- CODE 5:** *PWM control output* - Available for all I/O channels.
- CODE 6:** *Digital input* - Available for I/O5 and I/O6 channels and key **F**.
- Closed:** Manual control
- Opened:** Automatic control

I/O channel functions

| CODE | I/O TYPE | I/O FUNCTION |
|------|----------------|---|
| 0 | Digital Output | Digital Output to be set by the serial comm. |
| 1 | Digital Output | Alarm 1 Output |
| 2 | Digital Output | Alarm 2 Output |
| 3 | Digital Output | Alarm 3 Output |
| 4 | Digital Output | Alarm 4 Output |
| 5 | Digital Output | PWM Control Output |
| 6 | Digital Input | Automatic/Manual mode change |
| 7 | Digital Input | Run/Stop mode change |
| 8 | Digital Input | Select Remote Set Point Input |
| 9 | Digital Input | Executes/Holds selected ramp and soak profile |
| 10 | Digital Input | Enable/Disable R&S profile 1 selection |
| 11 | Analog Output | 0 ~ 20mA Analog control output |
| 12 | Analog Output | 4 ~ 20mA Analog control output |
| 13 | Analog Output | 0 ~ 20mA PV retransmission |
| 14 | Analog Output | 4 ~ 20mA PV retransmission |
| 15 | Analog Output | 0 ~ 20mA SP retransmission |
| 16 | Analog Output | 4 ~ 20mA SP retransmission |

- CODE 7:** *Digital input* - Available for I/O5, I/O6 and key **[F]**. Start/Stop input (“**rvn**”:
Yes / No).
- Closed:** Outputs Enabled
 Opened: Outputs Disabled
- CODE 8:** *Digital input* - Available for I/O5, I/O6 and key **[F]**.
- Closed:** Remote SP (4-20mA in remote SP input)
 Opened: Main SP (internal programmed SV)
- CODE 9:** *Digital input* - Available for I/O5, I/O6 and key **[F]**.
- Closed:** Enables R&S Program
 Opened: Holds R&S Program (the program resumes when the contact is closed again)
- CODE 10:** *Digital input* - Available for I/O5, I/O6 and key **[F]**. Selects R&S program 1.
 Used to alternate between the main Set-point and a second
 Set-point defined by the R&S program 1.
- Closed:** Selects Program 1
 Opened: Uses Main Set-Point
- CODE 11:** *Analog control output* - I/O5 only. 0-20 mA control output.
- CODE 12:** *Analog control output* - I/O5 only. 4-20 mA control output.
- CODES 13 to 16:** *Analog retransmission* -I/O5 only. Configures I/O5 to output a 0-20 mA or 4-20 mA
 analog signal proportional to PV or SP.

7.4 Alarm Configuration

The controller has 4 alarms, with the front panel indicators. The alarms can be configured to operate in any of the nine functions listed on Table below.

7.4.1 ALARM TIMER FUNCTIONS

Alarms 1 and 2 can be programmed to have timer functions. The 3 modes of operation are:

- * Pulse
- * Delayed actuation
- * Oscillator

The desired function can be achieved programming the parameters “**A 1t 1**”, “**A 1t 2**”, “**A 2t 1**” and “**A 2t 2**”. 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.

7.4.2 ALARM FUNCTIONS

| TYPE | PROMPT | ACTION |
|--|---------------|---|
| Disabled | <i>oFF</i> | No active alarm. This output can be used as a digital output to be set by the serial communication. |
| Sensor Break (input Error) | <i>iErr</i> | Alarm will be ON if PV sensor breaks, input signal is out of range or Pt100 is shorted. |
| Event Alarm (ramp and Soak) | <i>rS</i> | Can be activated at a specific segment of ramp and soak program. |
| Heater break detection resistance fail | <i>rFR IL</i> | Detects a heater broken condition |
| Low Alarm | <i>Lo</i> | |
| High Alarm | <i>Hi</i> | |
| LOW Differential | <i>dIFL</i> | <p>Positive span</p> <p>Negative span</p> |
| HIGH Differential | <i>dIFH</i> | <p>Positive span</p> <p>Negative span</p> |
| Differential | <i>dIF</i> | <p>Positive span</p> <p>Negative span</p> |

Where **SPAn** means “*SPR1*”, “*SPR2*”, “*SPR2*” and “*SPR4*”.

Advanced Timer Alarm (for alarms 1 or 2):

| ALARM FUNCTION | T1 | T2 | ACTION |
|----------------|---------------|---------------|--------|
| Normal | 0 | 0 | |
| Delayed | 0 | 1 s to 6500 s | |
| Pulse | 1 s to 6500 s | 0 | |
| Oscillator | 1 s to 6500 s | 1 s to 6500 s | |

7.4.3 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. The alarm will actuate only after the occurrence of a non-alarm condition followed by a new occurrence for the alarm. The initial blocking is disabled for the **sensor break** alarm function.

7.4.4 SQUARE ROOT EXTRACTION

Available when input type 19 is selected. The indicator displays the square root of the current signal input applied to terminals.

7.4.5 REMOTE SET-POINT

The remote Set-point (SP) is enabled by an external digital signal in either I/O5 or I/O6, when programmed with code 8 (*Select remote SP input*).

7.4.6 ANALOGUE RETRANSMISSION OF PV AND SP

The analog output, when not used for control purposes, is available for retransmitting the SV and SP values in 0-20 or 4-20mA. This analog output is electrically isolated from other inputs and outputs. The analog output signal is scalable, with the output range determined by the values programmed in the parameters "**SPLL**" and "**SPHL**". To obtain a voltage output, connect a resistor shunt to the current output terminals.

7.4.7 SOFT START

Defines the time interval for the output to reach its maximum value (100%). The soft start value is programmed in "**SFSE**". See also parameters "**ouLL**" and "**ouHL**".

7.4.8 FUNCTION KEY AND DIGITAL INPUT (I/O6) FUNCTIONS

Both the **F** key and the I/O6 digital input can be programmed to execute functions 7, 8, 9 and 10 shown in Table . The key function is configured in parameter "**FFun** . The digital input function is configured in parameter **IO6**. The digital input can also be configured for function 6: Auto/Manual mode change.

7.5 Program Security

Each menu cycle can be locked (protected) by pressing **◀** and **▶** simultaneously for 3 seconds. Press **◀** and **▼** for 3 seconds to unlock. A short blink of the display confirms the lock/unlock change. This will alternately lock or unlock the **▶** and **▼** keys to avoid tampering.

For further protection, the unlock operation through the keypad may be disabled by changing the position of an internal strap inside the controller:

When **PROT** is **OFF**, the user is allowed to lock and unlock the cycles using the keypad as explained above. If **PROT** is **ON**, the cycles lock/unlock operation is disable.

7.6 Auto Tune

During auto tune the process is controlled in ON/OFF mode at the programmed Set-Point Value (SV). Depending on the process characteristics large oscillations above and below SV may occur and auto tuning may take several minutes to be concluded. The recommended procedure is as follows:

- Disable the control output at the **rvn** prompt by selecting **NO**.
- Select auto mode operation at the **Avto** prompt by selecting **YES**.
- Disable the ramp and soak function (select **NO**) and program a new SV value other than the present PV (close to the desired set point).
- Enable auto tuning at the **Atvn** prompt by selecting **YES**.
- Enable the control output at the **rvn** prompt by selecting **YES**.

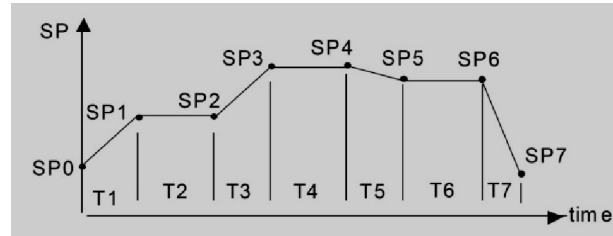
During the auto tune procedure the soft-start function will not operate and large oscillations will be induced around the setpoint. Make sure the process can accept these oscillations and fast control output changes. If auto tuning results are not satisfactory refer to the table below for manual fine tuning procedure.

Suggestions for manual tuning of PID parameters

| PARAMETER | RESPONSE | SOLUTION |
|-------------------|------------------------------|----------|
| Proportional Band | Slow Response | Decrease |
| | Large Oscillation | Increase |
| Integral Rate | Slow Response | Increase |
| | Large Oscillation | Decrease |
| Derivative Time | Slow Response or Instability | Decrease |
| | Large Oscillation | Increase |

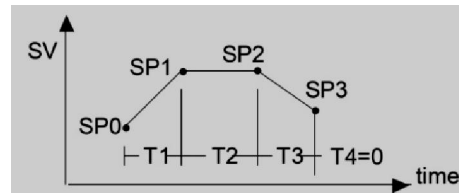
7.7 Ramp and Soak Profile Program

Seven ramp and soak profiles with up to 7 segments each can be programmed. Longer profiles of up to 49 segments can be created by linking 2 or more profiles.



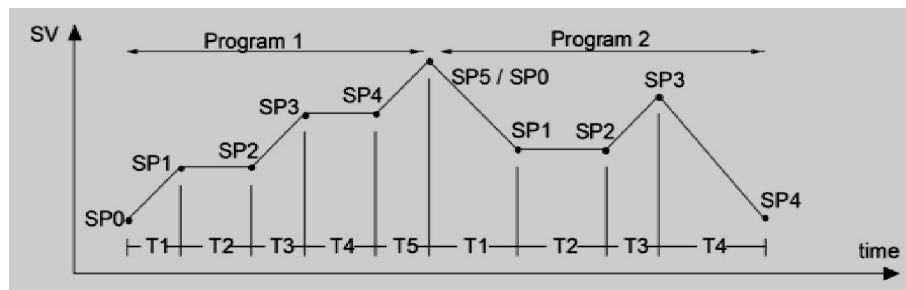
Example of a complete ramp and soak profile

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



Example of a profile with fewer segments (T4 is set 0)

The program tolerance **Ptol** defines the maximum deviation between PV and SV for the execution of the profile. If this deviation is exceeded, the program will be interrupted until the deviation falls to within the tolerance band. Programming 0 (zero) at this prompt disables the tolerance and the profile execution will not be halted even if PV does not follow SV (time priority as opposed to SV priority).



Example of two linked programs

The ramp and soak event function is used to activate alarms at any segment of program 1. This applies only to program 1. To enable this event function the alarms to be activated must be selected for **r5** function and are programmed at the **PE 0** to **PE 7** prompts. The number to be programmed at the prompt defines the alarms to be activated. To configure and execute a ramp and soak program:

- Program the tolerance value, SV, time and event.
- If any event alarm is required program the ramp and soak event function.
- Set the control mode to automatic.
- Select ramp and soak program to be executed at prompt **Prn** (0 to 4)
- Start control at the run prompt **run** by selecting **YES**.

Before executing the program the controller waits for PV to reach the first set point **SP0** if **PtoL** is different than zero. Should any power failure occur, when the controller resumes at the beginning of the segment that it was previously executing.

Event codes for ramp and soak

| CODE | ALARM 1 | ALARM 2 | ALARM 3 | ALARM 4 |
|------|---------|---------|---------|---------|
| 0 | | | | |
| 1 | X | | | |
| 2 | | X | | |
| 3 | X | X | | |
| 4 | | | X | |
| 5 | X | | X | |
| 6 | | X | X | |
| 7 | X | X | X | |
| 8 | | | | X |
| 9 | X | | | X |
| 10 | | X | | X |
| 11 | X | X | | X |
| 12 | | | X | X |
| 13 | X | | X | X |
| 14 | | X | X | X |
| 15 | X | X | X | X |

7.8 Serial Communication

An optional RS485 serial communication interface is available which allows up to 247 controllers in a network to communicate to a master device.

7.5.1 RS485

- Compatible signals with RS485 standard;
- Two-wire connection from master to up to 247 slave controllers in a multi-drop bus;
- Maximum communication distance: 1000 meters;

7.5.2 General Characteristics

- Optically isolated serial interface
- Programmable Baud rate: 1200, 2400, 4800, 9600 or 19200 bps.
- Data Bits: 8
- Parity: None
- Stop Bits: 1

8. SAFETY PRECAUTIONS

1. The unit should be powered for 15 minutes before use.
2. Use in ambient temperature of 0-60°C.
3. Avoid vibrations, shock, excessive dust, corrosive chemical materials or gaseous environment.
4. Input wire should not be too long. If measured signal have to be far away from the unit, please use 2-core shielded cable.
5. Use this instrument in the scope of its specifications, otherwise fire or malfunctions may result.
6. Contact of the instrument, with organic solvents or oils should be avoided.
7. Do not turn on the power supply until all of the wiring is completed. Otherwise electrical shock, fire or malfunction may result.
8. Do not disassemble, repair or modify the instrument.
9. All connections should be tightened properly.
10. Power supply should be constant, should not be fluctuating.

9. WARRANTY

ABUS provides the original purchaser of this instrument a one (1) year warranty against defects in material and workmanship under the following terms:

- The one year warranty begins on the day of shipment as stated on the sales bill.
- During the warranty period all costs of material and labor will be free of charge provided that the instrument does not show any evidence of misuse.
- For maintenance, return the instrument with a copy of the sales bill to our factory.
- All transportation and insurance costs should be covered by the owner of the equipment.
- Should any sign of electrical or mechanical shock, abuse, bad handling or misuse be evident the warranty voids and maintenance costs will be charged.

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