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- IO Module

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High Performance Process & Temperature Controllers

C Series (C22, C42, C62, C72, C82, C83, R22)
Features

01. Multi Color LCD Display
02. High Accuracy 18 Bit A-D Input and 15 Bit D-A Output
03. 200 msec Sampling Rate
04. Universal Inputs of Thermocouple, RTD, mA, VDC
05. Fuzzy + PID Control and Auto-Tuning
06. Soft-Start Function
07. Possibility of both RS-485 and Analog Retransmission
08. Ramp & Soak Profiler
09. CT Inputs for Heater-Break Detection
10. Bumpless Transfer
11. Remote Setpoint and Up to 6 Event Inputs
12. Bidirectional Menu Navigation
13. Lockout Protection
14. Approvals: UL, cUL, CE, RoHS, WEEE

Specifications

C Series (C22, C42, C62, C72, C82, C83, R22)

Power Supply
90 to 250 VAC, 47–63 Hz; 11 to 40 VDC / 20 to 28 VAC, 47–63 Hz

Power Consumption
C22/R22: 8VA, 4W maximum, C62: 10VA, 5W maximum, C72/C82/C83/C42: 12VA, 6W maximum

Signal Input

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-120°C to 1,000.0°C (184°F to 1,832°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>K</td>
<td>-200°C to 1,370.0°C (32°F to 2,498°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>T</td>
<td>-250°C to 400.0°C (418°F to 752°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>E</td>
<td>-100°C to 900.0°C (148°F to 1,652°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>B</td>
<td>0°C to 1,820.0°C (32°F to 3,038°F)</td>
<td>±2°C (200°C to 1,800°C)</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>R</td>
<td>0°C to 1,767.8°C (32°F to 3,124°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>S</td>
<td>0°C to 1,767.8°C (32°F to 3,124°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>N</td>
<td>-250°C to 1,300.0°C (418°F to 2,372°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>L</td>
<td>-200°C to 900.0°C (32°F to 1,652°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>U</td>
<td>-200°C to 600.0°C (32°F to 1,112°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>P</td>
<td>0°C to 1,395.0°C (32°F to 2,543°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>C</td>
<td>0°C to 2,300.0°C (32°F to 4,172°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>D</td>
<td>0°C to 2,300.0°C (32°F to 4,172°F)</td>
<td>±2°C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>PT100(DIN)</td>
<td>-200°C to 850.0°C (32°F to 1,562°F)</td>
<td>±0.4°C</td>
<td>1.3 KΩ</td>
</tr>
<tr>
<td>PT100(JIS)</td>
<td>-200°C to 600.0°C (32°F to 1,112°F)</td>
<td>±0.4°C</td>
<td>1.3 KΩ</td>
</tr>
<tr>
<td>mA</td>
<td>-3mA to 27mA</td>
<td>±0.05%</td>
<td>2.5 Ω</td>
</tr>
<tr>
<td>VDC</td>
<td>-1.3 VDC to 11.5 VDC</td>
<td>±0.05%</td>
<td>1.5 MΩ</td>
</tr>
<tr>
<td>mV</td>
<td>0 to 50 mV</td>
<td>±0.05%</td>
<td>2.2 MΩ</td>
</tr>
</tbody>
</table>

- Burn-out Current: 200 nA

Temperature Effect: 1.5μV/°C for all inputs except mA input, 3.0μV/°C for mA

Sensor Lead Resistance Effect: Thermocouple: 0.2μV/°C; 3-wire RTD: 2.8°C/°C of Difference of Resistance of two leads; 2-wire RTD: 2.6°C/°C of Sum of Resistance of two leads

Common Mode Rejection Ratio (CMRR): 120 dB

Normal Mode Rejection Ratio (NMRR): 55 dB

Sensor Break Detection: Sensor open for Thermocouple and RTD inputs, sensor short for RTD input, below 1 mA for 4–20mA input, below 0.25 VDC for 1–5 VDC input, not available for other inputs

Sensor Break Responding Time: Within 4 seconds for Thermocouple and RTD inputs, 0.1 second for 4–20mA and 1–5VDC inputs

Model

C22
C62
C82
C83
C72
C42
R22

Power Supply: 90 to 250 VAC, 47–63 Hz; 11 to 40 VDC / 20 to 28 VAC, 47–63 Hz

Power Consumption: C22/R22: 8VA, 4W maximum, C62: 10VA, 5W maximum, C72/C82/C83/C42: 12VA, 6W maximum

Temperature Controller
### Remote Set Point Input

<table>
<thead>
<tr>
<th>Type</th>
<th>Linear Current, Linear Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>-3 mA to 27 mA, -1.3 VDC to 11.5 VDC</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±0.05 %</td>
</tr>
<tr>
<td>Remote Set Point Option</td>
<td>Not Available</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>Current: 2.5 Ω, Voltage: 1.5 MΩ</td>
</tr>
<tr>
<td>Resolution</td>
<td>188 Bits</td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>1.66 Times/Second</td>
</tr>
<tr>
<td>Maximum Rating</td>
<td>280 mA maximum for Current Input, 12 VDC maximum for Voltage Input</td>
</tr>
<tr>
<td>Temperature Effect</td>
<td>±1.5 µV/°C for Voltage Input, ±3.0 µV/°C for Current Input</td>
</tr>
<tr>
<td>Sensor Break Detection</td>
<td>Below 1 mA for 4 - 20 mA input, below 0.25 VDC for 1 - 5 VDC input, not available for other inputs</td>
</tr>
<tr>
<td>Sensor Break Responding Time</td>
<td>0.1 seconds</td>
</tr>
</tbody>
</table>

### Event Input

<table>
<thead>
<tr>
<th>Number of Event Input</th>
<th>1</th>
<th>2</th>
<th>6</th>
<th>6</th>
<th>2</th>
<th>6</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic Low</td>
<td>-10 VDC minimum, 0.8 VDC maximum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logic High</td>
<td>2 VDC minimum, 10 VDC maximum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Refer to user manual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### CT Input

<table>
<thead>
<tr>
<th>CT Type</th>
<th>CT98-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>±5 % of Full Scale Reading, ±1 digit maximum</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>294 Ω</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>0 to 50A VAC</td>
</tr>
<tr>
<td>Output of CT</td>
<td>0 to 5 VDC</td>
</tr>
<tr>
<td>CT Mounting</td>
<td>Screw Mounting</td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>1 Time/Second</td>
</tr>
</tbody>
</table>

### Output 1/Output 2

<table>
<thead>
<tr>
<th>Type</th>
<th>Relay, Pulsed Voltage, Linear Voltage and Linear Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relay Rating</td>
<td>2A, 240VAC, 200,000 Life Cycles for Resistive Load</td>
</tr>
<tr>
<td>Pulsed Voltage</td>
<td>Source Voltage 5VDC, Current Limited Resistance 66Ω</td>
</tr>
<tr>
<td>Linear Output Resolution</td>
<td>15 Bits</td>
</tr>
<tr>
<td>Linear Output Regulation</td>
<td>0.02% for full load change</td>
</tr>
<tr>
<td>Linear Output Setting Time</td>
<td>0.13 second (Stable to 99.9%)</td>
</tr>
<tr>
<td>Isolation Breakdown Voltage</td>
<td>1,000 VAC</td>
</tr>
<tr>
<td>Temperature Effect</td>
<td>±0.01 % of Span/°C</td>
</tr>
<tr>
<td>Load Capacity of Linear Output</td>
<td>Linear Current: 5000Ω maximum, Linear Voltage: 10 KΩ minimum</td>
</tr>
<tr>
<td>Linear Output Ranges</td>
<td>0-22.2mA (0 - 20mA/4 - 20mA), 0-5.55VDC (0 - 5VDC, 1 - 5VDC), 0 - 11VDC (0 - 10VDC)</td>
</tr>
</tbody>
</table>

### Alarm

<table>
<thead>
<tr>
<th>Relay Type</th>
<th>Form A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Rating</td>
<td>2A, 240VAC, 200,000 Life Cycles for Resistive Load</td>
</tr>
<tr>
<td>Alarm Function</td>
<td>Dwell Timer, Deviation Low, Deviation High, Deviation Band Low, Deviation Band High, Process High, Process Low, Range Low, Range High, Range High Low, Heater Break, Heater Short, Profile End, Profile Holdback</td>
</tr>
<tr>
<td>Alarm Mode</td>
<td>Latching, Holding, Normal, Latching / Holding, Set Point Holding</td>
</tr>
<tr>
<td>Dwell Timer</td>
<td>0.1 to 4,553.6 Minutes</td>
</tr>
</tbody>
</table>

### Data Communication

<table>
<thead>
<tr>
<th>Interface</th>
<th>RS-485</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>Modbus RTU (Slave Mode)</td>
</tr>
<tr>
<td>Address</td>
<td>1 to 247</td>
</tr>
<tr>
<td>Baud Rate</td>
<td>2.8 KBPS to 115.2 KBPS</td>
</tr>
<tr>
<td>Parity Bit</td>
<td>None, Even or Odd</td>
</tr>
<tr>
<td>Stop Bit</td>
<td>1 or 2 Bits</td>
</tr>
<tr>
<td>Data Length</td>
<td>7 or 8 Bits</td>
</tr>
<tr>
<td>Communication Buffer</td>
<td>160 Bytes</td>
</tr>
</tbody>
</table>

### Analog Retransmission

| Output Signal           | 4 - 20mA, 0 - 20mA, 0 - 10VDC |
|                       | 15 Bits |
| Accuracy               | ±0.05 % of Span ±0.0025%/°C |
| Load Resistance         | 0 to 500Ω for Current Output, 10 KΩ minimum for Voltage Output |
| Output Regulation       | 0.01% for full load change |
| Output Setting Time     | 0.13 Second (Stable to 99.9%) |
| Isolation Breakdown Voltage | 1,000 VAC minimum |
| Integral Linearity Error | ±0.005 % of Span |

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**Temperature Controller**

C Series (C22, C42, C62, C72, C82, C83, R22)
Analog Retransmission

| Temperature Effect | ±0.0025% of Span/°C |
| Saturation Low | 0 mA or 0 VDC |
| Saturation High | 22.2 mA or 5.55 VDC, 11.1 VDC minimum |
| Linear Output Range | 0–22.2 mA (0–20 mA / 4–20 mA), 0–5.55 VDC (0–5 VDC / 1–5 VDC), 0–11.1 VDC (0–10 VDC) |

User Interface

| Keypad | 4 Keys |
| Display Type | 4 Digit LCD Display |
| Number of Display | 2 |
| Upper Display Size | 0.4" (10 mm) |
| Lower Display Size | 0.19" (4.8 mm) |

Programmation Port

| Interface | Micro USB |
| Function | Parameter Configuration and Firmware Upgrade |

Control Mode

| Output 1 | Reverse (Heating) or Direct (Cooling) Action |
| Output 2 | PID cooling control, Cooling P band 50–300% of PB, Dead band -36.0 – 36.0% of PB |
| ON-OFF | 0.1–50.0°C (0.1–90.0°F) hysteresis control (P band =0) |
| P or PD | 0 – 100.0% offset adjustment |
| PID | Fuzzy logic modified Proportional band 0.1–500.0°C(0.1–800.0°F), Integral time 0–3,600 Seconds, Derivative time 0–360.0 Seconds |
| Cycle Time | 0.1 to 90.0 Seconds |
| Manual Control | Heat(MV1) and Cool(MV2) |
| Auto-tuning | Cold Start and Warm Start |
| Failure Mode | Auto transfer to manual mode while sensor break or A – D Converter damage |
| Ramping Control | 0–500.0°C (0–900.0°F) / Minute or 0–500.0°C (0–900.0°F) / Hour Ramp Rate |

Digital Filter

| Function | First Order |
| Time Constant | 0, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60 Seconds Programmable |

Profler

| Availability | No, Option, Option, Option, Option, Option, No |
| No of Programs | N/A, 4 / 2 / 1, 4 / 2 / 1, 4 / 2 / 1, 4 / 2 / 1, 4 / 2 / 1, N/A |
| Number of Segments / Program | N/A, 4 / 8 / 16, 4 / 8 / 16, 4 / 8 / 16, 4 / 8 / 16, N/A |

Environmental and Physical Specifications

| Operating Temperature | -10°C to 50°C |
| Storage Temperature | -40°C to 60°C |
| Humidity | 0 to 90% RH (Non-Condensing) |
| Altitude | 2,000 Meters maximum |
| Pollution | Degree II |
| Insulation Resistance | 20 MΩ minimum (≥ 500 VDC) |
| Dielectric Strength | 2,000 VAC, 50 Hz for 1 Minute |
| Vibration Resistance | 10 to 55 Hz, 10 m/s² for 2 Hours |
| Shock Resistance | 200 m/s² (20 g) |
| Molding | Flame Retardant Polycarbonate |
| Mounting | DIN Rail |
| Panel Size | DIN Rail |
| Panel Dimensions (W x H x D) (mm) | 45 x 22.2 |
| Depth Behind Panel (mm) | 84 |
| Cut Out Dimensions (mm) | 45 x 92 |
| Weight (grams) | 120 |

Approval Standards

| Safety | UL61010-1, CSA 22.2 No.61010-1-12, EN61010-1IEC1010-1, RoHS, REACH |
| Protective Class | IP 50 for panel, IP 20 for terminals and housing, all indoor use |
| EMC | EN61326 |
## Ordering Code

### Power Input

- **C22**
  - 4: 90 to 250VAC, 47–63Hz
  - 5: 11 to 40VDC / 20 to 28VAC, 47–63Hz

- **R22**

### Output 1

- **Form A Relay**
- **SSRD, 5 VDC / 30mA**
- **Isolated 4–20mA / 0–20mA (OM98-3)**
- **Isolated 0–10VDC (OM98-5)**
- **SSRD, 14 VDC / 40mA (OM94-7)**

### Output 2 / Alarm 1

- **None**
- **Form A Relay**
- **SSRD, 5 VDC / 30mA**
- **Isolated 4–20mA / 0–20mA (OM98-3)**
- **Isolated 0–10VDC (OM98-5)**
- **SSRD, 14 VDC / 40mA (OM94-7)**

### Option 1

- **None**
- **RS-485**
- **1 Event Input (EI1)**
- **1 CT Input (CT1)**

### Option 2

- **None**
- **Retransmit 4–20mA / 0–20mA (OM98-3)**
- **Retransmit 0–10VDC (OM98-5)**
- **Alarm 2 (Form A relay)**
- **1 Event Input (EI2 only for R22)**
- **1 CT Input (CT2 only for R22)**

### Accessories for All Models

- **OM94-7 = 14 VDC / 40mA SSR Drive Module**
- **OM98-3 = Isolated 4–20mA / 0–20mA Analog Output Module**
- **OM98-5 = Isolated 0–10VDC Analog Output Module**
- **CM98-3 = Isolated 4–20mA / 0–20mA Retransmission Module for all models except C22 & R22**
- **CM98-5 = Isolated 0–10VDC Retransmission Module for all models except C22 & R22**
- **CT98-1 = Current Transformer 0-50A**
- **PA98-1 = USB Programming Adaptor**
- **CC98-1 = Programming Port Cable (1.5M)**
- **BC-SET = Configuration Software**

### Related Products

- **SNA10A = Smart Network Adaptor for third party software, which converts 255 channels of RS-485 or RS-422 to RS-232 Network**
**Power Input**

4: 90 to 250VAC, 47–63Hz
5: 11 to 40VDC / 20 to 28VAC, 47–63Hz

**Output 1**

1: Form A Relay
2: SSRD, 5VDC / 30mA
3: Isolated 4–20mA / 0–20mA (OM98-3)
5: Isolated 0–10VDC (OM98-5)
C: SSRD, 14VDC / 40mA (OM94-7)

**Output 2/Alarm 1**

0: None
1: Form A Relay
2: SSRD, 5VDC / 30mA
3: Isolated 4–20mA / 0–20mA (OM98-3)
5: Isolated 0–10VDC (OM98-5)
C: SSRD, 14VDC / 40mA (OM94-7)

**Alarm 2**

0: None
1: Form A Relay

**Option 1**

0: None
1: RS-485

**Option 2**

0: None
1: 2 Event Inputs
2: 1 Event Input and 1 CT Input
3: 2 CT Inputs

**Option 3**

0: None
1: Retransmit 4–20mA / 0–20mA (CM98-3)
2: Retransmit 0–10VDC (CM98-5)
3: Alarm 3 (Form A Relay)

**Option 4**

0: None
1: Terminal Cover
**Power Input**

4: 90 to 250VAC, 47–63Hz
5: 11 to 40VDC / 20 to 28VAC, 47–63Hz

**Output 1**

1: Form A Relay
2: SSRD, 5VDC / 30mA
3: Isolated 4–20mA / 0–20mA (OM98-3)
5: Isolated 0–10VDC (OM98-5)
C: SSRD, 14VDC / 40mA (OM94-7)

**Output 2/Alarm 1**

0: None
1: Form A Relay
2: SSRD, 5VDC / 30mA
3: Isolated 4–20mA / 0–20mA (OM98-3)
5: Isolated 0–10VDC (OM98-5)
C: SSRD, 14VDC / 40mA (OM94-7)

**Alarm 2 to 3**

0: None
1: Form A Relay on Alarm 2
2: Form A Relay on Alarm 2 to 3

**Event Inputs**

0: None
1: 6 Event Inputs (2 Event Inputs for C72)

**Option 1**

0: None
1: RS-485 and Remote Setpoint

**Option 2**

0: None
1: 1 CT Input and Remote Setpoint
2: 2 CT Inputs and Remote Setpoint

**Option 3**

0: None
1: Retransmit 4–20mA / 0–20mA (CM98-3) and Remote Setpoint
2: Retransmit 0–10V (CM98-5) and Remote Setpoint
3: Alarm 4 (Form A Relay) and Remote Setpoint
4: Alarm 4 (Form A Relay), Retransmit 4-20mA / 0-20mA (CM98-3) and Remote Setpoint (Unavailable for C72)
5: Alarm 4 (Form A Relay), Retransmit 0-10VDC (CM98-5) and Remote Setpoint (Unavailable for C72)

**Option 4**

0: None
1: Terminal Cover
2: Ramp & Soak Profiler
3: Terminal cover and Ramp & Soak Profiler
Fuzzy + PID Process / Temperature Controller

Features:
- High accuracy 18-bit input A-D
- High accuracy 15-bit output D-A
- Fast input sample rate (5 times/second)
- Basic & full function
- User menu configurable
- Pump control
- Fuzzy/PID microprocessor-based control
- Automatic tuning
- Differential control
- Auto-tune function
- Self-tune function
- Sleep mode function
- "Soft-start" ramp and dwell timer
- Programmable inputs (thermocouple, RTD, mA, VDC)
- Analog input for remote set point and CT
- Event input for changing function & set point
- Programmable digital filter
- Hardware lockout + remote lockout protection
- Loop break alarm
- Heater break alarm
- Sensor break alarm + Bumpless transfer
- RS-485, RS-232 communication
- Analog retransmission
- Signal conditioner DC power supply
- A wide variety of output modules available
- Safety UL / CSA / IEC1010-1
- EMC / CE EN 61326

BTC-4300
BTC-8300
BTC-9300
BTC-2500

Temperature Controller
300 Series (BTC-2500, BTC-4300, BTC-8300, BTC-9300)
The Fuzzy Logic plus PID microprocessor-based controller series, incorporates a bright, easy to read 4-digit LED display, indicating process value and set point value. The Fuzzy Logic technology enables a process to reach a predetermined set point in the shortest time, with the minimum of overshoot during power-up or external load disturbance.

BTC-9300 is a 1/16 DIN size panel mount controller, BTC-2500 is a 1/32 DIN size panel mount controller, BTC-6300 is a 1/6 DIN size panel mount controller and BTC-4300 is a 1/4 DIN size panel mount controller.

These units are powered by 11-26 VDC or 90-264 VAC supply. Incorporating a 2 amp. control relay output as standard. Alternative output options include triac, SV logic output, linear current and linear voltage. The units are fully programmable for PT100 and thermocouple types J, K, T, E, B, R, S, N, L with no need to modify the unit. The input signal is digitized by using a 18-bit A to D converter. Its fast sampling rate allows the unit to control fast processes.

Digital communications RS-485 or RS-232 are available as an additional option. These options allow the units to be integrated with supervisory control system and software.

A programming port is available for loading the configuration data with no need to use the keypads on front panel.

By using proprietary Fuzzy modified PID technology, the control loop will minimize the overshoot and undershoot in the shortest time. The following diagram is a comparison of results with and without Fuzzy technology.

**Overview**

**Fuzzy Control**
The function of Fuzzy control is to adjust PID parameters from time to time in order to make manipulation output value more flexible and adaptive to various processes. The results is to enable a process to reach a predetermined set point in the shortest time, with the minimum of overshoot and undershoot during power-up or external load disturbance.

**Digital Communication**
The units are equipped with RS-485 or RS-232 interface card to provide digital communication. By using the twisted pair wires there are at most 247 units can be connected together via RS-485 interface to a host computer.

**Programming Port**
A programming port is used to connect the unit to a PC for quick configuration, also can be connected to an ATE system for automatic testing & calibration.

**Auto-tune**
The auto-tune function allows the user to simplify initial setup for a new system. A clever algorithm is provided to obtain an optimal set of control parameters for the process, and it can be applied either as the process is warming up (cold start) or as the process has been in a steady state (warm start).

**Lockout Protection**
The parameters can be locked to prevent from being changed by using either Hardware lockout or Remote lockout or both.

**Bumpless Transfer**
Bumpless transfer allows the controller to continue to control by using its previous value as the sensor breaks. Hence, the process can be well controlled temporarily as if the sensor is normal.

**Self-start Ramp**
The ramping function is performed during power up as well as any time the set point is changed. It can be ramping up or ramping down. The process value will reach the set point with a predetermined constant rate.

**Digital Filter**
A first order low pass filter with a programmable time constant is used to improve the stability of process value. This is particularly useful in certain application where the process value is too unstable to read.

**SEL Function**
The units have the flexibility for user to select those parameters which is most significant to him and put these parameters in the front of display sequence. There are at most 5 parameters can be selected to allow the user to build his own display sequence.

**Pump Control**
Only the superior noise rejection capability in addition to the fast sampling rate owned by this series of controllers can control the water pressure in a pump system which is driven by a variable speed motor.
Connection Diagrams

BTC-4300, BTC-8300

BTC-9300

BTC-2500

Specifications

Power
90 - 264 VAC, 47 - 63 Hz, 15VA, 7W maximum
11 - 26 VAC / VDC, 15VA, 7W maximum

Input 1

<table>
<thead>
<tr>
<th>Type</th>
<th>Range (°C)</th>
<th>Accuracy @25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-120° to 1000°C (184°F to 1832°F)</td>
<td>±2°C</td>
<td>2.2M</td>
</tr>
<tr>
<td>K</td>
<td>-200° to 1370°C (392°F to 2502°F)</td>
<td>±2°C</td>
<td>2.2M</td>
</tr>
<tr>
<td>T</td>
<td>-250° to 400°C (421°F to 752°F)</td>
<td>±2°C</td>
<td>2.2M</td>
</tr>
<tr>
<td>E</td>
<td>-100° to 400°C (185°F to 752°F)</td>
<td>±2°C</td>
<td>2.2M</td>
</tr>
<tr>
<td>B</td>
<td>0° to 1562°C (32°F to 2844°F)</td>
<td>±2°C</td>
<td>2.2M</td>
</tr>
<tr>
<td>R</td>
<td>0° to 1767°C (32°F to 3114.4°F)</td>
<td>±2°C</td>
<td>2.2M</td>
</tr>
<tr>
<td>S</td>
<td>0° to 1767°C (32°F to 3114.4°F)</td>
<td>±2°C</td>
<td>2.2M</td>
</tr>
<tr>
<td>N</td>
<td>-250° to 1300°C (418°F to 2372°F)</td>
<td>±2°C</td>
<td>2.2M</td>
</tr>
<tr>
<td>L</td>
<td>200° to 600°C (392°F to 1112°F)</td>
<td>±2°C</td>
<td>2.2M</td>
</tr>
<tr>
<td>P1</td>
<td>20°C to 700°C (68°F to 1580°F)</td>
<td>±0.4°C</td>
<td>1.3K</td>
</tr>
<tr>
<td>P1</td>
<td>20°C to 600°C (68°F to 1112°F)</td>
<td>±0.4°C</td>
<td>1.3K</td>
</tr>
</tbody>
</table>

Input 2

Resolution: 18 bits
Sampling Rate: 5 times / second
Maximum Rating: 2 VDC minimum, 12 VDC maximum
(1 minute for mA input)
Temperature Effect: ±1.5 mV/°C for all inputs except mA
input ±0.0 mV/°C for mA input

Sensor Lead Resistance Effect:
T/C: 0.2 mV/ohm
3-wire RTD: 2.6 °C/ohm of resistance difference of two leads
2-wire RTD: 2.6 °C/ohm of resistance sum of two leads 200nA

Common Mode Rejection Ratio (CMRR): 120dB
Normal Mode Rejection Ratio (NMRR): 55dB

Sensor Break Detection:
Sensor open for TC, RTD and mV inputs,
below 1 mA for 4-20 mA input,
below 0.25V for 1 - 5 V input, unavailable for other inputs.

Sensor Break Responding Time:
Within 4 seconds for TC, RTD and mV inputs,
0.1 second for 4-20 mA and 1 - 5 V inputs.

Characteristics:

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>C74-1</td>
<td>0-50.0 A</td>
<td>±0.05%</td>
<td>80Ω</td>
</tr>
<tr>
<td>mA</td>
<td>-3mA-27mA</td>
<td>±0.05%</td>
<td>80Ω</td>
</tr>
<tr>
<td>V</td>
<td>-1.25V-16.5V</td>
<td>±0.05%</td>
<td>80Ω</td>
</tr>
</tbody>
</table>

Input 3 (Event Input)

Logic Low: -10V minimum, 0.8V maximum
Logic High: ≥2V minimum, 10V maximum

External pull-down Resistor: 400KΩ maximum
External pull-up Resistor: 1.5KΩ minimum

Functions:
Select second set point and/or PID, reset alarm 1 and/or alarm 2, disable output 1 and/or output 2, remote lockout.

Output 1 / Output 2

Relay Rating: 2A/240 VAC, life cycles 200,000 for resistive load
Pulsed Voltage: Source Voltage 5V, current limiting resistance 68

Linear Output Characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>Zero Tolerance</th>
<th>Span Tolerance</th>
<th>Load Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>mA</td>
<td>0 mA ±0.6 mA</td>
<td>20-21 mA ±0.6 mA</td>
<td>500 mA max.</td>
</tr>
<tr>
<td>mA</td>
<td>0 mA ±0.6 mA</td>
<td>20-21 mA ±0.6 mA</td>
<td>500 mA max.</td>
</tr>
<tr>
<td>V</td>
<td>0 V ±0.5 V</td>
<td>5-5.25 V ±0.5 V</td>
<td>10 KΩ min.</td>
</tr>
<tr>
<td>V</td>
<td>0 V ±0.5 V</td>
<td>5-5.25 V ±0.5 V</td>
<td>10 KΩ min.</td>
</tr>
<tr>
<td>V</td>
<td>0 V ±0.5 V</td>
<td>10-10.5 V ±0.5 V</td>
<td>10 KΩ min.</td>
</tr>
<tr>
<td>V</td>
<td>0 V ±0.5 V</td>
<td>10-10.5 V ±0.5 V</td>
<td>10 KΩ min.</td>
</tr>
</tbody>
</table>

Linear Output

Resolution: 15 bits
Output Regulation: 0.01% for full load change
Output Setting Time: 0.1 sec. (stable to 99.9%) Isolation Breakdown Voltage: 1000 VAC
Temperature Effect: ±0.025% of SPAN /°C
Temperature Controller

300 Series (BTC-2500, BTC-4300, BTC-8300, BTC-9300)

Triac (SSR) Output
Rating: 1A / 240 VAC
Inrush Current: 20A for 1 cycle
Min. Load Current: 50 mA rms
Max. Off-state Leakage: 3 mA rms
Max. On-state Voltage: 1.5 V rms
Insulation Resistance: 1000 Mohms min. at 500 VDC
Dielectric Strength: 2500 VAC for 1 minute
DC Voltage Supply Characteristics (Installed at Output 2)

<table>
<thead>
<tr>
<th>Type</th>
<th>Tolerance</th>
<th>Max. Output</th>
<th>Ripple</th>
<th>Isolation</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 V</td>
<td>±0.1 V</td>
<td>25 mA</td>
<td>0.7 Vp-p</td>
<td>500 VAC</td>
</tr>
<tr>
<td>12 V</td>
<td>±0.5 V</td>
<td>40 mA</td>
<td>1.1 Vp-p</td>
<td>500 VAC</td>
</tr>
<tr>
<td>5 V</td>
<td>±0.25 V</td>
<td>80 mA</td>
<td>0.35 Vp-p</td>
<td>500 VAC</td>
</tr>
</tbody>
</table>

Alarm 1 Alarm 2 (Output 2)
Alarm 1 Relay:
Form A or Form B for BTC-9300, Form C for BTC-4300, BTC-8300, 5V Logic output for BTC-2500 Max. Rating 2A/240VAC, life cycles 200,000 for resistive load. Life cycles 200,000 for resistive load.
Alarm 2 Relay:
Form A, Max. rating 2A/240 VAC, life cycles 200,000 for resistive load.
Alarm Functions:
- Dwell time
- Deviation High / Low Alarm
- Deviation Band High / Low Alarm
- PV1 High / Low Alarm
- PV2 High / Low Alarm
- PV1 or PV2 High / Low Alarm
- PV1-PV2 High / Low Alarm
- Loop Break Alarm
- Sensor Break Alarm

Alarm Mode: Normal, Latching, Hold, Latching / Hold
Dwell Timer: 0 - 65535.5 minutes

Data Communication
Interface: RS-232 (1 unit), RS-485 (up to 247 units)
Protocol: Modbus Protocol RTU mode
Address: 1 - 247
Baud Rate: 0.3 - 38.4 Kbps/sec
Data Bits: 7 or 8 bits
Parity Bit: None, Even or Odd
Stop Bit: 1 or 2 bits
Communication Buffer: 50 bytes

Analog Retransmission
Functions: PV1, PV2, PV1-PV2, PV2-PV1, Set Point, MV1, MV2, PV-SV deviation value
Output Signal: 4-20 mA, 0-20 mA, 0-1V, 0-5V, 1-5V, 0-10V
Resolution: 15 bits
Accuracy: ±0.05% of span ±0.0025% /°C
Load Resistance: 0 - 500 ohms (for current output), 10 K ohms minimum (for voltage output)
Output Regulation: 0.01% for full load change
Output Settling Time: 0.1 sec. (stable to 99.9%)
Isolation Breakdown Voltage: 1000 VAC min.
Integral Linearity Error: ±0.005% of span
Temperature Effect: ±0.0025% of span /°C
Saturation Low: 0 mA (or 0V)
Saturation High: 22.2 mA (or 5.5V, 11.1V min.)
Linear Output Range: 0 - 22.2mA (0-20mA or 4-20mA), 0 - 5.55V (0 - 5V, 1 - 5V), 0 - 11.1V (0 - 10V)

User Interface
Dual 4-digit LED Displays:
BTC-4300
Upper 0.55" (14mm)
Lower 0.4" (10mm)
BTC-8300, BTC-9300
Upper 0.4" (10mm)
Lower 0.31" (8mm)
BTC-2500
0.4" (10mm)

Keypad: 3 keys
Programming Port: For automatic setup, calibration and testing
Communication Port: Connection to PC for supervisory control

Control Mode
Output 1: Reverse (heating) or direct (cooling) action
Output 2: PID cooling control, cooling P band 1 – 255% of PB
ON-OFF: 0.1 – 55.6 °C hysteresis control (P band = 0)
P or PD: 0 – 100 % offset adjustment
PID: Fuzzy logic modified. Proportional band 0 – 500 °C. Integral time 0 - 10000 seconds, derivative time 0 – 3600 seconds
Cycle Time: 0.1 – 100.0 seconds
Manual Control: Heat (MV1) and Cool (MV2)
Auto-tuning: Cold start and warm start
Failure Mode: Auto-transfer to manual mode while sensor break or A-D converter damage
Ramping Control: 0 - 500.0 °C/minute or 0 - 5000.0 °C/hour ramp rate
Sleep Mode: Enable or Disable
Ramping Control: 0 - 500.0 °C/minute or 0 - 5000.0 °C/hour ramp rate
Power Limit: 0 - 100% output 1 and output 2
Pump / Pressure Control: Sophisticated functions provided
Remote Set Point: Programmable range for voltage or current input
Differential Control: Control PV1 – PV2 at set point
Digital Filter
Function: First order
Time Constant: 0, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60 seconds programmable

Environmental & Physical
Operating Temperature: -10 °C to 50 °C
Storage Temperature: -40 °C to 60 °C
Humidity: 0 to 90% RH (non-condensing)
Insulation Resistance: 20 Mohms min. (at 500 VDC)
Dielectric Strength: 2000 VAC, 50/60 Hz for 1 minute
Vibration Resistance: 10 - 55 Hz, 10 m/s² for 2 hours
Shock Resistance: 200 m/s² (20 g)
Moisture: Flame retardant polycarbonate
Dimensions:
BTC-4300: 96mm(W) x 96mm(H) x 65mm(D), 53 mm depth behind panel
BTC-8300: 96mm(W) x 96mm(H) x 80mm(D), 65 mm depth behind panel
BTC-9300: 50.7mm(W) x 56.7mm(H) x 98.5mm(D), 75mm depth behind panel
BTC-2500: 50.7mm(W) x 26.5mm(H) x 110.5mm(D), 90.8 mm depth behind panel
Mounting:
BTC-4300: Panel mount, cutout 92 x 92 (mm)
BTC-8300: Panel mount, cutout 45 x 92 (mm)
BTC-9300: Panel mount, cutout 45 x 45 (mm)
BTC-2500: Panel mount, cutout 45 x 22.2 (mm)

Weight:
BTC-4300: 255 grams
BTC-8300: 220 grams
BTC-9300: 150 grams
BTC-2500: 120 grams

Approval Standards
Safety: UL 61010-1, CSA C22.2 No. 24-93, EN61010-1 (IEC61010-1)
Protective Class:
BTC-8300, BTC-4300: IP 20 housing and terminals with protective covers
BTC-2500, BTC-9300: NEMA 4x/IP66 front panel, IP 20 housing and terminals
EMC: EN61326

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Temperature Controller

300 Series (BTC-2500, BTC-4300, BTC8300, BTC-9300)

Accessories

| CT94-1 | 0-50 Amp. AC Current Transformer |
| OM95-3 | Isolated 4-20mA / 0-20mA Analog Output Module |
| OM95-4 | Isolated 1 - 5V / 0-5V Analog Output Module |
| OM95-5 | Isolated 0 - 10V Analog Output Module |
| OM94-6 | Isolated 1A / 240VAC Triac Output Module (SSR) |
| OM94-7 | 14V / 40mA SSR Drive Module |
| DC94-1 | Isolated 20V / 25 mA DC Output Power Supply |
| DC94-2 | Isolated 12V / 40 mA DC Output Power Supply |
| DC94-3 | Isolated 5V / 80 mA DC Output Power Supply |
| CM94-1 | Isolated RS - 485 Interface Module |
| CM94-2 | Isolated RS - 232 Interface Module |
| CM94-3 | Isolated 4 - 20 mA / 0-20 mA Retransmission Module |
| CM94-4 | Isolated 1 - 5V / 0 - 5V Retransmission Module |
| CM94-5 | Isolated 0 - 10V Retransmission Module |
| CC94-1 | RS-232 Interface Cable (2M) |
| CC91-3 | Programming Port Cable |

Related Products

| SNA10A | Smart Network Adaptor for Third Party Software, converts 355 channels of RS-485 or RS-422 to RS-232 Network |
| SNA12A | Smart Network Adaptor for Programming Port to RS-232 interface |

BC-Set = Configuration software
Auto-tune PID Temperature Controller

FEATURES
• Easy-to-use
• Fuzzy modified PID heat & cool control
• Fast A-D sampling rate (5 times/s)
• Universal input (PT100, thermocouple) with high accuracy 18-bit A-D
• Analog output (linear current or voltage) uses high accuracy 15-bit D-A
• RS-485 RS-232 interface
• Programming port provided on board
• Support manual control & auto-tune function
• Wide variety of alarm mode selection
• Lockout protection control
• Bumpless transfer during failure mode
• Soft-start ramp and dwell timer
• Bright display stabilized with digital filter
• SEL function allows to rearrange user menu
• UL/CSA/CE approval
• High performance with low cost
The Fuzzy Logic plus PID microprocessor-based controller series incorporate two bright, easy to read 4-digit LED displays, indicating process value and set point value. The Fuzzy Logic technology enables a process to reach a predetermined set point in the shortest time, with the minimum of overshoot during power-up or external load disturbance.

BTC-9100 is a 1/16 DIN size panel mount controller. BTC-7100 is a 1/8 DIN size panel mount controller. BTC-8100 is a 1/4 DIN size panel mount controller. These units are powered by 11-26 or 90-250 VDC/VAC supply, incorporating a 2 amp. control relay output as standard. The second output can be used as cooling control, or an alarm. Both outputs can select triac, 5V logic output, linear current or linear voltage to drive external device. There are six types of alarm plus a dwell timer can be configured for the third output. The units are fully programmable for PT100 and thermocouple types J, K, T, E, B, R, S, N, L with no need to modify the unit. The input signal is digitized by using a 18-bit A to D converter. Its fast sampling rate allows the unit to control fast processes.

Digital communications RS-485 or RS-232 (for BTC-9100, BTC-08100, BTC-4100) are available as an additional option. These options allow the units to be integrated with supervisory control system and software.

A programming port is available for automatic configuration, calibration and testing without the need to access the keys on front panel.

By using proprietary Fuzzy modified PID technology, the control loop will minimize the overshoot and undershoot in a shortest time. The following diagram is a comparison of results with and without Fuzzy technology.

- **PID control with properly tuned**
- **PID + Fuzzy control**

![Diagram showing temperature control with and without Fuzzy control](image)

**High Accuracy**
The series are manufactured with custom designed ASIC (Application Specific Integrated Circuit) technology which contains a 18-bit A to D converter for high resolution measurement (true 0.1°F resolution for thermocouple and PT100) and a 15-bit D to A converter for linear current or voltage control output. The ASIC technology provides improved operating performance, low cost, enhanced reliability and higher density.

**Overview**

**Fast Sampling Rate**
The sampling rate of the input A to D converter reaches 5 times/second. The fast sampling rate allows this series to control fast processes.

**Fuzzy Control**
The function of Fuzzy control is to adjust PID parameters from time to time in order to make manipulation output value more flexible and adaptive to various processes. The results is to enable a process to reach a predetermined set point in the shortest time, with the minimum of overshoot and undershoot during power-up or external load disturbance.

**Digital Communication**
The units are equipped with RS-485 or RS-232 interface card to provide digital communication. By using the twisted pair wires there are at most 247 units can be connected together via RS-485 interface to a host computer.

**Programming Port**
A programming port is used to connect the unit to a pc for quick configuration, also can be connected to an ATE system for automatic testing & calibration.

**Auto-tune**
The auto-tune function allows the user to simplify initial setup for a new system. A clever algorithm is provided to obtain an optimal set of control parameters for the process, and it can be applied either as the process is warming up (cold start) or as the process has been in steady state (warm start).

**Lockout Protection**
According to actual security requirement, one of four lockout levels can be selected to prevent the unit from being changed abnormally.

**Bumpless Transfer**
Bumpless transfer allows the controller to continue to control by using its previous value as the sensor breaks. Hence, the process can be well controlled temporarily as if the sensor is normal.

**Soft-start Ramp**
The ramping function is performed during power up as well as any time the set point is changed. It can be ramping up or ramping down. The process value will reach the set point with a predetermined constant rate.

**Digital Filter**
A first order low pass filter with a programmable time constant is used to improve the stability of process value. This is particularly useful in certain application where the process value is too unstable to be read.

**SEL Function**
The units have the flexibility for user to select those parameters which are most significant to him and put these parameters in the front of display sequence. There are at most 8 parameters can be selected to allow the user to build his own display sequence.
Specifications

Power
90-250 VAC, 47-63 Hz, 12VA, 5W maximum
11-26 VAC / VDC, 12VA, 5W maximum

Signal Input
Resolution : 18 bits
Sampling Rate : 5 times / second
Maximum Rating : -2 VDC minimum, 12 VDC maximum
(1 minute for mA input)
Temperature Effect : ±1.5 uV/C for all inputs except
mA input
±3.0 uV/C for mA input

Sensor Lead Resistance Effect :
T/C: 0.2uV/ohm
3-wire RTD: 2.6°C/ohm of resistance difference of two leads
2-wire RTD: 2.6°C/ohm of resistance sum of two leads
Burn-out Current : 200mA
Common Mode Rejection Ratio (CMRR): 120dB
Normal Mode Rejection Ratio (NMRR): 55dB

Sensor Break Detection :
Sensor open for TC, RTD and mV inputs,
Sensor short for RTD input,
below 1 mA for 4-20 mA input,
below 0.25V for 1 - 5 V input,
unavailable for other inputs.

Sensor Break Responding Time :
Within 4 seconds for TC, RTD and mV inputs,
0.1 second for 4-20 mA and 1 - 5 V inputs.

Characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-120°C-1000°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-184°F-1832°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>-200°C-1370°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-328°F-2498°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>-250°C-400°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-418°F-752°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>-100°C-900°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-148°F-1652°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>0°C-1800°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(32°F-3272°F)</td>
<td>(200°C-1800°C)</td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>0°C-1767.8°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
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<td></td>
<td>(32°F-3214°F)</td>
<td>(200°C-1800°C)</td>
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<td>S</td>
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<tr>
<td></td>
<td>(32°F-3214°F)</td>
<td>(200°C-1800°C)</td>
<td></td>
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<tr>
<td>N</td>
<td>-250°C-1300°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-418°F-2372°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>-200°C-900°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-328°F-1652°F)</td>
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</tr>
<tr>
<td>PT100 (DIN)</td>
<td>-210°C-700°C</td>
<td>±0.4°C</td>
<td>1.3KΩ</td>
</tr>
<tr>
<td></td>
<td>(-346°F-1292°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT100 (JIS)</td>
<td>-200°C-600°C</td>
<td>±0.4°C</td>
<td>1.3KΩ</td>
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<tr>
<td></td>
<td>(-328°F-1112°F)</td>
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<tr>
<td>mV</td>
<td>-8mV-70mV</td>
<td>±0.05%</td>
<td>2.2MΩ</td>
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<tr>
<td>mA</td>
<td>-3mA-27mA</td>
<td>±0.05%</td>
<td>70.5Ω</td>
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<tr>
<td>V</td>
<td>-1.3V-11.5V</td>
<td>±0.05%</td>
<td>650KΩ</td>
</tr>
</tbody>
</table>

Output 1 / Output 2
Relay Rating : 2A/240 VAC, life cycles 200,000 for resistive load
Pulsed Voltage : Source Voltage 5V,
current limiting resistance 66Ω.

Linear Output Characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>Zero</th>
<th>Span</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tolerance</td>
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<td>Capacity</td>
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<td>4-20 mA</td>
<td>3.6-4 mA</td>
<td>20-21 mA</td>
<td>500Ωmax.</td>
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<td>0-20 mA</td>
<td>0 mA</td>
<td>20-21 mA</td>
<td>500Ωmax.</td>
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<tr>
<td>0-5 V</td>
<td>0 V</td>
<td>5-5.25 V</td>
<td>10 KΩmin.</td>
</tr>
<tr>
<td>1-5 V</td>
<td>0.9-1 V</td>
<td>5-5.25 V</td>
<td>10 KΩmin.</td>
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<tr>
<td>0-10 V</td>
<td>0 V</td>
<td>10-10.5 V</td>
<td>10 KΩmin.</td>
</tr>
</tbody>
</table>

Linear Output
Resolution : 15 bits
Output Regulation : 0.02 % for full load change
Output Settling Time : 0.1 sec. (stable to 99.9 %)
Isolation Breakdown Voltage : 1000 VAC
Temperature Effect : ±0.01 % of SPAN / °C

Triac (SSR) Output
Rating : 1A / 240 VAC
Inrush Current : 20A for 1 cycle
Min. Load Current : 50 mA rms
Max. Off-state Leakage : 3 mA rms
Max. On-state Voltage : 1.5 V rms
Insulation Resistance : 1000 Mohms min. at 500 VDC
Dielectric Strength : 2500 VAC for 1 minute

Alarm
Alarm Relay : Form C, Max. rating 2A/240VAC,
life cycles 200,000 for resistive load.
Alarm Functions : Dwell timer,
Deviation High / Low Alarm,
Deviation Band High / Low Alarm,
Process High / Low Alarm,
Alarm Mode : Normal, Latching, Hold, Latching / Hold.
Dwell Timer : 0.1 - 4553.6 minutes

Data Communication
Interface : RS-232 (1 unit), RS-485 (up to 247 units)
Protocol : Modbus Protocol RTU mode
Address : 1 - 247
Baud Rate : 2.4 - 38.4 Kbits/sec
Data Bits : 7 or 8 bits
Parity Bit : None, Even or Odd
Stop Bit : 1 or 2 bits
Communication Buffer : 160 bytes

Analog Retransmission
Output Signal : 4-20mA, 0-20mA, 0-5V, 1-5V, 0-10V
Resolution : 15 bits
Accuracy : ±0.05% of span ±0.002%/°C
Load Resistance : 0-500 ohm (for current output)
10k ohm minimum (for voltage output)
Output Regulation : 0.01% for full load change

User Interface
Dual 4-digit LED Displays :
BTC-4100
Upper 0.56” (14mm)
Lower 0.4” (10 mm)
**Temperature Controller**

**100 Series (BTC-4100, BTC-7100, BTC-8100, BTC-9100)**

**Keypad:** 4 keys

**Programming Port:** For automatic setup, calibration and testing

**Communication Port:** Connection to PC for supervisory control

### Control Mode

**Output 1:** Reverse (heating) or direct (cooling) action

**Output 2:** PID cooling control, cooling P band 50 – 300% of PB, dead band -36.0 – 36.0% of PB

**ON-OFF:** 0.1 – 90.0 (°F) hysteresis control

(P band = 0)

**P or PD:** 0 – 100.0 % offset adjustment

**PID:** Fuzzy logic modified

- Proportional band: 0.1 – 900.0°F
- Integral time: 0 – 1000 seconds
- Derivative time: 0 – 360.0 seconds

**Cycle Time:** 0.1 – 90.0 seconds

**Manual Control:** Heat (MV1) and Cool (MV2)

**Auto-tuning:** Cold start and warm start

**Failure Mode:** Auto-transfer to manual mode while sensor break or A-D converter damage

**Ramping Control:** 0 – 900.0°F/minute or 0 – 900.0°F/hour ramp rate

### Digital Filter

**Function:** First order

**Time Constant:** 0.02, 0.5, 1.2, 5.10, 20, 30, 60 seconds programmable

### Environmental & Physical

**Operating Temperature:** -10°C to 50°C

**Storage Temperature:** -40°C to 60°C

**Humidity:** 0 to 90% RH (non-condensing)

**Altitude:** 2000m maximum

**Pollution:** Degree 2

**Insulation Resistance:** 20 Mohms min. (at 500 VDC)

**Dielectric Strength:** 2000 VAC, 50/60 Hz for 1 minute

**Vibration Resistance:** 10 – 55 Hz, 10 m/s² for 2 hours

**Shock Resistance:** 200 m/s² (20 g)

**Moldings:** Flame retardant polycarbonate

**Dimensions:**

- BTC-4100: 96mm(W) X 96mm(H) X 65 mm(D), 53 mm depth behind panel
- BTC-7100: 72mm(W) X 72mm(H) X 78.2 mm(D), 65 mm depth behind panel
- BTC-8100: 48mm(W) X 96mm(H) X 80mm(D), 65 mm depth behind panel
- BTC-9100: 48mm(W) X 48mm(H) X 116mm(D), 105 mm depth behind panel

**Mounting:**

- BTC-4100: panel mount, cutout 92 X 92 (mm)
- BTC-7100: panel mount, cutout 68 X 68 (mm)
- BTC-8100: panel mount, cutout 45 X 92 (mm)
- BTC-9100: panel mount, cutout 45 X 45 (mm)

**Weight:**

- BTC-4100: 250 grams
- BTC-7100: 200 grams
- BTC-8100: 210 grams
- BTC-9100: 150 grams

### Approval Standards

**Safety:** UL61010C-1

CSA C22.2 No. 24-93

EN61010-1 (IEC61010-1)

**Protective Class:**

- IP65 front panel with additional option,
- IP50 front panel without additional option,
- all indoor use,
- IP 20 housing and terminals with protective cover.

**EMC:** EN61326

### Connection Diagrams
**Ordering Code**

**BTC-9100 - BTC-8100 - BTC-7100 - BTC-4100 -**

**Power Input**
- 4: 90 - 250 VAC, 50/60 Hz
- 5: 11 - 26 VAC or VDC
- 9: Special Order

**Signal Input**
1: Standard Input
   - Thermocouple: J, K, T, E, B, R, S, N, L
   - RTD: PT100 DIN, PT100 JIS
2: 0 - 60 mV
3: 0 - 1 V
4: 0 - 5 V
5: 1 - 5 V
6: 4 - 20 mA
7: 0 - 20 mA
8: 0 - 10 V
9: Special Order

**Options**
- 0: Panel mount IP50 standard
- 1: Panel mount IP65 water resistant rubber installed
- 2: DIN Rail mount with IP50 (for BTC-9100 only)
- 3: DIN Rail mount with IP65 (for BTC-9100 only)

**Communications**
- 0: None
- 1: RS-485 interface
- 2: RS-232 interface (not available for BTC-7100)
- 3: Retransmit 4-20mA / 0-20mA
- 4: Retransmit 1-5V / 0-5V
- 5: Retransmit 0-10V
- 9: Special order

**Alarm**
- 0: None
- 1: Form C relay 2A/240VAC
- 9: Special order

**Output 1**
- 0: None
- 1: Relay rated 2A/240VAC
- 2: Pulsed voltage to drive SSR, 5V/30mA
- 3: Isolated 4 - 20mA / 0 - 20mA
- 4: Isolated 1 - 5V / 0 - 5V
- 5: Isolated 0 - 10V
- 6: Triac output, 1A / 240VAC, SSR
- C: Pulsed voltage to drive SSR, 14V/40mA
- 9: Special order

**Output 2**
- 0: None
- 1: From A relay 2A/240VAC
- 2: Pulsed voltage to drive SSR, 5V/30mA
- 3: Isolated 4 - 20mA / 0 - 20mA
- 4: Isolated 1 - 5V / 0 - 5V
- 5: Isolated 0 - 10V
- 6: Triac output, 1A / 240VAC, SSR
- 7: Isolated 20V/25mA Transducer Power Supply
- 8: Isolated 12V/40mA Transducer Power Supply
- 9: Isolated 5V/80mA Transducer Power Supply
- C: Pulsed voltage to drive SSR, 14V/40mA
- A: Special order

Standard model without option
BTC-x100-4110000: power 90-250VAC, standard input thermocouple + PT100,
output 1 - relay, output 2 - none, alarm - none, communication - none, panel mount IP50 standard
Accessories

OM94-6 = Isolated 1A / 240VAC Triac Output Module (SSR)
OM94-7 = 14V / 40mA SSR Drive Module
OM94-3 = Isolated 4 - 20 mA / 0 - 20 mA Analog Output Module
OM94-4 = Isolated 1 - 5V / 0 - 5V Analog Output Module
OM94-5 = Isolated 0 - 10V Analog Output Module
CM94-1 = Isolated RS-485 Interface Module for BTC-7100 / 8100 / 4100
CM94-2 = Isolated RS-232 Interface Module for BTC-8100 / 4100
CM94-3 = Isolated 4-20mA / 0-20mA Retrans Module for BTC-8100 / 4100 / 7100
CM94-4 = Isolated 1-5V / 0-5V Retrans Module for BTC-8100 / 4100 / 7100
CM94-5 = Isolated 0-10V Retrans Module for BTC-8100 / 4100 / 7100
CM97-1 = Isolated RS-485 Interface Module for BTC-9100
CM97-2 = Isolated RS-232 Interface Module for BTC-9100
CM97-3 = Isolated 4-20mA / 0-20mA Retrans Module for BTC-9100
CM97-4 = Isolated 1-5V / 0-5V Retrans Module for BTC-9100
CM97-5 = Isolated 0-10V Retrans Module for BTC-9100
DC94-1 = Isolated 20V / 25mA DC Output Power Supply
DC94-2 = Isolated 12V / 40mA DC Output Power Supply
DC94-3 = Isolated 5V / 80mA DC Output Power Supply
CC94-1 = RS-232 Interface Cable (2M)
CC91-1 = Programming Port Cable
RK91-1 = Rail Mount kit for BTC-9100

Related Products

SNA10A = Smart Network Adaptor for third party software, which converts 255 channels of RS-485 or RS-422 to RS-232 Network.
SNA12A = Smart Network Adaptor for programming port to RS-232 interface.
BC-Set = Configuration Software
Low Cost

Auto-tune PID Temperature Controller

FEATURES
- Easy-to-use
- Fuzzy modified PID heat & cool control
- Fast A-D sampling rate (5 times/s)
- Universal input (PT100, thermocouple) with high accuracy 18-bit A-D
- Analog output (linear current or voltage) uses high accuracy 15-bit D-A
- RS-485 RS-232 interface
- Programming port provided on board
- Support manual control & auto-tune function
- Wide variety of alarm mode selection
- Lockout protection control
- Bumpless transfer during failure mode
- Soft-start ramp and dwell timer
- Bright display stabilized with digital filter
- Front panel sealed to NEMA 4X & IP65 (model C21)
- UL/CSA/CE approval
- High performance with low cost
The Fuzzy Logic plus PID microprocessor-based controller series incorporate a bright, easy to read 4-digit LED display, indicating process value or set point value. The Fuzzy Logic technology enables a process to reach a predetermined set point in the shortest time, with the minimum of overshoot during power-up or external load disturbance.

C21 is a 1/32 DIN size panel mount controller. C91 is a 1/16 DIN size panel mount controller. These units are powered by 11-26 or 90-250 VDC/VAC supply, incorporating a 2 amp. control relay output as standard. The second output can be used as cooling control, an alarm or dwell timer. Both outputs can select triac, SV logic output, linear current or linear voltage to drive external device.

There are six types of alarm plus a dwell timer can be configured for the second output. The units are fully programmable for PT100 and thermocouple types J, K, T, E, B, R, S, N, L with no need to modify the unit. The input signal is digitized by using a 16-bit A to D converter. Its fast sampling rate allows the unit to control fast processes.

Digital communications RS-485 or RS-232 (for C21) are available as an additional option. These options allow the units to be integrated with supervisory control system and software.

A programmable port is available for automatic configuration, calibration and testing without the need to access the keys on front panel.

By using proprietary Fuzzy modified PID technology, the control loop will minimize the overshoot and undershoot in a shortest time. The following diagram is a comparison of results with and without Fuzzy technology.

---

**High Accuracy**

The series are manufactured with custom designed ASIC (Application Specific Integrated Circuit) technology which contains a 18-bit A to D converter for high resolution measurement (true 0.1°F resolution for thermocouple and PT100) and a 15-bit D to A converter for linear current or voltage control output. The ASIC technology provides improved operating performance, low cost, enhanced reliability and higher density.

---

**Overview**

**Fast Sampling Rate**

The sampling rate of the input A to D converter reaches 5 times/second. The fast sampling rate allows this series to control fast processes.

**Fuzzy Control**

The function of Fuzzy control is to adjust PID parameters from time to time in order to make manipulation output value more flexible and adaptive to various processes. The results is to enable a process to reach a predetermined set point in the shortest time, with the minimum of overshoot and undershoot during power-up or external load disturbance.

**Digital Communication**

The units are equipped with RS-485 or RS-232 interface card to provide digital communication. By using the twisted pair wires there are at most 247 units can be connected together via RS-485 interface to a host computer.

**Programming Port**

A programming port is used to connect the unit to a pc for quick configuration, also can be connected to an ATE system for automatic testing & calibration.

**Auto-tune**

The auto-tune function allows the user to simplify initial setup for a new system. A clever algorithm is provided to obtain an optimal set of control parameters for the process, and it can be applied either as the process is warming up (Cold start) or as the process has been in steady state (Warm start).

**Lockout Protection**

According to actual security requirement, one of four lockout levels can be selected to prevent the unit from being changed abnormally.

**Bumpless Transfer**

Bumpless transfer allows the controller to continue to control by using its previous value as the sensor breaks. Hence, the process can be well controlled temporarily as if the sensor is normal.

**Soft-start Ramp**

The ramping function is performed during power up as well as any time the set point is changed. It can be ramping up or ramping down. The process value will reach the set point with a predetermined constant rate.

**Digital Filter**

A first order low pass filter with a programmable time constant is used to improve the stability of process value. This is particularly useful in certain application where the process value is too unstable to be read.
Specifications

**Power**
90-250 VAC, 47-63 Hz, 10VA, 5W maximum
11-26 VAC / VDC, 10VA, 5W maximum

**Signal Input**
Resolution: 18 bits
Sampling Rate: 5 times / second
Maximum Rating: -2 VDC minimum, 12 VDC maximum
(1 minute for mA input)
Temperature Effect: ±1.5 uV/°C for all inputs except
mA input
±3.0 uV/°C for mA input

Sensor Load Resistance Effect:
T/C: 0.2uV/ohm
3-wire RTD: 2.6 °C/ohm of resistance difference of two leads
2-wire RTD: 2.6 °C/ohm of resistance sum of two leads
Burn-out Current: 200mA
Common Mode Rejection Ratio (CMRR): 120dB
Normal Mode Rejection Ratio (NMRR): 55dB

Sensor Break Detection:
Sensor open for T/C, RTD and mV inputs,
Sensor short for RTD input,
below 1 mA for 4-20 mA input,
below 0.25V for 1-5 V input,
available for other inputs.

Sensor Break Responding Time:
Within 4 seconds for T/C, RTD and mV inputs,
0.1 second for 4-20 mA and 1-5 V inputs.

Characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-120°C-1000°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
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<td>(-184°F-1832°F)</td>
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<td>K</td>
<td>-200°C-1370°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
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<td></td>
<td>(-329°F-2498°F)</td>
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<td></td>
</tr>
<tr>
<td>T</td>
<td>-250°C-400°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
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<td>(-418°F-752°F)</td>
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<td></td>
</tr>
<tr>
<td>E</td>
<td>-100°C-900°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
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<td></td>
<td>(-148°F-1652°F)</td>
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<tr>
<td>B</td>
<td>0°C-1800°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
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<td></td>
<td>(32°F-3272°F)</td>
<td>(200°C-1800°C)</td>
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</tr>
<tr>
<td>R</td>
<td>0°C-1767.8°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
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<td></td>
<td>(32°F-3214°F)</td>
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<td></td>
</tr>
<tr>
<td>S</td>
<td>0°C-1767.8°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(32°F-3214°F)</td>
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<tr>
<td>N</td>
<td>250°C-1300°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
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<td></td>
<td>(-418°F-2372°F)</td>
<td></td>
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<tr>
<td>L</td>
<td>200°C-900°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-329°F-1652°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT100</td>
<td>-210°C-700°C</td>
<td>±0.4°C</td>
<td>1.3KΩ</td>
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<tr>
<td>(DIN)</td>
<td>(-346°F-1282°F)</td>
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<td></td>
</tr>
<tr>
<td>PT100</td>
<td>-200°C-600°C</td>
<td>±0.4°C</td>
<td>1.3KΩ</td>
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<td>(JIS)</td>
<td>(-329°F-1112°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mV</td>
<td>0-8mV - 70mV</td>
<td>±0.05%</td>
<td>2.2MΩ</td>
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<tr>
<td>mA</td>
<td>0-3mA - 27mA</td>
<td>±0.05%</td>
<td>70.5Ω</td>
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<td>V</td>
<td>-1.3V - 11.5V</td>
<td>±0.05%</td>
<td>650KΩ</td>
</tr>
</tbody>
</table>

Output 1 / Output 2

**Relay Rating**: 2A/240 VAC, life cycles 200,000 for resistive load.

**Pulsed Voltage**: Source Voltage 5V,
current limiting resistance 66Ω.

**Linear Output Characteristics**

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<th>Span</th>
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<td>4-20 mA</td>
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</tr>
<tr>
<td>0-5 V</td>
<td>0 V</td>
<td>5-5.25 V</td>
<td>10 KΩmin</td>
</tr>
<tr>
<td>1-5 V</td>
<td>0.5-1 V</td>
<td>5-5.25 V</td>
<td>10 KΩmin</td>
</tr>
<tr>
<td>0-10 V</td>
<td>0 V</td>
<td>10-10.5 V</td>
<td>10 KΩmin</td>
</tr>
</tbody>
</table>

**Linear Output**

Resolution: 15 bits
Output Regulation: 0.02% for full load change
Output Settling Time: 0.1 sec. (stable to 99.9%)
Isolation Breakdown Voltage: 1000 VAC
Temperature Effect: ±0.01% of SPAN /°C

**Triac (SSR) Output**

Rating: 1A / 240 VAC
Inrush Current: 20A for 1 cycle
Min. Load Current: 50 mA rms
Max. Off-state Leakage: 3 mA rms
Max. On-state Voltage: 1.5 V rms
Insulation Resistance: 1000 Mohms min. at 500 VDC
Dielectric Strength: 2500 VAC for 1 minute

**Alarm (Output 2)**

Alarm Relay: Form A, Max. rating 2A / 240VAC,
life cycles 200,000 for resistive load.

Alarm Functions: Dwell timer,
Deviation High / Low Alarm,
Deviation Band High / Low Alarm,
Process High / Low Alarm,
Alarm Mode: Normal, Latching, Hold, Latching / Hold,
Dwell Timer: 0.1-4553.6 minutes

**Data Communication**

Interface: RS-232 (1 unit), RS-485 (up to 247 units)
Protocol: Modbus Protocol RTU mode
Address: 1 - 247
Baud Rate: 2.4 ~ 38.4 Kbits/sec
Data Bits: 7 or 8 bits
Parity Bit: None, Even or Odd
Stop Bit: 1 or 2 bits
Communication Buffer: 160 bytes

**Analog Retransmission**

Output Signal: 4-20mA, 0-20mA, 0-5V, 1-5V, 0-10V
Resolution: 15 bits
Accuracy: ±0.05% of span ±0.0025%°C
Load Resistance: 0-500 ohm (for current output)
10K ohm minimum (for voltage output)
Output Regulation: 0.01% for full load change

**User Interface**

Single 4-digit LED Displays: 10 mm (C21, C91)
Connection Diagrams

Keypad: 3 keys (C21), 4 keys (C91)
Programming Port: For automatic setup, calibration and testing
Communication Port: Connection to PC for supervisory control

Control Mode
Output 1: Reverse (heating) or direct (cooling) action
Output 2: PID cooling control, cooling P band 50 ~ 300% of PB, dead band -36.0 ~ 36.6% of PB
ON-OFF: 0.1 - 90.0 (°F) hysteresis control (P band = 0)
P or PD: 0 - 100.0 % offset adjustment
PID: Fuzzy logic modified
  Proportional band 0.1 ~ 900.0°F
  Integral time 0 - 1000 seconds
  Derivative time 0 - 360.0 seconds
Cycle Time: 0.1 - 90.0 seconds
Manual Control: Heat (MV1) and Cool (MV2)
Auto-tuning: Cold start and warm start
Failure Mode: Auto-transfer to manual mode while sensor break or A-D converter damage
Ramping Control: 0 ~ 900.0°F/minute or 0 ~ 900.0°F/hour ramp rate

Digital Filter
Function: First order
Time Constant: 0, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60 seconds programmable

Environmental & Physical
Operating Temperature: -10°C to 50°C
Storage Temperature: -40°C to 60°C
Humidity: 0 to 90% RH (non-condensing)
Altitude: 2000m maximum
Pollution: Degree 2
Insulation Resistance: 20 Mohms min. (at 500 VDC)
Dielectric Strength: 2000 VAC, 50/60 Hz for 1 minute
Vibration Resistance: 1g - 55 Hz, 10 m/s² for 2 hours
Shock Resistance: 200 m/s² (20 g)
Moldings: Flame retardant polycarbonate

Dimensions:
  C21: 50mm(W) X 26.5mm(H) X 110.5mm(D), 96.0 mm depth behind panel
  C91: 48mm(W) X 48mm(H) X 94mm(D), 86 mm depth behind panel
Mounting: C21: panel mount, cutout 22 X 45 (mm)
         C91: panel mount, cutout 45 X 45 (mm)
Weight: C21: 120 grams
        C91: 140 grams

Approval Standards
Safety: UL61010C-1
        CSA C22.2 No. 24-93
        EN61010-1 (IEC1010-1)
Protective Class:
  NEMA 4X (IP55) front panel for C21,
  IP36 front panel for C91, all indoor use,
  IP 20 housing and terminals
EMC: EN61326
Ordering Code

C21 -  C91 -

Power Input
4: 90 - 250 VAC, 50/60 Hz
5: 11 - 26 VAC or VDC
9: Special Order

Signal Input
1: Standard Input
   Thermocouple: J, K, T, E, B,
   R, S, N, L
   RTD: PT100 DIN, PT100 JIS
2: 0 - 60 mV
3: 0 - 1 V
4: 0 - 5 V
5: 1 - 5 V
6: 4 - 20 mA
7: 0 - 20 mA
8: 0 - 10 V
9: Special Order

Display Color
0: Red color
1: Green color

Communication (for C21 only)
0: None
1: RS-485 interface (for C21)
2: RS-232 interface (for C21)
3: Retransmit 4-20mA / 0-20mA (for C21)
4: Retransmit 1-5V / 0-5V (for C21)
5: Retransmit 0-10V (for C21)
9: Special order

Output 2
0: None
1: Form A relay 2A/240VAC
2: Pulsed voltage to drive SSR, 5V/30mA
3: Isolated 4 - 20mA / 0 - 20mA
4: Isolated 1 - 5V / 0 - 5V
5: Isolated 0 - 10V
6: Triac output, 1A / 240VAC, SSR
7: Isolated 20V/25mA transducer power supply
8: Isolated 12V/40mA transducer power supply
9: Isolated 5V/50mA transducer power supply
A: RS-485 interface (for C91)
B: Pulsed voltage to drive SSR, 14V/40mA
C: Retransmit 4-20mA / 0-20mA (for C91)
D: Retransmit 1-5V / 0-5V (for C91)
E: Retransmit 0-10V (for C91)
9: Special order

Output 1
0: None
1: Relay rated 2A/240VAC
2: Pulsed voltage to drive SSR, 5V/30mA
3: Isolated 4 - 20mA / 0 - 20mA
4: Isolated 1 - 5V / 0 - 5V
5: Isolated 0 - 10V
6: Triac output 1A / 240VAC, SSR
7: Pulsed voltage to drive SSR, 14V/40mA
9: Special order

Standard model without option
C11 - 411000: power 90-250VAC, standard input thermocouple + PT100,
output 1 - relay, output 2 - none, communication - none, red display
### Accessories

- OM94-6 = Isolated 1A / 240VAC Triac Output Module (SSR)
- OM94-7 = 14V / 40mA SSR Drive Module
- OM96-3 = Isolated 4-20mA / 0-20mA Analog Output Module
- OM96-4 = Isolated 1-5V / 0-5V Analog Output Module
- OM96-5 = Isolated 0-10V Analog Output Module
- CM94-1 = Isolated RS-485 Interface Module for C21
- CM94-2 = Isolated RS-232 Interface Module for C21
- CM94-3 = Isolated 4-20mA / 0-20mA Retrans Module for C21
- CM94-4 = Isolated 1-5V / 0-5V Retrans Module for C21
- OM94-5 = Isolated 0-10V Retrans Module for C21
- CM96-1 = Isolated RS-485 Interface Module for C91
- DC94-1 = Isolated 20V / 25mA DC Output Power Supply
- DC94-2 = Isolated 12V / 40mA DC Output Power Supply
- DC94-3 = Isolated 5V / 80mA DC Output Power Supply
- CC94-1 = RS-232 Interface Cable (2M)
- CC91-1 = Programming port for C21
- CC91-2 = Programming port for C91

### Related Products

- SNA10A = Smart network adaptor for Brainchild software Data Acquisition Studio or third party software, which converts 255 channels of RS-485 or RS-422 to RS-232 network
- SNA12A = Smart network adapter for programming port to RS-232 interface
- BC-Sel = Configuration software
- Data Acquisition Studio software = PC software for data logging
- PC-E = RS-232/485 to Ethernet converter
- PC-W = RS-232/422/485 x 2 + Ethernet x 1 converted to Ethernet wireless
The BTC-9090 is a new generation miniature controller using the latest SMD technology. Assembly is fully automatic and the units are checked and configured by computer. Software has been refined over several years and offers a very logical menu structure and high noise immunity. Using an unique command called SEL, the user has some flexibility in which parameters are accessible in level 2 of the menu. This is of great value for users as it is easy to limit access to suit the application specifically.

With 4 digit resolution and fully programmable decimal point, the 9090 can be configured for linear voltage and current inputs and with the addition of a single module, with 4-20mA control output. This is one of the most versatile units available.

Manual control of the output is possible and Offset and Shift functions allow process values to be readily corrected for instinct offsets and in-site calibrations.

**FEATURES**
- Full 4 digit display.
- Autotune PID.
- Input user selectable.
- 90-240 VAC supply.
- Ramp rate function.
- Timer function.
- SEL function.
- Optional 4-20 mA input.
- 4-20 mA control output version.
- Three level software access.
- Safety: UL, CSA
- EMC, LVD: CE

**KEYPAD OPERATION**

<table>
<thead>
<tr>
<th>TOUCHKEYS</th>
<th>FUNCTION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔄</td>
<td>Scroll Key</td>
<td>Advance the index display to the desired position. Indexes advanced continuously and cyclically by pressing this keypad.</td>
</tr>
<tr>
<td>⬆️</td>
<td>Up Key</td>
<td>Increased the parameter.</td>
</tr>
<tr>
<td>⬇️</td>
<td>Down Key</td>
<td>Decreased the parameter.</td>
</tr>
<tr>
<td>⬅️</td>
<td>Return Key</td>
<td>Resets the controller to its normal status. Also stops auto-tuning, output percentage monitoring and manual mode operation.</td>
</tr>
<tr>
<td>Press 🔄 longer than 6 secs.</td>
<td>Long Scroll</td>
<td>Allows more parameters to be inspected or changed.</td>
</tr>
<tr>
<td>Press 🔄 and ⬆️</td>
<td>Output Percentage Monitoring</td>
<td>Allows the set point display to indicate the control output value.</td>
</tr>
<tr>
<td>Press 🔄 and ⬇️ longer than 6 secs.</td>
<td>Manual Mode Execution</td>
<td>Allows the controller to enter the manual mode.</td>
</tr>
</tbody>
</table>
**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>IN</th>
<th>Sensor</th>
<th>Input Type</th>
<th>Range (°F)</th>
<th>Accuracy (°F)</th>
<th>Range (°C)</th>
<th>Accuracy (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>J</td>
<td>Iron-Constantan</td>
<td>-58 to 1830°F</td>
<td>±3.6°F</td>
<td>-50 to 999°C</td>
<td>±2°C</td>
</tr>
<tr>
<td>1</td>
<td>K</td>
<td>Chromel-Alumel</td>
<td>-58 to 2500°F</td>
<td>±3.6°F</td>
<td>-50 to 1370°C</td>
<td>±2°C</td>
</tr>
<tr>
<td>2</td>
<td>T</td>
<td>Copper-Constantan</td>
<td>-454 to 752°F</td>
<td>±3.6°F</td>
<td>-270 to 400°C</td>
<td>±2°C</td>
</tr>
<tr>
<td>3</td>
<td>E</td>
<td>Chromel-Constantan</td>
<td>-58 to 1382°F</td>
<td>±3.6°F</td>
<td>-50 to 750°C</td>
<td>±2°C</td>
</tr>
<tr>
<td>4</td>
<td>B</td>
<td>Pt30%RH/Pt6%RH</td>
<td>572 to 3272°F</td>
<td>±5.4°F</td>
<td>300 to 1800°C</td>
<td>±3°C</td>
</tr>
<tr>
<td>5</td>
<td>R</td>
<td>Pt13%RH/Pt</td>
<td>32 to 3182°F</td>
<td>±3.6°F</td>
<td>0 to 1750°C</td>
<td>±2°C</td>
</tr>
<tr>
<td>6</td>
<td>S</td>
<td>Pt10%RH/Pt</td>
<td>32 to 3182°F</td>
<td>±3.6°F</td>
<td>0 to 1750°C</td>
<td>±2°C</td>
</tr>
<tr>
<td>7</td>
<td>N</td>
<td>Nicrosil-Nisil</td>
<td>-58 to 2372°F</td>
<td>±3.6°F</td>
<td>-50 to 1300°C</td>
<td>±2°C</td>
</tr>
<tr>
<td>8</td>
<td>RTD</td>
<td>PT100 ohms (DIN)</td>
<td>-328 to 752°F</td>
<td>±0.72°F</td>
<td>-200 to 450°C</td>
<td>±0.4°C</td>
</tr>
<tr>
<td>9</td>
<td>RTD</td>
<td>Pt100 ohms (JIS)</td>
<td>-328 to 752°F</td>
<td>±0.72°F</td>
<td>-200 to 450°C</td>
<td>±0.4°C</td>
</tr>
<tr>
<td>10</td>
<td>Linear</td>
<td>Linear -10mV to 60mV</td>
<td>-1999 to 9999</td>
<td>±0.05%</td>
<td>-1999 to 9999</td>
<td>±0.05%</td>
</tr>
</tbody>
</table>

**RANGE AND ACCURACY OF INPUTS**

<table>
<thead>
<tr>
<th>IN</th>
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<th>Input Type</th>
<th>Range (°F)</th>
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</table>

**SPECIFICATIONS**

**INPUT**

RTD: PT100 ohm RTD (DIN 43760/BS1904 or JIS)
Linear: -10 to 60mV, configurable input attenuation.
Range: User configurable, refer to Table above.
Accuracy: Refer to Table above.
Cold Junction Compensation: 0.1°C / °C ambient typical.
Sensor Break Protection: Protection mode configurable.
External Resistance: 100 ohms max.
Normal Mode Rejection: 60dB
Common Mode Rejection: 120dB
Sample Rate: 3 times / second

**CONTROL**

Proportion Band: 0-100% of SPAN
Reset (Integral): 0-3600 seconds
Rate (Derivative): 0-1000 seconds
Ramp Rate: 0-2000°C / Hour (0-3600°F / Hour)
Dwell: 0-3600 minutes
Anti-Reset Windup: Inhibit integral action outside P band
ON-OFF: With adjustable hysteresis (0-20% of SPAN)
Cycle Time: 0-120 seconds
Control Action: Direct (for cooling) and reverse (for heating)

**INDICATION**

Process Display: 0.4" red LED, 4 digits
Setpoint Display: 0.3" green LED, 4 digits
Status Indicator: Control-green LED, Alarm-red LED

**POWER**

Rating: 90-240VAC
50/60Hz
Consumption: Less than 5VA

**ENVIRONMENTAL & PHYSICAL**

Operating Temperature: -10 to 50°C
Humidity: 0 to 90% RH (non-condensing)
Insulation: 20M ohms min. (500VDC)
Breakdown: AC2000V, 50/60Hz, 1 minute
Vibration: 10-55Hz, amplitude 1mm 200 m/ s² (20g)
Shock: Weight: 170 grams

**DIMENSIONS**

H 48mm (1.89")
W 48mm (1.89")
D 94mm (3.7")
Depth behind panel 86mm (3.4")
Panel cutout 45 X 45mm (1.77" x 11.77")

**CONNECTION DIAGRAM**

**ORDERING INFORMATION**

Model No. (1) (2) (3) (4) (5) (6) (7) (8)
(1) Power Input
4 90-240VAC
5 20-32VAC-VDC
9 Other
(2) Signal Input
1 6 5V
3 PT100 DIN
5 TC
7 0 20mA
8 0 10V
(3) Range Code
1 Configurable
9 Other
(4) Control Mode
3 PID / ON-OFF Control
(5) Output 1 Option
0 None
1 Relay rated 3A / 240VAC resistive
2 SSR Drive rated 20mA / 24V
4 0-20mA linear, max load 500 ohms (Module OM93-1)
5 0-10V linear, min. impedance 500K ohms (Module OM93-3)
9 Other
(6) Output 2 Option
0 None
1 Relay rated 2A / 240VAC resistive
9 Other
(7) Alarm Option
0 None
1 Relay rated 2A / 240VAC resistive
9 Other
(8) Communication
0 None

Temperature Controller BTC-9090
Temperature / Process Controllers & Programmers

PID with Time / Temperature Profiling Controllers

Features

Total 9 profiles, a profile with 16, 32 or 64 segments at most
Each segment to be configured as a ramp or dwell (soak)
After event process goes to run, hold, abort, manual, failure transfer,
off mode, next segment or select the second PID values
High accuracy of 18-bit A to D input, and 15-bit D to A output
The fast sample rate of 200 msec
Fuzzy control to reach set point at the least overshooting & less time
Up to three relays are configurable for event output
Analog retransmission of process value & set point value
Optional RS-485 or 232 communications
Programmable port for easy configuration or calibration
Lockout protection for security requirement
Bumpless transfer of safely control while sensor breaks
Digital filter to improve the stability of process value
SEL function for easy operation
Overview

The Fuzzy Logic plus PID microprocessor-based profiling controller series incorporate two bright, easy-to-read 4-digit LED displays, indicating process value and set point value. The Fuzzy Logic technology enables a process to reach a predetermined set point in the shortest time, with the minimum of overshoot during power-up or external load disturbance.

P91 is a 1/16 DIN size panel mount profiling controller. It can also be used for rail mount by adding a rail mount kit. P41 is a 1/4 DIN size panel mount profiling controller. These units are powered by 11-26 or 90-250 VDC/VAC supply, incorporating a 2 amp. control relay output as standard. The second output can be used as cooling control, an event output or an alarm. Both outputs can select triac, logic output, linear current or linear voltage to drive external device. The units are fully programmable for PT100 and thermocouple types J, K, T, E, B, R, S, N, L, C, P with no need to modify the unit. The input signal is digitized by using a 14-bit A to D converter. Its fast sampling rate allows the unit to control fast processes.

There are more functions than the heating and cooling control could be configured for the controller outputs, these include: up tp three alarm outputs, up to three event outputs and up to two analog retransmission outputs.

Digital communications RS-485 or RS-232 are available as an additional option. These options allow the units to be integrated with supervisory control system and software.

A programming port is available for automatic configuration, calibration and testing without the need to access the keys on front panel.

By using proprietary Fuzzy modified PID technology, the control loop will minimize the overshoot and undershoot in a shortest time. The following diagram is a comparison of results with and without Fuzzy technology.

![PID control with properly tuned vs PID + Fuzzy control]

The series can be configured as a single set point controller (static mode) or a ramp and dwell profiling controller (profile mode). The profile mode feature allows the user to program up to 9 profiles of up to 64 free-format (ramp, dwell, jump or end) segments each. The total segments available for the product is 288 segments. The profiling controllers contain the following features:

Flexible Configuration of Program

There are up to 64 segments can be defined for a profile. Each segment can be configured as a ramp or a dwell (soak) segment or defining a repeat number of cycles at arbitrary location within the profile and finally terminated by an end segment. The user can edit a currently running profile.

Maximum Capacity of Program

There are at most 9 profiles can be defined and 288 segments totally available for all profiles. The profiles are divided into three kinds of length. The short length profile contains 16 segments, the medium length profile contains 32 segments while the long length profile contains 64 segments at most.

Event Input

The event input feature allows the user to select one of eight functions: enter profile run mode, enter profile hold mode, abort profile mode, enter manual mode, perform failure transfer, enter off mode, advance to the next segment and select second set of PID values.

Programmable Event Outputs

Up to three relays are configurable for event outputs and the state of each output can be defined for each segment and end of profile.

Analog Retransmission

The output 4 and output 5 (P41 only) of the products can be equipped with analog output module. The output can be configured for transmitting the process value as well as set point value.

High Accuracy

The series are manufactured with custom designed ASIC(Application Specific Integrated Circuit) technology which contains a 18-bit A to D converter for high resolution measurement (true 0.1°F resolution for thermocouple and PT100) and a 15-bit D to A converter for linear current or voltage control output. The ASIC technology provides improved operating performance, low cost, enhanced reliability and higher density.

Fast Sampling Rate

The sampling rate of the input A to D converter reaches 5 times/second. The fast sampling rate allows this series to control fast processes.

Fuzzy Control

The function of Fuzzy control is to adjust PID parameters from time to time in order to make manipulation output value more flexible and adaptive to various processes. The results is to enable a process to reach a predetermined set point in the shortest time, with the minimum of overshoot and undershoot during power-up or external load disturbance.

Digital Communication

The units are equipped with RS-485 or RS-232 interface card to provide digital communication. By using the twisted pair wires there are at most 247 units can be connected together via RS-485 interface to a host computer.

Programming Port

A programming port is used to connect the unit to a hand-held programmer or a PC for quick configuration, also can be connected to an ATE system for automatic testing & calibration.

Auto-tune

The auto-tune function allows the user to simplify initial setup for a new system. A clever algorithm is provided to obtain an optimal set of control parameters for the process, and it can be applied either as the process is warming up (cold start) or as the process has been in steady state (warm start).

Lockout Protection

According to actual security requirement, a password is provided to prevent the unit from being changed abnormally.

Bumpless Transfer

Bumpless transfer allows the controller to continue to control by using its previous value as the sensor breaks. Hence, the process can be well controlled temporarily as if the sensor is normal.

Digital Filter

A first order low pass filter with a programmable time constant is used to improve the stability of process value. This is particularly useful in certain application where the process value is too unstable to be read.

SEL Function

The units have the flexibility for user to select those parameters which are most significant to him and put these parameters in the home page. There are at most 8 parameters can be selected to allow the user to build his own display sequence.
Connection Diagrams

A special connector can be used to touch the programming port which is connected to a PC for automatic configuration, also can be connected to an ATE system for automatic calibration and testing.

The programming port is used for off-line automatic setup and testing procedures only. Don't attempt to make any connection to these pins when the unit is used for a normal control purpose.

Specifications

Power
90 – 250 VAC, 47–63 Hz, 12 VA, SW maximum
11 – 26 VAC / VDC, 12 VA, SW maximum

Input
Resolution: 18 bits
Sampling Rate: 5 times / second
Maximum Rating: -2 VDC minimum, 12 VDC maximum
(1 minute for mA input)
Temperature Effect: A1.5uW/°C for all inputs except mA input
A3.0uW/°C for mA input
Sensor Lead Resistance Effect:
- T/C: 0.2uW/ohm
- 3-wire RTD: 2.6 °C/ohm of resistance difference of two leads
- 2-wire RTD: 2.6 °C/ohm of resistance sum of two leads

Burn-out Current: 200 mA
Common Mode Rejection Ratio (CMRR): 120dB
Normal Mode Rejection Ratio (NMR): 55dB
Sensor Break Detection:
Sensor open for T/C, RTD and mV inputs,
Sensor short for RTD input
below 1 mA for 4–20 mA input,
below 0.25V for 1 – 5 V input,
available for other inputs.
Sensor Break Responding Time:
Within 4 seconds for T/C, RTD and mV inputs,
0.1 second for 4–20 mA and 1 – 5 V inputs.
**Temperature Profiling Controller**

**P41, P91**

**Characteristics:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-120°C to +100°C (614°F to 1832°F)</td>
<td>±2°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>K</td>
<td>-20°C to +220°C (4°F to 428°F)</td>
<td>±0.5°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>T</td>
<td>-250°C to +400°C (141°F to 752°F)</td>
<td>±0.5°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>E</td>
<td>-180°C to +900°C (324°F to 1652°F)</td>
<td>±0.5°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>B</td>
<td>0°C to 180°C (32°F to 322°F)</td>
<td>±2°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>R</td>
<td>0°C to 176°C (32°F to 379°F)</td>
<td>±1°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>S</td>
<td>0°C to 176°C (32°F to 379°F)</td>
<td>±1°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>N</td>
<td>-250°C to +1380°C (414°F to 2532°F)</td>
<td>±2°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>L</td>
<td>-250°C to +900°C (32°F to 1652°F)</td>
<td>±2°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>P</td>
<td>0°C to -139°C (32°F to -254°F)</td>
<td>±2°C</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>PT100 (ΩIN)</td>
<td>-210°C to 750°C (340°F to 1400°F)</td>
<td>±0.4°C</td>
<td>1.3 kΩ</td>
</tr>
<tr>
<td>PT100 (ΩLS)</td>
<td>-280°C to 600°C (528°F to 1112°F)</td>
<td>±0.4°C</td>
<td>1.3 kΩ</td>
</tr>
<tr>
<td>mV</td>
<td>8 mV to 70 mV</td>
<td>±0.05%</td>
<td>2.2 kΩ</td>
</tr>
<tr>
<td>mA</td>
<td>3 mA to 27 mA</td>
<td>±0.05%</td>
<td>70.5 kΩ</td>
</tr>
<tr>
<td>V</td>
<td>-1.3V to 11.5V</td>
<td>±0.05%</td>
<td>610 kΩ</td>
</tr>
</tbody>
</table>

**Output 1 / Output 2**

- **Relay rating:** 2A/240 VAC, life cycles 200,000 for resistive load
- **Pulsed Voltage:** Source Voltage, current limiting resistance 66Ω

**Linear Output Characteristics:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Zero Tolerance</th>
<th>Span Tolerance</th>
<th>Span Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>4–20 mA</td>
<td>3.6–4 mA</td>
<td>20–21 mA</td>
<td>500Ω max.</td>
</tr>
<tr>
<td>0–20 mA</td>
<td>0 mA</td>
<td>20–21 mA</td>
<td>500Ω max.</td>
</tr>
<tr>
<td>0–5 V</td>
<td>0 V</td>
<td>5–5.25 V</td>
<td>10 kΩ min.</td>
</tr>
<tr>
<td>1–5 V</td>
<td>0.95–1 V</td>
<td>5–5.25 V</td>
<td>10 kΩ min.</td>
</tr>
<tr>
<td>0–10 V</td>
<td>0 V</td>
<td>10–10.5 V</td>
<td>10 kΩ min.</td>
</tr>
</tbody>
</table>

**Triac (SSR) Output**

- **Rating:** 1A/240 VAC
- **Inrush Current:** 20A for 1 cycle
- **Min. Load Current:** 50 mA rms
- **Max. Off-state Leakage:** 3 mA rms
- **Max. On-state Voltage:** 1.5 V rms
- **Insulation Resistance:** 1000 Megohms min. at 500 V DDC
- **Dielectric Strength:** 2500 VAC for 1 minute

**DC Voltage Supply Characteristics (Installed at Output 2)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Tolerance</th>
<th>Max. Output Current</th>
<th>Ripple Voltage</th>
<th>Isolation Barrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>28V</td>
<td>±1V</td>
<td>25 mA</td>
<td>0.2 Vp-p</td>
<td>500 VAC</td>
</tr>
<tr>
<td>12V</td>
<td>±0.5V</td>
<td>40 mA</td>
<td>0.1 Vp-p</td>
<td>500 VAC</td>
</tr>
<tr>
<td>5V</td>
<td>±0.25V</td>
<td>80 mA</td>
<td>0.05 Vp-p</td>
<td>500 VAC</td>
</tr>
</tbody>
</table>

**Alarm**

- **Relay Rating:** Form C Rating
- **24VAC/240VAC, life cycles 200,000 for resistive load:**
- **Alarm Functions:** Dwell timer, Deviation High / Low Alarm, Deviation Band High / Low Alarm, PVT High / Low Alarm, PVT High / Low Alarm
- **Mode:** Normal, Latching, Hold, Latching / Hold
- **Dwell Time:** 0.1–455.5 minutes

**Data Communication**

- **Interface:** RS-232 (1 unit), RS-485 (up to 247 units)
- **Protocol:** Modbus Protocol RTU mode
- **Address:** 2-255
- **Baud Rate:** 2.4–38.4 Kbits/sec
- **Parity Bit:** None, Even or Odd
- **Stop Bit:** 1 or 2 bits
- **Communication Buffer:** 64 bytes

**Analog Retransmission**

- **Output Signal:** 4–20 mA, 0–20 mA, 0–5 V, 1–5 V, 0–10 V
- **Resolution:** 15 bits
- **Accuracy:** ±0.05% of span ±0.0025 %/°C
- **Load Resistance:** 0 – 500 ohms (for current output)
- **10 kohms minimum (for voltage output)**
- **Output Regulation:** ±0.01% for full load change
- **Output Settling Time:** 0.1 sec. (stable to 99.9%)
- **Isolation Breakdown Voltage:** 1000 VAC min.
- **Integral Linearity Error:** ±0.005% of span
- **Temperature Effect:** ±0.0025% of span /°C
- **Saturation Low:** 0 mA (or 0V)
- **Saturation High:** 22.2 mA (or 5.55V, 1.1V min.)
- **Linear Output Range:** 0–22.2 mA (0–20mA or 6–20mA)
- **0–5.55V (0–5V, 0–5V)
- **0–11.1 V (0–10V)

**User Interface**

- **Dual 4-digit LED Displays**
- **Keypad:** 4 keys
- **Programming Port:** For automatic setup, calibration and testing
- **Communication Port:** RS-232 and RS-485

**Control Mode**

- **Output 1:** Heat (heating) or direct (cooling) action
- **Output 2:** PID cooling control, Cooling P band 50–100% of PB, dead band 36.3 – 36 °C of PB
- **ON-Off:** 0.1 – 90.0 °F (Integral time 0.1-10000 seconds)
- **P or PD:** 100.0 % offset adjustment
- **PID:** Fuzzy logic modified
- **Failure Mode:** Auto-transfer to manual mode while sensor break or A-D converter damage
- **Ramping Control:** 0–900.0 °F/minute or 0–900.0 °F/hour ramp rate

**Digital Filter**

- **Function:** First order
- **Time Constant:** 0, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60 seconds programmable

**Profilier**

- **Number of profiles:** 9
- **Number of Segment per profile:** 1, 2, 3, 4, 5, 6, 7, 8

**Environmental & Physical**

- **Operating Temperature:** -10°C to 50°C
- **Storage Temperature:** -40°C to 60°C
- **Humidity:** 0 to 90% RH (non-condensing)
- **Altitude:** 2000m maximum
- **Pollution:** Degree 2
- **Insulation Resistance:** 20 Megohms min. [at 500 VDC]
- **Dielectric Strength:** 2000 VAC, 50/60 Hz for 1 minute
- **Vibration Resistance:** 10–55 Hz, 10 m/s² for 2 hours
- **Shock Resistance:** 200 m/s² (25g)
- **Molding:** Flame retardant polycarbonate
- **Dimensions:** (H) X (W) X (D): 96mm X 86mm X 44mm (ID), 53 mm depth behind panel
- **Panel Cutout:** 46mm(W) X 49mm(H) X 116mm(ID), 105 mm depth behind panel
- **Weight:** 250 grams
- **Approval Standards:** UL61010-1

**Protective Class**

- **IP63 for panel with additional option**
- **IP20 for panel without additional option**
- **IP20 for terminals and housing with protective cover**
- **All indoor use.**

**EMC:** EN61326
### Ordering Code

<table>
<thead>
<tr>
<th>Power Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>4: 90 - 250 VAC, 47-63 Hz</td>
</tr>
<tr>
<td>5: 11 - 26 VAC or VDC, SELV, Limited Energy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signal Input</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Standard Input</td>
</tr>
<tr>
<td>Thermocouple:</td>
</tr>
<tr>
<td>RTD: PT100 100, PT100 JIS</td>
</tr>
<tr>
<td>Voltage: 0-60mV</td>
</tr>
<tr>
<td>0-1V, 0-5V, 0-5V, 0-5V</td>
</tr>
<tr>
<td>0-20/4-20 mA</td>
</tr>
<tr>
<td>9: Special Order</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: None</td>
</tr>
<tr>
<td>1: Relay rated 2A/240VAC</td>
</tr>
<tr>
<td>2: Pulsed voltage to drive SSR, 5V/30mA</td>
</tr>
<tr>
<td>3: Isolated 4 - 20mA / 0 - 2mA</td>
</tr>
<tr>
<td>4: Isolated 1 - 5V / 0 - 5V / 0 - 10V</td>
</tr>
<tr>
<td>6: Triac output 1A / 240VAC, SSR</td>
</tr>
<tr>
<td>C: Pulsed voltage to drive SSR, 14V/40mA</td>
</tr>
<tr>
<td>9: Special order</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: None</td>
</tr>
<tr>
<td>1: Relay rated 2A/240VAC</td>
</tr>
<tr>
<td>2: Pulsed voltage to drive SSR, 5V/30mA</td>
</tr>
<tr>
<td>3: Isolated 4 - 20mA / 0 - 20mA</td>
</tr>
<tr>
<td>4: Isolated 1 - 5V / 0 - 5V / 0 - 10V</td>
</tr>
<tr>
<td>6: Triac output 1A / 240VAC, SSR</td>
</tr>
<tr>
<td>7: Isolated 20V/25mA transducer power supply</td>
</tr>
<tr>
<td>8: Isolated 12V/40mA transducer power supply</td>
</tr>
<tr>
<td>A: Isolated 5V/80mA transducer power supply</td>
</tr>
<tr>
<td>9: Special order</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: None</td>
</tr>
<tr>
<td>1: Relay rated 2A/240VAC</td>
</tr>
<tr>
<td>2: Pulsed voltage to drive SSR, 5V/30mA</td>
</tr>
<tr>
<td>6: Triac output 1A / 240VAC, SSR</td>
</tr>
<tr>
<td>7: Isolated 20V/25mA transducer power supply</td>
</tr>
<tr>
<td>8: Isolated 12V/40mA transducer power supply</td>
</tr>
<tr>
<td>A: Isolated 5V/80mA transducer power supply</td>
</tr>
<tr>
<td>9: Special order</td>
</tr>
</tbody>
</table>

### Options

| 0: Panel mount IP50 standard |
| 1: Panel mount IP65 water resistant rubber installed |
| 2: DIN rail mount with IP50 (for P91 only) |
| 3: DIN rail mount with IP65 (for P91 only) |

<table>
<thead>
<tr>
<th>Output 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: None</td>
</tr>
<tr>
<td>3: Retransmit 4 - 20mA / 0 - 20mA</td>
</tr>
<tr>
<td>4: Retransmit 1 - 5V / 0 - 5V / 0 - 10V</td>
</tr>
<tr>
<td>7: Isolated 20V/25mA transducer power supply</td>
</tr>
<tr>
<td>8: Isolated 12V/40mA transducer power supply</td>
</tr>
<tr>
<td>A: Isolated 5V/80mA transducer power supply</td>
</tr>
<tr>
<td>D: Isolated RS-485 interface</td>
</tr>
<tr>
<td>E: Isolated RS-232 interface</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: None</td>
</tr>
<tr>
<td>1: Relay rated 2A/240VAC</td>
</tr>
<tr>
<td>2: Pulsed voltage to drive SSR, 5V/30mA</td>
</tr>
<tr>
<td>3: Isolated 4 - 20mA / 0 - 20mA</td>
</tr>
<tr>
<td>4: Isolated 1 - 5V / 0 - 5V / 0 - 10V</td>
</tr>
<tr>
<td>6: Triac output 1A / 240VAC, SSR</td>
</tr>
<tr>
<td>7: Isolated 20V/25mA transducer power supply</td>
</tr>
<tr>
<td>8: Isolated 12V/40mA transducer power supply</td>
</tr>
<tr>
<td>A: Isolated 5V/80mA transducer power supply</td>
</tr>
<tr>
<td>C: Pulsed voltage to drive SSR, 14V/40mA</td>
</tr>
<tr>
<td>9: Special order</td>
</tr>
</tbody>
</table>
Accessories
OM94-6 = Isolated 1A / 240VAC Triac Output Module (SSR)
OM94-7 = 14V / 40mA SSR Drive Module
OM98-3 = Isolated 4-20 mA / 0-20 mA Analog Output Module
OM98-5 = Isolated 0-10V Analog Output Module
CM94-1 = Isolated RS-485 Interface Module for P41 Output 5
CM94-2 = Isolated RS-232 Interface Module for P41 Output 5
CM94-3 = Isolated 4-20mA/0-20mA Retrans Module for P41 Output 5
CM94-5 = Isolated 0-10V Retrans Module for P41 Output 5
CM97-1 = Isolated RS-485 Interface Module for P91 Output 5
CM97-2 = Isolated RS-232 Interface Module for P91 Output 5
CM97-3 = Isolated 4-20mA/0-20mA Retrans Module for P91 Output 5
CM97-5 = Isolated 0-10V Retrans Module for P91 Output 5
DC94-1 = Isolated 20V/25mA DC Output Power Supply
DC94-2 = Isolated 12V/40mA DC Output Power Supply
DC94-3 = Isolated 5V/80mA DC Output Power Supply
DC97-1 = Isolated 20V/25mA DC Output Power Supply for P91 Output 5
DC97-2 = Isolated 12V/40mA DC Output Power Supply for P91 Output 5
DC97-3 = Isolated 5V/80mA DC Output Power Supply for P91 Output 5
CC94-1 = RS-232 Interface Cable (.2M)
CC91-1 = Programming Port Cable
RK91-1 = Rail Mount kit for BTC-8100 / P91
DC21-1 = Isolated 20V/25mA DC Output Power Supply for P41 Output 5
DC21-2 = Isolated 12V/40mA DC Output Power Supply for P41 Output 5
DC21-3 = Isolated 5V/80mA DC Output Power Supply for P41 Output 5

Related Products
SNA10A = Smart network adaptor for Brainchild software
    DAQ Studio or third party software, which converts 255 channels of
    RS-485 or RS-422 to RS-232 network.
SNA12A = Smart network adapter for programming port to RS-232
    interface
BC-Set = Configuration software
DAQ Studio software = PC software for data logging
PC-E = RS-232/485 to Ethernet converter
PC-W = RS-232/422/485 x 2 + Ethernet x 1 converted to Ethernet wireless
L41 / L91 Temperature Limit Controller
The L41 / L91 is a microprocessor based specially designed limit controller to protect the equipment from high temperature and low temperature. A latched relay cuts power to the process if safe values are exceeded. These units must be reset before the process continues. The temperature controller takes an input from the universal input which is fully programmable for PT100, thermocouple types J, K, T, E, B, R, S, N, L, C, P and 0~60mV. The controller equipped with 2 Amp form C relay as limit control output and equipped with the optional RS-232 or RS-485 communication, retransmission output and transmitter power supply.

Features

» Fastest Sampling Rate of 200 msec
» Universal Input
» High or Low or High / Low Limit
» Normal / Latching Alarm Output
» Limit Annunciator
» Remote Reset / Remote Lock via Event Input
» PV /SP Retransmission
» Connect with HMI for Alarm Monitoring
» Network up to 247 Controllers on RS-485 (Modbus Protocol)
» FM, UL, CSA, CE, RoHS, REACH Approval
» Available in ¼ DIN and 1/16 DIN Size
### Features
- Fastest Sampling Rate of 200 msec
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### Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>L41</th>
<th>L91</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply</td>
<td>90-250 VAC, 47-63 Hz, 11-26 VAC/VDC, SELV, Limited Energy</td>
<td></td>
</tr>
<tr>
<td>Power Consumption</td>
<td>10VA, 5W Maximum</td>
<td>II</td>
</tr>
<tr>
<td>Over Voltage Category</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Signal Input</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermocouple: J, K, T, E, B, R, S, N, L, P (L41 only), C (L41 only); RTD: PT100 DIN, PT100 JIS; mV: 0<del>60 mV; Current: 0</del>20mA; Voltage: 0<del>1 V, 0</del>10V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>18 Bits</td>
<td></td>
</tr>
<tr>
<td><strong>Sampling Rate</strong></td>
<td>5 Times / Second (200 msec)</td>
<td></td>
</tr>
</tbody>
</table>

### Input Characteristics

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25° C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-120° C to 1000° C (-184° F to 1832° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>K</td>
<td>-200° C to 1370° C (-328° F to 2498° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>T</td>
<td>-250° C to 400° C (-418° F to 752° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>E</td>
<td>-100° C to 900° C (-184° F to 1652° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>B</td>
<td>0° C to 1820° C (-32° F to 3308° F)</td>
<td>± 2° C (200° C to 1800° C)</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>R</td>
<td>0° C to 1767.8° C (-32° F to 3214° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>S</td>
<td>0° C to 1767.8° C (-32° F to 3214° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>N</td>
<td>-250° C to 1300° C (-418° F to 2372° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>L</td>
<td>-200° C to 900° C (-328° F to 1652° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>P (L41 only)</td>
<td>0° C to 1395° C (32° F to 2543° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>C (L41 only)</td>
<td>0° C to 2315° C (32° F to 4199° F)</td>
<td>± 2° C</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>PT100(DIN)</td>
<td>-210° C to 700° C (-346° F to 1292° F)</td>
<td>± 0.4° C</td>
<td>1.3 KΩ</td>
</tr>
<tr>
<td>PT100(JIS)</td>
<td>-200° C to 600° C (-328° F to 1112° F)</td>
<td>± 0.4° C</td>
<td>1.3 KΩ</td>
</tr>
<tr>
<td>mV</td>
<td>-8mV to 70mV</td>
<td>± 0.05%</td>
<td>2.2 MΩ</td>
</tr>
<tr>
<td>mA</td>
<td>-3mA to 27mA</td>
<td>± 0.05%</td>
<td>L41: 70.5 Ω, L91: 100Ω</td>
</tr>
<tr>
<td>VDC</td>
<td>-1.3VDC to 11.5VDC</td>
<td>± 0.05%</td>
<td>L41: 302 KΩ, L91: 510 KΩ</td>
</tr>
</tbody>
</table>

### Temperature Effect

- 1.5µV /° C

### Sensor Lead Resistance Effect

- **Thermocouple**: 0.2 µV /° Ω
- **3-wire RTD**: 2.6° C /Ω of Difference of Resistance of two leads
- **2-wire RTD**: 2.6° C /Ω of Sum of Resistance of two leads

### Burn-out Current

- 200nA

### CMRR

- 120 dB

### NMRR

- 55dB

### Sensor Break Detection

- Sensor open for Thermocouple, RTD, mV inputs, Below 1mA for 4 to 20mA, Below 0.25V for 1 to 5V

### Sensor Break Response Time

- Within 4 seconds for TC, RTD and mA inputs, 0.1 second for 4-20 mA and 1-5V inputs
## Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>L41</th>
<th>L91</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output 1 / Output 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay Rating</td>
<td>2A / 240 VAC, life cycles 200,000 for resistive load</td>
<td></td>
</tr>
<tr>
<td>Pulsed Voltage</td>
<td>Source Voltage 5V, current limiting resistance 66 Ω</td>
<td></td>
</tr>
<tr>
<td>Triac Output</td>
<td>Rating: 1A / 240 VAC, Inrush current: 20A for 1 cycle. Minimum Load Current: 50 mA rms, Max. Off-state Leakage: 3 mA rms, Max. On-state Voltage: 1.5 V rms, Insulation Resistance: 1000 MΩ min. at 500 VDC, Dielectric Strength: 2500 VAC for 1 minute</td>
<td></td>
</tr>
<tr>
<td>Limit Control Function</td>
<td>High Limit, Low limit and High / Low Limit programmable</td>
<td></td>
</tr>
<tr>
<td>Alarm Function</td>
<td>Process Value High, Process Value Low</td>
<td></td>
</tr>
<tr>
<td>Alarm Mode</td>
<td>Normal, Latching</td>
<td></td>
</tr>
<tr>
<td><strong>Transmitter Power Supply (Output 2)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmitter Power Supply Output Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Tolerance</td>
<td>Maximum Output Current</td>
</tr>
<tr>
<td>20V</td>
<td>± 1V</td>
<td>25mA</td>
</tr>
<tr>
<td>12V</td>
<td>± 0.6V</td>
<td>40mA</td>
</tr>
<tr>
<td>5V</td>
<td>± 0.25V</td>
<td>80mA</td>
</tr>
<tr>
<td><strong>Digital Filter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>First Order</td>
<td></td>
</tr>
<tr>
<td>Time Constant</td>
<td>0, 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60 Seconds, Programmable</td>
<td></td>
</tr>
<tr>
<td><strong>Event Input</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logic Low</td>
<td>-10V minimum, 0.8V maximum</td>
<td></td>
</tr>
<tr>
<td>Logic High</td>
<td>2V minimum, 10V maximum</td>
<td></td>
</tr>
<tr>
<td>Event Input Functions</td>
<td>Remote reset, remote lockout</td>
<td></td>
</tr>
<tr>
<td><strong>Data Communication</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interface</td>
<td>RS-485 or RS-232</td>
<td></td>
</tr>
<tr>
<td>Protocol</td>
<td>Modbus RTU (Slave Mode)</td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td>1 to 247</td>
<td></td>
</tr>
<tr>
<td>Baud Rate</td>
<td>2.8KBPS to 115.2KBPS</td>
<td></td>
</tr>
<tr>
<td>Parity Bit</td>
<td>None, Even or Odd</td>
<td></td>
</tr>
<tr>
<td>Stop Bit</td>
<td>1 or 2 Bits</td>
<td></td>
</tr>
<tr>
<td>Data Length</td>
<td>7 or 8 Bits</td>
<td></td>
</tr>
<tr>
<td>Communication Buffer</td>
<td>50 Bytes</td>
<td></td>
</tr>
<tr>
<td><strong>Analog Retransmission</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Signal</td>
<td>4 - 20mA, 0 - 20 mA, 0 - 10VDC, 0 - 5VDC, 1 - 5VDC</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>15 Bits</td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>± 0.05% of Span ± 0.0025% / °C</td>
<td></td>
</tr>
<tr>
<td>Load Resistance</td>
<td>0 to 500Ω for current output, 10KΩ minimum for Voltage Output</td>
<td></td>
</tr>
<tr>
<td>Output Regulation</td>
<td>0.01% for full load change</td>
<td></td>
</tr>
<tr>
<td>Output Setting Time</td>
<td>0.1 second (stable to 99.9%)</td>
<td></td>
</tr>
<tr>
<td>Isolation Breakdown</td>
<td>1000VAC min</td>
<td></td>
</tr>
</tbody>
</table>
## Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>L41</th>
<th>L91</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analog Retransmission</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integral Linearity Error</td>
<td>± 0.005% of span</td>
<td></td>
</tr>
<tr>
<td>Temperature Effect</td>
<td>± 0.0025% of span / °C</td>
<td></td>
</tr>
<tr>
<td>Saturation Low</td>
<td>0mA or 0VDC</td>
<td></td>
</tr>
<tr>
<td>Saturation High</td>
<td>22.2mA or 5.55V, 11.1V min</td>
<td></td>
</tr>
<tr>
<td>Linear Output Ranges</td>
<td>0 - 22.2mA (0 - 20mA / 4 - 20mA), 0 - 5.55VDC (0 - 5VDC / 1 - 5VDC), 0 - 11.1VDC (0 - 10VDC)</td>
<td></td>
</tr>
</tbody>
</table>

### User Interface

<table>
<thead>
<tr>
<th>Feature</th>
<th>L41</th>
<th>L91</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keypad</td>
<td>4 Keys</td>
<td></td>
</tr>
<tr>
<td>Display Type</td>
<td>4 Digit LCD Display</td>
<td></td>
</tr>
<tr>
<td>No of Display</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Upper Display Size</td>
<td>0.55” (14mm)</td>
<td>0.4” (10mm)</td>
</tr>
<tr>
<td>Lower Display Size</td>
<td>0.55” (14mm)</td>
<td>N.A.</td>
</tr>
</tbody>
</table>

### Environmental and Physical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>L41</th>
<th>L91</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature</td>
<td>-10° C to 50° C</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40° C to 60° C</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>0 to 90 % RH (Non - Condensing)</td>
<td></td>
</tr>
<tr>
<td>Altitude</td>
<td>2000 Meters Maximum</td>
<td></td>
</tr>
<tr>
<td>Pollution</td>
<td>Degree II</td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>20MΩ Minimum (@500V DC)</td>
<td></td>
</tr>
<tr>
<td>Dielectric Strength</td>
<td>2000VAC, 50/60 Hz for 1 Minute</td>
<td></td>
</tr>
<tr>
<td>Vibration Resistance</td>
<td>10 to 55 Hz, 10m/s2 for 2 Hours</td>
<td></td>
</tr>
<tr>
<td>Shock Resistance</td>
<td>200 m/s2(20g)</td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td>Flame Retardant Polycarbonate</td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>Panel Mounting</td>
<td></td>
</tr>
<tr>
<td>DIN Size</td>
<td>1 / 4</td>
<td>1/16</td>
</tr>
<tr>
<td>Dimensions (W<em>H</em>D) (mm)</td>
<td>96<em>96</em>65 mm</td>
<td>48<em>48</em>94 mm</td>
</tr>
<tr>
<td>Mounting (W*H) (mm)</td>
<td>92*92 mm</td>
<td>45*45 mm</td>
</tr>
<tr>
<td>Depth behind Panel</td>
<td>53 mm</td>
<td>86 mm</td>
</tr>
<tr>
<td>Weight (grams)</td>
<td>250 grams</td>
<td>150 grams</td>
</tr>
</tbody>
</table>

### Approval Standards

<table>
<thead>
<tr>
<th>Feature</th>
<th>L41</th>
<th>L91</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>FM Class 3545 (Oct. 1998), UL61010C-1, CSA C22.2 No. 24-93, EN61010-1 (IEC1010-1), RoHS, REACH</td>
<td>EN61326</td>
</tr>
<tr>
<td>Protective Class</td>
<td>IP65 for panel with additional option, IP50 for panel without additional option, IP20 for terminals and housing with protective cover. All indoor use</td>
<td>IP30 front panel, indoor use, IP20 housing and terminals (with protective cover)</td>
</tr>
<tr>
<td>EMC</td>
<td>EN61326</td>
<td></td>
</tr>
</tbody>
</table>
L41 Ordering Code

**Power Input**
- 4: 90-250 VAC, 47-63 Hz
- 5: 11-26 VAC or VDC, SELV, Limited Energy

**Signal Input**
1: Standard Input
   - RTD: PT100 DIN, PT100 JIS
   - mV: 0-60 mV
2: Voltage: 0-1 V
3: Voltage: 0-10 V
4: Current: 0-20mA
5: Voltage: 0-5 V
9: Special Order

**Output 1**
- 0: None
- 1: Form C relay rated 2A / 240VAC
- 2: Pulsed voltage to drive SSR, 5V / 30mA
- 6: Triac Output 1A / 240VAC, SSR
- C: Pulsed voltage to drive SSR, 14V / 40mA
- 9: Special Order

**Output 2**
- 0: None
- 1: Form C Relay 2A / 240VAC
- 2: Pulsed voltage to drive SSR, 5V / 30mA
- 6: Triac Output, 1A / 240VAC, SSR
- 7: Isolated 20V / 25mA DC Output Power Supply
- 8: Isolated 12V / 40mA DC Output Power Supply
- 9: Isolated 5V / 80mA DC Output Power Supply
- C: Pulsed voltage to drive SSR, 14V / 40mA
- H: Special Order

**Communication**
- 0: None
- 1: RS-485 Interface
- 2: RS-232 Interface
- 3: Retransmit 4-20mA / 0-20mA
- 4: Retransmit 1-5V / 0-5V
- 5: Retransmit 0-10V
- 9: Special Order

**Options**
- 0: IP50 Standard
- 1: IP65 Water Resistant Rubber Installed
**L91 Ordering Code**

**Power Input**
- 4: 90-250 VAC, 47-63 HZ
- 5: 11 - 26 VAC or VDC, SELV, Limited Energy

**Signal Input**
- 1: Standard Input
  - RTD: PT100 DIN, PT100 JIS
  - mV: 0~60 mV
- 2: Voltage: 0-1 V
- 3: Voltage: 0-10 V
- 4: Current: 0-20mA
- 5: Voltage: 0-5 V
- 9: Special Order

**Output 1**
- 0: None
- 1: Form C relay rated 2A/240VAC
- 2: Pulsed voltage to drive SSR, 5V/30mA
- 6: Triac Output 1A / 240VAC, SSR
- C: Pulsed voltage to drive SSR, 14V/40mA
- 9: Special Order

**Output 2**
- 0: None
- 1: Form C Relay 2A/240VAC
- 2: Pulsed voltage to drive SSR, 5V / 30mA
- 6: Triac Output, 1A / 240VAC, SSR
- 7: Isolated 20V / 25mA DC Output Power Supply
- 8: Isolated 12V / 40 mA DC Output Power Supply
- 9: Isolated 5V / 80mA DC Output Power Supply

**Accessories**
- OM94-6 = Isolated 1A/240VAC Triac Output Module (SSR)
- OM94-7 = 14V/40mA SSR Drive Module
- DC94-1 = Isolated 20V / 25mA DC Output Power Supply
- DC94-2 = Isolated 12V / 40mA DC Output Power Supply
- DC94-3 = Isolated 5V / 80mA DC Output Power Supply
- CM94-1 = Isolated RS-485 Interface Module for L41
- CM94-2 = Isolated RS-232 Interface Module for L41
- CM94-3 = Isolated 4-20mA / 0-20mA Retransmission Module for L41
- CM94-4 = Isolated 1-5V / 0-5V Retransmission Module for L41
- CM94-5 = Isolated 0-10V Retransmission Module for L41
- CC91-3 = Programming Port Cable for L41
- CM96-1 = Isolated RS-485 Interface Module for L91
- CM96-3 = Isolated 4-20mA / 0-20mA Retransmission Module for L91
- CM96-4 = Isolated 1-5V / 0-5V Retransmission Module for L91
- CM96-5 = Isolated 0-10V Retransmission Module for L91
- EI96-1 = Event Input Module for L91
- CC91-2 = Programming Port Cable for L91

**Related Products**
- » SNA-10A = Smart Network Adaptor for Third Party Software, Converts 255 channels of RS-485 or RS-422 to RS-232 Network
- » SNA-12A = Smart Network Adaptor for programming port to RS-232 Interface
- » BC-SET = Configuration Software
Terminal Connection

**L41**

90-250VAC
47-63 Hz
10VA

OP1
- 
+ 

RE+, TX1
RE-, TX2

OP2
- 
+ 

RS-232

50LC max. air ambient
Use copper conductors (except on T/C input)

**L91**

OUT2
RS-485
or Event Input

OUT1

2A
240 VAC

90-264VAC
47-63 Hz
10VA

Temperature Limit Controller L41, L91
PR Series Paperless Recorders
Math channels (in standard firmware)
- Digital inputs / Relay outputs
- Analog outputs
- PID Process control
- Displays
- Resolution
- MTFB backlight at 25°C
- Backlight
- Screen saver, Email
- CPU
- Internal Flash memory
- Ethernet
- RS-232/422/485
- SD card Slot, USB host x 2
- Pulse input
- START / STOP key
- Calibration correction
- Muttilingual
- PC software
- Power supply
- Outer dimensions (W x H x L mm)
- Shorter mounting depth (mm)
- DIN Panel cutout (W x H mm)
- Protection
- Operating temperature
- Storage temperature
- Safety standards

Features
- 100 milliseconds data logging
- FDA 21 CFR part11 compliance
- Batch control, log data in batches
- Timer, Counter, Totalizer & Math channels
- Custom display pages
- PID control with profile function
- Alarms by email
- On field calibration
- Web server
- Clock synchronization via internet
- Handwriting function in historical data
- Multiple Languages
- Circular chart in PR30
- Direct printer connectivity or PDF printer
- USB barcode reader connectivity for data entry
- Dynamic data exchange (DDE) via PC software

IO modules easy for expansion

Paperless Recorder PR10, PR20, PR30

72
Smart Mechanism

Front view, Back view

PR20 Front view

PR20 Back view

SD Slot
1st USB host
START/STOP
RESET
Touch LCD display

IO modules
Power terminals
RS-232/422/485 (option)
Ethernet port (standard)
2nd USB host (standard)
Power switch (option for panel mount) (standard for portables)

Expandable modules of inputs & outputs

AI206
6 AI (6 analog inputs)

AI203
3 AI (3 analog inputs)

RO206
6 relay outputs

DI206
6 DI (6 digital inputs)

PC201
single loop process control

AO206
6 AO (6 analog outputs)

RD233
3 relays + 3DI

PR10
(4 Slots, up to 6 AI)

PR20
(4 Slots, up to 24 AI)

PR30
(16 Slots, up to 48 AI)

Profile
Number of Profiles:
50 per recorder
Number of Segments per Profile:
32
Note:
Total Segments are limited to 1000 Segments

Self-tuning:
Select None and YES
0-500.0˚C (0 - 900.0˚F) / minute or
0-500.0˚C (0 - 900.0˚F) / hour ramp rate

Form C, life cycles 200,000 for resistive load

Portable recorders, Security key

Portable recorders

Security key

PR10

PR20

PR30
PC201: Single Loop PID Process Control Card

**Input 1 Characteristics:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-120°C -1000°C (-184°F -1832°F)</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>K</td>
<td>-200°C -1370°C (-328°F -2496°F)</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>T</td>
<td>-250°C -400°C (-418°F -725°F)</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>E</td>
<td>-100°C -900°C (-148°F -1652°F)</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>B</td>
<td>0°C -1820°C (32°F -3308°F) (200°C - 1820°C)</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>R</td>
<td>0°C -1767.8°C (32°F -314°F)</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>S</td>
<td>0°C -1767.8°C (32°F -314°F)</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>N</td>
<td>-250°C -1300°C (-418°F -2372°F)</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>L</td>
<td>-200°C -900°C (-328°F -1652°F)</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>PT100 (DN)</td>
<td>-210°C -700°C (-346°F -1220°F)</td>
<td>±0.4°C</td>
<td>1.3KΩ</td>
</tr>
<tr>
<td>PT100 (JIS)</td>
<td>-200°C -600°C (-328°F -1112°F)</td>
<td>±0.4°C</td>
<td>1.3KΩ</td>
</tr>
<tr>
<td>mV</td>
<td>0 to 800mV</td>
<td>±0.05%</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>mA</td>
<td>0 to 20mA</td>
<td>±0.05%</td>
<td>70.5Ω</td>
</tr>
<tr>
<td>V</td>
<td>-1.3V to 11.5V</td>
<td>±0.05%</td>
<td>302KΩ</td>
</tr>
</tbody>
</table>

**Resolution:** 18 bits

**Sampling Rate:** 5 times / second

**Maximum Rating:** -2 VDC minimum, 12 VDC maximum (1 minute for mA input)

**Temperature Effect:** ±1.5 µV/°C for all inputs except mA input ±3.0 µV/°C for mA input

**Sensor Lead Resistance Effect:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>T/C</th>
<th>±0.2uV/°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-wire RTD</td>
<td>2.6 °C/°C</td>
<td>T/C</td>
<td>±0.2uV/°C</td>
</tr>
<tr>
<td>2-wire RTD</td>
<td>2.6 °C/°C</td>
<td>T/C</td>
<td>±0.2uV/°C</td>
</tr>
</tbody>
</table>

**Common Mode Rejection Ratio (CMRR):**

| Normal Mode Rejection Ratio (NMRR): | 120dB |
| Sensor Break Detection: | 55dB |

**Input 2 Resolution:** 18 bits

**Sampling Rate:** 1.66 times / second

**Maximum Rating:** -2 VDC minimum, 12 VDC maximum

**Temperature Effect:** ±1.5µV/°C for all inputs except mA input ±3.0µV/°C for mA input

**Common Mode Rejection Ratio (CMRR):** 120dB

**Normal Mode Rejection Ratio (NMRR):** 55dB

**Sensor Break Detection:** Below 1 mA for 4-20 mA input, below 0.25V for 1 - 5 V input, unavailable for other inputs

**Sensor Break Responding Time:** 0.5 second

**Characteristics:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT94-1</td>
<td>0-50.0 A</td>
<td>±2% of Reading</td>
<td>302 KΩ</td>
</tr>
<tr>
<td>mA</td>
<td>-3mA to 27mA</td>
<td>±0.05%</td>
<td>70.5Ω + 0.8V Input current</td>
</tr>
<tr>
<td>V</td>
<td>-1.3V to 11.5V</td>
<td>±0.05%</td>
<td>302 KΩ</td>
</tr>
</tbody>
</table>

**Input 3 (Event Input):**

- **Logic Low:** -10V minimum, 0.8V maximum
- **Logic High:** 2V minimum, 10V maximum
- **External pull-down Resistance:** 400 kΩ maximum
- **External pull-up Resistance:** 1.5 MΩ minimum

**Output 1 / Output 2:**

- **Relay Rating:** 2A/240 VAC, life cycles 200,000 for resistive load
- **Pulsed Voltage:** Source Voltage 5V, current limiting resistance 66Ω

**Linear Output Characteristics:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Zero Tolerance</th>
<th>Span Tolerance</th>
<th>Load Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-20 mA</td>
<td>3.64 mA</td>
<td>20-21 mA</td>
<td>500 mA max</td>
</tr>
<tr>
<td>0-20 mA</td>
<td>0 mA</td>
<td>20-21 mA</td>
<td>500 mA max</td>
</tr>
<tr>
<td>0-5 V</td>
<td>0 V</td>
<td>5-5.25 V</td>
<td>10 kΩ min</td>
</tr>
<tr>
<td>1-5 V</td>
<td>0.9-1 V</td>
<td>5-5.25 V</td>
<td>10 kΩ min</td>
</tr>
<tr>
<td>0-10 V</td>
<td>0 V</td>
<td>10-10.5 V</td>
<td>10 kΩ min</td>
</tr>
</tbody>
</table>

**Linear Output Resolution:** 15 bits

**Output Regulation:** 0.01 % for full load change

**Output Settling Time:** 0.1 sec. (stable to 99.9 %)

**Isolation Breakdown Voltage:** 1000 VAC

**Temperature Effect:** ±0.0025% of SPAN / °C

**Triac (SSR) Output:**

- **Rating:** 1A / 240 VAC
- **Inrush Current:** 20A for 1 cycle
- **Min. Load Current:** 50 mA rms
- **Max. Off-state Leakage:** 3 mA rms
- **Max. On-state Voltage:** 1.5 V rms

**Insulation Resistance:** 1000 MΩ min. at 500 VDC

**Dielectric Strength:** 2500 VAC for 1 minute

**DC Voltage Supply Characteristics (Installed at Output 2):**

<table>
<thead>
<tr>
<th>Type</th>
<th>Maximum Output</th>
<th>Ripple Voltage</th>
<th>Isolation Barrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 V</td>
<td>±0.1 V</td>
<td>25 mA</td>
<td>0.2 Vp-p</td>
</tr>
<tr>
<td>12 V</td>
<td>±0.6 V</td>
<td>40 mA</td>
<td>0.1 Vp-p</td>
</tr>
<tr>
<td>5 V</td>
<td>±0.25 V</td>
<td>80 mA</td>
<td>0.05 Vp-p</td>
</tr>
</tbody>
</table>

**Alarm 1/Alarm 2 (Output 2):**

- **Alarm 1 Relay:** Form C, life cycles 200,000 for resistive load
- **Alarm 2 Relay:** Form A, Max. rating 2A / 240VAC, life cycles 200,000 for resistive load
- **Dwell Timer:** 0 - 6553.5 minutes

**Control Mode:**

- **Output 1:** Reverse (heating) or direct (cooling) action
- **Output 2:** PID cooling control, cooling P band 1 - 255% of PB
- **ON-OFF:** 0.1-100°C (0.1-100°F) hysteresis control (P band = 0) P or PD: 0 - 100.0 % offset adjustment
- **PID:** Fuzzy logic modified, Proportional band 0 - 500.0 °C, Integral time 0 - 1000 seconds, Derivative time 0 - 360.0 seconds
- **Cycle Time:** 0.1 - 100,0 seconds
- **Manual Control:** Heat (MV1) and Cool (MV2)
- **Auto-tuning:** Cold start and warm start
- **Self-tuning:** Select None and YES
- **Failure Mode:** Auto-transfer to manual mode while sensor break or A-D converter damage
- **Ramping Control:** 0-500.0°C (0 - 900.0°F) / minute or 0-500.0°C (0 - 900.0°F) / hour ramp rate
- **Sleep Mode:** Enable or Disable
- **Power Limit:** 0 - 100 % output 1 and output 2
- **Pump / Pressure Control:** Sophisticated functions provided
- **Remote Set Point:** Programmable range for voltage or current input
- **Differential Control:** Control PV1 - PV2 at set point

**Digital Filter:**

- **Function:** First order
- **Time Constant:** 0.2, 0.5, 1, 2, 5, 10, 20, 30, 60 seconds programmable

**Profiler:**

- **Number of Profiles:** 50 per recorder
- **Number of Segments per Profile:** 32
- **Note:** Total Segments are limited to 1000 Segments
User friendly functions in recorders

Configuration in Tree Layout is easy for operation

Handwriting messages are handy for users

Circular display (PR30 only)
For some industries preferred circular display, PR30 can offer this unique feature and set the display speed for each page/circle in 30 minutes, 1, 2, 4, 8, 12 hours, 1, 2 days, or 1, 2, 4 weeks.
Standard version of Firmware

**AI:** Analog input is offered various log speed in 100ms, 1, 2, 5, 10, 20, 30 Sec, 1, 2 Min/ Dot.

**DI:** Digital input is offered either normal Logic or high frequency Pulse.

**AO:** In analog output, mA or V and its Expression can be defined.

**DO:** Digital output/relay output can be enabled. Each DO card has 6 relays.

**Display:** Various display speeds are available in 100ms, 1, 2, 5, 10, 20, 30 Sec/Dot, or 1, 2, 10, 30 Min/Page, 1, 2, 4, 8, 12 Hour/Page, or 1 Day/Page.

**Timer:** Timer in Countdown, Repeat Countdown, Daily, Weekly or Monthly base, and various jobs can be defined.

**Clock:** Date Style of MM/dd/yy or dd/MM/yy, Time Synchronize via Internet, and Summer Saving Time can be defined.

**Communication:** Web Server and Email functions are available in Communication in Standard firmware.

**Instrument:** Brightness adjustment and Screen Saver are available in Instrument.

**Password:** If Normal Security is chosen, then only one password is offered. If high Security of CFR-21 is chosen, then 9 levels of password can be defined.

**Demo:** Enable or disable the demonstration.

**Auto-output:** Automatic output can be set to specify the printer, to print Historical data & Report data in specified period of time.

**System information:** It gives Firmware version number, Internal & External memory status, IP address, and IO card status of each Slot.

**Calibrate:** Sometimes the field calibration is required for high accuracy. In this case, a qualified engineer can do the necessary calibration.
User friendly functions in recorders

**Math:** Standard version includes mathematics

**Math:** It includes Math, Counter & Totalizer.

Math Expression is keyed in an easy way.
Plus versions offer more features of External Channels, Custom Display, Batch, FDA 21 CFR part 11.

External Channels: Besides AI & DI inputs, PR recorders accept inputs through communication called External Channels. PR10, PR20 & PR30 can work External Channels maximum up to 24, 48 & 96 respectively.

Custom Edited Display: In Plus versions, PC software Panel Studio allows users to edit the specific display instead of standard one, and then download it onto PR recorders.

Batch: Batch production record is constantly required for more strict production, for example food and drugs.

FDA 21 CFR part 11: This feature is complied with U.S. Food and Drug Administration with human health concern. All data should be avoided from manipulating after recording.
Powerful functions in PC Software

Free basic software

It consists of two parts, which are Configuration and Historical Viewer.

I. Configuration

It is easy to do recorder configuration on PC. Then, send the configuration files from PC to recorder.

II. Historical Viewer

It can display historical trends, historical alarms, events, and then print it. It can search data by time, time period, tag, alarm, events and remarks. It also can export data in CSV format.

Extensive software Data Acquisition Studio

III. RealTime Viewer

Besides Configuration & Historical Viewer, it offers additional software RealTime Viewer for real-time monitoring.
IV. Panel Studio
If Plus version 2 or 3 of Firmware is purchased, additional software Panel Studio is offered for editing custom display. The users can use it to edit specific displays on PC first, and then download it onto recorders. The custom edited displays will be additional pages to standard ones.

Edit it on PC

Download it onto recorders
### Ordering Code

#### PR10 Ordering Code

**PR1003**  
(3 analog inputs)  

<table>
<thead>
<tr>
<th>Other inputs &amp; outputs*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: none</td>
</tr>
<tr>
<td>1: 6 relays</td>
</tr>
<tr>
<td>3: 6 DI</td>
</tr>
<tr>
<td>6: 3 relays + 3 DI</td>
</tr>
</tbody>
</table>

**PR1006**  
(6 analog inputs)  

<table>
<thead>
<tr>
<th>Other inputs &amp; outputs*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: none</td>
</tr>
<tr>
<td>1: 6 relays</td>
</tr>
<tr>
<td>3: 6 DI</td>
</tr>
<tr>
<td>6: 3 relays + 3 DI</td>
</tr>
<tr>
<td>7: 6 relays + 6 DI</td>
</tr>
</tbody>
</table>

**Power**  
A: 90-250 VAC, 50/60 Hz  
D: 11-36 VDC

**Communication**  
0: standard Ethernet  
1: Ethernet + RS232  
2: Ethernet + RS-422/485

**Firmware**  
0: standard version with mathematics  
1: Plus version 1 with external channels, batch & FDA 21 CFR part 11  
2: Plus version 2 with custom edited display, an editing software Panel Studio to be supplied  
3: Plus version 3 including Plus version 1-2 above

**PC software**  
1: free basic software of Historical Viewer & Configuration  
2: extensive software Data Acquisition Studio (RealTime Viewer + Historical Viewer + Configuration)

**Mounting types, power cord & switch**  
0: panel mount, no power cord, no power switch  
1: panel mount, no power cord, power switch  
2: portable, UL & CSA power cord, power switch  
3: portable, VDE power cord, power switch  
4: portable, SAS power cord, power switch  
5: portable, BS power cord, power switch  
6: portable, no power cord, power switch  
7: panel mount, UL & CSA power cord, power switch  
8: panel mount, VDE power cord, power switch  
9: panel mount, SAS power cord, power switch  
A: panel mount, BS power cord, power switch

**Special options**  
0D: none  
S1: 16G SD card  
S2: 32G SD card

*Note: DI - digital inputs  
**PID Process control card can be purchased separately**

---

### Process Control card Ordering Code

#### Output 1

<table>
<thead>
<tr>
<th>0: None</th>
<th>1: Relay 2A/240VAC</th>
<th>2: Pulse voltage to drive SSR, 5V/30mA</th>
<th>3: Isolated 4-20mA/0-20mA (OM95-3)</th>
<th>4: Isolated 1-5V/0-5V (OM96-4)</th>
<th>5: Isolated 0-10V (OM95-5)</th>
<th>6: Triac output 1A/240VAC, SSR</th>
<th>C: Pulse voltage to drive SSR, 14V/40mA (OM96-7)</th>
</tr>
</thead>
</table>

#### Output 2

<table>
<thead>
<tr>
<th>0: None</th>
<th>1: Relay 2A/240VAC</th>
<th>2: Pulse voltage to drive SSR, 5V/30mA</th>
<th>3: Isolated 4-20mA/0-20mA (OM95-3)</th>
<th>4: Isolated 1-5V/0-5V (OM96-4)</th>
<th>5: Isolated 0-10V (OM95-5)</th>
<th>6: Triac output 1A/240VAC, SSR</th>
<th>C: Pulse voltage to drive SSR, 14V/40mA (OM96-7)</th>
</tr>
</thead>
</table>

#### Alarm 1

<table>
<thead>
<tr>
<th>0: None</th>
<th>1: Form C relay 2A/240VAC</th>
<th>7: Isolated 20VDC/25mA power supply (DC94-1)</th>
<th>8: Isolated 12VDC/40mA power supply (DC94-2)</th>
<th>9: Isolated 5VDC/80mA power supply (DC94-3)</th>
<th>C: Pulse voltage to drive SSR, 14V/40mA (OM96-7)</th>
</tr>
</thead>
</table>

#### Alarm 2

<table>
<thead>
<tr>
<th>0: None</th>
<th>1: Form A relay 2A/240VAC</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>

---

**Paperless Recorder**  
PR10, PR20, PR30

---

82
**PR20 Ordering Code**

<table>
<thead>
<tr>
<th>PR2003</th>
<th>(3 analog inputs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Other inputs &amp; outputs*</td>
</tr>
<tr>
<td></td>
<td>0: none</td>
</tr>
<tr>
<td></td>
<td>6: 2 relays + 3 DI</td>
</tr>
<tr>
<td></td>
<td>C: 3 relays + 3 DI + 6 AO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PR2006</th>
<th>(6 analog inputs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Other inputs &amp; outputs*</td>
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<tr>
<td></td>
<td>0: none</td>
</tr>
<tr>
<td></td>
<td>1: 8 relays</td>
</tr>
<tr>
<td></td>
<td>3: 8 DI</td>
</tr>
<tr>
<td></td>
<td>5: 6 AO</td>
</tr>
<tr>
<td></td>
<td>6: 2 relays + 3 DI</td>
</tr>
<tr>
<td></td>
<td>7: 6 relays + 6 DI</td>
</tr>
<tr>
<td></td>
<td>A: 8 relays + 6 AO</td>
</tr>
<tr>
<td></td>
<td>B: 6 DI + 6 AO</td>
</tr>
<tr>
<td></td>
<td>C: 2 relays + 3 DI + 6 AO</td>
</tr>
<tr>
<td></td>
<td>D: 8 relays + 6 DI + 6 AO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PR2009/12</th>
<th>(9-12 analog inputs)</th>
</tr>
</thead>
<tbody>
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<td>Other inputs &amp; outputs*</td>
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<tr>
<td></td>
<td>0: none</td>
</tr>
<tr>
<td></td>
<td>1: 8 relays</td>
</tr>
<tr>
<td></td>
<td>2: 12 relays</td>
</tr>
<tr>
<td></td>
<td>3: 6 DI</td>
</tr>
<tr>
<td></td>
<td>4: 12 DI</td>
</tr>
<tr>
<td></td>
<td>5: 6 AO</td>
</tr>
<tr>
<td></td>
<td>6: 3 relays + 3 DI</td>
</tr>
<tr>
<td></td>
<td>7: 8 relays + 6 DI</td>
</tr>
<tr>
<td></td>
<td>8: 9 relays + 3 DI</td>
</tr>
<tr>
<td></td>
<td>9: 3 relays + 9 DI</td>
</tr>
<tr>
<td></td>
<td>A: 8 relays + 6 AO</td>
</tr>
<tr>
<td></td>
<td>B: 6 DI + 6 AO</td>
</tr>
<tr>
<td></td>
<td>C: 3 relays + 3 DI + 6 AO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PR2015/18</th>
<th>(15-18 analog inputs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Other inputs &amp; outputs*</td>
</tr>
<tr>
<td></td>
<td>0: none</td>
</tr>
<tr>
<td></td>
<td>1: 8 relays</td>
</tr>
<tr>
<td></td>
<td>2: 6 DI</td>
</tr>
<tr>
<td></td>
<td>3: 6 AO</td>
</tr>
<tr>
<td></td>
<td>6: 3 relays + 3 DI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PR2021/24</th>
<th>(21-24 analog inputs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Other inputs &amp; outputs*</td>
</tr>
<tr>
<td></td>
<td>0: none</td>
</tr>
</tbody>
</table>

### Power

- A: 90-250 VAC, 50/60 Hz
- D: 11-38 VDC

### Communication

- 0: standard Ethernet
- 1: Ethernet + RS232
- 2: Ethernet + RS-422/485

### Firmware

- 0: standard version with mathematics
- 1: Plus version 1 with external channels, batch & FDA 21 CFR part 11
- 2: Plus version 2 with custom edited display, an editing software Panel Studio to be supplied
- 3: Plus version 3 including Plus version 1, 2 above

### PC software

- 1: free basic software of Historical Viewer & Configuration
- 2: extensive software Data Acquisition Studio (RealTime Viewer + Historical Viewer + Configuration)

### Mounting types, power cord & switch

- 0: panel mount, no power cord, no power switch
- 1: panel mount, no power cord, power switch
- 2: portable, UL & CSA power cord, power switch
- 3: portable, VDE power cord, power switch
- 4: portable, SAA power cord, power switch
- 5: portable, BS power cord, power switch
- 6: portable, no power cord, power switch
- 7: panel mount, UL & CSA power cord, power switch
- 8: panel mount, VDE power cord, power switch
- 9: panel mount, SAA power cord, power switch
- A: panel mount, BS power cord, power switch

### Special options

- 00: none
- 01: 1GB SD card
- 02: 2GB SD card

---

*Note: DI - digital inputs
AO - analog retransmission output
PID Process control card can be purchased separately
Process control card cannot be chosen together with PR2003, PR2006, PR2012, PR2018 order codes 5, A, B, C, D nor with PR2024 (24 analog inputs)
**PR30 Ordering Code**

- **PR3006** (6 analog inputs)
- **PR3012** (12 analog inputs)
- **PR3018** (18 analog inputs)
- **PR3024** (24 analog inputs)
- **PR3030** (30 analog inputs)
- **PR3036** (36 analog inputs)
- **PR3042** (42 analog inputs)
- **PR3048** (48 analog inputs)

**Relay outputs**
- 0: none
- 1: 6 relays
- 2: 12 relays
- 3: 18 relays
- 4: 24 relays

**Digital inputs**
- 0: none
- 1: 6 channels
- 2: 12 channels
- 3: 18 channels

**Analog outputs**
- 0: none
- 1: 6 channels
- 2: 12 channels

**Power**
- A: 90-250 VAC, 50/60 Hz
- D: 11-36 VDC

**Communication**
- 0: standard Ethernet
- 1: Ethernet + RS232
- 2: Ethernet + RS-422/485

**Firmware**
- 0: standard version with mathematics
- 1: Plus version 1 with external channels, batch & FDA 21 CFR part 11
- 2: Plus version 2 with custom edited display, an editing software Panel Studio to be supplied
- 3: Plus version 3 including Plus version 1+2 above

**PC software**
- 1: free basic software of Historical Viewer & Configuration
- 2: extensive software Data Acquisition Studio (RealTime Viewer + Historical Viewer + Configuration)

**Mounting types, power cord & switch**
- 0: panel mount, no power cord, no power switch
- 1: panel mount, no power cord, power switch
- 2: portable, UL & CSA power cord, power switch
- 3: portable, VDE power cord, power switch
- 4: portable, SAA power cord, power switch
- 5: portable, BS power cord, power switch
- 6: portable, no power cord, power switch
- 7: panel mount, UL & CSA power cord, power switch
- 8: panel mount, VDE power cord, power switch
- 9: panel mount, SAA power cord, power switch
- A: panel mount, BS power cord, power switch

**Special options**
- 00: none
- S1: 16G SD card
- S2: 32G SD card

*Note: PID Process control card can be purchased separately*
VR06 Paperless Recorder

- **6.5” Color TFT LCD with 640x480 pixels resolution**
- **The Maximum Channels:** 6 isolated analog input channels
- **Plug & Play Supported I/O Cards, 6 Slots**
- **The High Flexibility:** User configurable I/O card, Expandable modular architecture, Flexible screen configuration
- **User-Friendly:** Soft keys coupled with interactive dialog simplify setup & operation procedures, Easy-to-access function keys
- **Infrared Detector:** Shut off LCD automatically to prolong LCD life and save power while nobody near by
- **Save Space:** Only 169 mm (6.7”) depth behind panel
- **Various Display Formats:** Trend, Horizontal trend, Bar graph, Numerical or mixed
- **Save Data:** in Flash ROM, Compact Flash Card or PC
- **Communication:** Standard Ethernet and optional RS-232/422/485
- **The Highest Accuracy:** 18-bit A-D analog input, 15-bit D-A analog output.
- **Fast Sampling Rate:** Within 200 msec for all channels, Programmable filter or Moving Average Sampling Method
- **Statistics with Instant, Average, Min, Max, Values**
- **Programmable Alarms and Messages available**
**VR06 is the Low-Cost** paperless recorder in bigger size 6.5" with the highest resolution (true VGA, 640x480 pixels), infrared detector, 6 channels, plug & play I/O card, high flexibility, the most user-friendly and the shortest depth. In chemical plant, food & beverage plant, petrochemical plant, semiconductor plant, metal alloy, automotive plant, environmental monitoring or laboratory, VR06 can be used to monitor, record, evaluate the processes in the plants. The user can access data on the screen as well as on site from a remote place via RS-232, RS-485, RS-422 serial interface or Ethernet networking. The historical data can be stored in flash ROM, Compact Flash Card, or collected in a remote host PC for data evaluation and print-out.

**Panel Mounted Style**

6.5" color TFT LCD 640x480 pixels resolution

- Infrared detector protect LCD & save power
- Power switch
- Compact Flash Card

**12 SOFT KEYS FOR EASY OPERATION**

**Rear Terminals**

- standard Ethernet and optional RS-232/422/485

**Input & Output Cards**

- Digital input
- Digital output (6 alarms)
- Analog input

**Mixed Mode**

- View max. 6 mixed real time data trends horizontally.
- Display data in "Bars" and "Digits" together with mixed "Trends".
- Recognize data trends easily by different colors and tag names.
- Switch to other configured pages easily by “Page” function key.
- Display current “Time/Date” information.
- Remind the user of “Alarm” or “Memory Full”.

**Configure input by DIP switches**

- 6 SLOTs for Plug & play I/O cards, maximum 6 analog input or mixed with analog & digital I/O cards
**Trend Mode**

- View max. 6 real time data trends vertically.
- Recognize data trends easily by different colors and tag names.
- Switch to other configured pages easily by “Page” function key.
- Display current “Time/Date” information.
- Remind the user of “Alarm” or “Memory Full”.

**Bar Graph Mode**

- View max. 6 real time data in bar graphs.
- Scale individually by user in “configuration”.
- Display data value and tag name in different colors together with each bar graph.
- Mark “Hi/Lo” alarm limits.
- Display current “Time/Date” information.
- Remind the user of the “Alarm” or “Memory Full”.

**Historical Mode**

- Display max. 6 sets of historical data simultaneously.
- View desired data section by “↑ & ↓” function keys.
- Access precise data value at a point selected by moving the “ruler”.
- ‘Zoom’ to expand/contract the display time span.
- View historical data trends and their respective data values.
- Recognize trends easily by different colors and individual tag names.

**Alarm List**

- List all the alarm records clearly with useful information.
- Browse through the alarm list or “acknowledge” alarm easily by function keys on the vertical bar.
- Remind the user of the alarm status in different colors.

**Configuration Mode**

- Configure pen (input/output, pen name, event, job...).
- Configure page (color, pen, decimal, pen width...).
- Configure timer.
- Configure instrument (storage media, display, communication, time/date...).
INSTALLATION

Mechanical Data

Panel Cutout

Wiring Cable

Analog Input Card (AI181, AI182, AI183)

Analog Output Card (AO183I, AO183V)

Digital Input Card (DI181)

Digital Output Card (DO181)
SPECIFICATIONS

Power
90-250VAC or 20-28VAC, 47-63Hz, 60VA, 30W maximum
11-18, 18-36 or 36-72 VDC 60VA, 30W maximum

Display
8.5" TFT LCD, 640x480 pixel resolution, 256 colors

Memory
Storage Memory on board: 16MB
CF Card: 2GB standard

Analog Input Card (AI181, AI182, AI183)
Resolution: 18 bits
Sampling Rate: 5 times/second
Maximum Rating: -2 VDC minimum, 12 VDC maximum
(1 minute for mA input)
Temperature Effect: ±1.5 μV/V°C for all inputs except mA input
±3.0 μV/V°C for mA input

Sensor Lead Resistance Effect:
T/C: 0.2 μV/Vm
3-wire RTD: 2.6 °C/ohm of resistance difference of two leads
2-wire RTD: 2.6 °C/ohm of resistance sum of two leads
Burn-out Current: 200mA
Common Mode Rejection Ratio (CMRR): 120dB
Normal Mode Rejection Ratio (NMR): 55dB
Isolation Breakdown Voltage among channels: 430VAC min.

Sensor Break Detection:
Sensor open for TC, RTD and mV inputs,
below 1 mA for 4-20mA input,
below 0.25V for 1-5V inputs,
available for other inputs.
Sensor Break Responding Time:
Within 10 seconds for TC, RTD and mV inputs,
0.1 second for 4-20mA and 1-5V inputs.

Characteristics:

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-120°C to 1000°C</td>
<td>±1°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-184°F to 1832°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>-200°C to 1370°C</td>
<td>±1°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-328°F to 2498°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>-250°C to 400°C</td>
<td>±1°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-418°F to 752°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>-100°C to 900°C</td>
<td>±1°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-148°F to 1652°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>0°C to 1820°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(32°F to 3310°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>0°C to 1776.8°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(32°F to 3274°F)</td>
<td></td>
<td></td>
</tr>
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<td>S</td>
<td>0°C to 1776.8°C</td>
<td>±2°C</td>
<td>2.2MΩ</td>
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<tr>
<td></td>
<td>(32°F to 3274°F)</td>
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<td></td>
</tr>
<tr>
<td>N</td>
<td>-250°C to 1300°C</td>
<td>±1°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-418°F to 2372°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>-200°C to 900°C</td>
<td>±1°C</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td></td>
<td>(-328°F to 1652°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT100 (DIN)</td>
<td>-210°C to 700°C</td>
<td>±0.4°C</td>
<td>1.3KΩ</td>
</tr>
<tr>
<td></td>
<td>(-346°F to 1292°F)</td>
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<td></td>
</tr>
<tr>
<td>PT100 (JIS)</td>
<td>-200°C to 600°C</td>
<td>±0.4°C</td>
<td>1.3KΩ</td>
</tr>
<tr>
<td></td>
<td>(-328°F to 1112°F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mV</td>
<td>-8mV to 70mV</td>
<td>±0.05%</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>mA</td>
<td>±3mA ± 27mA</td>
<td>±0.05%</td>
<td>70 Ω</td>
</tr>
<tr>
<td>0–1V</td>
<td>-0.12 to 1.15V</td>
<td>±0.05%</td>
<td>32KΩ</td>
</tr>
<tr>
<td>0–5V</td>
<td>-1.3V to 11.5V</td>
<td>±0.05%</td>
<td>32KΩ</td>
</tr>
<tr>
<td>1–5V</td>
<td>-1.3V to 11.5V</td>
<td>±0.05%</td>
<td>32KΩ</td>
</tr>
<tr>
<td>0–10V</td>
<td>-1.3V to 11.5V</td>
<td>±0.05%</td>
<td>32KΩ</td>
</tr>
</tbody>
</table>

Analog Input Card (AI183Y)

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>-60–60mV</td>
<td>-62–62mV</td>
<td>±0.1%</td>
<td>2.2MΩ</td>
</tr>
<tr>
<td>-2–2V</td>
<td>-2.2–2.2V</td>
<td>±0.3%</td>
<td>340KΩ</td>
</tr>
<tr>
<td>-20–20V</td>
<td>-22–22V</td>
<td>±0.1%</td>
<td>3.64MΩ</td>
</tr>
<tr>
<td>-20–20mA</td>
<td>-22–22mA</td>
<td>±0.1%</td>
<td>70.5Ω</td>
</tr>
</tbody>
</table>

Digital Input Card (DI181)
Channels: 6 per card
Logic Low: 5V minimum, 0.8V maximum
Logic High: 2V minimum, 5V maximum
External Pull-down Resistance: 1KΩ maximum
External pull-up Resistance: 1.5MΩ minimum

Digital Output Card (DO181)
Channels: 6 per card
Contact Form: N.O. (form A)
Relay Rating: 5A/240 VAC, life cycles 200,000 for resistive load

Analog Output Card (AO183L, AO183V)
Output Signal: 4-20mA, 0-20mA (AO183L)
0-5V, 1-5V, 0-10V (AO183V)
Resolution: 15 bits
Accuracy: ±0.05% of Span ±0.0025% / °C
Load Resistance: 500 ohms (for current output)
10K ohms minimum (for voltage output)
Output Regulation: 0.01% for full load change
Output Settling Time: 0.1 sec (stable to 99.9%)
Isolation Breakdown Voltage: 1000VAC min.
Integral Linearity Error: ±0.005% of Span
Temperature Effect: ±0.0025% of Span / °C

COMM Module (CM181)
Interface: RS-232 (1 unit), RS-485 or RS-422 (up to 247 units)
Protocol: ModBus Protocol RTU mode
Address: 1-247
Baud Rate: 0.3-38.4 Kbits/second
Data Bits: 7 or 8 bits
Parity Bit: None, Even or Odd
Stop Bit: 1 or 2 bits

Standard Ethernet Communication
Protocol: Mod Bus TCP / IP, 10 BaseT
Auto polarity correction for 10 BaseT
Ports: RJ-45

Infrared Detector
Distance: Detect moving human body within 2 meters

Environmental & Physical
Operating Temperature: 5°C to 50°C
Storage Temperature: -25°C to 60°C
Humidity: 20 to 80% RH (non-condensing)
Insulation Resistance: 20 Mohms min. (at 500 VDC)
Dielectric Strength: 1350VAC 50/60 Hz for 1 minute
Vibration Resistance: 10-55 Hz, 10m/S² for 2 hours
Shock Resistance: 30 m/S² (3g) for operation, 100g for transportation
Dimensions: 173mm(W) x 152mm(H) x 169mm(D)

Approve Standards
Safety: UL61010 C-1
 CSA C22.2 No. 24-93
 CE: EN61010-1 (IEC61010-1)
 Overvoltage category II, Pollution degree 2
 Protective Class:
  IP 30 front panel, indoor use,
  IP 20 housing and terminals
EMC
Emission: EN50081-1, EN61326
(EN55011 class A, EN61000-3-2, EN61000-3-2)
Immunity: EN50082-2, EN61326
(EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5,
 EN61000-4-6, EN61000-4-8, EN61000-4-11)
**ACCESSORIES LIST**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI181</td>
<td>1-channel analog input card (Universal except -mA, -V)</td>
</tr>
<tr>
<td>AI182</td>
<td>2-channel analog input card</td>
</tr>
<tr>
<td>AI183</td>
<td>3-channel analog input card</td>
</tr>
<tr>
<td>AI183V</td>
<td>3-channel analog input card (+mA, ±V only)</td>
</tr>
<tr>
<td>DI181</td>
<td>6-channel digital input card</td>
</tr>
<tr>
<td>DO181</td>
<td>6-channel relay output card</td>
</tr>
<tr>
<td>AP181</td>
<td>24VDC auxiliary power supply</td>
</tr>
<tr>
<td>CM181</td>
<td>RS-232/422/485 &amp; Ethernet Comm module</td>
</tr>
<tr>
<td>CM182</td>
<td>Ethernet Comm module</td>
</tr>
<tr>
<td>PM181</td>
<td>90–250 VAC power supply</td>
</tr>
<tr>
<td>PM182</td>
<td>11–18 VDC power supply</td>
</tr>
<tr>
<td>PM183</td>
<td>18–36 VDC power supply</td>
</tr>
<tr>
<td>PM184</td>
<td>90–250 VAC power supply with power plug</td>
</tr>
<tr>
<td>PM185</td>
<td>36–72 VDC power supply</td>
</tr>
<tr>
<td>PM186</td>
<td>20–28 VAC power supply</td>
</tr>
<tr>
<td>MK181</td>
<td>Panel mount assembly kit</td>
</tr>
<tr>
<td>CF204</td>
<td>2GB compact flash card</td>
</tr>
<tr>
<td>AS181</td>
<td>Basic PC software Observer I</td>
</tr>
<tr>
<td>AS182</td>
<td>Extensive PC software Observer II</td>
</tr>
<tr>
<td>SC181</td>
<td>Slot cover for empty slot</td>
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<td>AO183I</td>
<td>3-channel analog output card with current output</td>
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<td>AO183V</td>
<td>3-channel analog output card with voltage output</td>
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<tr>
<td>BT182</td>
<td>Boot ROM w/ Math, Counter, Totalizer &amp; FDA 21 CFR part 11</td>
</tr>
<tr>
<td>SNA-10A</td>
<td>RS-485 to RS-232 converter</td>
</tr>
<tr>
<td>UMVR061</td>
<td>User Manual</td>
</tr>
</tbody>
</table>

**Ordering Code:**

VR06 - [ ] [ ] [ ] [ ] - [ ] [ ] [ ] [ ] [ ]

**Power**

4: 90–250 VAC, 47–63Hz
5: 20–28VAC, 47–63Hz
6: 11–18VDC
7: 15–36VDC
8: 36–72VDC

**Analog input card**

0: none
1: 1 channel with AI181
2: 2 channels with AI182
3: 3 channels with AI183
4: 4 channels with AI181 & AI183
5: 5 channels with AI182 & AI183
6: 6 channels with AI183
7: 6 channels with AI183 & AI183V
8: 3 channels with AI183V
9: 6 channels with AI183V

*See AI181/2/3 (V) to the left.*

**Digital input card**

0: none
1: 6 channels

**Digital output card**

0: none
1: 6 relays
2: 12 relays

**Communication**

0: standard Ethernet interface
1: RS-232/422/485 (three in one) + Ethernet interface

**PC software**

1: free basic software Observer I for non-communication application
2: extensive software Observer II for RS-232/422/485 or Ethernet

**Firmware**

1: with Mathematics, Counter, Totalizer & FDA 21 CFR part 11 compliance

**Storage media**

6: 2GB compact flash card

**Case / Mounting**

4: standard panel mounting in black case

**Special option**

0: none
1: 24VDC auxiliary power supply (for transmitter, 6 channels)
2: 3-channel current output
3: 6-channel current output
4: 9-channel current output
5: panel mounting with rear power plug & USA power cable
6: panel mounting with front power switch
7: 7=A+5, 24VDC auxiliary power supply with rear power plug
8: 8=A+6, 24VDC auxiliary power supply with front power switch
9: 9=A+5+6, 24VDC auxiliary power supply with rear power plug and front power switch
X: other options

Note: * Standard model without option VR06-4X00-011-140

* The rear slots of the recorder will only accept up to 6 optional cards in any combination.
VR18 Paperless Recorder

6.5" Color TFT LCD with 640x480 pixels resolution

The Maximum Channels:
- 18 isolated analog input channels
- Plug & Play Supported I/O Cards, 6 Slots

The High Flexibility:
- User configurable I/O card
- Expandable modular architecture
- Flexible screen configuration

User-Friendly:
- Soft keys coupled with interactive dialog simplify setup & operation procedures
- Easy-to-access function keys

Infrared Detector:
- Shut off LCD automatically to prolong LCD life
- and save power while nobody near by

Save Space:
- Only 169 mm (6.7") depth behind panel

Various Display Formats:
- Vertical trend, Horizontal trend,
- Bar Graph, Numerical or mixed

Save Data in Flash ROM,
- Compact Flash Card or PC

Communication:
- Standard Ethernet and optional RS-232/422/485

The Highest Accuracy:
- 18-bit A -D analog input, 15-bit D-A analog output

Fast Sampling Rate:
- Within 200 msec for all channels,
- Programmable Filter or Moving Average Sampling Method

Statistics with Instant, Average, Min./Max. Values
- Programmable Alarms and Messages available
**VR18 is the World First** paperless recorder of the same size with the highest resolution (true VGA, 640x480 pixels), infrared detector, 18 channels, plug & play I/O card, high flexibility, the most user-friendly and the shortest depth. In chemical plant, food & beverage plant, petrochemical plant, semiconductor plant, metal alloy, automotive plant, environmental monitoring or laboratory, VR18 can be used to monitor, record, evaluate the processes in the plants.

The user can access data on the screen as well as on site from a remote place via RS-232, RS-485, RS-422 serial interface or Ethernet networking. The historical data can be stored in flash ROM, Compact Flash Card, or collected in a remote host PC for data evaluation and print-out.

**Panel Mounted Style**

6.5” color TFT LCD 640x480 pixels resolution

Infrared detector protect LCD & save power

**Rear Terminals**

- standard Ethernet and optional
- RS-232/422/485

**Input & Output Cards**

- Digital input
- Digital output (6 alarms)
- Analog input

6 SLOTS for Plug & play I/O cards, maximum 18 analog input or mixed with analog & digital I/O cards

Configure input by DIP switches

**Mixed Mode**

- View max. 6 mixed real time data trends horizontally.
- Display data in “Bars” and “Digits” together with mixed “Trends”.
- Recognize data trends easily by different colors and tag names.
- Switch to other configured pages easily by “Page” function key.
- Display current “Time/Date” information.
- Remind the user of “Alarm” or “Memory Full.”
Trend Mode

- View max. 6 real-time data trends vertically.
- Recognize data trends easily by different colors and tag names.
- Switch to other configured pages easily by “Page” function key.
- Display current “Time/Date” information.
- Remind the user of “Alarm” or “Memory Full”.

Bar Graph Mode

- View max. 6 real-time data in bar graphs.
- Scale individually by user in “configuration”.
- Display data value and tag name in different colors together with each bar graph.
- Mark “Hi/Lo” alarm limits.
- Display current “Time/Date” information.
- Remind the user of the “Alarm” or “Memory Full”.

Numerical Mode

- View max. 6 real-time data in numbers.
- Display data value and tag name in different color.
- Mark “Hi/Lo” alarm limits.
- Display current “Time/Date” information.
- Remind the user of the “Alarm” or “Memory Full”.

Historical Mode

- Display max. 6 sets of historical data simultaneously.
- View desired data section by “↑” & “↓” function keys.
- Access precise data value at a point selected by moving the “ruler”.
- “Zoom” to expand/contract the display time span.
- View historical data trends and their respective data values.
- Recognize trends easily by different colors and individual tag names.

Alarm List

- List all the alarm records clearly with useful information.
- Browse through the alarm list or “acknowledge” alarm easily by function keys on the vertical bar.
- Remind the user of the alarm status in different colors.

Configuration Mode

- Configure pen (input/output, pen name, event, job,....)
- Configure page (color, pen, decimal, pen width,....)
- Configure timer.
- Configure instrument (storage media, display, communication, time/date,....)
INSTALLATION

Mechanical Data

Panel Cutout

Wiring Cable

Analog Input Card (AI181, AI182, AI183)

Analog Output Card (AO183I, AO183V)

Digital Input Card (DI181)

Digital Output Card (DO181)
**SPECIFICATIONS**

**Power**  
90-250VAC or 20-280VAC, 47-63Hz, 60VA, 30W maximum
11-18, 18-36 or 36-72 VDC 60VA, 30W maximum

**Display**  
6.5" TFT LCD, 640X480 pixel resolution, 256 colors

**Memory**  
Storage Memory on board: 16MB  
CF Card: 2GB standard

**Analog Input Card (A1181, A1182, A1183)**  
Resolution: 18 bits  
Sampling Rate: 5 times/second  
Maximum Rating: -2 VDC minimum, 12 VDC maximum  
(1 minute for mA input)

Temperature Effect: ±1.5 μV/C for all inputs except mA input  
±3.0 μV/C for mA input

**Sensor Lead Resistance Effect:**  
T/C: 0.2 μV/Ohm  
3-wire RTD: 2.6°C/Ohm of resistance difference of two leads  
2-wire RTD: 2.6°C/Ohm of resistance sum of two leads  
Burn-out Current: 200mA  
Common Mode Rejection Ratio (CMRR): 120dB  
Normal Mode Rejection Ratio (NMR): 55dB  
Isolation Breakdown Voltage among channels: 430VAC min.

**Sensor Break Detection:**  
Sensor open for TC, RTD and mA inputs, below 1 mA for 4-20mA input,  
below 0.25V for 1-5V inputs, unavailable for other inputs.

**Sensor Break Responding Time:**  
Within 10 seconds for TC, RTD and mA inputs,  
0.1 second for 4-20mA and 1-5V inputs.

**Characteristics:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
</table>
| J    | -120°C - 1000°C  
(-184°F - 1832°F) | ±1°C  | 2.2MQ |
| K    | -200°C - 1370°C  
(-328°F - 2498°F) | ±1°C  | 2.2MQ |
| T    | -250°C - 400°C  
(-418°F - 752°F) | ±1°C  | 2.2MQ |
| E    | -100°C - 900°C  
(-148°F - 1652°F) | ±1°C  | 2.2MQ |
| B    | 0°C - 1820°C  
(32°F - 3308°F) | ±2°C  | 2.2MQ |
| R    | 0°C - 1767.8°C  
(32°F - 3214°F) | ±2°C  | 2.2MQ |
| S    | 0°C - 1767.8°C  
(32°F - 3214°F) | ±2°C  | 2.2MQ |
| N    | -250°C - 1300°C  
(+418°F - 2372°F) | ±1°C  | 2.2MQ |
| L    | -200°C - 900°C  
(-328°F - 1652°F) | ±1°C  | 2.2MQ |

| PT100 (DIN) | -210°C - 700°C  
(-349°F - 1292°F) | ±0.4°C  | 1.3KΩ |
| PT100 (JIS) | -200°C - 600°C  
(-328°F - 1112°F) | ±0.4°C  | 1.3KΩ |

| mV | -5mV - 700mV  | ±0.05%  | 2.2MQ |
| mA | -3mA - 27mA  | ±0.05%  | 70.5KΩ |
| 0-1V | -0.12 - 1.15V  | ±0.05%  | 32KΩ |
| 0-5V | -1.3V - 11.5V  | ±0.05%  | 332KΩ |
| 1-5V | -1.3V - 11.5V  | ±0.05%  | 332KΩ |
| 0-10V | -1.3V - 11.5V  | ±0.05%  | 332KΩ |

**Analog Input Card (A1183V)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Accuracy @ 25°C</th>
<th>Input Impedance</th>
</tr>
</thead>
<tbody>
<tr>
<td>-60-60mV</td>
<td>-62-62mV</td>
<td>±0.1%</td>
<td>2.2MQ</td>
</tr>
<tr>
<td>-2-2V</td>
<td>-2.2-2.2V</td>
<td>±0.3%</td>
<td>332KΩ</td>
</tr>
<tr>
<td>-20-20V</td>
<td>-22-22V</td>
<td>±0.1%</td>
<td>332KΩ</td>
</tr>
<tr>
<td>-20-20mA</td>
<td>-22-22mA</td>
<td>±0.1%</td>
<td>70.5KΩ</td>
</tr>
</tbody>
</table>

**Digital Input Card (D181)**

Channels: 6 per card  
Logic Low: 0V minimum, 0.8V maximum  
Logic High: 5V minimum, 5V maximum  
External Pull-down Resistance: 1KΩ maximum  
External pull-up Resistance: 1.5Ω minimum

**Digital Output Card (DO181)**

Channels: 6 per card  
Contact Form: N.O. (form A)  
Relay Rating: 5A/240 VAC, life cycles 200,000 for resistive load

**Analogue Output Card (AO183, AO183V)**

Output Signal: 4-20mA, 0-20mA (AO183)  
0-5V, 1-5V, 0-10V (AO183V)

Resolution: 15 bits  
Accuracy: ±0.05% of span ±0.0025% / °C  
Load Resistance: 0-500 ohms (for current output)  
10K ohms minimum (for voltage output)

Output Regulation: ±0.01% for full load change  
Output Setting Time: 0.1 sec (stable to 99.9 %)  
Isolation Breakdown Voltage: 1000VAC min.  
Integral Linearity Error: ±0.005% of span  
Temperature Effect: ±0.0025% of span / °C

**COMM Module (CM181)**

Interface: RS-232 (1 unit), RS-485 or RS-422 (up to 247 units)  
Protocol: Modbus Protocol RTU mode  
Address: 1-247  
Baud Rate: 0.3-38.4 Kbits/sec.  
Data Bits: 7 or 8 bits  
Parity Bit: None, Even or Odd  
Stop Bit: 1 or 2 bits

**Standard Ethernet Communication**  
Protocol: Mod Bus TCP / IP, 10 BaseT  
Auto polarity correction for 10 BaseT  
Ports: RJ-45

**Infrared Detector**  
Distance: Detect moving human body within 2 meters

**Environmental & Physical**

Operating Temperature: 5°C to 50°C  
Storage Temperature: -25°C to 60°C  
Humidity: 20 to 80% RH (non-condensing)

Insulation Resistance: 20 Mohms min. (at 500 VDC)  
Dielectric Strength: 1500VAC 50/60 Hz for 1 minute  
Vibration Resistance: 10-55 Hz, 10m/s² for 2 hours  
Shock Resistance: 30 m/s² (3g) for operation, 100g for transportation

Dimensions: 173mm(W) x 152mm(H) x 189mm(D)

**Approval Standards**

Safety: UL61010 C-1  
CSA C22.2 No. 24-93  
CE: EN61010-1 (IEC1010-1)  
Overvoltage category II, Pollution degree 2  
Protective Class:  
IP 30 front panel, indoor use,  
IP 20 housing and terminals

EMC  
Emission: EN50081-1, EN61326 (EN55011 class A,  
EN61000-3-2, EN61000-3-3)  
Immunity: EN50082-2, EN61326 (EN61000-4-2, EN61000-4-3,  
EN61000-4-4, EN61000-4-5,  
EN61000-4-6, EN61000-4-8,  
EN61000-4-11)
## ACCESSORIES LIST

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI181</td>
<td>1-channel analog input card</td>
</tr>
<tr>
<td></td>
<td>(Universal except -mA, -V)</td>
</tr>
<tr>
<td>AI182</td>
<td>2-channel analog input card</td>
</tr>
<tr>
<td>AI183</td>
<td>3-channel analog input card</td>
</tr>
<tr>
<td>AI183V</td>
<td>3-channel analog input card</td>
</tr>
<tr>
<td></td>
<td>(±mA, ±V only)</td>
</tr>
<tr>
<td>DI181</td>
<td>6-channel digital input card</td>
</tr>
<tr>
<td>DO181</td>
<td>6-channel relay output card</td>
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<td>24VDC auxiliary power supply</td>
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<td>Ethernet Comm module</td>
</tr>
<tr>
<td>PM181</td>
<td>90—250 VAC power supply</td>
</tr>
<tr>
<td>PM182</td>
<td>11-18 VDC power supply</td>
</tr>
<tr>
<td>PM183</td>
<td>18-36 VDC power supply</td>
</tr>
<tr>
<td>PM184</td>
<td>90—250 VAC power supply with power plug</td>
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<td>36-72 VDC power supply</td>
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<td>Slot cover for empty slot</td>
</tr>
<tr>
<td>AO1831</td>
<td>3-channel analog output card with current output</td>
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<td>RS-485 to RS-232 converter</td>
</tr>
<tr>
<td>UMVR181</td>
<td>User Manual</td>
</tr>
</tbody>
</table>

### Ordering Code:

**Power**

1. 4: 90-250 VAC, 47-63Hz
2. 5: 20-28VAC, 47-63Hz
3. 6: 11-18VDC
4. 7: 18-36VDC
5. 8: 36-72VDC

**Analog input card**

- 0: none
- 1: 1 channel with AI181
- 2: 2 channels with AI182
- 3: 3 channels with AI183
- 4: 4 channels with AI181 & AI183
- 5: 5 channels with AI182 & AI183
- 6: 6 channels with AI183
- 7: 7 channels with AI183
- 8: 8 channels with AI183
- 9: 9 channels with AI183
- J: 9 channels with AI183
- K: 12 channels with AI183
- L: 15 channels with AI183
- M: 18 channels with AI183

*See AI181/2/3 (V) to the left.*

**Digital input card**

- 0: none
- 1: 6 channels
- 2: 12 channels
- 3: 18 channels
- 4: 24 channels
- 5: 30 channels
- 6: 36 channels

**Digital output card**

- 0: none
- 1: 6 relays
- 2: 12 relays
- 3: 18 relays
- 4: 24 relays

**Communication**

- 0: standard Ethernet interface
- 1: RS-232/422/485 (three in one ) + Ethernet interface

**PC software**

- 1: free basic software Observer I for non-communication application
- 2: extensive software Observer II for RS-232/422/485 or Ethernet

**Firmware**

- 1: with Mathematics, Counter, Totalizer & FDA 21 CFR part 11 compliance

**Storage media**

- 6: 2GB compact flash card

**Case / Mounting**

- 1: standard panel mounting in grey case

**Special option**

- 0: none
- 1: 24VDC auxiliary power supply
  (for transmitter, 6 channels)
- 2: 3-channel current output
- 3: 6-channel current output
- 4: 9-channel current output
- 5: 11-channel current output
- 6: 3-channel voltage output
- E: 6-channel voltage output
- F: 9-channel voltage output
- G: panel mounting with rear power plug & Europe power cable
- 5: panel mounting with rear power plug & USA power cable
- 6: panel mounting with front power switch
- 7: 8=1+6, 24VDC auxiliary power supply with rear power plug
- 8: 9=1+5+6, 24VDC auxiliary power supply with front power switch
- 9: with rear power plug and front power switch
- X: other options

*Note:* *Standard model without option VR18-4X00-011-610  
The rear slots of the recorder will only accept up to 6 optional cards in any combination*
CR06
HYBRID RECORDER
Low price, short case, light weight

New

FEATURES
- 6-channel dotting
- Short depth in 150mm
- Weights 1.5kg only
- Dust-proof, IP65 Water-resistance
- Standard RS-232 Communication interface
- Universal input and range
- UL, CSA, CE approved

Large LEDs with 18mm-height display
Easy Operation Keys
Analog Recording of 6 Point
Dust-proof, IP65 Water-resistance
Short Depth 150mm
CR06 HYBRID RECORDER

SPECIFICATIONS

Input
Nos. of input: 6
Input sampling: 10s/6ch, max
Type of input: Direct voltage: ±10mV, 0-20mV, 0-50mV, ±1V, 1-5V
Direct Current: 4-20mA
RTD: Pt100, Pt50, JPt100

Performance
Accuracy: ±0.2%±1 digit max. for Digital indicator/printing
Noise reduction: NMRR: 60dB min.
CMRR: 140dB min.
Isolation resistance: Each terminals/ground: 500VDC, 20MΩ min.
Dielectric strength: Power input terminal/ground: 1.5kVAC, 1 minute
Input terminal/ground: 0.5kVAC, 1 minute

Alarm
Nos. of relay outputs: 6 outs (Form a contacts; Built-in option)
Capacity: 30VDC 3A Max. Loaded

Communication
Interface: RS-232C (Standard), RS-485

Power Supply
Rated power voltage: 100-240VAC (50/60Hz)
Power consumption: 25VA max.

Structure
Mounting/housing: Panel mounting/Front panel: Dust-proof, Water-proof (IP-65)
Dimension: 144(W) x 144(H) x 150(D) mm
Weight: 1.5kg max.

Operation Condition
allowable conditions: Temperature: 0-50°C, Humidity: 20-80%RH

Recording / Printing Performance
Recording: Raster-scan printing
Printing: Dotting with 6 color ribbon
Dot print interval: 10.0s/6ch max.
Chart paper: Length: 16m, Dotting width: 100mm
Chart speed: User-selective from 28 speeds
In range: 10-1500mm/hr
Printing color: Purple, Red, Green, Blue, Brown, Black

ORDERING CODE

Communication
0 = standard RS - 232C
1 = RS -485

DI/DO ( digital input / output )
0 = none
1 = 6 relay output
2 = 3 DI
3 = 3 DI + 6 relay output

Out-of-paper sensor
0 = none
1 = yes

ACCESSORIES

Item | Part number
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Chart paper | HZCGA0105EL001
Ribbon cassette | WPSR188A000001A

DIMENSIONS & CUTOUT (mm)

Unit: mm

Front Side
Panel Cutout