

# Table of Contents

## Customer Assistance

**Custom Temperature and Power Controllers** ..... **2**  
**Systems Division** ..... **3**  
**Quick Reference Guide** ..... **4**  
**Manufacturing Facilities** ..... **23**  
**Sales Support Offices** ..... **24**

## Temperature Controllers



### Single-Loop Controllers

**Auto-Tuning PID**  
 SERIES SD31 ..... **27**  
 SERIES SD\_C ..... **29**  
 SERIES SD6C\_D ..... **33**  
 SERIES 96 ..... **35**  
 SERIES 988/989 ..... **39**  
 SERIES F4P ..... **45**  
 SERIES PD - Single Loop ..... **49**  
 MICRODIN® ..... **53**

### On-Off

SERIES CV ..... **57**  
 SERIES CF ..... **59**  
 SERIES 80M6 ..... **61**

### PID with Time/Temperature Profiling

SERIES SD\_R ..... **63**  
 SERIES SD6R\_D ..... **67**  
 SERIES 96\_AA ..... **69**  
 SERIES 981/982 ..... **73**  
 SERIES F4S ..... **77**

### Limits/Alarms

SERIES LV ..... **81**  
 SERIES LF ..... **83**  
 SERIES SD\_L ..... **85**  
 SERIES SD6L\_D ..... **89**  
 SERIES 97 ..... **91**

### Temperature Meter

SERIES TM ..... **95**

### Single-Loop Accessories

Current Transformers ..... **97**  
 Adapter Plates ..... **97**  
 Noise Suppression Devices ..... **98**

### Multi-Loop Controllers

#### Auto-Tuning PID

SERIES 998/999 ..... **99**  
 SERIES PD - Dual Loop ..... **103**  
 CLS200 ..... **107**  
 MLS300 ..... **111**  
 SERIES D8 ..... **115**

#### PID with Time/Temperature Profiling

CLS200 ..... **119**  
 MLS300 ..... **123**  
 SERIES F4D ..... **127**  
 SERIES N7 ..... **131**  
 MINICHEF® 2000 ..... **135**

#### Limits/Alarms

TLM-8 ..... **139**  
 CAS200 ..... **143**

#### PID with Programmable Logic

CPC400 ..... **147**  
 PPC-2000 ..... **151**

### Multi-Loop Accessories

DAC/SDAC Modules ..... **159**

## Power Controllers



DIN-A-MITE® ..... **161**  
 Style A ..... **166**  
 Style B ..... **167**  
 Style C ..... **168**  
 Style D ..... **171**  
 SERIES CZR ..... **173**  
 POWER SERIES ..... **175**  
 E-SAFE® RELAY ..... **179**  
 Solid State Relays (SSRs) ..... **181**  
 QPAC SCRs ..... **185**  
 Power Accessories ..... **189**

Replacement SCRs and Diodes ..... **189**  
 Current Transformers ..... **189**  
 Noise Suppression Devices ..... **190**  
 CE Filters for DIN-A-MITEs ..... **190**  
 DIN-Rail Mount Fuse Holders ..... **191**  
 Semiconductor Fuses ..... **191**

## Communication Gateways and Software



### Communication Gateways

EM GATEWAY ..... **193**  
 CDN GATEWAY ..... **195**

### Software

WATVIEW ..... **197**  
 ANAWIN3® (PPC) ..... **199**  
 WATCONNECT™ ..... **200**  
 LOGICPRO™ ..... **201**

## Control Systems



Process Systems ..... **203**  
 Control Panels ..... **207**  
 Control Consoles ..... **211**  
 Control Boxes ..... **218**  
 Control Accessories ..... **221**  
 Controller Output Comparison Guide ..... **225**  
 Temperature Sensor Ranges and Tolerances ..... **228**  
 Think Safety ..... **229**  
 Terms and Conditions ..... **230**

# Custom Temperature and Power Controllers

## Your Complete Source For Solutions With Control Confidence®

If the controllers contained in this catalog do not meet your application needs, contact Watlow about a custom controller solution. Whether the application requires a temperature or power controller—or a complete, ready-to-install control panel—Watlow has the engineering and manufacturing expertise to make your application a reality.

But more than that, Watlow provides you with a cooperative partnership based on service and ongoing product support. We have the experience, stability and total thermal system expertise to produce the controller that's right for your application.

### **Our Experience Includes:**

- Environmental chambers and ovens
- Foodservice equipment
- Medical equipment
- Packaging
- Plastics
- Refrigerated transport
- Semiconductor

### **Partnerships**

Partnership means providing the best solution for your application; being there after the product is delivered to make sure you receive optimum performance and value. Here is a brief overview of our partnering process:

1. Define specific application needs
2. Design the hardware package
3. Design the software
4. Refine order and meet specifications and requirements

5. Deliver prototype
6. Review prototype for changes and revisions; refine hardware and software; produce and test changes; deliver new prototype
7. Begin production and continue testing
8. File product documentation; apply for agency approvals; begin line production
9. Provide ongoing product support



### **Advanced Technology**

Watlow offers the most modern engineering, testing and production facilities. Our focus on electronics requires a significant investment in state-of-the-art technology and our engineers to continue their education in training programs that keep our personnel on the forefront of innovation. This advantage is available to give your company's product the competitive edge.

### **Innovation**

Watlow offers a diversity of experience. By serving many different industries, we offer a blending of technological backgrounds as well as an awareness of the latest in controller technology and advances. Watlow's versatility means we're not limited to the conventions of any one industry. It's easier for us to bring in better, innovative solutions.

### **Accountability**

We assume full accountability for managing the development process to a successful conclusion. A partnership with Watlow means you can devote your own resources to your core competencies. We work within your time requirements and we guarantee confidentiality and protection of proprietary information.

### **Controller Manufacturing Involves:**

#### **Hardware Design**

- Microprocessor, analog and discreet digital
- Surface mount technology
- Through-hole technology
- Qualification lab
- Electromagnetic compatibility
- Environmental testing
- Shock and vibration
- Agency approvals

#### **Packaging Design**

- Mold design
- Mold tools
- Injection molding in plant

#### **PC Board Design**

- Multi-layer
- Double-sided

#### **Software Design**

- High level language for flexibility and fast development
- Software demo design
- Communications
- Application overview screens
- Custom menus and functions
- Custom logic functions
- Custom communication protocols

### **Ask Watlow**

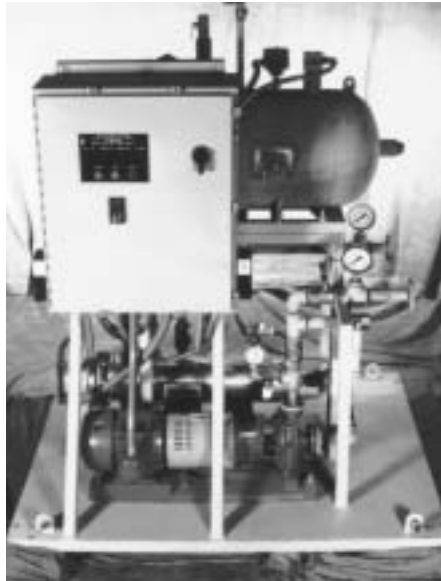
To find out more about Watlow's custom controller capability, contact your local Watlow representative listed on [pages 24 and 25](#).

## Systems Division

### Outsourcing Thermal System Integration

Watlow has developed a new Systems Division to better serve the needs of our customers. Watlow's product focus on heaters, sensors and controllers—the components of a thermal system—has now been expanded. Now, Watlow can work with the customer to design, manufacture, assemble, install and warranty entire thermal systems.

- Utilizing Watlow components allows us to provide you with a more extensive total system warranty
- Watlow's single-source responsibility creates consistency throughout every phase of the project, maximizing synergy between the design, manufacturing, assembly and installation
- Watlow is as flexible to your needs as required; select one service or an entire turnkey system:
  - Prototyping, on-site pre-work and field testing
  - Optimizing existing thermal systems and creating retrofit plans
  - Total system support, both hardware and software
  - Providing design concepts
  - Assisting in initial start-up
  - Providing on-site troubleshooting



#### Services Offered

Watlow Systems Division offers the following services:

#### Procurement

- Mechanical/electrical component
- Strategic partnerships
- Stocking

#### Design

- Optimizing existing thermal systems
- Retrofit plans
- Component interface
- Package
- Product tester
- Standard system products
- Mold designs
- Thermal process design
- Vacuum and injection mold design

#### Manufacturing

- ASME vessel fabrication
- Skid fabrication
- Standard products
- Custom engineered products
- Contract assembly
- Supports remote warehousing
- Remote manufacturing
- Kitting of components






#### Technical support

- Total system support, both hardware and software
- Prototyping, on-site pre-work and field testing
- Support during the conceptual phase and design cycle
- On-site during start-up
- On-site troubleshooting

Watlow Systems Division offers the following capabilities:

- Axial and SMT assembly
  - Paste screening - product test
- PCB test and calibration
- Machining
  - General CNC
  - Precision machining
  - Gun boring
- Welding and brazing
  - MIG, TIG and Stick
  - Laser
  - Vacuum
- Sheet metal fabrication
  - Aluminum and steel
  - Stainless steel and most alloys
- Finishing
  - Plating, anodizing, hard coating
  - Special coating
  - Painting and silk screening
- Agency approvals
- Plastic molding
- Metal casting
- Product testing/compliance
- System application expertise
- Purchasing/contracting
- Literature and documentation support

# Quick Reference Guide

Controller	Control Loop	Inputs	Outputs	Power Supply
<b>Single-Loop Auto-Tuning</b>				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA	2 outputs Function: Control - Heat/Cool, Alarm Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24V=(ac/dc)
<b>SERIES SD31</b> Page 27 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA	3 outputs, 2 outputs on 1/2 DIN Function: Control - Heat/Cool, Alarm Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24V=(ac/dc)
<b>SERIES SD_C</b> Page 29 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA	2 outputs Function: Control - Heat/Cool, Alarm Hardware: Switched dc, SSR, EMR, V=(dc), mA	100-240V~(ac) 24V=(ac/dc)
<b>SERIES SD6C_D</b> Page 33 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA 1 auxiliary - Functions: Event, Remote Set point input Hardware: V=(dc, Resistance contact)	4 outputs Function: Control - Heat/Cool, Alarm, Retransmit Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24V=(ac/dc)
<b>SERIES 96</b> Page 35 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA 2 auxiliary - Functions: Event, Remote Set point, Slidewire, Potentiometer, Current transformer, Cascade, Differential, Ratio Hardware: Thermocouple, RTD, V=(dc), mA, Resistance contact	4 outputs Function: Control - Heat/Cool, Alarm, Retransmit, Duplex, Signal conditioner power supply Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24V=(ac/dc)
<b>SERIES 988/989</b> Page 39 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				

### Abbreviation Legend

SW=(dc) = Switched Direct Current  
DC Pw. Sup. = DC Power Supply  
EMR = Electromechanical Relay  
H = Horizontal

H/V = Horizontal or Vertical  
Hum./Dehum. = Humidify/Dehumidify  
Int./Ext. = Internal/External  
LCD = Liquid Crystal Display  
LED = Light Emitting Diode

mA = Milliamp  
N/A = Not Applicable  
OC = Open Collector  
Opt. Rmt. = Optional Remote  
Retx = Retransmit  
Rev/Dir = Reverse/Direct

# Quick Reference Guide

Size Mounting	Agency Approvals	Control Mode	Indication Display	Accuracy	Communications	Time/Temp Profiling
<b>Single-Loop Auto-Tuning Cont.</b>						
½ DIN 30.8 mm (1.21 in.) (H) 53.6 mm (2.11 in.) (W)	UL®, CSA, CE, NSF, NEMA 4X (IP65)	PID	Single line 4 digit Digital LED	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU Modbus™, WATVIEW	
<b>SERIES SD31 Page 27</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
½, ⅙ ⅛, ¼ DINs	UL®, CSA, CE, FM, NSF, NEMA 4X (IP65)	PID	Dual line 4 digit Digital LED	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU IrDA wireless Modbus™ IrDA via IRCOMM WATVIEW	
<b>SERIES SD_C Page 29</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
⅙ DIN 52 mm (2.04 in.) (H) 52 mm (2.04 in.) (W)	UL®, CSA, CE, FM, NEMA 4X (IP65)	PID	Dual line 4 digit Digital LED	±0.1 percent span	DeviceNet™ on Canbus	
<b>SERIES SD6C_D Page 33</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
⅙ DIN 52 mm (2.04 in.) (H) 52 mm (2.04 in.) (W)	UL®, C-UL®, CE, NEMA 4X (IP65)	PID	Dual line 4 digit Digital LED	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU WATVIEW	
<b>SERIES 96 Page 35</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
⅙ DIN Vertical or Horizontal 55 mm x 102 mm (2.17 in. x 4.02 in.) 102 mm x 55 mm (4.02 in. x 2.17 in.)	UL®, C-UL®, CE, NEMA 4X (IP65)	PID	Dual line 4 digit Digital LED	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU EIA/TIA-422 - Modbus™ RTU	
<b>SERIES 988/989 Page 39</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						

RH = Relative Humidity  
 RTD = Resistance Temperature Detector  
 SSR = Solid State Relay  
 T/C = Thermocouple  
 V = Vertical

V=(dc) = Volts Direct Current

**Disclaimers**







- ① Select models only.
- ② Requires optional enhanced software.

Modbus™ is a trademark of Schneider Automation Incorporated  
 DeviceNet™ is a trademark of the Open DeviceNet Vendors Association

**Symbols**

- ⎓ = Direct Current
- ~ = Alternating Current
- ⎓ = Direct or Alternating Current






# Quick Reference Guide

Controller	Control Loop	Inputs	Outputs	Power Supply
<b>Single-Loop</b>				
<b>Auto-Tuning</b>				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA 4 auxiliary - Functions: Event Hardware: V=(dc), Resistance contact	4 outputs Function: Control - Heat/Cool, Alarm, Retransmit, Single or Dual Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24V=(ac/dc)
<b>SERIES F4P</b> Page 45 Watlow Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA 2 auxiliary - Functions: Event, Current transformer	4 outputs Function: Control - Heat/Cool, Alarm, On-board datalogging memory Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	24V=(ac/dc)
<b>SERIES PDS</b> Page 49 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD	2 outputs Function: Control, Alarm Hardware: Switched dc, EMR	24V=(ac/dc)
<b>MICRODIN®</b> Page 53 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
<b>On-Off</b>				
	1	Single input Hardware: Thermocouple, RTD	Single output Function: Control - Heat/Cool Hardware: Switched dc, EMR	120V~(ac) 230-240V~(ac) 24V~(ac)
<b>SERIES CV</b> Page 57 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	Single input Hardware: Thermocouple, RTD	Single output Function: Control - Heat/Cool, Alarm Hardware: Switched dc, EMR	120V~(ac) 230-240V~(ac) 24V~(ac)
<b>SERIES CF</b> Page 59 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	Single input Hardware: Thermocouple	Single output Function: Control - Heat/Cool, Alarm Hardware: EMR	120V~(ac) 240V~(ac)
<b>SERIES 80M6</b> Page 61 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				

# Quick Reference Guide

Size Mounting	Agency Approvals	Control Mode	Indication Display	Accuracy	Communications	Time/Temp Profiling
<b>Single-Loop</b>						
<b>Auto-Tuning Cont.</b>						
¼ DIN 100 mm x 100 mm (3.94 in. x 3.94 in.)	UL®, C-UL®, CE, NEMA 4X (IP65)	PID	Five lines 4 digit LED 4 line LCD	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	
<b>SERIES F4P</b> Page 45 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
¾ DIN Sub-panel or Din-rail mounting	UL®, C-UL®, CSA, CE	PID		±0.1 percent span	Ethernet - Modbus™ TCP/IP HTTP, FTP	
<b>SERIES PDS</b> Page 49 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
¾ DIN Sub-panel or Din-rail mounting	UL®, C-UL®, CE	PID		±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	
<b>MICRODIN</b> Page 53 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
<b>On-Off Cont.</b>						
¾ DIN square 72 mm x 72 mm (2.83 in. x 2.83 in.) or DIN-rail mount	UL®, CSA, CE, ANSI gas appliance	On-off	Single line 4 digit LED	±1 percent span	None	
<b>SERIES CV</b> Page 57 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
¾ DIN square 72 mm x 72 mm or (2.83 in. x 2.83 in.) DIN-rail mount or open board or potted case	UL®, CSA, CE, ANSI gas appliance	On-off	None	±1 percent span	None	
<b>SERIES CF</b> Page 59 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
Open board	UL®, C-UL®	On-off	None	± 10°F	None	
<b>SERIES 80M6</b> Page 61 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						

# Quick Reference Guide

Controller	Control Loop	Inputs	Outputs	Power Supply
<b>Single-Loop</b>				
<b>PID with Time/Temperature Profiling</b>				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA	3 outputs (2 on SD3R) Function: Control - Heat/Cool, Alarm Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24=(ac/dc)
<b>SERIES SD_R</b> Page 63 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA	2 outputs Function: Control - Heat/Cool, Alarm Hardware: Switched dc, SSR, EMR, V=(dc), mA	100-240V~(ac) 24=(ac/dc)
<b>SERIES SD6R_D</b> Page 67 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA 1 auxiliary - Functions: Event, Remote Set point input Hardware: V=(dc), Resistance contact	4 outputs Function: Control - Heat/Cool, Alarm, Retransmit, Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24=(ac/dc)
<b>SERIES 96_AA</b> Page 69 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA 2 auxiliary - Functions: Event, Slidewire Hardware: Thermocouple, TRD, V=(dc), mA, Resistance contact	4 outputs Function: Control - Heat/Cool, Alarm, Retransmit, Signal conditioner power supply Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24=(ac/dc)
<b>SERIES 981/982</b> Page 73 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA, RH percent 5 auxiliary - Functions: Cascade, Event Hardware: Thermocouple, TRD, V=(dc), mA, Resistance contact	4 outputs Function: Control - Heat/Cool, Compressor, Alarm, Retransmit Hardware: Single or Dual, Switched dc, Open Collector, SSR, EMR, V=(dc), mA 8 Digital Outputs	100-240V~(ac) 24=(ac/dc)
<b>SERIES F4S</b> Page 77 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				



# Quick Reference Guide

Size Mounting	Agency Approvals	Control Mode	Indication Display	Accuracy	Communications	Time/Temp Profiling
<b>Single-Loop</b>						
<b>PID with Time/Temperature Profiling Cont.</b>						
½, ⅙ ⅙ DINs	UL®, CSA, CE, NEMA 4X (IP65)	PID	Dual line 4 digit Digital LED	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU IrDA wireless (Except SD3R) Modbus™ IrDA via IRCOMM	4 profiles 40 total steps
<b>SERIES SD_R Page 63</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
⅙ DIN 52 mm (2.04 in.) (H) 52 mm (2.04 in.) (W)	UL®, CSA, CE, NEMA 4X (IP65)	PID	Dual line 4 digit Digital LED	±0.1 percent span	DeviceNet™ on Canbus	4 profiles 40 total steps
<b>SERIES SD6R_D Page 67</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
⅙ DIN 52 mm (2.04 in.) (H) 52 mm (2.04 in.) (W)	UL®, C-UL®, CE, NEMA 4X (IP65)	PID	Dual line 4 digit Digital LED	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	2 profiles 16 total steps
<b>SERIES 96_AA Page 69</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
⅙ DIN Vertical or Horizontal 55 mm x 102 mm (2.17 in. x 4.02 in.) 102 mm x 55 mm (4.02 in. x 2.17 in.)	UL®, C-UL®, CE, NEMA 4X (IP65)	PID	Dual line 4 digit Digital LED	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU EIA/TIA-422 - Modbus™ RTU	4 profiles 24 total steps
<b>SERIES 981/982 Page 73</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
¼ DIN 100 mm x 100 mm (3.94 in. x 3.94 in.)	UL®, C-UL®, CE, NEMA 4X (IP65)	PID	Five lines 4 digit LED 4 line LCD0	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	40 profiles 256 total steps
<b>SERIES F4S Page 77</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						






# Quick Reference Guide

Controller	Control Loop	Inputs	Outputs	Power Supply
<b>Single-Loop</b>				
<b>Limits/Alarms</b>				
	1	Single Input Hardware: Thermocouple, RTD	Single output Function: Limit, Alarm Hardware: EMR	120V~(ac) 230-240V~(ac) 24V~(ac)
<b>SERIES LV</b> Page 81 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	Single Input Hardware: Thermocouple, RTD	Single Output Function: Limit, Alarm Hardware: EMR	120V~(ac) 230-240V~(ac) 24V~(ac)
<b>SERIES LF</b> Page 83 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA	3 outputs (2 on SD3L) Function: Limit, Alarm Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24=(ac/dc)
<b>SERIES SD_L</b> Page 85 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA	2 outputs Function: Limit, Alarm Hardware: Switched dc, SSR, EMR, V=(dc), mA	100-240V~(ac) 24=(ac/dc)
<b>SERIES SD6L_D</b> Page 89 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	1 universal - Hardware: Thermocouple, RTD, V=(dc), mA 1 auxiliary - Functions: Event, Remote Set point Input Hardware: V=(dc), Resistance contact	4 outputs Function: Limit, Alarm, Retransmit Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA	100-240V~(ac) 24=(ac/dc)
<b>SERIES 97</b> Page 91 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				

# Quick Reference Guide

Size Mounting	Agency Approvals	Control Mode	Indication Display	Accuracy	Communications	Time/Temp Profiling
<b>Single-Loop</b>						
<b>Limits/Alarms Cont.</b>						
½ DIN square 72 mm x 72 mm (2.83 in. x 2.83 in.) or DIN-rail mount	FM, UL®, CSA, CE, ANSI gas appliance, DIN 3440	High/low limit	Single line 4 digit LED	±1 percent span	None	
<b>SERIES LV Page 81</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
½ DIN square 72 mm x 72 mm (2.83 in. x 2.83 in.) DIN-rail mount or open board or potted case	FM, UL®, CSA, CE, ANSI gas appliance, DIN 3440	High/low limit	None	±1 percent span	None	
<b>SERIES LF Page 83</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
½, ⅙, ⅛, ¼ DINs	UL®, CSA, CE, FM, NEMA 4X (IP65)	On-off	Dual line 4 digit Digital LED	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU IRDA wireless (except SD3L) Modbus™ IrDA via IRCOMM	
<b>SERIES SD_L Page 85</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
⅙ DIN 52 mm (2.04 in.) (H) 52 mm (2.04 in.) (W)	UL®, CSA, CE, FM, NEMA 4X (IP65)	On-off	Dual line 4 digit Digital LED	±0.1 percent span	DeviceNet™ on Canbus	
<b>SERIES SD6L_D Page 89</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
⅙ DIN 52 mm (2.04 in.) (H) 52 mm (2.04 in.) (W)	FM, CE, NEMA 4X (IP65)	On-off	Dual line 4 digit LED 4 line LCD0	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	
<b>SERIES 97 Page 91</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						

# Quick Reference Guide






Controller	Control Loop	Inputs	Outputs	Power Supply
<b>Single-Loop</b>				
<b>Temperature Meter</b>				
	1	Single Input Hardware: Thermocouple, RTD	None - Indicator only	120V~(ac) 230-240V~(ac) 24V~(ac)
<b>SERIES TM</b> Page 95 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
<b>Communication Gateways</b>				
		Ethernet to EIA-485/232 Modbus™ RTU converter  Allows the following Modbus™ controllers to connect to Ethernet: SERIES SD, 96, 97, 981/982, 998/999, F4, CLS200, POWER SERIES, MICRODIN		24V≈(ac/dc)
<b>EM GATEWAY</b> Page 193 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	1	DeviceNet™ to EIA-485/232 Modbus™ RTU converter  Allows the following Modbus™ controllers to connect to DeviceNet™: SERIES 96, 97, CLS200, MICRODIN		11-28V≈(dc)
<b>CDN GATEWAY</b> Page 195 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
<b>Multi-Loop</b>				
<b>Auto-Tuning PID</b>				
	2	1 universal - Hardware: Thermocouple, RTD, V≈(dc), mA 2 auxiliary - Functions: RH percent, Event Hardware: Thermocouple, RTD, V≈(dc), mA, Resistance contact	4 outputs Function: Control - Heat/Cool, Alarm, Retransmit, Signal conditioner power supply Hardware: Switched dc, Open Collector, SSR, EMR, V≈(dc), mA	100-240V~(ac) 24V≈(ac/dc)
<b>SERIES 998/999</b> Page 99 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	2	2 universal Hardware: Thermocouple, RTD, V≈(dc), mA 2 auxiliary - Functions: Event, Current transformer	5 outputs Function: Control - Heat/Cool, Alarm, Retransmit, On-board data logging memory Hardware: Switched dc, Open Collector, SSR, EMR, V≈(dc), mA	24V≈(ac/dc)
<b>SERIES PDD</b> Page 103 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				

# Quick Reference Guide

Customer Assistance

Size Mounting	Agency Approvals	Control Mode	Indication Display	Accuracy	Communications	Time/Temp Profiling
<b>Single-Loop</b>						
<b>Temperature Meter Cont.</b>						
½ DIN square 72 mm x 72 mm (2.83 in. x 2.83 in.) or DIN-rail mount	UL®, CSA, CE	Indicator only	Single line 4 digit LED	±1 percent span	None	
<b>SERIES TM Page 95</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
<b>Communication Gateways Cont.</b>						
	CE				Ethernet Modbus™ TCP HTTP - e-mail or alarm notification	
<b>EM GATEWAY Page 193</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
<b>CDN GATEWAY Page 195</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
<b>Multi-Loop</b>						
<b>Auto-Tuning PID Cont.</b>						
½ DIN Vertical or Horizontal 55 mm x 102 mm (2.17 in. x 4.02 in.) 102 mm x 55 mm (4.02 in. x 2.17 in.)	UL®, C-UL®, CE, NEMA 4X (IP65)	PID	Dual line 4 digit Digital LED	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU EIA/TIA-422 - Modbus™ RTU	
<b>SERIES 998/999 Page 99</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
½ DIN Sub-panel or DIN-rail mounting	UL®, C-UL®, CSA, CE	PID		±0.1 percent span	Ethernet - Modbus™ TCP/IP HTTP, FTP	
<b>SERIES PDD Page 103</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						

# Quick Reference Guide

Controller	Control Loop	Inputs	Outputs	Power Supply
<b>Multi-Loop</b>				
<b>Auto-Tuning PID</b>				
	4, 8 or 16	4, 8 or 16 Analog - Functions: Control Feedback, Cascade, Differential, Ratio, Remote Set point Hardware: Thermocouple, RTD (4 and 8 loop only) V=(dc), mA 8 Digital - Functions: Job Select, Output Override Hardware: V=(dc) 1 Pulse - Functions: 2kHz Rate Control Feedback Hardware: V=(dc)	36 Digital Functions: Control Heat/Cool, Alarm, Retransmit, Global Alarm, System Safe Hardware: Switched dc, Open Collector	15-24V=(dc)
<b>CLS200</b> Page 107 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	16 or 32	16 or 32 Analog - Functions: Control Feedback, Cascade, Differential, Ratio, Remote Set point Hardware: Thermocouple, RTD, V=(dc), mA 8 Digital - Functions: Job Select, Output Override Hardware: V=(dc) 1 Pulse - Functions: 2kHz Rate Control Feedback Hardware: V=(dc)	36 Digital Functions: Control Heat/Cool, Alarm, Retransmit, Global Alarm, System Safe Hardware: Switched dc, Open Collector	12-24V=(dc)
<b>MLS300</b> Page 111 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	4 or 8	4 or 8 Analog - Functions: Control Feedback, Cascade, Differential, Ratio, Remote Set point Hardware: Thermocouple, RTD, V=(dc), mA 8 Digital - Functions: Job Select, Output Override Hardware: V=(dc)	20 Digital Functions: Control Heat/Cool, Alarm, Retransmit, Global Alarm, System Safe Hardware: Switched dc, Open Collector	15-24V=(dc)
<b>D8</b> Page 115 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
<b>PID with Time/Temperature Profiling</b>				
	4, 8 or 16	4, 8 or 16 Analog - Function: Control Feedback Hardware: Thermocouple, RTD (4 and 8 loop only) V=(dc), mA 8 Digital - Functions: Job Select, Output Override, Trigger Hardware: V=(dc) 1 Pulse - Functions: 2kHz Rate Control Feedback Hardware: V=(dc)	36 Digital Functions: Control Heat/Cool, Alarm, Retransmit, Global Alarm, System Safe Event Hardware: Switched dc, Open Collector	15-24V=(dc)
<b>CLS200</b> Page 119 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	16 or 32	16 or 32 Analog - Functions: Control Feedback Hardware: Thermocouple, RTD (4 and 8 loop only) V=(dc), mA 8 Digital - Functions: Job Select, Output Override, Trigger Hardware: V=(dc) 1 Pulse - Functions: 2kHz Rate Control Feedback Hardware: V=(dc)	36 Digital Functions: Control Heat/Cool, Alarm, Retransmit, Global Alarm, System Safe, Event Hardware: Switched dc, Open Collector	12-24V=(dc)
<b>MLS300</b> Page 123 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				

# Quick Reference Guide

Size Mounting	Agency Approvals	Control Mode	Indication Display	Accuracy	Communications	Time/Temp Profiling
<b>Multi-Loop</b>						
<b>Auto-Tuning PID Cont.</b>						
½ DIN Horizontal	UL®, C-UL®, CE	PID	2 x 16 Vacuum Fluorescent Display	±0.08 percent span typical	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	
<b>CLS200 Page 107</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
½ DIN Horizontal Sub-panel mount analog input module	UL®, C-UL®, CE	PID	2 x 16 Vacuum Fluorescent Display	±0.08 percent span typical	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	
<b>MLS300 Page 111</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
½ DIN Horizontal	UL®, C-UL®, CE	PID	2 x 16 Vacuum Fluorescent Display	±0.08 percent span typical	DeviceNet™	
<b>D8 Page 115</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
<b>PID with Time/Temperature Profiling Cont.</b>						
½ DIN Horizontal	UL®, C-UL®, CE	PID	2 x 16 Vacuum Fluorescent Display	±0.08 percent span typical	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	17 Profiles 20 Steps Each
<b>CLS200 Page 119</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
½ DIN Horizontal Sub-panel mount analog input module	UL®, C-UL®, CE	PID	2 x 16 Vacuum Fluorescent Display	±0.08 percent span typical	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	17 Profiles 20 Steps Each
<b>MLS300 Page 123</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						

# Quick Reference Guide

Controller	Control Loop	Inputs	Outputs	Power Supply
<b>Multi-Loop</b>				
<b>PID with Time/Temperature Profiling</b>				
	2	3 universal Hardware: Thermocouple, RTD, V=(dc), mA, RH percent 4 auxiliary Functions: Cascade, Event Hardware: Thermocouple, RTD, V=(dc), mA, Resistance contact	4 outputs Function: Control - Heat/Cool, Alarm, Retransmit (Single or Dual) Hardware: Switched dc, Open Collector, SSR, EMR, V=(dc), mA 8 Digital outputs	100-240V~(ac) 24V=(ac/dc)
<b>SERIES F4D</b> Page 127 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	4	Hardware: Thermocouple, RTD, V=(dc), mA	6 outputs Function: Control, Alarm	24V~(ac)
<b>SERIES N7</b> Page 131 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	2	Two inputs Hardware: Thermocouple, RTD	3 outputs Function: Control Heat, Alarm Hardware: Switched dc, SSR 2 digital outputs Function: Event Hardware: Switched dc, SSR	24V~(ac)
<b>MINICHEF® 2000</b> Page 135 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
<b>Limits/Alarms</b>				
	8	8 Analog Function: High Limit Alarm Hardware: Thermocouple, RTD	2 or 10 Functions: Channel and Global High Limit Annunciation Hardware: Relay	10-26V=(dc)
<b>TLM-8</b> Page 139 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				
	16	16 Analog - Function: High, Low, Deviation Alarm Indicator Hardware: Thermocouple, V=(dc), mA 8 Digital - Functions: Job Select Hardware: V=(dc) 1 Pulse - Functions: 2 kHz Rate Hardware: V=(dc)	36 Digital Functions: Alarm, Global Alarm, System Safe Hardware: Switched dc, Open Collector	15-24V=(dc)
<b>CAS200</b> Page 143 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota				





# Quick Reference Guide

Customer Assistance

Size Mounting	Agency Approvals	Control Mode	Indication Display	Accuracy	Communications	Time/Temp Profiling
<b>Multi-Loop</b>						
<b>PID with Time/Temperature Profiling Cont.</b>						
¼ DIN 100 mm x 100 mm (3.94 in. x 3.94 in.)	UL®, C-UL®, CE, NEMA 4X (IP65)	PID	Five lines 5 digit LED 4 line LCD	±0.1 percent span	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	40 profiles 256 total steps
<b>SERIES F4D</b> Page 127 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
Flush mount	UL®, C-UL®, CSA, CE, NSF, NAFEM data protocol communications	PID	Dual line 4 digit 7 segment LED 8 digit alphanumeric	1.1°C	Ethernet - NAFEM protocol EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	
<b>SERIES N7</b> Page 131 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
Flush mount	UL®, C-UL®, CSA, CE, NSF, AGA	PID	Single line 5 digit LED	±0.35 percent span		
<b>MINICHEF 2000</b> Page 135 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
<b>Limits/Alarms Cont.</b>						
DIN-rail or Fastener Sub-panel mount	UL®, C-UL®, CE, FM	On-off		±5 percent or 1 percent of trip point		
<b>TLM-8</b> Page 139 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						
¼ DIN Horizontal	UL®, C-UL®, CE	On-off	2 x 16 Vacuum Fluorescent Display	±0.08 percent span typical	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	
<b>CAS200</b> Page 143 Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota						

# Quick Reference Guide





Controller	Control Loop	Inputs	Outputs	Power Supply
<b>Multi-Loop</b> <b>PID with Programmable Logic</b>				
	4 or 8	4 or 8 Analog - Functions: Control Feedback, Programmable Logic, Cascade, Differential, Ratio, Remote Set point Hardware: Thermocouple, RTD, V=(dc), mA 8 Digital - Functions: Programmable Logic, Job Select, Output Override Hardware: V=(dc) 1 Pulse - Functions: 2kHz Rate, Programmable Logic Hardware: V=(dc)	36 Digital Functions: Control Heat/Cool, Programmable Logic, Alarm, Retransmit, Global Alarm, System Safe Hardware: Switched dc, Open Collector	15-24V=(dc)
<b>CPC400</b> Page 147 <i>Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota</i>				
	8 to 48	8 to 48 Analog - Functions: Control Feedback, Programmable Logic, Cascade, Differential, Ratio Hardware: Thermocouple, RTD, V=(dc), mA Up to 26 Digital - Function; Programmable Logic Hardware: V=(dc), V~(ac) 29 Pulse - Functions: 10kHz Quadrature Rate/Count (1 Single-Phase), Programmable Logic Hardware: V=(dc)	Up to 288 Digital - Functions: Control Heat/Cool, Programmable Logic, Alarm, Retransmit, Global Alarm, System Safe Hardware: Switched dc, Open Collector, relay Up to 48 Analog - Functions: Control Heat/Cool, Programmable Logic, Retransmit Hardware: V=(dc) or mA	12-26V=(dc)
<b>PPC-2000</b> Page 151 <i>Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota</i>				

# Quick Reference Guide






Size Mounting	Agency Approvals	Control Mode	Indication Display	Accuracy	Communications	Time/Temp Profiling
<b>Multi-Loop</b> <b>PID with Programmable Logic Cont.</b>						
½ DIN Horizontal	UL®, C-UL®, CE	PID	2 x 16 Vacuum Fluorescent Display	±0.08 percent span typical	EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	
<b>CPC400</b> Page 147 <i>Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota</i>						
DIN-rail or Fastener Sub-panel mount	UL®, C-UL®, CE	PID		±0.11 percent span typical	2 Communications Ports EIA/TIA-485 - Modbus™ RTU EIA/TIA-232 - Modbus™ RTU	
<b>PPC-2000</b> Page 151 <i>Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota</i>						

Customer Assistance

# Quick Reference Guide

Controller	Maximum Current	Phase	Inputs	Output/ Features Mode	Mounting	Agency Approvals	Operating Environment
<b>Power Controllers - SCRs (Silicon Controlled Rectifiers)</b>							
<b>DIN-A-MITE</b>							
	Up to 25 amps @ 600V~(ac)	1-phase	V~(ac/dc) contactor, 4-20mA	Burst Fire	DIN-rail, Sub-panel	UL®, C-UL®, CE	80°C (176°F) Maximum 0 to 90 percent RH non-condensing
<b>Style A Page 166</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota							
	Up to 40 amps @ 600V~(ac)	1-phase 3-phase, 2-leg 3-phase, 3-leg	V~(ac/dc) contactor, 4-20mA, multi-zone input	Burst Fire Shorted SCR alarm	DIN-rail, Sub-panel	UL®, C-UL®, CE	80°C (176°F) Maximum 0 to 90 percent RH non-condensing
<b>Style B Page 167</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota							
	Up to 80 amps @ 600V~(ac)	1-phase 3-phase, 2-leg 3-phase, 3-leg	V~(ac/dc) contactor, 4-20mA, multi-zone input Potentiometer	Burst Fire Shorted SCR alarm Open heater alarm on Zero Cross Phase-angle (1-phase only)	DIN-rail, Sub-panel	UL®, C-UL®, CE	80°C (176°F) Maximum 0 to 90 percent RH non-condensing
<b>Style C Page 168</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota							
	Up to 100 amps @ 600V~(ac)	1-phase	V~(ac/dc) contactor	Burst Fire Shorted SCR alarm, Load Current Monitor CT, On-board semiconductor fusing	Sub-panel	UL®, C-UL®, CE	80°C (176°F) Maximum 0 to 90 percent RH non-condensing
<b>Style D Page 171</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota							

# Quick Reference Guide

Controller	Maximum Current	Phase	Inputs	Output/ Features Mode	Mounting	Agency Approvals	Operating Environment
<b>Power Controllers - SCRs (Silicon Controlled Rectifiers)</b>							
<b>CZR</b>							
	18-50 amps up to 600V~(ac)	1-phase	V~(ac/dc) contactor	Zero-cross Random	DIN-rail, Sub-panel	UL®, CSA, VDE, CE	75°C (167°F) Maximum 0 to 90 percent RH non- condensing
<b>CZR Page 173</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota							
<b>POWER SERIES</b>							
	65 - 250 amps	1-phase 3-phase, 2-leg 3-phase, 3-leg 3-phase, 4-wire, wye 2-single-phase zones 3-single-phase zones	0-20mA and 0-10V~(dc) scalable, multizone input	Burst Fire, zero- crossed, Phase- angle, Load Current Monitor CT, Soft Start - heater bakeout, Alarm output, Heater diag.	Sub-panel	UL®, C-UL®, VDE, CE	65°C (149°F) Maximum 0 to 90 percent RH non- condensing
<b>POWER SERIES Page 175</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota							
<b>Hybrid</b>							
<b>E-SAFE® RELAY</b>							
	20 or 40 amps 208/204V~(ac)	Three-pole	V~(ac) contactor		Definite purpose relay and MDR mounting footprint	UL®, C-UL®	55°C (131°F) Maximum 5 to 85 percent RH non- condensing
<b>E-SAFE® RELAY Page 179</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota							
<b>Solid State Relays - SSRs</b>							
	10 to 75 amps Up to 600V~(ac)	1-phase	V~(ac/dc) contactor	Random fire Burst fire, zero-cross - SBL Shorted SCR alarm - SDA	Sub-panel	UL®, CSA CE, VDE	50°C (122°F) Maximum with heat sink 0 to 90 percent RH non- condensing
<b>SSR Page 181</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota							
<b>QPAC - SCRs</b>							
	300 to 1000 amps Up to 575V~(ac)	1-phase 3-phase, 2-leg 3-phase, 3-leg	V~(ac/dc) contactor 4-20mA	Bursrt fire, Phase-angle, (No phase-angle on 2-leg model)	Sub-panel	UL®, C-UL® up to 300 amps	50°C (122°F) Maximum 0 to 90 percent RH non- condensing
<b>QPAC Page 185</b> Watlow USA Manufacturing Facility (F.O.B.): Winona, Minnesota							

## Customer Assistance

### Replacement Controllers

Existing Controller	Suggested New Replacement	Page
SERIES 93	SERIES SD6C	29
SERIES 94	SERIES SD6L	85
SERIES 935	SERIES SD31 or SD3C	27 or 29
SERIES 945	SERIES SD_C	29
SERIES 988LF	SERIES SD_C	29
SERIES 101	SERIES CV	57
SERIES 102	SERIES CV	57
SERIES 103	SERIES CV	57
SERIES 104	SERIES CV or SERIES CF	57 or 59
SERIES 942	SERIES 96_AA or SERIES SD4R	69 or 63
SERIES 142	SERIES LV or SERIES LF	81 or 83
SERIES 145	SERIES LV	81
SERIES 146	SERIES LV	81
SERIES 147	SERIES LV or SERIES LF	81 or 83
SERIES 550	SERIES TM	95
SERIES 733/734	SERIES N7	131
MDR	E-SAFE® RELAY	179

## Customer Assistance

### Watlow Manufacturing Facilities

#### United States Manufacturing Facilities

##### Anaheim, California

#### Watlow AOV, Inc.

Manufactures:

- Silicone Rubber Heaters
- 1400 North Kellogg Drive, Suite A  
Anaheim, CA 92807  
Phone: 714-779-2252  
FAX: 714-777-9626

##### Batavia, Illinois

#### Watlow Batavia

Manufactures:

- Cast-In Heaters
- 1310 Kingsland Drive  
Batavia, IL 60510  
Phone: 630-879-2696  
FAX #1: 630-879-1101  
FAX #2: 630-482-2042

##### Chesterfield, Missouri

#### Watlow Engineering

Manufactures:

- Machines
- 636 Goddard Avenue  
Chesterfield, MO 63005  
Phone: 636-530-0288  
Fax: 636-530-0395

##### Columbia, Missouri

#### Watlow Columbia/Ceramic Fiber

Manufactures:

- Ceramic Fiber Heaters
- 2407 Big Bear Court  
Columbia, MO 65202  
Phone: 573-443-8817  
FAX: 573-443-8818

##### Watlow Columbia/Flexible

Manufactures:

- Flexible Heaters
- 2101 Pennsylvania Drive  
Columbia, MO 65202  
Phone: 573-474-9402  
FAX: 573-474-5859

##### Fenton, Missouri

#### Single Iteration

A Consulting Services Division  
of Watlow

909 Horan Drive  
Fenton, MO 63026  
Phone: 866-449-6846  
FAX: 636-349-5352

##### Hannibal, Missouri

#### Watlow Hannibal

Manufactures:

- Circulation Heaters
  - Duct Heaters
  - Immersion Heaters
  - Multicell Heaters
  - Tubular Heaters
  - Thick Film Heaters
- #6 Industrial Loop Road  
P.O. Box 975  
Hannibal, MO 63401  
Phone: 573-221-2816  
FAX: Tubular/Process/Multicell  
573-221-3723  
FAX: Thick Film  
573-221-7578

##### Richmond, Illinois

#### Watlow Richmond

Manufactures:

- RTDs, Thermocouples, Thermistors
  - Thermocouple Wire and Cable
  - Temperature Measurement Devices
- 5710 Kenosha Street, P.O. Box 500  
Richmond, IL 60071  
Phone: 815-678-2211  
FAX: 815-678-3961

##### St. Louis, Missouri

#### World Headquarters and Watlow St. Louis

Manufactures:

- Band Heaters
  - Cable Heaters
  - FIREROD® Heaters
  - Radiant Heaters
  - Special Heaters
  - Strip Heaters
- 12001 Lackland Road  
St. Louis, MO 63146  
Phone: 314-878-4600  
FAX: 314-878-6814

##### Watsonville, California

#### Watlow Anafaze

Manufactures:

- Multi-Loop Controls
  - High Level Software
- Phone: 507-454-5300  
FAX: 507-452-4507

##### Winona, Minnesota - Controllers

#### Watlow Winona, Inc.

Manufactures:

- Custom Electronic Controllers
  - Power Controllers
  - Safety and Limit Controllers
  - Single-Loop Controllers
- 1241 Bundy Boulevard,  
P.O. Box 5580  
Winona, MN 55987-5580  
Phone: 507-454-5300  
FAX: 507-452-4507

##### Winona, Minnesota - Polymer

#### Watlow Polymer Technologies, Inc.

Manufactures:

- Polymer Heaters
- 1265 East Sanborn Street  
Winona, MN 55987  
Phone: 507-457-9797  
FAX: 507-457-9736

##### Wright City, Missouri

#### Watlow Process Systems

Manufactures:

- Process Heating Systems
- #10 Cooperative Way  
Wright City, Missouri 63390  
Phone: 636-745-7575  
FAX: 636-745-0537

##### Asian Manufacturing Facilities

#### Singapore

#### Watlow Asia Engineering

Manufactures:

- FIREROD Heaters
  - Thermocouples
  - Pump Line Heaters
  - Controllers
  - Power Controllers
- 16 Ayer Rajah Crescent, #03-23  
Singapore 139949  
Phone: +65-6777-1266  
FAX: +65-6777-7662

## Customer Assistance

### Watlow Manufacturing Facilities

#### European Manufacturing Facilities

##### Germany

###### Watlow GmbH

Manufactures:

- Cable Heaters
- Cartridge Heaters (FIREROD, EB Cartridge and Metric FIREROD)
- Silicone Rubber Heaters
- K-RING® Heaters
- Pump Line Heaters
- Electronic Assemblies

Lauchwasenstr. 1  
Postfach 1165  
D 76709 Kronau, Germany  
Phone: +49-7253-94-00-0  
FAX: +49-7253-94-00-44

##### Italy

###### Watlow Italy, S.r.l.

Manufactures:

- Thermocouples
- Via Meucci 14  
20094 Corsico - MI, Italy  
Phone: +39-02-4588841  
FAX: +39-02-45869954

##### United Kingdom

###### Watlow Limited

Manufactures:

- Band Heaters
  - Cartridge Heaters
  - FIREROD Heaters
  - Silicone Rubber Heaters
  - Thermocouples
- Robey Close  
Linby Industrial Estate  
Linby, Nottingham, England  
NG15 8AA  
Phone: +44-0-115-964-0777  
FAX: +44-0-115-964-0071

### Latin American Manufacturing Facilities

##### Mexico

###### Watlow de Mexico, S.A. de C.V.

Manufactures:

- FIREROD Heaters (Cartridge and Metric)
- Ceramic Knuckle Heaters
- THINBAND® Heaters
- HV Band Heaters
- Silicone Rubber Heaters
- Tubular Heaters
- Cable Heaters

Av. Epigmenio Gonzalez No. 5  
Col. Parques Industriales  
Querétaro C.P. 76130  
Querétaro, Mexico  
Phone: +52-442-217-62-35  
Fax: +52-442-217-64-03

## Sales Support

#### United States Sales Offices

##### Atlanta

1320 Highland Lake Drive  
Lawrenceville, GA 30045-8225  
Phone: 770-972-4948  
Fax: 770-972-5138

##### Austin

12343 Hymeadow, Suite 21  
Austin, TX 78750-1830  
Phone: 512-249-1900  
Fax: 512-249-0082

##### Birmingham

308 Honeysuckle Lane  
Chelsea, AL 35043-9669  
Phone: 205-678-2358  
Fax: 205-678-2567

##### Charlotte

10915 Tara Oaks Drive  
Charlotte, NC 28227-5493  
Phone: 704-573-8446  
Fax: 866-422-5998

##### Chicago

1320 Chase Street, Suite 2  
Algonquin, IL 60102-9668  
Phone: 847-458-1500  
Fax: 847-458-1515

##### Cincinnati

4700 Duke Drive, Suite 125  
Mason, OH 45040-9379  
Phone: 513-398-5500  
Fax: 513-398-7575

##### Cleveland

28 West Aurora Road  
Northfield, OH 44067-2063  
Phone: 330-467-1423  
Fax: 330-467-1659

##### Dallas

609 Storrs St.  
Rockwall, TX 75087  
Phone: 972-620-6030  
Fax: 972-620-8620

##### Denver

5945 West Sumac Avenue  
Littleton, CO 80123-0886  
Phone: 303-798-7778  
Fax: 303-798-7775



## Customer Assistance

### Sales Support

*United States Sales Offices Cont.*

#### Detroit

155 Romeo Road, Suite 600  
Rochester, MI 48307-1580

Phone: 248-651-0500  
Fax: 248-651-6164

#### Houston

3403 Chapel Square Drive  
Spring, TX 77388-5160

Phone: 281-440-3074  
Fax: 281-440-6873

#### Indianapolis

160 W. Carmel Drive, Suite 204  
Carmel, IN 46032-4745

Phone: 317-575-8932  
Fax: 317-575-9478

#### Kansas City

P.O. Box 15539  
Lenexa, KS 66285-5539

Phone: 913-897-3973  
Fax: 913-897-4085

#### Los Angeles

1914 West Oranewood Avenue  
Suite 101

Orange, CA 92868-2005

Phone: 714-935-2999  
Fax: 714-935-2990

#### Maryland/Virginia

85 Old Dublin Pike  
Doylestown, PA 18901-2468

Phone: 215-345-8130  
Fax: 215-345-0123

#### Milwaukee/Appleton

400 South Linwood Avenue, Suite 13  
Appleton, WI 54914-4970

Phone: 920-993-2161  
Fax: 920-993-2162

#### Minneapolis

14551 Judicial Road  
Suite 127

Burnsville, MN 55306-5529

Phone: 952-892-9222  
Fax: 952-892-9223

#### Nashville

212 Hidden Lake Road  
Hendersonville, TN 37075-5502

Phone: 615-264-6148  
Fax: 615-264-5654

#### New England

4 John Tyler Street, Suite E  
Merrimack, NH 03054-4800

Phone: 603-882-1330  
Fax: 603-882-1524

#### New York/Upstate

6032 Old Beattie Road  
Lockport, NY 14094-7943

Phone: 716-438-0454  
Fax: 716-438-0082

#### Orlando

5514 Meadow Pine Ct.  
Orlando, FL 32819

Phone: 407-351-0737  
Fax: 407-351-6563

#### Philadelphia

85 Old Dublin Pike  
Doylestown, PA 18901-2468

Phone: 215-345-8130  
Fax: 215-345-0123

#### Phoenix

14664 North 15th Drive  
Phoenix, AZ 85023-5179

Phone: 602-795-7712  
Fax: 602-298-6960

#### Pittsburgh

1241 West North Avenue  
Pittsburgh, PA 15233-1935

Phone: 412-322-5004  
Fax: 412-322-1322

#### Portland

1306 Northeast 149th Place  
Vancouver, WA 98684-3658

Phone: 360-254-1009  
Fax: 360-254-2912

#### Sacramento

1698 River Oaks Circle  
Fairfield, CA 94533-7797

Phone: 707-425-1155  
Fax: 707-425-4455

#### Saint Louis

12001 Lackland Road  
St. Louis, MO 63146-4039

Phone: 636-441-5077  
Fax: 636-447-8770

#### San Francisco

780 Montague Expressway,  
Suite 308

San Jose, CA 95131-1317

Phone: 408-434-1894  
Fax: 408-435-5409

#### Seattle

1420 NW Gilman Blvd., Suite 2571  
Issaquah, WA 98027-5394

Phone: 425-222-4090  
Fax: 425-222-5162

#### Tampa/St. Petersburg

831 Huntington Court  
Winter Park, FL 32789-4722

Phone: 407-647-9052  
Fax: 407-647-5466

#### Tulsa

4444 East 66th Street, Suite 101  
Tulsa, OK 74136-4205

Phone: 918-496-2826  
Fax: 918-494-8901

#### Asian Sales Offices

##### Australia

#### Watlow Australia Pty. Ltd.

23 Gladstone Park Drive  
Tullamarine, VIC 3043  
Australia

Phone: 61 (39) 335-6449

FAX: 61 (39) 330-3566

Sales Territory: Australia,  
New Zealand

#### Asian Sales Offices

##### China

#### Watlow China

Rm 1903, Chang De Building  
No. 478-5 Chang Shou Road  
Shanghai 200060, China

Tel: +86-21-62772138

+86-21-62273133

Fax: +86-21-62278559

Sales Territory : China

# Customer Assistance

## Japan

### **Watlow Japan Ltd.**

Azabu Embassy Heights 106  
1-11-12 Akasaka  
Minato-Ku, Tokyo, Japan 107-0052  
Phone: 011-81-3-5403-4688  
FAX: 011-81-3-5575-3373  
Sales Territory: Japan

## Korea

### **Watlow Korea Co., Ltd.**

3rd Fl., Taehong Bldg.  
20-6 Yangjae-dong, Seocho-gu  
Seoul, Korea 137-130  
Phone: 82 (2) 575-9804  
FAX: 82 (2) 575-9831  
Sales Territory: Korea

## Malaysia

### **Watlow Malaysia Sdn Bhd**

38B Jalan Tun Dr Awang  
11900 Bayan Lepas, Penang  
Malaysia  
Phone: 60 (4) 641-5977  
FAX: 60 (4) 641-5979  
Sales Territory: Malaysia

## Singapore

### **Watlow Singapore Pte. Ltd.**

55 Ayer Rajah Crescent, #03-23  
Singapore 139949  
Phone: +(65) 67739488  
FAX: +(65) 67780323  
Sales Territory: Singapore, South  
East Asia, Hong Kong, India, China  
Sales Support

## Taiwan

### **Watlow Taiwan**

10F-1 No. 189  
Chi-Shen 2nd Road  
Kaohsiung, Taiwan, 801  
Phone: 886-7-288-5168  
FAX: 886-7-288-5568  
Sales Territory: Taiwan

## Canadian Sales Offices

### Ontario

#### **Watlow Ontario**

60 Bristol Road East, Suite 460  
Mississauga, Ontario L4Z 3K8  
Canada  
Phone: 905-979-3507  
FAX: 905-979-4296

### Quebec and Atlantic Canada

#### **Watlow Quebec & Atlantic Canada**

C.P. 68084  
Blainville, Quebec J7C 4Z4 Canada  
Phone: 450-433-1309  
FAX: 450-433-0457

### Western Canada

#### **Watlow Western Canada**

9912 Lougheed Highway  
Burnaby, British Columbia V3J 1N3  
Canada  
Phone: 604-444-4881  
Fax: 604-444-4883

## European Sales Offices

### France

#### **Watlow France, S.A.R.L.**

Immeuble Somag  
16 Rue Ampere  
Cergy Pointoise 95307  
Phone: 33 (1) 3073-2425  
FAX: 33 (1) 3073-2875  
Sales Territory: France

### Germany

#### **Watlow GmbH**

Industriegebiet Heidig  
Lauchwasenstr. 1  
Postfach 1165  
76709 Kronau, Germany  
Phone: +49-7253-9400-0  
FAX: +49-7253-9400-44  
Sales Territory:  
All Other European Countries

## Italy

### **Watlow Italy, S.r.l.**

Via Meucci 14  
20094 Corsico - MI, Italy  
Phone: +39-02-4588841  
Fax: +39-02-45869954  
Sales Territory: Italy

## United Kingdom

### **Watlow Limited**

Robey Close Linby Ind. Estate  
Linby Nottingham  
England, NG15 8AA  
Phone: +44 (0) 115 964 0777  
FAX: +44 (0) 115 964 0071  
Sales Territory: Great Britain, Ireland

## Latin American Sales Office

### Mexico

#### **Watlow de Mexico S.A. de C.V.**

Av. Epigmenio Gonzalez No. 5  
Col. Parques Industriales  
Querétaro CP-76130  
Querétaro, Mexico  
Phone: +52 442 217-62-35  
FAX: +52 442 217-64-03  
Sales Territory: Mexico and  
Latin America

## Corporate Headquarters

### **Watlow Electric**

#### **Manufacturing Company**

St. Louis, MO  
12001 Lackland Road  
St. Louis, MO 63146  
Phone: 314-878-4600  
FAX: 314-434-1020  
Sales Territory: All countries and  
Canadian provinces not specified.

## Auto-Tuning PID Controllers

### SD31

The SERIES SD family of PID temperature controllers utilizes today's advanced micro-electronics technology to provide the value, benefits and accuracy you've come to expect from Watlow. The SERIES SD31 offers improved accuracy of 0.1 percent of span as well as a faster sampling rate of 6.5Hz in a ½ DIN package.

The SERIES SD31 controller delivers many flexible, user-friendly options. Easily choose factory or user defaults and display either process or set point values. Process inputs are scalable and invertible from the front panel. Other features include Variable Burst Fire and flexible Outputs, that users can select as On-Off, Heat/Cool or as Process or Deviation Alarms. Users can also select between 11 different Thermocouples, a 100 Ohm RTD, a 0 to 20mA or 0 to 10V process input - all from the front panel - which eliminates the need for dip-switches.

With optional EIA-485 communications, you can configure, monitor and data log with such optional software products like WATVIEW.

#### Features and Benefits

##### Simplified navigation

- Allows users to navigate forwards or backwards from any menu

##### INFOSENSE™ sensor technology

- Thermal sensing technology improves accuracy by a minimum of 50 percent

##### Watlow's patented User Defined Menu System

- Allows users to define, save, and access their most important Menu settings

##### Agency approvals

- UL®, C-UL®, CE IP65/NEMA 4X, plus CSA and NSF

UL® and C-UL® are registered trademarks of Underwriter's Laboratories, Inc.

Modbus™ is a registered trademark of Schneider Automation, Inc.



#### Variable burst fire

- Prolongs heater life
- Reduces replacement costs

#### “Save and Restore” feature

- Allows the user to save individual or factory settings

#### Specifications

##### Line Voltage/Power

- 100 to 240V~(ac), +10/-15 percent; (85-264V~[ac]) 50/60Hz, ±5 percent
- 24V~(ac/dc), +10/-15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

##### Environment

- -18 to 65°C (0 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

#### Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

#### Agency Approvals

- UL® 3121, C-UL®, CSA, CE, IP65/NEMA 4X
- NSF for Type J, K, T and E thermocouples

# Auto-Tuning PID Controllers

F.O.B.: Winona, Minnesota

## SD31

### Specifications Cont.

#### Controller

- Microprocessor based user-selectable control modes
- Single universal input, up to three outputs
- Control sampling rates: Input = 6.5Hz, Display = 10Hz and Outputs = 6.5Hz

#### Operator Interface

- Single 4 digit, 7 segment LED display
- "Set" infinity and up down keys
- Isolated EIA-485 Modbus™ serial communications, 9600, 19.2K or 38.4K baud rates

#### Wiring Termination-Touch Safe Terminals

- Input power and control outputs 12 to 22 AWG
- Sensor inputs and process outputs 20 to 28 AWG

#### Universal Input

- Thermocouple, grounded or ungrounded sensors
- RTD 2- or 3-wire, platinum, 100Ω @ 0°C calibration to DIN-curve (0.00385 Ω/Ω/°C)
- Process, 0-20mA @ 100Ω, or 0-10V<sub>rms</sub>(dc) @ 20kΩ input impedance; Scalable
- Inverse scaling
- >20MΩ input impedance
- Maximum of 20Ω source resistance

#### Allowable Operating Range

Type J:	0 to 815°C (32 to 1500°F)
Type K:	-200 to 1370°C (-328 to 2500°F)
Type T:	-200 to 400°C (-328 to 750°F)
Type N:	0 to 1300°C (32 to 2372°F)
Type E:	-200 to 800°C (-328 to 1470°F)
Type C:	0 to 2315°C (32 to 4200°F)
Type D:	0 to 2315°C (32 to 4200°F)

Type PT11:	0 to 1395°C (32 to 2543°F)
Type R:	0 to 1760°C (32 to 3200°F)
Type S:	0 to 1760°C (32 to 3200°F)
Type B:	0 to 1816°C (32 to 3300°F)
RTD (DIN):	-200 to 800°C (-328 to 1472°F)
Process:	-1999 to 9999 units

#### Control Outputs

##### Outputs 1 or 2

- User selectable for heat/cool as on-off, P, PI, PD, PID or Alarm action.
- Electromechanical relay. Form A, rated 2A @ 120V<sub>rms</sub>(ac), 2A @ 240V<sub>rms</sub>(ac) or 2A @ 30V<sub>rms</sub>(dc)
- Switched dc non-isolated minimum turn on voltage of 6V<sub>rms</sub>(dc) into a minimum 500Ω load with a maximum on voltage of not greater than 12V<sub>rms</sub>(dc) into an infinite load. Maximum switched dc power supply

current available for up to two outputs is 60mA

- Solid state relay, Form A, 0.5A @ 24V<sub>rms</sub>(ac) minimum, 264V<sub>rms</sub>(ac) maximum, opto-isolated, without contact suppression
- Process output (Non Isolated) User-selectable 0-10V<sub>rms</sub>(dc), 0-5V<sub>rms</sub>(dc), 1-5V<sub>rms</sub>(dc) @ 1KΩ minimum, 0-20mA, 4-20mA @ 800Ω maximum
- Open collector 42V<sub>rms</sub>(dc) @ 250mA maximum
- EIA-485 serial communications with Modbus™ protocol (output 2 only)
- 9600, 19.2K or 38.4 baud rates

#### Communications

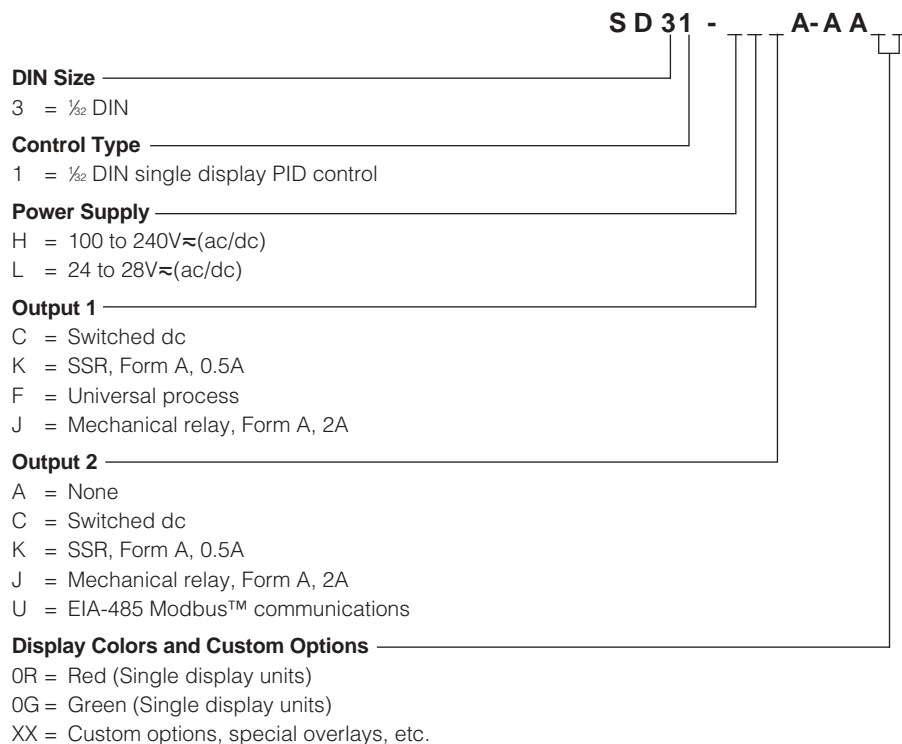
- Modbus™ EIA-485
- WATVIEW

#### Dimensions

- ½ DIN size
- 97.8 mm (3.85 in.) behind panel maximum
- Width 52.6 mm (2.07 in.)
- Height 29.7 mm (1.17 in.)

#### Ordering Information

To order, complete the model number on the right with the information below.



# Auto-Tuning PID Controllers

## SD\_C

The features and performance offered by SERIES SD\_C controllers make them ideally suited for a broad range of applications in temperature and process control.

The SERIES SD\_C controllers include a universal sensor input with up to three outputs that can be programmed for heat or cool temperature control or to operate as process or deviation alarms. Programming inverse scaling is also simplified with the user-friendly set-up menu, providing additional value without additional cost.

Advanced features of SERIES SD\_C controllers include EIA-485 Modbus™ serial communications, Watlow's INFOSENSE™ sensor technology, infrared remote communications operation, Watlow's patented User Definable Menu System and a "Save and Restore" feature that allows the restoration of either factory or user-defined settings.

Available in 1/2, 1/6, 1/8 and 1/4 DIN-panel mount sizes, Watlow's SERIES SD\_C controllers are backed by an industry leading three-year warranty from Watlow Winona. The SERIES SD\_C controllers are NSF, UL® and C-UL® listed, CSA and CE certified and include the NEMA 4X (IP65) seal.

### Features and Benefits

#### INFOSENSE™ sensor technology

- Improves sensor accuracy by a minimum of 50 percent

#### User Defined Menu System

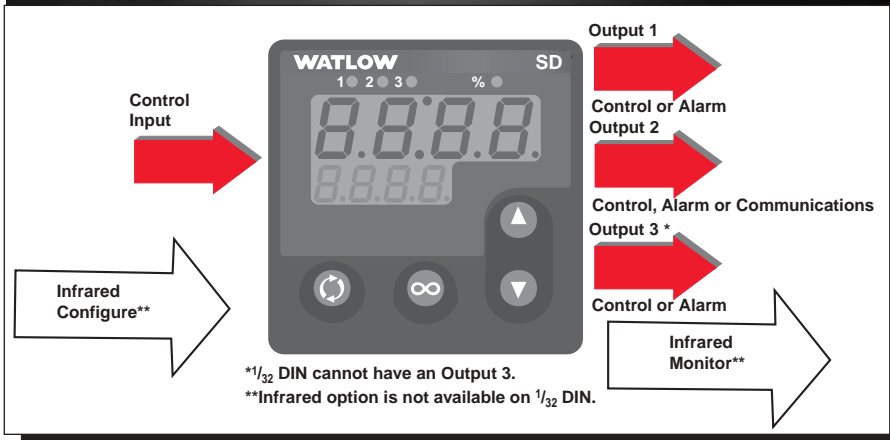
- Allows the user to assign up to 20 parameters in the operations menu
- Improves operational efficiency

#### "Save and Restore" feature

- Allows the user to save individual or factory settings

#### Variable burst fire

- Prolongs heater life
- Reduces replacement costs



Single-Loop  
Auto-Tuning PID

### WATVIEW HMI (Human Machine Interface)

- Permits operation, configuration and data logging via a standard Windows® PC

### Infrared communications (optional)

- Facilitates recipe management and data logging
- Allows easier controller setup, operation and monitoring

### Dual displays

- Provides better recognition of process changes

### Specifications

#### Line Voltage/Power

- 100 to 240V~(ac), +10/-15 percent; (85-264V~[ac]) 50/60Hz, ±5 percent
- 24V≈(ac/dc), +10/-15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Environment

- -18 to 65°C (0 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

Windows® is a registered trademark of Microsoft Corporation.

# Auto-Tuning PID Controllers

## SD\_C

### Specifications Cont.

#### Accuracy

- Calibration accuracy and sensor conformity:  $\pm 0.1$  percent of span,  $\pm 1^\circ\text{C}$  @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature =  $25^\circ\text{C} \pm 3^\circ\text{C}$  ( $77^\circ\text{F} \pm 5^\circ\text{F}$ )
- Accuracy span:  $540^\circ\text{C}$  ( $1000^\circ\text{F}$ ) minimum
- Temperature stability:  $\pm 0.1^\circ\text{C}/^\circ\text{C}$  ( $\pm 0.2^\circ\text{F}/^\circ\text{F}$ ) rise in ambient maximum

#### Agency Approvals

- UL® 3121, C-UL®, CSA, CE, NEMA 4X/IP65
- Limit version features FM approval
- NSF for Type J, K, T and E thermocouples

#### Controller

- Microprocessor based user-selectable control modes
- Single universal input, up to three outputs
- Control sampling rates: Input = 6.5Hz, Display = 10Hz, and Outputs = 6.5Hz

#### Dimensions

DIN Size	Behind Panel (max.)	Width	Height
$\frac{1}{32}$ DIN	97.8 mm (3.85 in.)	52.6 mm (2.07 in.)	29.7 mm (1.17 in.)
$\frac{1}{16}$ DIN	97.8 mm (3.85 in.)	52.1 mm (2.05 in.)	52.1 mm (2.05 in.)
$\frac{1}{8}$ DIN Vertical	97.8 mm (3.85 in.)	52.8 mm (2.08 in.)	99.8 mm (3.93 in.)
$\frac{1}{8}$ DIN Horizontal	97.8 mm (3.85 in.)	99.8 mm (3.93 in.)	52.8 mm (2.08 in.)
$\frac{1}{4}$ DIN	101.1 mm (3.98 in.)	99.8 mm (3.93 in.)	99.8 mm (3.93 in.)

#### Operator Interface

- Dual 4 digit, 7 segment LED displays
- Advance, infinity and up down keys
- Optional IrDA infrared port (not available on  $\frac{1}{32}$  DIN)
- Isolated EIA-485 Modbus™ serial communications. 9600, 19.2K or 38.4K baud rates

#### Wiring Termination -Touch Safe Terminals

- Input power and control outputs 12 to 22 AWG
- Sensor inputs and process outputs 20 to 28 AWG

#### Universal Input

- Thermocouple, grounded or ungrounded sensors
- RTD 2- or 3-wire, platinum,  $100\Omega$  @  $0^\circ\text{C}$  calibration to DIN-curve ( $0.00385 \Omega/\Omega/^\circ\text{C}$ )
- Process, 0-20mA @  $100\Omega$ , or 0-10V $\rightleftharpoons$ (dc) @  $20\text{k}\Omega$  input impedance; Scalable
- Inverse scaling
- $>20\text{M}\Omega$  input impedance
- Maximum of  $20\Omega$  source resistance

#### Allowable Operating Range

Type J:	0 to 815°C (32 to 1500°F)
Type K:	-200 to 1370°C (-328 to 2500°F)
Type T:	-200 to 400°C (-328 to 750°F)
Type N:	0 to 1300°C (32 to 2372°F)
Type E:	-200 to 800°C (-328 to 1470°F)
Type C:	0 to 2315°C (32 to 4200°F)
Type D:	0 to 2315°C (32 to 4200°F)
Type PT111:	0 to 1395°C (32 to 2543°F)
Type R:	0 to 1760°C (32 to 3200°F)
Type S:	0 to 1760°C (32 to 3200°F)
Type B:	0 to 1816°C (32 to 3300°F)
RTD (DIN):	-200 to 800°C (-328 to 1472°F)
Process:	-1999 to 9999 units

#### Control Outputs

##### Outputs 1, 2, 3 (Output 3 not available on $\frac{1}{32}$ DIN)

- User selectable for heat/cool as on-off, P, PI, PD, PID or Alarm action. Not valid for limit controls
- Electromechanical relay. Form A, rated 2A @ 120V~(ac), 2A @ 240V~(ac) or 2A @ 30V $\rightleftharpoons$ (dc)
- Switched dc non-isolated minimum turn on voltage of 6V $\rightleftharpoons$ (dc) into a minimum  $500\Omega$  load with a maximum on voltage of not greater than 12V $\rightleftharpoons$ (dc) into an infinite load. Maximum switched dc power supply current available for up to two outputs is 60mA
- Solid state relay, Form A, 0.5A @ 24V~(ac) minimum, 264V~(ac) maximum, opto-isolated, without contact suppression

# Auto-Tuning PID Controllers

## SD\_C

### Specifications Cont.

- Process output (Non Isolated)  
User-selectable 0-10V<sub>rms</sub>(dc),  
0-5V<sub>rms</sub>(dc), 1-5V<sub>rms</sub>(dc) @  
1K $\Omega$  minimum, 0-20mA, 4-20mA  
@ 800 $\Omega$  maximum
- Electromechanical relay. Form C,  
rated 5A @ 120V<sub>rms</sub>(ac),  
5A @ 240V<sub>rms</sub>(ac) or 5A @  
30V<sub>rms</sub>(dc)
- Open collector 42V<sub>rms</sub>(dc) @  
250mA maximum
- EIA-485 serial communications  
with Modbus™ protocol
- 9600, 19.2K or 38.4K baud rates



### Infrared Communications

The Infrared Data Communications (IDC) option is available on all SERIES SD controller models except the 1/2 DIN and can support complete SERIES SD parameter configuration and operation. The IDC option supports wireless communications with PDAs (personal digital assistants) or other devices equipped with infrared communications that support the Infrared Data Association (IrDA) 1.0 Standard.

The actual user interface or configuration is dependent on the master device application software. A source for this software is Instant HMI from Software Horizons. For more information, visit [www.instanthmi.com/watlow](http://www.instanthmi.com/watlow).

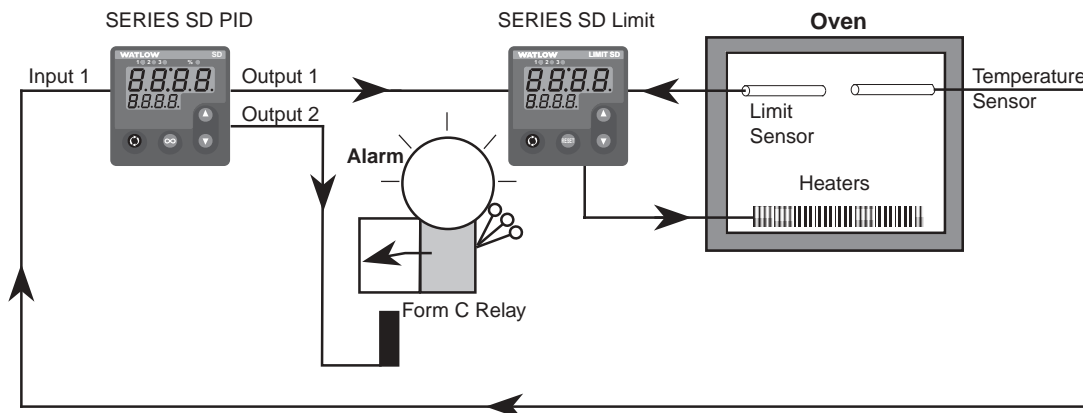
Advantages of IDC include automated logging of key process variables, increased accuracy and ease of use for recipe or configuration setups. Infrared data communications enhances controller data exchange in physically restricting environments (such as semiconductor clean rooms, governmental radio-active test labs or those hard to reach areas) and reduces the use of paper to record instrument information as well as human transposition errors.



### WATVIEW HMI

WATVIEW, Watlow's Windows® based HMI (Human Machine Interface) software, supports the SERIES SD controllers. The software can be used to setup, monitor and edit the values of controller parameters, to monitor and manage alarms and to log and graph process data.

### Typical Block Diagram



Note: Consult user manual for proper wiring.

# Auto-Tuning PID Controllers

F.O.B.: Winona, Minnesota

## SD\_C



### INFOSENSE™ Sensor Technology

Watlow's INFOSENSE™ sensor technology improves temperature sensing accuracy by 50 percent. Each INFOSENSE “smart” sensor contains four numeric values located on tags attached to each sensor that are programmed into the SERIES SD controller memory. These values characterize Watlow sensors and allow the controller to provide enhanced accuracy.

### Ordering Information

To order, complete the model number on the right with the information below.

**SERIES SD\_C** = Single channel PID controllers

#### DIN Sizes

- 3 = 1/2 DIN
- 6 = 1/6 DIN
- 8 = 1/6 DIN Vertical
- 9 = 1/6 DIN Horizontal
- 4 = 1/4 DIN

#### Control Type

- C = PID Control Dual Display

#### Power Supply

- H = 100 to 240V $\approx$ (ac/dc)
- L = 24 to 28V $\approx$ (ac/dc)

#### Output 1

- C = Switched dc
- K = SSR, Form A, 0.5A
- F = Universal process
- J = Mechanical relay, Form A, 2A

#### Output 2

- A = None
- C = Switched dc
- K = SSR, Form A, 0.5A
- J = Mechanical relay, Form A, 2A
- U = EIA-485 Modbus™ communications

#### Output 3 (Not available on 1/2 DIN)

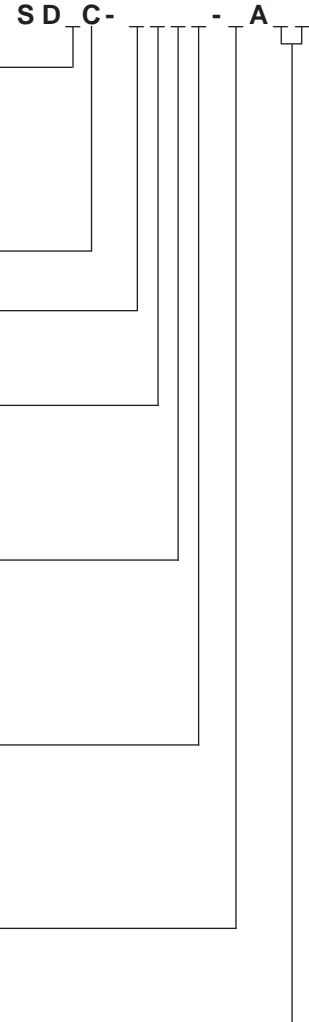
- A = None
- C = Switched dc/open collector
- K = SSR, Form A, 0.5A
- F = Universal process
- E = Mechanical relay, Form C, 5A

#### Infrared Comms Options (IrDA)

- A = None (Default selection on 1/2 DIN)
- R = IrDA ready (Not available on 1/2 DIN)

#### Display Colors and Custom Options

- RG = Red Green (Dual display units)
- RR = Red Red (Not available on 1/2 DIN Dual Display)
- XX = Custom options, special overlays, etc.





## Auto-Tuning PID Controllers

### SD6C\_D

Watlow SERIES SD6C\_D offers excellent static Set Point control and application flexibility in a 1/8th DIN panel mount package. The SERIES SD6C\_D controller has been successfully tested for use with both ODVA and Semi-conductor SIG standards for DeviceNet™ on CAN networks.

The SD6C\_D single channel controller includes a universal sensor input with two outputs that can be configured as heat or cool or alarm. The DeviceNet™ communications interface is supplied with either a five pin circular DIN connector for Semiconductor SIG specific applications, or with a five position removable screw terminal connector for traditional market applications.

Additional features of the SD6C\_D family of controllers include Watlow's INFOSENSE™ sensor technology, a user definable menu system and a Save and Restore feature that allows the restoration of factory and user defined parameter values.

Watlow SD6C\_D DeviceNet™ controllers offer a three year warranty; are UL®, C-UL® listed, CSA, CE and NSF certified and include IP65/NEMA 4 ratings.

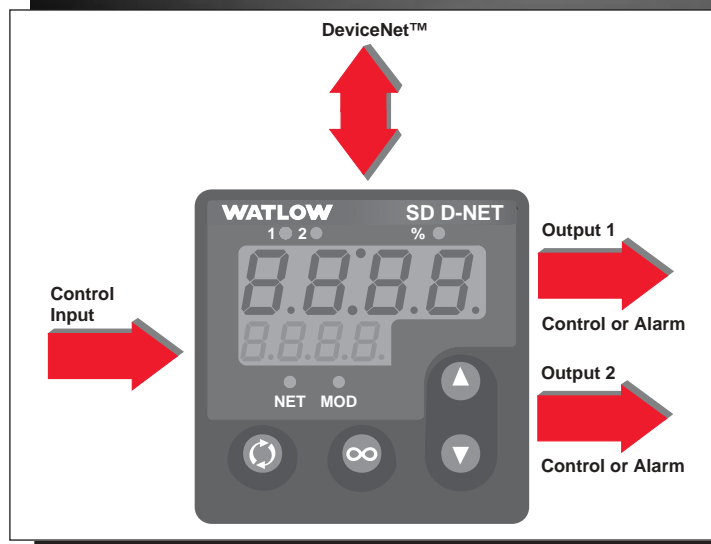
#### Features and Benefits

##### Variable burst fire

- Prolongs heater life

##### Ordering Options including DeviceNet™ on CAN or SEMI-SIG-ODVA protocols

- Provides DeviceNet™ on CAN for Semiconductor applications
- DeviceNet™ on CAN for the packaging or general industrial markets



#### Specifications

##### Line Voltage/Power

- 100 to 240V~(ac), +10/-15 percent; (85-264V~[ac]) 50/60Hz, ±5 percent
- 24V~(ac/dc), +10/-15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

##### Environment

- -18 to 65°C (0 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

#### Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

DeviceNet™ is a trademark of the Open DeviceNet Vendors Association.

Single-Loop  
Auto-Tuning PID

# Auto-Tuning-PID Controllers

F.O.B.: Winona, Minnesota

## SD6C\_D

### Specifications Cont.

#### Agency Approvals

- UL® 3121, C-UL®, CSA, CE, IP65/NEMA 4X and NSF-2
- Microprocessor based user-selectable control modes
- Single universal input, up to three outputs
- Control sampling rates: Input = 6.5Hz, Display = 10Hz and Outputs = 6.5Hz

#### Operator Interface

- Dual 4 digit, 7 segment LED displays
- Advance, infinity and up down keys
- DeviceNet™ on CAN or SEMI-SIG-ODVA protocols

#### Allowable Operating Range

Type J:	0 to 815°C (32 to 1500°F)
Type K:	-200 to 1370°C (-328 to 2500°F)
Type T:	-200 to 400°C (-328 to 750°F)
Type N:	0 to 1300°C (32 to 2372°F)
Type E:	-200 to 800°C (-328 to 1470°F)
Type C:	0 to 2315°C (32 to 4200°F)
Type D:	0 to 2315°C (32 to 4200°F)
Type PTII:	0 to 1395°C (32 to 2543°F)
Type R:	0 to 1760°C (32 to 3200°F)
Type S:	0 to 1760°C (32 to 3200°F)
Type B:	0 to 1816°C (32 to 3300°F)
RTD (DIN):	-200 to 800°C (-328 to 1472°F)
Process:	-1999 to 9999 units

### Control Outputs

#### Outputs 1 and 2

- User selectable for heat/cool as on-off, P, PI, PD, PID or Alarm action.
- Electromechanical relay. Form A, rated 2A @ 120V~(ac), 2A @ 240V~(ac) or 2A @ 30V=(dc)
- Switched dc non-isolated minimum turn on voltage of 6V=(dc) into a minimum 500Ω load with a maximum on voltage of not greater than 12V=(dc) into an infinite load. Maximum switched dc power supply current available for up to two outputs is 60mA
- Solid state relay, Form A, 0.5A @ 24V~(ac) minimum, 264V~(ac) maximum, opto-isolated, without contact suppression

- Process output (Non Isolated) User-selectable 0-10V=(dc), 0-5V=(dc), 1-5V=(dc) @ 1KΩ minimum, 0-20mA, 4-20mA @ 800Ω maximum
- Electromechanical relay. Form C, rated 5A @ 120V~(ac), 5A @ 240V~(ac) or 5A @ 30V=(dc)
- Open collector 42V=(dc) @ 250mA maximum

### Dimensions

#### SD6C\_D or SD6R\_D or SD6L\_D

- 1/6 DIN Size
- 97.8 mm (3.85 in.) behind panel maximum
- Width 52.1 mm (2.05 in.)
- Height 52.1 mm (2.05 in.)

### Ordering Information

To order, complete the model number on the right with the information below.

**SD6C- A-D**

**SERIES SD6C\_D** = 1/6 DIN panel mount PID controller with DeviceNet™

**Control Type**  
C = PID controller

**Power Supply**  
H = 100 to 240V=(ac/dc)  
L = 24 to 28V=(ac/dc)

**Output 1**  
C = Switched dc  
K = SSR, Form A, 0.5A  
F = Universal process  
J = Mechanical relay, Form A, 2A

**Output 2**  
A = None  
C = Switched dc  
K = SSR, Form A, 0.5A  
J = Mechanical relay, Form A, 2A  
U = EIA-485 Modbus™ communications

**DeviceNet™ Communications**  
N = DeviceNet™ on CAN (packaging or general industrial markets)  
S = SEMI-SG-ODVA compliant (semi-conductor markets)

**Display Colors and Custom Options**  
RG = Red Green (with Watlow name and SD logo)  
RR = Red Red (with Watlow name and SD logo)  
AA = Red Green (SD logo only)  
AB = Red Red (SD logo only)

# Auto-Tuning PID Controllers

## SERIES 96

Watlow's SERIES 96 is a powerful 1/6 DIN dual display controller that offers many advanced functions. This controller can be tailored to perform hardware and software needs with hardware modules that are pluggable and exchangeable, and software menus that may be user programmed to fit exact application requirements.

With one universal input, a second auxiliary input and four outputs the SERIES 96 can be programmed to perform: temperature measurement, input event switching, remote set point input, heating, boost heating, cooling, alarms, digital communications and retransmit.

With fast 10Hz sampling, variable time base burst firing outputs, NEMA 4X front panel and 0.1 percent calibration accuracy, this controller can easily handle some of the toughest application needs.

### Features and Benefits

#### Burst fire

- Increases heater life / better temperature controllability

#### One input, one auxiliary input, four outputs

- Powerful flexibility at a competitive price

#### No dipswitches

- Easily configurable from the front panel

#### Multiple set points

- Flexible automatic control

#### Pluggable output modules

- Field expandable

#### Fast 10Hz sampling

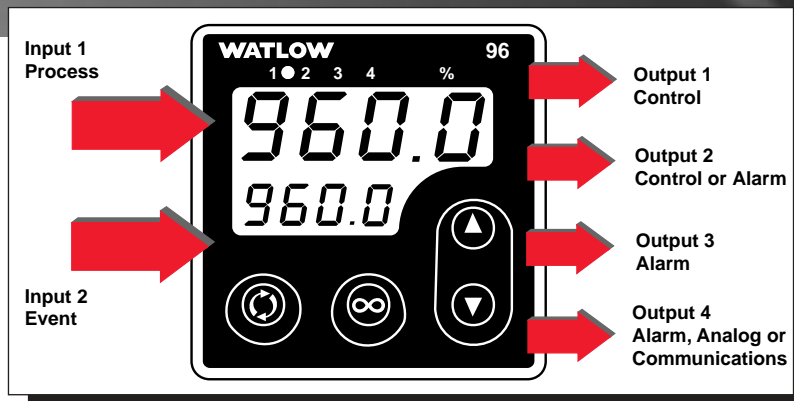
- Improved control responsiveness

#### Programmable menus (Patented)

- Can be self-tailored for exact user needs

#### Open loop break protection

- Indication of thermal loop problem



### NEMA 4X (IP65)<sup>①</sup>

- Water and corrosion resistant front panel can be washed down

### 16 programmable ramp and soak steps

- Profiles of dynamic production processes can be programmed into the controller

### Automatic-tuning

- Easy one step tuning of PID control parameters

### Applications

- Packaging
- Semiconductor
- Food processing
- Lab equipment
- Furnace and ovens
- Plastics

### Specifications

#### Operating Environment

- 0 to 65°C (32 to 149°F)

#### Controller

- Microprocessor-based, user selectable control modes
- Heat and cool auto-tune for control outputs
- Universal input one, auxiliary input two, four outputs
- Control outputs user selectable as on-off, P, PI, PID

#### Warranty<sup>②</sup>

- Industry leading three-years

<sup>①</sup> To effect NEMA 4X (IP65) rating requires a minimum mounting panel thickness of 1.5 mm (0.06 in.) and surface finish not rougher than 0.000812 mm (0.000032 in.).

<sup>②</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

# Auto-Tuning PID Controllers

## SERIES 96

### Specifications Cont.

- Input sampling rates: Single input 10Hz (100ms), dual input 5Hz (200ms) digital filter adjustable
- Display update: 2Hz (500ms), time filter adjustable
- Output update: burst, 0.1 to 999.9 seconds
- Input/Output/Communication isolation
- Displayed in °C, °F, or process units

### Operator Interface

- Dual four-digit LED displays: upper 10.2 mm (0.4 in.), lower 6.2 mm (0.244 in.)
- Advance, Up Arrow, Down Arrow, Infinity tactile keys

### Standard Conditions For Specifications

- Ambient temperature 25°C (77°F) ±3°C, rated line voltage, 50 to 60Hz, 0 to 90 percent RH non-condensing, 15 minute warm-up

### Universal Input 1

#### Thermocouple

- Type J, K, T, N, C (W5), E, Pt 2, D (W3), B, R, S thermocouple
- >20MΩ input impedance
- Maximum 20Ω source resistance
- 30μA open detection bias

#### RTD

- 2- or 3-wire platinum, 100Ω
- JIS and DIN-curves
- Whole or tenth degree indication
- 150μA nominal RTD excitation current

#### Process

- Range selectable: 0-10V<sub>rms</sub>(dc), 0-5V<sub>rms</sub>(dc), 1-5V<sub>rms</sub>(dc), 0-20mA, 4-20mA
- Voltage input impedance 20kΩ
- Current input impedance 100Ω
- Minimum current source resistance 1MΩ

- Input resolution 50,000 bits (approx.) at full scale
- mV input impedance 20MΩ

### Input 2

#### Event Input

- Contact or voltage
- 20KΩ input impedance
- Voltage input: event high state 3 to 36V<sub>rms</sub>(dc), event low state 0 to 2V<sub>rms</sub>(dc)
- Resistance/contact input: event high state >23kΩ, event low state 0 to 2kΩ

#### Remote Set Point Input: mA or V<sub>rms</sub>(dc) Range Selectable

- Voltage input impedance 20kΩ
- Current input impedance 100Ω

### Output Types

#### Open Collector/Switched DC

- Open collector configuration: Maximum voltage 42V<sub>rms</sub>(dc) Maximum current 200mA Maximum on resistance 1.1Ω Maximum off state leakage current 100μA
- Switched dc configuration: Switched dc supply voltage 22 to 28V<sub>rms</sub>(dc) dc supply current limited to 30mA

#### Solid State Relay

- Optically isolated
- Zero cross switched
- Without contact suppression
- Minimum load current 0.5mA rms
- Maximum current 0.5A rms at 20 to 280V<sub>rms</sub>(ac)
- Maximum off state leakage current 10μA rms
- For resistive loads only, must use RC suppression for inductive loads

#### Electromechanical Relay

- Form C contact configuration
- Minimum load current 10mA @ 5V<sub>rms</sub>(dc)
- Rated resistive and inductive loads: 2A @ 250V<sub>rms</sub>(ac) or 30V<sub>rms</sub>(dc) maximum

- Electrical life 100,000 cycles at rated current
- For resistive loads only, must use RC suppression for inductive loads

### Process

- Range selectable: 0-20mA, 4-20mA, 0-5V<sub>rms</sub>(dc), 1-5V<sub>rms</sub>(dc), 0-10V<sub>rms</sub>(dc)
- Reverse or direct acting
- 0 to 10V<sub>rms</sub>(dc) voltage output into 1000Ω minimum load resistance
- 0 to 20mA current output into 800Ω maximum load resistance
- Resolution: V<sub>rms</sub>(dc) ranges = 2.5mV nominal mA ranges = 5μA nominal
- Calibration accuracy: V<sub>rms</sub>(dc) ranges = ±15mV mA ranges = ±30μA
- Temperature stability 100ppm/°C

### Retransmit

- Range selectable: 0-20mA, 4-20mA, 0-5V<sub>rms</sub>(dc), 1-5V<sub>rms</sub>(dc), 0-10V<sub>rms</sub>(dc)
- 0 to 10V<sub>rms</sub>(dc) voltage output into a 1,000Ω minimum load resistance
- 0 to 20mA current output into an 800Ω maximum load resistance
- Resolution: V<sub>rms</sub>(dc) ranges = 2.5mV nominal mA ranges = 5μA nominal
- Calibration accuracy: V<sub>rms</sub>(dc) ranges = ±15mV mA ranges = ±30μA
- Temperature stability 100ppm/°C

### Communications

- EIA/TIA-485, EIA/TIA-232
- Opto-isolated
- Modbus™ RTU protocol
- 1200, 2400, 4800, 9600, 19200 baud rates
- 32 maximum units can be connected (With additional 485 repeater hardware, up to 247 units may be connected)

# Auto-Tuning PID Controllers

## SERIES 96

### Specifications Cont.

#### Accuracy

- Input ranges

Type J	0 to 750°C (32 to 1382°F)
Type K	-200 to 1250°C (-328 to 2282°F)
Type T	-200 to 350°C (-328 to 662°F)
Type N	0 to 1250°C (32 to 2282°F)
Type E	-200 to 900°C (-328 to 1470°F)
Type C(W5)	0 to 2315°C (32 to 4200°F)
Type D(W3)	0 to 2315°C (32 to 4200°F)
Pt 2	0 to 1393°C (32 to 2540°F)
Type R	0 to 1450°C (32 to 2642°F)
Type S	0 to 1450°C (32 to 2642°F)
Type B	870 to 1700°C (1598 to 3092°F)
DIN	-200 to 800°C (-328 to 1472°F)
JIS	-200 to 630°C (-328 to 1166°F)
Process	-1999 to 9999 units

#### Thermocouple Inputs

- Calibration accuracy  $\pm 0.1$  percent of span  $\pm 1^\circ\text{C}$  at standard conditions  
 Exceptions:  
 Type T: 0.12 percent of span for  $-200^\circ\text{C}$  to  $-50^\circ\text{C}$  ( $-328^\circ\text{F}$  to  $-58^\circ\text{F}$ )  
 Types R and S: 0.15 percent of span for  $0^\circ\text{C}$  to  $100^\circ\text{C}$  ( $32^\circ\text{F}$  to  $212^\circ\text{F}$ )  
 Type B: 0.24 percent of span for  $870^\circ\text{C}$  to  $1700^\circ\text{C}$  ( $1598^\circ\text{F}$  to  $3092^\circ\text{F}$ )
- Accuracy span:  $540^\circ\text{C}$  ( $1000^\circ\text{F}$ ) minimum
- Temperature stability:  $\pm 0.1$  degree per degree change in ambient

#### RTD Inputs

- Calibration accuracy  $\pm 0.1$  percent of span  $\pm 1^\circ\text{C}$  at standard conditions
- Accuracy span:  $540^\circ\text{C}$  ( $1000^\circ\text{F}$ ) minimum
- Temperature stability:  $\pm 0.05$  degree per degree change in ambient

#### Process Inputs

- Voltage input ranges  
 Accuracy  $\pm 15\text{mV} \pm 1$  LSD at standard conditions  
 Temperature stability  $\pm 100\text{ppm}/^\circ\text{C}$  maximum
- Milli-amp input ranges  
 Accuracy  $\pm 30\mu\text{A} \pm 1$  LSD at standard conditions  
 Temperature stability  $\pm 100\text{ppm}/^\circ\text{C}$  maximum

#### Agency Approvals

- UL® 916, File #E185611, C-UL®, CE, NEMA 4X

#### Terminals

- Touch safe
- 22 to 12 AWG

#### Power

- 100-240V~(ac) +10 percent, -15 percent; 50/60Hz,  $\pm 5$  percent
- 24-28V~(ac) or V=(dc) +10 percent, -15 percent; 50/60Hz,  $\pm 5$  percent
- 7.0VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Operating Environment

- 0 to  $65^\circ\text{C}$  (32 to  $149^\circ\text{F}$ )
- 0 to 90 percent RH, non-condensing
- Storage temperature:  $-40$  to  $85^\circ\text{C}$  ( $-40$  to  $185^\circ\text{F}$ )

#### Controller Weight (approx.)

- 0.2 kg (0.4 lb)

#### Allowable Operating Ranges

Type J	1.0	0 to 815°C (32 to 1500°F)
	0.1	0 to 815°C (32 to 1500°F)
Type K	1.0	-270 to 1370°C (-454 to 2500°F)
	0.1	-200 to 1000°C (-328 to 1832°F)
Type T	1.0	-270 to 400°C (-454 to 750°F)
	0.1	-200 to 400°C (-328 to 750°F)
Type N	1.0	0 to 1300°C (32 to 2372°F)
	0.1	0 to 1000°C (32 to 1832°F)
Type E	1.0	-270 to 800°C (-454 to 1470°F)
	0.1	-200 to 800°C (-328 to 1472°F)
Type C	1.0	0 to 2315°C (32 to 4200°F)
	0.1	0 to 1000°C (32 to 1832°F)
Type D	1.0	0 to 2315°C (32 to 4200°F)
	0.1	0 to 1000°C (32 to 1832°F)
Pt 2	1.0	0 to 1395°C (32 to 2543°F)
	0.1	0 to 1000°C (32 to 1832°F)
Type R	1.0	0 to 1760°C (32 to 3200°F)
Type S	1.0	0 to 1760°C (32 to 3200°F)
Type B	1.0	0 to 1816°C (32 to 3300°F)
DIN	1.0	-200 to 800°C (-328 to 1472°F)
	0.1	-200 to 800°C (-328 to 1472°F)
JIS	1.0	-200 to 630°C (-328 to 1166°F)
	0.1	-200 to 630°C (-328 to 1166°F)
Process	-1999 to 9999 units	

# Auto-Tuning PID Controllers

F.O.B.: Winona, Minnesota

## SERIES 96

### Functionality Matrix

	Universal Input	Event & Remote Set Point	Control	Alarm	Retransmit	232 485 Comm
Input 1						
Input 2						
Output 1						
Output 2						
Output 3						
Output 4						

### Dimensions

#### Overall

Height: 52 mm (2.05 in.)  
 Width: 52 mm (2.05 in.)  
 Length: 107 mm (4.2 in.)

#### Depth behind panel surface

98.4 mm (3.875 in.)

### Ordering Information

To order, complete the code number on the right with the information below:

**SERIES 96** = Microprocessor-based 1/6 DIN, with universal input 1. Options include: software, power supply, input 2, outputs and display color.

#### Power Supply

A = 100-240V $\approx$ (ac/dc)  
 B = 24-28V $\approx$ (ac/dc)

#### Input 2

0 = None  
 1 = Event input and 0-5V $\approx$ (dc)/4-20mA (Remote set point input)

#### Output 1

C = Switched dc/open collector  
 D = Electromechanical relay, Form C, 2A, without RC suppression  
 F = Universal Process, range selectable: 0-20mA, 4-20mA, 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10V $\approx$ (dc)  
 K = 0.5A solid state relay without RC suppression

#### Output 2

A = None  
 C = Switched dc/open collector  
 D = Electromechanical relay, Form C, 2A, without RC suppression  
 F = Universal Process, range selectable: 0-20mA, 4-20mA, 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10V $\approx$ (dc)  
 K = 0.5A solid state relay without RC suppression

#### Output 3

A = None  
 D = Electromechanical relay, Form C, 2A, without RC suppression

#### Output 4

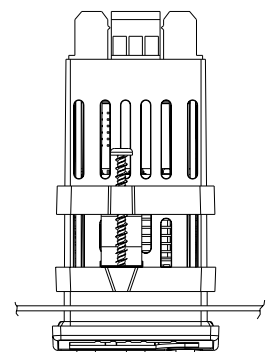
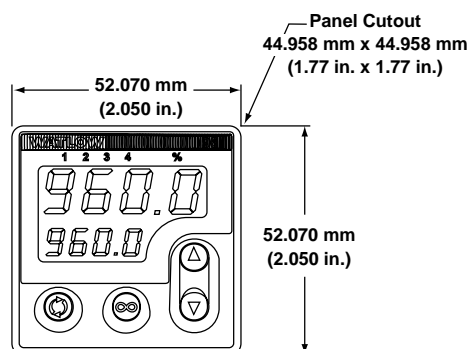
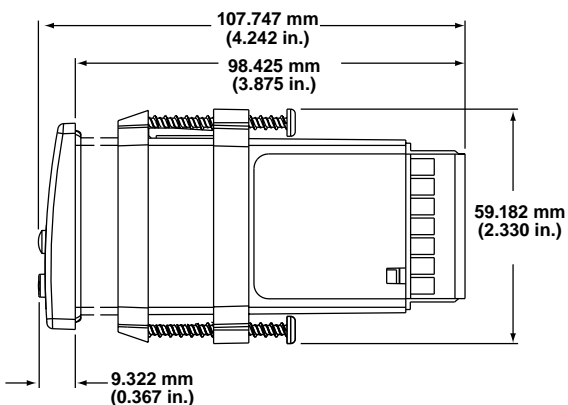
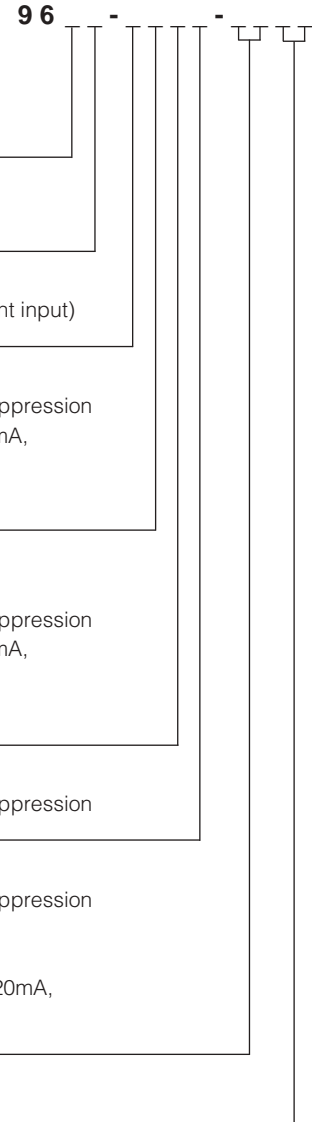
A = None  
 D = Electromechanical relay, Form C, 2A, without RC suppression  
 R = 232 Communications  
 U = 485 Communications  
 M = Universal Retransmit, range selectable: 0-20mA, 4-20mA, 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10V $\approx$ (dc)

#### Software/Preset Parameters

00 = Standard software

#### Display/Overlay

RR = Red/Red display      GR = Green/Red display  
 RG = Red/Green display      GG = Green/Green display



# Auto-Tuning PID Controllers

## SERIES 988/989

Watlow's SERIES 988 (vertical) and SERIES 989 (horizontal) temperature/process controllers are designed and manufactured for the demanding requirements of the industrial controller market. No other controller offers the flexibility, compact size and durability of the SERIES 988/989. The controller's industry leading feature set is its compact 1/2 DIN size and NEMA 4X<sup>®</sup> (IP65) water and corrosion resistant front panel.

The SERIES 988/989 has the auto-tuning and alarm features you would expect. Additionally, several unique control algorithms, not common to this price range, extend the SERIES 988/989's application potential. From the long list of product features, the SERIES 988/989's ability to provide single unit cascade control of a process is perhaps the most unique. Other features include heater current monitoring, remote set point input, differential or ratio control.

### Performance Capabilities

- Accuracy to 0.1 percent of span
- Operating environment 0 to 65°C (32 to 149°F)

### Features and Benefits

#### Three inputs and four outputs

- Provide application versatility

#### Universal high or low voltage power supply, horizontal or vertical mounting and display color options

- Add to application versatility

#### A 10Hz sampling rate, along with the burst fire

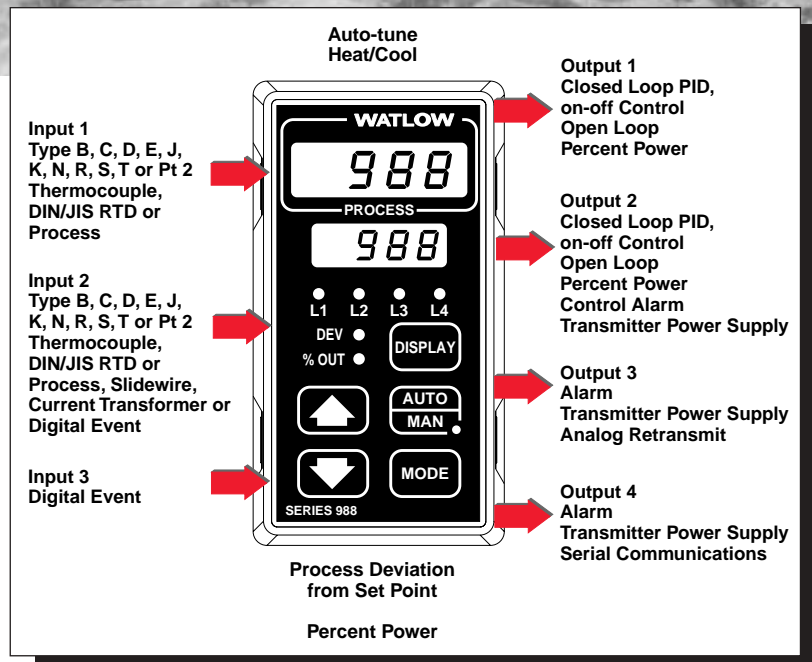
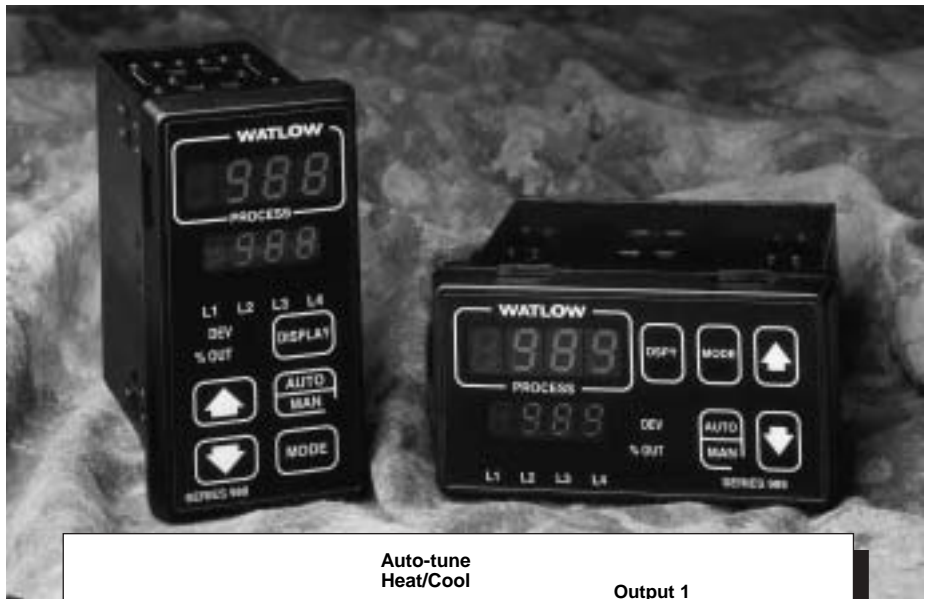
- Provides precise process control

#### Enhanced software option

- Provides advanced cascade, ratio or dual PID control

#### Signal conditioner power supply options

- Eliminate the need for external devices



### Serial communications

- Support for one-on-one as well as remote networking of controllers

### UL<sup>®</sup>, CE and NEMA 4X (IP65) approvals

- Help ensure product and operator safety

### Dual digital displays

- Provide simultaneous viewing of the set point and the actual process

### Three-year warranty<sup>②</sup>

- Provides Control Confidence<sup>®</sup>

### Applications

- Any process requiring cascade, ratio, burst fire or slidewire feedback control
- Food processing
- Packaging
- Plastics processing
- Semiconductor manufacturing

<sup>①</sup> To effect NEMA 4X (IP65) rating requires a minimum mounting panel thickness of 1.5 mm (0.06 in.) and surface finish not rougher than 0.000812 mm (0.000032 in.).

<sup>②</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

# Auto-Tuning PID Controllers

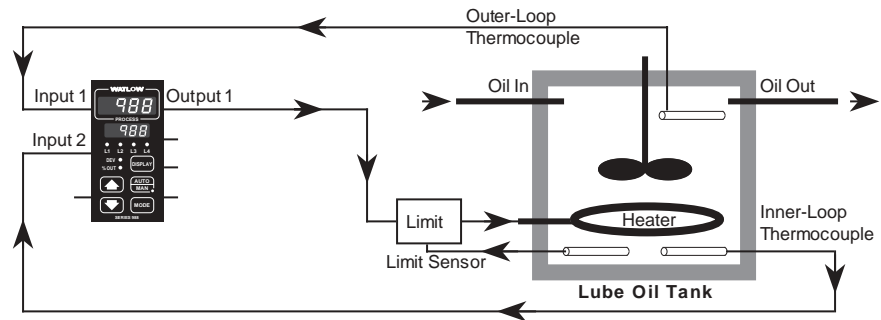
## SERIES 988/989

### Enhanced Software

#### Cascade Control

Cascade control is a control strategy in which one control loop provides the set point for another loop. It allows the process or part temperature to be reached quickly while minimizing overshoot. Cascade is used to optimize the performance of thermal systems with long lag times.

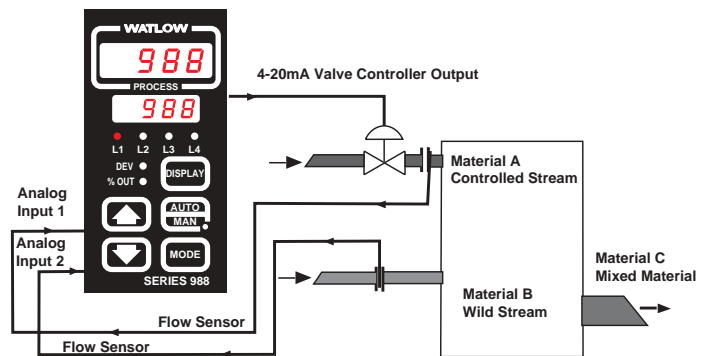
- Precise control via cascade configuration
- Display of both process variables
- Low cost; one unit does the work of two
- Increased operator productivity with fast setup



#### Ratio Control

Whether mixing materials or controlling temperature indirectly, ratio control with the SERIES 988 provides automatic set point adjustments in response to system changes.

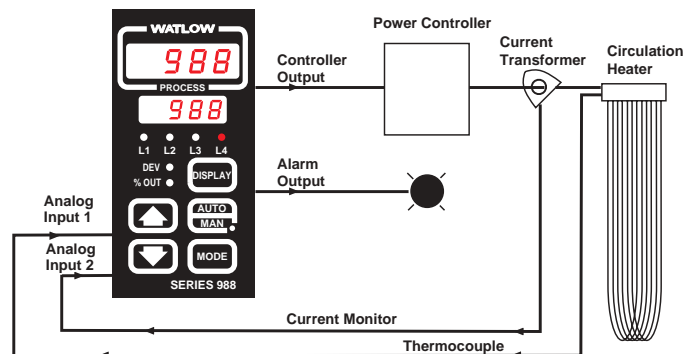
- Simplified process control; one controller does the work of two
- Low cost solution; one controller, display access - both process variables
- One controller for many applications
- Easy setup; increased operator productivity



#### Current Monitor

Current monitoring provides system performance and status information. The SERIES 988 accepts current transformer signal with no conditioning.

- Easily accessible heater status
- System performance data for troubleshooting or design enhancements
- System protection; fast shut down with overcurrent
- Easy setup: no external signal conditioner required





# Auto-Tuning PID Controllers

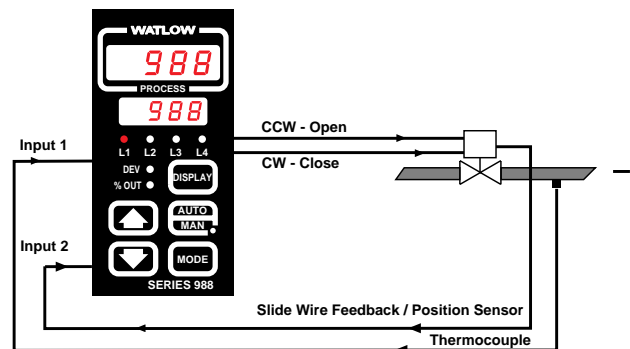
## SERIES 988/989

### Enhanced Software Cont.

#### Slidewire Feedback Valve Control

Valve positioning feedback (percent open, percent close) provides precise process control. The SERIES 988 is configurable for a wide variety of valves.

- Accepts virtually any valve input
- Front panel valve position display
- Increased valve life with anti-hunting parameter
- Greater process efficiency with precise control
- Easy setup; increased operator productivity



### Product Highlights

#### Easy to Operate

The SERIES 988's operator interface features the simplicity you expect from a Watlow controller. The display key allows the operator to view information pertinent to the process, including, among others, deviation from set point, percent output and units of measurement.

The display key also returns the operator to the process and set point display from anywhere in the menu system. The setup menu is segmented into input, output, global, and communication parameters and you can move forward or backward throughout the parameter sequence.

#### Use Up To Four Outputs

The controller can have up to four outputs total, including the standard Watlow output options, along with retransmit and communications. Up to three outputs can be defined as a power supply output to power external signal conditioners, eliminating the need for an external power supply. The output types are recognized by the controller to simplify setup and operation, with no need for DIP switches.

#### Three Inputs Allow Greater Flexibility

To accommodate unique system configurations, the SERIES 988 offers two universal analog inputs and one event (digital) input. The event input allows the operator to select a function at the close of a switch. This can lock out the front panel, switch PID values, go to a remote or second set point, etc. The inputs are optically isolated from all outputs, eliminating the need for external isolation circuitry.

### Specifications

#### Control Mode

- Dual input, quad output, optional retransmit of set point or process variable
- Programmable direct and reverse acting control outputs
- One step auto-tuning

#### Agency Approvals

- CE
- 89/336/EEC Electromagnetic Compatibility Directive

- EN 50081-2: 1994 Emissions
- EN 50082-2: 1994 Immunity
- 73/23/EEC Low Voltage Directive
- EN 61010-1: 1993 Safety
- UL® #873, C-UL® File #43684
- NEMA 4X

#### Operator Interface

- Local/remote set point capability
- Dual, 4 digit LED displays  
Upper: 10 mm (0.4 in.)  
Lower: 8 mm (0.3 in.)

- MODE, AUTO/MAN, DISPLAY, UP and DOWN keys

#### Accuracy

- Calibration accuracy and sensor conformity:  $\pm 0.1$  percent of span,  $\pm 1$  LSD,  $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$  ( $77^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ) ambient and rated line voltage  $\pm 10$  percent
- Accuracy span:  $540^{\circ}\text{C}$  ( $1000^{\circ}\text{F}$ ) minimum
- Temperature stability:  $0.1^{\circ}\text{C}/^{\circ}\text{C}$  ( $\pm 0.2^{\circ}\text{F}/^{\circ}\text{F}$ ) change in ambient

# Auto-Tuning PID Controllers

## SERIES 988/989

### Specifications Cont.

#### Sensors/Inputs

- Contact input for software function select (event input)
- Thermocouple Types B, C<sup>①</sup>, D<sup>①</sup>, E, J, K, N, R, S, T and Pt 2<sup>②</sup>
- RTD resolution in 1° or 0.1° increments
- Process variables: 0-50mV, 0-20mA<sub>dc</sub>, 4-20mA<sub>dc</sub>, 0-5V<sub>dc</sub>, 1-5V<sub>dc</sub>, 0-10V<sub>dc</sub>
- Slidewire, digital event input or heater current options
- Sensor break protection de-energizes system for safety, or selectable bumpless transfer to manual operation. Latching or non-latching
- °C or °F display or process units, user selectable

#### Input Range

Specified temperature ranges represent the controller's operational span. Refer to [page 228](#) for ANSI (thermocouple) and DIN/JIS (RTD) temperature sensor ranges/tolerances.

#### Thermocouple

Type B	870 to 1816°C (1598 to 3300°F)
Type C <sup>①</sup>	0 to 2316°C (32 to 4200°F)
Type D <sup>①</sup>	0 to 2316°C (32 to 4200°F)
Type E	-200 to 799°C (-328 to 1470°F)
Type J	0 to 816°C (32 to 1500°F)
Type K	-200 to 1371°C (-328 to 2500°F)
Type N	0 to 1300°C (32 to 2372°F)

Type R	0 to 1760°C (32 to 3200°F)
Type S	0 to 1760°C (32 to 3200°F)
Type T	-200 to 399°C (-328 to 750°F)
Pt 2 <sup>②</sup>	0 to 1395°C (32 to 2543°F)

#### RTD Resolution (DIN or JIS)

1° (DIN)	-200 to 800°C (-328 to 1472°F)
1° (JIS)	-200 to 630°C (-328 to 1166°F)
0.1° (DIN and JIS)	-73.3 to 537.7°C (-99.9 to 999.9°F)

#### Process

0-5V <sub>dc</sub>	-999 to 9999 units
1-5V <sub>dc</sub>	-999 to 9999 units
0-10V <sub>dc</sub>	-999 to 9999 units
0-20mA <sub>dc</sub>	-999 to 9999 units
4-20mA <sub>dc</sub>	-999 to 9999 units
0-50mV <sub>dc</sub>	-999 to 9999 units
Slidewire	100 to 1200Ω
Current	0 to 50mA
Potentiometer	0 to 1200Ω

#### Output Options

- Solid state relay, Form A, 0.5A @ 24V<sub>ac</sub> min., 253V<sub>ac</sub> max., opto-isolated, burst fire switching. With or without contact suppression. Off state output impedance is 20kΩ with RC suppression, 31MΩ without contact suppression
- Open collector or switched dc signal provides a minimum turn on voltage of 3V<sub>dc</sub> into a minimum 500Ω load; maximum on voltage not greater than 32V<sub>dc</sub> into an infinite load, isolated

- Electromechanical relay<sup>②</sup>, Form C, 5A @ 120/240V<sub>ac</sub>, 6A @ 28V<sub>dc</sub>, 1/8 hp @ 120V<sub>ac</sub>, 125VA @ 120V<sub>ac</sub>. With or without contact suppression. Off state output impedance with RC suppression is 20kΩ
- Process, 0-20mA<sub>dc</sub>, 4-20mA<sub>dc</sub> into 800Ω maximum, 0-5V<sub>dc</sub>, 1-5V<sub>dc</sub>, or 0-10V<sub>dc</sub> into 1kΩ minimum reverse acting, isolated
- Electromechanical relay<sup>②</sup>, Form A/B, 5A @ 120/240V<sub>ac</sub>, 6A @ 28V<sub>dc</sub>, 1/8 hp @ 120V<sub>ac</sub>, 125VA @ 120V<sub>ac</sub>, without contact suppression
- External transmitter power supply, 5, 12 or 20V<sub>dc</sub> @ 30mA
- EIA/TIA-232 communications or EIA/TIA-485, EIA/TIA-422 communications, opto-isolated
- Retransmit: 0-20mA<sub>dc</sub>, 4-20mA<sub>dc</sub> with 600Ω max. load impedance, or 0-5V<sub>dc</sub>, 1-5V<sub>dc</sub> and 0-10V<sub>dc</sub> with 500Ω min. load impedance

#### Line Voltage/Power

- 100-240V<sub>ac/dc</sub> +10 percent, -15 percent; 50/60Hz, ±5 percent
- 24-28V<sub>ac/dc</sub> +10 percent, -15 percent; 50/60Hz ±5 percent
- Power consumption 16VA maximum
- Fused internally (factory replaceable only) Slo-Blo<sup>®</sup> type (time-lag):  
*2A, 250V for high voltage versions*  
*5A, 250V for low voltage versions*
- Data retention upon power failure via non-volatile memory

<sup>①</sup> Not an ANSI symbol.

<sup>②</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

Slo-Blo<sup>®</sup> is a registered trademark of Littelfuse, Inc.

# Auto-Tuning PID Controllers

F.O.B.: Winona, Minnesota

## SERIES 988/989

### Specifications Cont.

#### Operating Environment

- 0 to 65°C (32 to 149°F)
- 0 to 90 percent RH, non-condensing

#### Storage Temperature

- -40 to 85°C (-40 to 185°F)

#### Terminals

- #6 compression universal head screws, accepts 20-14 gauge wire

#### Controller Weight

- 0.45 kg (1.0 lb)

#### Shipping Weight

- 1.35 kg (3.0 lbs)

### Availability

Four working days for orders less than 20 units. For orders over 20 units, consult factory for release and shipment schedules.

<sup>①</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

<sup>②</sup> A current transformer input cannot be used in conjunction with a process output installed on output 1.

### Ordering Information

To order, complete the code number to the right with the information below:

<p><b>SERIES 988/989</b> = Single channel, temperature/process controller, 1 analog input, 1 digital input, 1 analog or digital input, 4 outputs.</p> <p><b>Power Supply &amp; Mounting</b></p> <p>6 = 24 to 28V<math>\approx</math>(ac/dc) nominal, vertical mounting          7 = 24 to 28V<math>\approx</math>(ac/dc) nominal, horizontal mounting          8 = 100 to 240V<math>\approx</math>(ac/dc) nominal vertical mounting          9 = 100 to 240V<math>\approx</math>(ac/dc) nominal horizontal mounting</p> <p><b>Software</b></p> <p>A = Standard          B = Enhanced (Includes cascade, ratio, duplex, dual PID set)          S = Special customer feature</p> <p><b>Input 1</b></p> <p>1 = Thermocouple only (Excluding Type B, R and S)          2 = Universal signal conditioner</p> <p><b>Input 2</b></p> <p>0 = None          1 = Thermocouple only (Excluding Type B, R and S)          2 = Universal signal conditioner          3 = Slidewire feedback          4 = Current transformer<sup>②</sup>          5 = Digital contact event (One digital event is standard on all units)</p> <p><b>Output 1</b></p> <p>B = Solid state relay, Form A, 0.5A, with RC suppression          C = Switched dc or open collector, isolated          D = Electromechanical relay<sup>①</sup>, Form C, 5A with RC suppression          E = Electromechanical relay<sup>①</sup>, Form C, 5A without contact suppression          F = Universal process, 0-5V<math>\approx</math>(dc), 1-5V<math>\approx</math>(dc), 0-10V<math>\approx</math>(dc), 0-20mA, 4-20mA, isolated          K = Solid state relay, Form A, 0.5A, without contact suppression</p> <p><b>Output 2</b></p> <p>A = None          B = Solid state relay, Form A, 0.5A, with RC suppression          C = Switched dc or open collector, isolated          D = Electromechanical relay<sup>①</sup>, Form C, 5A with RC suppression          E = Electromechanical relay<sup>①</sup>, Form C, 5A without contact suppression          F = Universal process 0-5V<math>\approx</math>(dc), 1-5V<math>\approx</math>(dc), 0-10V<math>\approx</math>(dc), 0-20mA, 4-20mA, isolated          K = Solid state relay, Form A, 0.5A, without contact suppression          T = External signal conditioner power supply, 5, 12 or 20V<math>\approx</math>(dc) @ 30mA</p> <p><b>Output 3</b></p> <p>A = None          B = Solid state relay, Form A, 0.5A, with RC suppression          C = Switched dc, isolated          J = Electromechanical relay<sup>①</sup>, Form A or B, 5A without contact suppression          K = Solid state relay, Form A, 0.5A without contact suppression          M = Retransmit, 0-20mA, 4-20mA          N = Retransmit, 0-5V<math>\approx</math>(dc), 1-5V<math>\approx</math>(dc), 0-10V<math>\approx</math>(dc)          T = External signal conditioner power supply, 5, 12 or 20V<math>\approx</math>(dc) @ 30mA</p> <p><b>Output 4</b></p> <p>A = None          B = Solid state relay, Form A, 0.5A, with RC suppression          C = Switched dc or open collector, isolated          D = Electromechanical relay<sup>①</sup>, Form C, 5A with RC suppression          E = Electromechanical relay<sup>①</sup>, Form C, 5A without contact suppression          K = Solid state relay, Form A, 0.5A without contact suppression          R = EIA/TIA-232 communications, opto-isolated          S = EIA/TIA-485/EIA/TIA-422 communications, opto-isolated          U = EIA/TIA-232/EIA/TIA-485 software selectable          T = External signal conditioner power supply, 5, 12 or 20V<math>\approx</math>(dc) @ 30mA</p> <p><b>Display</b></p> <p>GG = Green/Green displays          GR = Green/Red displays          RG = Red/Green displays          RR = Red/Red displays          XX = Custom overlays or default settings</p>	<p><b>9 8</b> - - - - -</p>
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Single-Loop Auto-Tuning PID

# Auto-Tuning PID Controllers

## SERIES 988/989

### Dimensions

Vertical Orientation

#### Overall

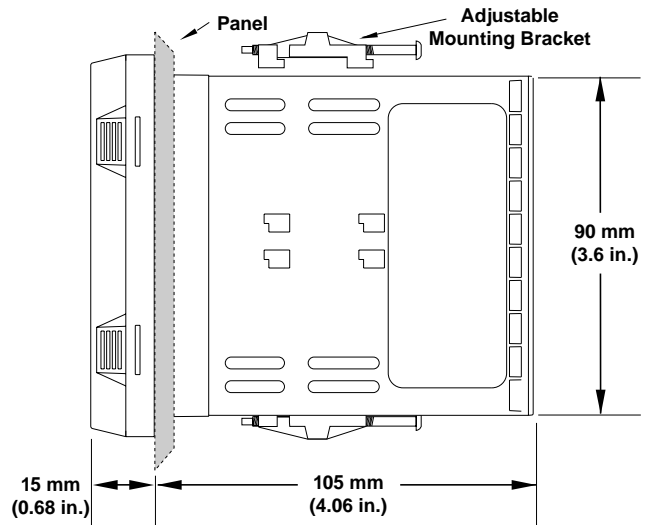
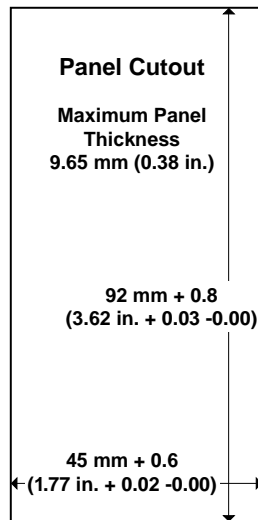
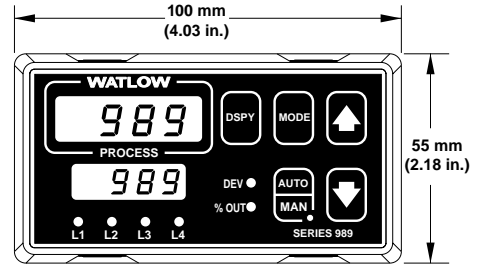
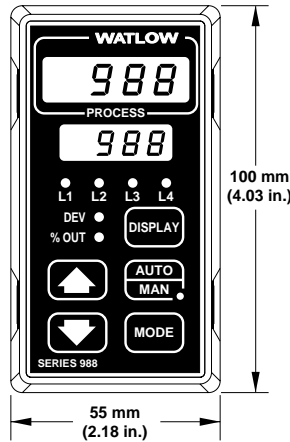
Height: 100 mm (4.03 in.)  
 Width: 55 mm (2.18 in.)  
 Depth: 120 mm (4.74 in.)

#### Bezel

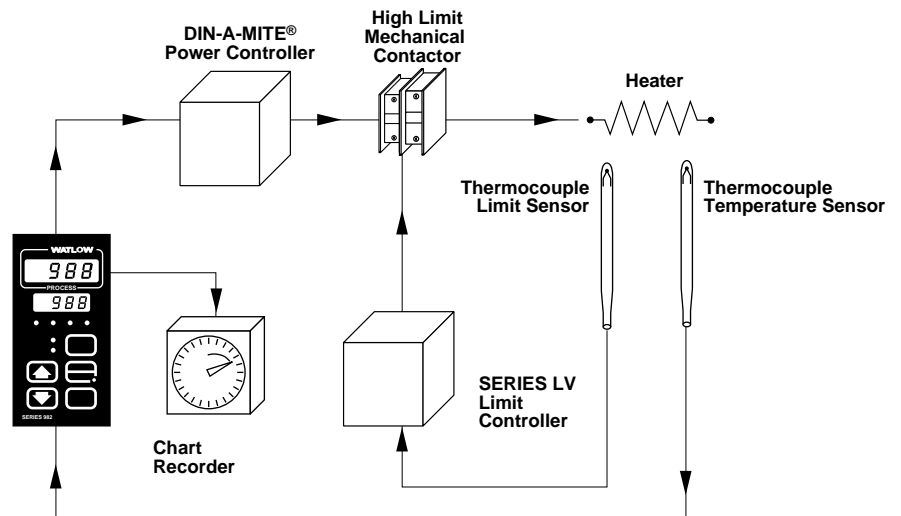
Height: 100 mm (4.03 in.)  
 Width: 55 mm (2.18 in.)  
 Depth: 15 mm (0.68 in.)

#### Chassis

Height: 90 mm (3.6 in.)  
 Width: 45 mm (1.7 in.)  
 Depth: 105 mm (4.06 in.)



### System Diagram



## Auto-Tuning PID Controllers

### SERIES F4P

The SERIES F4P ¼ DIN temperature process controllers offer the performance and features to meet a wide range of industrial processing needs. The F4P process controllers are ideally suited for semiconductor manufacturing equipment, plastics processing and packaging equipment and industrial process control applications.

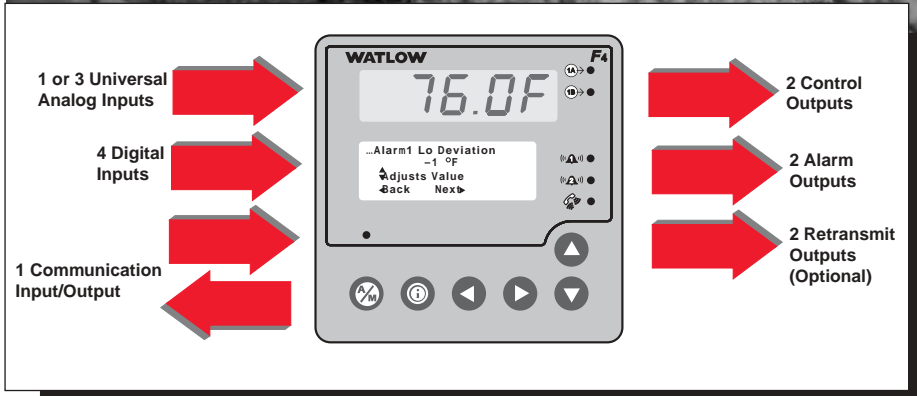
This competitively priced controller features a four line, high definition LCD interface display along with an information key that makes set up and control operation significantly easier with less chance for error. A 16 bit microprocessor supports all the accuracy and performance advantages you have come to expect from a Watlow controller.

The enhanced software option enables the SERIES F4P to support complex control applications such as cascade, ratio and differential control.

The four digital inputs can be used to remotely modify the operation of the controller or enable the display of pre-defined operator messages. Advanced features include cascade, ratio, differential, slidewire and retransmit options.

Serial communication and dual alarm relays are included in the base unit. The SERIES F4P is packaged with a NEMA 4X front face to withstand harsh environments and a four inch deep case with removable connectors for wiring convenience.

The SERIES F4P controller is manufactured by ISO 9001 registered Watlow Winona and is backed with a three-year warranty.



#### Features and Benefits

##### Guided set-up

- Removes “guess work” from the set up process
- Saves time by reducing programming errors

##### High definition, four-line LCD display

- Simplifies the set up process and operations
- Quickly and easily identifies process, alarm and set point values

##### Information “I” key

- Displays essential elements from the user manual on board

##### Customized menuing

- Quickly displays up to 16 parameters
- Allows users to create custom messaging and easily identify key events or alarms

##### High performance 16-bit microprocessor

- Provides precise process control with 20Hz update rate (input 1)
- Calibration accuracy of +/- 0.1 percent of span

##### Universal input

- Allows application versatility
- Eliminates the need for dip switches

##### Modbus™ communications ready

- Equipped to handle RS-232 or EIA-485 communications

##### Field upgradeable firmware

- Downloads available @ no charge from [www.watlow.com/F4](http://www.watlow.com/F4)
- Reduces downtime
- Eliminates the need for an RMA

# Auto-Tuning PID Controllers

## SERIES F4P

### General Purpose Control Operation

The SERIES F4P temperature process controller is a single channel PID controller that supports either closed or open loop operation. The design utilizes the latest technology to provide a controller capable to meeting very complex processing needs while maintaining an easily understood operator interface.

Full non-abbreviated parameter choices are displayed using a four line liquid crystal display. The display is back lit for wide angle viewing. The firmware guides the operator through parameter choices for feature configuration. An information key (I) provides the operator with detailed help information regarding the parameter or feature being configured. The main page menu can be programmed to display output power through 16 control variables including: bar graphs, set points and operating ranges. Up to four programmable messages can be activated remotely to let the operator know that the process requires their attention.

Five sets of PID values can be auto-tuned to support varying system reaction over the complete operating range. Up to 10 offset points can be programmed to compensate for differences between the actual process value and sensor readings caused by sensor placement.

### Control Inputs

Up to three universal analog inputs are supported. These inputs are configured through software to support thermocouples, RTDs and process (voltage/current) sensors. Auxiliary inputs 2 and 3 can function as a remote set point input, sources for retransmission or as the outer loop for cascade operation.

### Digital Inputs

These four inputs are programmable and can be used to remotely modify the operation of the controller as well as displaying pre-programmed messages on the operations display.

### Control Outputs

Heat/cool or reverse/direct action is supported. Time based outputs can be configured for variable burst fire or a cycle time can be selected. On-off boost heat or boost cool operation is also supported. Boost operation is enabled based on load power requirements.

### Alarms

Two alarms are included in the base unit. These alarms are programmable as process, deviation or rate.

### Serial Communications

Both EIA-232 and EIA-485 communications are included in the base unit. The SERIES F4P operates via the Modbus™ RTU protocol. The F4P responds to requests for information only when queried. Baud rate selections are 9600 or 19200.

### Retransmit

Up to two optional programmable voltage or current signal retransmit outputs are supported. Retransmit sources include up to three process variables, set point and output percent power.

### Enhanced Control Operation

When the enhanced operation option is ordered, the F4P process controller is supplied with two additional universal analog inputs (inputs 2 and 3) and enhanced firmware to support numerous features that utilize the two additional inputs. The enhanced control option can be configured to support cascade control, differential control, ratio control and slidewire valve control. The enhanced control option can also alternate between control inputs, display up to three process variables and support remote set point operation.

In this sample application the SERIES F4P process controller utilizes the enhanced cascade control feature to heat lube oil to 51.6°C (125°F). Cascade control is a control strategy in which one control loop provides the set point for another loop. It allows the process or part temperature to be reached quickly while minimizing overshoot. Cascade is used to optimize the performance of thermal

systems with long lag times. Input 3 measures the lube oil temperature before it leaves the tank. Input 1 measures the heater temperature. The input 3 process value is compared to the set point which generates an internal set point used to control the heater.

### Specifications

#### Universal Analog Inputs 1 (2 and 3 optional)

- Update rates: IN1 = 20Hz, IN2 and IN3 = 10Hz

#### Thermocouple

- Type J, K, T, N, C (W5), E, Pt 2, D (W3), B, R, S

#### RTD

- 2- or 3-wire platinum, 100Ω
- JIS or DIN-curves, 1.0 or 0.1 indication
- 500 or 1KΩ RTD available

#### Process

- Input resolution ≈ 50,000 bits at full scale
- Range selectable: 0-10V<sub>rms</sub>(dc), 0-5V<sub>rms</sub>(dc), 1-5V<sub>rms</sub>(dc), 0-50mV, 0-20mA, 4-20mA
- Voltage input impedance 20KΩ
- Current input impedance 100Ω

#### Digital Inputs (4)

- Update rate = 10Hz
- Contact or dc voltage; 36V<sub>rms</sub>(dc) max
- 10KΩ input impedance

#### Control Outputs (1A, 1B)

- Update rate = 20Hz

#### Open Collector/Switched dc

- Internal load switching (nominal): Switched dc, 22 to 28V<sub>rms</sub>(dc), limited @ 30mA
- External load switching max.: Open collector 42V<sub>rms</sub>(dc) @ 0.5A

#### Solid-state Relay

- Zero switched, optically coupled, 0.5A @ 24V<sub>rms</sub>(ac) minimum, 253V<sub>rms</sub>(ac) max.

# Auto-Tuning PID Controllers

## SERIES F4P

### Specifications Cont.

#### Electromechanical Relay

- Form C, 2A @ 250V~(ac) or 30V=(dc) max.
- Resistive or inductive load
- Without contact suppression

#### Process Outputs (Optional Retransmit)

- Update rate = 1Hz
- User-selectable 0-10V=(dc), 0-5V=(dc), 1-5V=(dc) @1KΩ min., 0-20mA, 4-20mA @ 800Ω max.
- Resolution:  
dc ranges = 2.5mV nominal  
mA ranges = 5μA nominal
- Calibration accuracy:  
dc ranges = ±15mV  
mA ranges = ±30μA
- Temperature stability 100ppm/°C

#### Alarm Outputs

- Output update rate 1Hz
- Electromechanical relay, Form C, 2A @ 30V=(dc) or 240V~(ac) max.

#### Communications

- EIA-232 and EIA-485 serial communications with Modbus™ RTU protocol. 9600 or 19.2K baud rate

#### Safety and Agency Approvals

- UL®/C-UL® 916-listed, File # E185611 process control equipment
- NEMA 4X and IP65
- CE to EN 61010-1 and 61326

#### Terminals

- Touch-safe, removable terminal blocks, accepts 12 to 22-gauge wire

#### Power

- 100-240V~(ac), -15 percent, +10 percent; 50/60Hz, ±5 percent
- 24-28V=(ac/dc), -15 percent, +10 percent (order option)

- 39VA maximum power consumption
- Data retention upon power failure via nonvolatile memory. Sensor input isolation from input to input to output to communication circuitry is 500V~(ac).

#### Operating Environment

- 0 to 65°C (32 to 149°F)
- 0 to 90 percent RH, non-condensing
- Storage temperature: -40 to 70°C (-40 to 158°F)

#### Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span ±1°C @ 25°C ±3°C (77°F ±5°F) ambient, and rated line voltage ±10 percent with the following exceptions:

Type T: 0.12 percent of span for -200°C to -50°C (-328°F to -58°F)

Types R and S: 0.15 percent of span for 0°C to 100°C (32°F to 212°F)

Type B: 0.24 percent of span for 870°C to 1700°C (1598°F to 3092°F)

- Accuracy span: Less than or equal to operating ranges, 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.1°F/°F) rise in ambient for thermocouples
- ±0.05°C/°C (±0.05°F/°F) rise in ambient for RTD sensors

#### Displays

- Process: 5, seven-segment LED red
- Control interface display: high-definition LCD green

#### Sensor Operating Ranges

Type J:	0 to 815°C (32 to 1500°F)
Type K:	-200 to 1370°C (-328 to 2500°F)
Type T:	-200 to 400°C (-328 to 750°F)
Type N:	0 to 1300°C (32 to 2372°F)

Type E:	-200 to 800°C (-328 to 1470°F)
Type C:	0 to 2315°C (32 to 4200°F)
Type D:	0 to 2400°C (32 to 4352°F)
Type Pt 2:	0 to 1395°C (32 to 2543°F)
Type R:	0 to 1760°C (32 to 3200°F)
Type S:	0 to 1760°C (32 to 3200°F)
Type B:	0 to 1816°C (32 to 3300°F)
RTD (DIN):	-200 to 800°C (-328 to 1472°F)
RTD (JIS):	-200 to 800°C (-328 to 1166°F)
Process:	-19,999 to 30,000 units

#### Sensor Accuracy Ranges

##### Input ranges

Type J:	0 to 815°C (32 to 1500°F)
Type K:	-200 to 1370°C (-328 to 2500°F)
Type T:	-200 to 400°C (-328 to 750°F)
Type N:	0 to 1300°C (32 to 2372°F)
Type E:	-200 to 800°C (-328 to 1470°F)
Type C:	0 to 2315°C (32 to 4200°F)
Type D:	0 to 2400°C (32 to 4352°F)
Type Pt 2:	0 to 1395°C (32 to 2543°F)
Type R:	0 to 1760°C (32 to 3200°F)
Type S:	0 to 1760°C (32 to 3200°F)
Type B:	0 to 1816°C (32 to 3300°F)
RTD (DIN):	-200 to 800°C (-328 to 1472°F)
RTD (JIS):	-200 to 800°C (-328 to 1166°F)
Process:	-19,999 to 30,000 units

# Auto-Tuning PID Controllers

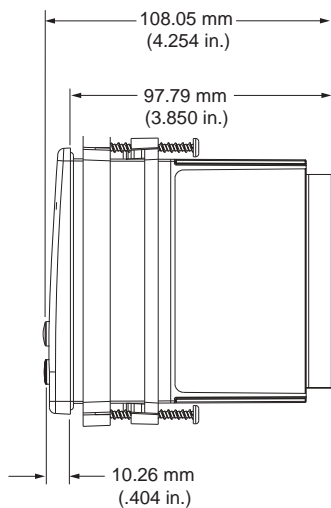
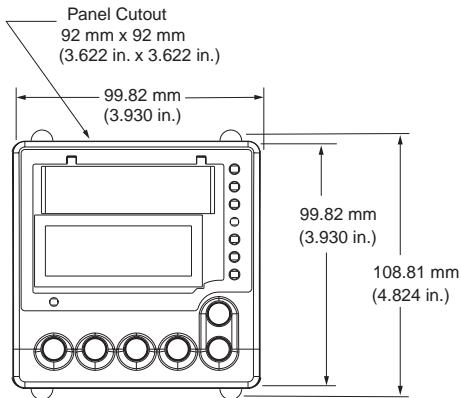
F.O.B.: Winona, Minnesota

## SERIES F4P

### Ordering Information

To order, complete the code number to the right with the information below:

**SERIES F4P** = ¼ DIN temperature process controller



### Specifications Cont.

#### Dimensions

- Width x height x depth  
99 mm x 99 mm x 97 mm panel mount (3.93 in. x 3.93 in. x 3.85 in.)

### SERIES F4P

#### Temperature/Process Controller

Single channel temperature/process controller, two alarms, EIA-232/485 comms, four event inputs

#### Power Supply

H = 100-240V $\approx$ (ac/dc)  
L = 24-28V $\approx$ (ac/dc)

#### Output 1A

C = Open collector/switched dc  
E = Electromechanical relay, Form C  
2 amp without contact suppression  
K = Solid state Form A 0.5 amp relay without contact suppression  
F = Process, 0-5, 1-5, 0-10V $\approx$ (dc), 0-20mA, 4-20mA

#### Output 1B

A = None  
E = Electromechanical relay, Form C  
2A without contact suppression  
C = Open collector/switched dc  
K = Solid state Form A 0.5 amp relay without contact suppression  
F = Process, 0-5, 1-5, 0-10V $\approx$ (dc), 0-20mA, 4-20mA

#### Enhanced Control Operation

A = Standard control operation  
B = Enhanced control operation, dual universal inputs, cascade, ratio, duplex, differential, slidewire

#### Auxiliary Retransmit Module

0 = None  
1 = Single retransmit output 0-5, 1-5, 0-10V $\approx$ (dc), 0-20mA, 4-20mA  
2 = Dual retransmit outputs 0-5, 1-5, 0-10V $\approx$ (dc), 0-20mA, 4-20mA

#### Language and RTD Options

1 = English with 100 $\Omega$ RTD	5 = English with 500 & 1K $\Omega$ RTD
2 = German with 100 $\Omega$ RTD	6 = German with 500 & 1K $\Omega$ RTD
3 = French with 100 $\Omega$ RTD	7 = French with 500 & 1K $\Omega$ RTD
4 = Spanish with 100 $\Omega$ RTD	8 = Spanish with 500 & 1K $\Omega$ RTD

#### Display and Custom Options

RG= Red/Green display  
XX = Custom options, software, setting parameters, overlays

F4 P - A -



# Auto-Tuning PID Controllers

## SERIES PD Single Loop

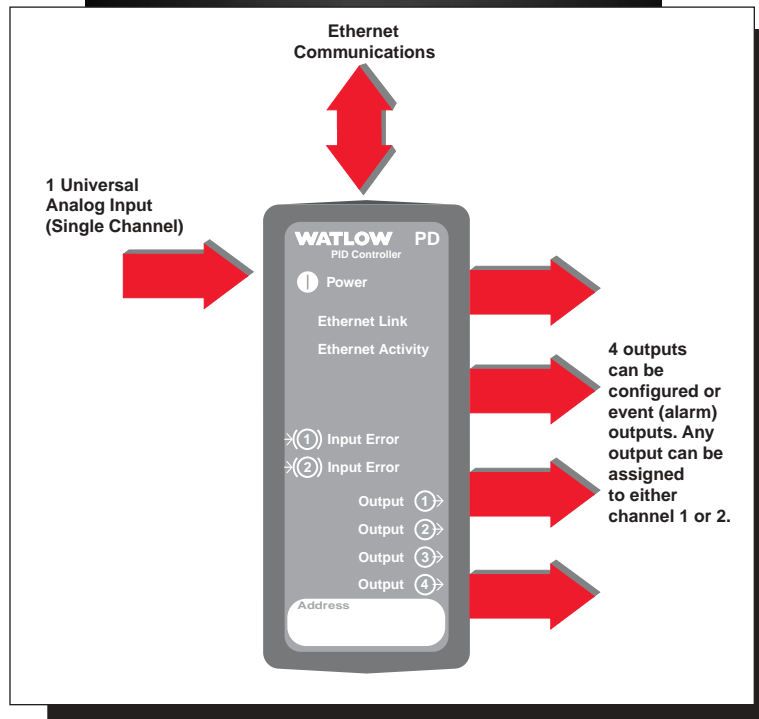
Watlow's new SERIES PD controller utilizes embedded Ethernet technology to provide a convenient, economical means for setting up and viewing key process variables such as temperature, pressure and humidity. The DIN-rail mount SERIES PD controller offers up to four control/alarm outputs, as well as a digital/current transformer input.

Watlow's SERIES PD controller is ideally suited for a wide range of temperature or process control applications where the operator interface is supported from a remote location. The SERIES PD provides interfacing via embedded firmware which serves dedicated web pages. These pages support key functions including operation, alarm monitoring, configuration and are displayed using standard web browser software. The SERIES PD is also capable of generating e-mail messages for remote alarm notification.

Ethernet-based products are rapidly gaining popularity in industrial applications because they allow an instantaneous exchange of information between processing equipment and the company's management system.

Advanced features of the SERIES PD controller include internal data logging of key control parameters, INFOSENSE-P technology, heater burn out detection and an enhanced control algorithm.

The SERIES PD controller is backed by a three-year warranty from Watlow Winona and is UL® 508, C-UL®, CSA and CE approved.



Single-Loop  
Auto-Tuning PID

# Auto-Tuning PID Controllers

## SERIES PD Single Loop

### Features and Benefits

#### Ethernet connectivity

- Convenient, easy to use operator interface
- Simplified process monitoring

#### DIN-rail sub panel mounting

- Quick, economic installation

#### Watlow INFOSENSE™ sensor technology

- INFOSENSE™ technology improves sensor accuracy by a minimum of 50 percent

#### Advanced control algorithm

- Tighter process control

#### Heater burn out detection

- Improved process yields

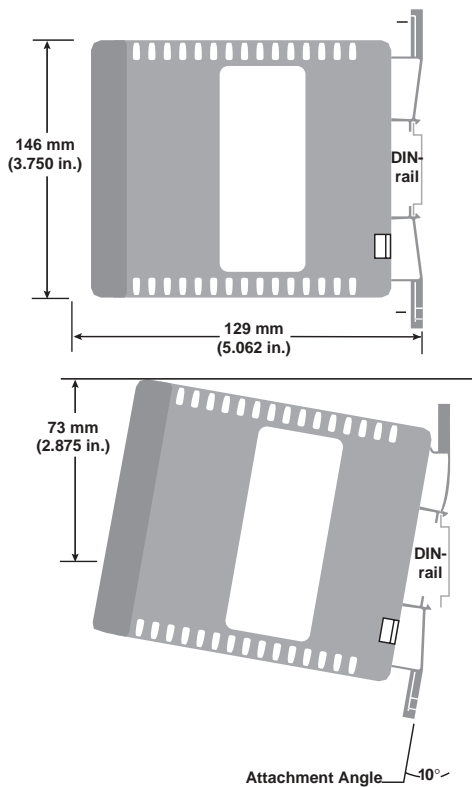
#### Internal data logging

- Reduces external hardware demands

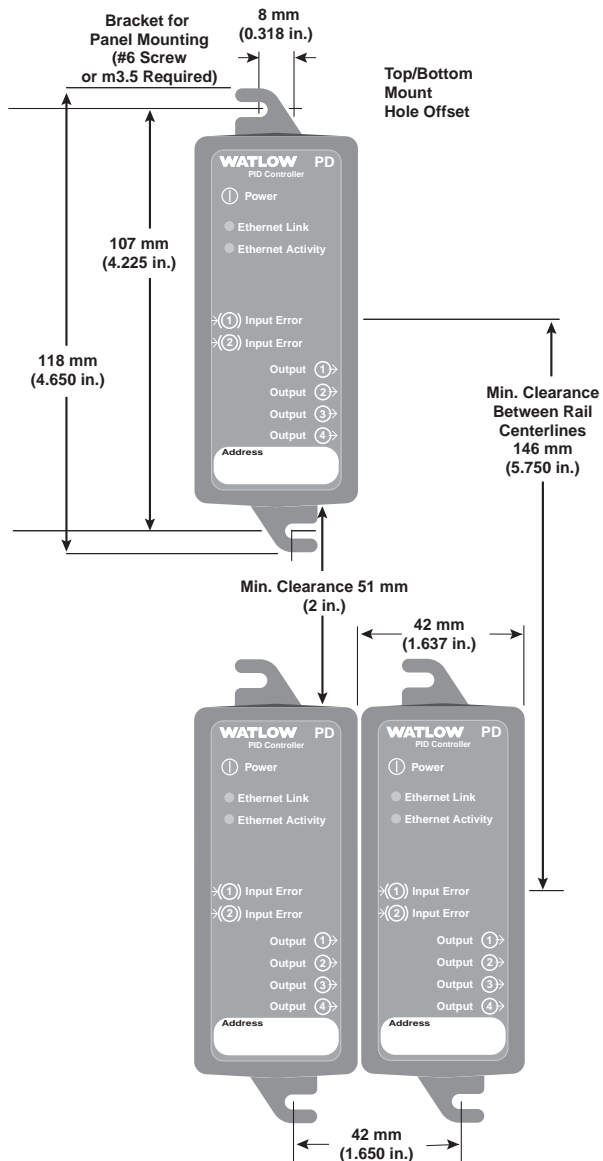
#### Virtual or hardware alarms with e-mail delivery

- Remote alarm notification

### Side View



### Front View



# Auto-Tuning PID Controllers

## SERIES PD Single Loop

### Specifications

#### Power

- 24V $\approx$ (ac/dc), +10/-15 percent, 50/60Hz,  $\pm$ 5 percent
- 12VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Environment

- 0 to 65°C (32 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

#### Accuracy

- Calibration accuracy and sensor conformity:  $\pm$ 0.1 percent of span,  $\pm$ 1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C  $\pm$ 3°C (77°F  $\pm$ 5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability:  $\pm$ 0.1°C/°C ( $\pm$ 0.2°F/°F) rise in ambient maximum

#### Agency Approvals

- UL® 508, C-UL®, CSA and CE

#### Controller

- Microprocessor based user-selectable control modes
- Single or dual channel universal inputs
- Current transformer inputs/digital inputs
- Up to four programmable outputs
- Update rates, inputs = 10Hz, outputs = 10Hz

#### Operator Interface

- Browser based HMI (Human Machine Interface)

#### Wiring Termination

- Touch safe removable terminals
- 14 to 22 AWG

### Universal Inputs (Electrically Isolated)

- Thermocouple, grounded or ungrounded sensors
- RTD 2-or 3-wire, platinum, 100 $\Omega$  @ 0°C calibration to DIN-curve (0.00385  $\Omega/\Omega/^\circ\text{C}$ )
- Process 0-20mA @ <100 $\Omega$ , or 0-10V $\approx$ (dc) @ 10k $\Omega$  input impedance (50,000 bits @ full scale)

### Digital Inputs

- Contact or dc voltage
- 10K $\Omega$  input impedance

### Current Transformer Inputs

- 0 to 50mA CT input into 100 $\Omega$  impedance

### Allowable Input Operating Range

Type J:	-200 to 1200°C	(-328 to 2192°F)
Type K:	-270 to 1370°C	(-454 to 2500°F)
Type T:	-270 to 400°C	(-454 to 750°F)
Type N:	-270 to 1300°C	(-454 to 2372°F)
Type E:	-270 to 975°C	(-454 to 1790°F)
Type C:	0 to 2315°C	(32 to 4200°F)
Type D:	0 to 2315°C	(32 to 4200°F)
Type PTII:	0 to 1395°C	(32 to 2543°F)
Type R:	0 to 1760°C	(32 to 3200°F)
Type S:	0 to 1760°C	(32 to 3200°F)
Type B:	0 to 1815°C	(32 to 3300°F)
RTD (DIN):	-200 to 800°C	(-328 to 1470°F)
Process V:	0 to 10V $\approx$ (dc)	
Process I:	0 to 20mA	

### Control/Alarm Outputs (1 - 4)

- User selectable as: on-off, P, PI, PD, PID, heat, cool, alarm action or retransmit with process output type hardware
- Open collector/switched dc
- Open collector 42V $\approx$ (dc) maximum @ 0.5A
- Switched dc 22 to 28V $\approx$ (dc) limited @ 30mA
- Solid state relay, Form A, 0.5A @ 24V $\sim$ (ac) minimum, 264V $\sim$ (ac) maximum, opto-isolated, without contact suppression
- User-selectable 0-10V $\approx$ (dc), 1K $\Omega$  minimum, scalable, 0-20mA @ 800 $\Omega$  maximum, scalable
- Electromechanical relay. Form C, rated 5A @ 120V $\sim$ (ac) or 5A @ 240V $\sim$ (ac) or 5A @ 30V $\approx$ (dc)

### Communications

- TCP/IP/Ethernet
- Modbus™ TCP
- Ethernet RJ 45 connector, 10 base T
- HTTP interface
- DHCP, auto IP or fixed IP address

### Dimensions

- Width x height x depth  
42 mm x 116 mm x 132 mm  
(1.64 in. x 4.56 in. x 5.19 in.)  
DIN-rail or chassis mount, DIN-rail spec DIN 5022  
35 mm x 7.5 mm (1.38 in. x 0.30 in.)

# Auto-Tuning PID Controllers

F.O.B.: Winona, Minnesota

## SERIES PD Single Loop

### Ordering Information

To order, complete the model number on the right with the information below.

	<b>P D S</b> - - - - <b>A</b>
<b>Auxiliary Inputs</b> _____	
1 = Dual digital inputs	
2 = One CT input and one digital input	
3 = Dual CT inputs (dual channel only)	
<b>Output 1</b> _____	
C = Switched dc, open collector	
K = SSR, Form A, 0.5A	
F = Universal process	
J = Mechanical relay, Form A, 2A <sup>①</sup>	
<b>Output 2</b> _____	
A = None	
C = Switched dc, open collector	
K = SSR, Form A, 0.5A	
E = Mechanical relay, Form C, 2A <sup>①</sup>	
<b>Output 3</b> _____	
A = None	
C = Switched dc, open collector	
K = SSR, Form A, 0.5A	
F = Universal process	
E = Mechanical relay, Form C, 2A <sup>①</sup>	
<b>Output 4</b> _____	
A = None	
C = Switched dc, open collector	
K = SSR, Form A, 0.5A	
E = Mechanical relay, Form C, 2A <sup>①</sup>	
<b>On Board Data Logging</b> _____	
0 = None	
1 = 16 megabytes of memory	
<b>Custom Options</b> _____	
AA = Watlow logo	
BB = No logo	

<sup>①</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

## Auto-Tuning PID Controllers

### MICRODIN®

The Watlow MICRODIN® SERIES controllers provide precise measurement and control with easy communication to personal computers and programmable logic controllers used in laboratories and industry. This superior controller is designed with simple and straightforward commands to make it easy to set up and operate. The MICRODIN is a high-performance controller that is capable of stand-alone operation and uses the popular Modbus™ communications protocol with a standard EIA-485 serial interface for parameter set up and viewing.

The behind-the-panel, DIN-rail mount design of the MICRODIN controller provides significant savings by eliminating the need for expensive panel hole punching and by simplifying panel wiring. Combine these savings with touch-safe removable connectors and the result is low installation costs and minimal down time for service and repair.

MICRODIN is the perfect solution for applications that require top-of-the-line dedicated temperature control loops with no user interface integrated into a complete control system using digital communications. The absence of an operator interface makes the MICRODIN excellent for use with PC-based software, such as WATVIEW.

#### Performance Capabilities

- Accuracy to  $\pm 0.1$  percent of span
- Operating environment  
0 to 65°C (32 to 149°F)

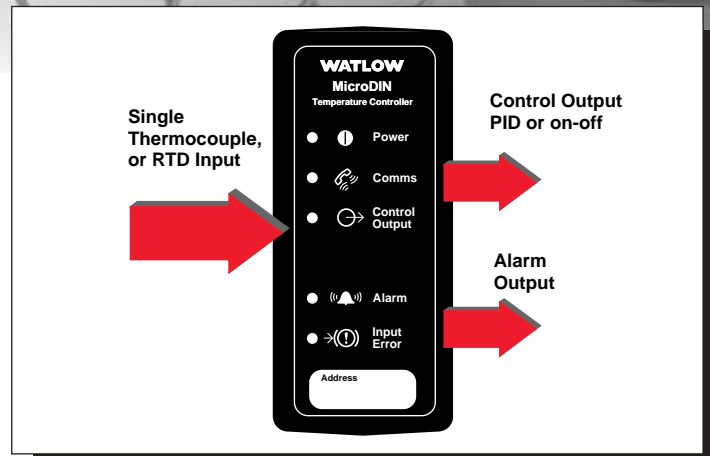
#### Features and Benefits:

##### EIA-485 serial communications with Modbus™ RTU protocol

- Provides easy remote set up and monitoring

##### DIN-rail/sub panel mounting

- Offers fast, low cost installation, eliminating expensive panel hole punch operations



#### Touch-safe removable connectors

- Easy and quick to remove for replacement and servicing

#### Single control output with alarm output

- Provides simple programming and operation of controller

#### Discrete loops of control, auto-tuning

- Gives performance equal to discrete panel-mount controllers, highly reliable

#### 10Hz update rate

- Improves input sampling and controllability

#### Applications

- Food processing
- Medical and dental equipment
- Packaging
- Plastics processing
- Scientific instrumentation

# Auto-Tuning PID Controllers

## MICRODIN

### Specifications

#### Control Mode

- Microprocessor-based, user selectable control modes
- Single input, single output
- Heat or cool auto-tuning

#### Agency Approvals

- UL®, C-UL® 508 recognized, File #E102269 Industrial Control Equipment
- CE to EN 61010

#### Operator Interface

- EIA-485 serial communications with Modbus™ RTU protocol
- 9600, 19200 user selectable baud rates
- One to 63 user selectable address range

#### Accuracy

- Calibration accuracy and sensor conformity:  $\pm 0.1$  percent of span  $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$  ( $\pm 1$  @  $77^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ) ambient, and rated line voltage  $\pm 10$  percent with the following exceptions:
  - Type T: 0.12 percent of span for  $-200^{\circ}\text{C}$  to  $-50^{\circ}\text{C}$  ( $-328^{\circ}\text{F}$  to  $-58^{\circ}\text{F}$ )
  - Types R and S: 0.15 percent of span for  $0^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  ( $32^{\circ}\text{F}$  to  $212^{\circ}\text{F}$ )
  - Type B: 0.24 percent of span for  $870^{\circ}\text{C}$  to  $1700^{\circ}\text{C}$  ( $1598^{\circ}\text{F}$  to  $3092^{\circ}\text{F}$ )
- Accuracy span: Less than or equal to operating ranges,  $540^{\circ}\text{C}$  ( $1000^{\circ}\text{F}$ ) minimum
- Temperature stability:  $\pm 0.2^{\circ}\text{C}/^{\circ}\text{C}$  ( $\pm 0.2^{\circ}\text{F}/^{\circ}\text{F}$ ) rise in ambient maximum for thermocouples,  $\pm 0.05^{\circ}\text{C}/^{\circ}\text{C}$  ( $\pm 0.05^{\circ}\text{F}/^{\circ}\text{F}$ ) rise in ambient maximum for RTD sensors
- Voltage stability:  $\pm 0.01$  percent of span per percent of rated line voltage

### Sensors Inputs

- Sensor input sampling rate: 10 samples/second 10Hz
- Thermocouple, grounded or ungrounded sensors
- RTD 2- or 3-wire, platinum,  $100\Omega$  @  $0^{\circ}\text{C}$  calibration to JIS curve ( $0.003916\Omega/\Omega/^{\circ}\text{C}$ ) or DIN-curve ( $0.00385\Omega/\Omega/^{\circ}\text{C}$ )
- Sensor break protection de-energizes control output to protect system or selectable bumpless transfer to manual operation
- $^{\circ}\text{F}$  or  $^{\circ}\text{C}$ , user selectable
- Sensor operating ranges:

Type B T/C	0 to 1816 $^{\circ}\text{C}$ (32 to 3300 $^{\circ}\text{F}$ )
Type C (W5) T/C	0 to 2315 $^{\circ}\text{C}$ (32 to 4200 $^{\circ}\text{F}$ )
Type D (W3) T/C	0 to 2315 $^{\circ}\text{C}$ (32 to 4200 $^{\circ}\text{F}$ )
Type E T/C	-200 to 800 $^{\circ}\text{C}$ (-328 to 1472 $^{\circ}\text{F}$ )
Type J T/C	0 to 815 $^{\circ}\text{C}$ (32 to 1382 $^{\circ}\text{F}$ )
Type K T/C	-200 to 1370 $^{\circ}\text{C}$ (-328 to 2500 $^{\circ}\text{F}$ )
Type N T/C	0 to 1300 $^{\circ}\text{C}$ (32 to 2372 $^{\circ}\text{F}$ )
Pt 2	0 to 1395 $^{\circ}\text{C}$ (32 to 2543 $^{\circ}\text{F}$ )
Type R T/C	0 to 1760 $^{\circ}\text{C}$ (32 to 3200 $^{\circ}\text{F}$ )
Type S T/C	0 to 1760 $^{\circ}\text{C}$ (32 to 3200 $^{\circ}\text{F}$ )
Type T T/C	-200 to 400 $^{\circ}\text{C}$ (-328 to 750 $^{\circ}\text{F}$ )
RTD (DIN)	-200 to 800 $^{\circ}\text{C}$ (-328 to 1472 $^{\circ}\text{F}$ )
RTD (JIS)	-200 to 630 $^{\circ}\text{C}$ (-328 to 1166 $^{\circ}\text{F}$ )
- Tenth degree resolution selectable over sensor operating range within limits of  $-199.9$  to  $999.9$ , except for thermocouple Types B, R and S

### Output 1: User selectable

- On-off; P, PI, PD, PID heat or cool action adjustable switching differential: 1 to 9999 or 0.1 to 999.9  $^{\circ}\text{C}$  or  $^{\circ}\text{F}$
- Proportional band: 0 to 9999, or 0.0 to 999.9  $^{\circ}\text{C}$  or  $^{\circ}\text{F}$
- Integral: 0.00 to 99.99 minutes per repeat
- Reset: 0.00 to 99.99 repeats per minute
- Derivative/rate: 0.00 to 9.99 minutes
- Cycle time: 0.1 to 60.0 seconds

### Output 2: User selectable

- Process or deviation alarm with flashing alarm status indicator
- Alarm with separate high and low set points
- Hysteresis: 1 to 9999 $^{\circ}$  switching differential

### Primary Control Output (heating or cooling)

- Output update rate: 10 per second, 10Hz (maximum)
- Internal load switching (nominal): Switched dc (isolated) signal, 22 to 28V $\approx$ (dc), current limited @ 30mA
- Overload current and short circuit protection
- External load switching (maximum): Open collector up to 42V $\approx$ (dc) @ 1A with external power supply

### Alarm Output:

- Output update rate 2 per second (2Hz)
- Electromechanical relay, Form A, 2A @ 30V $\approx$ (dc) or 240V $\sim$ (ac),
- Alarm output can be latching or non-latching, and process or deviation with separate high and low values. Alarm silencing (inhibit) on power-up

### Electromagnetic Compatibility and Immunity

- Complies with EN 50081, EN 50082

# Auto-Tuning PID Controllers

F.O.B.: Winona, Minnesota

## MICRODIN

### Specifications Cont.

#### Terminals

- Touch-safe set screw type, accepts 26-14 gauge wire

#### Power

- 24-28V $\approx$ (ac/dc), -15 percent, +10 percent (20.4 to 30.8V $\approx$ (ac/dc); 50/60Hz,  $\pm$ 5 percent for V $\sim$ (ac)
- 5VA typical power consumption
- Data retention upon power failure via nonvolatile memory
- Sensor input isolation to switched dc output and communication circuitry 500V $\sim$ (ac) dielectric

#### Operating Environment

- 0 to 65°C (32 to 149°F)
- 0 to 90 percent RH, non-condensing
- Storage temperature: -40 to 70°C (-40 to 158°F)

### Ordering Information

To order, complete the code number on the right with the information below:

UD1A-1CES-

**MICRODIN** = DIN-rail mount temperature control. 1 sensor input, 1 control output, 1 alarm output, no operator interface and EIA-485 Modbus™ RTU serial communications with Quick Start Guide.

#### Hardware

1A = Single channel, low voltage<sup>Ⓢ</sup>

#### Input

1 = Type B, C, D, E, J, K, N, Pt 2, R, S, T, 1°RTD, 0.1°RTD (JIS and DIN)

#### Control Output

C = Switched dc, logic signal, non-isolated<sup>Ⓢ</sup>

#### Alarm Output

E = Electromechanical relay, Form A, 2A, w/o contact suppression<sup>Ⓢ</sup>

#### Communications

S = EIA/TIA-485 communications, opto-isolated, Modbus™ RTU protocol

#### Software

00 = Standard  
XX = Custom setup parameters

#### Custom Options

00 = None  
AA = No Watlow logo on front bezel  
XX = Custom bezel or label

<sup>Ⓢ</sup> An IEC 742 rated power supply is required for CE compliance.

<sup>Ⓢ</sup> Electromechanical relays are warranted for 100,000 closures only.

Single-Loop  
Auto-Tuning PID

### Availability

**Stock:** Same day shipment on orders of 10 units or less; 10 working days on orders greater than 10 units.

**Non-Stock:** 10 working days

### Stock List

Code Number	Input	Output 1	Output 2	Power	Front Bezel
UDIA-1CES-0000	T/C and RTD	Switched dc	Relay, 2A	24 to 28 V	English

# Auto-Tuning PID Controllers

## MICRODIN

### Mounting a MICRODIN controller

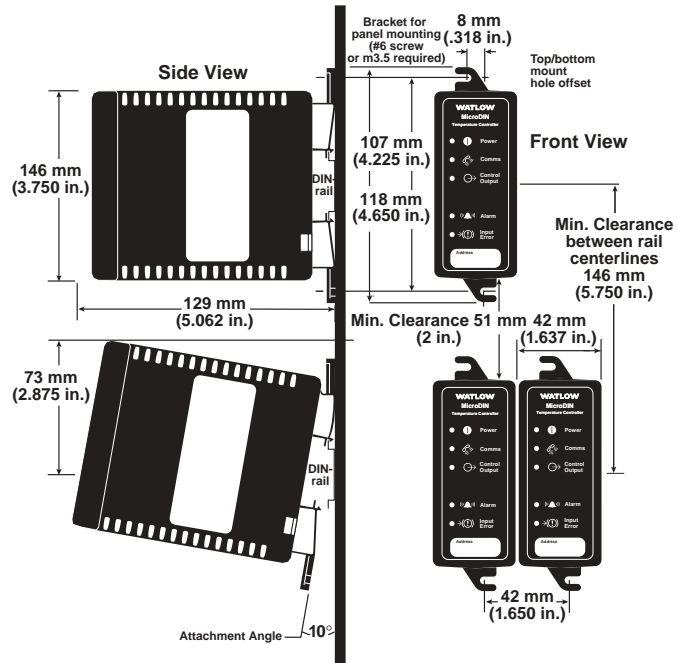
#### Dimensions

##### DIN-rail

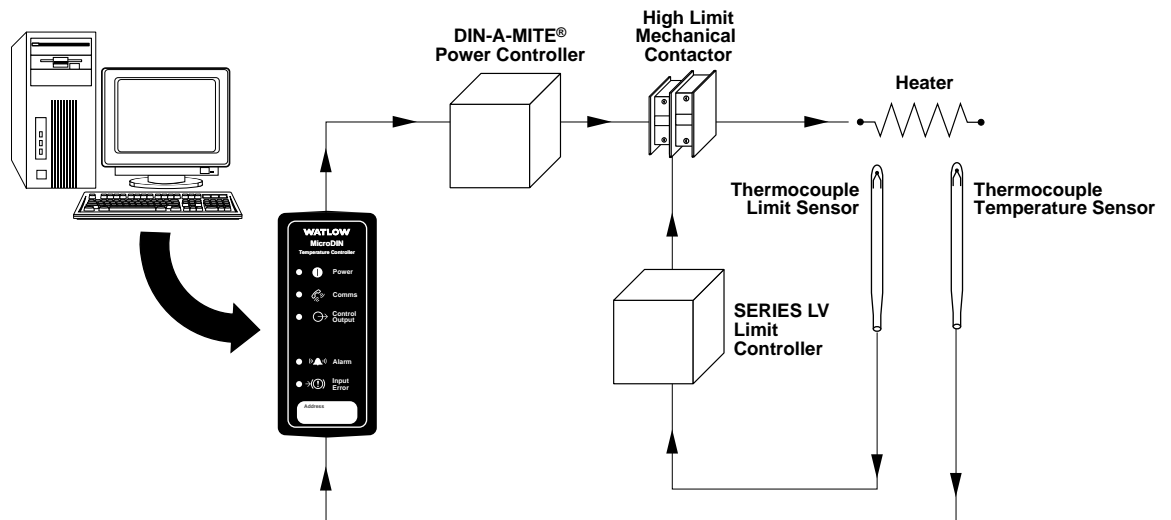
Width:	42 mm	(1.64 in.)
Height:	118 mm	(4.65 in.)
Depth:	132 mm	(5.19 in.)

##### Chassis

Width:	42 mm	(1.64 in.)
Height:	118 mm	(4.65 in.)
Depth:	129 mm	(5.06 in.)



### System Diagram





## On-Off Controllers

### SERIES CV

Watlow's family of microprocessor based temperature controllers provide an economical solution for applications requiring simple on-off control. These controllers are available in a broad range of packaging options, allowing users to select the best version for their individual application. The controllers are available with an operator interface and can be ordered in 1/8 DIN square panel mount or DIN-rail mount configurations.

The SERIES CV temperature controller incorporates a microprocessor design platform. This design provides significant improvements in the performance, repeatability and accuracy offered by Watlow's current line of analog basic temperature controllers.

The SERIES CV controller includes an operator interface for viewing and selecting the set point. A red, four-character seven segment LED displays the set point with a push to show process option. The set point selection is made with a continuous turn rotary encoder. Operating range temperature values are customer definable in the product configuration part number.

The SERIES CV controllers are UL® and C-UL® listed and carry CSA and CE approvals. Watlow's temperature controllers include industry leading service and support and are backed by a three-year warranty.

#### Applications

- Food preparation
- Industrial machinery
- Packaging
- Plastics processing

#### Features and Benefits

##### Adjustable set points

- Offer control flexibility

##### Four character LED display

- Improves set point selection accuracy

##### Multiple mounting options

- Minimize installation time



#### Heat or cool operation

- Provides application flexibility

#### Fahrenheit or Celsius operation with indication

- Offers application flexibility

#### Agency approvals

- Meet certification requirements/compliance

#### Microprocessor based technology

- Ensures accurate repeatable control

#### Specifications

##### On-Off Controller

- Microprocessor based, on-off control mode
- Nominal switching hysteresis, typically 1.7°C (3°F)
- Input filter time: 1 second

##### Operator Interface

- Four digit, seven segment LED displays, 7 mm (0.28 in.) high
- °C or °F indicator LED
- Load indicator LED
- Continuous turn, velocity sensitive rotary encoder for set point adjustment
- Front panel key push for set point or push for show process options

##### Standard Conditions For Specifications

- Rated line voltage, 50 to 60Hz, 0 to 90 percent, RH, non-condensing, 15-minute warm-up
- Calibration ambient range: 25°C (77°F) ±3°C

#### Sensor Input

##### Thermocouple

- Grounded or ungrounded
- Type E, J, K or T thermocouple
- >10 MΩ input impedance
- 250 nV input referenced error per 1Ω source resistance

##### RTD

- 2-wire platinum, 100Ω
- DIN-curve (0.00385 curve)
- 125 μA nominal RTD excitation current

##### Input Accuracy Span Range

Type E:	-200 to 800°C
	(-328 to 1470°F)
Type J:	0 to 750°C
	(32 to 1382°F)
Type K:	-200 to 1250°C
	(-328 to 2282°F)
Type T:	-200 to 350°C
	(-328 to 662°F)
RTD (DIN)	-200 to 800°C
	(-328 to 1472°F)

##### Thermocouple Input

- Calibration accuracy: ±1 percent of input accuracy span, ±1° at standard conditions and actual calibration ambient. Exception: Type T, ±2.4 percent of input accuracy span for -200 to 0°C (-328 to 32°F)
- Temperature stability: ±0.3 degree per degree change in ambient

# On-Off Controllers

F.O.B.: Winona, Minnesota

## SERIES CV

### Specifications Cont.

#### RTD Input

- Calibration accuracy  $\pm 1$  percent of input accuracy span  $\pm 1^\circ$  at standard conditions and actual calibration ambient
- Temperature stability:  $\pm 0.2$  degree per degree change in ambient

#### Allowable Operating Ranges

Type E:	-200	to	800°C
	(-328	to	1470°F)
Type J:	-210	to	1038°C
	(-346	to	1900°F)
Type K:	-270	to	1370°C
	(-454	to	2500°F)
Type T:	-270	to	400°C
	(-454	to	750°F)
RTD (DIN)	-200	to	800°C
	(-328	to	1472°F)

#### Output Types

##### Switched dc (non-isolated)

- Supply voltage maximum: 24V $\approx$ (dc) into an infinite load
- Supply voltage minimum: 5V $\approx$ (dc) at 10mA
- Minimum load impedance: 500 $\Omega$

##### Electromechanical Relay, Form C

- Minimum load current: 100mA
- 8 A @ 240V $\sim$ (ac) or 30V $\approx$ (dc) maximum, resistive
- 250VA pilot duty, 120/240V $\sim$ (ac) maximum, inductive
- Use RC suppression for inductive loads
- Electrical life 100,000 cycles at rated current

#### Agency Approvals

- UL<sup>®</sup> 60730-1 Recognized Temperature Controller and Indicator
- UL<sup>®</sup> 197 Reviewed for Use in Cooking Appliances
- ANSI Z21.23 Gas Appliance Thermostat Approval
- Temperature Control and Indicator CSA 22.2 No. 24

#### Terminals

- 6.3 mm (0.25 in.) quick connect, push on terminal

#### Power

- 24V $\sim$ (ac) +10 percent; -15 percent; 50/60Hz,  $\pm 5$  percent
- 120V $\sim$ (ac) +10 percent; -15 percent; 50/60Hz,  $\pm 5$  percent
- 230 to 240V $\sim$ (ac) +10 percent; -15 percent; 50/60Hz,  $\pm 5$  percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Operating Environment

- 0 to 70°C (32 to 158°F)
- 0 to 90 percent RH, non-condensing
- Storage temperature: -40 to 85°C (-40 to 185°F)

#### Dimensions

- DIN-rail model can be DIN-rail or chassis mount  
DIN-rail spec DIN 50022, 35 mm x 7.5 mm (1.38 in. x 0.30 in.)

Style	Width	Height	Depth
DIN-rail	78.1 mm (3.08 in.)	112.3 mm (4.42 in.)	90.7 mm (3.57 in.)
Square $\frac{1}{8}$ DIN-panel	72.4 mm (2.85 in.)	72.4 mm (2.85 in.)	Behind panel 51.7 mm (2.04 in.)

#### Ordering Information

To order, complete the model number on the right with the information below.

**CV**

**SERIES CV** = On-off controller rotary set point adjustment, four character, seven segment display

**Power Supply**

B = 120V $\sim$ (ac), switched dc output  
 C = 120V $\sim$ (ac), eight amp relay output  
 D = 230 to 240V $\sim$ (ac), switched dc output  
 E = 230 to 240V $\sim$ (ac), eight amp relay output  
 F = 24V $\sim$ (ac), switched dc output  
 G = 24V $\sim$ (ac), eight amp relay output

**Package**

1 = Panel mount square  $\frac{1}{8}$  DIN  
 2 = DIN-rail mount

**Sensor Type and Scale**

H = T/C Type J Fahrenheit (-346 to 1900°F)  
 J = T/C Type J Celsius (-210 to 1038°C)  
 K = T/C Type K Fahrenheit (-454 to 2500°F)  
 L = T/C Type K Celsius (-270 to 1370°C)  
 M = T/C Type T Fahrenheit (-454 to 750°F)  
 N = T/C Type T Celsius (-270 to 400°C)  
 P = RTD Fahrenheit (-328 to 1472°F)  
 R = RTD Celsius (-200 to 800°C)  
 S = T/C Type E Fahrenheit (-328 to 1470°F)  
 T = T/C Type E Celsius (-200 to 800°C)

**Control Type**

H = Heat  
 C = Cool

**Low Set Point Operating Range Value**<sup>①</sup> \_\_\_\_\_

**High Set Point Operating Range Value**<sup>①</sup> \_\_\_\_\_

**Overlay/Customs Options**

A = Standard  
 B = Push to show process  
 C = Push to adjust set point

<sup>①</sup>A (-) is used in the left most digit of the set point operating ranges to indicates a negative temperature value

## On-Off Controllers

### SERIES CF

Watlow's new family of micro-processor based temperature controllers provide an economical solution for applications requiring simple on-off control. These controllers are available in a broad range of packaging options, allowing users to select the best version for their individual application. The controllers are available without an operator interface and can be ordered in square 1/2 DIN panel mount, DIN-rail mount or open board design configurations.

The SERIES CF temperature controller incorporates a micro-processor design platform.

This design provides significant improvements in the performance, repeatability and accuracy offered by Watlow's current line of analog basic temperature controllers.

The SERIES CF controller offers fixed set points and is supplied without an operator interface. Operating set point temperature values are customer definable in the product configuration part number.

The new temperature controllers are UL® and C-UL® listed and carry CSA and CE approvals. Watlow's basic temperature controllers include industry leading service and support and are backed by a three-year warranty.

#### Applications

- Food preparation
- Industrial machinery
- Packaging
- Plastics processing

#### Features and Benefits

##### Fixed set points

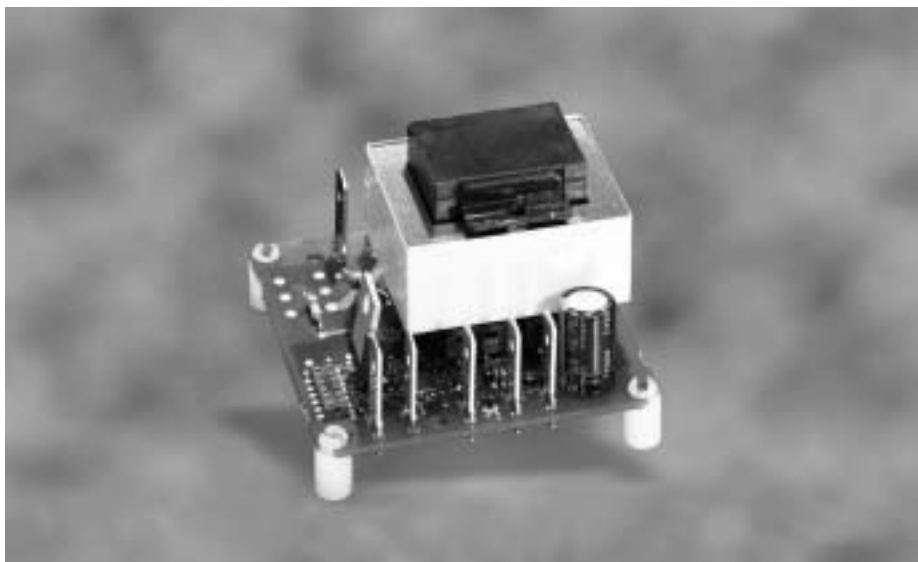
- Provide tamper-proof operation

##### Multiple mounting options

- Minimize installation time

##### Heat or cool operation

- Provides application flexibility



#### Fahrenheit or Celsius operation with indication

- Offers application flexibility

#### Agency approvals

- Meet certification requirements/compliance

#### Microprocessor based technology

- Ensures accurate repeatable control

#### Specifications

##### On-Off Controller

- Microprocessor based, on-off control mode
- Nominal switching hysteresis, typically 1.7°C (3°F)
- Input filter time: 1 second

##### Standard Conditions For Specifications

- Rated line voltage, 50 to 60Hz, 0 to 90 percent RH non-condensing, 15-minute warm-up
- Calibration ambient range: 25°C (77°F) ±3°C

##### Sensor Input

##### Thermocouple

- Grounded or ungrounded
- Type E, J, K or T thermocouple
- >10 MΩ input impedance
- 250 nV input referenced error per 1Ω source resistance

##### RTD

- 2-wire platinum, 100Ω
- DIN-curve (0.00385 curve)
- 125 μA nominal RTD excitation current

##### Input Accuracy Span Range

Type E:	-200 to 800°C
	(-328 to 1470°F)
Type J:	0 to 750°C
	(32 to 1382°F)
Type K:	-200 to 1250°C
	(-328 to 2282°F)
Type T:	-200 to 350°C
	(-328 to 662°F)
RTD (DIN)	-200 to 800°C
	(-328 to 1472°F)

##### Thermocouple Input

- Calibration accuracy: ±1 percent of input accuracy span, ±1° at standard conditions and actual calibration ambient. Exception: Type T, ±2.4 percent of input accuracy span for -200 to 0°C (-328 to 32°F)
- Temperature stability: ±0.3 degree per degree change in ambient

##### RTD Input

- Calibration accuracy ±1 percent of input accuracy span ±1° at standard conditions and actual calibration ambient
- Temperature stability: ±0.2 degree per degree change in ambient

# On-Off Controllers

F.O.B.: Winona, Minnesota

## SERIES CF

### Specifications Cont.

#### Allowable Operating Ranges

Type E:	-200 to 800°C	(-328 to 1470°F)
Type J:	-210 to 1038°C	(-346 to 1900°F)
Type K:	-270 to 1370°C	(-454 to 2500°F)
Type T:	-270 to 400°C	(-454 to 750°F)
RTD (DIN)	-200 to 800°C	(-328 to 1472°F)

#### Output Types

Switched dc (non-isolated)

- Supply voltage maximum: 24V $\rightleftharpoons$ (dc) into an infinite load
- Supply voltage minimum: 5V $\rightleftharpoons$ (dc) at 10mA
- Minimum load impedance: 500 $\Omega$

#### Electromechanical Relay, Form C

- Minimum load current: 100mA
- 8 A @ 240V $\sim$ (ac) or 30V $\rightleftharpoons$ (dc) maximum, resistive
- 250VA pilot duty, 120/240V $\sim$ (ac) maximum, inductive
- Use RC suppression for inductive loads
- Electrical life 100,000 cycles at rated current

#### Agency Approvals

- UL<sup>®</sup> 60730-1 Recognized Temperature Controller and Indicator
- UL<sup>®</sup> 197 Reviewed for Use in Cooking Appliances
- ANSI Z21.23 Gas Appliance Thermostat Approval
- Temperature Control and Indicator CSA 22.2 No. 24

#### Terminals

- 6.3 mm (0.25 in.) quick connect, push on terminal

#### Power

- 24V $\sim$ (ac) +10 percent; -15 percent; 50/60Hz,  $\pm$ 5 percent
- 120V $\sim$ (ac) +10 percent; -15 percent; 50/60Hz,  $\pm$ 5 percent
- 230 to 240V $\sim$ (ac) +10 percent; -15 percent; 50/60Hz,  $\pm$ 5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Operating Environment

- 0 to 70°C (32 to 158°F)
- 0 to 90 percent RH, non-condensing
- Storage temperature: -40 to 85°C (-40 to 185°F)

#### Dimensions

- DIN-rail model can be DIN-rail or chassis mount  
DIN-rail spec DIN 50022, 35 mm x 7.5 mm (1.38 in. x 0.30 in.)

Style	Width	Height	Depth
Open Board	61.7 mm (2.43 in.)	61.7 mm (2.43 in.)	45.1 mm (1.78 in.)
Potted	70.1 mm (2.76 in.)	102.9 mm (4.05 in.)	46.6 mm (1.84 in.)
DIN-Rail	78.1 mm (3.08 in.)	112.3 mm (4.42 in.)	90.7 mm (3.57 in.)
Square $\frac{1}{2}$ DIN-panel	72.4 mm (2.85 in.)	72.4 mm (2.85 in.)	Behind panel 51.7 mm (2.04 in.)

#### Ordering Information

To order, complete the model number on the right with the information below.

**SERIES CF** = On-off controller, fixed set point, no user interface

**Power Supply** \_\_\_\_\_

B = 120V $\sim$ (ac), switched dc output  
 C = 120V $\sim$ (ac), eight amp relay output  
 D = 230 to 240V $\sim$ (ac), switched dc output  
 E = 230 to 240V $\sim$ (ac), eight amp relay output  
 F = 24V $\sim$ (ac), switched dc output  
 G = 24V $\sim$ (ac), eight amp relay output

**Package** \_\_\_\_\_

1 = Panel mount square  $\frac{1}{2}$  DIN  
 2 = DIN-rail mount  
 3 = Open board, non potted  
 4 = Potted case

**Sensor Type and Scale** \_\_\_\_\_

H = T/C Type J Fahrenheit (-346 to 1900°F)  
 J = T/C Type J Celsius (-210 to 1038°C)  
 K = T/C Type K Fahrenheit (-454 to 2500°F)  
 L = T/C Type K Celsius (-270 to 1370°C)  
 M = T/C Type T Fahrenheit (-454 to 750°F)  
 N = T/C Type T Celsius (-270 to 400°C)  
 P = RTD Fahrenheit (-328 to 1472°F)  
 R = RTD Celsius (-200 to 800°C)  
 S = T/C Type E Fahrenheit (-328 to 1470°F)  
 T = T/C Type E Celsius (-200 to 800°C)

**Control Type** \_\_\_\_\_

H = Heat  
 C = Cool

**Fixed Set Point Temperature Value<sup>①</sup>** \_\_\_\_\_

**Overlay/Customs Options** \_\_\_\_\_

A = Standard

**C F** \_\_\_\_\_

**A A A A** \_\_\_\_\_

<sup>①</sup>A (-) is used in the left most digit of the fixed set point indicates a negative temperature value

## On-Off Controllers

### SERIES 80M6

Watlow's SERIES 80M6 temperature controllers provide an economical, easy to install unit for temperature sensing and control in a space saving package. The SERIES 80M6 delivers single zone, on-off heating control and is available in three temperature ranges. The controller features open sensor and positive off circuit protection, preventing heating once the sensor temperature falls below the low end of the set point range.

The SERIES 80M6 consists of a temperature controller along with a relay output potted in a rugged, plastic shell. This feature makes the SERIES 80M6 ideal for foodservice and other applications requiring rugged construction.

With 6.35 mm (0.25 in.) quick connect terminals for thermocouple input, power input and relay output as well as a sub-panel mount, the SERIES 80M6 also allows for simple, quick installation. The SERIES 80M6 provides the convenience of precision temperature control with the turn of a potentiometer and fits within the same footprint as the current Watlow 80M5.

The SERIES 80M6 controller is backed by a 12-month warranty from Watlow Winona and is UL® 873 and C-UL® recognized.



#### Applications

- Proofers
- Ovens
- Deep Fryers
- Griddles
- General heating applications

#### Features and Benefits

##### Potted shell design

- Safe for use in various environmental conditions

##### Compact size

- Easily retrofittable to the current 80M5
- Space-saving replacement for filled-bulb controllers

##### Open sensor protection

- Contacts de-energize in the event of an open sensor, turning off power to the load and preventing a runaway

##### Quick connect terminals

- Fast, easy installation

##### On-off control

- Provides simple, reliable operation

#### Specifications

##### Control Mode

- On-off control with a  $-16^{\circ}\text{C}$  ( $4^{\circ}\text{F}$ ) switching hysteresis for Type E thermocouple

##### Operator Interface

- Remote set point potentiometer - user mounted potentiometer provides set point adjustment and indication
- User provided dial scale

##### Input

- Type E thermocouple
- Sensor may be isolated or grounded
- Sensor break protection de-energized output

##### Output

- Electromechanical relay, SPST, sealed,  $24\text{V}=\text{(dc)}$ ,  $30\text{A}$  @  $120\text{V}\sim\text{(ac)}$ ,  $30\text{A}$  @  $240\text{V}\sim\text{(ac)}$  UL® rated

# On-Off Controllers

F.O.B.: Winona, Minnesota

## SERIES 80M6

### Specifications Cont.

#### Power

- Nominal voltage - 120 VRMS +10 percent, -15 percent (102 to 132V~(ac)), 240VRMS +10 percent, -15 percent (204 to 264V~(ac))
- Power requirements - 4.0 VA nominal
- Frequency - 47 to 63Hz (50Hz  $\pm 5$  percent and 60Hz  $\pm 5$  percent)

#### Operating Environment

- Operating temperature up to -0 to 55°C (32 to 131°F)
- 0 - 90 percent RH, non-condensing
- Shipping and storage temperature, 40 to 70°C (104 to 158°F)

#### Dimensions

##### Control

- Length: 112.5 mm (4.428 in.)
- Width: 91.8 mm (3.615 in.)
- Height: 38.1 mm (1.500 in.)
- Weight: 0.3402 kg (0.75 lb)

##### Set Pot Assembly

- Pot depth behind: 12.7 mm (0.5 in.)
- Shaft depth in front: 25.4 mm (1.0 in.)
- Lead length: 1066.8 mm (42 in.)
- Weight: 0.01 kg (0.03 lb)

##### Agency Approvals

- UL® 873 and C-UL® recognized

##### Terminals

- Quick connects, 6.4 mm (0.25 in.)

##### Accuracy

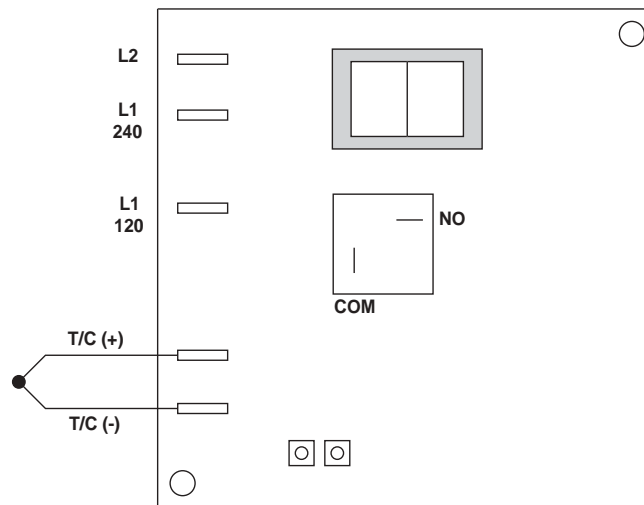
- Calibration accuracy  $\pm 10^\circ\text{F}$
- 120V~(ac) line, 102 min, 132 max, VRMS

- 240V~(ac) line, 204 min, 264 max, VRMS
- Switching differential 2 min, 4 max, F
- Positive off switch point 5° min, 25° max, mechanical degree from CCW

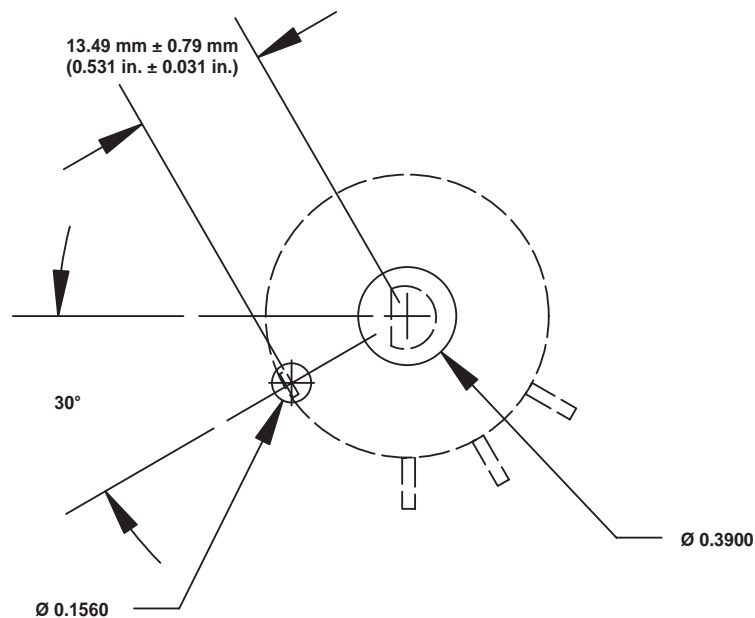
### Ordering Information

- 80M6-2623-2AAD — 65.5 to 287.8°C (150 to 550°F)
- 80M6-2624-2AAD — 10 to 121.1°C (50 to 250°F)
- 80M6-2634-2AAD — 10 to 218.3°C (50 to 425°F)

### Wiring Diagram



### Set Pot Cutout



# PID with Time/ Temperature Profiling Controllers

## SERIES SD\_R

The SERIES SD family of PID temperature controllers utilizes today's advanced technology to provide the value, benefits and accuracy you've come to expect from Watlow. The features and performance offered by SERIES SD controllers make them ideally suited for a broad range of applications in temperature and process control.

The SERIES SD single channel controllers include a universal sensor input with up to three outputs that can be programmed for heat or cool temperature control, or to operate as process or deviation alarms. Programming inverse scaling is also simplified with the user-friendly set-up menu, providing additional value without additional cost.

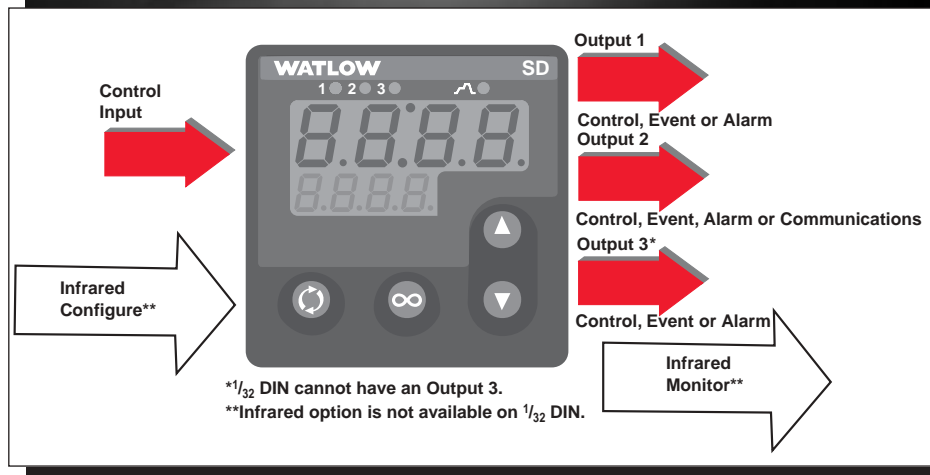
Advanced features of SERIES SD controllers include EIA-485 Modbus™ serial communications, Watlow's INFOSENSE™ sensor technology, infrared remote communications operation, Watlow's patented User Definable Menu System and a "Save and Restore" feature that allows the restoration of either factory or user-defined settings.

Available in 1/32, 1/16, 1/8 and 1/4 DIN panel mount sizes, Watlow's SERIES SD family is backed by an industry leading three-year warranty from Watlow Winona. The SERIES SD controllers are UL® and C-UL® listed, CSA, CE, NSF certified and include the NEMA 4X (IP65) seal.

The SD\_R ramping controllers are single input devices which will have profiling capability:

- Four profiles (maximum)
- 10 steps each (maximum)
- Five Profile Step Types:
  - Set point (ramp)
  - Soak
  - Jump loop
  - Link
  - End

UL® and C-UL® are registered trademarks of Underwriter's Laboratories, Inc.  
Modbus™ is a trademark of Schneider Automation, Inc.  
Windows® is a registered trademark of the Microsoft Corporation.



### Features and Benefits

#### INFOSENSE™ sensor technology

- Improves sensor accuracy by a minimum of 50 percent

#### User Defined Menu System

- Allows the user to assign up to 20 parameters in the operations menu
- Improves operational efficiency

#### “Save and Restore” feature

- Allows the user to save individual or factory settings

#### WATVIEW HMI (Human Machine Interface)

- Permits operation, configuration and data logging via a standard Windows® PC

### Infrared communications (optional)

- Facilitates recipe management and data logging
- Allows easier controller setup, operation and monitoring

### Dual display

- Provides better recognition of process changes

# PID with Time/ Temperature Profiling Controllers

## SERIES SD\_R

### Specifications

#### Line Voltage/Power

- 100 to 240V~(ac), +10/-15 percent; (85-264V~[ac]) 50/60Hz, ±5 percent
- 24V≈(ac/dc), +10/-15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Environment

- -18 to 65°C (0 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

#### Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

#### Agency Approvals

- UL® 3121, C-UL®, CSA, CE, NEMA 4X/IP65
- Limit version features FM approval
- NSF for Type J, K, T & E thermocouples

#### Controller

- Microprocessor based user-selectable control modes
- Single universal input, up to three outputs
- Control sampling rates: Input = 6.5Hz, Display = 10Hz and Outputs = 6.5Hz

#### Operator Interface

- Dual 4 digit, 7 segment LED displays
- Advance, infinity and up down keys
- Optional IrDA infrared port (not available on 1/32 DIN)
- Isolated EIA-485 Modbus™ serial communications. 9600, 19.2K or 38.4K baud rates.

#### Wiring Termination-Touch Safe Terminals

- Input power and control outputs 12 to 22 AWG
- Sensor inputs and process outputs 20 to 28 AWG

#### Universal Input

- Thermocouple, grounded or ungrounded sensors
- RTD 2- or 3-wire, platinum, 100Ω @ 0°C calibration to DIN-curve (0.00385 Ω/Ω/°C)
- Process, 0-20mA @ 100Ω, or 0-10V≈(dc) @ 20kΩ input impedance; Scalable
- Inverse scaling
- >20MΩ input impedance
- Maximum of 20Ω source resistance

#### Allowable Operating Range

Type J:	0	to	815°C
	(32	to	1500°F)
Type K:	-200	to	1370°C
	(-328	to	2500°F)

#### Dimensions

DIN Size	Behind Panel (max.)	Width	Height
1/32 DIN	97.8 mm (3.85 in.)	52.6 mm (2.07 in.)	29.7 mm (1.17 in.)
1/16 DIN	97.8 mm (3.85 in.)	52.1 mm (2.05 in.)	52.1 mm (2.05 in.)
1/8 DIN Vertical	97.8 mm (3.85 in.)	52.8 mm (2.08 in.)	99.8 mm (3.93 in.)
1/8 DIN Horizontal	97.8 mm (3.85 in.)	99.8 mm (3.93 in.)	52.8 mm (2.08 in.)
1/4 DIN	101.1 mm (3.98 in.)	99.8 mm (3.93 in.)	99.8 mm (3.93 in.)

Type T:	-200	to	400°C
	(-328	to	750°F)
Type N:	0	to	1300°C
	(32	to	2372°F)
Type E:	-200	to	800°C
	(-328	to	1470°F)
Type C:	0	to	2315°C
	(32	to	4200°F)
Type D:	0	to	2315°C
	(32	to	4200°F)
Type PTII:	0	to	1395°C
	(32	to	2543°F)
Type R:	0	to	1760°C
	(32	to	3200°F)
Type S:	0	to	1760°C
	(32	to	3200°F)
Type B:	0	to	1816°C
	(32	to	3300°F)
RTD (DIN):	-200	to	800°C
	(-328	to	1472°F)
Process:	-1999	to	9999 units

#### Control Outputs

##### Outputs 1, 2, 3 (Output 3 not available on 1/32 DIN)

- User selectable for heat/cool as on-off, P, PI, PD, PID or Alarm action. Not valid for limit controls
- Electromechanical relay. Form A, rated 2A @ 120V~(ac), 2A @ 240V~(ac) or 2A @ 30V≈(dc)



# PID with Time/ Temperature Profiling Controllers

## SERIES SD\_R

### Specifications Cont.

- Switched dc non-isolated minimum turn on voltage of 6V $\approx$ (dc) into a minimum 500 $\Omega$  load with a maximum on voltage of not greater than 12V $\approx$ (dc) into an infinite load. Maximum switched dc power supply current available for up to two outputs is 60mA
- Solid state relay, Form A, 0.5A @ 24V $\sim$ (ac) minimum, 264V $\sim$ (ac) maximum, opto-isolated, without contact suppression
- Process output (Non Isolated) User-selectable 0-10V $\approx$ (dc), 0-5V $\approx$ (dc), 1-5V $\approx$ (dc) @ 1K $\Omega$  minimum, 0-20mA, 4-20mA @ 800 $\Omega$  maximum
- Electromechanical relay. Form C, rated 5A @ 120V $\sim$ (ac), 5A @ 240V $\sim$ (ac) or 5A @ 30V $\approx$ (dc)
- Open collector 42V $\approx$ (dc) @ 250mA maximum
- EIA-485 serial communications with Modbus<sup>TM</sup> protocol



### WATVIEW HMI

WATVIEW, Watlow's Windows<sup>®</sup> based HMI (Human Machine Interface) software, supports the SERIES SD controllers. The software can be used to setup, monitor and edit the values of controller parameters, to monitor and manage alarms and to log and graph process data.

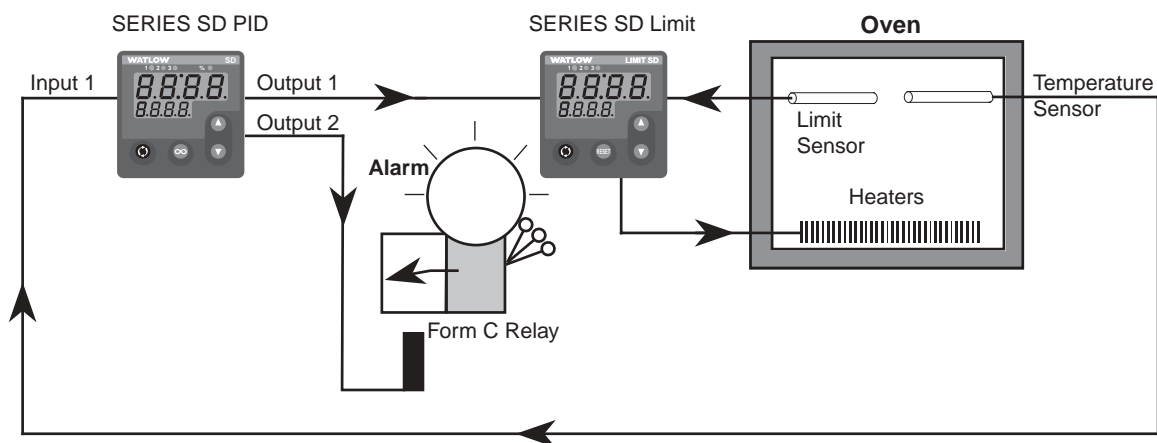
### INFOSENSE<sup>TM</sup> Sensor Technology

Watlow's INFOSENSE<sup>TM</sup> sensor technology improves temperature sensing accuracy by 50 percent. Each INFOSENSE "smart" sensor contains four numeric values located on tags attached to each sensor that are programmed into the SERIES SD controller memory. These values characterize Watlow sensors and allow the controller to provide enhanced accuracy.



Single-Loop  
PID with Time/Temperature Profiling

### Typical Block Diagram



Note: Consult user's manual for wiring.

# PID with Time/ Temperature Profiling Controllers

F.O.B.: Winona, Minnesota

## SERIES SD\_R



### Infrared Communications

The Infrared Data Communications (IDC) option is available on all SERIES SD controller models except the 1/32 DIN and can support complete SERIES SD parameter configuration and operation. The IDC option supports wireless communications with PDAs (personal digital assistants) or other devices equipped with infrared communications that support the Infrared Data Association (IrDA) 1.0 Standard.

The actual user interface or configuration is dependent on the master device application software. A source for this software is Instant HMI from Software Horizons. For more information, visit [www.instanthmi.com/watlow](http://www.instanthmi.com/watlow).

Advantages of IDC include automated logging of key process variables, increased accuracy and ease of use for recipe or configuration setups. Infrared data communications enhances controller data exchange in physically restricting environments (such as semiconductor clean rooms, governmental radio-active test labs or those hard to reach areas) and reduces the use of paper to record instrument information as well as human transposition errors.

### Ordering Information

To order, complete the model number on the right with the information below.

SERIES SD\_R = Single channel ramping controllers

#### DIN Sizes

- 3 = 1/32 DIN
- 6 = 1/16 DIN
- 8 = 1/8 DIN Vertical
- 9 = 1/8 DIN Horizontal
- 4 = 1/4 DIN

#### Control Type

- R = Ramping Dual Display

#### Power Supply

- H = 100 to 240V $\approx$ (ac/dc)
- L = 24 to 28V $\approx$ (ac/dc)

#### Output 1

- C = Switched dc
- K = SSR, Form A, 0.5A
- F = Universal process
- J = Mechanical relay, Form A, 2A<sup>Ⓟ</sup>

#### Output 2

- A = None
- C = Switched dc
- K = SSR, Form A, 0.5A
- J = Mechanical relay, Form A, 2A<sup>Ⓟ</sup>
- U = EIA/485 Modbus™ communications

#### Output 3 (Not available on 1/32 DIN)

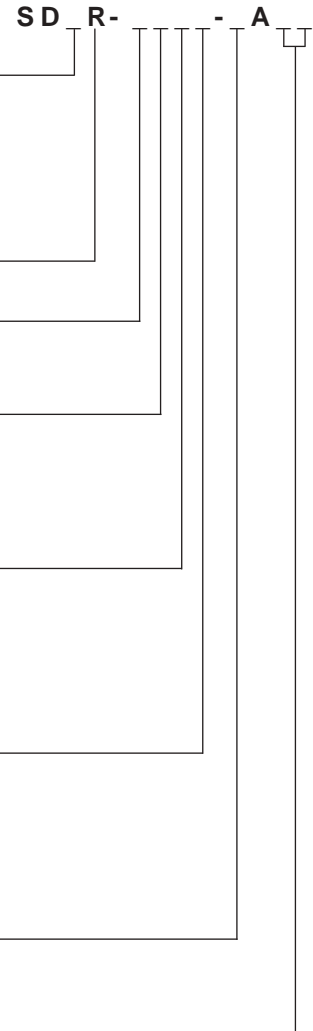
- A = None
- C = Switched dc/open collector
- K = SSR, Form A, 0.5A
- F = Universal process
- E = Mechanical relay, Form C, 5A<sup>Ⓟ</sup>

#### Infrared Comms Options (IrDA)

- A = None (Default selection on 1/32 DIN)
- R = IrDA ready (Not available on 1/32 DIN)

#### Display Colors and Custom Options

- RG = Red Green (Dual display units)
- RR = Red Red (Not available on 1/32 DIN Dual Display)
- XX = Custom options, special overlays, etc.



<sup>Ⓟ</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

## PID with Time/ Temperature Profiling Controllers

### SERIES SD6R\_D

Watlow SERIES SD6R\_D offers excellent static set point or Profile/Ramping control and application flexibility in a 1/8<sup>th</sup> DIN panel mount package. The SERIES SD6R\_D controller has been successfully tested for use with both ODVA and Semi-conductor SIG standards for DeviceNet™ on CAN networks. Ramping profile capabilities include four profiles (maximum), 10 steps each (maximum) and five profile step types (Set Point, Soak, Jump Loop, Link and End).

The SD6R\_D single channel controller includes a universal sensor input with two outputs that can be configured as heat or cool or alarm. The DeviceNet™ communications interface is supplied with either a five pin circular DIN connector for Semiconductor SIG specific applications, or with a five position removable screw terminal connector for traditional market applications.

Additional features of the SD6R\_D family of controllers include Watlow's INFOSENSE™ sensor technology, a user definable menu system as well as a Save and Restore feature that allows the restoration of factory and user defined parameter values.

Watlow SD6R\_D DeviceNet™ controllers offer a three year warranty, are UL®, C-UL® listed, CSA, CE and NSF certified, and include IP65/NEMA 4 ratings.

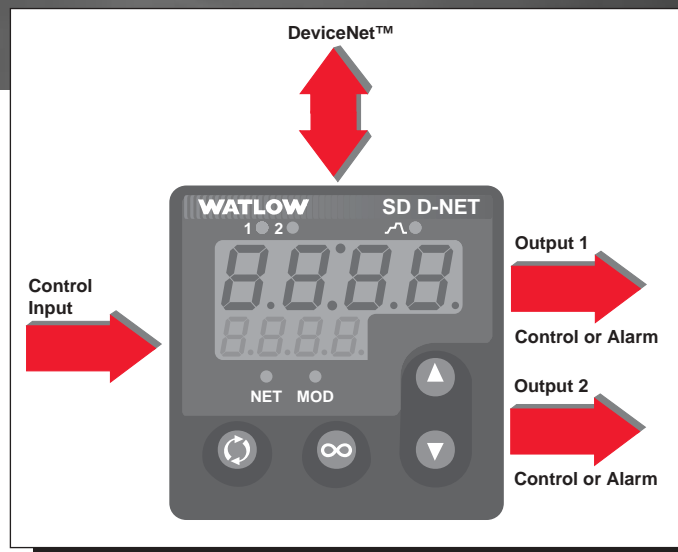
#### Features and Benefits

##### Variable burst fire

- Prolongs heater life

##### Ordering Options including DeviceNet™ on CAN or SEMI-SIG-ODVA protocols

- Provides DeviceNet™ on CAN for Semiconductor applications
- DeviceNet™ on CAN for the packaging or general industrial markets



#### Specifications

##### Line Voltage/Power

- 100 to 240V~(ac), +10/-15 percent; (85-264V~[ac]) 50/60Hz, ±5 percent
- 24V~(ac/dc), +10/-15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

##### Environment

- -18 to 65°C (0 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

#### Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

#### Agency Approvals

- UL® 3121, C-UL®, CSA, CE, IP65/NEMA 4X and NSF-2

DeviceNet™ is a trademark of the Open DeviceNet Vendors Association.

# PID with Time/ Temperature Profiling Controllers

F.O.B.: Winona, Minnesota

## SERIES SD6R\_D

### Specifications Cont.

#### Controller

- Microprocessor based user-selectable control modes
- Single universal input, up to three outputs
- Control sampling rates: input = 6.5Hz, display = 10Hz, outputs = 6.5Hz

#### Operator Interface

- Dual 4 digit, 7 segment LED displays
- Advance, infinity and up down keys
- DeviceNet™ on CAN (for the packaging or general industrial markets) or SEMI-SIG-ODVA (for the semi-conductor industry)

#### Allowable Operating Range

Type J:	0	to	815°C
	(32)	to	1500°F
Type K:	-200	to	1370°C
	(-328)	to	2500°F
Type T:	-200	to	400°C
	(-328)	to	750°F
Type N:	0	to	1300°C
	(32)	to	2372°F
Type E:	-200	to	800°C
	(-328)	to	1470°F
Type C:	0	to	2315°C
	(32)	to	4200°F
Type D:	0	to	2315°C
	(32)	to	4200°F
Type PTII:	0	to	1395°C
	(32)	to	2543°F
Type R:	0	to	1760°C
	(32)	to	3200°F
Type S:	0	to	1760°C
	(32)	to	3200°F
Type B:	0	to	1816°C
	(32)	to	3300°F
RTD (DIN):	-200	to	800°C
	(-328)	to	1472°F
Process:	-1999	to	9999 units

### Control Outputs 1 & 2

- User selectable for heat/cool as on-off, P, PI, PD, PID or Alarm action
- Electromechanical relay. Form A, rated 2A @ 120V~(ac), 2A @ 240V~(ac) or 2A @ 30V=(dc)
- Switched dc non-isolated minimum turn on voltage of 6V=(dc) into a minimum 500Ω load with a maximum on voltage of not greater than 12V=(dc) into an infinite load. Maximum switched dc power supply current available for up to two outputs is 60mA
- Solid-state relay, Form A, 0.5A @ 24V~(ac) minimum, 264V~(ac) maximum, opto-isolated, without contact suppression

- Process output (Non Isolated) User-selectable 0-10V=(dc), 0-5V=(dc), 1-5V=(dc) @ 1KΩ minimum, 0-20mA, 4-20mA @ 800Ω maximum
- Electromechanical relay. Form C, rated 5A @ 120V~(ac), 5A @ 240V~(ac) or 5A @ 30V=(dc)
- Open collector 42V=(dc) @ 250mA maximum

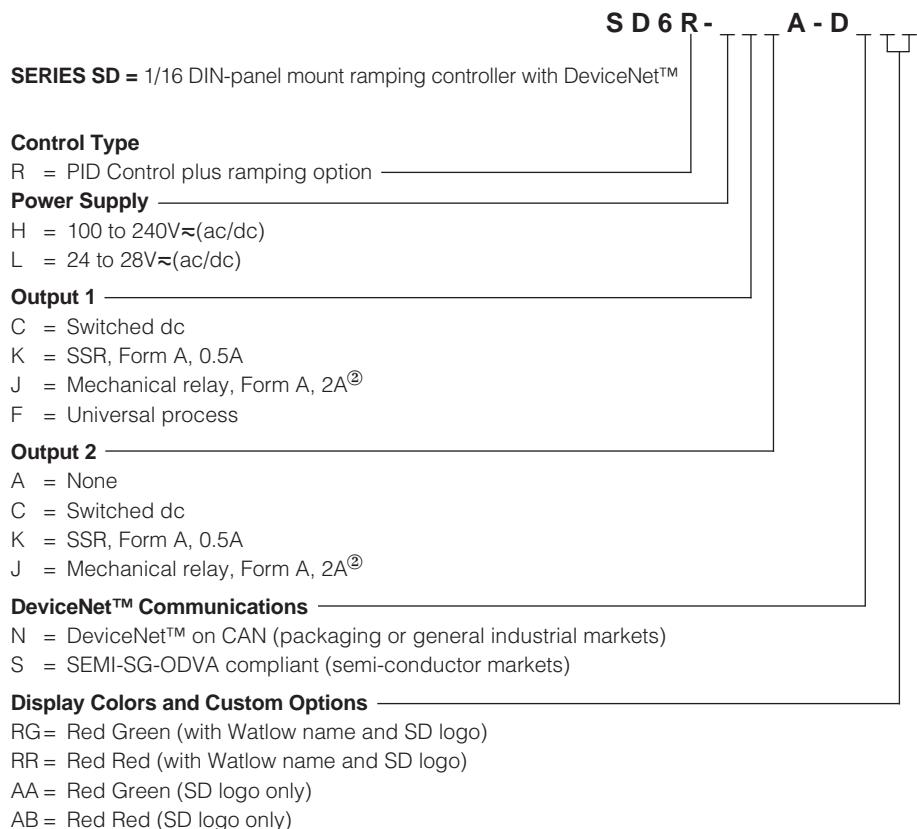
### Dimensions

#### SD6C\_D or SD6R\_D or SD6L\_D

- 1/16 DIN Size
- 97.8 mm (3.85 in.) behind panel maximum
- Width 52.1 mm (2.05 in.)
- Height 52.1 mm (2.05 in.)

### Ordering Information

To order, complete the model number on the right with the information below.



<sup>®</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

## PID with Time/ Temperature Profiling Controllers

### SERIES 96\_AA

Watlow's SERIES 96 is a powerful  $\frac{1}{6}$  DIN dual display controller that offers many advanced functions. This new controller can be tailored to perform hardware and software needs with hardware modules that are pluggable and exchangeable, and software menus that may be user programmed to fit exact application requirements.

With one universal input, a second auxiliary input and four outputs the SERIES 96 can be programmed to perform: temperature measurement, input event switching, heating, boost heating, cooling, alarms, digital communications and retransmit.

With fast 10Hz sampling, variable time base burst firing outputs, NEMA 4X front panel and 0.1 percent calibration accuracy, this controller can easily handle some of the toughest application needs.

#### Performance Capabilities

- Operating environment  
0 to 65°C (32 to 149°F)

#### Features and Benefits

##### Profiles

- Two (2) 8-step profiles can be linked to create one (1) 15-step profile

##### Burst fire

- Increase heater life / better temperature controlability

##### One input, one auxiliary input, four outputs

- Powerful flexibility at a competitive price

##### No dipswitches

- Easily configurable from the front panel

##### Multiple set points

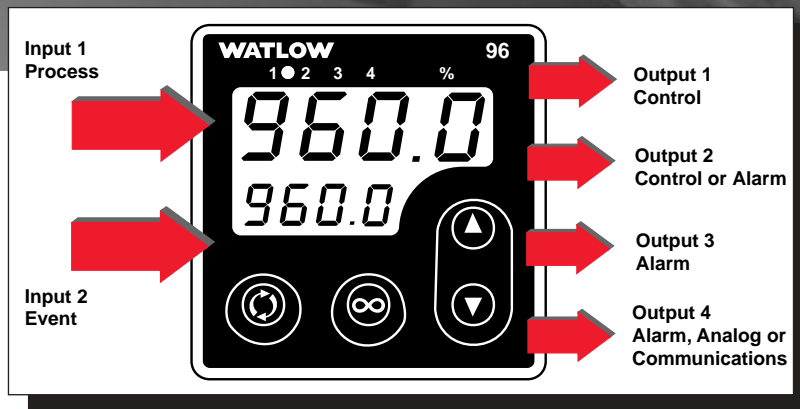
- Flexible automatic control

##### Pluggable output modules

- Field expandable

##### Fast 10Hz sampling

- Improved control responsiveness



#### Open loop break protection

- Indication of thermal loop problem

#### NEMA 4X (IP65)<sup>①</sup>

- Water and corrosion resistant front panel can be washed down

#### Compact size

- Allows it to be mounted in small areas

#### Automatic tuning

- Easy one step tuning of PID control parameters

#### Three-year warranty<sup>②</sup>

- Provides Control Confidence<sup>®</sup>

#### Applications

- Packaging
- Semiconductor
- Food processing
- Lab equipment
- Furnace and ovens
- Plastics

#### Specifications

##### Controller

- Microprocessor-based, user selectable control modes
- Heat and cool auto-tune for control outputs
- Universal input one, auxiliary input two, four outputs
- Control outputs user selectable as on-off, P, PI, PID

<sup>①</sup> To effect NEMA 4X(IP65) rating requires a minimum mounting panel thickness of 1.5 mm (0.06 in.) and surface finish not rougher than 0.000812 mm (0.000032 in.).

<sup>②</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

# PID with Time/ Temperature Profiling Controllers

## SERIES 96\_AA

### Specifications Cont.

- Input sample period; Single input 10Hz (100ms), dual input 5Hz (200ms) digital filter adjustable
- Display update; 2Hz (500ms), time filter adjustable
- Output update; burst, 0.1 to 999.9 seconds
- Input/Output/Communication isolation
- Displayed in °C, °F or process units

### Operator Interface

- Dual four-digit LED displays: upper 10.2 mm (0.4 in.), lower 6.2 mm (0.244 in.)
- Advance, Up Arrow, Down Arrow, Infinity tactile keys

### Standard Conditions For Specifications

- Ambient temperature 25°C (77°F) ±3°C, rated line voltage, 50 to 60Hz, 0 to 90 percent RH non-condensing, 15 minute warm-up

### Universal Input 1

#### Thermocouple

- Type J, K, T, N, C (W5), E, Pt 2, D (W3), B, R, S thermocouple
- >20MΩ input impedance
- Maximum 20Ω source resistance
- 30μA open detection bias

#### RTD

- 2- or 3-wire platinum, 100Ω
- JIS and DIN-curves
- Whole or tenth degree indication
- 150μA nominal RTD excitation current

#### Process

- Range selectable: 0-10V<sub>rms</sub>(dc), 0-5V<sub>rms</sub>(dc), 1-5V<sub>rms</sub>(dc), 0-20mA, 4-20mA
- Voltage input impedance 20kΩ
- Current input impedance 100Ω
- Minimum current source resistance 1MΩ

- Input resolution 50,000 bits (approx.) at full scale
- mV input impedance 20MΩ

#### Input 2

##### Event Input

- Contact or voltage
- 20KΩ input impedance
- Voltage input: event high state 3 to 36V<sub>rms</sub>(dc), event low state 0 to 2V<sub>rms</sub>(dc)
- Resistance/contact input: event high state >23kΩ, event low state 0 to 2kΩ

#### Output Types

##### Open Collector/Switched DC

- Open collector configuration: Maximum voltage 42V<sub>rms</sub>(dc) Maximum current 200mA Maximum on resistance 1.1Ω Maximum off state leakage current 100μA
- Switched dc configuration: Switched dc supply voltage 22 to 28V<sub>rms</sub>(dc) dc supply current limited to 30mA

##### Solid State Relay

- Optically isolated
- Zero cross switched
- Without contact suppression
- Minimum load current 0.5mA rms
- Maximum current 0.5A rms at 20 to 280V<sub>rms</sub>(ac)
- Maximum off state leakage current 10μA rms
- For resistive loads only, must use RC suppression for inductive loads

##### Electromechanical Relay

- Form C contact configuration
- Minimum load current 10mA @ 5V<sub>rms</sub>(dc)
- Rated resistive and inductive loads: 2A @ 250V<sub>rms</sub>(ac) or 30V<sub>rms</sub>(dc) maximum
- Electrical life 100,000 cycles at rated current
- For resistive loads only, must use RC suppression for inductive loads

#### Process

- Range selectable: 0-20mA, 4-20mA, 0-5V<sub>rms</sub>(dc), 1-5V<sub>rms</sub>(dc), 0-10V<sub>rms</sub>(dc)
- Reverse or direct acting
- 0 to 10V<sub>rms</sub>(dc) voltage output into 1000Ω minimum load resistance
- 0 to 20mA current output into 800Ω maximum load resistance
- Resolution: V<sub>rms</sub>(dc) ranges = 2.5mV nominal mA ranges = 5μA nominal
- Calibration accuracy: V<sub>rms</sub>(dc) ranges = ±15mV mA ranges = ±30μA
- Temperature stability 100ppm/°C

#### Retransmit

- Range selectable: 0-20mA, 4-20mA, 0-5V<sub>rms</sub>(dc), 1-5V<sub>rms</sub>(dc), 0-10V<sub>rms</sub>(dc)
- 0 to 10V<sub>rms</sub>(dc) voltage output into a 1,000Ω minimum load resistance
- 0 to 20mA current output into an 800Ω maximum load resistance
- Resolution: V<sub>rms</sub>(dc) ranges = 2.5mV nominal mA ranges = 5μA nominal
- Calibration accuracy: V<sub>rms</sub>(dc) ranges = ±15mV mA ranges = ±30μA
- Temperature stability 100ppm/°C

#### Communications

- EIA/TIA-485, EIA/TIA-232
- Opto-isolated
- Modbus™ RTU protocol
- 1200, 2400, 4800, 9600, 19200 baud rates
- 32 maximum units can be connected (With additional 485 repeater hardware, up to 247 units may be connected)

# PID with Time/ Temperature Profiling Controllers

## SERIES 96\_AA

### Accuracy

Input ranges

Type J	0 to 750°C (32 to 1382°F)
Type K	-200 to 1250°C (-328 to 2282°F)
Type T	-200 to 1250°C (-328 to 2282°F)
Type N	0 to 1250°C (32 to 2282°F)
Type E	-200 to 900°C (-328 to 1652°F)
Type C(W5)	0 to 2315°C (32 to 4200°F)
Type D(W3)	0 to 2315°C (32 to 4200°F)
Pt 2	0 to 1393°C (32 to 2540°F)
Type R	0 to 1450°C (32 to 2642°F)
Type S	0 to 1450°C (32 to 2642°F)
Type B	870 to 1700°C (1598 to 3092°F)
DIN	-200 to 800°C (-328 to 1472°F)
JIS	-200 to 630°C (-328 to 1166°F)

Process -1999 to 9999 units

### Thermocouple Inputs

- Calibration accuracy  $\pm 0.1$  percent of span  $\pm 1^\circ\text{C}$  at standard conditions
- Exceptions:
  - Type T: 0.12 percent of span for  $-200^\circ\text{C}$  to  $-50^\circ\text{C}$  ( $-328^\circ\text{F}$  to  $-58^\circ\text{F}$ )
  - Types R and S: 0.15 percent of span for  $0^\circ\text{C}$  to  $100^\circ\text{C}$  ( $32^\circ\text{F}$  to  $212^\circ\text{F}$ )
  - Type B: 0.24 percent of span for  $870^\circ\text{C}$  to  $1700^\circ\text{C}$  ( $1598^\circ\text{F}$  to  $3092^\circ\text{F}$ )
- Accuracy span:  $540^\circ\text{C}$  ( $1000^\circ\text{F}$ ) minimum
- Temperature stability:  $\pm 0.1$  degree per degree change in ambient

### RTD Inputs

- Calibration accuracy  $\pm 0.1$  percent of span  $\pm 1^\circ\text{C}$  at standard conditions
- Accuracy span:  $540^\circ\text{C}$  ( $1000^\circ\text{F}$ ) minimum
- Temperature stability:  $\pm 0.05$  degree per degree change in ambient

### Process Inputs

- Voltage input ranges
  - Accuracy  $\pm 15\text{mV} \pm 1$  LSD at standard conditions
  - Temperature stability  $\pm 100\text{ppm}/^\circ\text{C}$  maximum
- Milli-amp input ranges
  - Accuracy  $\pm 30\mu\text{A} \pm 1$  LSD at standard conditions
  - Temperature stability  $\pm 100\text{ppm}/^\circ\text{C}$  maximum

### Agency Approvals

- UL® 916, File #E185611, C-UL®, CE, NEMA 4X

### Terminals

- Touch safe
- 22 to 12 AWG

### Power

- 100-240V~(ac)  $+10$  percent,  $-15$  percent; 50/60Hz,  $\pm 5$  percent
- 24-28V~(ac) or V=(dc)  $+10$  percent,  $-15$  percent; 50/60Hz,  $\pm 5$  percent

- 7.0VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

### Operating Environment

- 0 to  $65^\circ\text{C}$  (32 to  $149^\circ\text{F}$ )
- 0 to 90 percent RH, non-condensing
- Storage temperature:  $-40$  to  $85^\circ\text{C}$  ( $-40$  to  $185^\circ\text{F}$ )

### Controller Weight (approx.)

- 0.2 kg (0.4 lb)

### Allowable Operating Ranges

Type J	1.0	0 to 815°C (32 to 1500°F)
	0.1	0 to 815°C (32 to 1499°F)
Type K	1.0	-270 to 1370°C (-454 to 2498°F)
	0.1	-199.9 to 999.9°C (-327.8 to 1831.8°F)
Type T	1.0	-270 to 400°C (-454 to 750°F)
	0.1	-199.9 to 400°C (-327.8 to 750°F)
Type N	1.0	0 to 1300°C (32 to 2372°F)
	0.1	0 to 999.9°C (32 to 1831.8°F)
Type E	1.0	-270 to 800°C (-454 to 1470°F)
	0.1	-199.9 to 800°C (-327.8 to 1472°F)
Type C	1.0	0 to 2315°C (32 to 4200°F)
	0.1	0 to 999.9°C (32 to 1831.8°F)
Type D	1.0	0 to 2315°C (32 to 4200°F)
	0.1	0 to 999.9°C (32 to 1831.8°F)
Pt 2	1.0	0 to 1395°C (32 to 2543°F)
	0.1	0 to 999.9°C (32 to 999.9°F)
Type R	1.0	0 to 1760°C (32 to 3200°F)
Type S	1.0	0 to 1760°C (32 to 3200°F)
Type B	1.0	0 to 1816°C (32 to 3300°F)
DIN	1.0	-200 to 800°C (-328 to 1472°F)
	0.1	-199.9 to 800°C (-327.8 to 1472°F)
JIS	1.0	-200 to 630°C (-328 to 1166°F)
	0.1	-199.9 to 630.0°C (-327.8 to 1166°F)

Process -1999 to 9999 units

# PID with Time/ Temperature Profiling Controllers

F.O.B.: Winona, Minnesota

## SERIES 96\_AA

### Ordering Information

To order, complete the code number on the right with the information below:

### Functionality Matrix

	Universal Input	Event & Remote Set Point	Control	Alarm	Retransmit	232 485 Comm
Input 1						
Input 2						
Output 1						
Output 2						
Output 3						
Output 4						

### Dimensions

#### Overall

Height: 52 mm (2.05 in.)  
Width: 52 mm (2.05 in.)  
Length: 107 mm (4.2 in.)

#### Depth behind panel surface

98.4 mm (3.875 in.)

**SERIES 96** = Microprocessor-based 1/8 DIN, with universal input 1. Options include: software, power supply, input 2, outputs and display color.

#### Power Supply

A = 100-240V $\approx$ (ac/dc)

B = 24-28V $\approx$ (ac/dc)

#### Input 2

0 = None

1 = Event input and 0-5V $\approx$ (dc)/4-20mA (Remote set point input)

#### Output 1

C = Switched dc/open collector

D = Electromechanical relay, Form C, 2A, without RC suppression<sup>®</sup>

F = Universal Process, range selectable: 0-20mA, 4-20mA, 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10V $\approx$ (dc)

K = 0.5A solid state relay without RC suppression

#### Output 2

A = None

C = Switched dc/open collector

D = Electromechanical relay, Form C, 2A, without RC suppression<sup>®</sup>

F = Universal Process, range selectable: 0-20mA, 4-20mA, 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10V $\approx$ (dc)

K = 0.5A solid state relay without RC suppression

#### Output 3

A = None

D = Electromechanical relay, Form C, 2A, without RC suppression<sup>®</sup>

#### Output 4

A = None

D = Electromechanical relay, Form C, 2A, without RC suppression<sup>®</sup>

R = 232 Communications

U = 485 Communications

M = Universal Retransmit, range selectable: 0-20mA, 4-20mA, 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10V $\approx$ (dc)

#### Software/Preset Parameters

AA = Ramping software

#### Display/Overlay

RR = Red/Red display

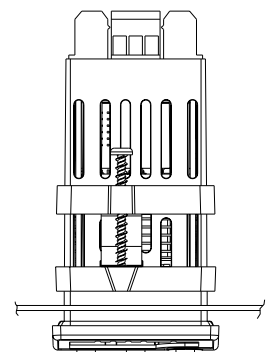
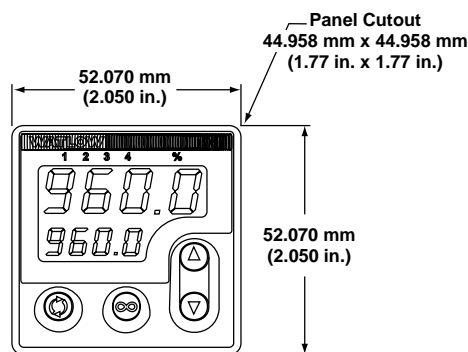
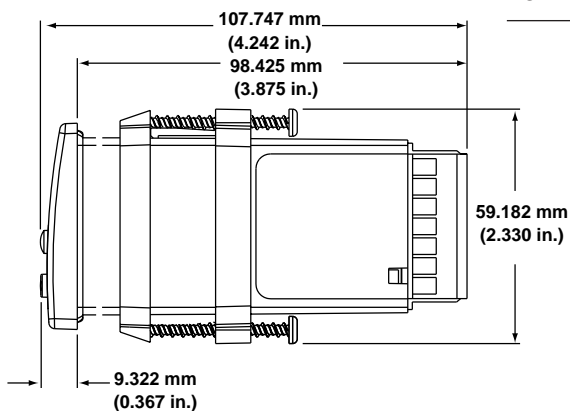
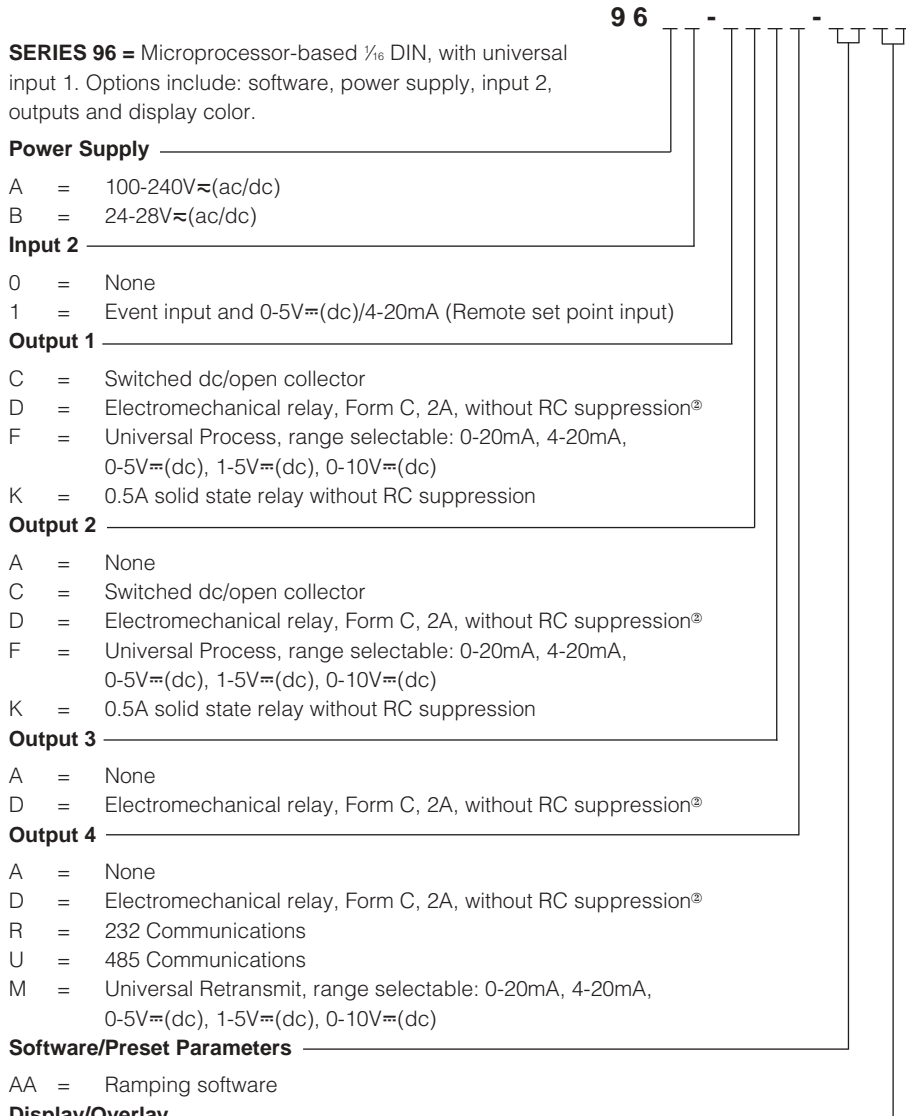
RG = Red/Green display

Upper/Lower

GR = Green/Red display

GG = Green/Green display

<sup>®</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.





# PID with Time/ Temperature Profiling Controllers

## SERIES 981/982

The Watlow SERIES 981 (horizontal) and SERIES 982 (vertical) are 1/8 DIN time/temperature profile controllers. Among the most easy-to-use time/temperature profile controllers, they are designed with most typical programming needs in mind. Both vertical and horizontal models offer four-file/24-step program capability or easy-to-use fixed set point operation.

Time/temperature profile operation includes four files with six steps in each file. Programming options include ramp-rate or time-based profiles, guaranteed soak deviation, program looping and program status selection after power outage. The files may be linked to create a single 24-step program.

The primary analog input accepts 11 different thermocouple types, RTD or scalable process inputs. A second analog input can be factory configured for a slidewire feedback input, common in gas valve control. With up to two event inputs, the SERIES 981/982 offers remote program start or hold capability and allows the operator to program a wait-for event.

### Performance Capabilities

- Exceptional accuracy to  $\pm 0.1$  percent of span
- Operating environment 0 to 55°C (32 to 130°F)

### Features and Benefits

#### Four files/six steps per file

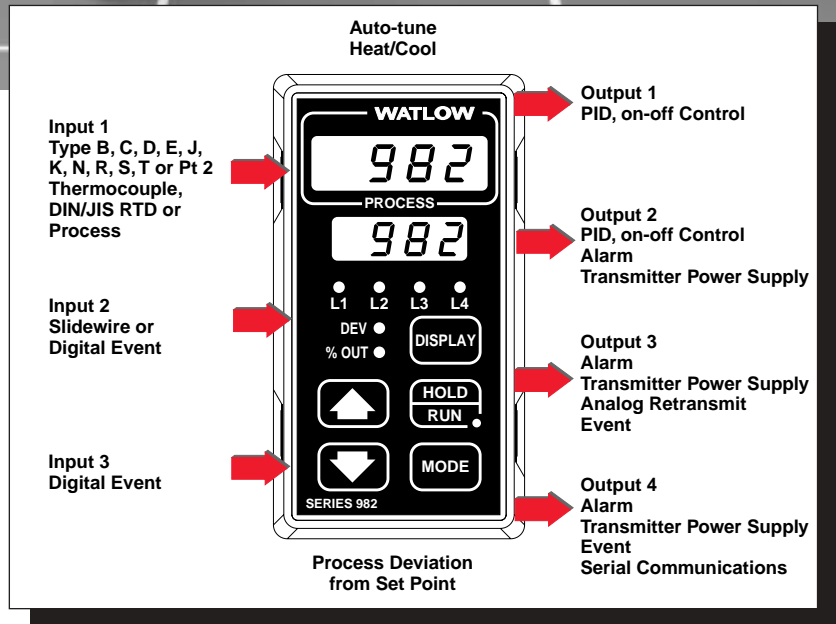
- Meets the need of most time/temperature profile applications (files may be linked together)

#### Auto-tuning of both heat and cool outputs

- Provide easy operation with one-step tuning of system parameters

#### Optional dual auxiliary outputs

- Give flexibility to time-based events or alarm outputs



#### Optional retransmit of set point or process variable

- For master programmer or chart recorder connection

#### Hardware and software parameter lockout options

- Provide several levels of operator security

#### UL®, CE, NEMA 4X® (IP65) front panel

- Provides corrosion resistance

#### 10Hz sampling rate and burst-fire control

- Delivers smooth, accurate process control

#### Slidewire feedback

- Interfaces with most slidewire input positioning devices

#### Three-year warranty<sup>2</sup>

- Provides Control Confidence<sup>®</sup>

#### Applications

- Any process requiring time/temperature profile control
- Processes requiring slidewire control of valves or positions

<sup>1</sup> To effect NEMA 4X (IP65) rating requires a minimum mounting panel thickness of 1.5 mm (0.06 in.) and surface finish not rougher than 0.000812 mm (0.000032 in.).

<sup>2</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

# PID with Time/ Temperature Profiling Controllers

## SERIES 981/982

### Applications Cont.

- Complex process furnaces
- Environmental chambers
- Processes needing data logging

### Specifications

#### Control Mode

- Single input, quad output, optional retransmit of set point or process variable
- Programmable direct and reverse acting control outputs
- 4-file/6 steps per file time/temperature profile or fixed set point control
- Ramp-rate or time-based programming
- Selectable control status following power loss

#### Agency Approvals

- 89/336/EEC Electromagnetic Compatibility Directive
- EN 50081-2: 1994 Emissions
- EN 50082-2: 1994 Immunity
- 73/23/EEC Low Voltage Directive
- EN 601010-1: 1993 Safety
- UL® #873, C-UL® File #43684
- NEMA 4X

#### Operator Interface

- Dual, four digit LED displays.  
Upper: 10 mm (0.4 in.)  
Lower: 8 mm (0.3 in.)
- MODE, HOLD/RUN, DISPLAY, UP and DOWN keys

#### Accuracy

- Calibration accuracy and sensor conformity:  $\pm 0.1$  percent of span,  $\pm 1$  LSD,  $25^\circ\text{C} \pm 3^\circ\text{C}$  ( $77^\circ\text{F} \pm 5^\circ\text{F}$ ) ambient and rated line voltage  $\pm 10$  percent
- Accuracy span:  $540^\circ\text{C}$  ( $1000^\circ\text{F}$ ) minimum
- Temperature stability:  $0.1^\circ\text{C}/^\circ\text{C}$  ( $\pm 0.2^\circ\text{F}/^\circ\text{F}$ ) change in ambient

#### Sensors/Inputs

- Contact input for software function select (event input)

- Thermocouple Types B, C<sup>①</sup>, D<sup>①</sup>, E, J, K, N, R, S, T and Pt 2<sup>①</sup>
- RTD resolution in  $1^\circ$  or  $0.1^\circ$  RTD scales
- Process variables:  $0\text{-}50\text{mV}=(\text{dc})$ ,  $0\text{-}20\text{mA}=(\text{dc})$ ,  $4\text{-}20\text{mA}=(\text{dc})$ ,  $0\text{-}5\text{V}=(\text{dc})$ ,  $1\text{-}5\text{V}=(\text{dc})$ ,  $0\text{-}10\text{V}=(\text{dc})$
- Slidewire or digital event input options
- Sensor break protection de-energizes system for safety. Latching or non-latching

#### Input Range

Specified temperature ranges represent the controller's operational span.

#### Thermocouple

Available with basic or universal signal conditioner

Type C <sup>①</sup>	0 to 2316°C (32 to 4200°F)
Type D <sup>①</sup>	0 to 2316°C (32 to 4200°F)
Type E	-200 to 799°C (-328 to 1470°F)
Type J	0 to 816°C (32 to 1500°F)
Type K	-200 to 1371°C (-328 to 2500°F)
Type N	0 to 1300°C (32 to 2372°F)
Type T	-200 to 399°C (-328 to 750°F)
Pt 2 <sup>①</sup>	0 to 1395°C (32 to 2543°F)

Available with universal signal conditioner

Type B	870 to 1816°C (1598 to 3300°F)
Type R	0 to 1760°C (32 to 3200°F)
Type S	0 to 1760°C (32 to 3200°F)

#### RTD Resolution (DIN or JIS)

$1^\circ$ (DIN)	-200 to 800°C (-328 to 1472°F)
$1^\circ$ (JIS)	-200 to 630°C (-328 to 1166°F)
$0.1^\circ$ (DIN and JIS)	-73.3 to 537.7°C (-99.9 to 999.9°F)

#### Process

$0\text{-}5\text{V}=(\text{dc})$	$1\text{-}5\text{V}=(\text{dc})$
$0\text{-}10\text{V}=(\text{dc})$	$0\text{-}20\text{mA}=(\text{dc})$
$4\text{-}20\text{mA}=(\text{dc})$	$0\text{-}50\text{mV}=(\text{dc})$
-999 to 9999 units	

#### #2 input slidewire feedback

100 to 1200 $\Omega$

#### Output Options

- Solid state relay, Form A, 0.5A @ 24V~(ac) min., 253V~(ac) max., opto-isolated, burst fire switching. With or without contact suppression. Off state output impedance is 20k $\Omega$  with RC suppression, 31M $\Omega$  without contact suppression
- Open collector or switched dc signal provides a minimum turn on voltage of 3V=(dc) into a minimum 500 $\Omega$  load; maximum on voltage not greater than 32V=(dc) into an infinite load, isolated
- Electromechanical relay<sup>②</sup>, Form C, 5A @ 120/240V~(ac), 6A @ 28V=(dc), 1/8 hp. @ 120V~(ac), 125VA @ 120V~(ac). With or without contact suppression. Off state output impedance with RC suppression is 20k $\Omega$
- Process,  $0\text{-}20\text{mA}=(\text{dc})$ ,  $4\text{-}20\text{mA}=(\text{dc})$  into 800 $\Omega$  maximum,  $0\text{-}5\text{V}=(\text{dc})$ ,  $1\text{-}5\text{V}=(\text{dc})$ , or  $0\text{-}10\text{V}=(\text{dc})$  into 1k $\Omega$  minimum reverse acting, isolated
- Electromechanical relay<sup>②</sup>, Form A/B, 5A @ 120/240V~(ac), 6A @ 28V=(dc), 1/8 hp. @ 120V~(ac), 125VA @ 120V~(ac). Without contact suppression

<sup>①</sup> Not an ANSI Symbol.

<sup>②</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

# PID with Time/ Temperature Profiling Controllers

F.O.B.: Winona, Minnesota

## SERIES 981/982

- External transmitter power supply, 5, 12 or 20V=(dc) @ 30mA
- EIA/TIA-232 communications or EIA/TIA-485/EIA/TIA-422 communications, opto-isolated
- Retransmit: 0-20mA=(dc), 4-20mA=(dc) with 600Ω max. load impedance, or 0-5V=(dc), 1-5V=(dc) and 0-10V=(dc) with 500Ω min. load impedance

### Line Voltage/Power

- 100-240V=(ac/dc) +10 percent, -15 percent; 50/60Hz, ±5 percent
- 24 to 28V=(ac/dc) +10 percent, -15 percent; 50/60Hz, ±5 percent
- Fused internally (factory replaceable only) Slo-Blo® type (time-lag) 2A, 250V for high voltage versions 5A, 250V for low voltage versions
- Power consumption 16VA maximum
- Data retention upon power failure via non-volatile memory

### Operating Environment

- 0 to 55°C (32 to 130°F)
- 0 to 90 percent RH, non-condensing

Note: If this output will drive a solenoid, MDR, contactor or other inductive device, order a Quencharc® (0804-0147-0000) for output protection. See user's manual for wiring.

① Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

② Output cannot be configured as an event output.

③ Event output capable.

### Availability

Four working days for orders less than 20 units. For orders over 20 units, consult factory for release and shipment schedules.

Slo-Blo® is a registered trademark of Littelfuse, Inc.  
Quencharc® is a registered trademark of ITW Paktron.

### Ordering Information

To order, complete the code number with the information below:

**SERIES 981/982** = Ramping controller  
1 analog input, 4 outputs, 2 digital inputs

#### Power Supply & Mounting

- 1 = 100 to 240V=(ac/dc) nominal, horizontal mounting
- 2 = 100 to 240V=(ac/dc) nominal, vertical mounting
- 3 = 24 to 28V=(ac/dc) nominal, horizontal mounting
- 4 = 24 to 28V=(ac/dc) nominal, vertical mounting

#### Software

- C = Standard (4-file/6 step per file program capability)
- S = Special customer feature

#### Input 1

- 1 = Basic thermocouple signal conditioner (excluding Type B, R and S)
- 2 = Universal signal conditioner (see Range Information)

#### Input 2

- 0 = None
- 3 = Slidewire feedback (see Range Information)
- 5 = Second digital event (one digital event is standard on all units)

#### Output 1<sup>②</sup>

- B = Solid state relay, Form A, 0.5A, with RC suppression
- C = Switched dc or open collector, isolated
- D = Electromechanical relay<sup>①</sup>, Form C, 5A with RC suppression
- E = Electromechanical relay<sup>①</sup>, Form C, 5A without contact suppression
- F = Universal process, 0-5V=(dc), 1-5V=(dc), 0-10V=(dc), 0-20mA=(dc), 4-20mA=(dc), isolated
- K = Solid state relay, Form A, 0.5A, without contact suppression

#### Output 2<sup>②</sup>

- A = None
- B = Solid state relay, Form A, 0.5A, with RC suppression
- C = Switched dc or open collector, isolated
- D = Electromechanical relay<sup>①</sup>, Form C, 5A with RC suppression
- E = Electromechanical relay<sup>①</sup>, Form C, 5A without contact suppression
- F = Universal process 0-5V=(dc), 1-5V=(dc), 0-10V=(dc), 0-20mA=(dc), 4-20mA=(dc), isolated
- K = Solid state relay, Form A, 0.5A, without contact suppression
- T = External signal conditioner power supply, 5, 12 or 20V=(dc) @ 30mA

#### Output 3<sup>③</sup>

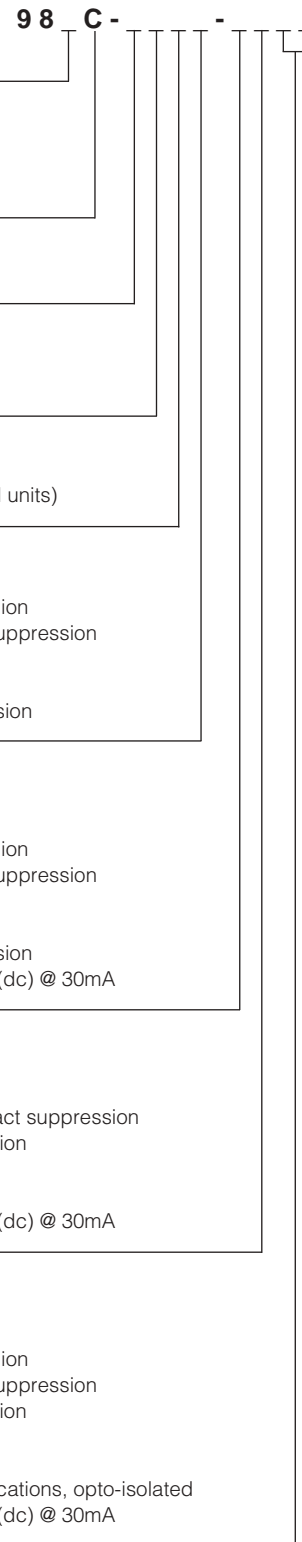
- A = None
- B = Solid state relay, Form A, 0.5A, with RC suppression
- C = Switched dc or open collector, isolated
- J = Electromechanical relay<sup>①</sup>, Form A or B, 5A without contact suppression
- K = Solid state relay, Form A, 0.5A without contact suppression
- M = Retransmit, 0-20mA=(dc), 4-20mA=(dc)
- N = Retransmit, 0-5V=(dc), 1-5V=(dc), 0-10V=(dc)
- T = External signal conditioner power supply, 5, 12 or 20V=(dc) @ 30mA

#### Output 4<sup>③</sup>

- A = None
- B = Solid state relay, Form A, 0.5A, with RC suppression
- C = Switched dc or open collector, isolated
- D = Electromechanical relay<sup>①</sup>, Form C, 5A with RC suppression
- E = Electromechanical relay<sup>①</sup>, Form C, 5A without contact suppression
- K = Solid state relay, Form A, 0.5A without contact suppression
- R = EIA/TIA-232 communications, opto-isolated
- S = EIA/TIA-485/EIA/TIA-422 communications, opto-isolated
- U = EIA/TIA-232, EIA/TIA-485 software selectable, communications, opto-isolated
- T = External signal conditioner power supply, 5, 12 or 20V=(dc) @ 30mA

#### Display Color (Upper/Lower)

- GG = Green/Green
- GR = Green/Red
- XX = Custom overlays or default settings
- RG = Red/Green
- RR = Red/Red



Single-Loop  
PID with Time/Temperature Profiling

# PID with Time/ Temperature Profiling Controllers

## SERIES 981/982

### Storage Temperature

- 40 to 85°C (-40 to 185°F)

### Terminals

- #6 compression universal head screws, accepts 28-14 gauge wire

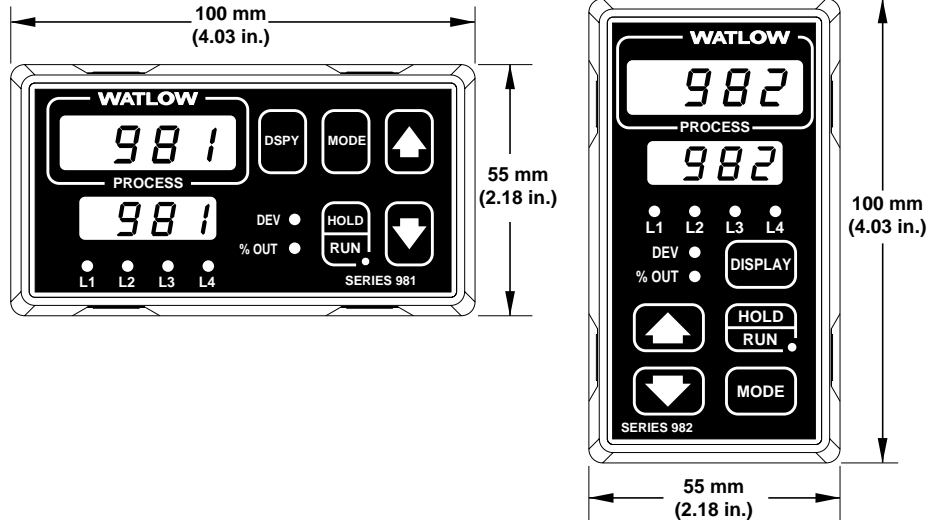
### Controller Weight

- 0.45 kg (1.0 lb)

### Shipping Weight

- 1.35 kg (3.01 lbs)

### Dimensions



### Dimensions

Vertical Orientation

#### Overall

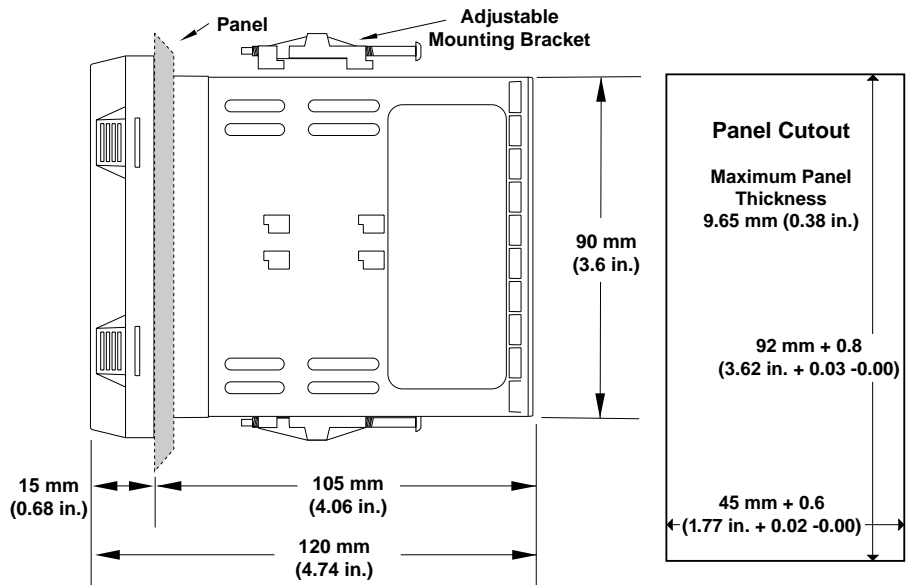
Height:	100 mm	(4.03 in.)
Width:	55 mm	(2.18 in.)
Depth:	120 mm	(4.74 in.)

#### Bezel

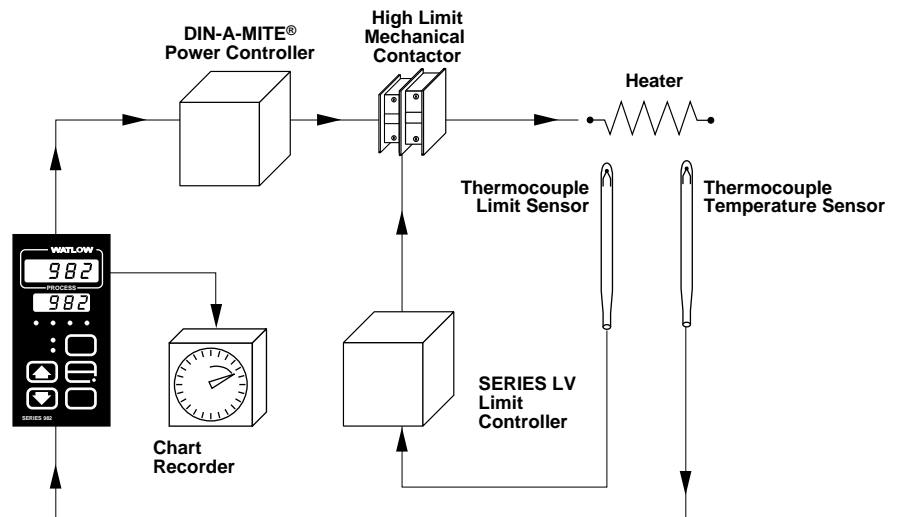
Height:	100 mm	(4.03 in.)
Width:	55 mm	(2.18 in.)
Depth:	15 mm	(0.68 in.)

#### Chassis

Height:	90 mm	(3.6 in.)
Width:	45 mm	(1.7 in.)
Depth:	105 mm	(4.06 in.)



### System Diagram



## PID with Time/ Temperature Profiling Controllers

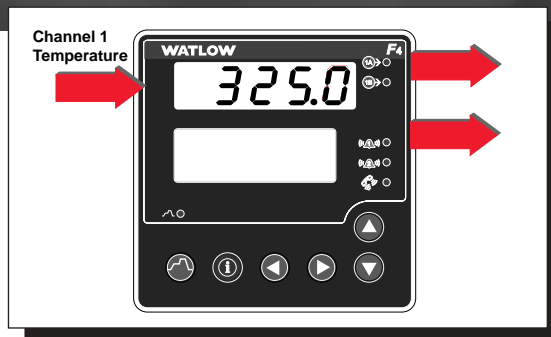
### SERIES F4S

The SERIES F4S ¼ DIN industrial ramping controllers offer an easy to set up and operate solution for the most demanding ramp and soak processing applications. The features and performance of these units make them ideally suited for environmental chamber or furnace and oven applications.

The F4S is a competitively priced controller which features a four line, high definition LCD interface display that makes profile programming and controller configuration significantly faster and easier. A 16 bit micro-processor supports all the accuracy and performance advantages you have come to expect from a Watlow controller.

Up to 256 steps can be programmed into as many as 40 nameable profiles. Profiles can be programmed to wait for events or for up to three different process variables. A guaranteed soak feature allows you to set how closely your process needs to be controlled.

The four digital event inputs can be programmed to remotely start, pause or terminate any of your preprogrammed process recipes. The eight event outputs are segment programmable, or three of them can be assigned to programmable compressor and boost heat/boost cool control. A real time clock can be used to start a profile at any time. Serial communication and dual alarm relays are included in the base unit. The SERIES F4S ramping controllers are packaged with a NEMA 4X front face to withstand harsh environments and a 101.6 mm (4.0 in.) deep case with removable connectors for wiring convenience.



#### Features and Benefits

##### Guided 256 step, 40 profile ramp and soak programmable memory

- Supports a wide range of processing applications

##### High definition four line LCD controller interface display

- Simplifies setup and operation

##### Menu customization

- Offers enhanced process monitoring

##### High performance 16 bit microprocessor

- Precise process control
- 20Hz update rate on input 1
- 10Hz update rate on inputs 2 and 3

##### Field upgradeable firmware

- Downloads available at no charge from [www.watlow.com/F4](http://www.watlow.com/F4)
- Reduces downtime
- Eliminates the need for an RMA

#### Universal inputs

- Provide application versatility

#### Expandable modular construction

- Field upgradeable

#### Enhanced environmental chamber control

- Supports humidity, compressor, boost heat/boost cool control

#### Cascade control

- Provides precise two variable control
- Auxiliary inputs required (ordering option)

#### Real time clock with battery backup

- Offers operational flexibility and peace of mind

# PID with Time/ Temperature Profiling Controllers

## SERIES F4S

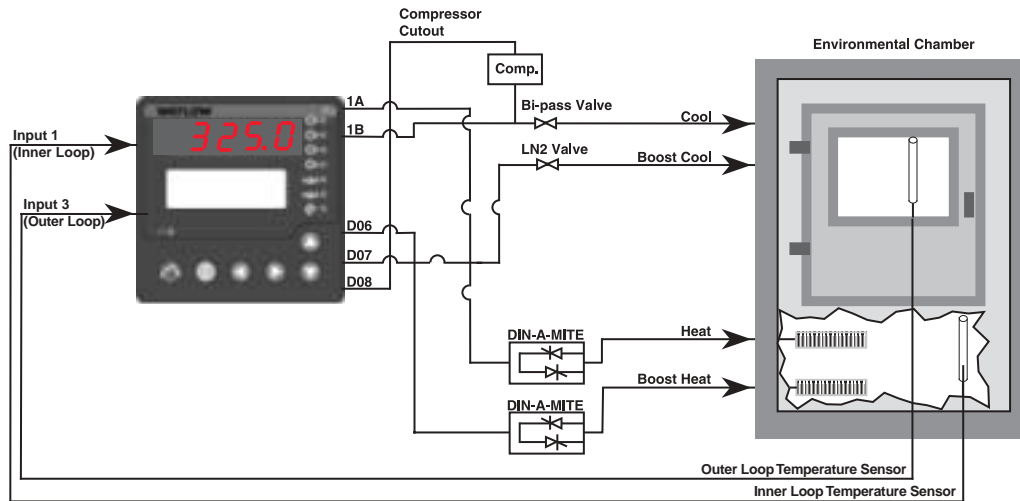
### Set Point Ramp and Soak Programming

The enhanced programming features found in the SERIES F4S ramping controllers are the result of listening to our customers' demand for greater capabilities with reduced programming complexity. A profile guide leads the programmer through the programming process by

offering choices for step configuration. For better operator recognition, profiles and digital I/O used for events can be given names of up to 10 characters in length. Five step types including ramp, soak, jump, auto start and end offer the programmer complete flexibility. Ramp steps can be based on time or rate. Ramp and soak steps can be programmed to wait for up to four event inputs and three process variables. Up to eight event outputs

are step selectable. Since your thermal systems characteristics may change over the operating range, up to 10 sets of PID heat/cool parameters are step selectable. The auto start step can start a profile based on a set date, a day of the week or daily, the choice is yours. The jump step can be used to jump within a profile or to another profile. The end step terminates a program with the control outputs programmed to your process needs.

### Temperature Chamber Application with Cascade

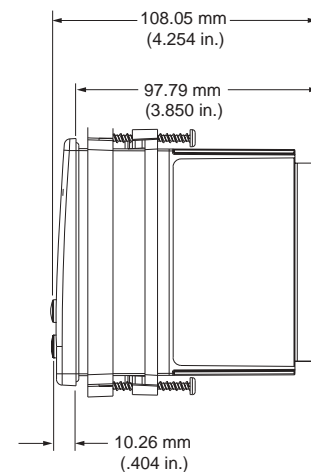
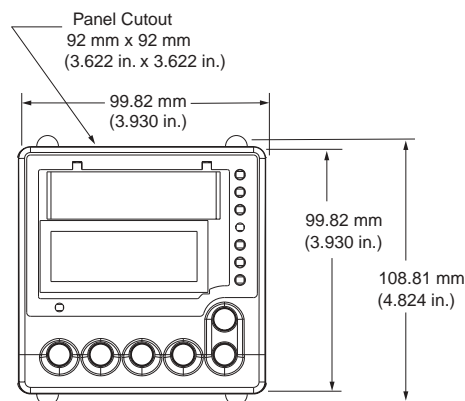


### Serial Communication

EIA-232 and EIA-485 serial communication interfaces are included in the base unit of both the SERIES F4S (single channel) and the SERIES F4D (dual channel) controllers. The baud rate is selectable as either 9600 or 19200 baud. The protocol is Modbus™.

### Alarms

Two Form "C" electromechanical alarm relays are included in the base units. These alarms can be programmed as either process or deviation alarms. The alarms can be tied to up to three process variables.



### Optional Retransmit(s)

Optional retransmit capability is available to retransmit one or two

variables. These variables include up to three process variables, control set points or percent load power.

# PID with Time/ Temperature Profiling Controllers

## SERIES F4S

### Specifications

#### Dimensions

- Width x height x depth  
99 mm x 99 mm x 97 mm panel  
mount (3.93 in. x 3.93 in. x 3.85 in.)

#### Universal Analog Inputs 1 (2 and 3 Optional)

- Updates rates, IN1 = 20Hz, IN2  
and IN3 = 10Hz

#### Thermocouple

- Type J, K, T, N, E, C (W5), D (W3),  
PTII, R, S, B
- Input impedance 20M $\Omega$

#### RTD

- 2- or 3-wire platinum, 100, 500 or  
1000 $\Omega$
- JIS or DIN-curves, 1.0 or 0.1  
indication

#### Process

- Input resolution  $\approx$ 50,000 bits at  
full scale
- Range selectable: 0-10V $\approx$ (dc),  
0-5V $\approx$ (dc), 1-5V $\approx$ (dc),  
0-50mV, 0-20mA, 4-20mA
- Voltage input impedance 20K $\Omega$
- Current input impedance 100 $\Omega$

#### Digital Inputs (4)

- Update rate = 10Hz
- Contact or dc voltage (36V $\approx$ (dc)  
maximum)
- 10K $\Omega$  input impedance

#### Control Outputs (1A, 1B)

- Update rate = 20Hz

#### Open Collector/Switched dc

- Internal load switching (nominal):  
Switched dc, 22 to 28V $\approx$ (dc),  
limited @ 30mA
- External load switching  
(maximum):  
Open collector 42V $\approx$ (dc) @ 0.5A

#### Solid State Relay

- Zero switched, optically coupled,  
0.5A @ 24V $\sim$ (ac) minimum,  
253V $\sim$ (ac) maximum

#### Process Outputs (Optional Retransmit)

- Update rate = 1Hz
- User selectable 0-10V $\approx$ (dc),  
0-5V $\approx$ (dc), 1-5V $\approx$ (dc) @ 1K $\Omega$  min.,  
0-20mA, 4-20mA @ 800 $\Omega$  max.
- Resolution:  
dc ranges = 2.5mV nominal  
mA ranges = 5 $\mu$ A nominal
- Calibration accuracy:  
dc ranges =  $\pm$ 15mV  
mA ranges =  $\pm$ 30 $\mu$ A
- Temperature stability 100ppm/ $^{\circ}$ C

#### Alarm Outputs

- Output update rate 1Hz
- Electromechanical relay, Form C,  
2A @ 30V $\approx$ (dc) or 240V $\sim$ (ac)  
maximum

#### Digital Outputs (8)

- Update rate = 10Hz
- Open collector output
- Off = 42V $\approx$ (dc) max @ 10 $\mu$ A
- On = 0.2V $\approx$ (dc) max @ 50mA sink
- Internal supply: 5V $\approx$ (dc), @ 80mA

#### Communications

EIA-232 and EIA-485 serial  
communications with Modbus™  
RTU protocol

#### Safety and Agency Approvals

- UL®/C-UL® 916 listed, File  
# E185611, process control  
equipment
- IP65 and NEMA 4X
- CE to EN 61010-1 and 631326

#### Terminals

- Touch-safe removable terminal  
blocks, accepts 12 to 22  
gauge wire

#### Power

- 100-240V $\sim$ (ac), -15 percent,  
+10 percent; 50/60Hz,  $\pm$ 5 percent
- 24-28V $\approx$ (ac/dc), -15 percent,  
+10 percent (order option)
- 39VA maximum power  
consumption
- Data retention upon power failure  
via nonvolatile memory (seven  
years for battery backed ram)
- Sensor input isolation from input  
to input to output to communi-  
cation circuitry is 500V $\sim$ (ac)

#### Operating Environment

- 0 to 55 $^{\circ}$ C (32 to 130 $^{\circ}$ F)
- 0 to 90 percent RH, non-condensing
- Storage temperature: -40 to 70 $^{\circ}$ C  
(-40 to 158 $^{\circ}$ F)

#### Accuracy

- Calibration accuracy and sensor  
conformity:  $\pm$ 0.1 percent of span  
 $\pm$ 1 $^{\circ}$ C @ 25 $^{\circ}$ C  $\pm$ 3 $^{\circ}$ C (77 $^{\circ}$ F  $\pm$ 5 $^{\circ}$ F)  
ambient and rated line voltage  
 $\pm$ 10 percent with the following  
exceptions:  
Type T: 0.12 percent of span for  
-200 $^{\circ}$ C to -50 $^{\circ}$ C (-328 $^{\circ}$ F to -58 $^{\circ}$ F)  
Types R and S: 0.15 percent of span for  
0 $^{\circ}$ C to 100 $^{\circ}$ C (32 $^{\circ}$ F to  
212 $^{\circ}$ F)  
Type B: 0.24 percent of span for  
870 $^{\circ}$ C to 1700 $^{\circ}$ C (1598 $^{\circ}$ F to  
3092 $^{\circ}$ F)
- Accuracy span: Less than or  
equal to operating ranges,  
540 $^{\circ}$ C (1000 $^{\circ}$ F) minimum
- Temperature stability:  $\pm$ 0.1 $^{\circ}$ C/ $^{\circ}$ C  
( $\pm$ 0.1 $^{\circ}$ F/ $^{\circ}$ F) rise in ambient for  
thermocouples  
 $\pm$ 0.05 $^{\circ}$ C/ $^{\circ}$ C ( $\pm$ 0.05 $^{\circ}$ F/ $^{\circ}$ F) rise in  
ambient for RTD sensors

#### Displays

- Process: Five, seven segment  
LED, red
- Control interface display: high  
definition LCD, green

# PID with Time/ Temperature Profiling Controllers

F.O.B.: Winona, Minnesota

## SERIES F4S

### Sensor Operating Ranges:

Type J:	0 to 815°C (32 to 1500°F)
Type K:	-200 to 1370°C (-328 to 2500°F)
Type T:	-200 to 400°C (-328 to 750°F)
Type N:	0 to 1300°C (32 to 2372°F)
Type E:	-200 to 800°C (-328 to 1472°F)
Type C: (W5)	0 to 2315°C (32 to 4200°F)
Type D: (W3)	0 to 2400°C (32 to 4352°F)
Type PTII:	0 to 1395°C (32 to 2543°F)
Type R:	0 to 1760°C (32 to 3200°F)
Type S:	0 to 1760°C (32 to 3200°F)
Type B:	0 to 1816°C (32 to 3300°F)
RTD (DIN):	-200 to 800°C (-328 to 1472°F)
RTD (JIS):	-200 to 800°C (-328 to 1472°F)
Process:	-19,999 to 30,000 units

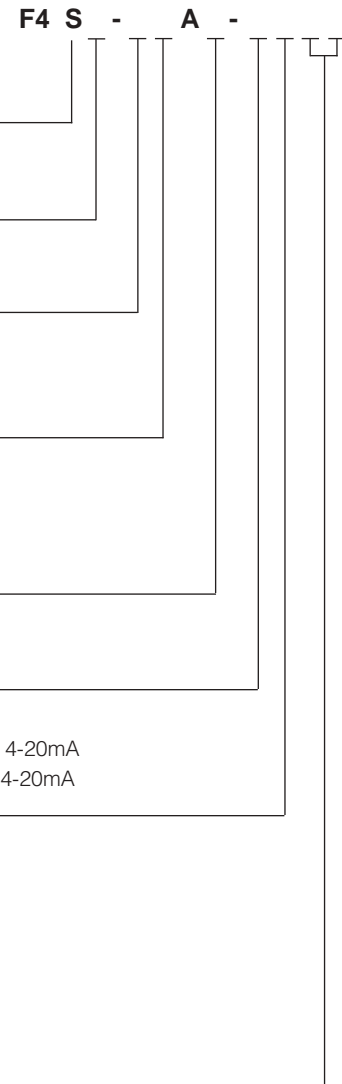
### Sensor Accuracy Ranges:

#### Input ranges

Type J:	0 to 750°C (32 to 1382°F)
Type K:	-200 to 1250°C (-328 to 2282°F)
Type T:	-200 to 350°C (-328 to 662°F)
Type N:	0 to 1250°C (32 to 2282°F)
Type E:	-200 to 800°C (-328 to 1472°F)
Type C(W5):	0 to 2315°C (32 to 4200°F)
Type D(W3):	0 to 2400°C (32 to 4352°F)
Type PTII:	0 to 1393°C (32 to 2540°F)
Type R:	0 to 1450°C (32 to 2642°F)
Type S:	0 to 1450°C (32 to 2642°F)
Type B:	870 to 1700°C (1598 to 3092°F)
RTD (DIN):	-200 to 800°C (-328 to 1472°F)
RTD (JIS):	-200 to 630°C (-328 to 1166°F)
Process:	-19,999 to 30,000 units

### Ordering Information

To order, complete the code number on the right with the information below:



**SERIES F4S** = ¼ DIN, single channel ramping controller

#### Single Channel Ramping Controller

1 universal analog input, 4-digital inputs, 8-digital outputs, 2 alarms, EIA-232/485 comms

#### Power Supply

H = 100-240V $\approx$ (ac/dc)

L = 24-28V $\approx$ (ac/dc)

#### Output 1A

C = Open collector/switched dc

F = Process, 0-5, 1-5, 0-10V $\approx$ (dc), 0-20mA, 4-20mA

K = Solid state Form A 0.5 amp relay

#### Output 1B

A = None

C = Open collector/switched dc

F = Process, 0-5, 1-5, 0-10V $\approx$ (dc), 0-20mA, 4-20mA

K = Solid state Form A 0.5 amp relay

#### Auxiliary Input Module

0 = None

6 = Dual universal inputs

#### Auxiliary Retransmit Module

0 = None

1 = Single retransmit output 0-5, 1-5, 0-10V $\approx$ (dc), 0-20mA, 4-20mA

2 = Dual retransmit outputs 0-5, 1-5, 0-10V $\approx$ (dc), 0-20mA, 4-20mA

#### Language and RTD Options

1 = English with 100 $\Omega$  RTD

2 = German with 100 $\Omega$  RTD

3 = French with 100 $\Omega$  RTD

4 = Spanish with 100 $\Omega$  RTD

5 = English with 500 and 1K $\Omega$  RTD

6 = German with 500 and 1K $\Omega$  RTD

7 = French with 500 and 1K $\Omega$  RTD

8 = Spanish with 500 and 1K $\Omega$  RTD

#### Display and Custom Options

RG = Standard display (Red/Green display only)

XX = Custom options: software, setting parameters, overlay



## Limits/Alarms

### SERIES LV

Watlow's family of microprocessor-based limit controllers provides an economical solution for applications requiring temperature limit control. These limits are available in a broad range of packaging options, allowing users to select the best version for their individual application. The limits are available with an operator interface and can be ordered in 1/2 DIN-square panel mount or DIN-rail mount design configurations.

The LV limit family incorporates a microprocessor design platform. This design provides significant improvements in the performance, repeatability and accuracy offered by Watlow's current line of analog limit controllers.

The variable SERIES LV limit includes an operator interface for viewing and selecting the set point. A red, four-character seven segment LED displays the set point. The set point selection is made with a continuous turn rotary encoder. Operating range temperature values are customer definable in the product configuration part number.

The limit controllers are FM approved with special UL® approval for the open board potted versions. Watlow's limit controllers include industry leading service and support and are backed by a three-year warranty.

#### Applications

- Food preparation
- Industrial machinery
- Packaging
- Plastics processing

#### Features and Benefits

##### Adjustable set points

- Offer control flexibility

##### Four character LED display

- Improves set point selection accuracy



#### Multiple mounting options

- Minimize installation time

#### High or low limit with auto or manual reset

- Provides application flexibility

#### Fahrenheit or Celsius operation with indication

- Offers application flexibility

#### Sensor break protection

- Provides positive system shutdown

#### Agency approvals

- Meet certification requirements/compliance

#### Microprocessor based technology

- Ensures accurate repeatable control

#### Specifications

##### Limit Controller

- Microprocessor based, limit controller
- Nominal switching hysteresis, typically 1.7°C (3°F)
- High or low limit, factory selectable
- Latching output requires manual reset upon over or under temperature condition
- Manual or automatic reset on power loss, factory selectable
- Internal front panel or external customer supplied momentary reset switch
- Input filter time: 1 second

#### Operator Interface

- Four digit, seven segment LED displays, 7 mm (0.28 in.) high
- °C or °F indicator LED
- Alarm indicator LED
- Continuous turn, velocity sensitive rotary encoder for set point adjustment
- Front panel SET/RESET

#### Standard Conditions For Specifications

- Rated line voltage, 50 to 60Hz, 0 to 90 percent RH non-condensing, 15-minute warm-up
- Calibration ambient range: 25°C (77°F) ±3°C

#### Sensor Input

##### Thermocouple

- Grounded or ungrounded
- Type E, J, K, T thermocouple
- >10 MΩ input impedance
- 250 nV input referenced error per 1Ω source resistance

##### RTD

- 2-wire platinum, 100Ω
- DIN-curve (0.00385 curve)
- 125 μA nominal RTD excitation current

# Limits/Alarms

F.O.B.: Winona, Minnesota

## SERIES LV

### Specifications Cont.

#### Input Accuracy Span Range

Type E:	-200 to 800°C
	(-328 to 1472°F)
Type J:	0 to 750°C
	(32 to 1382°F)
Type K:	-200 to 1250°C
	(-328 to 2282°F)
Type T:	-200 to 350°C
	(-328 to 662°F)
RTD (DIN)	-200 to 800°C
	(-328 to 1472°F)

#### Thermocouple Input

- Calibration accuracy: ±1 percent of input accuracy span, ±1° at standard conditions and actual calibration ambient. Exception: Type T, ±2.4 percent of input accuracy span for -200 to 0°C (-328 to 32°F)
- Temperature stability: ±0.3° per degree change in ambient

#### RTD Input

- Calibration accuracy ±1 percent of input accuracy span ±1° at standard conditions and actual calibration ambient
- Temperature stability: ±0.2° per degree change in ambient

#### Allowable Operating Ranges

Type E:	-200 to 800°C
	(-328 to 1472°F)
Type J:	-210 to 1038°C
	(-346 to 1900°F)
Type K:	-270 to 1370°C
	(-454 to 2500°F)
Type T:	-270 to 400°C
	(-454 to 750°F)
RTD (DIN)	-200 to 800°C
	(-328 to 1472°F)

#### Electromechanical Relay, Form C

- Minimum load current: 100mA
- 8 A @ 240V~(ac) or 30V=(dc) maximum, resistive
- 250VA pilot duty, 120/240V~(ac) maximum, inductive
- Use RC suppression for inductive loads
- Electrical life 100,000 cycles at rated current

#### External Reset Switch

- Momentary, dry contact closure

#### Agency Approvals

- UL® 873 recognized temperature regulator
- UL® 197 reviewed for use in cooking appliances
- ANSI Z21.23 Gas appliance thermostat approval
- DIN 3440 - Temperature control and limiting devices for heat generating systems
- CSA C22.2#24 approved limit control (applied for)
- FM Class 3545 temperature limit switches (applied for)

#### Terminals

- 6.3 mm (0.25 in.) quick connect, push on terminal

#### Power

- 24V~(ac) +10 percent; -15 percent; 50/60Hz, ±5 percent
- 120V~(ac) +10 percent; -15 percent; 50/60Hz, ±5 percent
- 230 to 240V~(ac) +10 percent; -15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Operating Environment

- 0 to 70°C (32 to 158°F)
- 0 to 90 percent RH, non-condensing
- Storage temperature: -40 to 85°C (-40 to 185°F)

#### Dimensions

- DIN-rail model can be DIN-rail or chassis mount  
DIN-rail spec DIN 50022, 35 mm x 7.5 mm (1.38 in. x 0.30 in.)

Style	Width	Height	Depth
DIN-rail	78.1 mm (3.08 in.)	112.3 mm (4.42 in.)	90.7 mm (3.57 in.)
Square 1/8 DIN-panel	72.4 mm (2.85 in.)	72.4 mm (2.85 in.)	Behind panel 51.7 mm (2.04 in.)

#### Ordering Information

To order, complete the model number on the right with the information below.

**SERIES LV =** Limit controller with eight amp relay output. Rotary set point, adjustment, four character, seven segment display, reset switch

**Power Supply** \_\_\_\_\_

C = 120V~(ac)  
E = 230 to 240V~(ac)  
G = 24V~(ac)

**Package** \_\_\_\_\_

1 = Panel mount square 1/8 DIN  
2 = DIN-rail mount

**Sensor Type and Scale** \_\_\_\_\_

H = T/C Type J Fahrenheit (-346 to 1900°F)  
J = T/C Type J Celsius (-210 to 1038°C)  
K = T/C Type K Fahrenheit (-454 to 2500°F)  
L = T/C Type K Celsius (-270 to 1370°C)  
M = T/C Type T Fahrenheit (-454 to 750°F)  
N = T/C Type T Celsius (-270 to 400°C)  
P = RTD Fahrenheit (-328 to 1472°F)  
R = RTD Celsius (-200 to 800°C)  
S = T/C Type E Fahrenheit (-328 to 1470°F)  
T = T/C Type E Celsius (-200 to 800°C)

**Limit Type** \_\_\_\_\_

U = High limit manual reset  
W = High limit auto reset  
Y = Low limit manual reset  
Z = Low limit auto reset

**Low Set Point Operating Range Value**® \_\_\_\_\_

**High Set Point Operating Range Value**® \_\_\_\_\_

**Overlay/Customs Options** \_\_\_\_\_

A = Standard

®A (-) is used in the left most digit of the set point operating ranges to indicate a negative temperature value

## Limits/Alarms

### SERIES LF

Watlow's family of microprocessor-based limit controllers provide an economical solution for applications requiring temperature limit control. These limits are available in a broad range of packaging options, allowing users to select the best version for their individual application. The controllers are available without an operator interface and can be ordered in square 1/2 DIN-panel mount, DIN-rail mount or open board design configurations.

The LF limit family incorporates a microprocessor design platform. This design provides significant improvements in the performance, repeatability and accuracy offered by Watlow's current line of analog basic temperature controllers.

The fixed SERIES LF limit offers fixed set points and is supplied without an operator interface. Operating set point temperature values are customer definable in the product configuration part number.

The LF limit controllers are FM approved with special UL® approval for the open board potted versions. Watlow's limit controllers include industry leading service and support and are backed by a three-year warranty.

#### Applications

- Food preparation
- Industrial machinery
- Packaging
- Plastics processing

#### Features and Benefits

##### Fixed set points

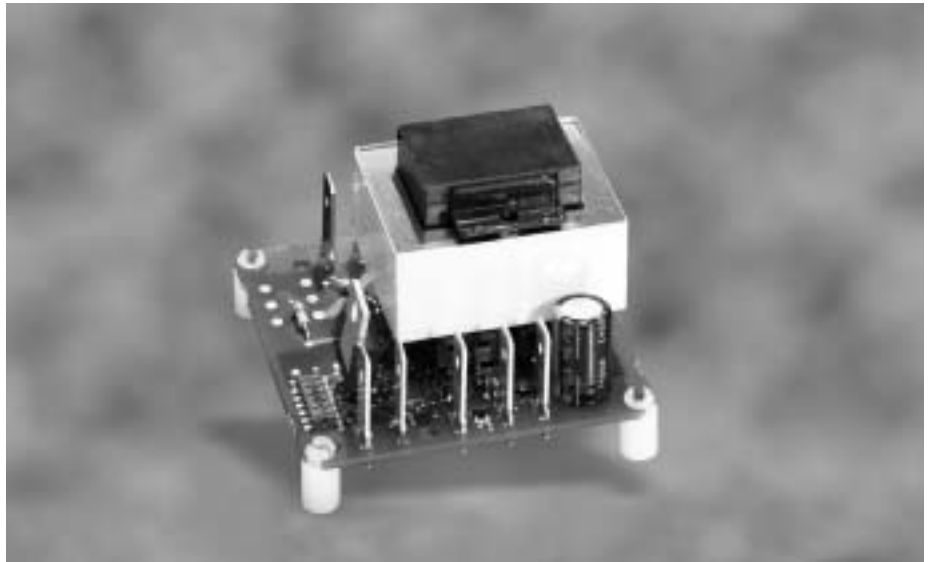
- Provide tamper-proof operation

##### Multiple mounting options

- Minimize installation time

##### High or low limit with auto or manual reset

- Provides application flexibility



#### Fahrenheit or Celsius operation with indication

- Offers application flexibility

#### Sensor break protection

- Provides positive system shutdown

#### Agency approvals

- Meet certification requirements/compliance

#### Microprocessor based technology

- Ensures accurate repeatable control

#### Specifications

##### Limit Controller

- Microprocessor based, limit controller
- Nominal switching hysteresis, typically 1.7°C (3°F)
- High or low limit, factory selectable
- Latching output requires manual reset upon over or under temperature condition
- Manual or automatic reset on power loss, factory selectable
- External customer supplied momentary reset switch
- Input filter time: 1 second

##### Standard Conditions For Specifications

- Rated line voltage, 50 to 60Hz, 0 to 90 percent RH non-condensing, 15-minute warm-up
- Calibration ambient range: 25°C (77°F) ±3°C

#### Sensor Input Thermocouple

- Grounded or ungrounded
- Type E, J, K, T thermocouple
- >10 MΩ input impedance
- 250 nV input referenced error per 1Ω source resistance

#### RTD

- 2-wire platinum, 100Ω
- DIN-curve (0.00385 curve)
- 125 μA nominal RTD excitation current

#### Input Accuracy Span Range

Type E:	-200 to 800°C
	(-328 to 1472°F)
Type J:	0 to 750°C
	(32 to 1382°F)
Type K:	-200 to 1250°C
	(-328 to 2282°F)
Type T:	-200 to 350°C
	(-328 to 662°F)
RTD (DIN)	-200 to 800°C
	(-328 to 1472°F)

#### Thermocouple Input

- Calibration accuracy: ±1 percent of input accuracy span, ±1° at standard conditions and actual calibration ambient. Exception: Type T, ±2.4 percent of input accuracy span for -200 to 0°C (-328 to 32°F)
- Temperature stability: ±0.3° per degree change in ambient

# Limits/Alarms

F.O.B.: Winona, Minnesota

## SERIES LF

### Specifications Cont.

#### RTD Input

- Calibration accuracy  $\pm 1$  percent of input accuracy span  $\pm 1^\circ$  at standard conditions and actual calibration ambient
- Temperature stability:  $\pm 0.2^\circ$  per degree change in ambient

#### Allowable Operating Ranges

Type E:	-200 to 800°C
	(-328 to 1472°F)
Type J:	-210 to 1038°C
	(-346 to 1900°F)
Type K:	-270 to 1370°C
	(-454 to 2500°F)
Type T:	-270 to 400°C
	(-454 to 750°F)
RTD (DIN)	-200 to 800°C
	(-328 to 1472°F)

#### Output Types

#### Electromechanical Relay, Form C

- Minimum load current: 100mA
- 8 A @ 240V~(ac) or 30V=(dc) maximum, resistive
- 250VA pilot duty, 120/240V~(ac) maximum, inductive
- Use RC suppression for inductive loads
- Electrical life 100,000 cycles at rated current

#### External Reset Switch

- Momentary, dry contact closure

#### Agency Approvals

#### SERIES LF (potted version only)

- UL® 991 recognized temperature limit for cooking industry
- CSA E60730-1, E60730-2-9 approved temperature regulator for cooking industry (applied for)

#### SERIES LF (including potted version)

- UL® 873 recognized temperature regulator
- UL® 197 reviewed for use in cooking appliances
- ANSI Z21.23 Gas appliance thermostat approval

- DIN 3440 - Temperature control and limiting devices for heat generating systems
- CSA C22.2#24 approved limit control (applied for)
- FM Class 3545 temperature limit switches (applied for)
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Operating Environment

- 0 to 70°C (32 to 158°F)
- 0 to 90 percent RH, non-condensing
- Storage temperature: -40 to 85°C (-40 to 185°F)

#### Dimensions

- DIN-rail model can be DIN-rail or chassis mount
- DIN-rail spec DIN 50022, 35 mm x 7.5 mm (1.38 in. x 0.30 in.)

#### Terminals

- 6.3 mm (0.25 in.) quick connect, push on terminal

#### Power

- 24V~(ac) +10 percent; -15 percent; 50/60Hz,  $\pm 5$  percent
- 120V~(ac) +10 percent; -15 percent; 50/60Hz,  $\pm 5$  percent
- 230 to 240V~(ac) +10 percent; -15 percent; 50/60Hz,  $\pm 5$  percent

Style	Width	Height	Depth
Open Board	61.7 mm (2.43 in.)	61.7 mm (2.43 in.)	45.1 mm (1.78 in.)
Potted	70.1 mm (2.76 in.)	102.9 mm (4.05 in.)	46.6 mm (1.84 in.)
DIN-rail	78.1 mm (3.08 in.)	112.3 mm (4.42 in.)	90.7 mm (3.57 in.)
Square 1/8 DIN-panel	72.4 mm (2.85 in.)	72.4 mm (2.85 in.)	Behind panel 51.7 mm (2.04 in.)

#### Ordering Information

To order, complete the model number on the right with the information below.

**SERIES LF =** Limit controller with eight amp relay output. Fixed set point, no user interface

**Power Supply** \_\_\_\_\_

C = 120V~(ac)  
E = 230 to 240V~(ac)  
G = 24V~(ac)

**Package** \_\_\_\_\_

1 = Panel mount square 1/8 DIN  
2 = DIN-rail mount  
3 = Open board, non potted  
4 = Potted case

**Sensor Type and Scale** \_\_\_\_\_

H = T/C Type J Fahrenheit (-346 to 1900°F)  
J = T/C Type J Celsius (-210 to 1038°C)  
K = T/C Type K Fahrenheit (-454 to 2500°F)  
L = T/C Type K Celsius (-270 to 1370°C)  
M = T/C Type T Fahrenheit (-454 to 750°F)  
N = T/C Type T Celsius (-270 to 400°C)  
P = RTD Fahrenheit (-328 to 1472°F)  
R = RTD Celsius (-200 to 800°C)  
S = T/C Type E Fahrenheit (-328 to 1470°F)  
T = T/C Type E Celsius (-200 to 800°C)

**Limit Type** \_\_\_\_\_

U = High limit manual reset  
W = High limit auto reset  
Y = Low limit manual reset  
Z = Low limit auto reset

**Fixed Set Point Temperature Value<sup>ⓐ</sup>** \_\_\_\_\_

**Overlay/Customs Options** \_\_\_\_\_

A = Standard

LF \_\_\_\_\_ AAAA \_\_\_\_\_

<sup>ⓐ</sup>A (-) is used in the left most digit of the fixed set point indicates a negative temperature value

## Limits/Alarms

### SERIES SD\_L

The SERIES SD family of limit controllers has been designed with the same microprocessor-based technology as the SERIES SD PID family of temperature controllers. The limits come with FM (Factory Mutual) agency approval — the industry’s most recognized designation for insurance concerns. Limit controllers are typically added to thermal applications to monitor an over-temperature condition as a safety precaution. Limit controllers provide a redundant safety assurance to guard against instances where a high temperature runaway condition could result from a shorted input sensor, or from an output device that fails in a closed position.

Limits are recommended and are often required in applications where thermal runaway could result in costly operator safety concerns, product scrap, damage to capital equipment or a fire hazard.

The SD\_L limit family is also designed to work with Watlow’s HMI software WATVIEW.

#### Features and Benefits

##### FM approved

##### Watlow’s patented User Defined Menu System

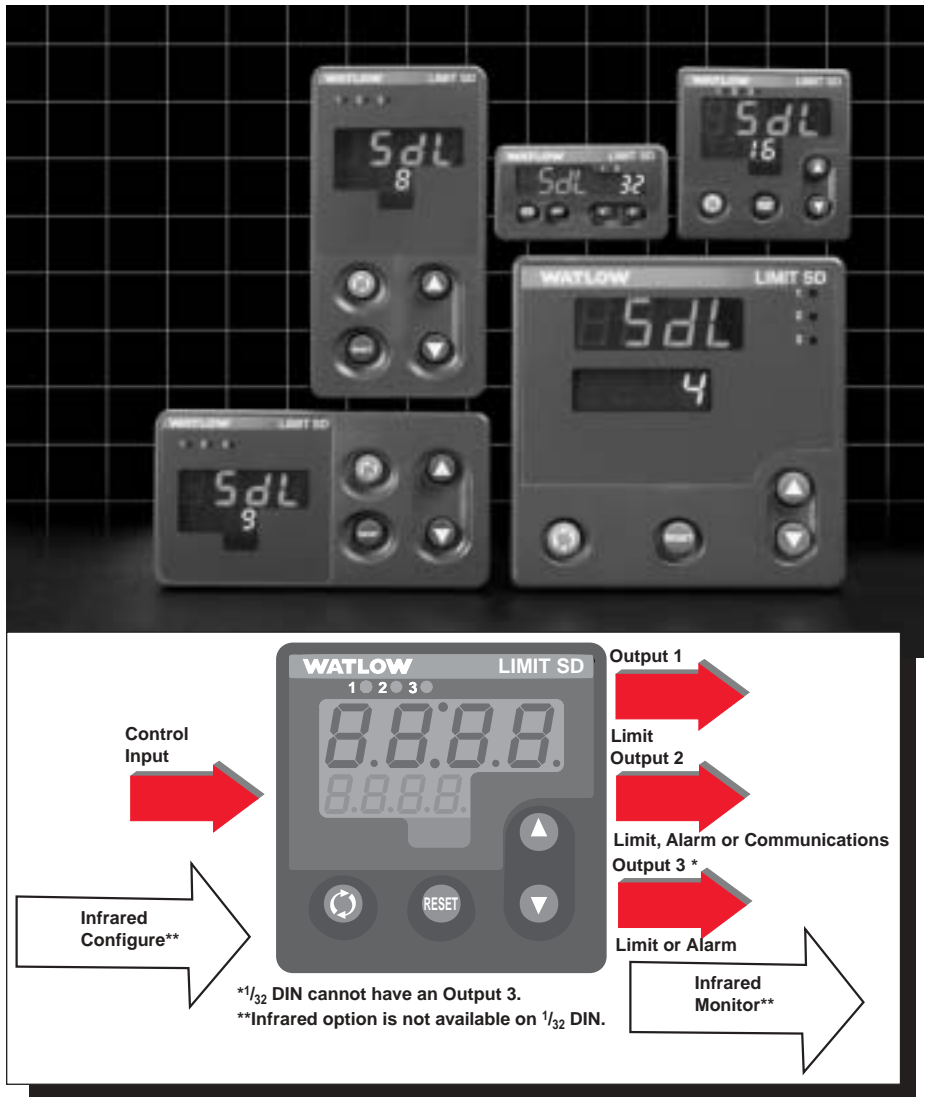
- Allows the user to assign up to 20 parameters in the operations menu
- Improves operational efficiency

##### “Save and Restore” feature for user settings

- Allows the user to save individual or factory settings
- Eliminates the need to contact the OEM or factory to restore settings

##### WATVIEW HMI (Human Machine Interface)

- Permits operation, configuration and data logging via a standard Windows® PC



Single-Loop  
Limits/Alarms

##### Up to three outputs (two for 1/32 DIN)

- Results in application versatility

##### Dual display on all limit models

- Provides better recognition of process changes

##### Infrared communications (optional)

- Facilitates recipe management and data logging
- Allows easier controller setup, operation and monitoring

##### Watlow’s INFOSENSE™ sensor technology

- Thermal sensing technology improves sensor accuracy by a minimum of 50 percent

##### Specifications

##### Line Voltage/Power

- 100 to 240V~(ac), +10/-15 percent; (85-264V~[ac]) 50/60Hz, ±5 percent
- 24V≈(ac/dc), +10/-15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

# Limits/Alarms

## SERIES SD\_L

### Specifications Cont.

#### Environment

- 18 to 65°C (0 to 149°F) operating temperature
- 40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

#### Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

#### Agency Approvals

- FM and NEMA 4X/IP65
- UL® 3121, C-UL®, CSA, CE for outputs 2 and 3
- NSF for Type J, K, T and E thermocouples

#### Controller

- Microprocessor based user-selectable control modes
- Single universal input, up to three outputs
- Control sampling rates: input = 6.5Hz, display = 10Hz, outputs = 6.5Hz

#### Operator Interface

- Dual 4 digit, 7 segment LED displays
- Advance, infinity and up down keys
- Optional IrDA infrared port (not available on 1/32 DIN)
- Isolated EIA-485 Modbus™ serial communications

### Wiring Termination -Touch Safe Terminals

- Input power and control outputs 12 to 22 AWG
- Sensor inputs and process outputs 20 to 28 AWG

### Universal Input

- Thermocouple, grounded or ungrounded sensors
- RTD 2- or 3-wire, platinum, 100Ω @ 0°C calibration to DIN-curve (0.00385 Ω/Ω/°C)
- Process, 0-20mA @ 100Ω, or 0-10V=(dc) @ 20kΩ input impedance; Scalable
- Inverse scaling
- >20MΩ input impedance
- Maximum of 20Ω source resistance

### Allowable Operating Range

Type J:	0 to 815°C (32 to 1500°F)
Type K:	-200 to 1370°C (-328 to 2500°F)
Type T:	-200 to 400°C (-328 to 750°F)
Type N:	0 to 1300°C (32 to 2372°F)
Type E:	-200 to 800°C (-328 to 1470°F)
Type C:	0 to 2315°C (32 to 4200°F)

### Dimensions

DIN Size	Behind Panel (max.)	Width	Height
1/32 DIN	97.8 mm (3.85 in.)	52.6 mm (2.07 in.)	29.7 mm (1.17 in.)
1/16 DIN	97.8 mm (3.85 in.)	52.1 mm (2.05 in.)	52.1 mm (2.05 in.)
1/8 DIN Vertical	97.8 mm (3.85 in.)	52.8 mm (2.08 in.)	99.8 mm (3.93 in.)
1/8 DIN Horizontal	97.8 mm (3.85 in.)	99.8 mm (3.93 in.)	52.8 mm (2.08 in.)
1/4 DIN	101.1 mm (3.98 in.)	99.8 mm (3.93 in.)	99.8 mm (3.93 in.)

Type D:	0 to 2315°C (32 to 4200°F)
Type PTH:	0 to 1395°C (32 to 2543°F)
Type R:	0 to 1760°C (32 to 3200°F)
Type S:	0 to 1760°C (32 to 3200°F)
Type B:	0 to 1816°C (32 to 3300°F)
RTD (DIN):	-200 to 800°C (-328 to 1472°F)
Process:-	1999 to 9999 units

### Control Outputs

#### Output 1

- Electromechanical relay. Form A, rated 2A @ 120V~(ac), or 240V~(ac) or 30V=(dc)

#### Output 2

- Electromechanical relay or E/A 485 comms, or switched DC, or SSR

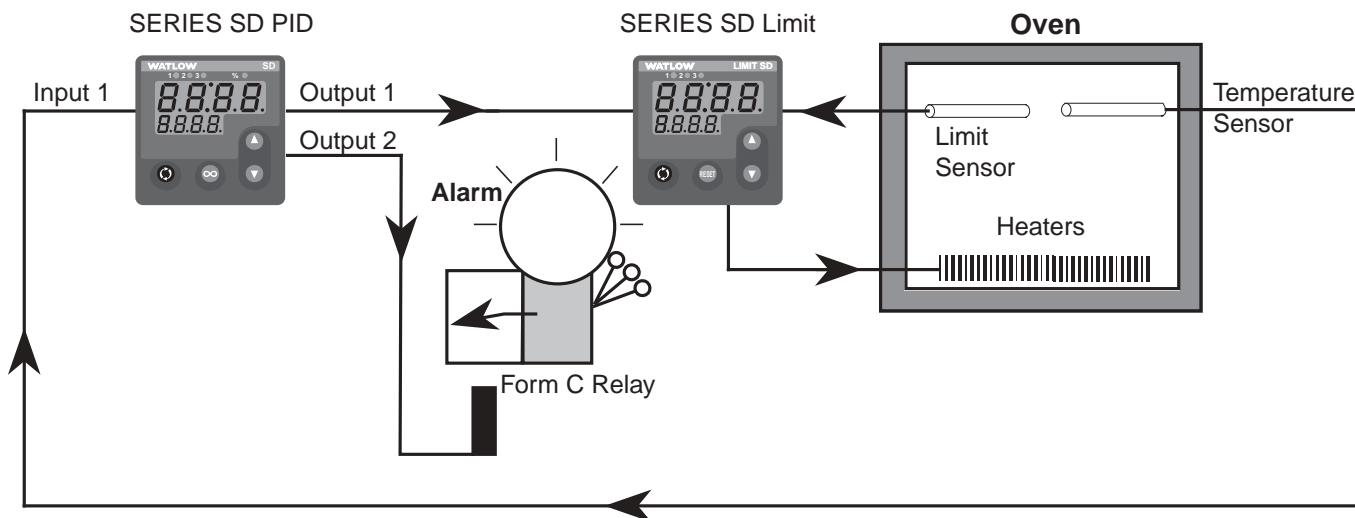
#### Output 3

- (not available on 1/32 DIN) 5 amp Form C EM-relay, or SSR, universal process, or switched DC

## Limits/Alarms

### SERIES SD\_L

#### Typical Block Diagram



Note: Consult user manual for proper wiring.



#### Infrared Communications

The Infrared Data Communications (IDC) option is available on all SERIES SD controller models except the 1/2 DIN and can support complete SERIES SD parameter configuration and operation. The IDC option supports wireless communications with PDAs (personal digital assistants) or other devices equipped with

infrared communications that support the Infrared Data Association (IrDA) 1.0 Standard.

The actual user interface or configuration is dependent on the master device application software. A source for this software is Instant HMI from Software Horizons. For more information, visit [www.instanthmi.com/watlow](http://www.instanthmi.com/watlow).

Advantages of IDC include automated logging of key process variables, increased accuracy and ease of use for recipe or configuration setups. Infrared data communications enhances controller data exchange in physically restricting environments (such as semiconductor clean rooms, governmental radio-active test labs or those hard to reach areas) and reduces the use of paper to record instrument information as well as human transposition errors.



#### WATVIEW HMI

WATVIEW, Watlow's Windows® based HMI (Human Machine Interface) software, supports the SERIES SD controllers. The software can be used to setup, monitor and edit the values of controller parameters, to monitor and manage alarms and to log and graph process data.

## SERIES SD\_L

### Ordering Information

To order, complete the model number on the right with the information below.

**S D L - J - A**

**SERIES SD\_L** = Temperature limit controllers<sup>®</sup>

**DIN Sizes**

- 3 = 1/32 DIN
- 6 = 1/16 DIN
- 8 = 1/8 DIN Vertical
- 9 = 1/8 DIN Horizontal
- 4 = 1/4 DIN

**Control Type**

- L = Limit Control Dual Display

**Power Supply**

- H = 100 to 240V $\approx$ (ac/dc)
- L = 24 to 28V $\approx$ (ac/dc)

**Output 1**

- J = Mechanical relay, Form A, 2A

**Output 2**

- A = None
- C = Switched dc
- K = SSR, Form A, 0.5A
- J = Mechanical relay, Form A, 2A
- U = EIA-485 Modbus™ communications

**Output 3 (Not available on 1/32 DIN)**

- A = None
- C = Switched dc/open collector
- K = SSR, Form A, 0.5A
- F = Universal process
- E = Mechanical relay, Form C, 5A

**Infrared Comms Options (IrDA)**

- A = None (Default selection on 1/32 DIN)
- R = IrDA ready (Not available on 1/32 DIN)

**Display Colors and Custom Options**

- RG = Red Green (Dual display units)
- RR = Red Red (Not available on 1/32 DIN Dual Display)
- XX = Custom options, special overlays, etc.

<sup>®</sup> Only available in dual displays, red/green.



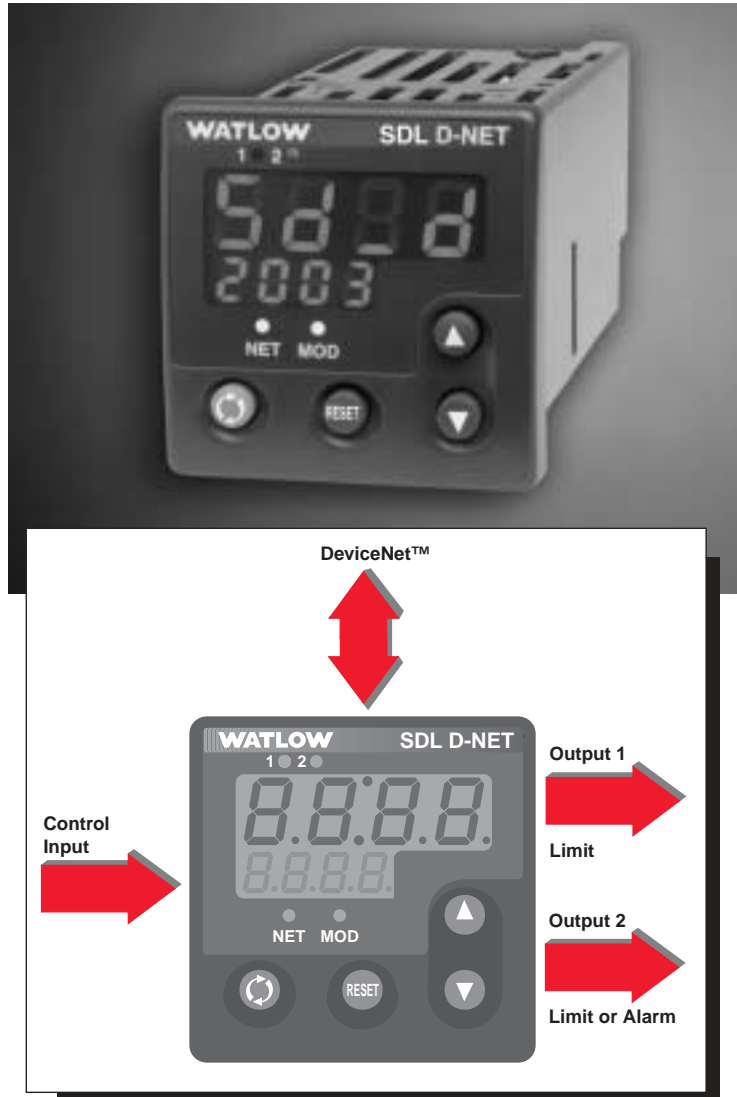
## Limits/Alarms

### SERIES SD6L\_D

Watlow SERIES SD6L\_D offers excellent Limit control and application flexibility in a 1/16<sup>th</sup> DIN panel mount package. The SERIES SD6L\_D controller has been successfully tested for use with both ODVA and Semi-conductor SIG standards for DeviceNet™ on CAN networks and comes with FM Approval.

The SD6L\_D single channel controller includes a universal sensor input with two outputs. Output 1 comes preconfigured with a Mechanical Relay dedicated for safety shutdown purposes to meet FM requirements. Output 2 can be configured as an Alarm. The DeviceNet™ communications interface is supplied with either a five pin circular DIN connector for Semiconductor SIG specific applications, or with a five position removable screw terminal connector for traditional market applications. Additional features of the SD6L\_D family of controllers include Watlow's INOFSENSE™ sensor technology, a user definable menu system as well as a Save and Restore feature that allows the restoration of factory and user defined parameter values.

Watlow SD6L\_D DeviceNet™ Limit controllers include a three year warranty and are FM approved with IP65/NEMA 4, CE and NSF ratings. When not used as a Limit device the following agency approvals apply: UL®, C-UL® listed, and CSA ratings.



#### Features and Benefits

##### Variable burst fire

- Prolongs heater life

##### Ordering Options including DeviceNet™ on CAN or SEMI-SIG-ODVA protocols

- Provides DeviceNet™ on CAN for Semiconductor applications
- DeviceNet™ on CAN for the packaging or general industrial markets

#### Specifications

##### Line Voltage/Power

- 100 to 240V~(ac), +10/-15 percent; (85-264V~[ac]) 50/60Hz, ±5 percent
- 24V≈(ac/dc), +10/-15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

DeviceNet™ is a trademark of the Open DeviceNet Vendors Association.  
UL® and C-UL® are registered trademarks of Underwriters Laboratories, Inc.

# Limits/Alarms

F.O.B.: Winona, Minnesota

## SERIES SD6L\_D

### Specifications Cont.

#### Environment

- 18 to 65°C (0 to 149°F) operating temperature
- 40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

#### Accuracy

- Calibration accuracy and sensor conformity: ±0.1 percent of span, ±1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C ±3°C (77°F ±5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.1°C/°C (±0.2°F/°F) rise in ambient maximum

#### Agency Approvals

- FM, IP65/NEMA 4X and NSF-2
- UL® 3121, C-UL®, CSA, CE,

#### Controller

- Microprocessor based user-selectable control modes
- Single universal input, up to three outputs
- Control sampling rates: Input = 6.5Hz, Display = 10Hz and Outputs = 6.5Hz

#### Operator Interface

- Dual 4 digit, 7 segment LED displays
- DeviceNet™ on CAN or
- Semi-SIG-ODVA

#### Allowable Operating Range

Type J: 0 to 815°C  
(32 to 1500°F)  
Type K: -200 to 1370°C  
(-328 to 2500°F)

Type T: -200 to 400°C  
(-328 to 750°F)

Type N: 0 to 1300°C  
(32 to 2372°F)

Type E: -200 to 800°C  
(-328 to 1470°F)

Type C: 0 to 2315°C  
(32 to 4200°F)

Type D: 0 to 2315°C  
(32 to 4200°F)

Type PTII: 0 to 1395°C  
(32 to 2543°F)

Type R: 0 to 1760°C  
(32 to 3200°F)

Type S: 0 to 1760°C  
(32 to 3200°F)

Type B: 0 to 1816°C  
(32 to 3300°F)

RTD (DIN): -200 to 800°C  
(-328 to 1472°F)

Process: -1999 to 9999 units

#### Control Outputs

- Electromechanical relay. Form A, rated 2A @ 120V~(ac), 2A @ 240V~(ac) or 2A @ 30V=(dc)

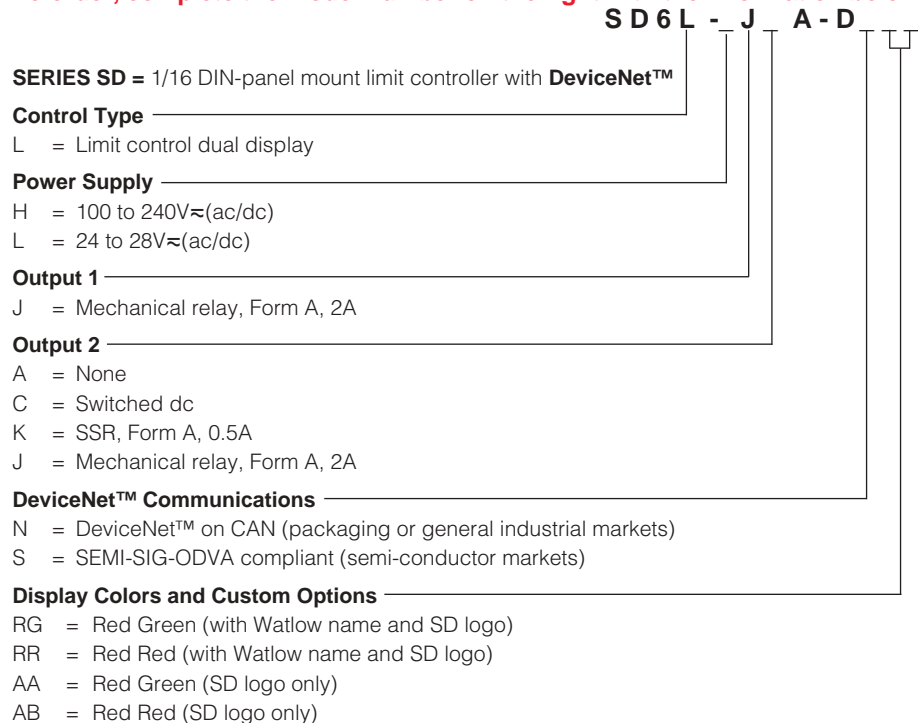
- Switched dc non-isolated minimum turn on voltage of 6V=(dc) into a minimum 500Ω load with a maximum on voltage of not greater than 12V=(dc) into an infinite load. Maximum switched dc power supply current available for up to two outputs is 60mA
- Solid-state relay, Form A, 0.5A @ 24V~(ac) minimum, 264V~(ac) maximum, opto-isolated, without contact suppression
- Electromechanical relay. Form C, rated 5A @ 120V~(ac), 5A @ 240V~(ac) or 5A @ 30V=(dc)
- Open collector 42V=(dc) @ 250mA maximum

#### Dimensions

- 1/16 DIN Size
- 97.8 mm (3.85 in.) behind panel maximum
- Width 52.1 mm (2.05 in.)
- Height 52.1 mm (2.05 in.)

#### Ordering Information

To order, complete the model number on the right with the information below.



## Limits/Alarms

### SERIES 97

Watlow's SERIES 97 is a micro-processor-based controller with a single input, second auxiliary input and four outputs. Input 1 is used to measure temperature from a sensor. Input 2 can be utilized as a remote reset switch or a hardware lockout switch. With up to four outputs, the controller is versatile in handling applications that require a high/low limit, alarms, retransmit and communications. The control is so user friendly it can be set up to display safety and limit messages created by the end user to meet the exact application need.

The SERIES 97 limit controller is added to thermal applications to limit over-temperature conditions. The SERIES 97 limit controller provides safety assurance against instances where a high temperature runaway condition could occur from a shorted input sensor or an output device that could fail in a closed position.

The SERIES 97 is recommended for any application where thermal runaway could result in large product scrap costs, affect operator safety, cause damage to equipment or create a fire hazard.

The SERIES 97 is manufactured by ISO 9001 registered Watlow Winona and reliably backed up by a three-year warranty.



#### Features and Benefits

##### Programmable messages (Patented)

- Controller can be set up to display user programmed limit message

##### NEMA 4X (IP65)

- Water and corrosion resistant; front panel can be washed down

##### Microprocessor-based

- Accurate set point settings and quick output response

##### Second auxiliary input

- Remote reset capability

#### Four outputs

- Handles high/low limit, alarms, communication and retransmit requirements

##### Software and hardware lockouts

- High security
- **Three-year warranty** provides Control Confidence®

##### Applications

- Furnace and ovens
- Environmental chambers
- Semiconductor
- Food processing
- Boilers
- Laboratory equipment

# Limits/Alarms

## SERIES 97

### Specifications

#### Controller

- Microprocessor-based
- Universal input 1, auxiliary input 2, 4 outputs
- Input sample period; Single input 10Hz (100 msec), dual input 5Hz (200 msec) digital filter adjustable
- Display update; 2Hz (500 msec), time filter adjustable
- Input/Output/Communication isolation
- Displayed in °C, °F

#### Operator Interface

- Dual 4-digit LED displays: upper 10.2 mm (0.4 in.), lower 6.2 mm (0.244 in.)
- Advance, Up Arrow, Down Arrow, Reset tactile keys

#### Standard Conditions For Specifications

- Ambient temperature 25°C (77°F) ±3°C, rated line voltage, 50 to 60Hz, 0 to 90 percent RH non-condensing, 15 minute warm-up

#### Universal Input 1

##### Thermocouple

- Type J, K, T, N, C (W5), E, PTII, D (W3), B, R, S thermocouple types
- >20MΩ input impedance
- Maximum 20Ω source resistance
- 30mA open detection bias

##### RTD

- 2- or 3-wire platinum, 100Ω
- JIS and DIN-curves
- Whole or tenth degree indication
- 150μA nominal RTD excitation current

#### Input 2

##### Event Input

- Contact or voltage
- 20KΩ input impedance

- Voltage input: event high state 3 to 36V<sub>DC</sub>, event low state 0 to 2V<sub>DC</sub>
- Resistance/contact input: event high state > 23kΩ, event low state 0 to 2kΩ

#### Output Types

##### Open Collector/Switched DC

- Open collector configuration: Maximum voltage 42V<sub>DC</sub> Maximum current 200mA Maximum "on" resistance 1.1Ω Maximum off state leakage current 100μA
- Switched dc configuration: Switched dc supply voltage 22 to 28V<sub>DC</sub> dc supply current limited to 30mA

##### Solid State Relay

- Optically isolated
- Zero cross switched
- Without contact suppression
- Minimum load current 0.5mA rms
- Maximum current 0.5A rms at 20 to 280V<sub>AC</sub>
- Maximum off state leakage current 10μA rms
- For resistive loads only, must use RC suppression for inductive loads

##### Electromechanical Relay

- Form C contact configuration
- Minimum load current 10mA @ 5V<sub>DC</sub>
- Rated resistive and inductive loads: 2A @ 250V<sub>AC</sub> or 30V<sub>DC</sub> maximum
- Electrical life 100,000 cycles at rated current
- For resistive loads only, must use RC suppression for inductive loads

#### Retransmit

- Range selectable: 0-20mA, 4-20mA, 0-5V<sub>DC</sub>, 1-5V<sub>DC</sub>, 0-10V<sub>DC</sub>
- 0 to 10V<sub>DC</sub> voltage output into a 1,000Ω minimum load resistance

- 0 to 20mA current output into an 800Ω maximum load resistance
- Resolution: V<sub>DC</sub> ranges = 2.5mV nominal mA ranges = 5μA nominal
- Calibration accuracy: V<sub>DC</sub> ranges = ±15mV mA ranges = ±30μA
- Temperature stability 100ppm/°C

#### Communications

- EIA/TIA-485, EIA/TIA-232
- Opto-isolated
- Modbus™ RTU protocol
- 1200, 2400, 4800, 9600, 19200 baud rates
- 32 maximum units can be connected (With additional 485 repeater hardware, up to 247 units may be connected)

#### Accuracy

- Input ranges
  - Type J: 0 to 750°C (32 to 1382°F)
  - Type K: -200 to 1250°C (-328 to 2282°F)
  - Type T: -200 to 350°C (-328 to 662°F)
  - Type N: 0 to 1250°C (32 to 2282°F)
  - Type E: -200 to 900°C (-328 to 1470°F)
  - Type C(W5): 0 to 2315°C (32 to 4200°F)
  - Type D(W3): 0 to 2315°C (32 to 4200°F)
  - Type PTII: 0 to 1393°C (32 to 2540°F)
  - Type R: 0 to 1450°C (32 to 2642°F)
  - Type S: 0 to 1450°C (32 to 2642°F)
  - Type B: 870 to 1700°C (1598 to 3092°F)
  - DIN: -200 to 800°C (-328 to 1472°F)
  - JIS: -200 to 630°C (-328 to 1166°F)

Modbus™ is a trademark of AEG Schneider Automation.

## Limits/Alarms

### SERIES 97

#### Specifications Cont.

##### Thermocouple Inputs

- Calibration accuracy  $\pm 0.1$  percent of span  $\pm 1^\circ\text{C}$  at standard conditions  
 Exceptions:  
 Type T: 0.12 percent of span for  $-200^\circ\text{C}$  to  $-50^\circ\text{C}$  ( $-328^\circ\text{F}$  to  $-58^\circ\text{F}$ )  
 Types R and S: 0.15 percent of span for  $0^\circ\text{C}$  to  $100^\circ\text{C}$  ( $32^\circ\text{F}$  to  $212^\circ\text{F}$ )  
 Types B: 0.24 percent of span for  $870^\circ\text{C}$  to  $1700^\circ\text{C}$  ( $1598^\circ\text{F}$  to  $3092^\circ\text{F}$ )
- Accuracy span:  $540^\circ\text{C}$  ( $1000^\circ\text{F}$ ) minimum
- Temperature stability:  $\pm 0.1^\circ$  per degree change in ambient

##### RTD Inputs

- Calibration accuracy  $\pm 0.1$  percent of span  $\pm 1^\circ\text{C}$  at standard conditions
- Accuracy span:  $540^\circ\text{C}$  ( $1000^\circ\text{F}$ ) minimum
- Temperature stability:  $\pm 0.05^\circ$  per degree change in ambient

##### Agency Approvals

- FM Class 3545, File # J.I. 1B5A6.AF
- NEMA 4X, IP65
- CE 89/336/EEC, electromagnetic compatibility directive  
 CE 73/23/EEC, low-voltage directive

##### Functionality Matrix

	Universal Input	Event	High/Low Limit	High/Low Alarm	Retransmit	232 485 Comm
Input 1						
Input 2						
Output 1						
Output 2						
Output 3						
Output 4						

Note: These specifications are subject to change without prior notice.

#### Terminals

- Touch safe
- 22 to 12 AWG

#### Power

- 100-240V~(ac) +10 percent, -15 percent; 50/60Hz,  $\pm 5$  percent
- 24-28V~(ac) or V=(dc) +10 percent, -15 percent; 50/60Hz,  $\pm 5$  percent
- 7.0VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Operating Environment

- 0 to  $65^\circ\text{C}$  (32 to  $149^\circ\text{F}$ )
- 0 to 90 percent RH, non-condensing
- Storage temperature:  $-40$  to  $85^\circ\text{C}$  ( $-40$  to  $185^\circ\text{F}$ )

#### Dimensions

- Width 52 mm (2.05 in.)
- Height 52 mm (2.05 in.)
- Length 107 mm (4.2 in.)
- Depth behind panel surface 98.4 mm (3.875 in.)
- Approximate controller weight 0.2 kg (0.4 lbs)

#### Allowable Operating Ranges

Type J:	1.0	0 to $815^\circ\text{C}$ (32 to $1500^\circ\text{F}$ )
	0.1	0 to $815^\circ\text{C}$ (32 to $1500^\circ\text{F}$ )
Type K:	1.0	$-270$ to $1370^\circ\text{C}$ ( $-454$ to $2500^\circ\text{F}$ )
	0.1	$-200$ to $1000^\circ\text{C}$ ( $-328$ to $1832^\circ\text{F}$ )
Type T:	1.0	$-270$ to $400^\circ\text{C}$ ( $-454$ to $750^\circ\text{F}$ )
	0.1	$-200$ to $400^\circ\text{C}$ ( $-328$ to $750^\circ\text{F}$ )
Type N:	1.0	0 to $1300^\circ\text{C}$ (32 to $2372^\circ\text{F}$ )
	0.1	0 to $1000^\circ\text{C}$ (32 to $1832^\circ\text{F}$ )
Type E:	1.0	$-270$ to $1800^\circ\text{C}$ ( $-454$ to $3272^\circ\text{F}$ )
	0.1	$-110$ to $800^\circ\text{C}$ ( $-166$ to $1472^\circ\text{F}$ )
Type C:	1.0	0 to $2315^\circ\text{C}$ (32 to $4200^\circ\text{F}$ )
	0.1	0 to $1000^\circ\text{C}$ (32 to $1832^\circ\text{F}$ )
Type D:	1.0	0 to $2315^\circ\text{C}$ (32 to $4200^\circ\text{F}$ )
	0.1	0 to $1000^\circ\text{C}$ (32 to $1832^\circ\text{F}$ )
Type PTII:	1.0	0 to $1395^\circ\text{C}$ (32 to $2543^\circ\text{F}$ )
	0.1	0 to $1000^\circ\text{C}$ (32 to $1832^\circ\text{F}$ )
Type R:	1.0	0 to $1760^\circ\text{C}$ (32 to $3200^\circ\text{F}$ )
Type S:	1.0	0 to $1760^\circ\text{C}$ (32 to $3200^\circ\text{F}$ )
Type B:	1.0	0 to $1816^\circ\text{C}$ (32 to $3300^\circ\text{F}$ )
DIN	1.0	$-200$ to $800^\circ\text{C}$ ( $-328$ to $1472^\circ\text{F}$ )
	0.1	$-200$ to $800^\circ\text{C}$ ( $-328$ to $1472^\circ\text{F}$ )
JIS	1.0	$-200$ to $630^\circ\text{C}$ ( $-328$ to $1166^\circ\text{F}$ )
	0.1	$-200$ to $630^\circ\text{C}$ ( $-328$ to $1166^\circ\text{F}$ )

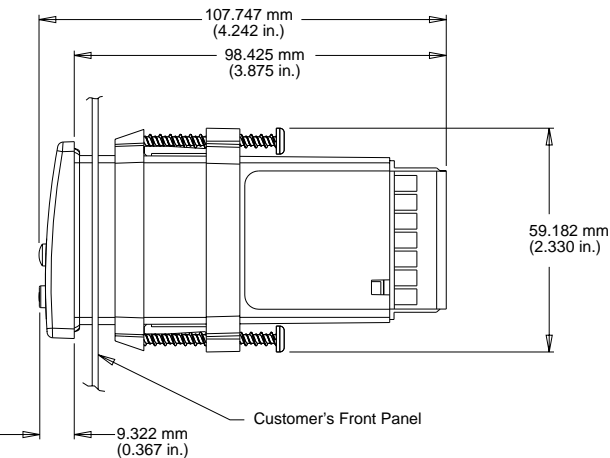
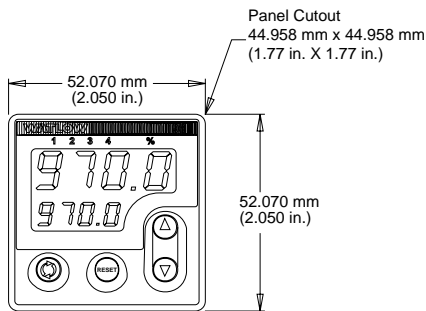
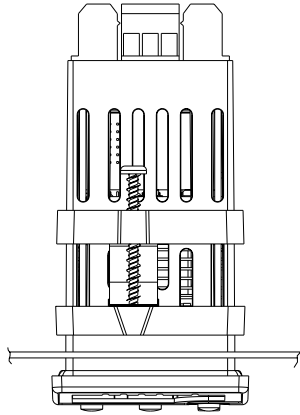
# Limits/Alarms

F.O.B.: Winona, Minnesota

## SERIES 97

### Ordering Information

To order, complete the model number on the right with the information below.



**SERIES 97** = Microprocessor-based 1/6 DIN with universal input 1, thermocouple and RTD. Options include: software, power supply, input 2, four outputs and display color

#### Power Supply

- A = 100-240V $\approx$ (ac/dc)
- B = 24-28V $\approx$ (ac/dc)

#### Auxiliary Input 2

- 0 = None
- 1 = Event input

#### Limit Output 1

- D = Electromechanical relay, Form C, 2A, without RC suppression

#### Alarm Output 2

- A = None
- C = Switched dc output/open collector
- D = Electromechanical relay, Form C, 2A, without RC suppression
- K = 0.5A Solid State Relay without RC suppression

#### Alarm Output 3

- A = None
- D = Electromechanical relay, Form C, 2A, without RC suppression

#### Auxiliary Output 4

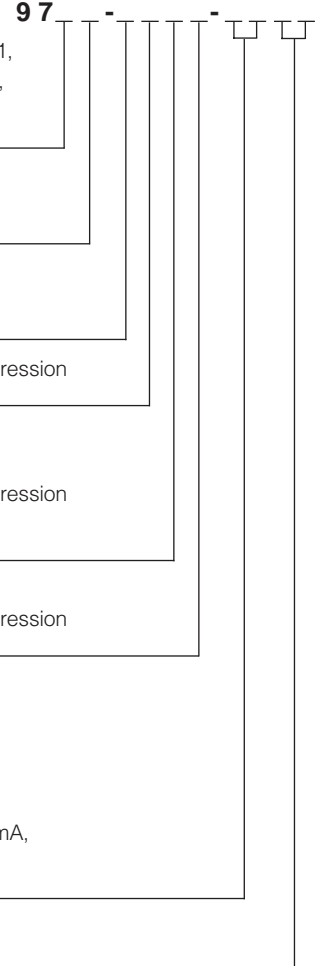
- A = None
- D = Electromechanical relay, Form C, 2A, without RC suppression
- R = 232 Communications
- U = 485 Communications
- M = Universal Retransmit, range selectable: 0-20mA, 4-20mA, 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10V $\approx$ (dc)

#### Software/Preset Parameters

- 00 = Standard software

#### Display/Overlay

- Upper/Lower
- RR = Red/Red display
- RG = Red/Green display
- GR = Green/Red display
- GG = Green/Green display



## Temperature Meter

### SERIES TM

Watlow's new family of micro-processor based temperature meters provide an economical solution for applications requiring process temperature viewing. The temperature meter can be ordered in 1/8 DIN-square panel mount or DIN-rail mount design configurations.

The TM temperature meter incorporates a microprocessor design platform. A red, four-character seven segment LED displays the temperature process value.

The new temperature meters are UL® and C-UL® listed and carry CSA and CE approvals. Watlow's temperature meters include industry leading service and support and are backed by a three-year warranty.

#### Applications

- Food preparation
- Industrial machinery
- Packaging
- Plastics processing

#### Features and Benefits

##### Four character LED display

- Easy to see process value

##### Multiple mounting options

- Minimize installation time

##### Fahrenheit or Celsius operation with indication

- Offers application flexibility

##### Agency approvals

- Meet certification requirements/compliance

##### Microprocessor based technology

- Ensures accurate repeatable temperature display

##### Specifications

##### Operator Interface

- Four digit, seven segment LED displays, 7 mm (0.28 in.) high
- °C or °F indicator LED



#### Standard Conditions For Specifications

- Rated line voltage, 50 to 60Hz, 0 to 90 percent RH, non-condensing, 15-minute warm-up
- Calibration ambient range: 25°C (77°F) ±3°C

#### Sensor Input Thermocouple

- Grounded or ungrounded
- Type E, J, K or T thermocouple
- >10 MΩ input impedance
- 250 nV input referenced error per 1Ω source resistance

#### RTD

- 2-wire platinum, 100Ω
- DIN-curve (0.00385 curve)
- 125 μA nominal RTD excitation current

#### Input Accuracy Span Range

Type E:	-200 to 800°C	(-328 to 1470°F)
Type J:	0 to 750°C	(32 to 1382°F)
Type K:	-200 to 1250°C	(-328 to 2282°F)
Type T:	-200 to 350°C	(-328 to 662°F)
RTD (DIN)	-200 to 800°C	(-328 to 1472°F)

#### Thermocouple Input

- Calibration accuracy: ±1 percent of input accuracy span, ±1° at standard conditions and actual calibration ambient. Exception: Type T, ±2.4 percent of input accuracy span for -200 to 0°C (-328 to 32°F)
- Temperature stability: ±0.3 degree per degree change in ambient

#### RTD Input

- Calibration accuracy ±1 percent of input accuracy span ±1° at standard conditions and actual calibration ambient
- Temperature stability: ±0.2 degree per degree change in ambient

#### Allowable Operating Ranges

Type E:	-200 to 800°C	(-328 to 1470°F)
Type J:	-210 to 1038°C	(-346 to 1900°F)
Type K:	-270 to 1370°C	(-454 to 2500°F)
Type T:	-270 to 400°C	(-454 to 750°F)
RTD (DIN)	-200 to 800°C	(-328 to 1472°F)

UL® and C-UL® are registered trademarks of Underwriter's Laboratories, Inc.

# Temperature Meter

F.O.B.: Winona, Minnesota

## SERIES TM

### Specifications Cont.

#### Agency Approvals

- UL® 60730-1 Recognized Temperature Controller and Indicator
- UL® 197 Reviewed for use in cooking appliances
- ANSI Z21.23 Gas Appliance Thermostat approval
- Temperature Control and Indicator CSA 22.2 No. 24

#### Terminals

- 6.3 mm (0.25 in.) quick connect, push on terminal

#### Power

- 24V~(ac) +10 percent; -15 percent; 50/60Hz, ±5 percent
- 120V~(ac) +10 percent; -15 percent; 50/60Hz, ±5 percent
- 230 to 240V~(ac) +10 percent; -15 percent; 50/60Hz, ±5 percent
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Operating Environment

- 0 to 70°C (32 to 158°F)
- 0 to 90 percent RH, non-condensing
- Storage temperature: -40 to 85°C (-40 to 185°F)

### Dimensions

- DIN-rail model can be DIN-rail or chassis mount
- DIN-rail spec DIN 50022, 35 mm x 7.5 mm (1.38 in. x 0.30 in.)

Style	Width	Height	Depth
DIN-rail	78.1 mm (3.08 in.)	112.3 mm (4.42 in.)	90.7 mm (3.57 in.)
Square 1/8 DIN-panel	72.4 mm (2.85 in.)	72.4 mm (2.85 in.)	Behind panel 51.7 mm (2.04 in.)

### Ordering Information

To order, complete the model number on the right with the information below.

**T M      A A A A A A A A**

**SERIES TM** = Indicator only, four character, seven segment display

**Power Supply** \_\_\_\_\_

B = 120V~(ac)  
D = 230 to 240V~(ac)  
F = 24V~(ac)

**Package** \_\_\_\_\_

1 = Panel mount square 1/8 DIN  
2 = DIN-rail mount

**Sensor Type and Scale** \_\_\_\_\_

H = T/C Type J Fahrenheit (-346 to 1900°F)  
J = T/C Type J Celsius (-210 to 1038°C)  
K = T/C Type K Fahrenheit (-454 to 2500°F)  
L = T/C Type K Celsius (-270 to 1370°C)  
M = T/C Type T Fahrenheit (-454 to 750°F)  
N = T/C Type T Celsius (-270 to 400°C)  
P = RTD Fahrenheit (-328 to 1472°F)  
R = RTD Celsius (-200 to 800°C)  
S = T/C Type E Fahrenheit (-328 to 1470°F)  
T = T/C Type E Celsius (-200 to 800°C)

**Overlay/Customs Options** \_\_\_\_\_

A = Standard



# Single-Loop Controllers

F.O.B.: Winona, Minnesota

## Accessories

The following accessories and replacement parts are available to enhance the application and service of Watlow temperature controllers.

To order, simply identify the specification of the desired part and use its code number.

Consult your Watlow representative for availability.

### Current Transformers

Code No.	Current Ratio
Current Transformer	
<b>16-0246</b> <sup>①</sup>	0 to 50 amps: 0 to 50mA
<b>16-0008</b> <sup>②</sup>	75 amp: 5 amp
<b>16-0044</b>	100 amp: 5 amp
<b>16-0072</b>	125 amp: 5 amp
<b>16-0008</b>	150 amp: 5 amp
<b>16-0045</b>	200 amp: 5 amp
<b>16-0073</b>	300 amp: 5 amp
Interstage Transformer	
<b>16-0176</b>	5 amp: 20mA


**Note:** An interstage transformer (code no. 16-0176) is required with any current transformer rated 75 amps or above.  
<sup>①</sup>Superceeds code numbers 16-0230, 16-0231, 16-0232, 16-0233.  
<sup>②</sup>Use two wire passes through the current transformer 16-0008 for 75 amp applications.

### Panel Mount Adapter Plates

Panel mount adapter plates provide a convenient, cost saving way to modify existing controller panels. Available in popular DIN and non-DIN sizes, adapter plates make changing out old, larger size temperature controllers with more sophisticated, compact controllers easy. Simply complete the build-a-code with the specifications you require.

### Ordering Information

**To order, complete the code number to the right with the information below:**

**Adapter plates to reduce panel cutout size.** **0 2 1 6 - 0 8**  **- P 0 0**

**Adapter Plate Size and Configuration**

- 65 = ¼ DIN to single/horizontal or vertical ¼ DIN
- 66 = ¼ DIN to single ¼<sub>16</sub> DIN
- 95 = ¼ DIN to single/horizontal ¼<sub>32</sub> DIN
- 96 = ¼ DIN to dual/ horizontal ¼<sub>32</sub> DIN
- 67 = Vertical ¼ DIN to ¼<sub>16</sub> DIN
- 97 = Vertical ¼ DIN to single horizontal ¼<sub>32</sub> DIN
- 98 = Vertical ¼ DIN to dual horizontal ¼<sub>32</sub> DIN
- 99 = Horizontal ¼ DIN to horizontal ¼<sub>32</sub> DIN
- 85<sup>①</sup> = 95 x 170 mm (3.75 in. x 6.75 in.) blank plate/no cutout
- 86<sup>①</sup> = 95 x 170 mm (3.75 in. x 6.75 in.) to dual ¼<sub>16</sub> DIN
- 87<sup>①</sup> = 95 x 170 mm (3.75 in. x 6.75 in.) to single ¼<sub>16</sub> DIN
- 88<sup>①</sup> = 95 x 170 mm (3.75 in. x 6.75 in.) to single ¼<sub>32</sub> DIN

**Finish**

- 2 = Black anodize
- 3 = Stainless steel

<sup>①</sup>Available in stainless steel finish only.

Single-Loop Accessories

# Single-Loop Controllers

## Accessories

### Replacement Parts

Description	Code No.
<b>SERIES 981/2/3/4/6/7/8/9</b>	
Mounting collar	0822-0438-0000
Mounting bracket	Z100-0636-0000
Protective terminal cover	0822-0444-0000
Internal bezel gasket	0830-0425-0000
Case gasket	0830-0424-0000
Electromechanical relay <sup>①</sup>	0003-0103-0000
Solid state relay <sup>①</sup>	0842-0164-0000
Quencharc <sup>®</sup> RC suppressor	0804-0147-0000
<b>Noise Suppression Devices</b>	
MOV, 150V~(ac), 20 joule	0802-0273-0000
Quencharc <sup>®</sup> RC suppressor	0804-0147-0000

<sup>①</sup>Solder-in part. Solder-in parts require opening the controller and soldering the component into the circuit board. **Note:** opening the controller for installation *will void warranty!* To retain warranty protection, Watlow Winona can install component. Consult factory for details.

Quencharc<sup>®</sup> is a registered trademark of ITW Paktron, Division of Illinois Tool Works.

# Auto-Tuning PID Controllers

## SERIES 998/999

The Watlow SERIES 998 (vertical) and the SERIES 999 (horizontal) are 1/2 DIN dual channel process controllers offering two channels of PID control in a single package. With up to six outputs, this controller is well suited for most applications where multiple process parameters need controlling.

The SERIES 998/999 features a NEMA 4X<sup>®</sup> (IP65) front panel to withstand wet and corrosive environments. Compact four-inch case depth and palm-safe wiring terminals make installation easy.

The two universal signal conditioner inputs accept 11 different thermocouple types, RTD and scaleable process inputs. A single event input allows operators to turn control outputs off, lock out the front panel or reset the alarm remotely.

Output options provide application flexibility:

- Dual heat/cool outputs per channel
- Optional two alarm outputs
- Optional retransmit output
- Optional serial communications

### Performance Capabilities

- Accuracy to  $\pm 0.1$  percent of span
- Operating environment 0 to 65°C (32 to 149°F)

### Features and Benefits

#### Two analog inputs, four control outputs and two alarm outputs

- Provide two complete control loops in a single package

#### Auto-tuning

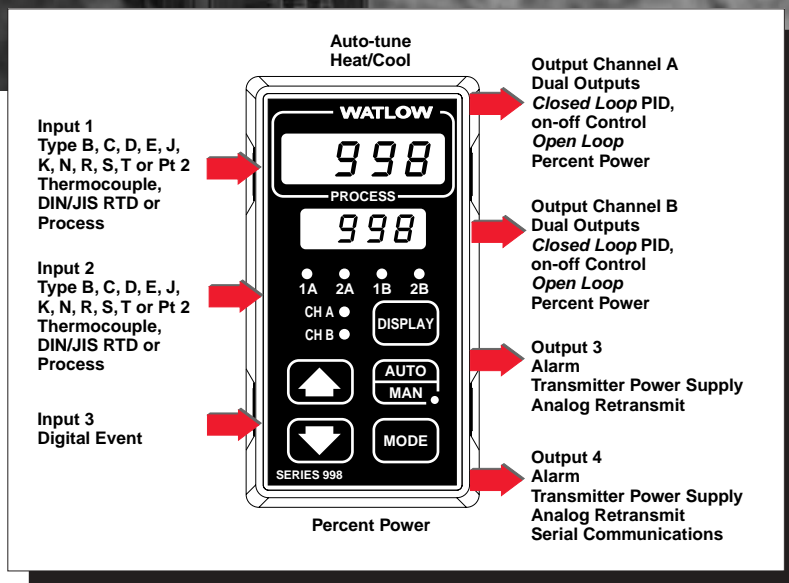
- For one step tuning of system parameters for each channel

#### Optional dual alarm outputs

- User-selectable to monitor either channel

#### Optional serial communications

- Provides remote operation using a host computer



### Hardware and software lockout options

- Offer several parameter levels of operator security

### UL<sup>®</sup>, CE, NEMA 4X<sup>①</sup> (IP65) front panel

- Provides corrosion resistance

### 5Hz sampling rate per channel and variable time base burst-fire control

- Delivers smooth, accurate process control

### Three-year warranty<sup>②</sup>

- Provides Control Confidence<sup>®</sup>

### Applications

- Any process requiring multiple control loops
- Complex process furnaces
- Environmental chambers
- Processes needing control/monitoring from a computer

UL<sup>®</sup> is a registered trademark of Underwriter's Laboratories, Inc.

<sup>①</sup> To effect NEMA 4X (IP65) rating requires a minimum mounting panel thickness of 1.5 mm (0.06 in.) and surface finish not rougher than 0.000812 mm (0.000032 in.).

<sup>②</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

# Auto-Tuning PID Controllers

## SERIES 998/999

### Specifications

#### Control Mode

- Dual input, four control outputs and two additional output options selected as retransmit, alarms or digital communication outputs
- Programmable direct and reverse acting control outputs
- One step auto-tuning

#### Agency Approvals

- 89/336/EEC Electromagnetic Compatibility Directive
- EN 50081-2: 1994 Emissions
- EN 50082-2: 1994 Immunity
- 73/23/EEC Low Voltage Directive
- EN 61010-1: 1993 Safety
- UL® #873, C-UL® File #43684
- NEMA 4X

#### Operator Interface

- Dual, four-digit LED displays: upper; 10 mm (0.4 in.), lower; 8 mm (0.3 in.)
- MODE, AUTO/MANUAL, DISPLAY, UP and DOWN keys

#### Accuracy

- Calibration accuracy and sensor conformity:  $\pm 0.1$  percent of span,  $\pm 1$  LSD,  $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$  ( $77^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ) ambient and rated line voltage  $\pm 10$  percent
- Accuracy span:  $540^{\circ}\text{C}$  ( $1000^{\circ}\text{F}$ ) minimum
- Temperature stability:  $0.1^{\circ}\text{C}/^{\circ}\text{C}$  ( $\pm 0.2^{\circ}\text{F}/^{\circ}\text{F}$ ) change in ambient

#### Sensors/Inputs

- Contact input for software function select (event input)
- Thermocouple Types B, C<sup>2</sup>, D<sup>2</sup>, E, J, K, N, R, S, T and Pt 2<sup>2</sup>
- RTD resolution in  $1^{\circ}$  or  $0.1^{\circ}$  increments
- Process variables: 0-100mV, 0-20mA, 4-20mA, 0-5V $\rightleftharpoons$ (dc), 1-5V $\rightleftharpoons$ (dc) or 0-10V $\rightleftharpoons$ (dc)

- Sensor break protection de-energizes to protect system
- Selectable bumpless transfer to manual operation; latching or non-latching
- $^{\circ}\text{C}$  or  $^{\circ}\text{F}$  display or process units, user selectable

#### Input Range

Specified temperature ranges represent the controller's operational span. Refer to ANSI (thermocouple) and DIN/JIS (RTD) temperature sensor ranges/ tolerances

#### Thermocouple

(Available with basic or universal signal conditioner)

Type C <sup>2</sup>	0 to 2316 $^{\circ}\text{C}$ (32 to 4200 $^{\circ}\text{F}$ )
Type D <sup>2</sup>	0 to 2316 $^{\circ}\text{C}$ (32 to 4200 $^{\circ}\text{F}$ )
Type E	-200 to 799 $^{\circ}\text{C}$ (-328 to 1470 $^{\circ}\text{F}$ )
Type J	0 to 816 $^{\circ}\text{C}$ (32 to 1500 $^{\circ}\text{F}$ )
Type K	-200 to 1371 $^{\circ}\text{C}$ (-328 to 2500 $^{\circ}\text{F}$ )
Type N	0 to 1300 $^{\circ}\text{C}$ (32 to 2372 $^{\circ}\text{F}$ )
Type T	-200 to 399 $^{\circ}\text{C}$ (-328 to 750 $^{\circ}\text{F}$ )
Pt 2 <sup>2</sup>	0 to 1395 $^{\circ}\text{C}$ (32 to 2543 $^{\circ}\text{F}$ )
(Available with universal signal conditioner)	
Type B	870 to 1816 $^{\circ}\text{C}$ (1598 to 3300 $^{\circ}\text{F}$ )
Type R	0 to 1760 $^{\circ}\text{C}$ (32 to 3200 $^{\circ}\text{F}$ )
Type S	0 to 1760 $^{\circ}\text{C}$ (32 to 3200 $^{\circ}\text{F}$ )

#### RTD Resolution (DIN or JIS)

$1^{\circ}$ (DIN)	-200 to 800 $^{\circ}\text{C}$ (-328 to 1472 $^{\circ}\text{F}$ )
$1^{\circ}$ (JIS)	-200 to 630 $^{\circ}\text{C}$ (-328 to 1166 $^{\circ}\text{F}$ )
$0.1^{\circ}$ (DIN and JIS)	-73.3 to 537.7 $^{\circ}\text{C}$ (-99.9 to 999.9 $^{\circ}\text{F}$ )

#### Process

0-50mV $\rightleftharpoons$ (dc)	0-5V $\rightleftharpoons$ (dc)
1-5V $\rightleftharpoons$ (dc)	0-10V $\rightleftharpoons$ (dc)
0-20mA	4-20mA
	-999 to 9999 units

#### Control Channel A and B Output Options

- Dual switched dc signal provides a source voltage of 23.5 to 30.2V $\rightleftharpoons$ (dc), with a source resistance of 1500 $\Omega$ , isolated
- Dual electromechanical relay<sup>1</sup>, Form A, 2A @ 120/240V $\sim$ (ac), 2A @ 28V $\rightleftharpoons$ (dc), without contact suppression
- Single process, 0-20mA, 4-20mA, 0-5V $\rightleftharpoons$ (dc), 1-5V $\rightleftharpoons$ (dc) or 0-10V $\rightleftharpoons$ (dc) reverse acting, isolated
- Dual solid state relay, Form A, 0.5A @ 24V $\sim$ (ac) min., 253V $\sim$ (ac) max., opto-isolated, burst fire switching. Without contact suppression. Off state output impedance is 31M $\Omega$  without contact suppression

#### Auxiliary Output 3 and 4 Options

- Solid state relay, Form A, 0.5A @ 24V $\sim$ (ac) min., 253V $\sim$ (ac) max., opto-isolated, burst fire switching. With or without contact suppression. Off state output impedance is 20k $\Omega$  with RC suppression, 31M $\Omega$  without contact suppression

<sup>1</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

<sup>2</sup> Not an ANSI symbol.

# Auto-Tuning PID Controllers

F.O.B.: Winona, Minnesota

## SERIES 998/999

### Specifications Cont.

- Open collector or switched dc signal provides a minimum turn on voltage of 3V $\approx$ (dc) into a minimum 500 $\Omega$  load; maximum on voltage not greater than 32V $\approx$ (dc) into an infinite load, isolated
- Electromechanical relay<sup>①</sup>, Form C, 5A @ 120/240V $\sim$ (ac), 6A @ 28V $\approx$ (dc), 1/8 hp. @ 120V $\sim$ (ac), 125VA @ 120V $\sim$ (ac). With or without contact suppression. Off state output impedance with RC suppression is 20k $\Omega$
- Retransmit: 0-20mA, 4-20mA with 600 $\Omega$  max. load impedance, or 0-5V $\approx$ (dc), 1-5V $\approx$ (dc) and 0-10V $\approx$ (dc) with 500 $\Omega$  min. load impedance
- EIA/TIA-232 or EIA/TIA-485, EIA/TIA-422 communications, opto-isolated
- External transmitter power supply, 5, 12 or 20V $\approx$ (dc) @ 30mA

### Line Voltage/Power

- 100-240V $\approx$ (ac/dc) +10 percent, -15 percent; 50/60Hz,  $\pm$ 5 percent
- 24-28V $\approx$ (ac/dc) +10 percent, -15 percent; 50/60Hz,  $\pm$ 5 percent
- Fused internally (factory replaceable only) Slo-Blo<sup>®</sup> type (time-lag)  
2A, 250V for high voltage versions  
5A, 250V for low voltage versions
- Power consumption  
16VA maximum
- Data retention upon power failure via non-volatile memory

### Availability

Four working days on orders less than 20 units. For orders over 20 units, consult factory for releases and shipment schedules.

<sup>①</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

<sup>②</sup> Not an ANSI symbol.

Slo-Blo<sup>®</sup> is a registered trademark of Littelfuse, Inc.

### Ordering Information

To order, complete the code number to the right with the information below:

9 9 D - - - - -

**SERIES 998/999** = Dual channel microprocessor based, dual input, six output temperature control, 1/2 DIN vertical or horizontal

#### Hardware

- 6 = 24-28V $\approx$ (ac/dc) nominal, vertical mounting
- 7 = 24-28V $\approx$ (ac/dc) nominal, horizontal mounting
- 8 = 100-240V $\approx$ (ac/dc) nominal, vertical mounting
- 9 = 100-240V $\approx$ (ac/dc) nominal, horizontal mounting

#### Software

- D = Dual channel software
- S = Special customer feature

#### Channel A Input

- 1 = Basic thermocouple signal conditioner (excluding Types B, R and S)
- 2 = Universal signal conditioner (see Range Information)

#### Channel B Input

- 1 = Basic thermocouple signal conditioner (excluding Types B, R and S)
- 2 = Universal signal conditioner (see Range Information)

#### Channel A Outputs

- C = Dual switched dc, isolated
- E = Dual electromechanical relay<sup>①</sup>, Form A, 2A, without contact suppression
- F = Single universal process. 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10V $\approx$ (dc), 0-20mA, 4-20mA, isolated
- K = Dual solid state relay, Form A, 0.5A, without contact suppression

#### Channel B Outputs

- C = Dual switched dc, isolated
- E = Dual electromechanical relay<sup>①</sup>, Form A, 2A, without contact suppression
- F = Single universal process, 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10V $\approx$ (dc), 0-20mA, 4-20mA, isolated
- K = Dual solid state relay, Form A, 0.5A, without contact suppression

#### Output 3

- A = None
- B = Solid state relay, Form A, 0.5A, with RC suppression
- C = Switched dc or open collector, isolated
- J = Electromechanical relay<sup>①</sup>, Form A or B, 5A, without contact suppression
- K = Solid state relay, Form A, 0.5A, without contact suppression
- M = Retransmit, 0-20mA, 4-20mA
- N = Retransmit, 0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-10 $\approx$ (dc)
- T = External signal conditioner power supply, 5, 12 or 20V $\approx$ (dc) @ 30mA

#### Output 4

- A = None
- B = Solid state relay, Form A, 0.5A, with RC suppression
- C = Switched dc or open collector, isolated
- D = Electromechanical relay<sup>①</sup>, Form C, 5A, with RC suppression
- E = Electromechanical relay<sup>①</sup>, Form C, 5A, without contact suppression
- K = Solid state relay, Form A, 0.5A, without contact suppression
- R = Isolated EIA/TIA-232 communications
- S = Isolated EIA/TIA-485/EIA/TIA-422 communications
- U = EIA/TIA-232, EIA/TIA-485 software selectable
- T = External signal conditioner power supply, 5, 12 or 20V $\approx$ (dc) @ 30mA

#### Display/Overlay

- GG = Green/Green display      RG = Red/Green display
- GR = Green/Red display      RR = Red/Red display
- XX = Custom overlays or default settings

# Auto-Tuning PID Controllers

## SERIES 998/999

### Sample/Update Rates

- 1 input: 10Hz
- 2 inputs: 5Hz
- Retransmit: 1Hz
- Remote set point: 1Hz
- PID: 10Hz
- Outputs: 10Hz
- Display: 2Hz

### Operating Environment

- 0 to 65°C (32 to 149°F)
- 0 to 90 percent RH, non-condensing

### Storage Temperature

- -40 to 85°C (-40 to 185°F)

### Terminals

- #6 compression universal head screws, accepts 28 to 14-gauge wire

### Controller Weight

- 0.45 kg (1.0 lb)

### Shipping Weight

- 1.35 kg (3.1 lbs)

### Dimensions

Vertical Orientation

#### Overall

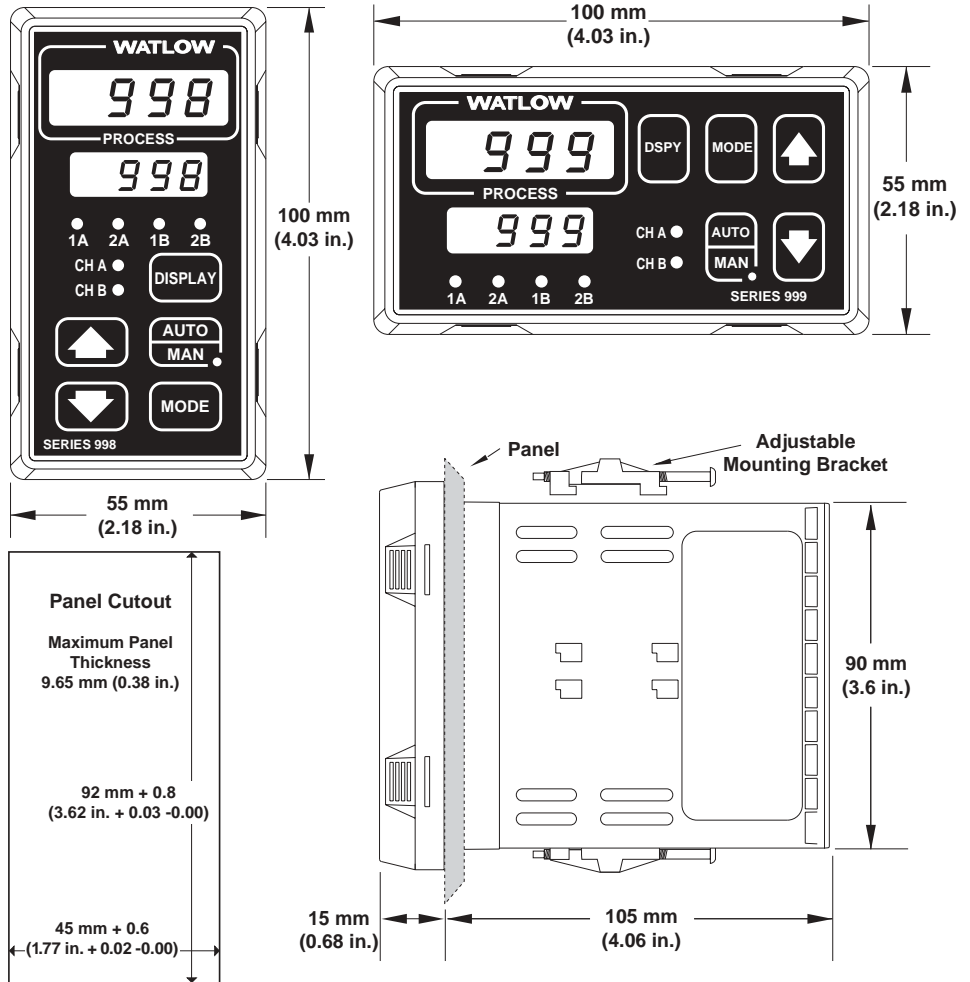
Height:	100 mm	(4.03 in.)
Width:	55 mm	(2.18 in.)
Depth:	120 mm	(4.74 in.)

#### Bezel

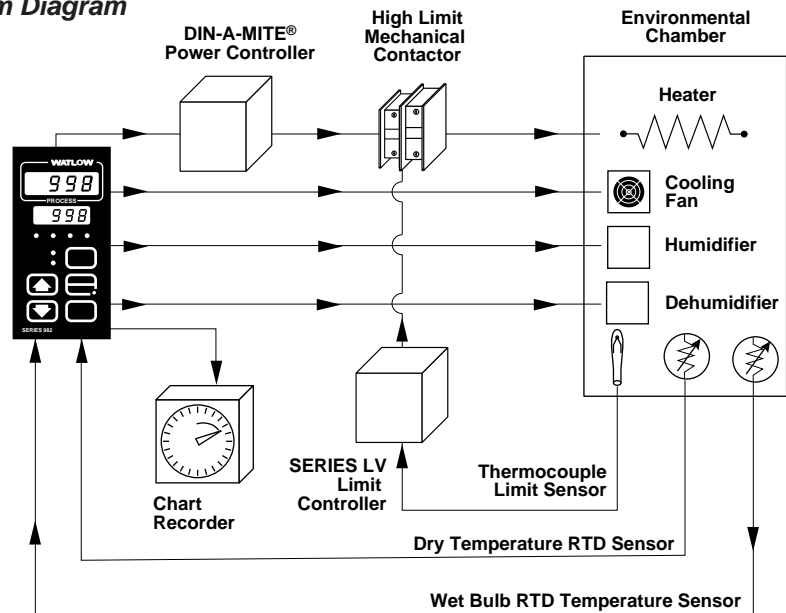
Height:	100 mm	(4.03 in.)
Width:	55 mm	(2.18 in.)
Depth:	15 mm	(0.68 in.)

#### Chassis

Height:	90 mm	(3.6 in.)
Width:	45 mm	(1.7 in.)
Depth:	105 mm	(4.06 in.)



### System Diagram



# Auto-Tuning PID Controllers

## SERIES PD Dual Loop

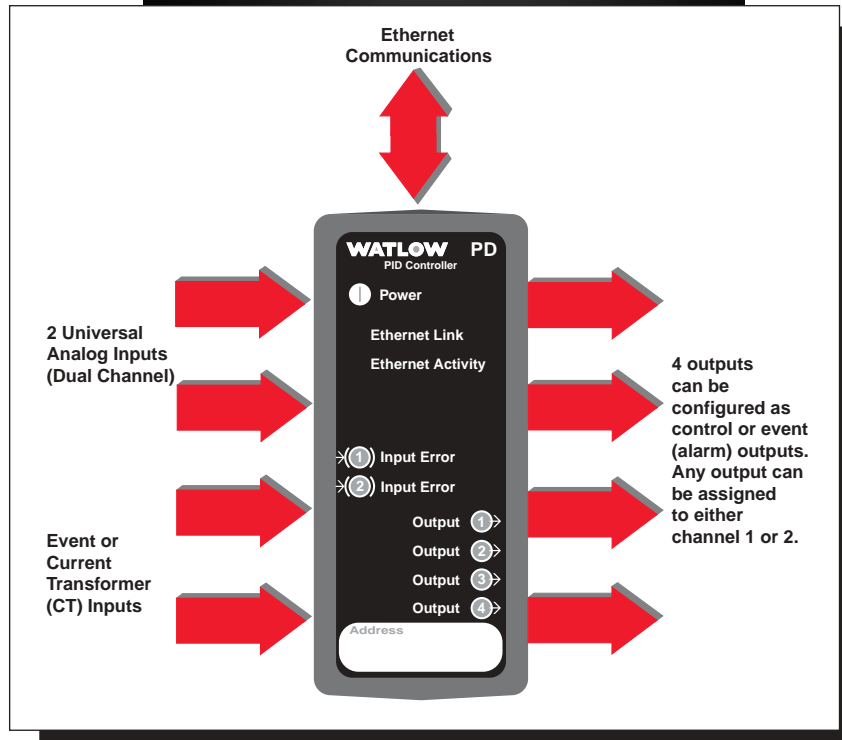
Watlow's SERIES PD controllers utilize embedded Ethernet technology to provide a convenient, economical means for setting up and viewing key process variables such as temperature, pressure and humidity. Available in single or dual channel versions, the DIN-rail mount SERIES PD controllers offer up to four control/alarm outputs, as well as a digital/current transformer input associated with each channel.

Watlow's SERIES PD controllers are ideally suited for a wide range of temperature or process control applications where the operator interface is supported from a remote location. The SERIES PD provides interfacing via embedded firmware which serves dedicated web pages. These pages support key functions including operation, alarm monitoring, configuration and are displayed using standard web browser software. The SERIES PD is also capable of generating e-mail messages for remote alarm notification.

Ethernet-based products are rapidly gaining popularity in industrial applications because they allow an instantaneous exchange of information between processing equipment and the company's management system.

Advanced features of the SERIES PD controllers include internal data logging of key control parameters, smart sensor technology, heater burn out detection and an enhanced control algorithm.

The SERIES PD controller is backed by a three-year warranty from Watlow Winona and is UL® 508, C-UL®, CSA and CE approved.



Multi-Loop Auto-Tuning PID

### Features and Benefits

#### Ethernet connectivity

- Convenient, easy to use operator interface
- Simplified process monitoring

#### DIN-rail sub panel mounting

- Quick, economic installation

#### Watlow INFOSENSE™ sensor technology

- INFOSENSE™ technology improves sensor accuracy by a minimum of 50 percent

#### Advanced control algorithm

- Tighter process control

# Auto-Tuning PID Controllers

## SERIES PD Dual Loop

### Features and Benefits Cont.

#### Heater burn out detection

- Improved process yields

#### Internal data logging

- Reduces external hardware demands

#### Single or dual channel versions

- Provides application versatility

#### Virtual or hardware alarms with e-mail delivery

- Improves quality control and reduces maintenance costs

### Specifications

#### Power

- 24V $\approx$ (ac/dc), +10/-15 percent, 50/60Hz,  $\pm$ 5 percent
- 12VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

#### Environment

- 0 to 65°C (32 to 149°F) operating temperature
- -40 to 85°C (-40 to 185°F) storage temperature
- 0 to 90 percent RH, non-condensing

#### Accuracy

- Calibration accuracy and sensor conformity:  $\pm$ 0.1 percent of span,  $\pm$ 1°C @ the calibrated ambient temperature and rated line voltage
- Calibration ambient temperature = 25°C  $\pm$ 3°C (77°F  $\pm$ 5°F)
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability:  $\pm$ 0.1°C/°C ( $\pm$ 0.2°F/°F) rise in ambient maximum

#### Agency Approvals

- UL<sup>®</sup> 508, C-UL<sup>®</sup>, CSA and CE

### Controller

- Microprocessor based user-selectable control modes
- Single or dual channel universal inputs
- Current transformer inputs/digital inputs
- Up to four programmable outputs
- Update rates, inputs = 10Hz, outputs = 10Hz

### Operator Interface

- Browser based HMI

### Wiring Termination

- Touch safe removable terminals
- 14 to 22 AWG

### Universal Inputs (Electrically Isolated)

- Thermocouple, grounded or ungrounded sensors
- RTD 2- or 3-wire, platinum, 100 $\Omega$  @ 0°C calibration to DIN-curve (0.00385  $\Omega$ / $\Omega$ /°C)
- Process 0-20mA @ <100 $\Omega$ , or 0-10V $\approx$ (dc) @ 10k $\Omega$  input impedance (50,000 bits @ full scale)

### Digital Inputs

- Contact or dc voltage
- 10K $\Omega$  input impedance

### Current Transformer Inputs

- 0 to 50mA CT input into 100 $\Omega$  impedance

### Allowable Input Operating Range

Type J:	0 to 815°C (32 to 1500°F)
Type K:	-200 to 1370°C (-328 to 2500°F)
Type T:	-200 to 400°C (-328 to 750°F)
Type N:	0 to 1300°C (32 to 2372°F)
Type E:	-200 to 800°C (-328 to 1470°F)
Type C:	0 to 2315°C (32 to 4200°F)
Type D:	0 to 2315°C (32 to 4200°F)

Type PT11: 0 to 1395°C  
(32 to 2543°F)

Type R: 0 to 1760°C  
(32 to 3200°F)

Type S: 0 to 1760°C  
(32 to 3200°F)

Type B: 0 to 1815°C  
(32 to 3300°F)

RTD (DIN): -200 to 800°C  
(-328 to 1470°F)

Process V: 0 to 10V $\approx$ (dc)

Process I: 0 to 20mA

### Control/Alarm Outputs (1 - 4)

- User selectable as: on-off, P, PI, PD, PID, heat, cool, alarm action or retransmit with process output type hardware
- Open collector/switched dc
- Open collector 42V $\approx$ (dc) maximum @ 0.5A
- Switched dc 22 to 28V $\approx$ (dc) limited @ 30mA
- Solid state relay, Form A, 0.5A @ 24V $\sim$ (ac) minimum, 264V $\sim$ (ac) maximum, opto-isolated, without contact suppression

### Process Output (Optional Retransmit)

- User-selectable 0-10V $\approx$ (dc), 1K $\Omega$  minimum, scalable, 0-20mA @ 800 $\Omega$  maximum, scalable
- Electromechanical relay. Form C, rated 5A @ 120V $\sim$ (ac) or 5A @ 240V $\sim$ (ac) or 5A @ 30V $\approx$ (dc)
- Ethernet communications
- Ethernet RJ 45 connector, 10 base T
- HTTP interface
- DHCP, auto IP or fixed IP address

### Dimensions

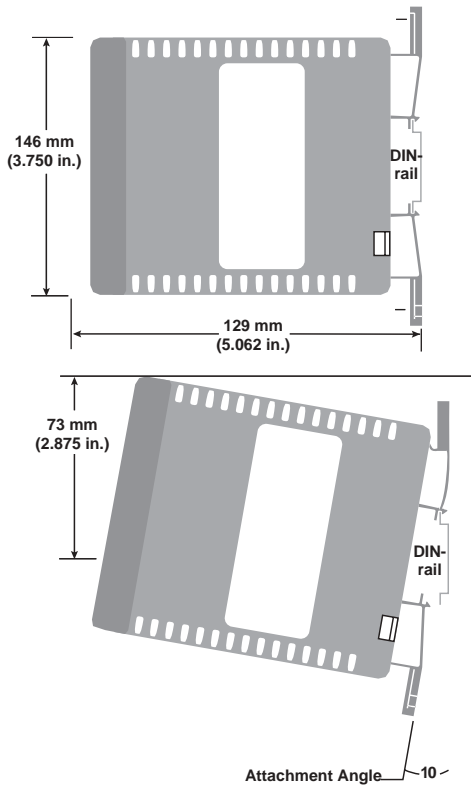
- Width x height x depth  
42 mm x 116 mm x 132 mm  
(1.64 in. x 4.56 in. x 5.19 in.)  
DIN-rail or chassis mount,  
DIN-rail spec DIN 5022  
35 mm x 7.5 mm  
(1.38 in. x 0.30 in.)



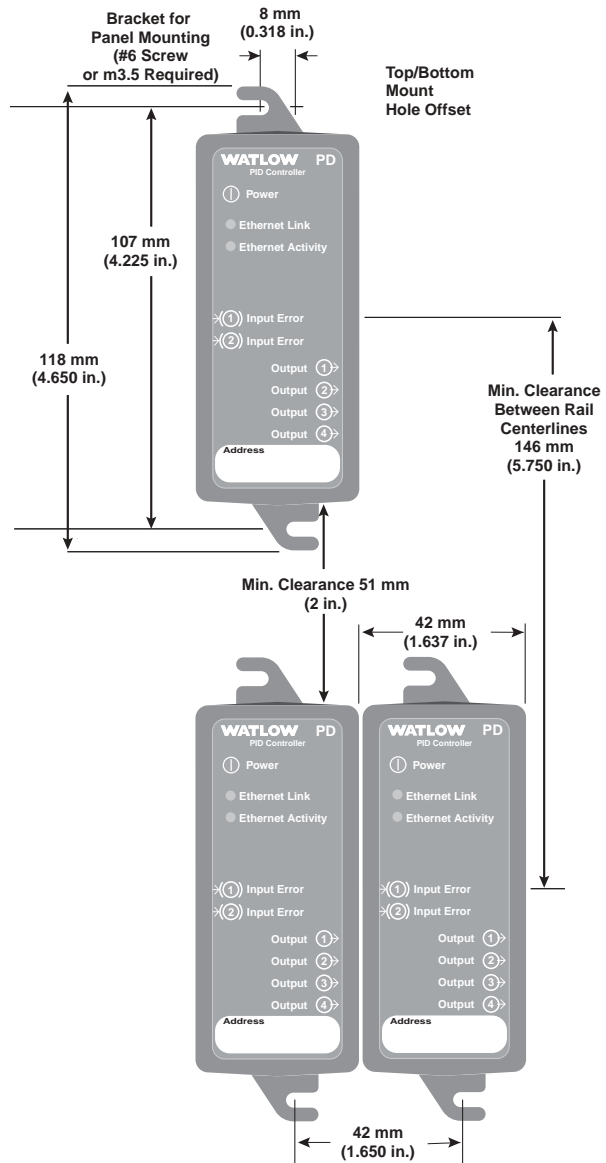
# Auto-Tuning PID Controllers

## SERIES PD Dual Loop

Side View



Front View



# Auto-Tuning PID Controllers

F.O.B.: Winona, Minnesota

## SERIES PD Dual Loop

### Ordering Information

To order, complete the code number on the right with the information below.

	P D D	-	-	-	-	-	-	A
<b>Auxiliary Inputs</b>	_____							
1 = Dual digital inputs								
2 = One CT input and one digital input								
3 = Dual CT inputs (dual channel only)								
<b>Output 1</b>	_____							
C = Switched dc, open collector								
K = SSR, Form A, 0.5A								
F = Universal process								
E = Mechanical relay, Form C, 2A <sup>①</sup>								
<b>Output 2</b>	_____							
A = None								
C = Switched dc, open collector								
K = SSR, Form A, 0.5A								
E = Mechanical relay, Form C, 2A <sup>①</sup>								
<b>Output 3</b>	_____							
A = None								
C = Switched dc, open collector								
K = SSR, Form A, 0.5A								
F = Universal process								
E = Mechanical relay, Form C, 2A <sup>①</sup>								
<b>Output 4</b>	_____							
A = None								
C = Switched dc, open collector								
K = SSR, Form A, 0.5A								
E = Mechanical relay, Form C, 2A <sup>①</sup>								
<b>On Board Data Logging</b>	_____							
0 = None								
K = 16 megabytes of memory								
<b>Custom Options</b>	_____							
AA = Watlow logo								
BB = No logo								

<sup>①</sup> Electromechanical relays warranted for 100,000 closures only. Solid state switching devices recommended for applications requiring fast cycle times or extended service life.

## Auto-Tuning PID Controllers

### 4-, 8-, 16-Loop CLS200 SERIES

The Watlow Anafaze CLS200 SERIES is a powerful line of controllers, combining performance and flexibility with compact design. The four, eight and 16-loop versions provide complete control solutions for a broad range of applications. Support for multiple types of sensor inputs is available, including thermocouples, RTDs, linear voltage, current and frequency. Each controller can operate as a stand-alone system, and includes built-in serial communications for computer interface and data acquisition. An enhanced features option offers cascade control, ratio control, differential control, process variable retransmit and remote analog set point.

The CLS200 SERIES controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.

#### Features and Benefits

##### PID control of up to 16 heat and cool loops

- Minimal panel space per loop
- Reduced installation time
- More reliable: fewer parts means fewer failures

##### Auto-tune

- Less time tuning
- Achieve excellent control with less expertise

##### Menu-guided operation with full text display

- Quick controller setup
- Easy to operate

##### Eight jobs stored and recalled

- Quickly change from one process to another



#### Multiple and mixed inputs

- Simply change sensor types at the last minute
- Less to learn, less inventory

#### Sensor failure detection

- Reduces time troubleshooting reversed, shorted and open sensors

#### High/low process and deviation alarms for each input

- Configure alarms as needed to integrate with PLC or other control elements

#### 34 digital outputs

- Flexible configuration: use outputs as needed for control, alarms and process variable retransmit

#### EIA/TIA-232 and 485 communications

- Use software to configure and operate
- Integrate with other controllers and software

#### Firmware Options

Choose firmware with the features needed for the application:

- Standard—includes closed-loop PID control, auto-tune, alarms, job memory and failed sensor detection
- Extruder— includes the standard firmware features, with PID control specifically adapted for plastic extruders

- Enhanced Features— includes the standard firmware features with the addition of process variable retransmit, remote analog set point, cascade control, ratio control and differential control algorithms. Each channel can be configured for standard PID control or one of the other control algorithms. Each channel of cascade control or remote analog set point requires two controller channels. Unused control outputs on any channel can be configured for retransmit.
- Ramp and Soak see [page 119](#)

Because the CLS200 has no onboard analog outputs, applications that use process variable retransmit typically require one SDAC module per retransmitted signal.



**Watlow Anafaze's WATVIEW software is ideal to use with the CLS200 SERIES. See [page 197](#) for more information and ordering details.**

# Auto-Tuning PID Controllers

## 4-, 8-, 16-Loop CLS200 SERIES

### Specifications

#### Operator Interface

- 32-character vacuum fluorescent display
- Eight-key keypad to access guided menus and prompts, enter passkey sequence, set values, switch between single channel and multiple channel displays
- Controller configuration can be loaded through the standard serial port

#### Analog Inputs

- CLS204 4 Differential
- CLS208 8 Differential
- CLS216 16 Single-ended

#### Noise Rejection

- 120db at 60Hz

#### Temperature Coefficient

- 40 ppm/°C

#### Sensors/Inputs

- Thermocouples: User-selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging
- RTD: (CLS204 and CLS208 only) 2- or 3-wire, platinum, 100Ω @ 0°C, DIN 0.003850Ω/°C curve. Two user-selectable ranges offer different resolutions. Requires scaling resistors. See Special/Linear Inputs in Ordering Information
- Linear: current and voltage signals from linear transmitters
- Pulse input

### Input Range and Accuracy

	Range	Accuracy
Type B	66 to 1760°C (150 to 3200°F)	±4.0°C (±7.2°F)
Type E	-200 to 787°C (-328 to 1448°F)	±1.0°C (±1.8°F)
Type J	-212 to 760°C (-350 to 1400°F)	±1.2°C (±2.2°F)
Type K	-268 to 1371°C (-450 to 2500°F)	±1.3°C (±2.3°F)
Type R	-18 to 1766°C (0 to 3210°F)	±2.8°C (±5.0°F)
Type S	-18 to 1760°C (0 to 3200°F)	±2.8°C (±5.0°F)
Type T	-268 to 399°C (-450 to 750°F)	±1.6°C (±2.9°F)

RTD's available on CLS204 and CLS208 only

	Range	Accuracy
(RTD1)	-100 to 275°C (-148 to 527°F)	1.1°C (2.0°F)
(RTD2)	-120 to 840°C (-184 to 1544°F)	1.6°C (2.9°F)

Note: Accuracy @ 25°C (77°F) ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 427°C to 1760°C (800°F to 3200°F.) RTD is for 100 percent of span

### Linear Voltage and Current Inputs

Requires scaling resistors. See Special Inputs in Ordering Information

- 0-10mA $\rightleftharpoons$ (dc)
- 0-20mA $\rightleftharpoons$ (dc)/4-20mA $\rightleftharpoons$ (dc)
- 0-100mV $\rightleftharpoons$ (dc)
- 0-500mV $\rightleftharpoons$ (dc)
- 0-1V $\rightleftharpoons$ (dc)
- 0-5V $\rightleftharpoons$ (dc)
- 0-10V $\rightleftharpoons$ (dc)
- 0-12V $\rightleftharpoons$ (dc)

Other ranges available. Consult factory

### Pulse Input

- One TTL-level square wave input up to 2kHz

### Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- CLS204: 6 samples per second, (update time: 0.167 sec.)
- CLS208: 3 samples per second, (update time: 0.333 sec.)
- CLS216: 1.5 samples per second, (update time: 0.667 sec.)

### Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

### Calibration

- Automatic zero and full scale

### Digital Inputs

- TTL-level used for selecting recipes or jobs or R/S triggers
- Eight inputs and one pulse input with 50-pin terminal board option
- Two inputs and pulse input or three inputs with 18-pin terminal block option

### Digital Outputs

- 34 digital outputs are available with 50-pin terminal board option
- 10 control outputs with 18-pin terminal block option
- One or two control outputs are user assigned for each loop
- Each control output can be configured for on-off time proportioning, or distributed zero crossing
- Outputs sink up to 60mA each at 5V $\rightleftharpoons$ (dc)
- 350mA at 5V $\rightleftharpoons$ (dc) available from on-board supply

### Analog Outputs

- Use DAC and SDAC accessory modules. For process variable retransmit, use SDAC only. See [page 159](#).

# Auto-Tuning PID Controllers

## 4-, 8-, 16-Loop CLS200 SERIES

### Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- User-programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

### Serial Interface

- EIA/TIA-232 or EIA/TIA-485

### Baud Rate

- 2400, 9600 or 19200, user-selectable

### Communication Protocol

- Modbus™ RTU

### Line Voltage/Power

- 15 to 24V $\overline{=}$ (dc)  $\pm$  3V $\overline{=}$ (dc) @ 1A (maximum), 300mA (no load)

### Agency Approvals

- UL®, C-UL® listed: UL® 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC

### Dimensions

#### Overall

Height:	50 mm	(1.96 in.)
Width:	96 mm	(3.78 in.)
Depth:	203 mm	(8.0 in.)

#### Bezel

Height:	50 mm	(1.96 in.)
Width:	96 mm	(3.78 in.)
Depth:	25 mm	(1.0 in.)

#### Chassis

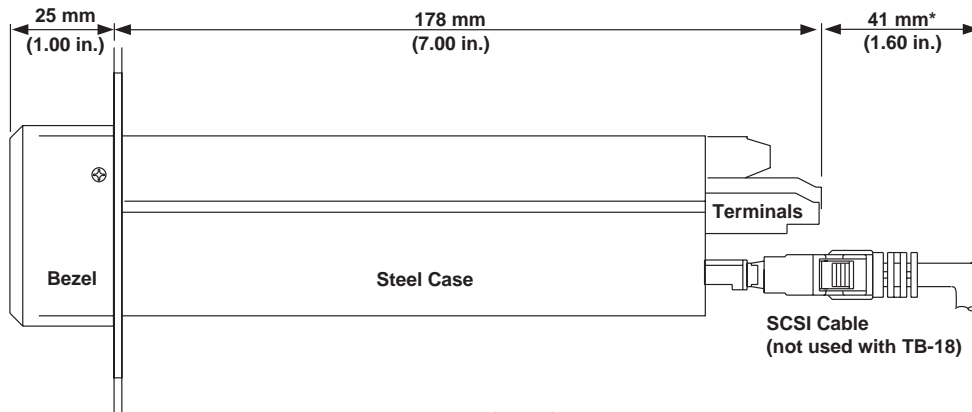
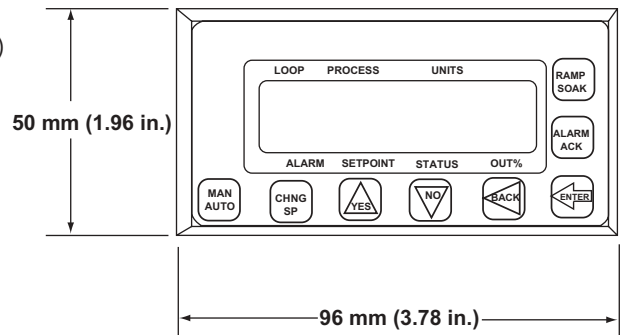
Height:	45 mm	(1.76 in.)
Width:	90 mm	(3.55 in.)
Depth:	178 mm	(7.0 in.)

#### Controller Weight

0.9 kg (1.98 lbs)

#### Shipping Weight

1.8 kg (4.0 lbs)



\*15 mm (0.6 in.) with Right Angle SCSI Connector

# Auto-Tuning PID Controllers

## 4-, 8-, 16-Loop CLS200 SERIES

**Note:** Controller is configured for thermocouples and -10 to 60mV $\approx$ (dc) linear inputs. For other sensors order special inputs, see below. For analog outputs order DAC or SDAC modules, see [page 159](#). For easy setup order WATVIEW software, see [page 197](#).

### Ordering Information

To order, complete the code number to the right with the information below:

<b>Number of Channels</b>	_____	2	-	_____	_____	_____	_____	_____	_____
04 =	4 channel								
08 =	8 channel								
16 =	16 channel								
<b>Controller Type</b>	_____								
1 =	Standard EPROM								
2 =	Extruder								
3 =	Ramp and soak								
4 =	Enhanced features								
<b>Terminal Block</b>	_____								
0 =	No terminal block accessory								
1 =	18-pin terminal block (CLS204 and CLS208 only)								
2 =	50-pin terminal block installed (includes 3 foot SCSI cable)								
<b>Power Supply</b>	_____								
0 =	No power supply								
2 =	120/240V $\sim$ (ac), 50/60Hz power supply adapter (5V $\approx$ [dc], @ 4A, 15V $\approx$ [dc] @ 1.2A) (CE approved)								
<b>SCSI Cables</b>	_____								
0 =	No SCSI cable (3 foot cable included with 50-pin terminal block)								
1 =	6 foot SCSI cable								
2 =	3 foot right angle SCSI cable								
3 =	6 foot right angle SCSI cable								
<b>Serial Communication Cables</b>	_____								
0 =	No serial communications cable								
1 =	10 foot serial communications cable (DB-9 female/bare wire)								
2 =	25 foot serial communications cable (DB-9 female/bare wire)								
3 =	50 foot serial communications cable (DB-9 female/bare wire)								
<b>Serial Communication Jumper Settings</b>	_____								
0 =	EIA/TIA-232								
1 =	EIA/TIA-485								
2 =	EIA/TIA-485 terminated								
<b>Special Inputs</b>	_____								
(Standard unit is configured for thermocouples and -10 to 60 mV linear inputs. For other sensors, order special inputs. See below for ordering instructions. For CLS216 specify two digits, for CLS204 and CLS208 specify one digit.)									
0 or 00 =	Thermocouples and -10 to 60 mV inputs only								
X or XX =	Number of current, voltage or RTD inputs								
<b>Special/Linear Input Type</b>	_____								
(Not required for thermocouple sensor inputs.)									
20 =	RTD 1: 0.1 $^{\circ}$ , -100.0 to 275.0 $^{\circ}$ C (-148.0 to 527.0 $^{\circ}$ F) Not available on CLS216								
21 =	RTD 2: 1 $^{\circ}$ , -120 to 840 $^{\circ}$ C (-184 to 1544 $^{\circ}$ F) Not available on CLS216								
43 =	0-10mA $\approx$ (dc)								
44 =	0-20mA $\approx$ (dc)/4-20mA $\approx$ (dc)								
50 =	0-100mV $\approx$ (dc)								
52 =	0-500mV $\approx$ (dc)								
53 =	0-1V $\approx$ (dc)								
55 =	0-5V $\approx$ (dc)								
56 =	0-10V $\approx$ (dc)								
57 =	0-12V $\approx$ (dc)								
<b>Start Channel</b>	_____								
XX =	Channel number XX								
<b>End Channel</b>	_____								
XX =	Channel number XX								

### Availability

Up to four weeks, depending on complexity and order release quantity. Consult factory for details

## Auto-Tuning PID Controllers

### 16-, 32-Loop MLS300 SERIES

The Watlow Anafaze MLS300 SERIES is a powerful line of controllers that combines performance and flexibility with compact design. The 16 and 32-loop versions provide complete control solutions for a broad range of applications. Support for multiple types of sensor inputs is available; including thermocouples, RTDs, linear voltage, current and frequency. Each controller can operate as a stand-alone system, and includes built-in serial communications for computer interface and data acquisition. The enhanced features option offers cascade, ratio and differential control, process variable retransmit and remote analog set point.

The remote analog input options allow for shorter sensor wires and flexible mounting which reduces sensor cost and installation time. Watlow's new CIM option provides OEMs with a space and labor saving alternative to the standard AIM module. This innovation allows users to construct a wiring harness to attach sensors via a connector instead of connecting individual wires to the controller.

The MLS300 SERIES controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.



#### Features and Benefits

##### PID control of up to 16 heat and cool loops or 32 heat loops

- Minimal panel space per loop
- Reduces installation time
- More reliable: fewer parts mean fewer failures

##### Auto-tuning

- Less time tuning
- Achieve excellent control with less expertise

##### Menu guided operation with full text display

- Quick controller setup
- Easy to operate

##### Eight jobs stored and recalled

- Quickly change from one process to another

##### Multiple and mixed inputs

- Simply change sensor types at the last minute
- Less to learn, less inventory

##### Sensor fail detection

- Reduces time troubleshooting reversed, shorted and open sensors

##### High/low process and deviation alarms for each input

- Configure alarms as needed to integrate with PLC or other control elements

##### TIA/EIA-232 and 485 communications

- Use software to configure and operate
- Integrate with other controllers and software

##### 34 digital outputs

- Flexible configuration: use outputs as needed for control, alarms and process variable retransmit

##### CIM300 option

- Small footprint per loop
- Reduced installation time



*Watlow Anafaze's WATVIEW software is ideal to use with the MLS300 SERIES. See [page 197](#) for more information and ordering details.*

# Auto-Tuning PID Controllers

## 16-, 32-Loop MLS300 SERIES

### Specifications

#### Operator Interface

- 32-character vacuum fluorescent display
- Eight-key keypad to access guided menus and prompts, enter passkey sequence, set values, switch between single channel and multiple channel displays
- Controller's configuration can be loaded through the standard serial port

#### Analog Inputs

- MLS316 16 Differential
- MLS332 32 Differential

#### Noise Rejection

- 120dB at 60Hz

#### Temperature Coefficient

- 40 ppm/°C

#### Temperature Sensors

- Thermocouples: User selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging
- RTD: 2- or 3-wire, platinum, 100Ω @ 0°C, DIN 0.003850Ω/°C curve. Two user-selectable ranges offer different resolutions. Requires special inputs. See Ordering Information

### Input Range and Accuracy

	Range	Accuracy
Type B	66 to 1760°C (150 to 3200°F)	±4.0°C (±7.2°F)
Type E	-200 to 787°C (-328 to 1448°F)	±1.0°C (±1.8°F)
Type J	-212 to 760°C (-350 to 1400°F)	±1.2°C (±2.2°F)
Type K	-268 to 1371°C (-450 to 2500°F)	±1.3°C (±2.3°F)
Type R	-18 to 1766°C (0 to 3210°F)	±2.8°C (±5.0°F)
Type S	-18 to 1760°C (0 to 3200°F)	±2.8°C (±5.0°F)
Type T	-268 to 399°C (-450 to 750°F)	±1.6°C (±2.9°F)
RTD1 (DIN)	-100 to 275°C (-148 to 527°F)	±1.1°C (±2.0°F)
RTD2 (DIN)	-120 to 840°C (-184 to 1544°F)	±1.6°C (±2.9°F)

Note: Accuracy @ 25°C (77°F) ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 427°C (800°F) to 1760°C (3200°F). RTD is for 100 percent of span

### Linear Voltage and Current Inputs

Requires special inputs. See Ordering Information

- 0-10mA $\rightleftharpoons$ (dc)
- 0-20mA $\rightleftharpoons$ (dc)/4-20mA $\rightleftharpoons$ (dc)
- 0-100mV $\rightleftharpoons$ (dc)
- 0-500mV $\rightleftharpoons$ (dc)
- 0-1V $\rightleftharpoons$ (dc)
- 0-5V $\rightleftharpoons$ (dc)
- 0-10V $\rightleftharpoons$ (dc)
- 0-12V $\rightleftharpoons$ (dc)

Other ranges available. Consult factory

### Pulse Input

One TTL-level square wave input up to 2kHz

### Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- MLS316: 1.5 samples per second, (update time: 0.667 sec.)
- MLS332: 0.75 samples per second, (update time: 1.33 sec.)

### Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

### Calibration

- Automatic zero and full scale

### Digital Inputs

- TTL level used for selecting recipes or jobs, or R/S triggers
- Eight inputs and one pulse input with 50-pin terminal board option

### Digital Outputs

- 34 outputs available with 50-pin terminal board option
- One or two control outputs are user assigned for each loop
- Each control output can be configured for on-off, time proportioning, or distributed zero crossing
- Outputs sink up to 60mA each at 5V $\rightleftharpoons$ (dc)

### Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- Programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

### Analog Outputs

- Use DAC and SDAC accessory modules. For process variable retransmit, use SDAC only, see [page 159](#).



# Auto-Tuning PID Controllers

## 16-, 32-Loop MLS300 SERIES

### Specifications Cont.

#### Serial Interface

- EIA/TIA-232 or EIA/TIA-485

#### Baud Rate

- 2400, 9600 or 19200, user-selectable

#### Communication Protocol

- Modbus™ RTU

#### Line Voltage/Power

- 15 to 24V<sub>DC</sub> ± 3V<sub>DC</sub> @ 1A

#### Agency Approvals

- UL®, C-UL® Listed: UL® 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC

#### Firmware Options

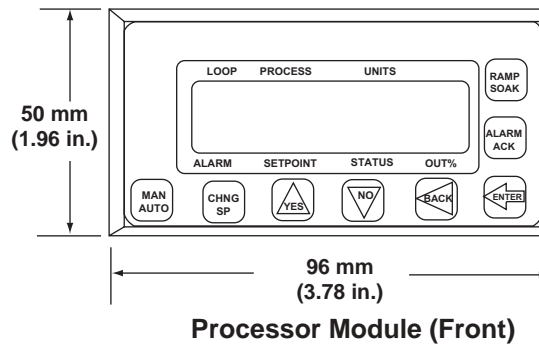
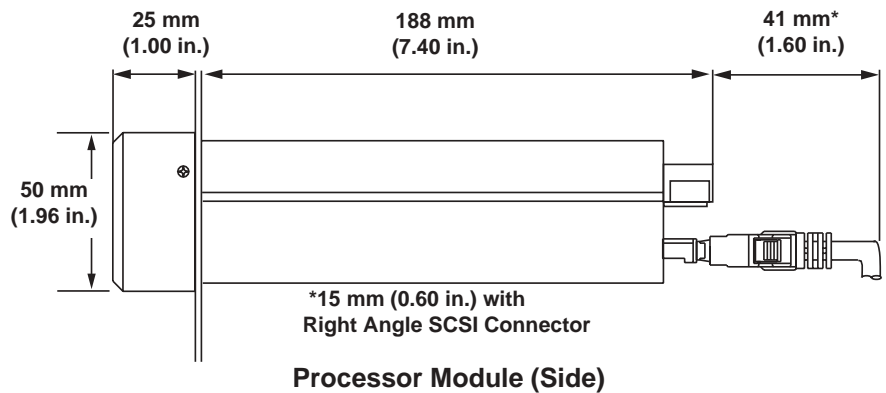
Choose firmware with the features needed for the application:

- Standard—includes closed-loop PID control, auto-tune, alarms, job memory and failed sensor detection
- Extruder— includes the standard firmware features, with PID control specifically adapted for plastic extruders
- Enhanced Features— includes the standard firmware features with the addition of process variable retransmit, remote analog set point, cascade control, ratio control and differential control algorithms. Each channel can be configured for standard PID control or one of the other control algorithms. Each channel of cascade control or remote analog set point requires two controller channels. Unused control outputs on any channel can be configured for retransmit
- Ramp and soak see [page 123](#)

### Input Module Options

Choose the input module appropriate for the application:

- AIM316 and AIM332 provides screw terminations for 16 or 32 sensors
- CIM316 and CIM332 provides DB-50 connector terminations for 16 or 32 sensors in a compact size

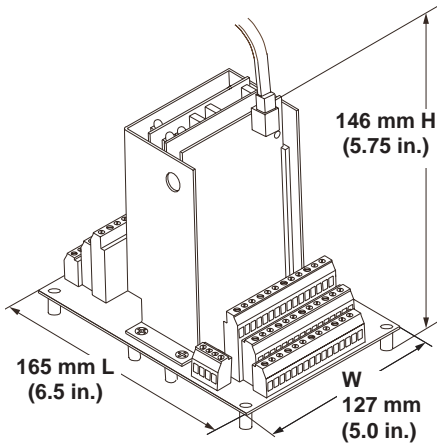


# Auto-Tuning PID Controllers

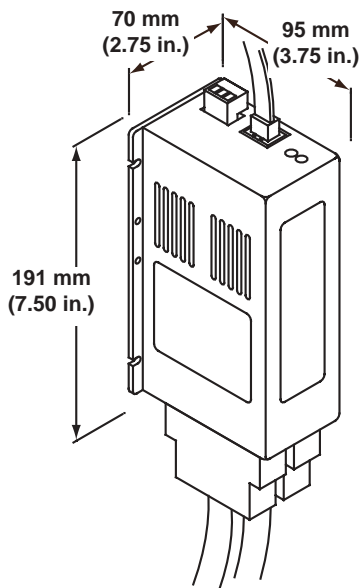
F.O.B.: Winona, Minnesota

## 16-, 32-Loop MLS300 SERIES

### Analog Input Module (AIM332 shown)



### Compact Input Module (CIM332 shown)



### Availability

Up to four weeks depending on complexity and order release quantity. Consult factory for details

### Ordering Information

To order, complete the code number to the right with the information below:

#### Input Module

- 16 = 16 channel analog input module (AIM316)
- 32 = 32 channel analog input module (AIM332)
- C1 = 16 channel compact input module (CIM316)
- C2 = 32 channel compact input module (CIM332)

#### Processor Module (MLS300-PM)

- 0 = Input module only (No MLS300-PM)
- 1 = MLS300-PM with standard firmware
- 2 = MLS300-PM with extruder firmware
- 3 = MLS300-PM with enhanced features firmware
- 4 = MLS300-PM with ramp and soak firmware

#### Terminal Block

- 0 = No terminal block accessory
- 1 = 50-pin terminal block, includes 3 foot SCSI cable

#### Power Supply

- 0 = None
- 2 = 120/240V~(ac) 50/60Hz power supply adapter  
[5V=(dc) @ 4A, 15V=(dc) @ 1.2A] CE approved

#### SCSI Cables (For use with 50-pin terminal board)

- 0 = No special SCSI cable (3 foot cable is included with 50-pin terminal board)
- 1 = 6 foot SCSI cable
- 2 = 3 foot right angle SCSI cable
- 3 = 6 foot right angle SCSI cable

#### Serial Communication Cables (For communications with computer)

- 0 = No serial communications cable
- 1 = 10 foot EIA/TIA-232 comm. cable, DB-9 female/RJ12 phone plug
- 2 = 25 foot EIA/TIA-232 comm. cable, DB-9 female/RJ12 phone plug
- 3 = 50 foot EIA/TIA-232 comm. cable, DB-9 female/RJ12 phone plug
- 7 = EIA/TIA-485 terminal block with 2 foot cable
- 8 = EIA/TIA-485 terminal block with 4 foot cable

#### Module Interconnect Cables

- 0 = No special cable (4 foot cable comes with input module)
- 1 = 10 foot cable, RJ45 connector/RJ45 connector
- 2 = 25 foot cable, RJ45 connector/RJ45 connector

#### Serial Communication Jumper

- 0 = EIA/TIA-232
- 1 = EIA/TIA-485
- 2 = EIA/TIA-485 terminated

#### Special Inputs

(Standard unit is configured for thermocouples and -10 to 60 mV linear inputs.  
For other sensors, order special inputs.)

- 00 = Thermocouples and -10 to 60 mV inputs only
- XX = Number of current, voltage, or RTD inputs. Include leading zero as needed

MLS300SI

#### Special Input Type

- 20 = RTD 1: 0.1° Platinum, -100 to 275°C (-148 to 527°F)
- 21 = RTD 2: 1° Platinum, -120 to 840°C (-184 to 1544°F)
- 43 = 0-10mA=(dc)
- 44 = 0-20mA=(dc)/4-20mA=(dc)
- 50 = 0-100mV=(dc)
- 52 = 0-500mV=(dc)
- 53 = 0-1V=(dc)
- 55 = 0-5V=(dc)
- 56 = 0-10V=(dc)
- 57 = 0-12V=(dc)

#### Start Channel

- XX = Channel number XX

#### End Channel

- XX = Channel number XX

## Auto-Tuning PID Controllers

### SERIES D8

The Watlow Anafaze SERIES D8 is a powerful line of controllers that combines performance and flexibility with compact design. Compliance with the ODVA and Semiconductor SIG standards means this controller is easy to integrate into systems with DeviceNet™ networks on CAN (Controller Area Network).

The four and eight loop versions of SERIES D8 controllers provide complete control solutions for a broad range of applications. Support for multiple types of sensor inputs including thermocouples, RTDs, linear voltage and current is also available.

Each loop can be individually configured for on-off control or PID control. Loops can be combined to achieve cascade, ratio or differential control. Process variable retransmit and remote analog set point are included.

The SERIES D8 controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.

#### Features and Benefits

##### PID control of up to eight loops

- Minimal panel space per loop
- Reduced installation time
- More reliable: fewer parts mean fewer failures

##### Complies with ODVA (Open DeviceNet™ Vendors Association) and Semiconductor SIG (Special Interest Group) specifications for DeviceNet™ on CAN (Controller Area Network)

- Integrates with other DeviceNet™ nodes and software
- Sealed micro connector minimizes installation time and footprint while maximizing reliability



- Rotary baud rate and node address switches simplify setup
- Network and module status LEDs simplify commissioning and troubleshooting a network

#### Flexible, easy-to-use interface

- Easy set up with menu guided, full-text prompts
- Context-sensitive, on-screen help saves time

#### Advanced control utilities

- Auto-tune optimizes control with minimal effort and expertise
- Cascade minimizes overshoot and improves control in systems with excessive thermal lag
- Ratio and differential enhance control in areas where the relationship between two or more loops is paramount

#### Specifications

##### Operator Interface

- 32-character vacuum fluorescent display
- Eight-key keypad to access guided menus and prompts, set values and view channel displays
- Built-in context sensitive help

##### Noise Rejection

- 120dB at 60Hz

##### Temperature Coefficient

- 40ppm/°C

##### Analog Inputs

- Thermocouples: User selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging.
- RTD: 2- or 3-wire, platinum, 100Ω @ 0°C, DIN-curve. Requires scaling resistors. See special inputs in ordering information
- Linear: current and voltage signals from linear transmitter

**DeviceNet™**  
CONFORMANCE TESTED

DeviceNet™ is a trademark of the Open DeviceNet Vendors Association.

# Auto-Tuning PID Controllers

## SERIES D8

### Specifications Cont.

#### Input Range and Accuracy

	Range	Accuracy
Type B	66 to 1760°C (150 to 3200°F)	±4.0°C (±7.2°F)
Type E	-200 to 787°C (-328 to 1448°F)	±1.0°C (±1.8°F)
Type J	-212 to 760°C (-350 to 1400°F)	±1.2°C (±2.2°F)
Type K	-268 to 1371°C (-450 to 2500°F)	±1.3°C (±2.4°F)
Type R	-18 to 1766°C (0 to 3210°F)	±2.8°C (±5.0°F)
Type S	-18 to 1760°C (0 to 3200°F)	±2.8°C (±5.0°F)
Type T	-268 to 399°C (-450 to 750°F)	±1.6°C (±2.9°F)
RTD (DIN)	-200.0 to 621.0°C (-328.0 to 1150.0°F)	±0.5°C (±0.9°F)

Note: Accuracy @ 25°C (77°F) ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 427°C (800°F) to 1760°C (3200°F). RTD is for 100 percent of span

#### Linear Voltage and Current Inputs

Requires scaling resistors. See special inputs in Ordering Information

- 0-10mA $\rightleftharpoons$ (dc)
- 0-20mA $\rightleftharpoons$ (dc)/4-20mA $\rightleftharpoons$ (dc)
- 0-100mV $\rightleftharpoons$ (dc)
- 0-500mV $\rightleftharpoons$ (dc)
- 0-1V $\rightleftharpoons$ (dc)
- 0-5V $\rightleftharpoons$ (dc)
- 0-10V $\rightleftharpoons$ (dc)
- 0-12V $\rightleftharpoons$ (dc)

Other ranges available. Consult factory

#### Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- D84: Six samples per second, (update time: 0.167 sec.)
- D88: Three samples per second, (update time: 0.333 sec.)

#### Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

#### Calibration

- Automatic zero and full scale

#### Digital Inputs

- TTL level used for logic, remote alarm acknowledge, selecting recipes or jobs
- Eight inputs with 50-pin terminal board option
- Three inputs with 18-pin terminal block option

#### Digital Outputs

- 18 digital outputs available with a 50-pin terminal board option
- 11 outputs available with 18-pin terminal block option
- One or two control outputs are user assigned for each loop
- Each control output can be configured for on-off, time proportioning, or distributed zero crossing
- Outputs sink up to 60mA each at 5V $\rightleftharpoons$ (dc)

#### Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- User programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

#### Analog Outputs

- Use DAC and SDAC accessory modules. See [page 159](#).

#### DeviceNet™ Interface

- Fully compliant with the interface guidelines for DeviceNet™ on semiconductor manufacturing tools
- Supports predefined master/slave connection set
- Group two only slave device
- Module status and network status LEDs
- Rotary baud rate and node address switches
- Hardware and software selectable baud rates: 125K, 250K and 500K
- Hardware and software selectable node address: 0 to 63
- Supports polled I/O and explicit messaging connections
- Polled I/O response: less than 1 millisecond
- Explicit message response: less than 50 milliseconds
- EDS (Electronic Data Sheet)
- Connector: 5-pin, micro style, sealed, male
- Optically isolated CANBUS interface
- Bus plugable while hot
- Bus miswire protection

#### Line Voltage/Power

- 15 to 24V $\rightleftharpoons$ (dc)  $\pm$  3V $\rightleftharpoons$ (dc) @ 1A (loaded) or 300mA (no load)

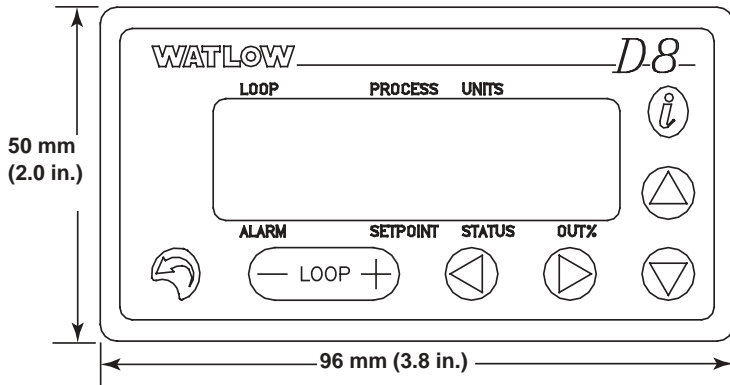
#### Agency Approvals

- UL®, C-UL® Listed: UL® 916, standard for energy management equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC
- ODVA conformance tested DeviceNet™

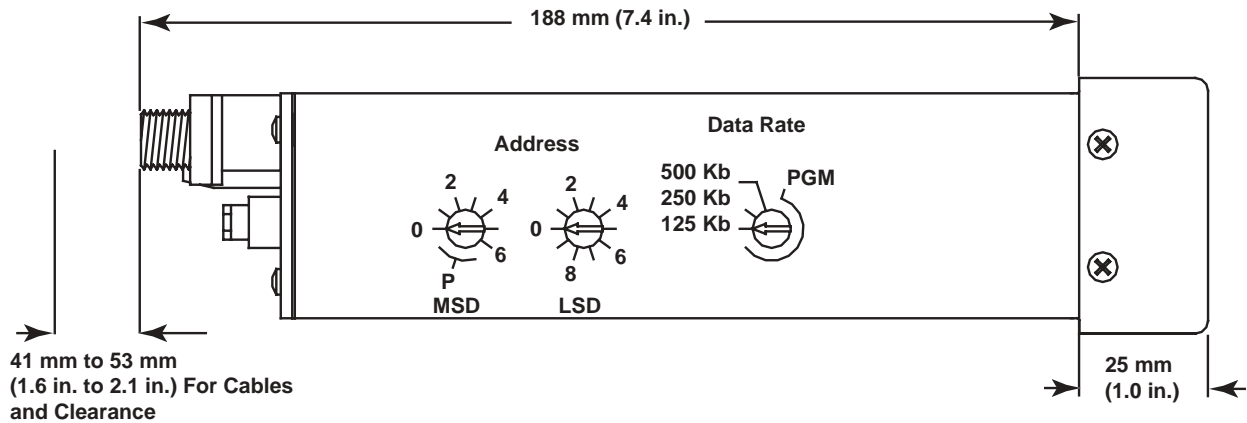
# Auto-Tuning PID Controllers

## SERIES D8

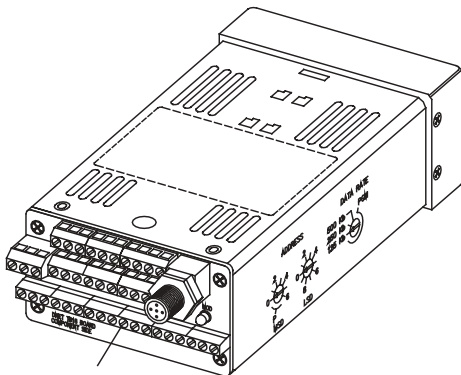
### Front View



### Side View

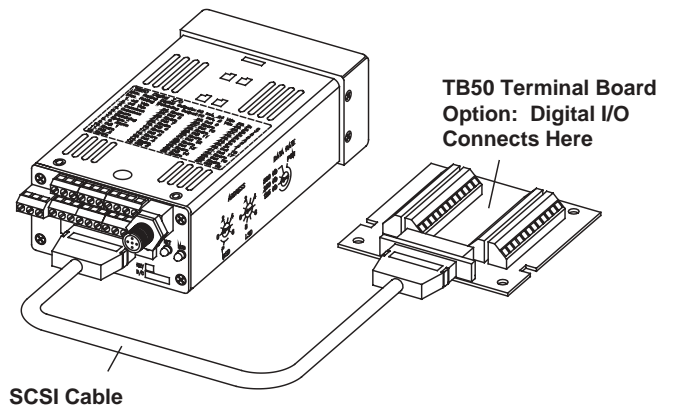


### D8 with TB18 Option for Digital I/O



Connect Digital I/O Here With TB18 Option

### D8 with SCSI/TB50 Option for Digital I/O



SCSI Cable

# Auto-Tuning PID Controllers

F.O.B.: Winona, Minnesota

## SERIES D8

### Ordering Information

To order, complete the code number on the right with the information below.

D 8 0 - 0 0 0 0 - 0

**Number of Loops** \_\_\_\_\_

4 = 4 loop controller  
8 = 8 loop controller

**Digital I/O Terminations** \_\_\_\_\_

0 = TB18 (Screw terminals on the controller)  
1 = SCSI connector, no terminal board or cable  
2 = SCSI connector, TB50 terminal board and 3-foot cable  
3 = SCSI connector, TB50 and 6-foot cable  
4 = SCSI connector, TB50 and 3-foot right angle cable  
5 = SCSI connector, TB50 and 6-foot right angle cable

**Power Supply** \_\_\_\_\_

0 = No power supply  
1 = CE power supply

**Special Inputs** \_\_\_\_\_

0 = Thermocouples and -10 to 60 mV inputs only  
X = Number of current, voltage and RTD inputs

### Special Inputs

Specify an input type for each channel or block of channels that needs factory installed resistors. Include a descriptor in the controller part description in the form specified below for each special input type. Make sure the number of special inputs specified is equal to the number of special inputs in the controller part number

D 8 S I - -

**Special Input Type** \_\_\_\_\_

(Not required for thermocouple sensor inputs)

23 = RTD  
43 = 0-10mA=(dc)  
44 = 0-20mA=(dc)/4-20mA=(dc)  
50 = 0-100mV=(dc)  
52 = 0-500mV=(dc)  
53 = 0-1V=(dc)  
55 = 0-5V=(dc)  
56 = 0-10V=(dc)  
57 = 0-12V=(dc)

**Start Channel** \_\_\_\_\_

XX = Channel Number XX

**End Channel** \_\_\_\_\_

XX = Channel Number XX

### Availability

Up to four weeks, depending on complexity and order release quantity. Consult factory for details

## PID with Time/ Temperature Profiling Controllers

### 4-, 8-, 16-Loop CLS200 SERIES

The Watlow Anafaze CLS200 SERIES is a powerful line of controllers, combining performance and flexibility with compact design. The four, eight and 16 loop versions provide complete control solutions for a broad range of applications. Support for multiple types of sensor inputs is available, including thermocouples, RTDs, linear voltage, current and frequency. Each controller can operate as a stand-alone system and includes built-in serial communications for computer interface and data acquisition. Ramp and soak features allow complex batch processing and sequencing. Up to 17 ramp and soak profiles can be programmed with up to 20 steps each. Individual loops can be configured for standard control or ramp soak. Unused control outputs can be configured for events, alarms and process variable retransmit.

The CLS200 SERIES controllers are UL® and C-UL® listed and meet the requirements of the European Community EMC Directive and carry the CE mark.



#### Features and Benefits

##### Ramp and soak control of up to 16 heat and cool loops

- Minimal panel space per loop
- Reduces installation time
- More reliable: fewer parts means fewer failures

##### Auto-tuning

- Less time tuning
- Achieve excellent control with less expertise

##### Menu-guided operation with full text display

- Setup controller quickly
- Easy to operate

##### Eight jobs stored and recalled

- Quick to change from one process to another

##### Multiple and mixed inputs

- Easy to change sensor types at the last minute
- Less to learn, less inventory

##### Sensor failure detection

- Reduces time troubleshooting reversed, shorted and open sensors

##### High/low process and deviation alarms for each input

- Configure alarms as needed to integrate with PLC or other control elements

##### 34 digital outputs

- Flexible configuration: use outputs as needed for control, alarms, process variable retransmit and ramp soak events

##### EIA/TIA-232 and 485 communications

- Use software to configure and operate
- Integrate with other controllers and software



**Watlow Anafaze's WATVIEW software is ideal to use with the CLS200 SERIES. See [page 197](#) for more information and ordering details.**

# PID with Time/ Temperature Profiling Controllers

## 4-, 8-, 16-Loop CLS200 SERIES

### Specifications

#### Ramp and Soak

- Up to 17 profiles
- Up to 20 steps per profile
- Up to two trigger inputs per step
- Up to four event outputs per step
- Up to 99 repeat cycles
- One external reset digital input
- Time base: minutes/seconds or hours/minutes

#### Operator Interface

- 32-character vacuum fluorescent display
- Eight-key keypad to access guided menus and prompts, enter passkey sequence, set values, switch between single channel and multiple channel displays
- Controller configuration can be loaded through the standard serial port

#### Analog Inputs

- CLS204 4 Differential
- CLS208 8 Differential
- CLS216 16 Single-ended

#### Noise Rejection

- 120db at 60Hz

#### Temperature Coefficient

- 40 ppm/°C

#### Sensors/Inputs

- Thermocouples: User-selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging

- RTD: (CLS204 and CLS208 only) 2- or 3-wire, platinum, 100Ω @ 0°C, DIN 0.003850Ω/°C curve. Two user-selectable ranges offer different resolutions. Requires scaling resistors. See Special/Linear Inputs in Ordering Information

- Linear: current and voltage signals from linear transmitters

- Pulse input

#### Input Range and Accuracy

	Range	Accuracy
Type B	66 to 1760°C (150 to 3200°F)	±4.0°C (±7.2°F)
Type E	-200 to 787°C (-328 to 1448°F)	±1.0°C (±1.8°F)
Type J	-212 to 760°C (-350 to 1400°F)	±1.2°C (±2.2°F)
Type K	-268 to 1371°C (-450 to 2500°F)	±1.3°C (±2.3°F)
Type R	-18 to 1766°C (0 to 3210°F)	±2.8°C (±5.0°F)
Type S	-18 to 1760°C (0 to 3200°F)	±2.8°C (±5.0°F)
Type T	-268 to 399°C (-450 to 750°F)	±1.6°C (±2.9°F)

RTD's available on CLS204 and CLS208 only

(RTD1)	-100 to 275°C (-148 to 527°F)	1.1°C (2.0°F)
(RTD2)	-120 to 840°C (-184 to 1544°F)	1.6°C (2.9°F)

Note: Accuracy @ 25°C ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 427°C to 1760°C (800°F to 3200°F.) RTD is for 100 percent of span

#### Linear Voltage and Current Inputs

Requires scaling resistors. See Special Inputs in Ordering Information

- 0-10mA=(dc)
- 0-20mA=(dc)/4-20mA=(dc)
- 0-100mV=(dc)
- 0-500mV=(dc)
- 0-1V=(dc)
- 0-5V=(dc)
- 0-10V=(dc)
- 0-12V=(dc)

Other ranges available. Consult factory

#### Pulse Input

- One TTL-level square wave input up to 2kHz

#### Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- CLS204: 6 samples per second (update time: 0.167 sec.)
- CLS208: 3 samples per second, (update time: 0.333 sec.)
- CLS216: 1.5 samples per second, (update time: 0.667 sec.)

#### Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

#### Calibration

- Automatic zero and full scale

#### Digital Inputs

- TTL-level used for selecting recipes or jobs, or R/S triggers
- Eight inputs and one pulse input with 50-pin terminal board option
- Two inputs and pulse input or three inputs with 18-pin terminal block option

#### Digital Outputs

- 34 digital outputs are available with 50-pin terminal board option
- 10 control outputs with 18-pin terminal block option
- One or two control outputs are user assigned for each loop



# PID with Time/ Temperature Profiling Controllers

## 4-, 8-, 16-Loop CLS200 SERIES

### Specifications Cont.

- Each control output can be configured for on-off time proportioning, or distributed zero crossing
- Outputs sink up to 60mA each at 5V<sub>DC</sub>
- 350mA at 5V<sub>DC</sub> available from on-board supply

### Analog Outputs

- Use DAC and SDAC accessory modules. For process variable retransmit, use SDAC only. See [page 159](#)

### Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- User-programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

### Serial Interface

- EIA/TIA-232 or EIA/TIA-485

### Baud Rate

- 2400, 9600 or 19200, user-selectable

### Communication Protocol

- Modbus™ RTU

### Line Voltage/Power

- 15 to 24V<sub>DC</sub> ± 3V<sub>DC</sub> @ 1A (maximum), 300mA (no load)

### Agency Approvals

- UL®, C-UL® listed: UL® 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC

## Dimensions

### Overall

Height:	50 mm	(1.96 in.)
Width:	96 mm	(3.78 in.)
Depth:	203 mm	(8.0 in.)

### Bezel

Height:	50 mm	(1.96 in.)
Width:	96 mm	(3.78 in.)
Depth:	25 mm	(1.0 in.)

### Chassis

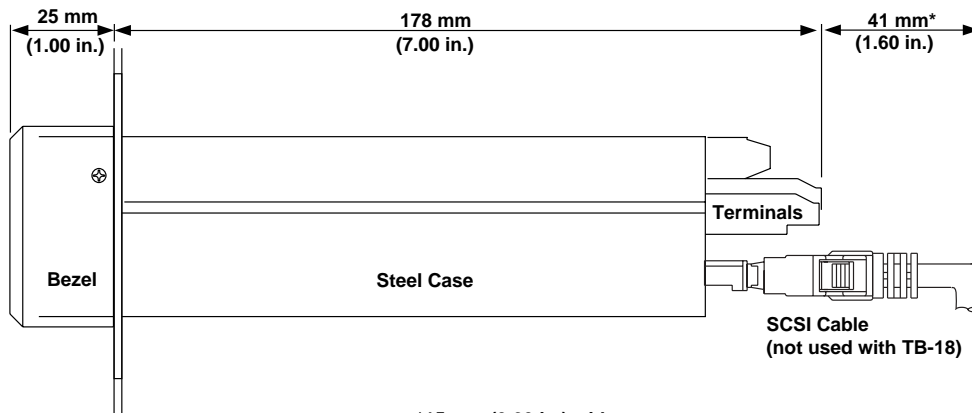
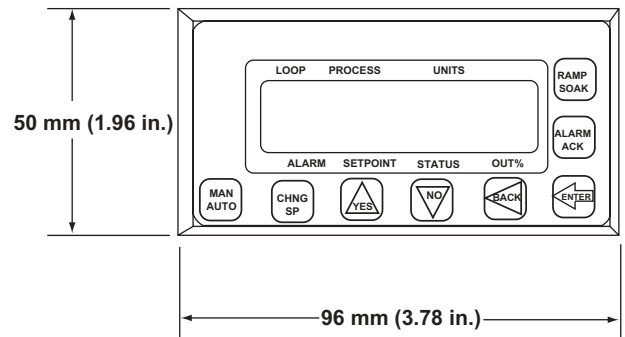
Height:	45 mm	(1.76 in.)
Width:	90 mm	(3.55 in.)
Depth:	178 mm	(7.0 in.)

### Controller Weight

0.9 kg (1.98 lbs)

### Shipping Weight

1.8 kg (4.0 lbs)



\*15 mm (0.60 in.) with Right Angle SCSI Connector

Multi-Loop  
PID with Time/Temperature Profiling

# PID with Time/ Temperature Profiling Controllers

F.O.B.: Winona, Minnesota

## 4-, 8-, 16-Loop CLS200 SERIES

**Note:** Controller is configured for thermocouples and -10 to 60mV=(dc) linear inputs. For other sensors order special inputs, see below. For analog outputs order DAC or SDAC modules, see [page 159](#). For easy setup order WATVIEW software, see [page 197](#).

### Ordering Information

To order, complete the code number to the right with the information below:

<p><b>Number of Channels</b> _____</p> <p>04 = 4 channel 08 = 8 channel 16 = 16 channel</p> <p><b>Controller Type</b> _____</p> <p>1 = Standard EPROM 2 = Extruder 3 = Ramp and soak 4 = Enhanced features</p> <p><b>Terminal Block</b> _____</p> <p>0 = No terminal block accessory 1 = 18-pin terminal block (CLS204 and CLS208 only) 2 = 50-pin terminal block installed (includes 3 foot SCSI cable)</p> <p><b>Power Supply</b> _____</p> <p>0 = No power supply 2 = 120/240V~(ac), 50/60Hz power supply adapter (5V=(dc), @ 4A, 15V=(dc) @ 1.2A) (CE approved)</p> <p><b>SCSI Cables</b> _____</p> <p>0 = No SCSI cable (3 foot cable included with 50-pin terminal block) 1 = 6 foot SCSI cable 2 = 3 foot right angle SCSI cable 3 = 6 foot right angle SCSI cable</p> <p><b>Serial Communication Cables</b> _____</p> <p>0 = No serial communications cable 1 = 10 foot serial communications cable (DB-9 female/bare wire) 2 = 25 foot serial communications cable (DB-9 female/bare wire) 3 = 50 foot serial communications cable (DB-9 female/bare wire)</p> <p><b>Serial Communication Jumper Settings</b> _____</p> <p>0 = EIA/TIA-232 1 = EIA/TIA-485 2 = EIA/TIA-485 terminated</p> <p><b>Special Inputs</b> _____</p> <p>(Standard unit is configured for thermocouples and -10 to 60 mV linear inputs. For other sensors, order special inputs. See below for ordering instructions. For CLS216 specify two digits, for CLS204 and CLS208 specify one digit.)</p> <p>0 or 00 = Thermocouples and -10 to 60mV inputs only X or XX = Number of current, voltage or RTD inputs</p> <p><b>Special/Linear Input Type</b> _____</p> <p>(Not required for thermocouple sensor inputs.)</p> <p>20 = RTD 1: 0.1°, -100.0 to 275.0°C (-148.0 to 527.0°F) Not available on CLS216 21 = RTD 2: 1°, -120 to 840°C (-184 to 1544°F) Not available on CLS216 43 = 0-10mA=(dc) 44 = 0-20mA=(dc)/4-20mA=(dc) 50 = 0-100mV=(dc) 52 = 0-500mV=(dc) 53 = 0-1V=(dc) 55 = 0-5V=(dc) 56 = 0-10V=(dc) 57 = 0-12V=(dc)</p> <p><b>Start Channel</b> _____</p> <p>XX = Channel number XX</p> <p><b>End Channel</b> _____</p> <p>XX = Channel number XX</p>	<p>2 -</p> <p>CL SSI - -</p>
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### Availability

Up to four weeks, depending on complexity and order release quantity. Consult factory for details.

## PID with Time/ Temperature Profiling Controllers

### 16-, 32-Loop MLS300 SERIES

The Watlow Anafaze MLS300 SERIES is a powerful line of controllers that combines performance and flexibility with compact design. The 16 and 32 loop versions provide complete control solutions for a broad range of applications. Support for multiple types of sensor inputs is available; including thermocouples, RTDs, linear voltage, current and frequency. Each controller can operate as a stand-alone system and includes built-in serial communications for computer interface and data acquisition. Ramp and soak features allow complex batch processing and sequencing. Up to 17 ramp and soak profiles can be programmed with up to 20 steps each. Individual loops can be configured for standard control or ramp and soak. Unused control outputs can be configured for events, alarms and process variable retransmit.

The remote analog input options allow for shorter sensor wires and flexible mounting which reduces sensor cost and installation time. Watlow's new CIM option provides OEMs with a space and labor saving alternative to the standard AIM module. This innovation allows users to construct a wiring harness to attach sensors via a connector instead of connecting individual wires to the controller.

The MLS300 SERIES controllers are UL® and C-UL® listed, meet the requirements of the European Community EMC Directive and carry the CE mark.



#### Features and Benefits

##### Ramp and soak control of up to 16 heat and cool loops or 32 heat loops

- Minimal panel space per loop
- Reduces installation time
- More reliable: fewer parts mean fewer failures

##### Auto-tuning

- Less time tuning
- Achieve excellent control with less expertise

##### Menu guided operation with full text display

- Set up controller quickly
- Easy to operate

##### Store and recall eight jobs

- Change quickly from one process to another

##### Multiple and mixed inputs

- Easy to change sensor types at the last minute
- Less to learn, less inventory

##### Sensor fail detection

- Reduces time troubleshooting reversed, shorted and open sensors

##### High/low process and deviation alarms for each input

- Configure alarms as needed to integrate with PLC or other control elements

##### TIA/EIA-232 and 485 communications

- Use software to configure and operate
- Integrate with other controllers and software

##### 34 digital outputs

- Flexible configuration: use outputs as needed for control, alarms, process variable retransmit and ramp soak events

##### CIM300 option

- Small footprint per loop
- Reduced installation time



**Watlow Anafaze's WATVIEW software is ideal to use with the MLS300 SERIES. See page 197 for more information and ordering details.**

# PID with Time/ Temperature Profiling Controllers

## 16-, 32-Loop MLS300 SERIES

### Specifications

#### Ramp and Soak

- Up to 17 profiles
- Up to 20 steps per profile
- Up to 2 trigger inputs per step
- Up to 4 event outputs per step
- Up to 99 repeat cycles
- One external reset digital input
- Time base: minutes/seconds or hours/minutes

#### Operator Interface

- 32-character vacuum fluorescent display
- Eight-key keypad to access guided menus and prompts, enter passkey sequence, set values, switch between single channel and multiple channel displays
- Controller's configuration can be loaded through the standard serial port

#### Analog Inputs

- MLS316 16 Differential
- MLS332 32 Differential

#### Noise Rejection

- 120dB at 60Hz

#### Temperature Coefficient

- 40 ppm/°C

#### Temperature Sensors

- Thermocouples: User selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging
- RTD: 2- or 3-wire, platinum, 100Ω @ 0°C, DIN 0.003850Ω/°C. Two user-selectable ranges offer different resolutions. Requires special inputs. See Ordering Information

### Input Range and Accuracy

	Range	Accuracy
Type B	66 to 1760°C (150 to 3200°F)	±4.0°C (±7.2°F)
Type E	-200 to 787°C (-328 to 1448°F)	±1.0°C (±1.8°F)
Type J	-212 to 760°C (-350 to 1400°F)	±1.2°C (±2.2°F)
Type K	-268 to 1371°C (-450 to 2500°F)	±1.3°C (±2.3°F)
Type R	-18 to 1766°C (0 to 3210°F)	±2.8°C (±5.0°F)
Type S	-18 to 1760°C (0 to 3200°F)	±2.8°C (±5.0°F)
Type T	-268 to 399°C (-450 to 750°F)	±1.6°C (±2.9°F)
RTD1 (DIN)	-100.0 to 275.0°C (-148.0 to 527.0°F)	±1.1°C (±2.0°F)
RTD2 (DIN)	-120 to 840°C (-184 to 1544°F)	±1.6°C (±2.9°F)

Note: Accuracy @ 25°C (77°F) ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 427°C (800°F) to 1760°C (3200°F). RTD is for 100 percent of span

### Linear Voltage and Current Inputs

Requires special inputs.  
See Ordering Information

- 0-10mA $\rightleftharpoons$ (dc)
- 0-20mA $\rightleftharpoons$ (dc)/4-20mA $\rightleftharpoons$ (dc)
- 0-100mV $\rightleftharpoons$ (dc)
- 0-500mV $\rightleftharpoons$ (dc)
- 0-1V $\rightleftharpoons$ (dc)
- 0-5V $\rightleftharpoons$ (dc)
- 0-10V $\rightleftharpoons$ (dc)
- 0-12V $\rightleftharpoons$ (dc)

Other ranges available. Consult factory

### Pulse Input

One TTL-level square wave input up to 2kHz

### Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- MLS316: 1.5 samples per second, (update time: 0.667 sec.)
- MLS332: 0.75 samples per second, (update time: 1.33 sec.)

### Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

### Calibration

- Automatic zero and full scale

### Digital Inputs

- TTL level used for selecting recipes or jobs, or R/S triggers
- 8 inputs and 1 pulse input with 50-pin terminal board option

### Digital Outputs

- 34 outputs available with 50-pin terminal board option
- One or two control outputs are user assigned for each loop
- Each control output can be configured for on-off, time proportioning, or distributed zero crossing
- Outputs sink up to 60mA each at 5V $\rightleftharpoons$ (dc)

### Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- Programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

### Analog Outputs

- Use DAC and SDAC accessory modules. For process variable retransmit, use SDAC only. See [page 159](#)

### Serial Interface

- EIA/TIA-232 or EIA/TIA-485

### Baud Rate

- 2400, 9600 or 19200, user-selectable

# PID with Time/ Temperature Profiling Controllers

## 16-, 32-Loop MLS300 SERIES

### Specifications Cont.

#### Communication Protocol

- Modbus™ RTU

#### Line Voltage/Power

- 15 to 24V $\overline{\text{dc}}$   $\pm$  3V $\overline{\text{dc}}$  @ 1A

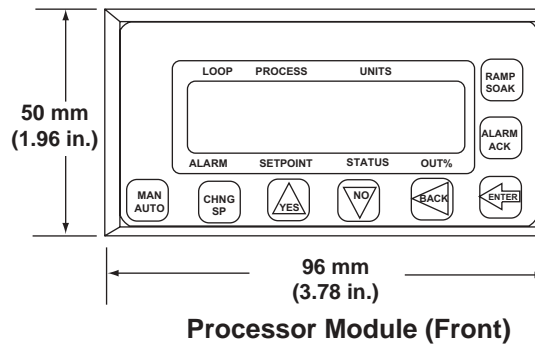
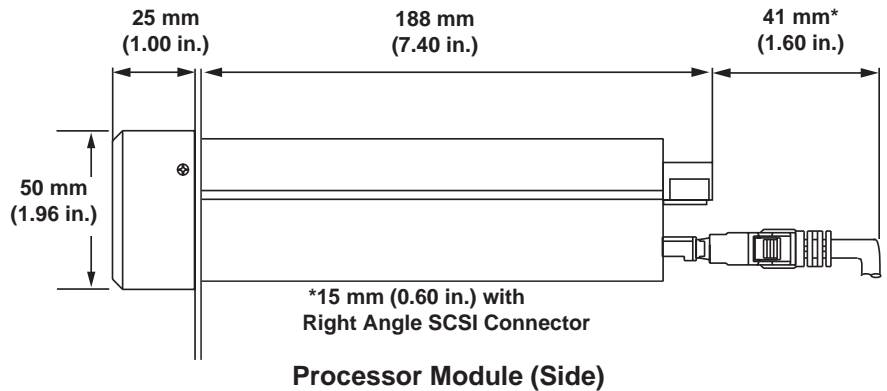
#### Agency Approvals

- UL®, C-UL® Listed: UL® 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC

#### Input Module Options

Choose the input module appropriate for the application:

- AIM316 and AIM332 provides screw terminations for 16 or 32 sensors
- CIM316 and CIM332 provides DB-50 connector terminations for 16 or 32 sensors in a compact size

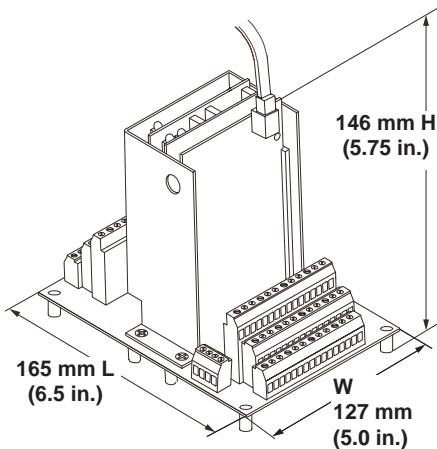


# PID with Time/ Temperature Profiling Controllers

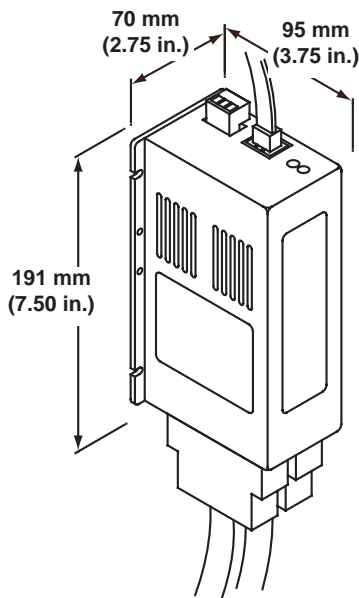
F.O.B.: Winona, Minnesota

## 16-, 32-Loop MLS300 SERIES

### Analog Input Module (AIM332 shown)



### Compact Input Module (CIM332 shown)



### Availability

Up to four weeks depending on complexity and order release quantity. Consult factory for details.

### Ordering Information

To order, complete the code number to the right with the information below:

#### Input Module

- 16 = 16 channel analog input module (AIM316)
- 32 = 32 channel analog input module (AIM332)
- C1 = 16 channel compact input module (CIM316)
- C2 = 32 channel compact input module (CIM332)

#### Processor Module (MLS300-PM)

- 0 = Input module only (No MLS300-PM)
- 1 = MLS300-PM with standard firmware
- 2 = MLS300-PM with extruder firmware
- 3 = MLS300-PM with enhanced features firmware
- 4 = MLS300-PM with ramp and soak firmware

#### Terminal Block

- 0 = No terminal block accessory
- 1 = 50-pin terminal block, includes 3 foot SCSI cable

#### Power Supply

- 0 = None
- 2 = 120/240V~(ac) 50/60Hz power supply adapter [5V=(dc) @ 4A, 15V=(dc) @ 1.2A] CE approved

#### SCSI Cables (For use with 50-pin terminal board)

- 0 = No special SCSI cable (3 foot cable is included with 50-pin terminal board)
- 1 = 6 foot SCSI cable
- 2 = 3 foot right angle SCSI cable
- 3 = 6 foot right angle SCSI cable

#### Serial Communication Cables (For communications with computer)

- 0 = No serial communications cable
- 1 = 10 foot EIA/TIA-232 comm. cable, DB-9 female/RJ12 phone plug
- 2 = 25 foot EIA/TIA-232 comm. cable, DB-9 female/RJ12 phone plug
- 3 = 50 foot EIA/TIA-232 comm. cable, DB-9 female/RJ12 phone plug
- 7 = EIA/TIA-485 terminal block with 2 foot cable
- 8 = EIA/TIA-485 terminal block with 4 foot cable

#### Module Interconnect Cables

- 0 = No special cable (4 foot cable comes with input module)
- 1 = 10 foot cable, RJ45 connector/RJ45 connector
- 2 = 25 foot cable, RJ45 connector/RJ45 connector

#### Serial Communication Jumper

- 0 = EIA-TIA-232
- 1 = EIA-TIA-485
- 2 = EIA-TIA-485 Terminated

#### Special Inputs

(Standard unit is configured for thermocouples and -10 to 60mV linear inputs.)

For other sensors, order special inputs.)

- 00 = Thermocouples and -10 to 60mV inputs only
- XX = Number of current, voltage, or RTD inputs. Include leading zero as needed

#### Special Input Type

- 20 = RTD 1: 0.1° Platinum, -100 to 275°C (-148 to 527°F)
- 21 = RTD 2: 1° Platinum, -120 to 840°C (-184 to 1544°F)
- 43 = 0-10mA=(dc)
- 44 = 0-20mA=(dc)/4-20mA=(dc)
- 50 = 0-100mV=(dc)
- 52 = 0-500mV=(dc)
- 53 = 0-1V=(dc)
- 55 = 0-5V=(dc)
- 56 = 0-10V=(dc)
- 57 = 0-12V=(dc)

#### Start Channel

- XX = Channel number XX

#### End Channel

- XX = Channel number XX

MLS300SI

## PID with Time/ Temperature Profiling Controllers

### SERIES F4D

Watlow's SERIES F4D ¼ DIN industrial controllers offer an easy to set up and operate solution for the most demanding ramp and soak processing applications. The features and performance of these units make them ideally suited for environmental chamber or furnace and oven applications. Single and dual channel versions are available.

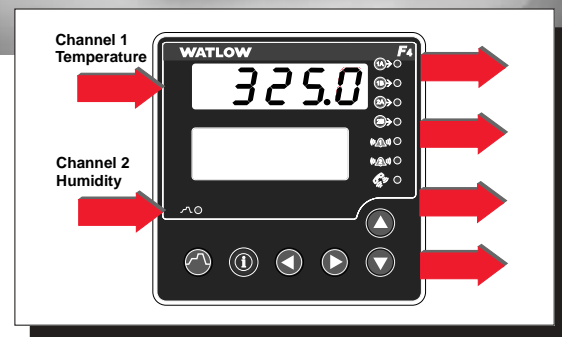
These competitively priced controllers feature a four line, high definition LCD interface display that makes profile programming and controller configuration significantly faster and easier. A 16 bit microprocessor supports all the accuracy and performance advantages you have come to expect from a Watlow controller.

Up to 256 steps can be programmed into as many as 40 nameable profiles. Profiles can be programmed to wait for events or for up to three different process variables. A guaranteed soak feature allows you to set how closely your process needs to be controlled.

Serial communication and dual alarm relays are included in the base unit. The SERIES F4D ramping controllers are packaged with a NEMA 4X front face to withstand harsh environments and a four inch deep case with removable connectors for wiring convenience.

#### Performance Capabilities

- Accuracy to  $\pm 0.1$  percent of span
- Operating environment: 0 to 54°C (32 to 130°F)



#### Features and Benefits

##### Guided 256 step, 40 profile ramp and soak programmable memory

- Supports a wide range of processing applications

##### High definition four line LCD controller interface display

- Simplifies setup and operation

##### Menu customization

- Enhances process monitoring

##### High performance 16 bit microprocessor

- Precise process control
- 20Hz update rate on input 1
- 10Hz update rate on inputs 2 and 3

##### Universal inputs

- Allows application versatility

##### Expandable modular construction

- Field upgradable

##### Enhanced environmental chamber control

- Supports humidity, compressor, boost heat/boost cool control

##### Cascade control

- Allows precise two variable control

##### Real time clock with battery backup

- Allows operational flexibility and peace of mind

##### Field upgradeable firmware

- Downloads available @ no charge from [www.watlow.com/F4](http://www.watlow.com/F4)
- Reduces downtime
- Eliminates the need for an RMA

##### Applications

- Environmental chambers
- Heat treating
- Ovens and furnaces
- Analytical equipment

# PID with Time/ Temperature Profiling Controllers

## SERIES F4D

### Specifications

#### Dimensions

- Width x height x depth  
(42 mm x 118 mm x 132 mm)  
3.96 in. x 3.96 in. x 3.85 in. panel  
mount

#### Universal Analog Inputs 1 (2-3 Optional)

##### Thermocouple

- Type J, K, T, N, C (W5), E, Pt 2,  
D (W3), B, R, S

##### RTD

- 2- or 3-wire platinum, 100, 500 or  
1000Ω
- JIS or DIN-curves, 1.0 or 0.1  
indication

##### Process

- Range selectable: 0-10V $\approx$ (dc),  
0-5V $\approx$ (dc), 1-5V $\approx$ (dc), 0-50mV,  
0-20mA, 4-20mA
- Voltage input impedance 20KΩ
- Current input impedance 100Ω

#### Digital Inputs (4)

- Contact or dc voltage
- 10KΩ input impedance
- Update rate = 10Hz

#### Control Outputs (1A, 1B, 2A, 2B)

##### Open Collector/Switched dc

- Internal load switching (nominal):  
Switched dc, 22 to 28V $\approx$ (dc),  
limited @ 30mA
- External load switching  
(maximum): Open collector  
42V $\approx$ (dc) @ 0.5A

##### Solid State Relay

- Zero switched, optically coupled,  
0.5A @ 24V $\approx$ (ac) minimum,  
253V $\approx$ (ac) maximum

#### Process Outputs (Optional Retransmit)

- User selectable 0-10V $\approx$ (dc),  
0-5V $\approx$ (dc), 1-5V $\approx$ (dc),  
0-20mA, 4-20mA
- Update rate = 1Hz

#### Alarm Outputs

- Output update rate = 1Hz
- Electromechanical relay, Form C,  
2A @ 30V $\approx$ (dc) or 240V $\approx$ (ac)  
maximum

#### Digital Outputs (8)

- Update rate = 10Hz
- Open collector output
- Off = 42V $\approx$ (dc) max @ 10μA
- On = 0.2V $\approx$ (dc) max @ 50mA sink
- Internal supply: 5V $\approx$ (dc), 80mA

#### Communications

EIA-232 and EIA-485 serial  
communications with Modbus™  
RTU protocol, 9600 or 19.2K baud

#### Safety and Agency Approvals

- UL®/C-UL® 916 listed,  
File # E185611 Process Control  
Equipment
- IP65 and NEMA 4X
- CE to EN 61010-1 and EN 61326

#### Terminals

- Touch-safe removable terminal  
blocks, accepts 12 to 22 gauge  
wire

#### Power

- 100-240V $\approx$ (ac), -15 percent,  
+10 percent; 50/60Hz, ±5 percent
- 24-28V $\approx$ (ac/dc), -15 percent,  
+10 percent (order option)
- 39VA max power consumption
- Data retention upon power failure  
via nonvolatile memory (7 years  
for battery backed RAM).  
Sensor input isolation from input  
to input to output to communi-  
cation circuitry is 500V $\approx$ (ac)

#### Operating Environment

- 0 to 55°C (32 to 130°F)
- 0 to 90 percent RH,  
non-condensing
- Storage temperature:  
-40 to 70°C (-40 to 158°F)

#### Accuracy

- Calibration accuracy and sensor  
conformity: ±0.1 percent of span  
±1°C @ 25°C ±3°C (77°F ±5°F)  
ambient, and rated line voltage  
±10 percent with the following  
exceptions:  
Type T: 0.12 percent of span for  
-200°C to -50°C (-328°F to -58°F)  
Types R and S: 0.15 percent of span  
for 0°C to 100°C (32°F to 212°F)  
Type B: 0.24 percent of span for  
870°C to 1700°C (1598°F to 3092°F)
- Accuracy span: Less than or equal  
to operating ranges, 540°C  
(1000°F) minimum
- Temperature stability: ±0.1°C/°C  
(±0.1°F/°F) rise in ambient for  
thermocouples  
±0.05°C/°C (±0.05°F/°F) rise in  
ambient for RTD sensors

#### Displays

- Process: five seven segment  
LED, red
- Control interface display: high  
definition LCD, green

#### Sensor Operating Ranges:

Type J	0 to 815°C (32 to 1500°F)
Type K	-200 to 1370°C (-328 to 2500°F)
Type T	-200 to 400°C (-328 to 750°F)
Type N	0 to 1300°C (32 to 2372°F)
Type E	-200 to 800°C (-328 to 1470°F)
Type C	0 to 2315°C (32 to 4200°F)
Type D	0 to 2400°C (32 to 4352°F)
Pt 2	0 to 1395°C (32 to 2543°F)
Type R	0 to 1760°C (32 to 3200°F)
Type S	0 to 1760°C (32 to 3200°F)



# PID with Time/ Temperature Profiling Controllers

## SERIES F4D

### Specifications Cont.

Type B	0 to 1816°C (32 to 3300°F)
RTD (DIN)	-200 to 800°C (-328 to 1472°F)
RTD (JIS)	-200 to 800°C (-328 to 1166°F)
Process:	-19999 to 30,000 units

### Sensor Accuracy Ranges:

#### Input ranges

Type J	0 to 750°C (32 to 1382°F)
Type K	-200 to 1250°C (-328 to 2282°F)
Type T	-200 to 350°C (-328 to 662°F)
Type N	0 to 1250°C (32 to 2282°F)
Type E	-200 to 800°C (-328 to 1470°F)
Type C (W5)	0 to 2315°C (32 to 4200°F)
Type D (W3)	0 to 2400°C (32 to 4352°F)
Pt 2	0 to 1393°C (32 to 2540°F)
Type R	0 to 1450°C (32 to 2642°F)
Type S	0 to 1450°C (32 to 2642°F)
Type B	870 to 1700°C (1598 to 3092°F)
RTD (DIN)	-200 to 800°C (-328 to 1472°F)
RTD (JIS)	-200 to 630°C (-328 to 1166°F)
Process:	-19999 to 30,000 units

### Serial Communication

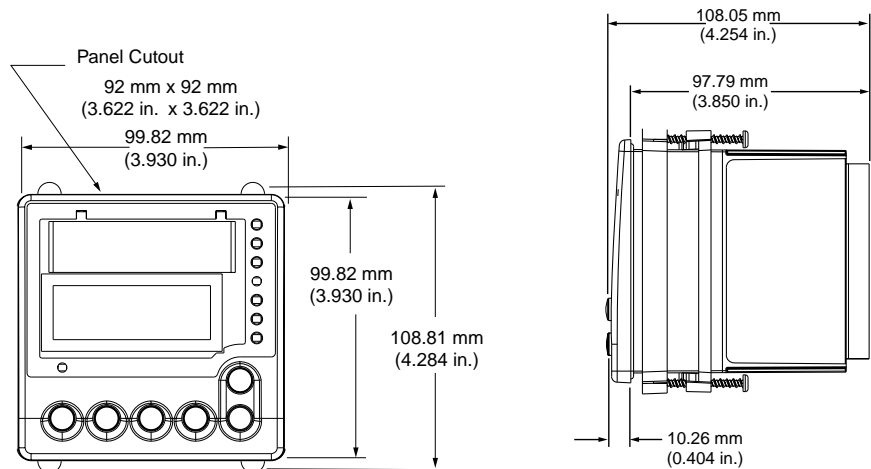
EIA-232 and EIA-485 serial communication interfaces are included in the base unit of both the SERIES F4S (single channel) and the SERIES F4D (dual channel) controllers. The baud rate is selectable as either 9600 or 19200 baud. The protocol is Modbus™.

### Optional Retransmit

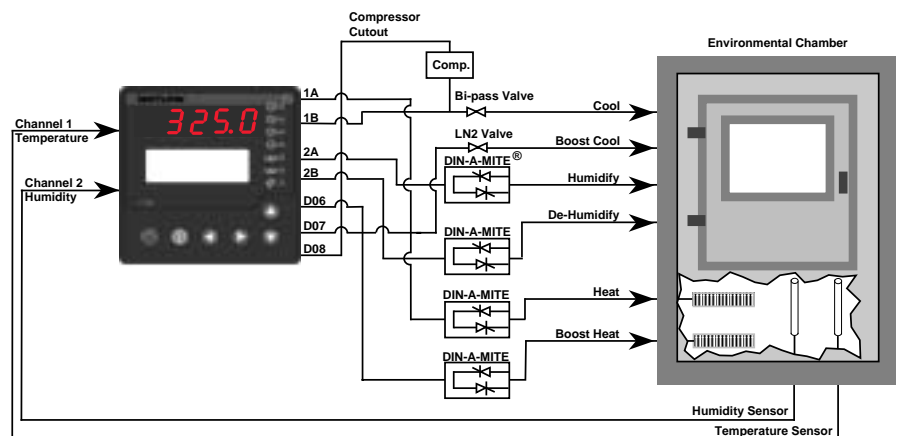
Optional retransmit capability is available to retransmit one or two variables. These variables include up to three process variables, control set points or percent load power. Update rate is 1Hz.

### Alarms

Two Form "C" electromechanical alarm relays are included in the base units. These alarms can be programmed as either process or deviation alarms. The alarms can be tied to up to three process variables.



### Temperature and Humidity Chamber Application



Multi-Loop  
PID with Time/Temperature Profiling

# PID with Time/ Temperature Profiling Controllers

F.O.B.: Winona, Minnesota

## SERIES F4D

### Set Point Ramp and Soak Programming

The enhanced programming features found in the SERIES F4D ramping controllers are the result of listening to our customers' demand for greater capabilities with reduced programming complexity.

A profile guide leads the programmer through the programming process by offering choices for step configuration. For better operator recognition profiles and digital I/O used for events can be given names of up to 10 characters in length.

Five step types including ramp, soak, jump, auto start and end offer the programmer complete flexibility. Ramp steps can be based on time or rate. Ramp and soak steps can be programmed to wait for up to four event inputs and three process variables. Up to eight event outputs are step selectable. Since your thermal systems characteristics may change over its operating range, up to 10 sets of PID heat/cool parameters are step selectable. The auto start step can start a profile based on a set date, a day of the week, or daily, the choice is yours. The jump step can be used to jump within a profile or to another profile. The end step terminates a program with the control outputs programmed to your process needs.

### Availability

Up to four weeks, depending on complexity and order release quantity. Consult factory for details.

### Ordering Information

To order, complete the code number on the right with the information below:

<p><b>SERIES F4D</b> = ¼ DIN dual channel ramping controller</p> <p><b>Dual Channel Ramping Controller</b> _____</p> <p>3 universal analog inputs, 4-digital inputs, 8-digital outputs, 2 alarms, EIA-232/485 comms</p> <p><b>Power Supply</b> _____</p> <p>H = 100-240V<math>\approx</math>(ac/dc)</p> <p>L = 24-28V<math>\approx</math>(ac/dc)</p> <p><b>Output 1A</b> _____</p> <p>C = Open collector/switched dc</p> <p>F = Process, 0-5, 1-5, 0-10V<math>\approx</math>(dc), 0-20mA, 4-20mA</p> <p>K = Solid state Form A, 0.5A amp relay</p> <p><b>Output 1B</b> _____</p> <p>A = None</p> <p>C = Open collector/switched dc</p> <p>F = Process, 0-5, 1-5, 0-10V<math>\approx</math>(dc), 0-20mA, 4-20mA</p> <p>K = Solid state Form A, 0.5A amp relay</p> <p><b>Output 2A</b> _____</p> <p>C = Open collector/switched dc</p> <p>F = Process, 0-5, 1-5, 0-10V<math>\approx</math>(dc), 0-20mA, 4-20mA</p> <p>K = Solid state Form A, 0.5A amp relay</p> <p><b>Output 2B</b> _____</p> <p>A = None</p> <p>C = Open collector/switched dc</p> <p>F = Process, 0-5, 1-5, 0-10V<math>\approx</math>(dc), 0-20mA, 4-20mA</p> <p>K = Solid state Form A, 0.5A amp relay</p> <p><b>Auxiliary Retransmit Module</b> _____</p> <p>0 = None</p> <p>1 = Single retransmit output 0-5, 1-5, 0-10V<math>\approx</math>(dc), 0-20mA, 4-20mA</p> <p>2 = Dual retransmit outputs 0-5, 1-5, 0-10V<math>\approx</math>(dc), 0-20mA, 4-20mA</p> <p><b>Language and RTD Options</b> _____</p> <p>1 = English w/100<math>\Omega</math> RTD</p> <p>2 = German w/100<math>\Omega</math> RTD</p> <p>3 = French w/100<math>\Omega</math> RTD</p> <p>4 = Spanish w/100<math>\Omega</math> RTD</p> <p>5 = English w/500 &amp; 1K<math>\Omega</math> RTD</p> <p>6 = German w/500 &amp; 1K<math>\Omega</math> RTD</p> <p>7 = French w/500 &amp; 1K<math>\Omega</math> RTD</p> <p>8 = Spanish w/500 &amp; 1K<math>\Omega</math> RTD</p> <p><b>Display and Custom Options</b> _____</p> <p>RG = Display</p> <p>XX = Custom options</p>	<p><b>F 4 D</b> - - - - -</p> <div style="border: 1px solid black; height: 100px; width: 100%; margin-top: 10px;"></div>
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## PID with Time/ Temperature Profiling Controllers

### SERIES N7

Watlow's SERIES N7 temperature controllers provide ample flexibility for use in a broad range of applications. The controllers feature expanded communication options as well as modular architecture that provides customers with design options based on their unique specifications. The SERIES N7 offers customizable firmware and overlays including up to 32 LEDs and 32 switches.

The SERIES N7's enhanced technology includes a powerful processor with additional memory for sophisticated control algorithms as well as the ability to monitor and count various events. The SERIES N7 delivers up to four zones of control that can be sensed with thermocouples or two-wire or three-wire RTDs. Input offerings are process inputs available as either voltage or current. The SERIES N7 also offers a wide variety of outputs. The base model is equipped with six open collector outputs, each with a nominal output voltage of 5V and a maximum current of 30mA. Two additional open collector outputs can be added for a total of eight possible outputs. The optional high voltage board offers up to six high voltage outputs which can be used in place of the open collector outputs. The SERIES N7 features two solid state relays (SSRs) with the option of six in total. Each SSR has a maximum operating current of 0.4 amps.

Watlow's SERIES N7 offers an optional NAFEM Ethernet communications interface to meet industry needs. The controller is UL® and C-UL® recognized, carries the EU LV and EMC directives for emissions and immunity, the NSF option and the CSA standard C22.2-24.



#### Features and Benefits

##### Modular design

- Dual displays can be tailored to offer flexibility and design options
- High voltage output module provides for up to six high voltage relays
- Custom firmware allows multiple applications in one controller
- Overlay can be easily modified, allowing users to create a unique look with membrane switches and LEDs

##### Enhanced Communications

- Ethernet communications module enables NAFEM protocol option
- Communications capable of flash downloading software, Modbus™ and PC communications

##### Customizable inputs and outputs

- Up to four sensor inputs can be customized to include thermocouples, RTDs or process inputs
- Up to 10 outputs provide ranges including open collectors, SSRs, electromechanical relays, no-arc relays, current and voltage
- Up to eight event inputs allow for door switch use

##### Low voltage controller

- Vertical and horizontal orientations offer mounting options
- Mechanically fits within 69.85 mm x 196.85 mm (2.75 in. x 7.75 in.) outline
- Auto-tuning simplifies tuning of PID parameters
- Ambient temperature rating of 80°C (176°F) allows controller to withstand hot environments
- On board variable audible alarm alerts operator of control conditions

# PID with Time/ Temperature Profiling Controllers

## SERIES N7

### Specifications

#### Control Mode

- Up to four zones of control, PID or on-off control
- Microprocessor based, programmable, direct-acting control outputs, flash download
- One step auto-tuning, WATCURVE temperature compensation
- Displayed in °C, °F or process variable units
- Battery backed, real-time clock
- One non-isolated passive serial communications channel
- One non-isolated master serial communications channel
- Optional Ethernet communications module
- Optional high-voltage output module

#### Agency Approvals

- UL® 60730, C-UL®
- EU LV Directive 72/23/EEC
- EU EMC Directive 89/336/EEC
  - Emissions
  - Immunity
- NSF option
- NAFEM NDP communications
- CSA standard E60730-209

#### Operator Interface

- Embedded membrane switch (LEDs and key switches embedded in overlay)
- Up to 32 embedded LEDs and 32 embedded switches
- Contamination and water resistant (Supplied by Watlow or customer)
- Displays: Four character 14.22 mm (0.56 in.) high, seven segment LED display and an eight character 5.08 mm (0.2 in.) dot matrix display

- Displays times, temperatures, user prompts and diagnostic codes
- User selectable time and temperature display formats. Time formats will include HH:MM, MM:SS, MMM:SS. Temperature formats will be °C or °F
- Menu driven operation and manual modes available
- Real time clock option displays time of day

#### Accuracy

- Calibration accuracy and sensor conformity:  $\pm 1^\circ\text{F}$  for Type J thermocouple and RTD
- Voltage  $\pm 25\text{mV}$
- Current  $\pm 40\mu\text{A}$
- Accuracy span: Normally  $540^\circ\text{C}$  ( $1000^\circ\text{F}$ ) minimum span
- Temperature stability

#### Configured Sensor Inputs

- Update rate: 5Hz

#### Thermocouple

- Requires ungrounded thermocouples
- Accuracy:  $\pm 1.1^\circ\text{C}$  ( $2^\circ\text{F}$ )
- Drift:  $\pm 0.10^\circ\text{C}/^\circ\text{C}$  ( $\pm 0.10^\circ\text{F}/^\circ\text{F}$ )
- Input ranges:
  - Type J:  $-46^\circ\text{C}$  to  $316^\circ\text{C}$  ( $-50^\circ\text{F}$  to  $600^\circ\text{F}$ )
  - Type K:  $-46^\circ\text{C}$  to  $316^\circ\text{C}$  ( $-50^\circ\text{F}$  to  $600^\circ\text{F}$ )

#### RTD

- 2- or 3-wire platinum
- DIN-curve (0.00385 curve)
- Accuracy:  $\pm 1.1^\circ\text{C}$  ( $2^\circ\text{F}$ )
- Drift:  $\pm 0.10^\circ\text{C}/^\circ\text{C}$  ( $\pm 0.10^\circ\text{F}/^\circ\text{F}$ )
- Range:  $-46^\circ\text{C}$  to  $316^\circ\text{C}$  ( $-50^\circ\text{F}$  to  $600^\circ\text{F}$ )

#### Voltage

- Input impedance: 60kW
- Input range: 0 to 12V
- Accuracy:  $\pm 25\text{mV}$
- Drift:  $\pm 5\text{mV}/\text{F}$

#### Current

- Input impedance: 100 W
- Input range: 0 to 22mA
- Accuracy:  $\pm 40\text{mA}$
- Drift:  $\pm 5\text{mA}/\text{F}$

#### Output Options

##### Switched DC Outputs

- 5V at 30mA maximum

##### Voltage Outputs

- Range: 0 to 12V at 50mA maximum
- Minimum: load impedance 500 W
- Accuracy:  $\pm 100\text{mV}$
- Drift:  $\pm 2.1\text{mV}/\text{F}$

#### Current Output

- Range: 0 to 22mA at 20V maximum
- Maximum load impedance: 1000 W
- Accuracy:  $\pm 100\text{mA}$
- Drift:  $\pm 4.3\text{mA}/\text{F}$

#### DC Input

- Input high: 3 to 30V or  $>10\text{kW}$
- Input low:  $-0.5$  to  $0.5\text{V}$  or  $<250\text{W}$

#### Optional High Voltage Board

- Optional high voltage board has six high-voltage outputs including two standard SSR outputs. The remaining four outputs can be SSRs, electromechanical or no arc relays
- Relay specification:
  - Operating temperature:  $0^\circ$  to  $80^\circ\text{C}$  ( $0^\circ$  to  $176^\circ\text{F}$ )
  - Contact type: normally open
  - Maximum operating current: 8 Amps
  - Maximum operating voltage:  $250\text{V}\sim(\text{ac})$
  - $120/240\text{V}\sim(\text{ac})$
  - $250\text{VA}$  pilot duty
- SSR specification
  - Operating temperature:  $0^\circ$  to  $80^\circ\text{C}$  ( $0^\circ$  to  $176^\circ\text{F}$ )
  - Contact type: normally open

# PID with Time/ Temperature Profiling Controllers

## SERIES N7

### Specifications Cont.

- Maximum operating current: 0.4 Amps
- Maximum operating voltage: 250V~(ac)
- 120/240V~(ac)
- 0.4A pilot duty
- No arc specification
- Operating temperature: 0° to 80°C (0° to 176°F)
- Contact type: normally open
- Maximum operating current: 8 amps
- Maximum operating voltage: 250V~(ac)

### Power/Line Voltage

- 24V~(ac) power input (20.4 to 26.4V~(ac))
- Class 2 power source required
- 47 to 63Hz
- 15VA maximum
- Program retention upon power failure via non-volatile memory
- Battery/real time clock option: 6 year lithium battery, provides power upon backup power failure, operation resumption after power recovery, ability to display time of day

### Audible Alarm

- Internal audible alarm, 85dB @ 10cm @ 2KHz. Output frequencies supported: 250, 500, 1000, 2000, 4000Hz

### Operating Environment

- 0°C to 80°C (32°F to 176°F), 0 to 90 percent relative humidity, non-condensing

### Storage Temperature

- -40°C to 80°C (-40°F to 176°F)

### Dimensions

- Vertical – 196.85 mm x 76.2 mm x 50.8 mm (7.75 in. x 3 in. x 2 in.)
- Horizontal – 76.2 mm x 196.85 mm x 50.8 mm (3 in. x 7.75 in. x 2 in.)

### Communications

- Communications parallel connector:
- Supports addition of Ethernet communications board
- Support development of additional memory
- DB 9 communications connector:
- EIA-232 and EIA-485 connections for:
- Flash download
- PC communications
- Modbus™ communications
- Expansion bus connector
- For connection to expansion devices such as:
- Motor speed control
- Encoder
- Multiple or custom displays
- Other custom remote I/O

### Connectors

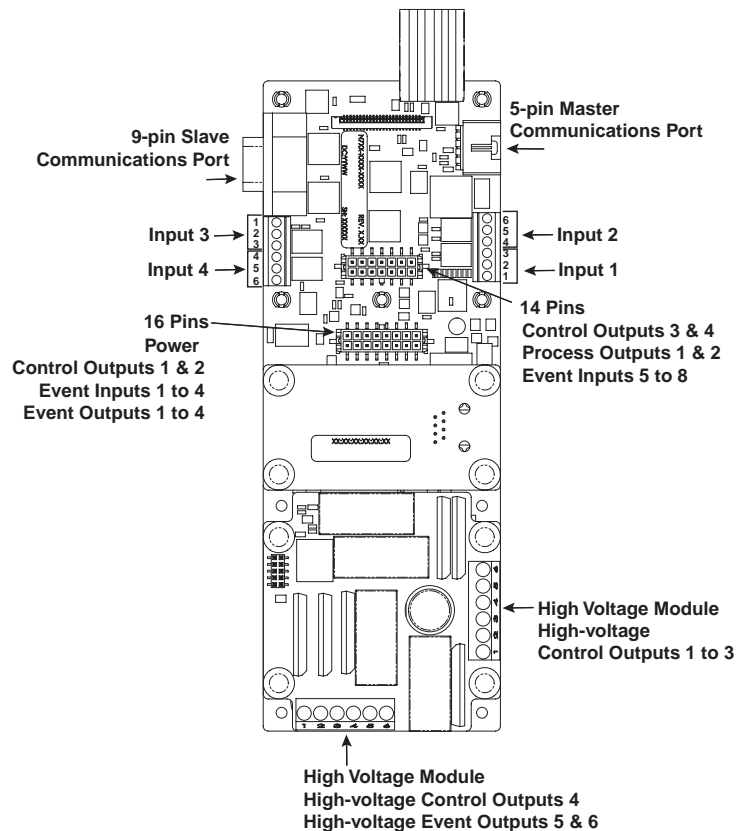
Connectors are customer supplied - Molex

- Standard I/O 16-pin connector housing – 43025-1600
- Optional I/O 14-pin connector housing – 43025-1400
- Pins – 43030-0007

### High Voltage Module Adder Board Ordering Information

- A007-2660-0000 – Two SSRs
- A007-2660-0001 – Two SSRs and four mechanical relays
- A007-2660-0002 – Six SSRs
- A007-2660-0003 – Four SSRs and 2 mechanical relays
- A007-2660-0004 – Two SSRs and four no-arc relays

### Location of Pins and Ports for Inputs and Outputs



Multi-Loop  
PID with Time/Temperature Profiling

# PID with Time/ Temperature Profiling Controllers

F.O.B.: Winona, Minnesota

## SERIES N7

### Ordering Information

To order, complete the code number on the right with the information below.

<p><b>SERIES N7</b> = Up to four channels of microprocessor-based time and temperature control: 24V~(ac) power input</p> <p><b>Abbreviation for Customer Name</b> _____</p> <p><b>Input 1 and Input 2</b> _____</p> <p>1 = Dual thermocouple          2 = Input 1 thermocouple / input 2 process input          3 = Input 1 thermocouple / input 2 RTD          4 = Dual process inputs          5 = Input 1 RTD / input 2 process input          6 = Dual RTD inputs</p> <p><b>Input 3 and Input 4</b> _____</p> <p>0 = None          1 = Input 3 and 4 thermocouples          2 = Input 3 process / input 4 thermocouple input          3 = Input 3 RTD / input 4 thermocouple          4 = Input 3 process input / input 4 process input          5 = Input 3 RTD / input 4 process input          6 = Input 3 RTD / input 4 RTD</p> <p><b>Process Outputs, Event Inputs and Control Outputs</b> _____</p> <p>0 = No events or process outputs          1 = 4 event inputs (rated @ 0 to 30V or contact closure) and 2 control outputs (rated for 5V @ 30mA)          2 = Current output 1 (0 to 20mA) with 4 event inputs and 2 control outputs          3 = Current outputs 1 and 2 (both are rated 0 to 20mA) with 4 event inputs and 2 control outputs          4 = Current output 1 and dc output 2 (rated 0 to 10V) with 4 event inputs and 2 control outputs          5 = DC output (rated 0 to 10V) with 4 event inputs and 2 control outputs          6 = DC outputs 1 and 2 with 4 event inputs and 2 control outputs          7 = DC output 1 and current output 2 with 4 event inputs and 2 control outputs</p> <p><b>Add on Ethernet Module</b> _____</p> <p>0 = None          1 = Ethernet module board</p> <p><b>Add on High Voltage Module</b> _____</p> <p>0 = None          1 = 2 SSRs (rated at 0.4A, normally open)          2 = 2 SSRs and 4 mechanical relays (rated at 8A, normally open)          3 = 6 SSRs          4 = 4 SSRs and 2 mechanical relays</p> <p><b>Display Options (Horizontal or Vertical)</b> _____</p> <p>1 = Vertical          2 = Horizontal left          3 = Horizontal right</p> <p><b>Custom Software and Options Designator</b> _____</p> <p>XX = Made to order controller, code number assigned by factory</p>	<p><b>N 7</b> - - - - -</p> <div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> <div style="position: absolute; top: 0; left: 0; width: 100%; height: 100%;"></div> </div>
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#### Notes:

- If customer wants to use inputs 3 or 4 as thermocouple, input 1 must also be thermocouple. Requires at least one ungrounded thermocouple.
- There is no option for suppression on any of the high voltage outputs.

## PID with Time/ Temperature Profiling Controllers

### MINICHEF® 2000

MINICHEF® 2000 is an industry first in an on-off or PID configurable temperature/time and machine-function controller offering dozens of pre-programmed applications. The foodservice equipment industry can now rely on one product to provide control of many cooking applications including cook and hold ovens, convection ovens, deep-fat fryers, griddles and rotisseries. You can easily switch the controller from one application to another or customize other applications by simply pressing a combination of keys. MINICHEF 2000 also adapts to changing needs, evolving as the product or process changes.

Because MINICHEF 2000 can operate different types of equipment, you can replace other controllers, simplifying inventory, manufacturing and reducing your supplier base. With a compact electrical case of 82.55 mm (3.25 in.) square x 50.8 mm (2 in.) deep, MINICHEF 2000 enables new opportunities for space-efficient equipment designs.

MINICHEF 2000 withstands the rigorous conditions of a kitchen environment with an 80°C (176°F) ambient rating and superior immunity to electrical interference.

#### Performance Capabilities

- Thermometer accuracy to  $\pm 2^\circ\text{F}$
- Operating environment 0 to 80°C (32 to 176°F)

#### Features and Benefits

##### Configurable cooking controller

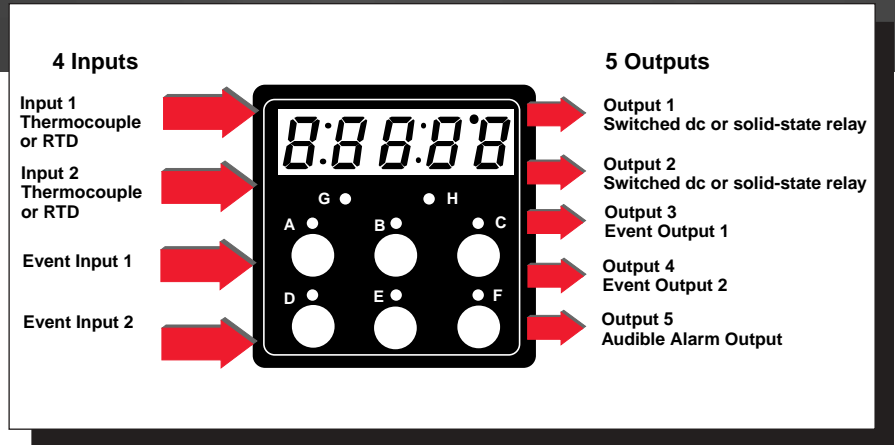
- Allows you to standardize on one controller simplifying inventory, manufacturing and reducing multiple suppliers

##### Multiple inputs/outputs

- Control temperatures, times and machine functions

##### Programmable menus

- Simplify repetitive tasks



#### Compact design

- Provides options for designing space-efficient equipment

#### Economical

- Costs less than units with fewer capabilities

#### WATHELP diagnostics

- Simplifies operation and troubleshooting

#### WATCURVE

- Compensates for temperature disturbances

#### “Smart Control”

- Optimizes system performance by calculating PID parameters automatically

#### Mid-point alarms

- Enables even cooking by alerting the user to an action such as stir or turn

#### Preheat option

- Prevents menu start until equipment is pre-heated

#### Meets CE, UL®, CSA, NSF, AGA standards

- Helps obtaining international and local code compliance

#### Three-year warranty

- Provides Control Confidence®

#### Applications

- Foodservice equipment
- Custom applications, consult factory

# PID with Time/ Temperature Profiling Controllers

## MINICHEF 2000

### Specifications

#### Control Mode

- Single and dual heat channels, PID or on-off
- Microprocessor-based, programmable, reverse-acting control outputs
- User-selectable embedded software applications define the operation of display, keys, inputs, outputs, timing action
- One-step auto-tuning, WATHELP diagnostics, WATCURVE temperature compensation

#### Agency

- CE approved: 89/336/EEC Electromagnetic Compatibility Directive  
-EN 50081-1: Emissions  
-EN 50082-1: Immunity  
73/23/EEC Low-Voltage Directive  
-EN 60730-1 and EN 60730-2-9
- NSF Listed, Criteria 2<sup>⑤</sup>
- A.G.A.: UL<sup>®</sup> tested to A.G.A. standard Z21.23, (UL<sup>®</sup> File # E43684).
- UL<sup>®</sup> and C-UL<sup>®</sup> recognized, UL<sup>®</sup> 197, 873, 991 and CSA standard C22.2-24, (UL<sup>®</sup> File # E43684)

#### Operator Interface

- Membrane overlay, contamination and water resistant (supplied by customer)
- LED display, five digit seven segment, 14.22 mm (0.56 in.) high, red
- Displays times, temperatures, user prompts and diagnostic codes
- User-selectable time and temperature display formats
- Temperature display formats °C or °F

- Time display formats: H:MM:SS, HH:MM or MMM:SS
- Audible alarms
- Eight red indicator lights
- Six tactile feedback keys
- Menu-driven operation and manual modes available
- Real-time clock option displays time of day
- WATHELP diagnostics

#### Accuracy

- Calibration accuracy and sensor conformity<sup>②</sup>: ±2.0°F for Type J thermocouple and RTD, ±0.35 percent of span for Type K and E thermocouples, ±1 LSD, 77°F ±5°F ambient and rated line voltage of ±10 percent
- Accuracy span: 540°C (1000°F) minimum
- Temperature stability: ±0.15°C/°C (0.15°F/°F) change in ambient typical

#### Sensors/Inputs<sup>⑤</sup>

- Thermocouple,<sup>③</sup> software selectable Type J, K or E, 0 to 650°C (32 to 1200°F) (Dual channel applications require at least one ungrounded thermocouple)
- RTD<sup>③</sup>, 2- or 3-wire, platinum, 100, 500, 1000Ω, at 0°C (32°F), software selectable DIN or JIS curves, -20 to 650°C (0 to 1200°F) (3-wire will function as 2-wire)
- Input A/D resolution: 15 bit
- Contact inputs, TTL compatible with internal pull-up resistor, two available

#### Output Options

- Solid state relay, 0.4A, with or without contact suppression
- Switched dc signal, 4.5V to 5.25V, 30mA maximum output, minimum load resistance > 150Ω, non-isolated

#### Audible Output Options

- Switched dc signal, 4.5V to 5.25V, 30mA maximum output, minimum load resistance > 150Ω, non-isolated
- Internal audible alarm, 75dB at 10 cm

#### Connectors

- Sensor Input Terminal Strip<sup>④</sup>: RIACON, 6-position, quick-connect available separately
- Power and Input/Output Terminal<sup>④</sup>: AMP, 15-position, quick-connect available separately

#### Power/Line Voltage

- 20.4 to 26.4V~(ac), 47 to 63Hz
- 15VA maximum
- For CE applications, input power must be limited to 15W external to the control
- Program retention upon power failure via non-volatile memory
- Battery/real-time clock option: six-year lithium battery, provides power backup upon power failure, operation resumption after power recovery, ability to display time of day

#### Operating Environment

- 0 to 80°C (32 to 176°F), 0 to 90 percent RH, non-condensing

#### Storage Temperature

- -40 to 80°C (-40 to 176°F)

① The MINICHEF 2000 controller is to be used in systems with an external high temperature limiting device.

② Thermocouple lead resistance of 200Ω causes < 1°C error. RTD, 22 gauge wire will not contribute more than 0.086°F error/ft.

③ Dual channel applications require either two thermocouple sensors or two identical RTD sensor types.

④ For mating connector information, see Ordering Information Accessory section.

⑤ NSF certified for thermometer accuracy (oven and hot food holding applications from 0°C to 315°C (32°F to 600°F) when used with an RTD or Type J thermocouple temperature sensor/probe).



# PID with Time/ Temperature Profiling Controllers

F.O.B.: Winona, Minnesota

## MINICHEF 2000

### Ordering Information

To order, complete the code number on the right with the information below:

#### Specifications Cont.

##### Mechanical

- Case: polycarbonate Lexan® with adjustable mounting collar (vertical or horizontal orientation), designed for mounting on 16, 18, 20 and 22 gauge panels
- Internal panel mounting requires a specified panel cutout and four #6-32 studs or equivalent
- Vibration: 2g, 10 to 150Hz, applied in any one of three axes

##### Dimensions

- Overall width x height x depth:

##### Horizontal

105 mm x 83 mm x 51 mm  
(4.13 in. x 3.25 in. x 2.00 in.);

##### Vertical

83 mm x 105 mm x 51 mm  
(3.25 in. x 4.13 in. x 2.00 in.)  
(Assumes mating connectors are attached. Does not include wire bundle space requirements.)

##### Weight

- 6.50 oz maximum

##### Program Storage

- All non-embedded user and factory programs are stored in non-volatile memory. Can be changed by reprogramming

##### Sample/Update Rates

- 1 input: 4Hz
- 2 inputs: 4Hz
- PID: 1Hz
- Control outputs: 100Hz
- Display: 10Hz

**MINICHEF 2000** = Cooking controller with numerous foodservice equipment application software sets, single and dual channel on-off or PID temperature regulation, timer and machine-function control, micro-processor-based, programmable, auto-tuning, WATCURVE, WATHELP diagnostics, 24V~(ac) power input, agency approved, flush mounted (membrane faceplate supplied by customer). Two switch contact event inputs

##### Inputs

- 1 = Dual thermocouple, Type J, K or E
- 2 = Dual RTD, platinum, 100Ω, curve selectable
- 3 = Dual RTD, platinum, 500Ω, curve selectable
- 4 = Dual RTD, platinum, 1000Ω, curve selectable

##### Output 1

- 1 = Switched dc, 5V nominal, 30mA, non-isolated
- 2 = Solid state relay, Form A, 0.4A, without RC suppression
- 3 = Solid state relay, Form A, 0.4A, with RC suppression

##### Output 2

- 1 = Switched dc, 5V nominal, 30mA, non-isolated
- 2 = Solid state relay, Form A, 0.4A, without RC suppression
- 3 = Solid state relay, Form A, 0.4A, with RC suppression

##### Output 3 and 4

- 1 = Two event outputs, switched dc, 5V nominal, 30mA, non-isolated

##### Battery and Real-time Clock

- 0 = None
- 1 = Includes battery and real-time clock

##### Audible Alarm

- 0 = Alarm signal available at connector, switched dc, 5V nominal, 30mA, non-isolated
- 1 = Internal alarm included

##### Software

- AA = Standard Food Equipment Application Software Set
- XX = Custom set-up parameters or Made-to-Order custom software. Consult your local Watlow sales engineer. Code number assigned by factory

F 2 H A - 1 - A A

# PID with Time/ Temperature Profiling Controllers

## MINICHEF 2000

### Accessories

#### 0238-0679-0000

Prototyping and Training Membrane Overlay, adhesive-backed, 120.65 mm x 120.65 mm (4.75 in. x 4.75 in.)

#### A001-0249-0001

120V~(ac) – 24V~(ac), stepdown transformer, class 2, quick-connect terminals included

#### A001-0249-0002

208/240V~(ac) – 24V~(ac), stepdown transformer, class 2, quick-connect terminals included

### MINICHEF 2000 Documentation Kit

Code Number	Description
0600-0006-0008 Rev A	The Complete MINICHEF 2000 User Manual
0600-0006-0010 Rev A	MINICHEF 2000 Tutorial Diskette (3½ inch)
0600-0006-0000 Rev A	MINICHEF 2000 General Setup Guide
0600-0006-0001 Rev A	MINICHEF 2000 Cook & Hold Application Guide
0600-0006-0002 Rev A	MINICHEF 2000 Convection Oven Application Guide
0600-0006-0003 Rev A	MINICHEF 2000 Deep-Fat Fryer Application Guide
0600-0006-0004 Rev A	MINICHEF 2000 Griddle Application Guide
0600-0006-0005 Rev A	MINICHEF 2000 Timer Application Guide
0600-0006-0006 Rev A	MINICHEF 2000 Shelf-Timer Application Guide
0600-0006-0007 Rev A	MINICHEF 2000 Rotisserie Application Guide

## Limits/Alarms

### TLM-8 Thermal Limit

The Watlow Anafaze TLM-8 SERIES is a low-cost solution for multi-channel, redundant temperature monitoring. Each TLM-8 has eight channels to continuously monitor thermocouples, RTDs or thermal switches, making it ideal for multi-zone applications. The resistor key model (TLME) has fixed temperature limits. Choose an individual temperature limit for each channel from the standard list or consult the factory for other limits. The precision model (TLMP) is available with specific limits, which are also field adjustable.

The TLM-8 is equipped with flexible interlocks, which are designed to interface with redundant controls. The alarms latch and require operator intervention to clear, resulting in process and equipment protection. Semiconductor capital equipment OEMs will find these features ideal for meeting SEMI S2-93 safety guidelines. The TLM-8 is compact and easy to install on a panel or a DIN-rail. No cutout is required, reducing installation and fabrication costs. Troubleshooting is simplified through a self-test diagnostics input which simulates the alarm state.

The TLM-8 bears the CE mark (LVD and EMC Directives), and is UL® listed and FM approved.

#### Applications

- Any process requiring multi-channel redundant temperature monitoring
- Semiconductor capital equipment requiring SEMI S2-93
- Electronics packaging equipment
- Plastics injection molding and extrusion equipment



#### Features and Benefits

##### Multi-channel monitoring

- Eight channels in one package make the TLM-8 ideal for multi-zone applications

##### Multiple sensor types

- TLM-8 supports six thermocouple types, RTDs and thermal switches (one sensor type per TLM-8)

##### Selectable alarm limits

- TLM-8 can be ordered with a different temperature limit on each channel
- TLM-P has field adjustable temperature limits

##### Compact, easy to install, sub-panel mounting

- Reduces installation time

##### Flexible interlocks

- Interfaces with redundant controls; ideal for SEMI S2-93 applications

##### Self-test diagnostics

- Simplifies troubleshooting

#### Latching alarms

- Protects process and equipment

#### CE, UL® and Factory Mutual (FM) Approvals

- Global acceptance for safety and EMC compliance

# Limits/Alarms

## TLM-8 Thermal Limit

### Specifications

#### Analog Inputs

- Eight sensor input channels

#### Sensor Inputs (Trip Point Ranges)

- RTD 100Ω, platinum, 2-wire (DIN-curve: -100 to 850°C (-148 to 1562°F))
- Thermal switch
- Type E T/C (TLME: 100 to 801°C (212 to 1474°F); TLMP: 100 to 660°C (212 to 1220°F))
- Type J T/C (100 to 754°C (212 to 1389°F))
- Type K T/C (100 to 1205°C (212 to 2201°F))
- Type R T/C (500 to 1720°C (932 to 3128°F))
- Type S T/C (500 to 1711°C (932 to 3112°F))
- Type T T/C (100 to 384°C (212 to 723°F))

#### Accuracy

- TLME: ±5 percent of trip point
- TLMP: ±1 percent of trip point

#### Repeatability

- <5°C (41°F)

#### Digital Inputs

- Alarm acknowledge digital input: 5-30V $\overline{\text{dc}}$ , optically isolated
- Alarm simulation digital input: 5-30V $\overline{\text{dc}}$ , optically isolated

#### Temperature Coefficient

- 40 ppm / °C accuracy

### Alarm Outputs

For “fail safe” operation, relay contacts are open in alarm and power off condition

- Global: 2 Form A (normally open) electromechanical relays, latching
- Channel: 8 Form A (normally open) electromechanical relays, latching
- Maximum contact rating: 1A @ 125V $\sim$ (ac) or 60V $\overline{\text{dc}}$
- UL $\text{\textcircled{R}}$  contact rating: 1A @ 30V $\overline{\text{dc}}$

### Dimensions

- 235 mm x 93 mm x 47 mm (9.25 in. x 3.65 in. x 1.85 in.) (L x W x H), H = 66 mm (2.60 in.) with DIN mount option

### Power Requirements

- 10-26V $\overline{\text{dc}}$  ±5 percent, 3.2 watts, class 2 power supply

### Environmental

- Temperature: 0 to 60°C (32 to 140°F) (operating); -20 to 100°C (-4 to 212°F) (storage)
- Relative humidity: 0-95 percent, non-condensing

### Agency Approvals/Compliance

- CE Directives: Low Voltage Directive (LVD) 73/23/EEC, Electromagnetic Compatibility (EMC) Directive 89/336/EEC
- UL $\text{\textcircled{R}}$  listed: UL $\text{\textcircled{R}}$  916 and UL $\text{\textcircled{R}}$  508
- C-UL $\text{\textcircled{R}}$  listed: CSA 22.2-205-M19
- Factory Mutual approval: temperature limit switches 3545

### Miscellaneous

- 8 individual alarm status LEDs (Red)
- 1 supply power LED (Green)

## Limits/Alarms

### TLM-8 Thermal Limit

TLME Trip Point Chart - (see Ordering Information, Option 4)

Temperature	Trip Point	Temperature	Trip Point
<b>RTD</b>		<b>Type K T/C (con't)</b>	
Unused Input	A	603°C (1117°F)	L
103°C (217°F)	B	651°C (1204°F)	M
121°C (250°F)	C	701°C (1294°F)	N
151°C (304°F)	D	753°C (1387°F)	O
215°C (419°F)	E	807°C (1485°F)	P
324°C (615°F)	F	851°C (1564°F)	Q
404°C (759°F)	G	907°C (1665°F)	R
478°C (892°F)	H	952°C (1746°F)	S
584°C (1083°F)	I	998°C (1828°F)	T
708°C (1306°F)	J	1057°C (1935°F)	U
824°C (1515°F)	K	1101°C (2014°F)	V
		1157°C (2115°F)	W
		1205°C (2201°F)	X
<b>Type E T/C</b>		<b>Type R T/C</b>	
Unused Input	A	Unused Input	A
101°C (214°F)	B	501°C (934°F)	B
202°C (396°F)	C	602°C (1116°F)	C
302°C (576°F)	D	708°C (1306°F)	D
403°C (756°F)	E	800°C (1472°F)	E
502°C (936°F)	F	903°C (1657°F)	F
600°C (1112°F)	G	999°C (1830°F)	G
702°C (1296°F)	H	1100°C (2012°F)	H
801°C (1474°F)	I	1206°C (2203°F)	I
<b>Type J T/C</b>		1306°C (2383°F)	J
Unused Input	A	1410°C (2570°F)	K
100°C (212°F)	B	1497°C (2727°F)	L
152°C (307°F)	C	1593°C (2899°F)	M
202°C (396°F)	D	1720°C (3128°F)	N
251°C (484°F)	E	<b>Type S T/C</b>	
302°C (576°F)	F	Unused Input	A
350°C (662°F)	G	506°C (943°F)	B
402°C (756°F)	H	601°C (1114°F)	C
450°C (842°F)	I	700°C (1292°F)	D
502°C (936°F)	J	810°C (1490°F)	E
554°C (1027°F)	K	902°C (1656°F)	F
600°C (1112°F)	L	1005°C (1841°F)	G
653°C (1207°F)	M	1110°C (2030°F)	H
704°C (1299°F)	N	1210°C (2210°F)	I
754°C (1389°F)	O	1313°C (2395°F)	J
<b>Type K T/C</b>		1404°C (2559°F)	K
Unused Input	A	1500°C (2732°F)	L
100°C (212°F)	B	1600°C (2912°F)	M
150°C (302°F)	C	1711°C (3112°F)	N
200°C (392°F)	D	<b>Type T T/C</b>	
252°C (486°F)	E	Unused Input	A
303°C (577°F)	F	100°C (212°F)	B
353°C (667°F)	G	202°C (396°F)	C
401°C (754°F)	H	291°C (556°F)	D
455°C (851°F)	I	384°C (723°F)	E
504°C (939°F)	J		
556°C (1033°F)	K		

# Limits/Alarms

F.O.B.: Winona, Minnesota

## TLM-8 Thermal Limit

### Ordering Information

To order, complete the code number to the right with the information below:

**TLME** = Fixed temperature limits model

**T L M E**

**Sensor Type**

- 0 = RTD, 100Ω platinum/thermal switch
- 1 = Type E T/C
- 2 = Type J T/C
- 3 = Type K T/C
- 4 = Type R T/C
- 5 = Type S T/C
- 6 = Type T T/C

**Alarm Relays**

- 0 = Global alarm relays only
- 1 = Global alarm relays and 8 channel alarm relays

**Mounting**

- 0 = Panel
- 1 = DIN-rail

**Trip Point (see Trip Point chart on page 141)**

- Channel 1
- Channel 2
- Channel 3
- Channel 4
- Channel 5
- Channel 6
- Channel 7
- Channel 8

**TLMP** = Precision model with adjustable limits

**T L M P -**

**Sensor Type**

- 0 = RTD
- 1 = Type E T/C
- 2 = Type J T/C
- 3 = Type K T/C
- 4 = Type R T/C
- 5 = Type S T/C
- 6 = Type T T/C

**Alarm Relays**

- 0 = Global relays only
- 1 = Global alarm relays and 8 channel alarm relays

**Mounting**

- 0 = Panel
- 1 = DIN-rail

**Trip Point**

- U = User specified (specify trip points in description)
- D = Default trip points

### TLMP Trip Point Descriptions

If user specified trip points are ordered in the TLMP part number, specify the following information for each channel in the part description:

**T L M P C H -**

**Channel Number**

- X = Channel number X (1-8)

**Trip Point**

XXXX = Trip point in Celsius. Include leading zeros to make four digits. See table on page 141 for ranges for each sensor type. Unspecified channels will be set to the default limit for the sensor.

## Limits/Alarms

### CAS200 Alarm Scanner

The Watlow Anafaze CAS200 (Compact Alarm Scanner) has 16 channels of alarm monitoring and data acquisition for a broad range of applications and processes. Its compact 1/2 DIN size, advanced features and enhanced performance make it ideal for industrial and laboratory applications that require reliable alarm monitoring and data analysis. The CAS200 comes standard with WATVIEW-CAS, Windows® software that provides on-line setup, alarm notification, recipe management, trend graphing and spreadsheet importable report data. The CAS200 now supports Modbus™ RTU protocol.

The CAS200 adds independent data acquisition and alarm monitoring to your process. It can measure up to 16 inputs. Sensor data is transferred to a computer or programmable logic controller (PLC) through a standard RS-232 or RS-485 port.



#### Features and Benefits

##### Multiple and mixed inputs

- Connect any combination of thermocouples, linear dc voltage or dc current

##### Serial communications

- Use EIA/TIA-232 or EIA/TIA-485 communications to connect up to 32 CAS200 alarm/monitoring systems

##### Process display in engineering units

- Shows the process in the engineering units used

##### Remote alarm acknowledge

- Digital input acknowledges alarms from an external contact or push button

##### Simple setup

- Configured with a series of pass-sequence-protected supervisory menus

##### Job storage and recall

- Stores up to eight jobs or recipes

##### Digital inputs

- Eight digital inputs available to select jobs

##### Digital outputs

- 34 digital outputs available for alarms

##### Process variable scanning and display

- Display one channel; or scan and display each channel
- Continuously monitor critical process variables

##### Versatile alarms

- Configure independent high and low process alarms and deviation band alarms

Windows® is a registered trademark of Microsoft Corporation.

Modbus™ is a trademark of Schneider Automation Incorporated.

## Limits/Alarms

### CAS200 Alarm Scanner

#### Specifications

##### Operator Interface

- 32-character vacuum fluorescent display
- 8-key keypad to access guided menus and prompts, enter passkey sequence, set values, switch between single channel and multiple channel displays
- Controller configuration can be loaded through the standard serial port

##### Analog Inputs

- 16 single-ended

##### Noise Rejection

- 120db at 60Hz

##### Temperature Coefficient

- 40 ppm/°C

##### Sensors/Inputs

- Thermocouples: User-selectable type, direct connection, linearization, reference junction compensation and upscale break protection
- Linear: current and voltage signals from linear transmitters
- Pulse input

##### Input Range and Accuracy

	Range	Accuracy
Type B	66 to 1760°C (150 to 3200°F)	±4.0°C (±7.2°F)
Type E	-200 to 787°C (-328 to 1448°F)	±1.0°C (±1.8°F)
Type J	-212 to 760°C (-350 to 1400°F)	±1.2°C (±2.2°F)
Type K	-268 to 1371°C (-450 to 2500°F)	±1.3°C (±2.3°F)
Type N	-268 to 1299°C (-450 to 2370°F)	±1.5°C (±2.7°F)

Type PL-II	10 to 1100°C (50 to 2012°F)	±1.0°C (±1.8°F)
Type R	-18 to 1766°C (0 to 3210°F)	±2.8°C (±5.0°F)
Type S	-18 to 1760°C (0 to 3200°F)	±2.8°C (±5.0°F)
Type T	-268 to 399°C (-450 to 750°F)	±1.6°C (±2.9°F)

Note: Accuracy @ 25°C (77°F) ambient. Valid for 10 to 100 percent of span except Type B, which is specified for 427°C to 1760°C (800°F to 3200°F)

##### Linear Voltage and Current Inputs

Requires scaling resistors. See Special Inputs in Ordering Information

0-10mA <sub>≐</sub> (dc)
0-20mA <sub>≐</sub> (dc)/4-20mA <sub>≐</sub> (dc)
0-100mV <sub>≐</sub> (dc)
0-500mV <sub>≐</sub> (dc)
0-1V <sub>≐</sub> (dc)
0-5V <sub>≐</sub> (dc)
0-10V <sub>≐</sub> (dc)
0-12V <sub>≐</sub> (dc)

Other ranges available. Consult factory

##### Pulse Input

- 1 TTL-level square wave input up to 2kHz

##### Input Sampling Rate at 60Hz

- 24 channels per second
- 1.5 samples per second, (update time: 0.667 sec.)

##### Calibration

- Automatic zero and full scale

##### Digital Inputs

- TTL-level used for remote alarm acknowledge and selecting recipes or jobs
- 8 inputs and 1 pulse input with 50-pin terminal board option
- 2 inputs and pulse input or 3 inputs with 18-pin terminal block option

##### Alarm Outputs

- Any alarm can be assigned to any available digital output. These include: process alarms and deviation alarms
- Global alarm: Digital output for any alarm. Output is cleared with front panel alarm acknowledge or remotely through the serial interface
- Watchdog output: on when scanner is functioning correctly
- Outputs sink up to 60mA each at 5V<sub>≐</sub>(dc)
- 350mA at 5V<sub>≐</sub>(dc) available from onboard supply

##### Serial Interface

- EIA/TIA-232 or EIA/TIA-485

##### Baud Rate

- 2400, 9600 or 19200 user selectable

##### Communication Protocol

- Modbus™ RTU

##### Line Voltage/Power

- 15-24V<sub>≐</sub>(dc) ±3V<sub>≐</sub>(dc) @ 1A (maximum), 320mA (no load)

##### Agency Approvals

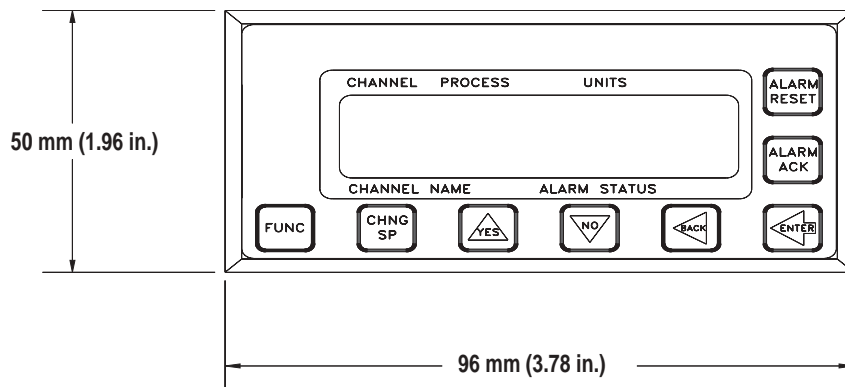
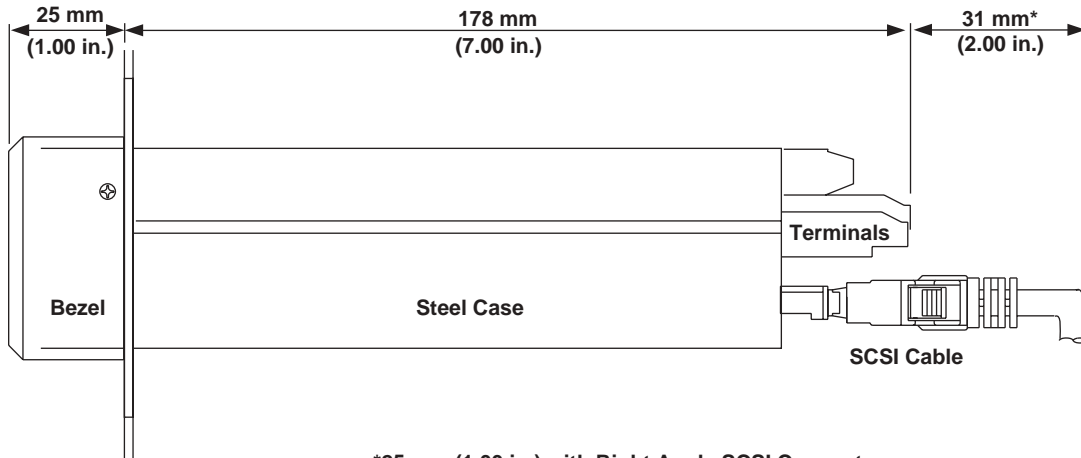
- UL®, C-UL® listed: UL® 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC



## Limits/Alarms

### CAS200 Alarm Scanner

#### Dimensions



# Limits/Alarms

F.O.B.: Winona, Minnesota

## CAS200 Alarm Scanner

### Ordering Information

To order, complete the code number to the right with the information below:

200 -

#### Terminal Board

- 0 = No terminal board accessory
- 1 = 18-pin terminal block mounted on unit, no SCSI cable required
- 2 = 50-pin terminal board (3 foot SCSI cable included)

#### Power Supply

- 0 = None
- 2 = 120/240V~(ac) 50/60Hz power supply adapter  
[5V=(dc) @ 4A, 15V=(dc) @ 1.2A] CE approved

#### SCSI Cables

- 0 = No cable accessory (3 foot SCSI cable is included with 50-pin terminal board)
- 1 = 6 foot SCSI cable
- 2 = 3 foot right angle SCSI cable
- 3 = 6 foot right angle SCSI cable

#### Serial Communication Cables (For communications with computer)

- 0 = 4 foot serial communication cable (DB-9 female/bare wire)
- 1 = 10 foot serial communications cable (DB-9 female/bare wire)
- 2 = 25 foot serial communications cable (DB-9 female/bare wire)
- 3 = 50 foot serial communications cable (DB-9 female/bare wire)

#### Scanner Software

- 1 = WATVIEW-CAS Windows®-based software

#### Serial Communication Jumper Settings

- 0 = EIA/TIA-232
- 1 = EIA/TIA-485
- 2 = EIA/TIA-485 terminated

#### Special Inputs

(Standard unit is configured for thermocouples and -10 to 60 mV linear inputs. For other sensors, order special inputs)

- 00 = Thermocouples and -10 to 60 mV inputs only
- XX = Number of current or voltage inputs. Include leading zero as needed

C A S S I - -

#### Special Input Type

- 43 = 0-10mA=(dc)
- 44 = 0-20mA=(dc)/4-20mA=(dc)
- 50 = 0-100mV=(dc)
- 52 = 0-500mV=(dc)
- 53 = 0-1V=(dc)
- 55 = 0-5V=(dc)
- 56 = 0-10V=(dc)
- 57 = 0-12V=(dc)

#### Start Channel

- XX = Channel number XX

#### End Channel

- XX = Channel number XX

### Availability

Up to four weeks depending on complexity and order release quantity. Consult factory for details.

## PID with Programmable Logic Controllers

### CPC400 SERIES

The Watlow Anafaze CPC400 controllers provide performance and flexibility in a compact design and integrate full-featured closed-loop control with user-written logic. Programmable logic can interact with closed-loop control and operate I/O independently.

Four and eight loop versions offer complete control solutions for a broad range of applications. The CPC400 supports thermocouples, RTDs, linear voltage, current and frequency. Built-in diagnostics automatically detect sensor failures including open, shorted and reversed conditions. I/O can also be utilized for closed-loop control, alarms and user programs.

Using the built-in communications port, system designers can interface one or more controllers to a host computer for operator controls and data acquisition. The CPC400 offers PID, cascade, ratio and differential control strategies. Process variable retransmit and remote analog set point can be used to integrate the CPC400 with other devices such as chart recorders.

The CPC400 carries the CE mark and is UL® listed.

#### Features and Benefits

##### Combines control loops with programmable logic

- Easy integration of PID control and logic
- Less time reinventing PID control
- Augment closed-loop control with user-written logic
- Add custom functions to controller
- Reduces installation and setup time
- Requires less panel space
- Fewer parts reduces failures and increases reliability



#### Flexible, easy-to-use interfaces

- Easy setup with menu guided, full-text prompts
- Context-sensitive, on-screen help saves time
- WATVIEW software minimizes setup time
- Integrate with other serial devices using Modbus™
- Connect to system components via analog I/O to retransmit process variables and read set points

#### Advanced control utilities

- Auto-tune optimizes control with minimal effort and expertise
- Cascade minimizes overshoot and improves control in systems with excessive thermal lag
- Ratio and differential enhances control where the relationship between two or more loops is paramount

#### Specifications

##### Operator Interface

- 32-character vacuum florescent display
- Eight-key keypad to access guided menus and prompts, set values and view channel displays

- Controller's configuration can be loaded through the standard serial port
- Built-in context sensitive help

#### Noise Rejection

- 120dB at 60Hz

#### Temperature Coefficient

- 40ppm/°C

#### Programmable Logic

- Programming languages: Ladder Logic, Sequential Function Chart, Function Block Diagram
- Memory: 64k flash (nonvolatile)
- Logic programs run concurrently with closed loop control
- Read/write access: controller I/O and closed loop control parameters



**Watlow Anafaze's WATVIEW and LOGICPRO software applications are ideal to use with the CPC400 SERIES. See page 197 for more information and ordering details.**

UL® is a registered trademark of Underwriter's Laboratories, Inc.  
Modbus™ is a registered trademark of Schneider Automation, Inc.

# PID with Programmable Logic Controllers

## CPC400 SERIES

### Specifications Cont.

#### Analog Inputs

- Thermocouples: User selectable type, direct connection, linearization, reference junction compensation, reversed and shorted T/C detection and upscale break protection with output averaging
- RTD: 2-or 3-wire, platinum, 100Ω @ 0°C, DIN curve. Requires scaling resistors. See Special/Linear Inputs in Ordering Information
- Linear: current and voltage signals from linear transmitter
- Pulse input: One TTL-level square wave input up to 2kHz

#### Sensor Range

Sensor	Range	Accuracy* at 25°C Ambient
Type B	66 to 1760°C (150 to 3200°F)	±4.0°C (±7.2°F)
Type E	-200 to 787°C (-328 to 1448°F)	±1.0°C (±1.8°F)
Type J	-212 to 760°C (-350 to 1400°F)	±1.2°C (±2.2°F)
Type K	-268 to 1371°C (-450 to 2500°F)	±1.3°C (±2.3°F)
Type R	-18 to 1766°C (0 to 3210°F)	±2.8°C (±5.0°F)
Type S	-18 to 1760°C (0 to 3200°F)	±2.8°C (±5.0°F)
Type T	-268 to 399°C (-450 to 750°F)	±1.6°C (±2.9°F)
RTD	-200 to 621.1°C (-328 to 1150°F)	±0.5°C (±0.9°F)

\* True for 10 percent to 100 percent of span except Type B, which is specified for 430°C to 1760°C (800°F to 3200°F.)

#### Linear Voltage and Current Inputs

Requires scaling resistors. See Special/Linear Inputs in Ordering Information

- 0-10mA=(dc)
- 0-20mA=(dc)/4-20mA=(dc)
- 0-100mV=(dc)
- 0-500mV=(dc)
- 0-1V=(dc)
- 0-5V=(dc)
- 0-10V=(dc)
- 0-12V=(dc)

Other ranges available. Consult factory

#### Input Sampling Rate @ 60Hz

Each channel has the following scans per second:

- CPC404: 6 samples per second, (update time: 0.167 sec.)
- CPC408: 3 samples per second, (update time: 0.333 sec.)

#### Internal Measurement Resolution

- 0.006 percent, greater than 14 bits

#### Calibration

- Automatic zero and full scale

#### Digital Inputs

- TTL level used for logic, remote alarm acknowledge, selecting recipes or jobs
- 8 inputs and 1-pulse input with 50-pin terminal board option
- 3 inputs (1 input configurable as pulse) with 18-pin terminal block option

#### Digital Outputs

- 34 digital outputs are available with a 50-pin terminal board option
- 11 outputs available with 18-pin terminal block option
- 1 or 2 control outputs are user assigned for each loop

- Each control output can be configured for on-off, time proportioning or distributed zero crossing
- Outputs sink up to 60mA each at 5V=(dc)
- 350mA at 5V=(dc) available from onboard supply

#### Alarm Outputs

- Independent process and deviation alarms for each channel
- Alarms can operate any output not used for control
- User programmable deadband, delay and startup suppression
- Global alarm output activates when any alarm occurs
- Watchdog output indicates controller is functioning correctly

#### Analog Outputs

- Use DAC and SDAC accessory modules. See [page 159](#)

#### Serial Interface

- EIA/TIA-232 or EIA/TIA-485

#### Baud Rate

- 2400, 9600 or 19200, user selectable

#### Communication Protocol

- Modbus™ RTU

#### Line Voltage/Power

- 12 to 24V=(dc) @ 1A (loaded) or 300mA (no load)

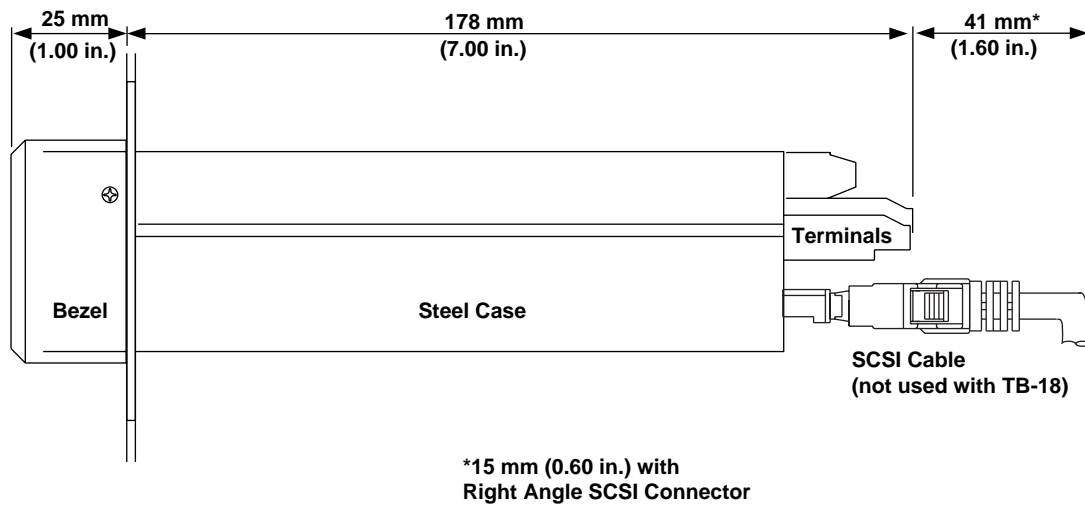
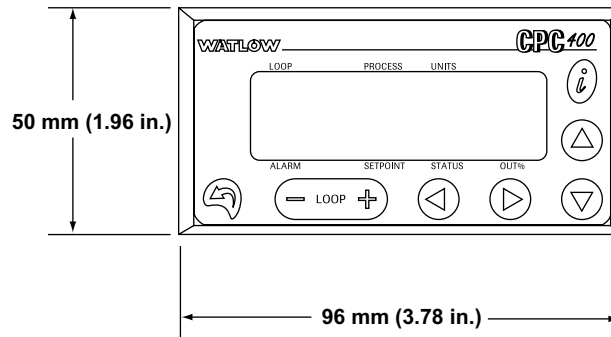
#### Agency Approvals

- UL®, C-UL® Listed: UL 916, Standard for Energy Management Equipment
- CE Mark: Electromagnetic Compatibility (EMC) Directive 89/336/EEC

# PID with Programmable Logic Controllers

## CPC400 SERIES

### Dimensions



# PID with Programmable Logic Controllers

F.O.B.: Winona, Minnesota

## CPC400 SERIES

### Ordering Information

To order, complete the model number on the right with the information below.

**4 0 - 1**

**Number of Loops** \_\_\_\_\_

4 = 4 loops  
8 = 8 loops

**Controller Type** \_\_\_\_\_

1 = Standard EPROM

**Terminal Board** \_\_\_\_\_

0 = No terminal board accessory  
1 = 18-pin terminal block mounted on unit (no SCSI cable required)  
2 = 50-pin terminal board (includes 3 foot SCSI cable)

**Power Supply** \_\_\_\_\_

0 = No power supply  
2 = 120/240V~(ac), 50/60Hz power supply adapter  
(5V= [dc] @ 4A, 15V= [dc] @ 1.2A) (CE approved)

**SCSI Cables (For use with 50-pin terminal board)** \_\_\_\_\_

0 = No special SCSI cable (3 foot cable included with 50-pin terminal block)  
1 = 6 foot SCSI cable  
2 = 3 foot right angle SCSI cable  
3 = 6 foot right angle SCSI cable

**Serial Communication Cables (For communications with computer)** \_\_\_\_\_

0 = No serial communication cable  
1 = 10 foot serial communication cable (DB-9 female/bare wire)  
2 = 25 foot serial communication cable (DB-9 female/bare wire)  
3 = 50 foot serial communication cable (DB-9 female/bare wire)

**Serial Communication Jumper Settings** \_\_\_\_\_

0 = EIA/TIA-232  
1 = EIA/TIA-485  
2 = EIA/TIA-485 terminated

**Special Inputs** \_\_\_\_\_

(Standard unit is configured for thermocouples and -10 to 60mV linear inputs.  
For other sensors, order special inputs.)  
0 = Thermocouples and -10 to 60mV inputs only  
X = Number of current, voltage or RTD inputs

### Special Inputs

Specify an input type for each channel or block of channels that needs factory installed resistors. Include a descriptor in the controller part description in the form specified below for each special input type. Make sure the number of special inputs specified is equal to the number of special inputs in the controller part number.

**C P C S I - -**

**Special Input Type** \_\_\_\_\_

(Not required for thermocouple sensor inputs)  
23 = RTD  
43 = 0-10mA=(dc)  
44 = 0-20mA=(dc)/4-20mA=(dc)  
50 = 0-100mV=(dc)  
52 = 0-500mV=(dc)  
53 = 0-1V=(dc)  
55 = 0-5V=(dc)  
56 = 0-10V=(dc)  
57 = 0-12V=(dc)

**Start Channel** \_\_\_\_\_

XX = Channel Number XX

**End Channel** \_\_\_\_\_

XX = Channel Number XX

**Availability**

Up to 4 weeks, depending on complexity and order release quantity. Consult factory for details.

## PID with Programmable Logic Controllers

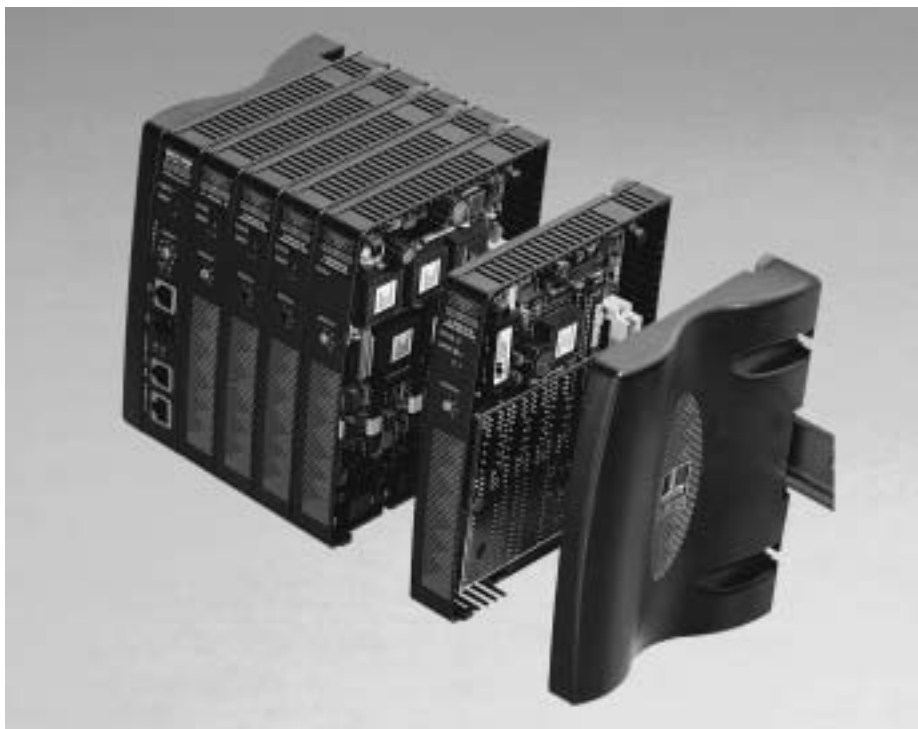
### PPC-2000 SERIES

The Watlow Anafaze PPC-2000 is a powerful, multi-loop programmable process control system. It combines easy-to-set up multi-loop process control and programmable logic control in one integrated package. Its modular design enables users to select a set of hardware and develop a logic control program based on their specific control loop and logic application, making it ideal for OEMs.

The PPC-2000 controls up to 48 PID loops and supports additional analog inputs for logic programming or monitoring. It accepts multiple sensor inputs including thermocouples, RTDs, linear dc voltage or current inputs and counters. The base system has 46 digital I/O for temperature control or programmable logic. Plug-in I/O modules expand the capacity of the base system. Options include modules for pulse inputs, current and voltage analog outputs, digital inputs for ac and dc signals and relay outputs.

Two serial communication ports support read/write access by a host computer and/or operator interface panel using Modbus™ RTU protocol. ANAWIN® 3, the PPC-2000's Human Machine Interface (HMI) software makes it easy to configure, monitor and customize applications.

LOGICPRO, graphical logic programming software package allows integration of programmable logic functionality into this new breed of multi-loop controller. Develop with easy-to-use drag and drop tools, then simulate and debug your program before downloading to the PPC-2000.



#### Applications

- Semiconductor processing equipment
- Electronic packaging equipment
- Plastic extrusion and thermoforming equipment
- Applications requiring 16 or more temperature or analog inputs

#### Features and Benefits

##### Up to 48 PID control loops

- Precisely control a large number of temperature zones and process loops with a single controller

##### Advanced auto-tune on all loops

- Quickly optimize PID parameters

##### Integrated programmable logic control

- Eliminates hard-wired relay logic or stand alone PLC
- Shares data between process control and logic functions

##### Fill-in-the-blank setup

- Easily setup and monitor closed-loop control

##### High density mixed analog input modules

- Connect any combination of T/C, RTDs, linear dc current or voltage on the same input module

##### Flexible and expandable I/O platform

- Saves cost and space by customizing a system to the exact I/O requirement

##### ANAWIN and LOGICPRO graphical software tools

- Easily configure, monitor and maintain processes
- Add custom functionality to support application requirements

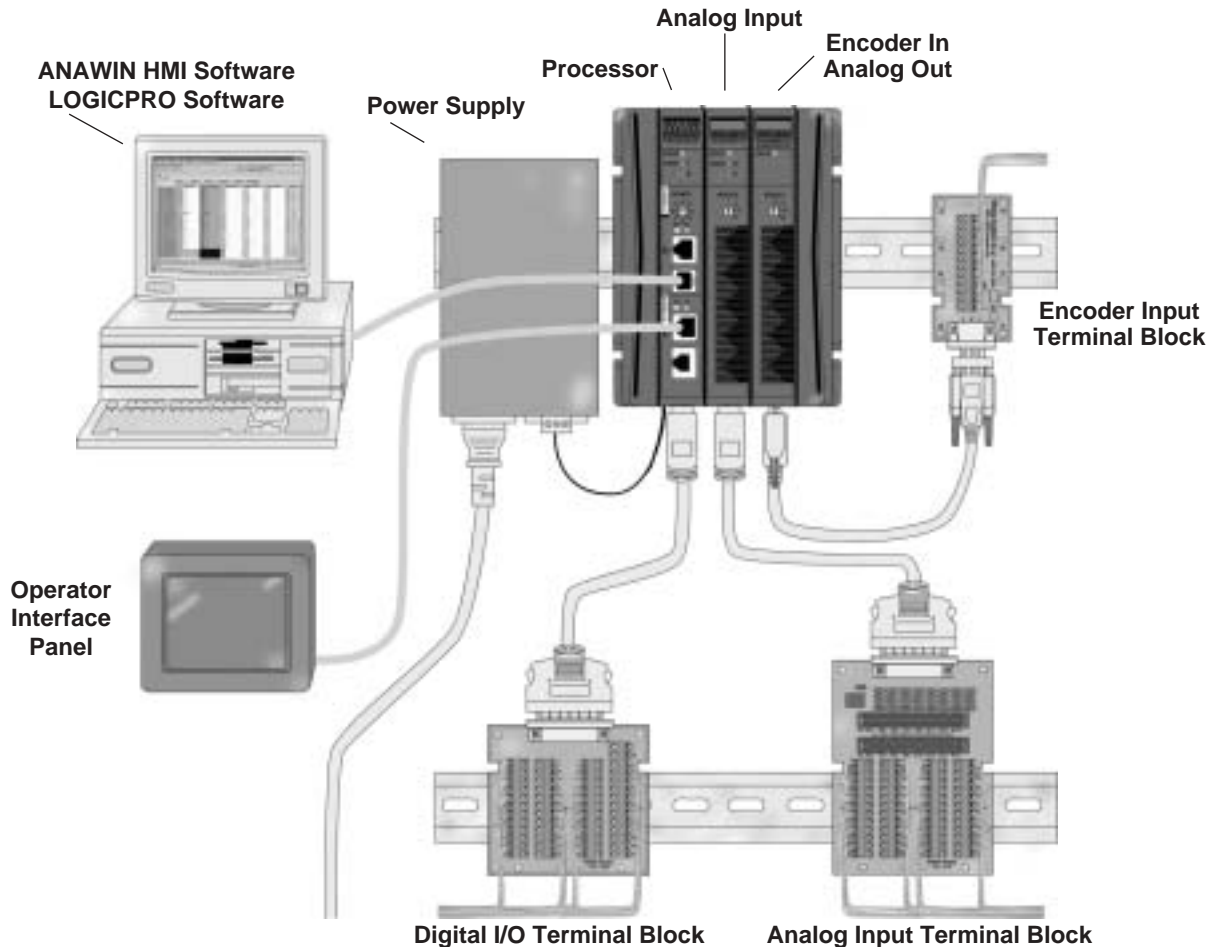


**Watlow Anafaze's ANAWIN3 and LOGICPRO software applications are ideal to use with the PPC-2000 SERIES. See pages 199 and 201 for more information and ordering details.**

# PID with Programmable Logic Controllers

## PPC-2000 SERIES

### PPC-2000 Single Controller System



### PPC-2000 System

#### Specifications

##### General

- System power: 12-28V $\overline{\text{dc}}$
- Storage temperature: -20°C to 70°C (-4°F to 158°F)
- Operating temperature: 0°C to 60°C (32°F to 140°F)
- Humidity: 10 to 95 percent, non-condensing
- Mounting: DIN-rail or panel mount
- Module dimensions: 203.2 mm (8.0 in.) H x 82.6 mm (3.25 in.) W x 133.4 mm (5.25 in.) D (add 24.38 mm (0.96 in.) width for each additional module)

##### CPU Specifications

- Maximum number of modules per system: 10
- Communications: 2 serial ports, EIA-232/EIA-485
- Protocol: Modbus™ RTU
- Programmable logic: Ladder, SFC, FBD
- HMI: ANAWIN3, Windows®95/98/NT/2000/XP

##### Process Control Specifications

- Control modes: P, PI, PID or on-off
- Outputs/loop: 2; heat, cool or heat/cool

- Control loops: 48 max.
- PID tuning: auto-tune or manual
- Output types: time proportioning, distributed zero crossing or analog
- Alarms: high/low process, deviation with configurable outputs

##### Safety and Agency Approvals

- UL® & C-UL® 3121-1 Listed, File E212113
- CE Safety EN 61010-1
- CE EMC EN 61326, EN 55011 (PPC-2030 excepted)

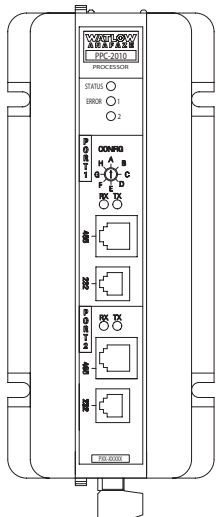


# PID with Programmable Logic Controllers

## PPC-2000 SERIES

### PPC-2010 - Processor Module

The PPC-2010 executes PID process control and programmable logic control. This unit contains the CPU, memory, communications and digital I/O.



#### Specifications

##### General

- Memory: 512kB flash, 128kB RAM (battery backed)

##### Digital Inputs and Outputs

- Number of digital I/O: 46 (24 input or output, 22 output only)
- 2 system outputs: System safe, global alarm
- Input limiting and protection: 40V<sub>rms</sub>(dc)
- Input logic levels: <math>0.6V\_{rms}</math>(dc) = Low; <math>3.8V\_{rms}</math>(dc) = High
- 1 counter input up to 10kHz (16 bit)
- Output current capacity: 100mA continuous sink to power common
- Maximum voltage on outputs: 24V<sub>rms</sub>(dc)

##### Communication Ports

- Ports 1 & 2: EIA/TIA-232 3-wire or EIA/TIA-485 5-wire, isolated
- Baud rate: 19,200 or 9600

### TB50-SCSI - Digital I/O Terminal Board

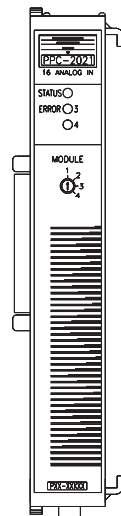
The PPC-TB50-1 connects to the PPC-2010 or PPC-2040 through a SCSI cable. The terminal board is used to interface field wiring to the PPC-2010 or PPC-2040.

#### Specifications

- Dimensions: 104 mm (4.1 in.) H x 102 mm (4.0 in.) W x 40.6 mm (1.6 in.) D
- Number terminal points: 50
- Mounting: DIN-rail or panel mount
- Discrete terminal type: Captive screw cage clamp

### PPC-202X - Analog Input Module

Analog input modules accept a wide variety of signals. A single module can easily be configured for any combination of thermocouple, RTD, linear voltage and linear current signals. Analog input modules are available with high isolation and standard isolation.



#### Specifications

##### General

- Maximum number of modules per system: 4

##### Input

##### Thermocouple and RTD Ranges

Type	Range	Total Accuracy
B:	0 to 1820°C (32 to 3308°F)	±3.3°C (±5.9°F)
C:	0 to 2316°C (32 to 4200°F)	±1.6°C (±2.8°F)
D:	0 to 2316°C (32 to 4200°F)	±1.5°C (±2.7°F)
E:	-270 to 661°C (-454 to 1221°F)	±1.0°C (±1.8°F)
F*:	0 to 1232°C (32 to 2250°F)	±2.3°C (±4.1°F)
G:	0 to 2316°C (32 to 4200°F)	±1.5°C (±2.7°F)
J:	-210 to 870°C (-346 to 1598°F)	±1.2°C (±2.1°F)
K:	-270 to 1232°C (-454 to 2249°F)	±2.2°C (±3.9°F)
N:	-270 to 1300°C (-454 to 2372°F)	±1.5°C (±2.7°F)
R:	-50 to 1768°C (-58 to 3215°F)	±2.6°C (±4.6°F)
S:	-50 to 1768°C (-58 to 3215°F)	±3.1°C (±5.6°F)
T:	-270 to 400°C (-454 to 752°F)	±1.2°C (±2.1°F)
RTD:	-240 to 272°C (-400 to 521°F)	±0.4°C (±0.8°F)
RTD High:	-250 to 850°C (-418 to 1562°F)	±2.3°C (±4.2°F)

\*Also known as Platinel® II

- Differential inputs: PPC-2021, PPC-2024, PPC-2025
- Single-ended inputs: PPC-2022
- Input types supported: thermocouples, 100Ω Platinum RTD, linear voltage, linear current
- Isolation from input to bus: 500V<sub>rms</sub>(dc) continuous
- Isolation from input to input (PPC-2021): ±60V<sub>rms</sub>(ac)
- Isolation from input to input (PPC-2024, 2025): 240V<sub>rms</sub>(ac)

Multi-Loop  
PID with Programmable Logic

# PID with Programmable Logic Controllers

## PPC-2000 SERIES

### PPC-202X - Analog Input Module Cont.

- Isolation between input and frame ground: 120V~(ac)
- DC voltage input range: ranges selectable 0-50mV, 0-100mV, 0-500mV, 0-1V, 0-5V or 0-10V
- DC mA input range: ranges selectable 0-20mA or 4-20mA
- T/C open detect: 2.5kΩ or more (upscale)
- Resolution: 0.003 percent greater than 15 bits
- Accuracy (voltage at 25°C (75°F)): 0.05 percent, 0.1 percent (PPC-2022)
- Accuracy (current at 25°C (75°F)): 0.1 percent, 0.75 percent (PPC-2022)
- Temperature coefficient: <50ppm/°C, 0.005 percent/°C
- Input sample and PID update rate  
PPC-2024: 220ms, 8 channels (4.5Hz)  
PPC-2021, PPC-2025: 380ms, 16 channels (2.6Hz)  
PPC-2022: 666ms, 32 channels (1.5Hz)

### PPC-AITB-1 - Analog Input Terminal Board

Sensor wires are terminated on a terminal board. A cable connects the analog input module to the terminal board.

#### Specifications

##### General

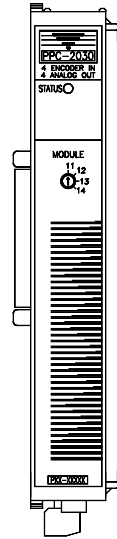
- Dimensions: 129.5 mm (5.1 in.) H x 106.7 mm (4.2 in.) W x 58.4 mm (2.3 in.) D
- Mounting: DIN-rail or panel mount
- Discrete terminal type: captive screw cage clamp

### Sensor Keys

The PPC-AITB-1 sensor inputs can be individually configured with sensor keys to accept thermocouples, RTDs, linear voltage and current. Sensor keys used with PPC-2022 configure 2 input channels.

### PPC-2030 - Encoder Input Analog Output Module

The PPC-2030 module accepts input signals from high speed pulse output devices such as encoders and generates analog output signals to control variable frequency drives, SCRs and other devices.



#### Specifications

##### General

- Maximum number of modules per system: 4

##### Input System

- Pulse inputs: 4 (high speed counter or encoder)
- Maximum input frequency: 10kHz (single-phase), 32 kHz (quadrature)
- Count range: 16 bits
- Sample rate: 250ms to sample all 4 inputs (4Hz)

### Output

- Analog outputs: 4 individually isolated analog outputs
- Isolation: 120V~(ac) to power common or ground
- Resolution: 12 bits
- Range (voltage mode): 0 to +10V @ 10mA max
- Accuracy (voltage mode): 0.3 percent of reading ±0.5 percent of range at 25°C (75°F)
- Range (current mode): 0 to 20mA with 8V minimum compliance (400Ω load)
- Accuracy (current mode): 1.5 percent of reading ±0.2 percent of range at 25°C (75°F)
- Output update time: 0.1 sec

### PPC-EITB-1 - Encoder Input Terminal Board

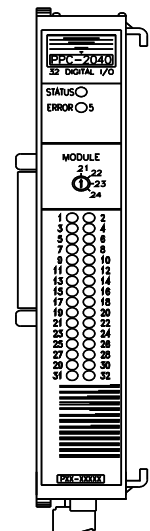
Pulse signal wires are terminated on a terminal board. A cable connects the module to the terminal board.

#### Specifications

- Dimensions: 101.6 mm (4.0 in.) H x 51 mm (2 in.) W x 38.1 mm (1.5 in.) D
- Mounting: DIN-rail or panel mount
- Discrete terminals: captive screw

### PPC-2040 - Digital I/O Module

The PPC-2040 accepts input signals from on-off sensors and high speed pulse output devices. It also drives actuators, relays, etc. Each output is user configurable for control, alarms or logic. Each I/O is user selectable as input or output. Field wiring is terminated on the TB50-SCSI terminal board.



# PID with Programmable Logic Controllers

## PPC-2000 SERIES

### PPC-2040 - Digital I/O Module Cont.

#### Specifications

##### General

- Each point selectable as input or output
- 2 points selectable as input, output or counter/frequency
- Maximum number of modules per system: 6

##### Counter/Frequency

- Number: 2
- Maximum frequency: 10kHz (single-phase)  
32kHz (quadrature)
- Sample rate: 250 ms (4Hz)
- Count range: 16 bits

##### Digital Input

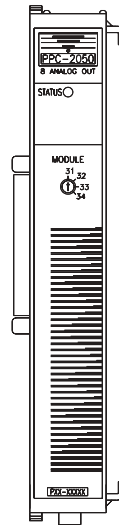
- Number: 32
- Voltage limiting and protection: 40V $\approx$ (dc)
- Logic levels: <0.6V $\approx$ (dc) = Low; >3.8V $\approx$ (dc) = High

##### Digital Output

- Number: 32
- Maximum voltage: 24V $\approx$ (dc)
- Maximum current: 150mA sink to common

### PPC-205X - Analog Output Module

The PPC-205X module generates analog output signals to control power controllers, variable frequency drives and other devices. The analog output module is available with 4 or 8 outputs.



#### Specifications

##### General

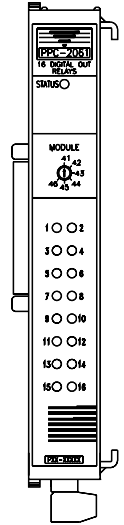
- Maximum number of modules per system: 4

##### Output

- Number: 4 (isolated) or 8 (pair isolated)
- Current or voltage selectable
- Isolation from power common and earth ground: 120V $\sim$ (ac)
- Isolation from output to output (PPC-2051): 120V $\sim$ (ac)
- Isolation between output pairs (PPC-2050): 120V $\sim$ (ac)
- Voltage range: 0-10V $\approx$ (dc) @ 10mA maximum
- Current range: 0-20mA with 8V maximum compliance (400 $\Omega$  load)
- Accuracy:  $\pm$ 0.5 percent voltage,  $\pm$  0.8 percent current of range at 25°C (75°F)
- Output update time: 0.1 second
- Resolution: 12 bit

### PPC-206X - Digital Output Module

The PPC-206X relay output drives actuators, pilot lights and other devices. Each output is user configurable for alarms or logic. The digital output module is available with 8 or 16 relays.



#### Specifications

##### General

- Output status LEDs
- Maximum number of modules per system: 6

##### Output

- Number: 8 or 16
- Contact voltage rating: 240V $\sim$ (ac), 30V $\approx$ (dc)
- Relay type: Form A (SPST, NO on fault or inactive)
- Isolation: 240V $\sim$ (ac) to power common or ground
- Maximum load current: 2A per relay (PPC-2062), 1A per relay, 5A per common (PPC-2061)
- Commons: 8 (PPC-2062), 2 (PPC-2061)

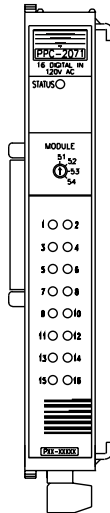
# PID with Programmable Logic Controllers

F.O.B.: Winona, Minnesota

## PPC-2000 SERIES

### PPC-207X - Digital Input Module

The PPC-207X accepts input signals from on-off sensors. The digital input module is available with 8 or 16 inputs.



### Specifications

#### General

- Input status LEDs
- Maximum number of modules per system: 4

#### Input

- Number: 8 or 16
- Input range: 70-120V~(ac) ± 10 percent (PPC-2070/1), 12-24V~(ac/dc) ± 10 percent (PPC-2072/3)
- Input response time: 32ms, 64 ms 12-20V~(ac)
- Logic levels: < 20V~(ac) = Low, >70V~(ac) = High (PPC-2070/1); < 3V~(dc) = Low, >10V~(dc) = High (PPC-2072/3)

### PPC-IPS-2 - Power Supply

The PPC-IPS-2 supplies power to a PPC-2000 system which requires a 12 to 28V~(dc) power source. The power supply also provides 5V~(dc) to drive digital outputs on the processor module.

### Specifications

#### General

- Dimensions: 114.3 mm (4.5 in.) H x 48.3 mm (1.9 in.) W x 215.9 mm (8.5 in.) D

- Mounting: DIN-rail or panel mount
- Input voltage: 120/240V~(ac), 50/60Hz
- Output voltage: V1 +5V~(dc) at 6 amps V2 +24V~(dc) at 4 amps
- Peak current output: 9A @ 5V~(dc); 6A @ 24V~(dc)
- Agency approvals: CE, UL® and C-UL® recognized

### PPC-2010 - Processor Module

### Ordering Information

To order, complete the model number on the right with the information below.

PPC-2010-

The PPC-2010 Processor Module includes ANAWIN3-CNF software for PPC-2000 configuration only and a TB50-SCSI digital I/O terminal board. A PPC-2000 system can have up to 10 modules.

#### Processor Module (with TB50)

#### Digital I/O Cable

- (Cable from module to terminal board)
- 1 = 3 foot cable (CA-SCSI-3)
  - 2 = 6 foot cable (CA-SCSI-6)

#### Communication Cable

- (Cable between processor and host computer)
- 1 = 10 foot EIA/TIA-232 cable, Handset plug to DB9F (CA-232-DB910)
  - 2 = 25 foot EIA/TIA-232 cable, Handset plug to DB9F (CA-232-DB925)
  - 3 = 50 foot EIA/TIA-232 cable, Handset plug to DB9F (CA-232-DB950)
  - 4 = 10 foot EIA/TIA-232 cable, Handset plug to DB25F (CA-232-DB2510)
  - 5 = 25 foot EIA/TIA-232 cable, Handset plug to DB25F (CA-232-DB2525)
  - 6 = 50 foot EIA/TIA-232 cable, Handset plug to DB25F (CA-232-DB2550)
  - A = EIA/TIA-485 terminal block with 2 foot cable
  - B = EIA/TIA-485 terminal block with 4 foot cable

#### Power Supply

- (DC power for the PPC-2000)
- 0 = No power supply (customer provides own supply)
  - 2 = PPC-IPS-2 supply; 24V~(dc) @ 4 A and 5V~(dc) @ 6A

# PID with Programmable Logic Controllers

F.O.B.: Winona, Minnesota

## PPC-2000 SERIES

### PPC-202X - Analog Input Module

#### Ordering Information

To order, complete the model number on the right with the information below.

PPC-202 -

Order up to four modules per system to accommodate sensor inputs. Do not exceed 128 inputs total. Only 48 inputs may be used for control. All modules accept T/Cs, current and voltage inputs. Only differential input modules accept RTDs. The high isolation modules provide 240V~(ac) protection between inputs and 120V~(ac) protection between input and ground. Each module includes an analog input terminal board with T/C/linear voltage keys (PPC-AITB-1). For other sensor input keys, see the special inputs section below.

#### Analog Input Modules (with AITB)

- 1 = 16 channel module, differential inputs (PPC-2021)
- 2 = 32 channel module, single-ended inputs (PPC-2022)
- 3 = 4 channel high isolation module, differential inputs (PPC-2023)
- 4 = 8 channel high isolation module, differential inputs (PPC-2024)
- 5 = 16 channel high isolation module, differential inputs (PPC-2025)

#### Analog Input Cable

- (Cable from module to terminal board)
- 1 = 3 foot cable (CA-SCSI-3)
- 2 = 6 foot cable (CA-SCSI-6)

### PPC-SIKX - PPC Special Input Keys

#### Ordering Information

To order, complete the model number on the right with the information below.

PPC-SIK

Each analog input terminal board ships configured with T/C sensor keys (this key can be also used for linear voltage). For other sensor types, choose from the special inputs below.

#### Input Type

- 1 = Single ended current (two inputs per key)
- 2 = Differential current 0-20mA (one input per key)
- 3 = 3-wire RTD (one input per key)

#### Note:

Contact the factory for fixed-configuration, analog input terminal boards in quantity.

# PID with Programmable Logic Controllers

F.O.B.: Winona, Minnesota

## PPC-2000 SERIES

### PPC-2030 - Encoder Input/Analog Output Module

#### Ordering Information

To order, complete the model number on the right with the information below.

PPC-2030-

Order up to four modules per system. The PPC-2030 includes four counter or encoder inputs and four analog outputs. Optional encoder input terminal boards with 10 foot or 25 foot cables are available to connect up to two counter or encoder inputs each to the PPC-2030. To connect directly to an encoder without a terminal board, a cable kit is available. The kit includes connector parts only, the customer provides the cable.

#### Encoder Input/Analog Output Module \_\_\_\_\_

#### Encoder Inputs 1 and 2 \_\_\_\_\_

- 1 = Encoder input terminal board with 10 foot cable (PPC-EITB-1-10)
- 2 = Encoder input terminal board with 25 foot cable (PPC-EITB-1-25)
- 3 = Encoder input connector kit (customer makes cable)

#### Encoder Inputs 3 and 4 \_\_\_\_\_

- 1 = Encoder input terminal board with 10 foot cable (PPC-EITB-1-10)
- 2 = Encoder input terminal board with 25 foot cable (PPC-EITB-1-25)
- 3 = Encoder input connector kit (customer makes cable)

### PPC-2040 - Digital I/O Module

#### Ordering Information

To order, complete the model number on the right with the information below.

PPC-2040-

Order up to six modules per system. A separate terminal board is included to interface with devices.

#### Digital I/O Cable (Cable from module to terminal board) \_\_\_\_\_

- 1 = 3 foot cable (CA-SCSI-3)
- 2 = 6 foot cable (CA-SCSI-6)

### PPC-205X - Analog Output Module

#### Ordering Information

To order, complete the model number on the right with the information below.

PPC-205

Order up to four modules per system. The terminal block is built into the module.

#### Quantity of Outputs \_\_\_\_\_

- 0 = 8 analog outputs
- 1 = 4 analog outputs

### PPC-206X - Digital Output Module

#### Ordering Information

To order, complete the model number on the right with the information below.

PPC-206

Order up to six modules per system. The terminal block is built into the module.

#### Quantity of Outputs \_\_\_\_\_

- 1 = 16 relay outputs
- 2 = 8 relay outputs

### PPC-207X - Digital Input Module

#### Ordering Information

To order, complete the model number on the right with the information below.

PPC-207

Order up to four modules per system. The terminal block is built into the module.

#### Quantity and Type of Inputs \_\_\_\_\_

- 0 = 8 point 120V~(ac)
- 1 = 16 point 120V~(ac)
- 2 = 8 point 24V≈(ac/dc)
- 3 = 16 point 24V≈(ac/dc)

## Multi-Loop Controllers

F.O.B.: Winona, Minnesota

### Accessories

#### **DAC and SDAC Modules**

The optional DAC and SDAC modules are used to convert open collector outputs to analog voltage or current signals. SDAC modules may only be used with Watlow Anafaze CLS200, CPC400, D8, MLS300 and PPC-2000 controllers.

#### **DAC**

The DAC (digital to analog converter) converts a controller's variable time base (also known as distributed zero crossing or DZC) output to an analog process control signal. Each DAC supports two independent analog outputs. Output signals are available in 4-20mA V<sub>dc</sub>, 0-5 V<sub>dc</sub> and 0-10V <sub>dc</sub>.

#### **DAC Specifications**

##### **Storage Temperature**

- -20 to 60°C (-4 to 140°F)

##### **Operating Temperature**

- 0 to 50°C (32 to 122°F)

##### **Humidity**

- 10 to 95 percent non-condensing

##### **Dimensions**

- Length 112 mm (4.4 in.), Width 91 mm (3.6 in.), Height 44 mm (1.75 in.)

##### **Power Requirements**

- 12 to 24 V<sub>dc</sub>, 100 mA @ 15 V<sub>dc</sub>

##### **Accuracy**

- ±6 percent of full scale

#### **SDAC**

The SDAC (serial digital to analog converter) allows CLS200, CPC400, D8, MLS300 and PPC-2000 controllers to output precise analog voltage or current signals. The unit is typically used for PV retransmit, open-loop control, motor or belt speed control or phase-angle fired SCR power controller. The SERIAL DAC is jumper-selectable for a 0 to 10 V<sub>dc</sub> or 4 to 20 mA outputs. Multiple SERIAL DAC modules can be used with the same controller.

#### **SDAC Specifications**

##### **Storage Temperature**

- -20 to 60°C (-4 to 140°F)

##### **Operating Temperature**

- 0 to 50°C (32 to 122°F)

##### **Humidity**

- 10 to 95 percent non-condensing

##### **Dimensions**

- Length 137 mm (5.4 in.), Width 91 mm (3.6 in.), Height 44 mm (1.75 in.)

##### **Power Requirements**

- 4.75 to 5.25 V<sub>dc</sub>, 100 mA

##### **Resolution**

- 15 bits

##### **Accuracy**

- 0.05 percent (voltage full scale); 0.5 percent (current full scale)

##### **Agency Approvals**

- UL® and C-UL® (UL® 916); CE (EMC directive 89/336/EEC)

# Multi-Loop Controllers

## Accessories

### Ordering Information

To order, complete the code number to the right with the information below:

D A C -

DAC Type

- 1 = Dual digital to analog converter module (converts two DZC control outputs to two 0-5V<sub>dc</sub> analog outputs). Separate power supply required
- 2 = Dual digital to analog converter module, (converts two DZC control outputs to two 0 - 10V<sub>dc</sub> analog outputs). Power supply is separate
- 3 = Dual digital to analog converter module, (converts two DZC control outputs to two 4 - 20mA<sub>dc</sub> analog outputs). Power supply is separate
- 4 = Serial digital to analog converter module (SDAC); provides one high precision isolated voltage or current analog output (range is set from the controller). Separate power supply required if more than 1 SDAC used

Additional Products

- A = None
- B = 120V<sub>ac</sub> 60Hz wall mount power supply adapter  
(15V<sub>dc</sub> @ 800mA, powers up to 8 dual DAC modules)
- C = 120/240V<sub>ac</sub> 50/60Hz panel mount power supply adapter  
(5V<sub>dc</sub> @ 4A, 15V<sub>dc</sub> @ 1.2A, powers up to 13 SDAC modules or 12 dual DAC modules)



## Power Controllers

### DIN-A-MITE® Family

Made in the United States of America, Watlow's DIN-A-MITE® family of solid state power controllers provides SCR control, heatsink, wiring and touch-safe exterior in one package. By designing the DIN-A-MITE® as a total power controller unit, the need to prep wires for terminals, find the right heat sink and determine adequate terminations is eliminated. It's a complete package you can install with Control Confidence®.

#### Performance Capabilities

Four DIN-A-MITE styles meet most power controller needs with ratings from 18 to 100 amps with voltages from 120 to 600V~(ac).

#### Features and Benefits

##### DIN-rail or sub-panel mounting

- Simple, fast installation

##### No mercury

- Environmentally safe product

##### Compact size

- Reduced panel space; less cost

##### Touch-safe exterior

Increased safety for installer/user

##### Easy Installation

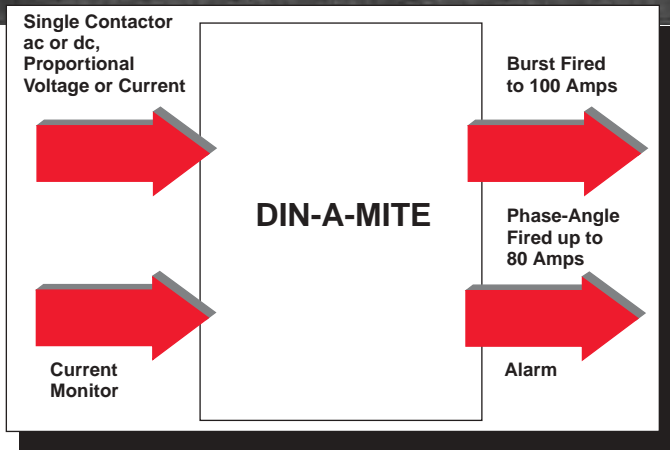
Installation is simple and fast; saving time and money. All you have to do is strip wires and make connections.

- Sub-panel or DIN-rail mounting
- No drilling and tapping necessary
- Same footprint as comparably rated MDRs

##### Agency Approvals

- UL®508 listed and C-UL®
- UL®50, UL®1604, and CE

**COMPLIES WITH EUROPEAN EMC DIRECTIVE**  
**EN 61326 (1997-98) and EN 50178**  
 Available on Request...  
 Consult Your Watlow Representative



#### Achieve Optimum Temperature Control With Variable Time Base Control

Variable time base control meets the rapid switching demands of PID temperature control to deliver more accurate process control. It also increases heater life by reducing temperature over- and undershoot.

#### Low Electrical Noise

Burst firing switches ac current at zero cross (zero potential) to produce minimal RFI and EMI electric noise (radio frequency interference/electromagnetic interference). This low electrical noise quality helps prevent

interference with sensor circuits and particularly sensitive equipment in your system.

#### Rugged, Back-to-Back SCR Design Insures Long Term Reliability

With solid state components, there's no limit on the number of switching cycles the DIN-A-MITE can perform. The four DIN-A-MITE styles meet most application requirements by tolerating harsh industrial environments, electrical spikes and dissipating less power. When properly applied, the DIN-A-MITE will outlast all other types of non-electronic power controllers.

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# Power Controllers

## DIN-A-MITE Family

### Reduce Wear On Thermal System

With optional variable time base switching, the DIN-A-MITE automatically adjusts output cycle time to meet system demands. The benefits of this option are:

- Heater output equal to load demand
- Minimized temperature over- and undershoot

### Terminal System Helps Prevent Wiring Failures

A proven high-current copper terminal design ensures optimum electrical connection to reduce heat build-up. This helps avoid connection failures and ensures overall wiring reliability. To further reduce “hot spots,” we've eliminated all unnecessary wires and fasteners which could possibly loosen, heat up and break down.

### Compact Solid State Power Controller Delivers Big Performance in a Small Package

Watlow's DIN-A-MITE Style A, B, C and D power controllers provide a low-cost, highly compact and versatile solid state power control. What's more, no need to worry about mercury; all DIN-A-MITEs are mercury free and fit the same footprint as a comparably rated MDR. Each feature sub-panel mounting, while Styles A, B and C also have DIN-rail mounting capability.

### Style A Capabilities

Style A capabilities include single-phase burst fire switching up to 25 amps at 600V~(ac) (see rating curve). Variable time base, 4-20mA=(dc) process control or V~(ac)/V=(dc) input contactor versions are available. All configurations are code number dependent and factory selectable, 50/60Hz independent.

### Style B Capabilities

Style B capabilities include 1-phase and 3-phase burst fire up to 40 and 33 amps, respectively, at 600V~(ac) (see rating curve).

Variable time base, 4-20mA=(dc) process control or V~(ac)/V=(dc) input contactor versions are available. All configurations are code number dependent and factory selectable, 50/60Hz independent.

### Style C Capabilities

Style C capabilities include 1-phase and 3-phase, 2-leg, and 3-phase, 3-leg burst fire, as well as 1-phase, phase-angle fire. Burst fire operation from 120 to 600V~(ac), phase angle operation from 120 to 600V~(ac). Current switching capabilities range from 30 to 80 amps depending on the model ordered (see output rating curve).

Input options include variable time base, 4-20mA=(dc) process control, linear voltage control, manual control or V~(ac)/V=(dc) contactor input. All configurations are code number dependent and factory selectable. All models are 50/60Hz independent.

### Style D Capabilities

Style D capabilities include 1-phase switching up to 100 amps at 600V~(ac) and 30°C (86°F) (see rating curve). Limited 3-phase operation is possible by ganging two and/or three Style D DIN-A-MITE contactor inputs together.

Style D features on-board semiconductor fuses (accessible from the front). Application is further enhanced with optional current transformer option for external load current monitoring and “shorted SCR detector” on some models.

Variable time base, 4-20mA=(dc) process control or V~(ac)/V=(dc) input contactor options are available. All configurations are code number dependent and factory selectable, 50/60Hz independent.

The standard sub-panel mounting footprint is equal to that of an industry standard mercury displacement relay.

### DIN-A-MITE Style A, B, C and D Features

- **Faster switching** with solid state components. Better control saves energy and extends heater life.
- **Back-to-back SCR design** for increased durability.
- **Three-year warranty** assures Control Confidence®.

### Style B and C Features

- **1- and 3-phase power** permits use in a variety of applications.
- **Shorted output detector** (optional) notifies a shorted SCR condition.

### Style C Features

- **Open heater detector** (optional) notifies when a partial or totally open heater occurs.

### Style D Features

- **On-board semiconductor fusing** provides quick access with no extra mounting necessary.
- **Optional load current monitor** detects changes in load current.

### Applications

- Petroleum/chemical
- Ovens/furnaces
- Wave solder and reflow
- Packaging
- Foodservice equipment
- Semiconductor processing

### Agency Approvals

- UL® 508 Listed, File #E73741
- C-UL® approved
- CE approved with proper line filter
- DIN-A-MITE Style C thru-wall mount is also UL®50 and UL®1604 approved.
- CE and EN 61326 Industrial Immunity Class A emissions with filter. EN 50178 safety directive

## Power Controllers

### DIN-A-MITE Family



	DIN-A-MITE Style A	DIN-A-MITE Style B	DIN-A-MITE Style C	DIN-A-MITE Style D
1-Phase <sup>①</sup>	Up to 25 amps @ 600V~(ac)	Up to 40 amps @ 600V~(ac)	Up to 80 amps @ 600V~(ac)	Up to 100 amps @ 600V~(ac)
3-Phase, 2-leg <sup>①</sup>	No	Up to 33 amps @ 600V~(ac)	Up to 80 amps @ 600V~(ac)	Gang 2 units
3-Phase, 3-leg <sup>①</sup>	No	Up to 22 amps @ 600V~(ac)	Up to 70 amps @ 600V~(ac)	Gang 3 units
V~(ac) & V=(dc) - Burst Fire Contactor Input	24, 120 & 240V~(ac) 4.5-32V=(dc)	24, 120 & 240V~(ac) 4.5-32V=(dc)	24, 120 & 240V~(ac) 4.5-32V=(dc)	24, 120 & 240V~(ac) 4.5-32V=(dc)
Multizone V~(ac) & V=(dc) Input	No	Yes	Yes	No
4-20mA=(dc) Input - Variable Time Base Output	Yes	Yes	Yes	Yes
Phase-Angle Fire Output <sup>②</sup>	No	No	Yes 1-phase only	No
Manual Control Via Potentiometer Input, or 0-5, 1-5 or 0-10V=(dc) Linear Voltage Input	No	No	Yes	No
Shorted SCR Alarm	No	Yes	Yes	Yes
Open Heater Alarm	No	No	Yes With "S" input only	No
Load Current Monitor CT	No	No	No	Yes
On Board Semiconductor Fusing	No	No	No	Yes
Din-Rail Mount	Yes	Yes	Yes	No
Sub-Panel Mount	Yes	Yes	Yes	Yes
Cabinet Thru-Wall Heatsink Mount UL <sup>®</sup> 50 and UL <sup>®</sup> 1604	No	No	Yes	No
Electrically Touch-Safe Package	Yes	Yes	Yes	Yes
Back-to-Back SCR Design	Yes	Yes	Yes	Yes
UL <sup>®</sup> 508 Listed/C-UL <sup>®</sup> /CE w/filter	Yes	Yes	Yes <sup>②</sup>	Yes
Dimensions	(95 X 45 X 98 mm) 3.7 H X 1.8 W X 3.9 in. D	(95 X 80 X 124 mm) 3.7 H X 3.1 W X 4.9 in. D	(150 X 80 X 146 mm) 6.0 H X 3.1 W <sup>③</sup> X 5.7 in. D	(185 X 65 X 240 mm) 7.25 H X 2.5 W X 9.4 in. D
Controller Weight: kg (lbs)	0.32 (0.71)	0.68 (1.5)	1.18 (2.6)	2.95 (6.5)
Controller Weight w/fan: kg (lbs)	N/A	N/A	1.45 (3.2)	N/A

<sup>①</sup> Refer to curves on page 164 for your specific application ratings.

<sup>②</sup> Phase angle fire is not CE approved.

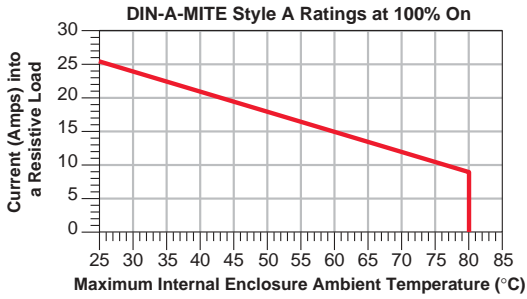
<sup>③</sup> Will fit within the width dimension of most comparable MDRs.

# Power Controllers

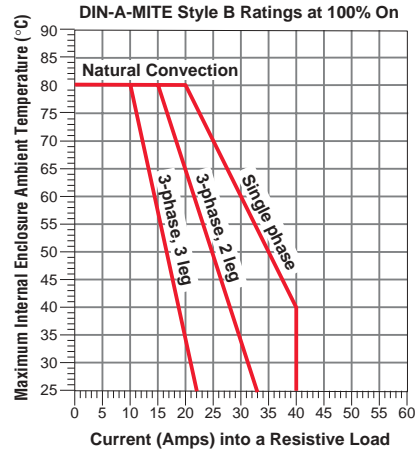
## DIN-A-MITE Family

### Output Current Rating Curves

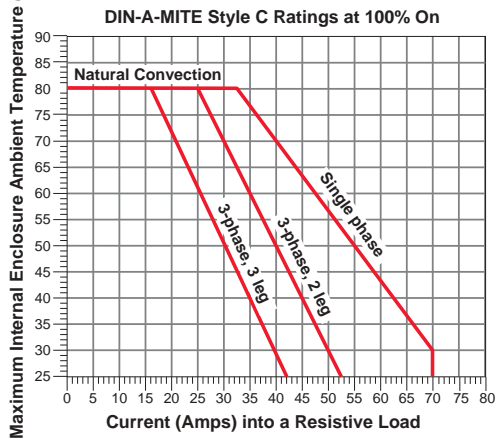
#### Style A



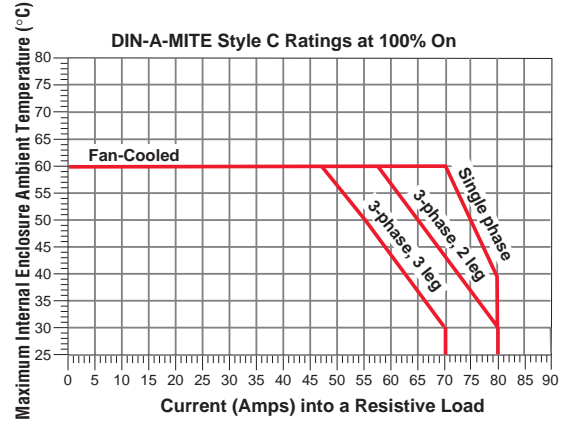
#### Style B



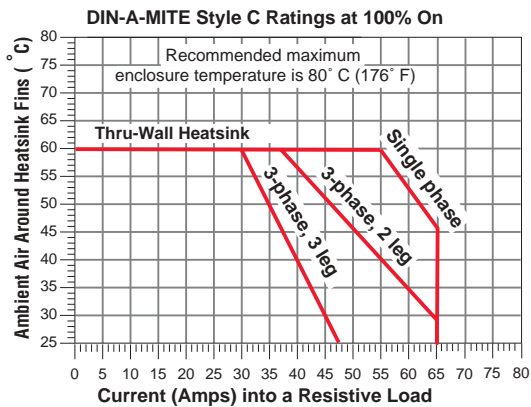
#### Style C



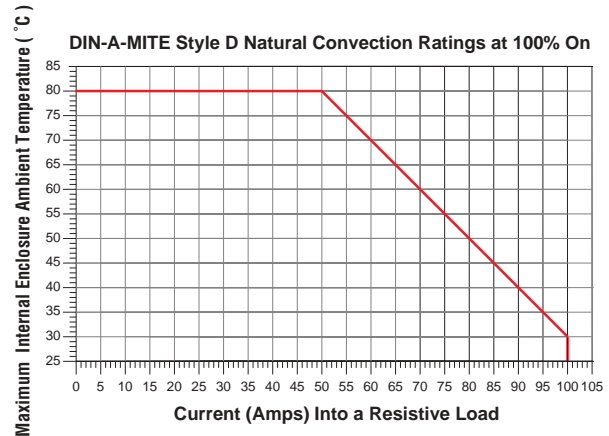
#### Style C - Fan Cooled



#### Style C—Thru-Wall



#### Style D



## Power Controllers

### DIN-A-MITE Family

#### Specifications Common To Styles A, B, C and D

##### Control Mode-Burst Fire

- V~(ac) input contactor
- V=(dc) input contactor
- 4-20mA=(dc) variable time base control

##### Operator Interface

- Command signal input
- Input signal indication LED

##### Input

- V~(ac): 24, 120, 240 nominal - 25mA maximum per controlled leg

#### Specifications Unique To Each Style

##### Multizone Input— Styles B & C

- V~(ac) input contactor
- V=(dc) input contactor
- Available 2 and 3 leg only

##### Amperage—Style A

- 1-phase, 24 amp output maximum at 30°C (86°F) into a resistive load<sup>③</sup>
- Maximum surge current for 16.6mSec. 380 amps peak
- Maximum I<sup>2</sup>t for fusing 4,000 A<sup>2</sup> Sec.

##### Amperage—Style B

- 1-phase and 3-phase models. See output rating curves on [page 164](#)
- Maximum surge current for 16.6mSec. 380 amps peak
- Maximum I<sup>2</sup>t for fusing 4,000 A<sup>2</sup> Sec.

##### Amperage—Style C

- Natural convection and fan cooled, in 1-phase and 3-phase models. See output rating curves on [page 164](#)
- Maximum surge current for 16.6mSec. 1350 amps peak
- Maximum I<sup>2</sup>t for fusing 9100 A<sup>2</sup> Sec.

- V=(dc): 4.5 to 32V=(dc): maximum current @ 4.5V is 6mA per leg. Add 2mA per LED used to the total current
- 4-20mA=(dc) loop powered: 375Ω input impedance

##### Output Voltage

- 120-240V~(ac) units: 48V~(ac) minimum to 265V~(ac) maximum
- 277-600V~(ac) units: 85V~(ac) minimum to 660V~(ac) maximum
- Off state leakage 1mA=(dc) at 25°C (77°F) maximum

##### Style C—Phase Angle Firing<sup>②</sup>

- 1-phase operation
- Line voltage compensation
- Soft start (4 seconds) on power up
- Missing half cycle detection (engages ESD and restarts soft)
- Optional current limit feature
- Linear voltage/current or manual control input. 5kΩ input impedance for voltage and 250 ohms for 4-20mA
- 120, 208, 240, 277, 400, 480, and 600V~(ac) operation. Model number dependent

##### Style C—Single Cycle Variable Time Base

- 1-phase and 3-phase operation
- Linearized input to output
- Linear voltage/current or manual control input. 5kΩ input impedance for voltage and 250 ohms for 4-20mA
- 120, 208, 240, 277, 400, 480, and 600V~(ac) operation. Model number dependent

##### Amperage—Style D

- 1-phase, 100 amp output maximum at 30°C (86°F)<sup>③</sup>
- Maximum surge current for 16.6mSec. 1800 amps peak
- Maximum I<sup>2</sup>t for fusing 20,000 A<sup>2</sup> Sec.

##### Operating Environment

- Up to 80°C (176°F),<sup>③</sup> see output rating curve for specific application

##### Storage Temperature

- -40 to 85°C (-40 to 185°F)

##### Mounting

Options include DIN-rail<sup>①</sup> or standard sub-panel mounting

- The DIN-rail specification is: DIN EN 50022, 35 mm x 7.5 mm

##### Shorted Output Alarm Option— Styles B, C & D

- Triac output
- 24 to 240V~(ac), 300mA @ 25°C, 125mA @ 80°C (176°F)
- Energizes on alarm
- Holding current 200μA minimum
- Latching current 5mA typical

##### Terminals—Styles A & B

- Compression - will accept #8-18 AWG wire (8.4 mm<sup>2</sup> - 0.82 mm<sup>2</sup>)

##### Terminals—Style C

- Compression - will accept #4-14 AWG wire (21.2 mm<sup>2</sup> - 2.1 mm<sup>2</sup>)

##### Terminals—Style D

- Compression - will accept #2-6 AWG wire (33.6 mm<sup>2</sup> - 13.3 mm<sup>2</sup>)

##### Mounting—Style D

- Standard sub-panel mounting; fits the same mounting pattern as a 100 amp 1-phase MDR
- Mounting holes offer clearance for #10 screw
- On-board semiconductor fusing, Bussmann P/N 170N3437

##### Current Sensing—Style D

- On-board current transformer, 0.2V~(ac) output signal per amp load current into 1000Ω load

<sup>①</sup> Not available on Style D

<sup>②</sup> Style C phase angle fire is not CE approved

<sup>③</sup> See output current rating curves, [page 164](#).

# Power Controllers

F.O.B. Winona, Minnesota

## Style A



### Availability

All combinations available in three working days or less.

CE approved product. Must use CE filter listed on page 190 for conducted emission.

### Ordering Information

To order, complete the code number on the right with the information below.

#### DIN-A-MITE

Style A = Solid state power controller

#### Phase

1 = 1-phase, 1 controlled leg

#### Cooling and Current Rating

0 = Natural convection current rating 18A @ 50°C (122°F)  
(See derating curve for current rating at other temperatures)

#### Line and Load Voltage

02 = 24 to 48V~(ac)  
24 = 100 to 240V~(ac)  
60 = 277 to 600V~(ac)

#### Input Type

C0 = 4.5 to 32V=(dc) contactor  
F0 = 4 to 20mA=(dc) proportional  
K1 = 22 to 26V~(ac) contactor  
K2 = 100 to 120V~(ac) contactor  
K3 = 200 to 240V~(ac) contactor

#### Manual Language

0 = English  
1 = German  
2 = Spanish  
3 = French

#### Custom parts Designation

00 = Standard parts

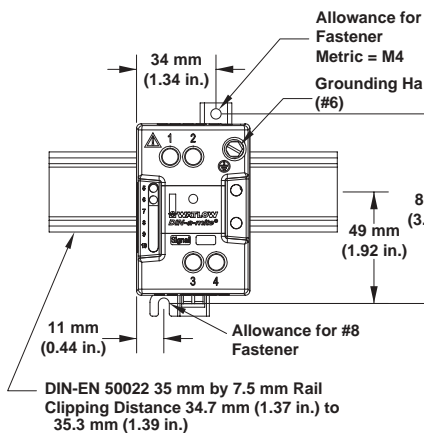
### Recommended Semiconductor Fuses and Fuse Kits

See page 191 for listings and part numbers.

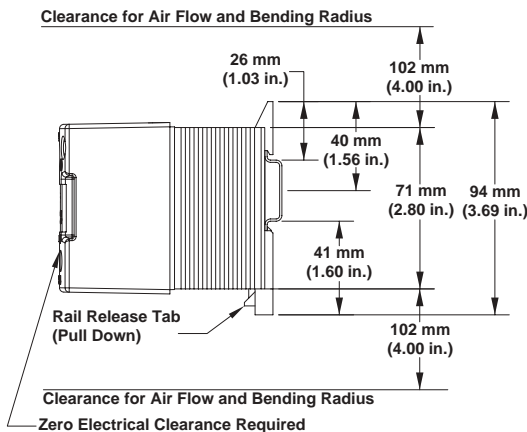
D A 1 0 - - 0

## Style A Dimensions

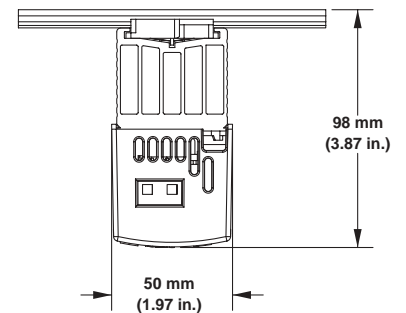
### Front



### Side



### Top



# Power Controllers

F.O.B.: Winona, Minnesota

## Style B



### Availability

All combinations available in three working days or less.

CE approved product. Must use CE filter listed on page 190 for conducted emission.

### Ordering Information

To order, complete the code number on the right with the information below.

#### DIN-A-MITE

Style B = Solid state power controller

#### Phase

- 1 = 1-phase, 1 controlled leg
- 2 = 3-phase, 2 controlled legs
- 3 = 3-phase, 3 controlled legs
- 8 = 2 independent zones (Input Type C or K)
- 9 = 3 independent zones (Input Type C or K)

#### Cooling and Current Rating Per Pole

- 0 = Natural convection standard DIN-rail or panel mount heatsink

#### Line and Load Voltage

- 02 = 24 to 48V~(ac)
- 24 = 120 to 240V~(ac)
- 60 = 277 to 600V~(ac)

#### Input Control Signal

- C0 = 4.5 to 32V=(dc) contactor
- F0 = 4 to 20mA=(dc) proportional
- K1 = 22 to 26V~(ac) contactor
- K2 = 100 to 120V~(ac) contactor
- K3 = 200 to 240V~(ac) contactor

#### Alarm

- 0 = No alarm
- S = Shorted SCR alarm (not available with options 8, and 9 above)

#### User Manual

- 0 = English
- 1 = German
- 2 = Spanish
- 3 = French

#### Custom Part Numbers

- 00 = Standard part
- XX = Any letter or number, custom options, labeling, etc.

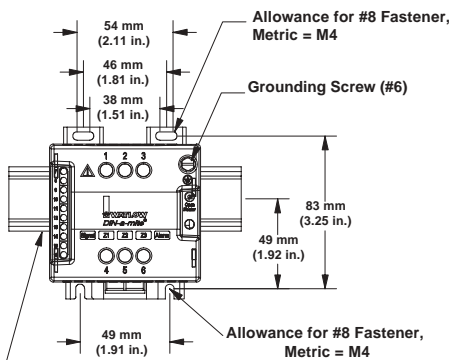
#### Recommended Semiconductor Fuses and Fuse Kits

See page 191 for listings and part numbers.



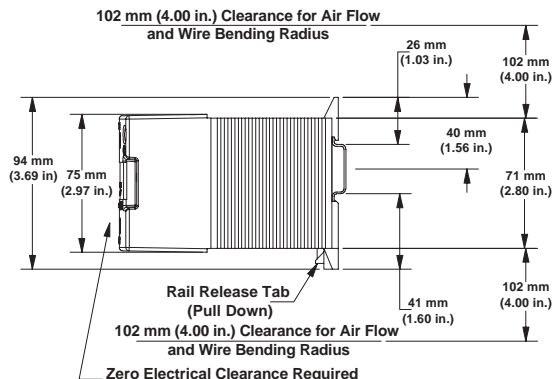
### Style B Dimensions

#### Front

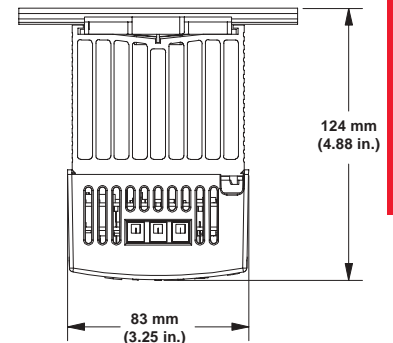


DIN-EN 50022 35 mm by 7.5 mm Rail  
Clipping distance 34.7 mm (1.366 in.)  
to 35.3 mm (1.390 in.)

#### Side



#### Top



## Style C



### Ordering Information

To order, complete the code number on the right with the information below:

**Style C** = Zero cross solid state power controller in natural and forced air cooled versions

#### Phase

- 1 = 1-phase, 1 controlled leg
- 2 = 3-phase, 2 controlled legs
- 3 = 3-phase, 3 controlled legs (use with four wire wye)
- 8 = 2 independent zones (Input Type C, K)
- 9 = 3 independent zones (Input Type C, K)

#### Cooling and Current rating Per Leg (see table on left)

- 0 = Natural convection standard Din-rail or panel heatsink
- 1 = Fan cooled 120V~(ac) standard Din-rail or panel heatsink
- 2 = Fan cooled 240V~(ac) standard Din-rail or panel heatsink
- 3 = Fan cooled 24V=(dc) standard Din-rail or panel heatsink
- T = Natural convection through wall or cabinet heatsink (NEMA 4X)

#### Line and Load Voltage

- 02 = 24 to 48V~(ac) (Control C, F, K)
- 24 = 100 to 240V~(ac) (Control C, F, K)
- 60 = 277 to 600V~(ac) (Control C, F, K)

#### Input Control Signal

- C0 = 4.5 to 32V=(dc) contactor
- F0 = 4 to 20mA=(dc) proportional
- K1 = 22 to 26V~(ac) contactor
- K2 = 100 to 120V~(ac) contactor
- K3 = 200 to 240V~(ac) contactor

#### Alarm

- 0 = No alarm
- S = Shorted SCR alarm (not available with options 8, and 9 above)

#### Language

- 0 = English
- 1 = German
- 2 = Spanish
- 3 = French

#### Custom Part Numbers

- 00 = Standard part
- XX = Any letter or number, custom options, labeling, etc.

#### Recommended Semiconductor Fuses and Fuse Kits

See [pages 191](#) for listings and part numbers.

**Note:** Allow one fuse and one holder per leg fused. Example, a 3-phase, 2-leg DIN-A-MITE requires two fuses and two holders.

### Current Rating Table

Phase	Cooling	Current at 50°C (122°F)
1	0	55A
1	T	60A
1	(1,2,3)	75A
2, 8	0	40A
2, 8	T	45A
2, 8	(1,2,3)	65A
3, 9	0	30A
3, 9	T	35A
3, 9	(1,2,3)	55A

### Availability

All combinations available in three working days or less.

**CE approved product. Must use CE filter listed on [page 190](#) for conducted emission.**



# Power Controllers

F.O.B.: Winona, Minnesota

## Style C

### Style C Enhancements



### Option

- Manual Control Kit for process input cards (1kΩ potentiometer) order #08-5362 separately.

### Current Rating Table

Phase	Cooling	Current at 50°C (122°F)
1	0	55A
1	T	60A
1	(1,2,3)	75A
2	0	40A
2	T	45A
2	(1,2,3)	65A
3	0	30A
3	T	35A
3	(1,2,3)	55A

CE approved product. Must use CE filter listed on page 190 for conducted emission.

### Ordering Information

To order, complete the code number on the right with the information below:

**DC** - - - - -

**Style C** = Zero cross and phase-angle fired solid state power controller in natural and forced air cooled versions.

**Phase** \_\_\_\_\_

1 = 1-phase, 1 controlled leg  
 2 = 3-phase, 2 controlled legs  
 3 = 3-phase, 3 controlled legs (use with four wire wye)

**Cooling and Current Rating Per Leg (see table on left)** \_\_\_\_\_

0 = Natural convection standard Din-rail or panel heatsink  
 1 = Fan cooled 120V~(ac) standard Din-rail or panel heatsink  
 2 = Fan cooled 240V~(ac) standard Din-rail or panel heatsink  
 3 = Fan cooled 24V=(dc) standard Din-rail or panel heatsink  
 T = Natural convection through wall or cabinet heatsink (NEMA 4X)

**Line and Load Voltage** \_\_\_\_\_

12 = 100 to 120V~(ac) (Control L, P, S)  
 20 = 200 to 208V~(ac) (Control L, P, S)  
 24 = 230 to 240V~(ac) (Control L, P, S)  
 27 = 277V~(ac) (Control L, P, S)  
 40 = 400V~(ac) (Control L, P, S)  
 48 = 480V~(ac) (Control L, P, S)  
 60 = 600V~(ac) (Control L, P, S)

**Input Control Signal** \_\_\_\_\_

L (0 to 5) = Phase-angle with current limiting<sup>Ⓢ</sup> (DC1 only, Alarm 0 only, includes one current transformer - Single-phase only)  
 P (0 to 5) = Phase-angle<sup>Ⓢ</sup> (DC1 only, Alarm 0 only - Single-phase only)  
 S (0 to 5) = Single cycle variable time base  
 (Select one of the following input options for L, P, S (0 to 5))  
 0 = 4 to 20mA  
 1 = 12 to 20mA (single cycle variable time base only - option 'S')  
 2 = 0 to 20mA  
 3 = 0 to 5V=(dc) proportional  
 4 = 1 to 5V=(dc) proportional  
 5 = 0 to 10V=(dc) proportional

**Alarm** \_\_\_\_\_

0 = No alarm  
 S = Shorted SCR alarm (for zero cross models only)  
 H = Open-heater and shorted-SCR alarm (for input control signal options S only)  
 1-phase, 1 controlled leg  
 3-phase, 2 controlled legs  
 3-phase, 3 controlled legs

**Language** \_\_\_\_\_

0 = English  
 1 = German  
 2 = Spanish  
 3 = French

**Custom Part Numbers** \_\_\_\_\_

00 = Standard part  
 10 = 1-second soft start (Control option P, L)  
 XX = Any letter or number, custom options, labeling, etc.

<sup>Ⓢ</sup> Phase angle models are not CE approved for conducted emissions.

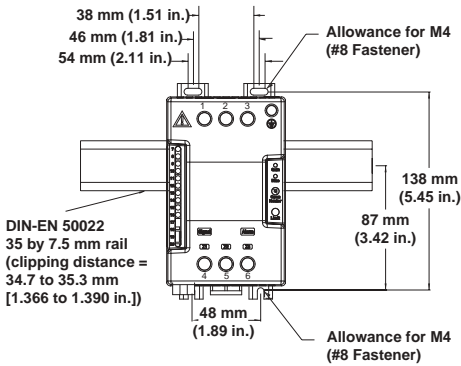
# Power Controllers

## Style C

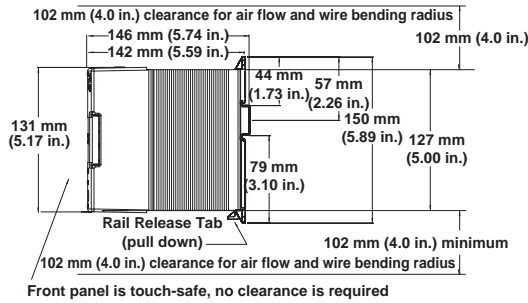
### Style C Dimensions

#### Without Cooling Fan

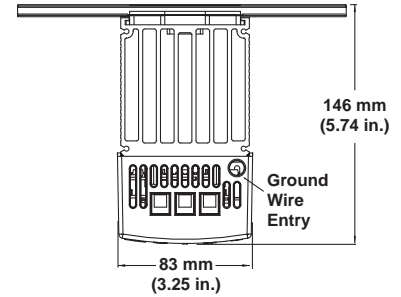
##### Front



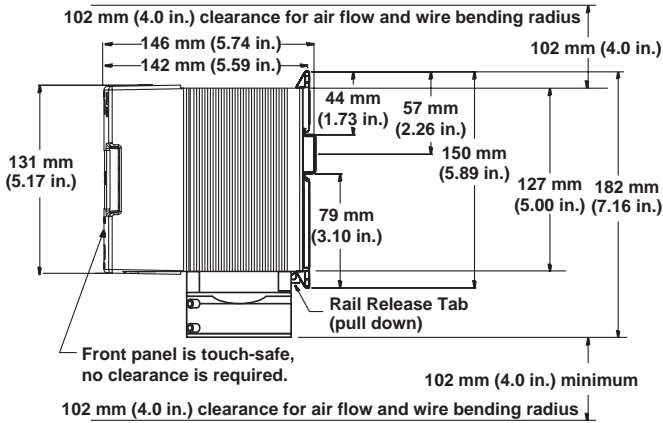
##### Side



##### Top

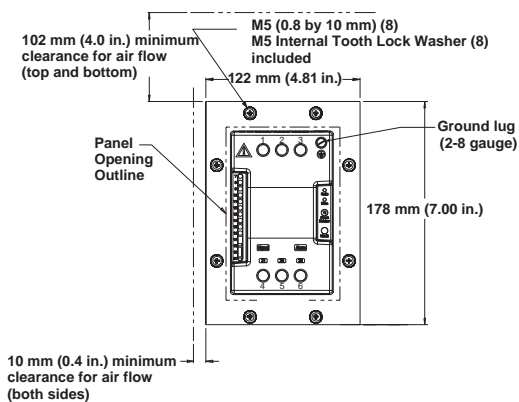


#### With Cooling Fan

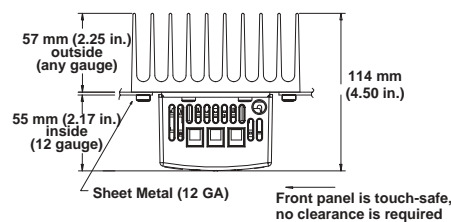


### Thru-Wall DIN-A-MITE Style C<sup>①</sup>

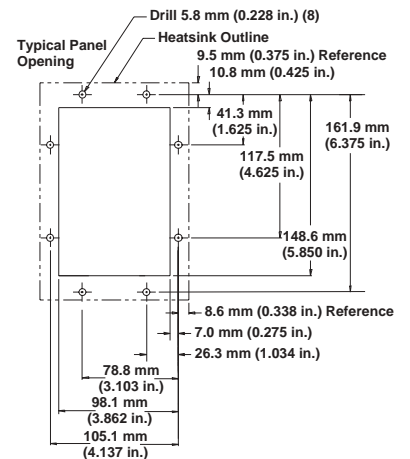
##### Front



##### Top



##### Panel Cutout



<sup>①</sup> With the potential for high thru-wall heatsink temperatures, application may require a touch-safe shield. See amperage curves on page 164 for details.

# Power Controllers

F.O.B.: Winona, Minnesota

## Style D



### Ordering Information

To order, complete the code number on the right with the information below:

**Style D** = Solid state power controller

**Phase** \_\_\_\_\_

1 = 1-phase, 1 controlled leg

**Cooling and Current Rating** \_\_\_\_\_

0 = Natural convection current rating 80A @ 50°C (122°F)

**Line and Load Voltage** \_\_\_\_\_

02 = 24 to 48V~(ac)

24 = 100 to 240V~(ac)

48 = 277 to 480V~(ac)

60 = 277 to 600V~(ac)

**Input Control Signal** \_\_\_\_\_

C0 = 4.5 to 32V=(dc) contactor

F0 = 4 to 20mA=(dc) proportional

K1 = 22 to 26V~(ac) contactor

K2 = 100 to 120V~(ac) contactor

K3 = 200 to 240V~(ac) contactor

**Current Sensing or Alarm** \_\_\_\_\_

0 = No alarm

1 = Load current transformer

S = Shorted SCR alarm

**User Manual Language** \_\_\_\_\_

0 = English

1 = German

2 = Spanish

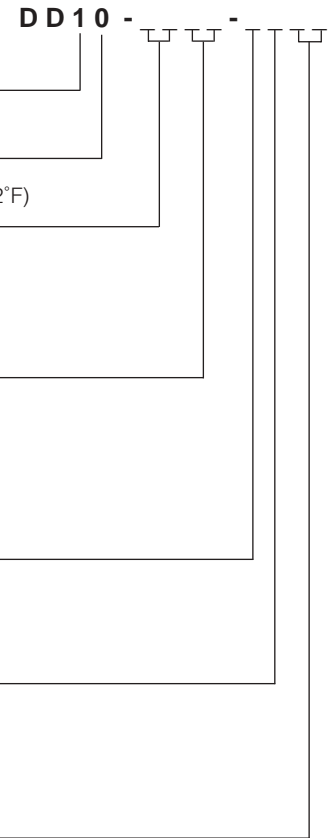
3 = French

**Custom Options** \_\_\_\_\_

00 = Standard parts

### Recommended Semiconductor Fuses

Bussmann part number 170N3437 65 amp® 660V~(ac), Watlow part number 0808-0096-0000 requires two fuses per Style "D" DIN-A-MITE. These should be replaced in pairs.



### Availability

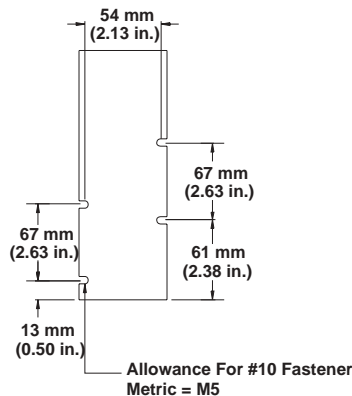
All combinations available in three working days or less.

CE approved product. Must use CE filter listed on page 190 for conducted emission.

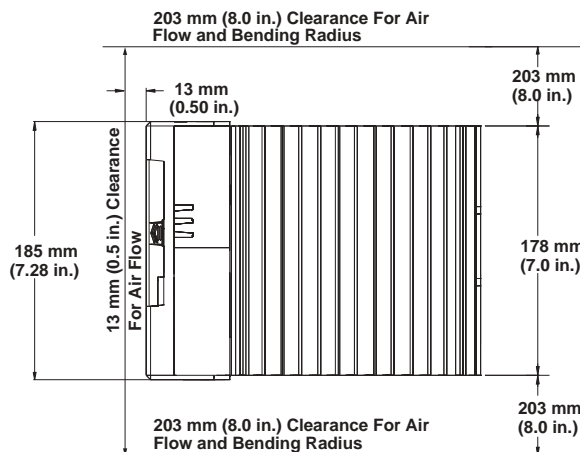
### Style D Dimensions

#### Footprint

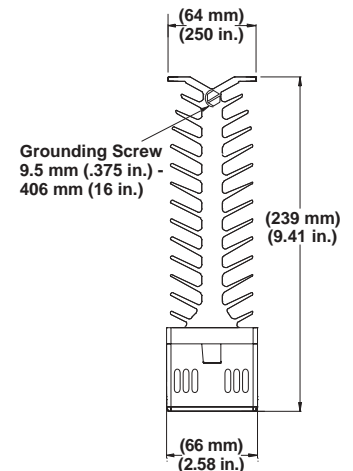
Same mounting footprint as industry standard mercury displacement relays.



#### Side



#### Top

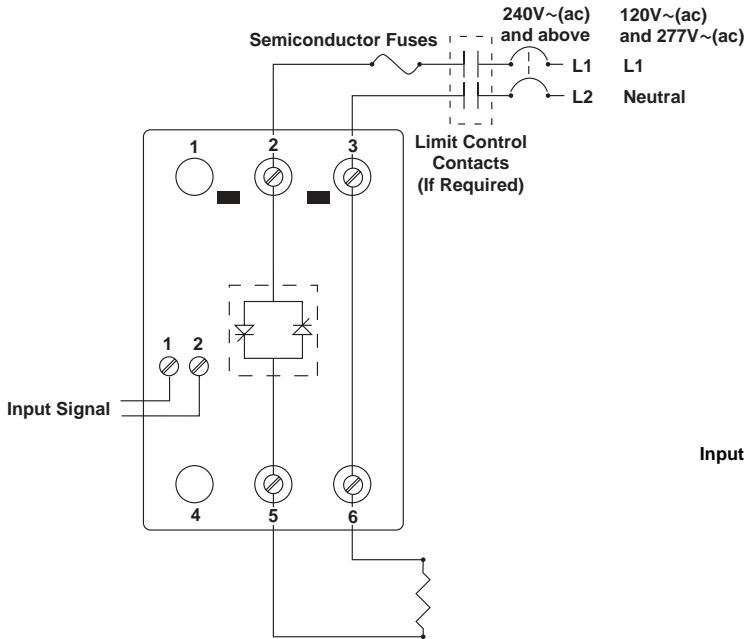


Power Controllers  
DIN-A-MITE®

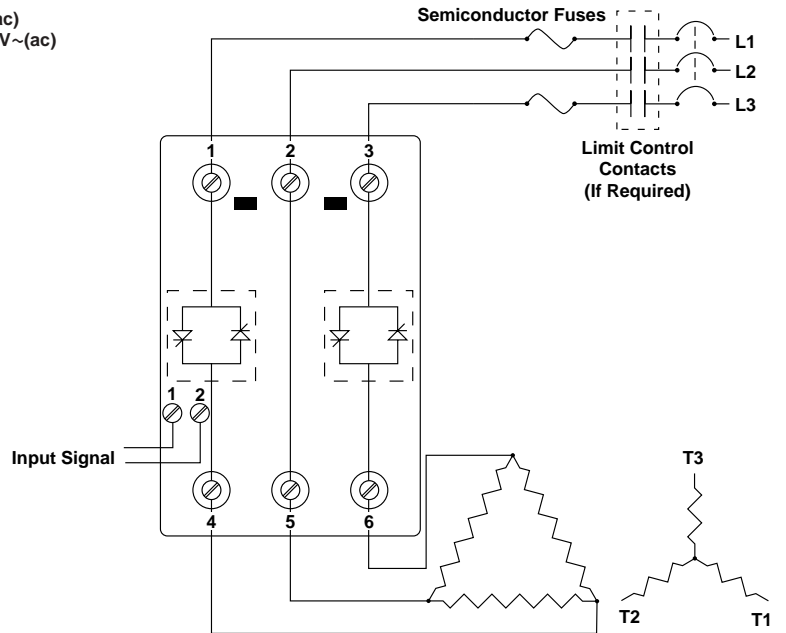
# Power Controllers

## System Diagram Examples

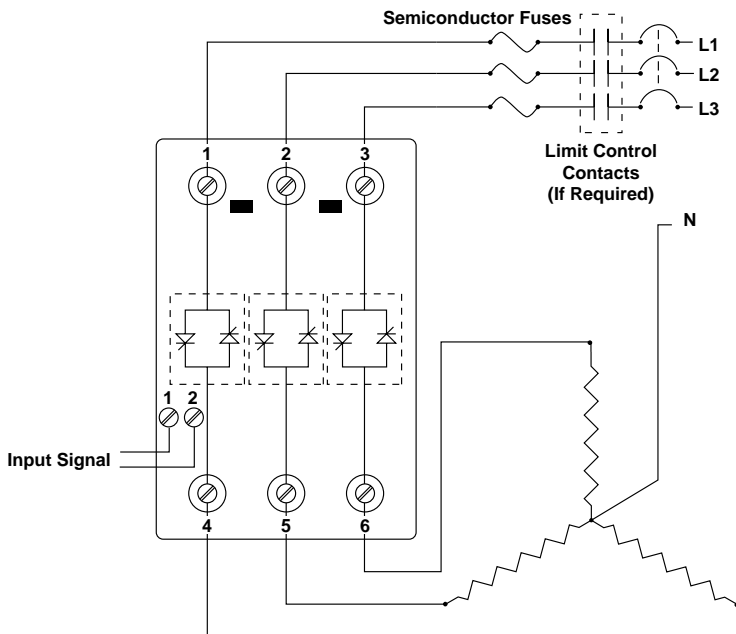
1-Phase Output, Styles A, B and C



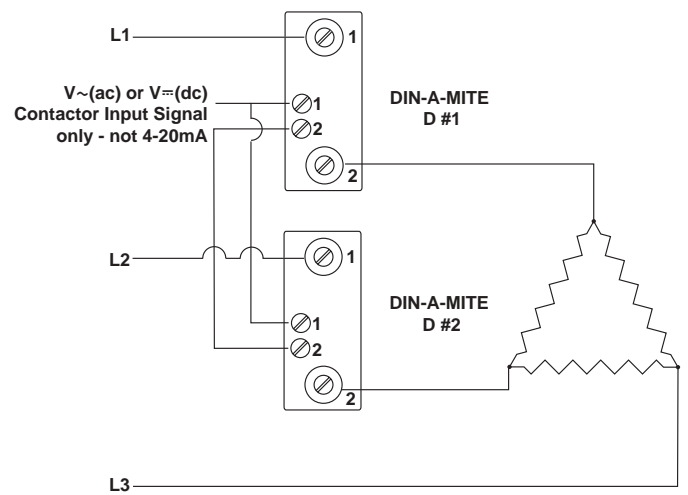
3-Phase, 2-Leg Output, Styles B and C



3-Phase, 3-Leg, 4-Wire Output, Styles B and C



3-Phase, 2-Leg Output, with Two Style D's



## Power Controllers

### SERIES CZR

The SERIES CZR solid state contactor provides a low-cost, highly compact and versatile solid state option for controlling electric heat. With din-rail and back panel mounting standard on every controller, the CZR allows for simple and quick installation.

The extensive capabilities of the SERIES CZR include single-phase, 18 to 50 amp zero-cross and random switching up to 600V~(ac) (see output rating curve). The unique integrated design removes the guesswork associated with selecting a proper heat sink and precise terminations for the application.

SERIES CZR contactors are available in V~(ac/dc) input contactor versions. All configurations are model number dependent and factory selectable.

The SERIES CZR is reliably backed by a two-year warranty from Watlow Winona.

#### Performance Capabilities

- Output 18 to 50 amps
- Output voltage up to 660V~(ac)

#### Features and Benefits

##### DIN-rail or standard panel mount

- Versatile, quick and low-cost installation

##### Compact size

- Reduces panel space; less cost

##### Touch-safe terminals

- Increase safety for installer and operator

##### Mercury-free

- Environmentally safe

##### Faster switching with solid state

- Saves energy and extends heater life

##### Agency Approvals

- UL® recognized, CSA certified, VDE and CE
- Applications requiring agency approval



#### Back-to-back SCR design

- Rugged design

#### Specifications

##### Control Mode

- Zero-cross or random fired contactor output

##### Operator Interface

- Command signal input
- Input signal indication LED

##### Input Command Signal

- Input Type DC1
  - Turn on voltage 4V~(dc) max., turn off voltage 1V~(dc) min.
  - Input current: dc typically 10mA @ 4V~(dc), 13mA @ 32V~(dc)
- Input Type AC1
  - 90 to 140Vrms, must turn on at 90V~(ac), must turn off at 10V~(ac)
  - Input current: 15mA typical @ 120V~(ac)
- Input Type AC2
  - 18 to 36V~(ac) input, must turn on at 18V~(ac), must turn off at 10V~(ac)
  - Input current: 10mA typical @ 24V~(ac)

#### Output Voltage

- 24 volt; 24V~(ac) min. to 280V~(ac) max.
- 480 volt; 48V~(ac) min. to 530V~(ac) max.
- 600 volt; 48V~(ac) min. to 660V~(ac) max. (not available on 18 amp version)
- Off state leakage  
1mA at 25°C (77°F) max. for 600V~(ac) models; 10mA at 25°C (77°F) max. for 24 through 480V~(ac) models
- Holding current: 250mA max.

#### Output Amperage

- See output rating curve. Ratings are into a resistive heater load

#### Output Amperage Rating

Model	18	24	34
Maximum Surge Current 16.6 mSec	625	250	625
Maximum I <sup>2</sup> t for fusing	1,620	260	1,620

Model	42	50
Maximum Surge Current 16.6 mSec	1,000	1,000
Maximum I <sup>2</sup> t for fusing	4,150	6,000

# Power Controllers

F.O.B.: Winona, Minnesota

## SERIES CZR

### Specifications Cont.

#### Agency Approvals

- Class II construction
- UL® 508 recognition, File #E73741 and CSA File LR 700195
- 73/23/EEC CE Low Voltage Directive
- VDE 0805, registration number 126921
- License number 136037 for 18 amp models
- License number 130515 for 24 to 50 amp models

#### Output Terminals

- Compression type
- For 18 amp models:
  - Maximum wire size 3.0 mm (10 AWG), torque to 0.6 Nm (5.3 in. lbs)
- For 24 to 50 amp models:
  - Maximum wire size 16.0 mm (6 AWG stranded) torque to 1.5-1.7 Nm (13-15 in. lbs)

#### Operating Environment

- Up to 80°C (176°F). See output rating curves for your application.
- 0 to 90 percent RH, non-condensing
- Insulation only tested to 3,000 meters
- Units are suitable for “pollution degree 2”
- Cycle time should be less than three seconds

### Mounting

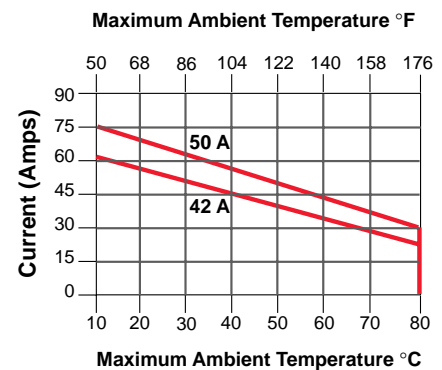
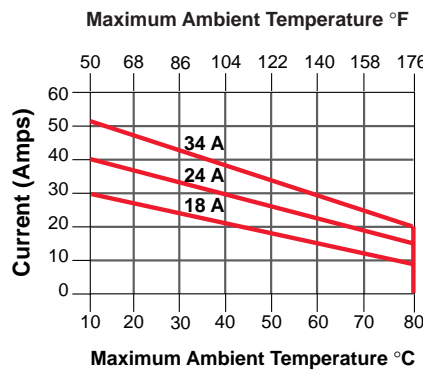
Options include DIN-rail or standard back panel mounting.

- The DIN-rail specification: DIN EN 50022, 35 mm x 7.5 mm (1.37 in. x 0.30 in.)
- Minimum clipping distance: 34.8 mm (1.37 in.)
- Maximum clipping distance: 35.3 mm (1.39 in.)
- Mount cooling fins vertical

### Weight/Dimensions

- 260 g (9.2 oz)
- 24 to 50 amp models: 100 mm (3.95 in.) high x 45 mm (1.75 in.) wide x 109 mm (4.3 in.) deep
- 18 amp models: 100 mm (3.95 in.) high x 22.6 mm (0.89 in.) wide x 99 mm (3.9 in.) deep

### Output Rating Curves



### Ordering Information

To order, complete the code number to the right with the information below:

Control Mode \_\_\_\_\_ C - A V - 0

R = Random  
Z = Zero-cross

Output Amperage \_\_\_\_\_

18 = 18 amp (not available with 600V output)  
24 = 24 amp  
34 = 34 amp  
42 = 42 amp  
50 = 50 amp

Output Voltage \_\_\_\_\_

24 = 24 to 280V~(ac)  
48 = 48 to 530V~(ac)  
60 = 60 to 660V~(ac) (not available with 18A model)

Input Type (Contactor) \_\_\_\_\_

DC1 = 4 to 32V=(dc)  
AC1 = 90 to 140V~(ac)  
AC2 = 18 to 36V~(ac)

**Note:** Do not use the AC1 and AC2 input type models with temperature control outputs that include an AC snubber filter. This could cause the CZR to stay full on.

## Power Controllers

### POWER SERIES

Watlow has manufactured solid state power controllers for over 30 years. Watlow's POWER SERIES represents the latest in SCR power controller technology. This microprocessor-based product offers features and application flexibility unmatched by any other SCR power controller on the market today.

Capabilities of Watlow's POWER SERIES controllers include single-phase and three-phase models from 65 to 250 amps. Field configurable phase-angle or zero cross firing improves application flexibility on site where you need it. The 50/60Hz independent operation allows utilization almost everywhere in the world without special calibration considerations. Serial communication utilizing Modbus™ protocol provides remote control setup and monitoring of load status from a nearby computer station or control room.

On-board semiconductor fusing improves reliability by protecting the SCRs from heater short circuits. Plus, on-board heater bakeout and control diagnostics can help eliminate initial start up problems. All these benefits are in a touch-safe package that can be quickly and easily mounted in your control cabinet.

Watlow's POWER SERIES controllers are UL® listed and C-UL®, so users can be assured that the controllers meet world safety and operational standards.

#### Performance Capabilities

- 65 to 250 amps
- Up to 660V~(ac)



#### Features and Benefits

##### Microprocessor-based technology

- Extremely versatile, field configurable

##### Snap-fit on a pre-mounted plate

- Easy installation

##### Models 65 through 250 amp ratings

- Handles a wide range of loads

##### Adjustable soft start

- Provides application flexibility

##### Heater and control diagnostics capabilities

- Monitor actual heater and control performance

##### Electrically touch-safe package

- Increased safety for installer and users

##### Serial communications with Modbus™ RTU protocol

- Computer control and/or monitoring

##### Multizone capability

- Increased application flexibility, reduced panel space

#### Specifications

##### Power Bases

- Single-phase, (2 SCRs)
- 3-phase, 2-leg control, (4 SCRs), resistive load only, zero cross firing only
- 3-phase, 3-leg control, (6 SCRs)
- 3-phase, 3-leg control, (6 SCRs) for 4-wire wye loads
- Multizone, two and three single-phase zones

##### Output Control Options

- Zero cross control, fixed time base
- Time base one or four seconds with digital programmer
- Zero cross control, variable time base
- Phase-angle control and phase-angle control with current limit (not for 3-phase, 2-leg models)
- Soft start factory default four seconds upon power-up, and adjustable from 0.0 to 120 seconds

# Power Controllers

## POWER SERIES

### Specifications Cont.

- Soft start upon input signal change, output rate of change adjustable to limit max rate of change from 0.1 to 100 percent per 0.1 second. Factory default 10 percent
- Current transformer included when required
- Line voltage compensated (variable time base and phase angle controllers only)
- Standby or non-operational mode

### Output Voltage and Current Rating

- 24 to 120V~(ac) (+10 percent, -15 percent)
- 200 to 480V~(ac) (+10 percent, -15 percent)
- 200 to 600V~(ac) (+10 percent, -15 percent)
- 65 through 250 amps per pole, model dependent; see Output Amperage Chart [page 178](#)
- Minimum load 1 amp rms ac
- Maximum leakage current 5mA

### Alarms

- Single alarm relay
- Latching or non-latching
- Separate high and low values
- Alarm silencing (inhibit) on power up for alarm
- Alarm indication LEDs, shorted SCR, open heater
- Electromechanical relay, form C contact, software configurable
- Minimum load current 10mA @ 5V=(dc)
- Rated resistive loads: 3 amps @ 250V~(ac) or 30V=(dc) max., inductive load rating 1.5 amps with a power factor  $\geq 0.4$  without contact suppression

### Heater Bakeout

- For single-phase (phase to neutral) and 3-phase 6 SCR models only (not for 3-phase, 2-leg models)
- Soft start with over current trip, runs until programmed bakeout time expires, then goes burst or phase-angle firing. Factory default of 24 hours
- Adjustable 0 - 9999 minutes with over current trip
- Internal current transformer included

### Command Signal Input Analog

- Field selectable linear voltage and current of low and high points within 0-20mA and 0-10V=(dc)
- Manual control input through front panel as a percent power
- Factory default 4-20mA input
- Voltage input impedance 11k $\Omega$  nominal
- Current input impedance 100 $\Omega$  nominal

### Digital

- On-board digital programmer/display and optional serial communications

### Retransmit

- Field selectable and scalable within 0-20mA, 800 $\Omega$  maximum or 0-10V=(dc), load, 1K $\Omega$  minimum load. The default is 4-20mA
- Resolution:  
mA ranges =  $\pm 5\mu\text{A}$  nominal  
V=(dc) = ranges 2.5mV nominal
- Calibration accuracy:  
mA ranges =  $\pm 20\mu\text{A}$   
V=(dc) ranges = 10mV nominal
- Temperature stability: 100ppm $^{\circ}\text{C}$

### Digital Programmer/Display and Communications Capabilities

- Programming functions
- Adjust input and output control type, alarms and soft start, heater bakeout and current limit prompts
- Monitoring functions
- Display input and output values along with actual output current
- Data retention of digital programmer/display upon power failure via nonvolatile memory

### Serial Communications

- RS-232 for single drop control
- EIA-485 for single or multidrop control
- 32 units maximum can be connected. With additional 485 repeater hardware, up to 247 units may be connected
- Isolated
- Modbus™ RTU protocol
- 1200, 2400, 4800, 9600, 19200 baud rates

### Controller Power Supply

- Universal line voltage input range 100 to 240V~(ac) (+10 percent, -15 percent) at 55VA max
- 50/60Hz  $\pm 5$  percent line frequency independent
- Controller line voltage for electronic power supply can be run on separate line voltage

### Natural Convection and Fan Cooled Models

- Cabinet venting may be required
- See chart on [page 178](#) for models that include fan cooling

### Power Dissipation (Watts)

- Approximately 1.25 watts/amp per controlled leg



## Power Controllers

### POWER SERIES

#### Specifications Cont.

#### Isolation

- Command signal to load and line/load to ground 2200V~(ac) minimum
- On-board semiconductor fuses provide SCR protection

#### Mounting

- Mounts on a removable subplate
- Heat sink fins must be mounted in vertical orientation

#### High Current Terminals

- Touch safe
- 10 mm (0.375 in.) Allen head compression terminals will accept #6 AWG to 350 MCM wire. Allen wrench adapter (included) for 10 mm (0.375 in.) socket, 6 point only
- Torque to 180 in.-lbs (20.3 Nm)
- Wire strip to 30 mm (1.125 in.)

#### Controller Terminals

- Touch safe
- 2.5 mm (0.125 in.) blade screw-driver, accepts 12-22 AWG or 2 No. 22-18 AWG wires
- Torque to 8 in.-lbs (0.9 Nm)
- Wire strip to 6 mm (0.24 in.)

#### Operating Environment

- 50°C (122°F) base rating
- 0 to 60°C (32 to 140°F) fan cooled
- 0 to 65°C (32 to 149°F) natural convection cooled
- 0 to 90 percent RH, non-condensing
- Meets EN50178, pollution degree three

#### Storage Temperature

- -40 to 85°C (-40 to 185°F)

#### Shipping Weight

- 10.3 kg (23 lbs)

#### Agency Approvals

- UL® 508 listed, File #E73741, Vol. three, Sec. two
- C-UL® listed to C22.2 NO. 14
- VDE EN 50178 License 115054
- CE 89/336/EEC (EN61326), Class A with filter, CE 73/23/EEC (EN50178)

#### Single-Phase Configuration

This configuration can be purchased with any or all the features available on the POWER SERIES, based on customer preference. It is intended for resistive heaters, but can also be used on transformer connected loads in the phase-angle firing mode.

#### Three-Phase, Two-Leg Configuration

This configuration is intended for zero cross firing only into a stable resistive heater. Typically, a three-phase delta or ungrounded wye connected heater is used and only two of the three V~ line phases are switched. The third-phase is a direct connection through a bussbar on board the POWER SERIES. Heater current monitoring and kVA options are available via the heater diagnostics option.

#### Three-Phase, Three Leg Configuration

All POWER SERIES options are available with this configuration. It works well with phase-angle firing into a three-phase, three-wire wye or delta connected heater. In this configuration, the more common applications are transformer connected loads with heaters requiring a soft start and/or current limiting.

The three-phase, four-wire configuration is intended for zero cross firing into a three-phase grounded wye/star heater (This is a separate hardware option, model number dependent.)

#### Single-Phase, Multizone Configuration

This configuration is available in two and three single-phase zones and all the features of a single-phase unit are available. (Note that there is only one alarm relay and all zones in the controller must use the same control method.)

#### Heater Diagnostics

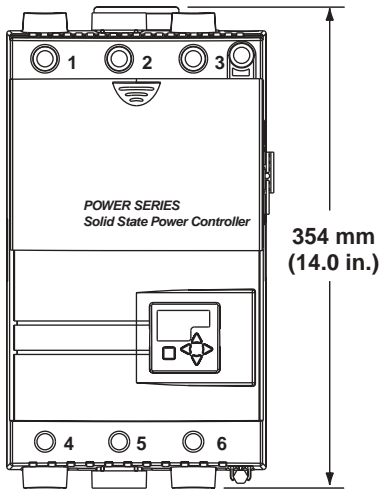
Heater diagnostics may include some or all of the features that require heater current monitoring, depending on the model selected. Heater current monitoring is only available with heater diagnostics installed on the controller. The features dependent on heater current monitoring are heater bakeout, current limiting, heater kVA monitoring, retransmit and heater monitoring alarms such as open heater, heater out of tolerance, load balance and shorted SCR detection/error. Heater diagnostics must also be installed if you need phase-angle control with current limit.

# Power Controllers

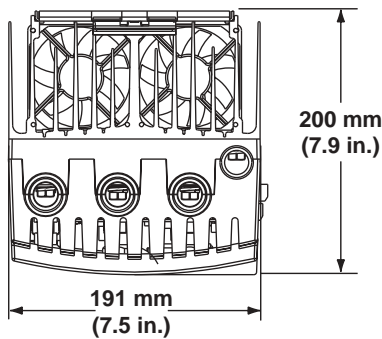
F.O.B.: Winona, Minnesota

## POWER SERIES

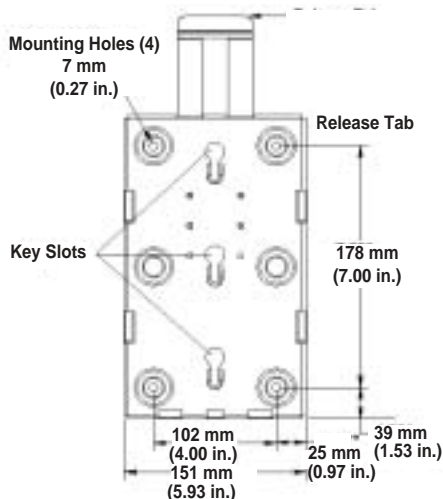
Front View



Top View



### Mounting Plate Dimensions



### Ordering Information

To order, complete the code number on the right with the information below.

**POWER SERIES** = Microprocessor-based, solid state power controller

**Package Style** \_\_\_\_\_

C = 65 to 250 amps

**Phase** \_\_\_\_\_

1 = 1-phase  
 2 = 3-phase/2-leg control, (4 SCRs)  
 3 = 3-phase/3-leg control, (6 SCRs)  
 4 = 3-phase/4-wire, wye connected load  
 8 = 2 single-phase zones  
 9 = 3 single-phase zones

**Heater Diagnostics** \_\_\_\_\_

0 = None  
 1 = Heater diagnostics (required for any heater current monitoring or current limiting).

**Output Amperage Rating** \_\_\_\_\_  
 (See amperage chart below.)

**Output Voltage Rating** \_\_\_\_\_

A = 24 to 120V  
 B = 200 to 480V  
 C = 200 to 600V

**Communications** \_\_\_\_\_

0 = None  
 1 = EIA/TIA-232/485 communications, opto-isolated (field selectable)

**Feedback/Retransmit** \_\_\_\_\_

0 = None  
 1 = Load current feedback (0 - 10V or 0 - 20mA scalable retransmit output)  
 Must have heater diagnostics selected)

**Custom** \_\_\_\_\_

00 = None  
 AA = No watlow logo with agency approval marks  
 XX = Custom, consult factory for options

**Note:** See replacement semiconductor fuses on [page 190](#).

### Amperage Chart—50°C (122°F)

#### Non-Fan Cooled

Single Phase		2-Zone and 3-Phase, 2-Leg		3-Zone and 3-Phase, 3-Leg	
Code	Amperage	Code	Amperage	Code	Amperage
N20	100A	N20	80A	N20	65A
N25	140A	N25	105A	N25	85A
N30	165A	N30	120A	N30	105A

#### Fan Cooled

Single Phase		3-Phase, 2-Leg		3-Phase, 3-Leg	
Code	Amperage	Code	Amperage	Code	Amperage
F20	125A	F20	120A	F20	90A
F25	200A	F25	160A	F25	140A
F30	250A	F30	185A	F30	155A

## Power Controllers

### E-SAFE® RELAY

The E-SAFE® mercury-free relay from Watlow provides reliable and accurate power switching for processing applications.

This relay can exceed the performance of typical mercury relays while fitting within the same footprint. The E-SAFE RELAY bridges the gap between mercury displacement relays (MDRs) and solid state relays (SSRs) by providing superior power switching in a non-mercury solution at a lower cost. This mercury-free relay also provides longer contact life and higher performance than typical mechanical relays used in equipment.

The E-SAFE RELAY eliminates mercury, reduces arcing and electrical noise and provides processors with an excellent solution for equipment power switching. The absence of mercury in the E-SAFE RELAY reduces toxic metal hazards in processing environments.

#### Performance Capabilities

- Up to 40 amps
- 240 V~(ac)

#### Features and Benefits

##### High current transient suppression

- High reliability
- Extended contact life
- Low electrical noise
- Out performs mechanical contactors

##### Compact size

- Fits footprint of definite purpose relays and most 30 to 50 amp mercury relays
- Easily retrofittable

##### Environmentally safer than mercury contactors

- Eliminates toxic waste (mercury) from the application environment and disposal from failed mercury contactors

##### Agency approvals

- UL® 508 listed and C-UL®



#### Specifications

- Output rating: from 20A to 40A maximum resistive load at -30 to 55°C (-22 to 130°F)
- Maximum power switching voltage: 208/240V~(ac), three pole
- Coil voltage: 24V~(ac), 120V~(ac) and 220V~(ac)
- Maximum operating ambient temperature: 55°C (130°F)
- Maximum cycle rate: 30 cycles per minute

#### Control Mode

- Zero cross switching output
- Form A outputs, without arcing
- Cycle rate: 30 cycles per minute, maximum

#### Input Command Signal

- 24V~(ac) (+10 / -15 percent), 120V~(ac) (+10 / -10 percent) 220V~(ac) (+10 / -15 percent)
- 50/60Hz, less than 9VA

**Note:** Do not place an R/C snubber (filter) on the E-SAFE RELAY input command signal. Do not place on temperature control output.

#### Output Rating

- 20A to 40A max. per pole into a resistive load
- 208/240V~(ac), 50/60Hz, each pole
- Three pole

#### Operating Life

- 1,000,000 switching cycles at max. rating

#### Weight/Dimensions

- Weight: 0.560 kg (1.25 lbs.)
- 96.0 mm (3.78 in.) high x 82.3 mm (3.24 in.) wide x 90.2 mm (3.55 in.) deep

#### Terminals

- Controller input: Compression, accept #22 to 10 (0.2 to 6 mm<sup>2</sup>) AWG wire. Torque to 7 in.-lbs (0.8 Nm) max.
- Output: Compression, accept #14 to 6 (2.5 to 16 mm<sup>2</sup>) AWG wire. Torque to 35 in.-lbs max. (3.95 Nm)

# Power Controllers

F.O.B.: Winona, Minnesota

## E-SAFE RELAY

### Specifications Cont.

#### Operating Environment

- Operating temperature up to -30 to 55°C (-22 to 130°F)
- 5 to 85 percent RH, non-condensing
- Shipping and storage temperature -40 to 85°C (-40 to 185°F)

#### Mounting

- Definite purpose relay and MDR mounting footprint

#### Agency Approvals

- UL® 508 listed, C-UL® approved, File #E213822

### Ordering Information

To order, complete the code number on the right with the information below.

**E-SAFE RELAY** = Hybrid zero cross contactor

#### Amperage

20 = 20 amp

40 = 30 amp

#### Number of Poles

3 = Three pole

#### Control Voltage

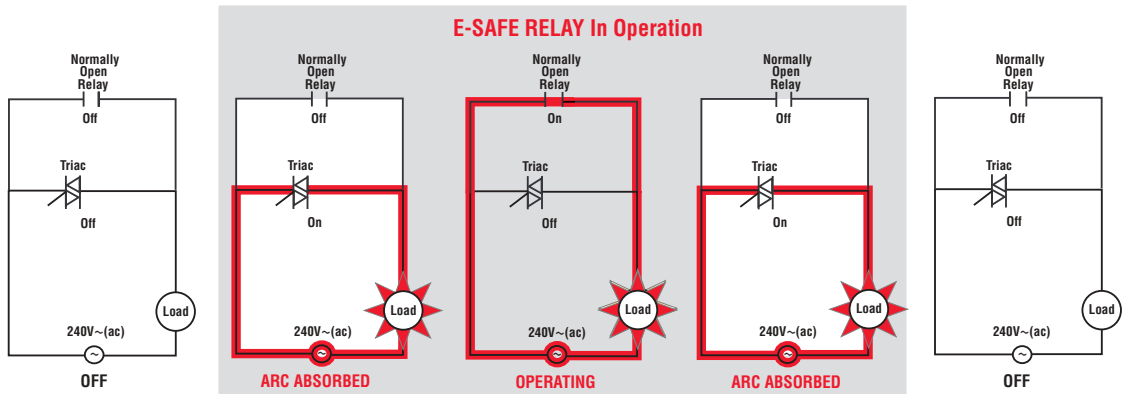
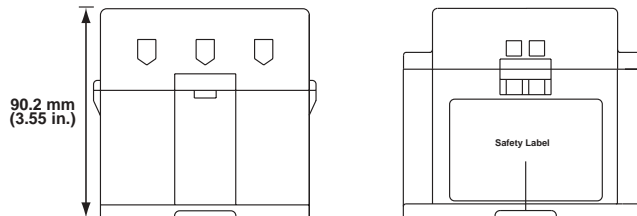
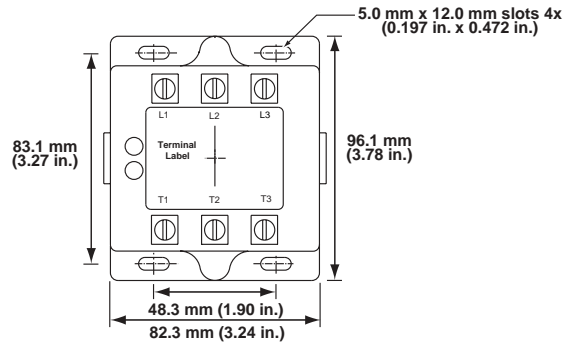
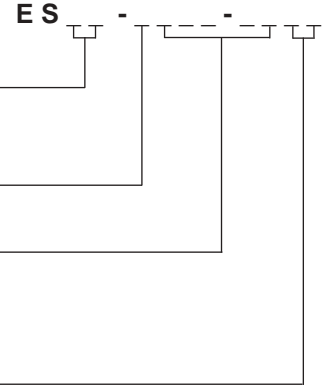
024-AC = 24V~(ac)

120-AC = 120V~(ac)

220-AC = 220V~(ac)

#### Label Options

00 = Standard product



Conduction Path

## Power Controllers

### Solid State Relays (SSRs)

Lower cost and longer heater life are the main advantages provided by Watlow solid state relays (SSRs). A unique loop-powered firing card permits a very fast time proportional cycle rate of less than one-tenth of a second that allows using higher watt density heating elements and/or increasing heater life. In addition, temperature control accuracy is optimized with this fast cycle card. Watlow SSRs can be ordered with all the components necessary for hassle-free mounting, including heatsinks, thermal foil and bevel washers along with semiconductor fuses.

#### Performance Capabilities

- Burst firing, 10 to 75 amps
- Operating environment -25 to 50°C (-13 to 122°F) with proper heatsink
- Can switch up to 575V~(ac)

#### Features and Benefits

##### Fast cycle card

- Heater life is increased, temperature control is optimized and higher watt density heaters can be used

##### Zero cross firing<sup>①</sup>

- Minimal electrical noise

##### Back-to-back SCR design

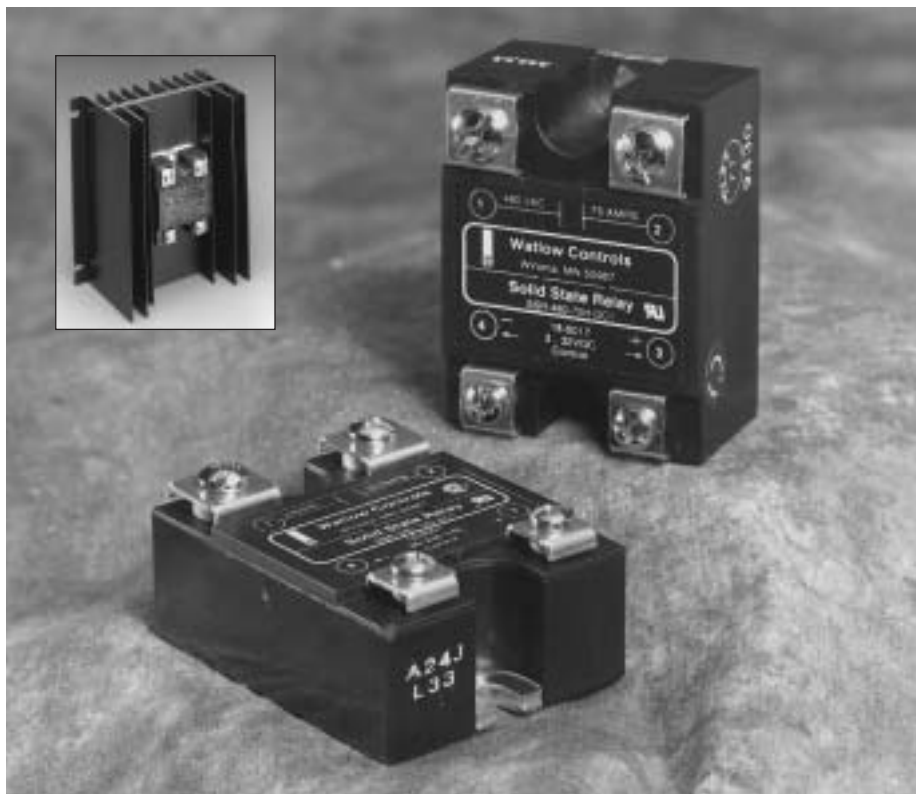
- Will withstand harsh or hostile environments

##### UL<sup>®</sup> recognized, CSA certified, VDE licensed

- For applications requiring agency approval

##### Applications

- Food processing equipment
- Lighting equipment
- Resistive heating



#### Specifications

Standard to all SSRs:

##### Agency Approvals

- UL<sup>®</sup> 873, File #E151484, E73741
- CSA #LR700195
- VDE 0805 EN60950, File #90995ÜG
- CE 60950

##### Dielectric Strength

- 4000 Volts RMS

##### DC Control Input

Voltage range

- 3-32V=(dc), model no. dependent
- 4-32V=(dc), model no. dependent

Input current

- 4mA @ 5V=(dc)

Turn on voltage

- 3V=(dc) minimum

Turn off voltage

- 1V=(dc) maximum

##### AC Control Input

Voltage range

- 90-280V~(ac)

Input current

- 2mA max. @ 120V~(ac)

Turn on voltage

- 90V~(ac) minimum

Turn off voltage

- 10V~(ac) maximum

##### Output (Maximum)

Forward voltage drop

- 1.5V~(ac) typically

Minimum holding current

- 50mA~(ac)

Turn on-off time

- 8.3ms

##### Storage Temperature

- -40 to 85°C (-40 to 185°F)

##### SSR Weight

- 0.090 kg (0.21 lb)

##### Shipping Weight

- 0.045 kg (1.0 lb)

<sup>①</sup> Not available on random fired models.

# Power Controllers

F.O.B.: Winona, Minnesota

## Solid State Relays (SSRs)

**Ordering Information** — Order by selecting the code number from the specifications table below.

Code Number	Output Current (Amps)	Output Voltage	Input Control Voltage	Off State Leakage	One Cycle Surge Current Amps	A <sup>2</sup> Sec. I <sup>2</sup> t For Fuse	Thermal Resistance	Frequency Range	Output Voltage Range	PIV Rating
SSR-240-10A-DC1	10	120/ 240V~(ac)	3-32V=(dc) Zero Cross	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-25A-DC1	25	120/ 240V~(ac)	3-32V=(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-40A-DC1	40	120/ 240V~(ac)	3-32V=(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-50A-DC1	50	120/ 240V~(ac)	3-32V=(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-75A-DC1	75	120/ 240V~(ac)	3-32V=(dc) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-10A-AC1	10	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-25A-AC1	25	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-40A-AC1	40	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-50A-AC1	50	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-240-75A-AC1	75	120/ 240V~(ac)	90-280V~(ac) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-480-25A-DC1	25	480V~(ac)	4-32V=(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-50A-DC1	50	480V~(ac)	4-32V=(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-75A-DC1	75	480V~(ac)	4-32V=(dc) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-25A-AC1	25	480V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-50A-AC1	50	480V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-480-75A-AC1	75	480V~(ac)	90-280V~(ac) Zero Cross	10mA	1000	4150	0.31°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-25A-DC1	25	600V~(ac)	4-32V=(dc) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-50A-DC1	50	600V~(ac)	4-32V=(dc) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-75A-DC1	75	600V~(ac)	4-32V=(dc) Zero Cross	10mA	1200	6000	0.28°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-25A-AC1	25	600V~(ac)	90-280V~(ac) Zero Cross	10mA	250	260	1.02°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-50A-AC1	50	600V~(ac)	90-280V~(ac) Zero Cross	10mA	625	1620	0.63°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-600-75A-AC1	75	600V~(ac)	90-280V~(ac) Zero Cross	10mA	1200	6000	0.28°C/W	47-63Hz	48-660V~(ac)	1200V~(ac)
SSR-240-10A-RND	10	240V~(ac)	4-32V=(dc) Random	10mA	120	60	1.48°C/W	47-63Hz	24-280V~(ac)	600V~(ac)
SSR-480-50A-RND	50	480V~(ac)	4-32V=(dc) Random	10mA	625	1620	0.63°C/W	47-63Hz	48-530V~(ac)	1200V~(ac)
SSR-480-75A-RND	75	480V~(ac)	4-32V=(dc) Random	10mA	1000	4150	0.31°C/W	47-63Hz	48-530V~(ac)	1200V~(ac)
SSR-100-20A-DC1	20	100V=(dc)	3-32V=(dc)	0.3mA	NA	NA	1.06°C/W	N/A	0-100V=(dc)	N/A

### Availability

**Stock:** Same day shipment

# Power Controllers

## Solid State Relays (SSRs)

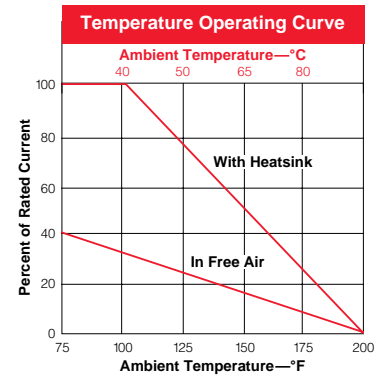
### Application Hints

#### Thermal Transfer

A thermal foil is provided with each solid state relay for mounting on the base of the relay to improve heat transfer. In addition, two bevel washers are supplied to provide the proper pressure for the transfer of

heat. Use two #8-32 screws, 15.8 mm (0.625 in.) long to secure the relay to the heatsink. See the derating curve, Temperature Operating Curve, for operation without heatsinks.

**Note:** This rating curve applies only to 10 and 25 amp SSRs. 40 through 75 amp SSRs should not exceed a seven amp load without using a heatsink.



### Replacing Contactors or MDRs

Improvements in heater life and control accuracy can be anticipated with solid state relays operated with rapid cycle times as compared to slower operating electromechanical relays or even mercury displacement relays in some applications. When replacing these types of relays with the SSR, it is important to consider two aspects:

#### 1. Heat

Solid state devices require a small voltage to turn on, which is consumed as heat (1.5 watts/amp). This heat must be removed from the device, and is usually accomplished by mounting the relay on heatsinks.

#### 2. Failure Mode

Solid state devices should last for many years when properly protected with voltage and RC suppressors

mounted on appropriate heatsinks, and when fused against the high currents caused by electrical shorts. However, if the unit fails, the most probable condition will be a short. Both mechanical relays mentioned above also have a good probability of failing short. In all cases where uncontrolled full power can cause damage, it is recommended that a high limit temperature controller and contactor be used for protection.

### System Diagrams

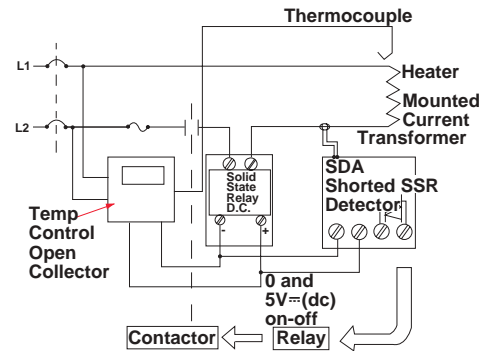
#### Shorted SSR Alarm—SDA

The most prevalent concern when using solid state relays is the possibility of a relay failing in a shorted condition. With this in mind, Watlow has designed a cost effective "Shorted SSR Alarm" SDA.

The device monitors the output (current through the heater) and activates a triac (alarm) if there is no

command signal from the temperature controller. The triac can be wired to a bell, or to a normally closed latching relay to remove power to the heater.

#### Single Phase—SDA



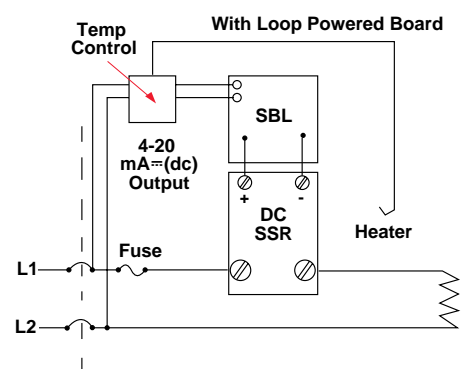
#### Single-Phase—SBL

4-20mA loop powered firing card for direct mounting on a dc solid state relay. Can be used in three-phase mode with two dc input and zero cross solid state relays (SSR).

#### Single-Phase—AT and BT

Requires external power switching transformer. Consult factory for part number and voltage required. AT requires a V<sub>ac</sub>(dc) input, random fired output SSR. BT requires V<sub>ac</sub>(dc) input, zero cross output SSR.

SSR Card	Description	Code No.
SBL	Burst firing 4-20mA only loop powered card for dc input relays only	08-5399
SDA	Shorted SSR alarm for dc input relays only	08-5386
AT	Single-phase, phase-angle firing	08-5422
BT	Single-phase variable time base, single cycle, burst firing, 4-20mA input	08-5406

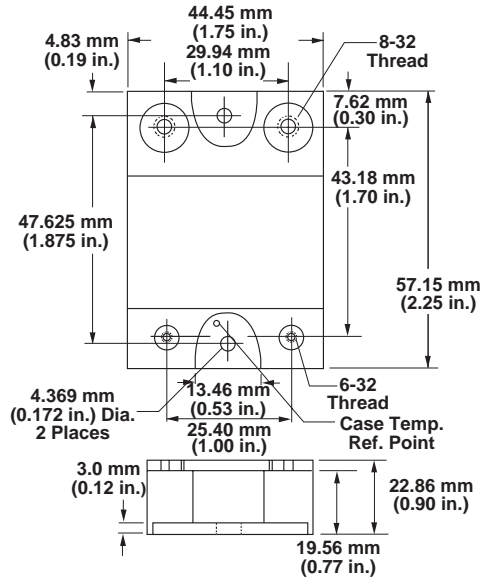


# Power Controllers

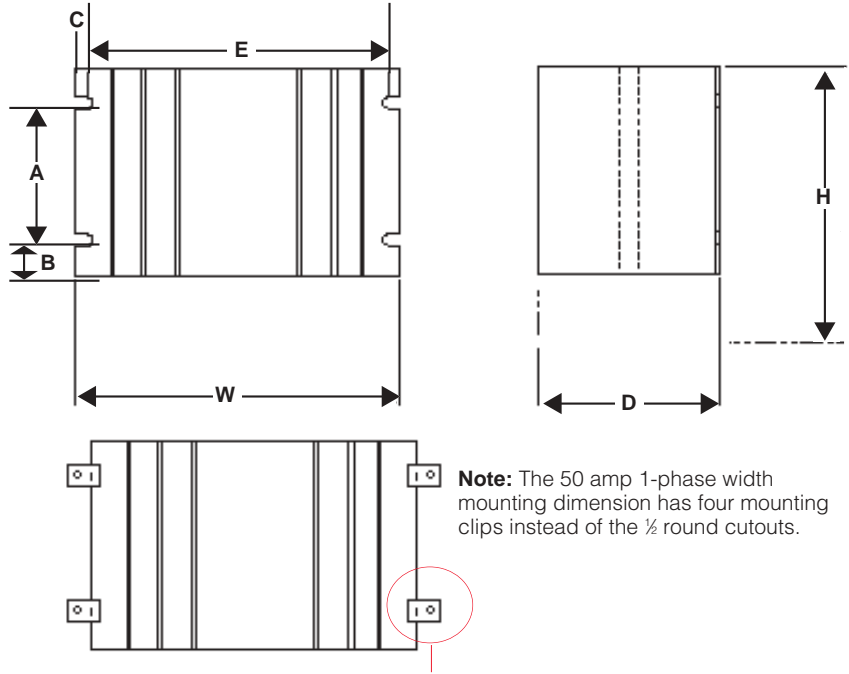
## Solid State Relays (SSRs)

### Dimensions

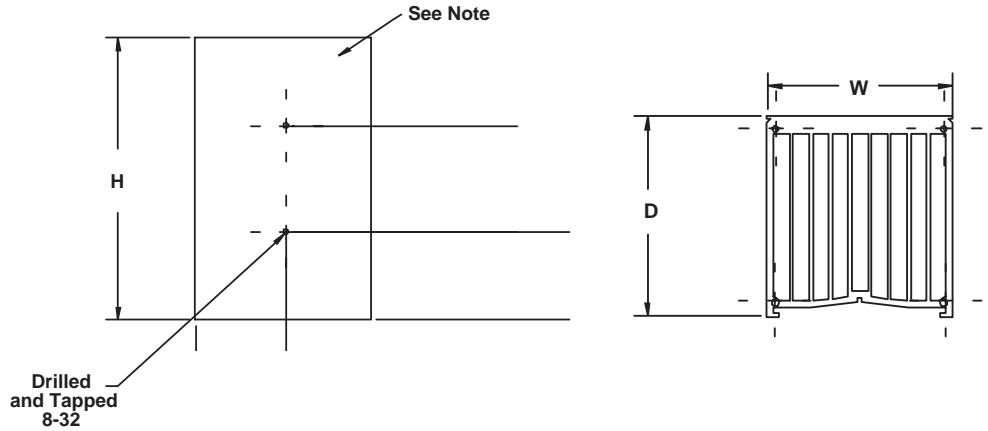
#### Solid State Relay



#### Heatsinks - HS-10, 25, 40, 50 and 75



#### Z100-0815-000 - A, B and C Heatsinks



#### Heatsinks – 1-Phase

Amps	Maximum Overall Dimensions			Mounting Dimensions				Fan Cooled	Code Number
	Height (H) mm (in.)	Width (W) mm (in.)	Depth (D) mm (in.)	A mm (in.)	B mm (in.)	C mm (in.)	E mm (in.)		
10	100 (4.00)	115 (4.50)	25 (1.03)	75 (3.00)	12 (0.50)	4 (0.15)	105 (4.20)	No	<b>HS-10</b>
18	94 (3.70)	46 (1.80)	48 (1.90)	N/A N/A	N/A N/A	N/A N/A	N/A N/A	No	<b>Z100-0815-000A</b>
25	75 (3.00)	120 (4.75)	65 (2.60)	50 (2.00)	12 (0.50)	4 (0.15)	115 (4.45)	No	<b>HS-25</b>
35	94 (3.70)	81 (3.20)	74 (2.90)	N/A N/A	N/A N/A	N/A N/A	N/A N/A	No	<b>Z100-0815-000B</b>
40	140 (5.50)	120 (4.75)	65 (2.60)	115 (4.50)	12 (0.50)	4 (0.15)	115 (4.45)	No	<b>HS-40</b>
50	230 (9.00)	125 (5.00)	90 (3.50)	175 (7.00)	N/A N/A	N/A N/A	150 (5.90)	No	<b>HS-50</b>
55	145 (5.70)	81 (3.20)	91 (3.60)	N/A N/A	N/A N/A	N/A N/A	N/A N/A	No	<b>Z100-0815-000C</b>
75	190 (7.50)	125 (5.00)	140 (5.50)	175 (7.00)	25 (1.00)	4 (0.15)	120 (4.70)	Yes <sup>②</sup>	<b>HS-75-1</b>
75	190 (7.50)	125 (5.00)	140 (5.50)	175 (7.00)	25 (1.00)	4 (0.15)	120 (4.70)	Yes <sup>③</sup>	<b>HS-75-2</b>

② Heatsink includes fan; requires customer to supply and wire 120V~(ac) to the fan.

③ Heatsink includes fan; requires customer to supply and wire 240V~(ac) to the fan.

Note: Z100-0815-000 A, B and C are DIN-rail or back panel mount heatsinks.



## Power Controllers

### QPAC SCRs

Watlow's modular QPAC SERIES SCR power controller features plug-in flexibility with ratings from 150 to 1000 amps in 1-phase, 3-phase, 2-leg and 3-phase, 3-leg. A variety of transformers from 120V~(ac) to 575V~(ac), along with 50/60Hz operation, enables the QPAC to operate virtually anywhere in the world. Firing modes are defined by plug-in cards that set the QPAC for:

- Burst fire variable time base
- Phase-angle operation
- Burst fire firing to act as a solid state contactor

Models are available with a wide variety of options. High speed semiconductor fuses are included to protect the SCR from higher currents. This modular approach, using a standard base and plug-in transformers and control cards, allows quick shipment of a power controller specifically tailored to a particular application.

#### Performance Capabilities

- Available in ratings from 150 to 1000 amps
- Ambient operating temperatures 0 to 50°C (32 to 122°F)

#### Features and Benefits

##### Completely modular power controller

- Delivers application flexibility with a variety of plug-in transformers and control cards

##### Available in 150 to 1000 amp ratings

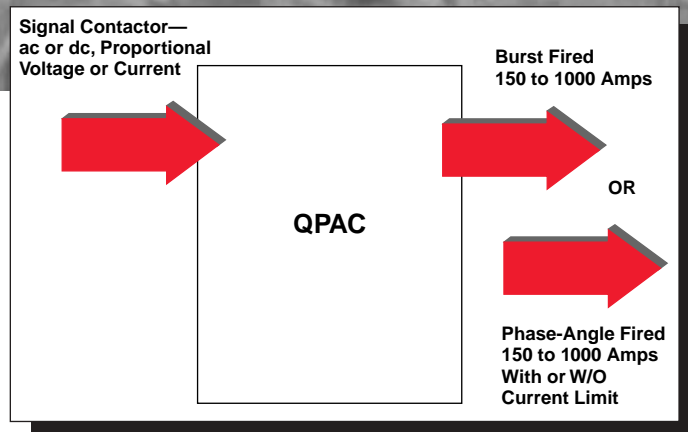
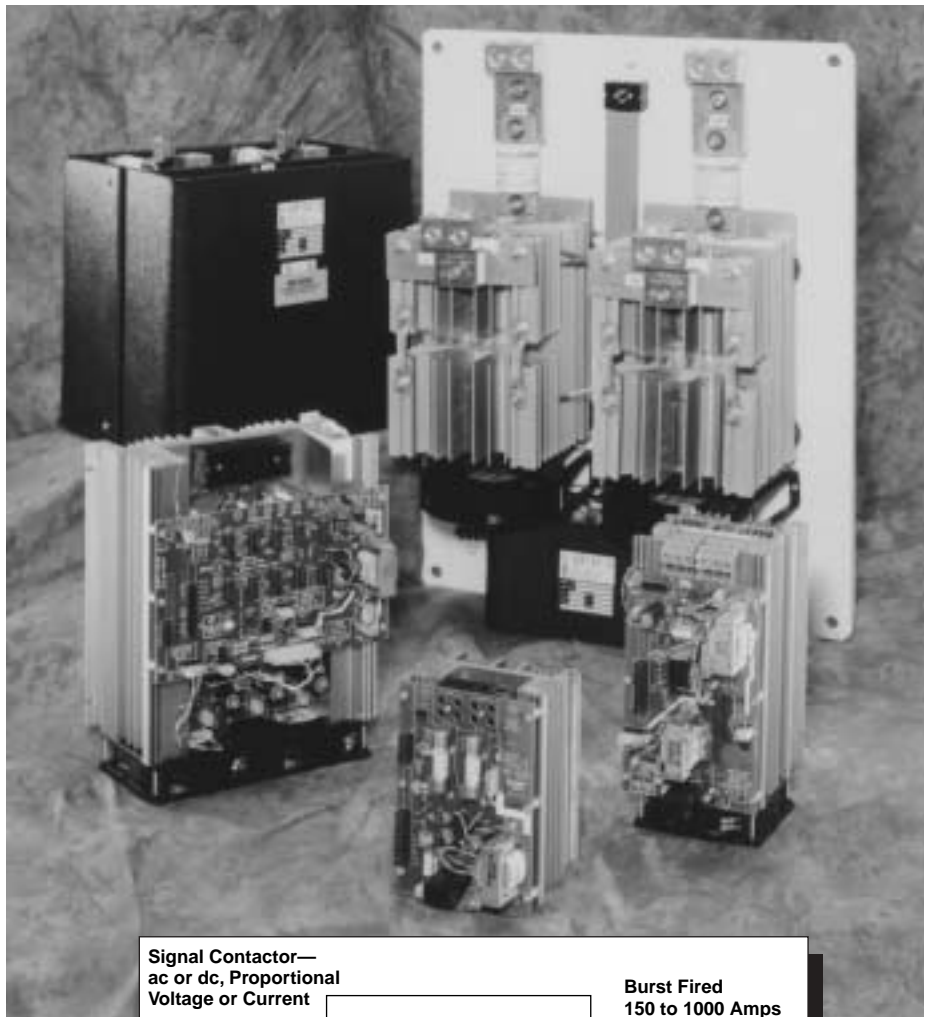
- Provides appropriate power switching for small and large loads

##### Burst firing, solid state contactor and phase-angle firing modes

- Meets most application requirements

##### High speed semiconductor fuses and RC snubbers

- Protects the SCR from voltage or current surges or spikes



##### High capacity heatsinks for 50°C (122°F) ambient operation

- Allows using full power rating in industrial applications

##### Open heater or shorted SCR detector option

- On burst fire models, provides diagnostic capability

##### Standard models up to 300 amps UL®508 listed and C-UL®

- For applications requiring agency approvals

# Power Controllers

## QPAC SCRs

### Specifications

#### Operation

#### Modular control base with plug-in card and transformer

- Plug-in control cards
  - Solid state contactor, ac or dc input
  - Burst fire control, fixed or variable time base
  - Phase-angle fire control with soft start
- Phase-angle control with soft start and current limiting
- Plug-in transformers (50/60Hz)
- 120, 208, 240, 380, 415, 480, 575V~(ac) operation

#### Power bases

- Single-phase (Q01), 1 pair of SCRs
- Three-phase (Q32), 2-leg control, 2 pair SCRs. Resistive load only, burst firing only.
- Three-phase (Q33), three pair hybrid SCRs/diodes. Recommended for phase-angle only with balanced load.

#### Agency Approvals

- UL® 508 and C-UL® Listed, File #E73741

#### Control Card Inputs

#### (CA) Solid state contactor, AC input

- 120V~(ac) @ 30mA minimum
- Ac signal input sources (i.e., triacs or mechanical relay outputs with noise suppression) require customer supplied resistors across the power controller ac command signal input terminals to prevent false firing.
  - 24V~(ac) input, 200Ω/10 watts typical;
  - 120V~(ac) input, 1kΩ/25 watts typical;
  - 240V~(ac) input, two 1kΩ/25 watts in series typical

#### (CD) Solid state contactor, DC input

- On, 4-10V=(dc); off, 0.5V=(dc)
- Built-in noise reduction network

#### (BF) Burst firing control fixed time base

- Process input factory set @ 4-20mA=(dc)
- Input impedance 250Ω (clip resistor for 5kΩ voltage input), or manual control input
- Time base four seconds (clip resistor for one sec)

#### (BV) Burst firing control, variable time base

- Process input factory set @ 4-20mA=(dc)
- Input impedance 250Ω (clip resistor for 5kΩ voltage input), or manual control input

#### (AF) Phase-angle control

- Process input factory set @ 4-20mA=(dc)
- Input impedance 250Ω (clip resistor for 5kΩ voltage input), or manual control input
- Soft start approximately six seconds upon power-up, one second upon set point change

#### (AL) Phase-angle control with current limit

- Process input factory set @ 4-20mA=(dc)
- Input impedance 250Ω (clip resistor for 5kΩ voltage input), or manual control input
- Soft start approximately 10 seconds upon power-up, one second upon set point change
- Current transformer included

#### Open Heater/Shorted SCR Detector

- Triac output
- 24 to 240V~(ac), 300mA @ 25°C, 125mA @ 80°C
- Energizes on alarm
- Holding current 200μA minimum
- Latching current 5mA typical

#### Outputs

- 120V~(ac) through 575V~(ac)
- One, two, or three leg
- 150 through 1000 amps per leg

#### Line Voltage/Power

- 50/60Hz ac line frequency
- Voltage: ±10 percent, 120, 208, 240, 277, 380, 415, 480, 575V~(ac)

#### Line Voltage Compensation

- 10 percent Δ in line, 2 percent Δ in load in the 30 percent to 70 percent power region (AF, AL and BV)

#### Power Dissipation (Watts)

- 1.5 watts/amps per controlled leg

#### Isolation

- Command signal to load 1250V~(ac) minimum

#### Linearity

- Within 2 percent, 30 to 70 percent power region (All units except CA & CD)

#### Off-State Leakage Current

- 20mA @ 480V~(ac)

#### SCR Protection

- Semiconductor fuses provided dv/dt 200V/μsec minimum
- MOV® and RC snubber network standard
- (Q32) 3rd leg fuse kit may be used, but not required, with 3-phase, 2-leg models

#### Mounting

- Heatsink fins must be mounted in vertical orientation

# Power Controllers

F.O.B.: Winona, Minnesota

## QPAC SCRs

### Controller Weights

Amps	1Ø	3Ø, 2-leg	3Ø, 3-wire
	Q01	Q32	Q33
	kg (lbs)	kg (lbs)	kg (lbs)
150	6.8 (15)	16.3 (36)	22.7 (50)
200	6.8 (15)	16.3 (36)	22.7 (50)
300	6.8 (15)	16.3 (36)	22.7 (50)
400-600	19.9 (44)	38.5 (85)	45.4 (100)
800-1000	22.2 (49)	54.4 (120)	61.2 (135)

### Specifications Cont.

#### Operating Environment

- 0 to 50°C (32 to 122°F)
- 0 to 90 percent RH, non-condensing

#### Storage Temperature

- -40 to 85°C (-40 to 185°F)

#### Options

- Manual Control Kit for process input cards (1kΩ potentiometer) order #08-5362 separately

#### Note

- The Q32 and Q33 models are 50/60Hz line frequency dependent. Specify application line frequency when ordering for proper calibration.

#### Availability

Shipment within five working days on models up through 300 amps. Beyond 300 amps consult the factory.

### Ordering Information

To order, complete the code number to the right with the information below:

**QPAC** = Modular power controller; phase-angle, burst or solid state contactor with fuse(s) and holder(s) included.

#### Phase

- 01 = Single-phase
- 32 = 3-phase,-2 leg (optional 3rd leg fuse kit extra.)
- 33 = 3-phase, 3-leg

#### Operating and Output Voltage

- 12 = 120V~(ac)
- 20 = 208V~(ac)
- 24 = 240V~(ac)
- 27 = 277V~(ac)
- 38 = 380V~(ac)
- 41 = 415V~(ac)
- 48 = 480V~(ac)
- 57 = 575V~(ac)

#### Cooling Fan Voltage<sup>®</sup>

Customer to supply wiring and hook-up.

- 1 = 120V~(ac)
- 2 = 240V~(ac)

#### Output Current (Amps)

- 150 = 150 amps
- 200 = 200 amps
- 300 = 300 amps
- 400 = 400 amps
- 500 = 500 amps
- 600 = 600 amps
- 800 = 800 amps
- 01K = 1000 amps

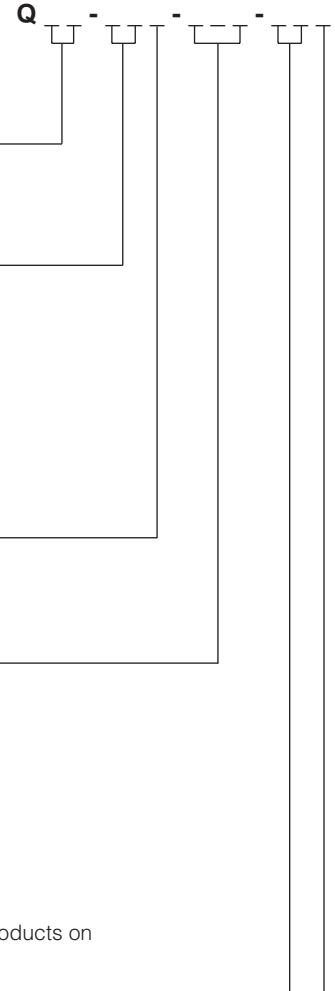
**Note:** See POWER SERIES and DIN-A-MITE<sup>®</sup> equivalent products on pages 168 and 175 for 30 through 100 amps.

#### Input Control Card

- CA = Solid state ac input (08-5285) contactor
- CD = Solid state dc input (08-5286) contactor
- BF = Burst fired, fixed time base (08-5289) 4-20mA
- BV = Burst fired, variable time base (08-5342) 4-20mA
- AF = Phase-angle fired, not available on Q32 (08-5288) 4-20mA
- AL = Phase-angle fired w/current limit, not available on Q32 (08-5411) 4-20mA; includes one current transformer. Add second CT for 3-phase, 3-leg. AL models 75 amps and above require one interstage transformer.

#### Open Heater/Shorted SCR Detector<sup>®④</sup>

- 0 = None
- 1 = Single-phase operation
- 2 = Three-phase operation



<sup>①</sup> MOV comes only on Q33 (3-phase, 3-leg).

<sup>②</sup> All cooling fans rated @ 20 watts each, must be wired by customer.

<sup>③</sup> The open heater/shorted SCR detector is for burst fire operation only.

<sup>④</sup> Included one current transformer for 1-phase and two current transformers for 3-phase. Models 150 amps and above require one interstage transformer.

# Power Controllers

## QPAC SCRs

### Wiring Information

**Note:** A circuit breaker (or disconnect) is required in addition to, and at least of the same rating as the semiconductor fuses. Fuse mounting for those controllers with external (EXT) fuses will require space near the terminal block. The space for the fuse will depend upon the current rating. On board fuses (O/B) do not require extra fuse space. Where third-leg fusing is selected, additional space is required. On 575V~(ac) models the fuses are mounted external to the QPAC.

Amps	Fuse Rating	Recommended Wire Size	Bending Radius mm (in.)	Lugs Accept Wire No.	Phase Code	Fuse Mounting	Current Transformer
150	200	Triple 0	100 (4)	4 to 3/0	All models	O/B	16-0008
200	250	250 MCM	115 (4.5)	6 to 350 MCM	All models	O/B	16-0045
300	400	500 MCM	205 (8)	4 to 500 MCM	All models	O/B	16-0073
400	500	Dual 250 MCM	380 (15)	2 to 600 MCM	All models	O/B	400A-0004-0286-0400
500	600	Dual 350 MCM	380 (15)	2 to 600 MCM	All models	O/B	500-0004-0286-0500
600	800	Dual 500 MCM	380 (15)	2 to 600 MCM	All models	O/B	600-0004-0286-0600
800	1000	Quad 250 MCM	380 (15)	2 to 600 MCM	All models	O/B	800-0004-0286-0800
1000	1250	Quad 350 MCM	380 (15)	2 to 600 MCM	All models	O/B	1000-0004-0286-1000

### Case Styles

Style C



Style E



Note: Style D eliminated and replaced with Style E.

### Q01

Style	Amps	Height (H) mm (in.)	Width (W) mm (in.)	Depth (D) mm (in.)	Weight kg (lbs)
C <sup>Ⓣ</sup>	150	330 (13)	175 (6.9)	255 (10)	6.8 (15)
C <sup>Ⓣ</sup>	200	330 (13)	175 (6.9)	255 (10)	6.8 (15)
C <sup>Ⓣ</sup>	300	330 (13)	175 (6.9)	255 (10)	6.8 (15)
E <sup>Ⓣ</sup>	400-600	685 (27)	430 (17)	300 (11.7)	19.9 (44)
E <sup>Ⓣ</sup>	800-1000	685 (27)	430 (17)	340 (13.3)	22.2 (49)

<sup>Ⓣ</sup> Includes fan cooling

### Q32

Style	Amps	Height (H) mm (in.)	Width (W) mm (in.)	Depth (D) mm (in.)	Weight kg (lbs)
C <sup>Ⓣ</sup>	150	330 (13)	355 (14)	260 (10.25)	16.3 (36)
C <sup>Ⓣ</sup>	200	330 (13)	355 (14)	260 (10.25)	16.3 (36)
C <sup>Ⓣ</sup>	300	330 (13)	355 (14)	260 (10.25)	16.3 (36)
E <sup>Ⓣ</sup>	400-600	685 (27)	535 (21)	300 (11.7)	38.5 (85)
E <sup>Ⓣ</sup>	800-1000	840 (33)	535 (21)	340 (13.3)	54.4 (120)

<sup>Ⓣ</sup> Includes fan cooling



### QPAC Replacement SCRs and Diodes

See [page 189](#)

### Current Transformers

See [page 189](#)

### Third Leg (Semiconductor) Fuse Kits

See [page 192](#)

### Semiconductor Replacement Fuses

See [page 192](#)

### Q33

Style	Amps	Height (H) mm (in.)	Width (W) mm (in.)	Depth (D) mm (in.)	Weight kg (lbs)
C <sup>Ⓣ</sup>	150	330 (13)	525 (20.7)	260 (10.25)	23 (50)
C <sup>Ⓣ</sup>	200	330 (13)	525 (20.7)	260 (10.25)	23 (50)
C <sup>Ⓣ</sup>	300	330 (13)	525 (20.7)	260 (10.25)	23 (50)
E <sup>Ⓣ</sup>	400-600	840 (33)	685 (27)	300 (11.7)	45.4 (100)
E <sup>Ⓣ</sup>	800-1000	840 (33)	685 (27)	340 (13.3)	61.2 (135)

<sup>Ⓣ</sup> Includes fan cooling

# Power Controllers

F.O.B.: Winona, Minnesota

## Accessories

The following accessories and replacement parts are available to enhance the application and service of Watlow power controllers.

To order, simply identify the specification of the desired component and use its part number. Consult your Watlow representative for availability.

### QPAC Replacement SCRs and Diodes

Amps	QPAC Part Numbers		
	Q01	Q32	Q33
150 amp	<b>18-5052</b>	<b>18-5052</b>	<b>18-5052<sup>④</sup></b>
200 amp	<b>18-5052</b>	<b>18-5052</b>	<b>18-5052<sup>④</sup></b>
300 amp	<b>18-5052</b>	<b>18-5052</b>	<b>18-5052<sup>④</sup></b>
400-600 amp	<b>18-5214</b>	<b>18-5214</b>	<b>18-5214<sup>④</sup></b>
800 amp	<b>18-5215</b>	<b>18-5215</b>	<b>18-5215<sup>④</sup></b>
1000 amp	<b>18-5216</b>	<b>18-5216</b>	<b>18-5215<sup>④</sup></b>
<b>Diodes</b>			
150 amp			<b>18-1044<sup>④</sup></b>
200 amp			<b>18-1044<sup>④</sup></b>
300 amp			<b>18-1044<sup>④</sup></b>
400-600 amp			<b>18-1064<sup>④</sup></b>
800 amp			<b>18-1068<sup>④</sup></b>
1000 amp			<b>18-1068<sup>④</sup></b>

<sup>④</sup> All units (except Q33) require two SCRs (1 pair) per controlled leg. Q33 (150 amp and above) uses one replaceable diode and one SCR per controlled leg.

### Current Transformers

Part No.	Current Ratio
<b>Current Transformer</b>	
<b>16-0230</b>	(See 16-0246)
<b>16-0231</b>	(See 16-0246)
<b>16-0232</b>	(See 16-0246)
<b>16-0233</b>	(See 16-0246)
<b>16-0246<sup>①</sup></b>	20 amp: 20mA to 50 amp: 50mA
<b>16-0008<sup>②</sup></b>	75 amp: 5 amp
<b>16-0044</b>	100 amp: 5 amp
<b>16-0072</b>	125 amp: 5 amp
<b>16-0008</b>	150 amp: 5 amp
<b>16-0045</b>	200 amp: 5 amp
<b>16-0073</b>	300 amp: 5 amp
<b>0004-0286-0400</b>	400 amp: 5 amp
<b>0004-0286-0500</b>	500 amp: 5 amp
<b>0004-0286-0600</b>	600 amp: 5 amp
<b>0004-0286-0800</b>	800 amp: 5 amp
<b>0004-0286-1000</b>	1000 amp: 5 amp
<b>Interstage Transformer</b>	
<b>16-0176</b>	5 amp: 20mA

**Note:** An interstage transformer (code no. 16-0176) is required with any current transformer rated 75 amps or above.

- <sup>①</sup> Supercedes code numbers 16-0230, 16-0231, 16-0232, 16-0233.
- <sup>②</sup> Use 2-wire passes through the current transformer 16-0008 for 75 amp applications.

## Power Controllers

F.O.B.: Winona, Minnesota

### Accessories

#### Noise Suppression Devices

Description	Code No.
MOV, 150V~(ac), 20 joule	<b>0802-0273-0000</b>
MOV, 275V~(ac), 15 joule	<b>0802-0266-0000</b>
Quencharc® (250V~(ac) max)	<b>0804-0147-0000</b>

#### CE Filters for DIN-A-MITE Products

Code Number	Description	Stocked
<b>14-0019</b>	Single-phase, parallel connected filter	Yes
<b>14-0020</b>	Three-phase, parallel connected filter	Yes

#### Replacement Fuses for Power Series

Watlow Code No.	Description	Ferraz Part No.	Bussmann Part No.
<b>0808-0102-0100</b>	100 amp @ 600V~(ac)	L330037	170M1317
<b>0808-0102-0125</b>	125 amp @ 600V~(ac)	M330038	170M1318
<b>0808-0102-0160</b>	160 amp @ 600V~(ac)	N330039	170M1319
<b>0808-0102-0200</b>	200 amp @ 600V~(ac)	P330040	170M1320
<b>0808-0102-0250</b>	250 amp @ 600V~(ac)	Q330041	170M1321
<b>0808-0102-0315</b>	315 amp @ 600V~(ac)	R330042	170M1322

Quencharc® is a registered trademark of ITW Paktron.

# Power Controllers

F.O.B.: Winona, Minnesota

## Accessories

### Semiconductor Fuse Selection Guidelines

The following steps will help you identify the proper semiconductor fuse for your application.

1. Semiconductor fuses are required for SCR protection.
2. In North America, semiconductor fuses are considered a specialty fuse and not yet approved for branch circuit or cable protection.
3. All fuses should be rated at 125 percent of the connected load (or the next standard fuse rating above 125 percent). Do not exceed 160 percent of the DIN-A-MITE®.
4. Due to special applications, cooler ambient temperatures, small loads, etc., the connected load should be the determining factor—although the semiconductor fuse I<sup>2</sup>t rating must not exceed the SCR I<sup>2</sup>t requirement.

**For example:**

A 30 amp Style B DIN-A-MITE with a 20 amp connected load should use a 25 amp semiconductor fuse.

The following charts may be modified following the above guide lines.

### Semiconductor Fuses for DIN-A-MITE® Power Controllers

*Styles A, B, C and D...Can Also Be Used For VPAC, SSRs and CZR's*



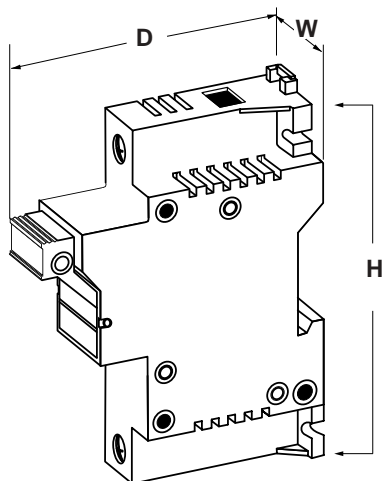
### DIN-Rail Mount Semiconductor Fuses and Holders

Fuse Amp Rating	Fuse Voltage Rating	Watlow Fuse Part No.	Ferraz Fuse Part No.	Bussman Equiv. Fuse Part No.	Watlow Holder Part No.
12	600	17-8012	H330011	FWC-12A10F	17-5110
20	600	17-8020	K330013	FWC-20A10F	17-5110
25	600	17-8025	L330014	FWC-25A10F	17-5110
32	700	17-8030	M330015	FWP-32A14F	17-5114
40	700	17-8040	A93909	FWP-40A14F	17-5114
50	700	17-8050	B093910	FWP-50A14F	17-5114
63	700	17-8063	T094823	FWP-63A22F	17-5122
65	660	0808-0096-0000	N/A	170N3437	See Note 1
80	700	17-8080	A94829	FWP-80A22F	17-5122
100	700	17-8100	N/A	FWP-100A22F	17-5122

**Note 1:** Replacement fuse for DIN-A-MITE Style D

**Note 2:** On part number 17-8030 the fuse is a 32 ampere fuse

### Dimensions



### DIN-Rail Mount Fuse Holders Maximum Dimensions

Holder Part No.	Height mm (in.)	Width mm (in.)	Depth mm (in.)	Fuse Type (mm)
17-5110	81 (3.18)	18 (0.71)	59 (2.32)	10 X 38
17-5114	111 (4.36)	26 (1.02)	77 (3.03)	14 X 51
17-5122	128 (5.04)	35 (1.38)	77 (3.03)	22 X 58

Power Controllers  
Accessories

# Power Controllers

## Accessories

### QPAC Semiconductor Fuses

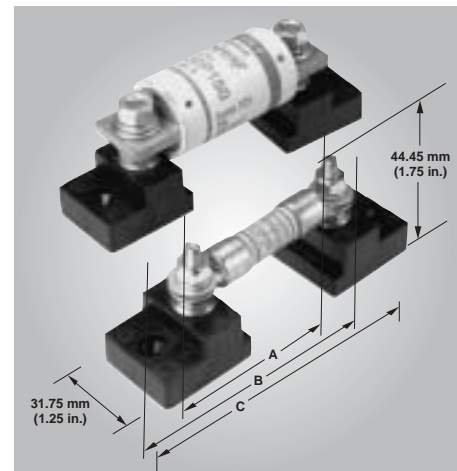
Description	Part No.	QPAC Models Used On
20 amp @ 700V~(ac)	<b>17-7071</b>	All Q01 30 amp - 2 fuses required
30 amp @ 700V~(ac)	<b>17-7072</b>	All Q01 50 amp - 2 fuses required
40 amp @ 700V~(ac)	<b>17-7007</b>	All Q32 and Q33 30 amp
70 amp @ 700V~(ac)	<b>17-7010</b>	All Q32 and Q33 50 amp
100 amp @ 700V~(ac)	<b>17-7012</b>	All 75 amp, 600V QPACs
100 amp @ 500V~(ac)	<b>17-7050</b>	All 75 amp, 480V or less QPACs
125 amp @ 500V~(ac)	<b>17-7051</b>	All 100 amp, 480V or less QPACs
200 amp @ 500V~(ac)	<b>17-7053</b>	All 150 amp, 480V or less QPACs
250 amp @ 500V~(ac)	<b>17-7054</b>	All 200 amp, 480V or less QPACs
400 amp @ 500V~(ac)	<b>17-7056</b>	All 300 amp, 480V or less QPACs
500 amp @ 500V~(ac)	<b>17-7057</b>	All 400 amp, 480V or less QPACs
600 amp @ 500V~(ac)	<b>17-7058</b>	All 500 amp, 480V or less QPACs
800 amp @ 500V~(ac)	<b>17-7059</b>	All 600 amp, 480V or less QPACs
1,000 amp @ 700V~(ac)	<b>17-7082</b>	All 800 amp QPACs
1,250 amp @ 700V~(ac)	<b>17-7081</b>	All 1,000 amp QPACs

### Third Leg Semiconductor Fuse Kits for QPAC and VPACs

Description	Part No.	Dimensions		
		A mm (in.)	B mm (in.)	C mm (in.)
One 15 amp fuse, one 1-phase holder	<b>3LF-10</b>	85 (3.25)	110 (4.25)	120 (4.75)
One 25 amp fuse, one 1-phase holder	<b>3LF-20</b>	85 (3.25)	110 (4.25)	120 (4.75)
One 40 amp fuse, one 1-phase holder	<b>3LF-30</b>	110 (4.25)	135 (5.25)	145 (5.75)
One 70 amp fuse, one 1-phase holder	<b>3LF-50</b>	110 (4.25)	135 (5.25)	145 (5.75)
One 100 amp fuse, one 1-phase holder	<b>3LF-75</b>	90 (3.50)	115 (4.50)	125 (5.00)
One 125 amp fuse, one 1-phase holder	<b>3LF-100</b>	90 (3.50)	115 (4.50)	125 (5.00)
One 200 amp fuse, one 1-phase holder	<b>3LF-150</b>	90 (3.50)	115 (4.50)	125 (5.00)
One 250 amp fuse, one 1-phase holder	<b>3LF-200</b>	85 (3.28)	20 (0.76)	150 (6.00)
One 400 amp fuse, one 1-phase holder	<b>3LF-300</b>	85 (3.28)	20 (0.76)	150 (6.00)
One 500 amp fuse, one 1-phase holder	<b>3LF-400</b>	85 (3.28)	20 (0.76)	150 (6.00)
One 600 amp fuse, one 1-phase holder	<b>3LF-500</b>	85 (3.28)	20 (0.76)	150 (6.00)
One 800 amp fuse, one 1-phase holder	<b>3LF-600</b>	Consult factory		
One 1000 amp fuse, one 1-phase holder	<b>3LF-800</b>	Consult factory		
One 1250 amp fuse, one 1-phase holder	<b>3LF-1000</b>	Consult factory		

**Note:** For safe operation, fuses must be rated 125 percent of power controller rating.  
 Example: 100 amp power controller should use a 125 amp semiconductor fuse.  
 This 125 amp fuse is already included in the above 3LF-100 fuse kit.

### Fuse Block Dimensions





## Communication Gateways

### EM GATEWAY

Watlow's EM GATEWAY serves as a bridge for Modbus™ communication between Ethernet and Watlow standard controllers. The gateway provides a quick, convenient and economical means of adapting controllers to Ethernet connectivity.

Ethernet communications is rapidly gaining popularity in industrial control applications by enabling the flow of information between processing equipment and the company's Ethernet-based management systems.

Watlow's EM GATEWAY provides an operator interface by serving web pages to an Internet browser to support key control operations such as process monitoring, set point changes, alarm management and error notification. The browser can be used to monitor the process, make set point changes, manage alarms and generate e-mails to notify remote locations of an alarm condition.

The gateway communicates with Watlow controllers via a Modbus™ EIA-485/EIA-232 communications network. Watlow controllers supported by the EM GATEWAY include:

- SERIES 981/982\*
- SERIES 988/989\*
- SERIES 998/999\*
- SERIES 96/97
- SERIES F4
- SERIES SD
- POWER SERIES
- CLS200
- MICRODIN®

WATVIEW, Watlow's Windows® based HMI (Human/Machine Interface) software, can utilize the gateway to configure as well as

\* These controllers are not supported by WATVIEW.

Windows® is a registered trademark of Microsoft Corporation.  
Modbus™ is a trademark of Schneider Automation Incorporated.



operate, monitor and data log key control parameters such as process, value, set point and alarm status. The EM GATEWAY supports up to 16 controllers in any combination, making it ideal for applications that require multiple loops of control.

The EM GATEWAY is a standard product available from stock for quick shipment, and is backed by a three-year warranty.

#### Features and Benefits

##### Ethernet/Internet connectivity

- Allows the user to operate and monitor their process remotely

##### Embedded Web Server

- Remote operation & process monitoring with standard web browsers

##### Dedicated web page design

- Web pages specifically designed for easy use and operation

##### E-mail alarm notification

- Reduces process monitoring costs

##### WATVIEW communications capability

- Allows the user to operate WATVIEW or a browser with the same PC connection

#### Specifications

##### Power Supply

- Voltage input 24V $\approx$ (ac/dc) + 10 percent, -15 percent, 50/60Hz  $\pm$  5
- Connection through two position removable screw style terminal block

##### Environmental

- Operating temperature range 0 to 60°C (32 to 140°F)
- Storage temperature range -40 to 70°C (-40 to 158°F)
- Operating and storage humidity 0 to 90 percent non-condensing

##### Indication

- Green LED for Ethernet connection
- Green LED for Ethernet activity
- Green LED for EIA-485/232 activity

##### Agency

- EN 50082-1 light industry

# Communication Gateways

F.O.B.: Winona, Minnesota

## EM GATEWAY

### Specifications Cont.

#### Communications

- Modbus™ RTU communications
  - EIA-485/EIA-232 supported
  - Connection through five position removable screw style terminal block
- Ethernet communications
  - Ethernet RJ 45 connector
  - 10 base T
  - HTTP interface
  - Modbus™ TCP
  - DHCP, Auto IP or fixed IP address
  - E-mail alarm notification

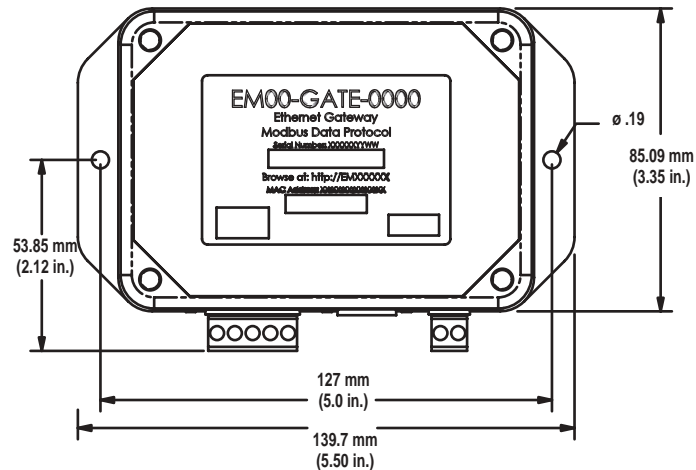
#### Dimensions

- 85.09 mm (3.35 in.) width
- 139.7 mm (5.50 in.) length
- 34.54 mm (1.36 in.) depth

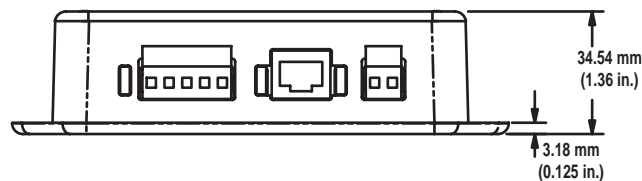
### Ordering Information

Order part number EM00-GATE-0000

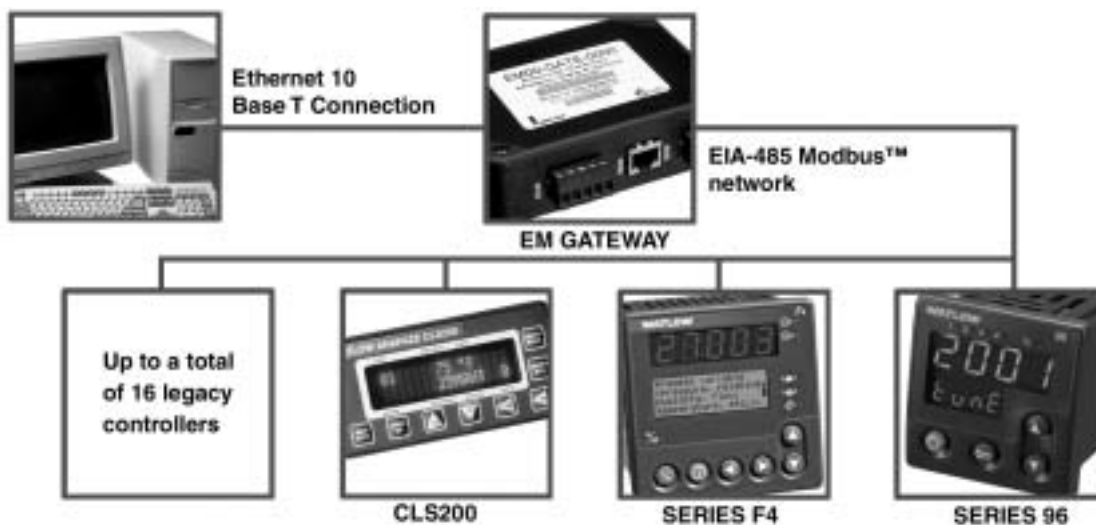
### Top View



### Front View



### EM GATEWAY Network Wiring Diagram



## Communication Gateways

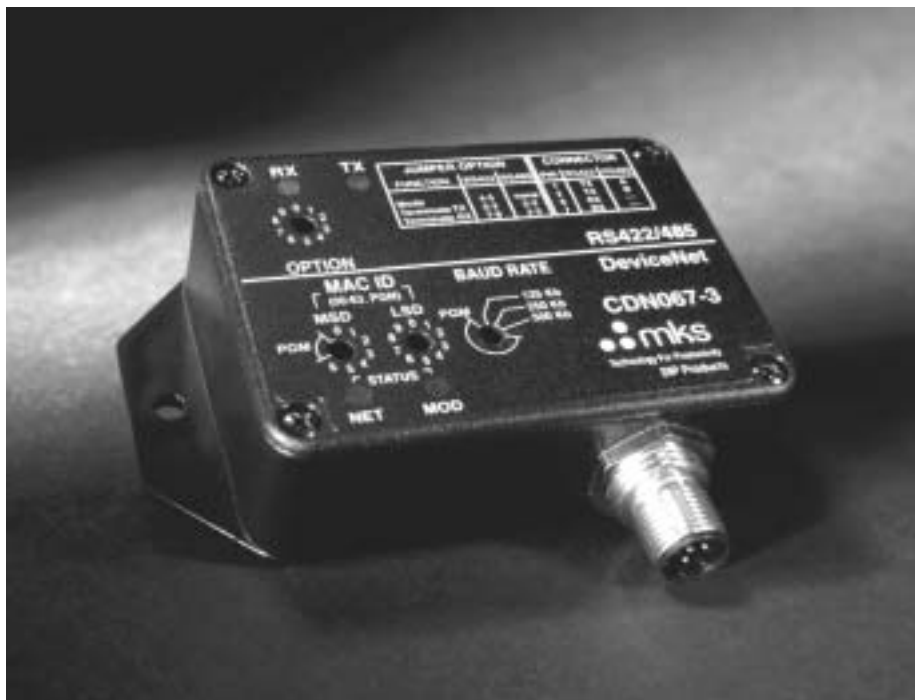
F.O.B.: Winona, Minnesota

### CDN GATEWAY

The new CDN GATEWAY enables customers to connect Watlow's Modbus™ RTU-based controllers to their existing DeviceNet™ on CAN-based management systems. DeviceNet™ on CAN communication protocol has widespread popularity in industrial control applications where communication between computers, controllers, sensors and actuators is necessary to improve process performance and reduce costs.

The CDN GATEWAY enables DeviceNet™ master nodes to send and receive data using standard POLL or EXPLICIT messaging. Up to 32 unique Modbus™ pairs may be accessed in each POLL transaction and the Modbus™ registers may reside in one or a combination of up to 32 supported controllers.

The CDN GATEWAY unit is enclosed in a 63.5 mm x 82.55 mm (2.5 in. x 3.25 in.) plastic housing with mounting tabs. A nine-pin D-sub connector provides the EIA-485 interface and is fully isolated from the DeviceNet™ power. The CDN GATEWAY is backed by a 12-month warranty from Watlow Winona.



#### Features and Benefits

##### Allows existing Modbus™ RTU-based controllers to interface with DeviceNet™-based networks

- Eliminates the need to purchase new controllers

##### Five-pin DeviceNet™ micro-connector

- Industry standard for DeviceNet™
- Enhances ease of use

##### Nine-pin D EIA-485 interface connector

- Allows multiple controllers to work effectively with one gateway

##### EIA-485 serial channel is fully isolated from the DeviceNet™ power

- Allows temperature controllers to operate independently from the DeviceNet™ network

#### Specifications

##### Temperature

0-70° C (32-158° F)

##### Size

83 mm x 62 mm x 28 mm  
(3.30 in. x 2.45 in. x 1.10 in.)

##### Mounting

13 mm (0.50 in.) tab  
5 mm (0.1875 in.) hole

##### Encapsulation

RTV silicon compound



## Software

### WATVIEW HMI Software

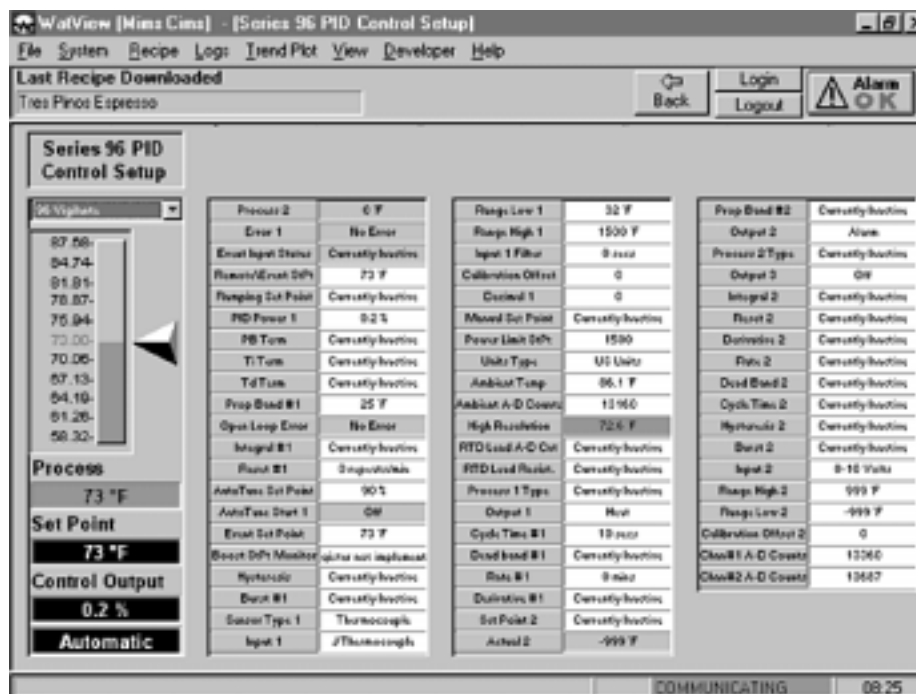
Searching for a quick, efficient way to set up your controllers? Need rapid data-logging and graphing capabilities? We have the answer: WATVIEW.

WATVIEW is Watlow Anafaze's HMI (Human/Machine Interface) software designed to set up and monitor up to 32 Watlow controllers. With easy controller setup, a recipe and alarm manager, data-logging and trend plot graphing capabilities, animated custom overview screens and a superior online help system, you can be assured that WATVIEW is the ideal software for your application.

#### WATVIEW Editions:

WATVIEW is available in three editions making your software decision quick and effortless.

- WATVIEW-R:  
The Run-Time Edition**  
Provides trend plot graphing, setup screens, data-logging, recipe manager with calendar-start, spreadsheet data editor, system activity log and alarm manager. The Run-Time Edition will "play back" custom screens created with the Developer Edition.
- WATVIEW-D:  
The Developer Edition**  
Includes all functions of the Run-Time Edition plus a custom screen designer and user-defined variables.
- WATVIEW-C:  
The Configurator Edition**  
Includes only spreadsheet data editor, recipe manager without calendar-start and system activity log.



#### Features and Benefits

##### Easy controller setup

- WATVIEW automatically detects which controllers are connected to the computer, then WATVIEW loads the appropriate setup screens for those controllers. Use built-in setup screens to adjust the controller parameters, or the simple "spreadsheet view" for a quick, intuitive interface. The spreadsheet categorizes all controller parameters according to their parameter groupings.

##### Recipe manager

- All editions of WATVIEW include the ability to create recipes (arrays of controller settings). Recipes can be created, edited, stored and downloaded to the controllers. Use recipes to store commonly used controller settings, to speed up repetitive controller setups and to create a "snapshot" of your setups.

The Run-Time and Developer Editions also include a calendar-start function, allowing users to automatically download recipes on a one-time or repeating schedule.

##### Alarm manager

- WATVIEW Run-Time and Developer Editions receive alarms from controllers, maintain a log of alarms and allow users to clear and acknowledge alarms.

##### Data-logging and trend plot graphs

- WATVIEW Run-Time and Developer Editions include continuous data-logging of the parameters you choose. You can export the collected data to an Excel®-compatible spreadsheet file, or view up to 20 data items on a WATVIEW trend plot graph. An unlimited number of graphs may be named and stored for simple future retrieval.



## Software

### ANAWIN®3 HMI Software for PPC-2000

ANAWIN®3 is Watlow Anafaze's HMI (Human/Machine Interface) software designed specifically for PPC-2000. Use it to set up and monitor up to 32 controllers. With easy controller setup, a recipe and alarm manager, data-logging and trend plot graphing capabilities, animated custom overview screens and a superior online help system, you can be assured that ANAWIN3 is the ideal software for your application.

#### ANAWIN3 Editions:

ANAWIN3 is available in three editions making your software decision quick and effortless.

#### • ANAWIN3-R:

##### The Run-Time Edition

Provides trend plot graphing, setup screens, data-logging, recipe manager with calendar-start, spreadsheet data editor, system activity log and alarm manager. The Run-Time Edition will "play back" custom screens created with the Developer Edition.

#### • ANAWIN3-D:

##### The Developer Edition

Includes all functions of the Run-Time Edition plus a custom screen designer and user-defined variables.

#### • ANAWIN3-C:

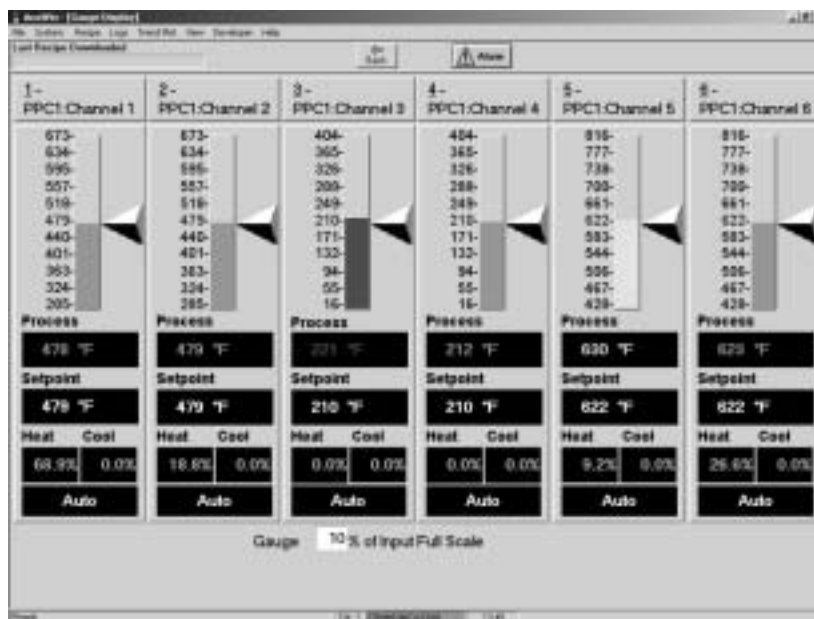
##### The Configurator Edition

Includes only spreadsheet data editor, recipe manager without calendar-start and system activity log.

#### Features and Benefits

##### Easy controller setup

- Use ANAWIN3's built-in setup screens to adjust the controller parameters, or the simple "spreadsheet view" for a quick, intuitive interface. The spreadsheet categorizes all controller parameters according to their parameter groupings.



#### Recipe manager

- All editions of ANAWIN3 include the ability to create recipes (arrays of controller settings). Recipes can be created, edited, stored and downloaded to the controllers. Use recipes to store commonly used controller settings, to speed up repetitive controller setups, and to create a "snapshot" of your setups. The Run-Time and Developer Editions also include a calendar-start function, allowing users to automatically download recipes on a one-time or repeating schedule.

#### Alarm manager

- ANAWIN Run-Time and Developer Editions receive alarms from controllers, maintain a log of alarms and allow users to clear and acknowledge alarms.

#### Data-logging and trend plot graphs

- ANAWIN3 Run-Time and Developer Editions include continuous data-logging of the parameters you choose. You can export the collected data to an Excel®-compatible spreadsheet file, or view multiple data items on

ANAWIN3 trend plot graph. An unlimited number of graphs may be named and stored for simple future retrieval.

#### Colorful, animated custom overview screens

- Use ANAWIN3 Developer edition to create custom screens, easily! ANAWIN3's Custom Overviews (COVs) incorporate your graphic images (such as digital camera photos) with real-time data from the controllers, to make a custom interface. You can also use ANAWIN3's AnaMator program to create animated sequences, which can show your actual process in action. Custom Overview's created with the Developer edition can be used with any ANAWIN3 edition.

#### Ordering Information

ANAWIN3-C ANAWIN3 HMI Configurator Edition  
ANAWIN3-R ANAWIN3 HMI Runtime Edition  
ANAWIN3-D ANAWIN3 HMI Developer Edition

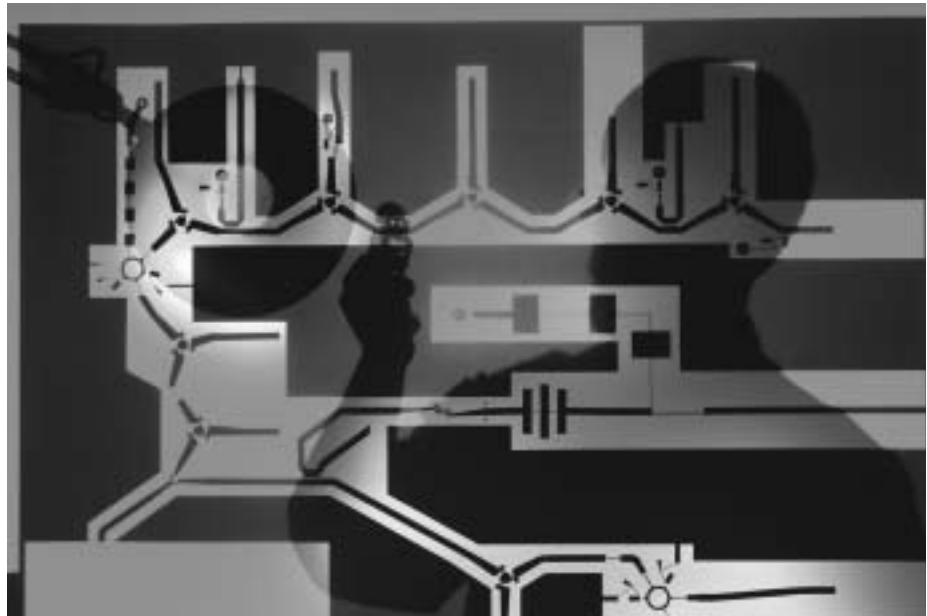
## Software

### **WATCONNECT™ Communications Library**

WATCONNECT™ is Watlow's new Windows®-based software library for Modbus™-RTU communications. This software tool kit makes it easy for programmers working in Visual Basic, C, C++ and Visual C++ to develop Windows® applications that communicate with Watlow controllers using the Modbus™ RTU protocol. The simplicity of the interface insures a short learning curve and shortened development times for Human Machine Interface or other applications that communicate with controllers.

The main benefit of the tool kit is that the programmer does not need to learn the details of the Modbus™ protocol or the operation of a Windows® serial port to successfully develop programs that read and set parameter values in controllers. The library provides four, easy-to-use functions: open port, close port, read data and write data. To use these functions, the programmer just needs to know the communications port settings and address of the desired data.

For more information, please contact your local Watlow representative.



#### **Features and Benefits**

##### **Allows communication with one to 247 controllers**

- Scalable

##### **Safe for multithreaded applications**

- Several parts of a program can use the same communications port

##### **Single source solution**

- Eliminates multiple vendors
- Assures compatibility
- Saves time and money

##### **License agreement allows user written applications to be distributed royalty free**

- Adds no recurring cost to applications

##### **Sample code provided for Visual C++ and Visual Basic environments**

- Easy to follow examples shorten the learning curve

##### **Reads and writes all standard Modbus™ data table locations: coils, inputs and registers**

- Allows access to all controller parameters

##### **Can handle custom-named ports such as serial port expanders**

- Assures flexibility

Windows® is a registered trademark of Microsoft Corporation.

Modbus™ is trademark of AEG Schneider Corporation.



## Software

### LOGICPRO™: Logic Programming Software for PPC-2000 and CPC400

#### LOGICPRO™

LOGICPRO™ is a Windows®-based graphical logic programming software package. LOGICPRO is the perfect counterpart to the powerful multi-loop PID control features in the PPC-2000 and CPC400. Develop programs in a choice of three logic programming languages: ladder diagram, sequential function chart or function block diagram.

#### Features and Benefits

**Develops custom logic programs with easy-to-use, drag-and-drop tools, then simulates and debugs on the development PC before downloading to the PPC-2000**

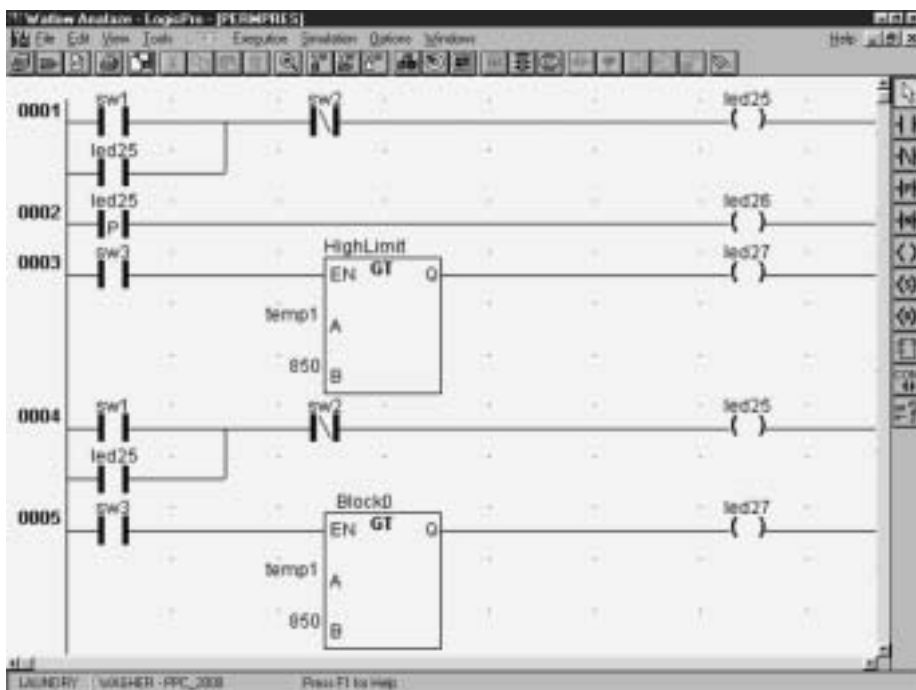
- Reduces time and cost during system start-up, trouble-shooting and fine tuning

#### Real-time monitoring

- Reduces time to verify system logic operation

#### Integrates programmable logic and PID control in a single controller

- Eliminates cumbersome and inflexible communications schemes between separate process and logic controllers, saving development time and costs



#### Full set of logic functions and programming tools

- Adds value by easily customizing your process

#### LOGICPRO Editions

LOGICPRO-S supports up to 150 I/O driver points. I/O driver points are physical I/O and any data table accessed parameters.

LOGICPRO-P supports an unlimited number of I/O points. Both utilize keys, which are attached to the development computer's parallel port.

#### System requirements:

- IBM compatible PC
- EIA-232 serial port
- Pentium® processor, 166 MHz minimum
- Windows® 95/98 or Windows® NT
- 32 MB RAM
- 40 MB minimum hard disk space
- Parallel port

#### Ordering Information

LOGICPRO-S LOGICPRO Standard Edition

LOGICPRO-P LOGICPRO Professional Edition



## Control Systems

### Process Systems

Watlow has the manufacturing capability to design and fabricate complete thermal heating systems for process industries.

Watlow's application engineers work hand in hand with our customer's technical staff, insuring that detailed system proposals provide a clear technical description of the product, as well as costing options. This close communication continues with detailed approval drawings for customer review and confirmation, before production is started. Production schedules and in-plant production or final review visits by our customers are available based on each customer's preference. Complete, technical installation and maintenance (I&M) instructions, as-built drawing packets and component specification sheets are provided to support setup of the system once it is shipped. On-site, factory training or start-up assistance can be provided, when needed. Follow-up service after commissioning is provided by local Watlow sales engineers.

Watlow has the distinct advantage of being the only designer of electric thermal systems to actually manufacture all of the major components in the thermal system. Watlow's vast technical knowledge and experience is combined with these individual components to produce the most effective thermal solution for each unique need.

#### Technical Specifications

#### Standards and Certifications

Thermal systems from Watlow are made up of components that have all passed the same high standards of quality control testing. Watlow's process engineers and technicians are trained for specialized system design and construction and are the experts in the application of Watlow product lines.



**Modular dual circuit heat/cool DI water system fully enclosed in cabinet with castor wheels.**

Prior to manufacturing, designs for all projects are submitted for customer approval. This process ensures you of an exacting custom design along with complying to local and international technical standards. Watlow can build assemblies to fit the following standards and certifications:

- ASME - American Society of Mechanical Engineers
- ANSI - American National Standard Institute
- API - American Petroleum Institute
- AWS - American Welding Society
- ASTM - American Society for Testing and Materials

- TEMA - Tubular Exchanger Manufacturers Association
- ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
- SSPC - Steel Structures Painting Council
- US MIL STDS
- UL® - Underwriter's Laboratories
- FM - Factory Mutual
- NEMA - National Electrical Manufacturers Association
- NFPA - National Fire Protection Association

UL® is a registered trademark of Underwriter's Laboratories, Inc.

# Control Systems

## Process Systems

- NEC - National Electric Code
- CSA - Canadian Standards Association
- CE - European Union Mark of Conformance
- CENELEC - European Committee for Electrotechnical Standardization
- PED - European Union Pressure Equipment Directive
- BASEEFA - British Approval Service for Electrical Equipment in Flammable Atmospheres
- IEC - International Electrotechnical Commission
- JIC - Joint Industrial Council
- SEMI-S2 - Semiconductor Equipment and Materials Institute

### Testing and Services

Watlow can provide special testing and services for a variety of needs. These include:

- Radiography
- Charpy impact testing
- Die penetrant testing
- Hydrostatic pressure testing
- Ultrasonic thickness testing
- Magnetic particle testing
- MTRs (Material Test Reports)
- ASME calculations
- Earthquake, stress or vibration calculations
- PE stamp documents (Professional Engineer)
- Helium leak testing
- Tensile testing
- PMI (Positive Material Identification) testing

- Post-weld heat treating
- Chemical passivation
- Electropolishing
- Microscopic analysis
- Brinell hardness testing
- Special metal coatings from thermal spray to galvanizing

### Summary of Product Capabilities and Services

Watlow builds any system to suit your needs. We design and fabricate specialty systems to simulate unique industry needs. Some of the capabilities available to build a Watlow process system include:

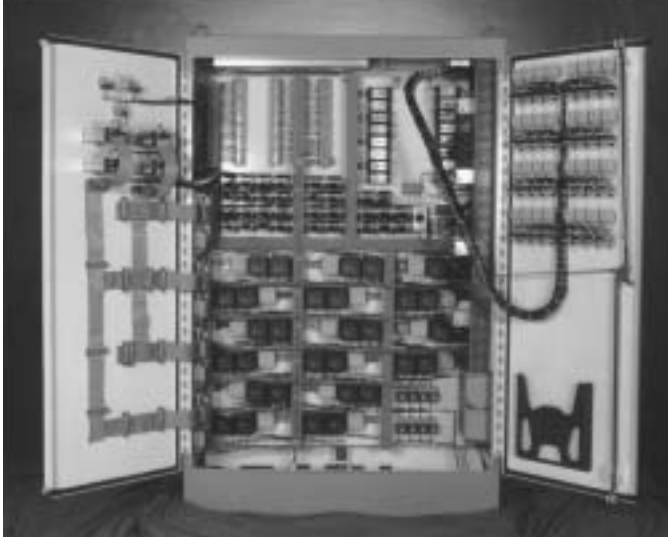
- Complete fabrication of low alloy carbon steel through alloy 800, alloy 600, alloy 20 and all exotic metals
- Fabrication of special parts of with CNC machining, lathes, mills, plasma cutting and laser cutting
- ASME Section IX welder and weld procedure qualifications, ASME "U," "S" and "R" stamps
- Electrical control panel design and assembly. UL® listed and CE certified panels available
- Full interconnection of various system components prior to shipment to minimize field installation difficulties
- Design and fabrication of larger systems - heater sizes from single element, 20 watt assemblies to 600 plus elements, 1016 mm (40 in.) flanges, to multi-vessel stacked systems to 2.5 megawatt
- Standard vessel fabrication up to 1524 mm (60 in.) diameter and wall thickness from schedule five to specialty plate rolled vessels over 25.4 mm (1 in.) thick with lengths up to 20 feet, larger sizes can also be provided

- Ability to integrate valves, pumps, flow switches, strainers, expansion joints, expansion tanks, level glass, level switches, blowers, compressors, differential pressure switches and all fluid flow components as required
- Specialize in high pressure and high temperature design including pressures to 4500 psi and gas heating from cryogenic -226°C to 982°C (-375°F to 1800°F)
- Heater systems designed with best heater for application. Low end temperatures using silicone rubber heaters to ultra-high temperature using ceramic fiber heaters
- Skid-mounting designing and fabrication
- Piping design and fabrication
- Fabrication of heating and control systems for all hazardous and non-hazardous locations. CSA and CENELEC certified enclosures to 1270 mm (50 in.) flange
- Special cleaning procedures including passivation and electropolishing
- Special finishing, blasting and painting of complete thermal systems
- Special packaging and crating for domestic and export systems
- Able to ship F.O.B. factory, F.O.B. U.S. port, ex-factory, C&F destination, CIF destination
- Can coordinate all Freight Forwarder shipping issues to insure smooth and timely export
- Complete I&M packages, drawings, nameplates in English or other international languages as required
- On-site technical reviews, training, commissioning, service by factory engineers and local representatives

## Control Systems

F.O.B.: Wright City, Missouri

### Process Systems

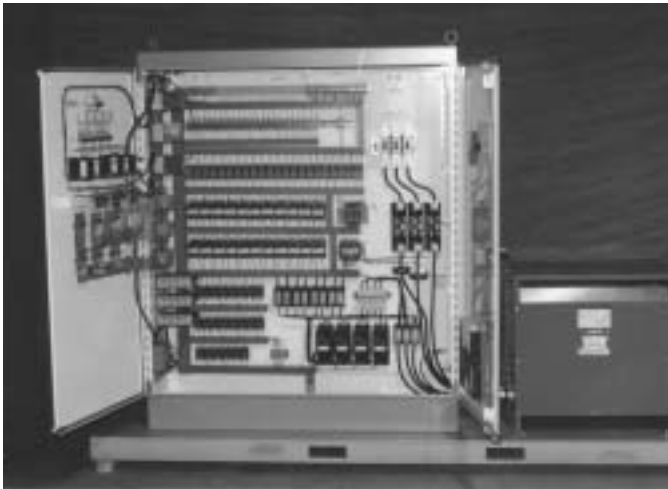


#### Multi-Zone Control Panel

- Four Watlow Anafaze 32MLS controllers
- 128 total control loops
  - Four loops per zone
  - Two process and two alarm outputs
- Emergency stop pushbutton
- Interior lighting
- NEMA 12 fan cooled cabinet

Each zone contains

- On-off selector switch with pilot light
- Watlow DIN-A-MITE® for power switching
- Capacitors and resistors for Torodial heater coil



#### 22-Zone Control System

- 75 kVA, 480V x 240V step-down transformer
- Four C-Style DIN-A-MITE SCR power switching devices
- Three Watlow Anafaze MLS332 multi-loop controllers
- Four Watlow SERIES 988 temperature controllers with remote set point
- NEMA 12 skid-mounted cabinet
- Main disconnect switch
- 22 safety contactors
- 22 sets of load fusing
- Watt transducer



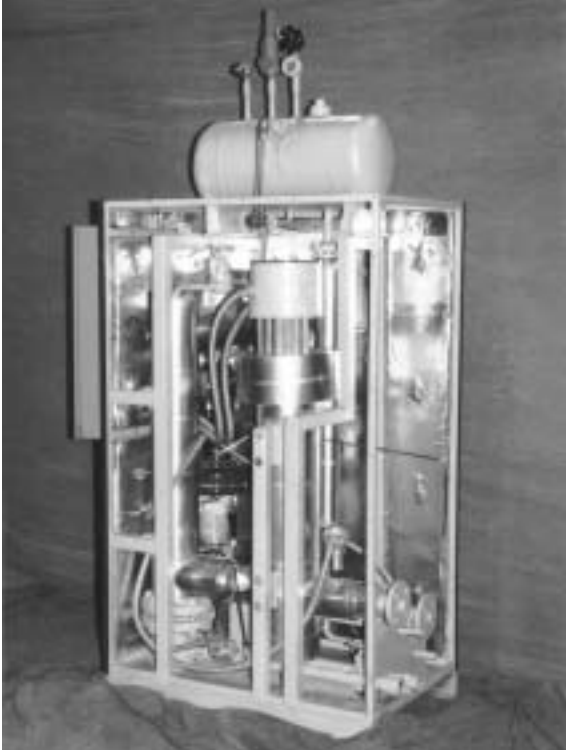
#### Water Heating System

- Two 50kW heaters piped in parallel
- 60 gpm pump
- Solenoid valve
- Isolation valve
- Flow switches
- High limit thermocouples

Completely interconnected to control system consisting of:

- Watlow process temperature and limit temperature controllers
- Main disconnect
- Mechanical contactors for power switching

### Process Systems



#### High Temperature 399°C (750°F) Hot Oil System

- 20kW, 480V, 3PH
- Watlow circulation heater
- 30 gpm high temperature “canned” sealless pump
- Water cooled heat exchanger
- Cooling water pressure switch and solenoid valve
- High temperature three way control valve
- Expansion tank with sight level gauge
- Pressure relief and back pressure purge valves
- Watlow SERIES 988 process temperature controller
- Watlow SERIES 988 mixing valve temperature controller
- Manual disconnect
- Watlow DIN-A-MITE power controller
- NEMA 12 control cabinet
- Framed skid with sealed drip pan
- Insulated skid shroud for low temperature safe touch



#### Panel-Mounted Calorifier Tank

- 400 gallon water calorifier
- Internal epoxy coating on tank
- 40kW, 400V, 3Ph flange immersion heater
- NEMA 4X control panel
- Watlow SERIES 988 process temperature controller
- Two Watlow DIN-A-MITE power controllers with through wall heatsinks
- Drain and vent valves
- Pressure relief valve
- Pressure and temperature indicating gauges

## Control Systems

### Standard and Made-to-Order Control Panels

#### SCR Control Panel

The SCR control panel provides the highest degree of process control accuracy with the capability to maintain process temperatures within  $\pm 1^{\circ}\text{C}$  ( $\pm 2^{\circ}\text{F}$ ).

#### DIN-A-MITE® Control Panel

The DIN-A-MITE control panel is a lower cost alternative to the SCR and provides greater life than a mechanical contactor.

#### Mechanical Contractor Control Panel

The M.C. control panel is a lower DIN-A-MITE cost alternative to the SCR panel. This control panel is well suited for stable applications requiring multiple heater circuits with separate fuse protection.

#### Performance Capabilities

##### Amperage Ranges

- SCR to 300 amps
- Con to 300 amps
- For higher amperages consult factory
- DIN-A-MITE to 120 amps

##### Operating Environment

- 0 to  $35^{\circ}\text{C}$  (32 to  $95^{\circ}\text{F}$ )
- Consult factory for higher or lower temperatures

##### Accuracy For Span

- SCR:  $\pm 1^{\circ}\text{C}$  ( $\pm 2^{\circ}\text{F}$ )
- DIN-A-MITE:  $\pm 1^{\circ}\text{C}$  ( $\pm 2^{\circ}\text{F}$ )



#### Control Panel Features

##### Temperature Controller

- The microprocessor-based digital SERIES 988  $\frac{1}{8}$  DIN temperature controller offers auto-tuning capability plus a 10Hz sampling rate to provide optimum process control. The controller also offers a large variety of thermocouple, RTD and process signal input options and communications capabilities.

The controller is also designed to meet NEMA 4X standards for water and corrosion resistance. This makes the control panel ideal for many applications where equipment needs to be cleaned frequently.

- Watlow's SERIES SD  $\frac{1}{16}$  DIN microprocessor-based digital controller has auto-tuning capability plus thermocouple, RTD or process inputs.

##### Safety Limit Controller

- The SERIES LV, UL®/C-UL®/CE/FM approved high limit safety controller automatically shuts down the system when an over-temperature condition exists.

##### NEMA Rating

- All control panels: NEMA 12 standard.

##### Documentation

- All control panels versions have a complete wiring schematic provided with every unit.

##### Panel Power Disconnect and Fusing, Etc.

- All models: A manual disconnect switch with a through-door interlocking operating mechanism, terminal blocks for heater connection, plus a control circuit transformer with primary and secondary fusing.
- When necessary, a fan, with filter, cools the cabinetry to extend solid state power controller life.
- Semiconductor fuses and a control circuit transformer with primary and secondary fusing protects the panel.

# Control Systems

F.O.B.: Wright City, Missouri

## SCR (Silicon Controlled Rectifier)

Nominal Voltage	Phase	Max. kW	Fused Circuits	Est.Ship. Weight (lbs)	Code No.
240	3	60	1	450	<b>271</b>
380	3	95	1	450	<b>371</b>
480	3	120	1	450	<b>471</b>
240	3	60	3	450	<b>273</b>
380	3	95	3	450	<b>373</b>
480	3	120	3	450	<b>473</b>
240	3	60	4	450	<b>274</b>
380	3	95	4	450	<b>374</b>
480	3	120	4	450	<b>474</b>
240	3	80	1	550	<b>281</b>
380	3	125	1	550	<b>381</b>
480	3	160	1	550	<b>481</b>
240	3	80	2	530	<b>282</b>
380	3	125	2	530	<b>382</b>
480	3	160	2	530	<b>482</b>
240	3	80	3	580	<b>283</b>
380	3	125	3	580	<b>383</b>
480	3	160	3	580	<b>483</b>
240	3	80	4	580	<b>284</b>
380	3	125	4	580	<b>384</b>
480	3	160	4	580	<b>484</b>
240	3	120	1	830	<b>291</b>
380	3	190	1	830	<b>391</b>
480	3	240	1	830	<b>491</b>
240	3	120	2	840	<b>292</b>
380	3	190	2	840	<b>392</b>
480	3	240	2	840	<b>492</b>
240	3	120	3	850	<b>293</b>
380	3	190	3	850	<b>393</b>
480	3	240	3	850	<b>493</b>
240	3	120	4	840	<b>294</b>
380	3	190	4	840	<b>394</b>
480	3	240	4	840	<b>494</b>
240	3	120	6	850	<b>296</b>
380	3	190	6	850	<b>396</b>
480	3	240	6	850	<b>496</b>

## DIN-A-MITE Solid State Power Controller

Nominal Voltage	Phase	Max. kW	Fused Circuits	Est.Ship. Weight (lbs)	Code No.
120	1	6	1	165	<b>111</b>
240	1	12	1	165	<b>211</b>
380	1	19	1	165	<b>311</b>
480	1	24	1	165	<b>411</b>
240	3	16.6	1	165	<b>231</b>
380	3	26.3	1	165	<b>331</b>
480	3	33.2	1	165	<b>431</b>
240	3	33.2	2	230	<b>232</b>
380	3	52.6	2	230	<b>332</b>
480	3	66.5	2	230	<b>432</b>
240	3	49.8	3	375	<b>233</b>
380	3	78.9	3	375	<b>333</b>
480	3	99.7	3	375	<b>433</b>

## MDR (Mercury Displacement Relay)

Nominal Voltage	Phase	Max. kW	Fused Circuits	Est.Ship. Weight (lbs)	Code No.
240	1	12	1	135	<b>221</b>
380	1	19	1	135	<b>321</b>
480	1	24	1	135	<b>421</b>
240	3	20	1	135	<b>241</b>
380	3	32	1	135	<b>341</b>
480	3	40	1	135	<b>441</b>
240	3	40	2	200	<b>262</b>
380	3	62	2	200	<b>362</b>
480	3	80	2	200	<b>462</b>
240	3	60	3	270	<b>273</b>
380	3	95	3	270	<b>373</b>
480	3	120	3	270	<b>473</b>
240	3	60	4	350	<b>274</b>
380	3	95	4	350	<b>374</b>
480	3	120	4	350	<b>474</b>
240	3	80	4	350	<b>284</b>
380	3	125	4	350	<b>384</b>
480	3	160	4	350	<b>484</b>
240	3	120	6	490	<b>296</b>
380	3	190	6	490	<b>396</b>
480	3	240	6	490	<b>496</b>



# Control Systems

F.O.B.: Wright City, Missouri

## Made-to-Order Control Panels

### How to Order

To order your standard control panel, please specify:

- Watlow code number
- Process sensor type
- High limit thermocouple/sensor type
- Options
- Quantity

If our standard units do not meet your application needs, Watlow can manufacture control panels to your special requirements.

For **standard** units, please complete the code number in the build-a-code to the right and include any additional requirements.

### Availability

**Standard:** DIN and CON configured panels available in five to seven days shipment. SCR panels available in 10 to 15 days shipment.

**Made-to-Order:** Consult factory.

### Temp. Controller Specifications

Power/ Temperature Controller	Code Number
<b>DIN-A-MITE</b>	
SERIES SD SERIES 988	<b>SD6C-HCAA-AARG 988A-10CA-AARR</b>
<b>SCR</b>	
SERIES SD SERIES 988	<b>SD6C-HCAA-AARG 988A-10CA-AARR</b>
<b>CON</b>	
SERIES SD SERIES 988	<b>SD6C-HKAA-AARG 988A-10BA-AARR</b>

### Ordering Information

To order, complete the code number to the right with the information below:

**Power Controller Type**

DIN = DIN-A-MITE solid state power controller  
 SCR = SCR power controller  
 CON = Mechanical contractor

**Code Number**

Enter three digit code number from table on [page 208](#)

**NEMA Rating**

01 = NEMA 1 general purpose enclosure  
 04 = NEMA 4 moisture resistant enclosure  
 4X = NEMA 4X<sup>①</sup> corrosion resistant enclosure  
 47 = NEMA 4/7 moisture/explosion resistant enclosure  
 07 = NEMA 7 explosion resistant enclosure  
 12 = NEMA 12 dust resistant enclosure (standard)

**Temperature Controller<sup>②</sup>**

00 = No temperature controller  
 SD = SERIES SD 1/6 DIN temperature controller  
 98 = SERIES 988 temperature controller

**Temperature Controller Sensor Type**

0 = No sensor  
 D = RTD  
 J = Type J  
 K = Type K  
 X = Special (Specify in notes)

**Limit Controller**

00 = No limit controller  
 LV = SERIES LV limit controller

**Limit Controller Sensor Type**

0 = No limit sensor  
 D = RTD (DIN/JIS)  
 J = Type J (max. 540°C/1000°F)  
 K = Type K (max. 1205°C/2200°F)  
 X = Special (specify in notes)

**System Power Requirements (kW)**

Specify maximum kW here

**Options**

0 = Without options  
 1 = With options (See options list on [page 210](#))

Control Systems  
Control Panels

<sup>①</sup> Stainless steel enclosure.  
<sup>②</sup> See temperature controller specification table.

# Control Systems

## Made-to-Order Control Panels

### Dimensions

#### SCR

Amps	Size mm (in.)
150	1260 x 915 x 305 (48 x 36 x 12)
200	1524 x 915 x 305 (60 x 36 x 12)
300	1524 x 1220 x 406 (60 x 48 x 16)

#### DIN-A-MITE

20, 40, 50	610 x 508 x 254 (24 x 20 x 10)
80	914 x 610 x 254 (36 x 24 x 10)
120	1065 x 915 x 255 (42 x 36 x 10)

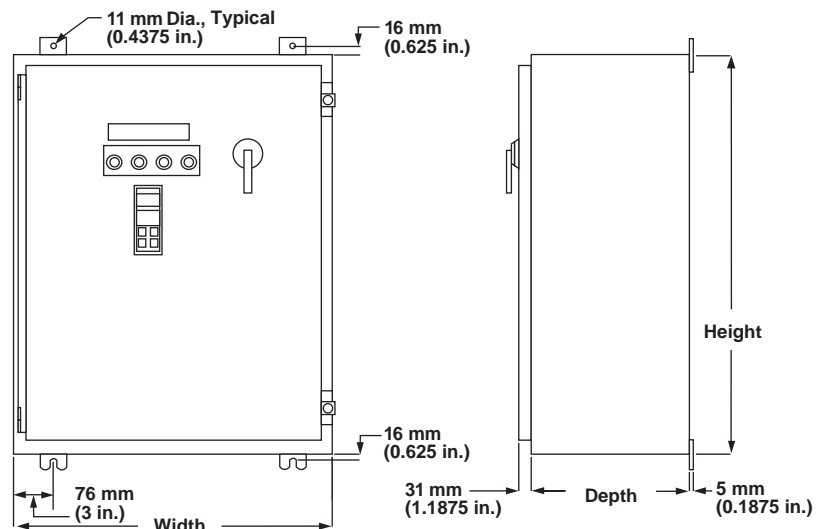
#### CON

50	610 x 510 x 205 (24 x 20 x 8)
100	760 x 610 x 205 (30 x 24 x 8)
150 & 200	1030 x 915 x 205 (42 x 36 x 8)
300	1524 x 915 x 305 (60 x 36 x 12)

### Options

- NEMA 4
- NEMA 4X
- NEMA 1
- NEMA 7
- Other Watlow temperature and limit controllers
- UL® listing per UL® 508
- Other third part certification
- Special paint
- Other custom features available upon request

### NEMA 12 Panel



### Accessories

- Air conditioning/mechanical cooling
- Air-flow switch
- Alarm (with alarm silence push button)
- Amperage meter
- Back-up mechanical contactors (per load circuit)
- Circuit breaker
- Conformal coating
- Control panel (UL® listed per UL® 508)
- Control relay
- Enclosure heater
- Expedited shipping date
- Fungicide protection
- Ground fault detection with relay
- Installation operation and maintenance manual
- Interlocks
- Mechanical cooling
- Motor starters
- NFPA 496 Purge for Class 1, Division 2 areas
- Pilot light (120V~[ac])
- Purge systems to meet NFPA 496 Type Z Purge for Class 1, Division 2, Groups B, C and D
- Push button
- Two position selector switch
- Three position selector switch
- Volt meter

## Control Systems

### Control Consoles

Watlow combines superior products and innovative mechanical designs in its new series of control consoles. Watlow designed these units using many of its temperature and process controllers, making them an excellent choice for point of use applications.

The standard Watlow control consoles are available in one, two or four control loop configurations. Each unit is supplied with a heavy-duty fused line cord, fused output receptacle, a solid state relay and on-off rocker switch. The powder-coated metal case has vent openings on the top and bottom for heat dissipation, keeping internal case temperatures lower. On some models, serial communication options are available through Watlow's ANAWIN® Windows® 95-based software or EIA/TIA-232 or EIA/TIA-422.

Custom-made systems are also available. Please consult a Watlow sales representative for details.

Watlow provides total system development from concept to design... through quality controlled manufacturing to on-site installation and start-up.



#### Features and Benefits

##### Compact size

- Fits easily into confined areas

##### Control options including on-off, proportional or PID control

- Provides simple, reliable operation

##### Self-contained units

- Require no external components

##### Pre-wired

- Fast start-up and installation time

##### Thermocouple and RTD input

- Allows use of a low cost sensor of your choice

##### Serial communications

- Support for one-on-one, as well as remote networking of controllers

#### Applications

- Plastics
- Packaging
- Food processing
- Semiconductor
- Laboratory
- Process

# Control Systems

F.O.B.: Winona, Minnesota

## Control Consoles

### Mini Control Consoles



The mini series is the smallest and most compact control console offered, but features are not limited. The mini utilizes a Watlow SERIES SD controller which can be set to a number of different control modes. The solid state relay provides longer heater life and a lower cost than other power switching devices. The heater output is pre-wired for your convenience. The AMP Mate-'n'-Lok® heater connector makes installation quick and easy.

#### Features

- Small foot print
- Pre-wired output
- AMP Mate-'n'-Lok® output connection (2-pin)
- Miniature thermocouple connector
- Watlow SERIES SD controller
- On-off rocker switch

#### Specifications

##### Controller

- Watlow SERIES SD (SD3C)

##### Dimensions

- 76 mm H x 90 mm W x 180 mm D (3.0 in. H x 3.5 in. W x 7.1 in. D)

##### Output Power Switching

- 8 amp maximum load
- Output is powered through the line cord

#### Power Requirements

- 120V~(ac), +10 percent, -15 percent (NEMA 5-15 Plug)
- 208/240V~(ac), ±10 percent (NEMA 6-15 Plug)
- Fused 10 amp

#### Sensor Input

- Factory selectable thermocouple
- Miniature thermocouple jack and plug

#### Output Configuration

- AMP Mate-'n'-Lok® connector
- Mating connector provided

#### Operating Environment

- 0 to 45°C (32 to 113°F)
- 0 to 90 percent RH, non-condensing

#### Weight

- 2 lbs (0.9 kg)

#### Ordering Information

To order, complete the code number on the right with the information below:

MINI - \_\_\_\_\_ - 0 0 0 0

##### Mini Control Console

##### Input

- J = Type J thermocouple
- K = Type K thermocouple
- T = Type T thermocouple
- R = RTD (2-wire)

##### Control

- 5 = SERIES SD

##### Display

##### SERIES SD

- R = Red/Green

##### Line Voltage

- 1 = 120V~(ac)
- 2 = 208/240V~(ac)

Mate-'n'-Lok® is a registered trademark of AMP Company.

## Control Systems

F.O.B.: Winona, Minnesota

### Control Consoles Single Control Consoles



The single series offers a variety of control, input and heater output options. The single series can be fitted with either a Watlow SERIES 96 or SD controller. The heater output and control circuit are fused to protect the internal components from damage. The heater output connector can be ordered as either an AMP Mate-'n'-Lok® or a twist and lock connector. The heater output is pre-wired making installation quick and easy.

#### Features

- Small foot print
- Pre-wired output
- AMP Mate-'n'-Lok® (two-pin) or a twist and lock output connection
- Miniature thermocouple connector
- Watlow SERIES 96 or SERIES SD controller
- On-off rocker switch

#### Specifications

##### Controller

- Watlow SERIES 96
- Watlow SERIES SD

##### Dimensions

- 119 mm H x 76 mm W x 191 mm D (4.7 in. H x 3.0 in. W x 7.5 in. D)

##### Output Power Switching

- Utilizes a solid state relay
- 8 amp maximum load
- Output is powered through the line cord

##### Power Requirements

- 120V~(ac), +10 percent, -15 percent (NEMA 5-15 Plug)
- 208/240V~(ac), ±10 percent, (NEMA 6-15 Plug)
- Controller is fused to 1.0 amp

#### Sensor Input

- Factory selectable thermocouple
- Miniature thermocouple jack and plug

#### Output Configuration

- Factory selectable AMP Mate-'n'-Lok® connector
- A twist and lock connector
- Mating connector provided

#### Operating Environment

- 0 to 45°C (32 to 113°F)
- 0 to 90 percent RH, non-condensing

#### Weight

- 2 lbs (0.9 kg)

#### Ordering Information

To order, complete the code number on the right with the information below:

**SNGL - - 0 0**

**Single Control Console Control** \_\_\_\_\_

4 = SERIES 96  
 5 = SERIES SD (1/32 DIN)  
 6 = SERIES 96 w/232 comms  
 7 = SERIES SD (1/16 DIN)  
 A = SERIES 96 with ramp and soak

**Input** \_\_\_\_\_

J = Type J thermocouple      T = Type T thermocouple  
 K = Type K thermocouple      R = RTD (2-wire)

**Display** \_\_\_\_\_

**SERIES 96/SD**

RG = Red/Green (only color option available on SD (1/32 DIN))  
 RR = Red/Red  
 GG = Green/Green (only available on 96)  
 GR = Green/Red (only available on 96)

**Output Connector** \_\_\_\_\_

1 = AMP Mate-'n'-Lok®  
 2 = Twist and lock

**Line Voltage** \_\_\_\_\_

1 = 120V~(ac)  
 2 = 208/240V~(ac)

# Control Systems

F.O.B.: Winona, Minnesota

## Control Consoles

### Dual Control Consoles



The dual series is the first package that offers multiple control zones in one package. Watlow's SERIES 96 or SERIES SD controller can be used as the controller for the dual series. Each zone utilizes a solid state relay for longer heater life and a lower cost than other power switching devices. The heater output connector can be ordered as either an AMP Mate-'n'-Lok® or a twist and lock connector.

#### Features

- Small foot print
- Pre-wired outputs
- AMP Mate-'n'-Lok® (2-pin) or a twist and lock output connection
- Miniature thermocouple connector
- Watlow SERIES 96 or SD controller
- On-off rocker switch

#### Specifications

##### Controller

- Watlow SERIES 96
- Watlow SERIES SD

##### Dimensions

- 114 mm H x 152 mm W x 191 mm D  
(4.5 in. H x 6.0 in. W x 7.5 in. D)

##### Output Power Switching

- Utilizes solid state relays
- Output is powered through line cord
- Light duty dual
  - 8 amp maximum load (4 amps per zone)
- Heavy duty dual
  - 16 amp maximum load (8 amps per zone)
- Light duty control/limit
  - (8 amps maximum load)
- Heavy duty control/limit
  - (12 amps maximum load)

#### Power Requirements

- Light duty dual or controller/limit
  - 120V~(ac), +10 percent, -15 percent (NEMA 5-15 plug)
  - 208/240V~(ac), ±10 percent, -15 percent (NEMA 6-15 plug)
- Heavy duty dual or controller/limit
  - 120V~(ac), +10 percent, -15 percent (NEMA 5-20 plug)

#### Sensor Input

- Factory selectable thermocouple
- Miniature thermocouple jack and plug

#### Output Configuration

- Factory selectable AMP Mate-'n'-Lok® connector
- A twist and lock connector
- Mating connector provided

#### Operating Environment

- 0 to 45°C (32 to 149°F)
- 0 to 90 percent RH, non-condensing

#### Weight

- 5 lbs (2.3 kg)

#### Ordering Information

To order, complete the code number on the right with the information below:

**DUAL -      -      00**

**Dual Control Console**

**Control** \_\_\_\_\_

A = SERIES 96 with ramp and soak  
 B = SERIES 96/SERIES 97 with ramp and soak  
 4 = SERIES 96  
 5 = SERIES SD (1/32 DIN)  
 7 = SERIES SD (1/16 DIN)  
 8 = SERIES 96/SERIES 97 controller/limit  
 9 = SERIES SD6C/SERIES SD6L controller/limit

**Input** \_\_\_\_\_

J = Type J thermocouple      T = Type T thermocouple  
 K = Type K thermocouple      R = RTD (2-wire)

**Display** \_\_\_\_\_

**SERIES 96/97/SD**

RG = Red/Green (only color option available on SD (1/32 DIN))  
 RR = Red/Red  
 GG = Green/Green (only available on SERIES 96 and SERIES 97)  
 GR = Green/Red (only available on SERIES 96 and SERIES 97)

**Output Connector** \_\_\_\_\_

1 = AMP Mate-'n'-Lok®  
 2 = Twist and lock

**Line Voltage/Power** \_\_\_\_\_

1 = 120V~(ac) (4A per zone; 8A total)  
 2 = 208/240V~(ac) (4A per zone; 8A total)  
 3 = 120V~(ac) (4A per zone; 16A total)

## Control Systems

F.O.B.: Winona, Minnesota

### Control Consoles Quad Control Consoles



The quad series offers four zones of control in one compact package. Watlow SERIES 96 or SERIES SD controllers can be utilized for each zone. Each zone utilizes a solid state relay for longer heater life and a lower cost than other power switching devices. The heater output connector can be ordered as either an AMP Mate-'n'-Lok® or a twist and lock connector.

#### Features

- Small foot print
- Pre-wired outputs
- AMP Mate-'n'-Lok® (2-pin) or a twist and lock output connection
- Miniature thermocouple connector
- Watlow SERIES 96 or SD controllers
- On-off rocker switch

#### Specifications

##### Controller

- Watlow SERIES 96
- Watlow SERIES SD

##### Dimensions

- 114 mm H x 305 mm W x 191 mm D (4.5 in. H x 12.0 in. W x 7.5 in. D)

##### Output Power Switching

- Utilizes solid state relays
- Output is powered through line cord
- 16 amp maximum load (4 amps per zone)

##### Power Requirements

- 120V~(ac), +10 percent, -15 percent (NEMA 5-20 plug)

##### Sensor Input

- Factory selectable thermocouple
- Miniature thermocouple jack and plug

##### Output Configuration

- Factory selectable AMP Mate-'n'-Lok® connector
- A twist and lock connector
- Mating connector provided

##### Operating Environment

- 0 to 45°C (32 to 11°F)
- 0 to 90 percent RH, non-condensing

##### Weight

- 6 lbs (2.7 kg)

#### Ordering Information

To order, complete the code number on the right with the information below:

**QUAD - - 0 0**

**Quad Control Console** \_\_\_\_\_

**Control** \_\_\_\_\_

A = SERIES 96 with ramp and soak  
 4 = SERIES 96  
 5 = SERIES SD (1/32 DIN)  
 7 = SERIES SD (1/16 DIN)

**Input** \_\_\_\_\_

J = Type J thermocouple    T = Type T thermocouple  
 K = Type K thermocouple    R = RTD (2-wire)

**Display** \_\_\_\_\_

**SERIES 96/SD**

RG = Red/Green (only color option available on SD (1/32 DIN))  
 RR = Red/Red  
 GG = Green/Green (only available on 96)  
 GR = Green/Red (only available on 96)

**Output Connector** \_\_\_\_\_

1 = AMP Mate-'n'-Lok®  
 2 = Twist and lock

**Line Voltage** \_\_\_\_\_

1 = 120V~(ac)

## Control Systems

### Control Consoles

#### PLCC Control Console

Watlow has combined superior products, innovative mechanical design and time-proven temperature control knowledge into a new control system ideal for vacuum pump line heating applications.

The single-loop control enclosure is built around a Watlow SERIES SD temperature controller. Standard features for this unit include full PID control, high and low process alarms and digital readout of the process temperature. These enclosures are built with solid state relays for noise-free operation and tight power control of the heating system. A mechanical relay is included to provide positive break of the load power in case of an alarm or error condition. Each unit is supplied with a heavy duty line cord, fused output receptacle and on-off rocker switch. The standard console powers up to 8 amps @ 120V~(ac). All Watlow pump line heating system heater and thermocouple cables plug right in for quick, tool-free installation. A ground fault circuit interrupt is available as an option.

Custom made systems are also available. Please consult a Watlow sales representative for details.



#### **Process Benefits**

- In combination with Watlow pump line heaters, vacuum pump lines can be controlled to a maximum of 200°C (392°F) to greatly reduce solid buildup.
- Using multiple control zones, the temperature may be varied or staged at different points along the line to “steer” buildup to a manageable location.

#### **Features and Benefits**

##### **Compact Size**

- Small foot print

##### **PID control**

- Maintains precise temperature

##### **Self-contained units**

- No external components required

##### **Prewired output, miniature thermocouple connector, on-off rocker switch**

- Quick, tool-free installation and fast start up



## Control Systems

### Control Consoles PLCC Control Console

#### Specifications

##### Controller

- Watlow SERIES SD 1/32 DIN

##### Sensor Input

- Type K or Type J thermocouple, factory selectable
- Miniature type thermocouple jack
- Mates with Watlow pump line thermocouples

##### Heater Output

- Solid state relay power control
- Maximum 8 amps @ 120V~(ac), fused at 10A
- Amp Universal Mate-N-Lok® connector, 3-position
- Mates with Watlow pump line heaters

##### Alarm Output

- Disconnects power to heaters when tripped
- Alarm signal via 5 amp contact closure
- Amp Universal Mate-N-Lok® connector, 2-position
- Alarm set points adjustable

##### Power Requirements

- 120V~(ac) (+10 percent -15 percent, 50/60Hz)
- IDE style fused input power receptacle with six foot long power cord
- On-off rocker switch
- Optional GFCI line cord available
- Data retention upon power failure via non-volatile memory

##### Extension Cables

- Heater Power Extension Cable: Type SJ, 16-3 stranded. Enclosure connection: Amp Universal Mate-N-Lok® connector, 3-position. Heater connection: Amp Universal Mate-N-Lok® connector, 2-position, with separate ring terminal ground.

- Thermocouple Extension Cable: FEP Teflon® insulated, 24 Ga stranded. Enclosure connection: miniature type thermocouple plug. Sensor connection: miniature type thermocouple jack. Calibration as specified

##### Mechanical

- Overall Dimensions: 76.2 mm W x 114.3 mm H x 178 mm D (3 in. W x 4.5 in. H x 7 in. D)
- Weight: Approx. 1.7 lbs
- Table-top style rubber mounting feet

##### Operating Environment

- Ambient temperature: 0 - 45°C (32 - 113°F)
- 0 - 90 percent RH, non-condensing



#### Ordering Information

To order, complete the code number on the right with the information below:

PLCC - \_\_\_\_\_ - 00 \_\_\_\_\_

**SERIES PLCC** = Control console with single thermocouple control input, 8A heater control output, contact alarm output

**Input Type** \_\_\_\_\_

J = Type J thermocouple  
K = Type K thermocouple

**Extension Cable Length\* (ft)** \_\_\_\_\_

00 = None  
05 = 5 ft  
10 = 10 ft (standard length)  
15 = 15 ft  
25 = 25 ft

**Power Options** \_\_\_\_\_

0 = Standard line cord  
G = GFCI line cord

**Custom Options** \_\_\_\_\_

00 = None  
AA - ZZ = Consult factory for options

\* Includes both heater and thermocouple cables

Teflon® is a registered trademark of E.I. du Pont de Nemours & Company

# Control Systems

## Control Boxes

To complete or upgrade a heater installation, Watlow offers complete, ready-to-install control boxes. Three basic models save time and hassle by allowing customers to specify controller and power switching devices to meet application objectives.

### Control Box Configurations

**Model 1**—Process and high-limit controllers

**Model 2**—Process or high-limit controllers

Capable of switching up to 50 amps and 480V~(ac), each control box comes pre-wired with customer specified options.

### Fast Shipment

All configurable control boxes ship within five to 10 working days.

### Enclosure Options<sup>①</sup>

- Moisture resistant steel (NEMA 4)
- Corrosion resistant fiberglass (NEMA 4X)

### Controller Options<sup>①</sup>

- PID auto-tuning SERIES SD and 96 with ramp-to-set point
- On-off SERIES CV controllers
- High-limit protection SERIES LV and 97



### Power Switching Options<sup>①</sup>

- Electromechanical relay (contactor)<sup>②</sup>
- E-SAFE<sup>®</sup> RELAYS
- SCR DIN-A-MITES<sup>®</sup>

### Availability

**Assembly Stock:** Five to 10 working days

**Modified Stock<sup>④</sup>:** Five to 10 working days

**Made-to-Order:** 15 working days

Options, complexity and quantity may affect availability and lead-times. Consult factory.

## Control Box Dimensions

Control Box	NEMA Enclosure Rating	Enclosure Material	Dimensions (in.)				
			A	B	C	G	H
Model 1	4	Metal	12	12	6	12.75	10
	4X	Fiberglass	12	10	6	12.9375	8
Model 2	4	Metal	12	14.375	6	12.75	10
	4X	Fiberglass	10	8	6	10.9375	6

<sup>①</sup> Consult specific model option information for availability.

<sup>②</sup> Electromechanical relays are not recommended for PID control. They are warranted for only 100,000 contact closures.

<sup>③</sup> Application at stated ampacity is sensitive to ambient temperature.

<sup>④</sup> Assembly Stock units with catalog options.

# Control Systems

F.O.B.: Wright City, MO

## Control Boxes

### Control Box Model #1—Process and High Limit Controller

#### Base Model CBCVJ4XLVJLD30 Includes:

- SERIES CV on-off controller, Type J input, 0 to 315°C (32 to 600°F)
- NEMA 4X - fiberglass box - 305 x 254 x 152 mm (12 x 10 x 6 in.)
- SERIES LV high-limit with Type J input, 0 to 750°C (32 to 1382°F)
- E-SAFE RELAY
- Mechanical relay for high-limit circuit isolation
- Illuminated on-off control switch
- Control fusing

#### Options—Choose Only One In Each Category

Controller	Function	Input	Range	Code No.
SERIES CV	On-off	Type J	0 to 315°C (32 to 600°F)	<b>CVJ</b>
SERIES CV	On-off	Type K	0 to 1250°C (32 to 2282°F)	<b>CVK</b>
①SERIES SD ½ DIN	PID	Type J	0 to 750°C (32 to 1382°F)	<b>P3J</b>
①SERIES SD ½ DIN	PID	Type K	0 to 1250°C (32 to 2282°F)	<b>P3K</b>
①SERIES SD ¼ DIN	PID	Type J	0 to 750°C (32 to 1382°F)	<b>P6J</b>
①SERIES SD ¼ DIN	PID	Type K	0 to 1250°C (32 to 2282°F)	<b>P6K</b>
①SERIES 96	PID	Type J	0 to 750°C (32 to 1382°F)	<b>96J</b>
①SERIES 96	PID	Type K	0 to 1250°C (32 to 2282°F)	<b>96K</b>

Enclosure	Material	Dimensions	Code No.
NEMA 4	Metal Box	305 x 305 x 152 mm (12 x 12 x 6 in.)	<b>04</b>
NEMA 4X	Fiberglass	305 x 254 x 152 mm (12 x 10 x 6 in.)	<b>4X</b>

High-Limit	Function	Input	Range	Code No.
SERIES LV	High-Limit	Type J	0 to 750°C (32 to 1382°F)	<b>LVJ</b>
SERIES LV	High-Limit	Type K	0 to 1250°C (32 to 2282°F)	<b>LVK</b>
SERIES 97	High-Limit	Type J	0 to 750°C (32 to 1382°F)	<b>97J</b>
SERIES 97	High-Limit	Type K	0 to 1250°C (32 to 2282°F)	<b>97K</b>
①SERIES SD ½ DIN	High-Limit	Type J	0 to 750°C (32 to 1382°F)	<b>L3J</b>
①SERIES SD ½ DIN	High-Limit	Type K	0 to 1250°C (32 to 2282°F)	<b>L3K</b>
①SERIES SD ¼ DIN	High-Limit	Type J	0 to 750°C (32 to 1382°F)	<b>L6J</b>
①SERIES SD ¼ DIN	High-Limit	Type K	0 to 1250°C (32 to 2282°F)	<b>L6K</b>

#### Power Switching Devices

(Includes appropriately sized high-limit electromechanical relay)

Type	Amps	Poles/Phase	Code No.
E-SAFE RELAY	20 amp	3-Pole	<b>LD3</b>
E-SAFE RELAY	40 amp	3-Pole	<b>MD3</b>
SCR	②③16 amps, 480V, DIN-A-MITE A	1-phase	<b>D16</b>
SCR	②③20 amps, 480V, DIN-A-MITE B	3-phase	<b>D20</b>
SCR	②③45 amps, 480V, DIN-A-MITE C	3-phase	<b>D45</b>

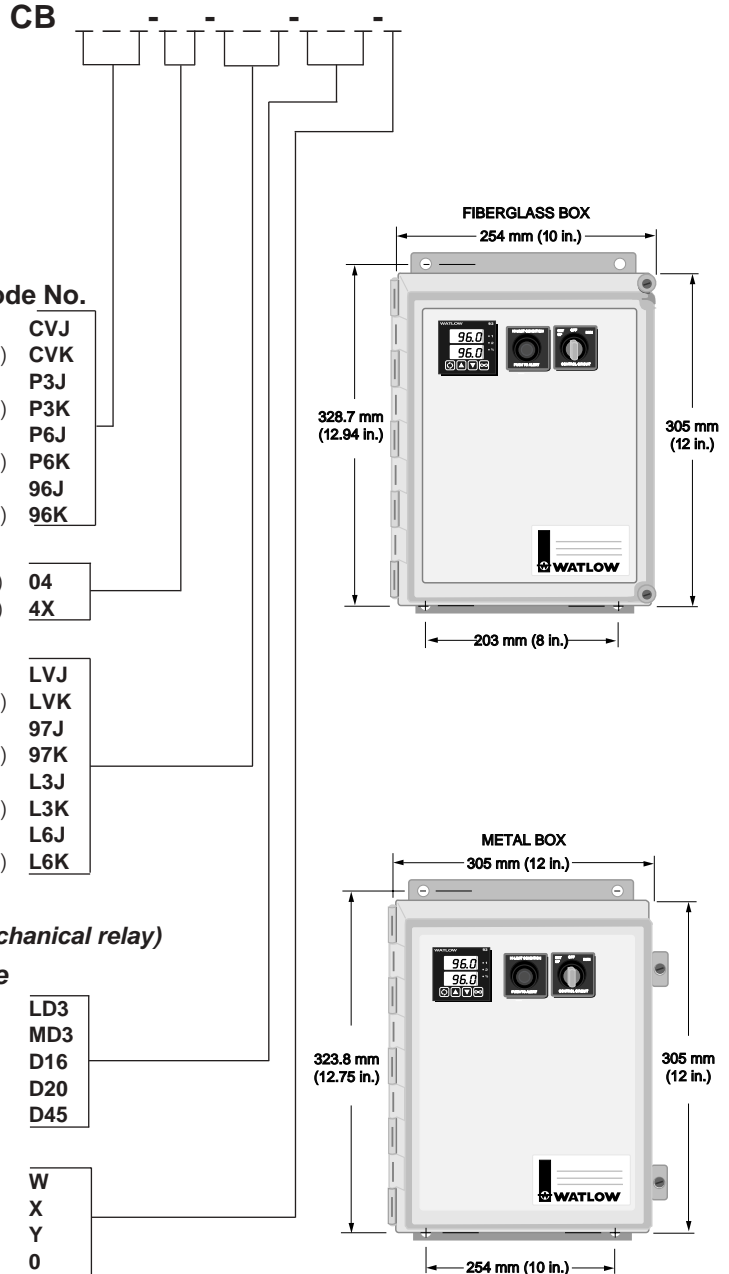
#### ④Control Transformers

240 to 120V~(ac)	<b>W</b>
480 to 120V~(ac)	<b>X</b>
208 to 120V~(ac)	<b>Y</b>
No Transformer	<b>0</b>

Availability: Five to 10 working days

#### Notes:

- ① Not recommended for use with electromechanical relays.
- ② Metal enclosure required for SSR, choose from above. For derating curves above stated ambient temperature, consult factory.
- ③ Includes semiconductor fusing, 3-phase units have 2-leg control.
- ④ Includes semiconductor fusing, 3-phase units have 2-leg control, NEMA 4 enclosure is not available.
- ⑤ If no transformer option is selected, 120V~(ac) service is required. Connections on terminal block provided.



Control Systems  
Control Boxes

## Control Boxes

### Control Box Model #2—Process or High Limit Controller

#### Base Model CBCVJ4X000LD30 Includes:

- SERIES CV on-off controller, ANSI Type J input, 0 to 315°C (32 to 600°F)
- NEMA 4X - fiberglass box - 254 x 203 x 152 mm (10 x 8 x 6 in.)
- E-SAFE RELAY
- Illuminated on-off control switch
- Control fusing

#### Options—Choose Only One In Each Category

Controller	Function	Input	Range	Code No.
SERIES CV	On-off	Type J	0 to 315°C (32 to 600°F)	<b>CVJ</b>
SERIES CV	On-off	Type K	0 to 1250°C (32 to 2282°F)	<b>CVK</b>
①SERIES SD ½ DIN	PID	Type J	0 to 750°C (32 to 1382°F)	<b>P3J</b>
①SERIES SD ½ DIN	PID	Type K	0 to 1250°C (32 to 2282°F)	<b>P3K</b>
①SERIES SD ¼ DIN	PID	Type J	0 to 750°C (32 to 1382°F)	<b>P6J</b>
①SERIES SD ¼ DIN	PID	Type K	0 to 1250°C (32 to 2282°F)	<b>P6K</b>
①SERIES 96	PID	Type J	0 to 750°C (32 to 1382°F)	<b>96J</b>
①SERIES 96	PID	Type K	0 to 1250°C (32 to 2282°F)	<b>96K</b>
SERIES LV	High-Limit	Type J	0 to 750°C (32 to 1382°F)	<b>LVJ</b>
SERIES LV	High-Limit	Type K	0 to 1250°C (32 to 2282°F)	<b>LVK</b>
SERIES 97	High-Limit	Type J	0 to 750°C (32 to 1382°F)	<b>97J</b>
SERIES 97	High-Limit	Type K	0 to 1250°C (32 to 2282°F)	<b>97K</b>
①SERIES SD ½ DIN	High-Limit	Type J	0 to 750°C (32 to 1382°F)	<b>L3J</b>
①SERIES SD ½ DIN	High-Limit	Type K	0 to 1250°C (32 to 2282°F)	<b>L3K</b>
①SERIES SD ¼ DIN	High-Limit	Type J	0 to 750°C (32 to 1382°F)	<b>L6J</b>
①SERIES SD ¼ DIN	High-Limit	Type K	0 to 1250°C (32 to 2282°F)	<b>L6K</b>

Enclosure	Material	Dimensions	Code No.
NEMA 4	Metal	254 x 203 x 152 mm (12 x 12 x 6 in.)	<b>04</b>
NEMA 4X	Fiberglass	254 x 203 x 152 mm (10 x 8 x 6 in.)	<b>4X</b>

#### Power Switching Devices

Type	Amps	Poles/Phase	Code No.
E-SAFE RELAY	20 amp	3-Pole	<b>LD3</b>
E-SAFE RELAY	40 amp	3-Pole	<b>MD3</b>
SCR	③16 amps, 480V, DIN-A-MITE A	1-phase	<b>D16</b>
SCR	③20 amps, 480V, DIN-A-MITE B	3-phase	<b>D20</b>
SCR	③45 amps, 480V, DIN-A-MITE C	3-phase	<b>D45</b>

304.8 x 304.8 x 152.4 mm (12 x 12 x 6 in.) metal enclosure required for SSR and SCR, choose from above

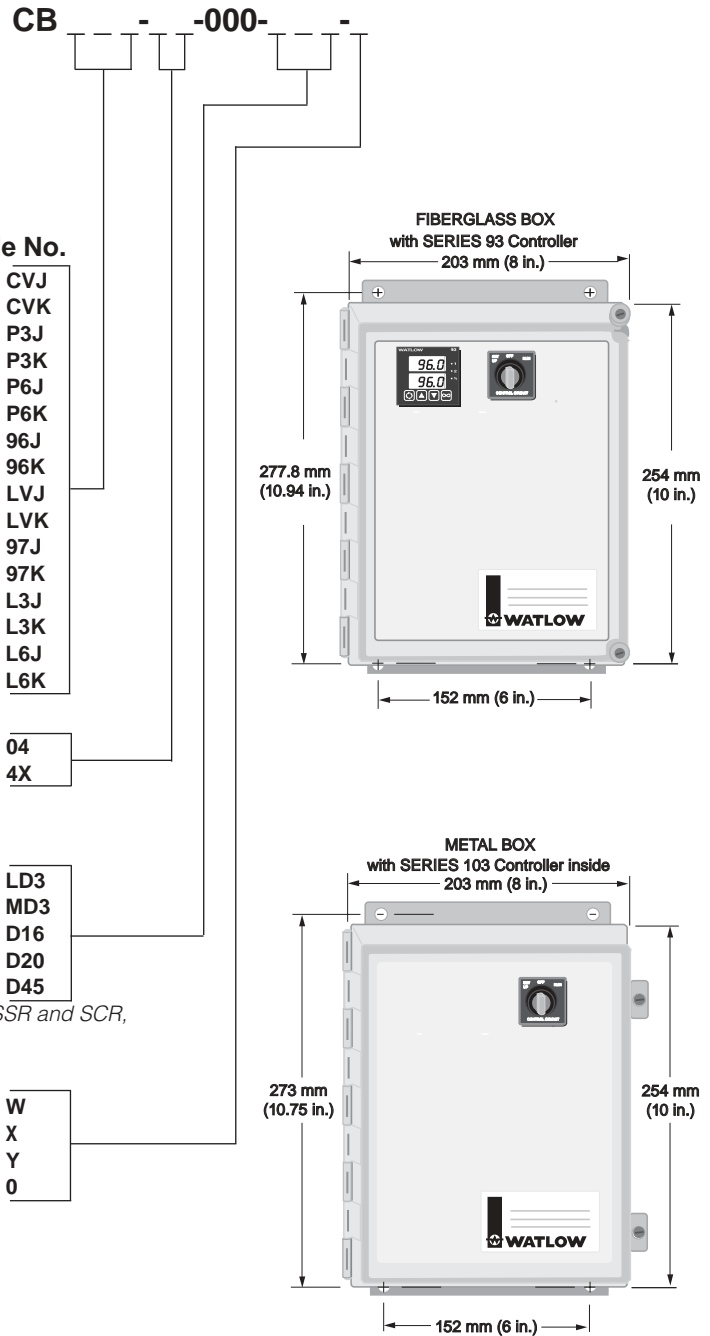
#### ④ Control Transformers

240 to 120V~(ac)	<b>W</b>
480 to 120V~(ac)	<b>X</b>
208 to 120V~(ac)	<b>Y</b>
No Transformer	<b>0</b>

Availability: Five to 10 working days

#### Notes:

- ① Not recommended for use with electromechanical relays.
- ② Metal enclosure required for SSR, choose from above. For derating curves above stated ambient temperature, consult factory.
- ③ Includes semiconductor fusing, 3-phase units have 2-leg control.
- ④ Includes semiconductor fusing, 3-phase units have 2-leg control, NEMA 4 enclosure is not available.
- ⑤ If no transformer option is selected, 120V~(ac) service is required. Connections on terminal block provided.



## Control Accessories

### Thermostats and Accessories

Thermostats regulate temperature in non-critical applications. They sense temperature, within a preset range and cycle heaters on and off to maintain the set point.

Thermostats may be mounted inside a terminal enclosure or remote mounted (separate from the heater assembly). If using a remote mounted thermostat, be sure to order sufficient capillary tube length to permit installation.

All Watlow thermostats are normally closed circuit and either single-pole, single throw (SPST) or double-pole, single throw (DPST). They can be used with or without an enclosure.

Thermostat selection should be based on temperature range, capillary tube length and sensor bulb size (diameter/length).

#### Remote Mount Thermostat Assemblies

Remote mounted thermostat assemblies can be supplied with the following enclosures:

- General purpose (NEMA 1)
- Moisture resistant (NEMA 4)
- Explosion resistant (NEMA 7)
- Explosion/moisture resistant (NEMA 7/4)
- Dust resistant (NEMA 12)

#### Pilot Light

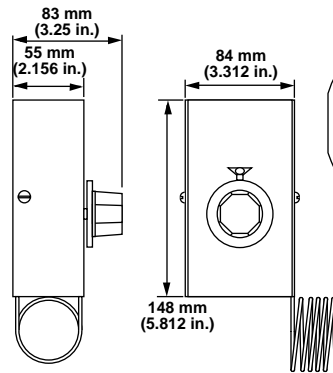
An optional pilot light gives visual indication whether the power supplied to the heating element(s) is on or off. To order, please specify suffix code **PL11**.

#### Thermostat Conversion Kits

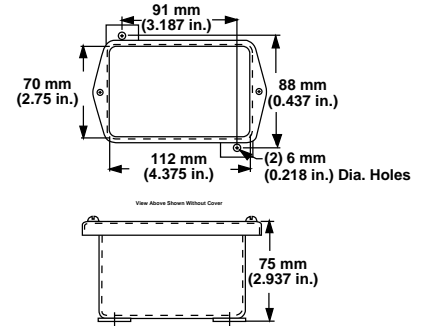
Kits are available to convert a heater's general purpose (NEMA 1) terminal enclosure to accept either a single or double pole thermostat. The kit contains all the necessary parts to change out the existing terminal enclosure cover and mount the thermostat inside. These are **hardware and wiring kits** only.

### Thermostats with Enclosures

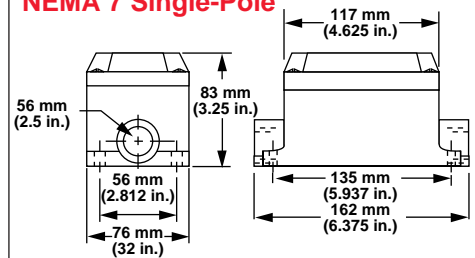
#### NEMA 1 Single and Double-Pole



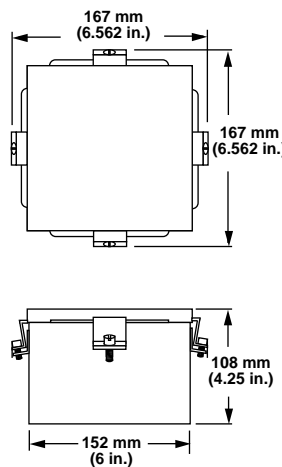
#### NEMA 4 and 12 Single-Pole



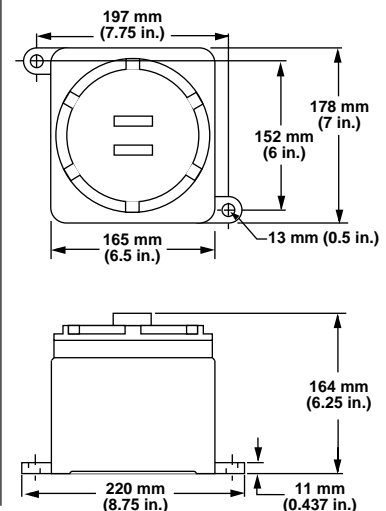
#### NEMA 7 Single-Pole



#### NEMA 4 and 12 Double-Pole



#### NEMA 7 Double-Pole



**Single pole conversion kit** covers 25.4, 31.75, 50.8 and 63.5 mm (1.125, 2 and 2.5 in.) NPT screw plugs. To order, specify code.

**K492-000-35-(thermostat type)**.

See Watlow's Heater catalog, page 425 for type.

**Double pole conversion kit** covers 50.8 and 63.5 mm (2 and 2.5 in.) inch NPT screw plugs. To order, specify code **K492-000-34-**

**(thermostat type)**. See Watlow's Heater catalog, page 425 for type.

#### Celsius Dial Scale

Thermostats are shipped with Fahrenheit (°F) dial scales. If your application requires a Celsius (°C) scale, order the optional dial face.

To order, specify code **CD**. Scale will match thermostat temperature range.

Incoloy® is a registered trademark of the Special Metals Corporation.

# Control Accessories

## Controls and Accessories

### Application Hints

- Locate the thermostat where ambient temperatures do not exceed 65°C (150°F).
- Mount the thermostat in an enclosure that is compatible with the surrounding environment.
- Immerse the entire sensing bulb in the media being heated.
- Make sure the sensing bulb is mounted away from the heating element(s) to negate any undue influence on the sensing bulb's temperature "reading."
- Keep the capillary tube insulated from electrical connections.
- Do not use a thermostat for high-accuracy temperature sensing. Use an appropriate thermocouple, RTD or thermistor and temperature control.
- Do not use thermostats as a primary power switching device. Use a disconnect switch or circuit breaker to cut power when servicing.

- Interconnect the thermostat to the heater only if:
  - The heater has one circuit
  - The heater's ampere draw is lower than the thermostat's rated ampacity at prescribed voltage.
- Interconnect either a single or double-pole thermostat with a single-phase heater when the supply voltage does not exceed 277V~(ac) for SPST or 480V~(ac) for DPST.
- Only interconnect three-phase delta heaters to DPST thermostats.
- Use a single-pole thermostat for pilot duty where the thermostat is not interconnected with the heater, or heater exceeds the volt/amp rating.

### Warning

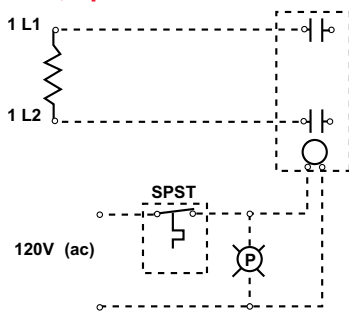
Do not use thermostats for high-limit sheath protection. Thermostats fail in a closed circuit mode and will not cut power to the heaters. Limit control should be provided by an isolated, redundant sensor and control system of the appropriate type, design and installation.

Thermostats are precalibrated at the factory. No adjustment, other than selecting the desired operating temperature, is required. All wiring should be performed by qualified personnel and comply with the National Electrical Code and other applicable state and local codes.

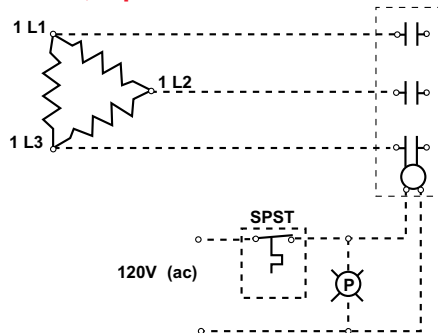
To help assure you select the correct thermostat, as well as install and wire it properly, we have put together a few helpful hints. Schematics are provided for interconnecting thermostats to single- and three-phase heaters.

### Pilot Duty Wiring

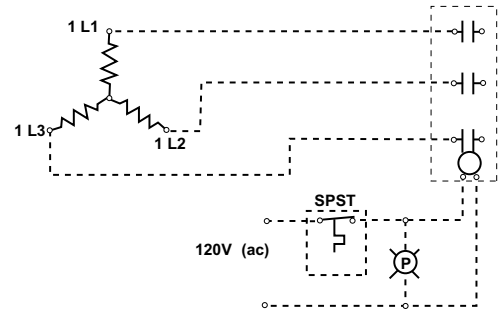
#### SPST, 1-phase



#### SPST, 3-phase delta

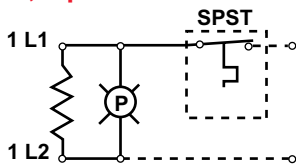


#### SPST, 3-phase wye

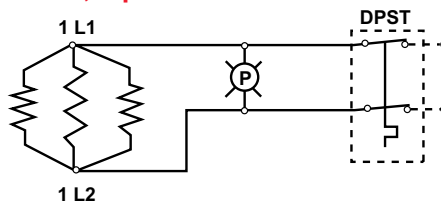


### Interconnected Wiring

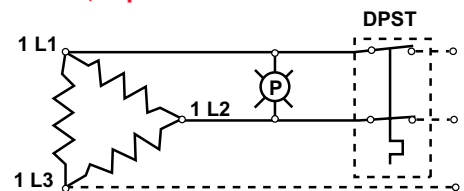
#### SPST, 1-phase



#### DPST, 1-phase



#### DPST, 3-phase delta



# Control Accessories

F.O.B.: Hannibal, Missouri

## Controls and Accessories

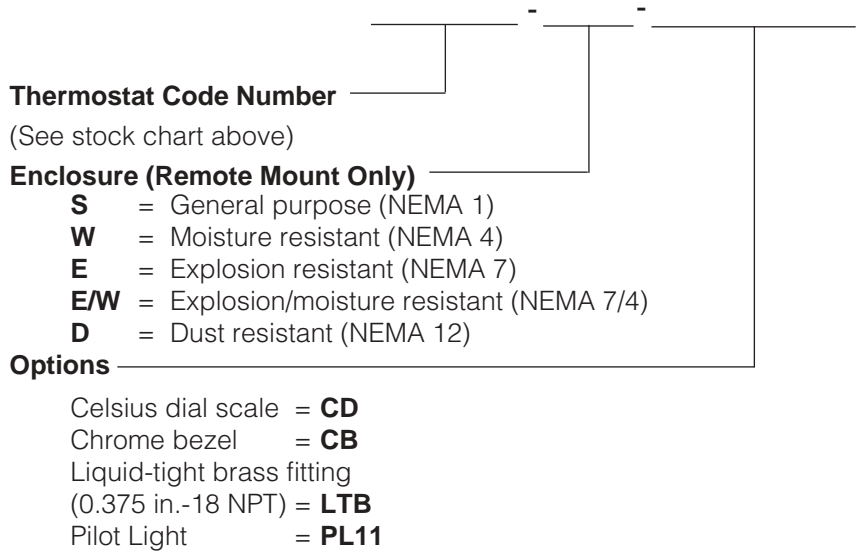
### Thermostat

Control Mode	Type	Temperature Range		Differential °C (°F)	Ampacity @ Line Voltage				Bulb Diameter		Bulb Length		Capillary Length		Terminal Type	Code No.	Est. Net Weight kg (lbs)	
		°C	(°F)		120	240	277	480	mm	(in.)	mm	(in.)	mm	(in.)				
On-off Temp Control	Single-Pole	0-40	(30-110)	0	(8)	25	25	22	—	6	(0.250)	121	(4.75)	455	(18)	#12 AWG	<b>1</b>	0.4 (1)
		0-120	(30-250)	8	(15)	25	25	22	—	6	(0.250)	85	(3.25)	455	(18)		<b>2</b>	0.4 (1)
	Single Throw (SPST)	0-120	(30-250)	8	(15)	25	25	22	—	6	(0.250)	85	(3.25)	2135	(84)	Stranded Leads	<b>2A</b>	0.4 (1)
		80-290	(175-550)	14	(26)	25	25	22	—	6	(0.250)	85	(3.25)	455	(18)		<b>3</b>	0.4 (1)
		80-290	(175-550)	14	(26)	25	25	22	—	6	(0.250)	70	(2.75)	2135	(84)		<b>3A</b>	0.4 (1)
		150-350	(300-700)	7	(12)	25	25	—	—	10	(0.375)	95	(3.75)	1525	(60)		<b>10</b>	0.4 (1)
	Double-Pole Single Throw (DPST)	15-70	(60-160)	10	(19)	30	30	30	20	6	(0.250)	110	(4.375)	355	(14)	#8-32 Screw Lug	<b>12A</b>	0.4 (1)
		0-40	(30-110)	7	(12)	30	30	30	21	10	(0.375)	160	(6.25)	915	(36)		<b>4</b>	0.9 (2)
		15-120	(60-250)	7	(12)	30	30	30	21	10	(0.375)	115	(4.25)	1220	(48)		<b>5</b>	0.9 (2)
		15-120	(60-250)	7	(12)	30	30	30	21	6	(0.250)	165	(6.5)	1220	(48)		<b>5A</b>	0.9 (2)
On-off with	(DPST)	40-290	(100-550)	12	(22)	30	30	30	21	10	(0.375)	100	(3.875)	1220	(48)	#10-32 Screw Lug	<b>7</b>	0.9 (2)
		40-290	(100-550)	12	(22)	30	30	30	21	6	(0.250)	179	(7.0625)	1220	(48)		<b>7A</b>	0.9 (2)
Manual Reset	(SPST)	15-120	(60-250)	7	(12)	30	30	30	—	6	(0.250)	165	(6.5)	1220	(48)	#10-32 Screw Lug	<b>8</b>	0.9 (2)
		40-290	(100-550)	12	(22)	30	30	30	—	8	(0.188)	305	(12)	1220	(48)		<b>9</b>	0.9 (2)
Manual Reset	(SPST)	180	(350 <sup>①</sup> )	—	—	30	30	20	—	6	(0.250)	90	(3.5)	915	(36)	#10-32 Screw Lug	<b>11</b>	0.4 (1)

① Fixed temperature setting

Control Accessories  
Controls and Accessories

### How to Order



### Availability

#### Thermostats

**Stock:** Same day shipment

#### Remote Mount Thermostats

**Stock:** Same day shipment

**Assembly Stock:** Three to five working days

**Modified Stock**<sup>②</sup>: Three to five working days

**Standard:** Eight to 10 working days

Options, complexity and quantity may affect availability and lead times. Consult factory.

② Stock or Assembly Stock units with catalog options.

## Control Accessories

F.O.B.: Hannibal, Missouri

### Sensors and Accessories

#### Low Liquid Level Sensor

The Watlow low liquid level sensor can protect a heating system by sensing when a liquid drops below a predetermined level. This is accomplished by locating the sensor at the minimum desired liquid level in the tank or vessel. The sensor's ANSI Type J thermocouple output can be connected to a variety of controls, alarms and limit protection devices.

To provide an additional margin of protection, the Type J thermocouple makes this low liquid level sensor respond considerably faster than conventional capillary bulb thermostats.

To order, specify code number **BCN5J1SJ**.

#### Application Hints

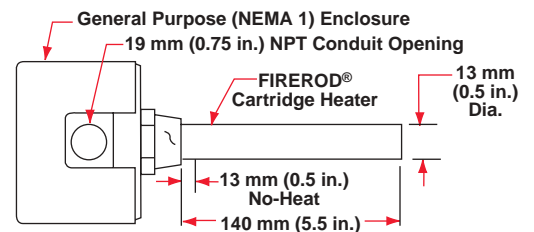
- Only use sensor in **non-flammable** liquids that are compatible with the Incoloy® sheath and 304 stainless steel screw plug.

- Application should tolerate sheath temperature at limit set point.
- The time delay between the low liquid level condition on-set, and the sensor's ability to signal the control device should be adequate to protect the heater(s). See *Installation and Maintenance Instructions* for details.

#### Controller Recommendation

- Use Watlow Safety Limit Temperature Controller SERIES 142 (Code number **142A-3605-1300**). This controller features compact sub-panel mounting and is sealed against ambient environment. UL® recognized for limit protection (UL® 991, "Tests For Safety-Related Controls Employing Solid State Devices").

Controller supplied by Watlow in Winona, Minnesota.



#### Specifications

**Screw plug:** 26 mm (1 in.) NPT

**Plug material:** 304 stainless steel

**Sheath material:** Incoloy®

**Watt density:** 13 W/in<sup>2</sup> (2 W/cm<sup>2</sup>)

**Watts:** 100

**Volts:** 120V~(ac)

**Immersed length:** 140 mm (5.5 in.)

**Thermocouple:** ANSI Type J

**Est. ship. wt.:** 1 kg (2 lbs)

#### Availability

**Stock:** Same day shipment

**Modified Stock**®: Five to seven working days

**Made-to-Order:** Four to six weeks

Options, complexity and quantity may affect availability and lead times. Consult factory.

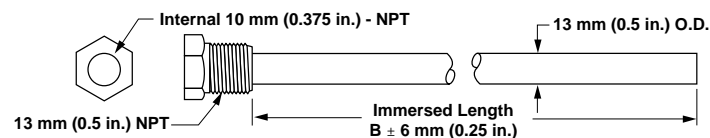
® Stock units with catalog options.

#### Protective Wells

Protective wells isolate and protect thermostat bulbs and other temperature sensors (thermocouples, RTDs or thermistors). They allow inserting the sensing element sufficiently into the media being heated without being damaged.

Steel or stainless steel protective wells are available in three lengths. They are supplied with 13 mm (0.5 in.) NPT mounting and 10 mm (0.375 in.)-18 NPT internal thread for mating to a liquid-tight bushing (LTB).

All units are stock. To order, specify the appropriate code number from the stock table.



#### Protective Wells

Plug and Thermowell Material	Immersed B Dimension mm (in.)	Code No.	Est. Ship. Weight kg (lb)
Steel	305 (12)	<b>PWS12</b>	0.5 (1)
	610 (24)	<b>PWS24</b>	1.0 (2)
	915 (36)	<b>PWS36</b>	1.0 (2)
Stainless Steel	305 (12)	<b>PWSS12</b>	0.5 (1)
	610 (24)	<b>PWSS24</b>	1.0 (2)
	915 (36)	<b>PWSS36</b>	1.0 (2)

#### Availability

**Stock:** Same day shipment

**Modified Stock**®: Five to seven working days

**Made-to-Order:** Three weeks

Options, complexity and quantity may affect availability and lead times. Consult factory.






® Stock units with catalog options.










# Controller Output Comparison Guide

I want to switch... I want to control...	Controller Output	Output Life
<ul style="list-style-type: none"> <li>Solenoid coil/valve</li> <li>Mercury displacement relay (MDR)</li> <li>Electromechanical relay</li> <li>General purpose contactor</li> </ul>	Solid state relay, Form A, with RC suppression	
<ul style="list-style-type: none"> <li>AC input solid state relay (SSR)</li> <li>AC input solid state contactor</li> <li>High impedance load, typ. ≥ 5kΩ</li> <li>Piezoelectric buzzer</li> <li>Indicator lamps</li> </ul>	Solid state relay, Form A, without contact suppression	
<ul style="list-style-type: none"> <li>Various devices in on-off mode with RC suppression</li> </ul>	Electromechanical relay, Form A,	
<ul style="list-style-type: none"> <li>Various devices in on-off mode (high impedance or inductive devices with coils suppressed)</li> <li>Indicator lamps</li> <li>Small heaters</li> <li>AC input solid state contactor</li> </ul>	Electromechanical relay, Form A, without contact suppression	
<ul style="list-style-type: none"> <li>A safety limit circuit with contactor, electromechanical relay or mercury displacement relay (MDR)</li> </ul>	Electromechanical relay, Form A or B, with RC suppression	N/A
<ul style="list-style-type: none"> <li>A safety limit circuit with contactor, electromechanical relay or mercury displacement relay (MDR)</li> </ul>	Electromechanical relay, Form C, without RC suppression	N/A
<ul style="list-style-type: none"> <li>Various devices in on-off mode</li> <li>Indicator lamps</li> <li>Small heaters</li> <li>AC input solid state contactor</li> </ul>	Electromechanical relay, Form A or B, without contact suppression	
<ul style="list-style-type: none"> <li>Various devices in on-off mode</li> <li>Solenoid coil/valve</li> <li>Mercury displacement relay (MDR)</li> <li>Electromechanical relay</li> <li>General purpose contactor</li> <li>Pilot duty relays</li> </ul>	Electromechanical relay, Form C, with RC suppression	
<ul style="list-style-type: none"> <li>Various devices in on-off mode (high impedance or inductive devices with coils suppressed)</li> <li>Indicator lamps</li> <li>Small heaters</li> <li>AC input solid state contactor</li> </ul>	Electromechanical relay, Form C, without contact suppression	
<ul style="list-style-type: none"> <li>DC input solid state relay (SSR)</li> <li>PLC-dc input</li> <li>Low voltage panel lamp</li> </ul>	Switched dc, isolated	
<ul style="list-style-type: none"> <li>DC input solid state relay (SSR)</li> <li>PLC-dc input</li> <li>Low voltage panel lamp</li> </ul>	Switched dc, non-isolated	
<ul style="list-style-type: none"> <li>DC input solid state relay (SSR)</li> <li>PLC-dc input</li> <li>Low voltage panel lamp</li> </ul>	Open collector, isolated	

# Controller Output Comparison Guide

I want to switch... I want to control...	Controller Output	Output Life
<ul style="list-style-type: none"> <li>Phase-angle or burst fire SCR</li> <li>0-20mA=(dc)<sup>①</sup> valve positioner</li> <li>Cascade control</li> <li>Other instruments</li> </ul>	Process 0-20mA=(dc), non-isolated	
<ul style="list-style-type: none"> <li>Phase-angle or burst fire SCR</li> <li>4-20mA=(dc) valve positioner</li> <li>Cascade control</li> <li>Other instruments</li> </ul>	Process 4-20mA=(dc), non-isolated	
<ul style="list-style-type: none"> <li>Multiple SCRs, phase-angle or burst fire</li> <li>0-5V=(dc) valve positioner</li> <li>Cascade control</li> <li>Other instruments</li> </ul>	Process 0-5V=(dc), non-isolated	
<ul style="list-style-type: none"> <li>Multiple SCRs, phase-angle or burst fire</li> <li>0-5V=(dc), 1-5V=(dc) or</li> <li>0-10V=(dc) valve positioner</li> <li>Cascade control</li> <li>Other instruments</li> </ul>	Process 0-5V=(dc), 1-5V=(dc), 0-10V=(dc), 0-20mA=(dc), 4-20mA=(dc), isolated	
<ul style="list-style-type: none"> <li>Multiple SCRs, phase-angle or burst fire</li> <li>0-10V=(dc) valve positioner</li> <li>Cascade control</li> <li>Other instruments</li> </ul>	Process 0-10V=(dc), non-isolated	
<ul style="list-style-type: none"> <li>Sensor transmitters</li> <li>Ancillary devices</li> </ul>	Power supply, 5, 12 or 20V=(dc) @ 30mA	N/A

## Retransmit/Alarms

<ul style="list-style-type: none"> <li>1 or 2 devices, impedance dependent</li> <li>Chart recorder</li> <li>Master-remote (slave) system</li> <li>Data logging device</li> </ul>	0-20mA=(dc), 4-20mA=(dc), non-isolated	
<ul style="list-style-type: none"> <li>1 or 2 devices, impedance dependent</li> <li>Chart recorder</li> <li>Master-remote (slave) system</li> <li>Data logging device</li> </ul>	4-20mA=(dc), non-isolated	
<ul style="list-style-type: none"> <li>Multiple devices, impedance dependent</li> <li>Chart recorder</li> <li>Master-remote (slave) system</li> <li>Data logging device</li> </ul>	0-5V=(dc), non-isolated	
<ul style="list-style-type: none"> <li>Multiple devices, impedance dependent</li> <li>Chart recorder</li> <li>Master-remote (slave) system</li> <li>Data logging device</li> </ul>	0-5V=(dc), 1-5V=(dc), 1-10V=(dc), Isolated	
<ul style="list-style-type: none"> <li>Various devices in on-off mode with RC suppression</li> </ul>	Electromechanical relay, Form A or B	
<ul style="list-style-type: none"> <li>Various devices in on-off mode without RC suppression</li> </ul>	Electromechanical relay, Form C	
<ul style="list-style-type: none"> <li>Various devices in on-off mode without RC suppression</li> </ul>	Electromechanical relay, Form A	

 **Best Life**

 **Better Life**

 **Good Life**

<sup>①</sup> Watlow power controller process inputs calibrated for 4-20mA unless otherwise specified with order.

<sup>②</sup> Standard output, no option code.

# Power Controller Comparison Guide

## Power Controller Characteristics

Initial Cost	3 Year Cost <sup>①</sup>	Control Life	Heater Life	EMI Generation	Control	Response Rate	Options	Comments
<b>Electromechanical Relay and Contactor</b>								
Low for low current	Highest	Limited <i>electrical and mechanical</i>	Shortest	Yes, coil and contacts	Poor	Slowest	None	To extend life the cycle time is normally extended to 30 seconds or more.
<b>E-SAFE RELAY<sup>®</sup></b>								
Low	Medium	High	Good	Minimal	Good	Fast	None	240V~(ac) maximum
<b>Mercury Displacement Relay (MDR)</b>								
Low for low to medium current	Medium	High	Good	Yes, coil and contact	Fair to good	Medium to fast	None	Mercury is not desirable. Minimum cycle time is two seconds. Position sensitive.
<b>Solid State Relay (SSR)</b>								
Medium	Medium	Extended	Extended	Minimal with burst fire	Good	Fast	None	Excellent control with one second cycle time. Requires heatsink.
<b>SCR Solid State Contactor</b>								
Medium	Low	Extended	Extended	Minimal	Good	Fast	None	Excellent control with one second cycle time.
<b>SCR Burst Firing</b>								
High	Low	Extended	Longest	Minimal	Excellent	Fastest	None	Fastest variable time base unit.
<b>SCR Phase-Angle Firing</b>								
High	Lowest	Extended	Longest	High	Excellent	Fastest	Current limit	Required for tungsten elements, transformers, or for current limiting.
<b>Saturable Core Reactor</b>								
Highest	Low	Extended	Longest	Minimal	Very good	Fast	Current limit	Cannot be turned full on or off, inefficient.

<sup>①</sup>Includes heater replacement and lost production.

## Power Controller Quick Selection Chart

Amps	Power Controller	Firing Mode	Electric Heating Element Type	Features	Agency Approvals
18 to 100A	DIN-A-MITE <sup>®</sup>	Burst fire, variable time base Phase-angle firing <sup>③</sup>	Nichrome <sup>™</sup> wire Other <sup>②</sup>	Four models meet power, budget and feature requirements. Same footprint as popular MDRs. Convenient DIN-rail mounting.	UL <sup>®</sup> 508 listed, C-UL <sup>®</sup> up to 100 amps and CE with proper filter
150 to 1000A	QPAC	Burst fire, variable time base Phase-angle firing	Nichrome <sup>™</sup> wire Other <sup>②</sup>	Modular design incorporating plug-in cards for contactor, burst fire, variable time base, or phase angle. Quick delivery.	UL <sup>®</sup> 508 listed and C-UL <sup>®</sup> up to 300A
10 to 75A	SSR	V~(ac) or V=(dc), burst fire contactor input	Nichrome <sup>™</sup> wire	Low cost, requires heatsink. Heatsink and over-temperature protection recommended. Stocked for same day shipment.	UL <sup>®</sup> 873 Recognized, CSA Certified and VDE 0805
18 to 50A	CZR	Contactor input	Nichrome <sup>™</sup> wire	Compact electrically. Touch safe package. Convenient DIN-rail mounting.	UL <sup>®</sup> 508 listed CSA Certified, VDE, CE
65 to 250A	POWER SERIES	Burst fire, Variable time base Phase-angle firing <sup>③</sup>	Nichrome <sup>™</sup> wire Other <sup>②</sup>	Microprocessor-based heater diagnostics. RS-232/485 communications. Heater bakeout feature.	UL <sup>®</sup> 508 listed C-UL <sup>®</sup> , VDE 50178, CE
20-40A	E-SAFE RELAY <sup>®</sup>	Contactor 24V~(ac), 120V~(ac) and 220V~(ac)	Nichrome <sup>™</sup> wire	Touch safe, long contact life. Mercury free. Fast cycling.	UL <sup>®</sup> 508 listed C-UL <sup>®</sup>

<sup>②</sup>Heating elements that change resistance value over time and temperature, i.e; silicone carbide and tungsten.

<sup>③</sup>Phase angle fire up to 65 amps. Single phase only. Not CE approved.

Nichrome<sup>™</sup> is a trademark of Driver-Harris Company.

# Ranges and Tolerances

## Thermocouples

### ANSI Tolerances

In 1969, nomenclature of the American National Standards Institute, Inc. (ANSI) superseded previously used ISA designations.

### Reference Junction 0 °C (32 °F)

Thermocouple Type	Temperature Range		Tolerances <sup>①</sup>	
	°C	°F	Standard	Special
B	870 to 1700	1598 to 3092	± 0.5%	
E	0 to 900	32 to 1652	± 1.7 °C or ± 0.5%	± 1.0 °C or ± 0.4%
J	0 to 750	32 to 1382	± 2.2 °C or ± 0.75%	± 1.1 °C or ± 0.4%
K	0 to 1250	32 to 2282	± 2.2 °C or ± 0.75%	± 1.1 °C or ± 0.4%
N	0 to 1250	32 to 2282	± 2.2 °C or ± 0.75%	± 1.1 °C or ± 0.4%
R or S	0 to 1450	32 to 2642	± 1.5 °C or ± 0.25%	± 0.6 °C or ± 0.1%
T	0 to 350	32 to 662	± 1.0 °C or ± 0.75%	± 0.5 °C or ± 0.4%

### Cryogenic Range

E <sup>②</sup>	-200 to 0	-328 to 32	± 1.7 °C or ± 1%	③
K <sup>②</sup>	-200 to 0	-328 to 32	± 2.2 °C or ± 2%	③
T <sup>②</sup>	-200 to 0	-328 to 32	± 1.0 °C or ± 1.5%	③

① Where tolerances are given in percent, the percentage applies to the temperature being measured in degrees Celsius. For example, the standard tolerance of Type J is ± 0.75 percent. If the temperature being measured is 538°C, the tolerance is ± 0.75 percent of 538°C, or ± 4.0°C. To determine the tolerance in degrees Fahrenheit, multiply the tolerance in degrees Celsius times 1.8.

② Thermocouples and thermocouple material are normally supplied to meet the tolerances specified in the table for the normal specified range. The same materials, however, may not fall within the cryogenic tolerances in the second section of the table. Tolerances indicated in this

The standard and special tolerances in this table come from ANSI Circular MC96.1-1982.

The standard and special tolerances stated apply only to the temperature ranges listed for each thermocouple type.

table are not necessarily an indication of the accuracy of temperature measurements in use after initial heating of the materials.

③ Little information is available to justify establishing special tolerances for cryogenic temperatures. Limited experience suggests the following tolerances for Types E and T thermocouples:

Type E -200 to 0 °C ±1.0 °C or ±0.5% (whichever is greater)

Type T -200 to 0 °C ±0.5 °C or ±0.8% (whichever is greater)

Due to the characteristics of the materials, cryogenic tolerances for Type J thermocouples and special cryogenic

### Letter Designations

ANSI Letter	T/C Leg	Popular Generic and Trade Names
B	BP BN	Platinum 30% Rhodium Platinum 6% Rhodium
C <sup>④</sup>	CP CN	W5Re (Tungsten 5% Rhenium) W26Re (Tungsten 26% Rhenium)
D <sup>④</sup>	DP DN	W3Re (Tungsten 3% Rhenium) W25Re (Tungsten 25% Rhenium)
E	EP EN	Chromel®, Tophel®, HAI-KP® Constantan, Cupron®, Advance®
J	JP JN	Iron Constantan, Cupron, Advance
K	KP KN	Chromel, Tophel, HAI-KP Alumel®, Nail®, HAI-KN®
N	NP NN	Nicrosil Nisil
Pt 2 <sup>④</sup>	PTP PTN	Platinel® 5355 Platinel® 7674
R	RP RN	Platinum 13% Rhodium Pure Platinum
S	SP SN	Platinum 10% Rhodium Pure Platinum
T	TP TN	Copper Constantan, Cupron, Advance

tolerances for Type K thermocouples are not listed.

④ Not an ANSI symbol.

Cupron®, Nial® and Tophel® are registered trademarks of Carpenter Technology. Advance®, HAI-KP® and HAI-KN® are registered trademarks of Harrison Alloys Co. Chromel® and Alumel® are registered trademarks of Hoskins Manufacturing Company. Platinel® is a registered trademark of the Engelhard Corporation.

## RTDs

### RTD Tolerance Class Definitions

The two equations below define tolerances for platinum DIN Class A and B RTDs, where [t] is the actual temperature of the platinum elements. JIS tolerances are the same as DIN tolerances.

DIN class A:  $\pm(0.15 + 0.002 [t^{\circ}\text{C}])$

DIN class B:  $\pm(0.30 + 0.005 [t^{\circ}\text{C}])$

Base resistance: 100Ω @ 0°C

Temperature Coefficient

of Resistance (TCR): 0.00385 Ω/Ω/°C (DIN-IEC-761)

0.003916 Ω/Ω/°C (JIS 1604-1981)

**For more information on thermocouples and RTDs...plus thermistors and more, order your Watlow Sensors catalog using the postcard in the back of this catalog.**

### Table of Tolerance Values<sup>⑤</sup>

Temperature (°C)	Resistance Value Ω	Tolerance DIN-IEC-761	
		Class A °C (Ω)	Class B °C (Ω)
-200	18.49	±0.55 (±0.24)	±1.3 (±0.56)
-100	60.25	±0.35 (±0.14)	±0.8 (±0.32)
0	100.00	±0.15 (±0.06)	±0.3 (±0.12)
100	138.50	±0.35 (±0.13)	±0.8 (±0.30)
200	175.84	±0.55 (±0.20)	±1.3 (±0.48)
300	212.02	±0.75 (±0.27)	±1.8 (±0.64)
400	247.04	±0.95 (±0.33)	±2.3 (±0.79)
500	280.90	±1.15 (±0.38)	±2.8 (±0.93)
600	313.59	±1.35 (±0.43)	±3.3 (±1.06)
650	329.51	±1.45 (±0.46)	±3.6 (±1.13)

⑤ Tolerance values applicable to JIS Curve 0.003916 (JIS 1604-1981).

## Responsible Engineering

### Think Safety

All thermal systems inherently pose hazards associated with misapplication, improper application and failure to adhere to recognized national, state and local electrical codes as well as agency standards. These can result in injury to personnel, or damage to plant and process.

The user is responsible for determining controller-to-application suitability. Care should always be exercised in controller selection, installation and use.

Each temperature and power controller comes with its own User's Manual.

Controller installation and wiring is the customer's responsibility. Take time to review and understand the User's Manual. This useful information will help maximize safety, thermal system performance, efficiency and life.

All Watlow temperature and power controllers should be installed by qualified personnel knowledgeable about the thermal system's characteristics and in accordance with the National Electrical Code and any applicable state or local codes.

***The following recommendations apply to all Watlow temperature and power controllers as well as control panels and boxes:***

- Carefully read, understand and follow the instructions contained in the User's Manual.
- Always disconnect electrical power prior to installing, servicing or replacing temperature or power controllers.
- All temperature and power controllers should be used with approved conductors of the correct wire gauge.
- Do not use solid state power controllers in safety limit controller circuits. Solid state components tend to fail in a closed circuit mode and will not cut power.
- Safety limit control should be provided by an isolated, redundant sensor and controller system of the appropriate type, design and installation.
- Electrical enclosures and/or control panels housing temperature and power controllers should match the application's environment and be able to withstand worst-case failures—especially in hazardous locations.
- Do not apply temperature or power controllers where ambient conditions exceed specified operating environments and/or exceed power draw permitted by the device or applicable rating curve.
- Special attention should be paid to wiring practices. Power, sensor and communications wiring should be effected in an appropriate way to avoid inductive and capacitive coupling. These conditions can create errant and/or erratic operation, and pose a safety hazard. Use noise suppression devices where appropriate. Make ground connections for any device only to the appropriate electrical ground for that device (chassis ground, safety ground or computer ground).

# Terms and Conditions

## Quantity and Weights:

Products purchased and sold hereunder shall be those for which Buyer submits an Order which is accepted by Watlow. Watlow's quantities shall govern unless proved to be in error. On Orders for Products carried in stock, Watlow will deliver the ordered quantity specified. However, in the manufacture of Products it is agreed that Watlow will be allowed production losses. Watlow shall have the right to manufacture, deliver and invoice for partial deliveries of Products as stated below:

Quantity Ordered	Delivery Variation
1-4	No variation
5-24	± 1 unit
25-74	± 2 units
75-99	± 3 units
100+	± 3 percent

SERV-RITE® Insulated  
Wire and Cable ± 10 percent  
XACTPAK® Sheathed Wire ± 10 percent

**Note:** Watlow will deliver exact quantities on Products with a net price of \$100.00 or more. If Buyer expressly requests no variation in delivered quantity of Products with a total net price under \$100.00, a ten percent (10%) surcharge will be added to the net billing on the invoice for such Order.

## Delivery:

F.O.B. Watlow's Plant. Risk of loss shall pass to Buyer on delivery at the F.O.B. point. Watlow shall prepay freight, assure the shipment and select the means of transportation unless Buyer provides specific written instructions otherwise with Buyer's order. Watlow shall not be bound to tender delivery of any quantities for which Buyer has not given shipping instructions. Watlow shall be entitled to designate from time to time the locations from which Buyer may receive or pick up Products.

## Payment Terms:

Terms are net 30 days upon approved credit. Prices and discounts are subject to change without notice. All quotations are valid for 30 days unless otherwise stated.

## Restocking Charges:

Stock heaters, controls, sensors and accessories which have not been used or modified may be returned to the relevant Watlow Plant for a twenty

percent (20%) restocking charge. For Watlow's Hannibal Plant Products only, modified-stock Products may be returned if not permanently modified, for a minimum thirty percent (30%) restocking charge. All stock and modified-stock Products require Watlow's prior authorization to be returned and must be returned within one hundred twenty (120) days from the date of delivery. Controls may not be returned if the packaging seal is broken. Non-stock (custom) heaters, controls, sensors and accessories are not returnable.

## Price Revision:

Prices are subject to change without advance notice. If Watlow desires to revise the discounts, prices, points of delivery, service allowances or terms of payment but is restricted to any extent against so doing by reason of any governmental request, law, regulation, order or action, or if the discounts, prices, points of delivery, service allowances or terms of payment then in effect are altered by reason of governmental request, law, regulation, order or action, Watlow shall have the right (i) to terminate this Order by notice to Buyer, (ii) to suspend deliveries for the duration of such restriction or alteration or (iii) to have applied to this Order (as of the effective date of such restriction or alteration) any discounts, prices, points of delivery, service allowances or terms of payment governmentally acceptable. Any delivery suspended under this Section may be canceled without liability.

## Return Policy:

Prior approval must be obtained from the relevant Watlow Plant to return any Product. Watlow will assign a return authorization number and record the reason for the return. Watlow will examine returned Product to determine the actual cause, if any, leading to Buyer's return. If Product has a manufacturing defect, Watlow, in its sole discretion, may issue a credit for the returned Product or repair or replace with like Product. If returned Product is not subject to Watlow's warranty, Buyer will be notified of the estimated cost of repair, if possible. Thereafter, Buyer must advise Watlow whether or not Buyer chooses to have Product repaired at Buyer's expense.

## Order Changes:

Buyer must notify Watlow in writing of requested changes in the quantity, drawings, designs or specifications for Products which are ordered but not yet in the process of manufacture. After receipt of such notice, Watlow will inform Buyer of any adjustments to be made in price, delivery schedules, etc. resulting from Buyer's requested changes prior to incorporating requested changes into manufactured Products. Control Products require written notice of requested changes not less than sixty (60) days prior to last scheduled shipping date.

## Freight and Taxes:

Prices do not include prepaid freight, federal, state or local taxes. Any increase in freight rates paid by Watlow on deliveries covered by this Order and hereafter becoming effective and any tax or governmental charge or increase in same (excluding any franchise or income tax or other tax or charge based on income) (i) increasing the cost to Watlow of producing, selling or delivering Products or of procuring Products used therein or, (ii) payable by Watlow because of the production, sale or delivery of Products, such as Sales Tax, Use Tax, Retailer's Occupational Tax, Gross Receipts Tax, Value Added Tax, and Ways Fees may, at Watlow's option, be added to the prices herein specified and be added to invoices.

## Engineering Charge:

On complex Products, systems or control software modifications, an engineering charge shall be applied or included in the price of Prototypes. This charge is not subject to discounts.

## Tooling:

All tooling and fixtures are the property of Watlow. Watlow will accept Buyer's special tooling if sent freight prepaid. Watlow will maintain this tooling, exercising reasonable care, in order to produce Buyer's Products. Permanent molds for aluminum cast-in and Polymer Products shall be the property and responsibility of Buyer.

## Cancellation Charges:

There will be no cancellation charge for non-modified stock Products. Non-stock and modified-stock Products may be subject to a cancellation charge to be determined by Watlow depending upon the portion of Product completed at the time of such cancellation.

## Terms and Conditions

### Excuse of Performance:

(A) Deliveries may be suspended by either party in the event of: Act of God, war, riot, fire, explosion, accident, flood, sabotage; lack of adequate fuel, power, raw materials, labor, containers or transportation facilities; compliance with Governmental Requirements (as hereinafter defined); breakage or failure of machinery or apparatus; national defense requirements or any other event, whether or not of the class or kind enumerated herein, beyond the reasonable control of such party; or in the event of labor trouble, strike, lockout or injunction (provided that neither party shall be required to settle a labor dispute against its own best judgment); which event makes impracticable the manufacture, transportation, sale, purchase, acceptance, use or resale of Products or a material upon which the manufacture of Products is dependent.

(B) If Watlow determines that its ability to supply the total demand for Products, or obtain any or a sufficient quantity of any material used directly or indirectly in the manufacture of Products, is hindered, limited or made impracticable, Watlow may allocate its available supply of Products or such material (without obligation to acquire other supplies of any such Products or material) among itself and its purchasers on such basis as Watlow determines to be equitable without liability for any failure of performance which may result therefrom.

(C) Deliveries suspended or not made by reason of this Section shall be canceled without liability, but this agreement and/or Order shall otherwise remain unaffected.

### Prototypes:

If Buyer orders and/or Watlow delivers a Product designated as a "Prototype", no guarantees, warranties or representations as to fitness for a particular purpose or merchantability are made with respect to such Prototype. Buyer shall have the duty and sole responsibility to test a Prototype prior to acceptance and/or incorporation into end-use applications. Further, a production Product based on a Prototype design may differ in assembly methods and materials from the Prototype. Buyer, therefore, shall have the duty and sole responsibility for testing and acceptance of production Products which are based on Prototype designs.

### Warranty and Limitation of Liability:

Watlow warrants its Products against defects in material and workmanship for at least one (1) year (three (3) years on some controls) from the date of delivery, provided such Product is properly applied, used and maintained. Refer to the express written warranty time period for each individual Product or contact the relevant Watlow plant for such warranty time period information. Watlow does not warrant any Product against damage from corrosion, contamination, misapplication, improper specification or wear and tear and operational conditions beyond Watlow's control. The terms of this Warranty are the exclusive terms available to Buyer and to any other person or entity to whom Products are transferred during the period of this Warranty. No person has authority to bind Watlow to a representation or warranty other than this express Warranty. Watlow shall not be liable for incidental or consequential damages resulting from the use of Products whether a claim for such damages is based upon warranty, contract, negligence or other cause of action. Should any Product fail while subject to this Warranty, such Product shall be repaired or a substitute Product shall be provided, at Watlow's option, at no charge to Buyer or to any other person or entity to whom Product is transferred during the period of this Warranty. Watlow must be notified of the alleged failure of Product within thirty (30) days of such event and advanced authorization for repair or replacement must be obtained in writing from Watlow.

**THIS WARRANTY IS MADE EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY ARISING FROM A COURSE OF DEALING OR USAGE OF TRADE, AND ALL OTHER SUCH WARRANTIES ARE SPECIFICALLY EXCLUDED. THE CORRECTION OF ANY DEFECT IN OR FAILURE OF PRODUCTS BY REPAIR OR REPLACEMENT TO THE EXTENT SET FORTH ABOVE, SHALL BE WATLOW'S LIMIT OF LIABILITY AND THE EXCLUSIVE REMEDY FOR ANY AND ALL LOSSES, DELAYS OR DAMAGES RESULTING FROM THE PURCHASE OR USE OF THE PRODUCTS. IN NO EVENT SHALL WATLOW BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES. WATLOW SHALL NOT BE LIABLE**

**FOR, AND BUYER AND ANY OTHER PERSON OR ENTITY TO WHOM PRODUCTS ARE TRANSFERRED DURING THE PERIOD OF THIS WARRANTY ASSUMES RESPONSIBILITY FOR, ALL PERSONAL INJURY AND PROPERTY DAMAGE RESULTING FROM OR RELATED TO THE HANDLING, POSSESSION OR USE OF PRODUCTS AND PRODUCTS MANUFACTURED AND SOLD BY WATLOW HEREUNDER.**

### Miscellaneous:

**THE VALIDITY, INTERPRETATION AND PERFORMANCE OF THIS AGREEMENT AND/OR ORDER AND ANY DISPUTE CONNECTED HERewith SHALL BE GOVERNED AND CONSTRUED IN ACCORDANCE WITH THE LAWS OF THE STATE OF MISSOURI.** These Terms and Conditions constitute the full understanding of the parties, a complete allocation of risks between them and a complete and exclusive statement of the terms and conditions of their agreement and/or Order relating to the subject matter herein. Except as otherwise expressly provided herein, no conditions, usage of trade, course of dealing or performance, understanding or agreement and/or Order purporting to modify, vary, explain or supplement the terms or conditions of this agreement and/or Order shall be binding unless hereafter made in writing and signed by the party to be bound, and no modification shall be effected by the acknowledgment or acceptance of any purchase order or shipping instruction forms containing terms or conditions at variance with or in addition to those set forth herein. No waiver by either party with respect to any breach or default or of any right or remedy and no course of dealing or performance shall be deemed to constitute a continuing waiver of any other breach or default or of any other right or remedy, unless such waiver be expressed in writing signed by the party to be bound. If any term, condition or provision of this agreement and/or Order or the application thereof is judicially or otherwise determined to be invalid or unenforceable, or if the parties mutually agree in writing to any revision of this agreement and/or Order, the remainder of this agreement and/or Order and the application thereof shall not be affected, and this agreement and/or Order shall otherwise remain in full force and effect.

