



# Basic Temperature and Limit Controllers

## Basic Temperature and Limit Controllers Provide Economical Solution for a Wide Range of Applications



The basic and limit microprocessor-based controllers from Watlow® provide an economical solution for applications requiring simple on-off control. These controllers and limits are available in a broad range of packaging options, allowing users to select the best version for their individual application. The controllers and limits are available with or without an operator interface and can be ordered in a 1/8 DIN square panel mount, DIN-rail mount or open-board design configurations.

The basic and limit design provides significant improvements in the performance, repeatability and accuracy offered by analog basic temperature and limit controllers.

The variable options for the SERIES CV (controller) and SERIES LV (limit) include an operator interface for viewing and selecting the set point. A red, four-character, seven segment LED displays the set point to show the process option. The set point selection is made with a continuous turn rotary encoder, or with discrete up/down cursor keys. Operating range temperature values are customer definable in the product configuration part number.

The fixed options for the SERIES CF (controller) and SERIES LF (limit) offer fixed set points and are supplied without an operator interface. Operating set point temperature values are customer definable in the product configuration part number. The SERIES TM temperature indicator is available as an additional order option.

These basic and limit controllers are UL® recognized and include CE approvals. The limit controllers are FM approved with special UL® approval for the open-board potted versions. CV and LV panel mount controllers ordered with discrete up/down cursor keys include NEMA 4X/IP65 seal protection. Watlow's basic temperature and limit controllers include industry leading service and support and are backed by a three-year warranty.

### Features and Benefits

#### Fixed or adjustable set points

- Provide tamper-proof operation
- 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

#### 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

### Typical Applications

- Food preparation
- Industrial machinery
- Packaging
- Plastics processing

## Specifications

### On-Off Controller

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

### Limit Controller

- Microprocessor based, limit controller
- Nominal switching hysteresis, typically 3°F (1.7°C)
- 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, 0.28 in. (7 mm) high
- °F or °C indicator LED
- Load/Alarm indicator LED
- Continuous turn, velocity sensitive rotary encoder for set point adjustment
- Front panel key on push for set point or push for show process options (on-off controller only)
- Front panel SET/RESET key on variable set point models (limit controller only)
- No operator interface on fixed set point models

### Standard Conditions For Specifications

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

### Sensor Input

#### Thermocouple

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

### Thermocouple Input

- Calibration accuracy: ±1% of input accuracy span, ±1° at standard conditions and actual calibration ambient  
Exception: Type T, ±2.4% 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% 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:	-328 to 1470°F	or	-200 to 800°C
Type J:	-346 to 1900°F	or	-210 to 1038°C
Type K:	-454 to 2500°F	or	-270 to 1370°C
Type T:	-454 to 750°F	or	-270 to 400°C
RTD (DIN)	-328 to 1472°F	or	-200 to 800°C

### Output Types

#### Switched dc (non-isolated, on-off controller only)

- Supply voltage max.: 24VDC into an infinite load
- Supply voltage min.: 5VDC at 10mA
- Min. load impedance: 500Ω

#### Electromechanical Relay, Form C

- Min. load current: 100mA
- 8A @ 240VAC or 30VDC max., resistive
- 250VA pilot duty, 120/240VAC max., inductive
- Use RC suppression for inductive loads
- Electrical life 100,000 cycles at rated current

#### External Reset Switch (limit controller only)

- Momentary, dry contact closure

#### Agency Approvals

- CE<sup>①</sup>, W.E.E.E., RoHS EU Directive (2002-95-EC)

#### Agency Approvals (on-off controller only)

- UL® 873 recognized temperature controller and indicator, File # E43684
- UL® 197 reviewed for use in foodservice appliances
- ANSI Z21.23 gas appliance thermostat approval
- Temperature control and indicator CSA 22.2 No. 24, File # 30586
- NEMA 4X/IP65 (SERIES CV and LV panel mount controllers with up/down cursor keys)

#### Agency Approvals (limit controller only)

#### SERIES LF (potted version only)

- UL® 991 recognized temperature limit for foodservice industry

#### SERIES LV and SERIES LF (including potted version)

- UL® 873 recognized temperature regulator, File # E43684
- UL® 197 reviewed for use in foodservice appliances
- ANSI Z21.23 gas appliance thermostat approval
- CSA C22.2#24 approved temperature control, File # 30586
- FM Class 3545 temperature limit switches, File # 3017239

#### Terminals

- 0.25 in. (6.3 mm) quick connect, push on terminal or removable screw style terminal block

#### Power

- 24VAC +10%; -15%; 50/60Hz, ±5%
- 100 to 120VAC +10%; -15%; 50/60Hz, ±5%
- 200 to 240VAC +10%; -15%; 50/60Hz, ±5%
- 10VA max. power consumption
- Data retention upon power failure via nonvolatile memory

#### Operating Environment

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

#### Dimensions

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

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

<sup>①</sup>See declaration of conformity.

## Ordering Information

### Part Number

Indicator only, 4 character, 7 segment display

① ②	③	④	⑤	⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭	⑮
	Power Supply	Package	Sensor Type and Scale		
TM				AAAAAAAAA	

③ Power Supply	
B =	120VAC
D =	230 to 240VAC
F =	24VAC

④ Package	
1 =	Panel mount, 1/8 DIN square - spade terminals
2 =	DIN-rail mount - spade terminals
5 =	Panel mount, 1/8 DIN square - screw terminals
6 =	DIN-rail mount - screw terminals
A =	NEMA 4X panel mount, (spade terminals)
C =	NEMA 4X panel mount, (screw terminals)

⑤ Sensor Type and Scale	
H =	T/C Type J °F (-346 to 1900°F)
J =	T/C Type J °C (-210 to 1038°C)
K =	T/C Type K °F (-454 to 2500°F)
L =	T/C Type K °C (-270 to 1370°C)
M =	T/C Type T °F (-454 to 750°F)
N =	T/C Type T °C (-270 to 400°C)
P =	RTD °F (-328 to 1472°F)
R =	RTD °C (-200 to 800°C)
S =	T/C Type E °F (-328 to 1470°F)
T =	T/C Type E °C (-200 to 800°C)

⑮ Overlay/Customs Options	
A =	Standard with Watlow logo
1 =	Standard without Watlow logo

## Ordering Information

### Part Number

Limit control with 8A relay output. Fixed set point, no user interface

① ②	③	④	⑤	⑥	⑦ ⑧ ⑨ ⑩	⑪ ⑫ ⑬ ⑭	⑮
	Power Supply	Package	Sensor Type and Scale	Limit Type	Fixed Set Point Temp. Value		Overlay/Custom Options
LF						AAAA	

③ Power Supply	
C =	120VAC
E =	230 to 240VAC
G =	24VAC

④ Package	
1 =	Panel mount, 1/8 DIN square - spade terminals
2 =	DIN-rail mount - spade terminals
3 =	Open, non potted - spade terminals
4 =	Potted case - spade terminals
5 =	Panel mount, 1/8 DIN square - screw terminals
6 =	DIN-rail mount - screw terminals
7 =	Open, non potted - screw terminals

⑤ Sensor Type and Scale	
H =	T/C Type J °F (-346 to 1900°F)
J =	T/C Type J °C (-210 to 1038°C)
K =	T/C Type K °F (-454 to 2500°F)
L =	T/C Type K °C (-270 to 1370°C)
M =	T/C Type T °F (-454 to 750°F)
N =	T/C Type T °C (-270 to 400°C)
P =	RTD °F (-328 to 1472°F)
R =	RTD °C (-200 to 800°C)
S =	T/C Type E °F (-328 to 1470°F)
T =	T/C Type E °C (-200 to 800°C)

⑥ Limit Type	
U =	High limit manual reset
W =	High limit auto reset
Y =	Low limit manual reset
Z =	Low limit auto reset

⑦ ⑧ ⑨ ⑩ Fixed Set Point Temperature Value	
<b>Note:</b> An A (-) used in the left most digit of the fixed set point indicates a negative temperature value.	

⑮ Overlay/Customs Options	
A =	Standard with Watlow logo
1 =	Standard without Watlow logo

## Ordering Information

### Part Number

Limit control with 8A relay output. Rotary set point adjustment, 4 character, 7 segment display, reset switch

① ②	③	④	⑤	⑥	⑦ ⑧ ⑨ ⑩	⑪ ⑫ ⑬ ⑭	⑮
<b>LV</b>	<b>Power Supply</b>	<b>Package</b>	<b>Sensor Type and Scale</b>	<b>Limit Type</b>	<b>Low Set Point Operating Range Value</b>	<b>High Set Point Operating Range Value</b>	<b>Overlay/Custom Options</b>

③ Power Supply	
C =	120VAC
E =	230 to 240VAC
G =	24VAC

④ Package	
1 =	Panel mount, 1/8 DIN square - spade terminals
2 =	DIN-rail mount - spade terminals
5 =	Panel mount, 1/8 DIN square - screw terminals
6 =	DIN-rail mount - screw terminals
A =	NEMA 4X panel mount, tactile keys (spade terminals)
B =	DIN-rail mount, tactile keys (spade terminals)
C =	NEMA 4X panel mount, tactile keys (screw terminals)
D =	DIN-rail mount, tactile keys (screw terminals)

⑤ Sensor Type and Scale	
H =	T/C Type J °F (-346 to 1900°F)
J =	T/C Type J °C (-210 to 1038°C)
K =	T/C Type K °F (-454 to 2500°F)
L =	T/C Type K °C (-270 to 1370°C)
M =	T/C Type T °F (-454 to 750°F)
N =	T/C Type T °C (-270 to 400°C)
P =	RTD °F (-328 to 1472°F)
R =	RTD °C (-200 to 800°C)
S =	T/C Type E °F (-328 to 1470°F)
T =	T/C Type E °C (-200 to 800°C)

⑥ Limit Type	
U =	High limit manual reset
W =	High limit auto reset
Y =	Low limit manual reset
Z =	Low limit auto reset

⑦ ⑧ ⑨ ⑩ Low Limit Set Point Operating Range Value	
<b>Note:</b> An A (-) used in the left most digit of the fixed set point indicates a negative temperature value.	

⑪ ⑫ ⑬ ⑭ High Set Operating Range Value	
<b>Note:</b> An A (-) used in the left most digit of the fixed set point indicates a negative temperature value.	

⑮ Overlay/Customs Options	
A =	Standard with Watlow logo
1 =	Standard without Watlow logo

## Ordering Information

### Part Number

On-off controller, fixed set point, no user interface

① ②	③	④	⑤	⑥	⑦ ⑧ ⑨ ⑩	⑪ ⑫ ⑬ ⑭	⑮
<b>CF</b>	<b>Power Supply</b>	<b>Package</b>	<b>Sensor Type and Scale</b>	<b>Control Type</b>	<b>Fixed Set Point Temp. Value</b>	<b>AAAA</b>	<b>Overlay/Custom Options</b>

③ Power Supply	
B =	120VAC, switched dc output
C =	120VAC, 8A relay output
D =	230 to 240VAC, switched dc output
E =	230 to 240VAC, 8A relay output
F =	24VAC, switched dc output
G =	24VAC, 8A relay output

④ Package	
1 =	Panel mount, 1/8 DIN square - spade terminals
2 =	DIN-rail mount - spade terminals
3 =	Open board, non potted - spade terminals
4 =	Potted case - spade terminals
5 =	Panel mount, 1/8 DIN square - screw terminals
6 =	DIN-rail mount - screw terminals
7 =	Open board, non potted - screw terminals

⑤ Sensor Type and Scale	
H =	T/C Type J °F (-346 to 1900°F)
J =	T/C Type J °C (-210 to 1038°C)
K =	T/C Type K °F (-454 to 2500°F)
L =	T/C Type K °C (-270 to 1370°C)
M =	T/C Type T °F (-454 to 750°F)
N =	T/C Type T °C (-270 to 400°C)
P =	RTD °F (-328 to 1472°F)
R =	RTD °C (-200 to 800°C)
S =	T/C Type E °F (-328 to 1470°F)
T =	T/C Type E °C (-200 to 800°C)

⑥ Control Type	
H =	Heat
C =	Cool

⑦ ⑧ ⑨ ⑩ Fixed Set Point Temperature Value	
<b>Note:</b> An A (-) is used in the left most digit of the set point operating ranges to indicate a negative temperature value.	

⑮ Overlay/Customs Options	
A =	Standard with Watlow logo
1 =	Standard without Watlow logo

## Ordering Information

### Part Number

On-off controller, rotary set point adjustment, 4 character, 7 segment display

① ②	③	④	⑤	⑥	⑦ ⑧ ⑨ ⑩	⑪ ⑫ ⑬ ⑭	⑮
CV	Power Supply	Package	Sensor Type and Scale	Control Type	Low Set Point Operating Range Value	High Set Point Operating Range Value	Overlay/Custom Options

③ Power Supply	
B =	120VAC, switched dc output
C =	120VAC, 8A relay output
D =	230 to 240VAC, switched dc output
E =	230 to 240VAC, 8A relay output
F =	24VAC, switched dc output
G =	24VAC, 8A relay output

④ Package	
1 =	Panel mount, 1/8 DIN square - spade terminals
2 =	DIN-rail mount - spade terminals
5 =	Panel mount, 1/8 DIN square - screw terminals
6 =	DIN-rail mount - screw terminals
A =	NEMA 4X panel mount, tactile keys (spade terminals)
B =	DIN-rail mount, tactile keys (spade terminals)
C =	NEMA 4X panel mount, tactile keys (screw terminals)
D =	DIN-rail mount, tactile keys (screw terminals)

⑤ Sensor Type and Scale	
H =	T/C Type J °F (-346 to 1900°F)
J =	T/C Type J °C (-210 to 1038°C)
K =	T/C Type K °F (-454 to 2500°F)
L =	T/C Type K °C (-270 to 1370°C)
M =	T/C Type T °F (-454 to 750°F)
N =	T/C Type T °C (-270 to 400°C)
P =	RTD °F (-328 to 1472°F)
R =	RTD °C (-200 to 800°C)
S =	T/C Type E °F (-328 to 1470°F)
T =	T/C Type E °C (-200 to 800°C)

⑥ Control Type	
H =	Heat
C =	Cool

⑦ ⑧ ⑨ ⑩ Low Set Point Operating Range Value	
<b>Note:</b> An A (-) is used in the left most digit of the set point operating ranges to indicate a negative temperature value.	

⑪ ⑫ ⑬ ⑭ High Set Point Operating Range Value	
<b>Note:</b> An A (-) is used in the left most digit of the set point operating ranges to indicate a negative temperature value.	

⑮ Overlay/Customs Options	
A =	Standard with Watlow logo
B =	Push to show process with Watlow logo
C =	Push to adjust set point with Watlow logo
D =	Show process push to adjust set point with Watlow logo
1 =	Standard without Watlow logo
2 =	Push to show process without Watlow logo
3 =	Push to adjust set point without Watlow logo
4 =	Show process push to adjust set point without Watlow logo

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