Chapter 1: Meet the Watlow Series 700

INTRODUCTION

The Watlow Series 700 is a microprocessor-based digital timer and temperature control with choice of **ON-OFF** or **PID** control options and selctable timing ranges. The control can input up to three programmed cycles (segments) of time and temperature-related profiles.

It features a tough, sealed tactile-feel membrane keyboard in a compact 1/2 DIN horizontal sized package. It has two separate LED digital displays, time on the left and temperature on the right. Each display can indicate set point data or process actual information. The Watlow Series 700 is a low cost, versatile control suited for a wide variety of industrial applications.

The Series 700 will act as either an ON/OFF control or a Time Proportioning control, easily switchable at your option. The sealed membrane front panel, allows fingertip data entry, yet is both water and acid resistant. In the event of a power outage this device has a non-volatile memory for programmed data protection. The 700 will resume operation automatically for up to 30 seconds without manual restart.

Watlow Series 700 features include:

- One channel temperature control at a range of 0° to 350°F or 0° to 500°F.
- A countdown timer with a range of 99 minutes or 99 hours.
- Both time and temperature displays roll over from maximum to minimum or vice versa for easy programming.
- ON/OFF or time proportioning control mode, switchable at your option.
- Tactile control, sealed membrane front panel.
- Highly readable, 0.5 inch, three digit, seven segment LED data displays.
- Automatic resumption at original programming following a power outage of from 30 seconds to five minutes.
- Permanent storage of set point data in the event of a power interruption.
- Digital calibration.

SPECIFICATIONS

Program Capacity:

- One segment of time and temperature, plus hold; or
- Three segment time/temperature stepping profile and hold option.

INPUTS:

- **Sensor:** Themocouple sensor, Type J with linearization throughout the range.
- **Sensor Input Reference:** To ground or floating.
- **Sensor Range:** 0° to 350°F or 0° to 500°F, DIP switch selectable.
- **Unit designed** for addition of different ranges or thermocouple types.
- **Upscale thermocouple break protection.** Relay de-energizes.
- **Automatic cold junction compensation.**
- **Common mode rejection:** 120 dB minimum.
- **Series mode rejection:** 60 dB minimum.
- **Common mode voltage:** 120 VAC r.m.s., 60Hz.
- **Series mode voltage:** 200mV or 5 times span at 60 Hz.

ACCURACY

- **Rated Accuracy:** ± .25% of span.
- **Set Point Shift with Ambient:** ≤ 2mV/°F miximum referred to the input.
- **Set Point Shift with Line Voltage:** < ± .25% of span for a shift of ± 10%.

CONTROL MODE

- **ON/OFF or PID proportioning.**
- **Time Proportioning:** DIP switch selectable.
- **Timing Range:** DIP Switch selectable for 0 to 99 minutes or 0 to 99 hours.
- **ON/OFF Control Switching Differential:** Type J thermocouple = 3°F
- **Time Proportioning:** DIP switch selectable.
- **One segment** of time and temperature, plus hold; **or**
- **Three segment** time/temperature stepping profile and hold option.

OUTPUTS:

- **Time Output:**

  3A @ 115/230VAC Form-C relay,
  or
  1A @ 115/230 VAC solid state option.

- **Temperature Output:**

  3A @ 115/230VAC Form-C relay,
  or
  1A @ 115/230 VAC solid state option.

DISPLAY:

- Two 3-digit, 7-segment, 0.5"-high red LEDs.
- Two red LEDs each for SET and ACTUAL display modes.
- Optional vertical bar graph LED for program/operate indication.

OPERATING CONDITIONS

• Supply Voltage:	115/230 VAC ±10%, 50-60 Hz
• Power Requirement:	Less than 10mVA
• Operating Ambient:	30° to 130°F or 0° to 55°C
• Storage Ambient:	-40° to 158°F or -18° to 70°C
• Relative Humidity:	0 to 90%, non-condensing
• Memory Protection:	Non-volatile memory retains all information when power is interrupted.

PHYSICAL DIMENSIONS

- **1/2 DIN-sized.**
- **3 and 3/16" high by 7 and 9/16" wide by 6 and 9/16" deep.**
- **Weight: 2 lb. 3 oz.**

Chapter 2: How to Install the 700

PACKING LIST

- **WATLOW Series 700**
- **Two Mounting Brackets**
- **One Owner's Manual**

MOUNTING

The Watlow Series 700 measures overall 3 13/16 inches high by 7 9/16 inches wide by 6 9/16 inches deep. It weighs 2.25 lbs. See **Figure 1** for unit dimensional and mounting information, including the size of the front panel cutout.

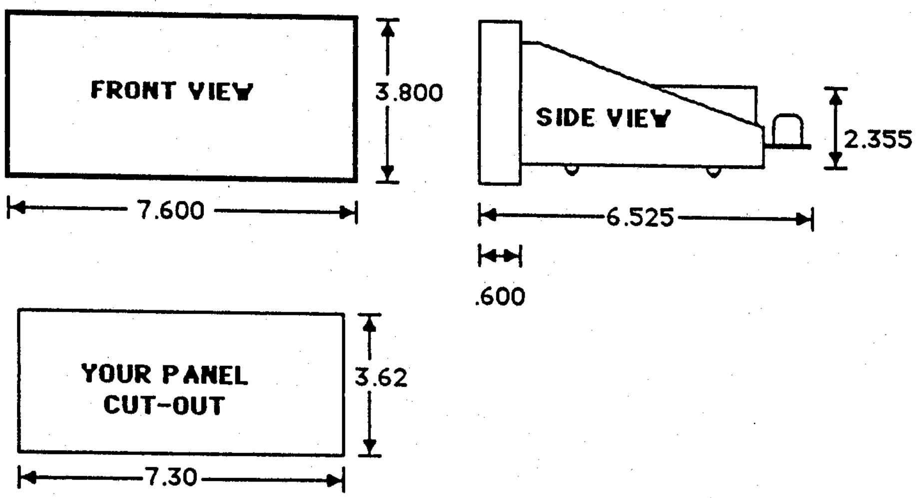


Figure 1 - Dimensional and Mounting Information

The Series 700 Time and Temperature Control attaches to your control panel via a cutout which you must make there. By tightening the four 5/16 inch nuts on the corners of the inside of the 700's front panel, you will seal the unit into your control panel. The terminal strip in the rear of the processor's main circuit board feeds power and signals to the unit.

INSTALLATION PROCEDURE

Follow this procedure to mount the Watlow Series 700 Time and Temperature Control:

1. Make a panel cutout per the dimensions in Figure 1.
2. Place the Series 700 in the cutout you just made.
3. Attach the mounting brackets included with the unit either to the

the unit by its rubber gasket into your control panel preventing any moisture infiltration.

5. Proceed to the wiring instructions.

ELECTRICAL CONNECTIONS INFORMATION

Warning: To avoid potential electric shock use recognized electrical safety practices when wiring and connecting this unit to a power source and to electrical sensors or devices.

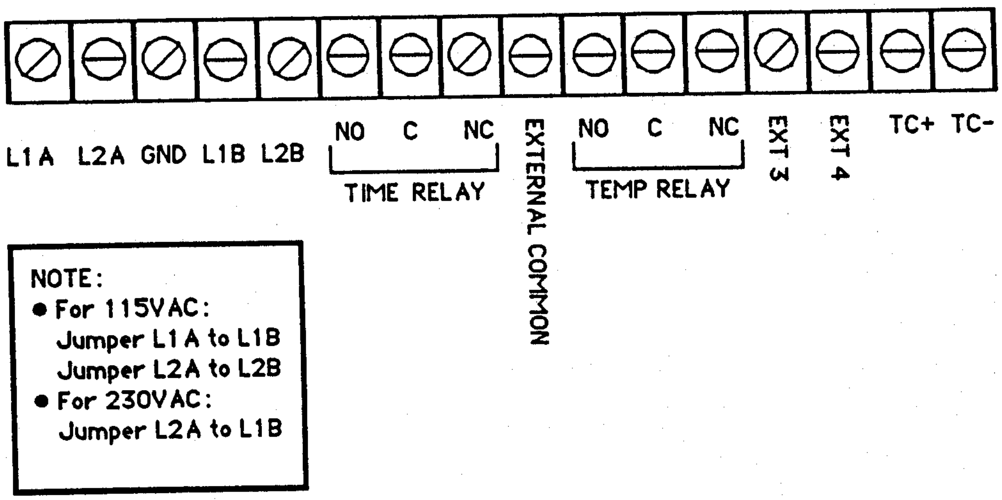


Figure 2 - Electrical Connection Information

Figure 2 shows you how to connect the Watlow Series 700 to your load or system. Study the strip connections carefully before beginning the hook-up. Then complete a correct and safe electrical attachment:

All wiring and fusing should conform to the National Electric Code NFPA70 and to any locally applicable codes as well.

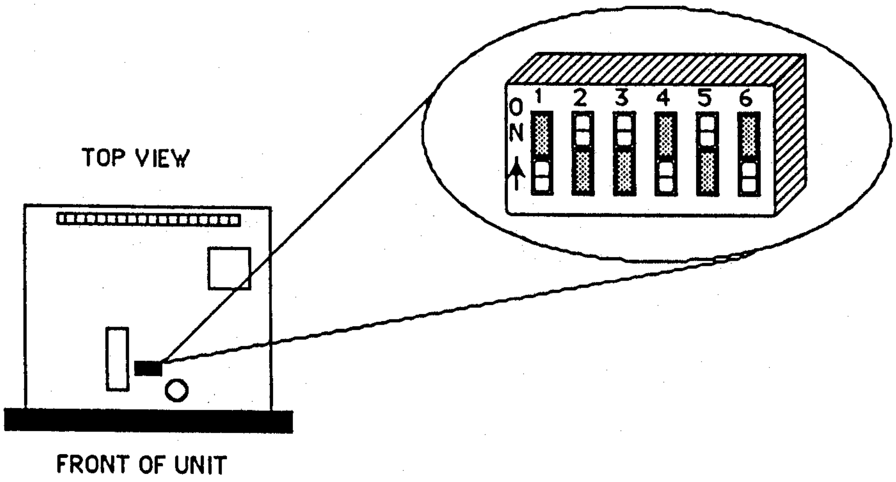


Figure 3 - DIP Switch Location

See Chapter 4, p. 4-1 for DIP Switch settings and function

How to "Read" the 700 Displays

DISPLAY, LED AND CONTROL KEY LOCATION AND EXPLANATION

The Watlow Series 700 Time and Temperature Control has a time and a temperature red digital LED display. Time is on the right and temperature is on the left. Below each display are triangular SET and ACTUAL red LEDs, which indicate whether the display is showing setpoint or actual information. Each side of the 700 front panel has a MODE key, as well as ADJUST (increment and decrement) keys for entering data into their respective displays. In addition, the time side of the Series 700 has a START/STOP key for countdown timer start and stop.

On the Series 700 Time/Temp. Stepping Profile Model and in the space between the time and temperature sides of the control is a vertical row of red LEDs visible only when active. These are, from top to bottom, HO, S1, S2, S3 and RUN. They indicate where the processor "is" in its programming or operation sequences. A full explanation of their information function follows.

Refer to Figure 4 and the subsequent numbered breakdown for location and explanation of the displays, LEDs and control keys.

Figure 4 - Series 700 Faceplate

ITEM	NAME	FUNCTION
1.	Time SET LED	When ON, indicates TIME display is showing set point time.
2.	TIME Display	Three digit, seven segment LED display indicating either SET point or ACTUAL time remaining.
3.	Time ACTUAL LED	When ON, indicates TIME display is showing actual time remaining.
4.	Temp. SET LED	When ON, indicates TEMPERATURE display is showing set point temperature.
5.	TEMPERATURE Display	Three digit, seven segment LED display indicating either SET point or ACTUAL temperature.
6.	Temp. ACTUAL LED	When ON, indicates TEMPERATURE display is showing actual process temperature.
7.	START/STOP Key	Alternate action switch to start or stop the countdown timer. START energizes the output relay and disables the ADJUST keys. STOP de-enegizes the output relay and activates the ADJUST keys.
8.	Time MODE Key	Selects the mode for the TIME display and either SET or ACTUAL LED.
9.	Time ADJUST Key	Increments the TIME display upward by one digit if pressed once lightly, or at an increasing rate if held.
10.	Time ADJUST Key	Decrements the TIME display downward by one digit if pressed once lightly, or at an increasing rate if held.

11.	HO, S1, S2, S3, RUN LEDs	These are LEDs, in a vertical bar gragh, and visible only when active, show where the processor "is" in its programming or operation sequences. **HO** denotes **HOLD;** it occurs when the processor is in the **STOP** condition; the load relay is de-energized. **S1** (1 Step Std. Model or ON/OFF control mode) or **S1, S2** and **S3** indicate which time segment is active in either programming or operation. **RUN** shows that the processor has accepted the **START** signal and the load relay is energized. The timer is counting down.
12.	Temp. MODE Key	Selects the mode for the TEMPERATURE display and either **SET** or **ACTUAL** LED.
13.	Temp. ADJUST Key	Increments the TEMPERATURE display upward by one digit if pressed once lightly, or at an increasing rate if held.
14.	Temp. ADJUST Key	Decrements the TEMPERATURE display downward by one digit if pressed once lightly, or at an increasing rate if held.

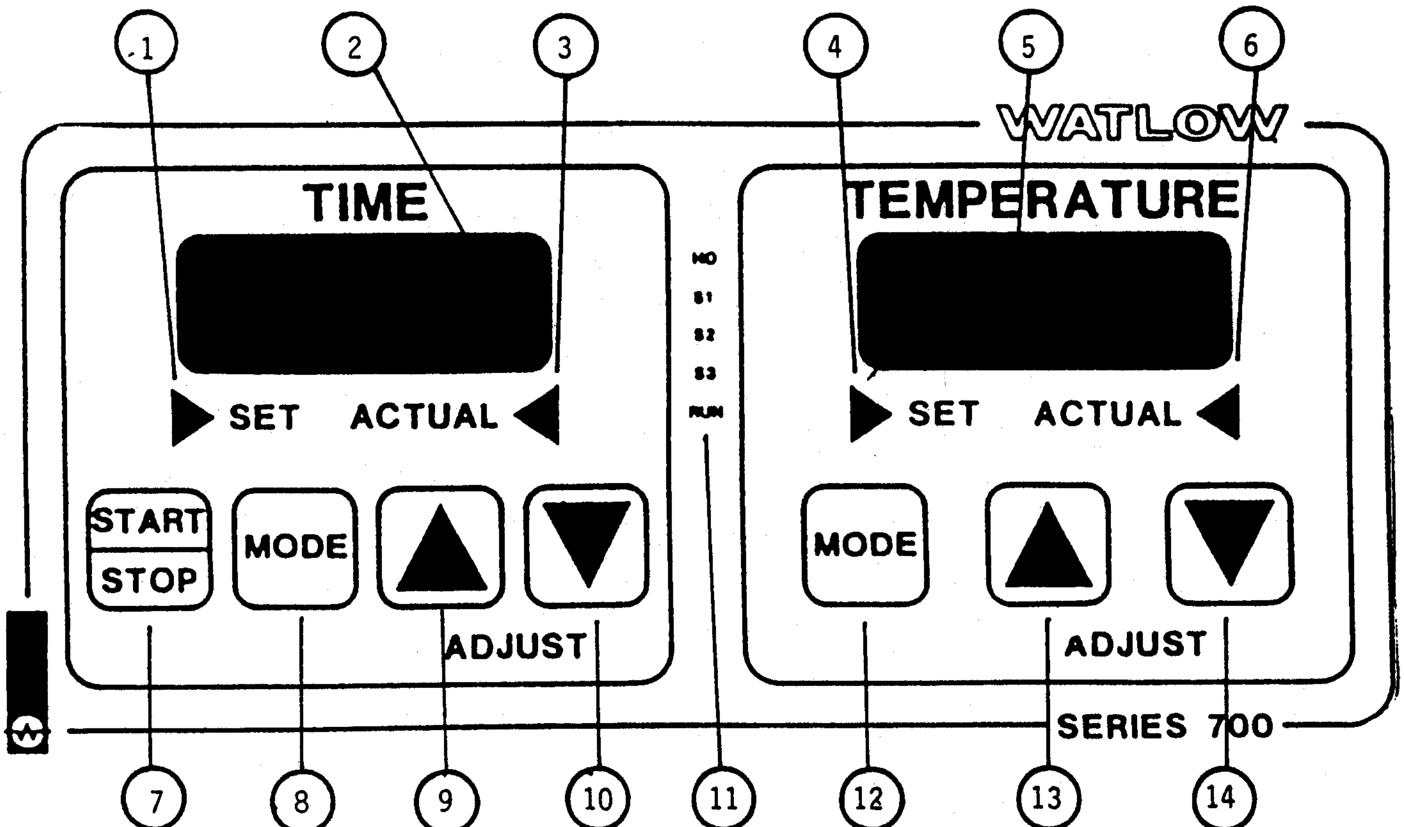


FIGURE 4

Chapter 1

Meet the Watlow Series 700

Introduction

The Watlow Series 700 is a microprocessor-based digital timer and temperature control with proportional control and selectable timing ranges. The control can have up to three programmed cycles (segments) of time and temperature-related profiles.

It features a sealed touch membrane keyboard in a horizontal package. It has two separate LED digital displays, time on the left and temperature on the right. Each display can indicate set point data or process actual information.

The sealed membrane front panel allows fingertip data entry, yet is both water and acid resistant. In the event of a power outage this device has a non-volatile memory for programmed data protection. The 700 will resume operation automatically for up to five minutes without manual restart.

Watlow Series 700 Features

- One channel temperature control at a range of 68° to 662°F (20° to 350°C) or 68° to 347°F (20° to 175°C).
- A countdown timer with a range of 99.9 minutes or 99.9 hours.
- Both time and temperature displays roll over from maximum to minimum or vice versa for easy programming.
- Time proportioning control mode.
- Tactile control, sealed membrane front panel.
- Highly-readable, 0.5 inch, three digit, seven segment LED data displays.
- Automatic resumption at original programming following a power outage of up to five minutes.
- Permanent storage of set point data in the event of a power interruption.
- Digital calibration.
- Chart recorder output, 0 to 1,000 mV where 1 mV = 1°F (non-linear)

Specifications

Program Capacity
- Three segment time/temperature stepping profile and hold option.

Inputs
- **Sensor:** Themocouple sensor, Type J with linearization throughout the range.
- **Sensor Input Reference:** To ground or floating.
- **Sensor Range (Programming):** 68° to 662°F or 68° to 347°F; 20 to 350°C or 20 to 175°C; DIP switch selectable.
- **Temperature Indication:** Fahrenheit or Celsius, DIP switch selectable.
- **Upscale thermocouple break protection.** Relay de-energizes.
- **Automatic cold junction compensation.**
- **Common mode rejection:** 120 dB minimum.
- **Series mode rejection:** 60 dB minimum.
- **Common mode voltage:** 120 VAC r.m.s., 60Hz.
- **Series mode voltage:** 200mV or 5 times span at 60 Hz.

Accuracy
- **Rated Accuracy:** ± 0.25% of span.
- **Set Point Shift with Ambient:** ≤ 2μV/°F maximum referred to the input.
- **Set Point Shift with Line Voltage:** < ± 0.25% of span for a shift of ± 10%.

Control Mode
- **Timing Range:** DIP Switch selectable for 0 to 99.9 minutes or 0 to 99.9 hours.
- **Time Proportioning control (PI)**
- **Three segment** time/temperature stepping profile and hold option, or
- **One segment** time/temperature/hold option, DIP Switch selectable.

Outputs
- **Exhaust Fan Output:**
  3A @ 115/230VAC Form C relay,

- **Temperature Output**
  1A @ 115/230 VAC solid state option, Form A relay only.

- **Chart Recorder Output**
  0 to 1000 mV range (non-linear) where 1 mV = 1°F

Display
- Two 3-digit, 7-segment, 0.5"-high red LEDs.
- Two red LEDs each for SET and ACTUAL display modes.
- Vertical bar graph LED for program/operate indication.

Operating Conditions
- **Supply Voltage:** 115/230 VAC ±10%, 50-60 Hz
- **Power Requirement:** Less than 10mVA
- **Operating Ambient:** 30° to 130°F or 0° to 55°C
- **Storage Ambient:** -40° to 158°F or -18° to 70°C
- **Relative Humidity:** 0 to 90%, non-condensing
- **Memory Protection:** Non-volatile memory retains all information when power is interrupted.

Physical Dimensions:
- 1/2 DIN-sized.
- 3 - 3/16" high by 7 - 9/16" wide by 6 - 9/16" deep.
- Weight: 2.2 lb.

Chapter 2

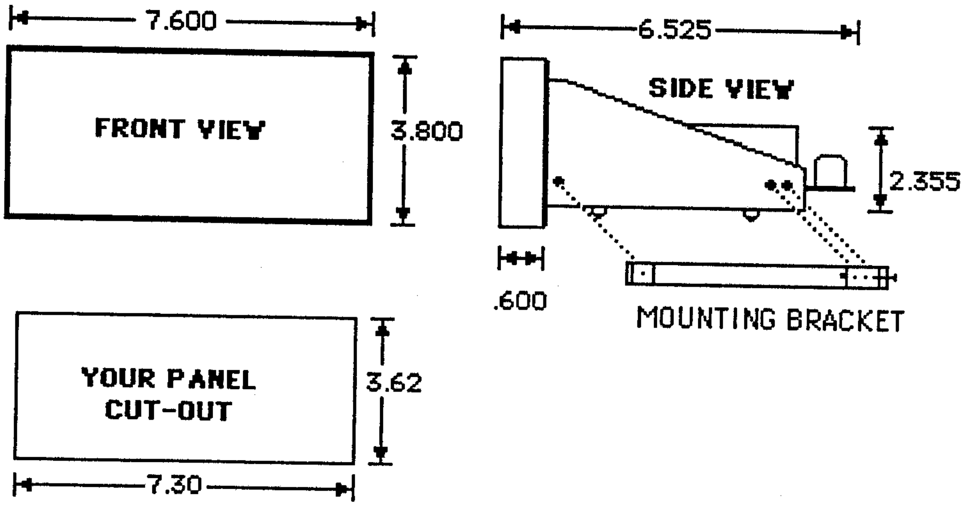
How to Install and Wire the Series 700

This chapter will tell you how to install and wire the Series 700. Read the entire chapter before beginning the installation.

Mounting

The Watlow Series 700 measures overall 3 -13/16 inches high by 7 - 9/16 inches wide by 6 - 9/16 inches deep. It weighs 2.2 lbs. See Figure 1 for unit dimensional and mounting information, including the size of the front panel cutout.

Figure 1 Dimensions and Panel Cutout Information



To install the Series 700, make a cutout in your system's control panel. Insert the control into the cutout from the front of the panel. Attach the mounting brackets to the sides of the control. By tightening the mounting bracket screws, you will seal the unit into your panel. The terminal strip in the rear of the processor's main circuit board feeds power and signals to the unit.

Installation Procedure

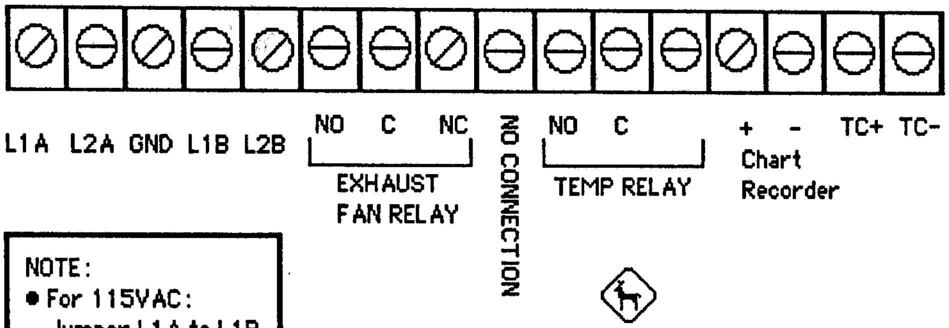
Follow this procedure to install the Watlow Series 700:

1. Make a panel cutout per the dimensions in Figure 1.
2. Place the Series 700 in the cutout you just made.
3. Attach the mounting brackets (included with the unit) to both sides of the case.
4. From behind your control panel, tighten the mounting bracket screws. This will seal the unit by its rubber gasket against your control panel, preventing moisture intrusion.
5. Proceed to the wiring instructions.

Wiring

Figure 2 shows you how to connect the Watlow Series 700 to your load or system. Study the strip connections carefully before beginning the hook-up. Then complete a correct and safe electrical connection.

WARNING



NOTE:
- For 115VAC:
  Jumper L1A to L1B
  Jumper L2A to L2B
- For 230VAC:
  Jumper L2A to L1B

WARNING:
To avoid potential electric shock, use recognized electrical safety practices when wiring and connecting this unit to a power source and to electrical sensors or devices.

Figure 2
Electrical Connection Information

CAUTION:
All wiring and fusing should conform to the National Electric Code NFPA70 and to any locally applicable codes as well.

Chapter 3

How To Use The Keys and Displays

This chapter provides all the information you'll need to operate the Series 700. After you've read through this material, try using all the keys with the control outputs disconnected.

CAUTION:
While learning to program the Series 700, disconnect the control's output load circuits from the outputs, or remove power from the outputs themselves. Do this to avoid entering set points that could potentially damage your equipment.

Display, Key, and LED Explanation and Locations

The Watlow Series 700 Time and Temperature Control has a time and a temperature red digital LED display. Time is on the left and temperature is on the right. Below each display are triangular SET and ACTUAL red LEDs, which indicate whether the display is showing setpoint or actual information. Each side of the 700 front panel has a MODE key, as well as ADJUST (up and down) keys for entering data into their respective displays. In addition, the time side of the Series 700 has a START/STOP key for timer/control cycle start and stop.

Between the time and temperature sides of the control is a vertical row of red LEDs which are visible only when active. From top to bottom, they are: HO, S1, S2, S3 and RUN. These LEDs indicate control cycle status. A full explanation of their information function follows.

Refer to Figure 4 and the numbered breakdown for location and explanation of the displays, LEDs and control keys.

Reference to Figure 3: Series 700 Faceplate

	Item	Function
1.	Time SET LED	When ON, indicates TIME display is showing set point time.
2.	TIME Display	Three digit, seven segment LED display indicating either time SET point or ACTUAL time remaining.
3.	Time ACTUAL LED	When ON, indicates TIME display is showing actual time remaining.
4.	Temperature SET LED	When ON, indicates TEMPERATURE display is showing set point temperature.
5.	TEMPERATURE Display	Three digit, seven segment LED display indicating either display SET point or ACTUAL temperature.
6.	Temp. ACTUAL LED	When ON, indicates TEMPERATURE display is showing actual process temperature.

Front Panel

7. **START/STOP Key** — Alternate action switch to start or stop the countdown timer. START energizes the output relay and disables the ADJUST keys. STOP de-energizes the output relay and activates the ADJUST keys. At the end of a cycle, the first START/STOP keystroke de-energizes the exhaust relay. The next keystroke STARTs a new cycle.

8. **Time MODE Key** — Selects the mode for the TIME display and either the SET or ACTUAL LED.

9. **Time ADJUST Keys** — Increase or decrease the TIME display by one digit if pressed once lightly, or at an increasing rate if held.

10. **HO, S1, S2, S3, RUN LEDs**

    These LEDs, in a vertical bar gragh, and visible only when active, show where the processor is in its programming or operation sequences.

    HO denotes HOLD; it occurs when the processor is in the STOP condition; the load relay is de-energized.

    S1, S2 or S3 indicates which time segment is active in either programming or operation. With one segment, or ON/OFF control, only S1 will appear.

    RUN shows that the processor has accepted the START signal and the load relay is energized. The timer is counting down.

11. **Temperature MODE Key** — Selects the mode for the TEMPERATURE display and either SET or ACTUAL LED.

12. **Temp. ADJUST Keys** — Increase or decrease the TEMPERATURE display by one digit if pressed once lightly, or at an increasing rate if held down.

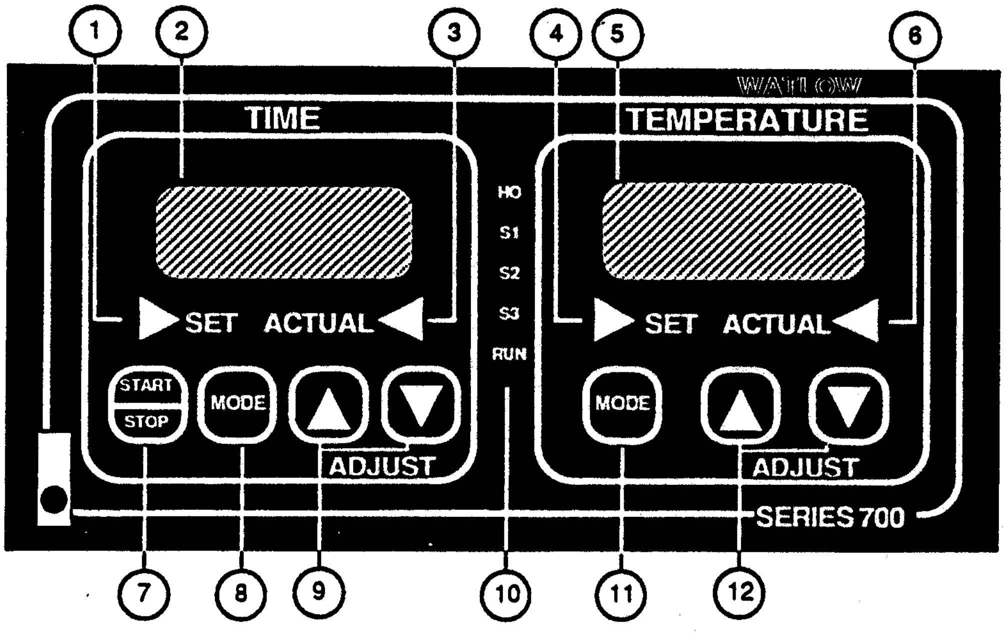


Figure 3
Series 700 Faceplate

Chapter 4

How To Program and Operate The Series 700

Programming Introduction

What does the Watlow Series 700 Time and Temperature Control do? It controls an output load for specific one or three segment heating operations. Your program, once it's entered, gives the Series 700 instructions for the work you want it to perform. We suggest that you write your program out on a copy of the programming chart on the next page. This will enable you to program the Series 700 quickly and without mistakes. The chart will also provide you with a complete record of your Series 700 program.

The programming chart on the next page lists both 1-Step and 3-Step Options for the Series 700. Use the appropriate blanks.

DIP Switch Location and Settings

Before you start programming, set the DIP Switches for the parameters you want. Figure 4 shows where the switches are and which direction is "ON." Table 1 shows the selection for each switch. Note that DIP Switch changes must be made with the power to the Series 700 OFF. If 3-Step is the mode you use, set SW #1 OFF. To use one or two steps without changing the DIP Switch, program zero (0.0) time for any unused steps.

CAUTION:
Power to the 700 must be OFF for a change in DIP Switch to take effect.

CAUTION:
DIP Switches #2, #6 and #8 must be OFF; and #7 must be ON for the Series 700 to operate in your system.

CAUTION

CAUTION

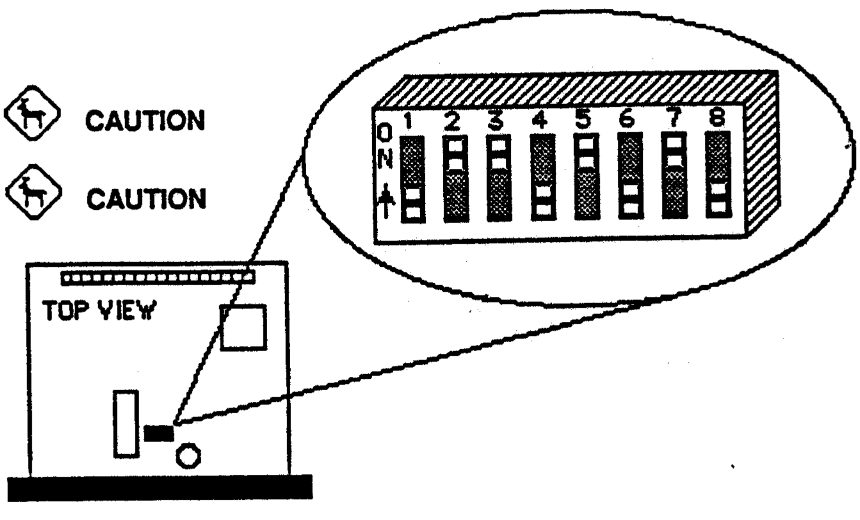


Figure 4
Series 700
DIP Switch Location

Program Chart

Chart 1
Watlow Series 700 Program and Operation Chart

Make photocopies of this page, keeping it unmarked as a master chart for each different program you use.

Date ______ **Process/System** ______________ **Program Number** ____

Table 1
DIP Switch Functions

DIP Switch#	Function ON	Function OFF	Your Selection
1	1 Step Time/Temp	3 Step Time/Temp	
2	—	Time Proportioning	OFF
3	Time in Minutes	Time in Hours	
4	Degrees Celcius	Degrees Fahrenheit	
5	68° to 662°F Range (20° to 350°C)	68° to 347°F Range (20° to 175°C)	
6	—	Factory Calibration	OFF
7	Factory Use Only	ON Only	ON
8	—	Factory Use Only	OFF

Time Programming

Model	Prompt	Choices	Entry	Units Minutes/Hours
1-Step	S1	00.0 to 99.0		
3-Step	S1	00.0 to 99.0		
	S2	00.0 to 99.0		
	S3	00.0 to 99.0		

Temperature Programming

Model	Prompt	Choices	Entry	Units °F / °C
1-Step	S1	68° to 662°F / 20° to 350°C 68° to 347°F / 20° to 175°C		
3-Step	S1	68° to 662°F / 20° to 350°C 68° to 347°F / 20° to 175°C		
	S2	68° to 662°F / 20° to 350°C 68° to 347°F / 20° to 175°C		
	S3	68° to 662°F / 20° to 350°C 68° to 347°F / 20° to 175°C		

Time Proportioning (DIP Switch #2 OFF)

Proportional Band (P)	P Range = 01 to 99	_____°F / °C

With PB DIP Switch #2 in OFF position, the TEMPERATURE display will indicate "PXX" (XX = 0 to 99) when the Temperature MODE key is pressed after selecting one or three temperatures. Increase or decrease P with the ADJUST keys. Press MODE again to enter PB and move to ACTUAL temperature.
Sheldon Manufacturing recommends P04 for most applications.

CAUTION:
While learning to program the Series 700, disconnect the control's output load circuits from the outputs, or remove power from the outputs themselves. Do this to avoid entering set points that could potentially damage your equipment.

Important Programming Note: The 700 is in the HO mode whenever the RUN LED is OFF.

How To Do 1-Step Programming

Here's how to program the Series 700 for one step of time and temperature. This procedure applies to the Standard 1-Step Model. To start:

- DIP Switch #1 must be ON.
- When you are programming time, TEMPERATURE must be in ACTUAL mode; for temperature, TIME must be in ACTUAL mode.

Programming 1-Step Time

Enter a new time for the countdown timer at any of these three conditions:
- After power up.
- During countdown to zero.
- After countdown to zero.

Do this:

1. If the processor is running with the RUN LED ON, stop it with the **START/STOP** key. Select the HO mode with the **TIME MODE** key. The HO and TIME ACTUAL LEDs are ON.

   See

2. Press the **TIME MODE** key to select TIME SET. HO LED is OFF. S1 and TIME SET LEDs are ON.

3. Select the time with the **TIME ADJUST** keys.

4. Press **TIME MODE** again to enter the time into the processor memory. The time display will read 00.0. TIME SET LED is OFF. TIME ACTUAL LED is ON. S1 LED is OFF. HO is ON. The time section is now programmed.

Programming 1-Step Temperature

You must program both a HOLD (HO) and a Segment 1 (S1) temperature here.

Do this:

1. Press the **TEMPERATURE MODE** key to select the TEMPERATURE SET LED. TEMP SET is ON. HO is ON.

2. Select the HOLD temperature set point with the **TEMPERATURE ADJUST** keys.

3. Press **TEMPERATURE MODE** again to enter the HOLD temperature into the processor memory. The temperature display will read any former temperature set point. The TEMP SET LED is ON. S1 is ON.

4. Select the S1 temperature set point with the **TEMPERATURE ADJUST** keys. (Continued on the next page)

5. Press **TEMPERATURE MODE** to enter the S1 set point into the processor memory and to select the proportional band. "PXX" will appear in the temperature display (XX=01 to 99). This is the proportional band prompt. Now enter a proportional bandwidth with the **TEMPERATURE ADJUST** keys, then press **TEMPERATURE MODE** to enter the value into the processor memory. The ACTUAL and HO LEDs will come ON.

The temperature section is now programmed.

1-Step Operation See ♪ ♫

Here's how to operate a 1-Step Series 700.

To Run:

- Press **START/STOP** to initiate the countdown. (When the control has just finished a cycle and the exhaust fan is running, the first **START/STOP** keystroke stops the exhaust fan. Press **START/STOP** again to start a new cycle.)
- When you press **START**, the time display will immediately read the time you entered for S1 and begin counting down. S1 and RUN will be ON.
- When countdown is complete, the time display will read 00.0 and the exhaust relay will energize, RUN will go out and HO will light. The oven will maintain the HO temperature setting.

To Stop:

- If you wish to stop the timer coundown, press **START/STOP**. HO is ON, RUN is OFF.
- The oven is now controlling at the HOLD set point.

To Resume:

- Press **START/STOP** again. The Watlow Series 700 will begin controlling temperature at the set point now in memory. The control resumes counting time where it stopped.

To Change Temperature/Proportional Band During Countdown:

- If you wish to change a temperature or proportional band set point, press **START/STOP** to place the control in the HOLD mode. Press the **TEMPERATURE MODE** key to select TEMPERATURE SET and HO. Press the **TEMPERATURE MODE** key again to select S1 SET, or again to select P SET.
- Enter the new set point value with the **TEMPERATURE ADJUST** keys.
- Press **START/STOP** to enter the new value into the processor and start the timer countdown with the new set point.

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Important Operations Note: The control will maintain the HO temperature in the oven except when it is executing a program.

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Important Programming Note: When you are programming time, TEMPERATURE must be in the ACTUAL mode. For temperature, TIME must be in ACTUAL mode.

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Important Programming Note: When you are programming time, TEMPERATURE must be in the ACTUAL mode. For temperature, TIME must be in ACTUAL mode.

To Change Time During Countdown:

When the Series 700 timer is counting down, the **ADJUST** keys are inactive. To enter a new time you must stop the timer. Do this:

- Press the **START/STOP** key to halt the timer. The TIME display will read 00.0. The HO and ACTUAL LEDs will come on.
- Press **TIME MODE** to select TIME SET. S1 will light. The time display is reading the old set point.
- Select the new time with the **TIME ADJUST** keys.
- Press **TIME MODE** again to enter the new time into memory, ACTUAL will light. HO will light. The TIME display will read 00.0.
- To restart, press **START/STOP**.

To Halt The Exhaust Fan At The End Of A Cycle

When the Series 700 finishes a timed cycle, the exhaust fan automatically comes ON. The oven is controlled at the HOLD set point.

- Press **START/STOP** to halt the exhaust fan.

1-Step Programming Examples

Use the examples below to learn the Series 700.

Example #1

Goal: To maintain a single temperature continuously using only the HO temperature set point.

Plan: Program your desired temperature as the HO temperature. Press **TEMPERATURE MODE** and **TIME MODE** to select the ACTUAL displays. (Do not press **START/STOP**; the control will automatically maintain the HO TEMP.)

Action: To maintain 125°C continuously, program as follows:
HO Set Point = 125°C

DIP Switch Settings:	
SW#1 = ON	1-Step Time
SW#2 = OFF	Time Proportioning
SW#3 = ON	Time in Minutes
SW#4 = OFF	°F Units
SW#5 = ON	68° to 662°F Range
SW#6 = OFF	Factory Requirement
SW#7 = ON	Factory Requirement
SW#8 = OFF	Factory Requirement

Example #2

Goal: To maintain a set temperature for a specific time period and then return to the lower holding temperature.

Plan: Program a 20°C HO value for final temperature and an S1 value of 150°C for desired elevated temperature. Program the S1 time as the desired 7.0 hours elapsed time.

Action: At end of cycle the exhaust fan outlet will be energized and remain so until START/STOP is pressed.
HO Temperature = 20°C S1 Temperature = 150°C
S1 Time = 7 hours

DIP Switch Settings:	
SW#1 = ON	1-Step Time
SW#2 = OFF	Time Proportioning
SW#3 = OFF	Time in Hours
SW#4 = ON	°C Units
SW#5 = ON	20 to 350°C Range
SW#6 = OFF	Factory Requirement
SW#7 = ON	Factory Requirement
SW#8 = OFF	Factory Requirement

Important Programming Note: When you are programming time, TEMPERATURE must be in the ACTUAL mode. For temperature, TIME must be in ACTUAL mode.

Where To Go From Here

You are now ready to put your 1-Step Series 700 Time and Temperature Control to work. Enter your working program into the control. Be sure to record all your settings on a copy of the Program Chart on p. 11; it will make a good record of any specific program.

Then remove power from the Series 700 and connect the output loads. Or, if you had simply removed power from your load devices while you were learning the control function, go ahead and reconnect power and start your system.

Open Sensor Indication

When the Series 700 (1-Step and 3-Step) detects an open sensor, it will show four dashes, "————" in both the time and temperature displays.
See Figure 5.

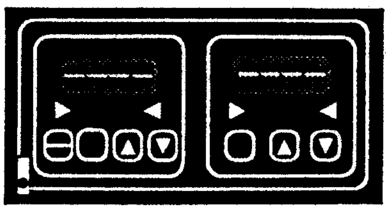

Figure 5
Open Sensor Indication

When you have corrected the sensor problem, you must reset power to the Series 700 to clear the dashed displays.

CAUTION:
While learning to program the Series 700, disconnect the control's output load circuits from the outputs, or remove power from the outputs themselves. Do this to avoid entering set points that could potentially damage your equipment.

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Important Operations Note: The 700 is in the HO mode whenever the RUN LED is OFF.

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Important Programming Note: When you are programming time, TEMPERATURE must be in the ACTUAL mode. For temperature, TIME must be in ACTUAL mode.

How To Do 3-Step Programming

Here's how to program the 3-Step Series 700.

Initial Condition: The Series 700 is in a STOP condition. The timer is __not__ counting down. Load relay is de-energized. HO is ON, indicating HOLD.

When you are programming time, TEMPERATURE must be in ACTUAL mode; for temperature, TIME must be in ACTUAL mode.

See ♪ ♫

Programming 3-Step Time

Do this:

1. Select TIME SET with the **TIME MODE** key. S1 is ON.
2. Select the desired time for Segment 1 (S1) with the **TIME ADJUST** keys.
3. Press **TIME MODE** to enter time for Segment 1. S1 is OFF, S2 is ON.
4. Select the desired time for Segment 2 (S2) with the **TIME ADJUST** keys.
5. Press **TIME MODE** to enter time for Segment 2. S2 is OFF, S3 is ON.

- If your program uses only two steps, press **TIME MODE** now without selecting a third step. TIME ACTUAL will light.

6. Select the desired time for Segment 3 (S3) with the **TIME ADJUST** keys.
7. Press **TIME MODE** to enter TIME for Segment 3, **TIME ACTUAL** will light.

The time section is now programmed.

Programming 3-Step Temperature

1. Select TEMPERATURE SET with the **TEMPERATURE MODE** key. HO is ON.
2. Select the HOLD set point with the **TEMPERATURE ADJUST** keys. Press **TEMPERATURE MODE** to enter the HO set point. S1 is ON.
3. Select the set point for Segment 1 with the **TEMPERATURE ADJUST** keys. Press **TEMPERATURE MODE** to enter the set point for Segment 1. S2 is ON.
4. Select temperature set point for Segment 2 with the **TEMPERATURE ADJUST** keys. Press **TEMPERATURE MODE** to enter the set point for Segment 2, S3 is ON. (Continued on the next page.)

- (If your program uses only two steps, press TEMPERATURE MODE again without selecting a third step with the ADJUST keys, ACTUAL will light).

5. Select the set point for Segment 3 (S3) with the **TEMPERATURE ADJUST** keys. Press **TEMPERATURE MODE** to enter the set point for Segment 3, ACTUAL will light.

6. "PXX" will now be in the temperature display (XX=01 to 99). This is the proportional band prompt. Enter a proportional bandwidth with the **TEMPERATURE ADJUST** keys, then press **TEMPERATURE MODE** to enter the value into the processor memory. The ACTUAL LED will come ON. The 3-Step temperature section is now programmed.

3-Step Operation ♪

Here's how to operate a 3-Step Series 700.

To Run:

- Press **START/STOP** to initiate the countdown. (When the control has just finished a cycle and the exhaust fan is running, the first **START/STOP** keystroke stops the exhaust fan. Press **START/STOP** again to start a new cycle.)
- When you press **START**, the time display will immediately read the time you entered for Segment1 and begin counting down. S1 and RUN will be ON.
- Countdown will continue through S1, S2, and S3 and the control will adjust temperatures as selected by the temperature set points for S1, S2, and S3, respectively.
- When countdown is complete, the time display will read 00.0 and the exhaust relay will energize, RUN will go out and HO will light. The oven will maintain the HO temperature setting.

To Stop:

- If you wish to stop the timer coundown, press **START/STOP**. HO is ON, RUN is OFF.
- The oven is now controlling at the HOLD set point.

To Resume:

- Press **START/STOP** again. The Watlow Series 700 will begin controlling temperature at the set point now in memory. The control resumes counting time where it stopped.

To Change Temperature During Countdown

- When the Series 700 timer is counting down, all the ADJUST keys are inactive. To enter a new set point, you must halt the timer.
- Press **START/STOP** to halt the timer. The temperature display will read the process ACTUAL temperature. The load relay will de-energize.
(Continued on the next page.)

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Important Operations Note: The control will maintain the HO temperature in the oven except when it is executing a program.

♫

Important Programming Note: When you are programming time, TEMPERATURE must be in the ACTUAL mode. For temperature, TIME must be in ACTUAL mode.

- Press **TEMPERATURE MODE** to select TEMPERATURE SET. Select the new set point with the **TEMPERATURE ADJUST** keys.

- Press **MODE** again to enter the new set point into memory. TEMPERATURE ACTUAL will light. The temperature display will read the new set point value.

  With a 3-Step Series 700 you may also enter new temperature set points for Segments 2 and 3 here. Notice indicators S2 and S3 and enter new set points as before.

- If you want to retain the temperature set points in S2 and S3, press **TEMPERATURE MODE** once for each temperature segment. Press **TEMPERATURE MODE** a third time to switch to ACTUAL.

- Then press the **START/STOP** key to resume countdown where it left off. The temperature display will immediately read the new set point and the countdown will continue to zero.

To Change Proportional Band During Countdown:

- Changing the proportional band is like changing a temperature set point. After halting the control just press TEMPERATURE MODE, successively stepping past the S1, S2, and S3 SET opportunities. You want the HO LED to be ON and "PXX" showing in the TEMPER ATURE display. (XX = 01 to 99.)

- After you pass by the Segment 3 set point temperature by pressing **TEMPERATURE MODE**, the temperature display will show the prompt, "P01," the proportional band default value.

- The "P" indicates Proportional Band, while the **01** is the Proportional Bandwidth itself. Increase or decrease the proportional bandwidth using the **TEMPERATURE ADJUST** keys. The bandwidth range is from 1 to 99. Press **TEMPERATURE MODE** again to enter the value into memory.

- Sheldon Manufacturing recommends a setting of P04 for most applications.

To Change Time During Countdown:

- When the Series 700 timer is counting down, all the **ADJUST** keys are inactive. To enter a new time you must halt the timer.

- Press the **START/STOP** key to halt the timer. The TIME display will read 00.0. The HO and ACTUAL LEDs will come on.

- Press **TIME MODE** to select TIME SET. S1 will light. The time display is reading the old set point. Press **TIME MODE** again for S2 or S3.

- Select the new time with the **TIME ADJUST** keys.

- Press **TIME MODE** to enter the new time into memory, ACTUAL will light. HO will light. The TIME display will read 00.0.

- To restart, press **START/STOP**.

To Halt The Exhaust Fan At The End Of A Cycle

When the Series 700 finishes a timed cycle, the exhaust fan automatically comes ON. The oven is controlled at the HOLD set point.

- Press **START/STOP** to halt the exhaust fan.

3-Step Programming Example:

Goal: To heat the product to three different temperatures and hold at each level for a specified time period and then return to the lower holding temperature.

Plan: Program HO TEMP for final temperature and S1 TEMP/S1 TIME, S2 TEMP/S2 TIME, and S3 TEMP/S3 TIME for the respective elevated temperatures and time.

Action: Run at 100°C for one hour, 200°C for two hours, 300°C for three hours, and return to 20°C, program. Enter these parameters:

HO TEMP = 20°C

S1 TEMP = 100°C	S1 TIME = 1.0 hours
S2 TEMP = 200°C	S2 TIME = 2.0 hours
S3 TEMP = 300°C	S3 TIME = 3.0 hours

DIP Switch Settings:	
SW#1 = OFF	3-Step Time
SW#2 = OFF	Time Proportioning
SW#3 = OFF	Time in Hours
SW#4 = ON	°C Units
SW#5 = ON	20° to 350°C Range
SW#6 = OFF	Factory Requirement
SW#7 = ON	Factory Requirement
SW#8 = OFF	Factory Requirement

Important Programming Note: When you are programming time, TEMPERATURE must be in the ACTUAL mode. For temperature, TIME must be in ACTUAL mode.

Where To Go From Here

You are now ready to put your 3-Step Series 700 Time and Temperature Control to work. Enter your working program into the control. Be sure to record all your settings on a copy of the Program Chart on p. 11; it will make a good record of any specific program.

Then remove power from the Series 700 and connect the output loads. Or, if you had simply removed power from your load devices while you were learning the control function, go ahead and reconnect power and start your system.

How to Program and Operate the Watlow Series 700

Programming Preamble

What does the Watlow Series 700 Time and Temperature Control do? It controls an output load for a specific one or three segment heating operation. Your program, once it's entered, gives the Series 700 instructions for the work you want it to perform. We suggest that you write your program out on a copy of the programming chart below. This will enable you to program the Series 900 quickly and without mistakes. The chart will also provide you with a complete record of your Series 700 program.

The programming chart below lists both One Step and Three Step Options for the Series 700. Use the appropirate blanks. Note that DIP Switch changes must be made at POWER DOWN for the processor to accept them.

Chart 1 - Watlow Series 700 Program and Operation Chart

Date ________ **Process/System** __________________ **Program Number** _______

DIP SWITCH SETTINGS

(Circle current settings - Change Switches at Power Down)

SWITCH #	POSITION
1	**ON** = 1 Step Time **OFF** = 3 Step Time/Temp
2	**ON** = ON/OFF Control **OFF** = Time Proportioning Control
3	**ON** = Time in Minutes **OFF** = Time in Hours
4	**OFF** (Spare)
5	**ON** = 0 to 350°F Range **OFF** = 0 to 500°F Range
6	**OFF Only** (Calibrate)

TIME SECTION

	ENTRY min/hr	POSSIBLE ENTRIES
STD. MODEL: (1 Step)	_____	00.0 to 99.0 minutes **or** hours
TIME/TEMP STEPPING PROFILE MODEL: (3 Step)		
S1	_____	00.0 to 99.0 minutes **or** hours
S2	_____	00.0 to 99.0 minutes **or** hours less S1
S3	_____	00.0 to 99.0 minutes **or** hours less (S1+S2)

TEMPERATURE SECTION

	ENTRY °F	POSSIBLE ENTRIES
STD. MODEL: (1 Step)	_____	0° to 350°F **or** 0° to 500°F
TIME/TEMP STEPPING PROFILE MODEL: (3 Step)		
S1	_____	0° to 350°F **or** 0° to 500°F
S2	_____	0° to 350°F **or** 0° to 500°F
S3	_____	0° to 350°F **or** 0° to 500°F

TIME PROPORTIONING Active

DIP Switch #2 OFF - Change Switch at Power Down

Proportional Band (PB) _____ PB Range = 05 to 99.

With PB option active (DIP Switch #2 in OFF position) the TEMPERATURE display will indicate "P25" when the Temperature MODE key is pressed after selecting the set point temperature. Increase or decrease PB from 25 at two digits on the right with ADJUST keys. Press MODE again to enter PB and move to ACTUAL temperature.

How To Enter Your Series 700 Program

You may program either the TIME or TEMPERATURE section first.

TIME Programming

You may enter a new TIME for the countdown timer at any one of three instances in the operation of the Series 700. They are:

- Following Power Up
- During Countdown
- After Countdown to Zero

The Series 700 behaves the same following power up as it does after countdown to zero.

STD. MODEL (1 Step) w/ DIP SWITCH #1 ON: (Only one Segment of time & Temp)

1. Select TIME **SET** with the TIME **MODE** key.
2. Enter the desired TIME with the **ADJUST** key(s) (keys with triangles).
3. Press **MODE** again to select ACTUAL and enter the time into the processor memory. The TIME display will read 00.0.

- ## Program TEMPERATURE section

1. Select TEMPERATURE **SET** with the TEMPERATURE **MODE** key.
2. Enter the desired temperature set point with theTEMPERATURE **ADJUST** key(s).
3. Press MODE again to select ACTUAL and enter the temperature into the processor memory. The TEMPERATURE display will read any former temperature set point.

OPERATION

1. Press **START/STOP** to initiate the countdown and energize the load relay.

Remember that **START** energized the load relay,
while **STOP** de-energizes it.

When you press **START**, the TIME display will immediately read the time you entered for Segment 1 and begin counting down. **S1** and **RUN** will be **ON.**

When countdown is complete in all the steps, the TIME display will read 00.0 and the load relay will de-energize, **RUN** will go out and **HO** will light, and finally the load relay will de-energize.

If you wish to stop the timer countdown, PRESS **START/STOP. HO** will light, RUN light will extinguish and the load relay will de-energize.

To resume operation

PRESS **START/STOP** again. The Watlow Series 700 will begin controlling temperature at the set point now in memory .

If you wish to change the temperature set point place the control in the hold mode. PRESS TEMPERATURE **MODE** BUTTON to select **SET**.

Now enter new set point values by using the TEMPERATURE **ADJUST** BUTTONS (buttons with triangles).

PRESS START/STOP and the timer coutdown will continue using the new set point temperature.

TIME Entry During Countdown

When the Series 700 timer is counting down, the ADJUST keys are inactive. to enter a new time you must halt the timer. Perform this procedure:

1. Press the **START/STOP** key to halt the timer. The TIME display will read 00.0. The load relay will de-energize. Optional **HO** LED will come on
2. Press **MODE** to select TIME **SET**.
3. Select the new time with the **ADJUST** key(s).
4. Press MODE again to enter the new time into memory, ACTUAL will light (**S1** will light). The TIME display will read 00.0.

TIME/TEMP STEPPING PROFILE MODEL (3 Step): DIP Switch #1 OFF

Initial Condition: The Series 700 is in a **STOP** condition. Timer is <u>not</u> counting down. Relay is de-energized. **HO** is **ON**, indicating HOLD

PROGRAMMING TIME

1. Select TIME **SET** with the TIME **MODE** key, **S1** will light.
2. Select the desired TIME for Segment 1 with the **ADJUST** key(s). (keys with triangles)
3. Press MODE to enter TIME for Segment 1, S2 will light.
4. Select the desired TIME for Segment 2 with the **ADJUST** key(s).
5. Press MODE to enter TIME for Segment 2, S3 will light.

   (If your program uses only two steps, press MODE again without selecting a third step with the ADJUST key(s), ACTUAL will light.)

6. Select the desired TIME for Segment 3 with the **ADJUST** key(s).
7. Press **MODE** to enter TIME for Segment 3, **ACTUAL** will light.

PROGRAMMING TEMPERATURE

1. Select TEMPERATURE **SET** with the TEMPERATURE **MODE** key, **S1** will light, **HO** will go out.
2. Select the desired TEMPERATURE set point for Segment 1 with the **ADJUST** key(s).
3. Press **MODE** to enter the set point for Segment 1, **S2** will light.
4. Select the desired TEMPERATURE set point for Segment 2 with the **ADJUST** key(s).
5. Press **MODE** to enter the set point for Segment 2, **S3** will light.

   (If your program uses only two steps, press **MODE** again without selecting a third step with the **ADJUST** key(s), **ACTUAL** will light.)

6. Select the desired TEMPERATURE set point for Segment 3 with the **ADJUST** key(s).
7. Press **MODE** to enter the set point for Segment 3, **ACTUAL** will light.

8. Press **START/STOP** to initiate the countdown and energize the load relay.

   When you press **START**, the TIME display will immediately read the time you entered for Segment 1 and begin counting down. **S1** and **RUN** will be **ON**. Countdown will continue through **S1, S2** and **S3** and the control will adjust temperatures as selected by the temperature setpoints for **S1, S2** AND **S3**, respectively. When countdown is complete in all the steps, the TIME display will read 00.0 and the load relay will de-energize, **RUN** will go out and **HO** will light.

TIME/TEMP STEPPING PROFILE MODEL (3 Step): DIP Switch #1 OFF

TEMPERATURE Entry During Countdown

When the Series 700 timer is counting down, the ADJUST keys are inactive. to enter a new TEMPERATURE set point you must halt the timer.

1. Press the **START/STOP** key to halt the timer. The TEMPERTURE **ACTUAL** display will read the the process temperature. The load relay will de-energize.
2. Press **MODE** to select TEMPERATURE **SET**.
3. Select the new TEMPERATURE set point with the **ADJUST** key(s).
4. Press MODE again to enter the new set point into memory, **ACTUAL** will light . The TEMPERATURE display will read the NEW set point value.

   With a 3-Step Series 700 you may also enter new temperature set points for Segments 2 and 3 here. Notice indicators **S2** and **S3** and enter new set points as in initial setup. If you want to retain the temperature setpoints in S2 and S3, PRESS **MODE** once for each temperature segment. Press **MODE** and third time to switch to ACTUAL

5. Press the **START/STOP** key to resume countdown where it left off. The load relay will re-energize. The TEMPERATURE display will immediately read the new set point and the countdown will continue to zero.

TIME Entry During Countdown

When the Series 700 timer is counting down, the **ADJUST** keys are inactive. to enter a new time you must halt the timer.

*Realize that the new time will not be activated until until the current timing cycle has timed out, or the **POWER** is turned **OFF** the **ON** again.*

1. Press the **START/STOP** key to halt the timer. The TIME display will read 00.0. The load relay will de-energize. Optional **HO** LED will come on
2. Press **MODE** to select TIME **SET**.
3. Select the new time with the **ADJUST** key(s).
4. Press time **MODE** again to select ACTUAL prior to attempting restart.

TIME PROPORTIONING-TEMPERATURE Programming

STD. MODEL - 1 Step (DIP Switch #1 ON)

Set DIP Switch #2 OFF. Change the switch at power down only for the processor to accept the change.

With Proportioning Band option active, TEMPERATURE programming will be the same as in the ON/OFF mode with **one exception.** After you enter the set point temperature by pressing TEMPERATURE **MODE**, the TEMPERATURE display will show the prompt, "**P25**" which is the default value.

The "**P**" indicates Proportional Band, while the **25** is the Proportional Bandwidth itself. Increase or decrease the proportional bandwidth using the TEMPERATURTE **ADJUST** keys. The bandwidth range is from 5 to 99. Then press **MODE** again to enter the proportional bandwidth into memory.

Then press TEMPERATURE **MODE** again to enter the proportional bandwidth into memory.

TIME/TEMP STEPPING PROFILE MODEL - 3 STEP

After you enter the Segment 3 set point temperature by pressing TEMPERATURE **MODE**, the TEMPERATURE display will show the prompt, "**P25**" which is the default value.

The "**P**" indicates Proportional Band, while the **25** is the Proportional Bandwidth itself. Increase or decrease the proportional bandwidth using the **ADJUST** keys. The bandwidth range is from 5 to 99. Then press **MODE** again to enter the proportional bandwidth into memory.

When programmed according to the guidelines and procedures listed above, the Watlow Series 700 Time and Temperature Control will perform as stated.