

Installation and Operation Manual

**Thermo Scientific Thermolyne Furnace
Benchtop Industrial/**

Type FD1500M,

Type Models:

FD1530M, FD1530MCN,

FD1530M-33, FD1535M,

FD1540M, FD1540MCN,

FD1540M-33, AND

FD1545M.

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IMPORTANT INFORMATION

This manual contains important operating and safety information. The user must carefully read and understand the contents of this manual prior to the use of this equipment.

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Safety Information

Alert Signals



Warning

Warnings alert you to a possibility of personal injury.



Caution

Cautions alert you to a possibility of damage to the equipment.



Note

Notes alert you to pertinent facts and conditions.



Hot Surface

Hot surfaces alert you to a possibility of personal injury if you come in contact with a surface during use or for a period of time after use.

This manual contains important operating and safety information. The user must carefully read and understand the contents of this manual prior to the use of this equipment.

Your Thermolyne furnace has been designed with function, reliability, and safety in mind. It is the user's responsibility to install it in conformance with local codes. For safe operation, please pay attention to the alert signals throughout the manual.

Warnings

To avoid electrical shock, this furnace must:

1. Use a properly grounded electrical outlet of correct voltage and current handling capacity.
2. Disconnect from the power supply prior to maintenance and servicing.
3. Have the door switch operating properly.

To avoid burns, this furnace must:

Not to be touched on the exterior or interior surfaces during use or for a period of time after use.

To avoid personal injury:

1. Do not use in the presence of flammable or combustible materials; fire or explosion may result. This device contains components which may ignite such materials.
2. Refer servicing to qualified personnel.

Please note the following WARNINGS:

WARNING

This warning is presented for compliance with California Proposition 65 and other regulatory agencies and only applies to the insulation in this product. This product contains refractory ceramic, refractory ceramic fiber or fiberglass insulation, which can produce respirable dust or fibers during disassembly. Dust or fibers can cause irritation and can aggravate preexisting respiratory diseases. Refractory ceramic and refractory ceramic fibers (after reaching 1000°C) contain crystalline silica, which can cause lung damage (silicosis). The International Agency for Research on Cancer (IARC) has classified refractory ceramic fiber and fiberglass as possibly carcinogenic (Group 2B), and crystalline silica as carcinogenic to humans (Group 1).

The insulating materials can be located in the door, the hearth collar, in the chamber of the product or under the hot plate top. Tests performed by the manufacturer indicate that there is no risk of exposure to dust or respirable fibers resulting from operation of this product under normal conditions. However, there may be a risk of exposure to respirable dust or fibers when repairing or maintaining the insulating materials, or when otherwise disturbing them in a manner which causes release of dust or fibers. By using proper handling procedures and protective equipment you can work safely with these insulating materials and minimize any exposure. Refer to the appropriate Material Safety Data Sheets (MSDS) for information regarding proper handling and recommended protective equipment. For additional MSDS copies, or additional information concerning the handling of refractory ceramic products, please contact the Customer Service Department at International at 1-800-438-4851.

Introduction

Intended Use

The Type 1500 furnaces are general laboratory and heat treating furnace. For optimum element life, it is suggested that this furnace be used for applications requiring temperatures from 212°F (100°C) to 2192°F (1200°C). For maximum element life, it is recommended to operate the furnace at temperatures from 212°F (100°C) to 1950°F (1066°C) for continuous use, or temperatures from 1950°F (1066°C) to 2192°F (1200°C) for intermittent use. Continuous use is operating the furnace for more than 3 hours and intermittent use is operating the furnace for less than 3 hours.

The unit consists of: 1) heating chamber, 2) a digital controller and 3) a door interlock relay for user safety.

General Usage

Do not use this product for anything other than its intended usage.

Principles of Operation

The furnace chamber is heated by four electric resistance heaters which are embedded in a refractory material. The chamber is insulated with ceramic fiber insulation. For safety, a door switch is incorporated to remove power from heating elements when door is opened. The furnace chamber is supported by the control section which also houses the electrical connections.

General Specifications

MODEL NUMBER		FD1540M, FD1530M	FD1540M-33 FD1530M-33	FD1545M FD1535M
CHAMBER DIMENSIONS IN. (CM)	WIDTH	4 (10 CM)	4 (10 CM)	4 (10 CM)
	HEIGHT	3-3/4 (9.5 CM)	3-3/4 (9.5 CM)	3-3/4 (9.5 CM)
	DEPTH	9 (22.9CM)	9 (22.9 CM)	9 (22.9 CM)
OVERALL DIMENSIONS IN. (CM.)	WIDTH	11 (28 CM)	11 (28 CM)	11 (28 CM)
	HEIGHT	16-1/2 (42 CM)	16-1/2 (42 CM)	16-1/2 (42 CM)
	DEPTH	18 (46 CM)	18 (46 CM)	18 (46 CM)
WEIGHT	LBS. (KG)	42 LBS (19 KG)	42 LBS (19 KG)	42 LBS (19 KG)
ELECTRICAL RATINGS	VOLTS	240	220-240	120
	AMPS	9.3	6.5	18.6
	WATTS	2230	1560	2230
	FREQ.	50/60	50/60	50/60
	PHASE	1	1	1
OPERATING TEMP RANGE	CONT.	100°C-1066°C	100°C-1066°C	100°C-1066°C
	INTERMITTENT	1066°C-1200°C	1066°C-1200°C	1066°C-1200°C

GENERAL SPECIFICATIONS

Environmental Conditions

Operating: 17°C - 27°C; 20% to 80% relative humidity, non-condensing. Installation Category II (over-voltage) in accordance with IEC 664. Pollution Degree 2 in accordance with IEC 664.

Altitude limit: 2,000 meters.

Storage: -25°C to 65°C; 20% to 80% relative humidity.

Declaration of Conformity

(For -33 models only)

Thermo Scientific hereby declares under its sole responsibility that this product conforms with the technical requirements of the following standards: EMC:

	EN 61326-1	Electrical equipment for measurement, control, and laboratory use; Part I: General Requirements
Safety:	EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use; Part I: General Requirements
	EN 61010-2-010	Part II: Particular requirements for laboratory equipment for the heating of materials

per the provisions of the Electromagnetic Compatibility Directive 2006/95/EC, and per the provisions of the Low Voltage Directive 2004/108/EC.

The authorized representative located within the European Community is:

Electrothermal Engineering Ltd.
419 Sutton Road
Southend On Sea
Essex SS2 5PH
United Kingdom

Copies of the Declaration of Conformity are available upon request.

Unpacking

Visually check for any physical damage to the shipping container. Inspect the equipment surfaces that are adjacent to any damaged area. Unpack furnace from box. The owner's manual and door handle are included in the box. After unpacking the furnace, attach the door handle and remove packing material from inside furnace chamber. The furnace is supplied with one hearth plate. **The 120V models are not supplied with a power cord because current requirements are too great to be handled by ordinary power cords and standard wall supply.**

Installation

**Caution**

Be sure ambient temperature does not exceed 104°F (40°C). The recommended ambient temperature is 17°C-27°C. Ambient above this level may result in damage to the controller.

**Caution**

Allow at least six inches of space between the furnace and any combustible surface. This permits the heat from the case surface to escape so as not to create a possible fire hazard.

**Warning**

To avoid electrical shock, this furnace must be installed by a competent electrician who ensures compatibility among furnace specification, power source and ground code requirements.

Site Selection

Install furnace on a sturdy surface and allow adequate space for ventilation.

Electrical Connections

The electrical specifications are located on the specification plate on the back of the furnace. Consult Thermo Scientific if your electrical service is different than those listed on the specification plate. Prior to connecting your Type 1500 furnace to your electrical supply, be sure the two position power switch is in the OFF position.

Your 120V Type 1500 furnace may be wired either directly through a conduit system or by using a power cord and plug which conforms to the National Electrical Codes and electrical code requirements of your area. The terminal block to be used in wiring is located on the lower rear of the furnace. For 120V supply connections, use 14 AWG or larger wires suitable for at least 105°C (221°F).

Operation, All Models



Warning

To avoid personal injury do not use in the presence of flammable or combustible chemicals; fire or explosion may result. This device contains components which may ignite such materials.



Hot Surface

Caution: Avoid Contact. To avoid burns, this furnace must not be touched on the exterior or interior surfaces during use or for a period of time after use.



Warning

Always wear safety glasses or a safety shield and high temperature gloves when loading or unloading the furnace. Long sleeved, fire retardant clothing and a fire retardant apron is also recommended.



Warning

To avoid electric shock, the door safety switch must be operating properly.

Power Switch

Both the ON/OFF power switch and the digital display will illuminate when power is switched ON. The furnace will begin to heat to the controller's current setpoint. (See the instructions for your type of controller for information on checking and setting the setpoint).

Cycle Light

The amber cycle light will illuminate whenever the power is being applied to the heating elements. The cycle light will flicker on/off as furnace reaches setpoint.

Door Safety Switches

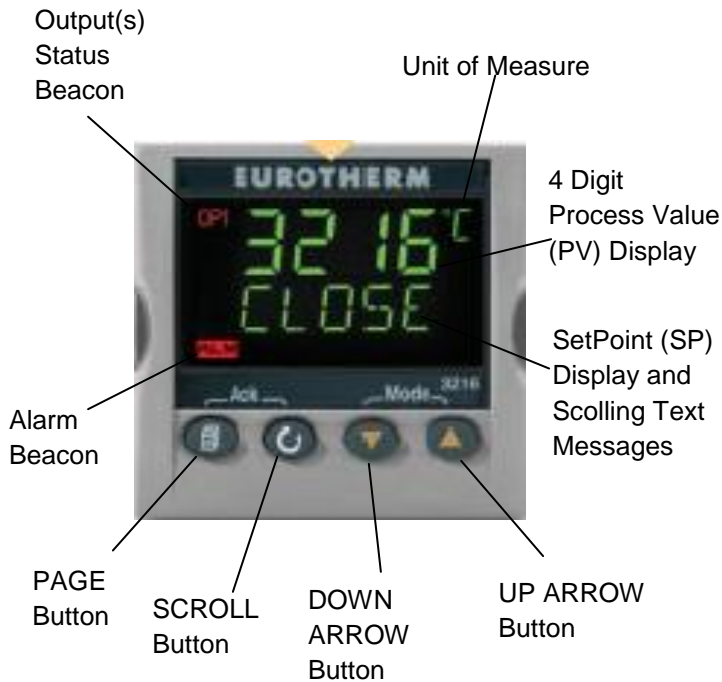
The door safety switches remove power from the heating elements when the door is opened. Open and close the door a few times; note that the amber CYCLE light will be out when door is open. This check must be done when furnace is heating or when cycle light is illuminated. If this condition is not true, consult the Troubleshooting section before proceeding.

Digital Readout

The digital readout continuously displays chamber temperature.

Single Setpoint w/OTP

Models FD1530M, FD1530MCN,
FD1530M-33, FD1535M



Single Setpoint Models



Note:

If at any time you want to return to the HOME DISPLAY, press PAGE button.

Eurotherm 3216 Controller Operation

The single setpoint model w/OTP furnace controller is a single setpoint controller, which provides a single digital display to indicate the current chamber temperature or setpoint temperature. This temperature controller features sensor break protection, self-tuning capability and over temperature protection (OTP) with an additional OTP relay device.

Basic Operation

When the controller is turned ON it will perform a short self-test and then display a default page. The measured value (process value) is found in the upper display and the setpoint is found in the lower display.

Buttons and Indicators

OP1 (Output 1): Illuminates when the output is ON (normally heating).

OP2 (Output 2): Illuminates when the output is ON (normally cooling).

OP4 (Output 4): Illuminates when the AA relay output is ON (will go on during an alarm situation).

PAGE button: Allows you to select a new list of parameters.

SCROLL button: Allows you to select a parameter within a list of parameters.

DOWN button: Allows you to decrease a value.

UP button: Allows you to increase a value.

To Change the Setpoint

If you want to change the setpoint, press the SCROLL button until "SP1" is displayed. Press the UP or DOWN button until the desired setpoint value is displayed and then release the button. A few seconds after the button is released, the controller will accept the new value and is indicated by a brief flash of the display. Press PAGE button to return to HOME DISPLAY.

To View the Display Units

Press SCROLL until "UNITS" is displayed. The temperature units are also shown on the HOME DISPLAY to the right of the measured value (process value).

Temperature units can be changed by pressing up and down buttons. Choice of Celsius (°C), Fahrenheit (°F), Kelvin (°K), Percentage (%), or None (nonE).

Controller Parameters

Home display

°C, °F, °K, %, or None: Temperature units in Celsius (default), Fahrenheit, Kelvin, Percentage (PERc), or None (nonE).

A1.DHI: Deviation high alarm.

A2.HI: High Limit alarm. Read Only.

A3.LO: Low Limit alarm. Read Only.

A.TUNE (tune): One-shot autotune enable.

WRK.OP: Working Output power. Read Only.

PV.OFS: Process Value Offset. Read Only.

SP.RAT: Ramp Rate Setpoint (default units is minutes).

DWELL: Time for dwell or delay (default units is minutes).

T.STAT: Timer Status. Active only when timer is active.

TM.CFG: Timer configuration.

Pid List

PB: Proportional band (in display units).

TI: Integral time in seconds.

TD: Derivative time in seconds.

ACCESS List Code: Access code (Code needed to enter or change the other configuration parameters which are not normally accessible). Not accessible.

Alarms

The controller will flash an alarm message in the home display if an alarm condition is detected.

A2.HI: Measured value full scale high alarm.

A1.DHI: Measured value deviation high alarm.

S.br: Sensor break: check that sensor is connected correctly.

LBR: Loop break: check that the heating circuits are working properly.

Ld.F: Heater Circuit fault: indication of either an open or short solid state relay, a blown fuse, missing supply or open circuit heater.

Sensor Break Protection

This controller provides sensor break protection in the event the thermocouple opens. If an open thermocouple condition occurs, the digital display will blink "S.br" and the power to the heating element will be shut OFF (Cycle light will extinguish).

Over-Temperature Protection (OTP)

The OTP will be in effect during any alarm condition when the temperature of the furnace has deviated beyond the limit. The "Deviation High" alarm is the only alarm value, which can be changed. To change it, press the SCROLL button until "A1.DHi" appears on the display. Press the UP or DOWN button to select the OTP value you desire. We recommend a value of

20° above your working temperature to provide protection for your workload. In addition to over temperature protection, units containing a single setpoint controller w/OTP feature a mechanical OTP relay device, which disconnects power from the elements in an alarm condition.

Tuning

This controller incorporates a self-tuning feature, which determines the optimum control parameters for the best temperature accuracy with your load and setpoint. Use this feature the first time you use your furnace and each time you change either your setpoint or the type of load you are heating. Thermo Fisher Scientific recommends you use this feature to provide the best temperature accuracy the controller can attain. To use the tuning feature:



Note:

Furnace must be at ambient temperature before starting a tune. “Stat” and “Sp.r” must be set to OFF or “tunE” will not initiate.

1. Start tuning with the process at ambient temperature. This allows the tuner to calculate the low cutback and high cutback values more accurately.
2. Adjust the setpoint to your desired value.
3. Press the SCROLL button until display reads, “A.TUNE.”
4. Press the UP or DOWN button to select, “on.”
5. Press the PAGE button to return to the HOME DISPLAY. The display will alternately flash between “tunE” and the HOME DISPLAY while tuning is in progress.
6. The controller will then turn the heating on and off to induce an oscillation. When the measured value reaches the required setpoint the first cycle will end.
7. Tuning will be complete after two oscillation cycles and then the tuner will turn itself off.
8. Normal control function will resume after the controller calculates tuning parameters.



Note:

Tune has completed when “tunE” stops flashing on display.

Single Setpoint with OTP

Single Ramp & Dwell



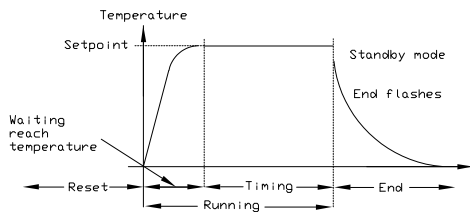
Note

These instructions are used with the Single Setpoint models with OTP only
(See models listed on front page).

Functions

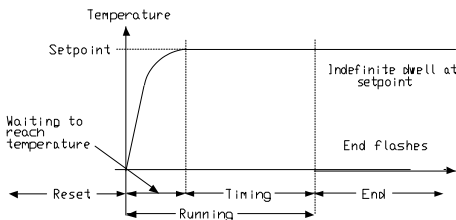
This type of controller has single ramp and dwell programming capabilities. The Ramp and Dwell can be configured to five different modes.

to



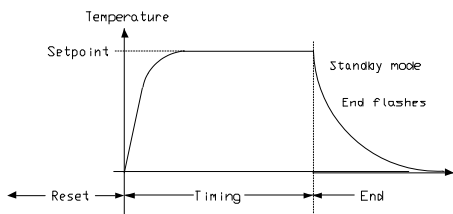
Mode 1 (Opt. 1)

1. Mode 1 (DWELL) The dwell time begins once the setpoint reaches the set threshold. The END TYPE action is executed when the dwell timer reaches the end.



Mode 2 (Opt. 2)

2. Mode 2 (DELY) The timer starts immediately upon instrument power-up, or when run is selected. The instrument remains in standby until the time has elapsed. After the time has elapsed, the instrument controls up to setpoint.



Mode 3 (Opt. 3)

3. Mode 3 (SF.ST) Starts automatically on power up. This is a soft-start function. If the PV is below the Soft Start Threshold, then the power is limited to the Soft Start Limit until the threshold is met.

Program Overview



Note:

The program must be stopped and the controller must be displaying the actual temperature before beginning the Setup.

- A program mode can be set by changing the “**TM.CFG**” variable (in the ‘Timer’ menu) to “DWEL, DELY, or SF.ST.”
Note: value of “None” deactivates the timer.
- A Ramp rate may be set by changing the “**SP.RAT**” variable (in the ‘SP’ menu) to a value. The Ramp rate units are set with the “**RAMPU**” variable (in the ‘SP’ menu). The selections are Hour / Min / Sec.
- The Dwell time can be set by changing the “**DWELL**” variable (in the ‘Timer’ menu) to the desired value. Dwell time units are set with the “**TM.RES**” variable (in the ‘Timer’ menu). The selections are Hour / Min.
- The program Status can be set by changing the “**T.STAT**” variable to “**run**”, “**hold**”, or “**res.**” This variable will start, hold, or stop the program.

SetPoint Rate Limit Setup

1. Press the **SCROLL** button until the “**SP.RAT**” (Ramp Rate) is displayed.
2. Set the desired Ramp rate with the UP or DOWN buttons, if the ramp to setpoint feature is needed. **If the Ramp rate is not needed, then set to “OFF”** with the feature is needed. **If the Ramp rate is not needed, then set to “OFF”** with the UP or DOWN buttons.
3. Press the **SCROLL** button until “**TM.CFG**” (Ramp & Dwell mode) will be displayed, select the desired mode with the UP or DOWN buttons. (DWEL, DELY, or SF.ST).
4. Press the **SCROLL** button until “**DWELL**” will be displayed set the desired Dwell time with the UP or DOWN buttons.
5. Press the **PAGE** button and **SCROLL** button together until the Actual temperature is displayed.

Running the Program

1. Press the **SCROLL** button until “**T.STAT**” is displayed, set to “**run**” with the UP or DOWN buttons; or from the HOME DISPLAY, press **UP and DOWN** arrows together.
2. Press the **PAGE** button to display Actual temperature.

Holding the Program

1. Press the **SCROLL** button until **"T.STAT"** is displayed. Set to **"hold"** with the UP or DOWN buttons; or from the HOME DISPLAY, press **UP and DOWN** arrows together.
2. Press the **PAGE** button to display Actual temperature.

Stopping the Program

Press the **SCROLL** button until **"T.STAT"** is displayed, Set to **"res"** with the UP or DOWN buttons.

Clearing the Flashing End

Press the PAGE and SCROLL buttons at the same time.

Verifying a Running Program

Press the SCROLL button until **"T.STAT"** is displayed. The display will show **"run"** if the program is running, **"hold"** if it is paused or **"res"** if it is not running. Press the PAGE button to display actual temperature.

8 Segment Programmable w/OTP

Models FD1540M, FD1540MCN, FD1540M-33, FD1545M



Note

The controller will return to the HOME DISPLAY if left idle for more than a few seconds.



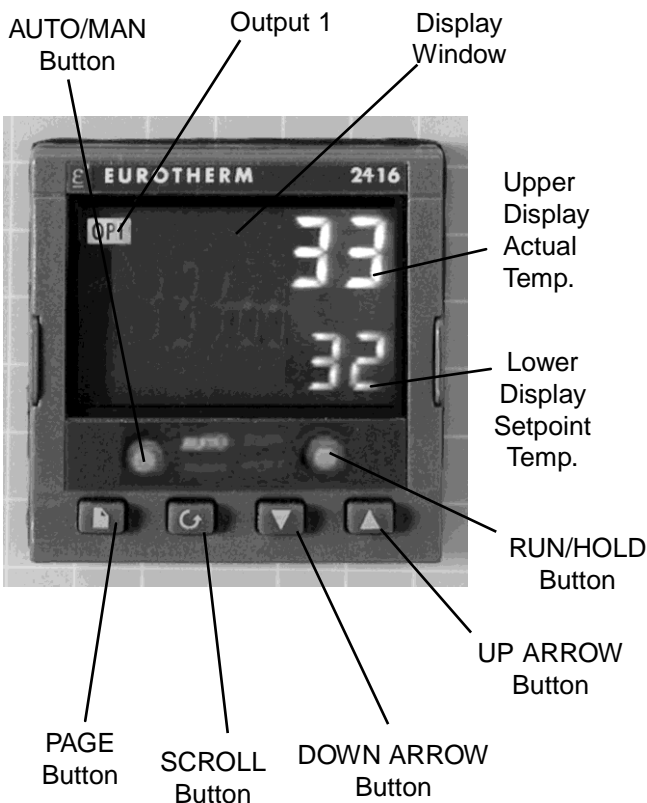
Note

Once the desired parameter has been selected, depressing either the UP or DOWN button will change the parameter value. In all cases, the value shown on the display is the current working value of that parameter.

The **8 segment programmable** controller consists of a microprocessor based three-mode PID (Proportional, Integral, and Derivative), programmable temperature controller with over-temperature protection and appropriate output switching devices to control the furnace. The digital readout continuously displays chamber (upper display) and setpoint (lower display) temperatures unless the SCROLL or PAGE button is depressed. The programmable controller can be used as a single setpoint controller or as a programmable controller. The 8 segment digital model enables eight segments of programming.

Basic Operation

When the controller is turned ON, it will perform a short self-test and then change to the HOME DISPLAY. The HOME DISPLAY shows the measured temperature (process value) in the upper display and the desired value (setpoint) in the lower display.



To Change the Setpoint

If you want to change the setpoint, press the UP or DOWN button until the desired setpoint value is displayed in the lower display and then release the button.

To View Display Units

From the HOME DISPLAY press the SCROLL button. The display will briefly show the temperature units in °C/F/K and then return to the HOME DISPLAY. (If you require a different temperature unit call Customer Service)

To View the % Output Power

From the HOME DISPLAY press the SCROLL button twice. Press the UP or DOWN button to display the value. This value is a read-only value and cannot be changed.

Buttons and Indicators

OP1 (Output 1): illuminates when the heating output of the temperature controller is on.

AUTO/MAN: (Auto/Manual Mode): when the controller is in the automatic mode the output automatically adjusts to keep the temperature or process value at the setpoint. The “AUTO” light will illuminate. The manual mode has been disabled through factory configuration. Call Customer Service for further information.

RUN/HOLD (Run/Hold button):

- Starts a program when pressed once—RUN light illuminates.
- Holds a program when pressed again—HOLD light illuminates.
- Cancels hold and continues running when pressed again—HOLD light is off and RUN light illuminates.
- Exits a program when the button is held down for two seconds—RUN and HOLD lights are off.
- At the end of a program the RUN light will flash.
- During holdback the HOLD light will flash.

PAGE button: allows you to choose a parameter from a list of parameters.

SCROLL button: allows you to choose a parameter within a list of parameters.

UP button: allows you to increase the value in the lower display.

DOWN button: allows you to decrease the value in the lower display.

Controller Parameters

Home Display

°C: measured temperature in Celsius. Temperature units cannot be changed without entering the configuration. Contact Customer Service if a different temperature unit is required.

OP: % output power demand; displayed in lower display (cannot be changed).

C.id: Controller identification number.

IdHi: Deviation High Alarm.

tunE: One-shot autotune enable.

run LiSt (Program Run List)

StAt: Displays the program status [OFF, run (running active program), hoLd (program on hold), HbAc (waiting for process to catch up), End (program completed)] in the lower display. The controller will default to "OFF."

FASt: Fast run through program (no/YES). The controller will default to "no."

SEG.d: Flash active segment type in the lower display of the home display (no/YES). The controller will default to "no."

ProG LiSt (Program Edit List)

Hb: Press the UP or DOWN ARROW to select the holdback type [OFF (disables holdback), Lo (deviation low holdback), Hi (deviation high holdback) or bAnd (deviation band holdback)] for the entire program. The controller will default to "OFF."

Hb.U: Press the UP or DOWN ARROW to select the holdback value (in display units).

rmP.U: Press the UP or DOWN ARROW to toggle between ramp units (SEc, min or Hour). Controller will default to "SEc."

dwL.U: Press the UP or DOWN ARROW to toggle between dwell units (SEc, min or Hour). Controller will default to "SEc."

Cyc.n: Press the UP or DOWN ARROW to set the number of program cycles (1 to 999 or cont). The controller will default to “cont.”

SEG.n: Press the UP or DOWN ARROW to select the segment number (1-8 in 8 segment models).

tYPE: Press the UP or DOWN ARROW to select the segment type [End (end of program), rmP.r = ramp rate (ramp to a specified setpoint at a set rate), rmp.t = ramp time (ramp to a specified temperature in a set time), dwEll (to maintain a constant temperature for a set time), StEP (climb instantaneously from current to specified temperature). The controller will default to “End.” Other parameters used with tYPE include; tGt target setpoint), Rate (rate of temperature increase) and dur (time to target setpoint or time to dwell)].

End.t: End segment type: dwELL (dwell continuous), rSEt (reset) and S OP (End Segment Output power level).

AL LiSt (Alarm List)

ldHi: Deviation High Alarm.

Atun LiSt: (Autotune List)

tunE: One-shot autotune enable.

drA: Adaptive tune enable.

drA.t: Adaptive tune trigger level in display units. Range = 1—9999.

Pid LiSt

G.SP (Gain Setpoint): Is the temperature at which the controller switches from the (SEt 1) PID values to the (SEt 2) PID values.

Pb: Proportional band in display units. (SEt 1)

ti: Integral time in seconds. (SEt 1)

td: Derivative time in seconds. (SEt 1)

Pb2: Proportional band. (SEt 2)

ti2: Integral time in seconds. (SEt 2)

td2: Derivative time in seconds. (SEt 2)

ACCS LiSt (Access List)

Access Code (Code needed to enter or change the other configuration parameters which are not normally accessible.) Call customer service if this configuration is required.

Alarms

The controller will flash an alarm message in the home display if an alarm condition is detected.

IdHi: PV deviation high alarm.

2FSH: PV full scale high alarm.

3FSL: PV full scale low alarm.

LCr: Load current low alarm.

HCr: Load current high alarm.

S.br: Sensor break: check that sensor is connected correctly.

L.br: Loop Break: Check that the heating circuits are working properly.

Ld.F: Heater Circuit Fault: indication of either an open or short solid state relay, a blown fuse, missing supply or open circuit heater.

SSr.F: Solid state relay failure indications in a solid state relay: indicates either an open or short circuit in the SSR.

Htr.F: Heater failure: Indication that there is a fault in the heating circuit: indicates a blown fuse, missing supply or open circuit heater.

Sensor Break Protection

This controller provides sensor break protection in the event the thermocouple opens. If an open thermocouple condition occurs, the digital display will Blink "S.br" and the power to the heating element will be shut OFF (Cycle light will extinguish).



Note

The following alarm messages are factory default settings and may vary if you have changed the configuration of your controller:

IDHi = 50°C
2FSH = 1025°C

Over-Temperature Protection (OTP)

The OTP will be in effect during any alarm condition when the temperature of the furnace has deviated beyond the limit. The “Deviation High” alarm is the only alarm value which can be changed. To change it, press the SCROLL button until “idHi” appears on the display. Press the UP or DOWN button to select the OTP value you desire. We recommend a value of 20° above your working temperature to provide protection for your workload.

To Operate the Controller as a Single Setpoint Controller

1. Switch the circuit breaker to the “ON” position. The setpoint temperature presently set in the controller will appear in the lower display. (The upper display indicates the actual chamber temperature.)
2. To change the setpoint, press the UP or DOWN button until the desired setpoint value is displayed; then release the button.
3. The furnace will begin to heat if the new setpoint temperature is higher than the present chamber temperature.

Programming the Controller

The controller is capable of varying temperature or process value with time through programming. A program is stored as a series of segments and can be run once, repeated a set number of times or run continuously. To create a customized program using the controller parameters listed under “Controller Parameters” at the beginning of this section, follow the procedures outlined in the preceding sections of this manual.

Hb: Holdback

Holdback consists of a value and a type. If the measured value lags behind the setpoint by an undesirable amount during a ramp or dwell, the holdback feature can be used to freeze the program at its current state (the HOLD light will flash). The program will resume when the error comes within the holdback value.

OFF: holdback is disabled.

Lo (Deviation Low Holdback): holds the program back when process variable deviates below the setpoint by more than the holdback value.

Hi (Deviation High Holdback): holds the program back when process variable deviates above the setpoint by more than the holdback value.

bAnd (Deviation Band Holdback): combines the features of the high and low deviation holdback in that it holds the program back when the process variable deviates above or below the setpoint by more than the hold- back value.

To set the holdback type:

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, "Hb."
3. Press the UP or DOWN button to toggle between "bAnd, Hi, Lo and OFF."

Hb U: Holdback Value

To set the holdback value:

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, "Hb.U."
3. Press the UP or DOWN button to enter a hold-back value.

rmP.U: Setting Ramp Units

Ramp units are time units which are used in “rmP.r” segments (ramp to a setpoint at degrees per second, minute or hour) and “rmP:t” segments (ramp to setpoint in a specific amount of time). See “Setting the Segment Type” for an explanation on how to set a ramp segment.

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, “rmP.U.”
3. Press the UP or DOWN button to toggle between seconds, minutes and hours.

dwL.U: Setting Dwell Units

Dwell units are time units which are used in “dwELL” segments (amount of time to remain at a specific temperature). See “Setting the Segment Type” for an explanation on how to set a dwell segment.

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, “dwL.U.”
3. Press the UP or DOWN button to toggle between seconds, minutes and hours.

CYC.n: Setting the Number of Cycles

Set the number of times a group of segments or programs are to be repeated by following the steps listed below.

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, “CYC.n.”
3. Press the UP or DOWN button to select the number of cycles you want to run or, press the DOWN button to select “cont.” so the program will run continuously.

Setting the Segment Type

There are five segment types. Proceed with the following steps according to the type of segment you have selected.

rmP.r (Ramp)

To ramp linearly at a set rate to a specified temperature:

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, "tYPE."
3. Press the UP or DOWN button until display reads, "rmP.r."

Steps 4 and 5 are used in the 4 program model only. If you are using an 8 segment program, skip to step 6.

4. Press the SCROLL button until display reads "Hb."
5. Press the UP or DOWN button to toggle between "bAnd, Hi, Lo and OFF."
6. Press the SCROLL button until display reads, "tGt."
7. Press the UP or DOWN button to set a target setpoint.
8. Press the SCROLL button until display reads, "rAtE."
9. Press the UP or DOWN button to select a value in ramp units (seconds, minutes or hours; set in the "rmP.U" parameter).



Note

The program ramp rate is designed to reduce the heatup rate or cooling rate that the furnace normally exhibits. When not using this feature, the furnace will operate at its maximum heating and cooling capability.



Note

When the program ramp has ended or has been reset, the furnace will continue to maintain setpoint temperature. It will not cool to ambient temperature unless the setpoint is set to ambient temperature by the program or by the operator.

rmP.t

To ramp to a specified temperature at a set time:

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, "tYPE."

3. Press the UP or DOWN button until display reads, "rmP.t."
4. Press the SCROLL button until display reads, "tGt."
5. Press the UP or DOWN button to set a target setpoint.
6. Press the SCROLL button until display reads, "dur."
7. Press the UP or DOWN button to select a time in ramp units (seconds, minutes or hours; set in the "rmP.U" parameter).

dwEIl

To maintain a constant temperature for a specified time:

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, "tYPE."
3. Press the UP or DOWN button until display reads, "dwEIl."
4. Press the SCROLL button until display reads, "dur."
5. Press the UP or DOWN button to select a time in dwell units (seconds, minutes or hours; set in the "dwL.U" parameter).

StEP

To climb instantaneously from the current temperature to a specified temperature.

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, "tYPE."
3. Press the UP or DOWN button until the display reads, "StEP."
4. Press the SCROLL button until display reads, "tGt."

5. Press the UP or DOWN button to set a target setpoint.

End

To end or repeat a program:

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, "tYPE."
3. Press the UP or DOWN button until display reads, "End."
4. Press the SCROLL button until display reads, "End.t."
5. Press the UP or DOWN button to toggle between "dWEll" (an indefinite dwell at last target level), "S OP" (End Segment Output Power) and "rSET" (reset will revert back to setpoint in Single Setpoint mode).

Running a Program (8 Segment Programmable Models)

To run a program, press the RUN/HOLD button. (The RUN light will illuminate).

Holding a Program

To put a running program on hold, press the RUN/HOLD button. (The HOLD light will illuminate).

Cancelling a Program

To cancel a program, hold the RUN/HOLD button down until the RUN and HOLD lights go off.

Tuning

The purpose of tuning your furnace is to match the characteristics of your controller to the characteristics of the

process being controlled. Good control is evidenced by: stable, straight-line control of the setpoint temperature with no fluctuations; No overshoot or undershoot of the setpoint temperature; rapid restoration of the setpoint temperature when external disturbances cause deviations from the setpoint.

This controller has automatic tuning features which install optimum tuning parameters to give the best temperature accuracy. No manual loading of tuning parameters is needed. We recommend that you tune the furnace to your specific application to obtain the best results. To provide the best temperature accuracy possible, use these features when you install your furnace and whenever you change your application or procedure.



Note

Display will flash “tu.ER” if an error occurs during tuning. To clear the error and restart tuning, simultaneously press the PAGE and SCROLL buttons and follow the steps outlined in “Autotuning.”



Note

To stop the tuning function, simultaneously press the PAGE and SCROLL buttons.

Tuning Error

The display will flash “tu.ER” if an error occurs during tuning. To clear the error and restart tuning, simultaneously press the PAGE and SCROLL buttons and follow the steps outlined in “Autotuning.”

G.SP: Gain Scheduling

Gain scheduling is the automatic transfer of control between two sets of PID values. The controller does this at a presettable process value. Gain scheduling is used for difficult control processes which show large changes in their response time or sensitivity at high or low temperatures, or when heating or cooling.

The G.SP gain schedule setpoint is factory set at 700° C. The G.SP must be adjusted to 200°C from the desired setpoint temperature when tuning.

Setting the Transfer Point

If gain scheduling has been enabled, “G.SP will appear at the top of the PID list. This sets the value at which the transfer will occur. When the process value is below this level, PID1 will be active and when it is above, Pid2 will be active. Set a value between the control regions that show the greatest change to achieve the best point of transfer.

Tuning

The two sets of PID values can be manually set or automatically tuned. To tune automatically you must tune above and below the transfer point G.SP. If the process value is below the transfer point G.SP, the calculated values will automatically be inserted into the (SEt 1) set and if the process value is above G.SP, the calculated values will automatically be inserted into the (SEt 2).

Autotuning

The Autotune feature automatically sets up the PID values in the control parameters to suit new process conditions.

To tune your furnace using autotuning:

1. Load your furnace with a load similar to your normal load and close the door.
2. Set the setpoint temperature.
3. Press the PAGE button until the display reads, "Atun LiSt."
4. Press the SCROLL button until "tunE OFF" is displayed.
5. Press the UP or DOWN button to select "on."
6. Simultaneously press the PAGE and SCROLL buttons to return to the HOME DISPLAY. The display will flash "tunE" while tuning is in progress.



Note

Start tuning with the process at ambient temperature. This allows the tuner to calculate the low cutback and high cutback values more accurately.

Adaptive Tuning

Adaptive tuning continuously evaluates tuning parameters. Adaptive tuning automatically installs new values if better accuracy is possible. Adaptive tuning should be used when the characteristics of a process change due to load or setpoint changes or, in a process that cannot handle the oscillation caused by a one-shot tune.

To tune your furnace using adaptive tuning:

1. Load your furnace with a load characteristic of those you intend to heat in it.

2. Press the PAGE button until display reads, "Atun LiSt."
3. Press the SCROLL button until "drA OFF" is displayed.
4. Press the UP or DOWN button to select "on."
5. Press the SCROLL button until "drA.t" is displayed.
6. Press the UP or DOWN button until the desired trigger value is achieved.



Caution

Do not overload your furnace chamber. If the load is to be heated uniformly it should not occupy more than the center two-thirds of the furnace chamber. Failure to observe this caution could result in damage to furnace components.

Furnace Loading

1. For best results, use only the center 2/3 of the furnace chamber.
2. If you are heating a number of small parts, spread them throughout the center two-thirds of the furnace chamber.
3. Keep objects away from thermocouple.
4. Use insulated tongs and mittens when loading and unloading furnace.
5. Always wear safety glasses.
6. Use the hearth plates supplied to protect bottom of chamber. Part # PHX2.

Preventive Maintenance

**Warning**

Before using any cleaning or decontamination method except those recommended by Thermo Scientific, users should check with Thermo Scientific that the proposed method will not damage the equipment.

**Warning**

Disconnect the furnace from power supply before cleaning.

**Warning**

Opening the door for an extended period of time will cause the painted surfaces above the door to be discolored or burnt.

Contamination is a major cause of element failure, therefore, when possible, remove the fume forming material before heating (e.g., cleaning cutting oil from tool steel).

The resistance wire is high-grade nickel-chromium. Some chemicals, notably sulphur, halogens, and cyanides, attack this wire at high temperatures, so avoid spilling these chemicals in the furnace or heating them any hotter than necessary. The refractory cement helps to protect the wire, but will not completely immunize it from damage.

All heating elements must be considered expendable, and replacement is expected; however, reasonable care in their use will greatly extend the service they will give. As the manufacturer has no control over the use or care of the elements, no specific service guarantee can be made.

Housekeeping is vital to your electric furnace—KEEP IT CLEAN! Run your furnace up to 871°C (1600°F) empty occasionally to burn off the contamination that may exist on the insulation and elements. Run for approximately two hours with the door slightly open. See warning.

Element life is reduced somewhat by repeated heating and cooling. If the furnace is to be used again within a few hours, it is best to keep it at the operating temperature or at a reduced level such as 260°C (500°F).

During normal use, the thermocouple in your furnace can become oxidized and cause inaccurate readings; therefore, we suggest that if you regularly use your furnace you should change your thermocouple once every six months to assure the accuracy of your controller readings.

Clean by wiping the outside case of the unit with a damp cloth and mild soap solution.

Troubleshooting

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Cycle light does not illuminate.	The furnace is not connected to power supply.	Reconnect furnace to power supply.
	Incorrect power source.	Connect to correct power source.
	ON and OFF power switch defective.	Replace power switch.
	Defective cycle light.	Replace cycle light.
	Door switch malfunction.	Realign or replace furnace door safety switch.
Furnace does not heat.	No power.	Check power source and fuses or breakers.
	Defective electrical hookup.	Repair electrical hookup.
	Thermocouple has oxidized and opened the circuit.	Replace thermocouple.
	Controller malfunction.	Replace controller.
	Heating elements burned out.	Replace defective elements.
	Solid state relay defective.	Replace solid state relay.
	Door switch malfunction.	Re-align or replace door switch.
	Defective OTP relay.	Replace relay.
Defective solid state relay.	Replace relay.	
Door switch does not cut power to heating elements.	Door switch not functioning	Realign or replace door safety switch.
Controller over-temp. does not cut power to furnace chamber.	Alarm output device malfunction.	Replace controller.
	OTP relay malfunction.	Replace relay.
	Element shorted to ground.	Replace faulty element.

TROUBLESHOOTING

Slow heatup.	Low line voltage.	Install line of sufficient size and proper voltage. (Isolate furnace from other electrical loads.)
	Wrong heating element.	Install proper element.
	Heating element burned out.	Replace element.
	Heavy load in chamber.	Lighten load in chamber to allow heat to circulate.
Repeated element burnout.	Overheating furnace.	Keep furnace under maximum temperature. Closer supervision of control setting.
	Heating harmful materials.	Enclose material in container. Clean up spills in and on chamber. Ventilate chamber by leaving top vent slightly open when heating known harmful reagents.
	Contamination present from previous burnout.	Replace insulation material.
Inaccurate temperature readout.	Oxidized or contaminated thermocouple.	Replace thermocouple.
	Poor thermocouple connection.	Tighten connections.
	Improper loading procedures.	Use proper loading procedures.
	Poor ventilation of control.	Clear area around furnace control.
	Thermocouple connections reversed.	Reconnect thermocouple correctly.

Maintenance and Servicing



Warning

To avoid electrical shock, this furnace must always be disconnected from the power supply prior to maintenance and service.

Perform only maintenance described in this manual. Contact an authorized dealer or our factory for parts and assistance.

Refer servicing to qualified personnel.

Maintenance and Servicing

To Replace a Heating Element

- 1) Disconnect furnace from power supply.
- 2) Remove back terminal cover.
- 3) Loosen the nuts on the terminals of the element to be replaced.
- 4) Straighten the leads of the old element.
- 5) Open the door and pull the defective element out. (It may be easiest to turn the furnace so that the element to be removed is on top.)
- 6) Slide the new element into place, threading the leads through the insulating porcelain bushing in the back of the furnace.
- 7) Reverse the disassembly procedure, making sure you thread all element lead wires through the insulating porcelain bushings on the back of the furnace and cut off any excess element lead wire after securing the leads to the terminal points.
- 8) Replace the back terminal cover.
- 9) Reconnect furnace to power supply.
- 10) Test the operation of the furnace.

To Replace The Platinel II Thermocouple:

- 1) Disconnect the furnace from power supply.
- 2) Remove the back terminal cover. (Note placement and connection of wires.)
- 3) Remove the screw and washer from clip holding the thermocouple in place and remove the nuts and washers on the thermocouple terminals.

**Note**

Pull the thermocouple straight out of the hole in the chamber to avoid damage to the insulation.

- 4) Remove the thermocouple.
- 5) Insert the new thermocouple straight through hole in the chamber until the tip extends approximately 1" into the chamber. Make sure the thermocouple lead wire with the colored bead is connected to the terminal marked positive.
- 6) Secure the thermocouple extension wires to the terminals (yellow to +).
- 7) Secure the thermocouple with clip, screw and washer.
- 8) Replace the back cover.
- 9) Reconnect furnace to power supply.
- 10) Test the operation of the furnace.

To Replace Door Switch (Micro-Switch)

- 1) Disconnect the furnace from power supply.
- 2) Remove the screws from the front dial and the three bottom screws and lock washers on the back cover of the control section.
- 3) Remove the back terminal cover.
- 4) Disconnect the two wires on terminals T1 and T2 going to the control section.
- 5) Slide the control section forward.
- 6) Remove two screws and nuts from the door switch and slide the switch from the wire rod.
- 7) Disconnect the wires from the door switch. Identify or mark the wires disconnected to insure proper placement and connection when re-installing.
- 8) Reconnect the wires identified or marked in step 7 to the new door switch.

**Note**

Do not pull excessively on the internal wires.

**Note**

Center the rod from front to back of hole in control case before tightening screws.

- 9) Install the new door switch while sliding it over the wire rod and secure with the screws and nuts removed in step 6.
- 10) Slide the control section back and replace the screws and lock washers described in step 2.
- 11) Connect wire marked T1 to terminal T1 and wire marked T2 to terminal T2 with nuts removed in step 4.
- 12) Replace the back terminal cover with screws and lock washers removed in step 3.
- 13) Test operation of door switch. (See next section "To Realign Door Switches" step 5.)
- 14) Reconnect to power supply.

To Realign Door Switches

- 1) Disconnect the furnace from power supply.
- 2) Loosen the setscrew on the cam. Open the door approximately 1" and rotate the cam counterclockwise until you hear a click then rotate the cam clockwise until you hear a click, tighten the set screw on adjusting cam.
- 3) Open and close the door; the switch should click when the door is opened approximately 2" and 1" to 2" before the door is closed.
- 4) Reconnect to power supply.
- 5) To test the operation of the door switch: turn the power switch on, set the control to a setting high enough to keep the control from cycling, open and close the door; the cycle light should turn OFF when the door is opened approximately 2" and turn back ON 1" to 2" before the door is closed.

To Replace the Controller

The controller plugs into a panel mounting sleeve, which should be left permanently installed in the furnace housing. To remove the controller, release the side clips and slide the controller out. Do not attempt to dismantle this unit further; replace it with a Thermolyne loaner or a new unit.

Replacement Parts

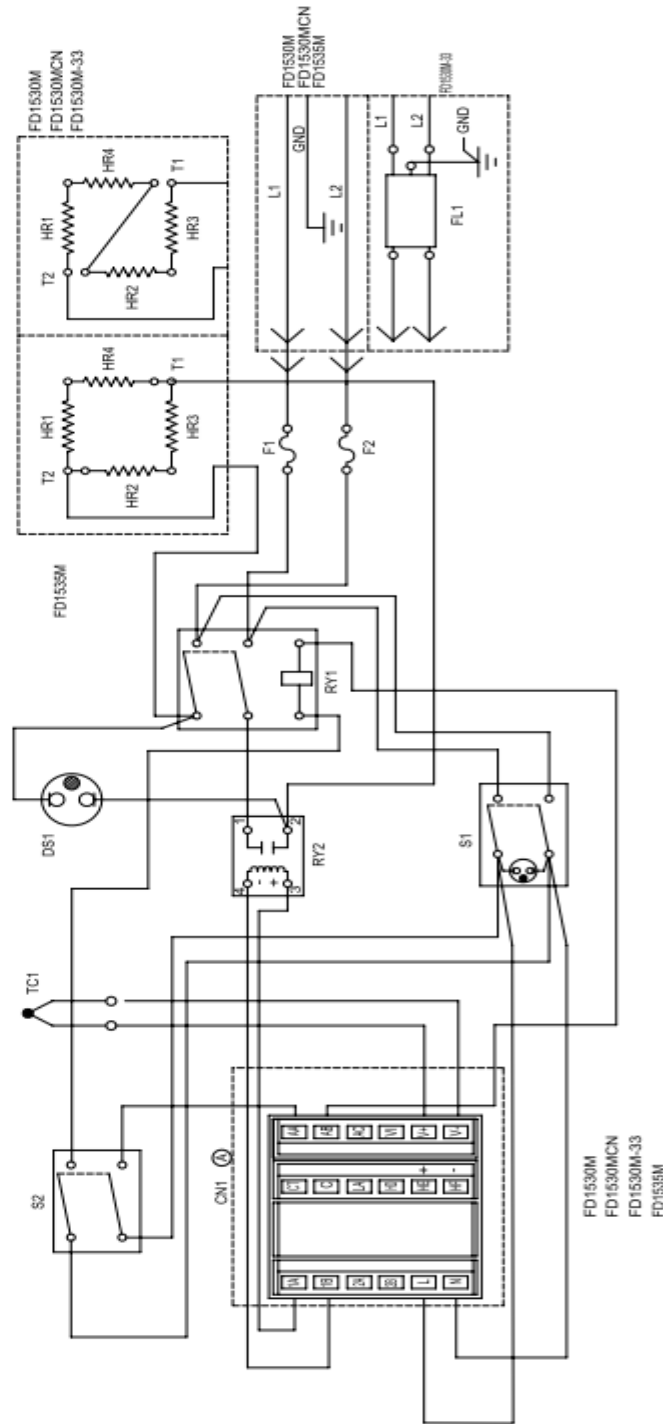
Part Number	Description	Model Number
EL11X11	Heating Element, Top or Bottom	FD1530M, FD1530MCN, FD1535M, FD1540M, FD1540MCN, FD1545M
EL11X12	Heating Element, Sides	FD1530M, FD1530MCN, FD1535M, FD1540M, FD1540MCN, FD1545M
EL1170X1	Heating Element, Top or Bottom	FD1530M-33, FD1540M-33
EL1170X2	Heating Element, Sides	FD1530M-33, FD1540M-33,
TC408X1A	Platinel II Thermocouple	All Models
RYX34	Solid State Relay	All Models
RYX56	Mechanical Relay (120V)	FD1535M, FD1545M
RYX57	Mechanical Relay (240 volt)	FD1530M, FD1530MCN, FD1530M-33, FD1540M, FD1540MCN, FD1540M-33
SWX78	Door Switch	All Models
CN71X178	Temperature Control, Single Set Point	FD1530M, FD1530MCN, FD1535M
CN71X159	Temperature Control, Programmable (2 ramp & 2 dwell)	FD1540M, FD1540MCN, FD1545M
CN71X179	Temperature Control, Single Set Point	FD1530M-33
CN71X160	Temperature Control, 8 Segment	FD1540M-33
CR1170X1	Cord Set	FD1530M, FD1540M
CR1170X2	Cord Set	FD1530M-33, FD1540M-33
CR1170X3	Cord Set	FD1530MCN, FD1540MCN
SWX137	Power Switch (100-120 volt)	FD1535M, FD1545M
SWX138	Power Switch (208-240 volt)	FD1530M, FD1530MCN, FD1530M-33, FD1540M, FD1540MCN, FD1540M-33
PLX76	Cycle Light (100-120 volt)	FD1535M, FD1545M
PLX82	Cycle Light (208-240 volt)	FD1530M, FD1530MCN, FD1530M-33, FD1540M, FD1540MCN, FD1540M-33
DR327X3A	Door Only (Insulated)	All Models
PHX2	Hearth Plate	All Models
DR327X4A	Door Assembly (includes handle and hinge.)	All Models
PT327X4A	Terminal Plate w/ Insulators	All Models
CAX94	Line Filter	-33 Models
TRX192	Terminal Block	All Models

Wiring Diagrams

Single Setpoint w/OTP Control

DIAGRAM COMPONENT LIST

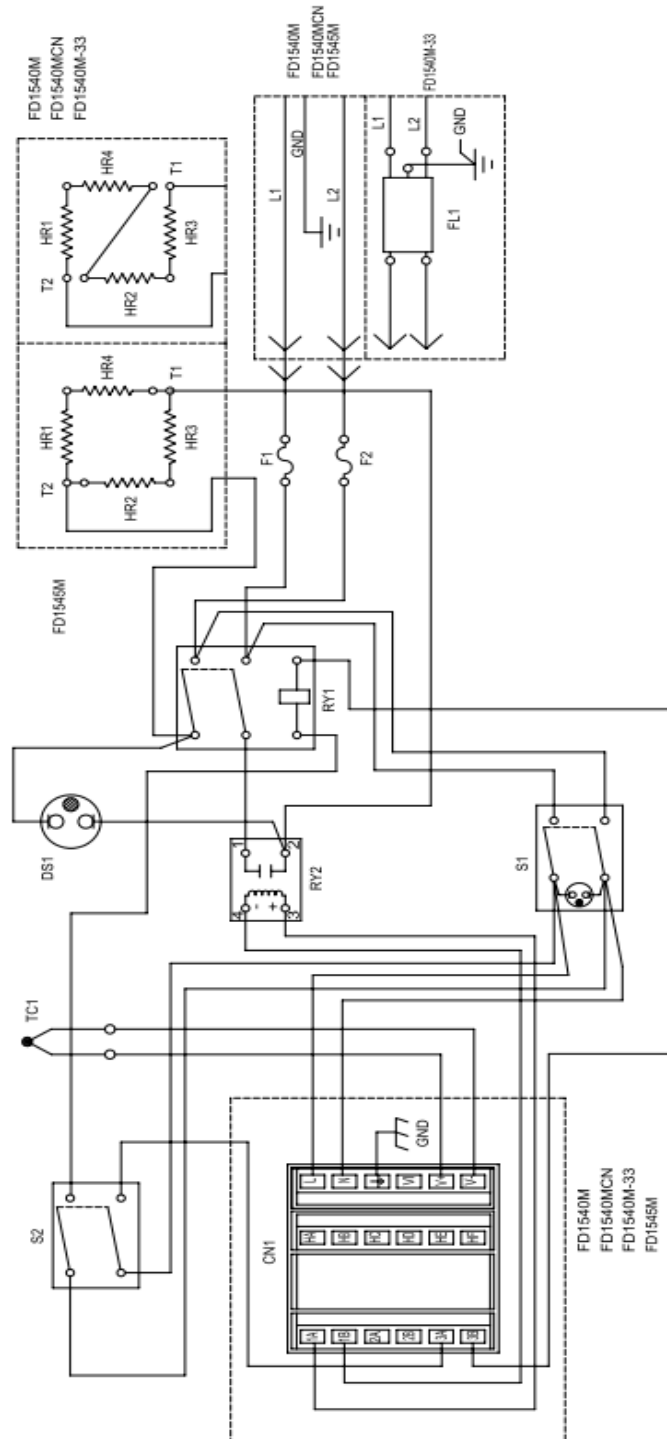
REF. NO.	DESCRIPTION	MODEL NO. AND OUR PART NO.(S)	
		FD1530M FD1530MCN	FD1530M-33 FD1530M-TS
CN1	CONTROLLER	CN71X178 PLX82	CN71X179 PLX76
DS1	CYCLE LIGHT	5120-0036	FZK63
F1	FUSE	5120-0036	FZK63
F2	FUSE	5120-0036	FZK63
FL1	LINE FILTER	CA304	
HR1	HEATING ELEMENT	EL1170X1	EL11X11
HR2	HEATING ELEMENT	EL1170X2	EL11X12
HR3	HEATING ELEMENT	EL1170X1	EL11X11
HR4	HEATING ELEMENT	EL1170X2	EL11X12
RY1	RELAY, DPST, N.O.	RYX57	RYX56
RY2	RELAY, SOLID STATE	RYX34	RYX34
S1	SWITCH, POWER	SWX143	SWX143
S2	SWITCH, DOOR	SWX78	SWX78
TC1	THERMOCOUPLE	TC408X1A	TC408X1A



WIRING DIAGRAMS

DIAGRAM COMPONENT LIST

REF. NO.	DESCRIPTION	MODEL NO. AND OUR PART NO.(S)	
		FD1540M FD1540MCN	FD1540M-33 FD1545M
CN1	CONTROLLER	CN71X159	CN71X159
DS1	CYCLE LIGHT	PLX82	PLX76
F1	FUSE	5120-0036	FZ663
F2	FUSE	5120-0036	FZ663
FL1	LINE FILTER	CAX94	
HR1	HEATING ELEMENT	EL11X11	EL11X11
HR2	HEATING ELEMENT	EL11X12	EL11X12
HR3	HEATING ELEMENT	EL11X11	EL11X11
HR4	HEATING ELEMENT	EL11X12	EL11X12
RY1	RELAY, DPST, N.O.	RYX57	RYX56
RY2	RELAY, SOLID STATE	RYX34	RYX34
S1	SWITCH, POWER	SWX143	SWX143
S2	SWITCH, DOOR	SWX78	SWX78
TC1	THERMOCOUPLE	TC408X1A	TC408X1A



Ordering Procedures

Please refer to the Specification Plate for complete model number, serial number, and series number when requesting service, replacement parts or in any correspondence concerning this unit.

All parts listed herein may be ordered from the Thermo Scientific dealer from whom you purchased this unit or can be obtained promptly from the factory. When service or replacement parts are needed, we ask that you check first with your dealer. If the dealer cannot handle your request, then contact our Customer Service Department at 800-438-4851.

Prior to returning any materials to Thermo **Scientific**, please contact our Customer Service Department for a "Return Materials Authorization" number (RMA).

Important

For your future reference and when contacting the factory, please have the following information readily available:

Model Number: _____

Serial Number: _____

Date Purchased: _____

The above information can be found on the dataplate attached to the equipment. If available, please provide the date purchased, the source of purchase (manufacturer or specific agent/rep organization), and purchase order number.

IF YOU NEED ASSISTANCE:

LABORATORY PARTS and SERVICE

Phone: 800/438-4851

FAX: 828/658-2576

TECHNICAL SUPPORT

Phone: 800/438-4851

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