



Muffle Furnace

OPERATION MANUAL AND PARTS LIST *Series 1262*

<u>Model</u>	<u>Voltage</u>	<u>Control</u>	<u>Display</u>
5300A40/F30420C-TS	240V	Single Setpoint	°C
5300A45/F30430CM-TS	240V	4x16 Segment Programmable Models with OTP	°C

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IMPORTANT INFORMATION

This manual contains important operating and safety information. You 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.

Your Thomas Scientific 5300A40/F30420C-TS or 5300A45/F30430CM-TS furnace has been designed with function, reliability and safety in mind. It is your responsibility to install it in conformance with local electrical codes. For safe operation, please pay attention to the alert signals throughout the manual.

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 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 material.
2. Caution: Hot Surface - Avoid Contact. To avoid burns, do not touch the exterior or interior surfaces of this furnace during use or for a period of time after use.
3. 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.
4. Refer servicing to qualified personnel.

Warning

Please note the following WARNINGS:

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 pre-existing 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 Thomas Scientific at 1-800-345-2100.

Introduction

Intended Use

The 5300A40/F30420C-TS and 5300A45/F30430CM-TS Automatic and Programmable furnaces are general laboratory and heat treating furnaces. For optimum element life, Thomas Scientific recommends these furnaces for applications requiring temperatures from 400°F (204°C) to 1800°F (982°C) for continuous use, or temperatures from 1800°F (982°C) to 2000°F (1093°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.

Furnaces consist of 1) a heating chamber; 2) an automatic proportioning digital set, digital read control with over temperature protection and 3) a door interlock relay for user safety.

The 5300A40/F30420C-TS Automatic furnace is designed as a single set point controller which reaches and maintains one temperature value.

The 5300A45/F30430CM-TS Programmable furnace is designed to control a programmed temperature profile. The profile is in the format of ramps and dwell segments. The first ramp, RAMP 1, starts at the initial measured furnace temperature. This ramp is positive going at a programmed rate until the programmed level is reached. The setpoint will stay at this level for a period determined by the setting of DWELL 1. Additional positive or negative going ramps are now initiated starting at the level at the end of DWELL 1. When the second ramp reaches the second programmed level, the setpoint stays at that level for the duration of the segment. Depending upon the model ordered, additional ramp and dwell segments may be added. See specific model number in proceeding chart for total number of program segments.



Note

When in the program RUN mode, the programmable controller serves to provide a programmed temperature profile as described earlier. When in the single setpoint automatic mode, the unit serves as an automatic temperature controller.

General Usage

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

Principles of Operation

Furnace: The furnace chamber is heated by four electric resistance heaters which are embedded in a refractory material. The chamber is insulated with a ceramic fiber insulation.

The temperature is controlled by an automatic proportioning controller using a platinum thermocouple to feed back information. The control is located under the furnace chamber and is well insulated from the heat generated in the furnace chamber. The temperature is controlled by one of three types of controllers.

MODEL NUMBER	DIGITAL COMM.	TOTAL NUMBER OF PROGRAMMABLE SEGMENTS	NUMBER OF STORED PROGRAMS
5300A40/F30420C-TS	NO	0	N/A
5300A45/F30430CM-TS	YES	64	16 Segment Programs

General Specifications

Models 5300A40/F30420C-TS and 5300A45/F30430CM-TS Furnaces

Dimensions in. (cm)	Overall	Width	21 1/2 (55)
		Height	29 1/2 (75)
		Depth	25 1/2 (65)
	Chamber	Width	14 (35)
		Height	14 (35)
		Depth	14 5/8 (37)
Weight	Lbs. (kg)	188 (86)	
Electrical	Volts	240	
Ratings	Amps	22.9	
	Watts	5500	
	Freq.	50/60	
	Phase	1	
Oper. Temp. Range	°F (°C)	Cont.	Intermittent
		400°-1800°F (204°-982°C)	1800°-2000°F (982°-1093°C)

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; ; 10% to 85% relative humidity.

Unpacking

1. Visually check for any physical damage to the shipping container.
2. Inspect the equipment surfaces that are adjacent to any damaged area.
3. Open the furnace door and remove the packing material from inside the furnace chamber.
4. Vacuum the chamber prior to use to remove the insulation dust due to shipment.
5. Retain the original packaging material if reshipment is foreseen or required.

Installation



Caution

Be sure ambient temperature does not exceed 104°F (40°C). Ambients above this level may result in damage to the controller.

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



Warning

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



Warning

Do not use in the presence of flammable or combustible materials; fire or explosion may result. This device contains components which may ignite such material.



Hot Surface

“Caution: Hot Surface. 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.

Site Selection

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

Electrical Connections

The electrical ratings are located on the specification plate on the back of the furnace. Consult Thomas Scientific if your electrical service is different than those listed on the specification plate. Be sure the front power switch is in the OFF position before connecting the furnace to your electrical supply.

NOTE: Please observe the alert signals on the left-hand side of this page before operating your furnace.

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 electrical 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 its controller's current setpoint. (See the instructions for your type of controller for information on checking and setting the setpoint.)

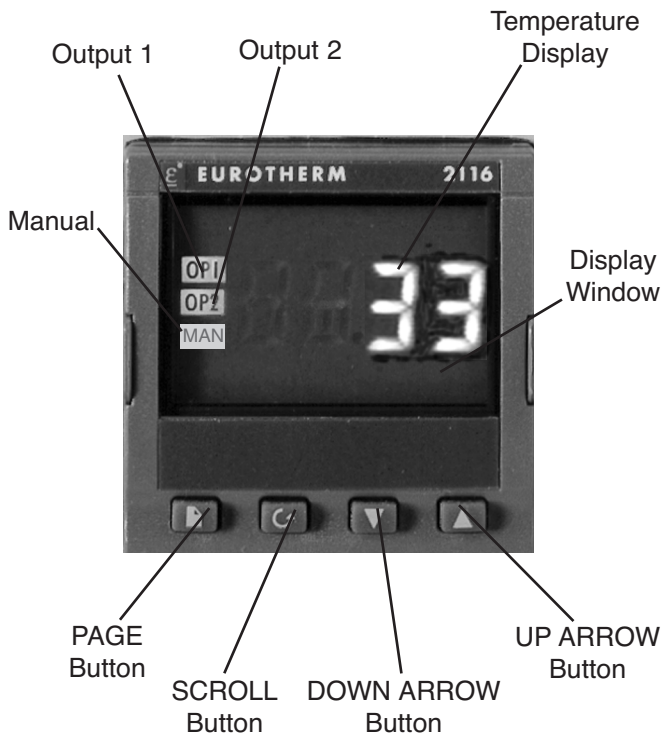
Cycle Light

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

Door Safety Switch

The door safety switch removes 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 switch off when the door is opened. If this condition is not true, consult the Troubleshooting section before proceeding. This check must be done when the furnace is heating and the cycle light is illuminated.

Single Setpoint Models w/OTP



Single Setpoint Models



Note

If at any time you want to return to the HOME DISPLAY, simultaneously press the PAGE and SCROLL buttons.

The **single setpoint model w/ OTP** furnace 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 the measured value (process value) in the HOME DISPLAY.

Buttons and Indicators

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

OP2 (Output 2): Illuminates when the relay output is ON (will go out 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 View or Change the Setpoint

To view the setpoint, press and release the UP or DOWN buttons. If you want to change the setpoint, continue pressing 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 revert to the HOME DISPLAY.

To View the Display Units

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

To View the % Output Power

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

Controller Parameters

Home display

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

OP: % output power demand.

IdHi: Deviation high alarm. Factory preset to 50.

AL List (Alarm List)

IdHi: Deviation high alarm. Factory preset to 50.

3FSL: Full scale low alarm. Factory preset to -88. Cannot be adjusted by end users.

Atun List (Autotune List)

tunE: One-shot autotune enable.

Pid List (Proportional, Integral, Derivative)

Pb: Proportional band (in display units). Factory preset to 9.00.

ti: Integral time in seconds. Factory preset to 14.49.

td: Derivative time in seconds. Factory preset to 2.28.



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 = 1118°C



Note

3FSL is not a true alarm. The value can be seen in the user list but cannot be changed.

ACCS 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.

2FSH: Measured value full scale high alarm. The full scale high alarm is for furnace protection. The parameter is not accessible from the user list.

IdHi: Measured value deviation high alarm. The deviation alarm is for load protection. Factory preset at 50°C. If the chamber temperature rises to 50°C above the setpoint temperature, this error condition will alert end users. The furnace will continue to heat as the **IdHi** is only a soft alarm. End users must power off the furnace and contact Customer Service for troubleshooting assistance. Do not reset this alarm below 20.

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

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.

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 “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.

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 (only in furnaces with OTP relay).

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.

Thomas Scientific recommends you use this feature to provide the best temperature accuracy the controller can attain.

To use the tuning feature:

1. Adjust the setpoint to your desired value.
2. Press the PAGE button until display reads, “Atun.”
3. Press the SCROLL button. Display will read, “tunE.”
4. Press the UP or DOWN button to select, “on.”
5. Simultaneously press the PAGE and SCROLL buttons 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.



Note

Furnace must be at ambient temperature before starting a tune.



Note

“Stat” and “Sp.rr” in Sp list must be set to OFF or “tunE” will not initiate.

SINGLE SETPOINT MODELS w/OTP

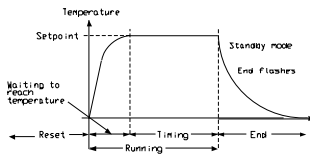


Note

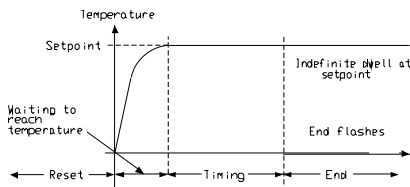
Tune has completed when “tunE” stops flashing on display.

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.

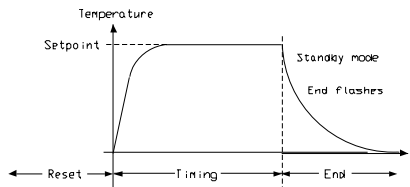
Single Ramp & Dwell



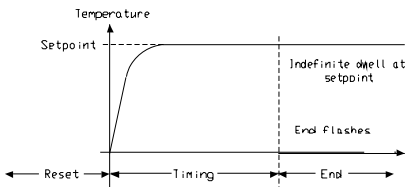
Mode 1 (Opt. 1)



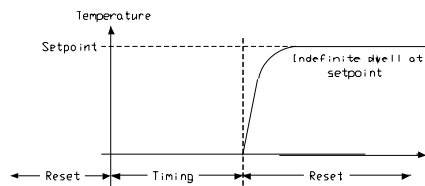
Mode 2 (Opt. 2)



Mode 3 (Opt. 3)



Mode 4 (Opt. 4)



Mode 5 (Opt. 5)

Functions

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

1. Mode 1 (Opt. 1) is a Ramp (if needed) to the Setpoint temperature, a Dwell, and then a cool down.
2. Mode 2 (Opt. 2) is the same as mode 1, except the controller continues to heat at the Setpoint after the Dwell has completed. (This mode does not cool down.)
3. Mode 3 (Opt. 3) is the same as mode 1, except the Dwell time includes the Ramp (if needed).
4. Mode 4 (Opt. 4) is the same as mode 2, except the Dwell time includes the Ramp (if needed).
5. Mode 5 (Opt. 5) is a Dwell (delay time) before the controller Ramps (if needed) to the Setpoint temperature.

Program Overview

- A program mode can be set by changing the "tm.OP" variable to "Opt. 1, Opt. 2, Opt. 3, Opt. 4, or Opt. 5.
- A Ramp rate may be set by changing the "SPrr" variable to a value. The Ramp rate units are in degrees per minute.
- The Dwell time can be set by changing the "dwEll" variable to the desired value. Dwell time units are in minutes.
- The program Status can be set by changing the "StAt" variable to "run" or "oFF." This variable will start or stop the program.



Note

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

Program Setup

1. Press the PAGE button until the “SP” is displayed.
2. Press the SCROLL button once, “SPrr” (Ramp Rate) will be displayed, 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 UP or DOWN buttons.
3. Press the SCROLL button once, “tm.OP” (Ramp & Dwell mode) will be displayed, select the desired mode with the UP or DOWN buttons. (Opt. 1, Opt. 2, Opt. 3, Opt. 4, Opt. 5)
4. Press the SCROLL button once, “dwEl” will be displayed, set the desired Dwell time with the UP or DOWN buttons. (Dwell in minutes.)
5. Press the PAGE button until the Actual temperature is displayed.

Running the Program

1. Press the SCROLL button until “StAt” is displayed, set to “run” with the UP or DOWN buttons.
2. Press the PAGE button to display Actual temperature.

Stopping the Program

Press the SCROLL button until “StAt” is displayed, set to “oFF” 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 “StAt” is displayed. The display will show “run” if the program is running, or “oFF” if it is not running. Press the PAGE button to display Actual temperature.

4x16 Segment Programmable Model w/OTP



Note

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



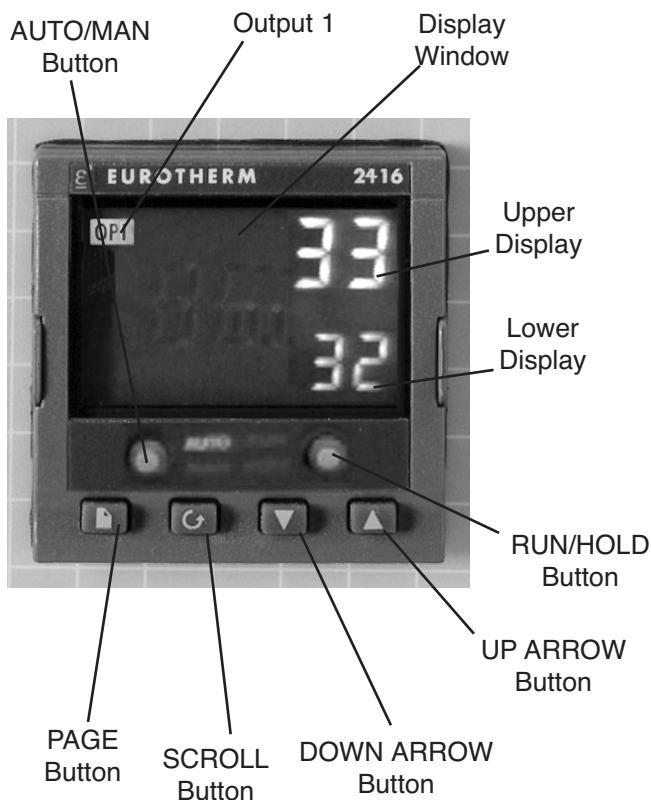
Note

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 **4x16 segment programmable** controller consists of a microprocessor based three-mode PID (Proportional, Integral, Derivative), programmable temperature controller with over-temperature protection and appropriate output switching devices to control the furnace. The digital read-out 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 4 program controller has four 16 segment programs.

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 Thomas Scientific Customer Service.)

To View the % Output Power

From the HOME DISPLAY press the SCROLL button twice. 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 can not 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.

PrG: Program number (displayed when a program is running; 4x16 programmable models only.)

IdHi: Deviation High Alarm. Factory preset to 50.

tunE: One-shot autotune enable.

run LiSt (Program Run List)

PrG: Currently running program (only used on 4x16 programmable models)

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)

PrG.n: Press the UP or DOWN ARROW to select the program number (program number will be displayed in lower display on 4x16 programmable models only.)

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, 1-16 in 4x16 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), cALL (to call a program as a subroutine, available only on 4x16 programmable models)]. 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. Factory preset to 50.

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 (SEt1) PID values to the (SEt 2) PID values. Factory preset to 700.

Pb: Proportional band in display units. (SEt 1) Factory preset to 9.

ti: Integral time in seconds. (SEt 1) Factory preset to 889.

td: Derivative time in seconds. (SEt 1) Factory preset to 148.

Pb2: Proportional band. (SEt 2) Factory preset to 3.

ti2: Integral time in seconds. (SEt 2) Factory preset to 132.

td2: Derivative time in seconds. (SEt 2) Factory preset to 22.

ACCS LiSt (Access List)

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



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: = 1118°C

Alarms

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

IDHi: PV deviation high alarm. Factory preset to 50.

2FSH: PV full scale high alarm. Factory preset to 1118°C.

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

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 “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.

Creating a New Program or Editing an Existing Program

The same steps are used when creating a new program and editing an existing program with the exception being that a new program starts with all its segments set to End in the tYPE parameter. Temporary changes can be made to these parameters when the program is in the hold state but permanent changes must be made in the reset state. Follow the steps below to create or edit a program.

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, "PrG.n."
3. Press the UP or DOWN button to select a number for a new program or to edit an existing program.

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 holdback 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."



Note

The value set in this parameter is always for the entire program.

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 holdback 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.

**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.

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.

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).

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 set-point.

cALL

To call a program as a subroutine:

If you want to run multiple programs, you can program the controller to "call" or link one program to another. This makes it possible to run one program at any time during another program and also return to the original program if desired.

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, "cALL."
4. Press the SCROLL button until display reads, "PrG.n."
5. Press the UP or DOWN button to select a program number to be linked.
6. Press the SCROLL button until display reads, "CYC.n."
7. Press the UP or DOWN button to select the number of cycles the linked program is to be run.

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), "S OP" (End Segment Output Power) and "rSET" (reset).

Setting the Target Setpoint

1. Press the PAGE button until you reach the program list (ProG LiSt).
2. Press the SCROLL button until display reads, "tGt."
3. Press the UP or DOWN button to set the target setpoint temperature.

Running a Program

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

1. Press the PAGE button until you reach the run list (run LiSt).
2. Press the SCROLL button until display reads, "PrG."
3. Press the UP or DOWN button to select the program number you want to run.
4. Press the RUN/HOLD button once to start the program. (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.



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 your Furnace

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.

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.”

Gain Scheduling

G.SP: Gain Scheduling

Gain scheduling is the automatic transfer of control between two sets of PID values. The 2416 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.

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 can not 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.

Furnace Loading



Note

Failure to connect the exhaust port to an appropriate exhaust system will result in smoke and gases filling the work area. Without the connection, gases and smoke will escape around the door seal and at the rear of the furnace.



Caution

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

- For best results, use only the center two-thirds of the furnace chamber.
- Use a hearth plate to elevate load when placing on bottom heating element. This prevents bottom heating element from overheating and burning out.
- If you are heating a number of small parts, spread them throughout the center of the furnace chamber.
- Keep objects away from thermocouple.
- Use insulated tongs and mittens when loading and unloading furnace.
- Always wear safety glasses.

Preventative Maintenance

This unit is equipped with a venting system on the top of the furnace. This is for the removal of fumes from the chamber of the unit. Contamination is a major cause of element failure, therefore, remove all fume forming material before heating. (e.g. clean cutting oil from tool steel).

Housekeeping is vital to your electric furnace - KEEP IT CLEAN. Run your furnace up to 1600°F empty occasionally to burn off the contamination that may exist on the insulation and elements. Maintain 1600°F for at least 4 hours to insure complete ashing of foreign materials. 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 500°F (260°C).

General Cleaning Instructions

Wipe exterior surfaces with lightly dampened cloth containing mild soap solution.

Problem Solving

The Problem Solving section is intended to aid in defining and correcting possible service problems. When using the chart, select the problem category that resembles the malfunction. Then proceed to the possible causes category and take necessary corrective action.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
The power switch does not illuminate.	<p>The furnace is not connected to power supply.</p> <p>ON and OFF power switch is defective.</p> <p>Door switch defective.</p> <p>Incorrect power source.</p> <p>Defective circuit breaker.</p>	<p>Check furnace connection to power source.</p> <p>Replace power switch.</p> <p>Realign door strike or replace door safety switch.</p> <p>Check power source.</p> <p>Replace circuit breaker.</p>
The furnace does not heat.	<p>No power.</p> <p>Defective electrical hookup.</p> <p>Thermocouple has oxidized and opened the circuit.</p> <p>Controller malfunction.</p> <p>Two or more heating elements burned out.</p> <p>Door switch malfunction.</p> <p>Defective safety relay.</p> <p>Defective solid state relay (SSR).</p>	<p>Check power source and fuses or breakers.</p> <p>Repair electrical hookup.</p> <p>Replace thermocouple.</p> <p>Contact customer service.</p> <p>Replace defective elements.</p> <p>Realign door strike or replace door safety switch.</p> <p>Replace safety relay.</p> <p>Replace solid state relay.</p>
Slow heatup.	<p>Low line voltage.</p> <p>Heavy load in chamber.</p>	<p>Install line of sufficient size and proper voltage (isolate furnace from other electrical loads.)</p> <p>Lighten load in chamber to allow heat to circulate.</p>

PROBLEM (cont.)	PROBABLE CAUSE (cont.)	CORRECTIVE ACTION (cont.)
Slow heatup (continued).	Wrong heating element. One or more heating elements are burned out. Wired improperly.	Install proper element. Replace burned out elements. Check wiring diagram for correct wiring of your furnace.
Door switch does not cut power to the furnace chamber.	Door switch is not functioning. Safety relay malfunction.	Realign door strike or replace door safety switch. Replace safety relay.
Repeated element burnout.	Overheating furnace. Heating harmful materials. Contamination present from previous burnout. Wired improperly.	Do not exceed the maximum operating temperature of furnace or recommended continuous intermittent use values. Enclose material in container. Clean up spills on chamber. Ventilate chamber by leaving door cracked slightly open when heating known harmful reagents. Clean and/or replace insulation material. Check wiring diagram for correct wiring of your furnace.
Inaccurate.	Oxidized or contaminated thermocouple. Poor thermocouple connections. Improper loading. Poor ventilation of base. Control out of calibration.	Replace thermocouple. Tighten connections. Use proper loading procedures. Clear area around furnace base. Contact customer service.

Maintenance and Servicing



Warning

Refer servicing to qualified personnel.



Warning

Replace fuses with same type and rating.



Warning

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).



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.

To Replace a Heating Element

- a. Disconnect furnace from power supply.
- b. Remove the back terminal cover of the furnace (Note placement and connections of wires).
- c. Loosen the screws and nuts on the terminals of the element to be replaced.
- d. Open the door and pull the defective element out.
- e. Slide the new element into place, threading the leads through the insulating porcelain bushing on the back of the furnace.
- f. Cut off any excess lead wire. Be careful not to nick element lead wires. Reinstall terminal connections and tighten screws and nuts securely.
- g. Replace the back terminal cover.
- h. Reconnect furnace to power supply.
- i. Test operation of furnace.

To Replace a Platinel II Thermocouple

- a. Disconnect furnace from power supply.
- b. Remove the back terminal cover of the furnace. (Note placement and connection of T/C lead wires).
- c. Remove the screws on the thermocouple terminals and pull the thermocouple straight out.
- d. Insert the new thermocouple into the furnace with colored beaded lead connected to the positive (+) marked terminal and other lead to negative (-) terminal.
- e. Secure connections with screws removed earlier.

- f. Replace the back terminal cover.
- g. Reconnect the furnace to power supply.
- h. Test operation of furnace.

To Replace Solid State Relay

- a. Disconnect furnace from power supply.
- b. Remove the screws on the front dial and the screws on the lower back cover.
- c. Remove the upper back cover.
- d. Disconnect the element lead wires and one ground wire from back of furnace. Also, disconnect T/C lead wire from terminal block. (Note placement and connection of wires).
- e. Slide control section forward and disconnect two wires from door switch. (Note placement and connection of wires).
- f. Control section can now be removed from furnace housing.
- g. Disconnect the wires from the relay and remove relay. (Note placement and connection of wires).
- h. Install new relay.
- i. Reverse steps a - e to reassemble furnace.
- j. Test operation of furnace.

To Replace Door Switch (Microswitch)

- a. Disconnect furnace from power supply.
- b. Remove the screws on the front dial and the screws on the lower back cover.

- c. Remove the upper back cover.
- d. Disconnect the element lead wires and one ground wire from back of furnace. Also, disconnect the lead wire from terminal block (note placement and location of wires).
- e. Slide the control section forward.
- f. Disconnect the wires from the door switch. (Note connection and placement of wires to Microswitch).
- g. Control section can now be removed from furnace housing.
- h. Remove the two screws and nuts from the Microswitch.
- i. Insert new Microswitch and secure with screws and nuts removed in Step h.
- j. Slide control section back and replace the wires on the door switch.
- k. Reverse steps b, c, d and e to reassemble furnace.
- l. Reconnect to power supply.
- m. Test operation of door switch. (To realign door strike, see To Realign Door Strike).

To Realign Door Strike

- a. Disconnect furnace from power supply.
- b. Loosen the screws which retain the door strike on the bottom left side of the door.
- c. Move the bracket closer to the furnace to make strike engage sooner. Move bracket further away to make strike engage later. (Lightly tighten screws between each adjustment to hold bracket while you test the strike.)
- d. The door switch should click when the door is approximately 1" from being completely closed.

- e. Tighten screws when bracket is positioned correctly.
- f. Reconnect to power supply.
- g. To test the operation of the door strike: 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 switch on when the door is approximately 1" from being closed.

To Replace Control Module

- a. Gently pry the retaining tabs on both sides out, then pull the control straight out of the sleeves. Install the new controller to the sleeve.

Replacement Parts

Single Setpoint Models

5300A40/F30420C-TS

Part Number	Description	Quantity
0165A28	Controller	1
0165A43	Element	1
0165A44	Element	1
0165A45	Element	2
0165A49	Fan	1
0165A69	Pilot light	1
0165A72	S.S. relay	1
0165A74	Mechanical relay	1
0165A77	Circuit breaker	1
0165A79	Power switch	1
0165A80	Door switch	1
0165A87	Thermocouple	1
0165A93	Terminal block	1
0165A90	Terminal block	1

4X16 Segment Programmable Model with OTP

5300A45/F30430CM-TS

Part Number	Description	Quantity
0165A29	Controller	1
0165A43	Element	1
0165A44	Element	1
0165A45	Element	2
0165A49	Fan	1
0165A77	Circuit breaker	1
0165A69	Pilot light	1
0165A72	S.S. relay	1
0165A74	Mechanical relay	1
0165A79	Power switch	1
0165A80	Door switch	1
0165A93	Terminal block	1
0165A90	Terminal Block	1
0165A87	Thermocouple	1

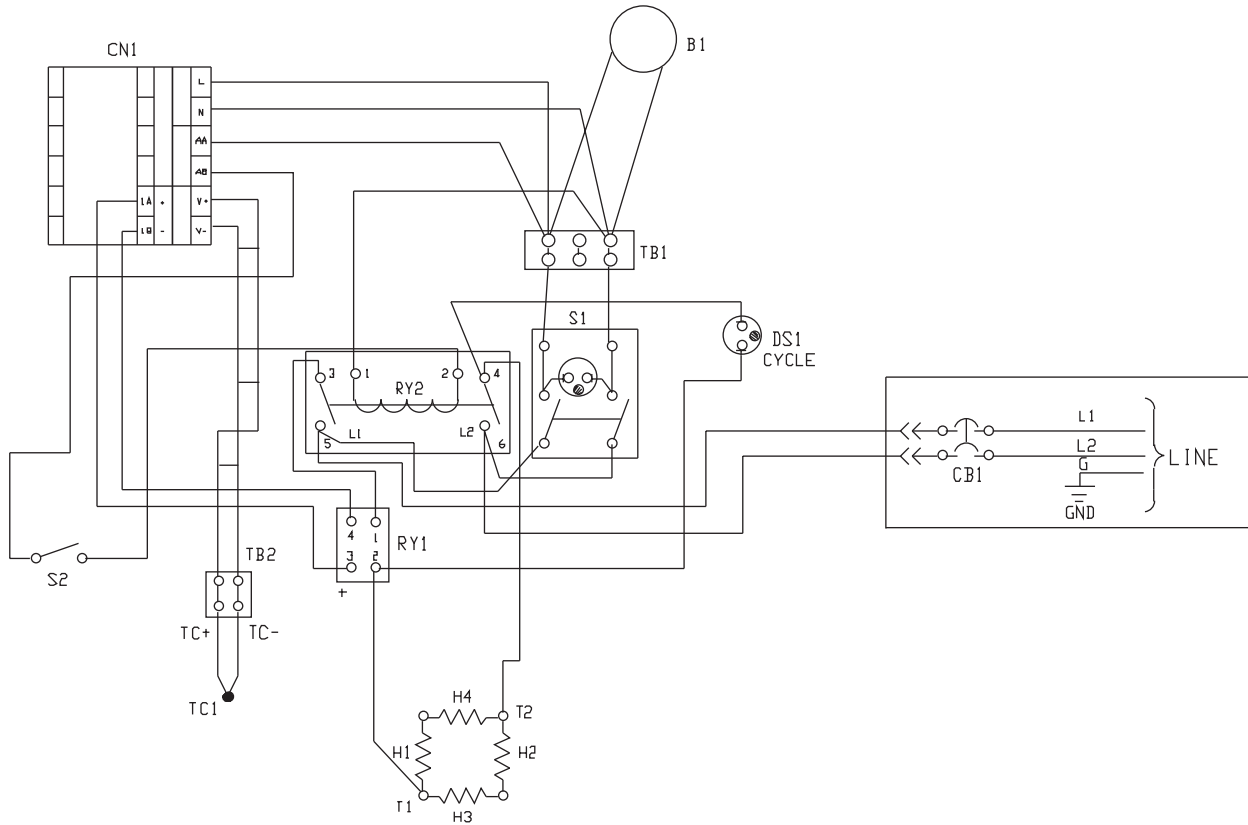
Ordering Procedures

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

Wiring Diagrams

SINGLE SETPOINT CONTROL

WIRING DIAGRAM

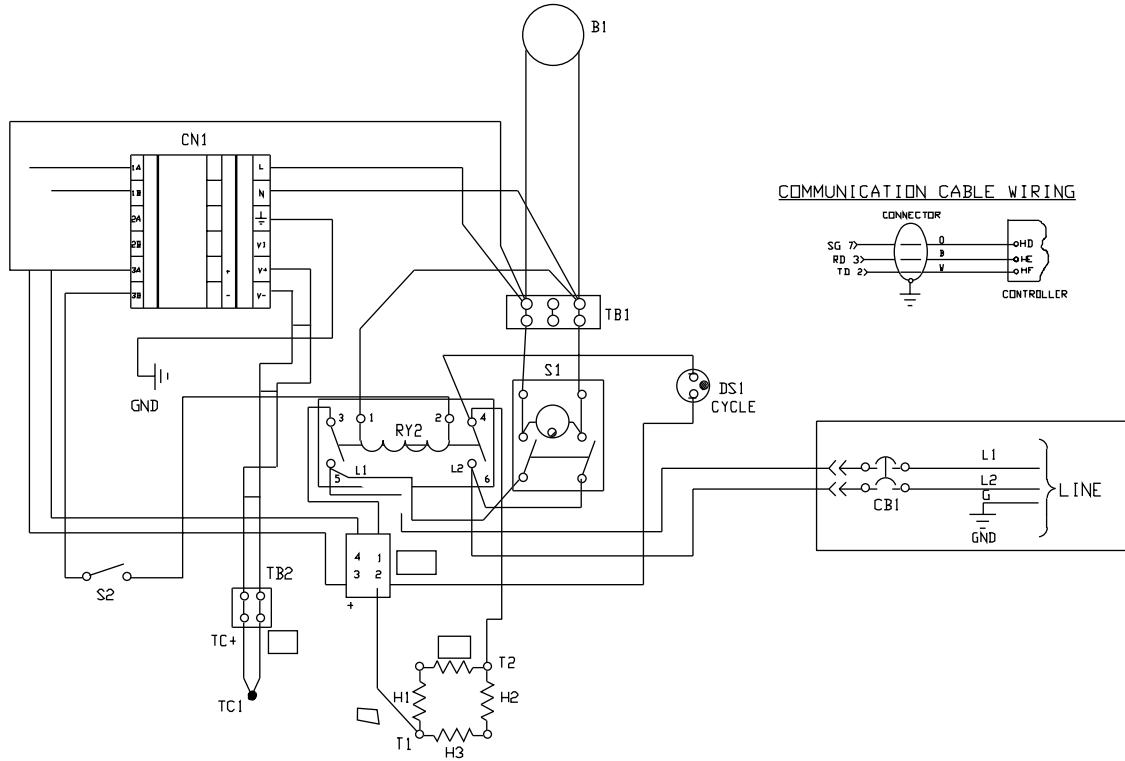


REF. NO.	DESCRIPTION	MODEL NO. AND OUR PART NO. (s)
		F30420C TS
B1	BLOWER FAN	FA1262X1
CB1	CIRCUIT BREAKER	SWX103
CN1	CONTRL	CN71X88
DS1	PILOT LIGHT, NEON	PLX82
H1	HEATING ELEMENT	EL412X4
H2	HEATING ELEMENT	EL412X5
H3	HEATING ELEMENT	EL412X6
H4	HEATING ELEMENT	EL412X6
RY1	SOLID STATE RELAY	RYX37
RY2	RELAY DPST, N.O.	RYX62
S1	SWITCH	SWX144
S2	DOOR SWITCH	SWX163
TB1	TERMINAL BLOCK	TRX178
TB2	TERMINAL BLOCK	TRX96
TC1	THERMOCOUPLE	TC412X1A

WIRING DIAGRAMS

4X16 SEGMENT PROGRAMMABLE CONTROL

WIRING DIAGRAM



REF. NO.	DESCRIPTION	MODEL NO. AND OUR PART NO. (s)
		F30430CM-TS
B1	BLOWER FAN	FA1262X1
CB1	CIRCUIT BREAKER	SWX103
CN1	CONTRL	CN71X90
DS1	PILOT LIGHT, NEON	PLX82
H1	HEATING ELEMENT	EL412X4
H2	HEATING ELEMENT	EL412X5
H3	HEATING ELEMENT	EL412X6
H4	HEATING ELEMENT	EL412X6
RY1	SOLID STATE RELAY	RYX37
RY2	RELAY DPST, N.O.	RYX62
S1	SWITCH	SWX144
S2	DOOR SWITCH	SWX163
TB1	TERMINAL BLOCK	TRX178
TB2	TERMINAL BLOCK	TRX96
TC1	THERMOCOUPLE	TC412X1A

Warranty Repair and Service

In addition to manufacturer warranties, Thomas Scientific (the Company) warrants all instruments and equipment (other than supplies, small items, reagents and chemicals) delivered to and retained by their original purchasers to be free from defect in material and workmanship for one year from the date of the Company's invoice to the purchaser (Thomas Scientific makes no warranty with respect to consumable parts or supplies). For a period of one year from the date of such invoice, the Company will correct, either by repair or replacement at the Company's sole election, any defect in material or workmanship (not including defects due to misuse, abuse, abnormal conditions or operation, accident, alteration, improper installation, acts of God, or service or modification of the product without prior authorization of the Company) without charge for labor, parts or shipment of the product to and from the service facility designated by the Company. Manufacturer warranties that extend beyond this 1-year period are the sole responsibility of the manufacturer.

The determination of whether any product has been subject to misuse or abuse will be made solely by the Company. The Company shall not be liable for any delay in performance under this warranty caused by any contingency beyond the Company's control, including war, government restrictions, strikes, acts of God, or reduced supply of materials. The Company shall not be liable for any special, incidental, or consequential damages, or any damage to plant, personnel, equipment or products, directly or indirectly resulting from the use or misuse of any product. Representations and warranties made by any person, including dealers and representatives of the Company which are inconsistent, in conflict with or in excess of the terms of this warranty shall not be binding upon the Company unless placed in writing and approved by an officer of the Company.

This warranty and all claims hereunder shall be governed by the laws of the State of New Jersey, United States of America.

The foregoing warranty is in lieu of all other warranties, guarantees, or representations, whether oral, written or implied, including any warranty of merchantability or fitness for use or purpose.

The Company's liability under this warranty or otherwise with respect to products of their use (including liability for negligence or otherwise in tort) is limited exclusively to the remedies provided herein and no other right or remedy shall be available to any person.



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