thermoscientific

Thermo Scientific Lindberg/Blue M 1500°C General-Purpose Tube Furnaces

Models: STF55433

Installation and Operating Manual

305435H03 • Revision B • November 2020

ThermoFisher SCIENTIFIC

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Safety Precautions

Explanation of Symbols

This symbol when used alone indicates important operating instructions which reduce the risk of injury or poor performance of the unit.

DANGER : Indicates a hazardous situation which, if not avoided, will result in death or serious injuries.

WARNING : Indicates a hazardous situation which, if not avoided, could result in death or serious injuries.

CAUTION : Indicates a situation which, if not avoided, could result in damage to equipment or property.

Before installing, using or maintaining this product, please be sure to read the manual and product warning labels carefully. Failure to follow these instructions may cause the product to malfunction, which could result in injury or damage

This symbol indicates possible pinch points which may cause personal injury.

This symbol indicates surfaces which may become hot during use and may cause a burn if touched with unprotected body parts.

WARNING : This symbol indicates situations where dangerous voltages exist and potential for electrical shock is present.

This symbol indicates a need to use gloves during the indicated procedures.
If performing decontamination procedures, use chemically resistant gloves.

Use gloves during the daily usage.

WARNING : This symbol indicates a situation which fire hazards exits in the Product.

WARNING : Unauthorized repair of your Furnace will invalidate your warranty. Contact Technical Service at 1-800-438-4851 for additional information.

This symbol indicates power is ON.

This symbol indicates power is OFF.

This symbol indicates Alternating current.

This symbol indicates Earth ground power.

This symbol indicates Protective conductor terminal.

Safety Considerations

DANGER :
Use this product only in the way described in the product literature and in this manual. Before using it, verify that this product is suitable for its intended use. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not modify or use equipment in a manner other than expressly intended. Modification of equipment other than that for which it is explicitly designed could cause severe injury or death. Any customer after-market retrofit violates the warranty of the equipment.

Do not modify or disconnect any safety features provided. Disconnection of the unit safety features could allow the unit to become overheated and start on fire, causing personal injury or death, product and property damage.

Do not use components or materials not specifically designed for this equipment. Failure to comply with this precaution could result in damage to equipment used or the furnace and may create an overheat situation. Also, do not use anything other than OEM exact replacement equipment and parts. Not using OEM replacement parts could cause faulty instrumentation readings. inoperable equipment or temperature overshoot. Both situations may cause personal injury or death, product, and property damage.

Before using, user shall determine the suitability and integrity of the product for the intended use and that the unit has not been altered in any way. Misapplication may compromise the safety of the end user or the life of the product.

WARNING : Use appropriate Personal Protective Equipment (PPE) per local protocols.

Your unit must be properly grounded in conformity with national and local electrical codes. Do not connect the unit to overloaded power sources.

Disconnect the unit from all power sources before cleaning, troubleshooting, or performing other maintenance on the product or its controls.

CAUTION : This product contains refractory ceramic fiber or other refractories which can result in the following:

- May be irritating to skin, eyes, and respiratory tract.
- May be harmful if inhaled.
- May contain or form cristobalite (crystalline silica) with use at high temperature (above 871°C (1599.8°F)) which can cause severe respiratory disease.
- Possible cancer hazard based on tests with laboratory animals. Animal studies to date are inconclusive. No human exposure studies with this product have been reported.

WARNING : This product can expose you to chemicals including arsenic, which is known to the state of California to cause cancer. For more information go to www.P65Warnings.ca.gov.

WARNING : Before maintaining this equipment, read the applicable SDS (Safety Data Sheets). SDS is provided with unit.

WARNING : When installing, maintaining or removing the fiberglass insulation, the following precautions will minimize airborne dust and fiber:

- Keep personnel not involved in the installation out of the area.
- Use a good vacuum to clean area and equipment. Use a dust suppressant if sweeping is necessary. Do not use compressed air.
- Use a disposable mask suitable for nuisance dust.
- Wear long sleeve clothing, gloves, hat and eye protection to minimize skin and eye contact. Do not wear contact lenses.
- Thoroughly wash self after work is complete.
- Launder work clothing separate from other clothes and thoroughly clean laundering equipment after use. If clothing contains a large amount of dust and/or fiber, dispose of rather than clean.
- Promptly place used ceramic fiber parts and dust in plastic bags and dispose of properly.

Standards and Directives

The tube furnaces complies with the following standards and guidelines:

European Union

The European voltage models of this product meet all the applicable requirements of the European Directives and therefore display the CE Marking. The most current EU Declaration of Conformity may be obtained from the manufacturer.

Product Safety

This product family has been tested to applicable product standards by UL a Nationally Recognized Test Laboratory (NRTL).

Electromagnetic Compatibility

FCC Statement (USA)

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian ISED IC Notice

This ISM digital apparatus complies with Canadian ICES-001.

Cet appareil ISM est conforme á la norme NMB-001 du Canada.

South Korean EMC Statement

사용자안내문이기기는업무용환경에서사용할목적으로적합성평가를받은기기로 서가정용환경에서사용하는경우전파간섭의우려가있습니다 .

EMC Registration is done on this equipment for business use only. It may cause interference when the product would be used in home.

Evaluation of Chemicals - Regulations and Directives

Proposition 65 - California

WARNING : Cancer and Reproductive Harm - www.P65Warnings.ca.gov

REACH - Europe

Thermo Fisher Scientific is committed to meeting all compliance obligations to evaluate, communicate and register any Substances of Very High Concern (SVHC) and finding alternates where appropriate.

RoHS - Europe

Thermo Fisher Scientific is determined to reduce the impact on the environment and so can declare that this product fully complies with the European Parliament's RoHS2 (Restriction of Hazardous Substances) Directive 2011/65/EU, with respect to all the following substances:

- Lead (0.1%)
- Mercury (0.1%)
- Cadmium (0.01%)
- Hexavalent chromium (0.1%)
- Polybrominated biphenyls (PBB) (0.1%)
- Polybrominated diphenyl ethers (PBDE) (0.1%)

Our compliance is witnessed by written declaration from our suppliers and/or component testing. This confirms that any potential trace contamination levels of the substances listed above or below the maximum level set by the latest regulations are exempt due to their application.

RoHS – China

This product complies with the requirements of the legislative act Administration on the Control of Pollution Caused by Electronic Information Products (ACPEIP). The following label of conformance, may be found on the product:

Introduction

Thermo Fisher Scientific STF55433 is a reliable, energy efficient 1500°C laboratory tube furnace designed for years of dependable laboratory service. The Silicon Carbide heating elements and low thermal mass Moldatherm® insulation provide fast duty cycles, energy conservation, and efficient programming. Refer to Table 1 “Thermo Fisher Scientific STF55433 Series Tube Furnaces” for specifications.

Features and Benefits

- Controlled heat-up rate eliminates thermal shock to materials.
- Quick heat-up and cool-down rates.
- Energy efficient Moldatherm insulation suitable for high interior-exterior temperature differential. The unit is rated for a maximum operating temperature of 1500°C.
- Main power ON/OFF switch on control panel and act as disconnecting device from Mains Power.
- Digital instrumentation for precise temperature setpoint and display. Microprocessor automatically optimizes control parameters during furnace operation.
- Three sizes of tube adapters available to accommodate 1 in., 2 in., and 3 in. outside diameter process tubes.
- Double wall construction.
- Front control panel is recessed at the top. This feature provides easy viewing of the control LED and protection for the control instrumentation.

Intended Use

This furnace is intended as a general purpose laboratory, ashing and heat treating furnace at 1500°C for continuous (over 3 hours) or intermittent (under 3 hours) use, for industrial, laboratory and commercial applications only. The furnace is designed for thermal technology applications in laboratories, such as those found in manufacturing trades and industry, schools, universities and biology. It is used for ageing, analysis, tempering, decomposing, baking, annealing, hardening, soldering, oxidizing, reducing, incineration and preheating.

This tube furnace is suited for use with process tubes with 1in.,2 in., and 3 in. OD diameter, e.g. for heating under inert gas atmosphere. **Please note that tubes are not provided by Thermo Fisher Scientific.**

Non-Intended Use

This furnace is not intended for the following:

- To heat up food.
- For drying or heat treatment of substances which release gases or vapors into the atmosphere that are flammable or dangerously explosive when mixed with air.
- This furnace is equally unsuitable for the heat treatment of combustible dusts and fibrous materials.

Specifications

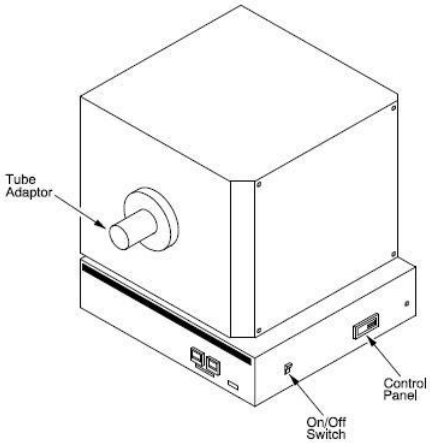


Figure 1 Laboratory Tube Furnace

Table 1 Thermo Fisher Scientific STF55433 Series Tube Furnaces

Model	STF55433BC-1 STF55433BCOMC-1*	STF55433PBC-1 STF55433PBCOMC-1*
Heating Zone	30.5 cm (12 in)	30.5 cm (12 in)
Temp. Range	100°C to 1500°C	100°C to 1500°C
Process tube diameter	2.5-7.5 cm (1-3 in.)	2.5-7.5 cm (1-3 in.)
Overall (L x W x H)	48.3 x 58.4 x 43.2 cm (19 x 23 x 17 in)	48.3 x 58.4 x 43.2 cm (19 x 23 x 17 in)
Main Control	3216p	3504
Over Temp controller	3216i	3216i
Electrical	208/240 V 50/60 HZ 25 A	208/240 V 50/60 HZ 25 A
Shipping Weight	123 kg (270 Lb.)	123 kg (270 Lb.)

*COM = Unit includes male and female RS 485 Digital Communications DB-9 ports.

3216p = 1/16 DIN, 5 program 16 segment digital dual display controller.
3504 = 1/4 DIN, 25 program 500 segment digital dual display controller.
3216i = 1/16 DIN, Over temperature digital dual display controller.

Pre-Installation

Unpacking

Carefully unpack and inspect the unit and all accessories for damage. If you find any damage, keep the packing materials and immediately report the damage to the carrier. We will assist you with your claim, if requested. **Do not return goods to Thermo Fisher Scientific without written authorization**. When submitting a claim for shipping damage, request that the carrier inspect the shipping container and equipment.

Inside the furnace cabinet is a bag containing:

- User Manual, SDS, User Information Instructions*
- Heating elements, Elements straps, Element Terminal Clamp, Element Clamp Tool & Bag of Alumina Silica Fibre.
- Tube adapters

*NOTE May be contained on optional USB thumb drive.

Operating Conditions

High concentrations of sulfates, chlorides, fluorides, alkalis and V_2O_5 can have corrosive effects on the ceramic fiber. Contact Thermo Scientific for additional information about the effects of specific atmospheres on furnace performance.

With prolonged use, hairline cracks can develop in the insulation materials. These minor cracks will not affect the furnace's performance. We recommend turning off the furnace completely when not in use. The heating unit is not damaged by rapid heating and cooling cycles.

Environmental Conditions

Indoor Use Only.

Class of Equipment	Class I
Mains Supply Fluctuations	Mains supply voltage fluctuations not to exceed ±10% of the nominal voltage.
Operating	The recommended ambient temperature is 17°C to 27°C (62.6°F to 80.6°F); 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. Do not exceed ambient temperature of 40°C (104°F).
Altitude Limit	2,000 meters (6561.68 feet).
Storage	-25°C (-13°F) to 65°C (149°F); 20% to 80% relative humidity.

Atmosphere Systems

The STF55433 Series tube furnaces are designed for use with combustible or inert atmospheres when contained in a process tube.

WARNING : Do not use combustible gases directly in this furnace. Process gasses must always be contained in a separate tube.

CAUTION : Avoid combustible products which generate toxic or hazardous vapor or fumes. Work should only be done in a properly vented environment.

NOTE Thermo Fisher Scientific tube furnace must be used with process tubes. Do not operate the furnace without an appropriately installed customer supplied process tube or other customers supplied vessel.

Installation

CAUTION : Be sure ambient temperature does not exceed 40°C (104°F). Ambient above this level may result in damage to the controller. The recommended ambient temperature is 17°C to 27°C (62.6°F to 80.6°F).

CAUTION : Allow at least 12"(30.48 cm) of space between the furnace, at least 12"(30.48 cm) above the furnace and any combustible surface. This permits the heat from the 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 electrician who ensures compatibility among furnace specification, power source and ground code requirements.

Lifting and Carrying

CAUTION :
Heavy loads. Lift with care!

1. To avoid injury through physical strain, such as strain trauma and slipped discs, do not attempt to lift the furnace alone.
2. To avoid injury through dropped loads, wear Personal Protective Equipment (PPE) per local protocols, such as safety shoes, when lifting the furnace.
3. To avoid crushing your fingers or hands or damaging the furnace, do not use any other lift points than the bottom sides of the furnace.

Transport

1. For transport, do not lift the device using installed components (e.g. tube adapter or process tube) as lifting points.
2. Lift at the bottom sides of the furnace with NIOSH rated straps and/or using appropriate number of personnel per local safety policies and regulations.

Location

Install the furnace in a level area free from vibration. To permit proper air flow, leave at least 12"(30.48 cm) of space on all sides of the unit and 12"(30.48 cm) above the unit.

Wiring

For detailed wiring information, refer to:

- Figure 13 “Wiring Diagram STF55433 series”
- Figure 14 “Wiring Diagram STF55433P Series” at the end of this manual.

NOTE The furnace and control are wired and bolted together at the factory. The control must be wired to a power source before operation (refer to Section “240 VAC Operation”).

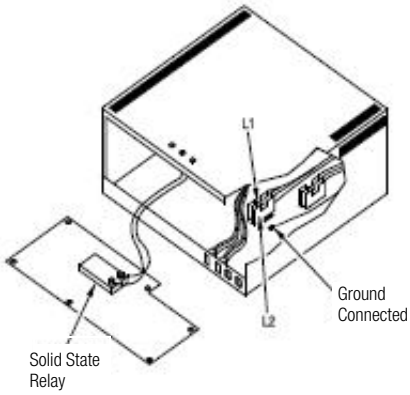


Figure 2 Control Wiring

240 VAC Operation

The STF55433 models are 240 VAC furnaces. Power and ground wires are not provided with these furnaces. Note that the heating elements also must be installed (Refer to Section “Heating Elements”).

1. Determine the length of wire needed to connect the furnace to the power source. Furnace installation requires two power wires and one ground wire. Refer to below Table for minimum recommended wire gauge sizes.
2. Label the power wires Line1 and Line2 and label the ground wire Ground.

NOTE For Europe, L2 connection at furnace is wired to Neutral.

NOTE Electrical installation must be performed by a qualified electrician. Consult local electrical codes for proper sizing of power and control wiring.

3. Swing the control back panel down to the horizontal position (refer to Figure 2 “Control Wiring”). Use of flexible or rigid conduit and necessary fitting per local electrical codes are recommended.
4. Thread the Line, Neutral, and Ground wires through the 7/8 in. knock-out in the bottom rear panel. Use a screwdriver to insure proper placement of the appropriate wires to the terminal.

Wire	Screw	Wire Gauge
Line	L1	10AWG
Neutral	L2	10AWG
Ground	GND	10AWG

5. Check that all electrical connection are secure.
6. Replace the control back panel.
7. Connect into a 240 VAC, grounded line. The furnace draws approximately 26.6 amps at 240 VAC.

208 VAC Operation

The tube furnace heating elements are specifically designed for operation on 208 or 240 VAC.

A furnace wired for 240 VAC operation can also operate on 208 VAC. However, heat up and recovery times will be longer.

Thermocouple Check

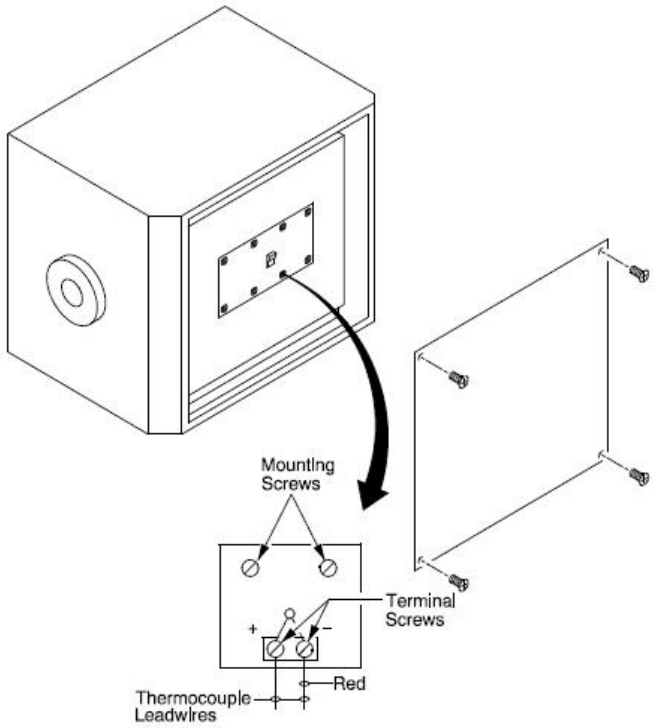


Figure 3 Thermocouple

Check that the thermocouple is securely mounted and undamaged. Check the thermocouple wiring connections. Refer to Figure 3 “Thermocouple”. Red is always negative.

CAUTION : Failure to check thermocouple wiring connections before initial start up could result in damage to the furnace.

To check the thermocouple wiring connections, complete the following steps:

1. Remove the furnace rear panel.
2. Inspect the thermocouple and check the wiring. Red is always negative.
3. Replace the furnace panel.

NOTE At initial installation, install the heating elements (Refer to Section “Heating Elements”) before replacing the furnace back panel.

Heating Elements

WARNING : Disconnect furnace from main power before attempting any maintenance to furnace or its controls.

The STF55433 furnaces require installation of the heating elements before operation. The furnace is shipped with eight individually-wrapped silicon carbide heating elements and a bag of ceramic wool for insulation. Refer to the manual included with the furnace for additional installation and handling instructions.

To install the heating elements, complete the following steps:

1. Remove the furnace front and rear panel.
2. Hold the element with two hands and gently insert the element into the top right terminal hole. (Refer to Figure 4 “Heating Element Installation”).
3. Carefully unwrap one of the heating elements.
4. Slide the element into the terminal hole and through the furnace. Make sure the elements are evenly distributed through the furnace with an equal amount of rod sticking out front both the sides.

CAUTION : Wear gloves and a face mask when handling the ceramic wool.

5. Use a flat blade screwdriver to pack ceramic wool evenly around the heating element between the furnace and the element jacket. Make sure that the ceramic wool fills all spaces so that no heat is lost during operation.

NOTE The ceramic wool should only extend 0.5 to 1 inch inside the terminal hole.

6. Slide an element into the next top terminal hole and, using a screwdriver, pack ceramic wool around the element.
7. Connect the two elements with a double-loop braided wire strap. Assure excess strap does touch other parts or chassis.
8. Use the expansion tool to spread a C clamp and place the clamp over a braided wire and element connection. Remove the expansion tool. Repeat with other element.
9. Slide an element into the bottom right terminal hole. Pack ceramic wool around the element, and connect 2 single-loop braided wire strap to the element and to the terminal block (refer to Figure 4 “Heating Element Installation”).

CAUTION : Make sure that the braided wires do not come in contact with any metal other than the element terminal. Failure to align the element correctly can result in damage to the heating element.

10. Refer to the wiring configuration, front and back. Continue until all heating elements are installed.

11. Replace front and back furnace panels.

CAUTION : When packing ceramic wool around heating elements, make sure the heating elements are not damaged. Exercise caution when handling due to the fragility of the heating elements.

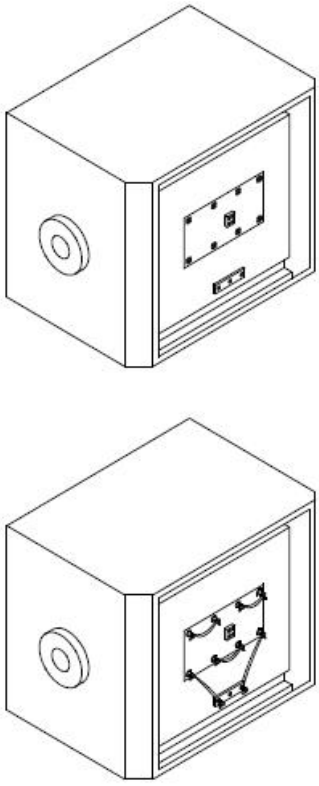
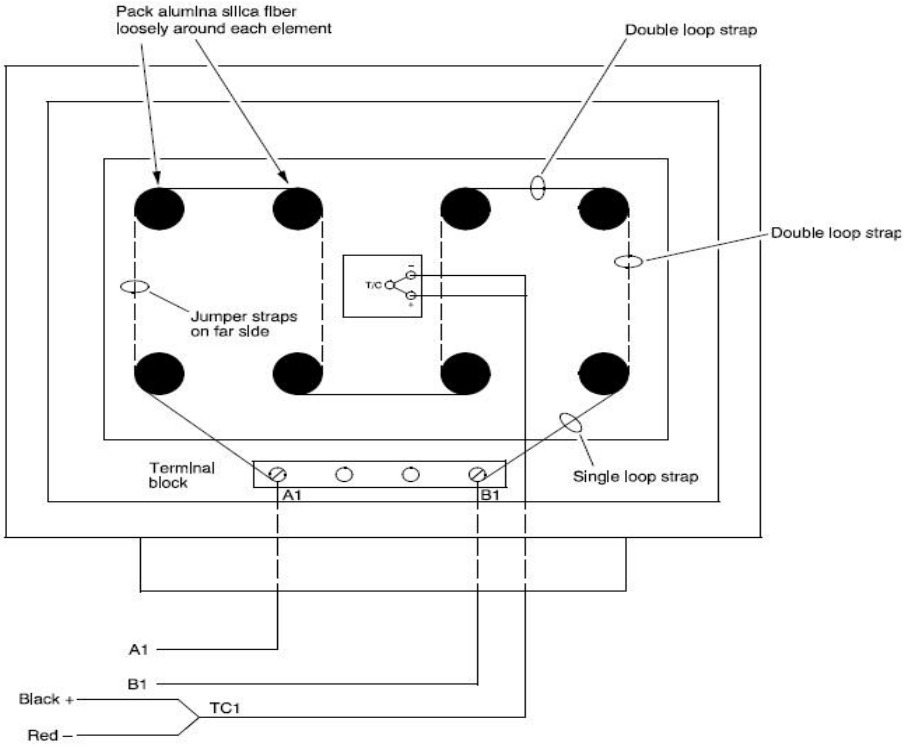
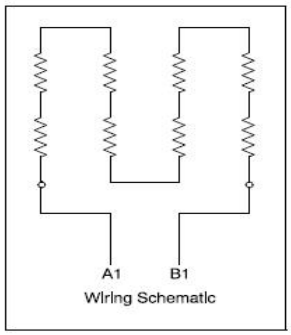


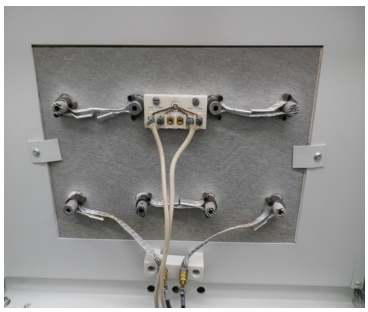
Figure 4 Heating Element Installation



Watts	Volts	Amps
6000	240	25
5500	230	24
4500	208	22



Heating elements connection
FAR side



Heating elements connection
Rear side

Figure 5 Customer Wiring

Tube Adapters

CAUTION : Do not operate the furnace without properly sized and installed tube adapters.

Install tube adapters to each end of the furnace, through the tube adapter at the end, through the furnace chamber below careful. Do not touch / Burn the elements, allow and push through tube adapter on opposite end of furnace.

Similar to the element in Section “Heating Elements”, pack ceramic wool into any gaps between the outside of the process tube and the tube adapter.

NOTE Only an authorized or a qualified person shall place the process tube in the device while in operation. Do not place your hand inside the unit while placing the process tubes. If misused, the person may come in contact with live electrical parts and touching the live parts can result in an electrical shock, burn, or electrocution. It is always recommended to have appropriate electrical PPE while operating the device; insulated TOOLS; insulating clothing; OPERATOR standing on an insulating surface etc.

Start-Up

CAUTION : Observe the following precautions when operating the furnace:

- Never stand at the ends of the furnace without proper protection.
- Wear protective eyeware.
- Wear protective gloves.
- Use tongs to insert and remove furnace load.
- Do not allow the load to touch the furnace walls.
- Always use customer supplied process tube.

CAUTION : Some process tubes cannot tolerate large temperature changes or differentials over the length. Adjust the program heat up and cool down times to operate within the recommendations of the process tubes supplier, keep the process tubes free of work loads during the initial setup.

Initial Furnace Start-Up / Drying-Out Process

To start up the furnace, complete the following steps:

1. Turn furnace ON.
2. Adjust the setpoint to 550°C, following the instructions in section “Operation - 3504 Controller”and “5x16 Segment Programmable Model w/OTP”.
3. Run the furnace for two hours at 550°C.
4. Adjust the setpoint to 1,500°C.
5. Run the furnace for two hours at 1,500°C.
6. Adjust setpoint to room temperature.

Main Controller: 5x16 Segment Programmable

Eurotherm 3216 Controller

The Eurotherm 3216p temperature controller senses the furnace's chamber air temperature (the PV or process value) and provides the heat needed to reach the required set point.

The 3216p controller offers single setpoint and 5-program 16-segment, this controller can store upto 5-different programs and each program can contain 16 segments.

This chapter provides brief instructions on various controller operations which include:

- Setting target temperature
- Setting the ramp rate
- Changing display units
- Auto tuning the controller
- Setting over-temperature protection (OTP)
- Temperature offset procedure
- 5x16 programmer operation (3216p controller only)

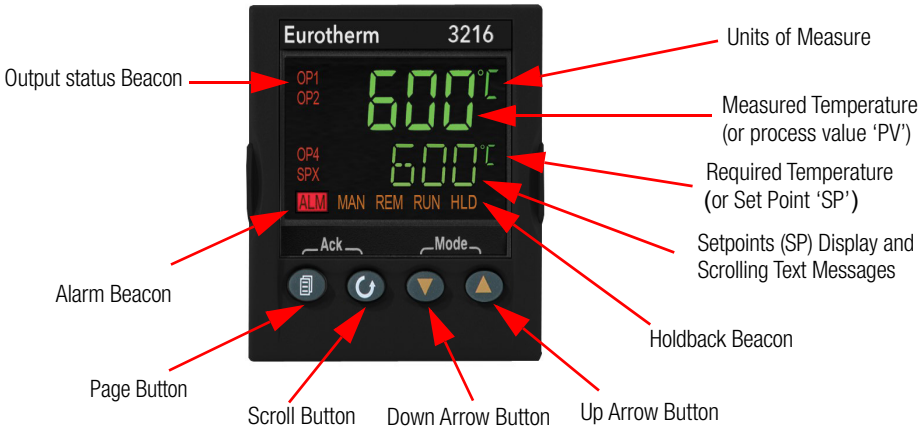
CAUTION : Before operating the controller, read this chapter carefully. Wrong procedures can change the unit characteristics and design parameters, which can hamper performance and make the equipment dangerous to use.

The furnace temperature controller is configured and tuned at the factory to function well for most applications. Occasionally, it may be advisable to configure the temperature controller differently to suit a particular working environment or process.

Operator Interface & HOME Display

When the controller is turned ON, it will perform a brief self-test and then display the HOME Display page. The measured value (process value) is found in the upper display and the set point is found in the lower display.

The description of interface beacons and buttons are shown in “Beacon Display and Description” & “Operator Buttons” respectively.



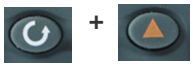
Beacon Display and Description

OP1 (Output 1)	Illuminates when the output to heater
OP4 (Output 4)	Illuminates when the output is ON (Over-temperature alarm).
SPX	Alternative set point in use (SP2)
ALM	Alarm active (Red)
REM	Remote set point or communication active
RUN	Program running for 3216p
RUN (flashing)	Program hold for 3216p
HLD	Program Segment Holdback (See Section “Holdback Function”)

Operator Buttons

Press to select a new list of parameters and from any display - press PAGE to return to the HOME Page

Press to select new parameter from the page header. If held down, it will continuously scroll through parameters.



Hold down SCROLL and press UP ARROW to scroll back parameters.

Press to decrease or change the state of a value.

Press to increase or change the state of a value.

Single Set Point Operation

3216p controller has capability to select set point-1 and set point-2. User can setup two different set points to select the desired set point, SP.SEL function can be used.

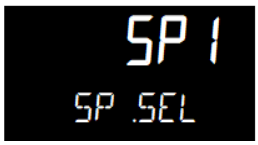
To set the desired temperature set point, complete the following steps:

1. Press the SCROLL button until SP1 or SP2 is displayed.

2. Press UP or DOWN button until the desired setpoint 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.
3. Press PAGE button to return to the HOME display.

Alternate Set Point Selection (SP2)

1. Press the SCROLL button from HOME display until SP.SEL is displayed.
2. Press UP or DOWN button to select SP1 or SP2.



If SP2 is selected, then SPX beacon will appear on the HOME display indicating the action of alternate set point in use.

Set Point Ramp Rate

The ramp rate SP.RAT is designed to reduce the heating rate that the furnace normally exhibits. When SP.RAT is 'OFF', the furnace will operate at its maximum heating capability. But if ramp rate feature is used, then the chamber is heated at any rate slower than the maximum capability of the unit. To fine tune ramp rates, you may need to test the furnace using loads that you intend to use in furnace application or with loads having similar mass and thermal properties.

NOTE If ramp rate exceed the capability of the furnace unit, it will run the max 100% output of heater capacity. If ramp rate value set less than 100%, furnace unit heater output is reduced and furnace unit chamber gets heated slowly.

Complete the following steps to set the ramp rate units:

1. The ramp rate units can be set in seconds, minutes or hours.
2. Press the SCROLL button until RAMPU is displayed.
3. Press UP or DOWN button until the desired ramp rate unit is indicated on the display.

4. The new ramp rate unit is applied when the button is released and is indicated by a brief flash of the display.
5. Press PAGE button to return to HOME display.

Complete the following steps to change the ramp rate of SSP.

6. Press the SCROLL button until SP.RAT is displayed.

7. Press UP or DOWN button until the desired ramp rate is indicated on the display. The unit of ramp rate depends on the type of ramp unit RAMPU selected.

8. The new ramp rate is applied when the button is released and is indicated by a brief flash of the display.
9. Press PAGE button to return to home display.

View or Change the Display Units

To change the temperature scale in 3216p controller to operate on °F instead of the factory setting of °C, or to change from °F to °C, follow these steps.

1. Press the SCROLL button until “UNITS” is shown in the lower display. The current unit is shown in the upper display.

2. Press UP or DOWN button to change the display unit.
   a. (°C): Degrees Celsius

   b. (°F): Degrees Fahrenheit

   c. (°K): Kelvin

d. (NONE): No units displayed

e. (PERC): Percent

NOTE Do not use nonE & PErc, they are used to measure other applications types other than temperature.

Auto Tuning

In Auto Tuning the characteristics (PID parameters) of the controller are matched to the characteristics of the product load in order to obtain good control.

Good control means:

- Stable control of the set point
- No overshoot or undershoot
- Quick response to deviations from the set point
- Removal of fluctuations

The 3216p controller uses a one-shot tuner which automatically sets the initial values of the parameters listed in Table 2 “Parameter Description and Accessibility in 3216p”.

Thermo Fisher recommends that you tune the furnace to your specific application to obtain the best results.

Steps to Auto Tune the Controller

1. Load the chamber with materials that have the same mass and thermal characteristics as a typical product load.
2. Set the temperature as per requirement; refer to section “Single Set Point Operation” on setting SP1 or SP2.
3. Press SCROLL button to scroll through the list of parameters until A.TUNE is displayed.

4. To enable the auto-tune, set the A.TUNE parameter to ON by using DOWN or UP button.

5. Press the PAGE button to return to the HOME display. The display will flash TUNE to indicate that tuning is in progress.

The auto tune is completed when the regular display of the measured temperature is shown and the process is allowed to control at the target set point using the new control terms.

NOTE

- If the process temperature or load changes significantly another auto tune session may be necessary to optimize the chamber performance.
- If the controller is auto tuning and sensor break occurs, the auto tune will abort. Auto tune must be re-started when the sensor break condition is no longer present.
- If an Auto tune cannot be performed an error message, Etun will be flashed in the display.
- Auto tune will not work when controller is running program or Timer.

Parameter List

Parameters are available under different levels of security and are defined as Operator Level 1 (LEv1) & Operator Level 2 (LEv2). This section describes various parameters used in each operator levels.

Operator Level 1

Operator level 1 is designed for day to day operation of the controller and parameters are not protected by a security code. From HOME display, press SCROLL button to scroll through the list of parameters in Level 1.

The parameter mnemonic and its scrolling description are shown in the lower display. The value of the parameter is shown in the upper display. After 5 seconds, a description of the parameter will scroll once along the display and then revert back to the mnemonic. The scrolling text can be interrupted at any time by a single press of any of the buttons, but will not scroll again until the parameter is returned to.

Operator Level 2

Operator Level 2 provides access to additional parameters and this access is protected by a security code. The Level 2 access should typically be granted to a specially trained person, since changing parameters can have major impact on the temperature performance of the furnace. After entering Level 2, press SCROLL button to scroll through the list of parameters. Like Level 1, the mnemonic of the parameter is shown in the lower display, followed once by a scrolling help message showing a longer description of the parameter. The value of the parameter is shown in the upper display.

Press DOWN or UP button to adjust this value. If no button is pressed for about 30 seconds, the display returns to 'HOME Display'.

Back scroll is achieved when you are in the list by pressing UP button while holding DOWN and SCROLL button.

To Enter Level 2

1. From any display press and hold PAGE button.
2. After a few seconds, the display will show 'LEv1 GOTO'.

3. Release SCROLL button. (If no button is pressed for about 45 seconds the display returns to the HOME Display).
4. Press the UP or DOWN button to choose LEv2 (Level 2).

5. Press UP or DOWN button to enter the password. The default code is '25'.

If an incorrect code is entered the display reverts to Level 1.

To Return to Level 1

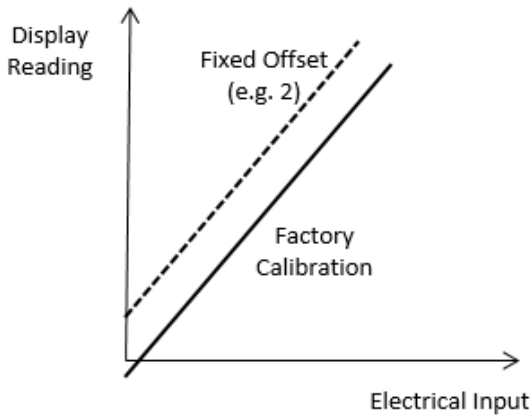
1. Press and hold PAGE button to show the current operator level.
2. Press UP or DOWN button to select LEv1.

When Level 1 is selected the display reverts to the HOME display. A passcode is not required when moving from a higher level to a lower level.

Offset Procedure

All ranges of the controller have been calibrated against traceable reference standards. This means that if the input type is changed it is not necessary to calibrate the controller. There may be occasions, however, when you wish to apply an offset to the standard calibration to take account of known errors within the process, for example, a known sensor error or a known error due to the positioning of the sensor. In these instances it is not advisable to change the reference (factory) calibration, but to apply a user defined offset.

PV Offset applies a single offset to the temperature or process value over the full display range of the controller and can be adjusted in Level 2. It has the effect of moving the curve up or down about a central point as shown in the example below:-



To Apply an Offset

Connect the input of the controller to the source device which you wish to calibrate to. Set the source to the desired calibration value. The controller will display the current measurement of the value. If the display is correct, the controller is correctly calibrated and no further action is necessary. If you wish to offset the reading:

1. Enter Level 2, refer to section “To Enter Level 2” for steps to enter Level 2.
2. Press SCROLL button to scroll through the parameter list until ‘PV.OFS’ displayed.

3. Press UP or DOWN button to set the required offset value.

Alarms & Diagnostics

Alarms are used to alert an operator when a pre-set level has been exceeded. They are indicated by a scrolling message on the display and the red ALM beacon.

Alarm Indication & Acknowledgment

Alarm Indication & Acknowledgement should go before Sensor Break.

- If an alarm occurs the red ALM beacon will flash, a scrolling message will give the source of the alarm and the alarm (relay) output will operate. A typical default message will show the source of the alarm followed by the type of alarm. For example, ‘ALARM 1 FULL SCALE HIGH’. If more than one alarm is present, further messages are flashed in turn in the main display. The alarm indication will continue while the alarm condition is present and is not acknowledged.
- ALM beacon on continuously = alarm has been acknowledged.

- Press PAGE and SCROLL button together to acknowledge an Alarm. If the alarm is still present the ALM beacon lights continuously.

The action which takes place depends on the type of alarm configured:

Sensor Break & Loop Break Protection

Sensor Break Protection - The controller provides sensor break protection in the event the thermocouple opens. If an open thermocouple condition occurs, the digital display will blink “S.br”, a red alarm beacon will be illuminated and the power to the heating element will be shut off.

Loop Break alarm is displayed as CONTROL LOOP BROKEN**.** This occurs if the controller does not detect a change in process value following a change in output demand after a suitable delay time. Since the time of response will vary from process to process the Loop Break Time parameter ‘LBT’ allows a time to be set before a loop break alarm is initiated. In these circumstances the output power will drive to high or low limit. For a PID controller, if the PV has not moved by 0.5 x Pb in the loop break time the loop is in break.

The loop break time is set by the AutoTune, a typical value is 12 x Td. The loop break alarm may be disabled by setting its time to Off.

Over-Temperature Protection (OTP)

The over-temperature protection will be in effect during any alarm condition when the temperature of the furnace has deviated beyond the limit. The Deviation High alarm is triggered when the measured temperature becomes higher than the set point by the amount of the threshold/deviation. Thermo Fisher recommends a value of 50°C above your working temperature to provide protection for your workload.

In certain units, full scale high alarm ‘Hi’ is also present. Full scale high alarm will be detected if the PV value exceeds the full alarm trip level.

To Configure Deviation High Alarm

1. Press SCROLL button until “A1.DHi” appears on the display.

2. Press UP or DOWN button to select the OTP value you desire. We recommend a value of 50.

Program/Timer Segment Types

Each program is made of multiple segments. Generally a program segments consist of a controlled rate ramp to a target set point followed by a dwell at that set point. These values can be set by the user.

a. Target set point

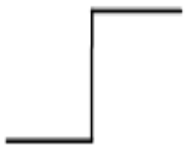
Target set point will ramp from the current value of the measured temperature to the target set point value based on ramp rate.

b. Ramp Rate

A Ramp segment provides a controlled change of set point from an original to a target set point. The duration of the ramp is determined by the rate of change specified. The segment is specified by the target set point and the desired ramp rate. The ramp rate parameter is presented in engineering units (°C, °F, Eng.) per real time units (Seconds, Minutes or Hours). If the units are changed, all ramp rates are re-calculated to the new units.

c. Step

The set point changes instantaneously from its current value of the measured temperature to a new value at the beginning of a segment. Step can be achieved by turning off Ramp rate. A Step segment has a minimum duration of 1 second.



d. Dwell

The set point remains constant for a specified period at the specified target. The operating set point of a dwell is inherited from the previous segment.

5-Program 16-Segment Controller Operation

The 3216p temperature process controller is a single loop PID based controller that can store up to 5 programs with 16 segments each. This controller consists of microprocessor based three-mode PID (Proportional, Integral, and Derivative), programmable temperature controller and appropriate output switching devices to control the furnace. The programmable controller can be used as a single set point controller or as a programmable 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, repeat a set number of times or run continuously. This 16 segment digital model can enable 16 segments in each program.

Some of the commonly used parameters in operator Level 1 and Level 2 of 3216p controller are:

Table 2 Parameter Description and Accessibility in 3216p

No.	Parameter	Description	Level	Access	Value	Page no.
1	P.STAT	Program Status	Level 1 + 2	Read/Write	Reset	6-45
2	T.REMN	Timer Remaining	Level 1 + 2*	Read Only*	-	6-35
3	T.ELAP	Elapsed Time	Level 1 + 2*	Read Only*	-	6-35
4	A1.DHI	Deviation High Alarm Set Point	Level 1	Read/Write	50	6-31
5	A2.HI	High Temperature Alarm Set Point	Level 2	Read Only	1525	6-31
6	SP.SEL	Set point Select	Level 1 + 2	Read/Write	SP1	6-23
7	SP1	Set point 1	Level 1 + 2	Read/Write	25	6-24
8	SP2	Set point 2	Level 1 + 2	Read/Write	25	6-23
9	RAMPU	Set point Ramp Units	Level 1 + 2	Read/Write	Mins	6-24
10	SP.RAT	Set point Rate Limit	Level 1 + 2	Read/Write	Off	6-25
11	A.TUNE	Auto Tune Enable	Level 1 + 2	Read/Write	Off	6-26
12	UNITS	Display Units	Level 1 + 2	Read/Write	Deg C	6-25
13	PROG	Current Program Number	Level 1 + 2	Read/Write	1 to 5	6-35
14	END.T	Program End Type	Level 1 + 2	Read/Write	Dwell	6-43
15	H.BACK	Program Holdback	Level 1 + 2	Read/Write	1	6-42
16	DWEL.U	Dwell Units	Level 1	Read Only	Mins	6-44
17			Level 2	Read/Write		6-44
18	TSP.1 to TSP.8	Target Set point 1 to Target Set point 8	Level 2	Read/Write	550	6-44
19	RMP.1 to RMP.8	Ramp Rate 1 to Ramp Rate 8	Level 2	Read/Write	OFF	6-44
20	DWEL.1 to DWEL.8	Dwell Time 1 to Dwell Time 8	Level 2	Read/Write	1 hour	6-45

No.	Parameter	Description	Level	Access	Value	Page no.
21	PB	Proportional Band	Level 2	Read/Write	70	-
22	TI	Integral Time	Level 2	Read/Write	220	-
23	TD	Derivative Time	Level 2	Read/Write	37	-
24	LBT	Loop Break Time	Level 2	Read/Write	30 mins	6-31
25	PV.OFS	PV Offset	Level 2	Read/Write	0	6-30
26	ADDR**	Comms Address	Level 2	Read/Write	1	7-48
27	BAUD**	BAUD RATE	Level 2	Read/Write	9600	7-48
28	IN.TYP	Input Type	Level 2	Read Only	R Type Thermocouple	-
29	ID	Customer ID	Level 2	Read Only	310 (without COMMS) 311 (with COMMS)	-

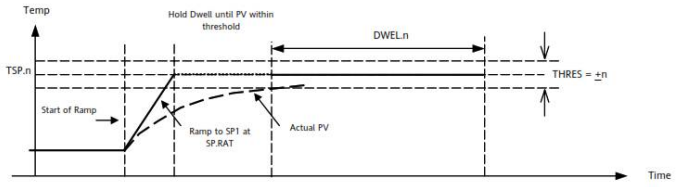
*Level 1+2 Read Only states that, Level 1 gives Read only access to user where as Level 2 gives Write access along with Read access.

**COMMS units only

Holdback Function

The temperature ramp rate of the program is quicker than the furnace or oven can achieve, the program will wait until the temperature of the furnace or oven catches up. e.g. If a holdback value of 10 is set and the program is set to ramp to a set point of 600°C, the program will reach 600°C, then go into an hold state; the hold indicator will light until the furnace or oven temperature reaches 590°C, the program will then continue to control again.

The holdback will only apply once per Segment, therefore when control has been reestablished, the holdback will not apply again to that segment, even if the furnace or oven temperature go outside the holdback band. Each program can have its own holdback value assigned to it.



H.BACK can be accessed from Level 1 or Level 2. To set the holdback value:

1. Press SROLL button until display reads, **“H.back”**

2. Press the UP or DOWN button to set holdback value or to turn off holdback function.

Creating a New Program or Editing an Existing Program

3216p is a 16 segment programmer consisting of eight ramp/ dwell pairs. Each ramp consists of a controlled rate of change of set point to a target level. Each ramp is followed by a dwell at that level. The ramp rate, target level and dwell time are set by the user.

The same steps are used when creating a new program and editing an existing program. A currently active program cannot be altered. Go into reset mode before starting to create or modify a program. Follow the steps below to create or edit a program.

1. **‘PROG’** can be accessed from Level 1or Level 2.
2. Press the SCROLL button until you reach the program parameter **‘PROG’**

3. Press the UP or DOWN button to select a number for a new program or to edit an existing program. The scrolling display shows “CURRENT PROGRAM NUMBER”.

End Type parameter

The action which occurs at the end of program or in reset depends on the configuration of the **END.T** parameter. The **END.T** can be:

dwEll : Controls at last program setpoint.

SP2 : Controls at setpoint 2 (When the programmer completes the target setpoint will switch to setpoint 2. The setpoint 2 may be a lower or a higher temperature).

rES : Reset on completion and reverts to SP1 or SP2, based on the setpoint selection.

SCROLL button through parameters in Level 2 and set the required End.T by pressing UP or DOWN button.

OR


OR


To Configure the Programmer

1. Enter Level 2: refer to section "To Enter Level 2" for steps to enter Level 2.
2. To select the Programmer, press SCROLL button as many times as necessary to view **'PROG'.**

3. To configure the first Program, press DOWN or UP button to select program number **'1'.**

Similarly you can configure program (1, 2, 3, 4 or 5) for configuration.

4. To set the ramp unit, press SCROLL button to select **'RAMP.U'** and then press DOWN or UP button to select **hour, min or sec** (In this example the ramp unit is set in min).

5. To set the Dwell unit, press SCROLL button to select 'DWEL.U' and then press DOWN or UP button to select **hour or min** (In this example the dwell unit is set in min).

6. To set the first Target Set point, press SCROLL button to select 'TSP.1'. Press DOWN or UP button to set the value.

7. To set the first Ramp rate, press SCROLL button to select 'RMP.1'. Press DOWN or UP button to set the value.

8. To set the first Dwell, press SCROLL button to select 'DWEL.1'. Press DOWN or UP button to set the value.

9. Now repeat the above three steps (6, 7 & 8) to set remaining all segments.

NOTE

- If not all the segments are used for a program, the Ramp & Dwell of each of the subsequent segments should be set to OFF.
- A program will end in one of two ways, either revert to the control Set Point or dwell at the temperature set in the last segment used. When a program finishes on a dwell and the dwell time expires the temperature will revert to the control set point.
- Before running a program ensure that the control set point is set to Zero to avoid unexpected heating at the end of the program.
- When a Holdback is set, each segment used must have a Ramp Rate assigned to it, in order for it to be recognized by the program.

To Operate the Programmer

Operation	Action	Indication
To Run a program	Press and quickly release +	Beacon RUN = On Scrolling display - CURRENT PROGRAM STATE
To Hold a program	Press and quickly release +	Beacon RUN = Flashing Scrolling display - PROGRAM HOLD
To Reset a program	Press and hold + for more than 1 second	If program has ended then 'PROGRAM END' will be displayed at the end of the program

Programs can also be operated from the **'P.STAT'** parameter found in the level 1 parameter list.

OR


OR


NOTE

- The program ramp rate is designed to reduce the heating 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.
- When the program ramp has ended or has been reset, the furnace will continue to maintain set point temperature. It will not cool to ambient temperature unless the set point is set to ambient temperature by the program or by the operator.
- When a step change is required, the ramp rate should be set to 'OFF'.
- Where ramp/dwell pairs are not required, the ramp rate should be set to 'OFF' and the target set point, TSP, the same as the preceding segment.
- END TYPE - when the end type is SP2, Timer END does not occur until the ramp is complete or SP2 is achieved. It is more usual to use a DWELL (default) or RESET end type.

Main Controller: 25x500 Segment Programmable

Eurotherm 3504 Controller

The 3504 temperature process controller is a single Loop PID based controller that can store up to 25 programs with up to 500 Segments. A 'Factory' code used to configure all the functions essential for temperature controlling process This includes input sensor type, measurement range, control options and alarms.

Controller Operation

After switching on the unit, the controller following a brief self-test sequence will start up in AUTO mode.

NOTE

Manual operation means that the controller output power is adjusted by the user. The input sensor is still connected and reading the PV but the control loop is open.

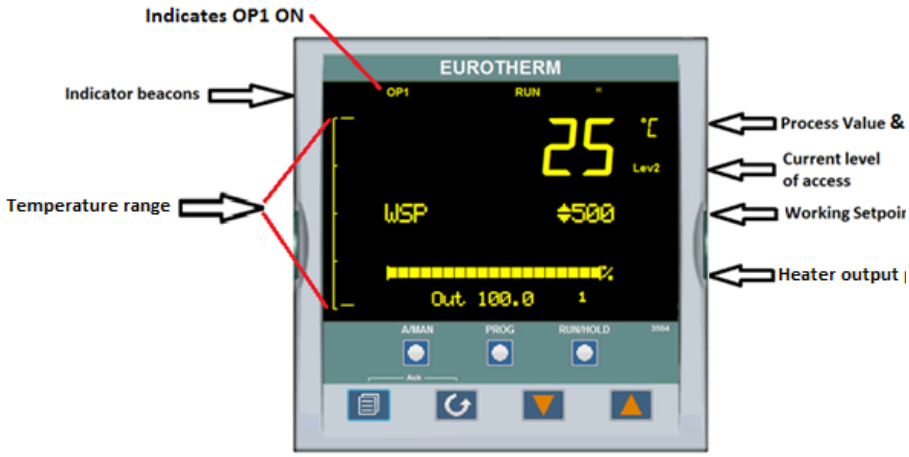
Auto means that the controller is automatically adjusting the output to maintain control, i.e., the loop is closed.

If the controller is in manual mode, 'MAN' light will be indicated.

If the controller is powered down in Manual operation, it will resume this mode when it is powered up again.

Auto tune can be performed at any time, but normally it is performed only once during the initial commissioning of the process. However, if the process under control subsequently becomes unstable (because its characteristics have changed), it may be necessary to tune again for the new conditions.

3504 Controller HOME display

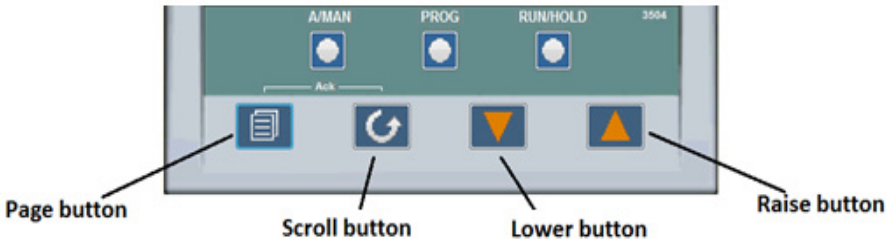


Beacon Display and Description

Beacon	Description
OP1	In a single loop controller OP1 indicates when HEAT is ON
MAN	MAN illuminates if Loop 1 is in manual mode. (The outputs from the controller are connected to devices on the plant which cause the heating (or cooling) demand to be adjusted resulting in a change in PV which, in turn, is measured by the sensor. This is referred to as closed loop control.)
ALM	If an alarm occurs, the red alarm beacon flashes. This is accompanied by a message showing the source of the alarm, for example 'Abs HI'. To acknowledge press and .
RUN	Illuminates when program running – flashing indicates End
HLD	Illuminates when program held
H	Flashes when H communication is active
A/MAN	Toggles the selected loop between Auto and Manual operation. Manual operation means that the controller output power is adjusted by the user. The input sensor is still connected and reading the Process Value (PV) but the control loop is open. Auto means that the controller is automatically adjusting the output to maintain control, i.e., the loop is closed. If the controller is in manual mode, 'MAN' light will be indicated. If the controller is powered down in Manual operation, it will resume this mode when it is powered up again.

Beacon	Description
PROG	To select the program summary page.
RUN / HOLD	Press once to start a program. 'RUN' will be indicated. Press again to hold a program. 'HLD' will be indicated. Press and hold for at least two seconds to reset a program. 'RUN' will flash at the end of a program. 'HLD' will flash during holdback.

The Operator Buttons



	Press to select a new list of parameters and from any display - press PAGE to return to the HOME Page
	Press to select new parameter from the page header. If held down it will continuously scroll through parameters.
	Press to decrease or change the state of a value.
	Press to increase or change the state of a value.

Shortcut Key Presses

Action	Key Presses
Backpage	Press ⊟ followed by ▲. With ⊟ held down continue to press ▲ to scroll page headers backwards. (With ⊟ still pressed you can press ▼ to page forward. This action is the same as pressing ⊟ alone).
Backscroll	When in a list parameters, press ↻ followed by ▲. With ↻ held down continue to press ▲ to scroll parameters backwards. (With ⊟ still pressed you can press ▼ to page forward. This action is the same as pressing ⊟ alone).

Action	Key Presses
Jump to HOME display	Press +
Alarm Ack/reset	Press + when the HOME screen is being displayed to jump to the 'Acknowledge All alarms' page. Pressing acknowledges all alarms if it can. Pressing cancels the operation.

To Select Manual Operation

Press 

(A/MAN) button.

Pressing the A/MAN button will toggle loop 1 between Auto and Manual. The beacon 'MAN' will light and the indication of output power is preceded by up/down buttons.

The output power will change continuously while either or is pressed.

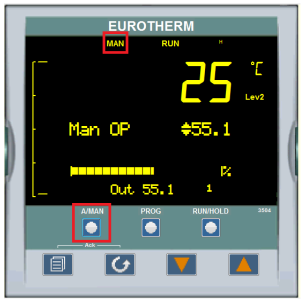


Table 3 Parameter Description and Accessibility

Parameter	Description	Value	Access
Units	Display Units	°C	Level1
ALARM.1.Threshold (AbsHi)	Alarm HIGH threshold	1510°C (Max value)	Read only
ALARM.1.HIGH Hysteresis	Alarm HIGH Hysteresis	1°C	Read only
ALARM.2.Threshold (AbsLo)	Alarm LOW threshold	0°C	Level2
ALARM.2.LOW Hysteresis	Alarm LOW Hysteresis	1°C	Level2
ALARM.3.Deviation (DevHi)	Alarm Deviation threshold	50°C	Level2
ALARM.3.Deviation HYS	Alarm Deviation Hysteresis	1°C	Level2
PV Offset	PV Offset	0°C	Level2
PV input type	Process Value type	Thermocouple	Read Only
Linearization Type	Type of TC	R-Type	Read Only
Logic Output Type	Type of output	Time proportional (Voltage output)	Read Only
Proportional Band	Proportional Band	20.7	Level2

Parameter	Description	Value	Access
Integral Time	Integral Time	161	Level2
Derivative Time	Derivative Time	27	Level2
Range High	Range High Limit	1525	Read Only
Range Low	Range Low Limit	0	Read Only
L2 pass code	L2 pass word	25	Read Only
Customer ID	Customer ID	200	Read Only

NOTE

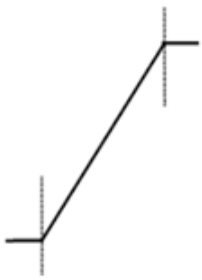
Level 1 = Operator, Level 2 = Customer Technician

Program Segment Types

Rate

A Ramp segment provides a controlled change of setpoint from an original to a target setpoint. The duration of the ramp is determined by the rate of change specified. Two styles of ramp are possible in the range, Ramp-Rate or Time-To-Target.

The segment is specified by the target setpoint and the desired ramp rate. The ramp rate parameter is presented in engineering units (°C, °F, Eng.) per real time units (Seconds, Minutes or Hours). If the units are changed, all ramp rates are re-calculated to the new units and clipped if necessary.

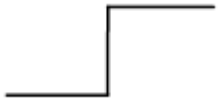


Dwell

The setpoint remains constant for a specified period at the specified target. The operating setpoint of a dwell is inherited from the previous segment.

Step

The setpoint changes instantaneously from its current value to a new value at the beginning of a segment. A Step segment has a minimum duration of 1 second.



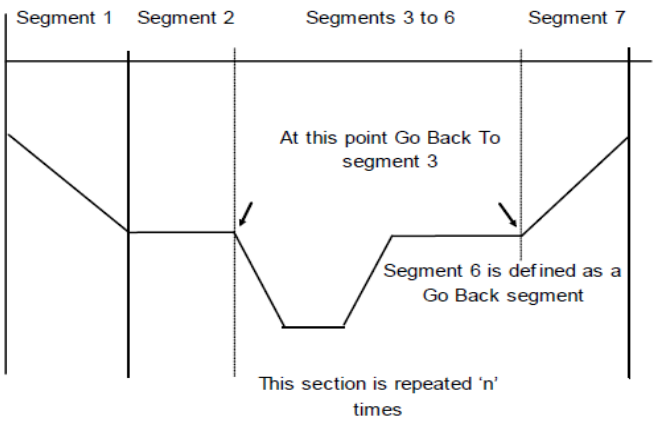
Time

A time segment defines the duration of the segment. In this case the target setpoint is defined and the time taken to reach this value. A dwell period is set by making the target setpoint the same value as the previous setpoint.

GoBack

Go Back allows segments in a program to be repeated a set number of times. The diagram shows an example of a program which is required to repeat the same section a number of times and then continue the program.

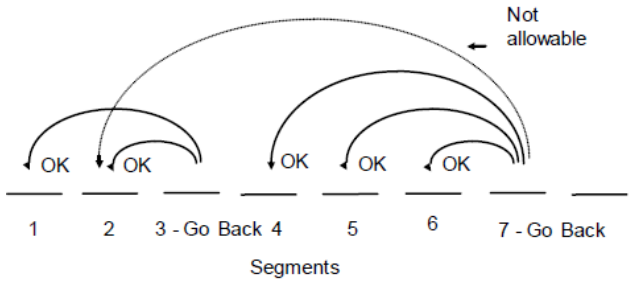
When planning a program it is advisable to ensure that the end and start setpoint of the program are the same otherwise it will step to the different levels.



'Goback Seg' specifies the segment to go back to 'Goback Cycles' specifies the number of times the Goback loop is executed Overlapping Goback loops are disallowed.

NOTE If a second or more 'Go Back' segments are created, they cannot return to a segment before the previous 'Go Back' segment as shown.

In this diagram a Go Back segment can be created from 3 to 2 or 1. Go Back segments can also be created from 7 to 6 or 5 or 4 but not from 7 to 2 or 1.



Call

A CALL segment is only available when single programmer mode is configured. CALL segments may only be selected in instruments offering multiple program storage.

The CALL segment allows programs to be nested within each other.

To prevent re-entrant programs from being specified, only higher number programs may be called from a lower program.
i.e., program 1 may call programs 2 through 50, but program 49 may only call program 50.

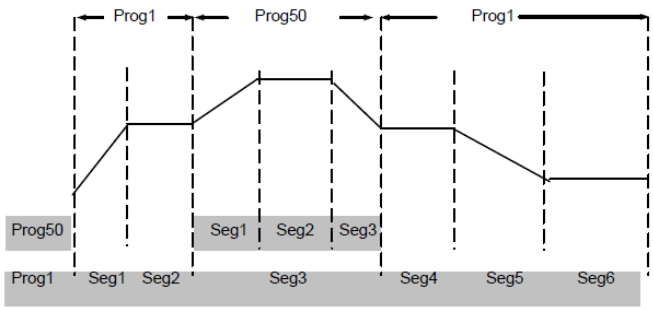
When a CALL segment is selected, the operator may specify how many cycles the called program will execute. The number of cycles is specified in the calling program. If a called program has a number of cycles specified locally, they will be ignored.

A CALL segment will not have a duration, a CALL segment will immediately transfer execution to the called program and execute the first segment of that program.

Called programs do not require any modification, the calling program treats any END segments as return instructions.

The example shows Prog 50 (Ramp/Dwell/Ramp) inserted in place of segment 3/Program1.

Prog 50 can be made to repeat using the ‘Cycles’ parameter.



End

A program may contain one End segment. This allows the program to be truncated to the number of segments required.

The End segment can be configured to have an indefinite dwell at the last target setpoint or to reset to the start of the program or to go to a defined level of power output (SafeOP). This is selectable by the user.

If a number of program cycles are specified for the program, then the End segment is not executed until the last cycle has completed.

Programmer Types:

Time to Target Programmer:

Each segment consists of a single duration parameter and a set of target values for the profiled variables.

1. The duration specifies the time that the segment takes to change the profiled variables from their current values to the new targets.
2. A dwell type segment is set up by leaving the target setpoint at the previous value.
3. A Step type segment is set up by setting the segment time to zero.

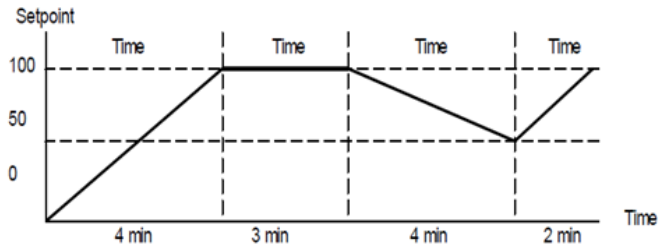


Figure 5 Time to Target Programmer

Ramp rate programmer

A ramp rate programmer specifies it's ramp segments as maximum setpoint changes per time unit. Each segment can be specified by the operator as Ramp Rate, Dwell or Step.

1. Ramp Rate– The setpoint changes at a rate in units/time.
2. Dwell– The time period is set – there is no need to set the target value as this is inherited from the previous segment.
3. Step – Specify target setpoint only – the controller will use that setpoint when the segment is reached.

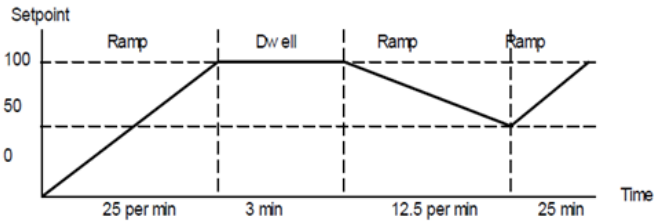


Figure 6 Ramp Rate Programmer

Program Edit Summary Parameters:

The table below shows a list of all possible parameters which may be set up in operator Levels 1 and 2 using the procedure in the below programming example.

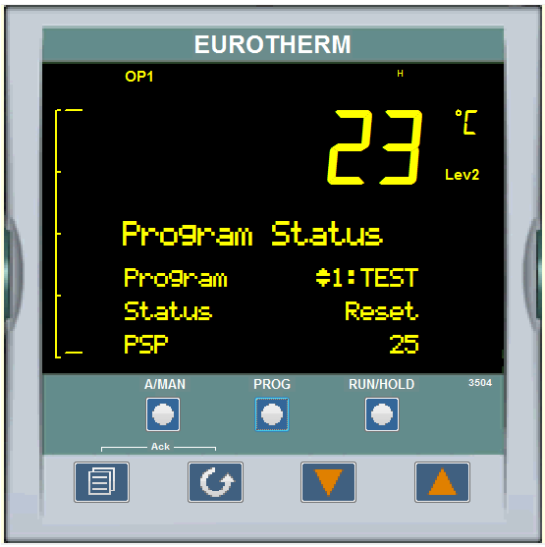
Parameter Name	Parameter Description	Value	
Program	Program number (and name if this has been configured)	1 to 25	
Segments Used	Displays the number of segments in the program. This value automatically increments each time a new segment is added	1 to max number of segments (500)	
Ch1HldBkVal	Channel 1 holdback value	0 to 99999	
Cycles	Number of times the whole program repeats	Continuous Repeats 1 to 999 times	
Segment	To select the segment number	1 to 50	
Segment Type	Defines the type of segment. The type of segment varies depending on whether the program is Single, SyncAll or SyncStart. Call only available in single programmer Rate, Dwell, Step not available in SyncAll programmer	Rate	Rate of change of SP
		Time	Time to target
		Dwell	Soak at constant SP
		Step	Step change to new SP
		Wait	Wait for condition
		GoBack	Repeat previous segs
		Call	Insert new program
		End	Final segment
Target SP	Value of SP required at the end of the segment.	Range of controller	
Ramp Rate	Rate of change of SP. Only shown if the Segment Type = Rate.	Units/sec, min or hour	
Holdback Type	Deviation between SP and PV at which the program is put into a hold condition to wait for the PV to catch up. Only appears if configured	Off Low High Band	No holdback PV<SP PV>SP PV<>SP
Duration	Time for a Dwell or Time segment. Only shown if Segment Type = Time.	0:00:00 to 500.00 secs, mins or hours	
End Type	Defines the action to be taken at the end of the program	Dwell	Continue at current SP
		SafeOP	Go to a defined level
		Reset	Reset to start of prog
GoBack Seg	Only appears if the segment type is ‘GoBack’. It defines the segment to return to repeat that part of the program	1 to the number of segments defined	

To Select and Run a Program

This example assumes the program to be run has already been entered, to create program follow steps as in the “Create a Program”

1. Press PROG button.

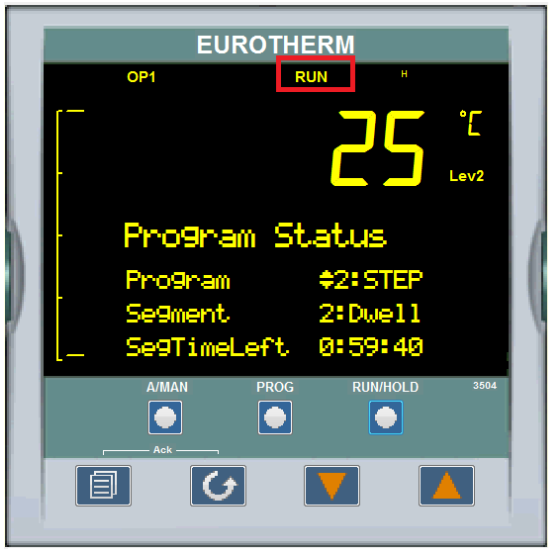
2. Select the program by pressing Lower or Raise button.



3. After selecting the desired program press RUN/HOLD button.

4. Once the program is loaded, RUN will show on display.

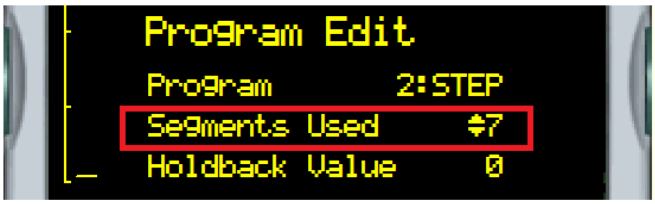
5. To HOLD a program, press RUN/HOLD button.



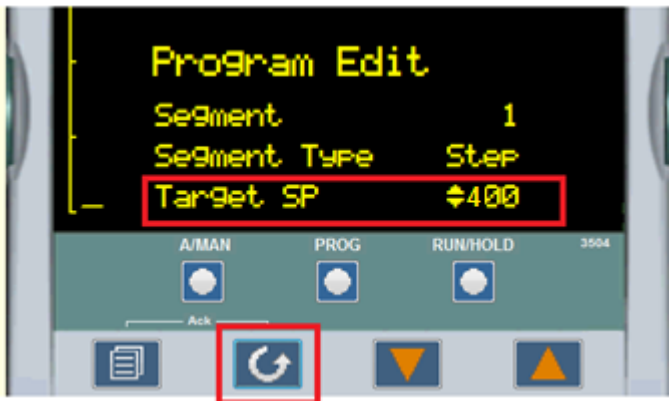
6. Press RUN/HOLD button again to continue the program.
7. To Reset a program, Press and hold RUN/HOLD button for at least 3 seconds. Program will be re-started from beginning at the first program step.

Steps to Edit the Target SP and Duration

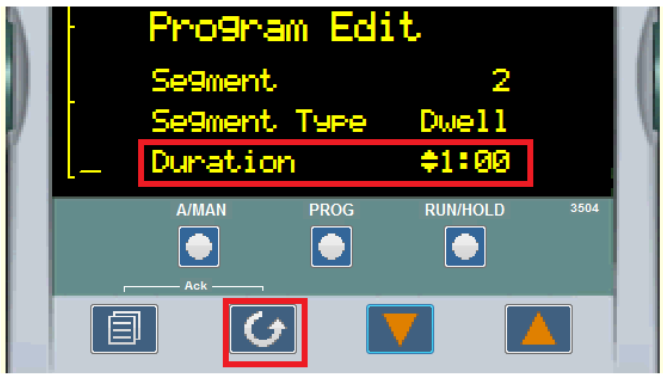
1. Press PROG button.
2. Press PAGE button.
3. Select the program STEP by pressing Lower or Raise button.
4. Press SCROLL button to edit the program.



5. In this program, total 7 segments are used. Press SCROLL button until segment1 Target SP is selected.

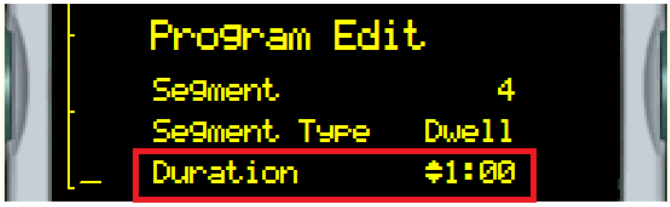


6. Change the segment1 Target SP by pressing Lower or Raise button with desired value, the controller will accept the new value, which is indicated by a brief flash of the display.
7. Press SCROLL button until segment2 Duration is selected.

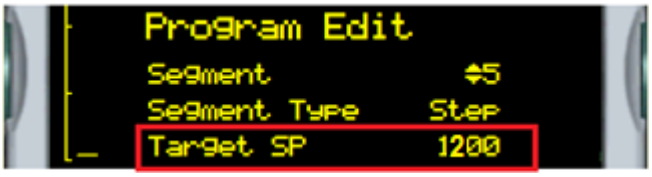


8. Modify segment2 Duration by pressing Lower or Raise button (HH:MM rmat), the controller will accept the new value which is indicated by a brief flash of the display.
9. Press SCROLL button until segment3 Target SP is selected.

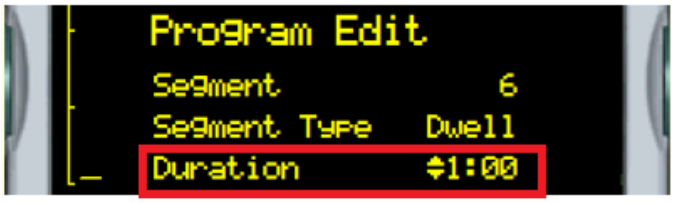
10. Change the segment3 Target SP by pressing Lower or Raise button with desired value, the controller will accept the new value which is indicated by a brief flash of the display.
11. Press SCROLL button until segment4 Duration is selected.



12. Modify segment4 Duration by pressing Lower or Raise button (HH:MM format), the controller will accept the new value which is indicated by a brief flash of the display.
13. Press SCROLL button until segment5 Target SP is selected.



14. Change the segment5 Target SP pressing Lower or Raise button with desired value, the controller will accept the new value which is indicated by a brief flash of the display.
15. Press SCROLL button until segment6 Duration is selected.



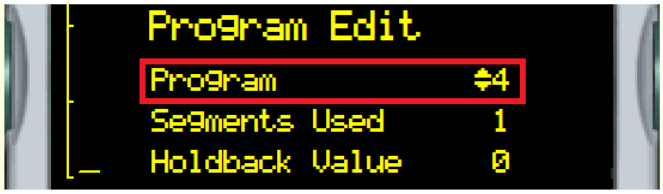
16. Modify segment6 Duration by pressing Lower or Raise button (HH:MM format), the controller will accept the new value which is indicated by a brief flash of the display.
17. Press SCROLL button until segment7 Safe OP is selected.

18. This completes the program edit with Target SP and duration values.

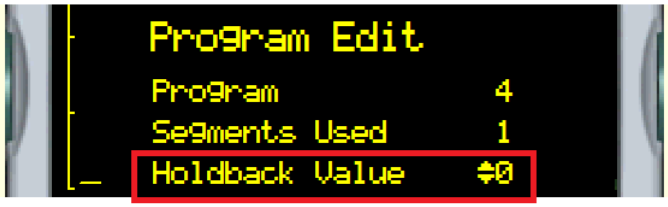
NOTE To create or edit the program user must change the level of access to “L2”.

To Create a Program

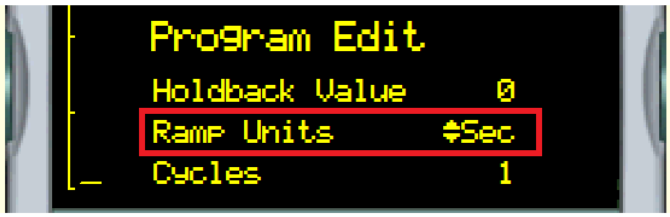
1. Press PROG button.
2. Press PAGE button.
3. Select the program from available programs of 4 to 25 which are empty.
4. Press SCROLL button to edit the program.



5. Press SCROLL button to select Holdback Value.



6. Keep Holdback value 0.
7. Press SCROLL button to select Ramp Units, default is Sec.



8. Press SCROLL button and change the Cycles value to repeat the program if needed with the Lower or Raise button.

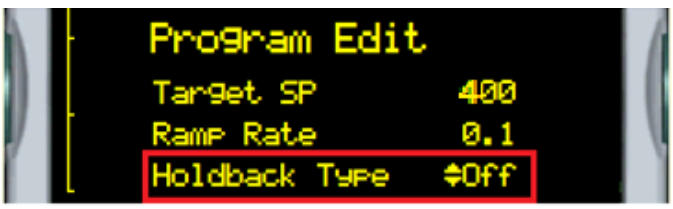
9. Press SCROLL button until Segment1 Segment Type is displayed, change Segment Type as per the requirement, in below example segment type is selected as Rate.

10. Press SCROLL to select Segment1 Target SP, modify Target SP as per the requirement with the Lower or Raise button, the controller will accept the new value which is indicated by a brief flash of the display.

11. Press SCROLL to select Ramp Rate, its default value is 0.1 (Ramp rate/Sec). It can be altered as per the requirements with the Lower or Raise button, the controller will accept the new value which is indicated by a brief flash of the display.

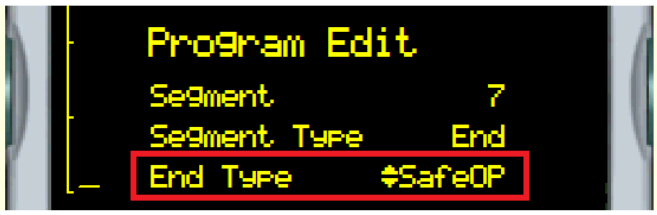
12. Press SCROLL to select Holdback Type, its default value is Off.

13. Press SCROLL to select Event Outs, Skip all Event outs by pressing SCROLL button.



14. Continue the program by entering next Segment values as shown in the above steps.

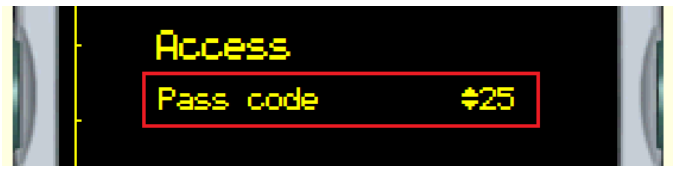
15. To end the program select segment type as END and END Type as SafeOP with the Lower or Raise button. In some cases, program segment can be selected as Dwell to maintain constant setpoint for a duration as per the requirements.



To Change the Access level from L1 to L2 (Level 1 to Level 2)

1. Press PAGE until display shows Access menu, change Goto value to Level 2 with Lower or Raise button.

2. Press Raise button to enter pass code, its value is 25.



3. Then controller will grant the access to modify parameters.

NOTE Some parameters are protected under a higher level of security – Level 2. In these cases it will be necessary to select 'Access Level 2'. (Example: For Auto tune, to change the PV offset value).

Level 1 Access = Operator; Level 2 Access = Engineer.

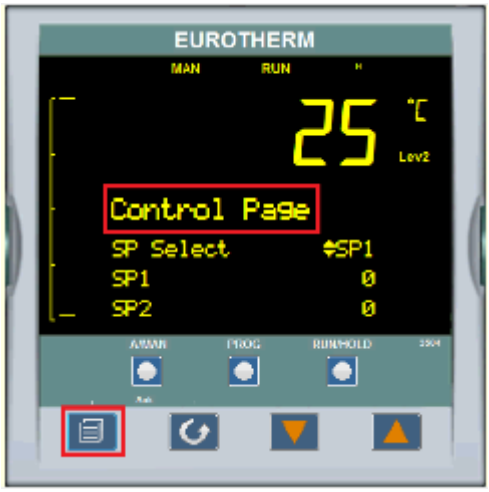
Auto Tune

Auto Tune is used to set the control terms (PID values) as close as possible to match the characteristics of the process.

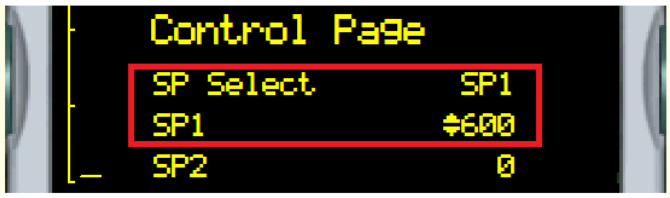
It uses the auto tuner which works by switching the output on and off to induce an oscillation in the process value. For this reason, the auto tune process should be done off line but using load conditions as close as possible to those to be found in practice. From the amplitude and period of the oscillation, it calculates the control parameter values.

Steps to Auto Tune:

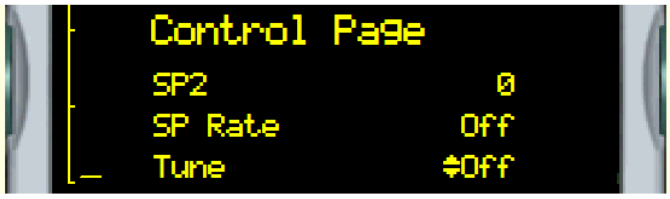
1. Press PAGE button until Control Page is displayed on the controller screen.(access in Level 2)



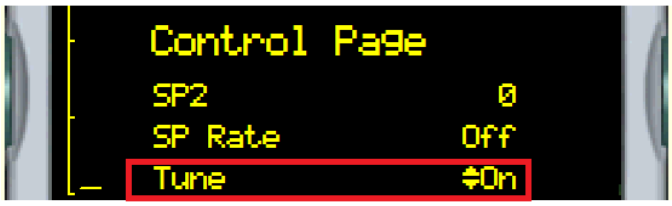
2. Press SCROLL button to select SP1.
3. Change the SP1 value to desired value for tuning with up/down buttons. (In following example SP1 is selected as 600°C). The controller will accept the new value and is indicated by a brief flash of the display.



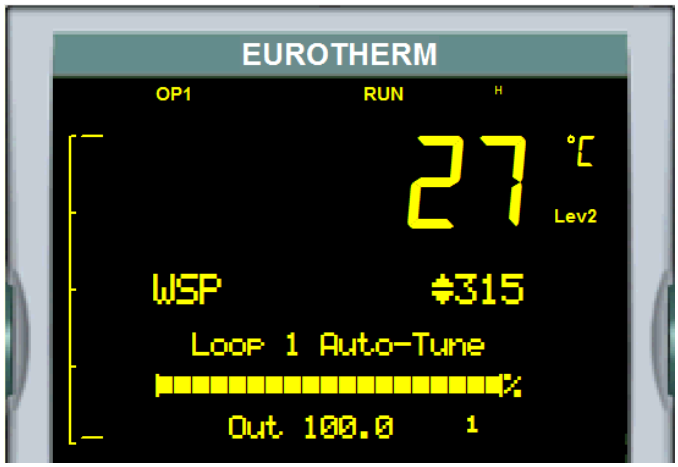
4. Press SCROLL button until TUNE is selected.



5. Change the Tune value ON with UP button.



6. Press PAGE + SCROLL buttons to start the Auto tune process.
7. Controller begin the Auto tuning process.



8. Once after Auto tune, new PID value will be loaded in to the controller with respective to the tuned SP value.

NOTE In the Factory, PID values are Auto tuned to 550°C.

It is recommended to tune to desire Setpoint for best accuracy.

After Auto tune, PID value will be changes with respect to tuned setpoint value.

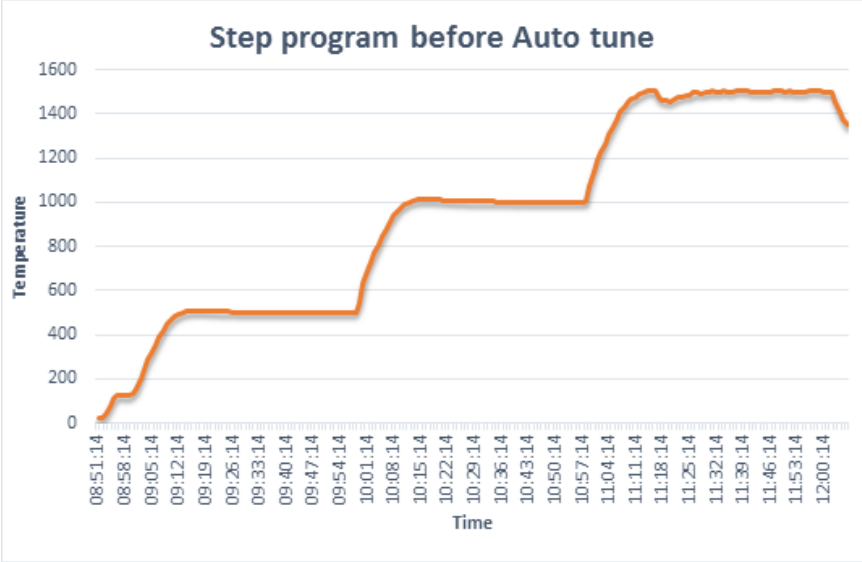


Figure 7 Graph data without Auto tune(Shown example for 1500°C Furnaces)

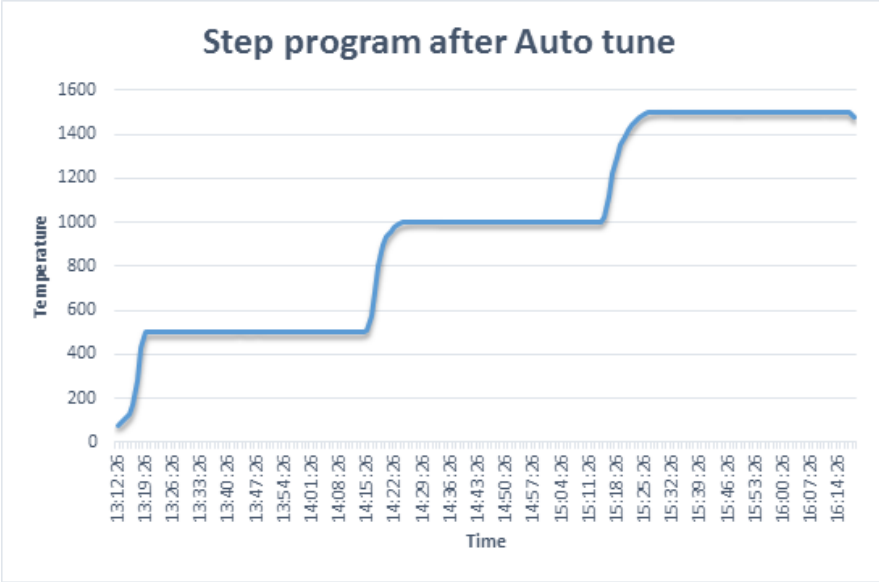
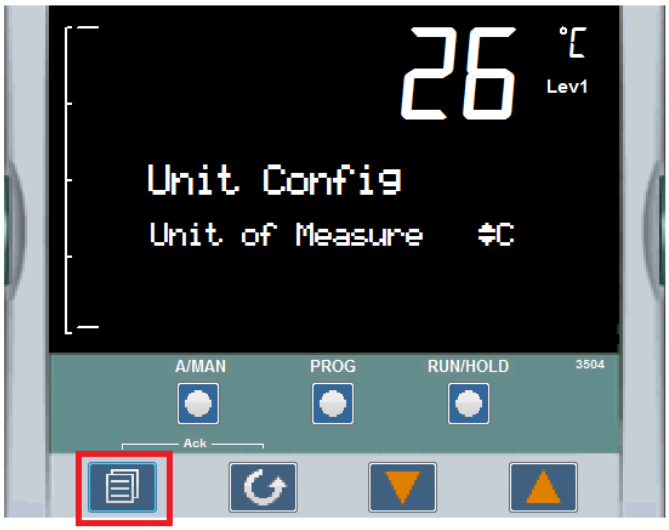


Figure 8 Graph data with Auto tune(Shown example for 1500°C Furnaces)

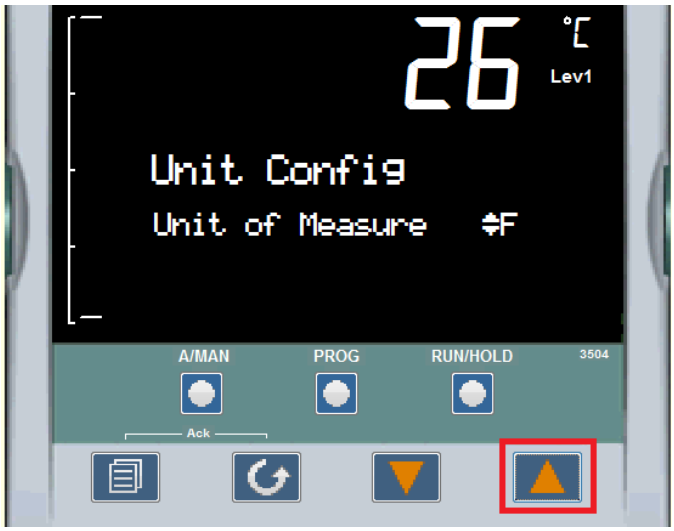
To Change the Display Units

Units of measure can be altered in Level 1 access

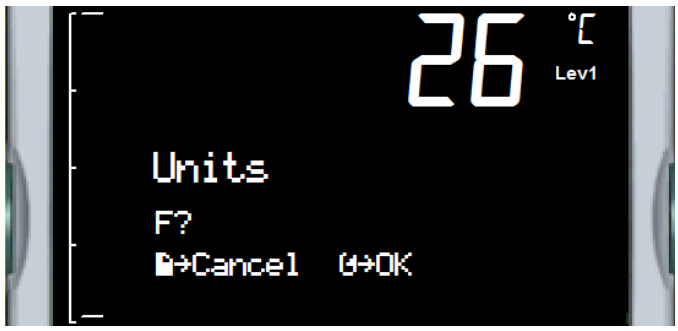
1. Press PAGE until below image is displayed on the screen.



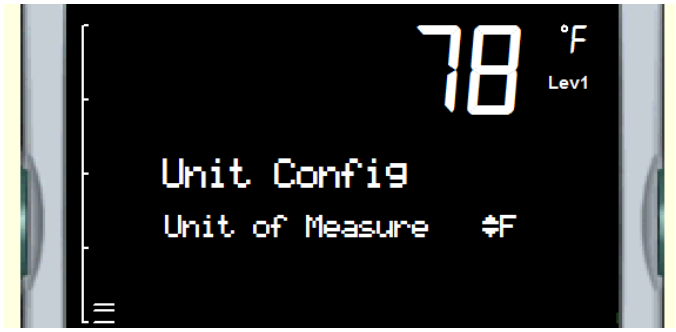
2. Press RAISE button to change the Units type to F.



3. Press SCROLL button to accept the change.

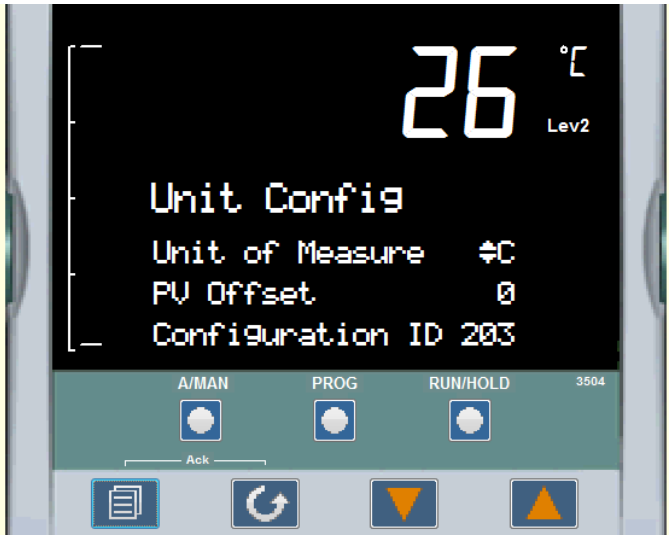


4. Display Units will be updated from Celsius to Fahrenheit.

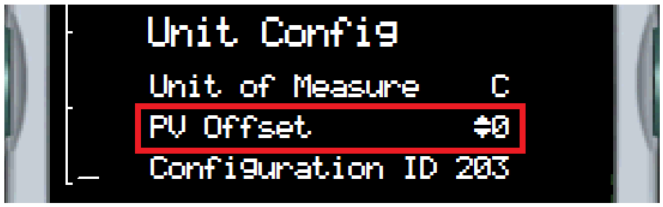


To Change the PV Offset

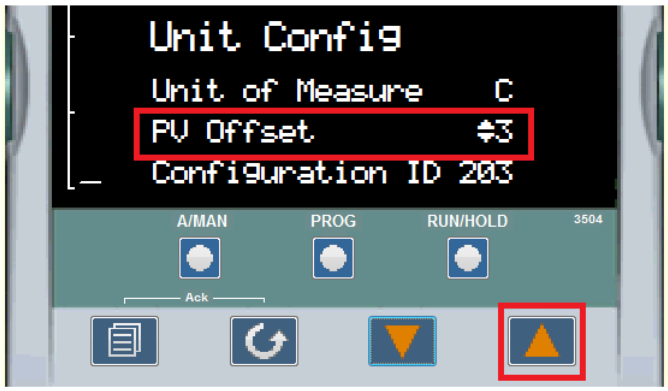
1. Get the Level 2 access to adjust the process offset value.
2. Press PAGE until following image is displayed on the screen.



3. Press SCROLL until PV Offset value get selected.

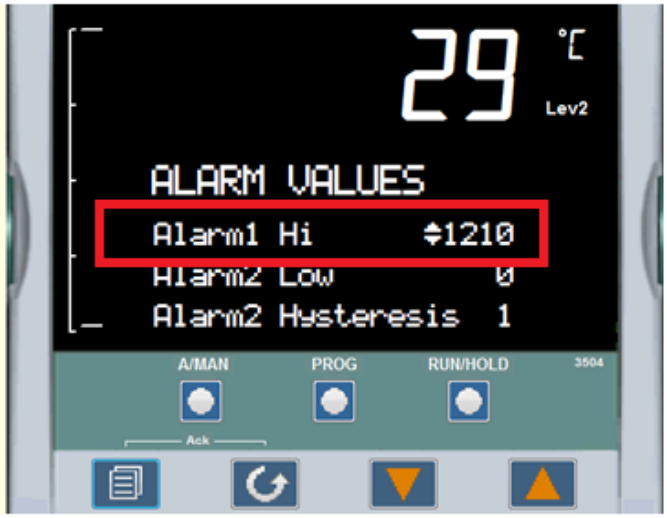


4. Modify PV offset value as per requirement, the controller will accept the new value which is indicated by a brief flash of the display.



To Change the ALARM Values

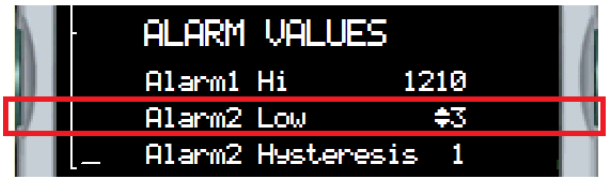
1. Get the Level 2 access to adjust the ALARM Values.
2. Press PAGE until following image is displayed on the screen.



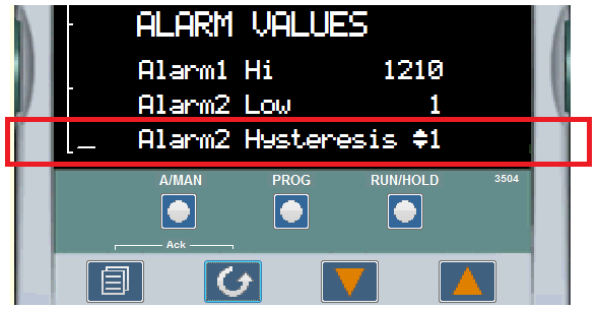
3. "Alarm1 Hi" is read only value in both L1 and L2 access.

4. Press SCROLL button to select Alarm2 Low threshold value.

5. Press RAISE/LOWER buttons to change Alarm2 Low Threshold value, the controller will accept the new value and is indicated by a brief flash of the display.



6. Press SCROLL button to select Alarm2 Hysteresis value.

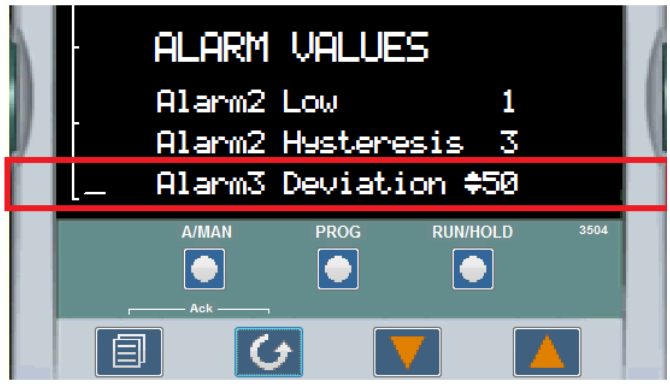


7. Press RAISE button to change Alarm2 Hysteresis value, the controller will accept the new value and is indicated by a brief flash of the display.

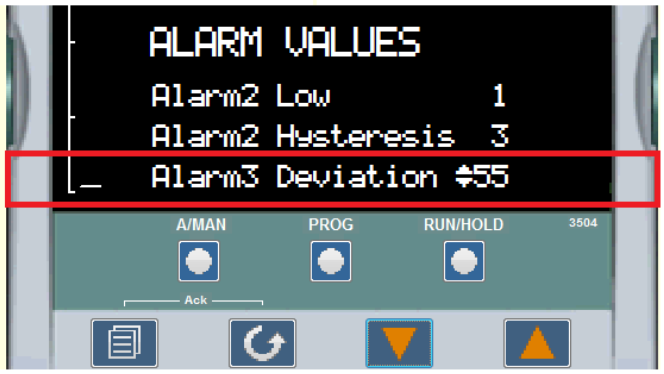
NOTE Alarm1 (Absolute high) is read only; Alarm2 and Alarm3 are L2 access alarms.

To Change the ALARM3 and its HYSTERESIS values (Deviation Alarm)

1. Press PAGE until following image is shows on the display.
2. Press SCROLL to select Alarm3 Threshold value.



3. Press raise/lower buttons to change Alarm3 Deviation value, the controller will accept the new value which is indicated by a brief flash of the display.



4. Press SCROLL button to select Alarm3 Hysteresis value.

5. Press Raise button to change Alarm3 Hysteresis value, the controller will accept the new value which is indicated by a brief flash of the display.

NOTE Alarm1 HIGH Threshold value should not be greater than 1525°C

Deviation High - an alarm occurs when the PV is higher than the setpoint by a set threshold.

Operation - 3216i Over Temperature Controller

The 3216i controller serves as the Excess Temperature controller, when installed in the unit, provides an additional, independent temperature control system to help protect products from excess temperatures. The excess temperature controller is a single setpoint controller, which provides a single digital display to indicate the setpoint temperature (excess temperature Alarm threshold).

The Excess Temperature Alarm Threshold is typically set about 50°C (122°F) above the operating temperature of the chamber to account for variance for the process value temperature of the chamber. For example, Chamber temperature = 1500°C (2732°F) then Excess Temperature Alarm Threshold = 1510°C (2750°F). The maximum allowable Excess Temperature Alarm Threshold for this unit is 1550°C (2822°F) or +50°C (122°F) from maximum rating of the chamber temperature.

Excess temperature controller features are OTP (Over temperature protection), sensor break protection, and power failure indication.

NOTE *After turn on the unit & power failure, user must press PAGE button + SCROLL button for the normal operation of the unit.

Table 4 Default settings for the Excess temperature controller (STF55433PBC-1, STF55433PBCOMC-1)

Parameter	Description	Level	Access
ALARM.1.Threshold	Excess temp threshold	1550°C	Level 1+2 Read/Write
ALARM.1.Hysteresis	Alarm Hysteresis	1°C	Level 2 Read only
INPUT.Units	Display Units	°C	Level 1+2 Read/Write
INPUT.PVInValue	PV Input Value	Displays Process Value	Level 1+2 Read only
ACCESS.HomeDisplay	Home Display	Excess temp threshold (1550°C)	Level 1+2 Read/Write
INPUT.PeakHigh	Peak High	Peak High PV value	Read only
INPUT.PeakReset	Peak Reset	Peak Reset	Level 1+2 Read/Write
INPUT.PVOffset	PV Offset	+/- adjusted with respect to main controller PV reading	Level 1+2 Read/Write
Customer ID	Customer ID	1500	Level 2 Read only

NOTE *Level 1+2 Read Only states that, Level 1 gives Read only access to user where as Level 2 gives Write access along with Read access.

NOTE To enter Level 2 and Level 1 refer to the section “To Enter Level 2” .

Table 5 Default settings for the Excess temperature controller (STF55433BC-1, STF55433BCOMC-1)

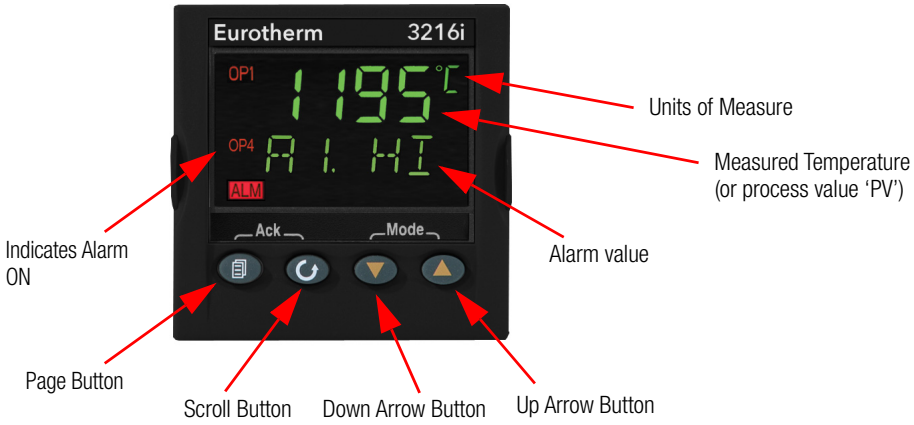
Parameter	Description	Level	Access
ALARM.1.Threshold	Excess temp threshold	1550°C	Level 1+2 Read/Write
ALARM.1.Hysteresis	Alarm Hysteresis	1°C	Level 2 Read only
INPUT.Units	Display Units	°C	Level 1+2 Read/Write
INPUT.PVInValue	PV Input Value	Displays Process Value	Level 1+2 Read only
ACCESS.HomeDisplay	Home Display	Excess temp threshold (1550°C)	Level 1+2 Read/Write
INPUT.PeakHigh	Peak High	Peak High PV value	Read only
INPUT.PeakReset	Peak Reset	Peak Reset	Level 1+2 Read/Write
INPUT.TimeUnits	Time Units	Mins	Level 1+2 Read/Write
INPUT.Time	Time exceeded	Time in alarm	Level 1+2 Read/Write
INPUT.PVOffset	PV Offset	+/- adjusted with respect to main controller PV reading	Level 1+2 Read/Write
Customer ID	Customer ID	1502	Level 2 Read only

NOTE *Level 1+2 Read Only states that, Level 1 gives Read only access to user where as Level 2 gives Write access along with Read access.

NOTE To enter Level 2 and Level 1 refer to the section “To Enter Level 2” .

Over Temperature controller Operation

When the controller is turned ON it will perform a short self-test and then display a default page as shown in the below image. The excess temperature Alarm threshold (setpoint) is found in the display. This excess temperature controller will be configured with respect to its functionality in the factory.



Buttons and Indicators

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.

Operational Instructions

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

1. To turn on the Load:

   Press PAGE and SCROLL buttons to acknowledge the "ALM".

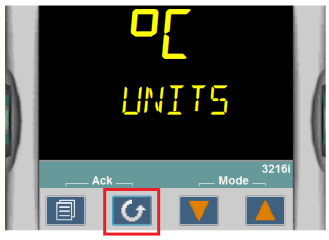
Following image will be displayed after acknowledging the ALARM and load (heating element) will be turned on.

2. To change the Display Units:

   Press SCROLL button until “UNITS” is displayed, then change the desired unit’s type with up/down arrow. 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.

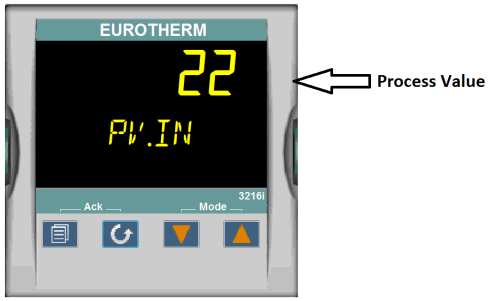
   Press PAGE button to return to HOME display.

   Units Choice of Celsius (°C), Fahrenheit (°F), Kelvin (°K), Percentage (%), or None (none).



3. To get the PV value (Process Value):

   Press SCROLL button until “PV.IN” shows on the controller display.



4. To change the Excess temperature Alarm threshold (High Limit / Setpoint)

   Press the SCROLL button until “A1.HI” is displayed, then press the UP or DOWN button for the desired alarm threshold 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.

5. To change the ALARM HYSTERSIS

   Press the SCROLL button until "A1.HYS" is displayed, then press the UP or DOWN button for the desired HYSTERSIS 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.

6. To get the Peak High Temperature reading

   Press SCROLL button until "HIGH" shows on the controller display. (example: below image shows maximum achieved temperature since the unit powered up)

7. To REST the Peak High Temperature rating

   Press scroll button until “P.RST” shows on the screen. Press UP or DOWN button to rest peak values to the current process values.

Value Options

0 (OFF): Peak values not reset
1 (ON): Peak values reset

8. Sensor Break

   Check for Thermocouple connection if controller displays below message.

9. TIME UNITS

   Press SCROLL button until TIME UNITS shows on the controller display.

   (example: below image shows alarm time units are set as Minutes)

10. TIME

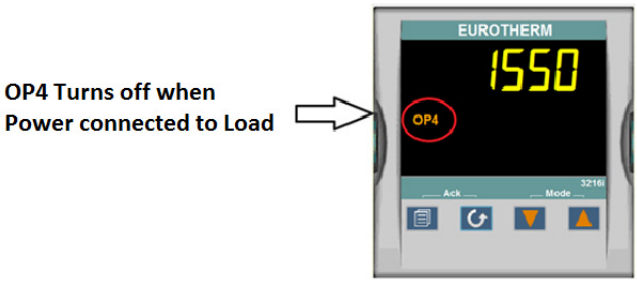
Press SCROLL button until TIME shows on the controller display. The value shown on display is Time in Alarm.

(example: below image shows ALARM ON time, since the alarm raised on the controller)

11. OP4 (Output4)

Output is controlled thought Relay and the logic is inverted in the configuration file with respect to the excess temperature functionality.

When “OP4” is illumined load is not powered up and when “OP4” is not illuminated load is powered up.



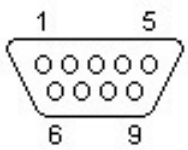
Communication Option

The factory installed optional RS 485 Digital Communications Port allows controller to be connected to a PC for remote monitoring and control of the furnace. The equipment with communication option (COM) is equipped with two DB9 serial ports (1 Male port & 1 Female port). These ports are intended for connection to the PC or a Laptop & making a communication chain of furnace with communication option (COM) Capability. The RS 485 communication allows multiple devices (up to 30) to communicate at half-duplex on a single pair of wires, plus a ground wire..

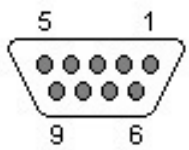
NOTE The RS 485 pin should match with your DB9 to USB or 232 adapters for the communication option to work.

Furnace DB9-Pinout	RS 485 Output
Pin 2	A / D-
Pin 3	B / D+
Pin 5	Ground

DB-9 Male



DB-9 Female



Adapters - RS 485 to RS 232/USB

The communication option requires an RS 485 to USB Adapter or RS 485 to RS 232 Adapter to for the furnace to communicate with the PC or Laptop. The RS 485 to USB or RS 485 to RS 232 adapter with terminal block is recommended for free wire connections. RS 485 adapter is suggested as pin connections vary with different adapter manufacturers and may not work properly if they don't match with the above DB9 pinout of the furnace.

NOTE Please ensure the adapter is compatible with the operating system of your PC/Laptop. Some adapters need driver softwares & port access privileges on your PC/Laptop for proper functioning. Please contact your local IT for assistance.

NOTE Contact Thermo Fisher Scientific for availability for serial cable connections

Host Computer & Software

The host computer can communicate with furnaces with communication option (COM). A data logging & control software is required for data logging & control of the furnace using the RS 485 communication. Thermo Fisher Scientific does not provide any software - please refer to specialized software suppliers like SpecView or Eurotherm. These softwares can communicate with either a single Furnace or a network of several Furnaces with the communication option.

3504_Controller Parameters for Communication

Table 4 3504 Controller Parameters for Communication

Parameter	Value
Comms Module Identity	Comms (67)
Communications Protocol	Modbus
Baud Rate	9600_baud (0)
Parity	even(1)
Comms Address	1
Comms Wait States	No (0)
Single value Broadcast Enable	No (0)
Network Watchdog Flag	Off (0)
Network Watchdog Action	Auto (1)
Network Watchdog Timeout	0
Network Watchdog Recovery	0

3216_Controller Parameters for Communication

Table 5 3216 Controller Parameters for Communication

Parameter	Value
Comms Module Identity	Comms (67)
Communications Protocol	Modbus
Communication Interface	RS 485
Baud Rate	9600_baud (0)
Parity	none
Comms Address	1

Troubleshooting Communications

If your connection is not working properly, check the following conditions:

A. Verify complete and tight cable connections between the furnace and the PC.

B. Verify that power has been supplied to the unit and temperature controller before starting the software program.

c. Verify DB-9 pin connections as shown in wiring diagram, interchange 2 & 3 connections if communication is not working.

d. Verify the configuration values in the controller, listed in the Table 4, “3504 Controller Parameters for Communication” Table 5, “3216 Controller Parameters for Communication”.

Maintenance & Cleaning

CAUTION : Maintenance should only be performed by trained personnel.

WARNING : Disconnect furnace from main power before attempting any maintenance to furnace or its controls.

WARNING : Use appropriate Personal Protective Equipment (PPE) per local protocols.

WARNING : When installing, maintaining or removing the refractory insulation, the following precautions will minimize risk of airborne dust and ceramic fiber:

- Keep personnel not involved in maintenance out of the area.
- Use a good vacuum to clean area and equipment. Do not use compressed air.
- Use NIOSH high efficiently respirator (3M #8710 or equivalent).
- Wear long sleeve clothing, gloves, hat and eye protection to minimize skin and eye contact. Do not wear contact lenses.
- Thoroughly wash self after work is complete.
- Launder work clothing separate from other clothes and thoroughly clean laundering equipment after use. If clothing contains a large amount of dust and/or ceramic fiber, dispose of rather than clean.
- Promptly place used ceramic fiber parts and dust in plastic bags and dispose of properly.

Thermocouple Replacement

WARNING : Disconnect furnace from main power before attempting any maintenance to furnace or its controls.

NOTE For optimal performance, the thermocouple should be replaced once a year. In some situations a more frequent replacement schedule is recommended. S.br Fail on the controller display indicates a broken thermocouple.

Refer to Figure 9 “Thermocouple Replacement” as you perform the following procedure:

1. Disconnect the main power.
2. Remove the eight corner screws from the back furnace panel. Locate the thermocouple (item #1 in Figure 9).

NOTE There are wires connecting the back panel to the furnace. Be careful to place the back panel next to the furnace without disturbing these wires.

3. Note polarity and thermocouple wire location. Remove the terminal screws and remove the thermocouple lead wires. Refer to Figure 13 “Wiring Diagram STF55433 series”, 14 “Wiring Diagram STF55433P Series”
4. Remove the thermocouple mounting screws.
5. Pull the thermocouple straight out of the heating unit.

NOTE The thermocouple could be damaged if it is not pulled out carefully.

6. Slide the new thermocouple straight into the heating unit and replace the mounting screws.
7. Connect the thermocouple lead wire to the terminal screws on the thermocouple. Be careful not to bend the thermocouple wire. Red is always negative. (If the extension leads are black and white, white is negative). Refer to Figure 13 “Wiring Diagram STF55433 series”, 14 “Wiring Diagram STF55433P Series” for additional wiring information.
8. Replace the furnace rear panel.

NOTE Inspect all wire connections before reassembling the back panel.

WARNING : Failure to check all wire connections may cause damage to the unit.

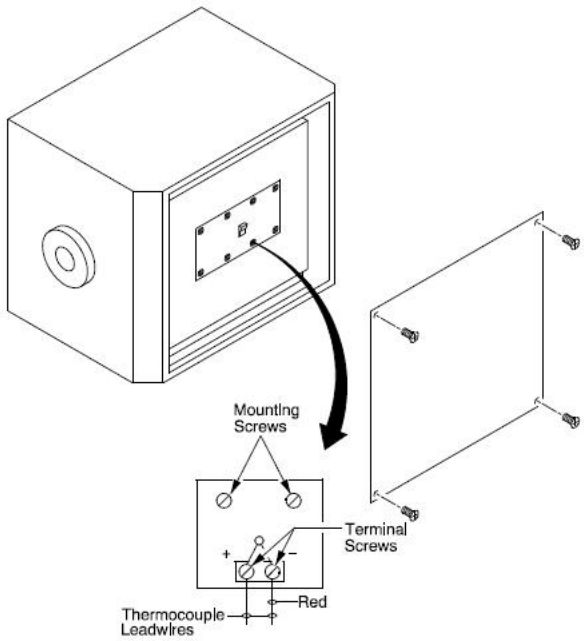


Figure 9 Thermocouple Replacement

Heating Element Replacement

WARNING : Disconnect furnace from main power before attempting any maintenance to furnace or its controls.

The STF55433 heating elements must be matched in Amps values. Perform a continuity check on the elements to determine which element is bad. Mark the other elements with their Amp value they can be used again if matched with elements with the Amp Value.

CAUTION : When installing new elements, always replace all elements so the Amps value match. Refer to the Heater manual included with the furnace for additional installation and handling instructions.

To install the heating elements, complete the following steps (refer to Figure 10“Heating Element Replacement”):

1. Disconnect the main power.

CAUTION : This product contains ceramic fiber or other refractory which can result in the following:

- May be irritating to skin, eyes and respiratory tract.
- May be harmful if inhaled.
- May contain or form Cristobalite (crystalline silica) with use at high temperature (above 871°C) which can causes severe respiratory disease.
- Possible cancer hazard bases on test with laboratory animals. Animal studies to date are inconclusive. No human exposure studies with this product have been reported.

2. Remove the furnace front and back panels.
3. Use the extension tool to remove the C clamps, and remove the element straps.
4. Carefully remove each heating element. Save any old elements that are still operational for later use.
5. Carefully unwrap one of the new heating elements.
6. Hold the element with two hands and gently insert the element into the terminal hole.
7. Slide the element into the terminal hole and through the furnace.

CAUTION : Wear gloves and a face mask when handling the ceramic wool.

8. Pack ceramic wool around the heating element between the furnace and the element. Make sure that the ceramic wool fills all spaces so that no heat is lost during operation.

NOTE The ceramic wool should only extend 0.5 to one inch inside the terminal hole.

9. Slide the rest of the elements into the terminal holes and pack ceramic wool around each element.
10. Use the expansion tool to spread a C clamp and place the clamp over a braided wire and element connection. Remove the expansion tool. Repeat with the other element.
11. Use the expansion tool to spread a C clamp and place the clamp over the braided wire and element connection.Remove the expansion tool.

CAUTION : Make sure that the braided wires do not come In contact with any metal other than the element terminals.

12. Refer to the wiring diagram in Section “Wiring Diagram” for the wiring configuration, front and back. Continue until all heating elements are installed.
13. Replace front and back furnace panels.

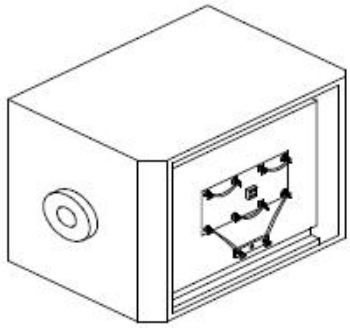


Figure 10. Heating Element Replacement

Control Module Replacement

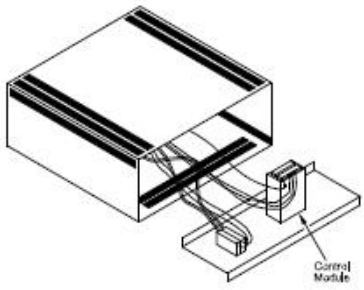


Figure 11. Control Module Replacement

WARNING : Disconnect furnace from main power before attempting any maintenance to furnace or its controls.

To replace the control module, complete the following steps (refer to Figure 11“Control Module Replacement”):

1. Disconnect main power and switch the circuit breaker to the OFF position.
2. Remove the two screws located on each side of the furnace near the lower front. Pull the control panel forward and swing to the horizontal position to access the module.

NOTE

If the control panel does not detach easily, insert the blade of a small screwdriver between the panel and the side of the control and gently pry the control panel out.

3. Note the terminal connections of the wires and label them for reattachment. Remove power input and output wires from the back of the control module. Observe polarity for the thermocouple lead wire. Red is always negative.
4. Unscrew and remove the mounting brackets from the module.
5. Remove the module.
6. Install the replacement instrument by reversing the above procedure.
7. Slide the bottom edge of the control panel under the lip inside the control and gently push the panel back into position.
8. Replace the screws.

NOTE The top of the control panel is recessed at a 5° angle.

Solid- State Relay Replacement.

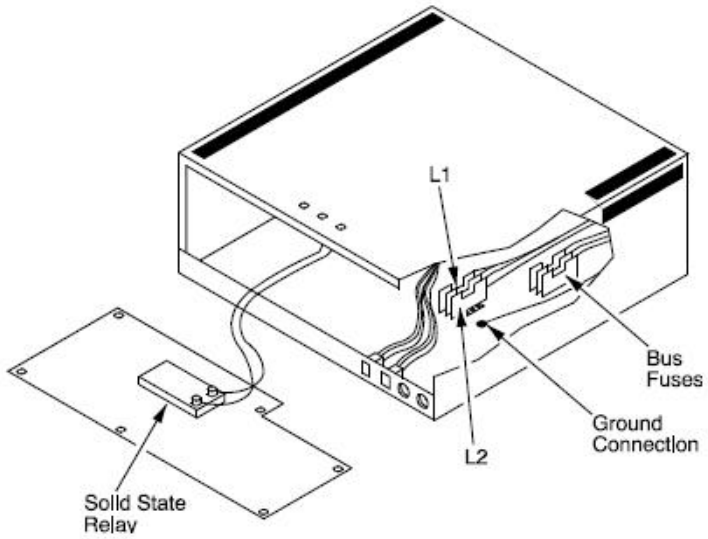


Figure 12. Control

Refer to the “Troubleshooting” Section for relay testing. If the solid-state relay is inoperable, complete the following steps to replace the relay (refer to Figure 12“Control”):

WARNING : Disconnect furnace from main power before attempting any maintenance to furnace or its controls.

Remove the five screws located on the control back panel.

1. Swing the panel down to the horizontal position.
2. Locate the solid-state relay on the back panel (refer to Figure 12“Control”).
3. Note the terminal connections of the relay wires and label them for reattachment. Remove the wires from the terminals of the relay.
4. Remove the mounting screws from the relay.
5. Replace the relay and reconnect the wires.
6. Reassemble the unit.

Control Fuse Replacement

WARNING : Disconnect furnace from main power before attempting any maintenance to furnace or its controls.

To replace the fuses located on the control back panel, complete the following steps:

1. Press on the red fuse button and release (refer to Figure 12“Control”).
2. Slide the fuse button out of the control back panel.
3. Pull the fuse out of the button and insert a new 3 amp fuse.
4. Replace the fuse button and press until the button is firmly seated in the panel.

Heating Element Measuring System

CAUTION : Measurements of the live electrical system while the furnace is at high temperatures are necessary to complete these steps.

A high degree of safety practices MUST be adhered to during this procedure. Including but not limited to sufficient space to safely access the electrical enclosures while at high temperatures, protective clothing for high temperatures & electricity and electrically insulated test probes with clips.

1. Review this entire Procedure BEFORE starting.
2. Remove Element Terminal Covers from the Furnace Cabinet.
3. Identify the element set(s) and terminal positions.

4. Operate the furnace to a stable 500°C temperature setpoint.
5. Make temperature setpoint to 700°C to cause full amp draw on elements.
6. Measure and record the Amps at ONE Element. An Amp Clamp around the braided strap for each element would be an appropriate measuring location.
7. Measure and record the Volts at EACH Element. A Voltmeter Probe on the braided strap of each end of the SAME element would be appropriate measuring locations.
8. Select a low temperature setpoint to cool the furnace.
9. Replace the Element Terminal Covers onto the Furnace Cabinet.
10. Complete the following mathematical formula to determine the individual Element Resistance.

Ve1 = Voltage at Element 1

Ae = Amperes at Element
Used in formula, Ve1 / Ae = Re1

Re1 = Resistance at Element 1

For example:

Ve1 = 30 and Ae = 25

Therefore, Ve1 / Ae = Re1 and 30 125 = 1.2 Ohms Resistance for Element 1

Apply the other Element Voltage measurements to the same formula to obtain the corresponding Resistance for the additional Elements.

VeX = Voltage at Element X

Ae = Amperes at Element
Used in formula, VeX / Ae = ReX

ReX = Resistance at Element X

Additional Calculations can be made to identify the Amps (Current) for EACH Element

VeX / ReX = AeX

From example above:

Ve1 = 30 and Re1 = 1.2 Ohms

Therefore, Ve1 / Re1 = Ae1 and 30 /1.2 = 25 Amps (Current) for Element 1

NOTE

An Element Set is defined as the group of Elements that are powered from the same electrical supply. Often the Elements are connected electrically in series.

Each Element set should have elements that are within 2 amps of each other. For example, an eight-element set may properly have elements measuring 15, 15, 15, 16, 16. 16, 17 & 17 Amps.

While another element set with elements measuring 14, 15, 16. 17, 17, 17, 18 & 18 Amps has too wide of an Amp range to produce the necessary uniform heating in the furnace chamber. The uneven amps will also cause some elements to operate hotter then the others and reduce their life expectancy.

The Element resistance is useful to track the life expectancy. With a resistance increase of approximately 20% from the original resistance, an element would be considered unable to produce enough wattage to achieve maximum temperatures.

Cleaning and Decontamination

Furnace must be kept clean in order to ensure proper operation. Cleaning routine should be started with furnace at room temperature.

1. Vacuum the interior of the furnace to remove dust/debris, if needed.
2. Clean/Disinfect all exterior surfaces with a general-use laboratory disinfectant, such as quaternary ammonium. Rinse thoroughly with sterile distilled water, then 70% alcohol. Dry with a clean cloth as needed. Be sure not to spray any liquids directly on electronics, controls, ceramic insulating materials, or heating elements.
3. Interior Surfaces Cleaning: Do not use any liquids on ceramic insulating materials or heating elements.
    a. Organic contaminants may be removed by burning them out. Refer to section “Furnace Start Up” to do this.
    b. Inorganic contaminants may embed themselves into the ceramic insulating materials and heating elements. Recommend replacement. Contact Technical Service for further use or replacement.

Troubleshooting

WARNING : Troubleshooting procedures involve working with high voltages which can cause injury or death. Troubleshooting should only be performed by a qualified technician.

This section is a guide to troubleshooting furnace problems.

Table 6 Controller Troubleshooting for 3504 & 3216p

Problem	Probable Cause	Solution
Etun	Auto tune cannot be performed.	Note the error and contact your supplier.
EConF	A change made to a parameter takes a finite time to be entered. If the power to the controller is turned off before the change has been entered then this alarm will occur. Do not turn the power off to the controller while EConF is flashing.	Enter configuration mode then return to the required operating mode. It may be necessary to re-enter the parameter change since it will not have been entered in the previous configuration.
ECAL	Calibration error.	Re-instate Factory calibration.
E2.Er	EEPROM error.	Return to factory for repair.
EE.Er	Non-vol memory error.	Note the error and contact your supplier.
E.Lin	Invalid input type. This refers to custom linearization which may not have been applied correctly or may have been corrupted.	Go to the INPUT list in configuration level and set a valid thermocouple or input type.
The controller displays do not illuminate.	The furnace is not connected to the power supply.	Check furnace connection to power source.
	Main switch is defective.	Replace power switch or controller. This should be done by trained technician.
	Fuse(s) blown.	Replace fuse(s) and verify power connections. Contact your supplier.
S.Br	Thermocouple open/broken .	Replace the thermocouple or contact your supplier for thermocouple replacement.

Table 7 Troubleshooting Furnace problems

Problem	Solution
Furnace Temp Exceeds Setpoint.	If the unit heats past set-point but heating stops at Hi temp alarm and element power on light extinguishes check the solid-state relay. First disconnect power from the furnace and remove the controller leads to solid state relay. Re-connect power to furnace. If the unit heats, replace the solid-state relay.
Furnace does not heat.	Front panel red indicator light is on: If the controller OP1 is off, check that the setpoint temperature is higher than the furnace display temperature. If the OP1 is on, disconnect power from the furnace and check the heating elements for continuity.
	Front panel red indicator light is off: Check that the power switch is on. Check that the indicator lights on the controller display are on. Check the electrical wires for visible damage. Replace the electrical wires if necessary. This should be done by trained technician. Check that the Alarm Setpoint on the controller is set higher than the operating temperature.

Wiring Diagrams

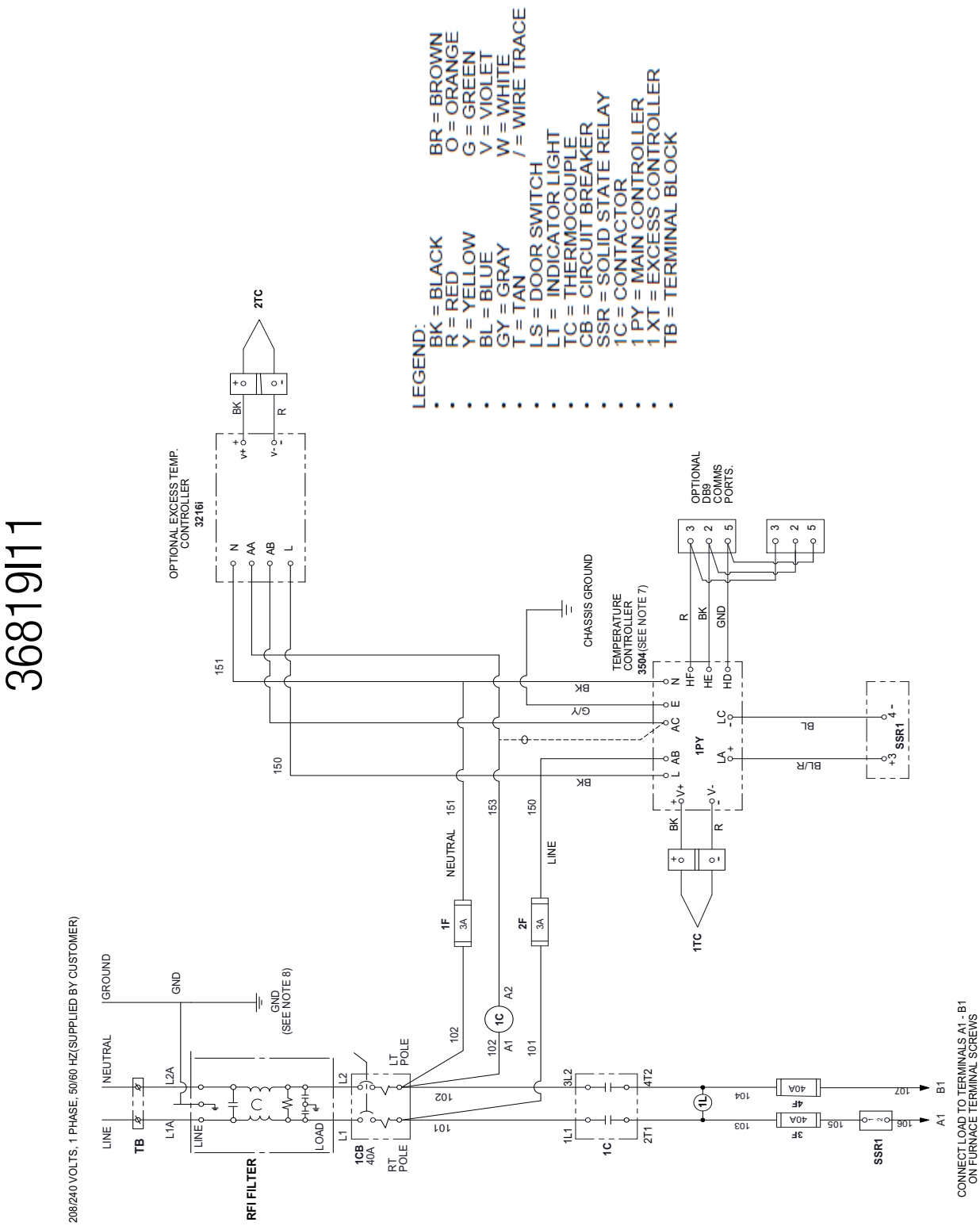


Figure 13 Wiring Diagram STF55433 series

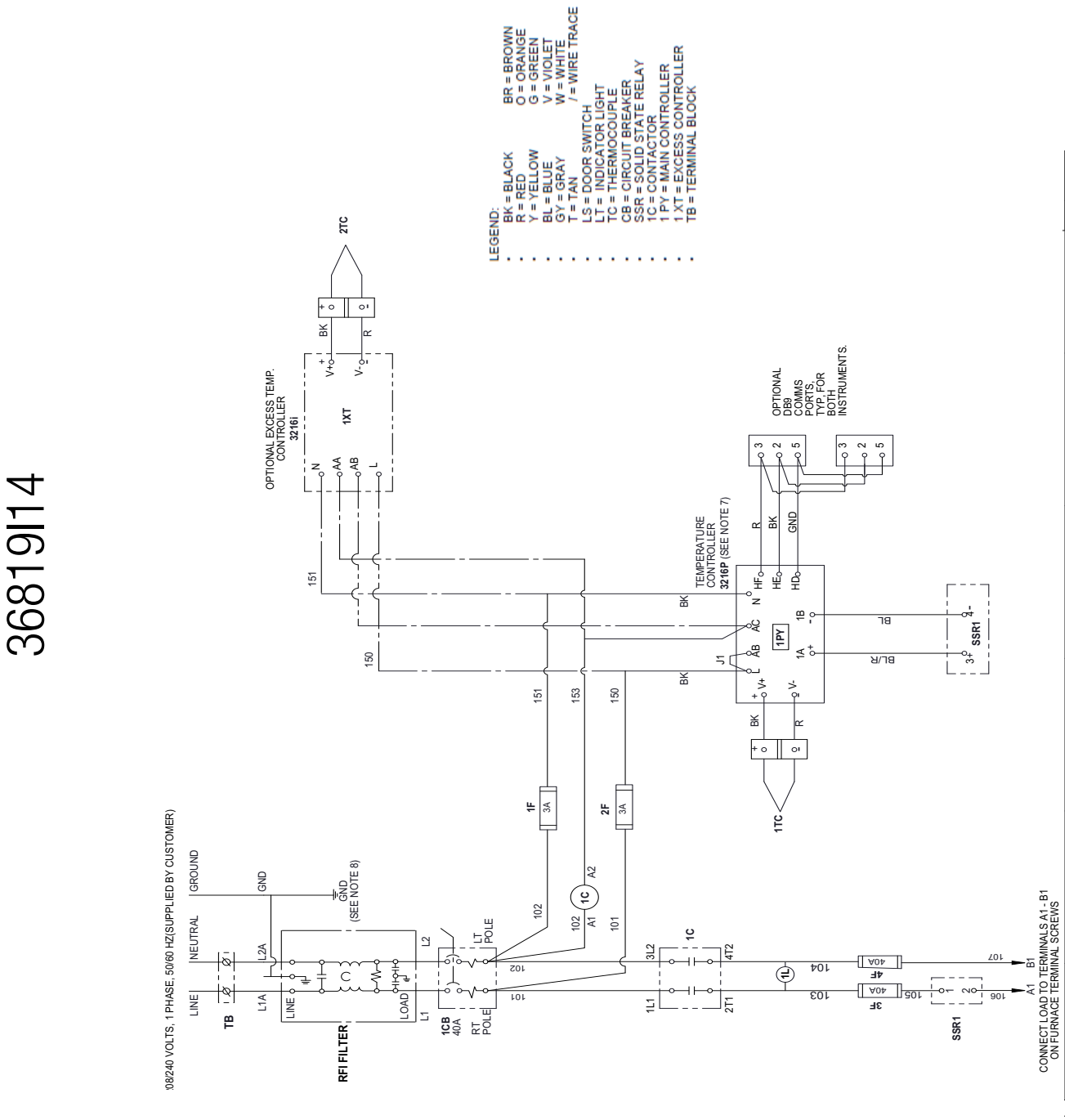


Figure 14 Wiring Diagram STF55433P Series

Replacement Parts

Table 8 Model STF55433, Tube Furnaces, 1500°C

Description	Item	STF55433BC-1	STF55433BCOMC-1
Heating Element	7217-2277-092	8	8
Thermocouple Type “R” Assembly Double	7299-1210-00X	1	1
Element Straps			
Single loop 6 in. long	22272-002	2	2
Double loop 4.in long	22271-002	3	3
Double loop 6.in long	22271-003	4	4
Element Terminal Clamp	22080-020	16	16
Element Clamp Tool	22080-020	1	1
Furnace Terminal Block	4000-2133-001	1	1
Bag- Alumina Silica Fibre (0.5 lb)	34907H02	1	1
Tube Adaptor			
1 in. diameter bore	7100-2444-070	2	2
2 in. diameter bore	7100-2444-068	2	2
3 in. diameter bore	7100-2444-069	2	2
Fuses			
40 AMP 250V	32655-045	2	2
3 AMP 250V	32656-022	2	2
Solid State Relay kit	102460	1	1
Circuit Breaker	302795H07	1	1
RFI filter	CAX99	1	1
Contactor	300088H01	1	1
Light, Indicator Red	49200H08	1	1
Main Controller	CN71X310	1	0
	CN71X311	0	1
Over-temp Controller	CN71X1502	1	1
Wiring Diagram	36819I14	1	1
Operational Manual	305435H03	1	1

Table 9 Model STF55433P series, Tube Furnaces, 1500°C

Description	Item	STF55433PBC-1	STF55433PBCOMC-1
Heating Element	7217-2277-092	8	8
Thermocouple Type “R” Assembly Double	7299-1210-00X	1	1
Element Straps			
Single loop 6 in. long	22272-002	2	2
Double loop 4.in long	22271-002	3	3
Double loop 6.in long	22271-003	4	4
Element Terminal Clamp	22080-020	16	16
Element Clamp Tool	22080-020	1	1
Furnace Terminal Block	4000-2133-001	1	1
Bag- Alumina Silica Fibre(0.5 lb)	34907H02	1	1
Tube Adaptor			
1 in. diameter bore	7100-2444-070	2	2
2 in. diameter bore	7100-2444-068	2	2
3 in. diameter bore	7100-2444-069	2	2
Fuses			
40 AMP 250V	32655-045	2	2
3 AMP 250V	32656-022	2	2
Solid State Relay kit	102460	1	1
Circuit Breaker	302795H07	1	1
RFI Filter	CAX99	1	1
Contactor	300088H01	1	1
Light, Indicator Red	49200H08	1	1
Main Controller	CN71X200	1	0
	CN71X206	0	1
Over-temp Controller	CN71X1500	1	1
Wiring Diagram	36819I11	1	1
Operational Manual	305435H03	1	1

End of Life Care

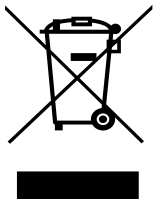
Be sure to follow local regulations when disposing of any unit. Some additional suggestions are listed below:

- Be sure to clean up any biological safety hazards
- Have a certified technician remove the insulation from the unit then dispose per SDS and local laws and regulations.

WEEE Compliance

WEEE Compliance. This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2012/19/EU. It is marked with the following symbol. Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State, and this product should be disposed of or recycled through them. Further information on our compliance with these Directives, the recyclers in your country, and information on Thermo Scientific products which may assist the detection of substances subject to the RoHS Directive are available at www.thermofisher.com/

Great Britain



WEEE Konformittät. Dieses Produkt muss die EU Waste Electrical & ElectronicEquipment (WEEE) Richtlinie 2012/19/EU erfüllen. Das Produkt ist durch folgendes Symbol gekennzeichnet. Thermo Fisher Scientific hat Vereinbarungen getroffen mit Verwertungs-/Entsorgungsanlagen in allen EU-Mitgliederstaaten und dieses Produkt muss durch diese Firmen widerverwetet oder entsorgt werden. Mehr Informationen über die Einhaltung dieser Anweisungen durch Thermo Scientific, dieVerwerter und Hinweise die Ihnen nützlich sein können, die Thermo Fisher Scientific Produkte zu identizfizieren, die unter diese RoHS. Anweisungfallen, finden Sie unter www.thermofisher.com/

Deutschland

Conformità WEEE. Questo prodotto deve rispondere alla direttiva dell' Unione Europea 2012/19/EU in merito ai Rifiuti degli Apparecchi Elettrici ed Elettronici (WEEE). marcato col seguente simbolo.Thermo Fischer Scientific ha stipulato contratti con una o diverse società di riciclaggio/smaltimento in ognuno degli Stati Membri Europei. Questo prodotto verrà smaltito o riciclato tramite queste medesime. Ulteriori informazioni sulla conformità di Thermo Fisher Scientific con queste Direttive, l'elenco delle ditte di riciclaggio nel Vostro paese e informazioni sui prodotti Thermo Scientific che possono essere utili alla rilevazione di sostanze soggette alla Direttiva RoHS sono disponibili sul sito http://www.thermofisher.com/

Italia

Conformité WEEE. Ce produit doit être conforme à la directive euro-péenne (2012/19/EU) des Déchets d'Equipements Electriques et Electroniques (DEEE). Il est marqué par le symbole suivant. Thermo Fisher Scientific s'est associé avec une ou plusieurs compagnies de recyclage dans chaque état membre de l'union européenne et ce produit devraitêtre collecté ou recyclé par celles-ci. Davantage d'informations sur laconformité de Thermo Fisher Scientific à ces directives. les recycleurs dans votre pays et les informations sur les produits Thermo Fisher Scientific qui peuvent aider le détection des substances sujettes à la directive RoHS sont disponibles sur http://www.thermofisher.com/

France

Cumplimiento de WEEE. Se requiere que este producto cumpla con la Directiva 2012/19/UE de Desechos de Equipos Eléctricos y Electrónicos (WEEE) de la Unión Europea. Está marcado con el siguiente símbolo. Thermo Fisher Scientific ha contratado a una o más empresas de reciclaje / eliminación en cada Estado miembro de la UE, y este producto debe desecharse o reciclarse a través de ellos. Para obtener más información sobre el cumplimiento de estas Directivas, los recicladores de su país e información sobre los productos Thermo Scientific que pueden ayudar a detectar sustancias sujetas a la Directiva RoHS, visite www.thermofisher.com/

Spanish

Contact Information

Thermo Fisher Scientific products are backed by a global technical support team ready to support your applications. Visit www.thermofisher.com or call:

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Germany international	+49 6184 90 6000
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For countries not listed here, visit www.thermofisher.com and go to the Contact Us page under the Services menu to locate the contact information for your area.

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