

Thermo Fisher Scientific Literature

Yokogawa UT150 to Eurotherm 3216c Controller Conversion Procedure for 3-Zone Slave Controller

LT71X31 • Revision C • August, 2020

UT150 to 3216c Controller Change

Caution: The unit must be turned off and disconnected from the power supply or follow Lockout/Tagout procedures as necessary to prevent electrical shock.

To replace the UT150 controller with the 3216c controller remove the wires from the UT150 controller terminals and reconnected to the appropriate terminals on the 3216c Controller. The terminal conversion is listed below.

UT150 Terminals #	3216c Terminals #	Function	Notes
7	V+	TC +	Thermocouple
8	V-	TC -	
9	L	L1 Line Voltage	AC Input
10	N	L2 Neutral	
14	1A	SSR Control Output +	Solid State Relay
15	1B	SSR Control Output -	
12	AC	Alarm Relay N/C	
13	AB	Alarm Relay Common	
3	HF	RS485 +	RS485 Communication
4	HE	RS485 -	
5	HD	RS485 Common	

Table1: *Wiring changes*

Use new jumper wire provided in the service kit for new controller to connect L and AB terminals. After the controller is wired, put the clips supplied with the controller on the top and bottom then slide them forward until controller is tightly secured into unit. 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.

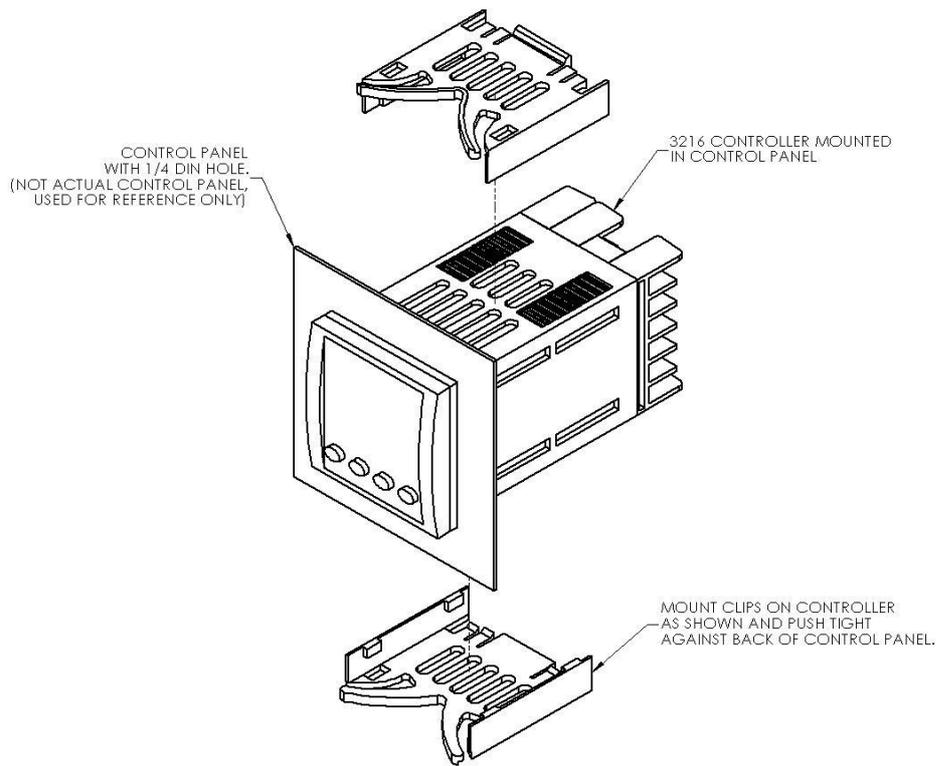


Figure 1
Controller Installation View

Single Setpoint Controller

Eurotherm 3216 Controller

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

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



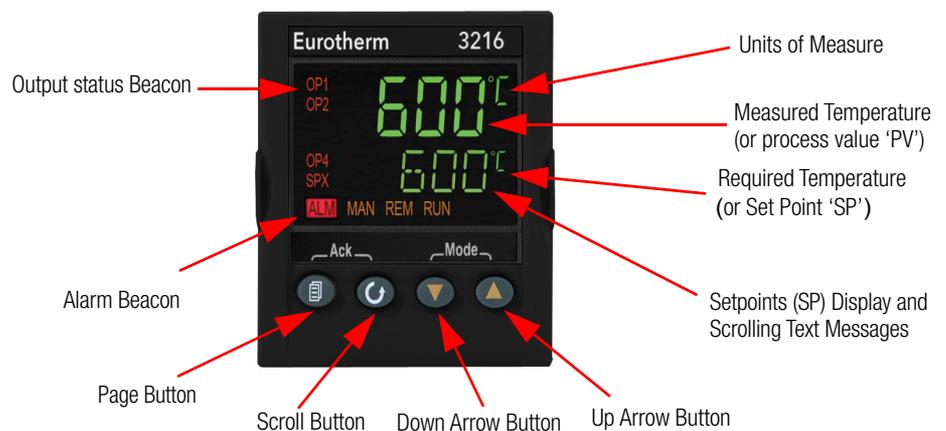
CAUTION : Before operating the controller, read this chapter carefully. Wrong procedures can change the unit characteristics and design parameters, which can hamper performance and make the equipment dangerous to use.

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

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.



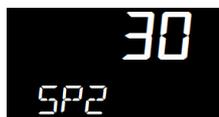
Press to increase or change the state of a value.

Single Set Point Operation

3216 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:

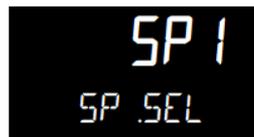
1. Press the SCROLL  button until SP1 or SP2 is displayed.



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

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 'LEv 1 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 LEv 1.

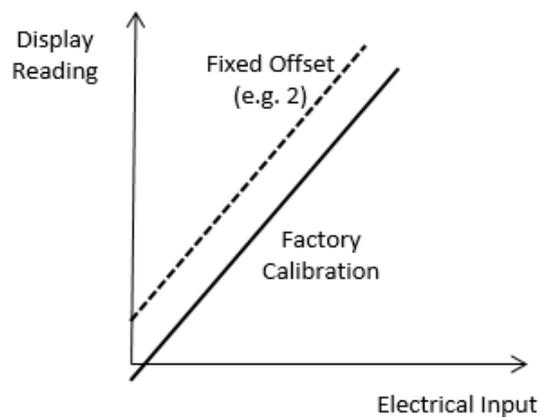


When Level 1 is selected the display reverts to the HOME display. A passcode is not required when moving from a higher level to a lower level.

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.

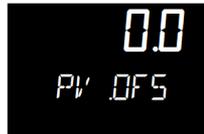
PV Offset applies a single offset to the temperature or process value over the full display range of the controller and can be adjusted in Level 2. It has the effect of moving the curve up or down about a central point as shown in the example below:-



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  button 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 DOWN  button and UP  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 $0.5 \times P_b$ in the loop break time the loop is in break.

The loop break time is set by the AutoTune, a typical value is $12 \times T_d$. The loop break alarm may be disabled by setting its time to Off.

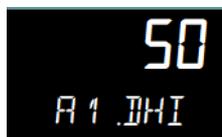
Over – Temperature Protection (OTP)

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.

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

Table 2 Parameter Description and Accessibility in 3216c

No.	Parameter	Description	Level	Access	Value	Page No.
1	A1.DHI	Deviation High Alarm Set Point	Level 1	Read/Write	50	10
2	A2.HI	High Temperature Alarm Set Point	Level 2	Read Only	1225°C	10
3	SP.SEL	Set point Select	Level 1 + 2	Read/Write	SP1	2
4	SP1	Set point 1	Level 1 + 2	Read/Write	0-1200	2
5	SP2	Set point 2	Level 1 + 2	Read/Write	0-1200	2
6	RAMPU	Set point Ramp Units	Level 1 + 2	Read/Write	Mins	3
7	SP.RAT	Set point Rate Limit	Level 1 + 2	Read/Write	Off	4
8	A.TUNE	Auto Tune Enable	Level 1 + 2	Read/Write	Off	5
9	UNITS	Display Units	Level 1 + 2	Read/Write	Deg C	4
10	PB#	Proportional Band	Level 2	Read/Write	-	-
11	TI#	Integral Time	Level 2	Read/Write	-	-
12	TD#	Derivative Time	Level 2	Read/Write	-	-
13	LBT	Loop Break Time	Level 2	Read/Write	30 mins	10
14	PV.OFS	PV Offset	Level 2	Read/Write	0	9
15	ADDR	Comms Address	Level 2	Read/Write	1	15
16	BAUD	BAUD RATE	Level 2	Read/Write	9600	15
17	IN.TYP	Input Type	Level 2	Read Only	Platinel ii	-
18	ID	Customer ID	Level 2	Read Only	312 Without COMMS 313 With COMMS	-

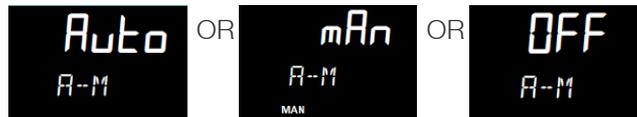
#After Controller replacement perform Auto Tune for optimize the PID parameters for better unit performance.

AUTO/MAN/OFF: (Auto/Manual/OFF Mode)



CAUTION : Thermo Fisher Scientific does not recommend to use controller in MANUAL mode or OFF mode, as Manual mode can damage the unit or cause over-heating without care or proper operation. If controller set as MANUAL mode operation, the end user must use a separate 'over-temperature' controller for safe operation of the unit.

Operation	Action	Indication
To change Auto to Manual model	Press and hold  +  for more than 3 seconds	Controller display Shows Auto mode as A-M.



1. AUTO: When the controller is in the automatic mode the output automatically adjusts to keep the temperature or process value at the setpoint. Auto mode is also referred to as “closed loop” as the controller will use thermocouple temperature as feedback to control the furnace temperature.
2. MAN: Manual mode means that the controller output power can be adjusted directly by the user. The input sensor is still connected and reading the PV but the control loop is ‘open’. In manual mode the MAN beacon will be lit, Band and deviation alarm are masked, the auto-tuning timer and programmer functions are disabled. The power output can be continuously increased or decreased using the up or down buttons.
3. OFF: Off mode means that the heating and cooling outputs are turned off. The process alarm and analogue retransmission outputs will however, still be active while Band and deviation alarm will be OFF.



CAUTION : Thermo Fisher does not recommend to use controller in MANUAL mode or OFF mode, as Manual mode can damage the unit or cause over-heating without care or proper operation. If controller set as MANUAL mode operation, the end user must use a separate 'over-temperature' controller for safe operation of the unit.

Three Zone Operation

Models STF55346C-1 and STF55666C-1 are capable of three-zone operation. These tube furnaces are designed with ample reserve power in the end zones to compensate for inherent heat losses from the ends of the furnace.

Generally, the greatest furnace temperature uniformity exists in the center zone, over a length that reaches almost to the ends of the center zone heating unit. This length of uniformity will change depending on how you balance the end zones of your furnace.

To achieve the desired uniformity within the furnace, it is necessary to use a separate monitoring thermocouple in conjunction with an appropriate measuring instrument, such as digital thermometer.

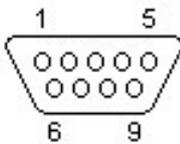
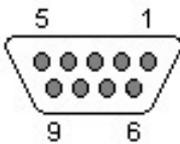
By recording the temperature at various points inside the furnace process tube, a graph of temperature versus length can be drawn. Using the graph as a guide, make end zone adjustments in small increments.

A minimum of 60 minutes should be allowed for the power change to stabilize within the furnace. Make temperature measurements each time before making another adjustment.

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	DB-9 Male	DB-9 Female
Pin 2	A / D-		
Pin 3	B / D+		
Pin 5	Ground		

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 adapter needs 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 Furnaces with the communication option.

Controller Parameters for Communication

Table 4 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 “Controller Parameters for Communication”.