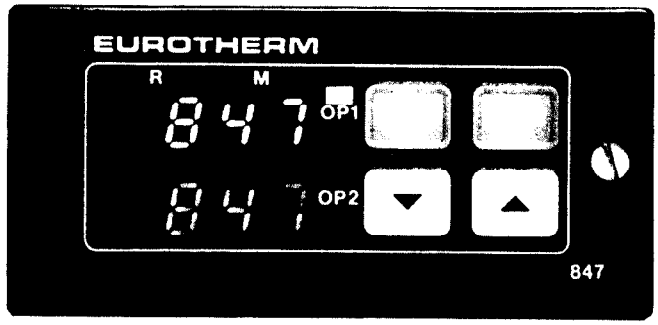
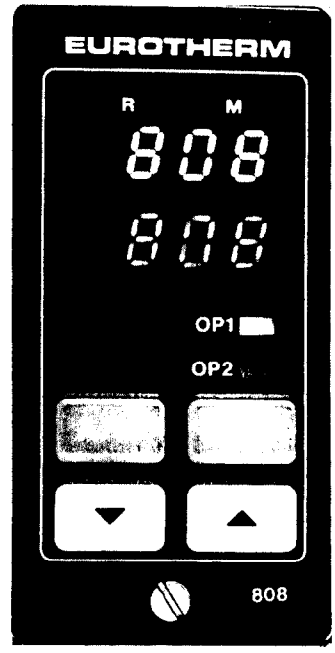
EUROTHERM

Digital controllers with setpoint programming

Models 808 and 847

options **QP** and **QPS**





- **Dual LED displays for simultaneous viewing of setpoint and measured value**
- **3 output channels configurable as heat and cool channels plus alarm, or single output channel plus 2 alarms**
- **4-segment programming (2 ramp/dwell pairs)**
- **Up to 200 program repetitions or continuous run feature**
- **Adjustable holdback for loads with propagation delays and lags**
- **3-way program control: front panel, rear terminals, and communications link**
- **Optional self-tuning feature operable upon start-up or near setpoint**
- **Choice of type J, K, L, R, S, T, Platinel II™ thermocouples or RTD for input sensor**
- **Operation in °F, °C or process units**
- **Fully isolated bidirectional EIA-232-D or EIA-422-A digital communications for computer supervision and control**
- **2 supervisory systems available: *Eurotherm Supervisory Package (ESP)* and *Eurovis***
- **4-button operation with user-selectable security level for each and every parameter**
- **Advanced PID control with variable overshoot inhibition**
- **Selection of 4 different cooling algorithms**
- **Recalibration to factory specifications from front panel**
- **Splash-proof NEMA 3 (IP-54) front panel**

The Models **808** and **847** microprocessor-based programmer/controllers combine innovative hardware and software design techniques to integrate features not even found on larger, more costly instruments. They require only 3.78x1.85" of panel space—the 96x48mm "1/8 DIN" size—and are available in either vertical-profile (Model **808**) or horizontal-profile (Model **847**) units.

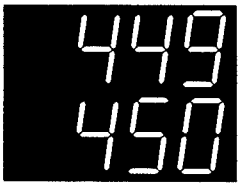
These programmer/controllers break from the tradition of 1/8 DIN-size instruments by offering exceptional performance characteristics *and* setpoint programming in one package. The controller features 0.25% calibration accuracy, 20:1 CJC rejection, fast input-scan rate of 8 times per second, and 0.67μV input resolution. In addition, Eurotherm has incorporated its proven **EM-1** control algorithm for adjustable overshoot inhibition and 4 cooling algorithms oriented towards specific applications. The flexible setpoint programmer allows the user to create and run 4-segment programs suitable for a wide variety of applications.

The digital communications link allows remote modification and interrogation of all controller and programmer parameters. Downloading of a single parameter, entire parameter schedules or a setpoint program from a computer is possible, as well as monitoring controller parameters and the measured value for data logging.

The Models **808** and **847** are completely engineered and manufactured in the United States and are covered by Eurotherm's 2-year warranty.

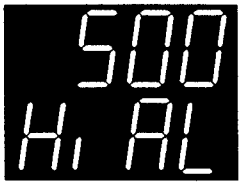
Front Panel

The front panel comprises 4 dome-membrane pushbuttons and the dual 0.3"-high LED displays. The Models 808 and 847 **display both the measured value and the setpoint simultaneously** under normal conditions.



Measured value equal to 449° in upper display. Setpoint of 450° in lower display.

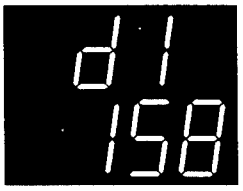
Alarm conditions are annunciated by flashing messages in the lower display and the measured value above.



High alarm annunciation: measured value flashes, high alarm message alternates with setpoint.

All parameter types—PID, alarm, setpoint, configuration and programmer—can be viewed in the displays and adjusted with the pushbuttons. The parameter name is shown in mnenomics (English abbreviations) in the upper display, with its current value below:

Proportional band equal to 30°C.



158 minutes remaining in first dwell segment in program.

In addition to the yellow LEDs indicating when Output 1 and Output 2 are functioning, there are 3 green LED dots in the upper display for manual mode, communications tranmission in progress, and the programmer state (RUN, HOLD or IDLE).

Operator Controls

OPERATION

All of the configuration, setpoint, control, and programmer parameters can be accessed from the front panel. The parameters and their current values are viewed in succession by pushing on the **PAR** button. Depressing the **UP** or **DOWN** buttons adjusts the parameter value.

Values for the program parameters (ramp rates, dwell times, number of repetitions) can be entered from the front panel like the controller parameter values. The operator can launch the program from the front panel or from external pushbuttons connected to the rear terminals.

The auto/manual (**A/M**) button permits operating the controller in the manual mode; it can be disabled permitting only automatic operation.

SECURITY

The user can tailor the controllers to specific shop-floor requirements by assigning to each parameter one of three security access levels. The priority levels range from complete operator inaccessibility to full modification privileges.

CONFIGURATION

The configuration procedure consists of selecting from the front panel the input sensor to be connected, the plug-in output device types installed, and the control parameters. These parameters can then be removed from the operators' list if desired after configuration. Instruments are delivered pre-configured according to the Product Code. It is possible to configure and assign parameter access levels through the communciations port.

COMMUNICATIONS

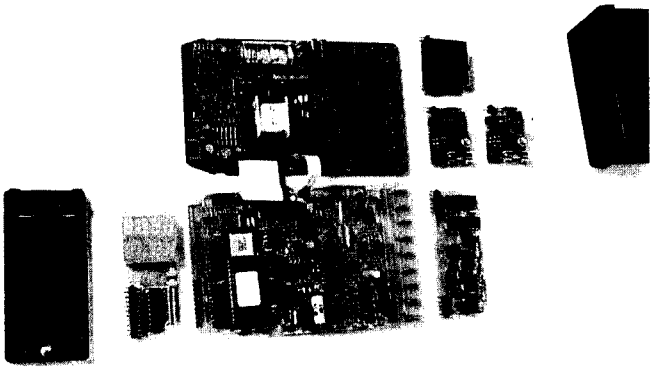
Through the communications port, all the operations that can be performed at the front panel by an operator can be performed remotely by computer. This feature is especially useful with setpoint programming; a program library can be stored in the host computer and the appropriate program downloaded when required. Coordination with other process equipment is simplified. The front panel controls can be disabled through the communications link if desired.

CALIBRATION

No recalibration of the instrument is necessary if the input sensor type or display units are changed. The original factory calibration parameters reside permanently in memory and can be recalled into service at any time.

Mechanical Features

- UL-approved rear terminal screws with pressure plates for secure wiring.
- Plug-in construction — boards plug into the sleeve and the output modules plug into the boards.
- Easy removal from sleeve with a screwdriver.



Setpoint programming option QP

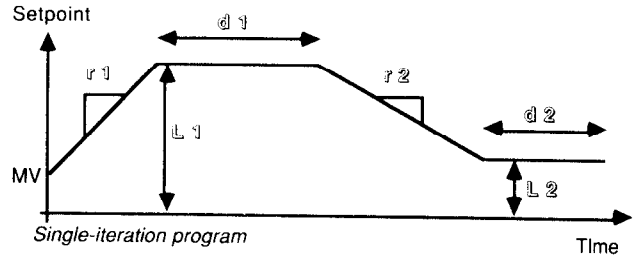
The Models **808** and **847** with option **QP** contain an independent firmware setpoint generator in addition to the controller function. The setpoint generator, or *programmer*, outputs a series of straight-line segments that are adjustable in duration and slope. The controller ensures that the measured value respects this profile as closely as possible.

Option **QP** is found mostly in (but not limited to) general furnace applications where timing is an important process parameter: heat treating, epitaxy, environmental chambers, incubators, etc.

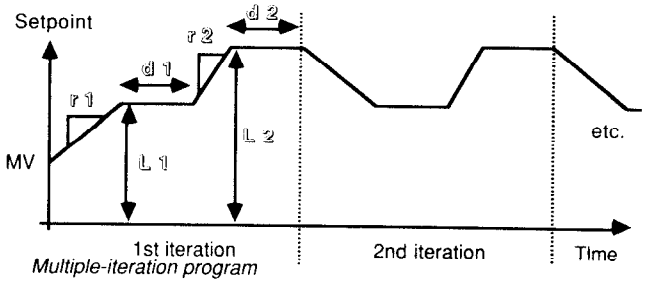
PROGRAM SEGMENTS

The **808/847** programmer/controller generates a fixed-format, 4-segment program (2 ramp/dwell pairs). The slopes of the 2 ramp segments (display mnemonics r1 and r2) are adjustable from 0.01 to 99.99°/minute. The target levels to which the setpoint ramps (L1 and L2) are adjustable over the entire range of the input sensor. The dwell segments (d1 and d2) can be varied from 0 to 9999 minutes.

Various program profiles for many applications can be developed from these 4 basic segments. By using the loop counter feature (LC), the programmer can be set to cycle the program up to 200 times or continuously.



Single-iteration program



Multiple-iteration program

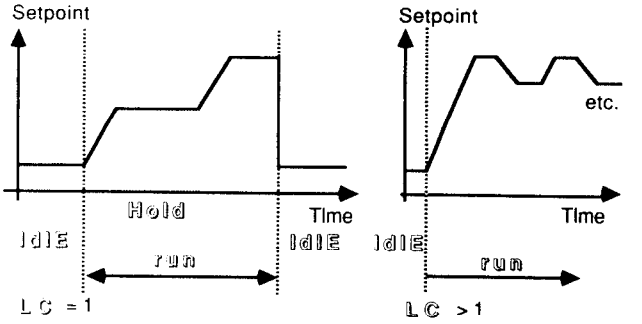
PROGRAMMER STATES

The Model **808/847** programmer can be in one of 3 states. IdlE, run or Hold.

With the programmer in IdlE, the instrument behaves like a normal controller.

Placing the programmer in run launches the program. After completion, the programmer returns to IdlE.

If Hold is selected during a program, the time base is stopped and the setpoint remains unchanged until the Hold is released. Any changes made to the programmer parameters during Hold are valid only during the current iteration of the program. It is possible to perform a self-tune procedure during Hold.



Programmer states.

PROGRAM CONTROL

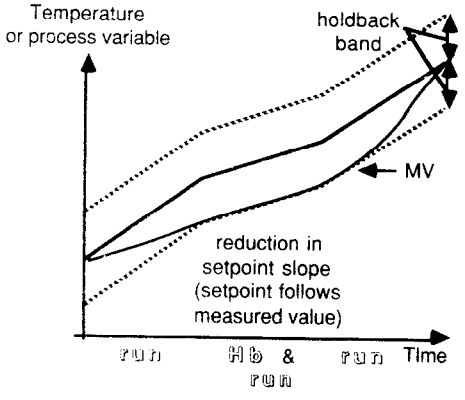
Program control consists of changing the state of the programmer. This can be accomplished 3 ways:

- Front-panel pushbuttons. The operator scrolls to the parameter mnenomic Prog and selects the desired state.
- Rear terminals. The rear terminals are available for connection of RUN and HOLD pushbuttons, or for interfacing to auxiliary equipment through a dry contact or opto-coupler.
- Communications port. All aspects of the programming feature and the controller can be accessed through the digital communications port.

HOLDBACK

The holdback function automatically places the programmer into Hold if the measured value deviates more than a specified amount from the programmer setpoint (the *holdback band*, Hb). When the measured value re-enters the holdback band, the timing for the segment resumes.

Holdback is recommended for those systems with appreciable propagation delays and exponential lags. During a ramp segment, holdback can have the effect of flattening out the slope of the ramp. During a dwell segment holdback guarantees a minimum soak time by stopping the clock if the measured value deviates outside the holdback band.



Self tuning option QS

The Models **808** and **847** incorporate an optional self-tuning algorithm that automatically determines values for the PID parameters and, if appropriate, values for the overshoot inhibition parameters (cutback).

Self-tuning offers several advantages:

- Fast , simultaneous adjustment of several loops in a multi-zone system saves time.
- Inexperienced personnel can perform the one push-button procedure.
- No elaborate equipment (such as chart recorders or memory oscilloscopes) is required.
- Consistant approach of the tuning algorithm produces repeatable results.

TYPES OF SELF TUNING

These controllers feature 2 types of self tuning. Both are operable on heat-only, cool-only, and heat/cool systems encompassing endothermic or exothermic processes (negative feedback systems only).

Tune from ambient

A self-tune procedure from ambient is performed if the measured value is not near the control setpoint. This can apply to a "normal" heat-up condition or tuning a load which operates predominantly in cooling, i.e. the setpoint is well below ambient.

Tune from setpoint

A self-tune procedure from setpoint is performed if the measured value is near the control setpoint. This can apply to either an endothermic or an exothermic process or a process which must be cooled to maintain control point.

PARAMETERS CALCULATED

Both types of self tuning calculate values for the PID parameters: proportional band (mnemonic: PrOP), integral time constant (Int.t), and derivative time constant (der.t).

In addition, the tune-from-ambient operation calculates the high- and low-cutback levels (H cb and L cb) for overshoot inhibition. The tune-from-setpoint simply verifies that the cutback levels are not within the proportional band; if they are, they are moved out to the edge of the proportional band.

PROCEDURES

Two different parameters can be used to launch a tune operation. Both determine if a tune from ambient or a tune from setpoint would be appropriate. These two parameters can be manipulated through the communications port.

While the tuning algorithm is running, the message tunE flashes in the lower display. Upon completion of the tuning operation, the lower display again shows the setpoint and the values calculated for the parameters can be viewed in the scroll list.

Tune on demand

This parameter (mnenomic tunE) is set to on by the operator to launch the tuning operation

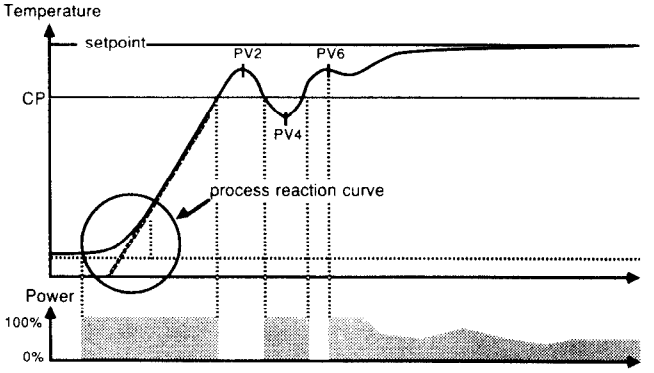
Tune on start-up

When the parameter t Su (tune on start-up) is set to YES, the controller automatically performs a tuning operation upon the next application of power. After a successful tuning operation, the controller switches t Su to no, disabling the tune on start-up feature. As long as t Su remains set to YES (meaning that a successful start-up tune operation has never been performed) a self-tuning operation will be launched the next time power is applied to the unit.

OPERATION

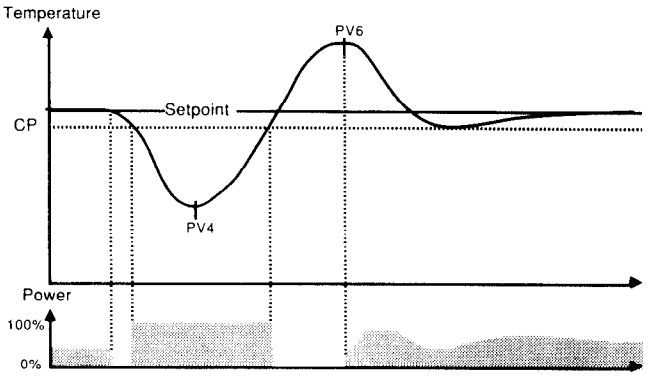
Tune from ambient

The example below illustrates the heat-up case for a start-up tune. The outputs from the controller are turned OFF for 1 minute. Heat is applied and the start-up process reaction curve is evaluated. Once the temperature has reached the switch-off point, **CP**, power is set to 0%. Oscillations through **PV4** and **PV6** are forced as shown. Values for the PID terms and the high and low cutback levels are then calculated from this response.



Tune from setpoint

Self tuning of an endothermic process is illustrated here. Upon initiation the output power is fixed for 1 minute. Both outputs are turned off and the direction of the response noted. When the temperature drops, oscillations are induced around the control point **CP**. Values for the PID terms are then calculated from the response.



Specifications

1. INPUTS

All inputs

Calibration accuracy	0.15% of reading +12μV ±1/2 l.s.d. (typ.)
Sampling frequency	8Hz
Maximum sensor break reaction time	30s
Sensor break output level adjustment range	-99.9 to 100.0%
Maximum common-mode voltage @ 50/60Hz	$264V_{ac\ rms}$ (with respect to neutral)
Common mode rejection @ 50/60 Hz	≥120dB
Series mode rejection @ 50/60 Hz	≥60dB

Thermocouples

Number of thermocouple types	7 (J, K, L, R, S, PL2, T)
Thermocouple linearization accuracy	0.2°C
Cold junction compensation rejection ratio	20:1 (with internal detector) ±0.5°C

Resistance temperature detector

Device	100Ω Pt (DIN 43760/BS 1904/JIS C1602), 3-wire connection
Resistance at 0°C	100Ω
Resistance at 100°C	138.5Ω
Linearization accuracy	0.1°C

2. OUTPUT DEVICES

Triac module (isolated from all other circuits)

Maximum load current (resistive load)	$1A_{rms}$
Line fuse	2AG, 1A, 250V (Littelfuse 225001)

Logic module (not isolated from thermocouple circuit)

Output	10mA into a maximum of 1.8KΩ ($18V_{dc}$ compliance)
Maximum short-circuit current	20mA (typ.)

Relay module (isolated from all other circuits)

Output contacts	
O/P 1 and O/P 2 channels	Form A, isolated
Alarm 1 channel	Form C, isolated
Maximum load voltage	$264V_{ac}$
Maximum load current (resistive load)	$2A_{rms}$
Minimum load voltage	$10V_{peak}$

DC module (not isolated from thermocouple circuit)

Current output ranges	0-20mA and 4-20mA
Compliance	18V
Resolution	<0.01%
Linearity	±0.5%

3. CONTROL CHARACTERISTICS

General

Automatic operation

Control mode	ON/OFF, or PID with or without programming feature
Proportional band range	1-4500°C (1-8100°F) or equivalent in %
Integral time constant range	"OFF" and 1-8000s
Derivative time constant range	"OFF" and 1-999s
Overshoot suppression	Adjustable high and low "cutback" points

Manual operation

Auto/manual selection	Bumpless changeover
Power level adjustment range	-99.9 to 100.0%

Output 1 (Heat)

Signal type	Time proportioned or continuously variable
Cycle time range (time proportioned)	0.3-80s
Power feedback compensation range (selectable with t.p. only)	±15% of nominal supply voltage

Output 2 (Cool or Alarm 2)

Cool

Signal type	Time proportioned
Cycle time range	0.3-80s
Cool gain multiplier (relative to heat channel)	0.1-10.0
Modes (specialized algorithms)	Water, air, oil, 5% minimum cycle time, OFF and ON

Alarm 2 (see §4)

4. ALARMS

Number of independent alarm output channels	2: AL1 and AL2 (AL2 occupies Output 2)
Number of independent alarm input functions	3: "Full-scale" high, "Full-scale" low, and deviation band, each with its own setpoint
Annunciation memory	Latching or non-latching. Memory for each of the 3 alarm functions can be independently selected.
Hysteresis	1°C
Alarm 1 action	Failsafe (alarm state affirmed by de-energized output)
Alarm 2 action	Alarm state affirmed by energized output
Number of alarm functions assignable to output channel	Alarm 1: 3; Alarm 2: 1

5. COMMUNICATIONS

Transmission standard	EIA-232-D or EIA-422-A (formerly RS designations)
Transmission rate selection	300, 600, 1200, 2400, 4800, 9600 or 19200 baud
Number of stop bits	1
Parity	Even

6. GENERAL

Overall dimensions	3.78" x 1.89" x 6.5" deep (96 x 48 x 165 mm)
Power supply	
Line voltage range	85-264$V_{ac\ rms}$ (switchmode)
Line frequency range	48-62Hz
Power dissipation	5W
Environmental considerations	
Operating temperature range	0-50°C
Relative humidity	5-95%, non-condensing
Vibration specification	Mil Std 810D, method 516-I
Fascia seal rating	NEMA 3 (IP-54) with optional gasket kit

7. PROGRAMMER (option QP...)

Program size and format	
Number of segments/program	4
Program format	2 ramp/dwell pairs
Number of programs in memory	1
Maximum number of program repetitions	200 (with possibility of continuous program repetition)
Ramp rates	0.01 to 99.99° or units/minute
Dwell times	0 to 9999 minutes
Program control	
Control means	Front panel pushbuttons, rear-terminal connections, or communications port
Number of programmer states	3 (RUN, HOLD, IDLE)
Holdback band	1 to 999° or units
Starting method	Servo start from measured value
Ending method	Return to front-panel (base) setpoint

8. SELF TUNING (option QS)

Self-tune initiation means	On demand or on startup
Parameters determined	
Tune from ambient	PID terms, high and low cutback levels
Tune from setpoint	PID terms

Input sensors

THERMOCOUPLES			RANGE				Precision
Type	Positive material	Negative material	°F min.	°F max.	°C min.	°C max.	°F or °C
J	Iron	SAMA constantan (Cu-45%Ni)	-211	1832	*-135*	*1000*	1
K	Chromel™ (Ni-10%Cr)	Alumel™ (Ni-2%Al-2%Mn-1%Si)	-418	2543	*-250*	*1395*	1
L	Iron	DIN Konstantan	-148	1652	*-100*	*900*	1
PL2	Platinel II™ (alloy #5355)	Platinel II™ (alloy #7674)	32	2543	*0*	*1395*	1
R	Platinum-13% Rhodium	Platinum	32	2912	*0*	*1600*	1
S	Platinum-10% Rhodium	Platinum	32	2912	*0*	*1600*	1
T	Copper	Adams constantan (Cu-45%Ni)	-418	752	*-250*	*400*	1
J	Iron	SAMA constantan (Cu-45%Ni)	-99.9	752.0	*-75.0*	*400.0*	0.1
L	Iron	DIN Konstantan	-99.9	752.0	*-99.9*	*400.0*	0.1
RTD-3	DIN 43760 / BS 1904 / JIS C1602		-99.9	752.0	*-99.9*	*400.0*	0.1

Note: Linear process inputs are also available. See doc. no. 1029 "Digital temperature/process controllers; Models 808 and 847."

Product code for controllers with setpoint programming (option QP...)

HARDWARE CODE [1]

Model	output 1	output 2	alarm	options [4] comms	options [4] additional options
808 or 847	/	/	/	/	QP... /

CONFIGURATION CODE [1]

(	config. type	sensor	setpoint range	display units	output 1	output 2	alarm output	)/
	A							

Product code
for optional NEMA 3 (IP-54) front-panel gasket kit:
KIT / 808NEMA3 / GASKET

HARDWARE CODE *[1]*
output 1 (heat) and output 2 (cool or alarm)

NO	Not fitted	
D1	DC (0-20mA & 4-20mA)	*[2]*
L1	Logic	
R1	Relay (2 A rms)	
T1	Triac (1 A rms)	*[3]*

alarm

NO	Not fitted
L1	Logic
R1	Relay (2 A rms)

options *[4]*
communications

NO	Not fitted
C2	EIA-232-D
C4	EIA-422-A

additional options *[5]*

QP	Setpoint programming
QPS	Setpoint programming with self tuning

CONFIGURATION CODE *[1]*
configuration type *[6]*

A	Standard
@A	Non-standard

sensor input

Thermocouples		
J	Fe/SAMA constantan	*[7]*
K	Chromel™/Alumel™	
L	Fe/Konstantan (DIN)	*[7]*
P	Platinel II™	
R	Pt-13%Rh/Pt	
S	Pt-10%Rh/Pt	
T	Cu/Adams constantan	
Resistance temperature detector (RTD/3-wire)		
Z	DIN43760/BS1904/JIS C1602	

setpoint range *[8]*

	(°C)	(°F)	J	K	L	P	R	S	T	Z
A	-250+250	-400+500		•					•	
B	-100+100	-150+200		•					•	
C	-100+400	-100+750		•					•	
D	-75.0+400.0	-99.9+750.0	•		•					•
E	0-100	32-200	•	•	•	•	•	•	•	•
F	0-200	32-400	•	•	•	•	•	•	•	•
G	0-300	32-600	•	•	•	•	•	•	•	•
H	0-400	32-800	•	•	•	•	•	•		
J	0-600	32-1200	•	•	•	•	•	•		
K	0-800	32-1400	•	•		•	•	•		
L	0-1000	32-1800		•		•	•	•		
M	0-1200	32-2100		•		•	•	•		
N	0-1600	32-2900					•	•		

display units *[9]*

C	Degrees Centigrade
F	Degrees Fahrenheit

output 1 (heat)

1	Slow cycle	*[10]*
2	Fast cycle	*[11]*
3	0-20mA	*[12]*
4	4-20mA	*[12]*

output 2 (cool or alarm)

0	None	
1	Water cooling	
2	Oil cooling	
3	Fan cooling	
4	Full-scale low alarm	*[13]*
5	Full-scale high alarm	*[13]*
6	Deviation band alarm	*[13]*

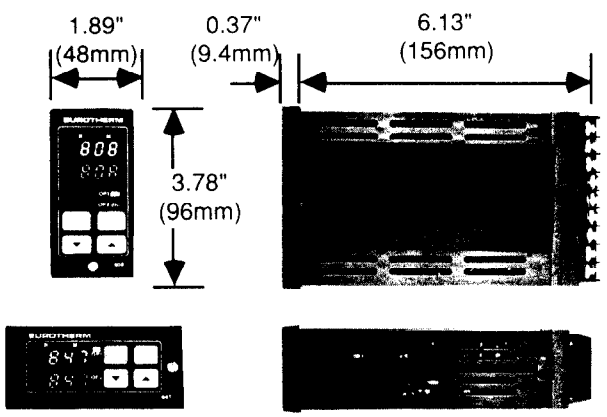
alarm output *[14]*

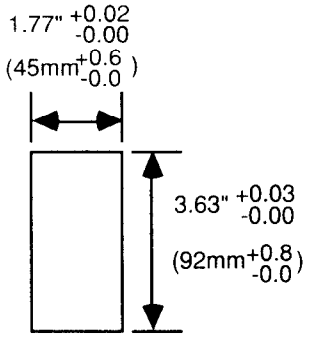
0	None
4	Full-scale low alarm
5	Full-scale high alarm
6	Deviation band alarm

NOTES:

1. *The complete Product Code consists of both the Hardware Code and the Configuration Code.*
2. *DC analog output module not available on Output 2.*
3. *Triac output module not available on Output 2 when used as second alarm output.*
4. *If a particular option is not desired, the corresponding option field must be omitted from the Product Code.*
5. *Minimum additional option of* **QP** *must be specified .*
6. *Standard: selections from this page. Non-standard: configurations requiring other parameter combinations or hardware modifications. Call your nearest Eurotherm sales and service representative.*
7. *Selection of setpoint range* **D** *with type J or L thermocouple invokes tenths' precision display.*
8. *These are preconfigured setpoint limits only; the input sensor is always linear over the entire range given in the Input Sensors table.*
9. *Units for all adjustable temperature parameters.*
10. *Available only with hardware modules* **L1**, **R1** *and* **T1**.
11. *Available only with hardware modules* **L1** *and* **T1**.
12. *Available only with hardware module* **D1**.
13. *Alarms are non-latching. Alarm state affirmed by energized output.*
14. *Alarms are non-latching. Alarm state affirmed by de-energized output.*

Dimensions

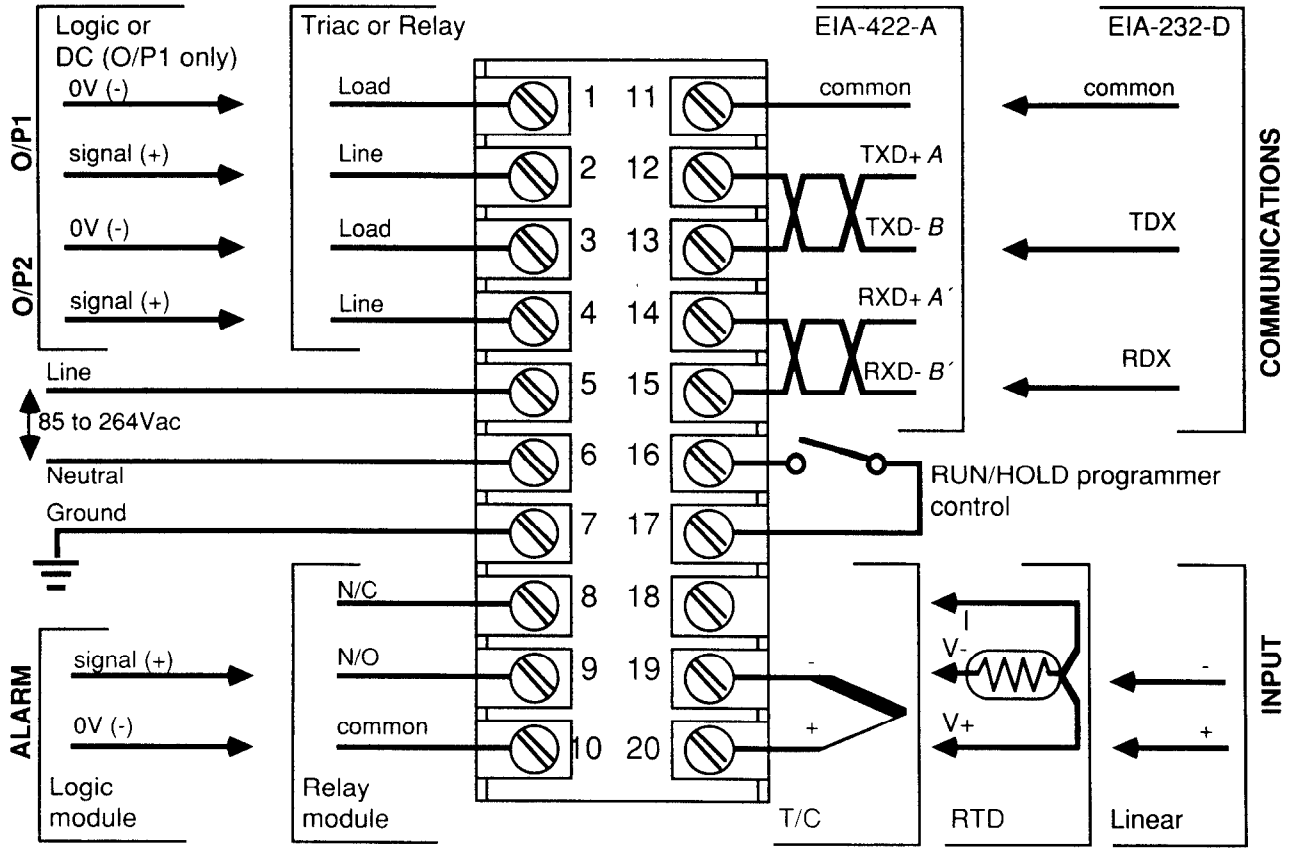




Panel Cutout
Maximum panel thickness:
0.25" (6mm)

Panel depth: with input adapter IA...: 7.11" (180.5mm)

Rear terminal connections



Subject to change without notice.

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Doc. 1043-C 8909 First Printing 8909