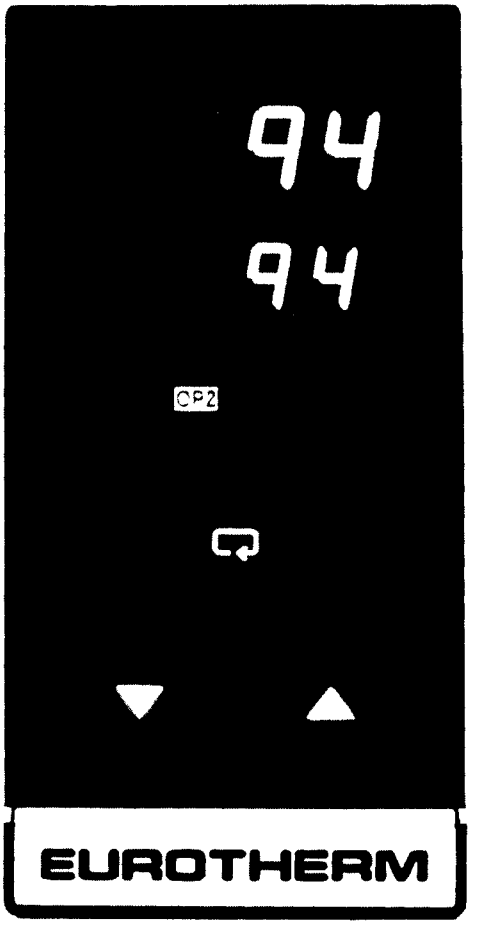
EUROTHERM
CONTROLS

Installation and Operation Manual

MODEL 94
TEMPERATURE CONTROLLER

MODEL 94C
TEMPERATURE CONTROLLER
WITH DIGITAL COMMUNICATIONS



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CAUTION!
Before installing, operating or servicing this unit supplied by Eurotherm, please read the following:

INSTRUCTIONS FOR SAFE USE OF EUROTHERM EQUIPMENT

(Note: These instructions represent good engineering principles and are applicable to all control equipment of the same type, whether from Eurotherm or any other supplier.)

ENCLOSURE OF LIVE PARTS

This unit should be installed inside a suitable grounded metal enclosure to prevent live parts being accessible to human hands and metal tools. It is recommended that rear terminal covers (available as an option) be fitted.

WIRING

It is important to connect the unit correctly in accordance with the installation data in this manual.
Wiring should conform to appropriate standards of good practice and local codes and regulations. Conductors should be commensurate with voltage and current ratings of the units.

OUT-OF-LIMITS ALARMS

In applications where excessive deviation of a controlled parameter due to equipment failure could cause damage to machinery or materials, or injury to personnel, it is strongly recommended that an additional separate unit with its own input sensor be used to give alarm indication or to shut down the process or both, as may be appropriate. (Note: The alarm function built into controllers may not give sufficient protection in these circumstances.). When the controller alarm function or separate alarm units are used they should be checked for correct operation at regular intervals.

CONFIGURATION

Many instrument functions are user selectable from the front panel. It is the user's responsibility to verify that the instrument configuration is correct. Personal injury, property loss and equipment damage could result from an improperly configured instrument.

GROUNDING

This instrument has internal circuits which are isolated or "floating." This is necessary to prevent the occurrence of a "ground loop" in signal circuits. To avoid possible shock hazards in the event of an internal fault causing breakdown of insulation, it is recommended that all equipment connected to this unit be enclosed in a grounded metal enclosure. Sheaths of thermocouples (or other sensors) should be properly grounded by a separate conductor (instead of being dependent on grounding via the machine framework).

Continued inside back cover...

INSTALLATION AND OPERATION MANUAL

MODEL 94 TEMPERATURE CONTROLLER

MODEL 94C TEMPERATURE CONTROLLER WITH DIGITAL COMMUNICATIONS

TABLE OF CONTENTS

PLEASE READ THIS FIRST!

Do you have the right instrument?

This manual covers the installation, configuration and operation of the Models 94 and 94c. Look on the label on the side of the instrument for "Model 94 Temperature Controller" or "Model 94c Temperature Controller." It is **not** possible to fit a Model 94 with communications hardware in order to convert it into a Model 94c.

Does your application require the DC output option?

An analog DC output is available on channel 1 of the Model 94 as an option. The instrument must be ordered fitted with this option from your Eurotherm distributor—this option cannot be installed by the end user. Look on the label to see if the box "DC analog output" is checked.

Is your Model 94 or 94c properly configured for the application?

The Model 94(c) is a flexible instrument intended for many applications. This flexibility allows the end user to change the configuration of the controller: type of input sensor, types and functions of the outputs, alarm functions, etc.

This information is specified in the *Configuration code* portion of the Product code (the part in parentheses) upon ordering the instrument. If the Configuration code is not indicated on the instrument packaging or on the label, it can be verified by following the procedure in §4.2. Then, if the code is not what is required, see §3.1 for instructions on how to modify the code.

Please read "INSTRUCTIONS FOR SAFE USE OF EUROTHERM EQUIPMENT" on the inside covers of this manual.

For specific questions, refer to:

§1 for the preparation of the sheet metal cutout for installing the instrument.

§2 for wiring connections.

§3 for the configuration procedure and the configuration code.

§4 for basic operating procedures, such as modifying the setpoint and the alarms.

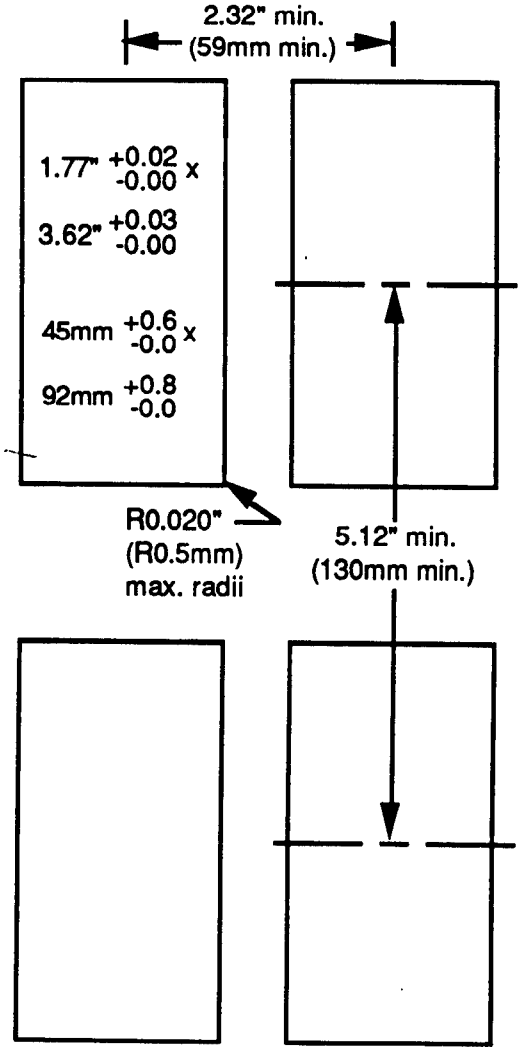
§5 for instructions on how to use self-tuning and information concerning parameter adjustment.

§6 for information concerning the communications parameters for the Model 94c for both EI Bisync and Modbus/Jbus protocols. Refer to the appropriate protocol manual for information about the protocol itself.

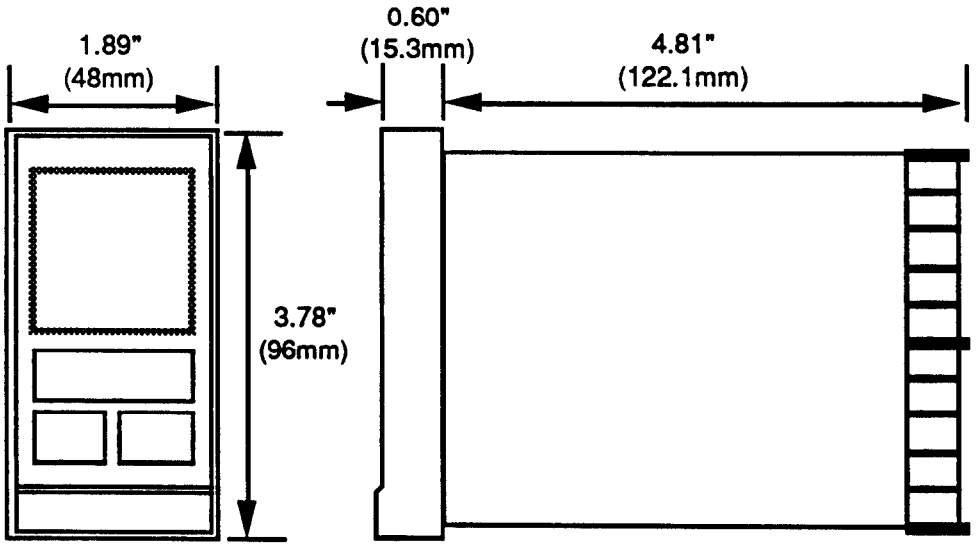
Should you encounter any difficulty, please contact your nearest Eurotherm distributor for assistance.

1. MECHANICAL INSTALLATION

- Prepare panel cutout in sheet metal enclosure. Enclosure temperature must remain within 32-131°F (0-55°C) range.
- Install the optional front panel gasket (part no. BO133943) if required. Remove the backing from the gasket and apply it around the panel cutout on the *outside of the panel.*
- Slide instrument sleeve into the cutout from the front of the panel.
- Position the mounting bracket on the rear of the instrument sleeve with the 2 clips facing the rear.
- While holding the sleeve, slide the mounting bracket towards the panel until the clips engage on the ratchets. While still pulling back on the sleeve, press on the upper left and lower right hand corners of the bracket to seat the mounting bracket. Another push on the clips with a screwdriver might be necessary to secure the installation.



Panel cutout and minimum spacing. Maximum panel thickness : 0.51" (13mm).



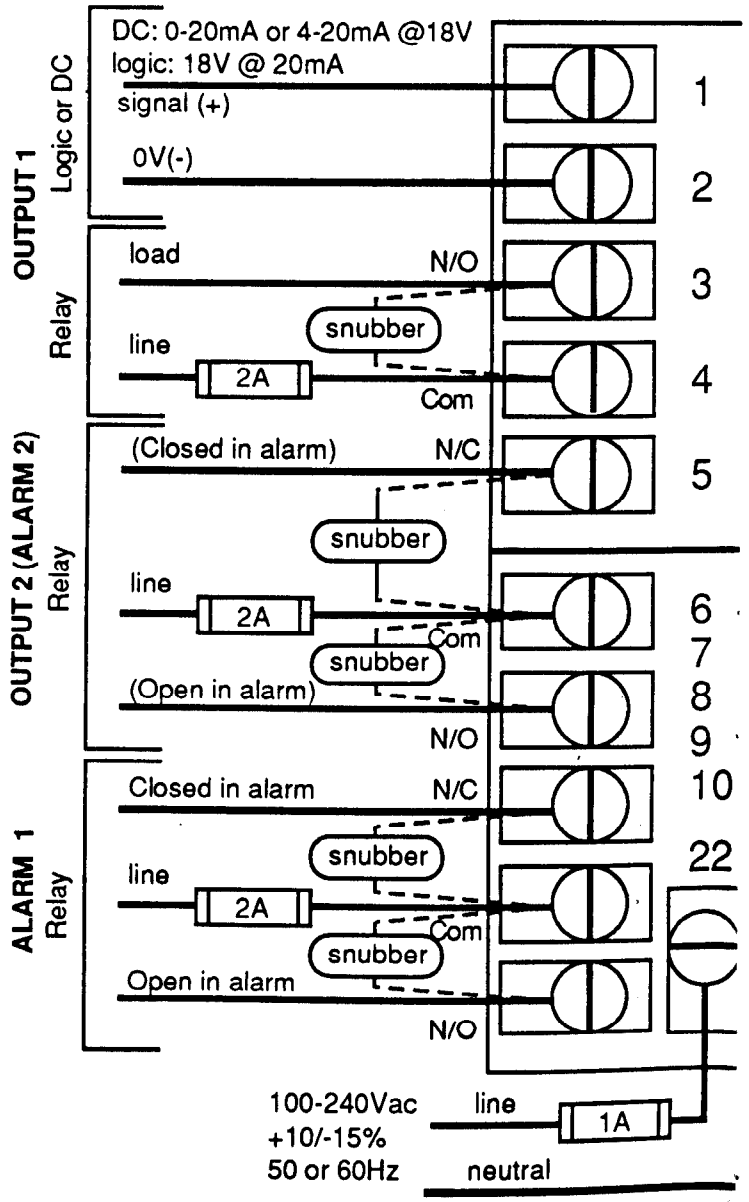
Dimensions.
Panel depth: with rear terminal cover: 4.96" (126.1mm),
with gasket fitted: less 0.060" (1.5mm)

2. ELECTRICAL CONNECTIONS

WARNING! Ensure that the maximum voltage which is applied to the unit power supply, between any two isolated circuits, or between any isolated circuit and ground does not exceed 264Vac.

CAUTION! It is the user's responsibility to calculate the maximum possible current in each power and common wire. Do not exceed the rated current for any particular wire size permitted by the local electrical code. Overheated wires and damaged insulation may result from overloading.

WARNING! This product should not be used on a multiphase power system with a floating star connection.

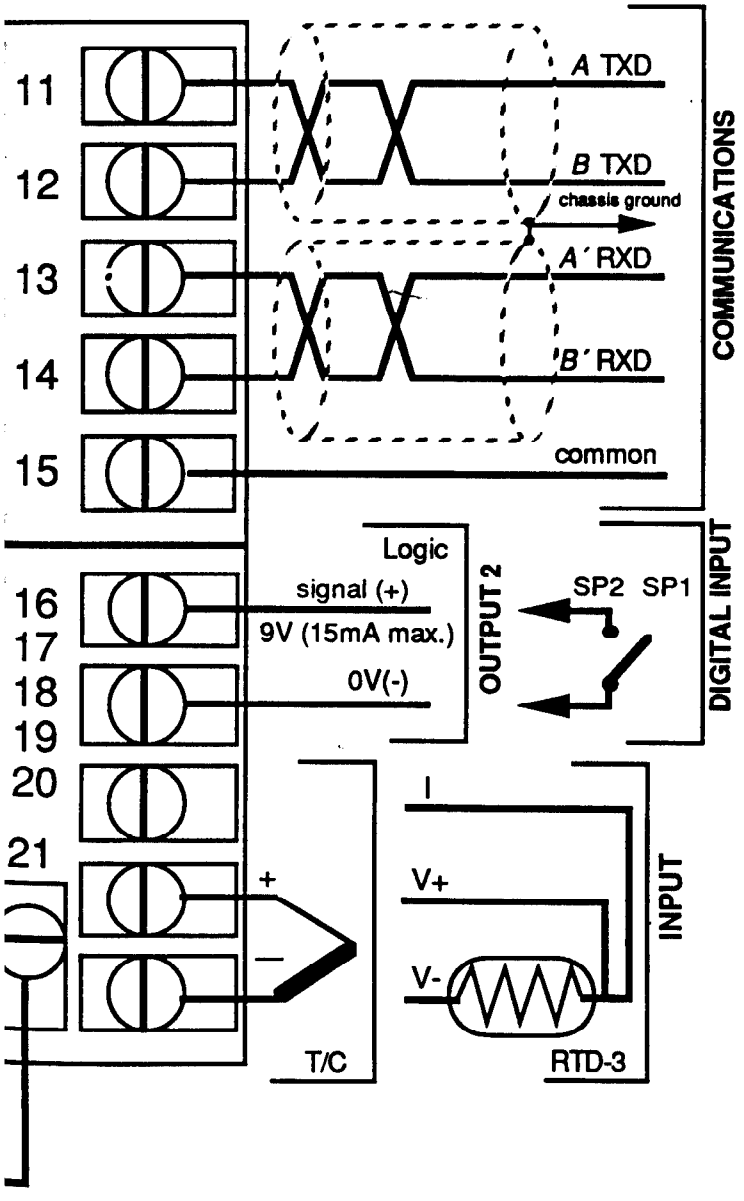


2.1 Power

Respect the polarity of the AC power supply: line wire must be connected to terminal 22, and the neutral must be connected to terminal 21. Place a 1-Amp fuse in the line-side of the AC supply.

2.2 Output 1

- Logic output (terminals 1 and 2): Signal goes high (current flows) during ON phase of output cycle (yellow "OP1" lamp ON). Output 1 is isolated.
- DC analog signal output (terminals 1 and 2): 0 to 20mA or 4 to 20mA output is available. Yellow "OP1" lamp is ON whenever the output power demand is greater than zero.
- Relay (terminals 3 and 4): Contact is closed during ON phase of output cycle (yellow "OP1" lamp ON). Relay channel operative only when the appropriate configuration is selected. A snubber may be required; see §2.6.



2.3 Output 2

- Logic output (terminals 16 and 17): Signal goes high (current flows) during ON phase of output cycle (yellow "OP2" lamp ON). Connect only to opto-isolated device loads, never connect to any grounded circuit. Keep wiring run shorter than 3' (1m) and well away from noise generating circuits.

NOTE: Logic output 2 is NOT isolated from the control input.

- Relay (terminals 5, 6 and 7): The relay output 2 is available only when channel 2 is not used as alarm 2. Relay contact shorts terminals 6 and 7 during ON phase of output cycle (yellow "OP1" lamp ON). Relay channel operative only when the appropriate configuration is selected. A snubber may be required; see §2.6.

2.4 Alarm 1

The alarm 1 output is failsafe: the relay is de-energized during the alarm condition (or power down (terminals 8 and 9 shorted). The red "AL1" lamp is ON during an alarm condition. The attached alarm circuit should be designed for failsafe operation and fused appropriately. A snubber may be required; see §2.6.

2.5 Alarm 2

The alarm 2 output is available only when channel 2 is not used as output 2. The alarm 2 output is failsafe: the relay is de-energized during the alarm condition (red "AL2" lamp ON) or power down (terminals 5 and 6 shorted). The red "AL2" lamp is ON during an alarm condition. The attached alarm circuit should be designed for failsafe operation and fused appropriately. A snubber may be required; see §2.6.

2.6 Snubbers

Connect snubbers CZ140398 (22nf + 100Ω) across the appropriate output or alarm relay contacts when driving AC inductive loads (mechanical contactors and solenoids). *Do not use snubbers when driving high impedance loads.* The snubber passes 1mA in 120Vac circuits, and 2mA in 240Vac circuits; this is sufficient to hold in certain relays with high impedance coils *and should not be used in such installations.*

Any voltage transients that occur on power supply lines, isolated inputs or outputs, must not exceed 2.5kV (in series or common mode). If occasional voltage transients of 2.5kV or higher are expected or measured, transient limiting devices should be part of the installation.

WARNING! When an alarm contact is to be implemented as part of a failsafe alarm scheme, it is the user's responsibility to verify that the effect of the snubber does not interfere with the operation of the circuit. Certain high impedance circuits are not able to detect a contact opening when the snubber is placed across the contact. In these cases the snubber should not be installed across the relay contact.

2.7 Control Input

WARNING! This temperature controller must have its own input sensor. Never connect the input terminals 19 and 20 in parallel with the input of any other instrument, e.g. recorder, alarm unit, etc. The paralleled inputs of other instruments interfere with proper operation of the sensor break detection circuitry and may also impair the measurement accuracy.

NOTE: The input circuit and the logic output 2 (terminals 16 and 17) are NOT isolated from one another.

Use of shielded, twisted pair is recommended for the input sensor. The shield must be connected to terminal 20 even when grounded elsewhere.

- Thermocouple: Use appropriate compensation cable. Keep loop resistance as low as possible (1kΩ maximum).
- RTD: Use 3 copper wires of same length and diameter. (20Ω/lead maximum resistance.)

2.8 Logic Input (terminals 16 and 17)
Connect 2-position selector switch (SPST). Open switch position corresponds to setpoint 1 selection. Keep wiring run shorter than 3' (1m) and well away from noise generating circuits. This input is suitable for isolated contact inputs only.

NOTE: The logic input is NOT isolated from the control input. Do not connect logic inputs of several Model 94s in parallel; use separate contacts for each one.

2.9 Communications (terminals 11 through 15)
Use Belden #9843 or an equivalent low capacitance, extended distance computer cable. Attach the shields to the the chassis ground at the supervisor-end of the link.

2.10 Rear terminal covers
After wiring, attach 2 rear terminal covers BD133125 with 2 screws FY133264U001.

3. CONFIGURATION

3.1 Procedure

NOTE: Before configuring the instrument, select the 8 digits of the configuration code (listed in §3.2 and on the instrument label) and write them down!

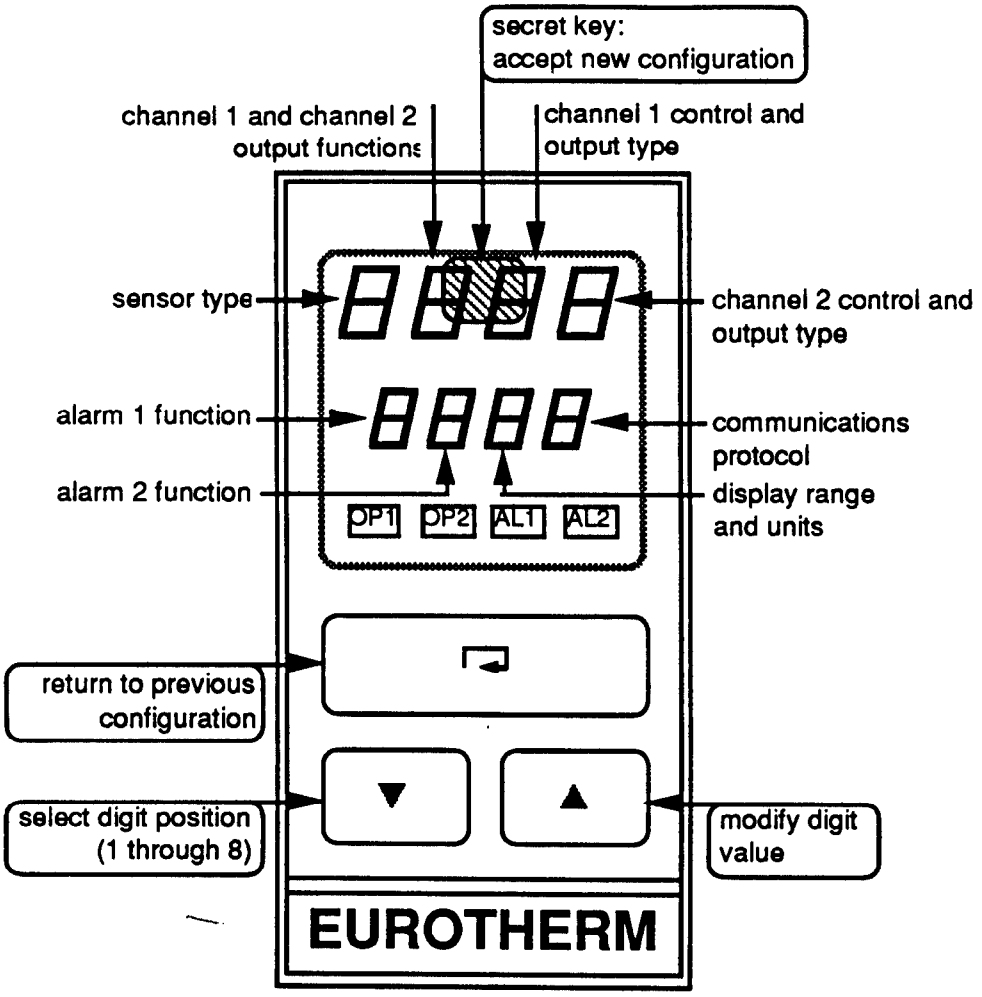
1. Cycle power OFF and ON. Self test follows: **tESt 1111** appears, then **8888 8888**, followed by the 8-digit configuration code. Touch secret key when 8-digit configuration code appears after self test to enter configuration mode.

2. See configuration code with first digit blinking (leftmost digit in upper display).

3. Enter new code:
   ▼ = select digit position (1 through 8)
   ▲ = modify digit value.

4. To exit configuration mode do either one of these:
   Secret key = accept new configuration; parameter value check follows. This is a list of all scroll list parameters (and their values) that pertain to the new configuration. Parameters not required for the selected configuration are removed from the list.
   ↵ = abort; return to previous configuration.

NOTE: After changing the configuration code, it is important that the user verify the value of each parameter. Changing the input sensor type or display range could result in forced modifications to some parameter values. These might not be what are required for the application, and should be set to new values appropriate to the new configuration.



Configuring the Model 94:
Pushbutton functions during configuration (in bubbles)
and configuration code digit functions .

3.2 Configuration code

Upper display

1st digit: sensor type

		full specified range			
		°F min	°F max	°C min	°C max
0	RTD (units' precision display)	*-148*	*1112*	*-100*	*600*
1	RTD (tenths' precision display)	*-99.9*	*999.9*	*-99.9*	*600.0*
2	B—Pt-30%Rh/Pt-6%Rh	*1112*	*3308*	*600*	*1820*
3	J—Fe/SAMA constantan	*-328*	*2192*	*-200*	*1200*
4	K—Chromel™/Alumel™	*-418*	*2502*	*-250*	*1372*
5	L—Fe/Konstantan	*-148*	*1652*	*-100*	*900*
6	N—NiCroSil/NiSil	*32*	*2372*	*0*	*1300*
7	Platinel II™	*-418*	*2543*	*-250*	*1395*
8	R—Pt-13%Rh/Pt	*32*	*3213*	*0*	*1767*
9	S—Pt-10%Rh/Pt	*32*	*3213*	*0*	*1767*
A	T—Cu/Adams constantan	*-427*	*752*	*-255*	*400*

2nd digit: channel 1 and channel 2 output functions

	channel 1	channel 2
0	heat	cool
1	cool	heat
2	heat	disabled
3	cool	disabled
4	disabled	heat
5	disabled	cool
6	heat	alarm 2
7	cool	alarm 2

Refer to illustration on p. 15.

The logic output 2 (terminals 16 and 17) is not operative on channel 2 if alarm 2 selected (selections **6** and **7**).

Digital input 2 (terminals 16 and 17) can be configured for operation with any of the channel 2 output functions; see the 4th digit in upper display.

3rd digit: channel 1 control and output type

	control type	output type
0	ON/OFF	logic & relay
1	ON/OFF	logic only
2	PID	logic & relay
3	PID	logic only
4	PID	4-20mA DC
5	PID	0-20mA DC

Analog DC outputs (selections **4** and **5**) are available only on those units with DC output option.

4th digit: channel 2 control and output type

	control type	output type
0	ON/OFF	logic & relay
1	ON/OFF	logic only
2	PID	logic & relay
3	PID	logic only
4	ON/OFF	relay & dig. I/P
5	PID	relay & dig. I/P

Control type relevant only if channel 2 configured as output 2 (not as alarm 2).

To enable digital input when channel 2 is configured as alarm 2 or disabled, select **4** or **5**.

Lower display

1st digit: alarm 1 function

0	Off (no alarm function)
1	Deviation low alarm
2	Deviation high alarm
3	Deviation band alarm
4	Full scale low alarm
5	Full scale high alarm
6	Sensor break alarm
7	Loop break alarm
Sensor break and loop break alarms in combination with temperature alarm:	
8	Deviation low alarm
9	Deviation high alarm
A	Deviation band alarm
B	Full scale low alarm
C	Full scale high alarm

Selections **8** through **C**: temperature alarm is logically "ORed" with sensor break and loop break alarms, i.e. the alarm relay trips if the temperature alarm OR the sensor break alarm OR the loop break alarm is active.

2nd digit: alarm 2 function

0	Off (no alarm function)
1	Deviation low alarm
2	Deviation high alarm
3	Deviation band alarm
4	Full scale low alarm
5	Full scale high alarm
6	Sensor break alarm
7	Loop break alarm
Sensor break and loop break alarms in combination with temperature alarm:	
8	Deviation low alarm
9	Deviation high alarm
A	Deviation band alarm
B	Full scale low alarm
C	Full scale high alarm

Selections **8** through **C**: temperature alarm is logically "ORed" with sensor break and loop break alarms, i.e. the alarm relay trips if the temperature alarm OR the sensor break alarm OR the loop break alarm is active.

Selection relevant only if alarm 2 enabled.

3rd digit: display range and units

	upper range limit	disp. units	prop. band units
0	400°C	°C	°C
1	752°F	°F	°F
2	400°C	°C	% of 400
3	800°C	°C	°C
4	1472°F	°F	°F
5	800°C	°C	% of 800
6	Sensor	°C	°C
7	upper	°F	°F
8	limit	°C	% of span

Use only selections **6** through **8** for type B thermocouple or RTD input.

The *effective span* is selected here. For selections **0** through **5**, the effective span is identical to the upper range limit. For selections **6** through **8**, it is the full span of the selected input sensor. The effective span is used as a limit for several parameters. See *Adjustable parameters* table.

4th digit: communications protocol

	protocol	parity
0	Disabled	N/A
1	EI BiSync	even
2	Modbus/Jbus	even
3	Modbus/Jbus	odd
4	Modbus/Jbus	none

Communications option available only on Model 94c.

3.3 Configuration examples

Example 1

Upper display **3 0 2 2**
Lower display **5 5 7 0**

Upper display:

1st digit	**3**	Type J thermocouple input;
2nd digit	**0**	Heat/cool controller with heat output on channel 1 and cool output on channel 2;
3rd digit	**2**	PID control on channel 1 (heat) output, both relay and logic outputs operative;
4th digit	**2**	PID control on channel 2 (cool) output, both relay and logic outputs operative.

Lower display:

1st digit	**5**	Full scale high alarm
2nd digit	**5**	Setting irrelevant—alarm 2 not configured;
3rd digit	**7**	Sensor range from -328°F to 2192°F, display units and proportional band units in °F;
4th digit	**0**	Communications disabled.

Example 2

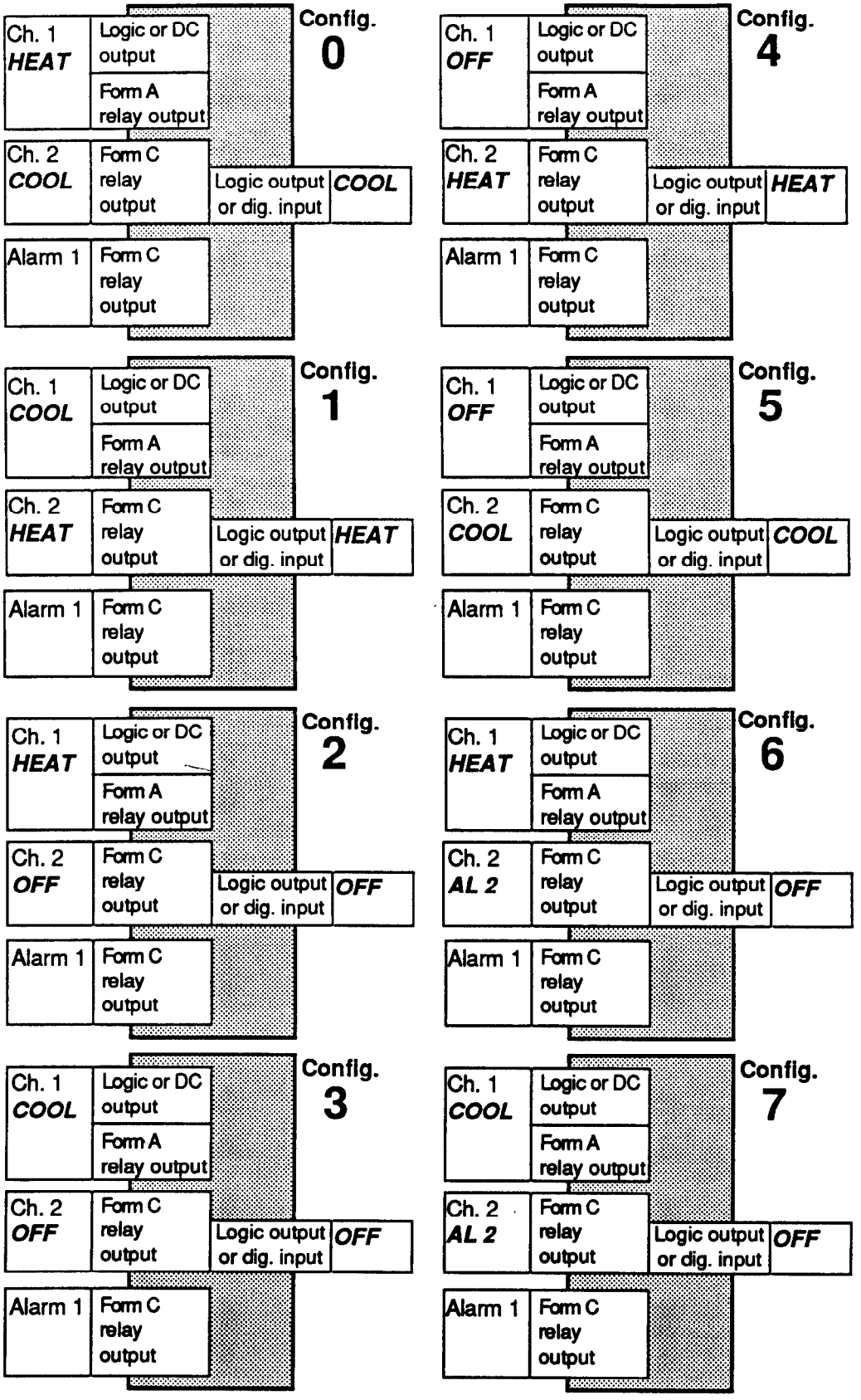
Upper display **6 6 4 4**
Lower display **3 7 6 1**

Upper display:

1st digit	**6**	Type N thermocouple input;
2nd digit	**6**	Heat only controller with heat output on channel 1 and alarm 2 output on channel 2;
3rd digit	**4**	PID control on channel 1 (heat) output, 4-20mA DC output;
4th digit	**4**	Digital input enabled (control type selection irrelevant when channel 2 is configured for alarm 2).

Lower display:

1st digit	**3**	Deviation band alarm;
2nd digit	**7**	Loop break alarm;
3rd digit	**6**	Sensor range from 0°C to 1300°C, display units and proportional band units in °C;
4th digit	**1**	EI-Bisync communications enabled.



Channel assignment configurations as viewed from rear (2nd config. digit, upper display). Digital input 2 always available for 2nd setpoint if logic output not required.

4. OPERATION

Basic procedures

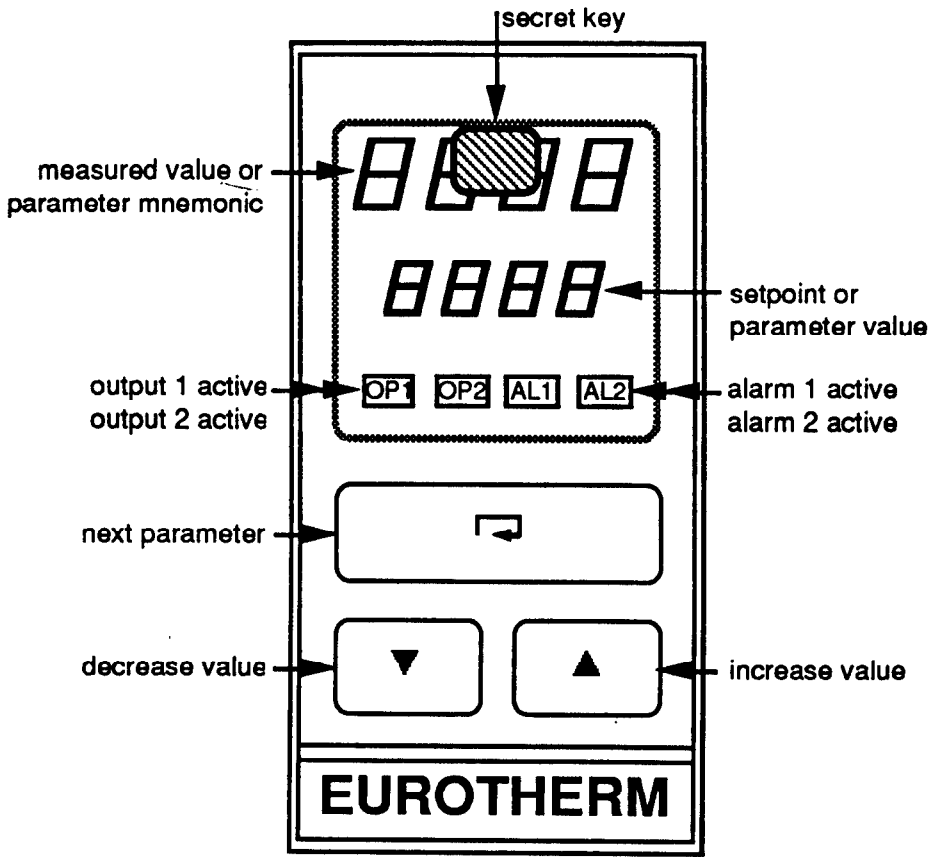
Refer to illustrations below and on opposite page.

4.1 Open list

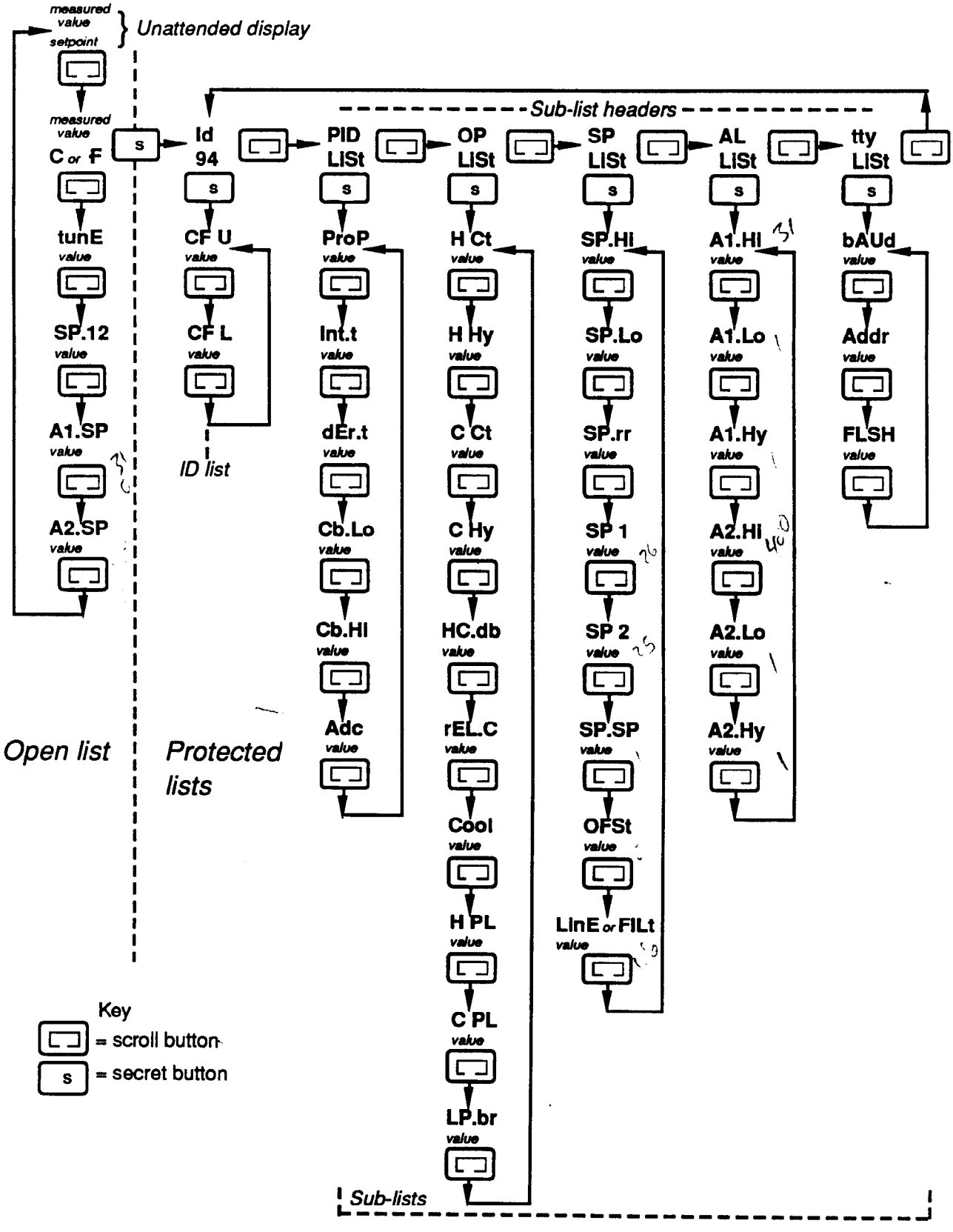
- To light up buttons: touch any button on front panel.
- To modify setpoint: ▲ or ▼.
- To view next parameter: use ↵ .
- To modify a parameter value: with the parameter mnemonic in upper display, use ▲ or ▼.

4.2 Protected lists

- To enter protected lists: use ↵ until **°C** or **°F** appears in open list, then use "secret key"; then...
- To verify configuration: Use "secret key" when **Id 94** or **Id 94c** is displayed. Inspect upper and lower configuration words (**CF U** and **CF L**) with ↵ .
- To view sub-list headers (those displays with **List** in the lower display): use ↵ .
- To access parameters in a sub-list when at a sub-list header: use "secret key". Then inspect and change parameter values as in the open list. To move to another sub-list, first return to the measured value display.
- To return to measured value (unattended) display when in a sub-list: use "secret key".



Model 94: front panel pushbuttons, displays, and lamps.



Model 94 scroll list parameters.

Note: Only those parameters required by the configuration appear in the scroll lists!

Table 4.1
Adjustable Parameters (Part 1)

Mnemonic	Parameter	Adjustable range	Comments	Bisync	Mod/J
Open list					
None	Setpoint1 or setpoint 2 (whichever is active)	"SP.Lo" to "SP.Hi"	Displayed without mnemonic in unattended mode. Cannot be modified if self tuning in progress.	SL or S2	17 or 18
°C or °F	Display units	View only.	"Lin" for non-temperature sensors.	---	---
tunE	Self tune on demand	Disable self tune or self tuning completed **oFF** Start self tune on heat-only loop **HEAt** Start self tune on cool-only loop **CooL** Start self tune on heat/cool loop **HtCL**		TU	32
SP.12	Setpoint selection	Setpoint 1 active **SP 1** Setpoint 2 active **SP 2**	Displayed only if "SP.SP" = "SP12". "SP 2" flashes in lower display if second setpoint selected.	SS	20
A1.SP A2.SP	Alarm 1 & 2 setpoints	Alarm 1: "A1.Lo" to "A1.Hi" Alarm 2: "A2.Lo" to "A2.Hi"	For each alarm, not displayed if configured uniquely for sensor break or loop break alarm, or if alarm is disabled.	A1 A2	13 14
Protected list entry point					
Id	Model number	View only: "94" or "94c"		II	122
CF U	Upper configuration code (first 4 digits)	View only.	Can be changed upon power up only.	CU	48
CF L	Lower configuration code (last 4 digits)			CL	49

Table 4.1
Adjustable Parameters (Part 2)

Mnemonic	Parameter	Adjustable range	Comments	Bisync	Mod/J
Pid LiSt					
ProP	Proportional band	1 l.s.d. to effective span, or 0.1 to 100.0% of effective span		XP	6
Int.t	Integral time constant	"oFF" plus 10 to 2000s		TI	8
dEr.t	Derivative time constant	"oFF" plus 1 to 200s		TD	9
Cb.Lo	Low cutback	"Auto" plus 1 l.s.d. to effective span	When set to "Auto", "Cb.Lo" = 3 x "ProP".	LB	34
Cb.HI	High cutback	"Auto" plus 1 l.s.d. to effective span	When set to "Auto", "Cb.Hi" = 3 x "ProP".	HB	35
Adc	Automatic droop compensation (similar to manual reset)	Disabled or 0% reset **oFF** Reset fixed at 50% of output **50Pc** Application of calculated reset **on** Calculation of required reset **CAlc**	PI or PID operation. Sets proportional band symmetrically about setpoint in PD or P operation. Maintains last calculated or set value of manual reset. Momentary setting which adds proportional error to current manual reset value.	AC	36
OP LiSt					
H ct	Heat cycle time for logic output type Heat cycle time for relay output type	0.2 to 240.0s 5.0 to 240.0s	Displayed only for time proportioned PID or ON/OFF heat outputs. For ON/OFF control, becomes minimum heat ON or OFF time.	CH	10
H Hy	Heat hysteresis	1 l.s.d. to effective span	Displayed only for ON/OFF heat output.	YH	37
C ct	Cool cycle time: for logic output type for "Fan" cool algorithm for relay output type	 0.2 to 240.0s 1.0 to 240.0s 5.0 to 240.0s	Displayed only for time proportioned PID or ON/OFF cool outputs. For ON/OFF control, becomes minimum cool ON or OFF time.	CC	38
C Hy	Cool hysteresis	1 l.s.d. to effective span	Displayed only for ON/OFF cool output.	YC	39

Table 4.1
Adjustable Parameters (Part 3)

Mnemonic	Parameter	Adjustable range	Comments	Bisync	Mod/J
OP LISt	(continued)				
HC.db	Heat-cool deadband: for ON/OFF cool control	-10.0 to 10.0% of effective span	Displayed only if cooling enabled. Set to 0.0% except if required by process.	DB	40
	for PID cool control	-10.0 to 10.0% of output power			
rEL.C	Relative cool gain (with respect to heat channel)	0.1 to 10.0	Displayed only for heat/cool PID control. Suggested starting values: 0.2 to 0.5 for "H2O" cooling algorithm 1.0 for "OIL" cooling algorithm 2.0 for "FAn" cooling algorithm	RG	41
COOL	Cooling algorithm selection		Displayed only for time-proportioning PID cooling.	CA	42
		Linear **LIn**	Linear, min. ON time = 40ms		
		Evaporative water **H2O**	Non-linear, min. ON time = 40ms		
		Fan **FAn**	Non-linear, min. ON time = 0.5s		
		Oil or nonevaporative water **OIL**	Non-linear, min. ON time = 40ms		
H PL	Heat power limit	0.0 to 100.0%	Displayed only for PID heating.	HO	43
C PL	Cool power limit	0.0 to 100.0%	Displayed only for PID cooling.	LO	44
LP.br	Loopbreak time	"oFF" plus 10 to 4000s		BT	45
SP LISt					
SP.HI	Setpoints 1 and 2 high limit	Greater of current value of "SP 1" or "SP 2" to upper range limit.		HS	21
SP.LO	Setpoints 1 and 2 low limit	Lower range limit to lesser of "SP 1" or "SP 2".		LS	22
SP.rr	Setpoint ramp rate	"oFF" plus 0.10 to 1/10 of effective span °C/min. (or °F/min.)	For non-temperature inputs: 0.01 to 1/10 effective span or display limit	RR	23
SP 1	Setpoint 1	"SP.Lo" to "SP.Hi"	For adjustment of setpoint not currently displayed in Open List.	SL	17
SP 2	Setpoint 2			S2	18

Table 4.1 Adjustable Parameters (Part 4)

Mnemonic	Parameter	Adjustable range	Comments	Bisync	Mod/J
SP LISt	(continued)				
SP.SP	Setpoint mode selection	Setpoint 1 only **SP 1** Setpoints 1 and 2 selectable from front only **SP.12** Setpoints 1 and 2 selectable from rear input only **IP 2**	Displayed only if channel 2 is configured as digital input.	SM	19
OFSt	Calibration offset	-50.0 to 50.0°C -90.0 to 90.0°F ±10.00% of effective span for Lin		PO	24
LInE	Line frequency	50 Hertz **50** 60 Hertz **60**	If displayed, set to appropriate frequency.	---	---
FILt	Input filter	1.0 to 10.0 sec	If displayed, use 1.6 sec as a starting value. Increase for greater filtering of noisy signals.	IF	25
AL LISt					
A1.HI	Alarm 1 setpoint high limit	Current value of "A1.SP" to upper range limit	Not displayed if configured uniquely for sensor break or loop break alarm, or if alarm is disabled.	U1	26
A1.Lo	Alarm 1 setpoint low limit for full scale alarms	Lower range limit to current value of "A1.SP"		Z1	27
	Alarm 1 setpoint low limit for deviation band alarms	1 l.s.d. to current value of "A1.SP"			
A1.HY	Alarm 1 hysteresis	1 l.s.d. to effective span		Y1	28

Table 4.1 Adjustable Parameters (Part 5)

Mnemonic	Parameter	Adjustable range		Comments	Bisync	Mod/J
AL LiSt	(continued)					
A2.Hi	Alarm 2 setpoint high limit	Current value of "A2.SP" to upper range limit		Not displayed if configured uniquely for sensor break or loop break alarm, or if alarm is disabled.	U2	29
A2.Lo	Alarm 2 setpoint low limit for full scale alarms	Lower range limit to current value of "A2.SP"			Z2	30
	Alarm 2 setpoint low limit for deviation band alarms	1 l.s.d. to current value of "A2.SP"				
A2.HY	Alarm 2 hysteresis	1 l.s.d. to effective span			Y2	31
tty LiSt						
bAUd	Baud rate selection	300 baud	**300**		BR	46
		600 baud	**600**			
		1200 baud	**1200**			
		2400 baud	**2400**			
		4800 baud	**4800**			
		9600 baud	**9600**			
		19,200 baud	**19.2**			
Addr	Instrument address	0.0 to 9.9		EI-Bisynch address range	AD	
		1 to 255		Modbus and Jbus address range		47
FLSH	Pushbutton flash during transmission	ON	**on**	Using pushbuttons overrides pushbutton flashing. Not adjustable through communications link.	---	---
		OFF	**oFF**			

4.3 Alarms

One or 2 alarm output channels can be configured for operation: alarm 1 and alarm 2. The following descriptions apply to both.

• **Temperature alarm** (configuration codes "1" through "5" for operation)
If the measured value enters the alarm condition as defined by the configuration code, the appropriate red "AL1" or "AL2" lamp lights up and the alarm relay is de-energized (failsafe operation). The alarm is non latching; the lamp goes out and the alarm relay is re-energized as soon as the measured value enters the "safe" condition.

• **Sensor break alarm** (For alarm relay output select configuration code "6" or "8" through "C"). If the controller has detected that the sensor circuit has failed, then the output power level is forced to 0% and **SnSr FAIL** is displayed.
A failed sensor is detected if:
• the input signal is out of the selected sensor's range,
• the input is open circuit, or
• the controller's operating temperature is outside of the specified operating range (thermocouple inputs only).
Upon reinstatement of the input sensor, the controller resumes controlling with the same output power level used at the moment of the break.

• **Loop break alarm** (For alarm relay output select configuration code "7" or "8" through "C")
For PID control, a loop break alarm occurs if the output remains at 0 or 100% and the measured value moves less than 1/2 of **ProP** setting toward the setpoint within time setting of **LP.br**.

For ON/OFF control, a loop break alarm occurs if the measured value moves less than 10% of the effective span towards the setpoint within the time setting of **LP.br** *and* there is no change in the output state. [For definition of effective span, see §3.2, (3rd digit, lower display).]

If the unit detects a break in the control loop, then **LP.Br** is displayed. The display (and optional relay operation) is latching. To reset, touch any key while **LP.Br** is displayed. The output level is determined by the control algorithm during the alarm condition.

If self tuning is used to determine the PID parameter values, then the value of **LP.br** can be automatically determined at the same time. Set **LP.br** to any value except **oFF** before starting self tuning; **LP.br** is then set to 2 x **Int.t** upon the completion of self tuning.

To determine starting values for **LP.br** manually:
PID control: Set **LP.Br** equal to or slightly longer than **Int.t.**
ON/OFF control: Set **LP.Br** equal to one period of oscillation around setpoint (ON + OFF times).
For both types of control: increase **LP.Br** if spurious alarms occur; decrease for greater sensitivity.

NOTE: The above described operation of sensor break and loop break alarms always occurs irrespective of the configuration of the alarm relay.

4.4 Second setpoint

• **Setup and operation**
Three modes of operation are possible. Go to **SP.SP** in **SP List** and select the desired mode of operation.
• **SP 1** (setpoint 1 only)
• **SP12** (setpoints 1 and 2 selectable from the front only). In the open list, select the desired setpoint (**SP 1** or **SP 2**) under the setpoint selection parameter, **SP12**
• **IP2** (setpoints 1 and 2 selectable from the rear terminals only). Use connected 2-position switch to select desired setpoint. The open position corresponds to set-point 1. [Verify the 4th configuration digit, upper display: it must be set to **4** or **5**.]

• **Displays**
• Setpoint 1 only: All parameters referring to setpoint 2 and the setpoint selection parameter, **SP12**, are removed from the lists.
• Setpoints 1 and 2: . **SP 2** flashes in the lower display whenever setpoint 2 is active. To adjust *active* setpoint, use ▲ or ▼. To adjust *inactive* setpoint, go to **SP 1** or to **SP 2** as the case may be in **SP List**.

4.5 Ramp-to-setpoint operation
The setpoint ramping feature is enabled by setting **SP.rr** to any value except **OFF**. Ramping is initiated only by one of 3 conditions:
• power-up
• change in setpoint
• switching between **SP 1** and **SP 2**.

Ramping starts from the the old setpoint, or on power up, from the measured value. The instantaneous setpoint moves towards the target setpoint (the setpoint displayed along with the measured value) at a constant speed (selectable by **SP.rr**). **SP.rr** remains constant for all ramps until it is changed by the user.

When the measured value follows a ramping setpoint through an alarm region, the alarm is detected, annunciated and output as follows:
• Full scale high and low alarms. The alarm is non latching; crossing the alarm set-point into the "safe" region ends the alarm condition.
• Deviation alarms. The deviation alarm threshold follows the ramping setpoint. If the measured value cannot track the setpoint within the bounds of the deviation alarm, an alarm condition is generated.

NOTE: Any value for SP.rr except oFF inhibits self tuning operation.

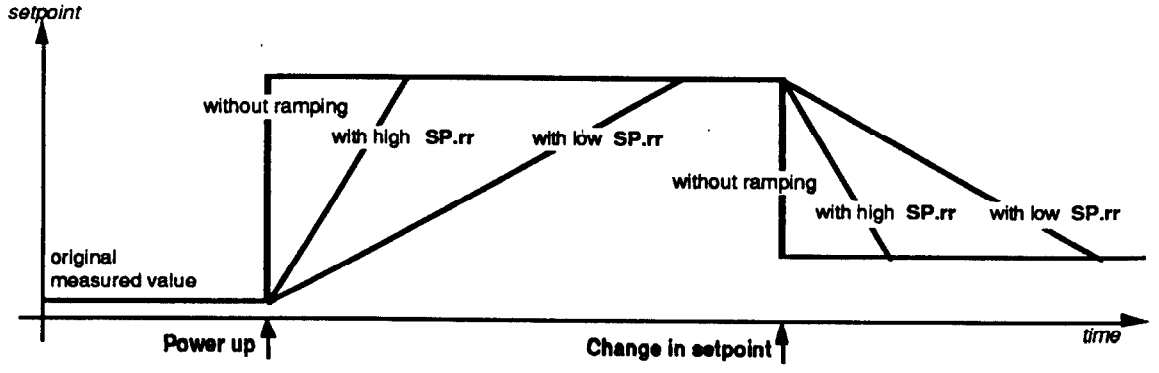


Table 4.2
Display messages (Part 1)

Message	Display condition	User action/comments
LOOP STATUS MESSAGES		
SnSr FAIL	Sensor fail. Input open or reversed; measured value outside of configured range.	Verify input sensor and connections. Message disappears when input signal is reinstated.
measured value **LP.br**	Break detected in control loop. See §4.3.	Verify output device, fuses, wiring and heater. Check that input wiring is not shorted. Acknowledge by touching any key.
measured value **SP.rr**	Setpoint ramping in progress.	Setpoint and "SP.rr" parameter still user-adjustable during ramping.
measured value **SP 2**	Setpoint 2 selected.	Setpoint 1 may be adjusted in protected list.
HHHH setpoint	Measured value greater than high sensor limit.	Unit should not be used in this range.
LLLL setpoint	Measured value less than low sensor limit.	Unit should not be used in this range.
param. mnemonic **LLLL or HHHH**	Parameter value out of range. May have resulted from change of configuration code.	In general, check (and reset if required) parameter values after reconfiguration.

Table 4.2
Display messages (Part 2)

Message	Display condition	User action/comments
SELF TUNE MESSAGES		
measured value **tunE**	Self tuning in progress.	Annunciation only. Adjustment of setpoint and PID values inhibited during self tuning.
tunE **FAIL**	Self tuning operation has failed because controller cannot maintain setpoint.	Acknowledge by touching any key. Remove cause of failure: e.g. heater fuse blown, etc.
LinE **FAIL**	Loss of controller power during self-tuning operation renders sampled data questionable.	Acknowledge by touching any key. Verify power supply. Reinitiate self tuning procedure.
SELF DIAGNOSTIC MESSAGES		
tESt **1111**	Internal self test upon power up.	Replace unit if all four 1's do not light up or fails to go to "8888". Do not touch front panel during self test.
8888 **8888**	Display test after above self test. Lasts for approximately 3 seconds.	User should verify that all digits and lamps light up to prevent erroneous readings.
EE **FAIL**	Memory corruption.	Verify and correct all parameter and configuration values. If display persists, replace unit.
tty **FAIL**	Communications hardware error. (Model 94c only)	Cycle power. If display persists, replace unit. [While awaiting a replacement unit, it is possible to use unit without communications by disabling communications in configuration. Set the last digit of the configuration code to "0".]

5. TUNING AND ADJUSTMENTS

WARNING! The two PID tuning procedures presented here are based on perturbation response; the step changes involved may be detrimental to sensitive systems.

CAUTION! On water cooled *evaporative* systems tuned with the self-tuning algorithm, damage can result to the system if COOL is improperly set. Be sure that COOL is set to H2O in this case.
For water cooling, be sure that the flow rate is correctly set before tuning.

NOTE: SP.rr must be set to oFF before performing either manual or self-tuning.

5.1 PID self tuning procedure

1. Set appropriate values for *all* parameters except **ProP**, **Int.t**, **dEr.t**, and **LP.br**. Also, set **Cb.Lo** and **Cb.Hi** to **Auto** if it is desired that their values be automatically determined.
For PI control set **dEr.t = oFF**. For PD control set **Int.t = oFF**. For proportional only control set **Int.t = dEr.t = oFF**.
The value for **LP.br** is also determined if the starting value is not set to **oFF**.
It is important that the cycle time parameters (**H ct** and **C ct**) and the maximum power limit parameters (**H PL** and **C PL**) be set before the tuning operation. It is of extreme importance that **COOL** be correctly set.

2. Initiate self tuning by setting **tunE** to
- **Ht.CI** for heat/cool loops;
- **HEAt** for heat-only loops or PID heat/ON/OFF cool loops; or
- **COOL** for cool-only loops or ON/OFF heat/PID cool loops.

The **tunE** message will flash in the lower display.

3. Wait for the tuning operation to finish: **tunE** will no longer be displayed.

4. The values for **ProP**, **Int.t**, and **dEr.t**, as well as **Cb.Lo**, **Cb.HI** and **LP.br** can be viewed in the protected sub-lists.

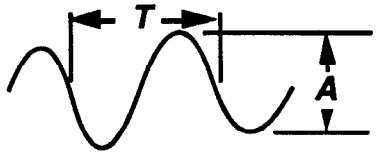
5. See the *Display messages* table for tuning messages.

5.2 PID manual tuning procedure

NOTE: Wait a sufficient period of time after each adjustment to see if the system will stabilize.

• Heat-only or cool-only systems

1. Set **Cb.Lo** and **Cb.HI** to **Auto**. Set the setpoint to the normal operating temperature, **ProP** = minimum, **Int.t** = OFF, and **dEr.t** = OFF. Observe the peak-to-peak amplitude (*A*) and period (*T*) of the oscillation of the measured value. This oscillation may not necessarily be centered about the setpoint.



2. Set **ProP** = 1.1 x *A*. If stable (probably not at setpoint) go to 3. If not, increase **ProP** until the temperature is stable.

3. Set **Int.t** = *T*. Wait at least 2 x *T*. If system becomes stable at setpoint, go to 4. If not, increase **Int.t** in small (<30%) steps until the temperature is stable at setpoint.

4. Set **dEr.t** = **Int.t**/6. If stable, go to 5. If not decrease **dEr.t** in small steps until temperature is stable. (**dEr.t** might have to be turned **oFF**.)

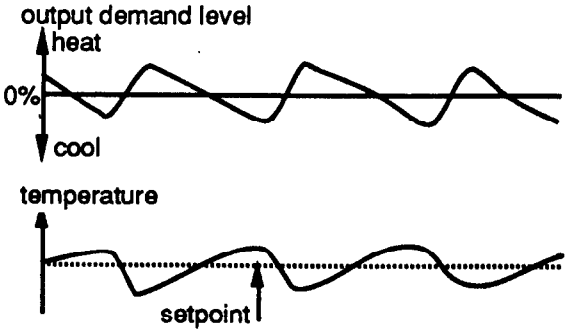
5. The loop should now be stable at setpoint. If not, try the following:
• If **Int.t** is shorter than the period of oscillation, increase **Int.t** to be slightly longer than the period. If stability is not achieved after several small increases, then try:
• Increase **ProP** in several small (<30%) steps. If oscillations continue, try:
• Set **dEr.t** = **oFF**. If the temperature is still unstable, try:
• Set **Int.t** = **oFF**. If stable, go to 3 above and repeat. If not, increase **ProP** until temperature is stable, then go to 3.

• Heat/cool systems

The procedure is similar the the procedure outlined above, except that a starting value of **rEL.c** must be set before beginning. Use the starting values given in the *Adjustable parameters* table.

If there is not enough cooling action (**rEL.c** too small) the temperature remains above setpoint for a prolonged period of time and is very sluggish in dropping back to setpoint (assuming that the controller is requesting cooling output). Increase the value of **rEL.c** in this case.

If there is too much cooling action (**rEL.c** too large) the temperature is rapidly pulled down each time cooling is applied. This is characterized by a sawtooth shaped waveform. Reduce the value of **rEL.c**.



5.3 Automatic droop compensation

The parameter **Adc** implements manual reset automatically. It can be used only if **Int.t** = **oFF**. **Adc** has two uses for PD or proportional only control loops:

• To place the proportional band symmetrically about the setpoint. Set **Adc** to **50pc**.

• To reduce droop. Wait until the measured value has stabilized near the setpoint, then set **Adc** to **CALC**. The loop resettles with little or no error. To remove further errors, wait for steady state and reselect **CALC**.
The Adc value is maintained if the power to the instrument is cycled OFF and ON.

5.4 ON/OFF control adjustment

The cycle time parameters, **H ct** and **C ct**, take on a different role in ON/OFF control—they define the minimum ON and OFF *dwell times* of the heat and cool outputs. This permits protection of output devices (such as mechanical contactors) and loads (such as compressors) from high switching frequencies without having to set hysteresis too wide.

First set **H ct** (and/or **C ct**) to the minimum switching ON or OFF time tolerated by the output device or the load. Then progressively increase the hysteresis (**H Hy** and/or **C Hy**) to increase the time between output switching operations.

6. COMMUNICATIONS (Model 94c only)

6.1 General

- The communications hardware standard complies electrically with EIA-485, but is connected as described by EIA-422-A. Refer to §2.9 for the wiring. Two different protocols can be selected by the configuration code (lower display, 4th digit): EI Bisync and Jbus/Modbus. It is assumed that the reader has access to documentation for the appropriate protocol; the information in this manual pertains only to the Model 94c.

- It is possible to begin communications with the Model 94c approximately 10 seconds after the unit completes power-up self tests and parameter value check.

- Parameter value updates are verified against any existing limits that may apply to that parameter; e.g., the value of Setpoint 1 (SL) cannot be modified to 500 if the current value of Setpoints 1 and 2 high limit (HS) is 400. In such cases it is necessary to adjust first the subordinating parameter values, then the dependent parameter value.

- Any parameter can be read from (and written to, if read/write) even though it may not be accessible from the front panel for the current configuration. For example, the PID parameters are not available for viewing or adjustment from the front panel if the unit is configured for ON/OFF control only. Through the communications link, however, the PID parameters can be retreived and modified as desired, even though they have no influence on ON/OFF control.

- During self tuning most read/write parameters become read-only. Those that do remain read/write are indicated in Tables 6.1 and 6.3.

6.2 EI Bisync protocol

For information concerning the protocol, refer to Doc. No. HA020161, *Instrument Communications Handbook.*

The instrument parameters available through communications are listed in Table 6.1: EI Bisync Parameters. These parameters include: process parameters in engineering units, enumerated parameters, and hexadecimal (binary) parameters. The parameters are presented in the fast poll scroll order. Refer to Table 4.1 for further information concerning the use of each parameter.

6.2.1 Process parameters

The precision and the units of the process parameters for communications purposes conform to those used on the front panel. If parameter values with more precision than the display value are received by the controller, they are accepted and rounded to the the display precision for retransmission (if requested) to the host. The parameter limits and display precisions are listed in Table 4.1.

Values for certain process parameters can be inspected only through the communications link. The data format and units for those parameters related to the measured value (SP, ER, 1S, and 1L) correspond to those for the measured value. The data format, range, and units for the 3 output power parameters (OP, 1P, and 2P) are given in Table 6.1.

Table 6.1 EI bisync parameters (Part 1)

Fast poll scroll order	EI Bisync mnemonic	Front panel mnemonic	Parameter	Data format	Access	Comments
1	PV	None	Measured value	°C, °F or Lin units	R/O	
2	SW	None	Status word	See "Hexadecimal Parameters" table	R/W	Remains R/W even if TU = HEAT, COOL, or HTCL.
3	OP	None	Output power (uncompensated)	-100 to 0% (cool only) 0 to 100% (heat only) -100 to 100% (heat/cool)	R/O	Valid only if at least one output is configured for PID control. Represents PID algorithm output without effects of HO, LO, RG, DB and CA.
4	SP	None	Instantaneous setpoint	°C, °F or Lin units	R/O	Represents effects of ramping and of switching between SL and S2. Not updated if "SnSr FAIL" displayed.
5	SL	SP1	Setpoint 1	°C, °F or Lin units	R/W	"Target" setpoint
6	S2	SP2	Setpoint 2	°C, °F or Lin units	R/W	"Target" setpoint
7	SS	SP.12	Setpoint selection	Enumerated: ASCII: 0 SP_1 1 SP_2	R/W	"_" indicates a mandatory space in ASCII parameter mnemonic [ASCII 20(hex) or 32(dec)]. USE ALL CAPS.
8	SM	SP.SP	Setpoint mode selection	Enumerated: ASCII: 0 SP_1 1 SP12 2 IP_2	R/W	"_" indicates a mandatory space in ASCII parameter mnemonic [ASCII 20(hex) or 32(dec)]. USE ALL CAPS.
9	RR	SP.rr	Setpoint ramp rate	°C/min., °F/min. or Lin units/min.	R/W	"0" disables ramping, i.e. step changes in setpoint are enabled.
10	XP	ProP	Proportional band	°C, °F, Lin; or % of effective span	R/W	
11	TI	Int.t	Integral time constant	Seconds	R/W	"0" turns integral action OFF, i.e. Proportional-only or PD control
12	TD	dEr.t	Derivative time constant	Seconds	R/W	"0" turns derivative action OFF, i.e. Proportional-only or PI control

Table 6.1
EI bisync parameters (Part 2)

Fast poll scroll order	EI Bisync mnemonic	Front panel mnemonic	Parameter	Data format	Access	Comments
13	LB	**CB.Lo**	Low cutback	°C, °F or Lin units	R/W	"0" sets "Cb.Lo" to "Auto", i.e. "Cb.Lo" = 3 x "ProP"
14	HB	**CB.Hi**	High cutback	°C, °F or Lin units	R/W	"0" sets "Cb.Hi" to "Auto", i.e. "Cb.Hi" = 3 x "ProP"
15	TU	**tunE**	Self tune on demand	Enumerated: ASCII: 0 OFF 1 HEAT 2 COOL 3 HTCL	R/W	USE ALL CAPS. Remains R/W even if TU = HEAT, COOL, or HTCL. Can be set to HEAT, COOL or HTCL only if RR = 0.
16	A1	**A1.SP**	Alarm 1 setpoint	°C, °F or Lin units	R/W	
17	A2	**A2.SP**	Alarm 2 setpoint	°C, °F or Lin units	R/W	
18	CH	**H ct**	Heat cycle time	Seconds	R/W	
19	YH	**H Hy**	Heat hysteresis	°C, °F or Lin units	R/W	
20	CC	**C ct**	Cool cycle time	Seconds	R/W	
21	YC	**C Hy**	Cool hysteresis	°C, °F or Lin units	R/W	
22	DB	**HC.db**	Heat-cool deadband	% of effective span (if ON/OFF cool control) % of output power (if PID cool control)	R/W	
23	AC	**Adc**	Automatic droop compensation	Enumerated: ASCII: 0 OFF 1 50PC 2 ON 3 CALC	R/W	USE ALL CAPS.

Table 6.1 EI bisync parameters (Part 3)

Fast poll scroll order	EI Bisync mnemonic	Front panel mnemonic	Parameter	Data format	Access	Comments
24	CA	COOL	Cooling algorithm selection	Enumerated: ASCII: 0 LIN 1 H2O 2 FAN 3 OIL	R/W	USE ALL CAPS.
25	HO	H PL	Heat power limit	% of output power	R/W	
26	LO	C PL	Cool power limit	% of output power	R/W	
27	PO	OFSt	Calibration offset		R/W	
28	IF	FILt	Input filter	Seconds	R/W	
29	RG	rEL.C	Relative cool gain	Unitless coefficient	R/W	
30	BT	LP.br	Loopbreak time	Seconds	R/W	"0" disables loopbreak detection.
31	Y1	A1.HY	Alarm 1 hysteresis	°C, °F or Lin units	R/W	
32	Y2	A2.HY	Alarm 2 hysteresis	°C, °F or Lin units	R/W	
33	U1	A1.HI	Alarm 1 setpoint high limit	°C, °F or Lin units	R/W	
34	Z1	A1.Lo	Alarm 1 setpoint low limit	°C, °F or Lin units	R/W	
35	U2	A2.HI	Alarm 2 setpoint high limit	°C, °F or Lin units	R/W	
36	Z2	A2.Lo	Alarm 2 setpoint low limit	°C, °F or Lin units	R/W	
37	MN	None	Mode number	See "Hexadecimal Parameters" table	R/W	Remains R/W even if TU = HEAT, COOL, or HTCL.
38	ER	None	Error (measured value - setpoint)	°C, °F or Lin units	R/O	
39	1P	None	Channel 1 output power (compensated)	0 to 100%	R/O	Represents PID algorithm output with effects of HO or LO, RG, DB, and CA.

Table 6.1
EI bisync parameters (Part 4)

Fast poll scroll order	EI Bisync mnemonic	Front panel mnemonic	Parameter	Data format	Access	Comments
40	2P	None	Channel 2 output power (compensated)	0 to 100%	R/O	Represents PID algorithm output with effects of HO or LO, RG, DB, and CA.
41	HS	**SP.Hi**	Setpoints 1 and 2 high limit	°C, °F or Lin units	R/W	
42	LS	**SP.LO**	Setpoints 1 and 2 low limit	°C, °F or Lin units	R/W	
43	1H	None	Sensor high limit	°C, °F or Lin units	R/O	
44	1L	None	Sensor low limit	°C, °F or Lin units	R/O	
45	BR	**bAUd**	Baud rate selection	Enumerated: ASCII: 0 300 1 600 2 1200 3 2400 4 4800 5 9600 6 19.2	R/W	
46	AD	**Addr**	Instrument address	0.0 to 9.9 (group and unit)	R/W	Decimal point is required.
47	BL	None	Buffer length	See "Hexadecimal Parameters" table	R/W	Remains R/W even if TU = HEAT, COOL, or HTCL.
48	EE	None	Communications error code	See "Hexadecimal Parameters" table	R/W	
49	CU	**CF U**	Upper configuration code (first 4 digits)	See "Hexadecimal Parameters" table	R/W	See "Reconfiguration through communications"
50	CL	**CF L**	Lower configuration code (last 4 digits)	See "Hexadecimal Parameters" table	R/W	See "Reconfiguration through communications"

Table 6.1
EI bisync parameters (Part 5)

Fast poll scroll order	EI Bisync mnemonic	Front panel mnemonic	Parameter	Data format	Access	Comments
51	CW	None	Configuration write enable	Enumerated: ASCII: 0 LOCK 1 GO	R/W	See "Reconfiguration through communications"
52	IM	None	Instrument mode	Enumerated: ASCII: 0 OPR 1 *unused* 2 CONF	R/W	See "Reconfiguration through communications"
53	II	**Id**	Model number	See "Hexadecimal Parameters" table	R/O	
54	V0	None	Main microcontroller version number	See "Hexadecimal Parameters" table	R/O	
55	V1	None	Communications micro controller version no.	See "Hexadecimal Parameters" table	R/O	
56	CI	None	Configuration information	See "Hexadecimal Parameters" table	R/O	
57	DI	None	Digital telemetry input	See "Hexadecimal Parameters" table	R/O	Available only on comms micro-controller version nos. 1.1 and greater.
58	DO	None	Digital telemetry output	See "Hexadecimal Parameters" table	R/W	Available only on comms micro-controller version nos. 1.1 and greater. Remains R/W even if TU = HEAT, COOL, or HTCL.

6.2.2 Enumerated parameters

Enumerated parameters can transmit and receive either numeric values (0, 1, 2...) or ASCII strings preceded by an apostrophe (ASCII 27_{16} or 39_{10}): e.g. 'OFF, 'HEAT, 'COOL... If the instrument receives any enumerated parameter value in ASCII, all other parameters switch into the ASCII mode. Similarly, while in the ASCII mode, reception of a numeric value causes all other parameters to revert to the numeric mode. Both the numeric and ASCII enumerations are presented in Table 6.1. Enumerated parameters default to the numeric mode after the power is cycled to the instrument.

6.2.3 Hexadecimal parameters

Hexadecimal parameter values consist of a string of 4 ASCII characters (0 through 9 and A through F) preceded by > ($3E_{16}$ or 62_{10}). In some parameters certain hexadecimal characters are decomposed into 4 binary bits.

In the Table 6.2 the 4 hexadecimal characters are represented from left to right as A, B, C, and D. Character A consists of the most significant bits (bits 15 through 12), character B consists of bits 11 through 8, and so forth. Each bit can have its own level of access—either read/write (R/W) or read only (R/O). Read/write bits serve both as a means of annunciation (read function) and as an input (write function). The write functions are presented in *italics* in the table. Several generalizations concerning read/write bits can be made:

- Normally there are no bits that need to be set; it is only necessary to write zeroes. Writing a 1 to a bit has no effect and is ignored; no NAK is retransmitted to the host in this case. (EXCEPTION: It is permitted to write a 1 to the digital telemetry output parameter DO.)
- To clear all clearable bits in a word transmit 0000_{16}. No NAK is returned if an attempt is made to clear a read-only bit, or if a read/write bit cannot be cleared.
- To clear a specific bit, transmit a word containing all ones except for a 0 in the place of the bit to be cleared.

Table 6.2
EI Bisync and Modbus/Jbus hexadecimal/binary parameters (Part 1)

EI Bisync mnemonic *(M/Jbus address)*	Parameter	Data format: Hex digit	Bit No.	Bit value	Read function *In italics: Write function (if any)*	Access	Comments
SW *(4)*	Status word	A	15	0	Not used	R/O	
			14	0	Not used	R/O	
			13	1	Setpoint 2 active	R/O	
				0	Setpoint 1 active		
			12	1	Any unacknowlegded alarm present	R/W	EI bisync only: Same information available in bit 15 of "MN". Writing to one parameter also writes to the other.
				0	No unacknowlegded alarms present *Acknowledge alarms*		
		B	11	1	Setpoint ramping enabled	R/O	
				0	Setpoint ramping disabled		
			10	1	Alarm 1 active	R/O	
				0	Alarm 1 cleared		
			9	1	Self tune in progress (TU = HEAT, COOL or HTCL)	R/O	
				0	Self tune OFF (TU = OFF)		
			8	1	Alarm 2 active	R/O	
				0	Alarm 2 cleared		
		C	7	1	Communications fault ("tty FAIL" displayed)	R/W	
				0	No communications fault *Acknowledge "tty FAIL"; clear message from display*		
			6	1	Memory corruption ("EE FAIL" displayed)	R/W	
				0	No memory corruption; "EE FAIL" not displayed *Acknowledge "EE FAIL"; clear message from display*		
			5	1	Parameter value changed from front panel	R/W	EI bisync only: Same information available in bit 14 of "MN". Writing to one parameter also writes to the other.
				0	No change in parameter *Acknowledge change in parameter*		
			4	1	"TunE FAIL" or "LinE FAIL" displayed	R/W	
				0	"TunE FAIL" or "LinE FAIL" not displayed *Acknowledge "TunE FAIL" or "LinE FAIL"; clear message from display*		

Table 6.2
EI Bisync and Modbus/Jbus hexadecimal/binary parameters (Part 2)

EI Bisync mnemonic ***(M/Jbus address)***	**Parameter**	**Data format**					**Comments**
		Hex digit	**Bit No.**	**Bit value**	**Read function** ***In italics: Write function (if any)***	**Access**	
SW *(4)*	Status word (continued)	D	3	1	"LP.br" displayed	R/W	
				0	"LP.br" not displayed *Clear "LP.br" from front panel, if possible*		
			2	0	Not used	R/O	
			1	1	Sensor fail condition ("SnSr FAIL" displayed)	R/O	
				0	"SnSr FAIL" not displayed		
			0	0	Free data format	R/O	EI bisync only: Fixed format not supported by 94c.
MN	Mode number	A	15	1	Any unacknowlegded alarm present	R/W	Same information available in bit 12 of "SW". Writing to one parameter also writes to the other.
				0	No unacknowlegded alarms present *Acknowledge alarms*		
			14	1	Parameter value changed from front panel	R/W	Same information available in bit 5 of "SW". Writing to one parameter also writes to the other.
				0	No change in parameter *Acknowledge change in parameter*		
			13	0	Not used	R/O	
			12	1	Memory corruption OR comms fault ("EE FAIL" OR "tty FAIL" displayed)	R/O	Reflects logical ORing of bits 6 and 7 of "SW".
				0	No memory corruption OR not comms fault (Neither "EE FAIL" nor "tty FAIL" displayed)		
		B	11	0	Free data format	R/O	Fixed format not supported by 94c.
			10	1	Sensor fail condition ("SnSr FAIL" displayed)	R/O	
				0	"SnSr FAIL" not displayed		
			9	1	Reset or instrument power cycle has occurred.	R/W	
				0	Reset or instrument power cycle has not occurred. *Acknowledge reset*		
			8	0	Not used	R/O	
		C	all	0000	Not used	R/O	
		D	all	0000	Not used	R/O	

Table 6.2
EI Bisync and Modbus/Jbus hexadecimal/binary parameters (Part 3)

EI Bisync mnemonic *(M/Jbus address)*	Parameter	Data format: Hex digit	Bit No.	Bit value	Read function *In italics: Write function (if any)*	Access	Comments
CI	Configuration information	A	15	0	Not used	R/O	
			14	1	Dual format support	R/O	Variable length data transmission supported.
			13	0	Multi-block support	R/O	Multi-block data transmission not supported.
			12	0	Not used	R/O	
		B	all	0001	Primary category	R/O	Eurotherm controller
		C	all	0001	Secondary category	R/O	Eurotherm controller
		D	all	0001	Tertiary category	R/O	Eurotherm controller
DI *(51)*	Digital telemetry input	A	all	0000	Not used	R/O	Available only if Communications microcontroller version no. is 1.1 or greater. See "Telemetry Parameters".
		B	all	0000	Not used	R/O	
		C	all	0000	Not used	R/O	
		D	3	0	Not used	R/O	
			2	0	Not used	R/O	
			1	1	Digital input closed	R/O	
				0	Digital input open		
			0	0	Not used	R/O	
DO *(52)*	Digital telemetry output	A	all	0000	Not used	R/O	Available only if Communications microcontroller version no. is 1.1 or greater. See "Telemetry Parameters".
		B	all	0000	Not used	R/O	
		C	7	0	Not used	R/O	
			6	0	Not used	R/O	
			5	1	Alarm 1 relay energized *Energize Alarm 1 relay*	R/W	
				0	Alarm 1 relay deenergized *Deenergize Alarm 1 relay*		
			4	0	Not used	R/O	
		D	all	0000	Not used	R/O	

Table 6.2
EI Bisync and Modbus/Jbus hexadecimal/binary parameters (Part 4)

EI Bisync mnemonic (M/Jbus address)	Parameter	Data format: Hex digit	Data format: Digit value	Data format: Function	Data format: Access	Comments
BL	Maximum buffer length	AB	07	7-character transmission buffer	R/W	No. of char. between STX and ETX. Reverts to 07 after unit reset.
			08	8-character transmission buffer		
		CD	08	8-character communications buffer	R/O	Max. transmission buffer length
EE	Communications error code: Instrument error code	AB	00	No error	R/O	
			01	Invalid mnemonic		
			02	Communications checksum error		
			03	Line error—parity, framing, or overrun		
			04	Not used		
			05	Write attempt on read-only parameter		
			06	Not used		
			07	Invalid data format		
			08	Data out of range		
	Instrument category	C	1	Primary category—Eurotherm controller	R/O	Duplicate of information in CI, hex digit B.
	Instrument error category	D	0	No error	R/O	
			1	Character error—parity, framing, or overrun		
			2	Message data error (checksum)		
			7	Invalid message (e.g. mnemonic unknown)		
			8	Invalid message content (e.g. range error, access)		
CU (48)	Upper configuration code (first 4 digits)	ABCD	any valid	See §3.2 for configuration code.	R/W	See "Reconfiguration through communications"
CL (49)	Lower configuration code (last 4 digits)	ABCD	any valid	See §3.2 for configuration code.	R/W	See "Reconfiguration through communications"
II (122)	Model number	ABCD	94C0	Model 94c	R/O	
V0 (123)	Main microcontroller version number.	AB	00-99	Major version number	R/O	Example: 0102 = version 1.2
		CD	00-99	Minor version number		
V1 (124)	Comms microcontroller version no.	AB	00-99	Major version number	R/O	Example: 0102 = version 1.2
		CD	00-99	Minor version number		

6.3 Modbus and Jbus protocols

Refer to Modbus or Jbus documentation for generalities about these protocols; the RTU (remote terminal unit) version is implemented. Modbus and Jbus are treated as a combined protocol; the parameter addresses are the same in both cases.

The instrument parameters available through communications are listed in Table 6.3: Modbus/Jbus Parameters. These parameters include the word parameters: process parameters in engineering units, enumerated parameters, and hexadecimal (binary) parameters. Refer to Table 4.1 for further information concerning the use of each parameter.

Word addresses 0, 7, 33, and 53 through 120 do not contain parameters and are read-only. When read, addresses 0, 7, and 33 return a value of 0. Addresses 53 through 120 return the largest negative number, -32768.

If a block read uses a valid starting address, but attempts to read bit addreses beyond 16 or word addresses beyond 124, only the valid parameters are returned. The byte count in the reply reflects only the data up to the highest address (16 or 124 as the case may be).

6.3.1 Process parameters

The precision and the units of the process parameters for communications purposes conform to those used on the front panel. Since data are always transmitted as integers, the placement of the decimal point is implicit to the particular parameter. Parameter resolutions are listed in Table 6.3. Those parameters for which the resolution follows that of the measured value (PV) have "As PV" for the entry in the "Resolution" column of the table. The parameter limits are listed in Table 4.1.

Values for certain process parameters can be inspected only through the communications link. The data format and units for those parameters related to the measured value (addresses 2, 5, 11, and 12) correspond to those for the measured value. The resolution, range, and units for the 3 output power parameters (addresses 3, 15, and 16) are given in Table 6.3.

6.3.2 Enumerated parameters

Enumerated parameters can transmit and receive only integer values (0, 1, 2...).

6.3.3 Binary parameters

Binary parameters consist of a 16-bit word which is either interpreted on a bit-wise or half-byte-wise basis. They are presented in Table 6.2; the Modbus/Jbus addresses are indicated in *italics*.

Each bit can have its own level of access—either read/write (R/W) or read only (R/O). Read/write bits serve both as a means of annunciation (read function) and as an input (write function). The write functions are presented in *italics* in the table. Several generalizations concerning read/write bits can be made:

- Normally there are no bits that need to be set; it is only necessary to write zeroes. Writing a 1 to a bit has no effect and is ignored; no error code is retransmitted to the host in this case. (EXCEPTION: It is permitted to write a 1 to the digital telemetry output parameter—address 52.)
- To clear all clearable bits in a word transmit 0000_{16}. No error code is returned if an attempt is made to clear a read-only bit, or if a read/write bit cannot be cleared.
- To clear a specific bit, transmit a word containing all ones except for a 0 in the place of the bit to be cleared.

Table 6.3
Modbus/Jbus word parameters (Part 1)

Modbus/ Jbus word address	Front panel mnemonic	Parameter	Data format	Resolution	Access	Comments
0	None	Not used	---	---	R/O	
1	None	Measured value (PV)	°C, °F or Lin units	1, 0.1, or 0.01	R/O	
2	None	Instantaneous setpoint	°C, °F or Lin units	As PV	R/O	Represents effects of ramping and of switching between 17 and 18. Not updated if "SnSr FAIL" displayed.
3	None	Output power (uncompensated)	-100 to 0% (cool only) 0 to 100% (heat only) -100 to 100% (heat/cool)	1	R/O	Valid only if at least one output is configured for PID control. Represents PID algorithm output without effects of 40 through 44.
4	None	Status word	See "Hexadecimal Parameters" table	---	R/W	Remains R/W even if value of 32 = 1, 2, or 3.
5	None	Error (measured value - setpoint)	°C, °F or Lin units	As PV	R/O	
6	**ProP**	Proportional band	°C, °F, Lin; or % of effective span	As PV or 0.1 if %	R/W	
7	None	Not used	---	---	R/O	
8	**Int.t**	Integral time constant	Seconds	1	R/W	"0" turns integral action OFF, i.e. Proportional-only or PD control
9	**dEr.t**	Derivative time constant	Seconds	1	R/W	"0" turns derivative action OFF, i.e. Proportional-only or PI control
10	**H ct**	Heat cycle time	Seconds	0.1	R/W	
11	None	Sensor low limit	°C, °F or Lin units	As PV	R/O	
12	None	Sensor high limit	°C, °F or Lin units	As PV	R/O	
13	**A1.SP**	Alarm 1 setpoint	°C, °F or Lin units	As PV	R/W	
14	**A2.SP**	Alarm 2 setpoint	°C, °F or Lin units	As PV	R/W	
15	None	Channel 1 output power (compensated)	0 to 100%	1	R/O	Represents PID algorithm output with effects of 41 through 44.

Table 6.3
Modbus/Jbus word parameters (Part 2)

Modbus/ Jbus word address	Front panel mnemonic	Parameter	Data format	Resolution	Access	Comments
16	None	Channel 2 output opwer (compensated)	0 to 100%	1	R/O	Represents PID algorithm output with effects of 40 through 44.
17	SP1	Setpoint 1	°C, °F or Lin units	As PV	R/W	"Target" setpoint
18	SP2	Setpoint 2	°C, °F or Lin units	As PV	R/W	"Target" setpoint
19	SP.SP	Setpoint mode selection	Enumerated: Display: 0 SP 1 1 SP.12 2 IP 2	1	R/W	
20	SP.12	Setpoint selection	Enumerated: Display: 0 SP 1 1 SP 2	1	R/W	
21	SP.Hi	Setpoints 1 and 2 high limit	°C, °F or Lin units	As PV	R/W	
22	SP.LO	Setpoints 1 and 2 low limit	°C, °F or Lin units	As PV	R/W	
23	SP.rr	Setpoint ramp rate	°C/min., °F/min. or Lin units/min.	0.01	R/W	"0" disables ramping, i.e. step changes in setpoint are enabled.
24	OFSt	Calibration offset	°C, °F or Lin units	0.1 if °C or °F 0.01 if Lin	R/W	
25	FILt	Input filter	Seconds	0.1	R/W	
26	A1.Hi	Alarm 1 setpoint high limit	°C, °F or Lin units	As PV	R/W	
27	A1.Lo	Alarm 1 setpoint low limit	°C, °F or Lin units	As PV	R/W	
28	A1.HY	Alarm 1 hysteresis	°C, °F or Lin units	As PV	R/W	

Table 6.3
Modbus/Jbus word parameters (Part 3)

Modbus/ Jbus word address	Front panel mnemonic	Parameter	Data format	Resolution	Access	Comments
29	A2.Hi	Alarm 2 setpoint high limit	°C, °F or Lin units	As PV	R/W	
30	A2.Lo	Alarm 2 setpoint low limit	°C, °F or Lin units	As PV	R/W	
31	A2.HY	Alarm 2 hysteresis	°C, °F or Lin units	As PV	R/W	
32	tunE	Self tune on demand	Enumerated: Display: 0 oFF 1 HEAt 2 CooL 3 HtCL	1	R/W	Remains R/W even if value of 32 = 1, 2, or 3. Can be set to 1, 2 or 3 only if value of 23 = 0
33	None	Not used	---	---	R/O	
34	Cb.Lo	Low cutback	°C, °F or Lin units	As PV	R/W	"0" sets "Cb.Lo" to "Auto", i.e. "Cb.Lo" = 3 x "ProP"
35	Cb.Hi	High cutback	°C, °F or Lin units	As PV	R/W	"0" sets "Cb.Hi" to "Auto", i.e. "Cb.Hi" = 3 x "ProP"
36	Adc	Automatic droop compensation	Enumerated: Display: 0 oFF 1 50Pc 2 on 3 CALC	1	R/W	
37	H Hy	Heat hysteresis	°C, °F or Lin units	As PV	R/W	
38	C ct	Cool cycle time	Seconds	0.1	R/W	
39	C Hy	Cool hysteresis	°C, °F or Lin units	As PV	R/W	
40	HC.db	Heat-cool deadband	% of effective span (if ON/OFF cool control) % of output power (if PID cool control)	0.1	R/W	

Table 6.3
Modbus/Jbus word parameters (Part 4)

Modbus/ Jbus word address	Front panel mnemonic	Parameter	Data format	Resolution	Access	Comments
41	rEL.C	Relative cool gain	Unitless coefficient	0.1	R/W	
42	COOL	Cooling algorithm selection	Enumerated: Display: 0 Lin 1 H2O 2 FAn 3 OIL	1	R/W	
43	H PL	Heat power limit	% of output power	0.1	R/W	
44	C PL	Cool power limit	% of output power	0.1	R/W	
45	LP.br	Loopbreak time	Seconds	1	R/W	"0" disables loopbreak detection.
46	bAUd	Baud rate selection	Enumerated: Display: 0 300 1 600 2 1200 3 2400 4 4800 5 9600 6 19.2	1	R/W	
47	Addr	Instrument address	1 to 255 (dec)	1	R/W	
48	CF U	Upper configuration code (first 4 digits)	See "Hexadecimal Parameters" table	1	R/W	See "Reconfiguration through communications"
49	CF L	Lower configuration code (last 4 digits)	See "Hexadecimal Parameters" table	1	R/W	See "Reconfiguration through communications"
50	None	Configuration write enable	Enumerated: Display: 0 (lock) none 1 (go) none	1	R/W	See "Reconfiguration through communications"

Table 6.3
Modbus/Jbus word parameters (Part 5)

Modbus/ Jbus word address	Front panel mnemonic	Parameter	Data format	Resolution	Access	Comments
51	None	Digital telemetry input	See "Hexadecimal Parameters" table	1	R/O	Available only on comms micro-controller version nos. 1.1 and greater.
52	None	Digital telemetry output	See "Hexadecimal Parameters" table	1	R/W	Available only on comms micro-controller version nos. 1.1 and greater. Remains R/W even if value of 32 = 1, 2, or 3.
53-120	None	Not used	---	---	R/O	
121	None	Company identification	500 (dec)	1	R/O	
122	Id	Model number	See "Hexadecimal Parameters" table	1	R/O	
123	None	Main microcontroller version number.	See "Hexadecimal Parameters" table	1	R/O	
124	None	Communations micro controller version no.	See "Hexadecimal Parameters" table	1	R/O	

6.3.4 Bit parameters

Table 6.4 lists the bit parameters. As with the binary parameters, if a write function exists, it is presented in *italics.*

Table 6.4
Modbus/Jbus bit parameters

Bit No.	Bit value	Read function *In italics: Write function (if any)*	Access
0	0	Not used	R/O
1	1	Self tuning in progress (value of 32 = 1, 2, or 3)	R/O
	0	Self tuning OFF (value of 32 = 0)	
2	0	Not used	R/O
3	1	Setpoint ramping in progress	R/O
	0	Setpoint not ramping	
4	1	Reset or instrument power cycle has occurred	R/W
	0	Reset or instrument power cycle has not occurred *Acknowledge reset*	
5	1	Alarm 1 active	R/O
	0	Alarm 1 cleared	
6	1	Alarm 2 active	R/O
	0	Alarm 2 cleared	
7	1	Memory corruption ("EE FAIL" displayed)	R/W
	0	No memory corruption; "EE FAIL" not displayed *Acknowledge "EE FAIL"; clear message from display*	
8	1	Communications fault ("tty FAIL" displayed)	R/W
	0	No communications fault *Acknowledge "tty FAIL"; clear message from display*	
9	1	"LP.br" displayed	R/W
	0	"LP.br" not displayed *Clear "LP.br" from front panel, if possible*	
10	1	Sensor fail condition ("SnSr FAIL" displayed)	R/O
	0	Measured value in range	
11	1	"TunE FAIL" or "LinE FAIL" displayed	R/W
	0	"TunE FAIL" or "LinE FAIL" not displayed *Acknowledge "TunE FAIL" or "LinE FAIL"; clear message from display*	
12	1	Output 1 ON	R/O
	0	Output 1 OFF	
13	1	Output 2 ON	R/O
	0	Output 2 OFF	
14	1	Any unacknowlegded alarm present	R/W
	0	No unacknowlegded alarms present *Acknowledge alarms*	
15	1	Parameter value changed from front panel	R/W
	0	No change in parameter *Acknowledge change in parameter*	
16	1	Setpoint 2 active	R/O
	0	Setpoint 1 active	

6.3.5 Functions

The following functions are implemented:

Table 6.5
Modbus/Jbus functions

Code	Operation
01 or 02	Read n bits
03 or 04	Read n words
05	Write 1 bit
06	Write 1 word
07	Fast read of status byte

6.3.6 Error codes

These error codes are associated with the functions:

Table 6.6
Modbus/Jbus error codes

Function code	Error code		
	01: Invalid function	02: Invalid address	03: Invalid data
01 or 02		✓	
03 or 04		✓	
05	✓	✓	✓
06	✓	✓	✓

6.3.7 Status byte

The fast read function (07) returns the 8 read/only bits of information shown in Table 6.7. These bits are a subset of the bit parameters in Table 6.4. Note that it is possible to write to these parameters only through the bit parameter addresses.

Table 6.7
Modbus/Jbus fast read function bits

Bit number		Bit value	Read function
In fast read status byte (Function 07)	At bit address (Functions 01, 02, 05)		
0	1	1	Self tuning in progress (value of 32 = 1, 2, or 3)
		0	Self tuning OFF (value of 32 = 0)
1	3	1	Setpoint ramping enabled
		0	Setpoint ramping disabled
2	5	1	Alarm 1 active
		0	Alarm 1 cleared
3	6	1	Alarm 2 active
		0	Alarm 2 cleared
4	9	1	"LP.br" displayed
		0	"LP.br" not displayed
5	10	1	Sensor fail condition ("SnSr FAIL" displayed)
		0	Measured value in range
6	12	1	Output 1 ON
		0	Output 1 OFF
7	13	1	Output 2 ON
		0	Output 2 OFF

6.4 Reconfiguration through communications

There are 2 methods for reconfiguring the Model 94c through digital communications:

- Method one is the preferred method; it retains the original value of the instrument address (AD in EI Bisync, 47 in Modbus/Jbus). Only the upper and lower configuration words can be modified.
- Method two, available only with the EI Bisync protocol, temporarily changes the instrument address to 0.0 during the configuration. Other parameter values in addition to the configuration words can be modified by repeating the procedure.

WARNING! It is the user's responsibility to insure that remote reconfiguration of the controller would not present any hazard to personnel or equipment. Controller operation is momentarily disabled during reset.

Table 6.8
Procedures for reconfiguration through communications

Step No.	Method 1—with CW (50) EI Bisync and Modbus/Jbus	Method 2—with IM EI Bisync only
1	Write upper configuration code to CU *(48)* (if required). Write lower configuration code to CL *(49)* (if required). Instrument continues to use old configuration codes until reset occurs. Continue with original instrument address AD *(47)*.	Write CONF (or 2) to Instrument mode IM. Instrument address AD automatically set to 0.0 Use this address during reconfiguration procedure.
2	Write GO (or 1) to Configuration write enable CW *(50)*. NOTE: Any communication with the instrument between CU *(48)* and/or CL *(49)* and CW *(50)* cancels reset and reconfiguration.	Write upper configuration code to CU (if required). Write lower configuration code to CL (if required). Instrument continues to use old configuration codes until reset occurs. Write OPR (or 0) to IM. AD reverts to original value.
3	Instrument resets if CU *(48)* and/or CL *(49)* have been changed. Parameter value check viewable on front panel display. Instrument does not control during reset.	
4	Instrument controls with new configuration. Set in new parameter values if required.	Instrument controls with new configuration values. Repeat procedure for parameter values.

6.5 Telemetry parameters

Telemetry on the Model 94c allows remote reading of the state of the digital input and remote operation of the Alarm 1 relay. This feature is available on units whose communications microcontroller version no. (V1 or 124) is greater than or equal to 1.1. The EI Bisync parameters involved are DI (Digital telemetry input) and DO (Digital telemetry output). The respective Modbus/Jbus addresses are 51 and 52.

6.5.1 Digital telemetry input DI

- **Setup**

Both the upper configuration word and the setpoint mode selection parameter need to be selected:

• Set the 4th digit of the upper configuration word **CU** to either **4** or **5**.
• Setpoint mode selection **SP.SP** should be set to either **SP 1** or **SP.12**. [Should **IP 2** be selected, the digital telemetry input still operates, but changes in the input cause the instrument to toggle between **SP 1** and **SP 2**.]

• **Operation**
Reading a value of 1 for DI indicates that the digital input terminals are short-circuited. A value of zero indicates that the digital input terminals are open circuited. [If the digital telemetry input is not enabled, then the value of DI (51) represents the state of logic output 2 as determined by the configuration and the control algorithm.]

6.5.2 Digital telemetry output DO

• **Setup**
• To enable set the 1st digit of the lower configuration word **CL** to **5** (Full scale high alarm). [If it is attempted to write to DO without having previousaly made this configuration, then the instrument returns NAK (EI Bisync) or error code 01 (Modbus/Jbus).]

• After each instrument reconfiguration (and the subsequent parameter value check on the front display), the value of DO (52) must be initialized: Write a 1 to energize the Alarm 1 relay, or a zero to deenergize the relay.

• **Operation**
• To energize the Alarm 1 relay: Write a 1 to DO (52). The AL1 lamp on the front panel goes out.
• To deenergize the Alarm 1 relay: Write a zero to DO (52). The AL1 lamp on the front panel lights up.
• Table 6.9 details the values of the front panel parameters and the communications parameters for the 2 possible values of DO (52).

Table 6.9
Digital telemetry output operation:
Relationships between Alarm 1 relay state, and values of front panel parameters and communications parameters

Value of DO (52)	State of:	Value of:		
	AL1 lamp *Alarm 1 relay*	**A1.SP** *A1 (13)*	**A1.HI** *U1 (26)*	**A1.Lo** *Z1 (27)*
1	**OFF** *Energized*	**HHHH** *15000.0*	**LLLL** *Prev. value*	**Prev. value** *Prev. value*
0	**ON** *Deenergized*	**LLLL** *-15000.0*	**Prev. value** *Prev. value*	**HHHH** *Prev. value*

NOTE: While the digital telemetry output function is in use do not modify the values of A1.SP, A1.HI, and A1.Lo from the front panel or through the communications link.

7. USER'S RECORDS

Write down parameter values in this table.

Open list

		Example			
SP	Setpoint	*70°F*			
°C or °F	Display units	*°F*			
tunE	Self tune on demand	*oFF*			
SP.12	Setpoint selection	*SP 1*			
A1.SP	Alarm 1 setpoint	*100°F*			
A2.SP	Alarm 2 setpoint	*not configured*			

Protected list entry point

Id	Model number	*94c*	*94 or 94c*	*94 or 94c*	*94 or 94c*
CFU	Upper config. code	*3022*			
CFL	Lower config. code	*5571*			

PId LISt

Prop	Proportional band	*60°F*			
Int.t	Integral time constant	*360s*			
Der.t	Derivative time constant	*60s*			
Cb.Lo	Low cutback	*180°F*			
Cb.HI	High cutback	*180°F*			
Adc	Auto. droop compensation	*oFF*			

OP LISt

H ct	Heat cycle time	*20s*			
H HY	Heat hysteresis	*not configured*			
C ct	Cool cycle time	*10s*			
C HY	Cool hysteresis	*not configured*			
HC.db	Heat-cool deadband	*0.0%*			
rEL.C	Relative cool gain	*0.5*			
COOL	Cooling algorithm	*H2O*			

OP LISt continued on next page

OP LISt (continued) *Example*

H PL	Heat power limit	*100.0%*			
C PL	Cool power limit	*100.0%*			
LP.br	Loopbreak time	*720s*			

SP LISt

SP.HI	Setpoints 1 & 2 high limit	*100°F*			
SP.Lo	Setpoints 1 & 2 low limit	*32°F*			
Sp.rr	Setpoint ramp rate	*oFF*			
SP 1	Setpoint 1	*70°F*			
SP 2	Setpoint 2	*70°F*			
SP.SP	Setpoint mode selection	*SP.12*			
OFSt	Calibration offset	*0.0°F*			
LInE	Line frequency	*60Hz*			
FILt	Input filter	*1.6s*			

AL LISt

A1.HI	Alarm 1 set-point high limit	*100F*			
A1.Lo	Alarm 1 set-point low limit	*100°F*			
A1. Hy	Alarm 1 hysteresis	*2°F*			
A2.HI	Alarm 2 set-point high limit	*not configured*			
A2.Lo	Alarm 2 set-point low limit	*not configured*			
A2. Hy	Alarm 2 hysteresis	*not configured*			

tty LISt

bAUd	Baud rate selection	*19.2*			
Addr	Instrument address	*2.0*			
FLSH	Pushbutton flash	*on*			

Write down parameter values in this table.

Open list

SP	Setpoint				
°C or **°F**	Display units				
tunE	Self tune on demand				
SP.12	Setpoint selection				
A1.SP	Alarm 1 setpoint				
A2.SP	Alarm 2 setpoint				

Protected list entry point

Id	Model number	*94 or 94c*	*94 or 94c*	*94 or 94c*	*94 or 94c*
CFU	Upper config. code				
CFL	Lower config. code				

Pid LISt

Prop	Proportional band				
Int.t	Integral time constant				
Der.t	Derivative time constant				
Cb.Lo	Low cutback				
Cb.HI	High cutback				
Adc	Auto. droop compensation				

OP LISt

H ct	Heat cycle time				
H HY	Heat hysteresis				
C ct	Cool cycle time				
C HY	Cool hysteresis				
HC.db	Heat-cool deadband				
rEL.C	Relative cool gain				
COOL	Cooling algorithm				

OP LISt continued on next page

OP LISt (continued)

H PL	Heat power limit				
C PL	Cool power limit				
LP.br	Loopbreak time				

SP LISt

SP.Hi	Setpoints 1 & 2 high limit				
SP.Lo	Setpoints 1 & 2 low limit				
Sp.rr	Setpoint ramp rate				
SP 1	Setpoint 1				
SP 2	Setpoint 2				
SP.SP	Setpoint mode selection				
OFSt	Calibration offset				
LInE	Line frequency				
FILt	Input filter				

AL LISt

A1.Hi	Alarm 1 set-point high limit				
A1.Lo	Alarm 1 set-point low limit				
A1. Hy	Alarm 1 hysteresis				
A2.Hi	Alarm 2 set-point high limit				
A2.Lo	Alarm 2 set-point low limit				
A2. Hy	Alarm 2 hysteresis				

tty LISt

bAUd	Baud rate selection				
Addr	Instrument address				
FLSH	Pushbutton flash				

NOTES

Continued from inside front cover.

ESD PRECAUTIONS

This instrument contains static sensitive components. Care should be taken to avoid electrostatic discharge (ESD) and thus reduce incidents of damage to the instrument when removed from its sleeve. Any manipulation of the instrument printed circuit boards should be performed on a conductive surface with the personnel in contact with the surface by means of a grounded, metal or conductive plastic wrist strap with a 1MΩ series resistor.

SUPPLY ISOLATORS

Every electrical system should be provided with means for isolating the system from the AC supply to allow safe working during repair and maintenance. SCRs and triacs are not adequate means of isolating the supply, and should always be backed by a suitable mechanical disconnect switch or circuit breaker, easily reachable and clearly marked as the disconnect device.

HAZARDOUS ATMOSPHERES

This unit is not suitable for use in areas subject to hazardous atmospheres. No Eurotherm product should be connected to a circuit which passes into or through a hazardous area unless appropriate precautions are taken (even though the instrument itself may be located in a safe area). Such an installation should conform to the requirements of the relevant Authority. (In the USA: Factory Mutual Research Corporation and Underwriters' Laboratories, Inc.). Conductive pollution, such as carbon dust, must be excluded from the cabinet in which the instrument is mounted.

PROCEDURE IN THE EVENT OF TROUBLE

Before beginning any investigation of a fault, the electrical supplies to all equipment concerned should be switched off and isolated. Units suspected of being faulty should be disconnected and removed to a properly equipped workshop for testing. Any attempt to troubleshoot while installed could be hazardous to personnel and equipment. There are no user-servicable parts inside this unit.

EUROTHERM
CONTROLS

EUROTHERM CONTROLS INC
11485 Sunset Hills Road, Reston, VA 22090-5286
TELEPHONE: 703-471-4870
FAX: 703-787-3437
BBS: 703-787-3444
FAX-ON-DEMAND: 703-787-3441
E-MAIL: Support@Controls.Eurotherm.Com