94 and 94C

Installation and Operating Handbook

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MODEL 94 and 94C TEMPERATURE CONTROLLERS

Contents

SAFETY AND EMC INFORMATION

Please read this section before installing the controller

This controller meets the requirements of the European Directive on Safety and EMC, however it is the responsibility of the installer to ensure the safety and EMC compliance of any particular installation.

Safety

This controller complies with the European Low Directive 73/23/EEC, amended by 93/68/EEC by the application of the safety standard EN 61010(93).

Electromagnetic compatibility

This controller conforms with the essential protection requirements of the EMC Directive 89/336/EEC, amended by 93/68/EEC by the application of a technical construction file.

INSTALLATION REQUIREMENTS FOR EMC

To ensure compliance with the European EMC directive certain installation precautions are necessary as follows:

- For general guidance refer to Eurotherm Controls EMC Installation Guide HA025464.
- When using relay or triac outputs it may be necessary to fit a filter suitable for suppressing the emissions. The filter requirements will depend on the type of load. For typical applications we recommended Schaffner or FN321or FN612.
- This product meets the general requirements of the generic industrial standards EN50081-2 and EN50082-2. For more information on the product compliance see the Technical construction file.
- It may be that this product is to be included in equipment that is to be used in the environment defined in the light industrial or commercial environment of EN50081-1 and EN50082-1. In this case the unit should be mounted in a suitable metallic cabinet to enclose any electromagnetic emissions. All cables passing out side the cabinet including the mains leads should pass through suitable RF filtering such as Schaffner FN321 or FN612.

Routing of wires

To minimise the pick-up of electrical noise, the logic output wiring and the sensor input writing should be routed away from high-current power cables. Where it is impractical to do this, you should use shielded cables with the shield grounded at both ends.

SERVICE AND REPAIR

This controller has no user serviceable parts. Contact your nearest Eurotherm Controls agent for repair.

Technical specification for safety purposes

Equipment ratings

Supply voltage:	85 to 264V a.c. ~.
Supply frequency:	48 to 52, or 58 to 62Hz a.c. ~.
Power consumption:	5 Watts
Relay output:	Maximum of 264V a.c. ~. Minimum of 10V peak Maximum current, 2A resistive
Leakage current:	Snubber components may be fitted externally. The leakage current through these snubber components is less than 2mA at 264V a.c. 50Hz.
Over current protection:	External over current protection devices are required that match the wiring of the installation. A minimum of 0.5mm^2 or 16/0,2mm wire is recommended. Independent fuses are required for the instrument supply and each relay output. suitable fuses are T type, (IEC 127; time-lag) as follows: Instrument supply: 1A (T) Relay outputs: 2A (T)
Low level I/O:	All other input and output connections are intended for low level signals less than 42V.

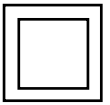
Environmental ratings

Panel sealing:	Instruments are intended to be panel mounted. An optional panel gasket is available to provide panel sealing to IP54 as defined in EN 60529 or NEMA 3.
Operating temperature:	0 to 55°C. Ensure the enclosure provides adequate ventilation.
Relative humidity:	5 to 95%, non-condensing.
Atmosphere:	The instrument is not suitable for use above 200m or in explosive or corrosive atmospheres.
Electrical safety	EN 61010(93), Installation category II, pollution degree 2.
Installation category II:	Voltage transients on any mains power connected to the instrument must not exceed 2.5kV.
Pollution degree 2:	Conductive pollution must be excluded from the cabinet in which the instrument is mounted.
Isolation:	PV input, channel 1 logic output, dc output, relay output and digital communications all have reinforced isolation which provides protection against electric shock. Channel 2 logic output and the digital input are electrically connected to PV input.

Safety symbols

Various symbols are used on the instrument, they have the following meaning:

Caution, (refer to the accompanying documents)



Equipment is protected by reinforced insulation

Equipment that is protected with reinforced insulation does not require a protective conductor.

INSTALLATION SAFETY REQUIREMENTS

Personnel
Installation must only be carried out by qualified personnel.

Enclosure of live parts
To prevent hands or metal tools touching parts that may be electrically live, the controller must be installed in an enclosure.

Wiring
It is important to connect the controller in accordance with the data given in this handbook. Take particular care not to connect AC supplies to the low voltage sensor input or DC or logic inputs and output. Wiring installations must comply with all local wiring regulations.

Isolation
The installation must include a power isolating switch or circuit breaker. This device should be in close proximity to the controller, within easy reach of the operator and marked as the disconnecting device for the instrument.

Overcurrent protection
To protect the internal PCB tracking within the controller against excess currents, the AC power supply to the controller and power outputs must be wired through the fuse or circuit breaker specified in the technical specification.

Voltage rating
The maximum continuous voltage applied between any of the following terminals must not exceed 264V ac:
- power supply to relay, logic or sensor connections;
- relay output to logic or sensor connections;
- any connection to ground

The controller should not be wired to a three phase supply with an unearthed star connection. Under fault conditions such a supply could rise above 264V ac with respect to ground and the product would not be safe.
Voltage transients across the power supply connections, and between the power supply and ground, must not exceed 2.5k V. Where occasional voltage transients over 2.5k V are expected or measured, the power installation to both the instrument supply and load circuits should include a transient limiting device.
These units will typically include gas discharge tubes and metal oxide varistors that limit and control voltage transients on the supply line due to lightening strikes or inductive load switching. Devices are available in a range of energy ratings and should be selected to suit conditions at the installation.

Conductive pollution

Conductive pollution must be excluded from the cabinet in which the instrument is mounted. For example, carbon dust is a conducting pollution. To secure a suitable atmosphere in conditions of conductive pollution, fit an air filter to the air intake of the cabinet. Where condensation is likely, for example in low temperatures, include a thermostatically controlled heater in the cabinet.

Grounding

The channel 2 logic output and digital input are not isolated from the sensor input. Because of this, two possible conditions need to be considered:

- The temperature sensor may be connected to the electrical heating element and hence be at the heater supply voltage. The controller is designed to operate under these conditions but the channel 2 logic output and digital input will also be at the heater potential. You must ensure that this will not damage the power control device that is connected to the channel 2 logic output and digital input and that some one servicing the equipment does not touch the sensor input, or the channel 2 logic output, or the digital input connections while they are live.
- In some installations it is a requirement to replace the temperature sensor while the controller is still powered up. Under these conditions, we recommend that the shield of the temperature detector is grounded. Do not rely on grounding through the framework of the machine.

Electrostatic discharge precautions

When the controller is removed from its sleeve, some of the exposed electronic components are vulnerable to damage by electrostatic discharge from someone handling the controller. To avoid this, before handling the unplugged controller discharge yourself to ground.

Over-temperature protection

When designing any control system it is essential to consider what will happen if any part of the system should fail. In temperature control applications the primary danger is that the heating will remain constantly on. A part from spoiling the product, this could damage any process machinery being controlled, or even cause a fire.

Reasons why the heating might remain constantly on include:

- the temperature sensor becoming detached from the process;
- thermocouple or thermocouple wiring becoming short circuit;
- the controller failing with its heating output constantly on;
- an external valve or contactor sticking in the heating condition;
- the controller setpoint set too high.

Where damage or injury is possible, we recommend fitting a separate over-temperature protection unit, with an independent temperature sensor, which will isolated the heating circuit.

Please note that the alarm relays within the controller will not give protection under all failure conditions.

Chapter 1

MECHANICAL INSTALLATION

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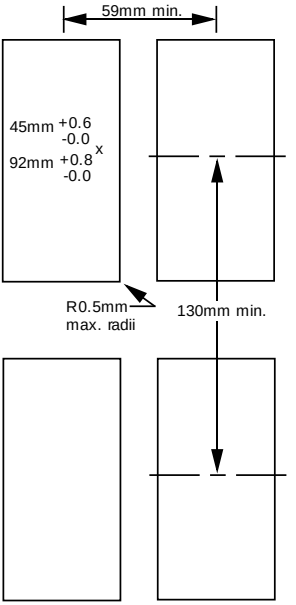
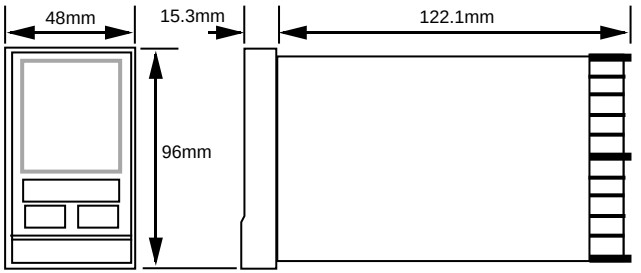
Chapter 1 MECHANICAL INSTALLATION

Panel cut-out

- Prepare panel cutout in sheet metal enclosure. Enclosure temperature must remain within 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 : 13mm.



Dimensions

Panel depth:
with rear terminal cover: 126.1mm
with gasket fitted: less 1.5mm

Chapter 2

ELECTRICAL CONNECTIONS

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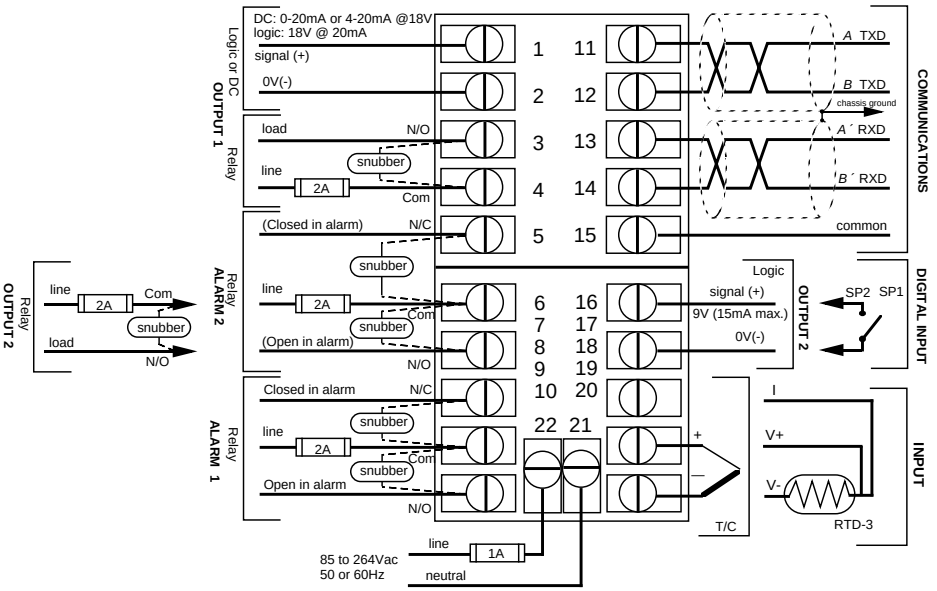
Chapter 2 ELECTRICAL CONNECTIONS

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.

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.

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 'Snubbers'.

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 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 'Snubbers'.

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 'Snubbers'.

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 'Snubbers'.

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.

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.

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 parallelled 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.)

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 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.

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.

Rear terminal covers

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

Chapter 3

CONFIGURATION

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Chapter 3 CONFIGURATION

Procedure

NOTE: Before configuring the instrument, select the 8 digits of the configuration code (listed in section 'Configuration Code', 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).

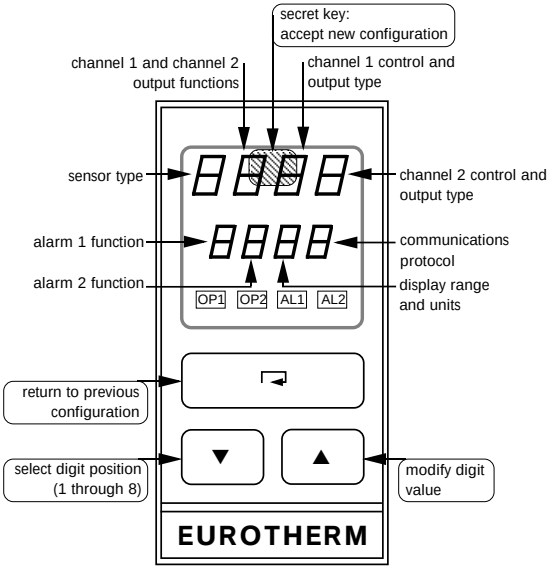
3. Enter new code:
   ▼ = select digit position (1 through 8)
   ▲ = modify digit value.

4. To exit configuration mode do either:

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

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 3-6.
- 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 p. 4-4.

4th digit: Communications protocol

	protocol	parity
0	Disabled	N/A
1	EI BiSyc	even
2	MODBUS/JBUS	even
3	MODBUS/JBUS	odd
4	MODBUS/JBUS	none

Communications option available only on Model 94c.

Configuration examples

Example 1

Upper display 4 0 2 2
Lower display 5 5 8 0

Upper display:

1st digit	4	Type K 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	8	Sensor range from -250C to 1372°C, display units and proportional band units in % of span;
4th digit	0	Communications disabled.

Example 2

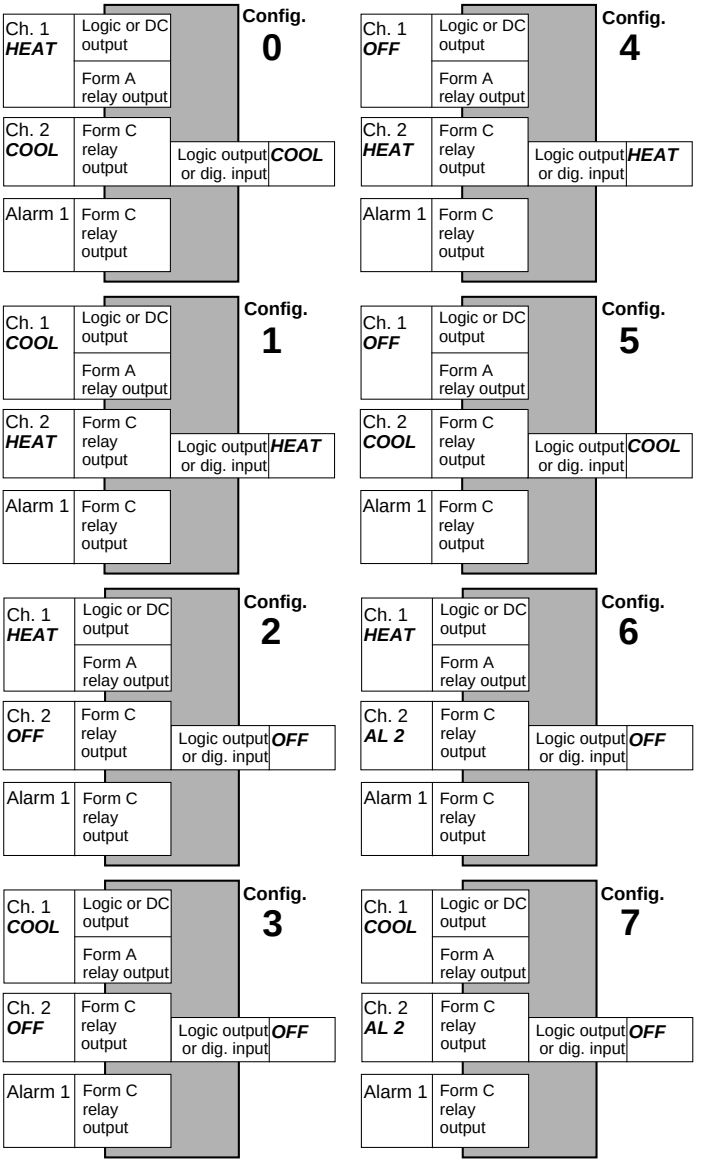
Upper display 6 6 4 4
Lower display 3 7 6 1

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 available.

Chapter 4

OPERATION

Contents page

Chapter 4 OPERATION

Basic procedures

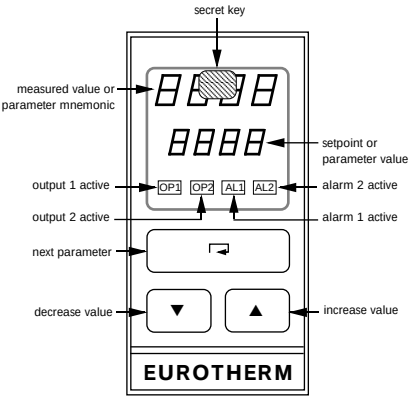
Refer to illustration below and over page.

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 ▼.

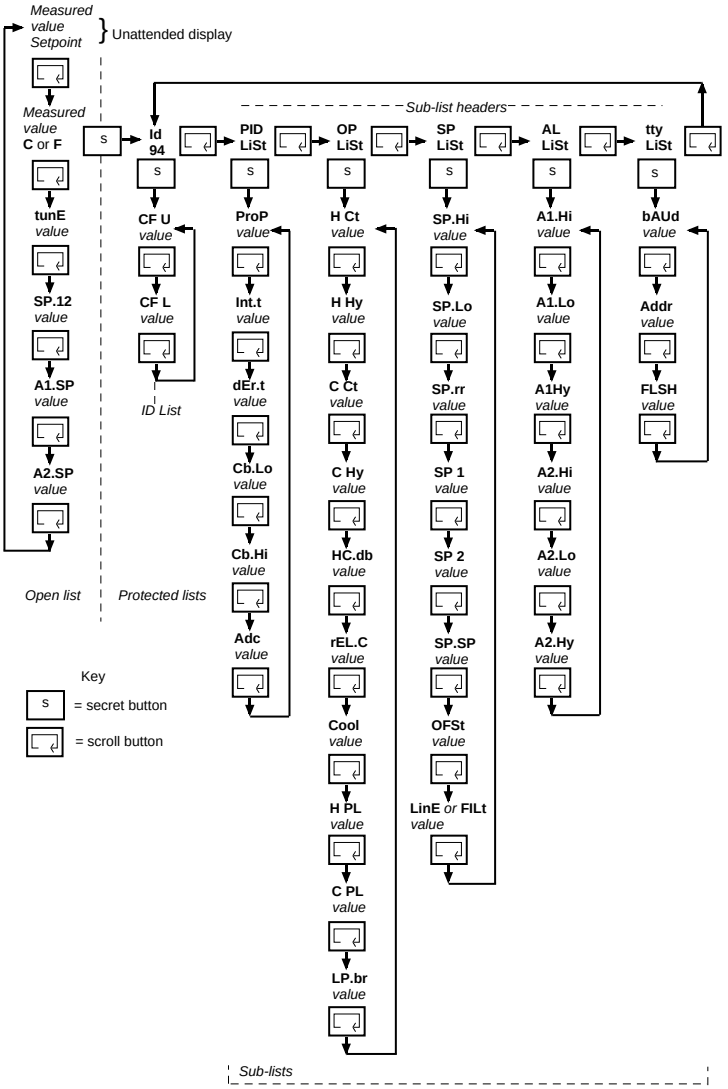
Protected lists

- 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 94c is displayed.
  Inspect upper and lower configuration words (CF U and CF L) with ↵.



Model 94: front panel pushbuttons, displays and lamps

- 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 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**		TU	32
		Start self tune on heat-only loop	**HEAt**			
		Start self tune on cool-only loop	**CooL**			
		Start self tune on heat/cool loop	**HtCL**			
SP.12	Setpoint selection	Setpoint 1 active	**SP 1**	Displayed only if "**SP.SP**" = "**SP12**". "**SP 2**" flashes in lower display if second setpoint selected.	SS	20
		Setpoint 2 active	**SP 2**			
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 View only. (first 4 digits)			Can be changed upon power up only.	CU	48
CF L	Lower configuration code (last 4 digits)				CL	49
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

Table 4.1 - Adjustable parameters (Part 2)

Mnemonic	Parameter	Adjustable range		Comments	Bisync	Mod/J
Open list						
Adc	Automatic droop compensation (similar to manual reset)	Disabled or 0% reset	**oFF**	PI or PID operation.	AC	36
		Reset fixed at 50% of output	**50Pc**	Sets proportional band symmetrically about setpoint in PD or P operation.		
		Application of calculated reset	**on**	Maintains last calculated or set value of manual reset.		
		Calculation of required reset	**CAlc**	Momentary setting which adds proportional error to current manual reset value.		
OP List						
H ct	Heat cycle time for logic output type	0.2 to 240.0s		Displayed only for time proportioned PID or ON/OFF heat outputs.	CH	10
	Heat cycle time for relay output type	5.0 to 240.0s		For ON/OFF control, becomes minimum heat ON or OFF time.		
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:			Displayed only for time proportioned PID or ON/OFF cool outputs.	CC	38
	for logic output type	0.2 to 240.0s				
	for "Fan" cool algorithm	1.0 to 240.0s		For ON/OFF control, becomes minimum cool ON or OFF time.		
	for relay output type	5.0 to 240.0s				
C Hy	Cool hysteresis	1 l.s.d. to effective span		Displayed only for ON/OFF cool output.	YC	39
HC.db	Heat-cool deadband:			Displayed only if cooling enabled.	DB	40
	for ON/OFF cool control	-10.0 to 10.0% of effective span		Set to 0.0% except if required by process.		
	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
OP LiSt						
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 non evaporative 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

Table 4.1 - Adjustable parameters (Part 3)

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	SL	17
SP 2	Setpoint 2		in Open List.	S2	18
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
SP LiSt					
LinE	Line frequency	50 Hertz 60 Hertz	50 "If displayed, set to appropriate frequency." 60	—-	—-
FILt	Input filter	1.0 to 10.0 sec	"If displayed, use 1.6 sec as a starting value. In-" crease 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 Alarm 1 setpoint low limit for deviation band alarms	Lower range limit to current value of "**A1.SP**" 1 l.s.d. to current value of "**A1.SP**"		Z1	27
A1.HY	Alarm 1 hysteresis	1 l.s.d. to effective span		Y1	28
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	30
A2.Lo	Alarm 2 setpoint low limit for full scale alarms Alarm 2 setpoint low limit for deviation band alarms	Lower range limit to current value of "**A2.SP**" 1 l.s.d. to current value of "**A2.SP**"		Z2	30
A2.HY	Alarm 2 hysteresis	1 l.s.d. to effective span		Y2	31

Mnemonic	Parameter	Adjustable range		Comments	Bisync	Mod/J
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.	—-	—-
		OFF	oFF	Not adjustable through communications link.		

Table 4.1 - Adjustable parameters (Part 4)

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 section 'Configuration Code' pg 3-3, (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.

Table 4.2 - Display messages

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.	"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.
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.
Message	**Display condition**	**User action/comments**
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".]

Chapter 5

TUNING AND ADJUSTMENTS

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Chapter 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.

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.Cl** 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.

Tuning

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

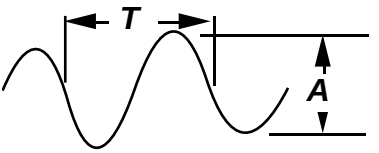
5. See the Display messages table for tuning messages. (table 4.2)

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.

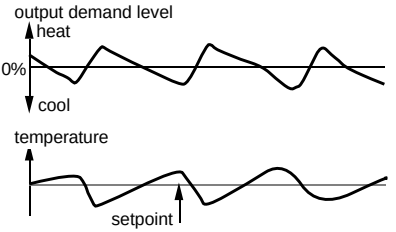
3. Set **Int.t** = T. Wait at least 2 x T. If system becomes stable at setpoint, go to 4. If not, increase Int.t in small (<30%) steps until the temperature is stable at setpoint.

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 to 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**.



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 set point. 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.

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.

Chapter 6

COMMUNICATIONS

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Chapter 6 COMMUNICATIONS (Model 94c only)

General

- The communications hardware standard complies electrically with EIA-485, but is connected as described by EIA-422-A. Refer to section 'Communications' p.2-4 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 neces sary 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.

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.

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 bisyc 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
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"

Table 6.1 EI bisyc parameters (Part 2)

Fast poll scroll order	EI Bisync mnemonic	Front panel mnemonic	Parameter	Data format	Access	Comments
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	Enumerated: ASCII: compensation 0 OFF 1 50PC 2 ON 3 CALC	R/W	USE ALL CAPS.
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	

Table 6.1 - EI bisyc parameters (Part 3)

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.
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	"°C, °F or Lin units" high limit	R/W	
42	LS	SP.LO	Setpoints 1 and 2	"°C, °F or Lin units" low limit	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	

Comms

Table 6.1 - EI bisyc parameters (Part 4)

Fast poll scroll order	EI Bisync mnemonic	Front panel mnemonic	Parameter	Data format	Access	Comments
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”
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 info.	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.

Enumerated parameters

Enumerated parameters can transmit and receive either numeric values (0, 1, 2…) or ASCII strings preceded by an apostrophe (ASCII 2716 or 3910): 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.

Hexadecimal parameters

Hexadecimal parameter values consist of a string of 4 ASCII characters (0 through 9 and A through F) preceded by > (3E16 or 6210). 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 000016. 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 bisyc 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 info. available in bit 15 of "MN". Writing to one parameter also writes to the other.
				0	No unacknowlegded alarms present *Acknowledg 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	Comms 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*		
		C	5	1	Parameter value changed from front panel	R/W	EI bisync only: Same info. available in bit 14 of "MN". Writing to one parameter also writes to the other.
				0	No change in parameter *Acknowledge change in parameter*		

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

			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		
		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	Param'r 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		

Table 6.2 - EI bisyc 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
MN	Mode number A		8	0	Not used	R/O	
		C	all	0000	Not used	R/O	
		D	all	0000	Not used	R/O	
CI	Configuration information	A	15	0	Not used	R/O	
			14	1	Dual format support	R/O	Variable length data trans mission supported.
			13	0	Multi-block support	R/O	Multi-block data transission 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 telemetary input	A	all	0000	Not used	R/O	Available only if Comms 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 telemetary	A	all	0000	Not used	R/O	Available only if Comms microcontroller version no. outputis 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	R/W	
					Energize Alarm 1 relay		
				0	Alarm 1 relay de-energized		
					De-energize Alarm 1 relay		
			4	0	Not used	R/O	
		D	all	0000	Not used	R/O	

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

BL	Max. 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	Comms 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 chapter 3, 'Configuration code'	R/W	See 'Reconfiguration through communications'
CU (49)	Upper configuration code (first 4 digits)	ABCD	any valid	See chapter 3, 'Configuration code'	R/W	See 'Reconfiguration through communications'
II	Model no.	ABCD	94C0	Model 94c	R/O	
V0 (123)	Main microcontroller version no.	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		

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).

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.

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 000016. 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 ramp ing 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	

Table 6.3 - Modbus/Jbus word parameters (Part 2)

15	None	Channel 1 output power (compensated)	0 to 100%	1	R/O	Represents PID algorithm output with effects of 41 through 44.
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: 1 0 SP 1 1 SP.12 2 IP 2	R/W	
20	SP.12	Setpoint selection	Enumerated:	Display: 1 0 SP 1 1 SP 2	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" 3 HtCL	As PV	R/W	
23	SP.rr	Setpoint ramp rate	"°C/min., °F/min. or "	0.01	R/W	""0" disables ramping, i.e. step" changes in are setpoint 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	"°C, °F or Lin units" limit	As PV	R/W	
27	A1.Lo	Alarm 1 setpoint low	"°C, °F or Lin units" limit	As PV	R/W	
28	A1.HY	Alarm 1 hysteresis	"°C, °F or Lin units"	As PV	R/W	
29	A2.Hi	Alarm 2 setpoint high	"°C, °F or Lin units" limit	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
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: 0 oFF 1 HEAt 2 CooL	Display: 1	R/W	"Remains R/W even if value of 32 = 1, 2 or 3 "Can be set to 1, 2 or 3 only 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: 0 oFF 1 50Pc 2 on 3 CALC	Display: 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	
41	rEL.C	Relative cool gain	Unitless coefficient	0.1	R/W	
42	COOL	Cooling algorithm selection	Enumerated: 0 Lin 1 H2O 2 FAn 3 OIL	Display: 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	

Table 6.3 - Modbus/Jbus word parameters (Part 4)

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"
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 Parameters" table	See "Hexadecimal	1	R/W	Available only on 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	

Bit parameters

The table 6.4 below lists the bit parameters. As with the binary parameters, if a write function exists, it is presented in bold.

Bit No.	Bit Value	Read function In ittalic: 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	P'meter 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	

Functions

The following functions are implemented:

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

Table 6.5 - Modbus/Jbus functions

Error codes

These error codes are associated with the functions:

Function code	Error code 01:Invalid function	02: Invalid address	03: Invalid data
01 or 02		3	
03 or 04		3	
05	3	3	3
06	3	3	3

Table 6.6 - Modbus/Jbus error codes

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 on page 6-24. Note that it is possible to write to these parameters only through the bit parameter addresses.

Bit No.		Bit value	Read function
In fast read status byte (Function 07)	A 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

Table 6.7 - Modbus/Jbus fast read function bits

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 ensure that remote reconfiguration of the controller would not present any hazard to personnel or equipment. Controller operation is momentarily disabled during reset.

Step No.	Method 1 - with CW (50) EI Bisync and Modbus/Jbus	Method 2 - with IM EI Bisync only
1	Write upper configuration codes to CU (4)) (if required). Write lower configuration code to use old configuration codes until reset occurs. Continue with original instrument address AD (47).	Write CONF (or 2) to instrument 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 value if required.	Instrument controls with new configuration values. Repeat procedure for parameter values.

Table 6.8 - Procedures for reconfiguration through communications

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.

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.]

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 previously 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).

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

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

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.

Chapter 7

USERS'S RECORDS

Chapter 7 USER'S RECORDS

Write down parameter values in this table.

Open list		Example			
SP	Setpoint	70°C			
°C	Display units or °F	°C			
tunE	Self tune on demand	oFF			
SP.12	Setpoint selection	SP 1			
A1.SP	Alarm 1 setpoint	100°C			
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°C			
Int.t	Integral time constant	360s			
Der.t	Derivative time constant	60s			
Cb.Lo	Low cutback	180°C			
Cb.Hi	High cutback	180°C			
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			

OP LISt (continued)		Example			
C HY	Cool hysteresis	not configured			
HC.db	Heat-cool deadband	0.0%			
rEL.C	Relative cool gain	0.5			
COOL	Cooling algorithm	H2O			
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°C			
SP.Lo	Setpoints 1 & 2 low limit	30°C			
Sp.rr	Setpoint ramp rate	oFF			
SP 1	Setpoint 1	70°C			
SP 2	Setpoint 2	70°C			
SP.SP	Setpoint mode selection	SP.12			
OFSt	Calibration offset	0.0°C			
LinE	Line frequency	60Hz			
FILt	Input filter	1.6s			

AL LISt

A1.Hi	Alarm 1 SP high limit	100°C			
A1.Lo	Alarm 1 SP low limit	100°C			
A1. Hy	Alarm 1 hysteresis	2°C			
A2.Hi	Alarm 2 SP high limit	not configured			
A2.Lo	Alarm 2 SP low limit	not configured			
A2. Hy	Alarm 2 hysteresis	not configured			

tty LISt		Example				
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	Display units or °F					
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				
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 SP high limit				
A1.Lo	Alarm 1 SP low limit				
A1. Hy	Alarm 1 hysteresis				
A2.Hi	Alarm 2 SP high limit				

AL LISt (continued)

A2.Lo	Alarm 2 SP low limit					
A2. Hy	Alarm 2 hysteresis					

tty LISt

bAUd	Baud rate selection					
Addr	Instrument address					
FLSH	Pushbutton flash					