Contents

Guide to this Handbook

This is the guide for using this Handbook.

Follow the directions below to obtain maximum benefit from this information provided.

installation

1

Follow the instructions in this section for successful mechanical mounting and correct electrical connections.

Important notes on the application and operation of all temperature controllers are in this section. Please read carefully before proceding.

Installation

Operation

2

This section contains the instructions which are normally needed in day to day operation of your 902, 3 or 4 instrument. It is recommended that the procedures in this section are understood before continuing to further sections,

Operation

Commission

3

This section contains instructions for correct matching of your instrument to the load being controlled. Described are the procedures needed to be followed when first installing the instrument and subsequently when carrying out any changes to the control loop.

Commission

Configure

4

Your 902, 3 or 4 instrument has been pre-configured to your requirements according to the order code. e.g. Range, Alarm types, etc. If there is a need to modify the basic operation of your instrument, use this section and then return to section 3 (Commission), or section 2 (Operation).

Configure

Calibration

5

Your controller has been factory calibrated to **a** very high standard. However you may wish to perform a regular calibration. This section provides all the information necessary or alternatively contact our service organisation at your local area office (Addresses at the back of this book for information on our field calibration service).

Calibration

Communications

6

This section contains all the information required for successfully operating your controller via its communications port. This allows the instrument to be connected as part of a computer controlled network or singly to a host computer.

Comms

Error Messages

7

This provides information relating to the current state of the control hardware, software and information about the measured values. This information can be used to localise a controller fault to a particular section of the instrument, thus enabling the user to rectify the problem and return the unit to correct operation quickly.

Error Messages

Section 1 - **Installation**

Contents

1.0   **INSTALLATION**

Before proceding with installing this instrument please ensure that you are acquainted with the caution notes in para. 3.0 of this section.

If the instrument is to be panel mounted, a DIN-size 92mm by 92mm cut-out is required as illustrated.

Should the instrument be required to be sealed to the panel surface, up to IP65, follow the instructions detailed in 'Instrument Sealing' paragraph 1.2.

Insert the instrument through the cutout via the front of the panel. Install the mounting clamps, one on the top and the other below the instrument. These clamps are located from the rear to ensure that the four feet are firmly seated in the slots in the case, as shown in figure 1.
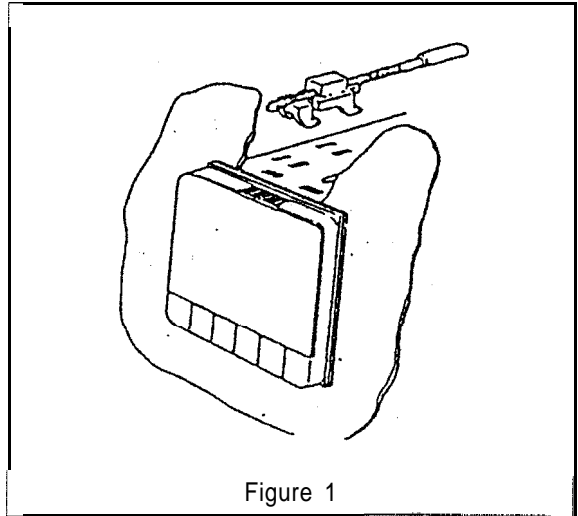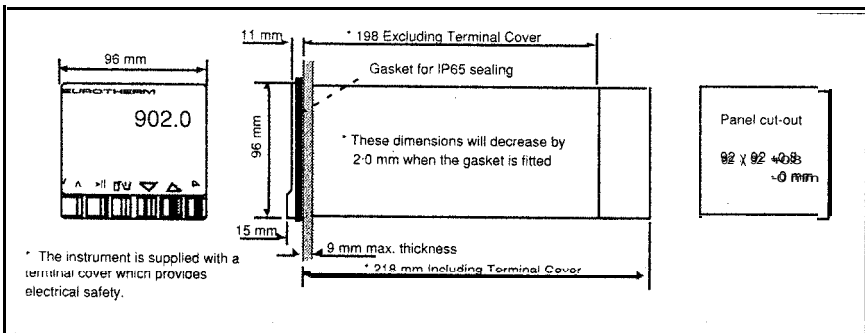
Figure 1

Tighten the screws firmly with a screwdriver from the rear of the mounting panel; a torque limiter in each clamp prevents over-tightening.

1.1   **Dimensional Details**

Installation

1.2 Instrument Sealing

A polythene bag within the instrument packing contains the 902 accessory kit (Part No. LA023792). In this accessory kit is a rubber seal. When this seal is correctly placed between the sleeve and the panel surface it will provide protection to the IP65 standard.

If protection of the instrument is not required this seal need not be fitted and only the installation instructions need be followed.

Fitting the seal should be carried out as soon as the instrument is removed from the packing. Place the seal over the front of the instrument so that it sits as shown in figure 2, against the back of the bezel. The instrument can now be mounted into the panel cut-out and assembly continued as described in the installation instructions. When fully compressed this seal increases the projection of the bezel in front of the panel by 1.5mm.

Figure 2
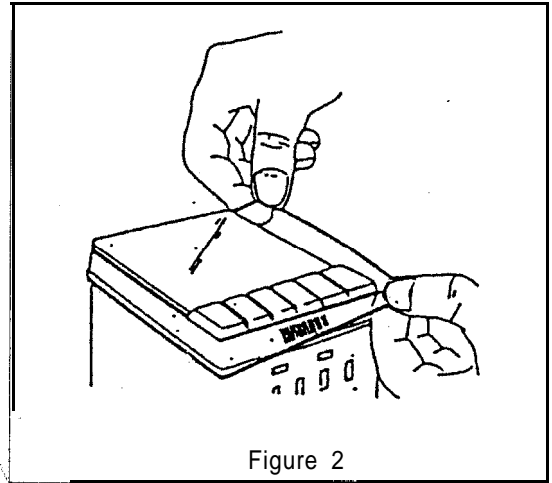
Note: It is important that the panel cut out dimensions are adhered to for IP65 to be effective. There must be no sharp or burred edges.,

1.3 Rear Terminal Cover

To remove the rear terminal protection cover four catches have to be released, two at the top and two at the bottom. Insert the tool supplied, in the accessory kit, to release each pair of catches.

Refit the cover so that the four catches engage in their respective slots.

Figure 3
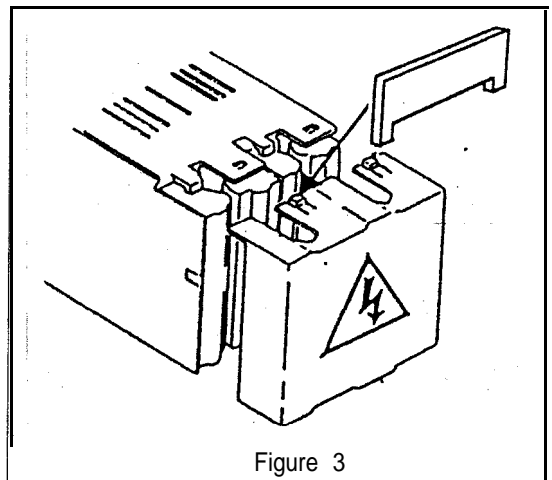
2.0 CONNECTIONS AND WIRING

Electrical connections are made via individual screw terminal blocks on the rear of the instrument. All connections are low current and a 16/0.20 wire size is adequate. Max. 14 AWG (1.6mm)(0.064")

Wires, once connected to the instrument, can be run up/down the trough and secured by ties as shown in figure 4.

The instrument supply should be fused externally, in accordance with local wiring regulations.
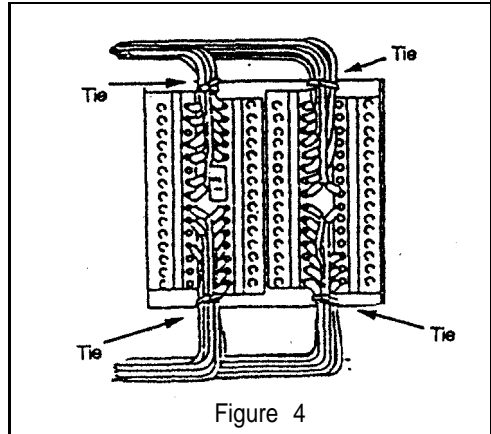
Do not over tighten screws as this will cause damage. Max. screw torque is 0.4Nm.

Figure 4

Installation

Instrument Labels

Labels on the instrument and case indicate the specific configuration and terminal number connections for the instrument.

This label is found on the sleeve of the instrument and indicates the rear terminal connections for the instrument ordered.

Product Code : 902S/IS/HRE/CTR/SRE/VH/XM//LE
IT/HAP/CLL/SA/XA///0/600/C/01

Serial Number: G34534-001-008-03-91

	A	B	C	D	E	F	G	H	
	HOP	COP			ALM 2	COMMS	DIGIN	PV1	
1	COM	LINE			COM	TX+	DIN 3		
2	N C				N C	TX-	DIN 2	V-	
3	N O	LOAD			N O	RX+	DIN 1		
4						RX-	COMM	V+	
5									

This label is found on the rear of the instrument and indicates the ordering code, serial no. etc.

Code : 902S/IS/HRE/CTR/SRE/VH/XM//LE
IT/HAP/CLL/SA/XA////0/600/C/01

Serial Number : G34534-001-006-03-91
Software Ver. : 1 .OO   Service Tel. : (01903)-268500

Installation

2.1 Instrument Layout

The 902/3/4 series of instruments can easily be configured to most customer requirements on site. The microprocessor, power supply and display boards are standard to all 902/3/4 series of instruments, see figure 5. Various plug-in hardware modules can then be fitted to provide the different functions. These modules can be allocated to one or two sites on the power supply board. If an options or analogue communications board is fitted in the instrument, a further two sites are available for installing these modules, as shown in Figure 6.

Power Supply Board

Options Board

Microprocessor Board

Figure 5. Printed Circuit Board Positions

Channel 1

Channel 3

Channel 2

Channel 4

Figure 6. Plug-in Module Slot Positions

2.2 Rear Terminal Connections

CHANNEL 4

CHANNEL 3

ANALOGUE COMMS

PSU
PCB

OPTIONS
PCB

MICRO
PCB

R
⊥
N
24
L
A1
A2
A3
A4
A5
B1
B2
B3
B4
B5

CHANNEL 1

CHANNEL 2

C1
C2
C3
C4
C5
D1
D2
D3
D4
D5
E1
E2
E3
E4
E5

F1
F2
F3
F4
F5
G1
G2
G3
G4
G5
H1
H2
H4
H5

DIGITAL COMMS

DIGITAL INPUTS

PROCESS VARIABLE

Screw
Terminals

Ident. Label   Wire   Connection

Installation

2.2.1   Power Supply

The power supply can be 85V to 264V, or a low level ac/dc supply of 17-30Vac /
20 - 40Vdc. If a low level supply is used the positive may be connected to
terminal 24.

Power supply

85V to 264V ac,
17V to 30V ac,
20V to 40V dc
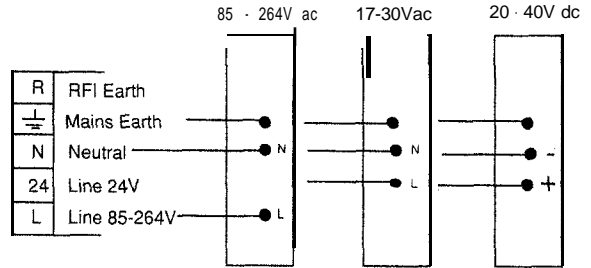
Suppression   Earth
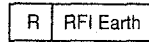
Terminal R is the radio frequency interference reference for the instrument.

When despatched   from the factory, terminal R and ⏚ are connected together.
In most cases it is acceptable to connect these terminals to supply earth.

Terminals R and ⏚ are connected together by a
link on the power supply pcb.

In a particularly noisy environment it may be
advantageous to separate the RFI from the
mains earth and connect to a cleaner earth
reference if available. If this is the case cut link
LK 1.
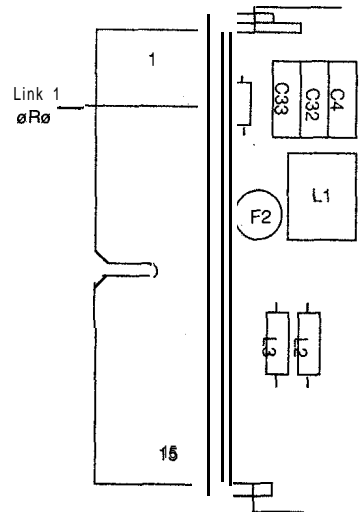
2.2.2 Inputs

This instrument has one input which can be set in the configuration to accept a number of different sensor types. Having set the configuration, the sensor must be connected to the correct terminals as shown on the following pages.

Thermocouple

Input
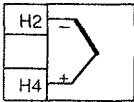
When the instrument has been configured for internal cold junction compensation (CJC), compensation cable of the correct type for the thermocouple used, or the thermocouple itself, must be wired to these terminals. Copper wire must NOT be used.

If an external cold junction (oven/ice reference) is to be used, then copper wires must be used between the rear terminals of the instrument and the cold junction reference.

Resistance Thermometer
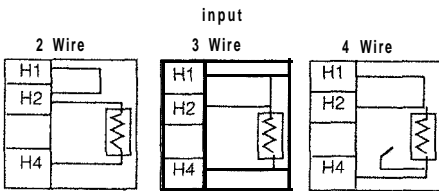
Note: When three conductors between the bulb and the rear terminals have identical resistances, the lead resistance error be minimised. When a four wire RTD is used the fourth wire is insulated from all other connections. If a two wire system is used the lead resistance will give errors.

Pyrometer
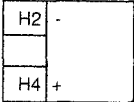
Input (Low Level)
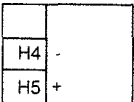
The pyrometer model number determines the rear terminal connections to be used. Paragraph 4.2.1 of section 4, the configuration, gives a table listing the various pyrometer model numbers. If the last column of this table carries the abbreviation "HL I/P" then the "Input (High Level)" terminals should be used.

Input (High Level)

For all other models of pyrometer, use the "Input (Low Level)" terminals. For pyrometer codes 48 and 51, (Q004, Q005), a 500Ω resistor must be connected across the rear terminals "H2" and "H4", together with the pyrometer wiring. In this case a suitable resistor, Part No. SUB902 SPARE 500R, colour coded yellow, will be found in the instrument packing. Pyrometer code 54, (R026/ORK), requires cold junction compensation within the instrument. The instrument software will automatically enable this feature, but the value of "C1 (A)", see paragraph 4.2.1 of section 4, the configuration, must be set to "0", to ensure the correct amount of compensation is applied.

Installation

DC Signals

Input

H2	-
	<100mV
H4	+

For inputs less than $100mV$ use terminals 2 and 4, polarity as shown.

	>100mV
H4	-
H5	+

For inputs from 1 $00mV$ to 1 OV use terminals 4 and 5, polarity as shown.

H2	-
	mA
H4	+

For mA inputs a 5Ω resistor module will be supplied within the instrument packing. This module is colour coded with a red dot and has a part number SUB902 SPARE 5R. The resistor is fitted between terminals "H2" and "H4" together with the signal connections. Observe the signal polarity as shown.

2.2.3   Heat / Process [+] Outputs (Channel 1)

Relay
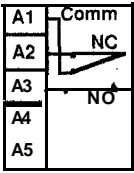
A1	Comm
A2	NC
A3	NO
A4	
A5	

Relay Output

The relays are shown in the de-energised state, i.e. with the instrument not powered. If the instrument has been configured as reverse acting then the relay will energise when power to the load is required for a conventional temperature controller. The relay contact rating is 2A/264V r.m.s.

Triac

A1	Line
A2	
A3	Load
A4	
A5	
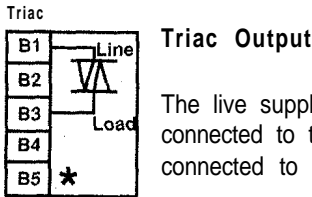
Triac Output

The live supply is connected to A1 terminal. One side of the load is connected to the A3 terminal, the other side of the load should' be connected to the neutral line. The triac is rated at IA/264V r.m.s.

Logic

A1	
A2	+
A3	-
A4	
A5	

Logic Output

Logic outputs are connected to terminals A2 and A3, A2 being the positive. This output is isolated from all other inputs and outputs.

The maximum capability of this output is 20mA and 15 volts.

DC.

A1	
A2	+
A3	-
A4	
A5	

D.C.Output

The isolated D.C. output is connected to terminals A2 and A3, A2 being positive. This output is isolated from all other inputs and outputs. This output can be either current or voltage.

The capability of this output is O-20mA for current and O-i Ov for voltage.

Installation

2.2.4 Cool / Process[-] Output (Channel 2)

Relay Output

```
Relay
B1 ─Comm
B2    NC
B3    NO
B4
B5  *
```

The relays are shown in the de-energised state, i.e. with the instrument not powered. If the instrument has been configured as reverse acting then the relay will energise when power to the load is required for a conventional temperature controller. The relay contact rating is 2A/264V r.m.s.

Triac Output

```
Triac
B1    Line
B2
B3    Load
B4
B5  *
```

The live supply is connected to B1 terminal. One side of the load is connected to the B3 terminal, the other side of the load should be connected to the neutral line.

The triac is rated at 1 A/264V r.m.s.
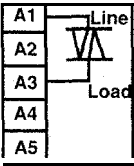
Logic Output

```
Logic
B1
B2  +
B3  -
B4
B5  *
```

Logic outputs are connected to terminals B2 and B3, B2 being the positive. This output is isolated from all other inputs and outputs.

The maximum capability of this output is 20mA and 15volts.

D.C. Output

```
D.C.
B1
B2  +
B3  -
B4
B5  *
```

The isolated D.C. output is connected to terminals B2 and B3, B2 being positive. This output is isolated from all other inputs and outputs. This output can be either current or voltage.

The capability of this output is 0-20mA for current and 0-10v for voltage.

NOTE (*) :- Terminal B5 marked above with an "*" is internally connected to the controller circuitry. It is important that no external wiring is connected to this terminal.

2.2.5   Valve Positioner Outputs (Channels 1 and 2)

EitherRelav
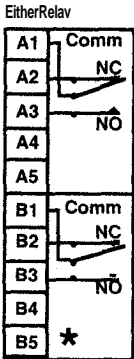
Relay Connections.

If relays are fitted in the controller, join terminals "A1' to "B1 " and also join these terminals to one side of the motor supply. Connect terminal "A3" to the raise connection of the motor and terminal "B3" to the lower connection on the motor. The common connection of the motor should be connected to the other side of the motor supply.

The instrument configuration can be changed to allow terminal "A3" to give the lower signal and terminal "B3" to give the raise signal.

or alternatively

Triac

Triac Connections
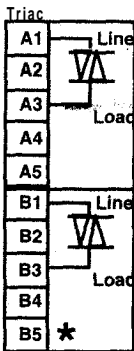
If triacs are fitted to the instrument, carry out the wiring procedure given under 'Relay Connections' above.

Optional Valve Position Potentiometer Input
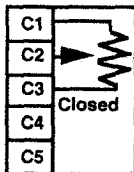
It Is not necessary to fit a valve position potentiometer input to the controller before the loop will control correctly. If fitted this potentiometer will enable the controller to display the true position of the valve at all times and allow the setting of limits in the movement of the valve. If a potentiometer with a resistance between 100 and 1000 5ohms fitted into the motor it should be wired as shown above observing the direction of drive.

NOTE (*) :- Terminal   B5 marked above with an "*" is internally connected to the controller circuitry. It is important that no external wiring is connected to this terminal.

NOTE :- The installation of a valve positioner loop in the 902, 3 or 4 controller limits the instrument to a single channel output. This can be used to control either a heat / process [+] or a cool / process [-] loop.

2.2.6 Alarm Outputs

Alarm 1 Relay
Either CH2

B1	Comm
B2	NC
B3	NO
B4	
B5	*

or CH3

D1	Comm
D2	NC
D3	NO
D4	
D5	
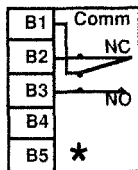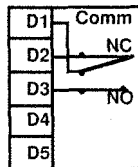
Alarm 1 Output (Channels 2 or 3)

In the instrument configuration alarm 1can be set to be active from terminals "B" or "D". To identify the configuration of a particular instrument refer to the instrument label. The default condition of the alarm relays is to drive them to the normally closed condition when the alarm is active. The ordering code does however permit the customer to specify the alarms to be in the normally open position for active alarms. The alarm relay contacts are rated at 2 A maximum at a voltage between 30 and 264 volts a.c.

NOTE (*) :- Terminal B5 marked above with an "*" is internally connected to the controller circuitry. It is important that no external wiring is connected to this terminal.

Alarm 2 Relay
or CH4

E1	Comm
E2	NC
E3	NO
E4	
E5	
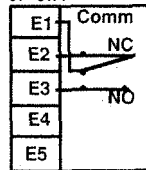
Alarm 2 Output (Channel 4)

The relay connections from this alarm always appear on terminals "E". The default condition of the alarm relays is to drive to the normally closed condition when the alarm is active. The ordering code does however permit the customer to specify the normally open position when the alarm is active.. The label on the instrument will indicate how these are set. The relay contacts are rated at 2A maximum at a voltage between 30 and 264 volts a.c.

2.2.7   Programme and Comms. Driven Relays (Channels 2, 3 or 4)

Terminals "B", 'D'and "E" are those used for relay connections driven by segments of the programme or via the digital communications link. The instrument configuration sets the number of relays driven by the programme and / or the digital communications link which can be none, one, two or three. To confirm how many and which relays are driven by programmer segments or digital communications link on a particular instrument, refer to the label mounted on the instrument.

Either CH2

B1	Comm
B2	NC
B3	NO
B4	
B5	*
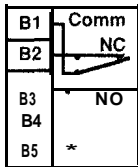
Programme Driven Relays

Parameters for defining for output condition are found in the programmer scroll list and set the state of these relays. A number being displayed indicates that particular relay will have its normally open contacts in the closed position during that segment. The assignment of these numbers to the rear terminals is shown below :-

or CH3

D1	Comm
D2	NC
D3	NO
D4	
D5	
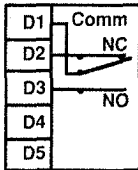
Number 2 indicates the condition of output terminals   "B"
Number 3 indicates the condition of output terminals   "D"
Number 4 indicates the condition of output terminals   "E"

or CH4

E1	Comm
E2	NC
E3	NO
E4	
E5	
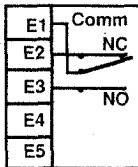
Digital Communications Driven Relays

In this case the three relays are driven by status words "OS" and "XS". Status word "XS" bit "6" sets the relay connected to terminals "B", status word "OS" bit "13" sets the relay connected to terminals "D" and status word "OS" bit"1 2" sets the relay connected to terminals "E". Setting these bits to a "1" will cause the relay to be set into the normally open position.

All of these relay contacts are rated at a maximum current of 2A operating on a voltage between 30 and 264 volts a.c.

NOTE (*) :- Terminal B5 marked above with an   "*"   is internally connected to the controller circuitry. It is important that no external wiring is connected to this terminal.

Installation

2.2.8   Digital Inputs

G1	Digin 3
G2	Digin 2
G3	Digin 1
G4	Com.
G5	★

Three digital inputs *are* provided on this instrument. These inputs are not isolated from one another or from the input on "H" terminals.

To activate any of these inputs connect between the particular input and the common "G4", by either a resistance of less than 1 00Ω, or a voltage of less than 0.7 volts d.c. For an input to be switched to the inactive state, the input device must have a resistance greater than 28kΩ, or a voltage greater than 4.0 volts d.c.

For a description of the available digital input functions;
See Operation Section 8.0.

NOTE (*) :- Terminal G5 marked above   with an "*" is internally connected to the controller circuitry. It is important that no external wiring is connected to this terminal.

2.2.9. Remote Analogue Inputs

One remote analogue input can be configured within the instrument, this will appear at either terminals "B", "C" or "E". refer to the instrument label for the configuration of a specific controller.

The remote analogue input can be a voltage or current. Potentiometer inputs can be accommodated but only when using terminals "Cl ", "C2" and "C3".

Either CH2

B1	
B2	Input +
B3	Input -
B4	
B5	*
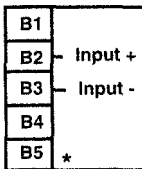
Voltage Inputs

For voltage inputs wire the incoming supply to terminal "2" and "3". Terminal "2" must be connected to the positive side of the supply.

or CH4

E1	
E2	Input +
E3	Input -
E4	
E5	
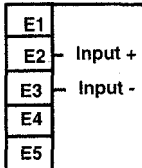
Current Inputs

Instruments ordered for a remote current analogue input will be supplied with a 50Ω resistor, colour coded with a brown dot. (Part No. SUB902 SPARE 50R), within the instrument packing. This resistor should be fitted between terminals "2" and "3" together with the signal connections. Observe the signal polarity as shown.

or ANAL COM

C1	
C2	Input +
C3	Input -
C4	
C5	
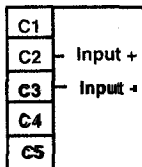
Potentiometer Inputs

ANAL COM

C1	Pot.Sup.
C2	Input +
C3	Input -
C4	
C5	
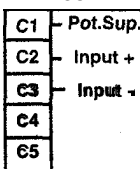
If the remote analogue input is to be derived from a potentiometer this must have an element resistance between $1 k\Omega$ and $100k\Omega$. Wire the zero end of the potentiometer to terminal "C3" and the span end of the potentiometer to terminal "Cl ". The wiper of the potentiometer should then be wired to terminal "C2".

NOTE (*) :- Terminal B5 marked above with an "*" is internally connected to the controller circuitry. It is important that no external wiring is connected to this terminal.

Installation

2.2.10 Retransmission Analogue Output

Either CH1

A1	
A2	Out. +
A3	Out. -
A4	
A5	
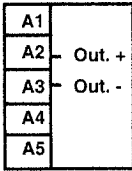
Only one retransmission output is available in the instrument and this will be routed to either terminals "A", "B", "C" or "D". Refer to the terminal label oh the side of the instrument to confirm the configuration in this case.

Wire to the appropriate terminals, as shown on the left of this page, observing the correct polarity.

or CH2

B1	
B2	Out. +
B3	Out. -
B4	
B5	★
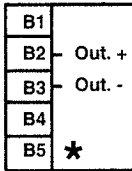
The range of the output, which can be either current or voltage, and the parameter being retransmitted is set in the instrument configuration. The maximum range of the output which can be voltage or current i$:-

-5 to +10 volts out of terminal "C"

0 to 10 volts out of terminals "A", "B" or "D".

or ANAL COM

C1	
C2	
C3	
C4	Out. +
C5	Out. -
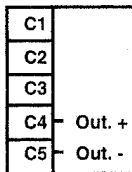
The maximum current range for all outputs is 0 to 20mA.

or CH3
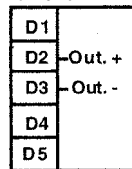
|	
D1	
D2	Out. +
D3	Out. -
D4	
D5	

NOTE (*) :- Terminal B5 marked above with an "*" is internally connected to the controller circuitry. It is important that no external wiring is connected to this terminal.

2.2.11. Digital Communications

Digital Communications

The instrument will support the digital communications specification type RS232 C or RS422. The instrument can be changed from one standard to the other by changing a link position on the rear of the microprocessor board, see Figure 1, paragraph 2.0, section 6, Communications.

RS 232 C

F1	‒ Tx +
F2	
F3	‒ Rx +
F4	
F5	‒ Com.

RS 232 C Standard

If the instrument has been configured for the RS232 C standard, connect the common wire to terminal "F5" the instrument transmit wire to terminal "F1" and the instrument' receive wire to terminal "F3".

RS 422

F1	‒ Tx +
F2	‒ Tx -
F3	‒ Rx +
F4	‒ Rx -
F5	‒ Com.

RS 422 Standard

If the instrument is configured for the RS422 standard make connections to the instrument as follows :-

Connect the instrument transmit positive wire to terminal **"F1"**

Connect the instrument transmit negative wire to terminal "F2"

Connect the instrument receive positive wire to terminal "F3"

Connect the instrument receive negative wire to terminal "F4"

3.0 SAFETY and EMC INFORMATION
Please read this section before installing the controller

This controller meets the requirements of the European Directives 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 Voltage Directive 73/23/EEC, amended by 93/68/EEC, by the application of the safety standard EN 61010.

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.

SERVICE AND REPAIR

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

Caution: **Charged capacitors**

Before removing an instrument from its sleeve, disconnect the supply and wait at least two minutes to allow capacitors to discharge. Failure to observe this precaution will expose capacitors that may be charged with hazardous voltages. In any case, avoid touching the exposed electronics of an instrument when withdrawing it from the sleeve.

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.

Cleaning

Do not use water or water based products to clean labels or they will become illegible. Isopropyl alcohol may be used to clean labels. A mild soap solution may be used to clean other exterior surfaces of the product.

TECHNICAL   SPECIFICATION

Equipment   ratings

Supply voltage:	100 to 240Vac -15%, +10%, optionally 17-30Vac, 20-40Vdc.
Supply frequency:	50 / 60 $\pm$2Hz
Power consumption:	10 Watts maximum.
Earth leakage current:	Less than 1mA. This may affect the design of an installation
(Due to RFI Filtering)	with multiple controllers protected by Residual Current Device, (RCD) or Ground Fault Detector, (GFD) type circuit breakers.
Relay output, (isolated):	Max. 264Vac, (min. 3OVac or dc). Max. current: 2A resistive.
Triac output, (isolated):	85 to 264Vac. Maximum current: 1A resistive.
Leakage current:	<2mA through triac and relay suppression components.
Over current protection:	External over current protection devices are required to protect the installation wiring. A minimum of 0.5mm2 or 16awg wire is recommended. Use independent fuses for the instrument supply and each relay or triac output. Suitable fuses are T type, (IEC 127 time-lag type) as follows;
	Instrument supply: 2A; Relay outputs: 2A; Triac outputs: 1A.
Low level I/O:	Input and output connections other than triac and relay are intended for low level signals less than 42V.
Logic output, (isolated):	15V (min) at 20mA.
Logic input, (non-isolated):	Active <0.7V, non active >4V, or volt free contact operation.
DC output, (isolated):	0 to 20mA (600Ω max), or 0 to 10V (500Ω min).
DC input, (isolated):	0 to 20mA, or 0 to 10V. Potentiometer supply; IOV, lOmA.
Valve position pot. input:	Supply; 0.5V, 10mA, (non isolated).
Digital Communications:	EIA-232, or EIA-422, (both are isolated).

Environmental   ratings

Panel sealing:	IP65, (EN 60529)
Operating temperature:	0 to 55°C. Ensure the enclosure provides adequate ventilation.
Relative humidity:	5 to 90%, non condensing.
Atmosphere:	The instrument is not suitable for use above 2000m or in explosive or corrosive atmospheres.

Electrical   safety

Standard:	EN 61010: 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:	Isolated outputs, have reinforced insulation to provide protection against electric shock. The non isolated logic and valve position potentiometer inputs are electrically connected to the main process variable input, (thermocouple).

General

Input range:	-10 to +lOOmV, or -1 to 10V.
Calibration error:	Better than +0.25% of span.

INSTALLATION AND OPERATING SAFETY REQUIREMENTS

Safety Symbols

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

 Caution, (refer to the accompanying documents) $\underline{\text{I}}$ Functional earth (ground) terminal

A functional earth is provided to ground RFI filters but is not required for safety purposes.

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. It is recommended that the rear terminal cover supplied with the instrument is fitted whenever possible.

Caution: **Live sensors**

The non-isolated logic, and valve positioner inputs are electrically connected to the sensor input. If the temperature sensor is connected to an electrical heating element then logic, and valve positioner inputs will also be live. The controller is designed to operate under these conditions. However you must ensure that this will not damage other equipment connected to these inputs and that service personnel do not touch connections to the sensor, logic, or valve positioner inputs while they are live. With a live sensor all cables, connectors and switches for connecting the sensor, logic, and valve positioner inputs must be mains rated.

Wiring

Wiring installations must comply with all local wiring regulations.
It is important to connect the controller in accordance with the wiring 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. Do not use unlabelled terminals as 'tie points' for other wires.

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 264Vac:

- 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 264Vac 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 2.5kV Where oc casional voltage transients over 2.5kV 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 lightning 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.

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. Apart 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 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 an independent temperature sensor
and over-temperature protection unit which is able to isolate the heating circuit.

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

Installation

Grounding of the temperature sensor shield

In some installations it is common practice to replace the temperature sensor while the controller is still powered up. Under these conditions, as additional protection against electric shock, we recommend that the shield of the temperature sensor is grounded. Do not rely on grounding through the framework of the machine.

EMC   INSTALLATION   REQUIREMENTS

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.
- Input cables must be threaded through the ferrite ring supplied with the product. Loop the cables so there are four complete turns through the ring. Use the ferrite ring for both the main PV input, (T/C, R/T, or linear inputs) and remote inputs, (setpoint, trim, etc.). Mount the ring as close as practical to the rear terminals, preferably inside the rear terminal cover. The Eurotherm part number for the ferrite ring is CO 025439.
- 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 recommend Schaffner FN321 or FN612.
- If the unit is used in table top equipment plugged into a standard power socket, then it is likely that compliance to the commercial and light industrial emissions standard is required. In this case to meet the conducted emissions requirement, a suitable mains filter should be installed. We recommend Schaffner types FN32 1 and FN612.

Routing of wires

To minimise the pick-up of electrical noise, the wiring for sensor input, digital communications, and low level I/O should be routed away from high-current power cables. Low level I/O are inputs and outputs other than triac and relay outputs, intended for low level signals less than 42V. Where it is impractical to do this, you should use shielded cables.

Section 2- Operation

Contents   Page

Operation

1 .o.   GENERAL

Display

The front presentation of the instrument has been divided into two illustrations.
The first shows the upper half of the display, containing the five large seven bar
characters plus the five upper beacons.
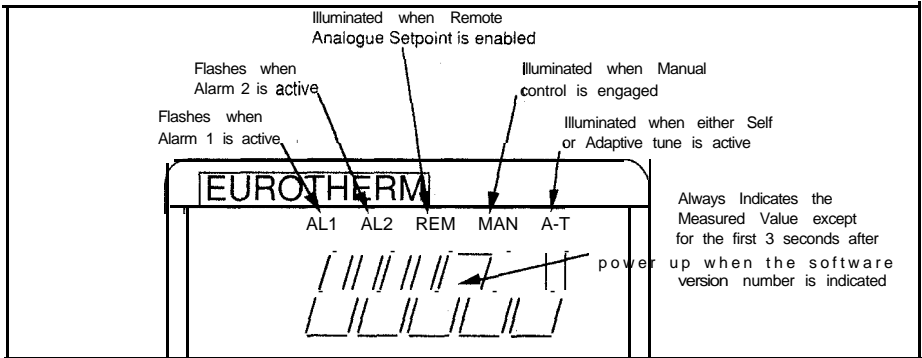
The lower half of the display, shown below, illustrates the five smaller seven bar
characters together with six further beacons, a single seven bar character plus a
rectangle.
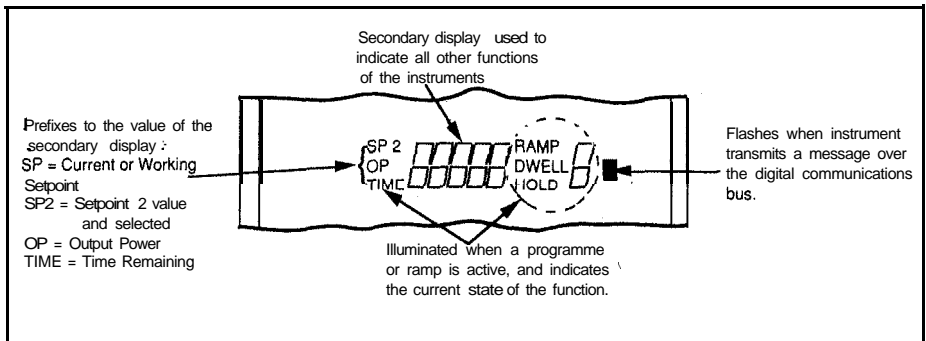
A more detailed description of the various instrument functions is given on the
following pages.

Time Out

Inclusion of a ☻ symbol within a diagram in this manual is indicative of that
parameter timing out. Parameters carrying this symbol will be replaced with the
last parameter in the short scroll, displayed before entering the main scroll, if
over a period of 15 seconds no key is depressed.

Operation

Key lock

It is possible to configure a digital input to the function keylock. When the digital input is active all front panel keys are disabled. The same function can be enabled using the digital communications status word (SW).

Digital Input inhibit

It is possible to inhibit the action of digital input using the digital communications Optional Status word (OS). However one digital input may be configured to Comms Lockout Defeat. This is provided to allow an override in the event of a comms failure.

1.1.   Front Panel Keys

Key layout and symbols completes the front presentation of the 902, 903 and 904 controllers as shown below.

SELECT   RUN/   AUTO/   DECREMENT   INCREMENT   SCROLL
(TURBO)   HOLD   MAN
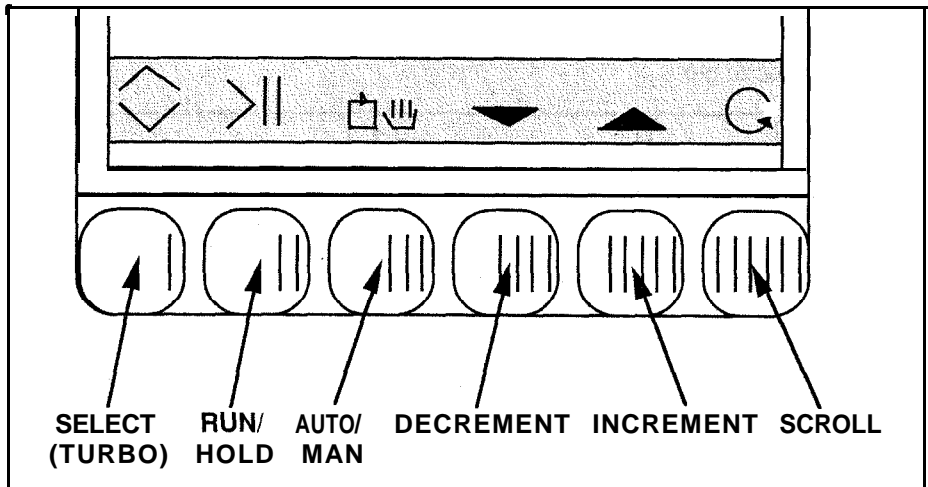
The instrument functions may be accessed by operating the six keys on the front of the instrument. The functions of these six keys are described as follows :-
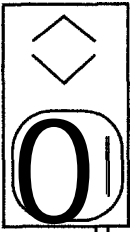
The SELECT/TURBO or "I" key allows access into a scroll list for each option from the Main Scroll List. This key is also used in conjunction with the UP or DOWN key to accelerate the change of a parameter.

The RUN/HOLD or "II" key is used exclusively to operate the programme/ ramp facility. If the programme/ramp feature has been configured then operating this key the first time will cause the loaded programme/ramp to run. Subsequent operations of this key will toggle the programme/ramp condition from run to hold.
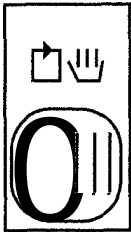
The AUTO/MANUAL or "III" key allows the controller to be toggled between the automatic and the manual condition.
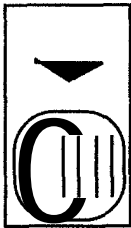
The DOWN or "IIII" key decrements the parameter appearing in the lower display.
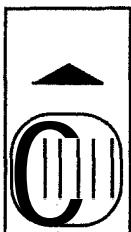
The UP or "IIIII" key increments the parameter appearing in the lower display.

The SCROLL or "IIIIII" key is used to access individual parameters in a particular scroll list.

Operation

3

Operation

1.2. Access Levels & Security

When first powered up the instrument automatically enters the Short Scroll Menu. This gives the operator access to parameters that he is most likely to require, working setpoint, output power and the time remaining if the setpoint rate limit or a programme is enabled.

Via the Main Scroll Menu, which may be accessed as illustrated in paragraph 1.5. below, the "OPERATOR", "PROGRAMME", "SUPERVISOR" and the "INSTALLATION" scroll lists may be entered where parameters requiring less frequent adjustment will be found.

Finally, from the Main Scroll Menu, a further "EXTENDED MAIN SCROLL (READ ONLY)" menu may be accessed. This allows the operator to view without the capability to change the basic instrument make up in the "USER CONFIGURATION (READ ONLY)", "INSTRUMENT CONFIGURATION (READ ONLY)" and the "RANGE CONFIGURATION (READ ONLY)".

Security

It is possible to inhibit operators from changing parameters in the instrument which are considered restricted. Several security strategies are available and are set in the instrument configuration. This access restriction may be overridden by a supervisor by using a security code. A digital input or digital communications message can be used to totally disable the front panel keys.

Parameter Modification Security (P.M.S.)

This level of security is set in the configuration and allows parameters in the Operator, Programme, Supervisor or Installation Menus to be set to read only. See configuration paragraph 6.0. This security can be temporarily disabled by using a P.M.S. disable code.

P.M.S. Disable

Entering the correct security code into the parameter "SEC" in the Extended
Main (Read Only) Scroll List, see paragraph 1.6, will override any configured
P.M.S. The security will be reset if no key action is performed within 15 seconds.
The code that will allow this security to be overridden is that stored under S2 in
the instrument configuration.   The code should be entered as illustrated below.

Changes are now possible to all those parameters normally disabled by the
P.M.S.

5
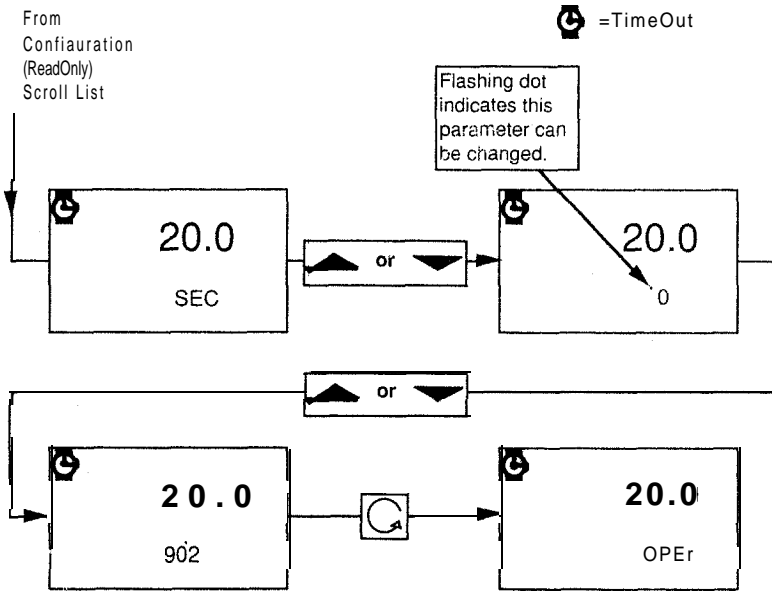
1.3.   Operation

It is quite possible that an individual user will not need to use all the key handling capability of the instrument. For this reason the instrument key handling has been divided up and presented under various paragraphs below, each describing a specific instrument application. The instrument can be operated by means of the panel keys, digital inputs or via the supervisory communications port. The text below covers operation from the front panel keys and digital inputs to the rear terminals. Operation of the instrument via the digital communications feature is given in the section on digital communications.

Reading and Setting Parameters

This section illustrates below the key handling procedure required to read and to set any parameter that appears in any level within the instrument.

From Either :
Operator Scroll List
o r
Programme Scroll List
o r
Supervisor Scroll List
o r
Installation Scroll List
o r
User Configuration Scroll List
or
Instrument Configuration Scroll List
o r
Range Configuration Scroll List

= Time Out

Flashing dot indicates this parameter can be change@

20.0

SPr·

or

20.0

15.3

or

20.0

13:1

20.0

Or
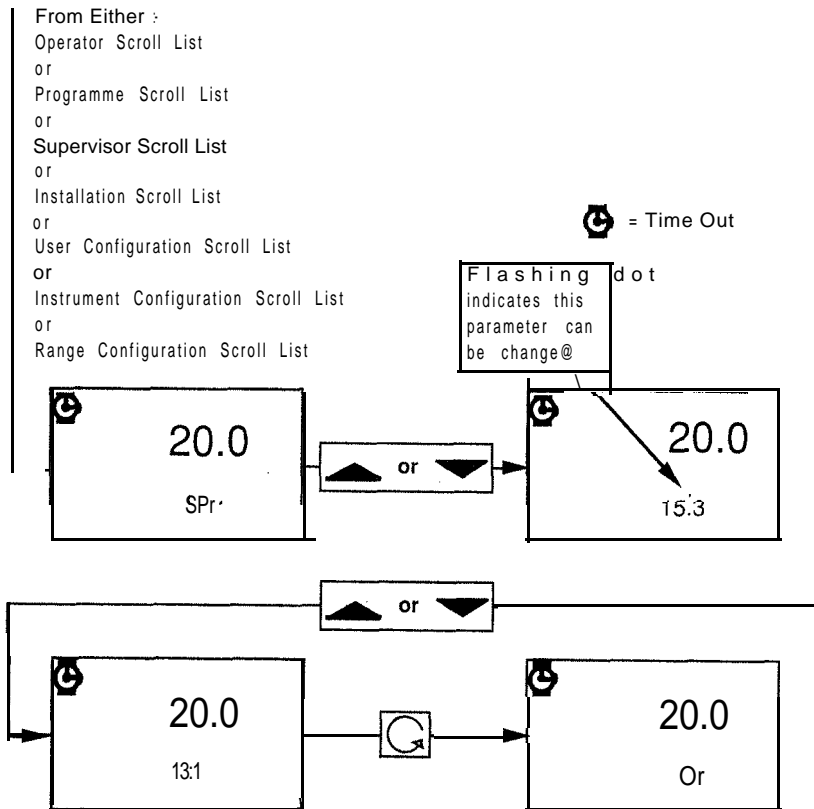
Security or some function already active within the controller, may prevent certain parameters from being altered. Under these circumstances it will be necessary to either disable the security and /or inhibit that instrument function so that the change can be performed.

Indication that a parameter has not been inhibited from change is a flashing dot observed in the top of the lower display between the 2 least significant digits. If this dot is not flashing it may first be necessary to disable the security if this has been set in the configuration, see paragraph 1 .O of this section.

The rate of change of a parameter will increase if the "UP" or "DOWN" key is kept depressed. Small adjustments can be made to **a** parameter by releasing the "UP", or "DOWN", key before the desired value is reached and then re-depress the key. This will cause the rate at which the parameter changes to revert to its original value. Large changes to a value, using this procedure will take a considerable time. This time period can be significantly reduced by using the "turbo" action described at the end of this section.

Selecting Remote and Tuning Modes

Certain mnemonics in the Operator Scroll List (OPEr) are used to select Local/ Remote and the Self and Adaptive Tune facilities of the instrument. Select these parameters as shown below.
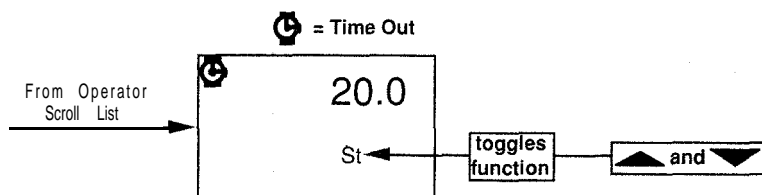
Two-state values can be identified, if doubt exists, by depressing the "UP" or "DOWN" key whilst viewing the mnemonic of a parameter. If the display does not change, this is a two-state value. Confirmation of an analogue parameter is given when the screen changes to reveal its value.

Additional Key Operations

The above procedure will allow full operation of the instrument. The additional key operations described below enable the operator to speed up certain procedures.

Reverse Scroll

On a very long scroll list, e.g. the programme mode, it may be advantageous to be able to re-access a mnemonic just passed, or access a value at the end of a list. Reverse scroll achieves this aim by depressing the "SCROLL" key followed by the "DOWN" key. Holding the "SCROLL" key depressed and pressing the "DOWN" key will continue the reverse scroll action.

Operation

Forward Scroll

6 ⇌ **Time Out**
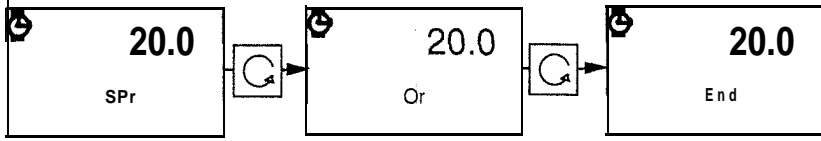
Reverse Scroll
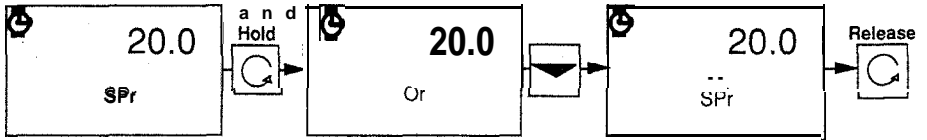
Turbo Action

Large changes to a parameter, using the above procedure described in Reading and Setting Parameters, can take a long time. This time can be dramatically reduced by using the turbo action. If while an "UP" or "DOWN" key is depressed the 'SELECT/TURBO" key is also depressed, "turbo" action will take place.

Under "turbo" action the extreme right hand, least significant, digit is scrolled for 2 seconds, whilst all other digits are frozen. Scrolling then passes to the digit one position to the left, again for 2 seconds. This procedure is continually repeated until all digits in the display have been scrolled or the key(s) are released.
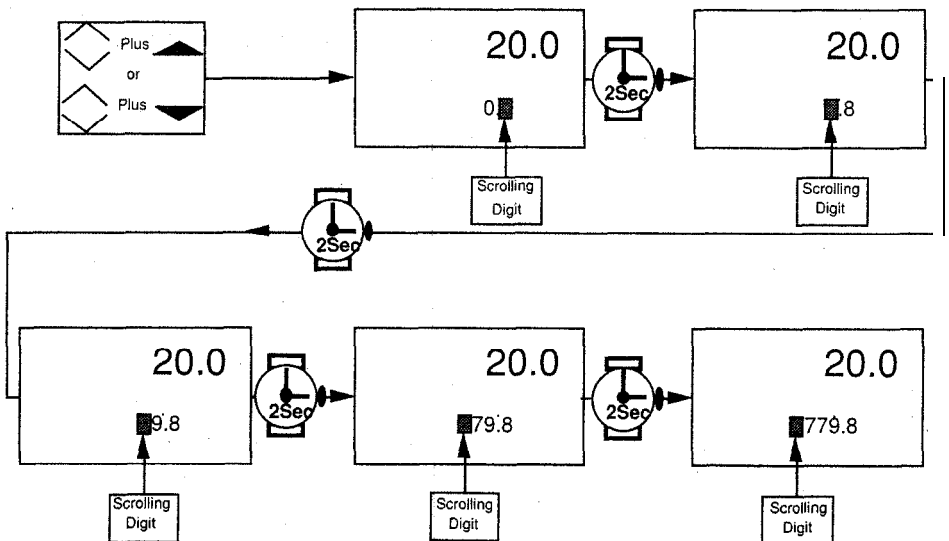
1.4. Short Scroll List

On power up the instrument displays the version of installed software for approximately three seconds, before revealing the default parameter in the Short Scroll.

Software Version Number

100

Power Up

3Secs

The parameter now displayed is the Short Scroll screen viewed at power down.

20.0

SP 180.0
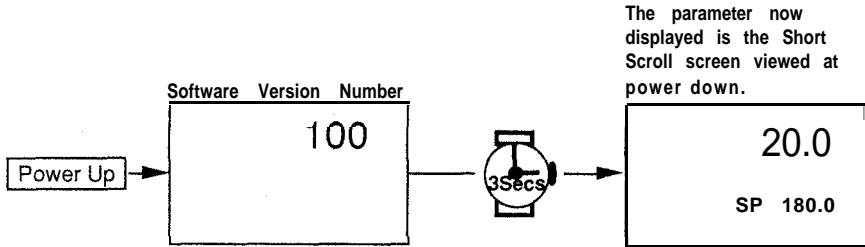
Parameters in the Short Scroll can be inspected by pressing and releasing the scroll.

Each operation of this key will force the instrument to reveal the next parameter in the Short Scroll. The parameter, "time" will only be available when either a ramp is active or a programme is running.

The Short Scroll list is "SP", "OP" and "TIME". SP displays the setpoint currently installed in the controller, (e.g. setpoint 1, setpoint 2, remote or programmer). If setpoint 2 is selected, the "SP2" legend will be illuminated. If it is possible to adjust this value, using the "UP" and "DOWN" keys, a flashing dot will be displayed at the top of the lower display, between the least two significant digit. This dot will be extinguished after 15 seconds but the setpoint may still be changed.

Output power being delivered by the controller to the process is indicated by the "OP" parameter. The value of "OP" is scaled as a percentage of the maximum power available for delivery to the process. Positive values of "OP" represent the output from the heat/process+ channel of the instrument whilst negative values represent the output from the cool/process- channel.

Only if a ramp is active or a programme is running will the "TIME" legend be displayed. If a ramp is active then the value displayed represents the time that has to elapse before the ramp reaches the installed setpoint. When a programme is running the value of this legend indicates the length of time that must elapse until the current programme segment is completed. If the "TIME" legend is followed with only numerals, then this value is in minutes. An "H" interposed between the "TIME" legend and the value indicates that the value is in hours.

Operation

The time parameter is only included in the Short Scroll when either a program is running or a ramp is enabled.
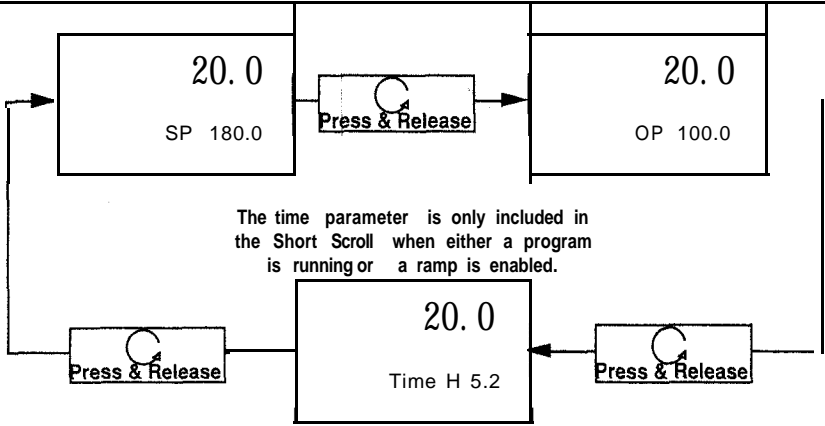
1.5. Main Scroll List

To enter the Main Scroll list the scroll key must be depressed and held down.

This action can be performed when viewing any parameter in the Short Scroll. In most cases the parameter in the Short Scroll viewed when this action is taken will be the parameter returned to when re-entering the Short Scroll. The instrument will enter the Main Scroll, indicated by the Main Scroll option "OPEr" appearing in the lower display. At this point the scroll key should be released.
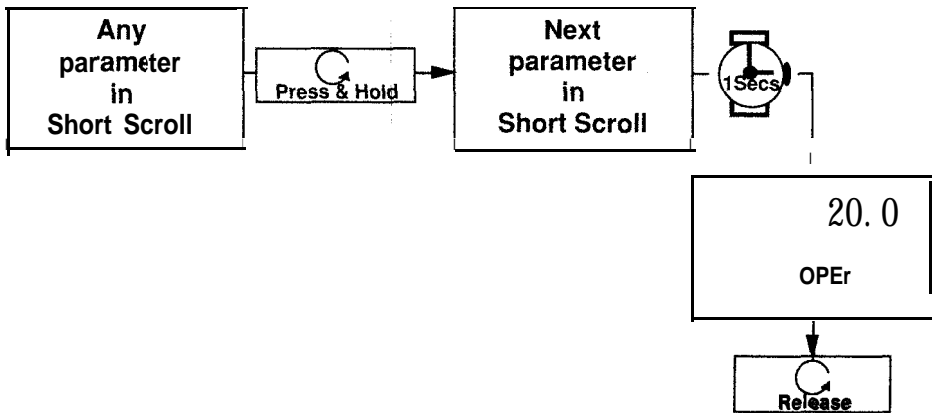
All displays in the Main Scroll and in the deeper access levels of the instrument, will time out and return to a parameter in the Short Scroll if no key is depressed for a 15 second time period. Commissioning and operating parameters within the controller are to be found within the Main Scroll list. These parameters are stored under 4 options in the Main Scroll list.

Entry from
the Short
Scroll.

🕐 = Time Out

🕐 20.0

OPEr

🔄

🕐 20.0

PrOG

🔄

🕐 20.0

SUPEr

🔄

🕐 20.0

InSt

🔄

Return to
setpoint
parameter in
Short Scroll
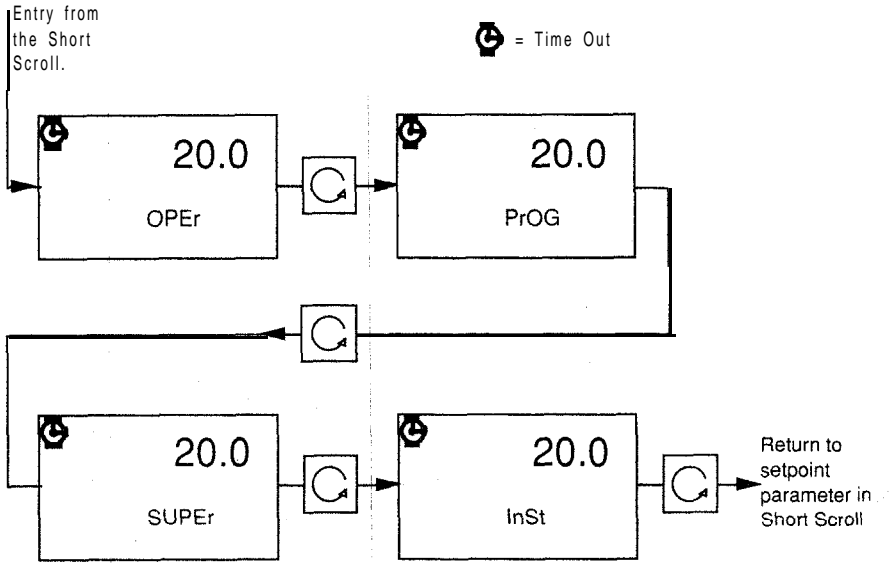
The meaning of the abbreviations used for these headings in the Main Scroll list
are shown below :-

OPEr	Operator Menu
PrOG	Programme Entry Menu
SUPEr	Supervisor Menu
InSt	Installation Menu

Operation

Operator Scroll List

This menu lists the parameters which control the operation of the instrument. These parameters can be viewed at all times but can only be changed if they are not inhibited, due to some other active controller function, or the instrument security barring access.

Indication of access to alter values is given by a dot at the top of the lower display that appears between the 2 least significant digits. This dot will flash if the value can be adjusted. Access the parameters in this scroll list by pressing the select key.
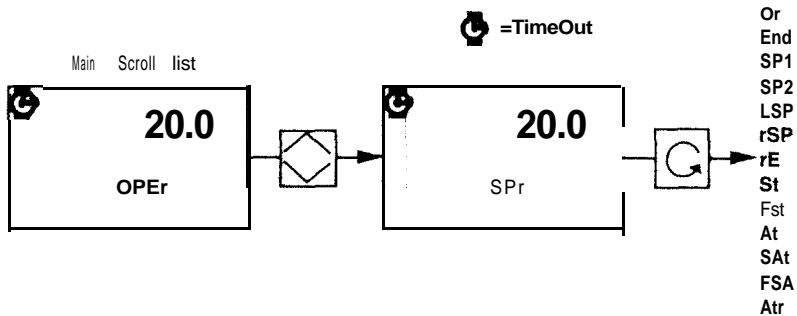
Below is given a complete list of the parameters that can appear in this list with a description of the parameter and the units being set. The setting of any individual instrument configuration may limit the number of parameters that appear in this list.

Operator Scroll List Parameters

SPr	Setpoint Rate Limit	Display Units/ Min (Hour)*
Or	Output Condition *During* Setpoint Rate Limit	On or Off
End	Output Condition at end of Setpoint Rate Limit	On or Off
SP1	Setpoint 1	Display Units
SP2	Setpoint 2	Display Units
LSP	Local Setpoint	Display units
rSP	Remote Setpoint	Display Units
rE	Select for Remote Setpoint	Enable or Disable**
St	Select for Self Tune	Enable or Disable**
FSt	Select for Fast Self Tune	Enable or Disable **
At	Select for Adaptive Tune	Enable or Disable**
SAt	Select Self + Adaptive Tune	Enable or Disable**
FSA	Select Fast Self + Adaptive Tune	Enable or Disable**
Atr	Adaptive Tune Trigger Level	Display Units

*Minute or Hour set in the configuration.

**Set by toggle action as shown in paragraph 1.3. of this section.

Return to the Main Scroll List by pressing the select key again.

SPr
Or
End
SP1
SP2
LSP-
rSP
rE
St
FSt
At
SAt
FSA
Atr

Main Scroll list

20.0

OPEr

= Time Out
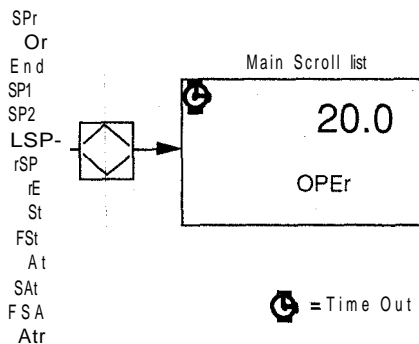
Operation

Programmer Menu (Not Applicable to Model 902s)

Access the parameters in this menu by pressing the select key.
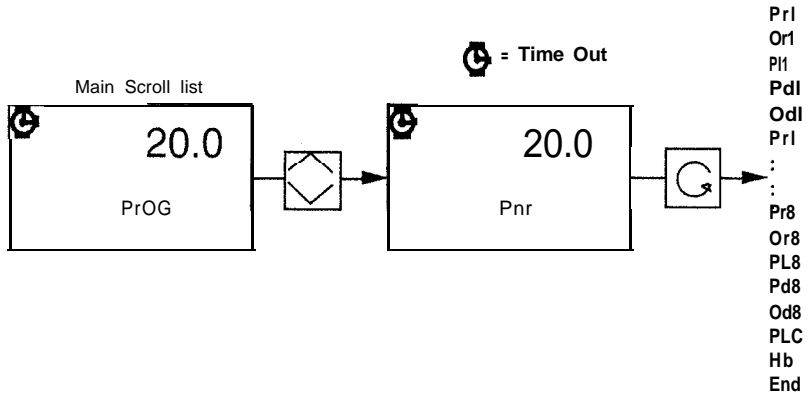
Parameters in this list can be viewed at any time, but can only be changed if a programme is not running, or is reset. In hold* some parameters may be changed (see below) and the instrument security disabled, (see paragraph 1.2 of this section). A flashing dot will appear at the top of the lower display, between the 2 least significant digits, when modification of a parameter is possible,

Below is a complete list of all the mnemonics that can appear in this list, with an explanation of the parameter and the units being set. The number of parameters appearing in a scroll list of any specific instrument at any specific time is dependent upon the configuration of the instrument, the programme entered and the programme state, running or reset.

* Note

1) If the programme has been configured as "time to target", alteration of ramp times and dwell levels is not possible.

2) Changes made to the loop remaining (Lr), during a hold, do not affect the loop count (PLC) parameter.

3) The programme number can only be changed when the programme has been reset.

Proarammer Scroll List Parameters

Lr	Loops remaining	Number (read only)*
Pnr**	Selected programme number	Number **
Prl	First ramp rate or	Display units/mins or hours** + StEP, nOnE and End.
	Time to perform first ramp**	Minutes or hours** + StEP, nOnE and End.
Or1 **	State of relay(s) during Prl	On or off
PLI	Level that will terminate Prl	Display units
Pdl	Time that setpoint will remain at PL1	Minutes or hours** and End.
Odl**	State of relay(s) during Pdl	On or off
Pr2	Second ramp rate or	Display units/mins or hours** + StEP, nOnE and End.
	Time to perform second ramp**	Minutes or hours** + StEP, nOnE and End.
Or2**	State of relay(s) during Pr2	On or off
PL2	Level that will terminate Pr2	Display units.
Pd2	Time that setpoint will remain at PL2	Minutes or hours** and End.
Od2**	State of relay(s) during Pd2	On or off
Pr3	Third ramp rate or	Display units/min or hour** + StEP, nOnE and End.
	Time to perform third ramp**	Minutes or hours** + StEP, nOnE and End.
Or3**	State of relay(s) during Pr3	On or off.
PL3	Level that will terminate Pr3	Display units.
Pd3	Time that setpoint will remain at PL3	Minutes or hours** and End.
Od3**	State of the relay(s) during Pd3 .	On or off.
Pr4	Fourth ramp rate or	Display units/min or hour** + StEP, nOnE and End.
	Time to perform fourth ramp**	Minutes or hours** + StEP, nOnE and End.
Or4**	State of relay(s) during Pr4	On or off.
PL4	Level that will terminate Pr4	Display units.
Pd4	Time that setpoint will remain at PL4	Minutes or hours** and End.
Od4**	State of the relay(s) during Pd4	On or off.
Pr5	Fifth ramp rate or	Display units/min or hour** + StEP, nOnE and End.
	Time to perform fifth ramp**	Minutes or hours** + StEP, nOnE and End.
Or5**	State of the relay(s) during Pr5	On or off.
PL5	Level that will terminate Pr5	Display units.
Pd5	Time that setpoint will remain at PL5	Minutes or hours** and End.
Od5**	State of the relay(s) during Pd5	On or off.

Operation

Operation

Pr6	Sixth ramp rate or	Display units/min or hour** + StEP, nOnE and End.
	Time to perform sixth ramp*	Minutes or hours + StEP, nOnE and End.
Or6**	State of the relay(s) during Pr6	On or off.
PL6	Level that will terminate Pr6	Display units.
Pd6	Time that setpoint will remain at PL6	Minutes or hours** and End.
Od6**	State of the relay(s) during Pd6	On or off.
Pr7	Seventh ramp rate or	Display units/min or hour** + StEP, nOnE and End.
	Time to perform seventh ramp**	Minutes or hours** + StEP, nOnE and End.
Or7**	State of the relay(s) during Pr7	On or off.
PL7	Level that will terminate Pr7	Display units.
Pd7	Time that setpoint will remain at PL7	Minutes or hours** and End.
Od7**	State of the relay(s) during Pd7	On or off.
Pr8	Eighth ramp rate or	Display units/min or hour** + StEP, nOnE and End.
	Time to perform eighth ramp**	Minutes or hours + StEP, nOnE and End.
Or8**	State of the relay(s) during Pr8	On or off.
PL8	Level that will terminate Pr8	Display units.
Pd8	Time that setpoint will remain at PL8	Minutes or hours** and End.
Od8**	State of the relay(s) during Pd8	On or off.
PLC	Number of repeats of the programme	Number or Cont*.
Hb**	Maximum deviation of M.V. from programme before programme held	Display Units.
End	State of the relay(s) during end	On or off.

* "Cont" is only available on instruments configured to have the multiprogramme facility. Setting "Cont" in any particular programme will, on completion of that programme, cause the next highest numbered programme to automatically be set into the run condition (linking). The numerical value of the loop count set in the last of a number of linked programmes determines the number of times the complete linked programme will be repeated.

** Configuration Dependent.

Return to the Main Scroll List by pressing the select key again.

```
Pnr
Prl
or1
Pl1
Pd1
Od1
Pr2
  :
  :
Pr8
Or8
PL8
Pd8
Od8
PLC
Hb
End
```

Main Scroll list

20.0

PrOG

🕐 = Time Out
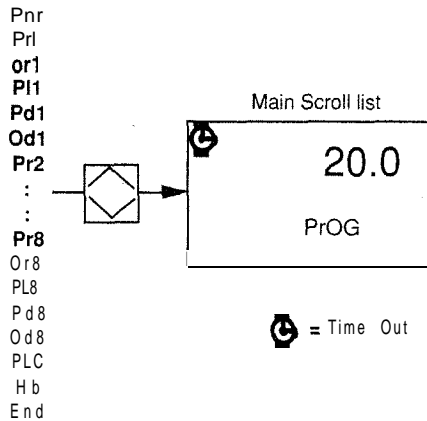
Supervisor Menu

This scroll list contains parameters for setting the alarm setpoints, sensor break power and the address used for digital communications.

As in other scroll lists all values may be read but alteration of parameters may be inhibited by the instrument security, see paragraph 6.3. of this section. A parameter may only be changed if a flashing dot appears in the top of the lower display, between the 2 least significant digits. Access the parameters in this scroll list by pressing the select key.

🕐 =TimeOut

Main Scroll list

20.0

SUPEr

20.0

AL1

AL2
Sbr
Add
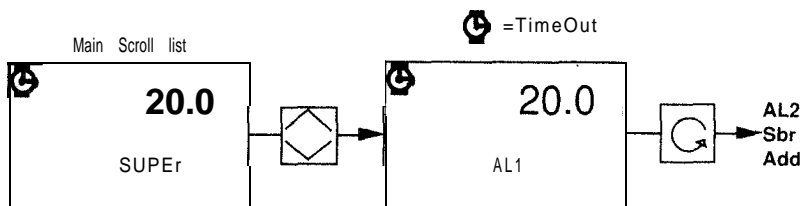
Below is a complete list of parameters, together with a description and the units to be set, that can appear in this list. The actual list appearing in any particular instrument is dependant on the instrument configuration.

Supervisor Scroll List Parameters

AL1 *	Alarm 1 setpoint	Display units.
AL2*	Alarm 2 setpoint	Display units.
Sbr	Manual power when sensor breaks	% of output power,
Add	Digital communications address	number, 2 digits.

* Dependent on the instrument configuration.

Return to the Main Scroll List by pressing the select key again.

Operation

Operation

Main Scroll list

AL1
AL2
Sbr
Add

20.0

SUPEr

⏱ =TimeOut
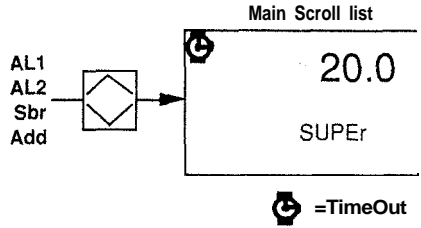
installation Menu

This menu lists the parameters which set the stability of the control loop. These values should be set at the installation stage, and thereafter should only require infrequent adjustment. Access to the parameters in this menu is by pressing the select key.

Main Scroll list

20.0

InSt

⏱ = Time Out

20.0

Pb

ti
rES
td
Pb2
ti2
rS2
td2
n
ttu
ttd
ot
ut
cbL
cbh
HL
rL
Hc
Cr
Cr2
CL
cc
Hc2
db
PL
Ph
ES
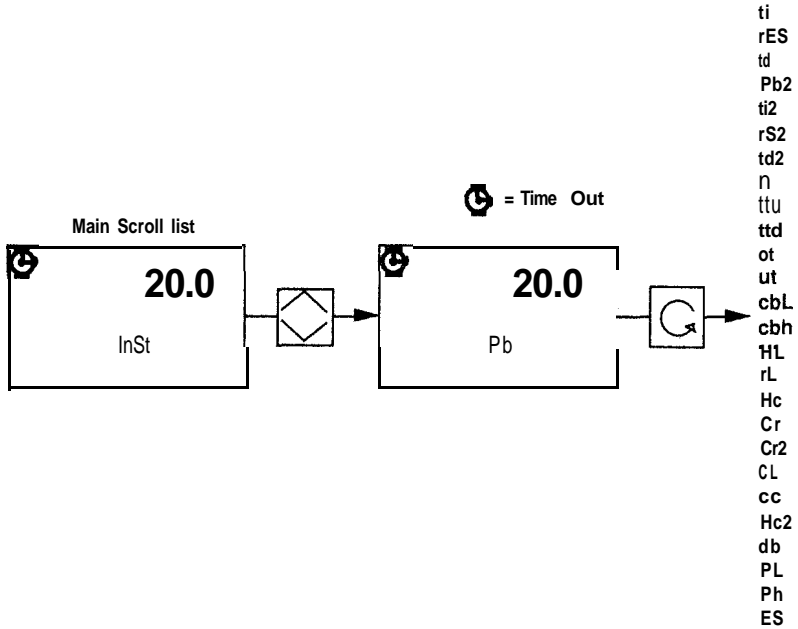
The values in this level may be read at any time, but adjustment of particular parameters may be barred due to either the instrument security being set or a particular function of the instrument being performed at that particular time. A parameter may be changed if a flashing dot appears in the top of the lower display, between the 2 least significant digits.

Below is a complete list of all the parameters that can appear in this list together with an explanation of the parameter and the units used for setting. The actual list that appears on any specific instrument is configuration dependent.

installation Scroll List Parameters

Pb	Proportional band	% of span or display units.
ti	Integral time	Seconds or minutes.
rES	Manual reset	% Output power.
td	Derivative time	Seconds or minutes.
Pb2	Proportional band for SP 2	% of span or display units.
ti2	integral time for SP 2	Seconds or minutes.
rS2	Manual reset for SP 2	% output power.
td2	Derivative time for SP 2	Seconds or minutes.
tt	VP travel time	Seconds.
ttu	VP travel time up	Seconds.
ttd	VP travel time down	Seconds.
ot	VP minimum on time,	Seconds.
ut	VP minimum update time	Seconds.
cbL	Cutback low	Display units.
cbh	Cutback high	Display units.
HL	Heat output limit	% heat power.
rL	Remote output limit	% heat power.
Hc	Heat cycle time	Seconds.
Cr	Relative cool gain	Cool Pb = Pb/Cr.
Cr2	Relative cool gain 2	Cool Pb =Pb/Cr.
CL	Cool output limit	% cool power.
cc	Cool cycle time	Seconds.
H2c	Second heat cycle time,	Seconds.
db	Heat/cool deadband	% of Pb.
PL	Pot. minimum limit	% of pot. span.
Ph	Pot. maximum limit	% of pot. span.
ES	Emissivity	Multiplying factor of black body radiation.

The list of parameters available will vary according to the configuration of the instrument.

Return to the Main Scroll List by pressing the select key again.

Operation

```
Pb
ti
rES
td
Pb2
ti2
rS2
td2
tt
ttu
ttd
ot
ut
cbL
cbh
HL
rL
HC
Cr
Cr2
CL
cc
Hc2
db
P L
Ph
ES
```

Main Scroll list

```
 2 0 . 0

  InSt
```
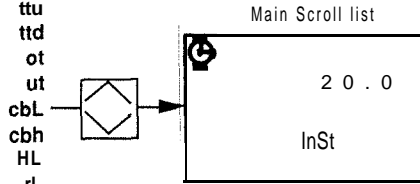
1.6.   Configuration (Read Only)

The Configuration of the instrument is available, read only, as an extension to
the Main Scroll List. A description of the parameters held in the Configuration
(Read Only) Scroll menus are given in this section. This additional set of menus
is accessed by the key sequence below.

Main Scroll list

20.0		20.0		20.0
InSt	**and**	UCOnF		ICOnF

20.0		20.0		20.0
rAnGE		SEC		OPEr

Returned to operator
mode in Main Scroll
List.

= Time **Out**
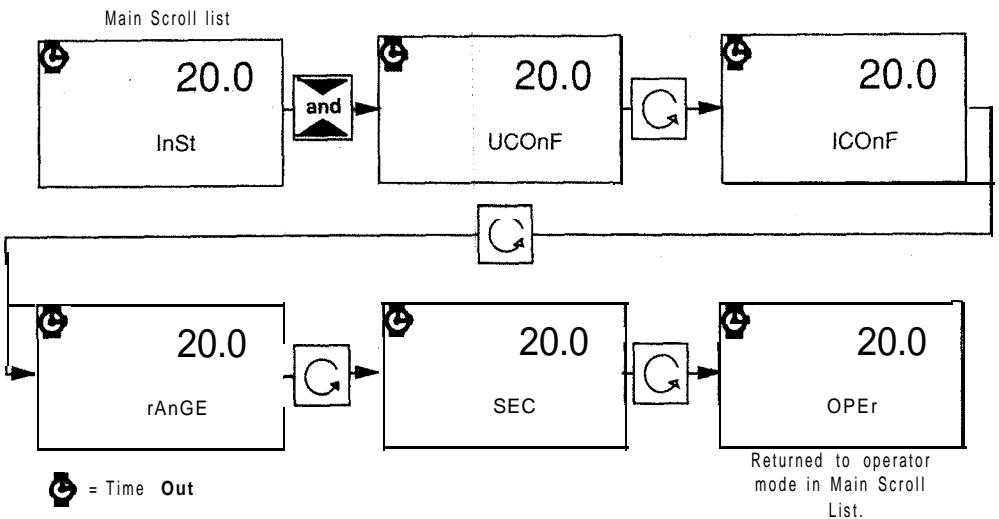
User Configuration Menu (Read Only)

The user configuration contains that part most likely to require changing by the user. Access the parameters in this menu by pressing the select key.

Configuration (Read Only) Scroll list   = Time Out

20.0
UCOnF

20.0
dIG

PFb
Hbt
tyP Ramp
rES Ramp
Uni Ramp
Uni Dwell
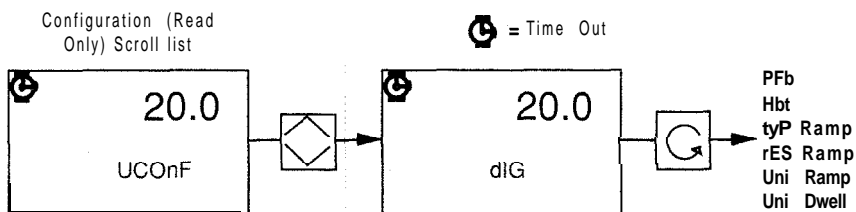
Any of the values of these parameters may be viewed, but no value can be changed. Below is given a list possible parameters.

User Configuration (Read Only) Scroll List   Parameters

dIG	Digital input functions	Code number.
PFb	Power feedback	On or off.
Hbt	Holdback	None, DVL, DVH or DVB.
tyP **Ramp**	Programme ramp type	Ramp rate or time to target.
rES Ramp	Programme ramp resolution	Normal or high.
Uni Ramp	Programme ramp units	Display units/min or hour (Minutes/hours -time to tar.).
Uni Dwell	Programme dwell units	Minutes or hours.

Return to the Configuration Scroll List by pressing the select key again.

dIG
PFb
Hbt
tyP Ramp
rES Ramp
Uni Ramp
Uni Dwell

Configuration (Read Only) Scroll list

20.0
UCOnF

= Time Out
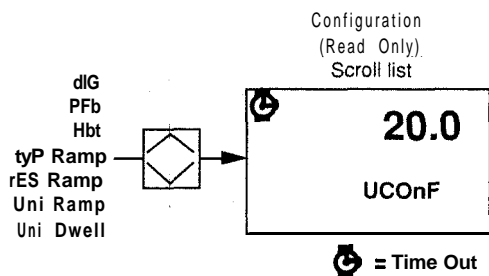
instrument Configuration Menu (Read Only)

The value of parameters in the instrument Configuration determines the basic functionality of the instrument. Access the parameters in this menu by pressing the select key.

Operation

Configuration
(Read Only)
Scroll list

🕐 = Time Out

C2
C3
C4
C5
C6
C7
C8
C9
C10
Idn
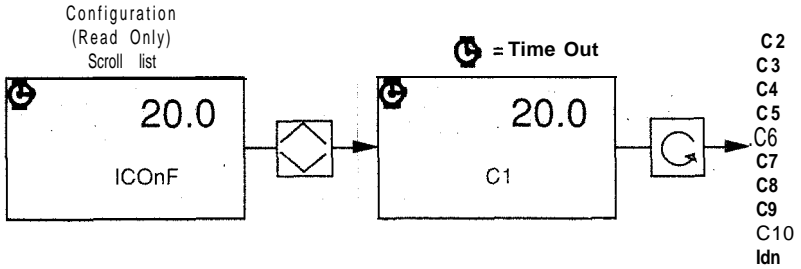
Parameters in this menu can be observed but alteration of their values is not permitted.

Instrument Configuration (Read Only) Scroll List Parameters

CI	Input type, CJC and filter	Code number.
c2	Channel 1 & 2 output & inversion	Code number.
c3	Channel 3 & 4 output & inversion	Code number.
c4	Programme, action, deriv. and dual PID	Code number.
C5	Input & PID units and cal trim	Code number.
C6	PMS, DP and language	Code number.
c7	Digital communications	Code number.
C8	Analogue communications	Code number.
C9	Function disable	Code number.
CI0	Function disable & track	Code number.
idn	Hardware identification	Code number.

Return to the Configuration Scroll List by pressing the select key again

C1
C2
C3
C4
C5
C6
C7
C8
C9
CI0
idn

Configuration
(Read Only)
Scroll list

🕐 = Time Out
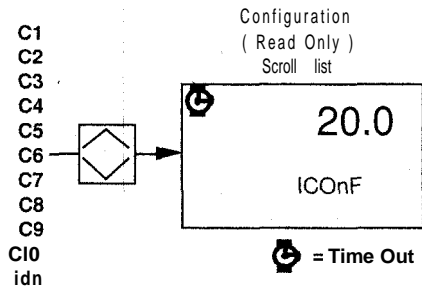
Range Configuration Menu (Read Only)

This part of the configuration contains the parameters that define setpoint limits, alarm hysteresis and transmission scalers. Access the parameters in this menu by pressing the select key.
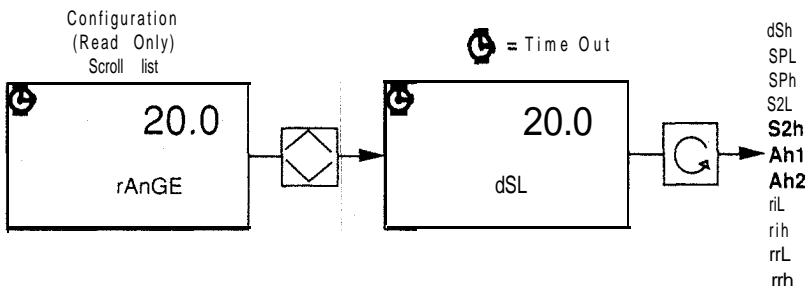
Parameters in this menu can be'observed but alteration of their values is not permitted.

Range Configuration (Read Only) Scroll List Parameters

dSL	Display low limit	Display units.
dSh	Display high limit	Display units.
SPL	Working setpoint low limit	Display units.
SPh	Working setpoint high limit	Display units.
S2L	Second setpoint low limit	Display units.
S2h	Second setpoint high limit	Display units.
Ah1	Alarm 1 hysteresis	% of display range
Ah2	Alarm 2 hysteresis	% of display range.
riL	Remote input low scaler	Display units. (% power on power limit)+.
rih	Remote input high scaler	Display units. (% power on power limit)*.
rrL	Retransmission low scaler	Display units or % power*.
rrh	Retransmission high scaler	Display units or % power*.

. Configuration Dependent.
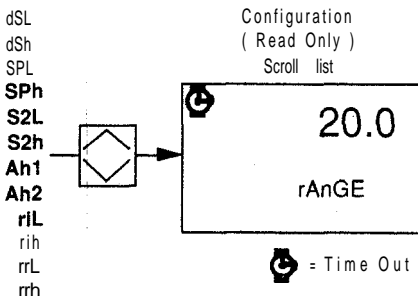
Return to the Configuration Scroll List by pressing the select key again.

2.0. AUTO/MANUAL

The instrument can be switched into the manual mode at any time. Manual mode allows the output power, either heat/process+ or cool/process-, to be set directly by using the "UP" and "DOWN" keys. The instrument is switched into this mode by means of the "AUTO/MANUAL" key, as shown below or by closing a configured digital input.
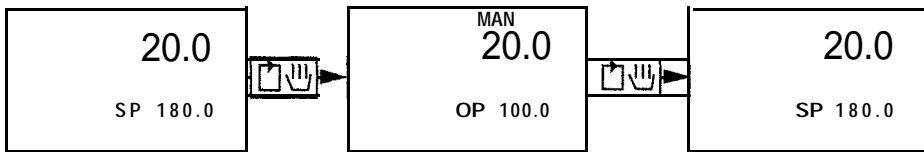
The instrument configuration may have been set to disable this feature in which case it will be necessary to amend the configuration to enter this mode.
Indication of the manual mode being selected, is by the MAN beacon appearing. The secondary display will also change to a display of output power, OP.
Operation of the 'UP" or "DOWN" keys will now increment and decrement the output power. Pressing the "AUTO/MANUAL" key a second time or by activating a configured digital input will revert the instrument back to automatic operation and the display to that showing before manual was selected.

3.0. SETPOINTS

The instrument can operate on a number of setpoints, selection of the current, or working setpoint being by either key operation or a configured digital input or via the digital communications network. The setpoints that are available for operating the instrument are :-

Setpoint 1

Setpoint 2

Remote Setpoint or Remote Setpoint plus Local setpoint (LSP)

Programmer Setpoint (Not Available on model 902s)

Setpoint Rate Limit

3.1. Working Setpoint

The Working setpoint is the current value of setpoint being used for control purposes regardless of the source. The value displayed in the Short Scroll List is always the working setpoint. Parameter modification whilst viewing the "SP" beacon in the Short Scroll List is only possible when setpoint 1 is selected. In all other cases the alteration must be carried out whilst viewing the relevant parameter mnemonic in one of the scroll lists.

3.2. Remote Setpoint

The instrument can control using a remote value derived from an external analogue signal fed into the controller. Selection of this remote setpoint is in the operation mode under the mnemonic "rE". This is a two-state parameter, and will therefore be enabled by pressing the "UP" and "DOWN" keys together, or by enabling a configured digital input. The instrument configuration may have been set to disable this feature, in which case it will be necessary to amend the configuration. Indication that this mode of operation is selected is an illuminated REM beacon in the display. Whilst the remote mode is selected, the SP beacon in the short scroll will indicate the remote value. This may be solely the remote signal, or the remote plus a Local Setpoint if the mnemonic "LSP" appears in the Operator Scroll list. Reselection of the local setpoint, SP1 or SP2, can be achieved by again scrolling to the mnemonic "rE" in the Operator Scroll list and pressing the "UP" and "DOWN" keys together or by activating a configured digital input.

<div style="text-align:right">Operation</div>
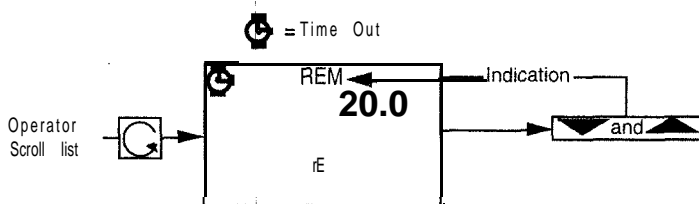
3.3. Setpoint Rate Limit

Applications that cannot permit the measured value to approach the setpoint at its maximum rate, e.g. Furnaces where thermal shock could cause mechanical failure, can be safely controlled using setpoint rate limit. This function ramps the setpoint from the measured value, at power up or when enabled, towards the installed local setpoint at a rate set under the mnemonic "SPr" in the Operator Scroll List. Whilst this feature is enabled the value of setpoint in the short scroll list is the instantaneous value of the ramp. The installed local setpoint cannot be changed from this screen. The local installed setpoint can only be changed by locating the mnemonic "SP1" or "SP2" in the Operator Scroll List and changing the value under these banners. A change of setpoint will initiate the rate limit to approach the new setpoint at the ramp rate.

Operating the Setpoint Rate Limit

If this feature has been installed in the instrument configuration then it can be enabled by depressing the RUN/HOLD key or activating a configured digital input, when viewing any screen

When SPRL is initiated by pressing the run button. The WSP will then ramp from the current PV to the selected SP. With display E if SP is changed then ramp is reactivated to ramp from PV to new SP. With SP1 and SP2 ramp will operate between the two.
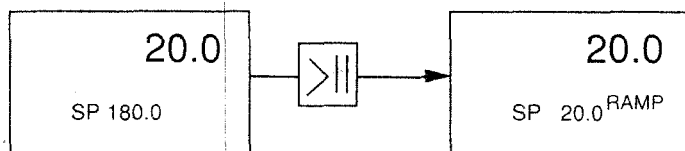
Operation

The instrument configuration may have been set to disable this feature in which case it will be necessary to amend the configuration. Indication of the enabling of this feature is the illumination of the RAMP beacon in the lower right hand corner of the display. When the ramp reaches the local setpoint, the RAMP beacon will be replaced by an E, illuminated just to the right of the ramp. Pressing the RUN/HOLD key or activating a configured digital input, while the RAMP beacon is illuminated, will force a hold condition onto the ramp, An additional beacon, HOLD, will be illuminated. To disable the hold feature press the RUN/HOLD key a second time or change the state of the digital input. This sequence may be repeated as many times as required. With the ramp feature enabled the time screen is present in the short scroll, indicating the time that has to elapse, excluding any hold conditions, until the ramp reaches the local setpoint. An "H" in the time display indicates the value is in hours. The absence of an "H" indicates the value is in minutes. The ramp feature can be disabled, when viewing any screen, by pressing the "UP" and "DOWN" keys together or by deactivating a digital input if configured.

3.4.   Operating a Programme

Only models 902P, 903P and 904P have the programme facility installed within the controller. The maximum number of programmes that can be stored in a controller is determined by the model number as shown below :-

MODEL NUMBER	MAXIMUM NUMBER OF STORED PROGRAMMES
902P	One
903P	Four
904P	Fifteen

A progamme allows the controller setpoint to automatically follow a predetermined profile with respect to time instead of remaining constant as with a "SP1" and "SP2". With the multi-programme versions, 903P and 904P any one of the stored programmes can be selected for running at any particular time.

On multi-programme models the value of the mnemonic "Pnr", found in the Programmer Scroll List, must firstly be set to the number of the-programme to be run.
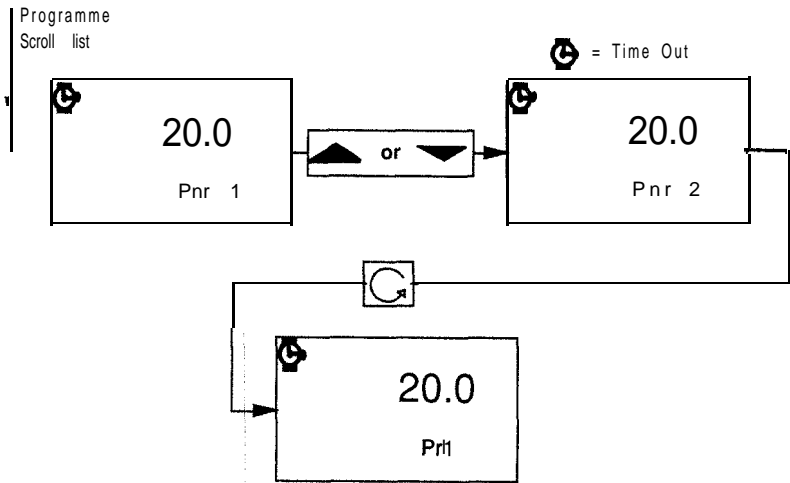
Programme
Scroll list

⊙ = Time Out

⊙

20.0

Pnr 1

▲ or ▼

⊙

20.0

Pnr 2

↻

⊙

20.0

Prt1

It may first be necessary to disable the security if this has been set in the configuration, see paragraph 1,0. of this section. If a digital input has been configured to activate this feature, its first closure will force the lower display to reveal the current selected programme, regardless of the screen being viewed.

The selected programme can be set running by depressing the "RUN/HOLD" key whilst viewing any screen or activating a configured digital input.

20.0

SP 180.0

▷‖

20.0

SP 20.0 RAMP 1
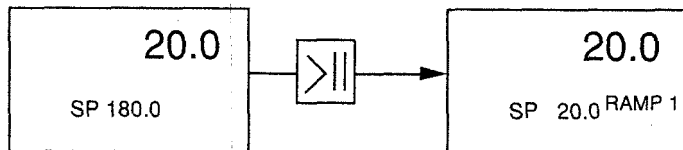
Failure of this key action to activate a programme is indicative of either the security within the configuration, set or a mutually exclusive function within the controller being enabled. Indication of a running programme is either the RAMP or the DWELL beacon illuminated plus a single character beside these beacons. The beacon indicates the type of segment, whilst the character indicates the number of the segment operating.

In the short scroll, the SP beacon indicates the current value of the programme setpoint whilst the TIME beacon shows the time remaining in the current segment, excluding any hold or holdback periods that may be implemented. Whilst a programme is running, an extra mnemonic "Lr", appears at the top of the programme mode scroll list. This indicates the number of times the running programme will be repeated, after completing the current one, before the END condition is reached.

Operation

A hold condition can be forced onto a running programme at any time by a further depression of the RUN/HOLD key or operation of a configured digital input.
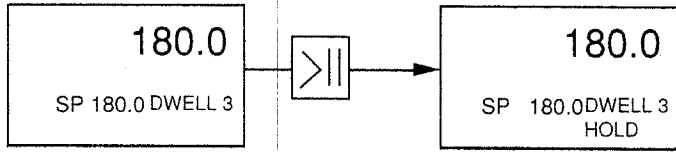
Some digital inputs require activating and others deactivating. Failure of this key action to activate a hold is indicative of the security within the configuration being set. The programme will be returne to a running state on a further depression of the RUN/HOLD key or by activati / deactivating the configured digital input. One particular setting of the configuration also necessitates the activation of a configured digital input to start the programme.

Holdback, if configured and set on, will also place the programme into hold if it becomes active. A flashing RAMP or DWELL beacon indicates an active holdback condition.

When a programme is completed, the END state is entered, indicated by both the RAMP and the DWELL beacons being extinguished and the single character illuminated as an "E". The controller; setpoint will be the value at the end of the last segment, and will remain as such until the programme is reset. This will cause the setpoint to revert back to either setpoint 1 or 2 depending on which one is selected.

To initiate a reset condition either depress the "UP" and "DOWN" keys together or activate a configured digital input.
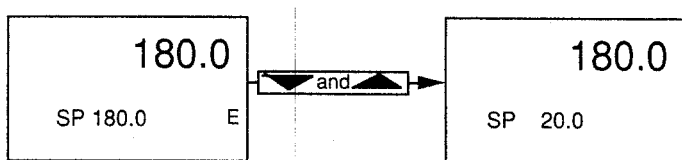
Failure of this key action to activate ,a reset is indicative of the security within the configuration being set. A RESET can be activated during a running programme, as well as during the END condition, In this case the progamme will be aborted, and control returned to either setpoint 1 or 2 dependent upon which is selected.

3.5. Setpoint Tracking

Two types of tracking can be set in the instrument configuration, manual and remote. Selecting manual tracking will cause the setpoint to follow or track the measured value whilst the instrument is switched into the manual mode. This will eliminate any "BUMP" in the output power when "auto" is again selected.

Remote tracking will force the local setpoint to follow or track the remote setpoint while remote is selected. If the remote setpoint has been configured to be "Remote + L.S.P." then while the local setpoint is selected L.S.P. will vary so that Remote + L.S.P. = Local Setpoint. This facility ensures that there is no "BUMP" in control action when switching from remote to local and local to remote.

4.0. TUNING

Optimum control performance is only obtained from the controller if the commissioning parameters are set to their critically damped values for the particular application. These critically damped values can be obtained by tuning the loop manually, as described in the commissioning section, or by using the automatic tuning facilities built into this instrument.

The two automatic tuning functions installed in this controller adjust many parameters within the installation mode scroll list to their critically damped values. It is recommended that the 'single shot', self tune feature be performed initially, as this is capable of making large changes, if necessary, to many parameters. The adaptive tune feature, if initiated, will then just trim "Pb", "ti' and "td' whilst controlling the process. Selection of the required tuning feature is made in the instrument configuration, see paragraph 4.2.9. of section 4 the Configuration.

4.1. Selection of Tuning

Self Tune

Certain values of mnemonics in the installation scroll list should be checked before enabling this feature. If mnemonics "ti" and/or "td" are set to the OFF position the instrument will tune the loop without these terms. If the relevant cutback mnemonic "cbL" or "cbh" is set to the OFF position, the instrument will not attempt to introduce this feature during the tune routine. The heat limit, and if applicable, the cool limit and dead band must also be set. On valve positioner models the travel time, minimum on time and update time must be set before self tuning is initiated. Scrolling down the operator scroll list to the mnemonic "St", and then pressing the "UP"and "DOWN keys together or enabling a configured digital input will activate this feature.

Operation

Operation
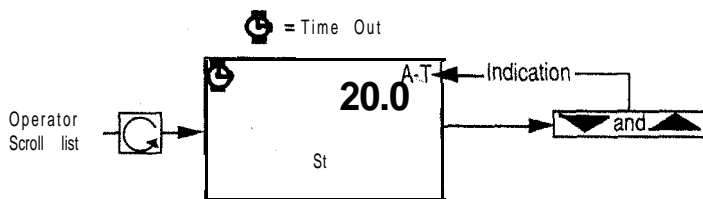
Indication of the self tune feature enabled is the illumination of the "A-T" beacon in the top right hand corner of the display. If the setpoint screen in the short scroll is selected, it will be noted that the "SP" beacon is flashing. This beacon will flash for one minute, during which time the setpoint should be adjusted to the normal running value, as the critically damped values are setpoint dependent. At the end of the one minute period, the "SP" beacon will be continuously illuminated but the "A-T" beacon will now flash. During the time this feature is active the values of mnemonics "Pb', "ti", "rES", "td", "tt", "ttu", "ttd", "ot", "ut", "cbL", "cbh", "HL", "Hc", "Cr", "cL", "Cc" and "db" are inhibited from adjustment. When completed, the instrument switches off the self tune function, extinguishing the "A-T" beacon. The self tune feature can be aborted at any time during the routine by again scrolling to the "St" mnemonic in the Operator Scroll list and pressing the "UP" and "DOWN" keys together or by activating a configured digital input.

If the Self-tune algorithm is unable to tune the loop for any reason, the primary display will alternately show the measured value and 'StOP'. Control outputs become inactive. Self-tune should then be manually aborted as described above.

Adaptive Tune

Pressing the "UP" and "DOWN" keys together whilst viewing the mnemonic "At" in the Operational Scroll List or activating a configured digital input will enable the adaptive tune feature. Indication of this action will be the illumination of the "A-T" beacon in the top right hand corner of the display.
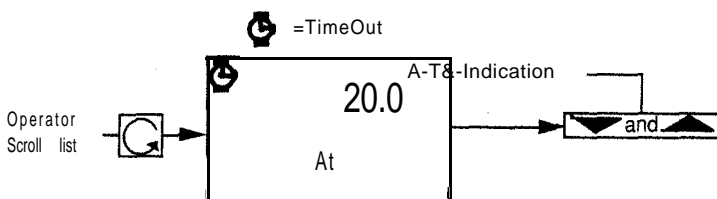
Values set under the mnemonics "ti" and "td" before enabling this feature are very important. If any of these values are set to OFF, the adaptive tune feature will not attempt to reintroduce them unless a large offset or droop exists in the loop for a long period of time, in which case the integral "ti" term will be switched on and tuned. While the adaptive tune feature is enabled, "Pb", "ti" and "td" cannot be manually changed.

Once enabled the adaptive tune feature will remain active, even though the instrument may be powered down and up again, and can only be disabled by a manual intervention. The instrument will perform the adaptive tune routine every time the measured value moves more than the adaptive tune trigger level, mnemonic "Atr", away from setpoint.

The value of the mnemonic "Atr" is recalculated from the default value during the self tune routine. If it is felt necessary, the value of the mnemonic "Atr" can be readjusted manually.

Scrolling down a second time to the mnemonic "At" and pressing the "UP" and "DOWN" keys together or activating a configured digital input will disable this feature.

Self plus Adaptive Tune
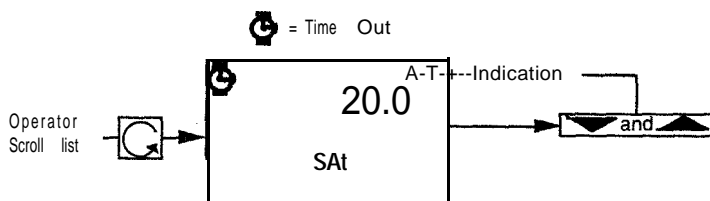
The two tune features described above can be performed sequentially, self followed by adaptive, by selecting the mnemonic "SAP in the Operator Scroll List and pressing the "UP" and "DOWN" keys together or by activating two configured digital inputs. These features can be disabled separately, using the mnemonics "St", "At" or by activating a configured digital input or using the "SAt" mnemonic.

4.2. Dual P.I.D.

On applications when the only requirement of a instrument is to control at two widely different display values, then the dual P.I.D. facitity may be found to be advantageous. If this option is set in the configuration the two fixed setpoints within the controller, SP1 and SP2, will each have their own values of proportional band, integral time, derivative time, manual reset, relative cool gain and heat cycle time. SP1 will use the parameters Pb, ti, td, rES, Cr and Hc whilst SP2 uses Pb2, ti2, td2, rS2, Cr2 and H2c. Switching from SP1 to SP2, via a configured digital input, will also select the relevant control parameters. This option may be found to have an advantage over the adaptive tuner as the predetermined control parameters are installed as soon as the setpoints are switched.

Operation

5.0. ALARMS

There are two alarms, AL1 and AL2, installed within the instrument and each of these can be configured to one of the five following types; deviation high (DVH), deviation low (DVL), deviation band (DVB), full scale high (FSH), or full scale low (FSL). Confirmation of the alarm settings on any particular instrument is given either in the code found on the instrument label or in the configuration. The configuration may have set these alarms off or to perform other functions. In this case the alarm mnemonics will not appear in the Supervisor Scroll List, and it will not be possible to illuminate that alarm beacon.

5.1. Alarm Setpoints

Scroll to the mnemonic "AL1", Alarm 1, "AL2", Alarm 2, in the Supervisor Scroll List. The value of each of these mnemonics represents that particular alarm setpoint in display units. Deviation alarms are set with respect to the controller current working setpoint, at that specific time. Full scale alarms are set with respect to absolute zero. The procedure for viewing or changing an alarm setpoint is shown below.
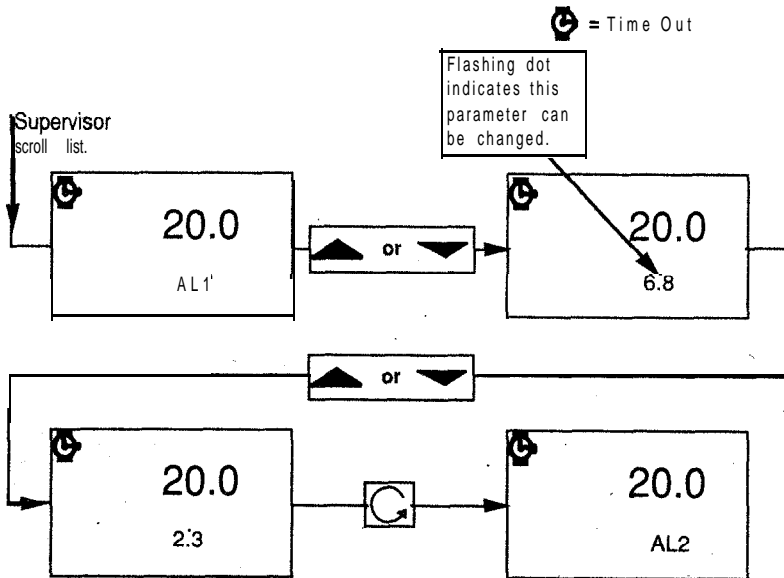
6. 0. OUTPUT POWER LIMITS

Limits can be set on the maximum outputs from all channels driven by the controller output, heat/process+ on its own or with the cool/process- output. The' parameters that control these limits are "HL" for the heat/ process+ channel and "CL" for the cool/process- channel. These parameters can be found in the Installation Scroll List. Both these parameters are scaled 0 to 100% of the maximum power output of the particular channel. All values of power set for the cool/process- channel are preceded by a negative sign.

Limits restricting the range of valve movement can be applied to valve positioner controllers fitted with a positioner potentiometer. The high and low limits are set by the parameters "Ph" and "PL" respectively.

NOTE: The instrument ignores valve position limits whilst switched to manual and if a potentiometer break is detected.

7. 0. SENSOR FAULTS

Generally, a sensor break, will cause the measured value to scroll upscale. The upper display will change to a flashing "Or" when the measured value reaches the instrument span plus 10%. Some sensor faults will cause the measured value to scroll down scale. Again when the measured value reaches the instrument span minus 10% the upper display will be replaced by a flashing "Or". This flashing "Or" indicates that the controller output stages are now driven at a constant power level and not by the three term signal. The value of this constant output power is set under the parameter "Sbr", found in the Supervisor Menu. This parameter on instruments configured to give PID outputs can be scrolled from 0 to 100%. If the controller is also fitted with a proportional cool/process- output stage, the value of "Sbr" can be scrolled from 100 to -100%. Positive values of "Sbr" set outputs from the heat/process+ channel while negative values set outputs from the cool/process- channel.

On on/off or valve positioner control, the value of "Sbr" is restricted to two options, either "0" or "100". Setting a "0" gives zero output on on/off loops and a closed valve on valve positioner loops. Conversely a setting of "100" gives full output on an on/off loop and an open valve on a valve positioner loop.

A break in the feedback potentiometer of a valve position control is indicated by "or" in the lower display. In this condition the position limits are ignored.

NOTE: Sensor faults on instruments with high level, or current inputs and certain R.T.D. faults may not be detected.

Operation

Operation

8.0. DIGITAL INPUT FUNCTIONS

The operation of digital inputs can be described as level or edged triggered.
The following descriptions are used to explain the digital input function table;

Level Triggered

HIGH   4.0 to 6.0V or open circuit
LOW   0 to 0.7V or closed circuit

Edge Triggered

RISE Rising edge
FALL Falling edge

When an input is enabled (LOW), the selected function is in operation. This operation cannot be switched off from either the front keys or by digital communications.
When an input is not enabled (HIGH), then the function can be activated using the front panel keys or digital communications.

Note that functions that are edge triggered will not be activated if a transition occurs while the instrument is powered down.
The available functions are described in the following table;

FUNCTION	STATE	
Broadcast	FALL - Enable Broadcast	RISE - Disable Broadcast
Comms Lockout	LOW - Defeat Lockout	HIGH - No effect
Keylock (Note 1)	LOW - Disable keys	RISE - Re-enable to PMS
Disable PMS (Note 1)	LOW - Disable PMS	HIGH - No effect
Manual	LOW - Manual	RISE - Auto
Remote	LOW - Select remote	RISE - Select local
SP 2 (Note 2)	LOW - SP & PID set 2	RISE -SP & PID set 1
PID 2 (Note 2)	LOW - PID set 2	RISE - PID set 1
Self tune	FALL - Run self tune	RISE - Stop self tune
Adaptive tune	LOW - Enable adapt tn.	RISE - Disable adapt tn.
Run (Note 3)	FALL - Start prog(ramp)	HIGH - No effect
Hold (Note 3)	LOW - Hold prog(ramp)	RISE - Cont. prog(ramp)
Reset (Note 3)	LOW - Reset	HIGH - No effect
Run/hold (Note 4)	LOW - Run(start)	RISE - Hold
Hold/run (Note 5)	LOW - Hold	RISE - Run(start)
Skip current segment	FALL - Skip	HIGH - No effect
Programme Number (Pr	Monitor / Step (Note 6):-	
(SP or OP displayed)	LOW - disp Pnr	HIGH - 🕒 t o SP/OP
(Pnr has not timed out)	FALL - inc. Pnr	HIGH - 🕒 to SP/OP
UP Key	LOW -UP Key	HIGH - No effect
/DOWN Key	LOW - DOWN Key	HIGH - No effect
TURBO key	LOW - Turbo action	HIGH - No effect

Note **1**:- PMS = Parameter Modification Security.(See paragraph 1 .0 General)

Note 2:-

Digital Input			Configuration Setting			
No.	Select With		C4(D)	diG(B)	dig(C)	diG(D)
	Low	Riśe				
1	SP1	SP2	0	3	Not 3	Not 4
2	SP1	SP2	0	Not 3 or 4	3	Not 4
1	SP1& PID1	SP2& PID2	1	3	Not 3	Not 4
2	SP1& PID1	SP2& PID2	1	Not 3 or 4	3	Not 4
1 and 3	SP1 PID1	SP2 PID2	1	3	Not 3	4
2 and 3	SP1 PID1	SP2 PID2	1	Not 3 or 4	3	4
2 and 1	SP1 PID1	SP2 PID2	1	4	3	Not 4
1	PID1	PID2	1	4	Not 3	Not 4
3	PID1	PID2	1	Not 3 or 4	Not 3	4

Note 3:- RUN, HOLD and RESET functions apply to either programmer or (ramp) functions, depending on configuration.

With the input HIGH, Run may be instigated from the front key. To Reset via a digital input the input is set LOW. To restart a programme or ramp, the digital input must first be set HIGH.

Note 4:- With the input HIGH, Run may be instigated from the front key. To hold via a digital input the input must first be set LOW, then to RISE. Continue a programme or ramp either by front key or setting the digital input LOW. If the digital input is LOW when the end state is reached, a programme will not automatically restart. To restart the programme must first be Reset.

Note 5:- With the input HIGH, Run may be instigated from the front key. To run from a digital input, first set the input LOW and then to RISE. To Hold via a digital input set the input to LOW. When in Hold via digital input, Run may not be instigated by front key. If the digital input is HIGH when the end state is reached, a programme will not automatically restart. To restart the programme must first be reset.

Note 6:- A FALL within the 15 second time out period will increment the programme number.

Operation

9.0 KEYHANDLING OVERVIEW
9.1 English Keyhandling Overview

The following pages give the full list of screens and parameters. The combination appearing in any particular instrument is dependant upon the configuration.

Scroll List Operation

Scroll Header Screen

To [arrow] From

20.0 SPr [or] 20.0 13.9 [or] **To change this value**

20.0 Or

Operator List	Programme List	Supervisor List	Installation List
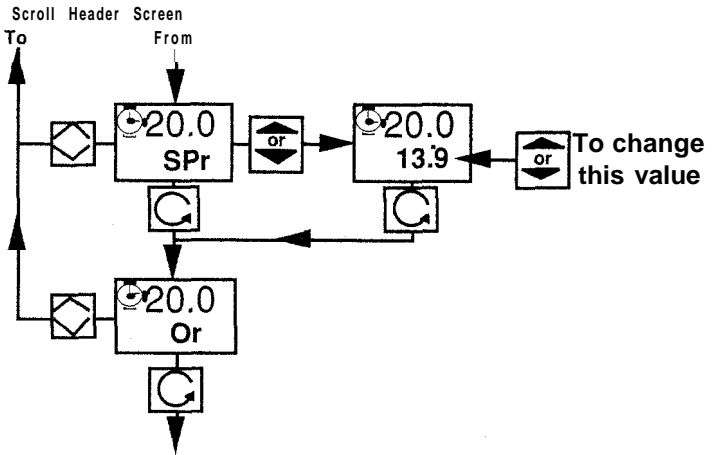
Operator List

SPr SP Ramp Rate
Or Ramp Output
End End Output
SP1 SP1
SP2 SP2
LSP Local SP
rSP Remote SP
rE Rem. Enable
St Self Tune
FSt Fast ST
At Adaptive Tune
SAt St&At
FSA Fast St & At
Atr At Trigger SP

↓
SPr
"

Programme List

Pnr1 Prog Number
Prl Prog Ramp 1
Or 1 Ramp 1 Out.
P/l Prog Level 1
Pdl Prog Dwell 1
Od1 Dwell 1 Output
"
"

Pr8 Prog Ramp 8
Or8 Ramp 8 Out.
Pl8 Prog Level 8
Pd8 Prog Dwell 8
Od8 Dwell 8 Output
PLc Loop Count
Hb Hold Back
Lr Loops Rem.
End End Output

↓
Pnrl
"

Supervisor List

AL1 Alarm 1 SP
AL2 Alarm 2 SP
Sbr Sensor Brk. P
Add Corns. Address

↓
AL1
'

Installation List

Pb Prop Band
ti Integral Time
rES Manual Reset
td Derivative
Pb2 2nd Pb
ti2 2nd ti
rS2 2nd rES
td2 2nd td
tt Travel Time
ttu ttup
ttd tt Down
ot Min on Time
ut Update Time
cbL Cutback Low
cbh Cutback High
HL Heat OP Limit
rL Rem. OP Limit
Hc Heat Cycle Tm
Cr Rel. Cool Gain
Cr2 2nd Cr
CL Cool OP Limit
Cc Cool Cycle Tm
H2C 2nd Hc
db Dead Band
PL Pot. Min. Limit
Ph Pot. Max. Limit
ES Emissivity

↓
Pb
"

User Config. List	Instrument Config. List	Range List
(See Page 40)	(See Page 40)	(See Page 40)

Note:- All the above Scroll Lists are circular, depressing the Scroll Key when the last parameter is displayed will re-display the first parameter.

9.2. French Keyhandling Overview

The following pages give the full list of screens and parameters. The combination appearing in any particular instrument is dependant upon the configuration.
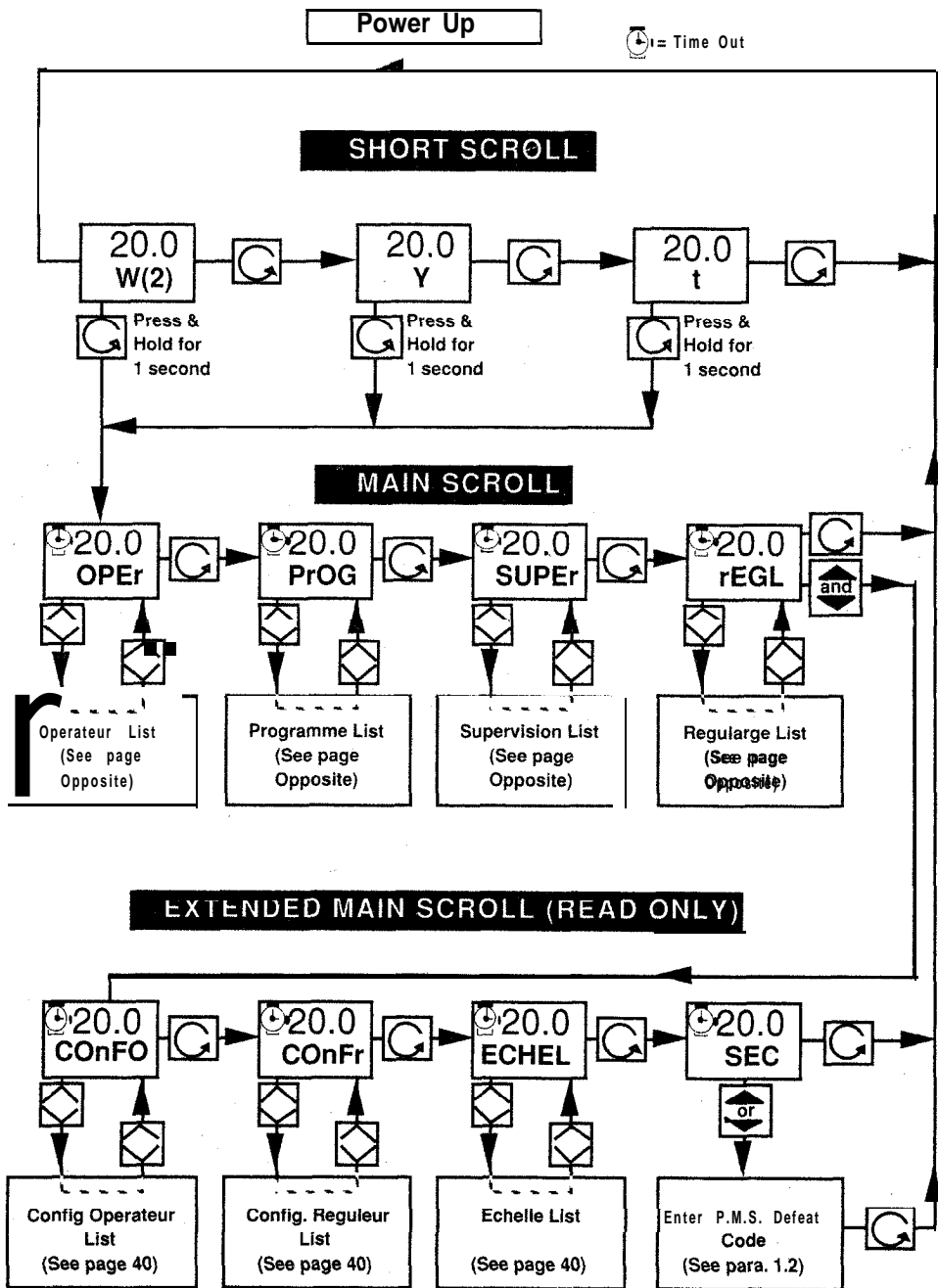
Scroll List Operation

Operation

Operateur List	Programme List	Supervision List	Regularge List
cr SP Ramp Rate	*Pnrl* Prog Number	*AL7* Alarm 1 SP	*Pb* Prop Band
Sr Ramp Output	*Pr1* Prog Ramp 1	*AL2* Alarm 2 SP	ti Integral Time
Fin End Output	Sr 1 Ramp 1 Out.	*rCA* Sensor Brk. P	**rES** Manual Reset
cl SP1	*Pn1* Prog Level 1	*Add* Corns. Address	to' Derivative
c2 SP2	*Pdl* Prog Dwell 1		*Pb2* 2nd Pb
cL Local SP	Sd1 Dwell 1 Output AL1		*ti2* 2nd ti
cE Remote SP			*rS2* 2nd rES
SE Rem. Enable	-		*td2* 2nd td
Ar Self Tune			tt Travel Time
rl Fast ST	*Pr8* Prog Ramp 8		ttu tt up
AA Adaptive Tune	*Sr8* Ramp 8 Out.		ttd tt Down
rA S t & A t	*Pn8* Prog Level 8		ot Min on Time
r2 Fast St & At	*Pd8* Prog Dwell 8		ut Update Time
SA At Trigger SP	*Sd8* Dwell 8 Output		*cbL* Cutback Low
	Pto Loop Count		*cbh* Cutback High
cr	*Ect* Hold Back		*HL* Heat OP Limit
"	*PrF* Loops Rem.		*rt* Rem. OP Limit
	Fin End Output		*Hc* Heat Cycle Tm
			Cr Rel. Cool Gain
	Pnrl		*Cr2* 2nd Cr
	"		CL Cool OP Limit
			Cc Cool Cycle Tm

Config Operateur List	Config Reguleur List	Echelle List
(See Page 40)	(See Page 40)	**(See** Page 40)

H2C 2nd Hc
db Dead Band
PL Pot. Min. Limit
Ph Pot. Max. Limit
ES Emissivity

Pb
"

Note:- All the above Scroll Lists are circular, depressing the Scroll Key when the last parameter is displayed will re-display the first parameter.

Extended Main Scroll Lists

User Config List (English) Config Operateur (French)		instrument Config. List (English) Config Reguleur (French)		Range List (English) Echelle List (French)	
dlG	Digital IP's	C1	Input Type	*dSL*	Dsp Low Lim
PFb	Power F,dback	C2	Channels 1,2	*dSh*	Dsp High Lim
Hbt	Holdback Type	*C3*	Ch 3,4 & Alm.	*SPL*	SP Low Lim
ramp typ	Ramp Type	C4	Control Opt.	*SPh*	SP High Lim
ramp rES	Resolution	C5	Units	*S2L*	SP2 Low Lim
ramp Uni	Ramp Unit	C6	Display	*S2h*	SP2 High Lim
dwel *Uni*	Dwel Units	C7	Digital Corns	*Ah7*	Alarm1 Hyst
		C8	Anal. Corns	*Ah2*	Alarm2 Hyst
↓		C9	Run, Hld, Res	*rrL*	Retran Low
dlG		C10	Remote, Man.	*rrh*	Retran High
"		*Idn*	Module Ident.	*riL*	Remote Low
		S1 *	Config Secur.	*rih*	Remote High
		S2*	PMS Defeat		
				↓	
		↓		*dSL*	
		CI		"	
		"			

(Hbt Para. Values)

nOnE	Holdback Off
dEV	Dev Band HB
HIGH	Dev High HB
LO	Dev Low HB

(ramp **typ Para. Values)**

rPf-rt	Ramp as Rate
t-tgt	Ramp asTime to Target

* = Only available in the Read / Write Configuration Mode

Note:- All the above Scroll Lists are circular, depressing the Scroll Key when the last parameter is displayed will re-display the first parameter.

Section 3 · Commission

Contents   Page

(Continued Over)

Section 3 · Commission (Cont)

Contents   *Page*

1.0   GENERAL

The instrument is despatched   from the factory with "default values" in all of the settable parameters. These values can be overwritten by the method described in section 2 Operating. When the instrument is first installed on a process the parameters mentioned in this section may be adjusted as described below.

2.0   LOOP TUNING

The default values in the Installation Parameter list, in the majority of cases, will give straight line control, ensuring that the measured value remains constant at, rather than oscillating about, the setpoint. Although this may appear to be satisfactory, the response of the measured value to loop disturbances may not be ideal with these default values installed. Loop disturbances occur when the power requirement of the process changes, such as a change in speed of an extruder, an adiabatic reaction in a chemical process or a cold charge placed into a furnace. The values of Installation Parameters that give the ideal,critically damped, control, minimising disturbances and maintaining straight line control vary from loop to loop. To determine these ideal values for any particular loop, it is necessary to carry out a procedure called loop tuning. The default values must then be replaced with the resultant values obtained from this procedure. Users of the 902,3 and 4 controllers have the option of either tuning the loop manually or using the self tune facilities installed within the instrument. These two procedures are described in detail below. Both of these procedures will give the ideal, critically damped, values for the selected setpoint and process conditions. If significant changes are made to the setpoint or the process lag time or mass, then it will be necessary to change the values installed in the Installation Parameters to maintain critical damping. Again this can be performed by retuning the loop manually, initiating the self tune routine, or initiating the adaptive tune routine. Adaptive tuning of a loop will probably be preferred to the other two methods as this is performed with minimal disruption to the normal control of the loop.

3.0   LIMITS AND DEADBAND

The heat and cool limits and heat/cool deadband must be set before either manual, or self tune, is initiated

3.1   Setting Heat/Cool Limits

The heat and cool channels have parameters that set the maximum power delivered to the load. These are "HL" for heat channel and "cL" for cool channel. These are usually only used during the installation period and are then generally set to 100% and -100% respectively. In some instances, for instance if driving a 220volt heater from a 240volt supply the heat limit may be set to 80% to ensure that the heater is not dissipating more than its maximum power.

Commission

3.2 Setting Heat/Cool Dead Band

On instruments fitted with a cool channel a parameter "db" sets the distance between the heat and cool proportional bands. This parameter has a maximum range of $\pm$ 5% of the proportional band.

Proportional Band

Range of Dead Band "db"
($\pm$ **5% of Proportional Band**)

100%

Heat Power

50%

0%

Measured Value

Cool Power

-50%

-100%
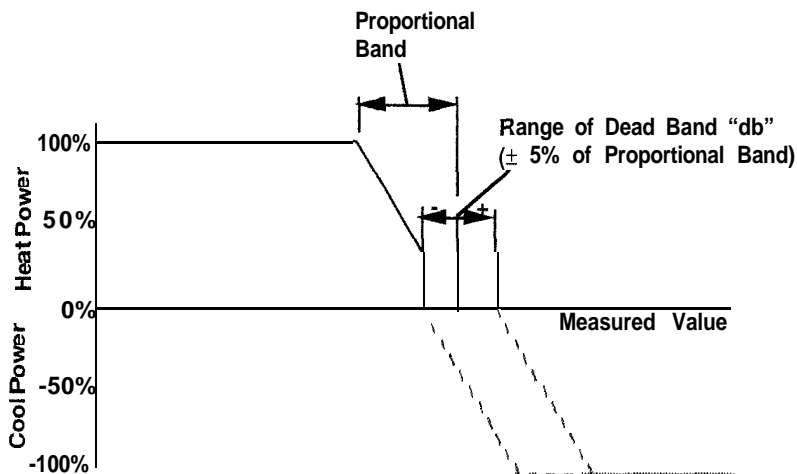
When one or both channels have an analogue output it may be necessary to set a negative value of dead band. If for instance, the output is driving a thyristor unit safety is built into the thyristor driver unit. That is the thyristor unit will give zero output just before the driver signal reaches zero, and will be of the order of 4% of span. To ensure that there is no discontinuity in the controller output the dead band is set to a small negative value to compensate for this 4% zero offset.

Positive values of dead band will be set when it is required to reduce the possibility of both the heat and the cool channels being on together, when the instrument has cycling output stages installed.

4.0 MANUAL TUNING

There are a number of methods of tuning loops manually, but in this booklet only the "Ziegler-Nichols" method will be described .

4.1 Setting Heat/Cool Cycle Time

If either or both of the output channels is fitted with a relay, triac or logic output, parameters will appear in the Installation list which regulate the cycling of these outputs. These parameters must be set correctly before any attempt is made to tune the loop manually. The setting of these values should be the longest time possible without causing the measured value to oscillate beyond the specification of the system. If the controller is placed in the manual mode and the power adjusted to bring the measured value to its normal running level, the heat cycling time parameter "Hc" should be adjusted down from a large value until the variation in measured value is within the specification of the system.

The cool cycle time parameter "Cc" is adjusted in a similar manner.

4.2   Tuning the Loop

Having set the above parameters the controller should be coupled to the finalised process and configured as proportional only. This can be achieved by selecting the parameters "ti", integral time and "td" derivative time and setting them to the off position. The controller set point should be adjusted to the normal running value and the proportional band, parameter "Pb", should be set to a reasonably large value such as 30%. If a cool channel is installed in the controller its output should be disabled during the tuning sequence. Power the loop and observe the measured value, ensuring that this settles at a constant value without oscillations. If oscillations are observed the first setting of the proportional band was not large enough. Once stability of the measured values is observed commence narrowing the proportional band in steps of roughly 70% of its previous value. At each setting observe the measured value ensuring that it is still stable and not oscillating. When an adjustment of the proportional band causes the measured value to break into, and sustain, oscillations, note the setting of the proportional   band(Pb)   and   the   time   of   oscillation(T).

Proportional   Band   Width
Wider   Narrower

Pb

TEMP.

Normal
running
setpoint

T

Measured
Value
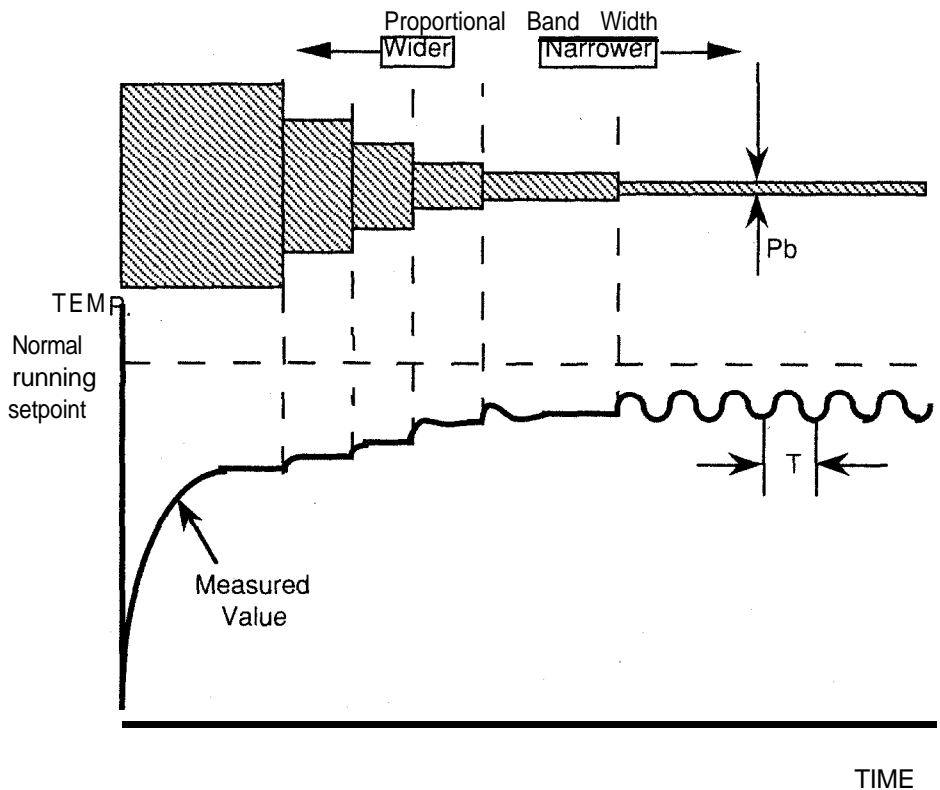
TIME

The value of the proportional band (Pb) where oscillations commenced, and the time of oscillation (T) should be used in the following table to determine the critically damped values for a proportional, proportional+integral or a proportional+integral+derivative control loop.

Final Control Loop Type	Setting of controller parameters for critical damping.		
	Proportional Band (Pb)	Integral Time Constant (Ti)	Derivative Time Constant (Td)
P	2 [Pb (Osc.)]		
P.I.	2.2 [Pb (Osc.)]	0.8T	
P.I.D.	1.67[Pb(Osc.)]	0.5T	0.12T

4.3 Setting the Relative Cool Gain

If the controller is fitted with a cool channel this should be re-enabled before the values of "Pb", "ti" and "td" are updated with the values in the table. Observe the oscillation waveform shape and adjust the relative cool gain, parameter "Cr", until a symmetrical waveform is observed. The values given above should now be installed under the parameters "Pb", "ti" and "td". The loop is now tuned to the critically damped values and is ready to be put into service.
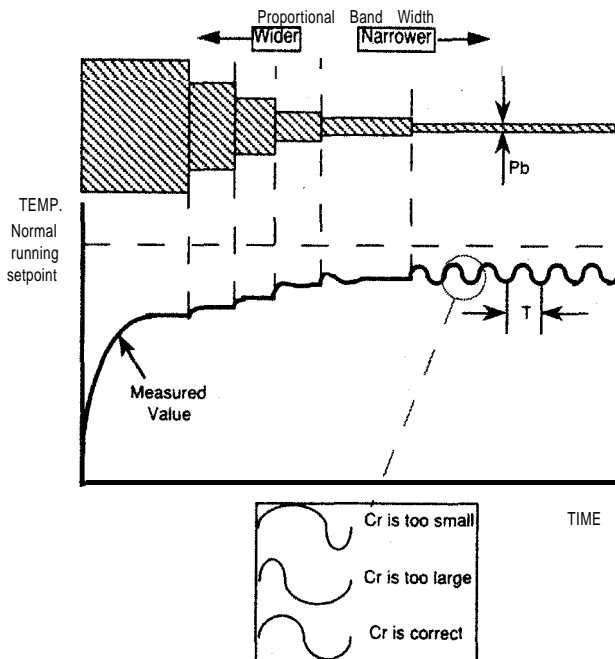
4.4 Setting High and Low Cutback

The parameters for cutback high "cbh" and cutback low "cbL" should both be initially set to one proportional band width, converted into display units. This can be calculated by taking the value in percentage that has been installed into the parameter "Pb" and entering it in the following formula :-

$$\frac{Pb}{100} \times \text{Span of the Instrument} = \text{Cutback High \& Low Value}$$

Overshoot and undershoot can be eliminated by the correct setting of cutback low (cbL) and cutback high (cbh) respectively. If overshoot is observed increase the value of the parameter (cbL) by the value of the overshoot in display units. Similarly if undershoot is observed increase the value of the parameter (cbh) by the value of the undershoot in display units.
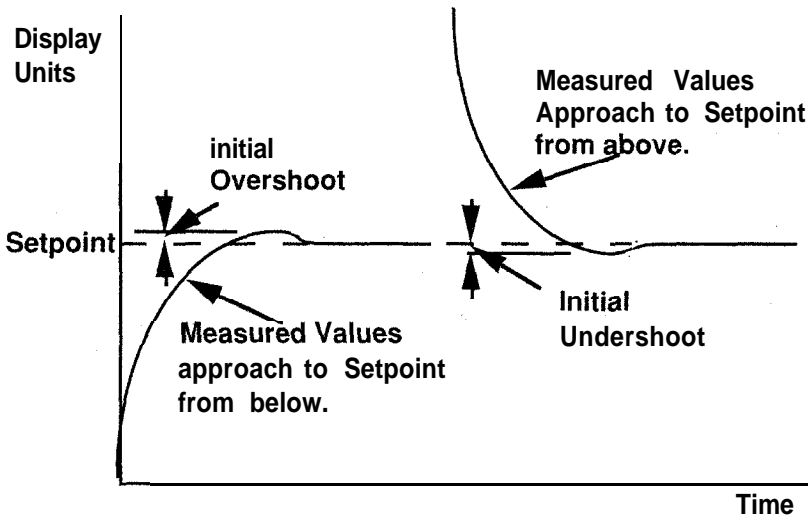
5.0 AUTOMATIC TUNING

Two automatic tuning programmes are installed in this controller, called Self and Adaptive Tune facilities. The self tune facility is primarily designed to be used during this commissioning phase and will overwrite certain default parameters in the installation list. Once the loop is in service the adaptive tune facility will trim the PID values, keeping them at their critically damped values as the set point and process characteristics change. As certain parameters used in the adaptive tune are set during the self tune routine it is essential to run Self Tune before installing Adaptive Tune.

Commission

5.1 Self Tuning

This routine is a single-shot process which will disable itself on completion. Once enabled the instrument exercises its output channels in a prescribed way, observing the effect this has on the measured value.

Display Units

Loop Setpoint

PseudoSetpoint

Instruments with Output 2 fitted

Time

+ 100%

Power 0%

Time

- 100%

Self Tune disabled revert to 3 term control on instruments with only output 1 fitted.

Self Tune disabled revert to 3 term control on instruments with both output 1 & 2 fitted.
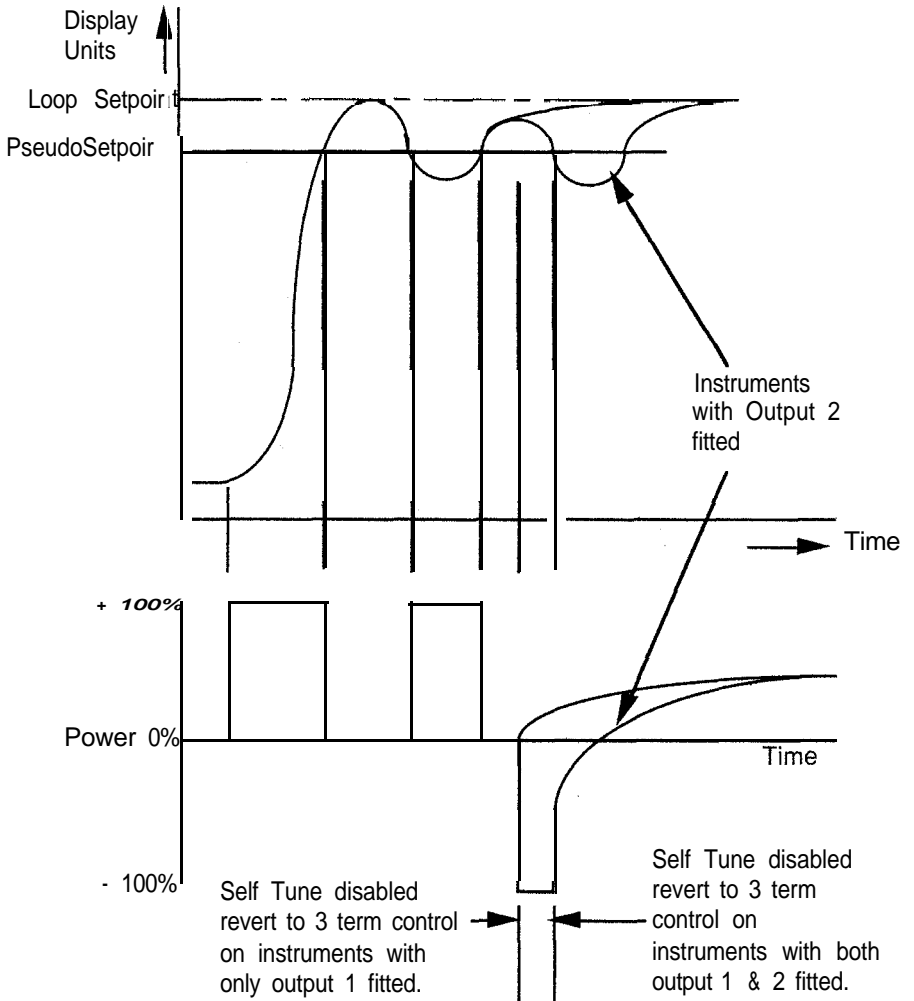
The enabling of this function is described in Section 2, paragraph 4.0. At the completion of this routine the instrument will control at the working setpoint as a one, two or three term controller dependent on the conditions set when the self tune was enabled. After completing this routine the instrument will automatically overwrite the following parameters in the Installation Scroll list :-

Pb, ti, td, cbL*, cbh*, Hc*, Cr* and Cc*.

* cbL only set if,at self tune enable, the measured value was more than 5% of span below the setpoint and the parameter was not set to "off".

* cbh only set if, at self tune enable, the measured value was more than 5% of span above the setpoint and the parameter was not set to "off".

* Hc only set if the instrument is fitted with a relay, logic or a triac output stage in the heat channel.

. Cr only set if the instrument is configured to drive a cool channel,

* Cc only set if the instrument is configured to drive a cool channel and that channel has either a relay, logic or a triac output stage installed.

5.2 **Adaptive Tuning**

As this facility trims the installed PID values in sympathy with setpoint and process changes it is recommended that this feature is enabled permanently. However it may be found on some difficult applications that this facility detunes rather than tunes the loop. In these cases it may be necessary to disable the adaptive tune feature. The operation of the adaptive tune facility is shown in section 2, Operating, paragraph 4.0. This feature will overwrite the parameters Pb, ti and td when a disturbance indicates that they are incorrect.
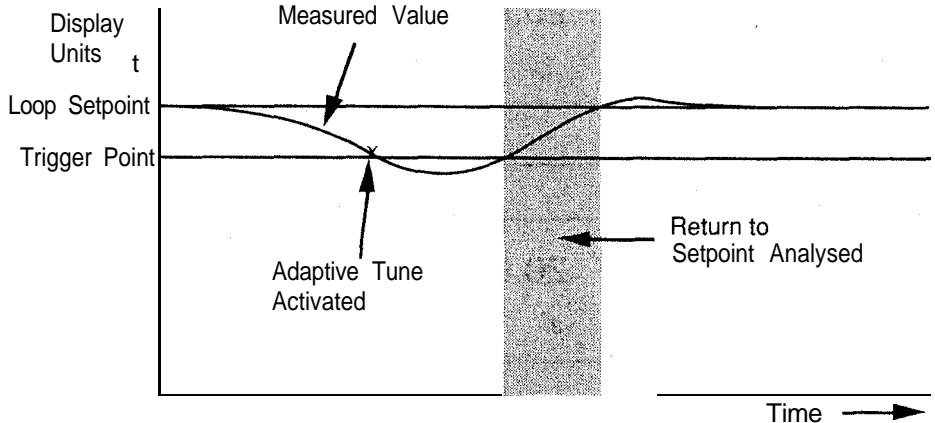
6.0 **SETPOINT RATE LIMIT FUNCTION**

This feature is generally used where the rate of change of measured value under full heating or cooling would be detrimental to the process or the equipment. The ramp rate should be set to the maximum rate of change of the measured value that is permissible. Relays within the controller can be activated whilst the ramp is active and when the ramp has reached a steady state setpoint value. The setting of these relays is also given below.

Commission

6.1 Setting a Setpoint Rate Limit Function

The parameter "SPr" in the Operator Scroll List sets the setpoint rate limit. The value is set in display units per minute or per hour depending on the setting of the configuration. The value of the parameter "Uni Ramp" in the User Configuration indicates whether this ramp rate is in display units per minute or per hour, "LO" indicates that the values are in minutes whilst "HIGH" indicates that the values are in hours.

6.2 Setting a Setpoint Rate Limit Event Output

The instrument configuration determines whether any combination of channels 2, 3 and 4 are active while the setpoint rate limit function is active. If any channel is configured the parameter "Or" will appear in the Operator Scroll List. The value of this parameter is numerals spaced by hyphens. The numerals are channel numbers and the presence of the numeral indicates that that channel's output is energised when setpoint rate limit is active. The condition of the output during the setpoint rate limit can be changed by using the "up" and "down" keys whilst viewing the channel number display.
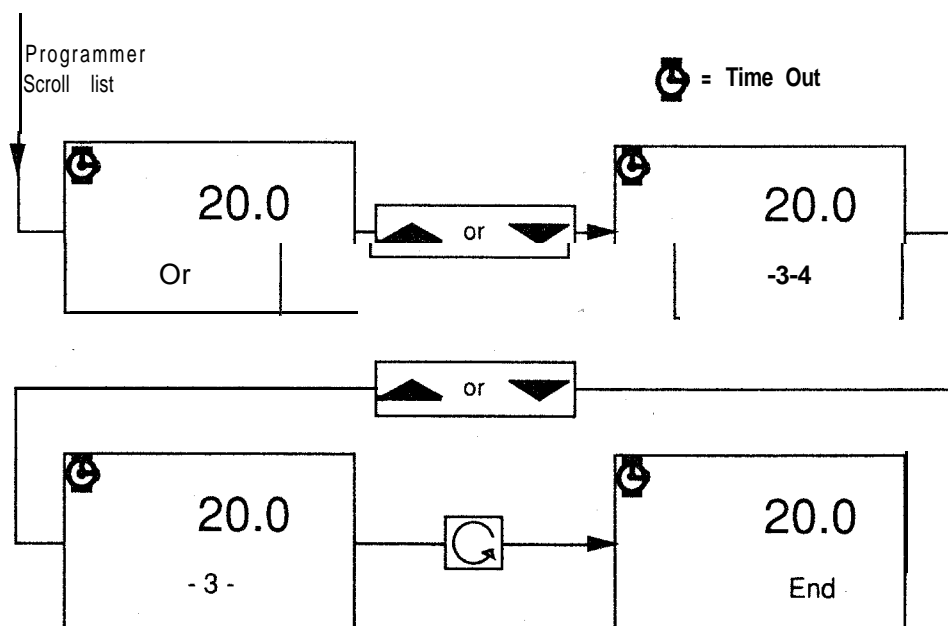
6.3 Setting an End Event Output

Whatever channels have been designated to be driven during the setpoint rate limit can also be set when the setpoint has reached steady state value. These are set under the parameter "End" also to be found in the Operator Scroll List. Again the display under this parameter indicates channel numbers which can be changed using the "up" and "down" keys.

7.0   ENTERING A PROGRAMME

All models except the 9025 are fitted with the programmer feature. This may however have been disabled in the configuration in which case it will be necessary to enter this mode to re-enable this feature. Model 902P contains one programme whilst 903P and 904P contain a maximum of four and fifteen programmes respectively. On the multi-programme version only one programme may be run at any one time but any number of programmes, up to the maximum for the controller, can be entered and stored.

7.1   Selecting a Programme

On the multi-programme models a parameter "Pnr" sets the programme number. The value of "Pnr" should therefore be set to the programme number to be entered as shown in section 2.0, Operating, paragraph 3.4. Entering a programme is not possible whilst another programme is running.

7.2   Setting a Ramp Rate

Parameters "Prl -8", set the values of ramps 1 - 8, the ramps being performed in this sequence when the programme is run. The values set under these parameters may be a time in minutes or hours or a ramp rate in display units per minute or per hour. Which of these options applies to a specific controller is determined by the user configuration setting as shown below :-

Programmer Ramp Parameters in the User Configuration

tyP Ramp	Ramps set as Rates	rP-rt
tyP Ramp	Ramps set as time	t-t9t
Uni Ramp	Minutes	LO
Uni Ramp	Hours	HIGH
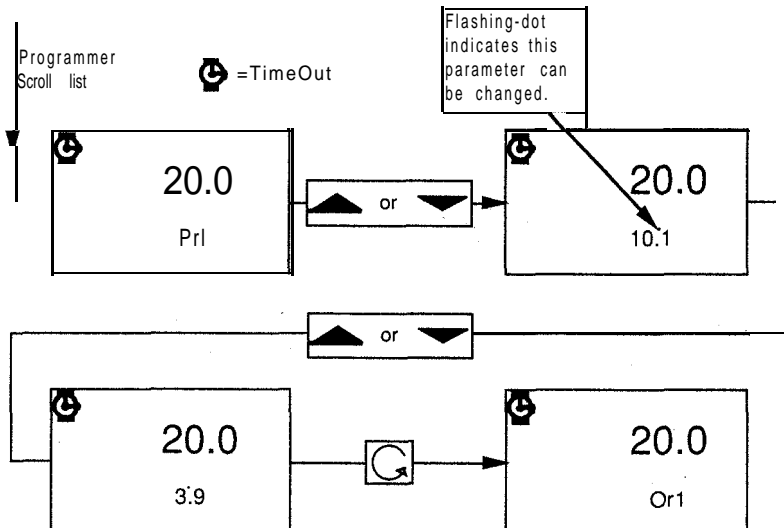
Some applications require instantaneous changes to the setpoint, in certain parts of the programme, instead of a ramp. This can be achieved instead of setting a ramp under parameters "Prl-8" by keeping the down key depressed after the smallest value is displayed in which case "StEP" is displayed. This will cause the programmer set point to instantaneously jump from the level in the previous segment to the level in the next segment.

7.3 Setting a Ramp Event Output

The instrument configuration determines whether any combination of channels 2, 3 and 4 outputs are active during a ramp segment. If any channel is configured the parameter "Or1 -8" will appear in the Operator Scroll List. These parameters represent the state of the outputs during ramps l-8 respectively. The value of this parameter is numerals spaced by hyphens. The numerals are channel numbers and the presence of the numeral indicates that that channel's output is energised during that particular ramp. The condition of the output during a ramp can be changed by using the "up" and "down" keys whilst viewing the channel number display.
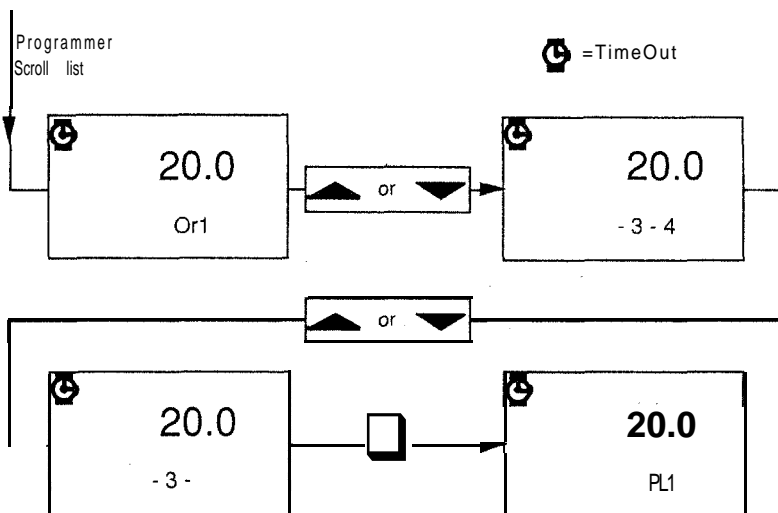
7.4 Setting a Dwell Segment

Parameters "PL1-8" set the level, in display units, at which a dwell segment is to be performed. These dwells are performed in sequence 1 being the first and 8 being the last. The time that the set point remains at any of the eight levels is determined by parameters "Pd1-8", these referring to levels "PL1-8". The values of "Pdl-8" are either in minutes or hours determined by the setting of the configuration. If "Uni dwell" in the user configuration "UCOnF" is set to "LO" the times are in minutes. If, however, this parameter is set to "HIGH" then the time is in hours.

Setting the Level

Programmer
Scroll list

 = Time Out

Flashing dot
indicates this
parameter can
be changed.

20.0

PL1

or

20.0

261.5

or

20.0

193.2

20.0

Pd1

Setting the Time

Programmer
Scroll list

Flashing dot
indicates this
parameter can
be changed.

20.0

Pd1

or

20.0

15.9

or

20.0

13.6

20.0

Od1
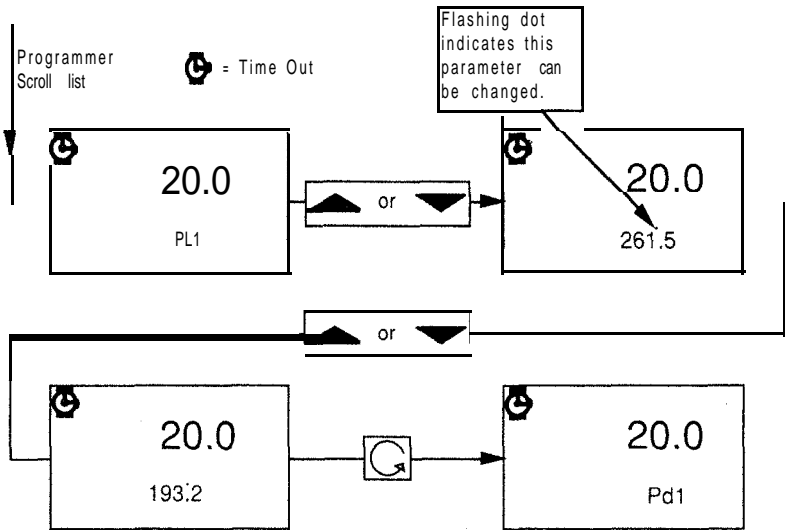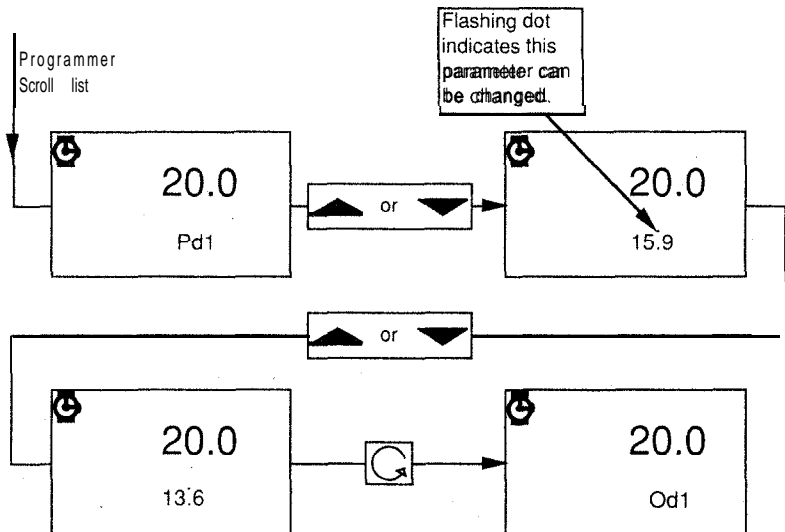
7.5 **Setting a Dwell Event Output**

The instrument configuration determines whether any combination of channels 2, 3 and 4 outputs are active during a dwell segment. If any channel is driven by this mode the parameter "Odl-8" will appear in the Operator Scroll List. These parameters represent the state of the outputs during dwells i-8 respectively. The value of this parameter is numerals spaced by hyphens. The numerals are channel numbers and the presence of the numeral indicates that that channel's output is energised during that particular dwell. The condition of the outputs during a dwell can be changed by using the "up" and "down" keys whilst viewing the channel number display.

Commission

Programmer Scroll list

 = Time Out
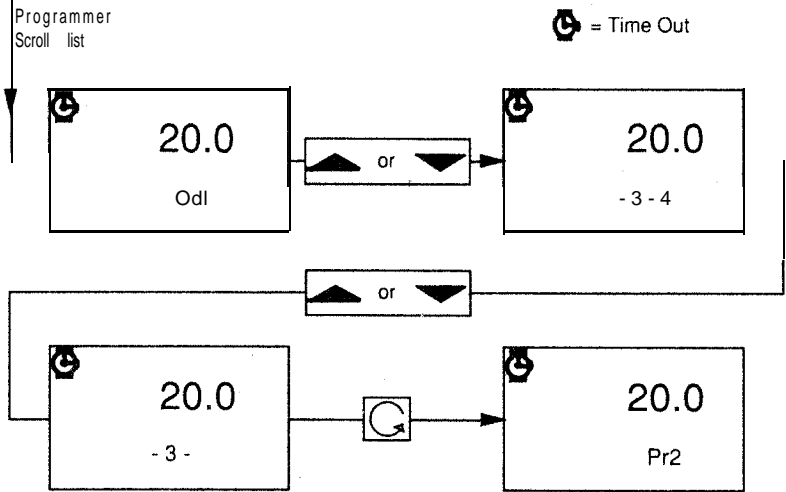
7.6   Ramp-Ramp or Dwell-Dwell Programmes

The programme sequence of this controller is Ramp · Dwell - Ramp-Dwell etc. Programmes that do not conform to this convention can be entered i.e. Ramp - Ramp - Dwell etc. or Dwell · Dwell - Ramp etc. These are accomplished by

Flashing dot indicates this parameter can be changed.

Programmer Scroll list   = Time Out
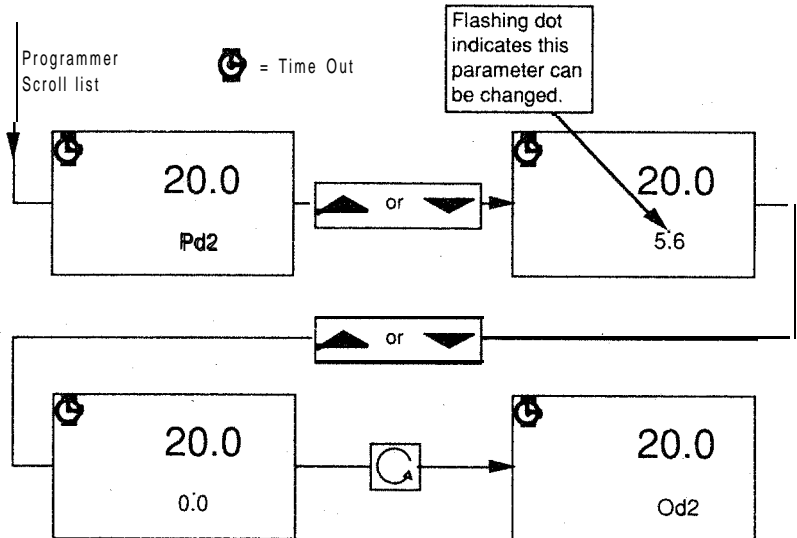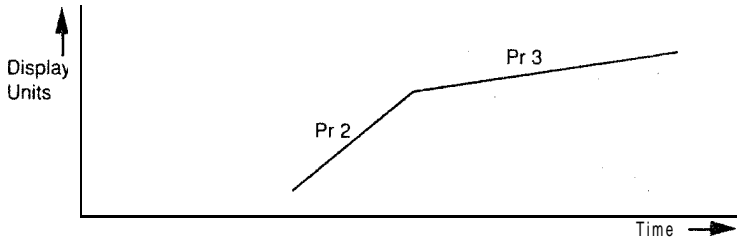
setting the intermediate segment to either "None" for a Ramp or "0.0" for a Dwell, which will remove that segment from the programme. When setting "Pr 1-8", if the "down" key is kept depressed after the lowest numerical value is displayed, the value "None" will be displayed; this removes that segment from the programme. Setting any of the parameters "Pd l-8" to a value of "0.0" will remove that segment from the programme.

7.7 Ending a Programme

It is quite possible that the required programme is not 16 segments long. Programmes that are less than 16 segments long can be entered by setting the segment after the last desired one, either a ramp "Prl -8" or a dwell "Pd1-8", to "End". All parameters after the one that is set to "End" will now disappear from the scroll list.
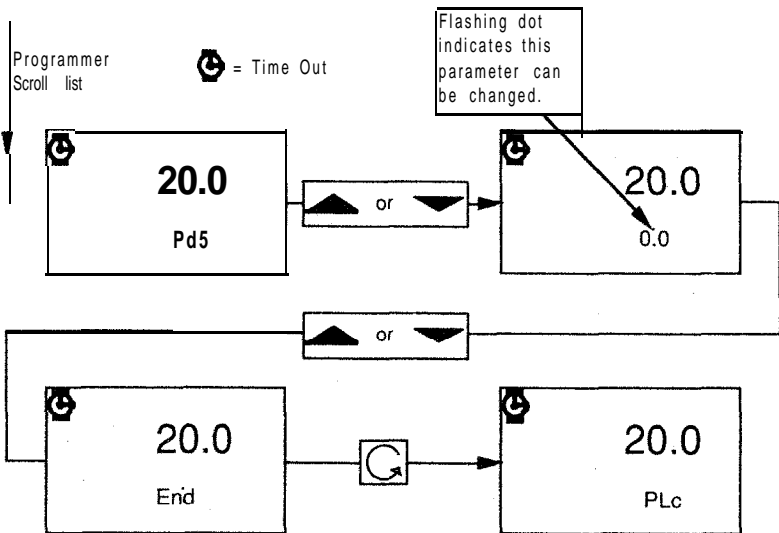
7.8 Setting an End Event Output

If any output stages in the controller have been configured to be driven by segments of the programme, see paragraph 7.3 above, then they can be set to any desired state during the end condition. This is set under the parameter "End" in the programmer scroll list and its value is identical to that shown in paragraph 7.3 above and can be changed as described in that paragraph.

7.9 Setting Loop Count

Any entered programme can be repeated a number of times when running. The parameter "Plc" sets the number of times that a programme is repeated. The value of the parameter "Plc" must be set, if it is not desired to repeat a programme a value of "1" should be entered.

Commission

7.10   Linking Programmes

For multi-programmers, consecutive programmes may be linked, producing programmes of 32, 48, 64 etc. segments. Setting the Loop Count in any programme to "COnt" will automatically link that programme to the next highest numbered programme. The value of the loop count in the last of a number of linked programmes set the number of repeats of the whole linked programme. If the loop count of programme 4 on a 903P (15 on a 904P) is set to "COnt", this programme will be linked to programme 1.

7.11   Setting Holdback

The holdback feature, if required, is set in the instrument user configuration "UCOnF" under the parameter Holdback Type "Hbt". The value of this parameter is explained in the following table:-

Parameters to set Holdback Type found in the User Configuration

nOnE	No holdback
dEV	Deviation band holdback
H I G H	High deviation holdback
LO	Low deviation holdback

If this parameter is set to any value other than "nOnE" then "Hb" will appear in the Programmer Scroll List. The value of this parameter is the deviation of the measured value from the programmer profile, in display units, that is allowed before the programme is placed into holdback. Any value between the display span limits can be set. If the down key is kept depressed when viewing a 1 as the least significant digit "OFF" will be displayed. This has removed the holdback feature from this particular programme.
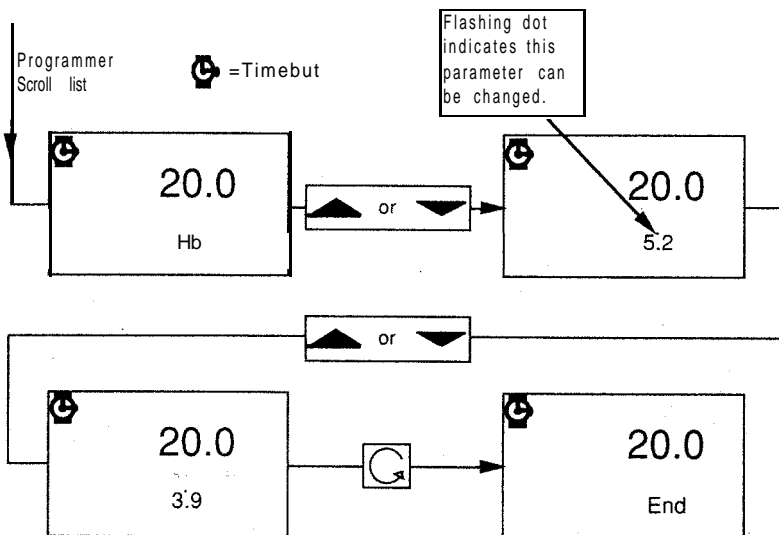
8.0   OPTICAL PYROMETER INPUTS

If the instrument has been configured for use with an optical pyrometer the value of character C and D of parameter "Cl " in the instrument configuration "ICOnF" will be 18, 19, 21, 22, 23, 24, 26, 27, 28, 29 or 30. Configuration of the instrument for this type of input will cause the parameter "ES" to appear in the Installation Scroll List. This parameter must be set to the emissivity of the object being viewed by the pyrometer.

8.1   Setting Emissivity

The value of the emissivity of the object being viewed by the pyrometer can be found in the literature supplied with the pyrometer. This value must then be entered under the parameter "ES".
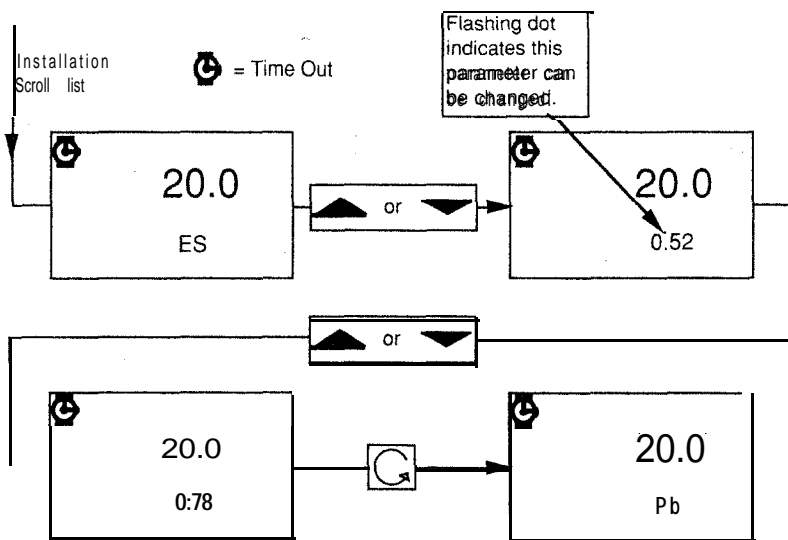
9.0 SENSOR BREAK POWER

Sensor break power is the default power to be requested when a process variable sensor break condition is detected. This could be a sensor going open circuit, over range or under range. During a sensor break condition, the main display will be replaced with a flashing indication; "Or".

Note: For high level inputs, inputs with current burden resistors and certain RT faults, sensor break may not be detected.

9.1 Setting the Sensor Break Power

The value entered under the parameter "Sbr" in the Supervisor Scroll list, (SUPEr), is the power delivered to the load under sensor break conditions. Scroll to this parameter and enter the value of power required.

For PID control, the sensor break power may be set to any value between 0 and the heat output limit (HL), (or the cool output limit (CL) and the heat output limit (HL) for heat/cool instruments).

For On/Off control, the sensor break power may only be set to 0 or 1 00%, (-100, 0 and +I00% for heat/cool instruments).

For motorised valve position control, sensor break power is limited to 0 or 100. A setting of "0" will cause the valve to close when sensor break is detected. A setting of "100" will cause the valve to open.
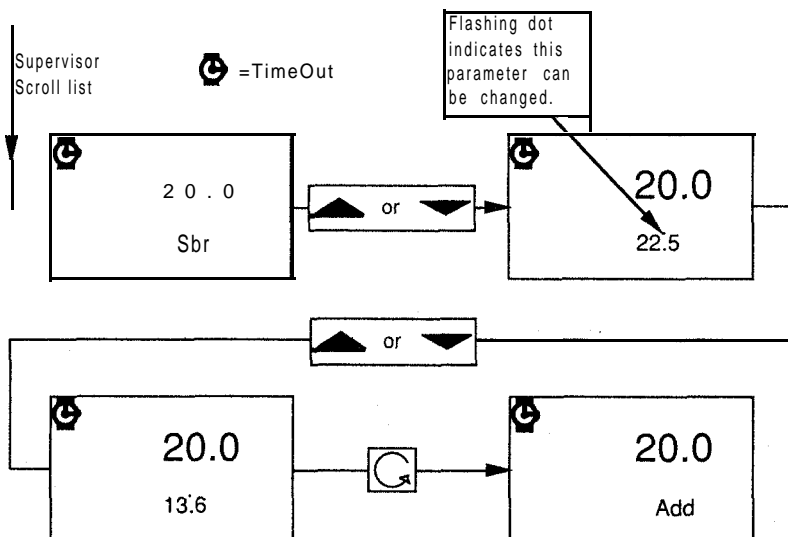
10. 0 DIGITAL COMMUNICATIONS

If the digital communications port is to be used on this instrument, with either the RS 232 or RS 422 standard then a value must be entered under the address parameter "Add" in the Supervisor Scroll List. This address must agree with the value written into the supervisory software for that particular control loop.

10.1 Setting the Address

The value of the address is entered under the parameter "Add" as a two digit number ranging from 00 to 99.
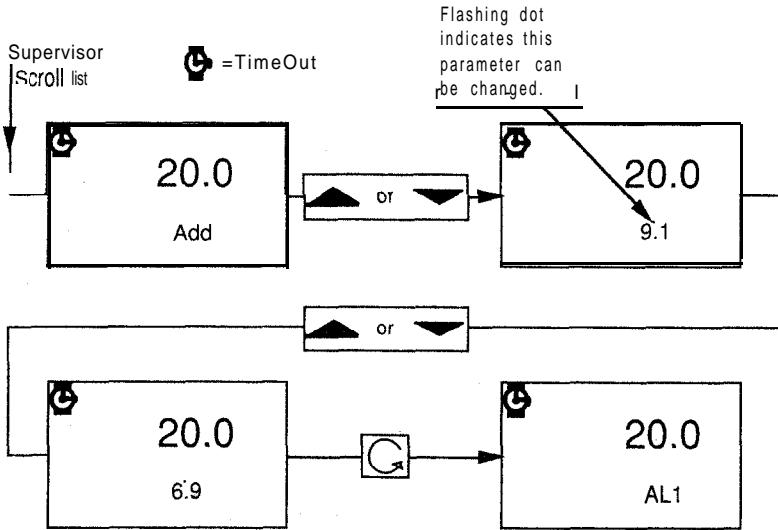
Commission

11.0 MOTOR VALVE POSITION CONTROL

Valve Position control uses the standard PID algorithm, modified by dedicated VP output drivers. Power feedback is not available. The VP may operate with either symetric or asymetric valve travel times. Provision is also made for a valve position indication and limiting, using feedback from a potentiometer fitted to the valve.

In VP mode, Channels 1 and 2 are used as "raise" and "lower" control outputs. The actual function of each channel is set at configuration.

The following additional parameters may be included in the Installation Scroll list, (InSt), (dependent on configuration).

tt	Travel time	seconds
ttU	Travel time up	seconds
ttd	Travel time down	seconds
ot	Minimum on time	seconds
ut	Valve update time	seconds
PL	Valve position minimum limit	% of calibrated travel
Ph	Valve position maximum limit	% of calibrated travel

NOTE: In manual, or if a position input break is detected, position limits are ignored.

11.1 Travel Time

Travel time "tt" is the time the valve takes to travel from open to closed. Where the travel time to open the valve is significantly different to the time taken to close the valve, an asymetrical configuration is possible. In this case two parameters travel time up "ttu" and travel time down "ttd" are available. Values between 5.0 and 999.9 seconds may be entered.

From
Instrument
S c ll ist

⏰ = **Time Out**

Flashing dot **1**
indicates this
parameter can
be changed.

⏰ 20.0
tt

⬆ **or** ⬇

⏰ 20.0
5.0

⬆ **or** ⬇

⏰ 20.0
25.0

↻

⏰ 20.0
ot
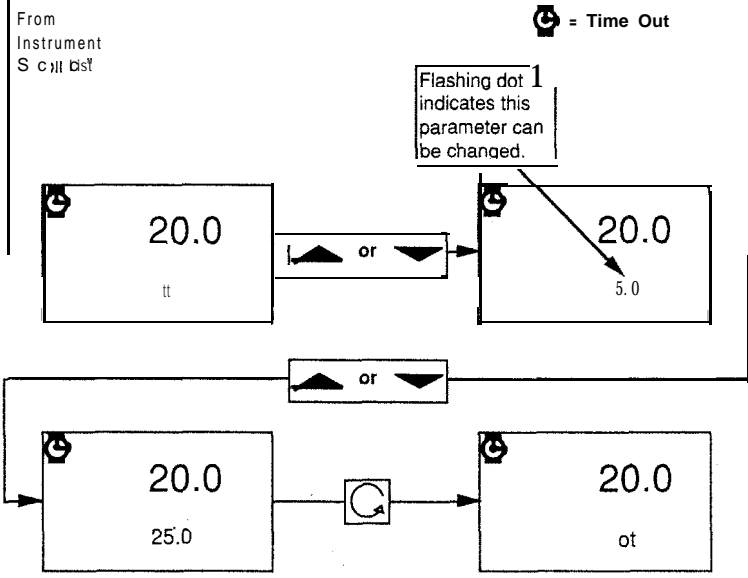
11.2   Minimum On Time

The parameter, "ot", is set to allow for inertia in the motorised valve. The value defines the minimum "raise" or "lower" output pulse duration from the controller, which should be slightly greater than the minimum response time of the valve mechanism.

Values between 0.1 second to 10% of travel time may be entered.

From
Instrument
Scroll List

⏰ = Time **Out**

Flashing dot
indicates   this
parameter can
be changed.

⏰ 20.0
ot

⬆ **or** ⬇

⏰ 20.0
0.1

⬆ **or** ⬇

⏰ 20.0
1.7

↻

⏰ 20.0
Ut
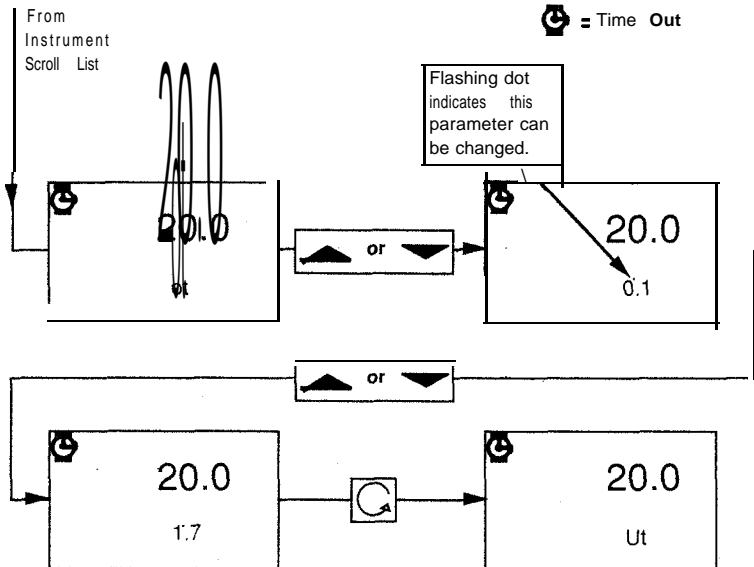
Commission

Commission

11.3 Valve Update Time

The parameter, "Ut", is set to minimise the amount of valve activity. The value defines the interval at which the required output is recalculated. Setting larger values reduces valve activity, but gives less stable control.

Values between 0.1 second to travel time may be entered.
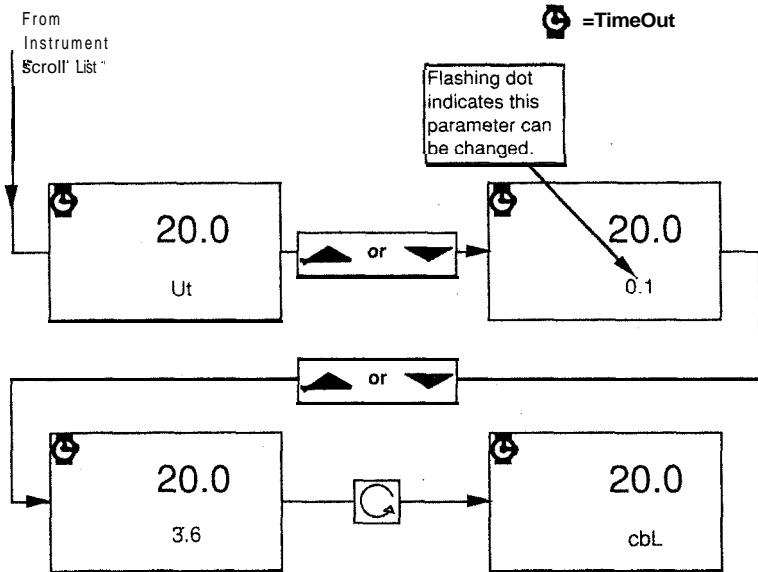
11.4 Valve Position Limits

If a valve position input is configured, position limits may be set and are active in self tune and auto mode.

Values between 0 and 100% of the calibrated position range may be entered.

NOTE: In manual, or if a position input break is detected, position limits are ignored.

Section 4 -Configure

1.0   GENERAL

The 902/3/4 instruments can easily be configured to most users' requirements on site. Changing the configuration will involve altering the software and may also involve hardware changes. The instrument is always fitted with a power supply PCB, a microprocessor PCB and a display PCB. To facilitate a large number of options a further two mutually exclusive options PCB's may be installed. The power supply PCB has sites for two modules, these being Channel 1 (Heat/Process +) output stage and Channel 2 (Cool/Process-) output stage. In the options position may be installed either an analogue communications board, giving one analogue input and one analogue output plus sites for channel 3 and 4 modules or an options PCB which just carries sites for Channel 3 and 4 modules. Figure 1 shows an illustration of this arrangement.

Channel 1
Channel 3
Channel 2
Channel 4

Figure 1.

Configure
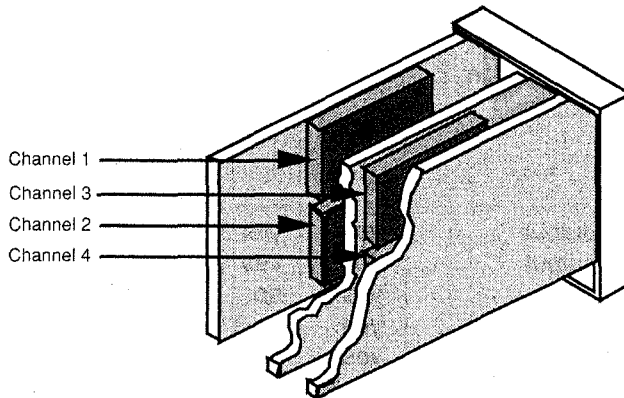
2.0   HARDWARE VARIANTS

There are a number of different modules available which can be plugged into the various module sites within the controller. Limitations apply to the position of a module in a particular site. The table below gives the permissible modules in each site.

Changes to the instrument software that alters the display units will require the installation of a new label on the top right hand corner of the bezel. A full set of these self adhesive labels is supplied within the accessory kit of new instruments. Further sets of these labels, part no. SUB 902 SPARE LABEL SET, are available if required.

Configure

Module Function	Channel Number			
	1	2	3	4
Heat output	yes	no	no	no
Cool output	no	yes	no	no
Alarm 1	no	yes	yes	no
Alarm 2	no	no	no	yes
Programmer relay	no	yes	yes	yes
Comms controlled relay	no	yes	yes	yes
Remote input	no	yes	no	Yes
Retrans output	yes	yes	yes	no
VP lower	yes	yes	no	no
VP raise	yes	yes	no	no

There are also limitations on the type of modules allowed to perform certain functions. A list of these permissible functions is given below :-

Module Function	Module Type					
	Relay	Triac	Logic	DC Control	DC Retran	DC Input
Heat output	yes	**yes**	yes	yes	no	no
Cool output	yes	**yes**	yes	yes	no	no
Alarm 1	yes	no	yes	no	no	no
Alarm 2	yes	no	yes	no	no	no
Programmer relay	yes	no	yes	no	no	no
Comms cont relay	yes	no	yes	no	no	no
Remote input	no	no	no	no	no	yes
Retrans output	no	no	no	no	yes	no
VP lower	yes	yes	no	no	no	no
VP raise	yes	yes	no	no	no	no

Any alteration that is to be made to the controller hardware sh ould be arried out using the above mandatory tables before attempting to make any'alterations to the software configuration.

User settable links will be found on certain modules and the analogue communications options board. The setting of these links should be as follows:-

1) Links found on the relay module connect the snubber network, resistor and capacitor in series, across either the normally open "NO" or normally closed "NC" relay contacts. Set this link to the contacts drawing the largest current.

2) Remote input modules and analogue communications options boards are fitted with links designated "X1"and "XI 0". "X1'sets the maximum input range to O-10 volts whilst the "X10" sets the maximum input range to O-1 volt. For current inputs set this link to "X10".

3) Retransmission/control output modules and analogue communications options boards are each fitted with two links, each designated "V" and "I". Placing both links into the "V" position gives a voltage output whilst both links placed into the "I" position gives a current output.

3.0 USER CONFIGURATION

Paramaters most likely to require amendment by the customer are located in the user configuration. To make changes to these parameters it is necessary to enter the read/write mode of the user configuration.

3.1 Access to User Configuration

To enter the User Configuration, switch off power to the instrument, depress in the SELECT/TURBO and the RUN/HOLD keys and then switch on power to the instrument. The instrument display will show "COnF" as illustrated below.
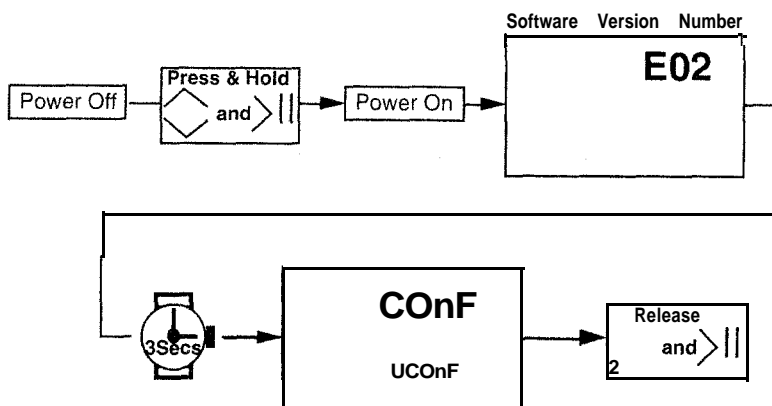
The User Configuration list is entered by depressing the SELECT/TURBO key as shown below.
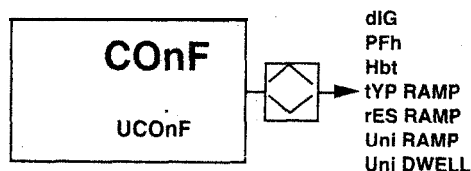
Configure

The various parameters in the user configuration are then scrolled by depressing the SCROLL key. individual parameters in the scroll list can be viewed and changed using either the UP or DOWN key, as shown below.
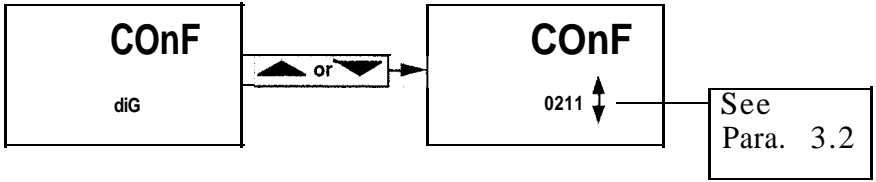
Depressing the SCROLL key will return the instrument to the user configuration scroll list, displaying the next parameter in the list, as shown in below.
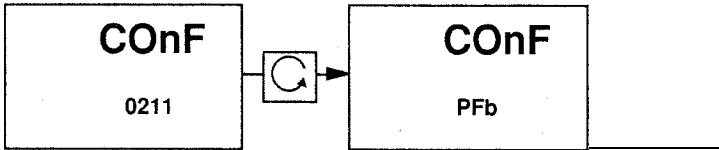
3.2 Key Handling in the Configuration Mode

The key handling in the read /write configuration mode is very similar to the operating mode except when adjusting the code numbers of "diG", "CI", "C2", "C3", **"C4", "**C5", **"C6",** "C7", "C8", "C9" and "CI 0". After selecting the desired mnemonic using the procedure outlined in Figure 4, the first depression of either the "UP" or the "DOWN" key will cause the extreme right hand digit to flash. Each further depression of the "UP" or "DOWN" key will increment or decrement that digit by a value of one. If other digits in the display are also to be changed, these can be selected by depressions of the "SELECT/TURBO" key. This procedure is illustrated below.
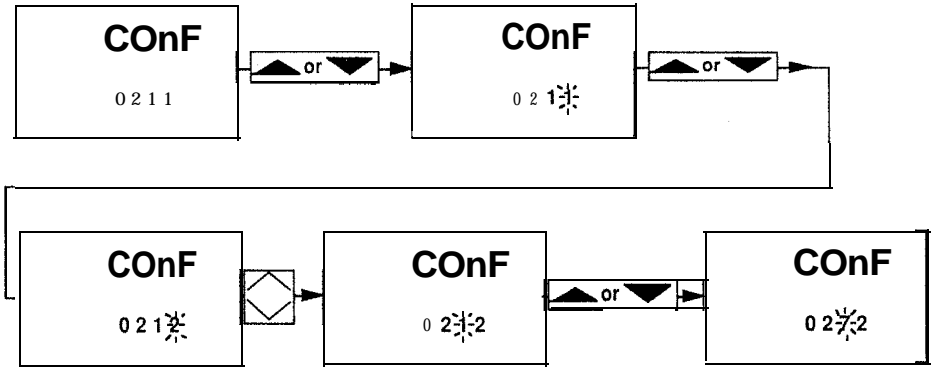
3.3 1Jser Configuration Parameters

A listing of the mnemonics with a description of their function is given in the table below :-

PARAMETER	DESCRIPTION	UNITS
dlG	Digital Input Functions	Code Number.
PFb	Power Feedback	On or Off.
Hbt	Holdback	None, DVL, DVH or DVB.
tyP Ramp	Programme Ramp Type	Ramp Rate or Time to Target.
rES Ramp	Programme Ramp Resolution	Normal or High.
Uni Ramp	Programme Ramp Units	Display Units/Min or Hour (Minutes/Hours -Time to Target).
Uni Dwell	Programme Dwell Units	Minutes or Hours.

The code number used for the first parameter "diG" is shown below in tabular form. The code consists of four digits, the extreme left hand digit being referred to as A in the table, the next B, the next C and finally D.

Configure

Configure

3.3.1 diG inputs diG = (ABCD)
(See Operation 8.0 for function explanation.)

Code

A   Unused

Code   Digital Input 1

B =0   None
   =1   Manual
   =2   Remote
   =3   Setpoint 2
   =4   PID 2
   =5   Adaptive tune
   =6   Run
   =7   Run/Hold
   =8   Programme number monitor/step
           (Digital input 1 = down key   )
   =9   (Digital input 2 = up key   )[C and D are ignored]
           (Digital input 3 = select/turbo key)

Code   Digital Input 2

C =0   None
   =1   Manual
   =2   Remote
   =3   Setpoint 2
   =4   Disable "PMS" *
   =5   Self tune
   =6   Hold
   =7   Hold/run
   =8   Skip current segment
   =9   Keylock

Code   Digital Input 3

D =o   None
   =1   Manual
   =2   Remote
   =3   Disables broadcast on digital comms.
   =4   PID 2
   =5   Adaptive tune
   =6   Self tune
   =7   Reset
   =8   Disable "PMS" *
   =9   Disables keylock and digital input inhibit set via digital
           comms.

* "PMS" = Parameter Modification Security

3.3.2   Holdback

The holdback mnemonic "Hb" has a number of values which are given in the
table below together with an explanation of their meaning.

MNEMONIC	DESCRIPTION
nOnE	No holdback
dEV	Deviation band holdback
HIGH	High deviation holdback
LO	Low deviation holdback

3.3.3   Programme and Ramp Parameters

An explanation of the other mnemonics used in the user configuration list is
given in the table below:-

MNEMONIC	VALUE	MEANING	
tyP Ramp	rP-rt	Ramps set as Rates	
tyP Ramp	t-tgt	Ramps set as time to target	
rES Ramp	LO	Ramp Resolution as M.V.	⌉ rES Ramp
rES Ramp	HIGH	Ramp Resolution as M.V. x 0.1	⌋ **=LO** for t-tgt
Uni Ramp	LO	Minutes	
Uni Ramp	HIGH	Hours	
Uni Dwell	LO	Minutes	
Uni Dwell	HIGH	Hours	

3.4.   Exit from User Configuration

The method of exiting the user configuration level, is shown graphically below:-
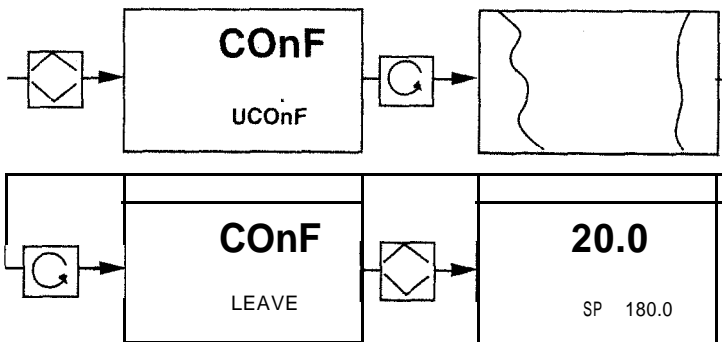
Configure

4.0. INSTRUMENT CONFIGURATION

This mode of operation contains the software that determines the basic operation of the instrument. It is very unlikely that the user will need to enter this level but if this becomes necessary the procedure outlined in paragraph 4.1 of this section should be followed.

4.1. Access to Instrument Configuration

To enter this mode of operation it is firstly necessary to carry out the procedure to enter the user configuration as described in paragraph 3.1 of this section. A security code now has to be entered to gain entry to the desired level. The procedure for entering this code is shown below using the (A) key actions.
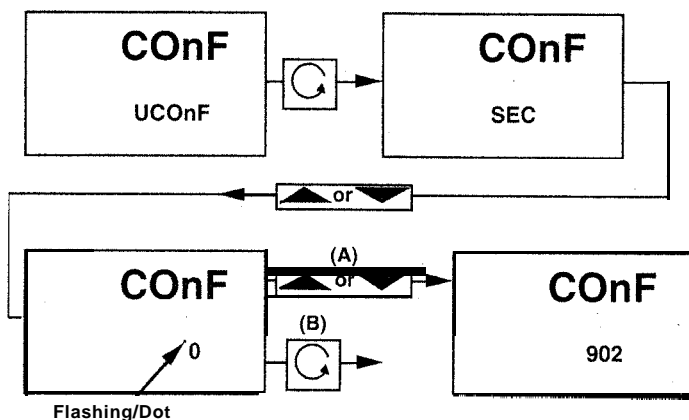
When the instrument is despatched from the factory this code is set at "0". To enter configuration use key action (B). The user can enter his own unique code under the mnemonic **"S1"** in the instrument configuration (see section 6.0). Having entered the correct code access to the instrument configuration is achieved by using the key handling technique shown below.

8
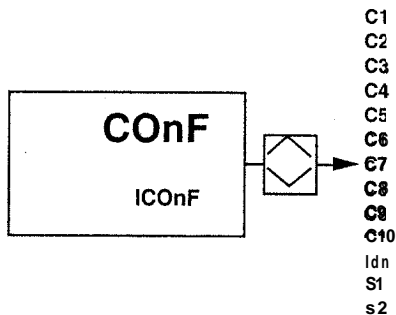
4.2. instrument Configuration Parameters

Mnemonics "Cl to C10", which are all code numbers, are initially displayed in this level. Each code consists of four numerals which are referred to in the following descriptions as A, B, C and D. Character A being the extreme left hand numeral in the display and character D being the extreme right hand one. To change any of these characters use the technique described in paragraph 3.2 of this section.   Below are given tables which decipher each of these codes :-

4.2.1. Cl INPUT (CI ⬛ ABCD)

Code   CJC Type

A   = 0 Internal CJC
         = 1 External 0°C
         = 2 External 45°C
         = 3 External 50°C

Code   Mains Noise Rejection

B   = 0 50Hz + 2Hz (60Hz ± .3Hz)
         = 1 60Hz ± 2Hz

Configure

Code   Input Type

Description	Type	El Code	Range °C		
CD = 00 NiCr/NiAl	K	03	-270	1372	
(Default IP)					
= 01 Fe/CuNi	J	01	-210	1200	
= 02 Fe/CuNi	L	02	-270	900	
= 03 NiCr/NiAl	K	03	-270	1372	
= 04 Cu/CuNi	T	04	-270	400	
= 05 Pt/PtRh13%	R	05	-50	1767	
= 06 Pt/PtRh10%	S	06	-50	1767	
= 07 PtRh6%/PtRh30%	B	08	40	1820	
= 08 NiCr/CuNi	E	12	-270	1000	
= 09 PtRh1 0%/PtRh40%		23	0	1800	
= 10 WRe5%/WRe26%	C	24& 11	0	2500	
= 11 PtRh20%/PtRh40%		25	0	1880	
= 12 Platinel II		28	-100	1370	
= 13 W/WRe26%	G2	29 & 09	0	2320	
= 14 NiCo 0.8%/NiMo18%		33	0	1500	
= 15 WRe 3%/WRe25%		35	-30	2410	
= 16 WRe 5%WRe26%		38	0	2000	
= 17 Nicrosil/Nisil		45	-270	1300	
= 18 Q004		4%	700	1600	500Ω load
= 19 Q003		51	600	1500	500Ω load
= 23 R 026/ORK 35-2-3		54	0	500	Use CJC
= 21 IVD1		61	500	2500	HL i/p
= 22 DT1		62	750	2500	HL i/p
= 23 R 023		64	700	1700	
=24 100 Ω Pt RT		70	-200	1000	
= 25 FP 10/GP 10		82	450	900	HL i/p
=26 FP 11/GP 11		83	600	1300	HL i/p
= 27 FP 12/GP 12		84	750	1850	HL i/p
= 28 FP 20/GP 20		85	300	750	HL i/p
= 29 FP 21/GP 21		86	500	1100	HL i/p
= 30 Square root		92	-9999	19999	
= 31 Square root 20% offset		32	-9999	19999	
=32 +10 to-10mV		00	-9999	19999	
= 33 10mV		00	-9999	19999	
= 34 20mV		00	-9999	19999	
= 35 100mV		00	-9999	19999	
= 36 10V		00	-9999	19999	
= 37 1 0mV 20% offset		00	-9999	19999	
= 38 20mV 20% offset		00	-9999	19999	
= 39 1 00m\20% offset		00	9999	19999	
= 40 1 OV 20% offset		00	-9999	19999	

4.2.2. C2 CHANNEL 1 and 2 (C2 = ABCD)

Code		Channel Relationship
A	=o	Channel 1 and 2 separate
	= 1	Channel 2 = Channel 1 [C2(D) is ignored]

Code		Channel Sense for PID Control
B	=0	Channel 1 normal, Channel 2 normal
	= 1	Channel 1 normal, Channel 2 inverted
	= 2	Channel 1 inverted, Channel 2 normal
	= 3	Channel 1 inverted, Channel 2 inverted

Code		Channel Sense for VP Control [Only applicable when C2(C)=4]
B	=0	Channel 1 raise, Channel 2 lower
	= 3	Channel 1 lower, Channel 2 raise
	= 4	Channel 1 raise, Channel 2 lower) Asymmetric
	= 5	Channel 1 lower, Channel 2 raise) valve only

Code		Channel 1
c	=o	None
	= 1	PID heat
	= 2	On/off heat
	= 3	Analogue retransmission
	=4	Valve positioner

If configured as a valve positioner, i.e. C2(C) = 4, then C2(D) is ignored.

Code		Channel 2
D	=0	None
	= 1	PID Cool (linear)
	= 2	PID Cool (non-linear)
	= 3	On/off Cool
	= 4	Analogue retransmission
	= 5	Alarm 1 [see C3 (B) for function]
	= 6	Dig out 2, control by programmer or ramp.
	= 7	Dig out 2, control via comms.
	= 8	Remote analogue input

Configure

Configure

4.2.3. C3 CHANNEL 3 AND 4 AND ALARM DEFINITION (C3 = ABCD)

Code		Alarm Relay Status (see note 1)
A	=0	Alarm 1 and 2 de-energised in alarm
	= 1	Alarm 1 de-energised, alarm 2 energised in alarm
	=2	Alarm 1 energised, alarm 2 de-energised in alarm
	=3	Alarm 1 and 2 energised in alarm

Code   Alarm 1 Function (Channel 2 or 3)

B   = o   None
        = 1   Deviation high alarm)
        =2   Deviation low alarm   ) Must select Channel 2 = Alarm 1
        =3   Deviation band alarm)   [C2(D)=5]
        =4   Full scale high alarm) or   Channel 3 = Alarm 1
        =5   Full scale low alarm   )   [C3(C)=l]

Code   Channel 3

C   = o   None
        = 1   Alarm 1 (see C3 {B} for function)
        =2   Dig out 3, control by programmer or ramp.
        = 3   Dig out 3, control via comms.
        =4   Analogue retransmission* (see note 2)

Code   Channel 4

D   = o   None
        = 1   Alarm 2, deviation high ⎤
        =2   Alarm 2, deviation low   ⎥
        =3   Alarm 2, deviation band ⎥ (see note 1)
        =4   Alarm 2, full scale high ⎥
        = 5   Alarm 2, full scale low ⎦
        =6   Dig out 4, control by programmer or ramp.
        =7   Dig out 4, control via comms.
        =8   Remote analogue input* (see note 2)

Notes

1, If changing the Alarm relay status when using relay alarm modules, check the position of the snubber link as described in paragraph 2.0, Hardware Variants.

2. No more than one retransmission and/or one remote input hardware can be installed in an instrument. Therefore the installation of an analogue communications board precludes any remote input or retransmission modules from being fitted. Under these circumstances C3(C) must not be set to a "3", and C3(D) must not be set to a "8".

4.2.4. **C4 CONTROL OPTIONS (C4 = ABCD)**

Code		Programmer function
A	= 0	No programmer function
	= 1	Ramp function
	= 2	Single Programme programmer
	= 3	Multiprogramme programmer(4 or 15)

Code		PID polarity
B	= 0	Reverse acting
	= 1	Direct acting

Code		Derivative action
C	= 0	Error driven
	= 1	PV driven

Code		Dual PID parameters
D	= 0	Single set of commissioning parameters
	= 1	Dual set of commissioning parameters

4.2.5. **C5 UNITS (C5 = ABCD)**

Code		Measurement Units
A	= 0	None
	=1	°C
	= 2	°F
	= 3	K

Code		Integral and Derivative units
B	= 0	Ti and Td in seconds
	= 1	Ti and Td in minutes

Code		Proportional Band units
C	= 0	Proportional band in percent
	= 1	Proportional band in display units

Code		Calibration Trim-units
D	= 0	Cal. trim in microvolts
	=1	Cal. trim in display units

Configure

4.2.6   C6 DISPLAY (C6 = ABCD)

Code   Power-fail recovery strategy

A   = o   Returns to dwell setpoint   at previous ramp rate
        = I   Returns to dwell   setpoint   immediately

Code   Parameter modification security (PMS)

B   = o   No modification of any parameter
        = 1   Modification of "OPEr" parameters only (set points)
        =2   Modification of "OPEr" and 'SuPEr" parameters only
        = 3   Modification of "OPEr" and "Prog" parameters only
        =4   Modification of "OPEr", "SuPEr" and "Prog" parameters only
        =5   Modification of "OPEr", SuPEr", "Prog" and "InSt" parameters

Code   Language   set

C   =0   English
        = 1   French

Code   Display   resolution

D   = o   x x x x x   Pyrometer   ) T/C or)
        = 1   x x x x . x   ) RT   ) Linear or
        =2   x x x . x x   ) Square root
        = 3   x x . x x x |

Note that changing the display resolution may result in a corruption of stored
programmes, see Communication, section 4.7, note 7.

4.2.7. C7 DIGITAL COMMUNICATIONS (C7 = ABCD)

| Code | | Comms. resolution (J-Bus and Modbus only) |

| A | = 0 | Integer only |
| | = 1 | Full resolution |

| Code | | Parity (J-Bus and Modbus only) |

| B | = 0 | No parity |
| | = 1 | Even parity |

| Code | | Baud rate |

c	= 0	9600 Baud
	= 1	4800 Baud
	= 2	3600 Baud
	= 3	2400 Baud
	=4	1200 Baud
	= 5	600 Baud
	= 6	300 Baud (Not available for J-Bus or Modbus)

| Code | | Digital comms type |

D	= 0	ASCII BI-SYNCH
	= 1	Modbus
	= 2	J-bus

Configure

Configure

4.2.8.   C8 ANALOGUE COMMUNICATIONS (C8 = ABCD)

Code		Hardware type
A	= o	No analogue comms. are required, or remote-input and/or retransmission module(s) fitted or VP Pot input
	= 1	Analogue communications PCB fitted
	=2	Digital communications remote input

Code		Analogue retransmission
B	= o	None
	= 1	Setpoint
	= 2	Process variable
	= 3	Error
	= 4	Output power
	= 5	Inverted set point
	= 6	Inverted process variable
	= 7	Inverted error
	=8	Inverted output power

Code		Remote Input Function
C	= o	None
	= 1	Remote setpoint
	= 2	Remote plus local setpoint (see note 1)
	=3	Remote heat power limit
	= 4	Remote cool power limit.
	=5	Motor valve positioner potentiometer. (see note 2)

Code		Remote Analogue input offset
D	= o	None
	= 1	20% offset

Note 1 :- Setpoint 2 is not available with this option.
Note 2 :- Potentiometer supply is only available on the analogue
            communications board. Digit A has no meanig for VP input.
            The remote input signal may be received from either;
            a) An analogue communication PCB.
            b) A remote analogue input module in channel 2 or 4.
            c) A digital communications

4.2.9. C9 SELECTION OF RUN, HOLD, RESET AND TUNER (C9 = ABCD)

Code		Selection of run/hold

A	= 0	Run/hold available rear only
		(only valid for ramp and programmer)
	=1	Run/hold available front and rear
		(only valid for ramp and programmer)

Code		Selection of reset

B	= 0	Reset available rear only
		(only valid for ramp and programmer)
	= 1	Reset available front and rear
		(only valid for ramp and programmer)

Code		Selection of adaptive tune

C	= 0	Not available
	= 1	Adaptive tune available front and rear
	= 2	Adaptive tune available rear only

Code		Selection of self tune

D	= 0	Not available
	= 1	Self tune available front and rear
	= 2	Self tune available rear only
	= 3	Fast self tune available front and rear
	= 4	Fast self tune available rear only

Note   "Front" indicates operation by the operating keys on the front bezel and "Rear" by a configured digital input.

Configure

Configure

4.2.10 C 10 SELECTION OF REMOTE AND AUTO/MAN OPTIONS (C10 ▫ ABCD)

Code		Setpoint tracking in remote
A	= 0	Setpoint 1 hold
	= 1	Setpoint 1 tracks remote setpoint
	= 2	Setpoint 1 tracks local setpoint

Code		Selection of remote input
B	= 0	Not available
	= 1	Remote available front and rear
	= 2	Remote available rear only

Code		Setpoint tracking in manual
C	= 0	Setpoint 1 hold
	= 1	Setpoint 1 tracks PV

Code		Selection of auto/manual
D	= 0	Not available
	= 1	Auto/manual available front and rear
	= 2	Auto/manual available rear only

Note :   "Front" indicates operation by the operating keys on the front bezel and "Rear" by a configured digital input.

4.2.11. "idn" HARDWARE IDENTIFICATION

If the scroll button is depressed when the mnemonic "C10" is on the display the instrument will show the mnemonic "idn". To display the value of "idn" the up and down keys must be depressed together. The display will change to a four character code, in the form "ABCD" as used in "Cl to Cl 0", which indicates the type of module inserted into the four channel positions. If any of these modules have been changed or removed depressing the up and down buttons will force the instrument to update its memory reflecting the change to the hardware. Failure to carry out this procedure will cause the instrument to display an error message when in the normal operating mode. The codes are read as follows :-

Character A = Hardware in Channel 4

Character B = Hardware in Channel 3

Character C = Hardware in Channel 2

Character D = Hardware in Channel 1

The code number that appears in each character position can be decoded as follows:-

0 = None

1 = Relay

2 = Logic

3 = Triac

4 = DC output

5 = Remote input

7 = Special module or hardware error

Configure

4.3. Exit from Instrument Configuration

The method of exiting the instrument configuration level is to scroll to the menu "LEAVE" and press the select key.
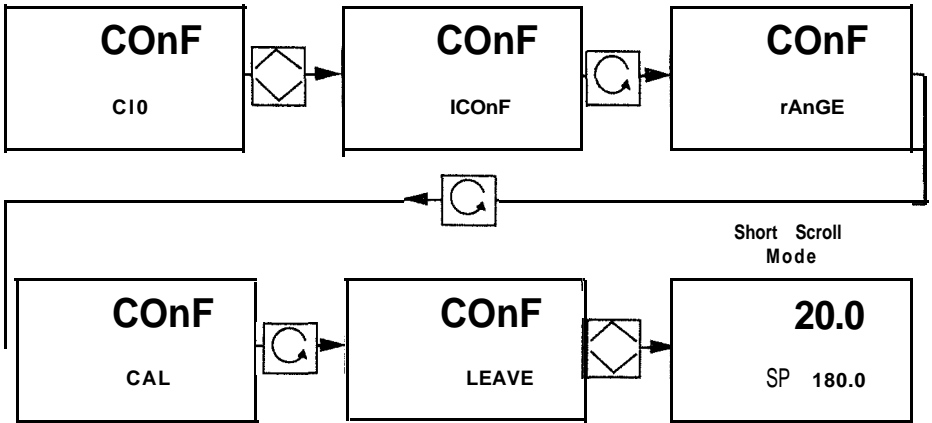
5.0 RANGE CONFIGURATION

This section of the configuration contains all of the analogue values relating to the digital information in the insrument configuration. It is accessed as outlined in paragraph 5.1 below.

5.1 Access to Range Configuration

To enter this mode of operation it is firstly necessary to carry out the procedure to enter the user configuration as described in paragraph 3.1. of this section. A security code now has to be entered to gain entry to the desired level. The procedure for entering this code is given in paragraph 4.1. of this section. When the instrument is despatched from the factory this code is set at "0". The user can enter his own unique code under the mnemonic "S1" in the instrument configuration. Having entered the correct code access to the range configuration is achieved by using the key handling technique shown in below.
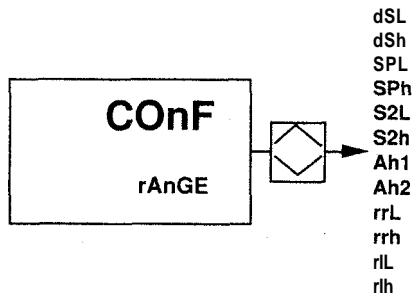
5.2 Range Configuration Parameters

The mnemonics used in this level of the configuration are shown below and the method of entering the value of each mnemonic is shown below.
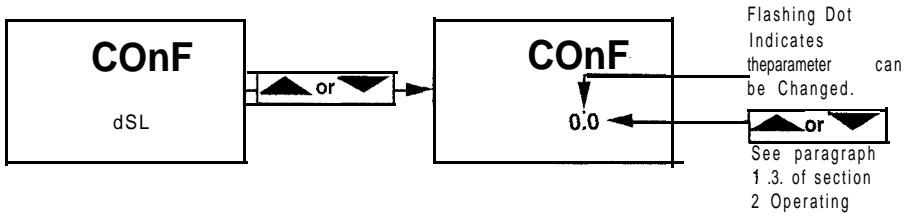
Below is given the table that shows these mnemonics with a description of their meaning and the range of their settings : -

Mnemonic	Description	Range
dSL	Display low limit	{ -9999 to 19999 T/c, RT and
		{pyrometer inputs limited to
dSh	Display high limit	{range in para. 4.2.1 above.
SPL	Setpoint I/Working' setpoint low limit	dSL to dSh
SPh	Setpoint1 /Working setpoint high limit	dSL to dSh
S2L	Setpoint Z/local SP low limit	-9999 to 19999
S2h	Setpoint Z/local SP high limit	-9999 to 19999
Ah1	Alarm 1 hysteresis	0.1 to 10% of input range
Ah2	Alarm 2 hysteresis	0.1 to 10% of input range
riL	Remote input low range scaler	{± display span when config- {ured as remote setpoint or
		(trim or 0.0 to 100% when
rih	Remote input high range scaler	{configured as remote power {limit.
rrL	Retransmission low range scaler	{dSL to dSh for {process variables,
		{ selected setpoint
rrh	Retransmission high range scaler	{limits for working {setpoint and error

5.3.   Exit From Range Configuration

The method of exiting the range configuration level is given in tabular form
below:-
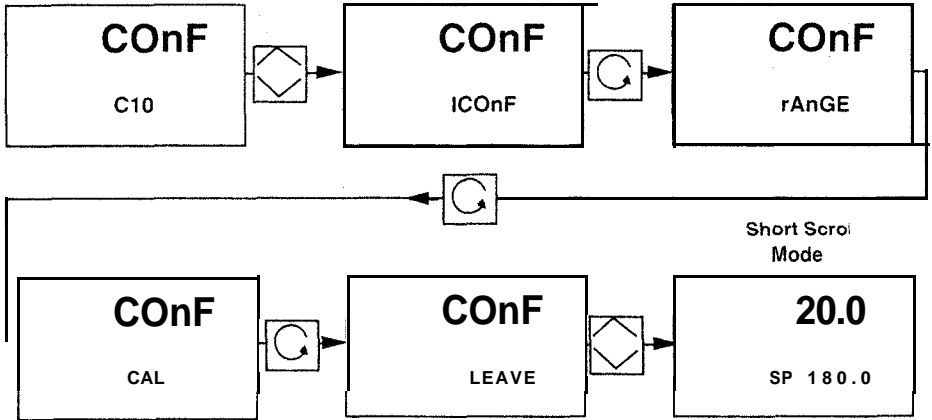
1) Press the "SELECT/TURBO" key.

2) This will cause "rAnGE" to appear on the display.

3) Pressing the "Scroll" key twice will index the display to "LEAVE".

4) Pressing the "SELECT/TURBO" key once will revert the controller to the short
   scroll in the mode of operation.

6.0 ## SECURITY CODES

Two security codes are used within the instrument which are as follows:-

S1 A code which allows access beyond User Configuration to Instrument Configuration, Range and Calibration levels.

S2 A code which overrides the parameter modification security (PMS)

These codes are set to zero when the instrument is despatched from the factory. The value of each of these codes can be reset under the mnemonics "S1" and "S2" in the Instrument Configuration. Once access has been gained to the Instrument Configuration, these codes can be amended by the method illustrated below.

ICOnF
scroll list

Flashing Dot Indicates theParameter can be Changed.

See paragraph 1.3. of section 2 Operating
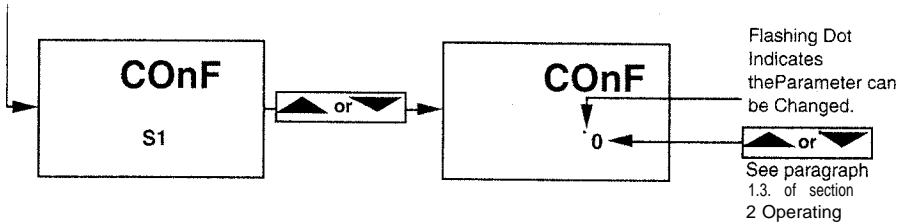
Once these codes have been amended exit from the instrument configuration mode as described in paragraph 4.3.

See operation 1.2., Access Levels and Security for details on using the code S2 to override PMS in the normal operation mode.

Section 5 - Calibration

Contents   *Page*

Calibration

1.0   GENERAL

The 902, 3 or 4 controller can be calibrated whilst installed in its sleeve if the relevant wiring can be re-routed to the calibration device.   Alternatively the instrument can be removed from its sleeve and calibrated on a bench, in which case an additional 902 sleeve, (Part Number SUB 902 SPARE SLEEVE), is required.

2.0   EQUIPMENT

To carry out the complete calibration of the 902, 3 or 4 controller a number of instruments are required. These are listed below:-

a) A suitable stable millivolt and voltage source with the ability to switch 'in' and 'out' some means to compensate for the cold junction of thermocouples. The accuracy of this millivolt and voltage source must be better than ± 1 μ volt when injecting 1 0.0milli volts, $\pm 2\mu$ volts when injecting 20.0milli volts, $\pm$ 10μ volts when injecting 1 00.0milli volts and ± 1 milli volt when injecting 10.0 volts.

b) A length of compensating cable suitable for the thermocouple to be used with the controller or type K.

c) A decade resistance box capable of being set to 50.00 and 250.00 ohms with an accuracy better than +/-0.01 ohms. Alternatively two precision resistors of this accuracy may be used.

d) A digital voltmeter capable of indicating a maximum voltage of 10 volts DC with an accuracy of better than 0.05% and an input impedance higher than 5 Megohms.

e) A digital current meter capable of indicating a maximum of 20mA DC with an accuracy of better than 0.05% and an input impedance of less than 400 ohms.

When the 902/3/4 instrument is despatched   from the factory it has been calibrated for all thermocouples, RTDs, pyrometers, voltage and current inputs.

Note:- Remote inputs and/or retransmission outputs are only factory calibrated if they are included in the original order.

When reconfiguring the instrument from one sensor type to another or one range to another it is not necessary to recalibrate the instrument, providing that the full calibration has not been corrupted.

The recalibration procedure can either be performed for the configured input and output ranges only, or for all ranges.

Calibration

3.0   PARTIAL CALIBRATION

The table below shows which mnemonics have to be selected to calibrate a particular range and input.

The configured range of the instrument being calibrated	Selected Mnemonic
Pyrometer or voltage inputs where input span is < 10mV	i01
Pyrometer or voltage inputs where input span is > 10mV and is < 20mV	i02
Pyrometer or voltage inputs where input span is > 20mV and is < 1 00mV	i10
D.C. voltage inputs where input span is >1 00mV and is <10 volts.	ihL
Display Trim (may be used with all inputs)	tr
Thermocouple inputs where input span is < 10mV	i01 & CJC
Thermocouple inputs where input span is > 10mV and is < 20mV	i02 & CJC
Thermocouple inputs where input span is > 20mV and is < 100mV	i10 & CJC
RTD Inputs	rtL & rth
Analogue remote inputs (channels 2 or 4 or analogue comms. option board.)	icL & ich
Analogue outputs (channels 1, 2 or 3 or analogue comms. option board.)	
Channel 1	**C1L&C1h**
Channel 2	C2L & C2h
Channel 3	C3L & C3h
Analogue comms. option board	roL & roh
Motor valve position potentiometer	PcL & Pch

To calibrate a single range use only those parts of the procedure containing the mnemonics in the above table.

4.0   **ACCESS TO INSTRUMENT CALIBRATION**

To alter the calibration of the instrument the configuration (Read/Write) mode has to be entered using the key operations shown below

Access into the calibration level of the controller is barred until the correct security code is entered.

Software Version Number

```
Power Off → Press & Hold ◇ and ＞ ‖ → Power On → E02
```

```
🕐 3Secs → COnF / UCOnF → Release ◇ and ＞ ‖
```
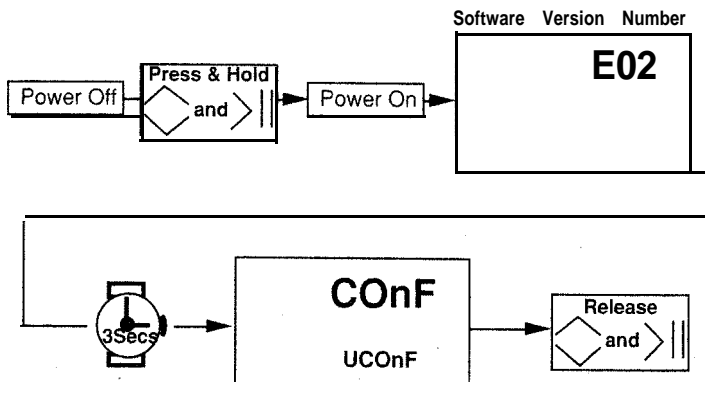
This code is set to "0", (no security), when the instrument is despatched from the factory, but can be set by the user to any value between "0" and "9999" under the mnemonic "S1" in the instrument configuration, see Section 4.0, Configuration, Paragraph 6.0.

```
COnF / UCOnF → 🔄 → COnF / SEC
                              │
                          ▲ or ▼
COnF / 0 (Flashing Dot) → ▲ or ▼ → COnF / 902
```
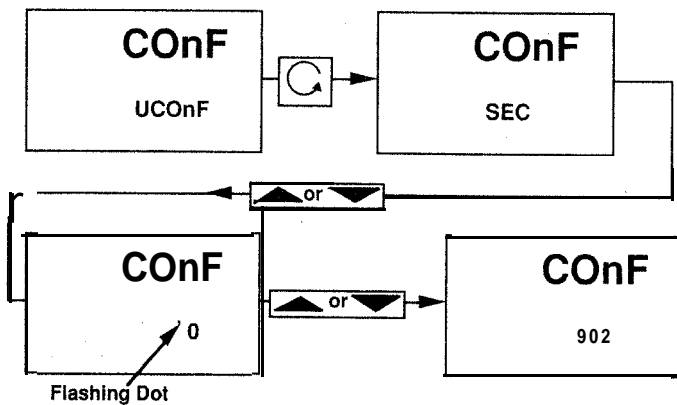
Calibration

After entering the correct code access to the calibration level is attained using the following key handling procedure.

i01 (See Para. 5.1)
i02 (See Para. 5.2)
ñ0 (See Para. 5.3)
tr   (See Para. 5.4)
cJc (See Para. 5.5)
rtL ⎤(See Para. 5.6)
rth ⎦
hLL ⎤(See Para. 5.7)
hLh ⎦
C1L ⎤
C1h
C2L
C2h ⎬ (See Para. 5.8)
C3L
C3h
roL
roh ⎦
ICL ⎤(See Para. 5.9)
ICh ⎦
PCL ⎤(See Para. 5.10)
PCh ⎦
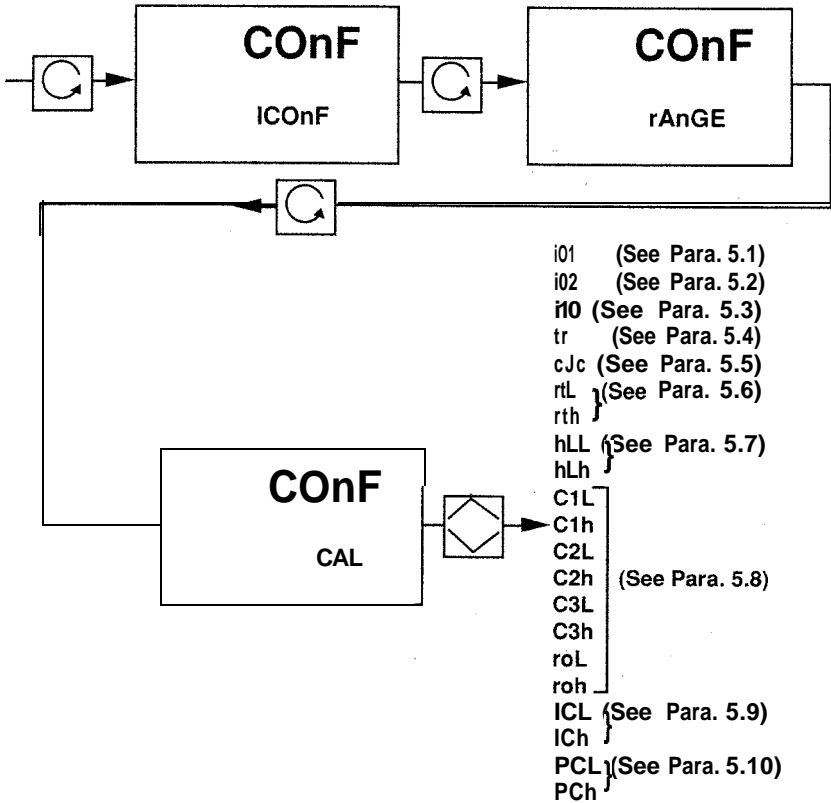
5. 0   CALIBRATION TECHNIQUE

In all calibration procedures make the necessary connections between the instrument and the calibrating equipment. Ail equipment requiring power should be powered up for at least 20 minutes before proceeding with the calibration.

5.1   10mV Calibration Procedure.
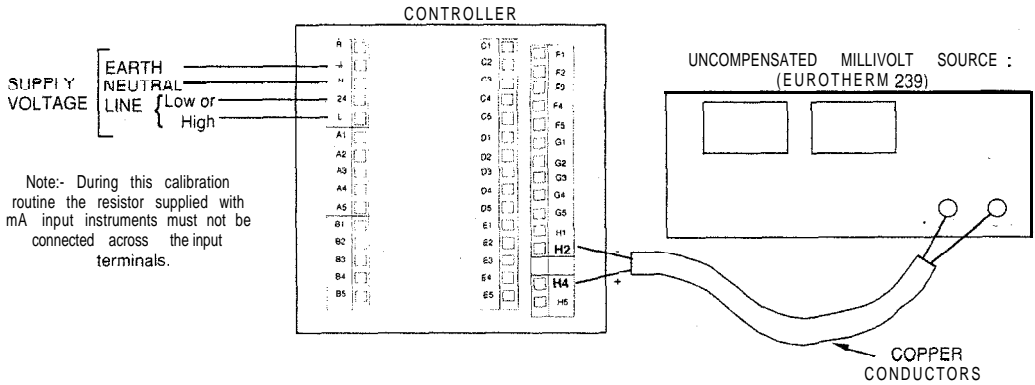
Figure 1 instrument connections for   i01, i02 and   i10 calibration procedure.

1) Connect the calibrater to the controller as shown in Figure 1.

2) Using the scroll key select the mnemonic "i01"

3   Set the output of the calibrator to 1 0.000mV.

4) Press the "up" and "down" keys together.

5) The 'i01" will disappear and the dot between the 2 least significant digits will flash for approximately 15 seconds.

6) The display will now indicate a mV reading of 10.000. A drift of more than a few µV's in this reading in 30 seconds indicates that the calibration procedure was unsuccessful.

7) f unsuccessful check the calibrator, instrument and interconnections.

8) Press the "up" and "down" keys together to repeat the calibration.

9) If the reading is to be accepted press the "scroll" key.

10) If no further calibrations are required leave configuration as described in paragraph 6.0 of this section.

5.2   20mV Calibration Procedure

1) Press the scroll key until "i02" is displayed.

2) Set the output of the calibrator to 20.000mV.

3) Repeat the procedure 4 to 9 of paragraph 5.1 above for mnemonic 'i02".

4) If no further calibrations are required leave configuration as described in paragraph 6.0 of this section.

5.3   1 00mV Calibration Procedure.

1) Press the scroll key until "i10" is displayed.

2) Set the output of the calibrator to 1 00.000mV.

3) Repeat the procedure 4 to 9 of paragraph 5.1 above for mnemonic 'i10".

4) If no futher calibrations are required leave configuration as described in paragraph 6.0 of this section.

5.4   Display Trim

1) The mnemonic "Tr" is provided to allow an offset between the input signal and the displayed value. If the sensor has been calibrated and its inaccuracy is known, then this error can be entered, with reverse polarity, into this trim value. If this procedure is carried out the display will indicate the true measured value at the point of measurement of the sensor.

    Default setting of calibration trim is zero.

2) The trim may be configured to be either in micro volts (Instrument configuration word $C5(D) = 0$) or in display units (Instrument configuration word $C5(D) = 1$) see section 4.0, configuration, paragraph 4.2.5.

3) Press the "scroll" button until "tr" (display trim) is shown.

4) Use the "up" or "down" key to set this value to the desired number of μV or display units of offset.

    e.g. if the thermocouple calibration shows that its output is $20\mu V$ above the table value scroll this trim value to $-20\mu V$.

5) If this feature is not going to be used it must be set to zero.

6) If no futher calibrations are required leave configuration as described in paragraph 6.0 of this section.

5.5 C.J.C. Calibration Procedure

7) The leads between the calibrator and the instrument should now be changed for compensating cable, see Figure 2.
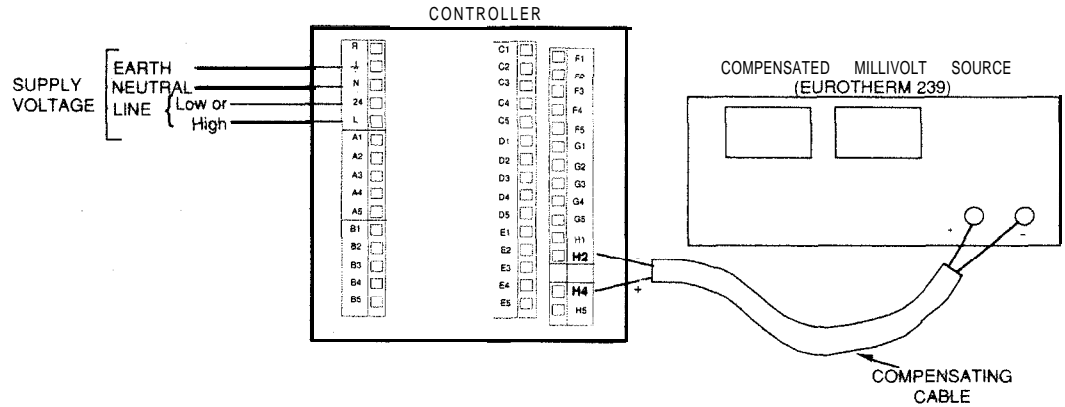
Figure2 instrument connections for CJC calibration procedure.

2) If the instrument has been configured for a thermocouple input the compensating cable should be for this thermocouple type.

3) If the instrument has been configured for a non-thermocouple input; eg. RTD, pyrometer, millivolts or current, then the compensating cable should be type K.

4) The compensation of the calibrator should be set to the same type as the compensating cable from the calibrator to the instrument.

5) Set the output of the calibrator to a value that represents 25°C for either the thermocouple that the instrument has been configured to, or to type "K" if the instrument is configured for a non-thermocouple input - ie. if type K, then set value at 1.000mV

6) Press the "scroll" key until "cjc" is displayed.

7) The "up" and "down" keys should now be pressed together the 'cJc' will disappear.

8) The top dot between the 2 L.S.D.'s will flash for approximately 15 seconds.

9) The display will now read the temperature in °C as 25.0.

Calibration

10) If the reading drifts by more than a few tenths of a degree in 30 seconds the calibration of 'cJc' has been unsucessful. Check the calibrator, instrument and compensating cable wiring.

11) Press the "up" and "down" keys simultaneously together to repeat the calibration of "cJc".

12) Once the reading is to be accepted press the "scroll" key.

13) if no futher calibrations are required leave configuration as described in paragraph 6.0 of this section.

5.6   Resistance Thermometer Calibration Procedure

1) Connect the input of the instrument to a decade resistance box as shown in Figure 3.
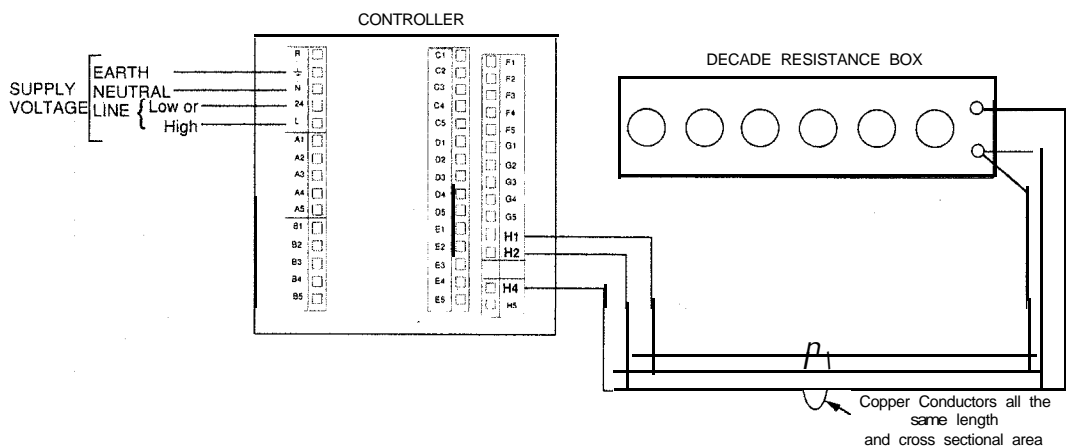
Figure 3 Instrument connections for   rtL and rth calibration procedure.

2) Press the "scroll" key until "rtL" is displayed.

3) Set the resistance box to 50.00 ohms (or use a precision resistor).

4) Simultaneously press the "up" and "down" keys. The lower display will now blank, leaving the top dot of the LSD of the display flashing for 15 seconds.

5) "rtL" will now be displayed.

6) Press the "scroll" key and "rth" will be displayed.

7) Set the resistance box to 250.00 ohms (or use a precision resistor)

8) Press the "up" and "down" keys simultaneously.

9) The "rth" will disappear and the top dot of the LSD will flash for approximately 15 seconds.

10) The display will now read 250.0

11) If the reading drifts by more than a few tenths of an Ω in thirty seconds, the RT calibration is unsucessful. Check the calibration resistors, instrument and wiring. Repeat procedure 1 to 10.

12) When calibration is satisfactory press the "scroll" key

13) If no futher calibrations are required leave configuration as described in paragraph 6.0 of this section.

5.7 10 Volt (or 5 Volt) Calibration Procedure

1) Connect the instrument and calibrator together as in Figure 4.
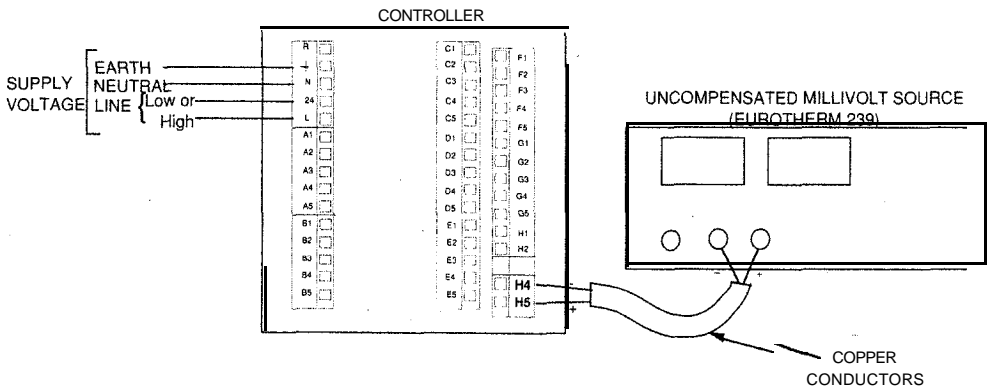
Figure 4 Instrument connections for hLL and hLh calibration procedure.

2 Using the scroll key select the mnemonic "ihL"

3) Set the output of the calibrator to 10.000 Volts (or 5.000 Volts).

4) Press the "up" and "down" keys together.

5) The "ihL" will disappear and the dot between the 2 L.S.D.'s will flash for approximately 15 seconds.

6) The display will now indicate a voltage reading of 10.000. A drift of more than a few mV's in this reading in 30 seconds indicates that the calibration procedure was unsuccessful.

7) If unsuccessful check the calibrator, instrument and interconnections.

8) Press the "up" and "down" keys together to repeat the calibration.

9) If the reading is to be accepted press the "scroll" key.

10) If no futher calibrations are required leave configuration as described in paragraph 6.0 of this section.

5.8 Retransmission Calibration Procedure

1) Determine how many Control Outputs and if a Retransmission Output is installed on the specific controller to be calibrated. This can be deduced from the instrument ordering code that appears on the side of the controller (refer to paragraph 2.0, section 1). These outputs will appear on the following terminal numbers and can be calibrated using the mnemonics indicated:-

Function	Terminals	Calibration Mnemonics
Control Output (Heat)	A2 & A3	CIL & CIh
Control Output (Cool)	B2 & B3	C2L & C2h
Either		
Retransmission (Channel 1)	A2 & A3	C1L&C1h
or		
Retransmission (Channel 2)	B2 & B3	C2L & C2h
or		
Retransmission (Channel 3)	D2 & D3	C3L & C3h
or		
Retransmission (Anal. Comms.)	c4 & C5	roL & roh

2) Scroll to the first (CI L, C2L, C3L or roL) of the relevant calibration mnemonic given in the table above.

3) Press the "up" and "down" keys together.

4) A numerical value, usually "0.0", will appear on the display. This numerical value is scaled in percentage. For current outputs 100.0%=20.0mA and for voltage outputs 1 00.0%=1 O.OVolts.

5) This percentage value converted to either current or voltage represents the minimum limit of the range of that specific output.

6) The "up" or "down" keys can now be used to adjust this percentage value to the desired minimum output i.e. for a 0-5.0 volt output, set 0.0%; for a 4-20mA output, set 20.0%.

7) The above procedure is sufficient for the outputs indicated as control in the table above. For outputs indicated as retransmission in the table above the following procedure should additionally be performed.

8) Connect the instrument and meter together as in Figure 5.
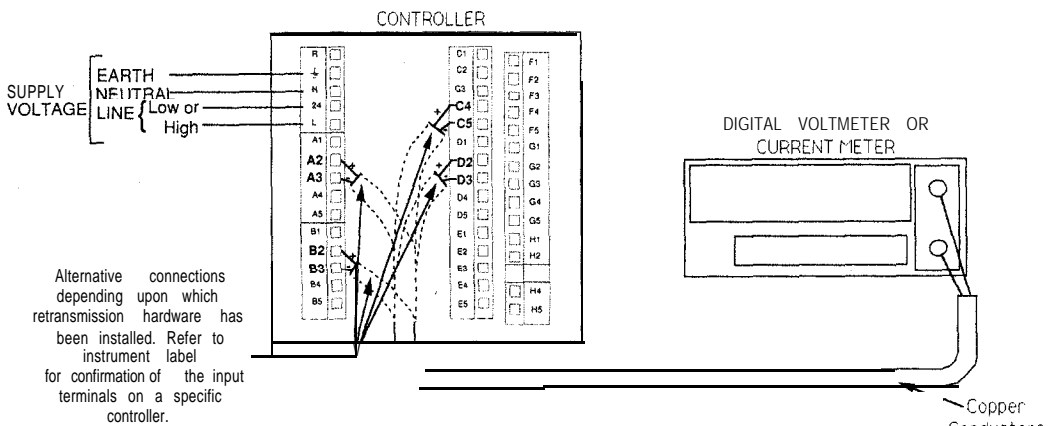
Figure 5 Instrument connections for C1 L, Cl h or C2L, C2h or C3L, C3h or roL, roh calibration procedure.

9) Use the "up" and "down" keys to set the meter reading exactly to the minimum output required from that channel.

10) Pressing the "scroll" key once reveals the mnemonic for setting the maximum limit of the range of that specific output (Cl h, C2h, C3h or roh)

11) Press the "up" and "down" keys together to reveal the maximum limit setting for the specific channel. Again this value, scaled as a percentage, is described in procedure 4 above.

12) Control outputs can be set by scrolling the display to the desired value i.e. for a 0.0-5.0volt output set 50.0%, for a 4-20mA output set 100.0%.

13) Retransmission outputs should be set by using the "up" and "down" keys to adjust the meter reading exactly to the maximum output limit of the channel.

14) Depressing the "scroll" key will advance the display on to the next mnemonic in the calibration scroll list.

15) If no futher calibrations are required leave configuration as described in paragraph 6.0 of this section.

5.9   Remote Input Calibration Procedure

1) Determine if a Remote Input is installed on the specific controller to be calibrated. This can be deduced from the instrument ordering code that appears on the side of the controller (refer to paragraph 2.0, section 1). These inputs will appear on one of the following pairs of terminal numbers:-

Function	Terminals
Either	
(Channel 2)	B2 & B3
or	
(Channel 4)	E2 & E3
or	
(Anal. Comms.)	c2 & c3

2) Connect the calibrator to the pair of terminals used for the remote input on the specific instrument to be calibrated, as in Figure 6.

Note:- The burden resistor normally connected across terminals B2, B3 or C2, C3 or E2, E3 on the back of the sleeve must be removed during calibration. The voltages used for calibrating these inputs is the relevent current in amps multiplied by 50.

Alternative connections depending upon which remote input hardware has been installed. Refer to instrument label for confirmation of the input terminals on a specific controller.

Figure 6 Instrument connections for icL and ich calibration procedure.

3) The mnemonics "icL" and "ich" are used for calibrating the remote input regardless of the input terminals used. Note: If this input is current rather than voltage the burden resistor normally connected on the rear of the sleeve must be removed during calibration. With this resistor removed, a voltages is injected into these rear terminals during the calibration procedure. The amplitude of this voltage is the relevant currents, in amps, multiplied by 50.

4) Connect a voltage source such as the Eurotherm 239 to the instrument as Figure 6 using the terminals numbers selected from the table above.

5) Press the "scroll" key until the display reads "icL".

6) Set the voltage source to the minimum input span.

Note;-

If the instrument has been configured with a 20% offset i.e. configuration "C8" character "D" set to 1 then the setting must be zero.

7) Press the "up" and "down" keys together.

8) The dot between the 2 L.S.D.'s will flash for approximately 15 seconds

9 "icL" will then be displayed as a percentage of the max span.

10) If this value in (9) above drifts significantly reset the voltage source and repeat paragraphs 7, 8 and 9.

11) Pressing the "scroll" key once will cause the display to read "ich".

12) Set the voltage source to the maximum input span volts.

13) Press the "up" and "down" keys together.

14) The dot between the 2 L.S.D.'s will flash for approximately 15 seconds.

15) "ich" will then be displayed as a percentage of the max. span.

16) If this value is incorrect reset the voltage source and again repeat paragraphs 13, 14 and 15.

17) If the value is correct press the "scroll" key.

18) If no futher calibrations are required leave configuration as described in paragraph 6.0 of this section.

5.10   Valve Positioner Potentiometer Calibration Procedure

(Only applicable to controllers where the Valve Positioner output has been configured to be used with a potentiometer)

The motorised valve plus potentiometer, that is to be used, must be wired to the controller, as shown in Figure 7, before commencing this calibration procedure.
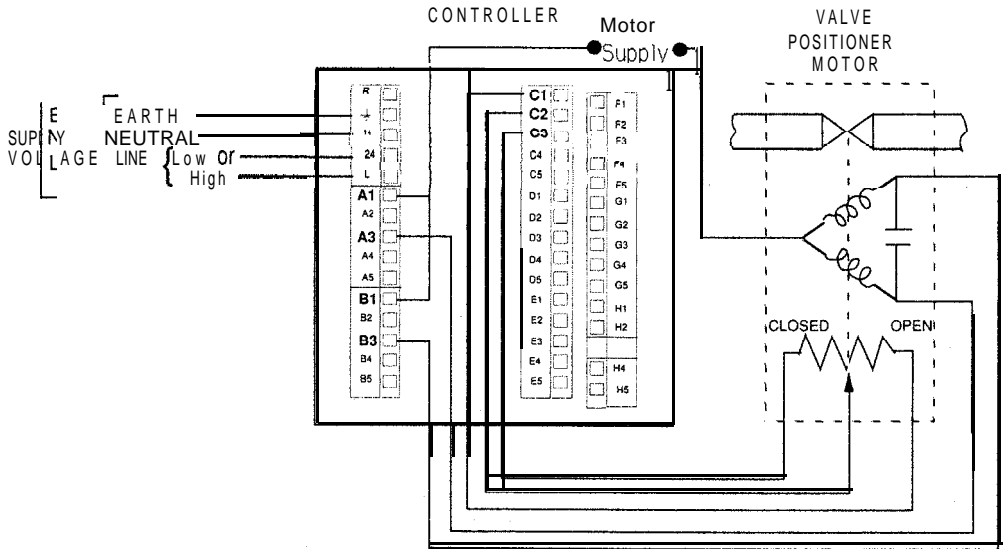
Figure 7 Instrument connections for PcL and Pch calibration procedure.

1) Press the "scroll" key repeatedly until the mnemonic "PcL" is displayed.

2) Use the "up" and "down" keys to drive the motor to the position representing the minimum valve opening required.

3) Push the "manual" key to enter this value.

4) Press the "scroll" key to index to the mnemonic "Pch".

5) Use the "up" and "down" keys to drive the motor to the position representing the maximum valve opening required.

6) Push the "manual" key to enter this value.

7) Press the "scroll" key to exit from the potentiometer calibration procedure.

8) If no futher calibrations are required leave configuration as described in paragraph 6.0 of this section.

This calibration procedure rescales the potentiometer, under the mnemonic "op" making the maximum and minimum selected positions now equal to 100% and 0% respectively. These settings limit the travel of the motor in the "Auto" mode. Potentiometer limits "PL" and "Ph" in the Installation Mode Scoll list can further restrict the movement of the motor if they are set to other than 0% and 100% respectively.

6.0   EXIT FROM CALIBRATION

To return to operating mode use the following procedure.

```
   ┌──────────┐                    ┌──────────┐
   │  COnF    │      ◇───▶         │  COnF    │
   │          │                    │          │
   │   PCh    │                    │  C A L   │
   └──────────┘                    └──────────┘
                    ↻

                              Short Scroll
                                 Mode
   ┌──────────┐                    ┌──────────┐
   │  COnF    │      ◇───▶         │   20.0   │
   │          │                    │          │
   │  LEAVE   │                    │ SP   180.0 │
   └──────────┘                    └──────────┘
```
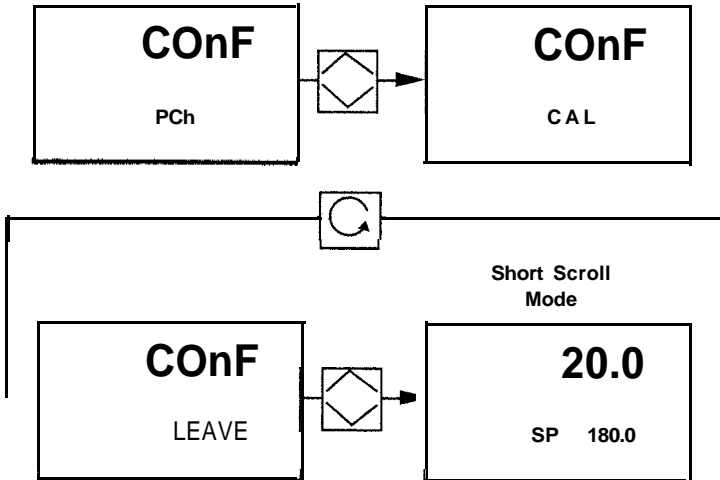
1) Press the "Select/Turbo" key.

2)   This will cause "CAL" to appear on the display.

3) Pressing the "Scroll" key once will cause the display to change to "LEAVE".

4) Pressing the "Select/Turbo" key once will revert the controller to the Short Scroll List in the operating mode.

Calibration

Section **6** · **Communications**

Con tents

Comms

1.0.   GENERAL

The 902/3/4 controller is designed to operate with either RS232 or RS422 (485)* digital communications. Many of the modes of operation that can be set by the push buttons on the front of the instruments or the digital inputs at the rear of the instrument can alternatively be activated by the digital communications link. Whilst the communications link is active a beacon on the display will be illuminated.

2.0.   TRANSMISSION STANDARDS

The 902/3/4 controller will support two types of physical links:-

Electrical Specification	Transmission Standards	
	RS 232c	RS422 (485)*
Max. Line Length	50 feet	4000 feet
Max. No. of Controllers on one Bus.	1	32

*Note:-   Although the 902/3/4 controller meets all the drive specifications of the RS 485 standard the Eurotherm system does not support the half duplex clauses within the standard.

Converting the instrument from one standard to the other is achieved by changing the rear terminal connections, as shown in section 1, paragraph 2.2.11, and changing the position of a link switch mounted on the rear of the microprocessor printed circuit board. The setting of this switch is shown in Figure 1 below.

Figure 1

Comms
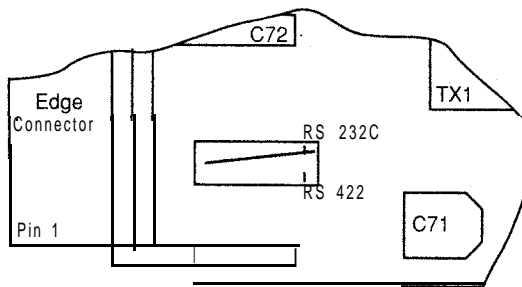
Communications

Isolation provided between the communication link, all inputs and all outputs, meets the IEC 348 and the UL 1092 specification. Baud rates in the range 300 to 9600 are set by character C7(C) in the instrument configuration.

3.0. PROTOCOL

Three types of protocol are supported by the 902/3/4 controller as shown below:-

Protocol Type	ANSI X 3.28-2.5 A4(ASCII)	Modbus® RTU and J-Bus® RTU
Data Rates	300,600, 1200,2400, 3600,4800,9600	4800, 9600
Data Format	1 start, 7 bit ASCII data, 1 stop bit.	1 start, 8 bit binary data, 1 stop bit.
Parity	Even.	Even or None.
Comms. Latency (Read/Write)	125mS/125mS	1 0mS/125mS

Two Eurotherm publications are available which contain more details on communication standards than can be covered in this text.

900 Series Digital Communications Handbook(HA 023776)

Modbus® and J-Bus® Protocol (HA 021450)

4.0. ASCII COMMUNICATIONS
4.1. Data Format

Four types of data format are supported in the digital communications used in the 902/3/4 controller. To identify the format in use, communications include an identifying character shown below:-

Description	Identifier
Numerical Fixed Format	. or -
Numerical Free Format	.or -
Hex Format	>
IEEE Format	@ (Write to instrument only)

2

Numerical Fixed Format:-

In this format 5 character positions must be filled, and for negative values, the decimal point is replaced by a minus sign.

Therefore + 5.3 can be entered as :

> (5.300)
> or
> (05.30)

and -5.3 can be entered as :

> (5-300)
> or
> (05-30)

This system has the advantage of having the same resolution for positive and negative numbers. To enable fixed format see the status word definition (SW bit 0).

Numerical Free Format:-

In this system all six character positions need not be filled. A negative number is designated by a negative sign in front of the number, a value of 13.9 can be entered in any of the following forms-

> (0013.9)
> (13.9)
> **(13.90)**
> **(13.9)**

and -2 can be entered as:

> (-2.0)
> (-2.0)
> (-2)
> (-2.)
> (-2)
> (-02.00)
> (-2.000)

To enable fixed format see the status word definition (SW bit 0).

Comms

4.2. Polling Sequence, instrument to Supervisor.

PROTOCOL PROCEDURE	ESTABLISH CONNECTION	PHASE A	MESSAGE TRANSFER	PHASEB	TERMINATION
SENDER	SUPERVISOR	INSTRUMENT		SUPERVISOR	SUPERVISOR
SUPERVISOR STATUS	MASTER	SLAVE		SLAVE	MASTER
INSTRUMENT STATUS	SLAVE	MASTER		MASTER	SLAVE
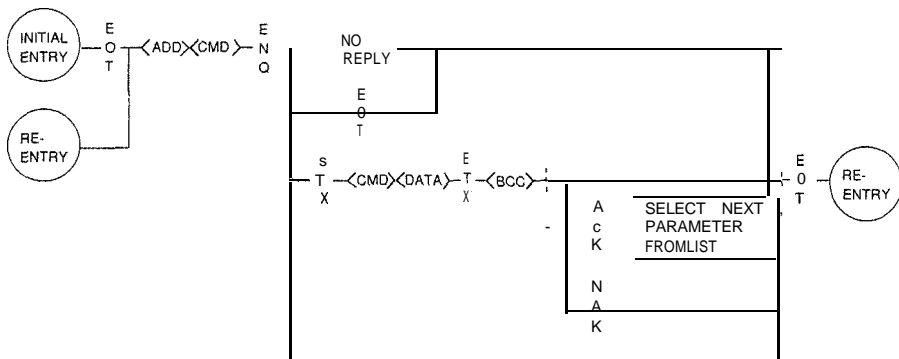
4.3. Selection Sequence, Supervisor to Instrument

PROTOCOL PROCEDURE	ESTABLISH CONNECTION	PHASE A	MESSAGE TRANSFER	PHASEB	TERMINATION
SENDER	SUPERVISOR	INSTRUMENT		SUPERVISOR	SUPERVISOR
SUPERVISOR STATUS	MASTER	SLAVE		SLAVE	MASTER
INSTRUMENT STATUS	SLAVE	MASTER		MASTER	SLAVE
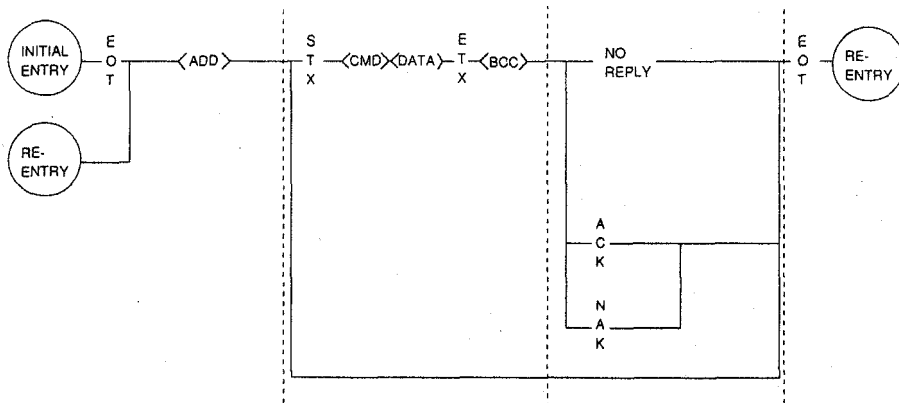
4.4. ASCII Fast Poll

The order of the list of mnemonics given in paragraph 4.7 is important. An "ACK" transmitted back to the 902/3/4 after a request for data will initiate a fast poll and cause the instrument to automatically transmit the next mnemonic in the list together with its data. Transmission of a further "ACK" will retrieve data from the next mnemonic in the list. This list can be treated as a circular buffer, i.e. the first parameter will follow the last.

4.5. Broadcast Mode

An identical single parameter change in a number of controllers on a single network can be achieved by the broadcast technique. When the host transmits a "request to change" message using the address **"~~"** all instruments on the network will accept the change to parameter data but will not respond. A transmitted "request to change" message from the host, using the address **"X~"** (X is a number from 0 to 9) will cause an acceptance from all instruments on the network with a "Group ID" (first character of the address) equal to the value of "X". The form of the broadcast message is identical to that given in paragraph 4.3 of this section. The receiving controllers do not respond; i.e. give a "ACK" or a "NAK". To confirm a successful broadcast transmission a further "request for data" message, using the mnemonic "EE" may be transmitted individually to all instruments concerned.

Broadcast mode is enabled or disabled with the communications mnemonic XS, Extension Status Word or by using a digital input.

4.6. Instrument Mode

The 902/3/4 will allow configuration to be entered via the digital communications. In configuration, outputs are disabled and P.V. measurement is suspended.

Instrument Modes :-

IM	= 0	Normal operation Mode
	= 1	No effect.
	= 2	Configuration Mode.

WARNING: Once in configuration mode several test functions are available via the mnemonic "IM". Writing any value other than 0 or 2 to "IM" may result in the loss of all configuration and calibration data.

Comms

4.7.   ASCII Parameter Mnemonic List

The order of this table is that which would be obtained if a fast poll was
performed commencing from Instrument Identifier (II). This is a complete list of
all the communication mnemonics. The actual list on any specific controller will
be a configuration dependant subset of this list. The order that parameters
appear in the complete list will still be adhered to in a fast poll.

MNEMONICS in ( ) are display mnemonics.

MNEMONIC	PARAMETER	AVAILABILITY
II	Instrument Identity (Note 1)	Always available (R/O)
vo	Software Version (Note 2)	Always available (R/O)
IM	Instrument Mode	Always available
EE	Last Message Status (Note 3)	Always available (R/O)
1H (dSh)	Display Maximum (Note 4)	Always available (R/O)
1L (dSL)	Display Minimum (Note 4)	Always available (R/O)
PV	Measured Value	Always available (R/O)
SP (SP)	Working Setpoint	Always available (R/O)
OP (OP)	Output (Note 5)	Always available
SW	Status Word (Note 6)	Always available
OS	Opt'l Status Word (Note 6)	Always available
xs	Extend'd Status Word (Note 6)	Always available
I A (AL1)	Alarm 1 SP	Configuration dependent
2A (AL2)	Alarm 2 SP	Configuration dependent
ER	Error	Always available (R/O)
S L (SP1)	Setpoint 1	Configuration dependent
s 2 (SP2)	Setpoint 2	Configuration dependent
RT (LSP)	Local Setpoint	Configuration dependent
MP	V.P. Pot Value	Configurable (R/O)
RI (rSP)	Remote Input (Note 8)	Remote I/P Configured but not as Power Limit (R/O)
01	Status Word 1 (Note 6)	Prgmr & dig out configured
02	Status Word 2 (Note 6)	Prgmr & dig out configured
03	Status Word 3 (Note 6)	Prgmr & dig out configured
04	Status Word 4 (Note 6)	Prgmr & dig out configured
05	Status Word 5 (Note 6)	Prgmr & dig out configured
06	Status Word 6 (Note 6)	Prgmr & dig out configured
CP (Pnr)	Current Programme Number	Multi Programmer
TM (TIME)	Time remaining in current programme segment	Programmer configured and a programme is running or in Hold or Ramp function configured and ramp active (R/O except in hold)

MNEMONIC		PARAMETER	AVAILABILITY
LR	(Lr)	Loops remaining for current programme	Programmer configured and programme is running or in hold. (R/O except in hold)
rl	(Pr1)	Ramp rate 1 or Time to Target 1	Programmer configured
Il	(Pl1)	Ramp level 1	Programmer configured
t1	(Pd1)	Dwell time 1	Programmer configured
r2	(Pr2)	Ramp rate 2 or Time to Target 2	Programmer configured
l2	(Pl2)	Ramp level 2	Programmer configured
t2	(Pd2)	Dwell time 2	Programmer configured
r3	(Pr3)	Ramp rate 3 or Time to Target 3	Programmer configured
l3	(Pl3)	Ramp level 3	Programmer configured
t3	(Pd3)	Dwell time 3	Programmer configured
r4	(Pr4)	Ramp rate 4 or Time to Target 4	Programmer configured
l4	(Pl4)	Ramp level 4	Programmer configured
t4	(Pd4)	Dwell time 4	Programmer configured
r5	(Pr5)	Ramp rate 5 or Time to Target 5	Programmer configured
l5	(Pl5)	Ramp level 5	Programmer configured
t5	(Pd5)	Dwell time 5	Programmer configured
r6	(Pr6)	Ramp rate 6 or Time to Target 6	Programmer configured
l6	(Pl6)	Ramp level 6	Programmer configured
t6	(Pd6)	Dwell time 6	Prograrnner configured
r7	(Pr7)	Ramp rate 7 or Time to Target 7	Programmer configured
l7	(Pl7)	Ramp level 7	Programmer configured
t7	(Pd7)	Dwell time 7	Programmer configured
r8	(Pr8)	Ramp rate 8 or Time to Target 8	Programmer configured
l8	(Pl8)	Ramp level 8	Programmer configured
t8	(Pd8)	Dwell time 8	Programmer configured
Hb	(Hb)	Holdback value	Programmer configured with holdback
Lc	(PLc)	Loop count	Programmer configured
RR	(SPr)	Ramp rate	Ramp function configured
HO	(HL)	Heat OP Limit	Controller with PID heat
LO	(CL)	Cool OP Limit	Controller with PID cool
RH	(rL)	Remote Heat Limit (Note 8)	PID heat + remote as heat Limit (R/O)
RC	(rL)	Remote cool limit (Note 8)	PID cool + remote as cool limit (R/O)
HS	(SPh)	Setpoint 1 maximum	Always available (R/O)
LS	(SPL)	Setpoint 1 minimum	Always available (R/O)
H2	(S2h)	Setpoint 2 maximum	Configuration dependent (R/O)
L2	(S2L)	Setpoint 2 minimum	Configuration dependent (R/O)
H3	(S2h)	Local setpoint Maximum	Configuration dependent (R/O)
L3	(S2L)	Local setpoint Minimum	Configuration dependent (R/O)
2H	(rih)	Remote Max Scaler	Configuration dependent (R/O)
2L	(riL)	Remote Min Scaler	Configuration dependent (R/O)

Comms

Communications

MNEMONIC	PARAMETER	AVAILABILITY
CH (Hc)	Cycle time for channel 1	Channel 1 configured as time proportioning.
XP (Pb)	Proportional band	PID heat configured
TI (ti)	Integral time	PID heat configured
M R (rES)	Manual Reset	On/Off, P or PD controller
TD (td)	Derivative time	PID heat configured
HB (cbh)	Cutback high	PID heat configured
L B (cbL)	Cutback low	PID heat configured
RG (Cr)	Relative cool gain	PID heat/cool configured
P2 (Pb2)	Proportional band (2)	Dual PID heat configured
I2 (ti2)	Integral time (2)	Dual PID heat configured
R2 (rS2)	Manual reset (2)	On/off or P or PD controller(Dual PID)
D2 (td2)	Derivative time (2)	Dual PID heat configured
G2 (Cr2)	Relative cool gain (2)	Dual PID heat/cool config'd
HC (db)	Heat cool deadband	Heat/cool instrument
cc (Cc)	Cool cycle time	Heat/cool instrument + time proportioning O/P 2
C 2 (H2c)	Channel 2 cycle time	Heat with dual O/P + time proportioning O/P 2
TT (tt)	Travel Time	VP configured
Tt (ttd)	Travel time down	VP configured
MT (ot)	Minimum on time	VP configured
TP (ut)	Valve update time	VP configured
LE (PL)	Motor Low Limit	VP configured
EH (Ph)	Motor High Limit	VP configured
PE (ES)	Emissivity	Pyrometer configured
BP (Sbr)	Power level at sensor break	Always available
TR (Atr)	Adaptive tune trigger point	Always available

Note 1 :- Format : 902X, Instrument Ref. , Software Class

Note 2 :- Format : A, B, CD Software Class, S/W Version, S/W Issue.

Note 3 :- Returned data is a code as follows :-

       0 =   Clear

       1=   Invalid Mnemonic

       4=   Read Only Error

       7=   Data Error

       a=   Limits Error

Note 4 :-   The true limit of PV are 1H + 10% of (1H - 1L) to 1 L - 10% of (1 H -IL).

Note 5 :-   In Auto Mode output power is read only. In Manual Mode output power is read /write. Not available in V.P. mode

Note 6 :-   For explanation of status words see paragraph 8.0 of this section.

Note 7 :-   Programmer   Mnemonics;

In ramp segments, mnemonics rl, r2, r3, r4, r5, r6, r7 and r8, time remaining, TM is read only.

In dwell segments, mnemonics tl, t2, t3, t4, t5, t6, t7 and t8, time remaining, TM is Read /Write.

Lc = 0 will cause programmes to link, see Commissioning, 7.10, Linking   Programmes.

Mnemonics for ramp and time have zero and -ve values, dependent on the configured P.V. decimal point, position as shown in the table below:-

Mnemonic	Action	xxxxx.	xxxx.x	xxx.xx	xx.xxx
rl , r2, etc.	stEP	0.	0.0	0.00	0.000
rl , r2, etc.	nonE	-1.	-0.1	-0.01	-0.001
rl, r2, etc.	End	-2.	-0.2	-0.02	-0.002
tl, t2, etc.	End	-3.	-0.3	-0.03	-0.003

Note 8 :-   If the remote input is configured as digital communications, (C8=2XXX) then R1, RH or RC become read write.

Communications

4.8. ASCII Status Word Format

Status words are used to transmit controller bi-state information over the communication lines. The data format for status words is identical to all other forms, except for the first character, which is always a ">" sign, indicating that the following four characters are hexadecimal. These characters are labelled "A", "B", "C" and ''D', "A" being transmitted directly after the ">" sign and character "D" being the last to be transmitted. The binary equivalant of character "A" gives bits 12 to 15, "B" gives bits 8 to 11, "C" gives bits 4 to 7 and "D" gives bits 0 to 3, in the tables below.

4.9. ASCII Status Words

Digits 'ABCD' are ASCII characters representing a

hexadecimal digit (O-9, A-F).

Status Word (SW)
Format (> ABCD)

Digit	Bit	Function	Attribute	Clear / Set
D	0	Data format	R/W	Free / Fixed
D	1	Sensor break	R/O	No / Yes
D	2	Key lock, front keys*	R/W	Enabled / disabled
D	3	N/A		
c	4	N/A		
c	5	Key Change of Parameter	R/W	Not change/changed
C	6	N/A		
c	7	N/A		
B	8	Alarm 2 state	R/O	On / Off
B	9	N/A		
B	10	Alarm 1 state	R/O	On / Off
B	11	N/A		
A	12	Alarm active 1 or 2	R/O	No alarm/Alarm 1 or 2
A	13	SP 2 active	R/W	SP1 /SP2
A	14	Remote active	R/W	Local / Remote
A	15	Manual mode	R/W	Auto / Man

* All front keys are disabled.

Optional Status Word (OS)
Format (>ABCD)

Digit	Bit	Function	Attribute	Clear / Set
D	0	Prog/Rmp St'us(LSB)		See Note 2
D	1	Prog/Rmp St'us		See Note 2
D	2	ProglRmp St'us		See Note 2
D	3	Prog/Rmp St'us(MSB)		See Note 2
c	4	Log of hold events	R/O	No hold/hold
c	5	Skip current segm't	R/W	Remain/skip
C	6	Ramp/dwell	R/O	Ramp/dwell
c	7	Digital input Inhibit	R/W	None/Inhibit
B	8	Segment no.(LSB)	R/O	See Note 1
B	9	Segment no.	R/O	See Note 1
B	10	Segment no.	R/O	See Note 1
B	11	Segment no.(MSB)	R/O	See Note 1
A	12	Dig Out Channel 4	R/W	Off / On
A	13	Dig Out Channel 3	R/W	Off I On
A	14	Digital Input 2	R/O	Off / On
A	15	Digital Input 1	R/O	Off /on

Note 1 :- Segment number is a nibble having the value 1 to 8 corresponding to the currently active segment.

Note 2 :-Program or ramp status is a nibble having the value 0 to 6.

Digit	Function	Attribute
D= 0	Reset programme / ramp	R/W
D=1	N/A	
D=2	Run programme / ramp	R/W
D=3	Hold programme	R/W
D=4	Programme end	R/O
D=5	Ramp end (still active*)	R/O
D=6	Programme in holdback	R/O

* After completing a ramp, should PV deviate from SP1, the working setpoint will ramp back to SP1 at the current ramp rate.

Comms

Communications

Extension Status Word (XS)
Format (>ABCD)

Digit	Bit	Function	Attribute	Clear / Set
D	0	Self tune	R/W	Off/St active
D	1	Adaptive tune	R/W	Off/At active
D	2	Disable Broadcast	R/W	Disable/Enable
D	3	N/A		
c	4	PID control	R/W	SP+PID/PID independent
c	5	Active PID set	R/W	PID 1 / PID 2
C	6	Dig Input 3	R/O	Off/on
c	7	Dig. Out Channel 2	R/W	Off/on
B	8	Programme No.(LSB)	R/W	See Note 4
B	9	Programme No.	R/W	See Note 4
B	10	Programme No.	R/W	See Note 4
B	11	Programme No.(MSB)	R/W	See Note 4
A	12	Motor Control(LSB)	R/W	See Note 3
A	13	Motor Control	R/W	See Note 3
A	14	Motor Control	R/W	See Note 3
A	15	Motor Control(MSB)	R/W	See Note 3

Note 3 :- For valve positioner configurations only. Motor control is a nibble with a value of 1 to 4, used to indicate or control the raise and lower outputs. In auto control, digit A is read only and will return a value of 0, 1 or 2. In manual, digit A is read or write and values of 3 and 4 are also valid to provide a nudge facility. A single write of value 3 will cause a lower pulse of minimum on time to be presented to the motor. Similarly a single write of a 4 will cause a raise pulse of the minimum on time to be presented to the motor.

A	=o	Raise and lower outputs off
A	=1	Lower output active.
A	=2	Raise output active.
A	=3	Nudge lower.
A	=4	Nudge raise.

Note 4 :- Programme number is a nibble with a value O-15 corresponding to the current programme number. The range of this parameter is dependent on the controller model number as shown below:-

Model	Attributes	Range of B
902P	R/O	0
903P	R/W	I-4
904P	R/W	I-15

Programme number is also available more directly using the mnemonic "CP"

Output Channel 3 (01)
Format (>ABCD)

Status of program controlled digital output 3 during each segment

Digit	Bit	Segment	Attribute	Clear / Set
D	0	ramp 1 to output 3	R/W	Active/non active
D	1	dwell 1 to output 3	R/W	Active/non active
D	2	ramp 2 to output 3	R/W	Active/non active
D	3	dwell 2 to output 3	R/W	Active/non active
c	4	ramp 3 to output 3	R/W	Active/non active
c	5	dwell 3 to output 3	R/W	Active/non active
C	6	ramp 4 to output 3	R/W	Active/non active
c	7	dwell 4 to output 3	R/W	Active/non active
B	8	ramp 5 to output 3	R/W	Active/non active
B	9	dwell 5 to output 3	R/W	Active/non active
B	10	ramp 6 to output 3	R/W	Active/non active
B	11	dwell 6 to output 3	R/W	Active/non active
A	12	ramp 7 to output 3	R/W	Active/non active
A	13	dwell 7 to output 3	R/w	Active/non active
A	14	ramp 8 to output 3	R/W	Active/non active
A	15	dwell 8 to output 3	R/W	Active/non active

Output End Status Channel 3 (02)
Format (>ABCD)

Status of program controlled digital output 3 at end

Digit	Bit	Segment	Attributes	Clear/Set
D	0	End to output 3	R/W	Active/non active
D	1	Spare		
D	2	Spare		
D	3	Spare		
c	4	Spare		
c	5	Spare		
C	6	Spare		
c	7	Spare		
B	8	Spare		
B	9	Spare		
B	10	Spare		
B	11	Spare		
A	12	Spare		
A	13	Spare		
A	**14**	Spare		
A	15	Spare		

Comms

Communications

Digital Output Status Word 3 (03)
Format (>ABCD)

Status of output 4 during each segment

Digit	Bit	Segment	Attributes	Clear/Set
D	0	ramp 1 to output 4	R/W	Active/non active
D	1	dwell 1 to output 4	R/W	Active/non active
D	2	ramp 2 to output 4	R/W	Active/non active
D	3	dwell 2 to output 4	R/W	Active/non active
c	4	ramp 3 to output 4	R/W	Active/non active
c	5	dwell 3 to output 4	R/W	Active/non active
C	6	ramp 4 to output 4	R/W	Active/non active
c	7	dwell 4 to output 4	R/W	Active/non active
B	8	ramp 5 to output 4	R/W	Active/non active
B	9	dwell 5 to output 4	R/W	Active/non active
B	10	ramp 6 to output 4	R/W	Active/non active
B	11	dwell 6 to output 4	R/W	Active/non active
A	12	ramp 7 to output 4	R/W	Active/non active
A	13	dwell 7 to output 4	R/W	Active/non active
A	14	ramp 8 to output 4	R/W	Active/non active
A	15	dwell 8 to output 4	R/W	Active/non active

Digital Output Status Word 4 (04)
Format (>ABCD)

Status of output 4 at end

Digit	Bit	Segment	Attributes	Clear/Set
D	0	End to output 4	R/W	Active/non active
D	1	Spare		
D	2	Spare		
D	3	Spare		
c	4	Spare		
c	5	Spare		
C	6	Spare		
c	7	Spare		
B	8	Spare		
B	9	Spare		
B	10	Spare		
B	11	Spare		
A	12	Spare		
A	13	Spare		
A	14	Spare		
A	15	Spare		

Digital Output Status Word 5 (05)
Format (>ABCD)

Status of output 2 during each segment

Digit	Bit	Segment				Attributes	Clear/Set	
D	0	ramp	1 to	output	2	R/W	Active/non	active
D	1	dwell	1 to	output	2	R/W	Active/non	active
D	2	ramp	2 to	output	2	R/W	Active/non	active
D	3	dwell	2 to	output	2	R/W	Active/non	active
c	4	ramp	3 to	output	2	R/W	Active/non	active
c	5	dwell	3 to	output	2	R/W	Active/non	active
C	6	ramp	4 to	output	2	R/W	Active/non	active
c	7	dwell	4 to	output	2	R/W	Active/non	active
B	8	ramp	5 to	output	2	R/W	Active/non	active
B	9	dwell	5 to	output	2	R/W	Active/non	active
B	10	ramp	6 to	output	2	R/W	Active/non	active
B	11	dwell	6 to	output	2	R/W	Active/non active	
A	12	ramp	7 to	output	2	R/W	Active/non	active
A	13	dwell	7 to	output	2	R/W	Active/non	active
A	14	ramp	8 to	output	2	R/W	Active/non	active
A	15	dwell	8 to	output	2	R/W	Active/non	active

Digital Status Word 6 (06)
Format (>ABCD)

Status of output 2 at end

Digit	Bit	Segment	Attributes	Clear/Set	
D	0	End to output 2	R/W	Active/non	active
D	1	Spare			
D	2	Spare			
D	3	Spare			
c	4	Spare			
c	5	Spare			
C	6	Spare			
c	7	Spare			
B	8	Spare			
B	9	Spare			
B	10	Spare			
B	11	Spare			
A	12	Spare			
A	13	Spare			
A	14	Spare			
A	15	Spare			

Comms

15

5.0. J BUS AND MODBUS

Parameter Words and Status Bits Address Maps.

Parameter Maps

Absolute Decimal Address		Attribute	Parameter	EI Mnemonic
J-Bus	Modbus			
1	**0**	R/O	Measured Value	PV
2	1	R/W	Setpoint 1	SL
3	2	R/O (R/W in manual)	Output Power	OP
4	3	R/W	Status Word	SW
5	4	R/W	Setpoint 1	SL
6	5	R/W	Prop. Band	XP
7	6	R/O	Set to Zero	0
8	7	R/W	Integral Time	TI
9	8	R/W	Derivative Time	TD
10	9	R/W	Cycle Time for Channel 1	CH
11	10	R/O	Display Min.	1L
12	11	R/O	Display Max.	1H
13	12	R/W	Alarm 1 SP	1A
14	13	R/W	Alarm 2 SP	2A
15	14	R/O	Set to 8000/H	
16	15	RAN	Heat Cool Dead Band	HC
17	16	R/W	Cutback Low	LB
18	17	R/W	Cutback High	HB
19	28	R/W	Relative Cool Gain	RG
20	19	R/W	Output 2 Cycle time	c2
21	20	R/W	Travel time	TT
23	22	R/O	VP Pot Value	MP
24	23	R/W	Setpoint 1	SL
25	24	R/W	Setpoint 2	s2
26	25	R/O	Remote Input	RI
27	26	R/W	Local Setpoint	RT
28	27	R/W	Manual Reset	MR
29	28	R/W	Cool Cycle Time	c c
30	29	R/W	O/P1 Limit	HO
31	30	R/W	O/P2 limit	LO
32	31	R/W	Remote O/P1 Limit	RH
33	32	R/W	Remote O/P2 Limit	RC
34	33	R/W	Power during Sensor Break	BP
35	34	R/W	Ramp Rate	RR
36	35	R/O	Time Remaining	TM
37	36	R/W	Adaptive Tune Trigger Point	TR
38	37	R/W	Emissivity	PE

Absolute Decimal Address		Attribute	Parameter	EI Mnemonic
J-Bus	Modbus			
39	38	R/O	Error	ER
40	39	R/W	Optional Status Word	OS
41	40	R/W	Extended Status Word	x s
42	41	R/W	Motor Low limit	LE
43	42	R/W.	Motor High Limit	EH
44	43	R/W	Travel Time Down	Tt
45	44	R/W	Minimum On Time	MT
46	45	R/W	Valve Update Time	TP
47	46	R/O	Set to 8000/H	
48	47	R/W	Proportional Band (2)	P2
49	48	R/W	Integral Time (2)	I2
50	49	R/W	Manual Reset (2)	R2
51	50	R/W	Derivative Time (2)	D2
52	51	R/W	Relative Cool Gain (2)	G2
53	52	R/O	Set to 8000/H	
54	53	R/W	Current Programe Number	CP
55	54	R/O	Measured Value	PV
56	55	R/W	Current Segment Number	OS(B)
57	56	R/W	Working	SP
58	57	R/O	Time Remaining	TM
59	58	R/O	Loops Remaining	LR
60	59	R/W	Output Status 1	01
61	60	R/W	Output Status 2	02
62	61	R/W	Output Status 3	03
63	62	R/W	Output Status 4	04
64	63	R/W	Loop Count	Lc
65	64	R/W	Holdback	Hb
66	65	R/W	Ramp 1	rI
67	66	R/W	Level 1	lI
68	67	R/W	Dwell	dI
69	68	R/W	Ramp 2	r2
70	69	R/W	Level 2	I2
71	70	R/W	Dwell 2	d2
72	71	R/W	Ramp 3	r3
73	72	R/W	Level 3	I3
74	73	R/W	Dwell 3	d3
75	74	R/W	Ramp 4	r4
76	75	R/W	Level 4	I4
77	76	R/W	Dwell 4	d4
78	77	R/W	Ramp 5	r5
79	78	R/W	Level 5	I5
80	79	R/W	Dwell 5	d5
81	80	R/W	Ramp	r6
82	81	R/W	Level 6	I6

Comms

Communications

Absolute Decimal Address		Attribute	Parameter	El Mnemonic
J-Bus	Modbus			
a3	a2	R/W	Dwell 6	d6
a4	a3	R/W	Ramp 7	r7
a5	a4	R/W	Level 7	l7
86	85	R/W	Dwell 7	d7
a7	86	RAN	Ramp 8	r8
88	a7	R/W	Level a	l8
a9	88	R/W	Dwell 8	d8
90	a9	R/W	Output Status 5	05
91	90	R/W	Output Status 6	06
92	91			
to	to	R/O	Set to 8000/H	
100	99			
107	106	R/O	Software Version Number	
108	107	R/O	Instrument Type = 9020	
109	108	R/O	Display Max.	
110	109	R/O	Display Min.	
111	110	R / O	Setpoint 1 Max	
112	111	R/O	Setpoint 1 Min.	
113	112	R/O	Setpoint 2 Max.	
114	113	R/O	Setpoint 2 Min.	
115	114	R/O	Local Trim High Limit	
116	115	R/O	Local Trim Low Limit	
117	116	R/O	Remote High Scaler	
118	117	R/O	Remote Low Scale	
119	118	R/O	8000/H	
120	119	R/O	8000/H	
121	120	R/O	Company Code = 500	
122	121	R/O	Inst. Type=9020	
123	122		Out of Map = ERROR 2	

Bit Map

Absolute Decimal Address		Attribute	Origin/Description
J-BUS	MODBUS		
1	**0**	R/O	Sensor Break
2	1	R/W	Manual
3	2	R/W*	Remote
4	3	R/W	Setpoint 2
5	4	R/O	Alarm (1) Active
6	5	R/O	Alarm (2) Active
7	6	R/W*	Self tune
8	7	R/W	Adaptive tune
9	8		0
10	9	R/O	Sensor Break
11	10	R/W	Keylock
12	11		0
13	12		0
14	13	R/C	Parameter changed via keys
15	14		0
16	15		0
17	16	R/O	Alarm 2
18	17	R/O	0
19	18	R/O	Alarm 1
20	19	R/O	0
21	20	R/O	Alarm 1 or 2
22	21	R/W*	Setpoint 2
23	22	R/W*	Remote
24	23	R/W	Manual
25	24	R/W*	Self tune
26	25	R/W	Adaptive tune
27	26		
to	to	R/O	**0**
40	39		
41	40	R/O	}
42	41	R/O	} Programme Status
43	42	R/O	} (only when program is running))
44	43	R/O	}
45	44	R/C	Hold Logged

Communications

Absolute Decimal Address J-BUS	MODBUS	Attribute	Origin/Description
46	45	R/W	Skip Current Segment
47	46	R/O	Dwell (0 = Ramp)
48	47	R/O	0
49	48	R/O	Segment No. (LSB)
50	49	R/O	Segment No.
51	50	R/O	Segment No.
52	51	R/O	Segment No. (MSB)
53	52	R/O	Dig. Output 2(Ch.4)
54	53	R/O	Dig. Output 1 (Ch.3)
55	54	R/O	Dig. Input 2
56	55	R/O	Dig. Input 1

Programme status is set by the value of the nibble created by addresses 41, 42, 43 and 44 as above where 41 = bit 0,42 = bit 1, 43 = bit 2 and 44 = bit 3.

Programme status is the value of the nibble as shown below :-

Value of Nibble

0	Reset Prog./Ramp Function	R/W
1	N/A	
2	Run Prog./Ramp Function	R/W
3	Hold Programmer	R/W
4	End Programmer	R/O
5	RMP Engaged	R/O
6	Programme in Holdback	R/O

Bit Position	Attribute	Status Description (if set)
LSB 1	R/O	Thermocouple Break
2	R/O	Manual Selected
3	R/O	Remote Selected
4	R/O	2nd S/P Selected
5	R/O	Alarm 1 Active
6	R/O	Alarm 2 Active
7	R/O	Selftune Selected
MSB 8	R/O	Autotune Selected

Section **7 -Error Messages**

Contents   *Page*

1.0 General

The 902/3/4 controller has incorporated in its software programmes to detect faults in the operating procedures of the instrument. If one of these faults are detected, an error message will appear in either the upper or lower displays. These error messages can then be used to determine the corrective action necessary to return the instrument to full operational status. Some of these error messages are the result of faults within the controller, whilst others are due to incorrect operation of the instrument. Below is given a list of these error messages and the corrective action necessary to illiminate them.

2.0 Configuration Mode Error Messages

Illegal values, i.e. don't appear in the configuration list(see paragraphs 4.2.1 to 4.2.10 and 3.3.1 of section 4), set for C1 to C1 in the instrument configuration and dlG in the user configuration will display that mnemonic plus an E(eg C2 E) when attempting to exit, as shown in Figure 1.
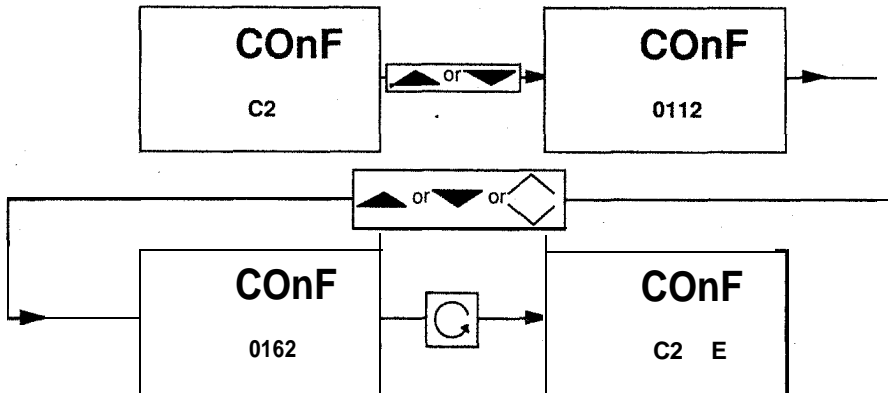

Figure 1

Trying to set character "A" of mnemonic "C4" to any value other than '0' or '1' on the instrument model number 902s will also cause the error display "C4 E" to appear. The corrective action in this instant is to return and correct the value of the corrupted mnemonic as shown in Figure 2.
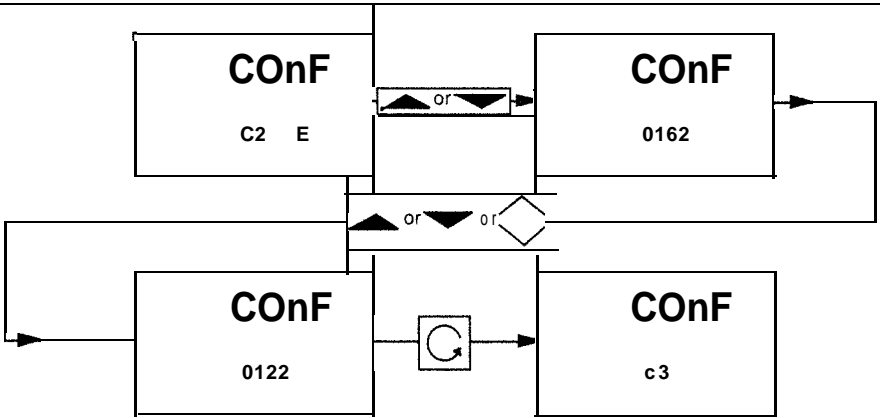
Error Messages

Figure 2

If the instrument mains supply is interrupted whilst an illegal value is set, then after performing the entry to configuration procedure(see paragraph 4.1 of section 4), "C Er" will be appear on the upper display. This indicates that the illegally set mnemonic, C1 to C10 or dlG must be corrected. If it is not known which mnemonic is set illegally, enter and attempt to exit each one, as described in paragraph 3.2 and 4.2 of section 4. When the illegally set mnemonic is entered the exit will be barred by an error message, i.e. "C2 E". Carry out the procedure illustrated in Figure 2. The "C En" message will not be cleared from the display until the configuration mode has been exited and re-entered.

3.0 **Operating Mode Error Messages.**

In the unlikely event of a fault occuring within the controller, an error message will be display if it is detected by the instrument software. The error message will be presented in the upper display in place of the measured value.

Because the outputs may default to an unsafe state under these conditions, the appearance of a error message on the display forces all the outputs to a predetermined safe condition, either fully on or fully off (see Note 1). The controller re-examines the fault condition every 5 seconds to assess if it still exists. As soon as the controller recognises that the fault has cleared, the current measured value replaces the error message and the outputs revert to normal drive. These error messages, their meaning and the corrective action necessary to illiminate them are given in the following table :-

Error Message	Fault Description	Necessary Corrective Action
1 Er	Watchdog Register	Change Microprocessor P.C.B.
3 Er	Stack Depth	Change Microprocessor P.C.B..
4 Er	Watchdog Timeout	Change Microprocessor P.C.B.
C Er	Invalid Config. Value	Enter Config., ammend incorrect value, exit config.
H Er	Invalid Hardware Ident	Check connections on all plug in hardware modules, enter config.,update "ldn", exit config.
C ch	Config. Checksum Error	Enter config., check all config. values and exit config.
P ch	Parameter C'ksum Error	Ammend corrupted value in "OPEr", "lnSt", "PrOG" or "SUPEr" scroll list.
Or	PV over or under range	Check sensor and wiring for open circuits or reverse polarity.
Or0	Lead Comp. or id'fication	Change Microprocessor P.C.B.
Or 1	Zero	If recalibration does not rectify this fault, change microprocessor P.C.B.
Or2	Reference	Change Microprocessor P.C.B.
Or3	C.J.C.	If recalibration does not rectify this fault, change microprocessor P.C.B.
Or 4	Power Feedback	Change Microprocessor P.C.B.
Or 5	Remote Input	If recalibration does not rectify this fault, change microprocessor P.C.B.
PrF	Power fail during a programme	No action necessary. This message will flash alternately with measured value until the programme setpoint is achieved.
stop	Aborted Self tune	Deselect Self tune

Note 1 :- The one error message that does not force the outputs to a predetermined safe condition, either on or off, is "Or". The display of the error message "Or" forces the output of either the heat or the cool channel to the value set under "Sbr" in the supervisor mode.

Error
Messages

Glossary of Terms

Adaptive Tune   Adaptive tune is a background algorithm which continuously monitors the error signal (P.V. - S.P.) and analyses the loop response during process   disturbances.

If the algorithm recognises an oscillitory or under damped response it then recalculates the P.I. and D. paramters.
Adaptive tune should be used in the following cases:
1) Processes that require frequent parameter variations as a result of load, setpoint or other changing conditions.
2) Process that cannot tolerrate the on/off sequence required for the selftune.
Adaptive tune should not be used in the following cases:
1) On processes that experience regular external disturbances that could mislead adaptive tune.
2)   On complex systems where loops are interwired. Adaptive tune wil operate unsuccessfully with interactive loops, e.g. typical multi-zone extruders.

When adaptive tune has been initiated the controller looks after its own control parameters and all the user need know is that he can only inspect the P.I and D parameters, as they are settable only by the DRA algorithm *unitl* adaptive tune is switched off.

The user may predefine the scope of operation by presetting some of the control parameters before initiating adaptive tune. If derivative time (TD) is set to zero before adaptive tune is initiated, the DRA algorithm will only adjust the P and I terms (if necessary).   This is a useful feature if it is required to hav PI control action only, for example when controlling a loop with a large transport delay.

If integral (TI) has been preset to zero to implement a PD controller, the algorithm may add integral action if the control action does not achieve zero error or if the P and D terms have been set sufficiently incorrect to cause a poor response.

In many instances the adaptive tuner will correct badly set control parameters first time and thereafter do nothing more than monitor for subsequent instances of poor response.

Disturbance Response Analysis (DRA), like most adaptive algorithms, can be confused by a regular external disturbance to the process or excessive process noise

Appendix

Auto/Manual Alternative control conditions that can be selected within the controller. The instrument can be set into an automatic mode or set into manual operation. In 'auto' a closed loop condition, the power to the process is automatically computed and set by the sensor output relative to the setpoint.

In 'manual' an open loop condition, the power to the process is manually set and not influenced by the sensor.

In manual the instrument is not controlling so ensure that the power output is set at safe level.

Auto Tune For slow loads the DRA algorithm gives best performance with fairly slow input filter. This filter is automatically applied inside the controller but it can be sized better if the self tuning algorithm is executed first.

Auto and Adaptive Tune The auto-tuner is a one-shot algorithm which permits the user to tune the instrument control parameters to suit new process loop conditions.

On completion the following parameters will be-automatically adjusted.

Parameters modified by the Self Tune Routine

Proportional Band, Integral Time, Derivative Time, Cutback Low, Cutback High, Heat Cycle Time, Cool Cycle Time, Relative Cool Gain

Cutback Action Cutback is provided to improve the large step response of PID control.

When cutback is set to zero it has no effect on control action.

When the process value is below setpoint an error value exceeding the cutback low limit, the integral accumulator is adjusted such as to maintain output at maximum. When PV becomes greater than setpoint minus cutback low, normal PID control action resumes.

A similar but inverse action occurs for cutback high (see integral).

Derivative Action Derivative action is normally used to give a fast response to changes in process value and to improve process stability. Alternatively derivative action may be configured to act on the error signal which is useful in ramping applications.

Direct Acting Control action such that the output increases as the process value increases.

Emissivity Used with pyrometer inputs, and is the measure of the efficiency of the radiating surface as compared to an ideal black-body radiator.

integral Action	Integral action is used to achieve zero steady state control error. The product of error and proportional gain is integrated into an accumulator which is added to output signal. A problem with integral action is that when large error signals exist for a significant period of time, such as following a large scale setpoint step, the integral accumulator assumes a very large value. The error signal must then go negative to reduce the integral accumulator. This will cause overshoot. Various steps are taken to reduce this effect when the outputs are saturated. Addititionally a facility 'Cutback' is provided (see Cutback).
Local/Remote	Alternative selections of the working setpoint. A local setpoint has a value stored within the controller and a remote setpoint is an analogue signal input into the rear terminals.
Manual	Allows manual adjustment of the output level which overrides the output level demanded by the control action of the automatic mode.
Motor Travel Time	Motor travel time is the time that the motor takes to travel from minimun to maximum position and can be determined from the data sheets or by timing.
Non-Latching Alarms	Non-Latching alarms respond only to the physical alarm condition. The alarm indication will be maintained for the duration of the condition only.
Programme	A programme creates a time/profile from a sequence of time and process coordinates. The resultant profile therefore consists of linear rates of change variable with time. Each linear section of the prifile is referred to as segment.
Proportional Action	With proportional action the output of the instrument varies proportionally to the error between setpoint and process value. The propband is the range of process value over which this linear gain action occurs before the output saturates at maximum or minimum. This often expressed as percentage of the instrument span. The gain of the instrument varies inversly as the proportional band increases.
Ramp	One segment of a programme where the controller setpoint moves from one level to another linearly during a fixed period of time.

Appendix

Reset   An action which returns a completed or running programme to the start condition i.e. controlling on SP1, SP2 or remote SP.

Reverse Action   Control action such that the output decreses as the process value increases.

Run   An action which starts a programme running or restarts ift from a hold condition.

Scroll   A method of presenting a large number of mnemonics or numerals, on the display, in sequence, so allowing the operator to make a choice.

Sensor Break Power   Sensor Break Power the default power to be requested when a sensor break condition is detected.

Setpoint   The value at which a controller is set to control a system.

Span   The difference between the upper and lower limits of a range expressed in the same units as the range.

Working Setpoint   The setpoint currently selected and being used by the control algorithm for calculating the output power,