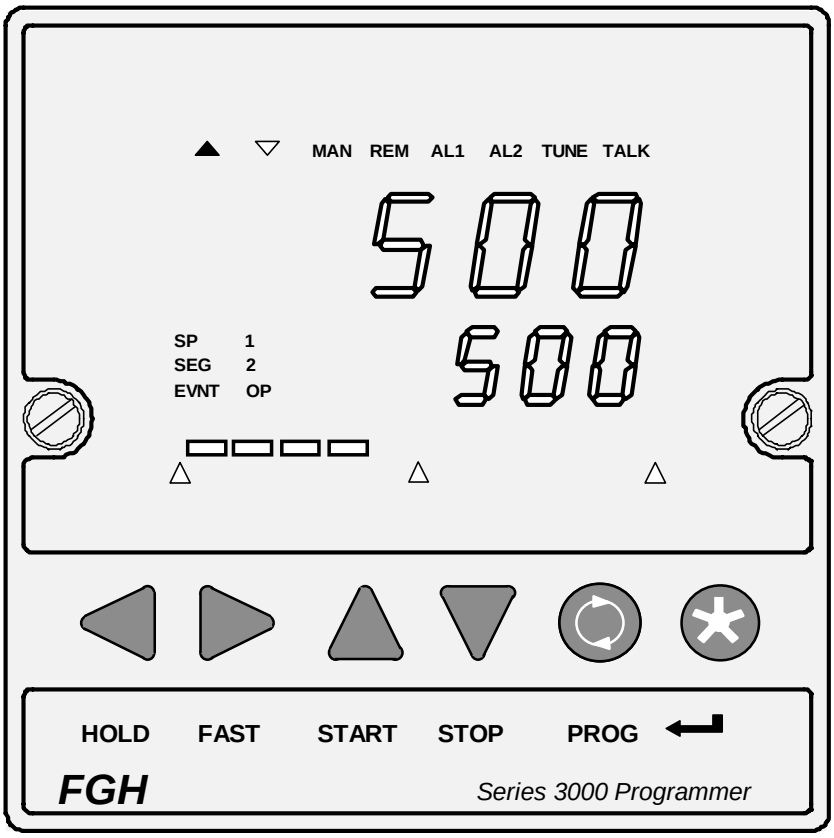
Engineers Manual



Series 3000

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Contents.

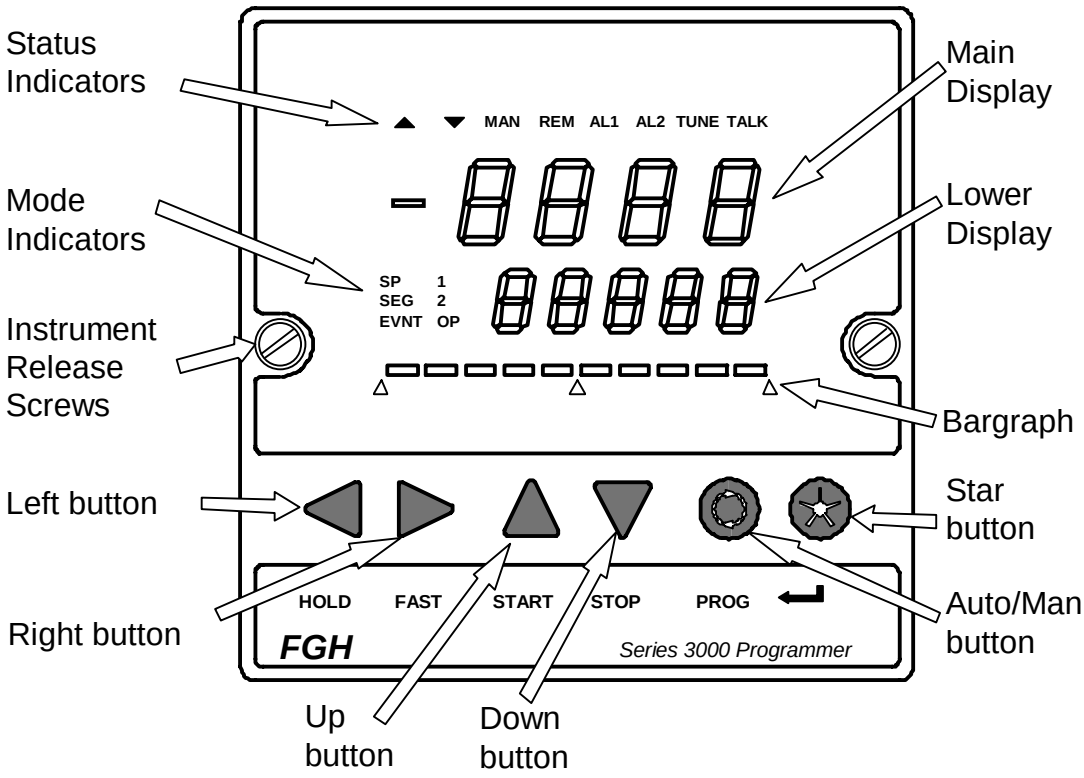
SECTION A - GENERAL

1.0 Introduction

This manual is designed to be read by an engineer configuring the P3000 programmer or S3000 Controller to customer requirements before delivering a new instrument, or the reconfiguring of an existing instrument to accommodate new requirements. It covers selection and fitting of option boards, hardware configuration of these boards with patch links, and software configuration and calibration of the instruments programmer and controller parameters.

The task of installing the S3000/P3000 is covered in a separate installation manual provided with the instrument. Also, the installation, configuration and use of the serial communications option is covered by the Series 3000 communications manual.

Series 3000 FRONT PANEL



1.1 Displays

The main display on the S3000/P3000 normally shows the process variable, while the lower display parameter is shown by the illuminated mode indicator; setpoint, output, valve position, time, segment or event.

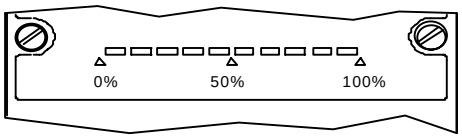
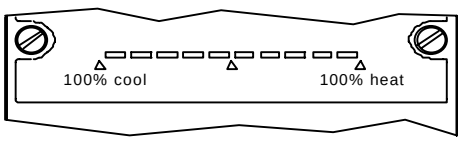
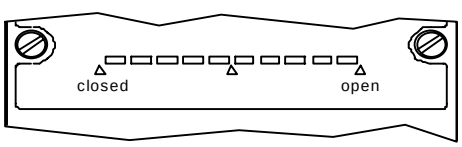
1.2 Status indicators

The status indicators provide information on the status of the instrument. The following is a brief explanation of each of the legends.

▲1	Heat output is on in time-proportion mode. Not used for analogue outputs.
▼2	Cool output is on in time-proportion mode if configured as a heat/cool instrument. Not used for analogue outputs.
MAN	The instrument output is under manual control
REM	Currently active setpoint is from a remote source, this may be from serial communications or analogue into a remote set point card option. (S3000 only)
AL1	Alarm 1 is active, if alarms are latched then this indication is also latched until cleared.
AL2	As alarm 1, but for alarm 2
TUNE	The tuner is currently running.
TALK	The instrument is being addressed via serial comms.

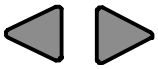
1.3 Bargraph

The S3000/P3000 is equipped with a bargraph, displaying output. The bargraph is arranged differently for different control types;

CONTROL TYPE	BARGRAPH DISPLAY
AUTO/MANUAL AND HEAT ONLY	
HEAT/COOL	
MOTORISED VALVE	

2.0 Buttons

The S3000/P3000 front panel buttons have the following functions:



The right and left buttons are used to select which parameter is to be displayed on the display. In short scroll these button are also used to enter the long scroll or profile scroll.

These buttons are used only to change the value of the parameter selected in the long scrolls or emode, or to change the value of output in the short scroll.

This is the auto/manual changeover button, it is used when the instrument is in short scroll displaying output

The star button is used to show different information on the main display during calibration (section E), and to unlatch a latched alarm when the relevant alarm level in the controller long scroll is being displayed. The star button is used on the P3000 profile generator to access the alternative functions assigned to each button (HOLD, FAST, STOP, START and PROG). To access these functions, press and hold the star button and then press the button above the desired function.

3.0 Short scroll

Short scroll is the normal operating condition of the instrument, when the main display is indicating the value of the process variable and the lower display is indicating the value of setpoint, output, valve position, time, segment or events depending on the mode indicator lit, **SP**, **OP**, **SEG** or **EVNT**.

The function of the lower display may be changed by pressing the ◁**3** or ▷**4** buttons. This will proceed forwards or backwards through the short scroll list depending on which button is pressed.

SP The current control setpoint.

SP + 1 The current control setpoint for profiler channel 1. Press the star key to view the current segment target level.

SP + 2 The current control setpoint for profiler channel 2. Press the star key to view the current segment target level.

2 The current value of the second measured input if used as MV2.

OP The current controller output in %. Press the A/M button to toggle between auto and manual modes.

OP+2 For thermal head ratio controllers, shows the current air setpoint.
For motorised valve controllers, press the Star key to display the actual valve position in %.

SEG If a profile is running the lower display shows the current running program and segment number. Press the star key to display the segment elapsed time in hours and minutes.
If no profile is running the lower display shows the currently selected profile number. Press Star + A/M to select a new profile number.

EVNT Shows the current event output status.

The short scroll list will only include those parameters that are applicable to the current operating mode of the instrument.

4.0 Long scrolls

In the S3000 controller, the long scroll is a controller scroll. This contains all the control parameters and commissioning data. The P3000 programmer has two long scrolls, the controller scroll, which is the same as the long scroll in the S3000, and the programmer scroll, which contains all the program data on the ten profiles stored in the P3000.

4.1 Entry and exit

To enter the long scroll of an S3000 Controller, press and hold the left or right button. After a second the display will change to show the mnemonic of the first of the long scroll parameters on the lower display and the value of that parameter on the main display.

To enter the controller scroll on the P3000 Programmer, press and hold the right button. After a few seconds the first parameter group mnemonic of the controller scroll will be seen on the lower display with the value of that parameter on the upper display.

To enter the programmer scroll on the P3000 Programmer, press and hold the left hand button. After a few seconds the first programmer parameter, delay, will be shown on the lower display and its value on the upper display.

To exit any long scroll, press and hold the left or right button. After a second the display will change back to that of the short scroll. Alternatively, if no buttons are pressed for about 20 seconds, then the instrument will automatically revert to short scroll.

4.2 Controller long scroll

Controller long scroll parameters include commissioning PID terms, setpoint and alarm levels. Only relevant parameters are included in the long scroll list, eg. if alarm 2 is not used then alarm 2 levels will not be on the long scroll list. Similarly, valve action time, for example, is only listed if the instrument is configured as a valve positioner.

4.2.1 Parameter groups

The controller scroll consists of a large number of parameters, so to improve ease and speed of use, the parameters are presented to the user in groups. At the start of each group, the group name is shown on the lower display with the upper display

blank. Pressing the star button will gain access to the parameters within that group. Pressing the scroll button will advance the scroll to the start of the next group.

If the group is entered (by means of the star button), then the parameters are listed in sequence in the usual way when the scroll button is pressed. At the end of the group the group name is displayed again. This enables the user to re-enter the same group again if required.

Some parameter groups are always present (such as the SP group), while others are present only if they contain parameters applicable to the current instrument configuration.

Scroll between parameters within a group using left and right buttons. These are the reverse and forward scroll controls. When the end of the long scroll list is reached the list wraps round to the beginning again.

The following is a complete list of the Controller long scroll parameters with their associated mnemonics and explanation of contents.

Group	Mnemonic	Parameter	Meaning
PASS	**PASS**	password entry	Password entry. See section 5.
SP	**SPLOC**	set point local	local set point in displayed units
	SPL 2	set point local 2	local set point 2 in displayed units for 2 channel profilers
	S-tyP	setpoint type	Setpoint to be used **loc** Local, set point = SPLOC **re** Remote, set point is remote **ind** Indexed, set point is sum of local and remote setpoint **lo** Remote setpoint is low clamped to SPLOC **hi** Remote setpoint is hi clamped to SPLOC
	rAtE	setpoint slew rate limit	Maximum rate of change of control set point in digits per hour
	GAIN	remote setpoint gain	The measured remote setpoint is multiplied by this GAIN value before being used for control.
	ASP1	aux setpoint 1	Setpoint value selected by digital input 1
	ASP2	aux setpoint 2	Setpoint value selected by digital input 2
Contr	**tune**	tuner on/off	On or off, perform one shot tune if on
	ProP	default prop band	Heating proportional band in % if positive, or on/off hysteresis in digits if negative. When terms sets are being used, press the STAR key to view the currently active prop band.
	IAt	default integral time	Integral action time in seconds When terms sets are being used, press the STAR key to view the currently active integral time.
	rESEt	manual reset	Manual reset value in % when PI or P only control action is used
	dAt	default derivative time	Derivative action time in seconds When terms sets are being used, press the STAR key to view the currently active derivative time.
	dAPr	derivative approach band	Band around set point in prop bands, in which derivative action is enabled
	rEL	cool relative PB	Cool propband in multiples of heat propband
	dbAnd	heat/cool deadband	For heat/cool, if positive, the % output band in which neither heat nor cool outputs are on. If negative, the amount of heat output power at which cool comes on
rAtio	**rAtio**	thermal head ratio	Themal head gain

	bAnd	ratio band	Band around setpoint inside which the ratio linearly reduces to 1.0 at zero error.
	hi-oP	max air SP output	High limit of air set point output
	th-hi	max thermal head	High limit of positive thermal head
	rEF	ratio limit reference	Parameter to which ratio thermal head limits th-hi and th-lo are referenced **off** th-hi and th-lo are not used **setp** limits are relative to load setpoint **load** limits are relative to load temperature
	th-lo	max thermal head low	High limit of negative thermal head
SEtS	**SP X**	terms set setpoint	Trigger setpoint for terms set X
	PB X	terms set propband	Proportional band in % used in terms set X
	Iat X	terms set integral	Integral time in secs used in terms set X
	dAt X	terms set derivative	Derivative time in secs used in terms set X
	Hb X	terms set hold band	Hold band in terms set X (P3000 only)
	Ht X	terms set hold type	Hold type in terms set X (P3000 only)
ALrS	**ALr-1**	alarm 1	Alarm 1 level Press A/M to view alarm type Press Star to reset the alarm
	ALr-2	alarm 2	Alarm 2 level Press A/M to view alarm type Press Star to reset the alarm
OP	**OP1**	auxiliary output 1	Auxiliary output power selected by digital input 1
	OP2	auxiliary output 2	Auxiliary output power selected by digital input 2
	H PL	h power limit	Heat power limit, in %, for heat/cool controllers, and high power limit for heat only units
	L PL	low power limit	Low power limit in %, for heat only controllers
	C PL	cool power limit	Cool power limit in %, for heat/cool controllers
	Act-t	valve action time	Time in seconds for full travel of motorised valve
	H CyC	heat cycle time	Heat output T.P cycle time in seconds
	C CyC	cool cycle time	Cool output T.P cycle time in seconds

4.3 Programmer long scroll

The programmer long scroll gives access to all the parameters governing profile generation in the P3000 Programmer. The programmer scroll is entered by pressing and holding the left scroll button.

As with the controller scroll, movement forwards and backwards through the programmer scroll is by use of the left and right hand buttons and the scroll wraps around at the end of the scroll back to the beginning.

The programmer scroll consists of two parts, the first group of parameters relate to the whole instruments profile generation facilities, such as the delay before the chosen program starts, and the other part is the editing of each of segments of the program number selected by the '**prog**' parameter.

All parameters in the programmer scroll are always present except for those that relate to the setting of the event relays, which are only present if one or more of the instruments option slots are configured as event outputs or as an event driver.

Mnemonic	Parameter	Meaning
dELAy	delayed start time	Profile delayed start time in hours and minutes up to a limit of 99 hours 59 minutes. This is the time that will elapse between the profile being started and the profile beginning to run.
Er-r	ready mode event status	This parameter shows what state the eight event relays will assume during a reset condition. ie. when a profile is not running, and when a delay start

		is executing. This and other event relay parameters, show the setting of the eight event relays, numbered 1 to 8, left to right, on the upper display. The relays are represented as high marks for on and low marks for off. The relays are edited one at a time, the one being edited flashes. press the A/M button to change the relay being edited. Use the up and down buttons to turn the selected relay on or off.
ProG	program number	This parameter is the program number to be examined in the rest of the programmer scroll. Use the up and down buttons to change this setting as usual.
Hold	hold band	The hold band is the band outside which the programmer will go into hold, ie. pause the program running, and represents the difference between measured variable and set point (error). The band is in the same units as the measured variable display and is settable between 1 and 100 digits. This parameter works in conjunction with the next to provide the comprehensive hold facility. If a profile is running and segment based terms sets are used then press the star key to view the currently active hold band value.
HtyPE	hold type	The hold type shows under what conditions, if any, the programmer will hold a running program when the error exceeds the hold band. The upper display consists of four digits or dashes. The digits represent hold conditions that are active, a dash indicates that the programmer would not go into hold during that condition. **d** dwell, hold during dwells, ie. segments with an aiming level the same as the previous segment. **r** ramps, hold during ramps, ie. segments with an aiming level different to that of the previous level and having a non-zero time. **b** below, hold when the measured variable is more than a hold band below the control set point. **a** above, hold when the measured variable is more than a hold band above the control set point. If a profile is running and segment based terms sets are used then press the star key to view the currently active hold band value.
rEPtS	repeats	The number of times that a program will repeat itself between segment 1 and an END or GO instruction, may be set between 0 (execute only once, do not repeat at all) and 999 (execute 1000 times in all) Press the star key to view the number of repeats remaining during a running profile.
t1 1	chan 1 seg 1 time	The time taken for segment 1 of the profile to execute on channel 1 The time is set in Hours and minutes.
L1 1	chan 1 seg 1 level1	The target level for segment 1 of the profile channel 1
t2 1	chan 2 seg 1 time	The time taken for segment 1 of the profile to execute on channel 2
L2 1	chan 2 seg 1 level	The target level for segment 1 of the profile channel 2
Er 1	seg 1 events	Event relay setting for segment 1. Interpretation of settings and adjustment is as for 'event relay-reset'
Set 1	seg 1 terms set	The terms set number to be applied during segment 1. Set to OFF if the default terms are to be used.
t1-2	chan 1 seg 2 time	time set in hours and minutes for segment 2 (and so on up to the maximum segment) to execute. In addition this parameter may be set to 'end' by pressing the down button when the time indicated is zero. This would cause the program to terminate when this segment is executed. Also, further presses of the down button will cause this parameter to be set to 'go 9', 'go 8' etc. When executed, this would cause program execution to switch to the beginning of the appropriately numbered program Note that a time of zero causes a step change in the setpoint when that segment is executed.
L1 2	chan 1 seg 2 level	level set as the aiming point for segment 2 (and so on until level-25). Note that if this level is the same as that for the previous segment then this segment is known as a dwell.
Er 2	seg 2 events	event relay settings for segment 2 (and so on up to segment 25), displays interpreted and settings adjusted as in 'event relay-reset'

Note that the programmer long scroll sequence is such that the four parameters time, level ,event relays and terms set are presented in identical fashion, in sequence, for segments 2 through to the maximum and that this section of the scroll along with the segment 1 parameters, hold and hold type are related to the program number set at the beginning of the long scroll.

5.0 Passwords

5.1 general

The S3000 controller is equipped with multi-zone password protection, enabling some parameters to be password protected while leaving others unprotected if desired.

The essence of the password is a four digit code representing a sequence of four button presses. When the password is being entered any of the six front panel buttons are valid, they are arbitrarily assigned values 1 to 6 with the left button as 1 and the star button as 6

5.2 Factory settings

When initially set up, the S3000 has its password set to 0000. This is the clear condition, when this is set then no password protection is provided.

5.3 Setting the password

In order to set the password the instrument must be put into 'E' mode. (See section 6.1). This consists of removing it from its sleeve, fitting the push on link to the back of the processor board and replacing the instrument in its sleeve.

With the instrument in 'E' mode repeatedly press the right button until **PASS** is displayed on the lower display and then press the star button to enter the group. The upper display now shows the current password, or 0000 if the password is clear.

Pressing the right button again causes **ALTER** to be displayed on the lower display. This is a question as to whether to alter the current password. The up and down buttons are used to select **yes**, **no** or **clr** (clear) in response to the question. To leave the password unchanged select '**no**', to set the password to 0000 select '**clr**' to modify the password select '**yes**'.

Press the right button. If **clr** was selected then the password has now been cleared, if **yes** was selected then **PASS** is now displayed and the new password should be entered. Press your selection of four buttons. On the fourth button press the display will change to request the scope of the new password.

5.4 Setting the scope

With the controller in 'E' mode and **SCOPE** on the lower display then the zones protected by the password may be selected.

P (P3000 only) When set, the password must be entered before any of the programmer long scroll parameters (except '**PROG**') can be modified.

S When set, the password must be entered before the setpoint value, type, rates or auxiliary setpoints can be modified.

A When set, the two alarm levels are protected.

H When set, the auto/man status of the instrument is protected.

Use the up and down buttons to select the zones requiring protection. This completes the setting of the password scope. Note that if the password is not clear then all the parameters of the controller long scroll not mentioned above are protected by the password.

SECTION B - SOFTWARE CONFIGURATION

6.0 General

The S3000/P3000 controller is capable of being configured as any of a multitude of different instruments. This is because all the software necessary to accommodate any of the sensor types, control formats and output types supported is built into the basic instrument. All that is required to produce a controller customised to a specific application is to fit the appropriate option boards (section D - hardware configuration), configure the instrument in 'E' mode and calibrate it.

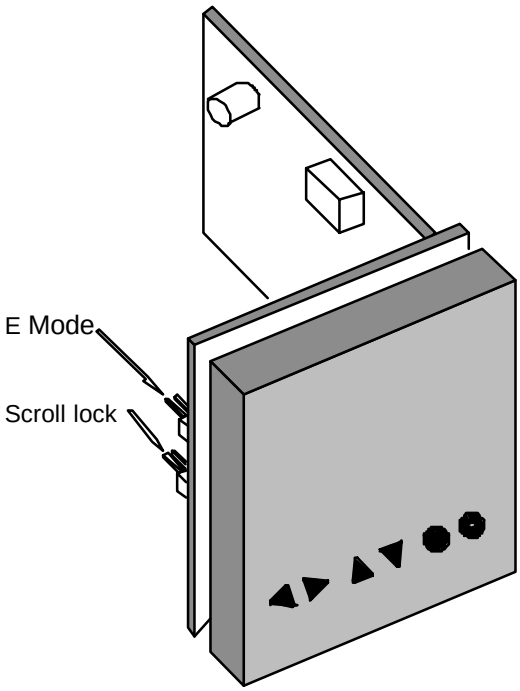
6.1 E Mode

'E' mode, or Engineers mode, is used to initially configure the instrument and modify seldom used parameters. It is also used for calibration.

To enter E mode, remove the instrument from its sleeve by undoing the two screws visible on the instrument front panel. The instrument should now withdraw smoothly.

It will now be seen that on the processor board, next to the square processor, are two pins labelled EMODE. The push on link provided should be fitted so as to connect these pins together.

The instrument may now be replaced in its sleeve and the front panel screws driven home. The instrument is now in E mode, remove this link to return the instrument to normal operating mode.



6.2 Lock mode

Next to the 'E' mode link are two pins marked 'LOCK'. The purpose of these pins is to provide a means of protecting the parameters in the long scroll from unauthorised tampering. If the push on link is fitted to the LOCK pins then no long scroll parameters can be modified from the front panel until the link is once more removed. In other words, the LOCK mode works as if a password with maximum scope had been set and could not be satisfactorily answered.

7.0 Emode parameter groups

The engineer mode scroll consists of a large number of parameters, so to improve ease and speed of use, the parameters are presented to the user in groups. At the start of each group, the group name is shown on the lower display with the upper display blank. Pressing the star button will gain access to the parameters within that group. Pressing the scroll button will advance the scroll to the start of the next group.

If the group is entered (by means of the star button), then the parameters are listed in sequence in the usual way when the scroll button is pressed. At the end of the group the group name is displayed again. This enables the user to re-enter the same group again if required.

Some parameter groups are always present (such as the IP1 group), while others are present only if they contain parameters applicable to the current instrument configuration.

7.1 Input 1 Group 'IP1'

The **IP** group contains the parameters used to set up the primary measurement input.

7.1.1 Input type

The first parameter listed in this group is **I-P**. This is the input sensor type and temperature units to be displayed. The number displayed is adjustable between 0 and 35. The meaning of this code is as follows.

	0 Type S,	(Pt-10% Rh / Pt),	BS 4937,	-50 to 1767°C
	1 Type R,	(Pt-13% Rh / Pt),	BS 4937,	-50 to 1767°C
	2 Type J,	(Fe / Cu-Ni),	BS 4937,	-210 to 1200°C
	3 Type K,	(Ni-Cr / Ni-Al),	BS 4937,	-270 to 1373°C
	4 Type T,	(Cu / Cu-Ni),	BS 4937,	-270 to 400°C
	5 Type E,	(Ni-Cr / Cu-Ni),	BS 4937,	-270 to 1000°C
	6 Type B,	(Pt-30%Rh/Pt-6%Rh)	BS 4937,	0 to 1820°C
	7 Type N,	(Ni-Cr-Si / Ni-Si)	BS 4937,	-270 to 1300°C
*	8 Type W,	(W / W-26% Re)		0 to 2300°C
*	9 Type W3,	(W-3% Re / W-25% Re)		0 to 2300°C
*	10 Type W5,	(W-5% Re / W-26% Re)		0 to 2300°C
*	11 Type NM,	(Ni / Ni-18% Mo)		0 to 1300°C
	12 Type L,	(Fe /Cu-Ni)	DIN 43710,	-200 to 900°C
	13 K10,	Type K in 1/10 °C,	BS 4937,	-50.0 to 500.0°C
	14 T10,	Type T in 1/10 °C,	BS 4937,	-50.0 to 400.0°C
	15 RT10,	(PT100) in 1/10 °C,	BS 1904,	-150.0 to 200.0°C
	16 RT,	(PT100),	BS 1904,	-150 to 200°C
	17 Type S,	(Pt-10% Rh / Pt),	BS 4937,	-58 to 3200°F
	18 Type R,	(Pt-13% Rh / Pt),	BS 4937,	-58 to 3200°F
	19 Type J,	(Fe / Cu-Ni),	BS 4937,	-340 to 2150°F
	20 Type K,	(Ni-Cr / Ni-Al),	BS 4937,	-450 to 2500°F
	21 Type T,	(Cu / Cu-Ni),	BS 4937,	-450 to 750°F
	22 Type E,	(Ni-Cr / Cu-Ni),	BS 4937,	-450 to 1800°F
	23 Type B,	(Pt-30% Rh / Pt-6% Rh)	BS 4937,	32 to 3300°F
	24 Type N,	(Ni-Cr-Si / Ni-Si)	BS 4937,	-450 to 2350°F
*	25 Type W,	(W / W-26% Re)		32 to 4150°F
*	26 Type W3,	(W-3% Re / W-25% Re)		32 to 4150°F
*	27 Type W5,	(W-5% Re / W-26% Re)		32 to 4150°F
*	28 Type NM,	(Ni / Ni-18% Mo)		32 to 2350°F
	29 Type L,	(Fe /Cu-Ni)	DIN 43710,	-300 to 1650°F
	30 K10,	Type K in 1/10 °F,	BS 4937,	-58.0 to 400.0°F

	31 T10,	Type T in 1/10 °F,	BS 4937,	-58.0 to 400°F
	32 RT10,	(PT100) in 1/10 °F,	BS 1904,	-148.0 to 400.0°F
	33 RT,	(PT100),	BS 1904,	-148 to 400°F
	34 Linear			
*	35 Root			

* *These ranges are available to special request only and are not present in the standard instrument*.

7.1.2 Cold junction compensation

CjC. This parameter will only be presented if a thermocouple input type is selected. The normal setting for this is **Auto**, since the instrument will then automatically compensate for the temperature of the cold junction at the instruments rear terminals. Fixed cold junction compensation temperatures of **0°C**, **20°C** and **50°C** are also provided for use with external cold junctions.

7.1.3 Input high and low scalars

Linear and root input ranges must be scaled to suit the users application. Unless otherwise specified, the instrument is shipped from the factory with the default scaling of 0 to 1000.
IPLH is the input high scalar and should be set to the value which the instrument is required to display at 100% input.
IPLL is the input low scalar and should be set to the value which the instrument is required to display at zero input.

For example. If the instrument is connected to a transducer which transmits 4 - 20mA equivalent to 200°C - 1600°C, then **IPLH** should be set to 1600 and **IPLL** should be set to 200.(also the input **bias** should be set to 20%. see section 7.1.6)

There are a few rules which must be obeyed when setting **IPLH** and **IPLL**:-
1. **IPLH** must be greater than **IPLL**.
2. **IPLH** minus **IPLL** must not be too large. (The instrument will warn the user if this is true by means of a fault code. see Appendix A)
3. **IPLH** must be greater than zero.

7.1.4 High and low setpoint limits

The high and low setpoint limits **SPLH** and **SPLL** are the limits outside which the setpoint cannot be set. They should be set to the maximum and minimum safe limits for the plant and its contents. The values of these limits are set by default to the max and min of the input sensor range selected.

7.1.5 Decimal point

If a linear or root range has been chosen, then the parameter '**dPnt**' will be displayed. This enables the user to position the decimal point as desired using the up and down buttons to provide a display with a custom scale.

7.1.6 Input Bias

bIAS is used to specify the zero value for live zero process inputs. It can be set as a percentage between 0 and 25% .

This allows the input to be scaled for live zero signals such as 4 to 20 mA. in this example, 4mA being 20% of 20mA, if '**bIAS**' were set to 20(%) then an input of 4mA would be taken as 0 and an input of 20mA as 100%.

For true zero inputs, set the bias to 0.

7.2 Controller Group 'Contr'

The **Contr** group contains primary controller setup information.

7.2.1 Control format

CtyP may be set to any of the following types.

AHS The instrument behaves as an auto/manual station. In auto the instrument will retransmit the measured input (as a percentage of the setpoint range **SPLH** to **SPLL**) to the selected control output. In manual, the operator has sole control of the control output.

So The PID controller provides a single control output.

HC The PID controller provides Heat and Cool outputs.

VP The PID controller provides two outputs (raise and a lower) to position a motorised valve (with or without slidewire feedback).

7.2.2 Control action

If the control format is of 'single output' or 'valve positioner' types, then **C-Act** provides a means of causing the control action to be **F'd** (forward) or **rev** (reverse) acting.

7.2.3 Thermal Head Ratio mode

The 3000 series controller can perform a thermal head ratio function and control within the same instrument.
The parameter **rAtio** is used to enable this feature.

OFF The instrument behaves as a single non ratio controller.

On The instrument performs a thermal head ratio **and** PID controller function.

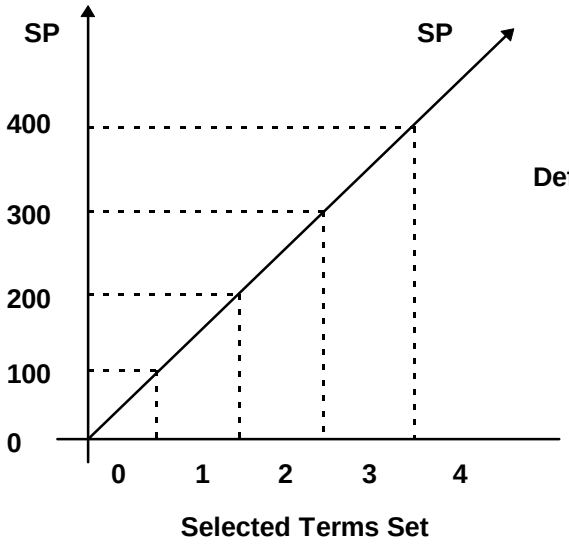
In this mode input 1 is taken to be the load temperature. Using the value of setpoint and load temperature a desired air temperature setpoint is calculated and passed to the PID controller as its setpoint. Input 2 is used as the air measured variable input.

7.2.4 Gain scheduling

The instrument has the ability to store and select a range of different P, I and D values according to the current setpoint or the current profile segment. Each group of PID values is called a terms set and up to 4 such sets can be stored.
The **SEtS** parameter is used to specify how the terms sets are to be selected.

OFF Terms sets are not used.

SP Terms sets are selected according to the current control setpoint.



	Set	SP	P	I	D
Default	**0**	-	1.6%	100	25
	1	100	2.5%	140	30
	2	200	3.6%	140	30
	3	300	5.3%	200	50
	4	400	6.5%	250	60

SEG Terms sets are selected according to the current profile segment number.

SEGH Terms and hold sets are selected according to the current profile segment number.

7.2.5 Tuner response

A one shot autotuner is available for use with all proportional controller types. The **tunEr** parameter allows this feature to be enabled or disabled as required.

OFF The tuner is disabled and may not be invoked from long scroll.

SLO The tuner will tune for an overdamped (minimal overshoot) response to a setpoint change.

nor The tuner will tune for a medium (single overshoot) response to a setpoint change.

FASt The tuner will tune for a fast (Zeigler & Nicholls) response to a setpoint change.

7.3 Failure Safety Group ‘FSAFE’

Series 3000 instruments are equipped with a safety feature which may be used to switch off all the control outputs if the measured input exceeds some preset safety limits. This feature works by comparing the main input value against the high and low safety limits. If the current measured input is within these limits then the controller functions normally. If not then the large display will flash **FAIL** and all control and retransmission outputs will be switched off.

7.3.1 Failure safety on/off switch

Since the safety feature is not applicable to all plant circumstances the user may switch it on or off using the **FSAFE** scroll element.

7.3.2 High safety limit

The **FS Hi** parameter should be set to the maximum acceptable input value which can prevail without there being a fault condition. If this limit is not required then it should be set to its maximum possible value of 9999 digits.

7.3.3 Low safety limit

The **FS Lo** parameter should be set to the minimum acceptable input value which can prevail without there being a fault condition. If this limit is not required then it should be set to its minimum possible value of -9999 digits.

7.4 Profiler Group 'ProF' (P3000 only).

7.4.1 Number of profiler channels

The **CHAnS** parameter is used to specify one or two profiler channels for the internal profile generator.

7.4.2 Channel 2 servo function.

If the instrument has two profiler channels and slot 5 is used as the PV2 function (second measured variable input) then the **SErV2** parameter may be used to specify the profile channel 2 start value.

SP2 The channel 2 profile will servo start from local setpoint 2.

PV2 The channel 2 profile will servo start from PV2.

7.4.3 Channel 2 setpoint limits.

The two parameters **SP2-H** and **SP2-L** are used to specify the valid range of the profiler channel 2 setpoint. This prevents the operator from programming a profile setpoint which is outside the valid range for the plant.

7.4.4 Channel 2 decimal point

The decimal point for the profiler channel 2 may be positioned using the parameter **Point**. Pressing either the up or down arrow keys will cause the available positions to be shown in sequence.

7.4.5 Number of profiles

The parameter **ProGS** is used to specify the number of programs available to the operator from one to the maximum allowed.

7.4.6 Synchronising 2 profiler channels

When using a 2 channel profile generator the parameter **Sync** may be used to force the channel 2 profile to use the same segment times specified for channel 1.

NO Profile channel 2 has its own segment times.

yES Profile channel 2 uses the same segment times as channel 1.

7.4.7 Disabling the delayed start

If the user never wishes to use the delayed profile start facility then this may be disabled using the **dELAy** parameter. When disabled the **dELAy** parameter is removed from the profile generator scroll.

NO The delayed start feature is disabled.
yES The delayed start feature is enabled.

7.4.8 Disabling profile repeats

If the user never wishes to repeat the profile , then this feature may be disabled using the **rEPtS** parameter. When disabled the **rEPtS** parameter is removed from the profile generator scroll.

NO The repeats feature is disabled.
yES The repeats feature is enabled.

7.5 Input/Output Group 'IO'

This group contains the parameters to configure the input/output slots. The Series 3000 has five general purpose slots available called SLOT1 to SLOT5. Each slot can be programmed as a digital output, a single channel analogue output or a single channel analogue input. The parameters present in this group are used by the instrument to direct the required inputs and outputs to the correct slots.

7.5.1 Slots 1 to 5

Next in the Emode scroll are the option board slots, **slot1** to **slot5**. These are presented in sequence and for each slot a type of board may be selected from the list via the up and down buttons. The following is a list of the board mnemonics.

OFF no option board fitted in this slot
tP time proportional output
H-tP heat, time proportional output
An analogue. Voltage or current output
H-An heat, analogue. Voltage or current output
C-tP cool, time proportional output
C-An cool, analogue. Voltage or current output
OPEn valve positioner, open valve.
SHUt valve positioner, shut valve.
AL-1 alarm 1 output
AL-2 alarm 2 output
rEtr retransmission voltage or current output
IP2 remote input
Evnt event, Programmer single internal event output
E-dr event driver, Programmer external event driver
E-Pr external program select input

Note that not all cards can fit in any slot. The following is a table of which functions are permitted in each slot.

Function	Slot 1	Slot 2	Slot 3	Slot 4	Slot 5
H-tP or tP	√				
H-An or An		√			
C-tP	√	√			
C-An		√	√		
OPEn	√				
SHUt		√			
AL-1	√	√	√		
AL-2			√	√	√
rEtr		√		√	
IP2					√
Evnt	‡	‡	‡	‡	‡
E-dr	‡		‡		‡
E-Pr			‡		

√ = function valid in this slot

‡ = function only valid on P3000

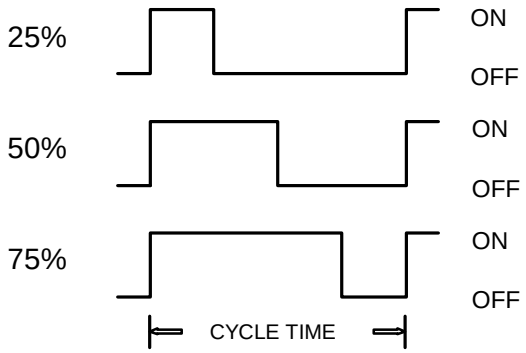
7.5.2 Time proportional output type

If a slot is defined as a time proportional output then an extra parameter **tPtyPE** is displayed. This is used to select the type of time proportional output required **CyC** or **ton**.

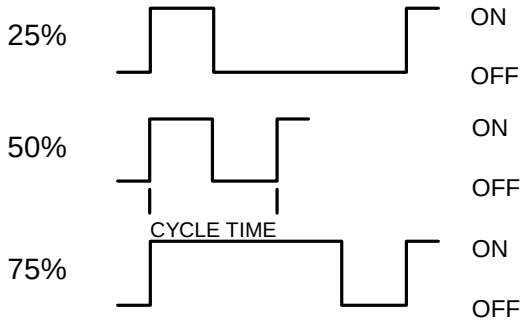
CyC.(Constant cycle time). The TP algorithm attempts to maintain a constant cycle time (set as **H CyC** or **C CyC**), except when the ON time falls below the time selected in **tPon**, in which case the OFF time is extended pro rata.

ton.(Constant on/off time). The TP algorithm maintains a constant ON time (for output powers between 0 to 50%) or a constant OFF time (for output powers between 50 and 100%). In either case the minimum ON or OFF time is never smaller than half of the set cycle time **H CyC** or **C CyC**. For this type of TP output the cycle time is defined only at 50% output power.

CONSTANT CYCLE TIME PROPORTIONAL OUTPUT



CONSTANT TON/TOFF TIME PROPORTIONAL OUTPUT



7.5.3 Constant cycle TP minimum on time

If any slot is configured as a TP output of constant cycle time, then a small minimum on time may be set using the parameter **tPon**. The purpose of this parameter is to prevent the control device (such as a contactor) from receiving pulses from the controller which are too short for it to respond. If, on small output power levels, the time proportional ON time tries to fall below the set minimum value, then the tp OFF time will be extended to preserve the correct ON/OFF ratio. This has the effect of lengthening the perceived cycle time. The minimum on time is programmable on slot 1A from 0.02 to 0.30 seconds in increments of 20mS, and from 0.05 to 0.75 seconds in increments of 50mS on any other slot.

7.5.4 Live and True zero analogue control outputs

If any of slots were configured as analogue control outputs then, after each slot the **Zero** will be present. This refers to a live or true zero being used for the analogue output of the current slot. The options are as follows;

LIVE When set to live, the analogue output set in the previous scroll element will have a fixed live zero of 20% This means that if, for example, the analogue output was a 0 - 20mA type, then when zero control output was required, 4mA would be delivered, thus turning the 0 - 20mA output into a 4 - 20mA one.

TrUE When set to true, the analogue output set in the previous scroll element will have a true zero. This means that if, for example, the analogue output was a 0 - 20mA type, then when zero control output was required then 0mA would be delivered.

7.5.5 Input 2 types

If **SLOt5** is configured to be input 2 then a further scroll parameter will appear; **tyPE**. This parameter is used to select the purpose of input 2.

rSP Input 2 is to be used as a remote setpoint input.

S-Fb Input 2 is to be used as a slidewire feedback input for a motorised valve controller.

PV2 Input 2 is to be used as a second measured variable input. This may be for servo start purposes on a two channel profiler, or for the air measured variable on a thermal head ratio system.

7.6 Digital input Group 'dinS'

7.6.1 Digital inputs

din1 and **din2** are the two digital inputs which are always available on the Series 3000 instrument. These inputs may be configured to control a variety of features on the instrument usually controlled by hand. When the digital input is used to control a feature then it has absolute priority and manual control of the feature will be disabled. If the two digital inputs are configured to control the same feature, then digital input 2 will override input 1.

OFF this digital input is unused

A-H **Auto-Hand Select**.
When contact is made MANUAL mode is selected.
When contact is broken AUTO mode is selected.

r-SP **Remote setpoint select**.
When contact is made the controller is forced to obey its REMOTE setpoint type set as parameter **StyP**.
When contact is open the controller obeys its LOCAL setpoint.

SCrL **Scroll Lock**.
When contact is made all of the parameters in the controller long scroll are protected and may not be altered from the front panel.
When contact is open normal password security is active.

F-OP **Freeze Output.**
When contact is made the controller is frozen at its present value.
When contact is open the controller operates normally.

UL-A **Unlatch alarms**.
When contact is made latched alarms will be unlatched and inhibited from latching.

In-A **Inhibit alarms**.
When contact is made all alarms are inhibited from operating. Latched alarms are left latched.

A-OP **Select Auxiliary output**.
When contact is made the controller output is forced to the Auxiliary output power selected.

A-SP **Select Auxiliary setpoint**.
When contact is made the controller uses the selected auxiliary setpoint.
When contact is open the controller uses the normal setpoint.

L-OP **Auxiliary low output limit**.
When contact is made the auxiliary output setting is used as a low limit for the current control output.

H-OP **Auxiliary high output limit**.
When contact is made the auxiliary output setting is used as a high limit for the current control output.

d-rA **Disable Ramp**.
When contact is made the setpoint ramp facility is disabled.

Strt **Profile Start**.(P3000 only)
When contact is made the profile generator will start execution of the selected program.

HOld **Profile hold** (P3000 only).
When contact is made the executing profile will be held.

Stop **Profile Stop**.(P3000 only)
When contact is made the profile generator will cease program execution and return to the ready state.

St-H **Profile Start/Hold**.(P3000 only)
This is a double function input.
If the profile generator is in the ready and the contact is made then the profile generator will commence execution of the selected program.

If the profile generator is running when the contact is made then profile execution will be held.

run **Profile Run/Reset**.(P3000 only)
When the contact is made the selected profile will be started and run until an end segment is encountered at which point the setpoint will be frozen at the last target value before the end segment.
When the contact is open the profile will be stopped and held in the ready state.

StEP **Profile Segment Step**.(P3000 only)
When the contact is made the currently running profile will step to the start of the next segment. One step per contact closure will be performed.

7.7 Alarms Group 'ALrS'

7.7.1 Alarms in general

The S3000 controller/P3000 programmer has the ability to drive two independent alarms implemented as relay outputs or isolated logic drivers. They may be configured to be energised or de-energised on alarm, and be latching or non latching. They may be of type high, low or indexed (high, low or both) alarms, and have independent hysteresis. In addition, there are several miscellaneous alarm functions available. The following configuration parameters will appear in the 'E' mode scroll if the alarm option **AL-1** or **AL-2** have been allocated to any of the slots. (See section 7.5.1)

7.7.2 Alarm sense and latching

A1SE and **A2SE** sense may be set to the following:

nE non-latching, energise on alarm
nd non-latching, de-energise on alarm
LE latching, energise on alarm
Ld latching, de-energise on alarm

7.7.3 Alarm type

A1ty and **A2Ty** may be set to the following

HI alarm when PV >= alarm level
LO alarm when PV <= alarm level
ind alarm when PV >= setpoint + alarm level or PV <= setpoint - alarm level
in-h alarm when PV >= setpoint + alarm level
in-L alarm when PV <= setpoint - alarm level
H-A hand (manual) acknowledge. Alarm when controller is in manual.
RE-A Remote setpoint acknowledge. Alarm when the control setpoint is a function of the remote setpoint.

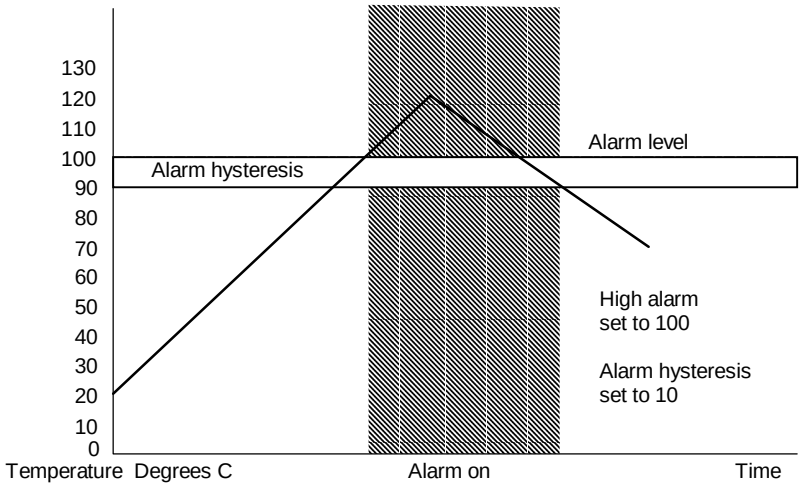
The following further alarm types are only available on a P3000 Programmer. These alarm types may not be latched, have inverted sense or hysteresis.

P-rL alarm output will be on when profile is running
r-rL alarm output will be on when profile is ready (not running)
U-rL alarm output will be on when profile setpoint is ramping up
d-rL alarm output will be on when profile is ramping down
S-rL alarm output will be on when profile is in a soak (dwell)

7.7.4 Alarm hysteresis

A1Hy and **A2Hy** are the hysteresis values for alarm levels 1 and 2. This may be set between 0 and 100 displayed units (for example degrees), and is the amount the process variable (measured value) must return within the alarm threshold after exceeding it, before the alarm condition is removed. For example, if alarm 1 were set to be a high alarm at 100°C and alarm 1 hysteresis for alarm 1 set to 10 (°C) then a process temperature rising from 20°C to 120°C will cause an alarm to be generated when the temperature gets to 100°C. If the process temperature then falls to 50°C the alarm will be maintained until the temperature reaches 90°C, below

which the alarm would be cleared. (If the alarm were of the latched type then the alarm would be maintained until cleared externally (see section 4.2.1) .

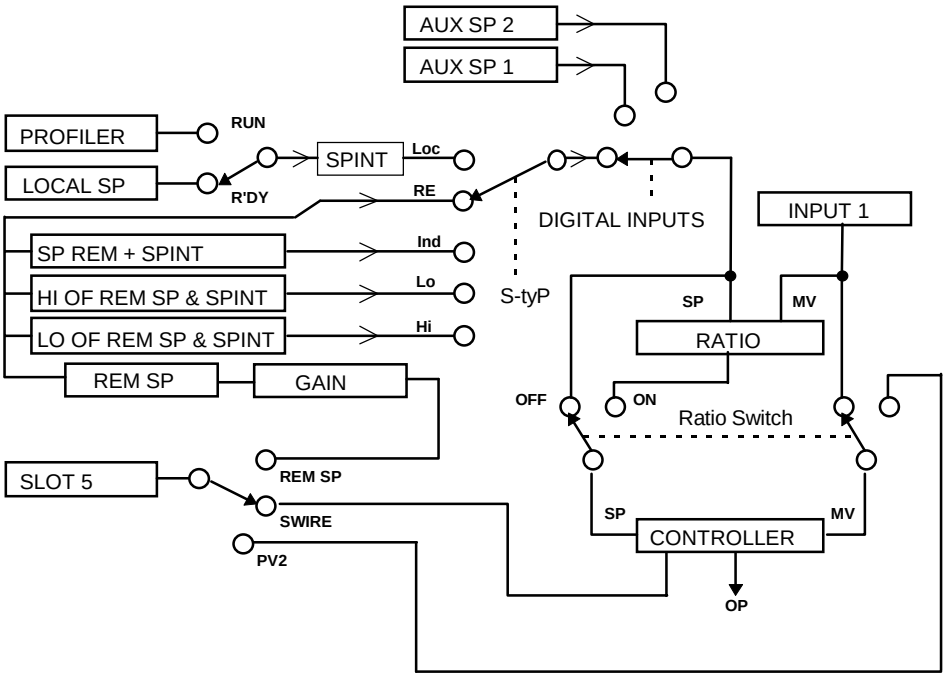


7.7.5 Unlatching alarms

An alarm set to be latching, when triggered, will continue to indicate an alarm until manually unlatched. This may be achieved in one of three ways; via serial comms (see the Series 3000 communications manual), by operating an appropriately configured digital input (see section 7.6) or by operating the star button when the alarm level of the latched alarm is being displayed in the controller long scroll. The alarm will be automatically unlatched if the mains power is removed from the instrument.

7.8 Input 2 Group 'IP2'

7.8.1 Remote inputs in general



The Series 3000 instrument may have many different setpoint sources for its internal controller. Setpoints may be input from external devices in either digital or analogue form and combined with the internal setpoints in various ways before being passed to the controller. Alternatively in ratio or 2 channel profiler modes, the remote input (slot 5) may be used to measure a second process variable (PV2). In thermal head ratio mode PV2 is used as the air measured value. With a 2 channel profiler PV2 may be used as the servo start value for channel 2.

7.8.2 Remote input point type

tyPE, The type of remote input, may be set from the list presented.

A-bt Analogue remote set point, via remote setpoint card, Bipolar, (input swings both sides of zero) True zero (no input offset).

A-Ut Analogue remote set point, via remote setpoint card, Unipolar, (input is always positive) True zero (lowest magnitude input is zero).

A-UL Analogue remote set point, via remote setpoint card, Unipolar, (input is always positive) Live zero fixed at 20%

7.8.3 Remote input 2 limits

The next two parameters in the configuration scroll are the input 2 high and low range limits, **I2-HI** and **I2-LO.** These parameters are scaling factors for the remote input and quite separate from the setpoint limits encountered earlier. Their purpose is to specify the resulting range of input 2 reading for the full span of the actual input signal. For example, if slot 5 is of a 0 - 10V type, and is configured in software as a unipolar true zero type, (positive input only, minimum input = 0V) then the input 2 reading with 0V input would be whatever is set for **I2-LO**, and with 10V input then the input 2 reading would be whatever is set for **I2-HI**.

In this way any convenient input could be used to produce the range of input 2 required. For example, if the desired range of resulting input 2 was -1000°C to

+1000°C, it is not necessary to use a bipolar input. Simply set **I2-LO** to -1000 and **I2-HI** to +1000, then with the 0 -10V unipolar true zero input, an input 2 reading of -1000 would result from a 0V input and a +1000 reading from a 10V input.

Please Note
When input 2 is used as the PV2 control variable then the same range constraints apply as for input 1. See section 7.1.3.

7.8.4 Remote setpoint gain on/off

When input 2 is used as an analog remote setpoint input, it is possible to apply a fixed gain to the remote setpoint value if the value for **I2-LO** is zero. This feature is useful when the user needs to allow the operator to change the scaling of the remote setpoint in the long scroll. The actual gain value is set in the long scroll **SP** group as the **GAIN** parameter. If this feature is not required then the **GAIN** switch should be set to **OFF**.

7.9 Retransmission Group 'rEtr'

7.9.1 Retransmission

If any slot is dedicated to **rEtr**, (retransmission) then the controller may be configured to retransmit one of a number of parameters as an analogue voltage. The retransmission range and bias are set in software. There may be up to two retransmission outputs in slots 2 and 4 and hence there are two sets of parameters, one for each output.

7.9.2 Retransmission Type

Some versions of the Series 3000 are available with characterised PWM (pulse width modulated) retransmission outputs as well as the standard linear analogue type. These instruments have the additional parameter **tyPEX** parameter which is used to select the retransmission type.

Lin Perform standard linear analogue retransmission

ChAr Perform characterised PWM retransmission. This is a digital logic signal designed to drive non-intelligent FGH controllers such as the Series 502 and DRMC. The output PWM signal mimics the output from the series 400 and 250A programmers.

7.9.3 Retransmission Range

When using characterised PWM retransmission it it necessary to specify the characterising range code using the parameter **rnGEX**. The characterisation range code should be entered using the same range numbering system as for input 1. However there is no need for the retransmission range to be the same as the main input range.

7.9.4 Retransmission parameter

PAr, the retransmission parameter dictates which of the parameters are to be retransmitted.

OFF no retransmission
PV1 Process variable 1, the value of input 1
PV2 Process variable 2, the value of input 2
SP1 set point 1, current set point value being used
SP2 set point 2, current set point value being used
Air the current air setpoint on a thermal head ratio system.
OP The current output level in %. Note this value can be negative on a heat/cool type controller.
USEr The value to be retransmit is supplied by the user via the serial communications parameter 'M'.

7.9.5 Retransmission limits for analog rtx

The next two parameters in the configuration scroll are the retransmission high and low range limits, **Hi X** and **Lo X** (+9999 to -9999). These will be included in the configuration scroll as long as the retransmission parameter, **PAr**, is not set to **OFF**. The selected parameter is scaled between these limits before retransmission to provide 100% output when the selected parameter has a value greater than or equal to **HI X** and 0% output when less than or equal to **Lo X**.

Note. The user may specify **Lo X** to be greater than **Hi X**. This has the affect of inverting the retransmission output.

7.9.6 Retransmission limits for PWM rtx

For PWM retransmission, the Hi X and Lo X parameters specify the range of the characterised output. This is usually 0 to 2000 degrees for compatibility with FGH series 502 and DRMC controllers.

7.9.7 Retransmission bias

The next configuration parameter is retransmission bias, **bIAS**. This may be used to provide a live zero output. If, for instance, the retransmission output has been arranged to provide a 0 to 20mA output over the range of values of interest, then if the retransmission bias is set to 20% the output will now be 4 to 20mA.

7.9.8 PWM Retransmission Trim

When using PWM retransmission, it is possible to apply a span trim to the output by using the parameter **trinX**. Since the PWM output is a digital signal, it is not possible to calibrate it using the normal zero and span method in the **CAL** scroll group. The **trinX** is therefore used to adjust the span of the output slightly to ensure better calibration.

7.10 Serial communication Group 'ConS'

7.10.1 Digital serial communications

All Series 3000 instruments have the option of fitting digital serial communications. If this feature is used then the following parameters should be set up to suit the device to which the instrument is connected.

bAUd select the baud rate required

AddrS select the controller address required, between 0 and 99. Bear in mind if it is desired to address groups of instruments simultaneously by use of the wildcard address then the address must be selected accordingly. (see the Series 3000 communications manual provided with the instrument).

Remember that with a P3000 the address set relates to the ***controller*** part of the instrument and the ***profile generator*** part of the instrument will have an address of the controller address+16.

7.10.2 Digital remote setpoint ON/OFF switch

All Series 3000 instruments may receive a remote setpoint value via the serial communications parameter '@'. This feature may be enabled or disabled using the **CrSP** scroll element.

OFF Digital remote setpoint is disabled.
On Digital remote setpoint is enabled.

7.10.3 Digital setpoint retransmission (P3000 Only)

It is possible to utilise the serial communications facility to transmit the setpoint to one or more remote controllers. This however precludes the use of the serial communications network with a host computer. Since the P3000 may have a 2 channel profiler, it is possible to direct the two setpoints to two different controller groups.

The parameter **Sout1** is provided to direct the digital channel 1 setpoint to the controller group required for profile channel 1 operation. Similarly **Sout2** is provided for channel 2.

For each parameter **Sout1** and **Sout2** the user has the following options.

OFF Digital setpoint transmission is disabled.

1_ The setpoint is directed to instruments with addresses 10 to 19 inclusive.
up to
9_ The setpoint is directed to instruments with addresses 90 to 99 inclusive.

External instruments required to receive this digital setpoint should be set up with remote digital setpoints enabled.

NOTE.

The digital setpoint retransmission feature will be disabled automatically under the following conditions.

The serial communications (Slot 6) is switched on.

AND The comms remote setpoint feature is enabled (**CrSP = On**).

AND A digital input has been up as remote/local setpoint control (**DinX=r-SP**)

AND The digital input is made (Remote SP is requested).

SECTION C - PROGRAMMING THE PROFILE GENERATOR

8.0 General

The P3000 programmer creates a time/temperature profile on up to two channels from a sequence of time and temperature (level) co-ordinates. the resultant profile therefore consists of linear rates of change of setpoint with time. Each linear section of the profile is referred to as a segment.

The profiler runs each segment in turn until it encounters an END segment or it reaches the last available segment. At this point the profile may automatically be repeated using the repeats feature. On a two channel profiler, the two profiles are synchronised at each segment boundary. The channel which completes its ramp or dwell first will wait at the end of the segment until the other channel has completed its operation.

During each segment the user may elect to specify a set of digital outputs (called events) and a set of applicable control terms (called terms sets). The profiler will automatically select and use the appropriate set for each segment.

The setpoint profile may deviate from the actual programmed profile on certain occasions namely profile start, mains supply interruptions and hold conditions. These three aspects are explained in detail below.

Although the Proteus can be employed to control a wide variety of variables, for the sake of simplicity these explanations will assume that the process variable being controlled is temperature.

8.1 Start sequence

When the profile generator is in it's ready state (ie. a profile is not running and the '**SEG**' element of the short scroll shows '**rEAdy**') then the controller obeys the local setpoint (SPLOC for channel1 and SPL 2 for channel 2). When the start instruction is given a complex sequence of events occurs that results in the controller obeying the profile generator setpoint. The start sequence is:

1. Scroll through the short scroll until the '**SEG**' element is displayed. Now use the star and Auto/Man (PROG) button to select the number of the program to be started.

2. The profile may be started in one of three ways: Manually by pressing and holding the star button and momentarily pressing the up (START) button, via serial communications by sending a ‘set start’ command to the profile generator or via one of the instruments digital inputs when it is configured as a START or a START/HOLD function. See section 7.6.

3. The controller continues to obey the local setpoint until the delay start time has elapsed

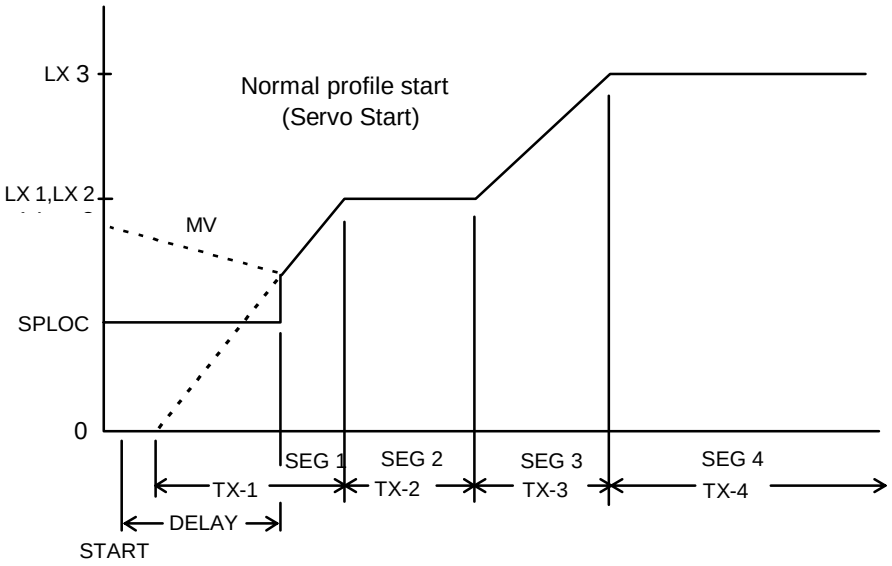
4. When the delay start time has elapsed the instrument advances to the first segment of the profile

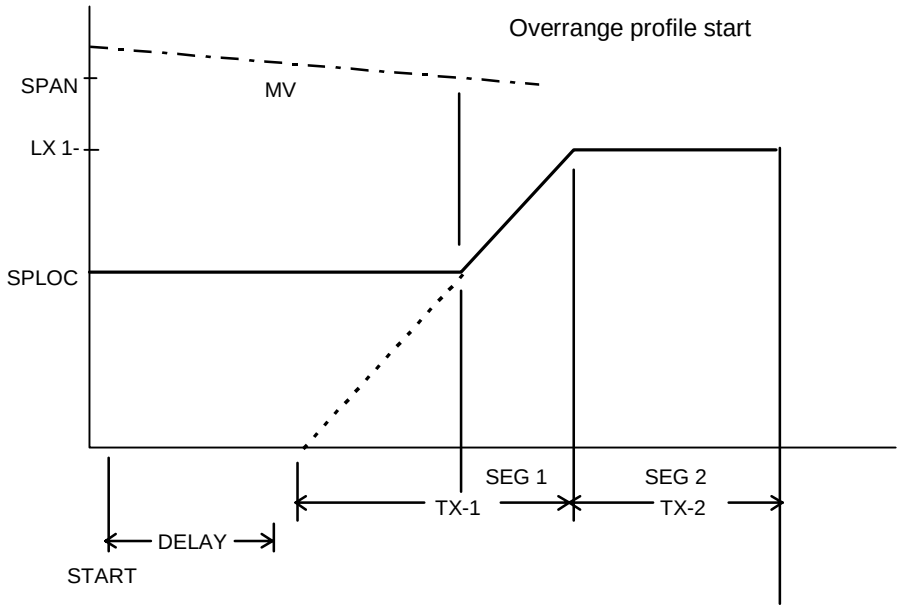
5. If the time of the first segment (**tX-1**) is zero then the profile step changes immediately to the first segment's level (**LX-1**) and the controller henceforth obeys the profile generator setpoint. The profile then advances and begins execution of the second segment.

6. If the time of the first segment (**tX-1**) is not zero then the instrument considers the measured value.

7. If the measured value is within the nominal range of the instrument then the profile jumps to equal the measured value and henceforth the controller obeys the profile generator setpoint. The profile then executes the first segment. The first segment will be a ramp that begins at the measured value and ends at segment 1 level (**LX-1**). ***The rate of the first segment will be as if segment 1 had started from a level of zero.***

8. If the measured value is outside the nominal range of the instrument then the profile jumps to equal the local setpoint and henceforth the controller obeys the profile generator. Since the measured value is out of range, the profile generator goes into a hold condition and the profile remains stationary. When the measured value comes into range the hold condition is freed and the profile executes the first segment. The first segment will be a ramp that begins at the local setpoint and ends at segment 1 level (**LX-1**). ***The rate of the first segment will be as if segment 1 had started from a level of zero.***





P3000 profile generators are equipped with a fast facility. This allows the profile, or part of the profile to be executed rapidly. While the star button and right (FAST) buttons are pressed the profile will execute at about 20 times normal speed.

8.2 Supply interruption

If the mains supply to the instrument is interrupted whilst a profile is being executed then a complex sequence of events occurs that attempts to minimise the disturbance to the process. ***The instruments behaviour after a supply interruption will result in an unexpectedly long total profile time.*** Upon restoration of the supply the sequence is:

1. The instrument delays for approximately 10 seconds whilst other controllers etc. recover after the mains failure

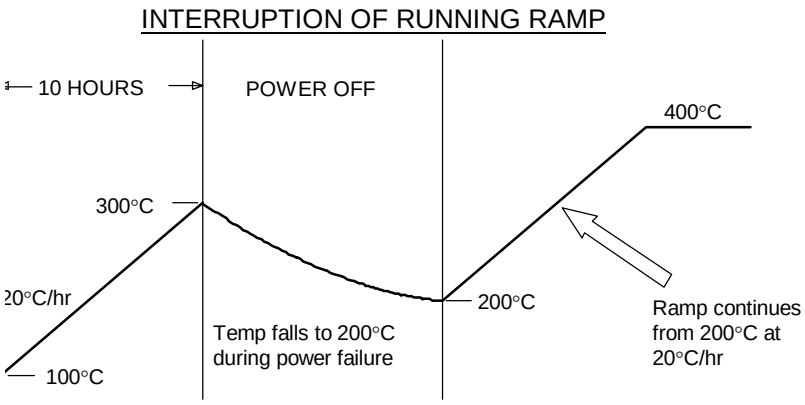
2. If the interrupted segment is a ramp and the measured value is within the nominal range and a hold is in existence, then the profile is made equal to the measured value, (Servo Start) and the ramp continues at the previous rate towards the segments level.

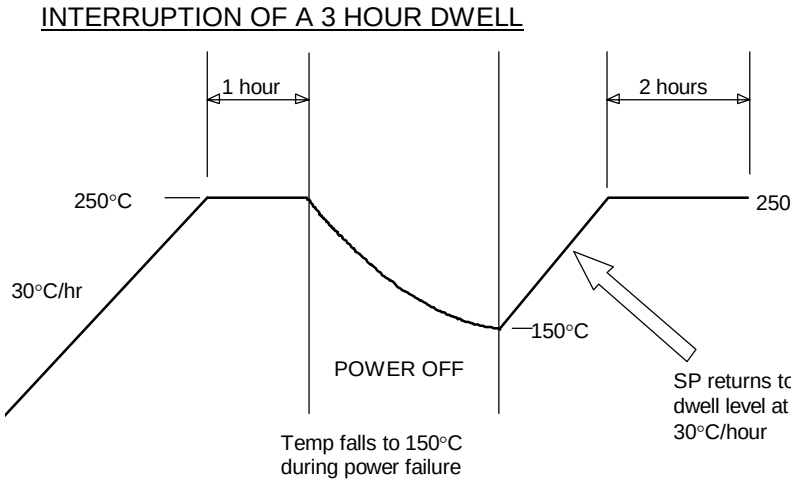
3. If the interrupted segment is a ramp and the measured value is out of range then the profile remains at the point it had reached before the interruption. Since the measured value is out of range the profile generator goes into a hold condition and the profile remains stationary. When the measured value comes within range the ramp continues.

4. If the interrupted segment is a dwell and the measured value is within the nominal range and a hold is in existence, then the profile is made equal to the measured value (Servo Start). The profile generator then calculates the rate of the last ramp performed and then brings the profile back to the dwell level at that rate. If the last ramp happened to be a step change then the profile step changes. Once the dwell level is reached then the dwell continues from where it was interrupted.

5. If the interrupted segment is a dwell and the measured value is out of range then the profile remains at the dwell level. Since the reading is out of range the profile generator goes into a hold condition; when the measured value comes back into range the dwell continues from where it was interrupted.

6. If, on recovery after a mains failure no hold conditions exist, then it is assumed that the mains failure was of very short duration and therefore the instrument does not servo start, but continues with the profile as if nothing had happened





8.3 Hold condition

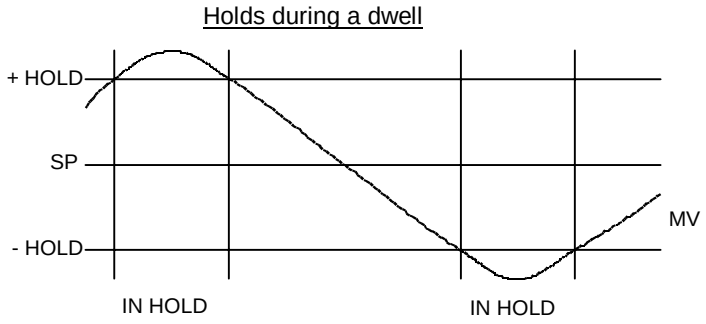
At certain times during the execution of a profile, the profile generator may go into a hold condition. ***A hold condition causes the normal progress of the profile to be modified and the total duration of the profile will not be as expected.*** When the instrument is in hold the lower display will flash to indicate this. Holds can originate from any of four sources:

- A hold can be caused manually from the instrument front panel. This is achieved by holding the star button and pressing the left (HOLD) button. Press this pair of buttons again to release the hold.

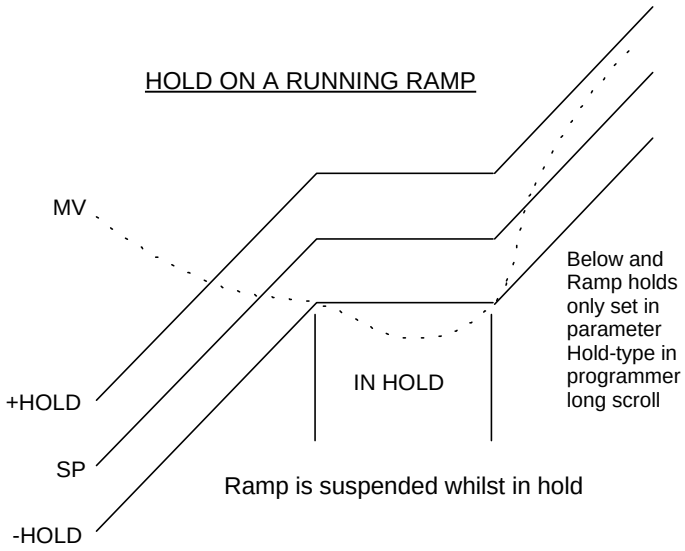
- A communicating profile generator may have its running profile held via the serial communications link by means of a ‘set hold’ command This hold is freed by sending a 'set free’ command to the instrument.

- A hold may be generated via a contact closure on one of the instruments digital inputs. In order for this to work, the appropriate digital input must be configured in 'E Mode' as a Hold. A digital input could also be configured and used as a 'Start/Hold'. see section 7.6
- A hold will be generated by the profile generator if the difference between the measured value and the control set point exceeds the hold band parameter set in the programmer long scroll ***and*** the hold is active for an error in that direction (Above or Below) as set on the hold-type parameter in the programmer long scroll ***and*** the part of the profile currently executing (Ramp or Dwell) is also set on the hold-type parameter in the programmer scroll.

  If a hold occurs during a ramp segment then the ramp will remain stationary for the duration of the hold. If a hold occurs during a dwell then the dwell time is extended by an amount equal to the period of the hold.



Dwell timer suspended during hold. Note that 'Above', 'Below' and 'Dwell' holds at least are set on in the hold-type parameter of the programmer long scroll.



Ramp is suspended whilst in hold

8.4 Ending a profile

A profile can be ended manually at any time during the profile or can be programmed to end at any segment of the profile. The profile will also end as a matter of course when segment 25 finishes. When the profile ends control reverts to the controllers local set point and the profile generator becomes ready. The profile ends by:

1. Holding the star button pressed and pressing the down (STOP) button.

2. Closure of a contact on one of the instruments digital inputs which has been configured as a 'STOP'. See section 7.6.

3. Via the serial communications facility by sending a ‘set stop’ command to the programmer.

4. Encountering an END instruction programmed into the profile. A segment is programmed with an end instruction if the segments time is reduced down to and past zero so that the lower display shows the mnemonic '**End**'. The end instruction tells the programmer to see if the profile is to be repeated, and if so, if the required number of repeats are done. If there are no repeats, or if they have all been done then the profile ends.

8.5 Repeating the profile

The profile is always run once when the start instruction is given, but it can also be programmed to repeat itself up to 999 times by setting the '**repts**' parameter in the programmer scroll to the required number of repeats. 0 means don't repeat at all. The profile will execute until either segment 25 has finished or an '**end**' or '**go**' instruction is encountered. At this point the profile returns to segment 1 and begins again

If the first segment is a step change then all repeats of segment 1 will be a step change; these steps will be from the last segments level to segment 1's level

If the first segment is a ramp then all repeats of segment 1 will be a ramp; these ramps will be from the last segments level to segment 1's level in segment 1's time.

While the profile is running the value of parameter '**repts**' remains unchanged, but the number of repeats remaining can be seen by viewing this parameter and pressing the star button. When the profile generator returns to the ready condition the number of repeats are restored.

8.6 Chaining profiles

If the segments available in one program are not enough for the profile desired then two or more programmes may be linked together to form a more complex profile. A segment may be set to a '**GO**' if the segment's time is reduced down to and past zero to '**END**' and then further down to '**Go 9**', '**Go 8**' etc. down to '**Go 0**'.

A program segment is set to a **Go** in place of an **End**. When the executing program encounters a **Go** segment it checks to see if any repeats are left, and if so these are performed between segment 1 and the **Go** segment. When all the repeats are

complete (or if there are none) then program control is transferred to the start of the program number specified in the **Go** segment, this new program will have its own unique number of repeats and may include its own **Go** segment to transfer control to yet another program.

8.7 Delay start timer

The Proteus may be programmed to run a profile at some convenient time in the future. For example, if the time is now 4:30 PM and it is desired to run a process that we know lasts 2 hours so that it just completes in time for the start of work tomorrow morning at 8:00, clearly we would like the profile to begin in 13 hours 30 minutes time. To achieve this, simply select the program required to be run in the short scroll, enter the programmer long scroll and set the first element (**Delay**) to 13.30 and exit the long scroll. Now start the profile and we know that the Proteus will continue to control at the local set point until the profile generator takes over the process at 6 am and that the process will just complete in time for our 8 o'clock start

SECTION D - HARDWARE CONFIGURATION

9.0 General

The S3000 controller/P3000 Programmer consists of a basic model which is capable of being configured as many different types of instrument and expanded using option cards and an options card carrier. Only the option cards required for performing the desired task are fitted and waste is therefore minimised.

The S3000 Controller/P3000 Programmer comprises a 'basic' instrument, which consists of a circuit board assembly that slides into channels in a metal case and plugs into the terminal assembly at the rear. The board assembly, which has the display unit fixed to the front of it, is then held in place with the two captive screws visible on the front panel.

9.1 Gaining access to the option boards

In order to gain access to the option boards the instrument must be removed from its case. This is achieved by unscrewing the two captive screws on the front panel, the instrument may then be drawn out from the case

In the basic model there is only one board attached to the display assembly, this is the power supply and input board. This board plugs into the processor board via a 15 way post and box. The board is held in place by two clips at the processor board end. these clips should be gently eased apart if the power supply board is to be removed

On the power supply board are two 'slots', slot 1 and slot 2. These are positions in which an options board may be fitted.

9.2 Fitting the options board carrier

If more options, or more sophisticated options such as retransmission or digital communications are required then an options board carrier may be fitted. This makes available slots 3 to 5 which may be fitted with other options boards, and slot 6, which may be fitted with the digital serial communications board.

The options board carrier plugs into the processor board in a similar manner to the power supply board, however, a power supply link, supplied with the options carrier board, must be fitted between the power supply board and the options carrier board. The link is connected at the power supply/input board, to the two pin post marked 'AUX POWER'. The connectors are polarised and cannot be connected the wrong way around.

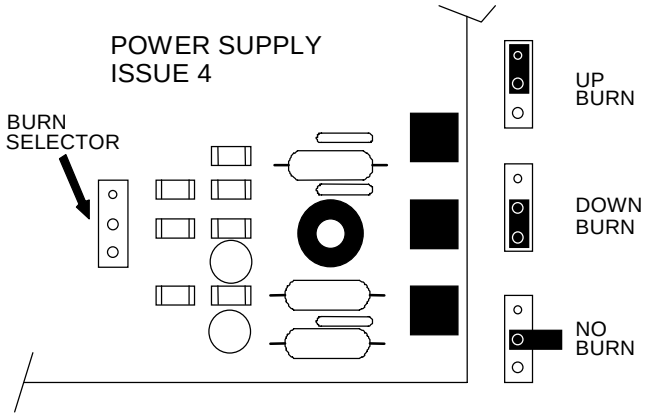
9.2.1 Transmitter power supply

The options board carrier also provides a d.c. power supply capable of providing up to 25mA which may be used to power remote transmitters. This supply has an open circuit output of approximately 30V. This power supply is always available in an expanded instrument, (ie. with options board carrier fitted) and does not occupy any of the options slots.

9.3 Broken sensor drive selection

On instruments fitted with power supply/input boards of revision 4 or later, there is provision for the selection of sensor burn out direction. This is the direction in which the measured input signal will move if the thermocouple sensor should break. On most systems using reverse acting control this should be up scale. Systems using forward acting control, or other special cases, may require down scale burnout. Linear or resistance thermometer inputs should have the burnout drive disabled.

The burnout direction is selected moving the jumper link as shown.



10.0 Options boards

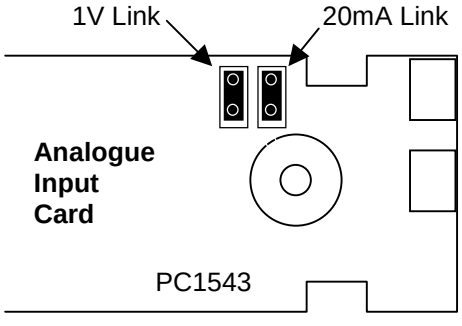
There are 7 different options boards which provide the additional facilities on the S3000 Controller. They are as follows;

10.1 Relay board PC1542

This board provides one isolated form 'C' (changeover) contact. A CR snubber circuit is fitted from each contact to common. The relay board option is used to provide heat and cool time proportioning control outputs, alarm outputs and motorised valve drive. The board is provided with two plastic spacers, so it is simply clicked into place.

10.2 Remote setpoint board PC1543

This board enables the S3000 controller to work from a remote analogue set point. The standard input to the board is ±10V, but if the push-on jumper link is fitted then the input range is changed to ±1V. Fitting both push-on jumper links enables 20mA input. The input is isolated from all other supplies and decoupled to earth.



Make both links for 20mA input

Fitting this board requires one plastic spacer to be clicked into place and an M3 screw and washer (supplied) to be fitted from the options board side.

10.3 Analogue output board PC1544

This board enables the controller to generate an analogue output, 0 to 20mA or, if the two push-on links are fitted, 0 to 10v. The output is isolated from all other supplies and decoupled to earth. Fitting this board requires one plastic spacer to be clicked into place and an M3 screw and washer (supplied) to be fitted from the options board or power supply board side.

10.4 Slide wire input board PC1545

This board enables the instrument to control a motorised valve with slide wire feedback. The board provides three wire connection to an unpowered slide wire as the board provides its own supply. The input is isolated from all other supplies and decoupled to earth. Fitting this board requires one plastic spacer to be clicked into place and an M3 screw and washer (supplied) to be fitted from the options board side.

10.5 Digital serial communications board PC1541

This board can only be fitted to slot 6 on the options board carrier, therefore, any instrument with serial comms must have an options board carrier to fit this board to. The serial comms board provides RS485, RS422 and RS232 type communications standards, depending on which links have been made on the board and how the instrument is wired. All these details are covered in the S3000/P3000 Communications manual provided with this board. Fitting this board requires only the four plastic spacers to be clicked into place on slot 6. The digital communication lines are isolated from the rest of the instrument and any other supplies.

10.6 Isolated logic drive and External event driver board PC1549

This board provides a switching nominal 12V for driving Solid State Relays etc. and the P3000 Programmers External Event Module. The 12v output is current limited to a nominal 20mA. The output is isolated from all other supplies and decoupled to earth. Fitting this board requires one plastic spacer to be clicked into place and an M3 screw and washer (supplied) to be fitted from the options board or power supply board side.

10.7 Remote program select input board PC1543A

This board may only be fitted to P3100 instruments and enables the user to select remotely the profile number to be run by the instrument. The input is actually a low resolution, high speed analogue input with a link selectable 1V or 10V span. For a board set to the 10V range, the program number is selected at the rate of 0.4V per program allowing programs 0 to 24 to be selected remotely by a plc or other means. For example an input of 0V +/- 0.1V will select program 0, and an input of 4V +/- 0.1V will select program 10.
For front of panel selection the 'FGH remote program selector switch' card PC1559 may be used to select programs 0 to 11.

11.0 Slot availability

When configuring the hardware of the instrument it is important to note that each option board can only go in certain slots, so the following table should be consulted to find an acceptable arrangement.

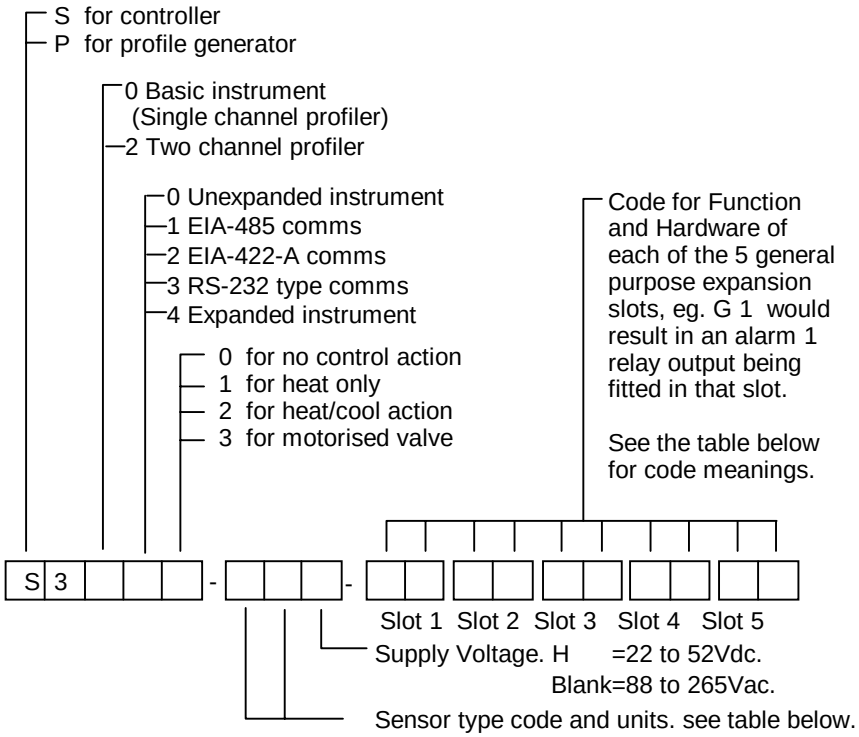
		Power supply		Options board carrier		
Function	Board	Slot1	Slot2	Slot3	Slot4	Slot5
Heat tp	Relay/Logic drive	*				
Heat analogue	Analogue out		*			
Cool tp	Relay/logic drive	*	*			
Cool analogue	Analogue out		*	*		
Raise valve	Relay/logic drive	*				
Lower Valve	Relay/logic drive		*			
Alarm 1	Relay/logic drive	*	*	*		
Alarm 2	Relay/logic drive			*	*	*
Retransmit	Analogue out		*		*	
Remote sp	Remote sp					*
Slidewire	Slidewire					*
Internal event	Relay/logic drive	*	*	*	*	*
Ext event drive	Logic drive	*		*		*
Ext prog select	Remote prog input			*		

Note. Slot 6 can only accept the serial comms board and the serial comms board can only fit in slot 6.

12.0 Part number coding

The part number consists of three parts, the instrument type, e.g. S3000, a two or three digit code showing the sensor type, and two or five pairs of digits which give the function of each of the expansion slots and what hardware is plugged into it.

Note that the instrument can be expanded or unexpanded. This means that if an expanded instrument is ordered then an extra circuit board is built into it which contains expansion slots 3, 4, 5 and 6. (slot 6 is only used for the digital serial communications option. comms is, therefore, not available in an unexpanded instrument.) If an unexpanded instrument is ordered, (S300x), then it is not necessary to fill in slots 3 to 5.



Example 1. S3001-03-B4 G1

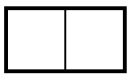
This describes an unexpanded controller, with a heat only analogue 0 - 20 mA control (in slot 1), and one alarm of relay type in slot 2. the instrument will be delivered configured for a type K thermocouple and work in degrees C. The 0 - 20mA control output may be set by the user in software, to have a live zero, for example, 4 - 20mA.

Example 2. P3213-15-E1 F1 G2 00 L8

This describes an expanded 2 channel profiler with EIA-485 serial communications, set up to drive a motorised valve, using a resistance thermometer sensor and working in tenths of degrees C. (-15-) with the option slots occupied as follows.

Slot 1 Raise motorised valve, relay output
Slot 2 Lower motorised valve, relay output
Slot 3 Alarm 1 with logic output (to drive an SSR)
Slot 4 Empty. Available for future use as alarm 2, retransmission or internal event.
Slot 5 Unpowered slidewire input

Slot Function and Hardware codes.



Slot Hardware

Slot Function

0	for not fitted
A	for heat t.p. output
B	for heat analogue output
C	for cool t.p. output
D	for cool analogue output
E	for mv raise output
F	for mv lower output
G	for alarm 1 output
H	for alarm 2 output
I	for retransmission output
K	for remote setpoint input
L	for mv slidewire input
M	for external event driver
N	for internal event
R	for Remote profile select input

0	for not fitted
1	for a form C relay output
2	for logic output (SSR driver)
3	for 0 - 10v analogue output *
4	for 0 - 20mA analogue *
5	for 4 - 20mA analogue *
6	for +/- 1v analogue input *
7	for +/- 10v analogue input *
8	for unpowered slidewire input

Note * user selectable level of live zero

Two digit input type code

00	Type S,	(Pt-10% Rh / Pt)	Degrees C
01	Type R,	(Pt-13% Rh / Pt)	Degrees C
02	Type J,	(Fe / Cu-Ni)	Degrees C
03	Type K,	(Ni-Cr / Ni-Al)	Degrees C
04	Type T,	(Cu / Cu-Ni)	Degrees C
05	Type E,	(Ni-Cr / Cu-Ni)	Degrees C
06	Type B,	(Pt-30% Rh / Pt-6% Rh)	Degrees C
07	Type N,	(Ni-Cr-Si / Ni-Si)	Degrees C
08*	Type W,	(W / W-26% Re)	Degrees C
09*	Type W3,	(W-3% Re / W-26% Re)	Degrees C
10*	Type W5,	(W-5% Re / W-26% Re)	Degrees C
11*	Type NM,	(Ni / Ni-18% Mo)	Degrees C
12	Type L,	(Fe /Cu-Ni)	Degrees C
13	K10,	Type K in 1/10 °C	Degrees C
14	T10,	Type T in 1/10 °C	Degrees C
15	RT10,	(PT100) in 1/10 °C	Degrees C
16	RT,	(PT100)	Degrees C
17	Type S,	(Pt-10% Rh / Pt)	Degrees F
18	Type R,	(Pt-13% Rh / Pt)	Degrees F
19	Type J,	(Fe / Cu-Ni)	Degrees F
20	Type K,	(Ni-Cr / Ni-Al)	Degrees F
21	Type T,	(Cu / Cu-Ni)	Degrees F
22	Type E,	(Ni-Cr / Cu-Ni)	Degrees F
23	Type B,	(Pt-30% Rh / Pt-6% Rh)	Degrees F
24	Type N,	(Ni-Cr-Si / Ni-Si)	Degrees F

25*	Type W,	(W / W-26% Re)	Degrees F
26*	Type W3,	(W-3% Re / W-26% Re)	Degrees F
27*	Type W5,	(W-5% Re / W-26% Re)	Degrees F
28*	Type NM,	(Ni / Ni-18% Mo)	Degrees F
29	Type L,	(Fe /Cu-Ni)	Degrees F
30	K10,	Type K in 1/10 °F	Degrees F
31	T10,	Type T in 1/10 °F	Degrees F
32	RT10,	(PT100) in 1/10 °F	Degrees F
33	RT,	(PT100)	Degrees F
34	Linear,	0 to +90mV input	
35*	Square Root,	0 to +90mV input	

* These ranges are available on special request only and are not included on standard instruments.

Note: All Type 34 (Linear) and 35 (Root) ranges except for 0 to +90mV input types are supplied with appropriate external signal conditioning boards.

SECTION E - CALIBRATION

13.0 General

The following procedure enables the S3000/P3000 Controller to be calibrated in the field if the reference equipment is available.

The reference equipment consists of a precision voltage and current source with an accuracy of at least 10 times better than the controller.

If the controller will also be required to work on resistance thermometer ranges then a reference resistance source and appropriate range tables will also be required.

A voltage reference source will also be required for calibrating the remote set point input.

A digital volt meter (DVM) will be required if it is intended to calibrate analogue outputs.

13.1 Preparation

The environment in which the controller is to be calibrated should be clean and dry, with a temperature between 15 and 25°C, humidity 0 to 80% Rh non-condensing.

The controller and any reference sources being used to calibrate it should have been in the calibration area and switched on for at least an hour prior to calibration of the controller.

13.2 Main input

Note. To preserve the range changing ability of the instrument, the main input should be calibrated in linear mode with any external signal conditioning removed. **ALL** of the steps detailed below are necessary for perfect calibration.

13.2.1 Main input span

Connect the EZECAL or other precision voltage source to the controller in place of the thermocouple, using ordinary copper wires.

Place the controller into 'E' mode by removing the instrument from its sleeve, placing a shorting link across the two terminals on the processor board marked EMODE and replacing the instrument in its sleeve. (See section 6.1).
Select the linear input range by setting the **I-P** parameter to 34. Set the input high limit **IPL-H** to 4500 and the input low limit **IPL-L** to 0. Scroll on until the **SPAN1** parameter is displayed.

Set the EZECAL or precision voltage source to deliver +80.000mV and, using the up and down keys, adjust the input span until the display just changes from 3999 to 4000.

When satisfied, press the star key and note down the displayed calibration constant for future reference.

13.2.2 Resistance span

Connect a precision decade resistance box to the input terminals in the manner of a resistance thermometer. Use three wires of equal length and gauge.

Select the RT input range by setting the **I-P** parameter to 15. Scroll on until the **SPANr** parameter is displayed.

Set the decade resistance box to a value of 175.83 Ohms. Adjust the resistance span using the up and down keys until the display just changes from 199.9 to 200.0.

When satisfied, press the star key and note down the displayed calibration constant for future reference.

Return the input type **I-P** and the range limits **SPL-H** and **SPL-L** to the required values and return to normal working mode by removing the **EMODE** link.

13.2.3 Span adjustment for external signal conditioning

If the instrument is fitted with an external signal conditioning card, then the span may be adjusted by using the on board potentiometer. Connect up a precision signal source to the signal conditioning board and inject an appropriate signal (current or voltage) near the span of the instrument. Adjust the on board span potentiometer until the instrument display is correct.

13.3 Cold junction zero

Measure the temperature of the instrument rear terminals with an accurate thermometer capable of being read to 0.1°C. Be sure to allow enough time for the reading to settle.

Scroll through the 'E' mode parameters until the **CJC-Z** parameter is displayed. Use the up/down keys to set this to the measured temperature of the instrument terminals.

When satisfied, press the star key and note down the displayed calibration constant for future reference.

13.4 Remote set point input calibration

NOTE. The main input must be calibrated and connected before any attempt is made to calibrate the remote setpoint input.

Input 2 can be configured as a remote set point input, or in the case of a valve positioner unit, a motorised valve slidewire input. The following is the calibration procedure for a remote set point card.

Place the instrument in the 'E' mode configuration scroll, see section 6.1

Ensure that a remote set point board is fitted in slot 5, that in the 'E' mode configuration scroll **SLOt5** is set to **IP2** and **r-SP** (remote set point) and that **rStyP** (remote set point type) is set to **A-bt** (analogue, bipolar true zero). Connect the link on the remote set point board to give it an input span of ±1V or remove it for ±10V span as required.

Set **rS-HI**, which is the setpoint reading required with a maximum analogue remote set point input, to 3000. Set **rS-LO**, which is the setpoint reading required with a minimum (most negative) analogue remote set point input, to -3000.

Set the current scroll element to **ZErO2** and use a calibrated voltage source to inject -1V or -10V as appropriate to the span set, into the remote set point board input terminals. Observe the input polarity which is terminal 26 with respect to terminal 25.

At this point, as before, there are two ways of calibrating this parameter, either hold down the star button and use the up/down keys to restore the input 2 zero calibration factor, or without using the star button, use the up/down buttons to set the display to -2999 and then carefully use repeated presses of the down button until the display ***just*** reads -3000. Record the input 2 zero calibration factor for future use

Set the scroll to **SPAn2** and change the calibrated input voltage to +1V or +10V as appropriate. Again either restore the span2 calibration factor by holding in the star button and using the up/down buttons or just use the up/down buttons to set the display to 2999, and then repeated presses of the up button until the display ***just*** reads 3000. Record the span2 calibration factor for future use.

Return the scroll to **ZErO2**, reset the input to -1V or -10V and check that the display reads -3000. Set the input to 0V and check that the display reads 0. If so then all is well.

Now that input 2 is calibrated you should return to **rStYPE** in the configuration scroll and set the remote set point type to the one required for operation. Adjust also the scaling factors **rS-HI** and **rS-LO** to whatever is required in use. Changing these parameters will not affect the calibration of the instrument. However, changing the input span between ±1V and ±10V will necessitate recalibration.

13.5 Slidewire input calibration

If input 2 is being used as a slidewire input, then it may be calibrated in the following manner.

First of all ensure that the instrument is configured as a motorised valve positioner, (**CTyP** is **VP**), that a slidewire input board in fitted in slot 5 (**SLt5** is **IP2** and **S-Fb**, slidewire feedback) and that the motorised valve to be used is correctly connected to the instrument rear terminals. (see installation manual).

Invoke 'E' mode as described in section 6.1 and scroll on to the **ZEr2** parameter in the **CAL** group, this shows the currently measured valve position on the upper display. While viewing this parameter the valve close output will be energised. This will cause the valve to motor to its fully closed position. When the reading has settled, press the star button to automatically calibrate the slidewire zero. The message **donE** will be displayed when this is complete. At this point the user may use the up and down buttons to make any fine adjustments required.

Scroll on to the next parameter **SPn2**, again the current measured valve position will be displayed on the upper display. This time the valve open output will be energised

causing the valve to motor to its fully open position. When the reading has settled, press the star button to automatically calibrate the slidewire span. The message **donE** will be displayed when this is complete. As before the user may make any fine adjustments required by using the up and down buttons.

13.6 Remote program selection input (P3000 only)

This input is a low resolution, high speed analogue input which is used to select remotely the program number to be used by the profiler, and therefore must be calibrated like any other analogue input. Calibration may be performed as follows:-

This procedure is given for a 10V input, the voltages required for a 1V input are given in brackets.

Connect a voltage signal source between terminals 19- and 20+. Activate Engineers mode and ensure that slot 3 is configured as a remote program select input by setting parameter **SLOt3** to **E-Pr**. Scroll on to the parameter **IP3-Z** and inject 0.0V from the signal source. Using the up and down keypads, adjust the displayed reading until it just changes from 1 to 0.
Inject +10.0V (+1.0V) from the signal source and scroll on to the parameter **IP3-S** , use the up and down keypads to adjust the reading until 1024 is displayed. Repeat these two operations until both readings are correct.

Finally note down the zero and span constants for future reference. (these values are obtained by holding down the star key whilst showing **IP3-Z** or **IP3-S**).

13.7 Analogue output calibration

There are 3 possible analogue outputs on the series 3000 instrument. These may be fitted in slots 2, 3 or 4. Slots 2 and 4 are high resolution outputs and are capable of very fine calibration. Slot 3 however, is a low resolution output and can only be calibrated to 0.5%.
This section will describe the calibration of an analogue output fitted in slot 2, but is equally applicable to slots 3 and 4.

Disconnect the wiring from the terminals of slot 2 and connect instead a digital volt meter (a 4½ digit DVM is desirable). Select the DVM range appropriate to the type of analogue output (20mA or 10V).

Enter EMODE as previously described and scroll on until the parameter **OP2-Z** is displayed. This is the output 2 zero adjustment. The instrument is now delivering 0V or 0mA, adjust the zero setting by using the up and down keys until the DVM reads 0V or 0mA as appropriate.

Scroll on one parameter until **OP2-S** is displayed. This is the output 2 span adjustment. The instrument is now trying to deliver its full scale output of 20mA or 10V. Adjust the span setting by using the up and down keys until the DVM reads 20.000mA or 10.000V as appropriate. (remember slot 3 cannot be adjusted this finely).

Back scroll one parameter to **OP2-Z** and check that the zero reading is still correct, if not then repeat the zero and span adjustment until no further adjustment is necessary.

Finally note down the zero and span constants for future reference. (these values are obtained by holding down the star key whilst showing **OP2-Z** or **OP2-S**).

Remove the EMODE link to return the instrument into its normal operating mode.

Appendix A - Fault codes

In the rare event that one of the stored parameters is invalid, for example, after replacing the RAM or memory back-up battery, then when power is first applied to the instrument a fault number will be displayed. When multiple faults occur the lowest numbered fault is generally shown first. Faults should be cleared one at a time until the fault indication disappears. This table shows which parameter must be corrected to restore operation.

Fault number	Group	Parameter at fault	
1	IP1	I-P	input type
2	IP1	----	set point limits crossed over
3	IP1	----	set point limits too far apart
4	IP1	SPL-H	splimh out of limits
5	IP1	SPL-L	spliml out of limits
6	IP1	CJC	cjc type
7	IP1	IPL-H	input 1 hi scalar
8	IP1	IPL-L	input 1 lo scalar
9	IP1	----	input 1 scalars crossed over
10	IP1	----	input 1 scalars too far apart
11	Contr	C-tyP	controller type
12	Contr	C-Act	forward/reverse switch
13	Contr	rAtIO	ratio on/off switch
14	Contr	SEtS	terms set type
15	Contr	tUnEr	tuner type
16	IO	tPtyP	slot 1 tp type
17	IO	tP on	slot 1 tp minimum on time
18	IO	tPtyP	slot 2 tp type
19	IO	tP on	slot 2 tp minimum on time
20	IO	ZErO	slot 2 live zero
21	IO	ZErO	slot 3 live zero
22	ProF	CHAnS	profiler channels
23	ProF	SErVb	channel B servo type
24	ProF	SPb-H	channel B hi sp limit
25	ProF	SPb-L	channel B lo sp limit
26	ProF	Point	channel B decimal point
27	ProF	PrOGS	profiles available
28	ProF	SynC	profiler sychronise switch
29	ProF	dELAy	delay on/off switch
30	ProF	rEptS	repeats on/off switch
31	dinS	din-1	digital input 1 type invalid
32	dinS	din-2	digital input 2 type invalid
33	ALrS	A1tyP	alarm 1 type
34	ALrS	A1SEn	alarm 1 sense
35	ALrS	A1HyS	alarm 1 hysteresis
36	ALrS	ALr-1	alarm 1 level
37	ALrS	A2tyP	alarm 2 type
38	ALrS	A2SEn	alarm 2 sense
39	ALrS	A2HyS	alarm 2 hysteresis
40	ALrS	Alr-2	alarm 2 level
41	IP2	tyPE	remote set point type
42	IP2	I2-HI	remote set point hi limit
43	IP2	I2-LO	remote set point lo limit
44	IP2	----	remote SP limits crossed
45	rEtr	tyPE1	retransmission 1 type

46	rEtr	PAr 1	retransmission 1 parameter
47	rEtr	HI 1	retransmission 1 high scalar
48	rEtr	LO 1	retransmission 1 low scalar
49	rEtr	bIAS1	retransmission 1 bias
50	rEtr	rnGE1	retransmission 1 char range
51	rEtr	tyPE2	retransmission 2 type
52	rEtr	PAr 2	retransmission 2 parameter
53	rEtr	HI 2	retransmission 2 high scalar
54	rEtr	LO 2	retransmission 2 low scalar
55	rEtr	bIAS2	retransmission 2 bias
56	rEtr	rnGE2	retransmission 2 char range
57	ConS	bAUd	comms baud rate
58	ConS	AddrS	comms address
59	ConS	Sout1	comms rtx 1
60	ConS	Sout2	comms rtx 2
61	PASS	PASS	password
62	SP	SPLOC	local setpoint
63	SP	S-tyP	setpoint type
64	SP	rAtE	setpoint slew rate limit
65	SP	SP1	auxiliary set point 1
66	SP	SP2	auxiliary set point 2
67	Contr	PrOP	heat prop band
68	Contr	Iat	heat integral time
69	Contr	dAt	derivative time
70	Contr	aAPr	derivative approach band
71	Contr	rEL	relative cool power
72	Contr	rESEt	manual reset value
73	Contr	dbAnd	heat/cool dead band
74	rAtIO	rAtIO	ratio
75	rAtIO	bAnd	ratio band
76	rAtIO	Hi-OP	ratio hi output limit
77	rAtIO	th-hi	ratio hi thermal head limit
78	rAtIO	rEF	ratio limit referece
79	rAtIO	th-lo	ratio lo thermal head limit
81	OP	Act-t	valve action time
82	OP	dbAnd	valve dead band
83	OP	C PL	cool power limit
84	OP	C CyC	cool cycle time
85	OP	PL-h	heat high power limit
86	OP	PL-l	heat low power limit
87	OP	H CyC	heat cycle time
88	OP	OP1	auxiliary output 1
89	OP	OP2	auxiliary output 2
90	SP	SP 2	local setpoint 2
91	FSAFE	FSAFE	on/off switch
92	FSAFE	FS Hi	safety high limit
93	FSAFE	FS Lo	safety low limit
94	IP1	bIAS	input 1 live zero bias%
95	IP2	GAIN	remote setpoint gain switch
96	SP	GAIN	remote setpoint gain value