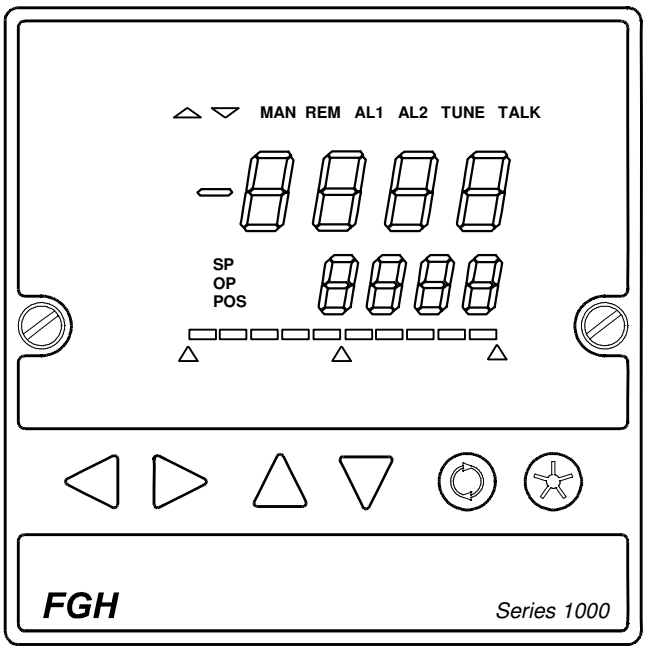
Engineers Manual



P1000 Programmer/S1000 Controller

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S1000/P1000 ENGINEERS MANUAL.
CONTENTS.

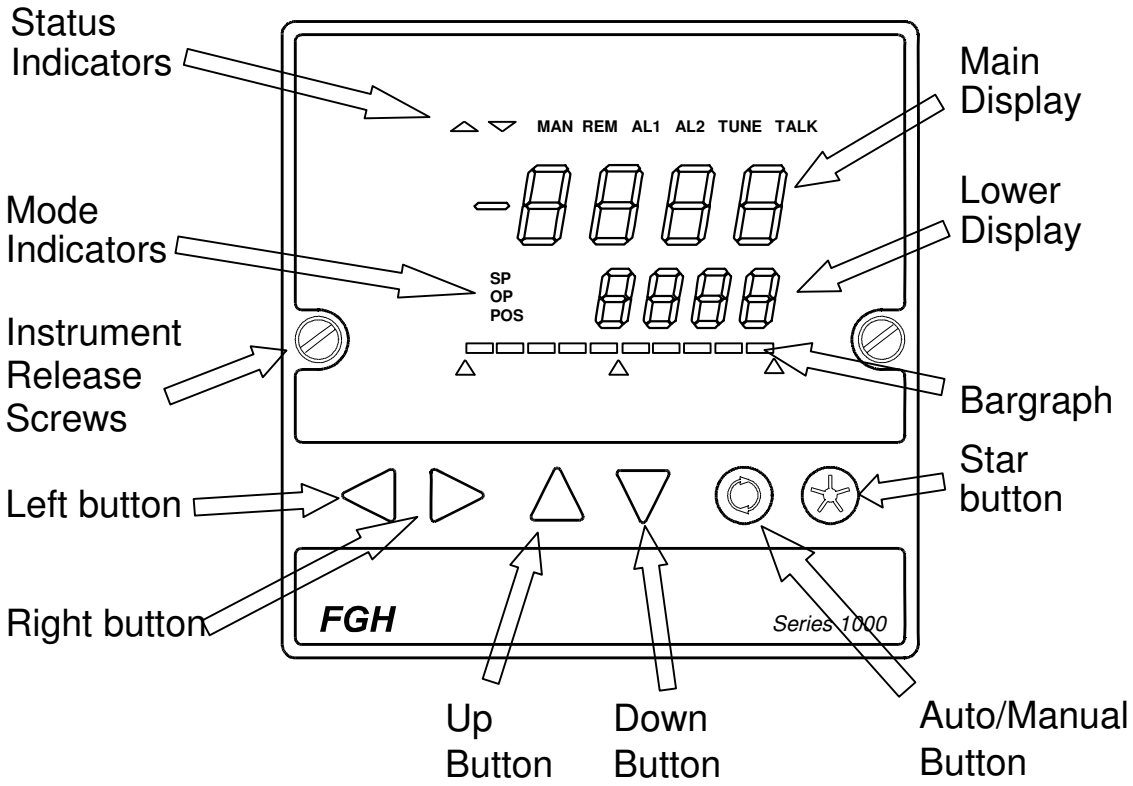
SECTION A – GENERAL

1.0 Introduction

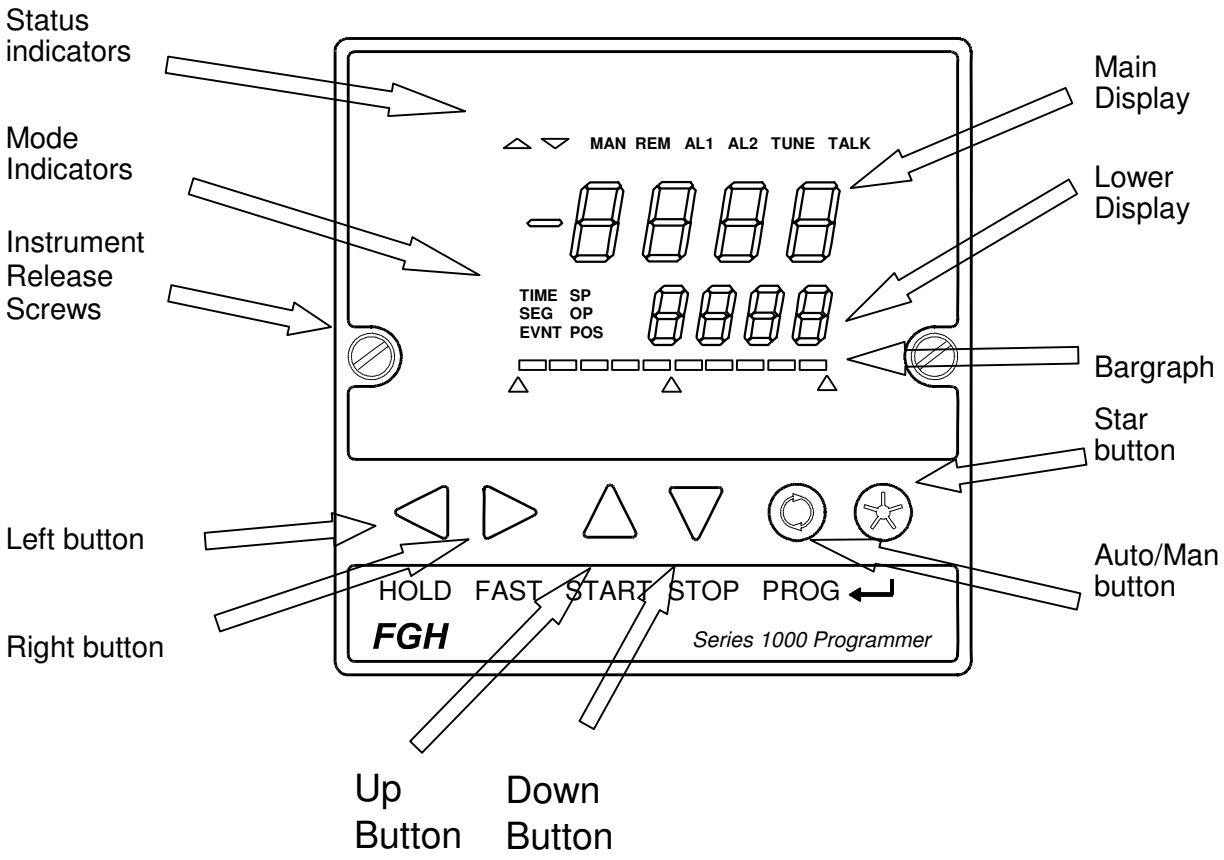
This manual is designed to be read by an engineer configuring the P1000 programmer or S1000 Controller to customer requirements before delivering a new instrument, or the reconfiguring of an existing instrument to accommodate new requirements. It covers selection and fitting of option boards, hardware configuration of these boards with patch links, and software configuration and calibration of the instruments programmer and controller parameters.

The task of installing the S1000/P1000 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 S1000/P1000 communications manual.

S1000 FRONT PANEL



P1000 FRONT PANEL



1.1 Displays

The main display on the S1000/P1000 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

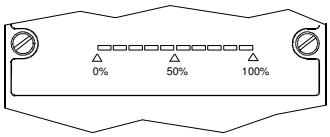
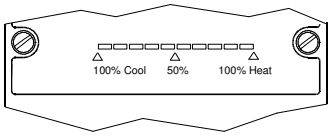
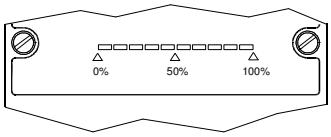
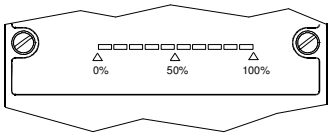
The status indicators provide information on the status of the instrument. The following is a brief explanation of each of the legends.

⌓	Heat output is on in time-proportion mode. Not used for analogue outputs.
⌔	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. (S 1000 only)
HOLD	Programmer is in hold. (P1000 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	If flashing, then instrument is in pretune, if on and steady then the instrument is in autotune (adaptive tune)
TALK	The instrument is being addressed via serial comms.

1.3 Bargraph

The S1000/P1000 is equipped with a bargraph, displaying output. The bargraph is arranged differently for different control types;

Control Type	Bargraph display
Auto/Manual Station and heat only	 of output
Heat/Cool	
Motorised valve	
Thermal head ratio	 of setpoint limits

2.0 Buttons

The S1000/P1000 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 P1000 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, POS, TIME, SEG** or **EVNT.**

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

The short scroll list will only include valve position if the S1000/P1000 is configured as a motorised valve positioner.

The short scroll list will only include time, segment and events if the instrument is a P1000, but in addition, events will only be included in the scroll if one or more of the option slots have been configured as an event output or event driver.

4.0 Long scrolls

In the S1000 controller, the long scroll is a controller scroll. This contains all the control parameters and commissioning data. The P1000 programmer has two long scrolls, the controller scroll, which is the same as the long scroll in the S1000, and the programmer scroll, which contains all the program data on the ten profiles stored in the P1000.

4.1 Entry and exit

To enter the long scroll of an S1000 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 P1000 Programmer, press and hold the right button. After a few seconds the first parameter 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 P1000 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.

Scroll between parameters 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.

Mnemonic	Parameter	Meaning
pass	password entry	If the password is set to other than 'clear' then the password sequence of four button presses must be entered here in order to be modified. See paragraph 5.0 After the password has been entered, **'good'** or **'bad'** is briefly display to indicate it the password was correct.
sploc	set point local	Local setpoint in displayed units
s-typ	set point type	setpoint to be used (S1000 only)
	loc	Local**,** setpoint = sploc
	re	Remote, setpoint is remote
	ind	Indexed, setpoint is sum of local setpoint and remote setpoint.
	lo	Setpoint is remote, but never lower than local setpoint (lo clamp)
	hi	Setpoint is remote, but never higher than local setpoint (hi clamp)
rate	rate of setpoint	Maximum rate of change of control setpoint in display units per hour (S1000 only)
sp1	aux set point 1	Setpoint value selected by digital input 1
sp2	aux set point 2	Setpoint value selected by digital input 2
thres	threshold	Amount the mv can deviate from setpoint before autotune begins, in displayed units.
ptune	pretune	On or Off, perform one shot pre-tune if on
atune	autotune	On or off, if on then adaptive autotune enabled if mv deviates by more that 'thres' from setpoint.
prop	propband	Heating proportional band in % if positive, or on/off hysteresis in digits if negative.
iat	integral time	Integral action time in seconds.

Mnemonic	Parameter	Meaning
reset	reset value	Manual reset value for output in % when proportional/derivative or proportional only control action set
dat	derivative	Derivative action time in seconds
dapr	derivative approach	Band around set point in prop bands, in which derivative action can occur
act-t	action time	Time in seconds for full travel of motorised valve
rel	relative	Cool propband in multiples of heat propband
dband	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
		For mv, the % output band around the required position when the valve is not driven at all
ratio	output ratio	Ratio of thermal head to difference between set point and load temperature
hi-op	high output	High limit of air set point output on ratio controller
th-hi	thermal head high	High limit of positive thermal head
ref-h	ratio reference high	Parameter to which ratio limit th-hi is referenced
	setp	Air set point output is limited to th-hi above load set point
	load	Air set point output is limited to th-hi above load temperature
	off	No limit on positive thermal head
lo-op	low output	Lower limit of air set point output on ratio controllers
th-lo	thermal head low	Maximum amount of negative thermal head
ref-l	ratio reference low	Parameter to which ratio limit th-lo is referenced

Mnemonic	Parameter	Meaning
	setp	Air set point output is limited to th-lo below load set point
	load	Air set point output is limited to th-lo below load temperature
	off	No limit on negative thermal head
alr-1	alarm 1	Alarm 1 level. The type of alarm set can be seen if the A/M key is pressed. A latched alarm 1 can be reset at this point by pressing the star key.
alr-2	alarm 2	Alarm 2 level. The type of alarm set can be seen if the A/M key is pressed. A latched alarm 2 can be reset at this point by pressing the star key.
op1	output 1	Auxiliary fixed output power (A-OP in e-mode) selected by digital input 1. OR Output high power limit (H-OP in e-mode) selected by digital input 1. OR Output low power limit (L-OP in e-mode) selected by digital input 1
op2	output 2	Auxiliary fixed output power (A-OP in e-mode) selected by digital input 2. OR Output high power limit (H-OP in e-mode) selected by digital input 2. OR Output low power limit (L-OP in e-mode) 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
h cyc	heat cycle	Heat output T.P cycle time in seconds
c cyc	cool cycle	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 P1000 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	delay start	settable in hours and minutes up to a limit of 99 hours 59 minutes. This is the period of time that will elapse after the selected profile has been told to start but before the conditions of segment 1 of the selected profile are applied.
er-r	event relay-reset	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 star button to change the relay being edited. Use the up and down buttons to turn the relay being edited on and off.
prog	program	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 sellable between 1 and 100 digits. This parameter works in conjunction with the next to provide the comprehensive hold facility.

Mnemonic	Parameter	Meaning
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, i.e. segments with an aiming level the same as the previous segment.
	r	ramps, hold during ramps, i.e. 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.
		note that for a hold to function then one or both of dwell or ramp must be set on **and** one or both of below or above must be set on.
rpts	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)
ti-1	time-1	time segment 1, the time taken for segment 1 of the program selected to execute
le-1	level-1	level segment 1, the aiming level for segment 1 of the selected program.
er-1	event relays-1	event relay setting for segment 1. Interpretation of settings and adjustment is as for 'event relay-reset'
ti-2	time-2	time set in hours and minutes for segment 2 (and so on up to segment 25) 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.

Mnemonic	Parameter	Meaning
le-2	level-2	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	event relays-2	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 three parameters time, level and event relays are presented in identical fashion, in sequence, for segments 2 through to 25 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 S1000 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 S1000 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 para 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. 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 **'cir'** to modify the password select **'yes'.**

Press the right button. If **cir** 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 tout 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 (P1000 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 S1000/P1000 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.

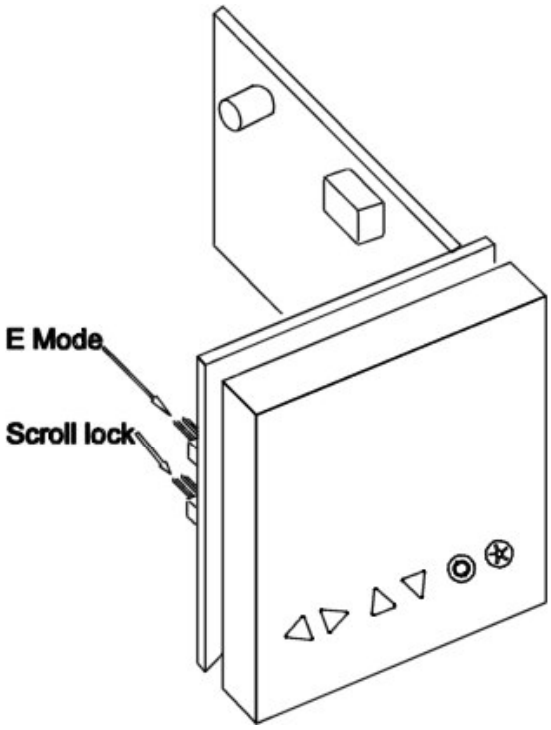
6.1 'E' Mode

'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 list

7.1 Input type

The first parameter listed in E mode 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.

input type	00 Type S	(Pt-10% Rh/ Pt)	BS 4937	Degree C
	01 Type R	(Pt-13% Rh/ Pt)	BS 4937	Degree C
	02 Type J	(Fe / Cu-Ni)	BS 4937	Degree C
	03 Type K	(Ni-Cr/ Ni-AI)	BS 4937	Degree C
	04 Type T	(Cu / Cu-Ni)	BS 4937	Degree C
	05 Type E	(Ni-Cr / Cu-Ni)	BS 4937	Degree C
	06 Type B	(Pt-30% Rh / Pt-6% Rh)	BS 4937	Degree C
	07 Type N	(Ni-Cr-Si / Ni-Si)	BS 4937	Degree C
	08 Type W	(W / W-26% Re)		Degree C
	09 Type W3	(W-3% Re / W-25% Re)		Degree C
	10 Type W5	(W-5% Re / W-26% Re)		Degree C
	11 Type NM	(Ni/ Ni-18% Mo)		Degree C
	12 Type L	(Fe /Cu Ni)	DIN 43710	Degree C
	13 K10	Type K in 1/10 Degree C	BS 4937	Degree C
	14 T10	Type T in 1/10 Degree C	BS 4937	Degree C
	15 RT10	(PT100) in 1/10 Degree C	BS 4937	Degree C
	16 RT	(PT100)	BS 4937	Degree C
input type	17 Type S	(Pt-10% Rh/ Pt)	BS 4937	Degree F
	18 Type R	(Pt-13% Rh / Pt)	BS 4937	Degree F
	19 Type J	(Fe / Cu-Ni)	BS 4937	Degree F
	20 Type K	(Ni-Cr / Ni-AI)	BS 4937	Degree F
	21 Type T	(Cu / Cu-Ni)	BS 4937	Degree F
	22 Type E	(Ni-Cr/ Cu-Ni)	BS 4937	Degree F
	23 Type B	(Pt-30% Rh / Pt-6% Rh)	BS 4937	Degree F
	24 Type N	(Ni-Cr-Si / Ni-Si)	BS 4937	Degree F
	25 Type W	(W / W-26% Re)		Degree F
	26 Type W3	(W-3% Re / W-25% Re)		Degree F
	27 Type W5	(W-5% Re / W-26% Re)		Degree F
	28 Type NM	(Ni / Ni-18% Mo)		Degree F
	29 Type L	(Fe /Cu-Ni)	DIN 43710	Degree F
	30 K10	Type K in 1/10 T	BS 4937	Degree F
	31 T10	Type T in 1/10 Degrees F	BS 4937	Degree F
	32 RT10	(PT100) in 1/10 Degrees F	BS 1904	Degree F
	33 RT	(PT100)	BS 1904	Degree F
	34 Linear			
	35 Root			

7.2 Cold junction compensation

A press of the right button scrolls to the next E mode parameter, **cjc.** This parameter will only be presented if a thermocouple input type is selected. The normal setting for this is **auto,** since the S1000 will then automatically compensate for the temperature of the cold junction at the instruments rear terminals. Fixed cold junction compensation temperatures of **0℃, 20℃** and **50℃** are also provided.

7.3 Input high and low scalars (V1.19 onwards)

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. **IPL-H** is the input high scalar and should be set to the value which the instrument is required to display at 100% input. **IPL-L** is the input low scalar and should be set to the value which the instrument is required to display at 0% input.

For example. If the instrument is connected to a transducer which transmits 4-20mA equivalent to 200"C - 1600℃, then **IPL-H** should be set to 1600 and **IPL-L** should be set to 200. (also the input **bias** should be set to 20%. see 7.6)

There are a few rules which must be obeyed when setting **IPL-H** and **IPL-L:**

1. **IPL-H** must be greater than **IPL-L.**
2. **IPL-H** minus **IPL-L** must be less than 6500.
3. **IPL-H** must be greater than zero.

7.4 High and low setpoint limits

The high and low setpoint limits **SPL-H** and **SPL-L** 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.

7.5 Decimal point

If a linear or root range has been chosen, then the parameter **'point'** 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.

7.6 Input Bias

Bias can be set as a percentage between 0 and 25 if the input type is ratio or linear. This allows the input to be scaled for live zero signals such as 4-20mA. 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.

7.7 Number of profiles (P1000 only).

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

7.8 Control format

C-typ may to 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 **SPL-H** to SPL-L) 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 lower) to position a motorised valve (with or without slidewire feedback)

Rat The controller provides an air setpoint output for connection to an air temperature controller in a thermal head ratio system.

7.9 Control action

If the control format is or '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)

7.10 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 titled 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	retransmissions voltage or current output
rAt	thermal head ratio air setpoint, voltage or current output
r-SP	remote set point input card
S-Fb	valve positioner, slidewire feedback input card
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				*	
rAt		*			
r-SP					†
S-Fb					*
Evnt	‡	‡	‡	‡	‡
E-dr					‡
E-Pr			‡		

* = function valid in this slot

† = function only valid on S1000

‡ = function only valid on P1000

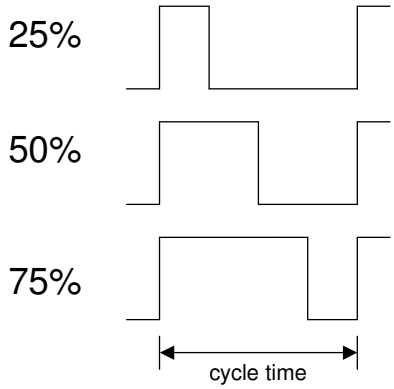
7.10.1 Time proportional output type

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

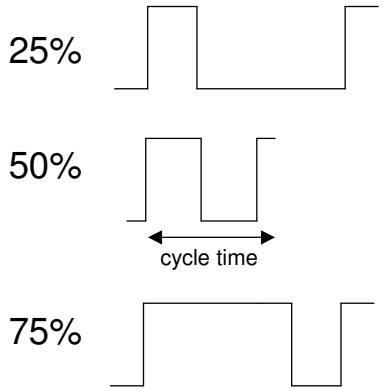
CYC. (Constant cycle time). The TP algorithm attempts to maintain a constant cycle time (set as **H CyC** or **C CyC**), except when the ON time falls below the time selected in **tP on,** in which case the OFF time is extended pro rata.

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



7.10.2 Constant cycle TP minimum on time

If slot 1 or slot 2 is configured as a TP output of constant cycle time, then a small minimum on time may be set using the parameter **tP on.** 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 1 from 0.02 to 0-30 seconds in increments of 20mS, and on slot 2 from 0.05 to 0.75 seconds in increments of 50mS.

7.10.3 Live and True zero analogue control outputs

Zero refers to a live or true zero being used for the output of the analogue control cards, heat analogue and cool analogue. The zero option is only presented if one of these functions is selected. 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.

7.11 Slot 6

Slot 6 is reserved for the serial communications option card. This is the only card that will fit in slot 6 and so the parameter **slot6** can only be set to **'on'** (comms present) or **'off** (slot 6 unused, no serial comms).

7.12 Digital inputs

din-1 and **din-2** are the two digital inputs which are always available on the S1000 controller/P1000 Programmer. 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 open AUTO mode is selected.

r-SP **Remote setpoint select** (S1000 only)
When contact is made the controller is forced to obey its REMOTE setpoint.
When contact is open the controller obeys its LOCAL setpoint.

Hold **Profile hold** (P1000 only).
When contact is made the executing profile will be held.

A-tU **Auto tune enable**.
When contact is made the adaptive tuner is enabled.
When contact is open the adaptive tuner is disabled.

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. See para 4.2.

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.

Strt **Profile Start**.(P1000 only)
When contact is made the profile generator will start execution of the selected program.

d-rA **Disable Ramp.** (S-1000 only)
When contact is made the setpoint ramp facility is disabled.

Stop **Profile Stop.** (P1000 only)
When contact is made the profile generator will cease program execution and return to the ready state.

St-H **Profile Start/Hold.** (P1000 only)
This is a double function input.
If the profile generator is in the ready state.
When the contact is made 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**. (P1000 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 reset state.

L-OP **Low Output Limit**
When the contact is made the controller output obeys a selected low output limit. (See para 4.2)

H-OP **High Output Limit**
When the contact is made the controller output obeys a selected high output limit. (See para 4.2)

StEP **Profile Segment Step** (P1000 only)
When the contact is made the current running profile will step to the start of the next segment. One step per contact closure will be performed.

7.13 Alarms

The S1000 controller/P1000 programmer has the ability to drive two independent alarms implemented as relay option boards or isolated SSR 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 para 7.10)

7.13.1 Alarm sense and latching

A1SEn and **A2SEn** 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

7.13.2 Alarm type

A1tyP and **A2TyP** may be set to the following

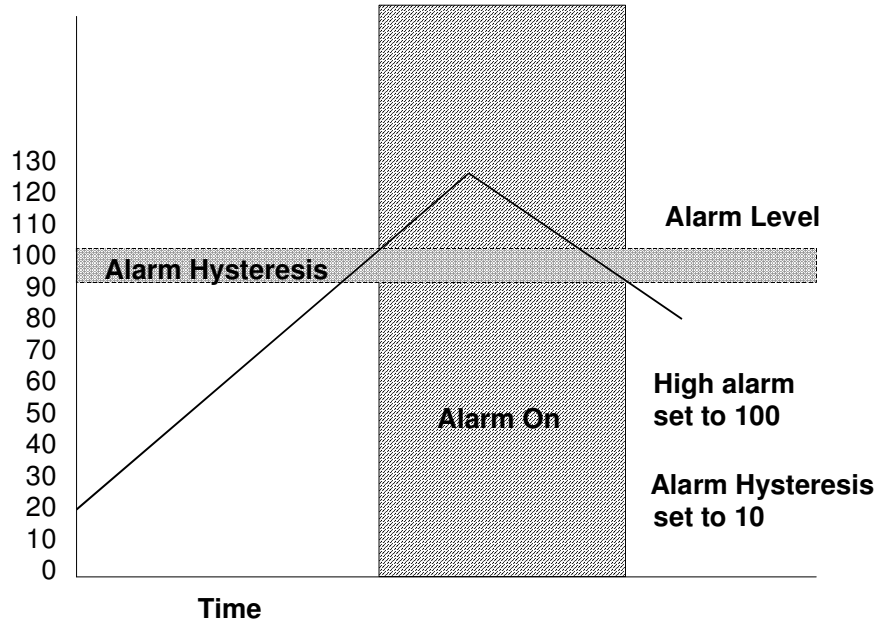
HI alarm when mv >= alarm level
LO alarm when mv < = alarm level
ind alarm when mv >= setpoint + alarm level or mv <-- setpoint - alarm level
in-h alarm when mv > = setpoint + alarm level
in-L alarm when mv <= setpoint - alarm level
H-A hand (manual) acknowledge. Alarm when controller is in manual.
RE-A (S1000 only) 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* P1000 *Programmer.
These alarm types may not be latched or have inverted sense.

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)

7.13.3 Alarm hysteresis

A1HyS and **A2HyS** 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℃ and alarm 1 hysteresis for alarm 1 set to 10 (℃) then a process temperature rising from 20°C to 120℃ will cause an alarm to be generated when the temperature gets to 100℃. If the process temperature then falls to 50°C the alarm will be maintained until the temperature reaches 90℃, 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 7.12.4)



7.13.4 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 S1000/P1000 communications manual), by operating an appropriately configured digital input (see para 7.12 of this manual) 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.

7.14 Remote set points (S1000 only)

7.14.1 Remote set point type

rStyP, The type of remote set point, may be set from the list presented. Options will include any that are valid, in particular, digital remote set point will only be included if slot 6 is occupied by digital serial communications, and the option for analogue remote set point will only be included if slot 5 is occupied by the remote set point, **r-SP.** The following is the fullest list of options that will ever be offered.

OFF no remote set point used
dIG Digital remote set point via digital serial comms.
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. (lowest magnitude input is some percentage of maximum).

7.14.2 Remote set point limits

The next two parameters in the configuration scroll are the remote set point high and low range limits, **rS-HI** and **rS-LO.** These will be included in the configuration scroll as long as remote set point type, **rStyP,** is not set to **OFF.**

These parameters are scaling factors for the remote set point input and quite separate from the setpoint limits encountered earlier. Their purpose is to specify the resulting range of remote set point for the full span of the input. For example, if the remote set point input 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 remote set point with 0V input would be whatever is set for **rS-LO,** and with 10V input then the remote setpoint would be whatever is set for **rS-HI.**

In this way any convenient input could be used to produce the range of remote setpoint required. For example, if the desired range of resulting remote setpoint was -1000℃ to +1000"C, it is not necessary to use a bipolar input. Simply set rS-LO to -1000 and rS-HI to +1000, then with the 0 - 10V unipolar true zero input, a remote setpoint of -1000 would result from a 0V input and a +1000 remote setpoint from a 10V input.

7.15 Retransmission

If slot 4 is dedicated to **rEtr,** (retransmission) then the controller may be configured to retransmit one of a number of parameters as an analogue voltage or current, with a span set in software and bias if required for live zero output.

7.15.1 Retransmission parameter

r-tYP, the retransmission type dictates which of the parameters are to be retransmitted.
OFF no retransmission
PrOC Process variable, the value of the controlled process
SP set point, current set point value being used
Err error, the difference between the process variable and the set point
OP current output level

7.15.2 Retransmission limits

The next two parameters in the configuration scroll are the retransmission high and low range limits, **rt-HI** and **rt-LO.** These will be included in the configuration scroll as long as the retransmission type, **r-tyP,** is not set to **OFF.** The selected parameter is limited thus before retransmission.

7.15.3 Retransmission bias

If the retransmission type, r-tyP, is not set OFF, then the next configuration parameter is retransmission bias, rblAS 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. S/P1000 Engineers Manual M22 Issue 4a page 24

7.16 Digital serial communications

The S1000 Controller may be equipped with digital serial communications by fitting the comms option board in slot 6 and configuring slot 6 'on', see para 7.11.

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 S1000/P1000 communications manual provided with the instrument).

Remember that with a P1000 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.

SECTION C " PROGRAMMING THE PROFILE GENERATOR

8.0 General

Although the Proteus can be employed to control a wide variety of variables, for the sake of simplicity this explanation will assume that the process variable being controlled is temperature. The P1000 programmer creates a time/temperature profile from a sequence of time and temperature (level) coordinates, the resultant profile therefore consists of linear rates of change of temperature with time. Each linear section of the profile is referred to as a segment.

The following three aspects of operation are fairly complex and should be fully understood if the behaviour of the instrument is not to be confusing.

8.1 Start sequence

When the profile generator is in it's ready state (i.e. a profile is not running and the **'TIME'** element of the short scroll shows **'rEAdy')** then the controller obeys the local setpoint. 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 'SXXS<CR>' string to the profile generator (where XX is the address of the profile generator) or via one of the instruments digital inputs when it is configured as a START or a START/HOLD function. See para 7.12, Digital inputs.

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

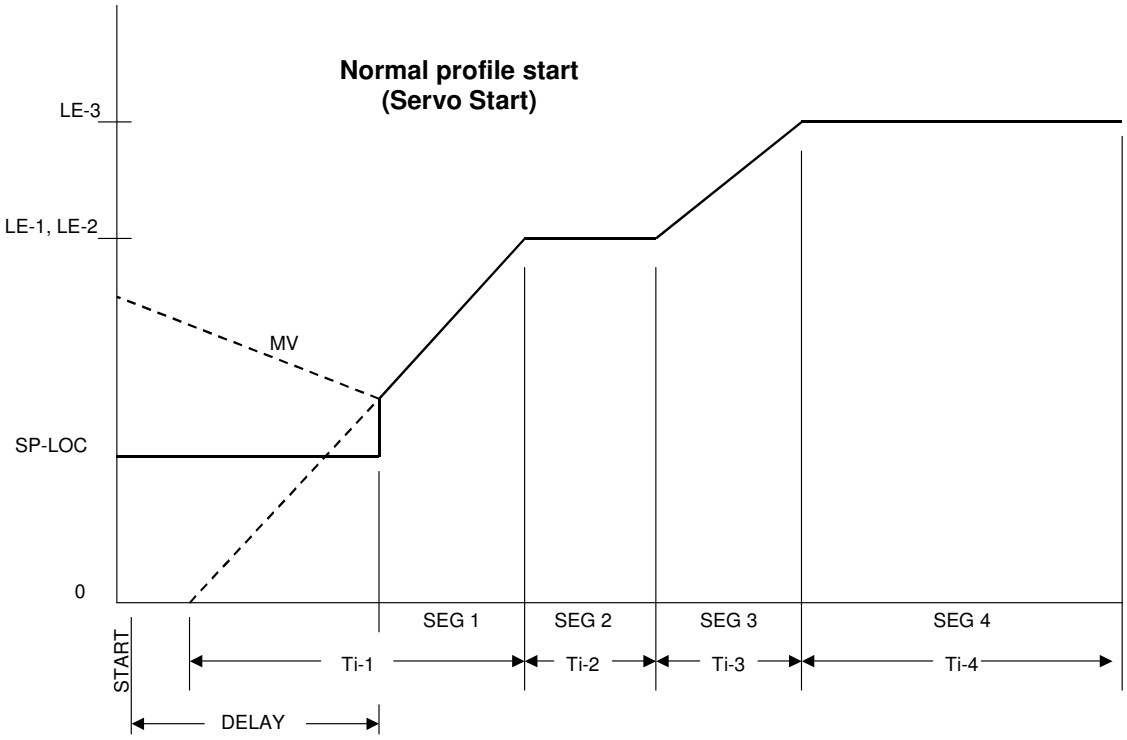
4 When the delay start time has elapsed the instrument advances to the first segment of the profile.

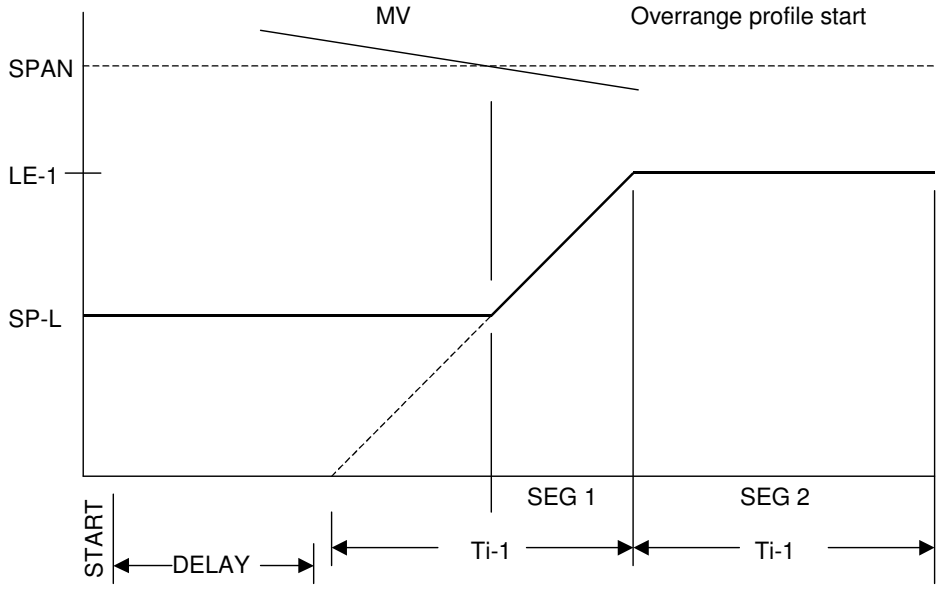
5 If the time of the first segment **(ti-1)** is zero then the profile step changes immediately to the first segment's level **(le-1)** and the controller henceforth obeys the profile generator setpoint. The profile then advances and begins execution of the second segment.

6 If the time of the first segment (ti-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 (le-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 **(le-1).** ***The rate of the first segment will be as if segment 1 had started from a level of zero.***





P1000 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.

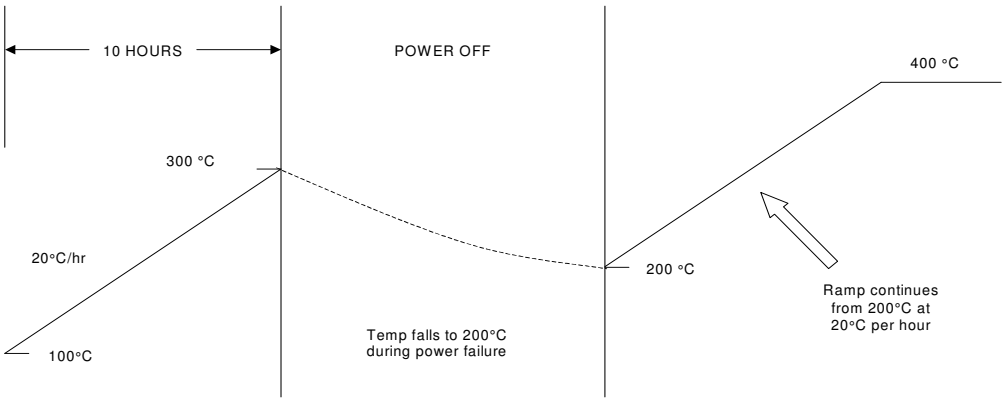
3) If the interrupted segment is a ramp and the measured value is out of range then the profile remains at the point it had reached before the interruption. Since the measured value is out of range the profile generator goes into a hold condition and the profile remains stationary. When the measured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

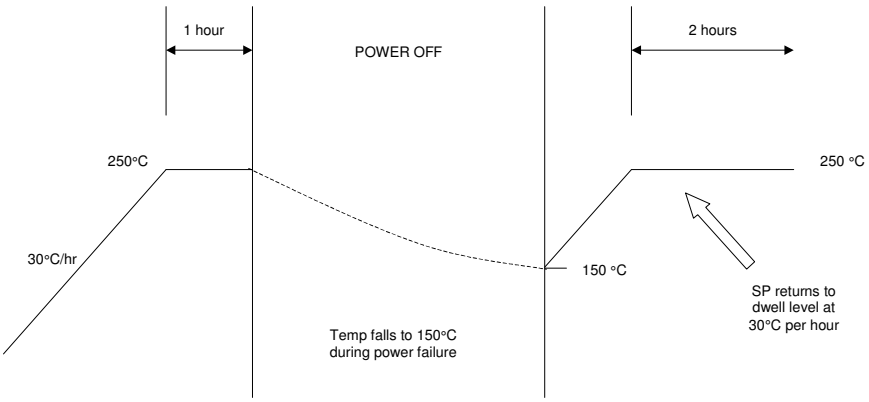
5) If the interrupted segment is a dwell and the measured value is out of range then the profile remains at the dwell level. Since the reading is out of range the profile generator goes into a hold condition; when the measured value comes back into range the dwell continues from where it was interrupted.

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.

INTERRUPTION OF RUNNING RAMP



INTERRUPTION OF A 3 HOUR DWELL PERIOD



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 **'HOLD'** legend will light up on the front panel to indicate this. Holds can originate from any of four sources:

1) 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. When the instrument is in this type of hold, the **'HOLD'** status indicator on the front of the instrument flashes on and off until the hold is released. All other types of hold cause the **'HOLD'** status indicator to be on and steady.

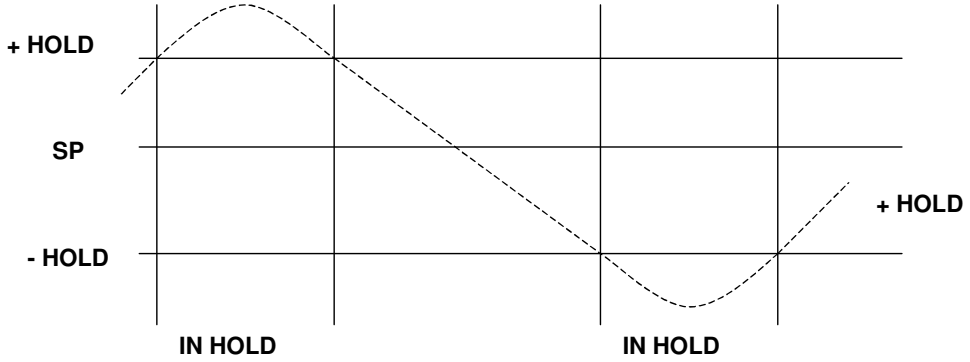
2) A communicating profile generator may have its running profile held via the serial communications link by sending a 'SXXH<CR>' to it (where XX is the address of the profile generator, ie 16 greater than the address of the controller). This hold is freed by sending a 'SXXF<CR>' to the instrument.

3) 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 para 7.12, Digital inputs.

4) 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.

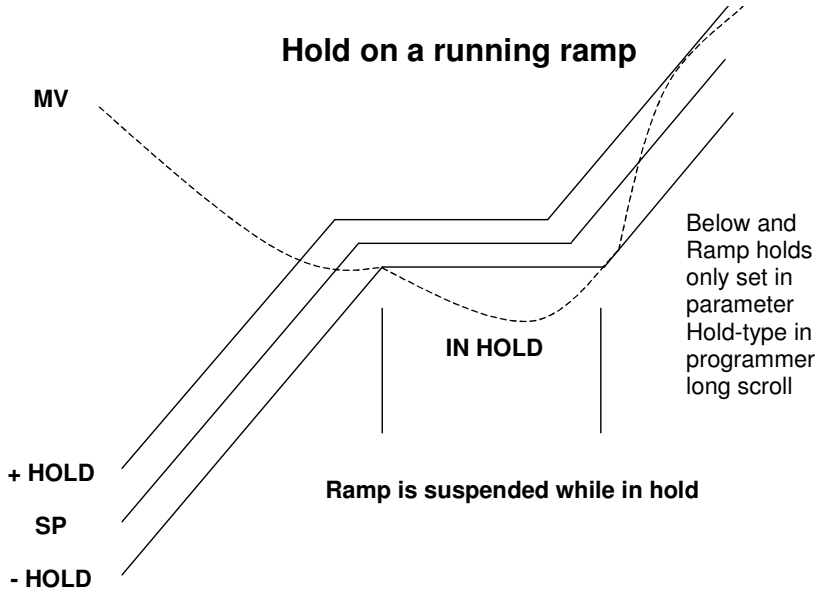
5) If a hold occurs during a ramp segment then the ramp will remain stationary for the duration of the hold. If a hold occurs during a dwell then the dwell time is extended by an amount equal to the period of the hold.

Hold during a dwell



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.

Hold on a running ramp



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 para 7.12, Digital inputs.

3) Via the serial communications facility by sending a 'SXXR<CR>' string to the programmer (where XX is the programmer address).

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.

NOTES

SECTION D - HARDWARE CONFIGURATION

9.0 General

The S1000 controller/P1000 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 S1000 Controller/P1000 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.

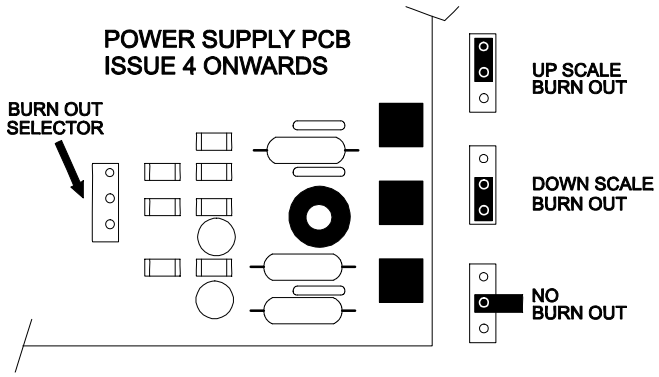
9.2.1 Transmitter power supply

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 5 different options boards which provide the additional facilities on the S1000 Controller. They are as follows;

10.1 Relay board PC1542

This board provides one isolated form 'C' (changeover) contact. A C-R 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 S1000 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. 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.

10.3 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 S1000/P1000 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 P1000 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 P1100 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 analog 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 pic 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.

Function	Board	Power supply		Options board carrier		
		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				✸	
Ratio sp	Analogue out	✸				
Remote sp	Remote sp					✸
Slidewire	Slidewire					✸
Internal event	Relay/logic drive	✸	✸	✸	✸	✸
Ext event drive	Logic drive					✸
Ext prog select	Remote prog input			✸		

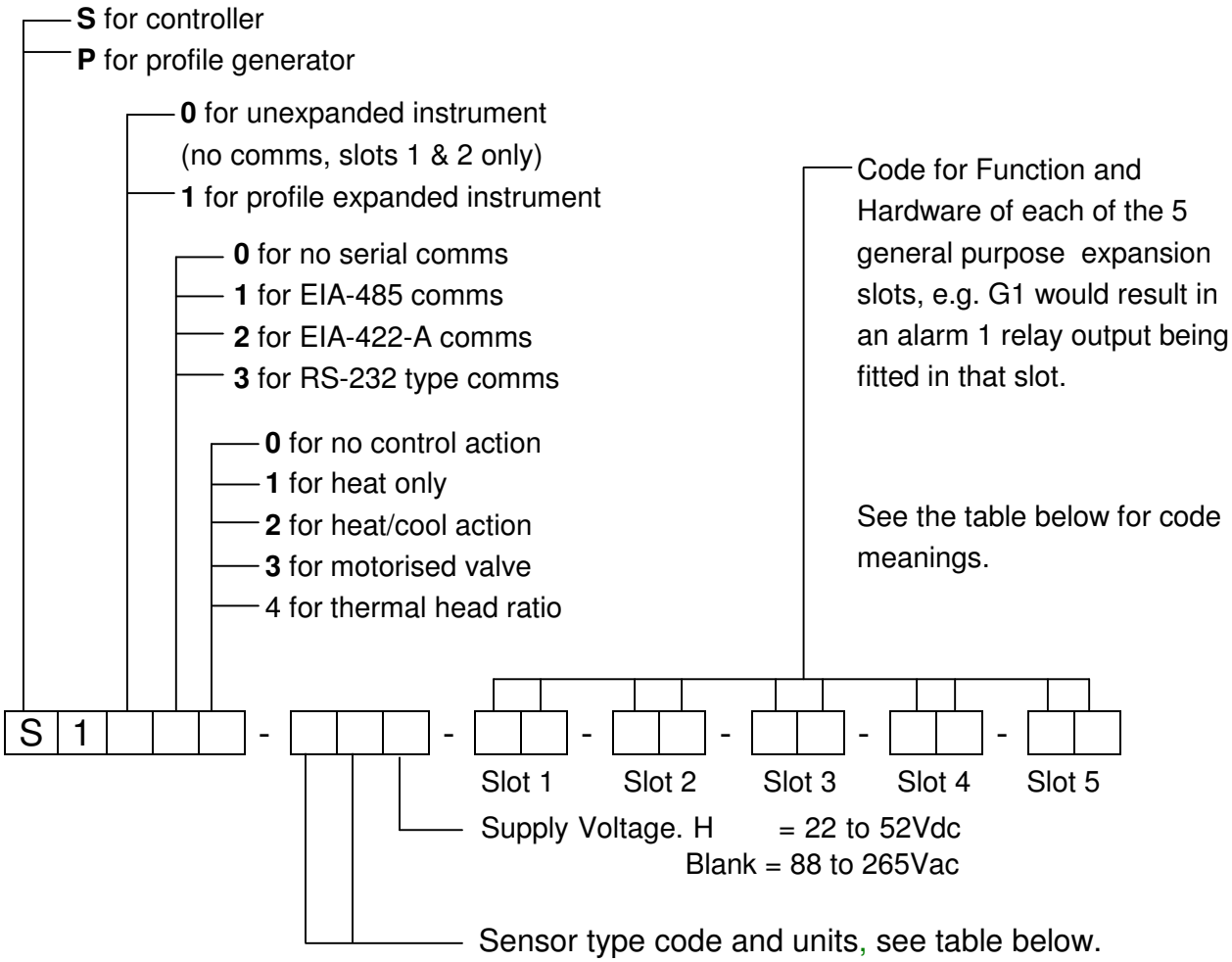
Note.

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. S1000, 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, (S100x), then it is not necessary to fill in slots 3 to 5.



Example 1. S1001-03-B4 G1

This describes an unexpanded controller, with a heat only analogue 0 - 20mA 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. S1113-15-E1 F1 G2 00 L8

This describes an expanded controller with EIA-485 serial communications, set up to drive a motorised valve (S1113), 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 alarm2, retransmission or internal event (on P1000)
Slot 5 Unpowered slidewire input

SlSlot Function and Hardware codes.

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
J	for thermal head ratio
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 output *
5 for 4 - 20mA analogue output *
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)	°C
= 01 Type R	(Pt-13% Rh/Pt)	°C
= 02 Type J	(Fe / Cu-Ni)	°C
= 03 Type K	(Ni-Cr / Ni-Al)	°C
= 04 Type T	(Cu / Cu-Ni)	°C

	= 05 Type E,	(Ni-Cr / Cu-Ni)	°C
	= 06 Type B,	(Pt-30% Rh / Pt-6% Rh)	°C
	= 07 Type N,	(Ni-Cr-Si / Ni-Si)	°C
	= 08 Type W,	(W / W-26% Re)	°C
	= 09 Type W3,	(W-3% Re / W-26% Re)	°C
	= 10 Type W5,	(W-5% Re / W-26% Re)	°C
	= 11 Type NM,	(Ni / Ni-18% Mo)	°C
	= 12 Type L,	(Fe /Cu-Ni)	°C
	= 13 K10,	Type K in 1/10°C	°C
	= 14 T10,	Type T in 1/10 °C	°C
	= 15 RT10,	(PT100) in 1/10°C	°C
	= 16 RT,	(PT100)	°C
input type	= 17 Type S,	(Pt-10% Rh/ Pt)	°F
	= 18 Type R,	(Pt-13% Rh / Pt)	°F
	= 19 Type J,	(Fe / Cu-Ni)	°F
	= 20 Type K,	(Ni-Cr / Ni-Al)	°F
	= 21 Type T,	(Cu / Cu-Ni)	°F
	= 22 Type E,	(Ni-Cr / Cu-Ni)	°F
	= 23 Type B,	(Pt-30% Rh / Pt-6% Rh)	°F
	= 24 Type N,	(Ni-Cr-Si / Ni-Si)	°F
	= 25 Type W,	(W / W-26% Re)	°F
	= 26 Type W3,	(W-3% Re / W-26% Re)	°F
	= 27 Type W5,	(W-5% Re / W-26% Re)	°F
	= 28 Type NM,	(Ni / Ni-18% Mo)	°F
	= 29 Type L,	(Fe /Cu-Ni)	°F
	= 30 K10,	Type K in 1/10 °F	°F
	= 31 T10,	Type T in 1/10 °F	°F
	= 32 RT10,	(PT100) in 1/10 °F	°F
	= 34 Linear,	0 to +90mV input	
	= 35 Square Root,	0 to +90mV input	

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 S1000/P1000 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 analog 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 para 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 para 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 **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 **ZEr02** 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 **ZEr02,** 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, **(C-TYP** is VP), that a slidewire input board in fitted in slot 5 **(SLOt5** is **S-Fb,** slidewire feedback) and that the motorised valve to be used is correctly connected to the instrument rear terminals, (see installation manual para 5.2).

Invoke 'E' mode as described in para 6.1 and scroll on to the **ZErO2** 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 **SPAn2,** 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 (P1000 only)

This input is a low resolution, high speed analog input which is used to select remotely the program number to be used by the profiler, and therefore must be calibrated like any other analog 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 -10.0V (-1.0V) 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 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 Analog output calibration.

There are 3 possible analog outputs on the series 1000 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 analog 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 1/4 digit DVM is desirable). Select the DVM range appropriate to the type of analog 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	parameter at fault
1	input type
2	output type
3	cjc type
4	alarm 1 type
5	alarm 1 sense
6	alarm 1 hysteresis
7	alarm 1 level
8	alarm 2 type
9	alarm 2 sense
10	alarm 2 hysteresis
11	alarm 2 level
12	setpoint type
13	ratio
14	ratio limit 1
15	ratio limit 2
16	ratio limit 3
17	ratio limit 4
18	valve action time
19	valve dead band
20	rel (relative cool power versus heat power)
21	manual reset value
22	local setpoint
23	auxiliary set point 1
24	auxiliary set point 2
25	cool power limit
26	heat/cool dead band
27	cool cycle time
28	heat prop band
29	heat integral time
30	heat integral approach band
31	heat derivative time
32	heat derivative approach band
33	heat high power limit
34	heat low power limit
35	heat cycle time
36	comms baud rate
37	comms address

38..... retransmission type
39..... retransmission high
40..... retransmission low
41..... retransmission bias
42..... ratio reference high
43..... ratio reference low
44..... setpoint rate
45..... slot 2 live zero
46..... slot 3 live zero
47..... invalid password
48..... set point limits crossed over
49..... set point limits too far apart
50..... splimh out of limits
51..... spliml out of limits
52..... auxiliary output 1 out of limits
53..... auxiliary output 2 out of limits
54..... tuner threshold out of limits
55..... forward/reverse value invalid
56..... digital input 1 type invalid
57..... digital input 2 type invalid
58..... remote set point type invalid
59..... remote set point hi limit invalid
60..... remote set point lo limit invalid
61..... remote set point limits crossed
62..... slot 1 tp type
63..... slot 1 tp minimum on time
64..... slot 2 tp type
65..... slot 2 tp minimum on time
66..... input 1 hi scalar (IPL-H)
67..... input 1 lo scalar (IPL-L)
68..... input 1 scalars crossed over
69..... input 1 scalars too far apart