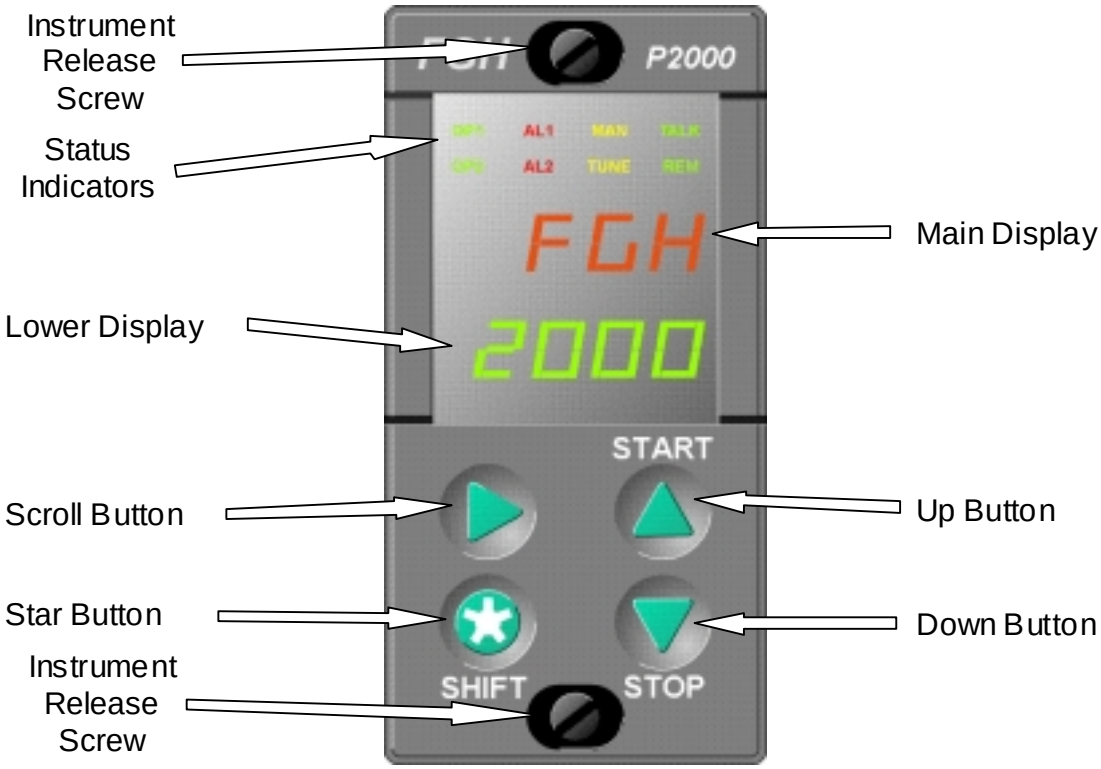
Operation and Installation Manual

Series 2000

FGH Controls Ltd
Openshaw Way,Letchworth
Herts. SG6 3ER
Tel: (01462) 686677
Fax: (01462) 480633
Email: sales@fghltd.demon.co.uk
www.fgh.co.uk

SERIES 2000 FRONT PANEL



SERIES 2000 INSTALLATION and OPERATORS MANUAL.
CONTENTS.

PART 1 OPERATION

1.0 GENERAL

The FGH Series 2000 instruments are highly advanced, autotuning PID single loop controllers and programmer/controllers. They are designed to be flexible in application and yet straightforward to use. This manual provides operation information on both the S2000 controller and the P2000 programmer/controller. Installation, engineers and communications handbooks are also available separately.

1.1 Software version

When power is first applied to the instrument the main display shows the letters **FGH**, while the lower display shows the software version number, then **2000** is shown on the lower display. This display is replaced after a few seconds with the usual one described below.

1.2 Front panel indications

The upper display usually shows the measured value, for example, the temperature of the process being controlled.

A flashing **U-r** message on this display indicates an under ranged input. Similarly a flashing **O-r** indicates an over ranged input.

The lower display normally shows the process setpoint but may be replaced by any short scroll parameter described in section 1.3

The status indicators at the top of the display tell you several things.

OP1 Output 1 is on
OP2 Output 2 is on
AL1 Alarm 1 is active
AL2 Alarm 2 is active
MAN The controller is in manual mode
TUNE (Flashing) Pretune is on
TUNE (On and steady) Autotune is on
TALK The controller is being talked to via serial comms link
REM The controller is obeying a remote setpoint.

1.2.1 Flashing displays.

A flashing setpoint display is used on the programmer version to indicate that the running profile is in **HOLD**. This means that the profile setpoint is temporarily frozen to allow the process variable to catch up with the setpoint. This condition may be the result of an internal HOLD (see section 3.2.4), or an external hard wired input from another instrument.

1.3 Short scroll

When the scroll button is pressed the **2000** enters short scroll. This means that the lower display is displaying one of a short list of parameters; setpoint, output, status, time or event.

The lower display shows a mnemonic which indicates the purpose of the value displayed on the upper display.

OP Output status, accompanied by either **Auto** or **HANd** on the upper display.

OP Output value, this is the current percentage output of the controller. When appropriate, heat is positive and cool is negative. This may be control output or a manually set value.

POS Value position, When the instrument is configured as a motorised valve positioner, this parameter shows the actual position of the valve in percent of open.

Stat Profile status (P2000 only), this shows the profile and segment number of the profile currently running, or if no program is running then **rd'y** is displayed.

Two other indications are also provided under the **Stat** element of the short scroll, the display **XX.PF** would indicate that program number XX is recovering from a power failure, and error indication **Er-x** indicates that the program that has been instructed to run is corrupt. x would be replaced with a number 1 to 7 to indicate the type of error. See Appendix C for a complete listing. To recover from this latter condition, press the star button momentarily to acknowledge the error and then enter the programmer scroll and repair the fault by re-entering the corrupt parameter.

ELAP Segment elapsed time (P2000 only). Displays the program time elapsed since the current segment started running.

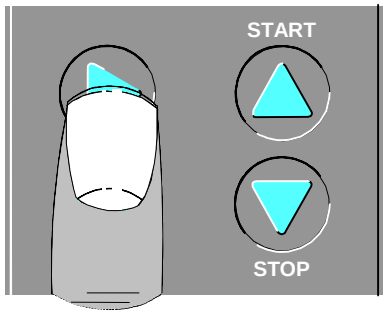
EVNT Event status (P2000 only). If the instrument has been configured as having at least one event output then this displays the current status of the eight events, a high bar being on and a low bar being off. The events read from left to right.

Prog Profile number (P2000 only). This value is only shown in ready mode and indicates the profile number which is to be executed.

The instrument may be left displaying any of the above short scroll parameters and this display will remain until changed by the operator or the instrument is repowered.

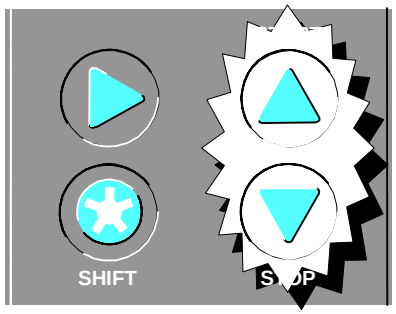
1.4 Using the keypad

The right arrow button (scroll button) is used to select a parameter to be viewed or modified. When this button is pressed, the next parameter in the scroll list is selected. By holding down the star button whilst pressing scroll, the instrument will display the previous parameter in the list.

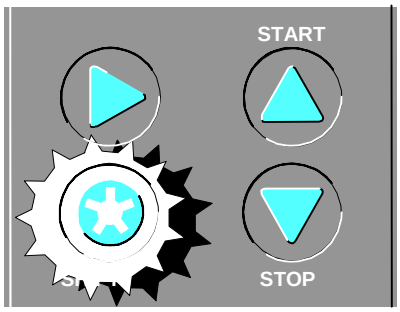


In the short scroll these buttons select which of a short list of parameters, consisting of setpoint, output, segment etc is on the upper display.

The up and down buttons adjust the value of the parameter selected. When the button is pressed it is changed by one at first but then at an increasing rate. This makes it easy to make large changes quickly.



Star button. This button is used to access the alternate functions of the keypad as shown in white next to the buttons. The star button is pressed and held and the other button then pressed to achieve the desired programmer function.
The star button is also used to unlatch latched alarms when the alarm level is displayed in the long scroll, to show remaining number of repeats and acknowledge failure to start a corrupt program. The star key is also used for initially configuring the programmer/controller.



1.5 Automatic and manual modes.

To toggle the controller between automatic and manual modes. Enter short scroll and scroll on until output is displayed in the short scroll, (lower display shows **OP**). The current status **Auto** or **HANd** is shown on the upper display. To change mode press the up or down button. In manual mode the **MAN** indicator at the top of the display is lit.

While the controller is in manual mode the output remains constant until changed by the operator or the instrument is placed back in automatic mode.

To manually change the output whilst in manual mode, press the scroll key once more until the top display shows the current output value in percent. This output value is changed by use of the up and down keys, but only within the limits set up in the long scroll.

In heat/cool control mode the output display shows the net power output which may well be a negative number indicating a net cooling output.

1.6 Profile select (P2000 only)

When the programmer is in ready mode (no profile is running) the short scroll **Prog** parameter shows the currently selected profile number. This is the number of the profile which will be started next. To change this profile to the one required, use the up and down arrow buttons to change the indicated number to the value desired.

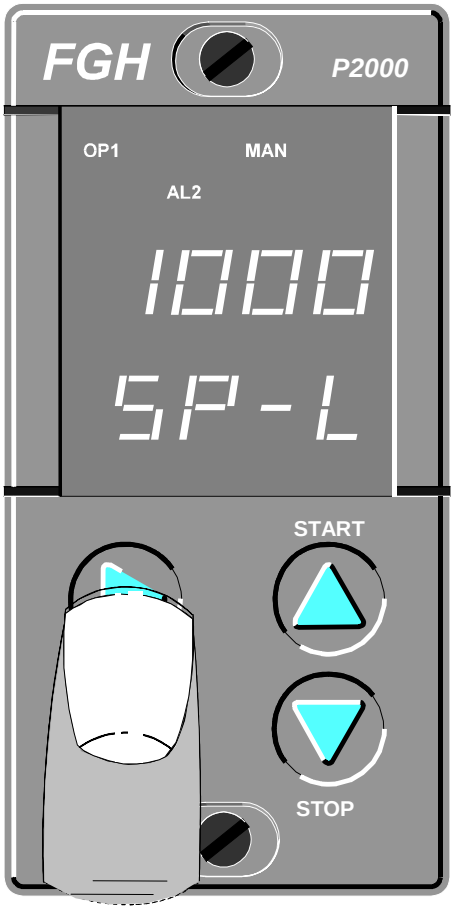
If a profile is currently running the **Prog** element is not present in the scroll and the **Stat** parameter shows the status of the running profile the upper display. This display will show two numbers separated by a decimal point, for example ' **4. 5**' this means that a program is currently running and that profile must be stopped before a new one can be selected. (**4. 5** would indicate that profile 4 is running and is currently executing segment 5)

1.7 Starting and stopping a profile

The program currently selected may be started at any time from within the short scroll by pressing and holding the star button and then briefly pressing the up button.

A running program may similarly be stopped at any time from within the short scroll by pressing and holding the star button and briefly pressing the down button.

2.0 CONTROLLER SCROLL



While there are only a few parameters in the short scroll, the controller scroll is a long scroll, and has many more. Only relevant parameters are held in the controller scroll, so as the setup of the instrument changes, so too will the contents of the controller scroll. Refer to APPENDIX A for a complete list.

To enter the controller scroll, press and hold the scroll button. After two seconds the display will change. You are now in the controller scroll. In the controller scroll each parameter has a unique mnemonic, which is shown on the lower display when that parameter is being examined. Each press of the scroll button will scroll forwards to the next parameter. Use the star and scroll buttons to scroll backwards through the list.

To return to short scroll, press and hold the scroll button again for two seconds. Alternatively, if no buttons are pressed for 20 seconds then the instrument will automatically revert to short scroll.

2.1 Modifying data

The up and down buttons are used to change the value of the parameter displayed. There will often be limits to the parameter being modified, and it will only be possible to change the value of the parameter within these limits.

If a parameter contains illegal data, for example when the configuration is changed, then when that parameter is viewed the upper display consists of all bars;(**- - - -**). Pressing the up or down buttons clears this and allows the parameter to be set to the desired value.

3.0 PROGRAMMER SCROLL

To enter the programmer scroll, hold down the star and scroll buttons, after two seconds the display will change. You are now in the programmer scroll.

To return to short scroll, press and hold the scroll button again for two seconds. Alternatively, if no buttons are pressed for 20 seconds then the instrument will automatically revert to short scroll.

3.1 Profile Program structure

The standard P2000 program controller can store 10 profile programs numbered 0 to 9. Each of these programs consists of up to 10 segments numbered 1 to 10.

Each segment consists of a target time (in hours and minutes) and a target level. The programmer will move the control setpoint from the previous target to the current target level in the target time. In the case of segment 1, the previous target is taken as the current measured variable. This is known as servo start. (See servo start in the engineers manual for further information).

In addition to the target time, segments 2 to 10 may be set to END, that is terminate this program at this point, or the segment may be set to GO to any of the ten programs and continue execution from the beginning of that program.

3.2 Programmer scroll global parameters

There is only one of each of the following parameters and they are not related to any particular profile program.

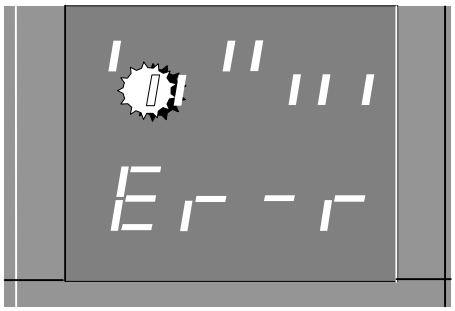
3.2.1 Delay Parameter

When the programmer scroll is first entered, the first parameter to be encountered is **DELAY**. This is an important parameter and shows a time in hours and minutes on the upper display. This time may be set with the up and down buttons to between 0 and 100 hours.

The time set represents a delay which will be executed after the profile had been commanded to start and before the conditions of segment 1 of the selected profile are applied.

This facility is provided so that a plant may be set to start up to 4 days after being programmed. For example, so that a furnace is ready for use first thing Monday morning, or to execute a process only during the night when cheap power is available.

3.2.2 Event relay reset status



If any of the instrument option slots have been configured as event outputs then pressing the right button causes the parameter **'Er r**' to be displayed on the lower display. On the upper display are eight lines representing the status of the eight events to be used when no profile program is running, or when the programmer is in delay before starting a profile.

Each of the events can be set to be on or off. An on condition is indicated by a high mark and an off condition by a low mark. The events are edited one at a time, the event currently being edited flashes. To turn on an event use the up button, to turn it off use the down button. To edit the next event press and release the star button.

The illustration shows that the reset condition is with events 1, 4 and 5 on and the rest are off. The star button has been pressed so that event 2, which is now flashing, can be edited.

The above procedure for editing events is also used when editing events in program segments, which will be encountered later.

3.2.3 Parameter PROG

After the delay parameter, (or event relay reset if events have been configured), a further press of the scroll button will cause the **Prog** legend to be displayed. This is the profile select and use of the up and down buttons will allow selection of the profile number to be viewed and/or modified.

The parameters following this element relate only to the profile number just selected. There will be a hold band, hold type and repeats setting for each of the many profile numbers available within the instrument.

3.2.4 Parameters Hold and Hold type

Parameter **Hold** may be set between 1 and 100 digits. These are in the same units as the measured value. This setting represents the hold band of the profile, ie. if the difference between the measured value and the setpoint (the error) is greater than the hold band then the profile will hold if dictated by the hold type.

The 'hold type' parameter **HtYP**, shows a line of four characters on the upper display, any or all of which may be replaced with a '_'

Use of the up and down buttons will cause the desired symbols to appear or be replaced with underscores. When the symbols are visible that parameter is active as follows.

The illustrations show an instrument which will go into hold on dwell or ramp segments only when the measured value goes more than 5.0 units above the control set point.

d Dwell, enables profile hold when the program segment is of 'dwell' type. A dwell type segment is one in which the level, or aiming point of that segment is the same as that of the previous segment.

Dwell enable must be accompanied by an above or below enable before dwell hold is active.

r Ramp, enables profile hold when the program segment is of 'ramp' type. A ramp segment is one in which the aiming level of that segment is not the same as the previous segment.

Ramp enable must be accompanied by an above or below enable before ramp hold is active.

b Below, enables profile hold when the process error is greater than or equal to the hold band.

A Above, enables profile hold when the process error is greater than or equal to the hold band.

3.2.5 Repeats

rEPS is shown on the lower display and a number on the upper display. This number may be set between 0 and 999 by use of the up and down buttons. This number represents the number of times that this profile will be repeated when it is executed. Repeats occur between segment 1 and the segment containing an **END** or a **GO**. All repeats are completed before the end or go segment is executed.

A repeat value of 0 would cause the profile to execute once only when evoked, and not repeat at all.

Whilst a profile is repeating, this parameter will show the number of repeats that were originally set, but if the star button is pressed and held then the number of repeats remaining is displayed.

3.3 Profile program parameters

These parameters form the profile program itself.

3.3.1 Time segment 1

On a further depression of the right button, the parameter ti 1 will be displayed. This may be set between 0 and 100 hours by use of the up and down buttons. This time is the time taken for segment 1 of the profile selected to execute. A time setting of 0 would cause a step change in the setpoint when that profile program was executed.

3.3.2 Level segment 1

The next parameter in the programmer scroll is shown as LE 1. This is the segment 1 target level. When a profile start occurs, the setpoint will ramp from the current measured value up (or down) to the segment 1 target level. The rate of ramp will be LE 1 divided by ti 1 digits per minute.

3.3.3 Segment events

If any of the instrument option slots have been designated as event outputs then each of the profile segments in each program will have associated with it, a set of eight events. These events are represented, as in the case of the reset event relays by the eight indicators on the upper display. Interpreting and editing of these events is as detailed in para 3.2.2

3.3.4 Time segments 2 to 10

Further presses of the right button will allow the times and levels of segments 2 onwards of the selected profile to be viewed and modified. These times are much as set for segment 1, adjustable by using the up and down buttons to between 0 and 100 hours, but in addition, if the down button is pressed when a time of zero is indicated then 'End' is shown on the upper display. This is an instruction to terminate this profile when this segment is run.

Further presses of the down button cause 'Go 9' to 'Go 0' to be shown on the upper display. These are instructions that cause control to switch to the start of another profile program of the specified number when this segment of this profile is executed.

3.3.5 Level segments 2 to 10

Setting the level of segments 2 onwards is identical to that of segment 1 except that one further option is available. If the level is set to be identical to the level set in the previous segment the profile will dwell for the period of time set. This segment is then known as a dwell segment for the purposes of hold types.

4.0 PASSWORD PROTECTION

Series 2000 instruments are equipped with a versatile password protection system, which, when used correctly, protects the plant and contents against an unauthorised person changing the instruments settings. The setting of a password and its type is outside the scope of this manual, but the following is included to assist the operator if a password has been set.

4.1 Password entry

If a password has been set then on entry to the programmer or controller long scroll the

password screen will be seen. At this point the sequence of four button pushes representing the password should be entered. The instrument will then briefly display good or bad depending on the correct password being entered, and then enter the appropriate long scroll. Unless the password is correctly entered, protected parameters can be viewed but not modified.

4.2 Manual mode with password protection

To set the instrument to manual mode when auto/man password protection is on, enter controller long scroll, type the correct password and exit long scroll by holding down the scroll button. Scroll to output with one press of the right button. The instrument may now be toggled between auto and man by using the up or down buttons, if valid, for the next 20 seconds. After this time auto/man changes will once more be locked out.

4.3 Selective password protection

There are four special groups of parameters which may be, together or singly, left unprotected by any password set. These four groups are auto/man changeover, alarms, setpoints and programmer scroll. During configuration any of these may be made unprotected to allow limited access to an operator not knowing the password. All other controller long scroll parameters are always protected if a password is set.

5.0 AUTOTUNE

5.1 General

Series 2000 instruments are equipped with an adaptive autotune facility. This enables the instrument to automatically modify its control parameters to accommodate changes in the plant, and thus optimise the control process.

The autotuner consists of two parts, the pretuner, which determines initial PID values for the controller by performing a modified version of the Zeigler and Nichols open loop step response method, and the continuous or adaptive tuner which continually monitors plant performance and modifies the control terms whenever required to maintain optimal plant performance.

5.2 Pretune

The pretuner is operated by entering the controller long scroll and scrolling to the 'Ptun' parameter. select this to be 'on' to start the one-shot pretuner

While the pretuner is working the **TUNE** status indicator will flash.

For the pretune to work correctly it is necessary that the measured value is close to the normal working value of the process and that the process is stable when the pretuner is engaged. If the process is not stable then it may be made so by one of the following methods:-

1. Setting the controller to manual mode so that the output power is fixed and waiting until the measured value settles.

2. In Auto, turn off integral and derivative actions, set prop band to a large value and wait for the measured value to settle.

In order to operate the pretuner the following conditions must be satisfied:-

1. The auxiliary fixed outputs must not be selected. These are manually set levels of output which may be configured so that they are applied whenever the correct digital input is made.

2. The password requirements are satisfied. If a password has been set for the tuner then the correct password must be used when entering the long scroll.

3. The controller must be configured as a heat only, heat/cool or motorised valve instrument. The action of the pretuner is inappropriate for thermal head ratio types.

When Pretune is started it will freeze the controller output power at the current level and wait for at least one minute for the measured value to become stable. When this has been achieved Pretune will apply step changes in output power whilst attempting to identify the plant characteristics.

The Pretuner will abort its tune operation under any of the following conditions:-

1. A mains interruption has occurred

2. An auxiliary output is selected

3. Pretune is switched off.

On completion, the controller will use P, I and D terms and the Auto/Manual status will be as it was before the Pretuner was engaged.

5.3 Adaptive Tune

Before the Adaptive tuner can be used the Pretuner of para 5.2 must be successfully run. It is not possible to use the adaptive tune without first running Pretune.

The Adaptive Tuner will not attempt to tune ramping or unstable setpoints of any kind.

While the Adaptive tuner is on, the P, I and D parameters can not be adjusted manually.

The Adaptive tuner is not designed to work on thermal head ratio type controllers.

APPENDIX A CONTROLLER LONG SCROLL ELEMENTS

This table shows which parameters will be in the long scroll sequence and which may be, depending on the configuration of the instrument. The relevant column appears under the output type configured.

	----------Output Type----------					
long scroll elements	**none**	**heat only**	**heat cool**	**valve posnr**	**ratio**	**dependant on:-**
SP-L	x	x	x	x	x	
StyP	x	x	x	x	x	if rem sp is used
SP1	c	c	c	c	c	if digin1 is aux sp
SP2	c	c	c	c	c	if digin2 is aux sp
thr	-	x	x	x	-	if tuner is enabled
Ptun	-	x	x	x	-	"
Atun	-	x	x	x	-	"
ProP	-	x	x	x	-	
IAt	-	x	x	x	-	
rSEt	-	c	-	c	-	if iat is zero
dAt	-	x	x	x	-	
dApr	-	c	c	c	-	if dat is not zero
VAt	-	-	-	c	-	if no slidewire
rel	-	-	x	-	-	
bAnd	-	-	x	x	x	
rAt	-	-	-	-	x	
h-op	-	-	-	-	x	
thhi	-	-	-	-	x	
refh	-	-	-	-	x	
l-op	-	-	-	-	x	
thlo	-	-	-	-	x	
refl	-	-	-	-	x	
Alr1	c	c	c	c	c	if alarm 1 fitted
Alr2	c	c	c	c	c	if alarm 2 fitted
OP1	c	c	c	c	c	if digin1 is aux op
OP2	c	c	c	c	c	if digin2 is aux op
h Pl	x	x	x	-	-	
l Pl	x	x	-	-	-	
c Pl	-	-	x	-	-	
hcyc	c	c	c	-	-	if heat output is tp
ccyc	-	-	c	-	-	if cool output is tp
addr	c	c	c	c	c	if digital rem sp is used

Key:-

x	This parameter is listed with this output type
c	This parameter is only listed if the condition specified is met with this output type
-	This parameter is not listed with this output type.

APPENDIX B CONTROLLER LONG SCROLL MNEMONICS

Listing of longhand controller long scroll mnemonics and password groups

mnemonic	parameter description	password group
SP-L	set point, local	setpoint
StyP	set point type	setpoint
SP1	auxiliary set point 1 for digital input 1	setpoint
SP2	auxiliary set point 2 for digital input 2	setpoint
thr	threshold of deviation for start of autotune	all
Ptun	pretune start/stop	all
Atun	autotune start/stop	all
ProP	proportional band in %	all+tune
IAt	integral time in seconds	all+tune
rSEt	quiescent output value in % (for P or PD control)	all
dAt	derivative action time in seconds	all+tune
dApr	derivative approach band in prop bands	all
VAt	valve action time in seconds	all
rel	relative cool power versus heat power	all+tune
bAnd	(Heat/cool or motor valve) area of no action in %	all
	(Ratio) ratio adjustment band in digits	all
rAt	thermal head ratio	all
h-op	ratio, upper limit of air set point output	all
thhi	ratio, maximum positive thermal head	all
refh	ratio reference high, to which th-hi is referenced	all
l-op	ratio, lower limit of air set point output	all
thlo	ratio, maximum negative thermal head	all
refl	ratio reference low, to which th-lo is referenced	all
Alr1	alarm 1 level	alarm
Alr2	alarm 2 level	alarm
OP1	auxiliary output 1 for digital input 1 in %	all
OP2	auxiliary output 2 for digital input 2 in %	all
h Pl	heat or high power limit in %	all
l Pl	low power limit in %	all
c Pl	cool power limit in %	all
hcyc	heat cycle time for time proportion output in secs	all
ccyc	cool cycle time for time proportion output in secs	all

all the above are only protected by password if the password has been set to anything except **'CLR'**, (clear)

password group type 'all' are protected by password regardless of the setting of 'scope' in the configuration scroll

In addition, groups alarm and setpoint are only protected if a and s respectively are set 'on' in the 'scope' configuration.
parameters marked 'tune' are not adjustable when the tuner is on.
All parameters in the programmer scroll are protected if password is anything but **'CLR'** (clear) and the P element in the 'scope' is on.

APPENDIX C CORRUPT PROFILE ERROR CODES

If it is attempted to start a profile program which for some reason has become corrupt.The lower display when in the **SEG** element of the short scroll, will indicate **Err-x** where the x will be replaced with a number between 1 and 7 to indicate which of the parameters have become corrupt as follows;

x = 1 = bad or corrupt profile number
2 = bad or corrupt hold band
3 = bad or corrupt hold type
4 = bad or corrupt repeats
5 = bad or corrupt end/goto
6 = bad or corrupt segment time
7 = bad or corrupt segment level

To clear this display press the star key.

PART 2 INSTALLATION

1.0 INTRODUCTION

This part of the manual covers the unpacking, panel mounting and connecting of the FGH series 2000 programmers and controllers.

Other useful information is to be found in the following manuals

P2000/S2000 Engineers Manual.
P2000/S2000 Communications Manual.

2.0 WARNING NOTES

WARNING
Fit a policeman. Should people be put in danger if your heating process goes out of control then you must fit a separate over-temperature trip. Wire this trip, or policeman, to turn off the heater if the process gets too hot or the policeman fails.

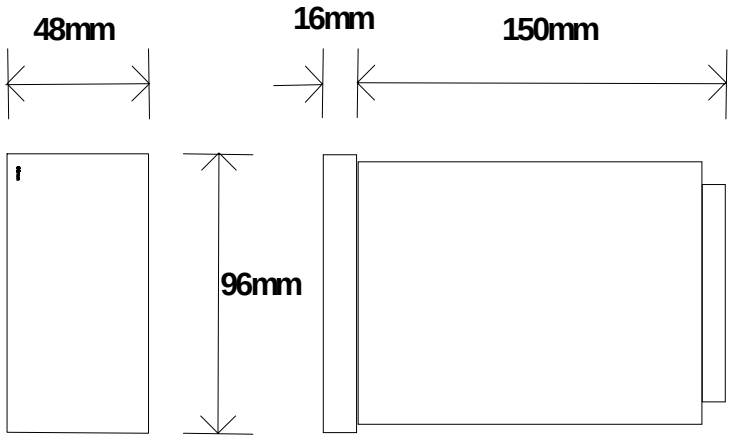
This may come about as a result of equipment failure, unauthorised tampering or any of a number of other reasons. It is also a good idea to fit a policeman so that 'out of control' heating will not damage the plant itself or its contents. For a suitable policeman contact FGH Controls ltd.

Note! Always provide the policeman with it's own independent temperature sensor.

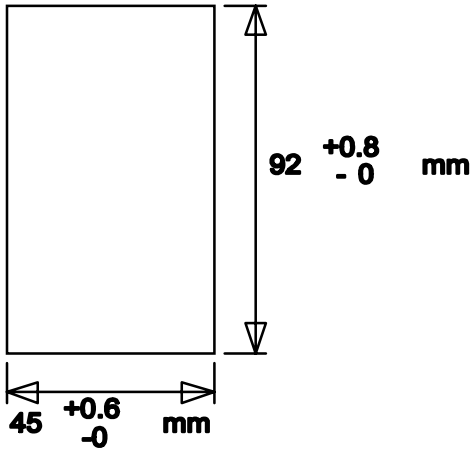
3.0 MECHANICAL

The instrument will fit into a DIN standard 92 +0.8mm -0mm high by 45 +0.6mm - 0mm wide cutout and will accommodate a panel thickness up to 15mm.

The instrument projects behind the panel by less than 150mm



PANEL CUTOUT



To fit the instrument into a panel first unhook the two panel clamps from the slots in the case. If IP65 sealing is required then the gasket provided must be fitted now. See 'Instrument Sealing' below.
If IP65 sealing is not required then the gasket is not required and the instrument case may now be inserted through the panel cutout

Hold the case against the panel and hook the panel clamps into the slots provided along the body of the case. Using a screwdriver, tighten the two clamp screws until the clutch mechanism starts to slip so that the instrument case is clamped against the panel and the sealing gasket is compressed.

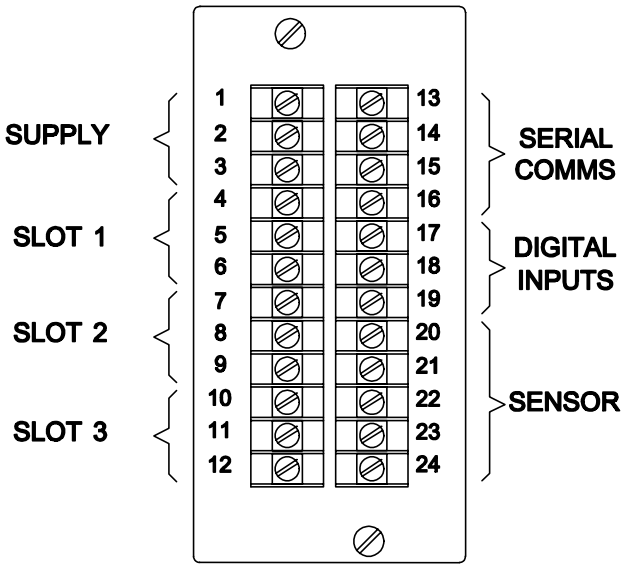
3.1 Instrument sealing

Each instrument is provided with a sealing gasket in a separate bag. This is used to seal the instrument bezel against the mounting panel to achieve sealing to the IP65 standard. To use this gasket, remove it from its bag and place it over the body of the instrument before fitting the instrument to the panel. Take care to place the gasket squarely around the bezel of the instrument before passing it through the panel cutout.The instrument may now be fitted into the panel as described by the installation instructions above.
Additional measures will be required to seal multiple instruments if they are mounted in a common slot. These measures may consist of sealing compound or other devices at the discretion of the installer.

4.0 INPUT CONNECTIONS

All connections are made to the instrument at the rear terminal block.

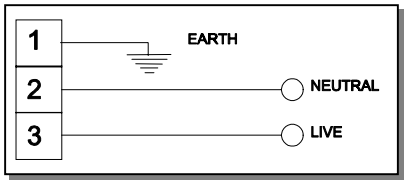
WARNING.
ISOLATE THE INSTRUMENT FROM MAINS VOLTAGE BEFORE GAINING ACCESS TO THE TERMINALS TO GUARD AGAINST ELECTRIC SHOCK. TAKE PARTICULAR CARE TO ISOLATE FROM HIGH VOLTAGES WHICH MAY HAVE BEEN CONNECTED TO THERMOCOUPLE, ALARM RELAYS ETC



Ensure that mains power wiring is routed separately to sensor and low voltage signal wiring. This is to avoid electrical noise affecting the controllers performance. Never run these two groups of cables together in the control cabinet or anywhere in the plant.

4.1 Mains

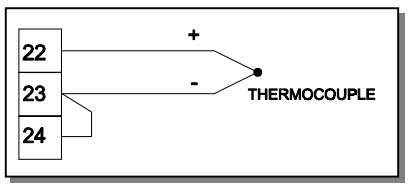
Power supply 88V to 265V AC is connected to terminals 2 and 3.



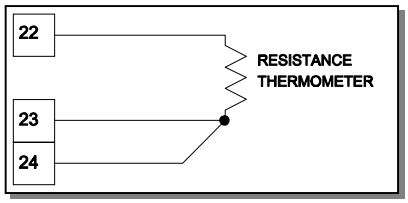
EARTH is connected to terminal 1. This is safety earth and is connected to the metal case of the instrument.

4.2 Temperature sensor

Thermocouple connection via compensating cable of the correct type is made to terminal (IN 1) 22 (+ve) and (IN 2) 23 (-ve). Make a link between (IN 2) 23 and (IN 3) 24.

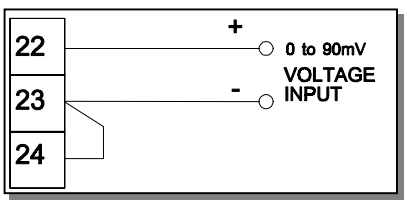


A resistance thermometer may be connected in a three wire bridge as follows. Take terminal (IN 1) 22 to one side of the resistance thermometer. Take the other side of the RT via two separate wires, to terminals (IN 2) 23 and (IN 3) 24. All three wires should be of the same gauge and length. Twist the wires together to reduce the effect of mains noise.



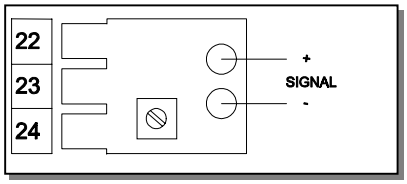
4.2.1 Low level voltage input

Input signals in the range 0 to 90mV may be connected directly to the instrument as shown; positive to (**IN 1**) pin 22, negative to (**IN 2**) pin 23 and connect a link between (**IN 2**) pin 23 and (**IN 3**) pin 24.



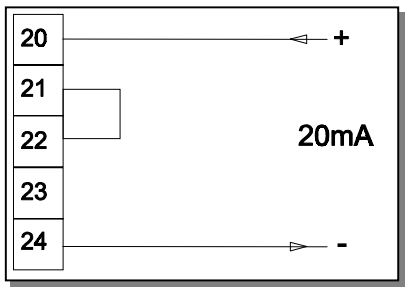
4.2.2 High level voltage input

For high level voltage inputs an external signal conditioning board is supplied. This provides the necessary shunts or dividing components to convert from the high level input signal down to the 0 to 90mV signal required by the instrument.

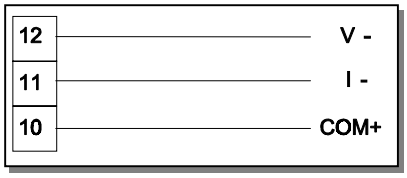


4.2.3 20mA Current input.

The instrument is fitted with an internal 100Ω shunt resistor between terminals 20 and 24. Connect the 20mA signal between these two terminals and link out terminals 21 and 22.



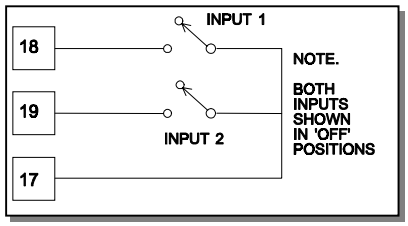
4.3 Remote setpoint input.



A remote setpoint card may be fitted to slot 3. This card can accept a ±1V, ±10V (link selectable) or 20mA input signal. A voltage remote setpoint is connected between terminals (**RSPV-**) 12 and (**RSPC+**) 10. A 20mA input is connected between terminals (**RSPI-**) 11 and (**RSPC+**) 10 as shown on the label attached to the instrument case. This input is scaled to the required values in software. Note the link on the remote setpoint card should be fitted for 20mA and ±1V input ranges.

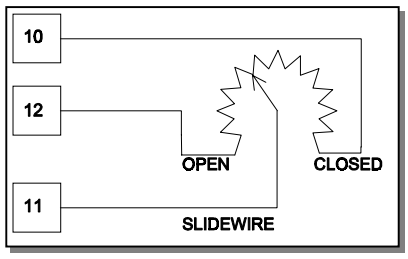
4.4 Digital inputs

All Series 2000 versions accept two digital inputs for use as process HOLD, LOCK etc as configured by software. DIGITAL input 1 is connected to terminal (DI-1) 18 and input 2 connected to terminal (DI-2) 19. The common for both inputs is terminal (DI-COM) 17.



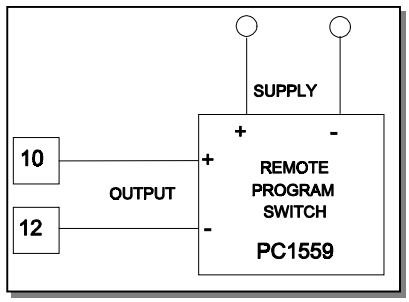
4.5 Slidewire input

If you have ordered the instrument with slidewire option then this board will be fitted. Connect the 'closed' end of the slidewire pot. to terminal 10, the 'open' end to terminal 12 and the slidewire pot wiper to terminal 11.



4.6 Remote Program Select Input (P2000 Only)

The remote program select input is a 0 to 10V analog signal connected into slot 3.
This may be used to select programs 0 to 24 inclusive (if available) at the rate of 0.4V per program. eg 0V will select program 0, 4V will select program 10 etc.
This function may be performed (for programs 0 to 11) by the FGH remote program selector switch card (wired as shown).
Alternatively, a 10V PLC output connected directly to terminals 10+ and 12- may be used to select programs 0 to 24 (if available).



5.0 OUTPUT CONNECTIONS.

The Series 2000 instrument has provision for three output 'slots'. Each slot can accept a single options card. There are basically three types of options card. Digital output cards are two channel (labelled channels A and B) and may be relay or logic. Analogue output cards are single channel voltage or current outputs. The analogue input card is again single channel.
Since there are many ways of configuring the instrument, the installer needs to refer to the instrument code (given on label on the case of the instrument) to establish the hardware and function of each of the 3 option slots. The terminal numbers may then be looked up in the following tables.

The following is a table of which functions are permitted in each slot.

	SLOT					
FUNCTION	1A	1B	2A	2B	3A	3B
HEAT TP	*				*	
HEAT ANALOGUE	*		*		*	
COOL TP		*	*			*
COOL ANALOGUE	*		*		*	
VALVE OPEN	*				*	
VALVE CLOSE		*				*
ALARM 1	*	*	*	*	*	*
ALARM 2		*	*	*		*
RETRANSMIT	*		*			
RATIO OUT	*		*			
REMOTE SETPOINT					*	
SLIDEWIRE					*	
INTERNAL EVENT	P	P	P	P	P	P
EXT' EVENT DRIVER				P		
REM' PROGRAM SELECT					P	

NOTES.
The function specified in slot 1A is duplicated in slot 3A since these two slots are physically wired to the same output pin.

P means available on P2000 only.

5.1 Relay Outputs.

Relay outputs are available as two channel option boards fitted within the instrument. These may be configured for use as time proportioning control outputs, alarm or event contacts. Each relay shares a common terminal with the other channel on the same board.

All relay outputs have arc suppressing C/R networks (snubbers) fitted to protect the relay contacts from arc damage when changing state. This does, however, result in a small leakage current flowing through the open contacts when the relay is used to switch AC voltages (about 3mA at 240V 50Hz). This may give problems if the load is very light, eg. a small contactor, because the small leakage current may be sufficient to hold the contactor on when it should turn off. If this problem is encountered DO NOT REMOVE the snubbers. Instead it is recommended that a 10k, 10W resistor be connected in parallel with the outputs load. eg. across the coil of the contactor. The resistor will run quite hot and should be mounted in such a way that this causes no hazard.

Take care not to exceed the current and voltage ratings specified for the relay output boards or damage will result.

Terminal numbers for connection of the relay outputs are given in the table below.

TERMINAL NUMBERS						
	SLOT 1A	SLOT 1B	SLOT 2A	SLOT 2B	SLOT 3A	SLOT 3B
Relay						
N/O	6	5	9	8	12	11
COM	4		7		10	

5.2 Logic Outputs.

Logic outputs are available as two channel option boards and may be configured as control, alarm or event outputs. Each logic output is intended for direct connection to a solid state relay and provides a nominal 12V at 20mA. The two logic outputs on the board share a common positive terminal.

TERMINAL NUMBERS						
	SLOT 1A	SLOT 1B	SLOT 2A	SLOT 2B	SLOT 3A	SLOT 3B
Logic Drive						
COM +ve	4		7		10	
-ve	6	5	9	8	12	11

5.3 Analogue Outputs.

Analogue outputs are available as single channel option boards. They may be configured for current (20mA) or voltage (10V) operation and used for control or retransmission outputs.

TERMINAL NUMBERS						
	SLOT 1A	SLOT 1B	SLOT 2A	SLOT 2B	SLOT 3A	SLOT 3B
Analogue Output						
+ve	6		9		12	
-ve	4		7		10	

5.4 Event outputs (P2000 only)

Any of the available I/O slots may be configured as an event output or configured later as such. Event outputs are either a relay or a logic drive output.

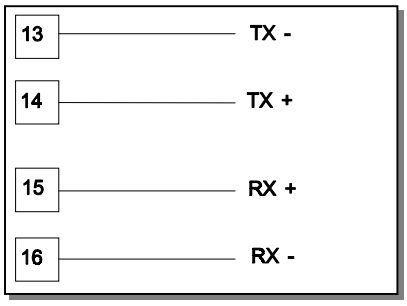
The numbering of event outputs is such that the lowest numbered option slot configured as an event output is made event 1, the next lowest numbered slot configured as an event output is made event 2 and so on.

5.5 External event driver (P2000 only)

A programmer may be fitted with an external event driver. This allows the P2000 to be connected to a separate external event relay module which in turn provides relay outputs for all eight events. The external event driver is actually one channel of a logic output board, the other channel may of course be used for any other digital function required. Connection to the external event driver is via the two terminals, 7+ and 8- .

6.0 COMMUNICATIONS.

All series 2000 instruments have serial communications fitted as standard. The connections given in the figure opposite are for information only. Please consult the **Series 2000 Communications manual** for details of the different connection modes.



7.0 TERMINAL LEGENDING.

Labels stuck on the instrument case identify which terminals have been used and for what purpose by means of a legend printed beside each used terminal number. The following is a list of the legends used for the labels and their meanings.

ALARM 1 N/C	Alarm 1 relay output, normally closed contact
ALARM 1 N/O	Alarm 1 relay output, normally open contact
ALARM 1 -	Alarm 1 logic output, negative
ALARM 2 N/C	Alarm 2 relay output, normally closed contact
ALARM 2 N/O	Alarm 2 relay output, normally open contact
ALARM 2 -	Alarm 2 logic output, negative.
COOL N/C	Cool output relay, normally closed contact
COOL N/O	Cool output relay, normally open contact
COOL -	Cool output logic, negative
COOL AN +	Cool analogue voltage/current output positive
COOL AN -	Cool analogue voltage/current output negative
DIG INPUT 1	Digital input 1
DIG INPUT 2	Digital input 2
DIG IN COMMON	Digital input common
EARTH	Mains earth, safety earth
EVT DRIVER -	External event driver output negative
EVENT 1 N/C	Event 1 relay output, normally closed contact
EVENT 1 N/O	Event 1 relay output, normally open contact
EVENT 2 N/C	Event 2 relay output, normally closed contact
EVENT 2 N/O	Event 2 relay output, normally open contact
EVENT 3 N/C	Event 3 relay output, normally closed contact
EVENT 3 N/O	Event 3 relay output, normally open contact
EVENT 4 N/C	Event 4 relay output, normally closed contact
EVENT 4 N/O	Event 4 relay output, normally open contact
EVENT 5 N/C	Event 5 relay output, normally closed contact
EVENT 5 N/O	Event 5 relay output, normally open contact
EVENT 1 -	Event 1 logic output, negative
EVENT 2 -	Event 2 logic output, negative
EVENT 3 -	Event 3 logic output, negative
EVENT 4 -	Event 4 logic output, negative
EVENT 5 -	Event 5 logic output, negative
HEAT N/C	Heat output relay, normally closed contact
HEAT N/O	Heat output relay, normally open contact
HEAT AN +	Heat analogue voltage/current output positive
HEAT AN -	Heat analogue voltage/current output negative
INPUT 1 20mA+	Main current input positive
INPUT 1 VOUT	Link to INPUT 1+ for current inputs
INPUT 1 +	Main voltage input terminal
INPUT 1 -	Main input terminal, negative
INPUT 1-20mA-	Main current input negative
LIVE	Live mains power input
MV LOWER N/C	Motorised valve, lower relay output, normally closed
MV LOWER N/O	Motorised valve, lower relay output, normally open

MV LOWER -	Motorised valve, lower logic output, negative
MV RAISE N/C	Motorised valve, raise relay output, normally closed
MV RAISE N/O	Motorised valve, raise relay output, normally open
MV RAISE -	Motorised valve, raise logic output, negative
NEUTRAL	Neutral mains power input
POWER +	DC positive power input
POWER -	DC negative power input
REM PROG +	Remote program select input positive
REM PROG -	Remote program select input negative
REM SP COM+	Remote set point input positive
REM SP V-	Remote set point voltage input negative
REM SP I-	Remote set point current input negative
RETRANSMIT +	Retransmission voltage/current output positive
RETRANSMIT -	Retransmission voltage/current output negative
COMMS RX +	Serial communications, receive positive
COMMS RX -	Serial communications, receive negative
RATIO SP +	Thermal head ratio set point output positive
RATIO SP -	Thermal head ratio set point output negative
S/WIRE CLOSED	Slidewire feedback input, 'closed' end of pot
S/WIRE OPEN	Slidewire input, 'open' end of pot
S/WIRE WIPER	Slidewire input, wiper of pot
COMMS TX +	Serial communications, transmit positive
COMMS TX -	Serial communications, transmit negative
TXPSU+	Transmitter power supply output positive
TXPSU-	Transmitter power supply output negative
SLOT 1 COM	Slot 1 common terminal
SLOT 2 COM	Slot 2 common terminal
SLOT 3 COM	Slot 3 common terminal