Techsys Corporation

SWORDFISH +

PRESSURE OPERATION MANUAL

MULTIPLE PUMP

FIXED SPEED PUMP CONTROL SYSTEMS

Version 1.2

INTRODUCTION

SWORDFISH + Pump Controller

The SWORDFISH + pump control system is a fully integrated pump controller for single or multiple pumps required to operate via pressure, level, temperature or flow control.

SWORDFISH + is suitable for up to 6 pumps of any type plus a jockey pump. The unique electronic - hydraulic control allows each pump to operate at the maximum performance level.

Easy access menu items and in-built pump and system protection allows simple adjustment for any pump application.

SWORDFISH + also offers a full complement of telemetry outputs for simple integration into central control applications.

The SWORDFISH + Pump Control system is part of the Techsys Pump Control range. Pump Controllers are available in a range of options to suit particular applications and user requirements.

Additional manuals available for:-

- Temperature control
- Level control
- Flow control
- Vacuum

Version History

This manual covers the software applications for Version No. 12.07v01 or later.
Please contact Techsys Corporation to obtain any verification of the currency of this manual for your applciation.

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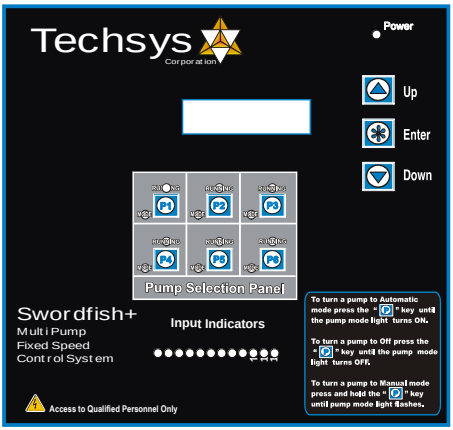
QUICKSTART

The following procedures are the minimum required to start and operate the SWORDFISH +. If you are concerned regarding the Commissioning of the unit please read the complete manual or call your closest Techsys Corporation representative.
The following test confirms the operational directions of all pumps in both Manual and Automatic Modes



ROTATION CHECK

This is a most important procedure and should be completed prior to any other commissioning procedure.
Only Qualified Personnel should be allowed to complete this procedure as there is High Voltage wiring within the switchboard.

1. Switch OFF all motor circuit breakers in the cabinet. ☐
2. Turn ON power to Swordfish controller. ☐
3. Make sure all Pump Mode indicators are OFF. If not press the “P” key to turn pump off (All pumps should be off) ☐
4. Adjust Overloads to to suit motor ratings. Switch ON all circuit breakers in the cabinet. ☐
5. Press “P1” to turn on Pump 1. The Running indicator should light up ☐

   (If the message “Key Pad Locked” appears, scroll up to the Access Code using the up key and input the number 21)

   Check Rotation against the pump manufacturers direction arrow.
   After checking turn Pump1 to OFF by pressing “P1” again.

6. Check the balance of the pumps for direction as descibed above.
   If any of the other pumps have the wrong direction of rotation change two of the wires on the wiring connected to the motor in question. ☐

   - Re-check direction

7. Rotation check complete. ☐

KEY SETTINGS

This sets the Operating Pressure of the System.

1. Press the Up Key until the Message **Access Code** is displayed.
2. Press the “Enter Key” once, the display should start to flash, now press the UP Key until the number 21 appears in the lower part of the screen, now press the Enter Key” again, the display should stop flashing. The correct Access code is now set.
3. Then press the “DOWN Key” once more. The Main Menu Marked **SETTINGS** will appear.
4. Press the “Enter Key” to access the **SETTINGS** Sub Menu.
5. Press the “DOWN Key” Until the **Cut In Pressure** screen is reached.
6. Adjust the **Cut In Pressure** by pressing the “Enter Key” once, the display should then start to flash, now press the “UP or DOWN Key” to alter the **Cut In Pressure.** If when increasing any setting you are prevented from further adjustment you may also need to adjust the parameter above or below the current setting being adjusted. Eg. Increasing the **Cut In Pressure** and trying to make it greater than the **Cut Out Pressure.**
7. Press the “DOWN Key” Until the **Cut Out Pressure** screen is reached.
8. Adjust the **Cut Out Pressure** by pressing the “Enter Key” once, the display should then start to flash, now press the “UP or DOWN Key” to alter the **Cut Out Pressure.** (The same sequence of key presses is used to adjust all settings on the SWORDFISH +)
9. After the adjustments have been made, press the “DOWN Key” until the sub menu is exited and the “SETTINGS” main screen appears.

CALIBRATING PRESSURE TRANSDUCER

For a full explanation go to the section marked - CALIBRATION OF ANALOGUE SENSORS.

1. Press the “DOWN Key” until you reach the Main Menu Marked “CONFIGURE”
2. Enter the submenu by pressing the “Enter Key”
3. Press the “DOWN Key” until the “Zero Pressure” screen is displayed. (At this point there should be NO pressure in the system)
4. Adjust the value in the bottom screen until the reading is “0” – Use the same key sequence to adjust zero. (If “Value too Low” appears, increase the Zero offset value slowly until a zero value is obtained by pressing the key).
5. Press the “DOWN key” until you reach “ADJUST PRESSURE”. (At this point a constant pressure needs to be introduced into the system).
6. Adjust the value in the “Adjust Pressure” screen until the pressure from the system gauge reads the same as the screen pressure.
7. The System is now Calibrated. Press the DOWN key until the main system pressure screen (Status Screen) returns.

Rotation

*******IMPORTANT*******

Failure to follow this procedure will void Warranty and cause failure of the pump station

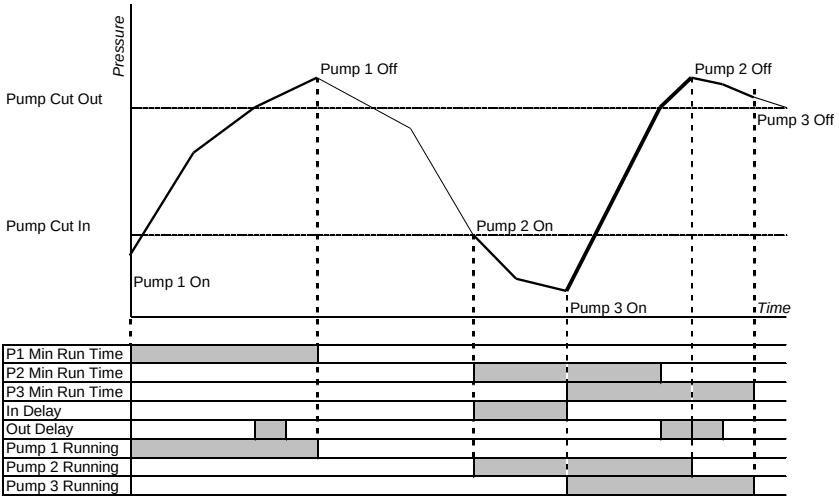
The rotation of each pump is checked prior to shipment on packaged units, however, it is essential to check the rotation of each pump. To do this select *MANUAL* for each pump individually and check the rotation. If the rotation is not correct swap two of the phases coming into the main isolation switch to reverse the rotation.

Note: any wiring changes made within the switchboard should be done with the ***approval of the service agent*** and by ***qualified personnel only.***

In models with phase failure relays the mains phase orientation must be set to the correct orientation. If only one light (either green or red) is showing then swap any two wires on the main isolation switch. This orientates the main's power to the correct rotation.

System Operation

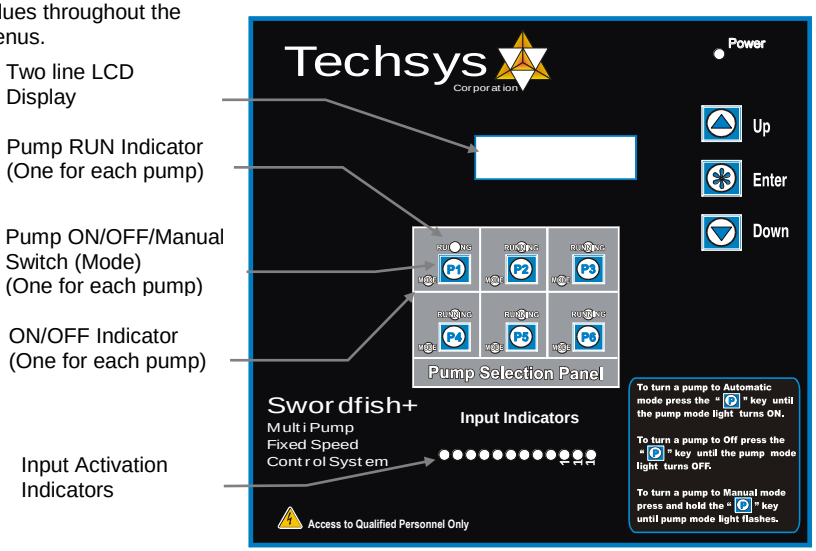
The operating constraints for the system are detailed below.



When the system pressure drops below the System Cut In pressure the controller will start the first pump. If one pump cannot satisfy the pressure requirement another pump will start after the IN delay timer has timed out. More pumps will be started until there are no further pumps available or the system pressure rises above the Cut In Pressure. If at any time the pressure rises above the Cut Out Pressure then the OUT delay timer is started and when it times out a pump will be turned off (Providing the minimum run time for that pump has also timed out) , this process continues until all pumps are turned OFF or the pressure falls below the Cut Out setting.

Pump Control Panel

The interface for SWORDFISH + Control Panel allows access for the operator to edit values throughout the menus.



Each pump is controlled by an individual Auto / Off / Manual Switch.

To enable a pump for operation
Press the ON/OFF/Manual Mode switch and the associated mode indicator will light up. The selected pump is now available for operation in Automatic mode.

To disable a pump in Automatic Mode
Press the Mode switch until the Mode indicator light turns off.

To operate a pump on Manual
In order to operate a pump in manual mode, press and hold the mode select switch for the relevant pump. After 3 seconds the system will start this pump in manual mode. The mode indicator LED will now start flashing at 2 times per second and the RUN indicator will be on. To turn a manual pump off, press and release the switch when the RUN led turns off. The pump is now disabled and to return it to Automatic press the Mode switch again and the Mode indicator should turn on.
In order for this mode to be selected the Access Code must be entered.

MANUAL MODE PROTECTION
Pump protection settings apply to all pumps including those in manual mode.

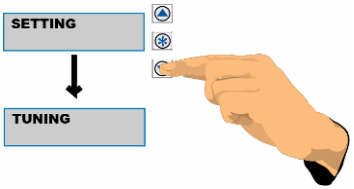
NB: By default all pumps will be off when system is powered.
To edit menu data
Press the ENTER key to edit data in the required menu, the top line will flash if the current menu is an editable screen. Use the UP and DOWN buttons to change the selection, then press ENTER again to confirm the change.

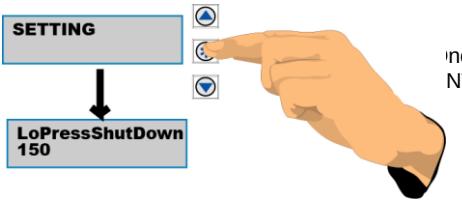
Moving Around & Editing Menu Items

To move between the Main Menu screens press the UP or DOWN key.

To Enter an adjustable sub menu press the ENTER key. Access to these menus is controlled by an Access Code, which needs to be entered prior to accessing the editable section of the menus. If the Access Code is not inserted correctly the system will disable entry into the Submenus and the use of any pump select or enable keys.

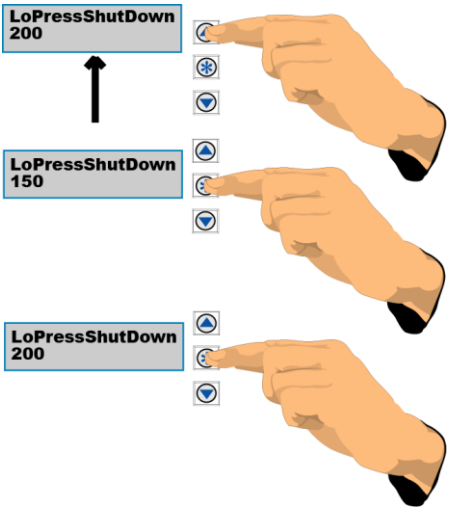
To scroll through the menus select the UP or DOWN keys





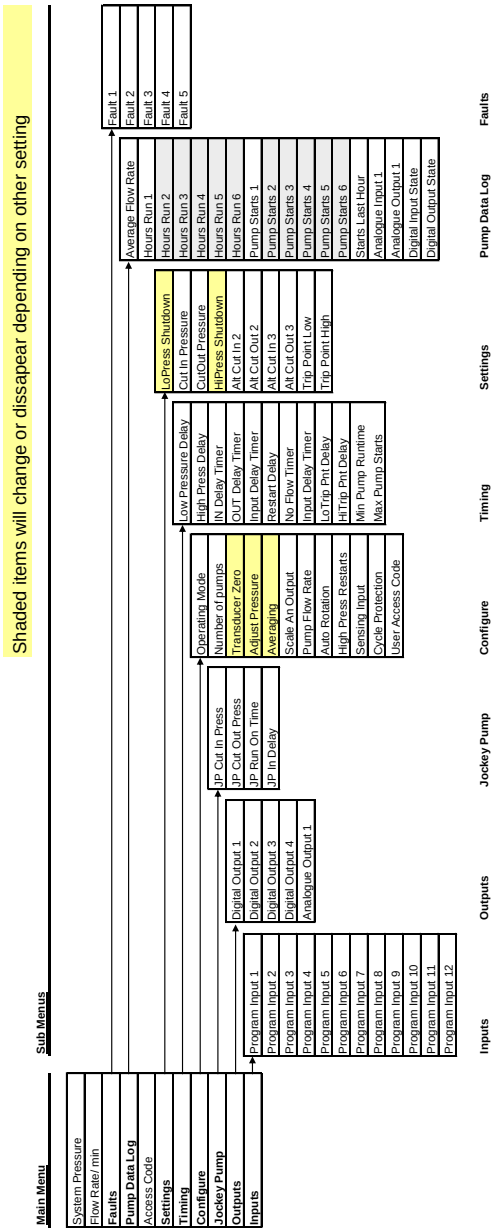
nce the required Menus is selected press the NTER Key to enter the specific menu

To edit a value press the ENTER key once, the display should now flash, now press the UP or DOWN key until the desired value is displayed. Press the ENTER Key again to save the value selected.



To move out of a submenu press the up or down key to scroll to the top or bottom of the submenu and the display will return to the main menu area.

MENUS


Shaded items will change or dissapear depending on other setting
Main Menu
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Jockey Pump
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The SWORDFISH + controller has numerous adjustment menus to allow the system to be tuned to suit each application. These are listed below and explained throughout this manual.
Menus throughout this manual show the complete range of options available. If a menu is not needed because the option is disabled then these screens will not appear. For example if only 3 pumps are implemented, then screens with options for pumps 4 to 6 will be hidden.

Main Menu		Units	Defaults	Range
System Pressure		number	display	0 - 9999
Flow Rate /Min		number	display	0 - 9999

Main Menu	Sub Menu	Units	Defaults	Range
FAULTS				
	Fault 1	selection	None Logged	None Logged Lo Press Shutdwn, Hi Press Shutdwn, No Flow Shutdwn, *Pump 1 - 6 Shutdown *Pump 1 - 6 No Flow Power Off Power Glitch Auto Reboot
	Fault 2	selection	None Logged	
	Fault 3	selection	None Logged	
	Fault 4	selection	None Logged	
	Fault 5	selection	None Logged	

* Pump 2-6 Shutdown are only displayed if "Number of pumps" is set accordingly
* Pump 2-6 No Flow are only displayed if "Number of pumps" is set accordingly

Main Menu	Sub Menu	Units	Defaults	Range
PUMP DATA LOG				
	Hours Run 1	hours	display	0 - 65535
	*Hours Run 2	hours	display	0 - 65535
	*Hours Run 3	hours	display	0 - 65535
	*Hours Run 4	hours	display	0 - 65535
	*Hours Run 5	hours	display	0 - 65535
	*Hours Run 6	hours	display	0 - 65535
	Pump Starts 1	number	display	0 - 65535
	*Pump Starts 2	number	display	0 - 65535
	*Pump Starts 3	number	display	0 - 65535
	*Pump Starts 4	number	display	0 - 65535
	*Pump Starts 5	number	display	0 - 65535
	*Pump Starts 6	number	display	0 - 65535
	Pump Starts Last Hr	number	display	0 - 65535
	Analogue Input 1	%	display	0.00 - 100.00
	Analogue Output 1	%	display	0.00 - 100.00
	Digital Input State	1 - 12	display	X for Active
	Digital Output State	1 -4	display	X for Active
	Curr & max retry	number	display	0 – 50 0 – 50
	Temperature	degrees C	display	0 - 999

* Hours Run 2-6 are only visible if "Number of pumps" is set accordingly
* Pump Start 2-6 are only visible if "Number of pumps" is set accordingly

Main Menu	Units	Defaults	Range
Access Code	number	21	0 - 250

Main Menu	Sub Menu	Units	Defaults	Range
SETTINGS				
	*LoPress Shutdown		*150	0 - 9999
	*LoPress Alarm		*150	0 - 9999
	*Low Limit		*OFF	*OFF
	Cut In Pressure		200	0 - 9999
	Cut Out Pressure		450	0 - 9999
	*HiPress Shutdown		650	0 - 9999
	*HiPress Alarm		650	0 - 9999
	*High Limt		*OFF	*OFF
	Alt Cut In 2		250	0 - 9999
	Alt Cut Out 2		500	0 - 9999
	Alt Cut In 3		300	0 - 9999
	Alt Cut Out 3		600	0 - 9999
	*Trip Point Low		300	0 - 9999
	*Trip Point High		400	0 - 9999

* LoPress Shutdown is displayed when "Low Limit Action" is set to "Shutdown"
* LoPress Alarm is displayed when "Low Limit Action" is set to "Alarm"
* Low Limit "OFF" is displayed when "Low Limit Action" is set to "OFF"

* HiPress Shutdown is displayed when "HighLimit Action: is set to "Shutdown"
* HiPress Alarm is displayed when "HighLimit Action: is set to "Alarm"
* High Limit "OFF" is displayed when "High Limit Action" is set to "OFF"

*Trip Point Low & High are displayed when a "Digital Output" is set to "Trip Point"

Main Menu	Sub Menu	Units	Defaults	Range
TIMING				
	*Lo Press Delay	seconds	120	*OFF, 0 - 250
	*High Press Delay	seconds	4	*OFF, 0 - 250
	In Delay Timer	seconds	4	0 - 999
	Out Delay Timer	seconds	1	0 - 999
	Restart Delay	seconds	0	0 - 999
	No Flow Timer	seconds	0	0 - 250
	Input Delay Timer	seconds	120	0 - 999
	*Press Trip Low Delay	seconds	0	0 - 999
	*Press Trip High Delay	seconds	0	0 - 999
	*Min Pump Runtime	seconds	60	0 - 240
	*Max Pump Starts	per Hour	60	0 - 240

* Press Trip delays are only visible if an OUTPUT is set to "Pressure Trip"
* "Min Pump Runtime" Is displayed when "ExcessRun Prot'n" is set to "Minimum Run Time"
* "Max Pump Starts" Is displayed when "ExcessRun Prot'n" is set to "Max Starts PerHr"
* OFF is displayed in the "Lo Press Delay" screen when "Low Limit Action" is set to "OFF"
* OFF is displayed in the "Hi Press Delay" screen when "HighLimit Action" is set to "OFF"

Main Menu	Sub Menu	Units	Defaults	Range
CONFIGURE				
	Operating Mode	selection	Pressure	Pressure, Flowrate, Temperature, Single Level Multi Level.
	Number of pumps	number	3	0 - 6
	*Transducer Zero	unitless		0 - 9999
	*Adjust Pressure	unitless		0 - 9999
	*Averaging	number	20	0 - 50
	Scale An Output	number	1000	
	Pump Flow Rate	per Min	5	1-9999 /Min
	Auto Rotation	selection	Full	Full, *Pump 1 - Pump 6, Every 24 Hours, Low Hours.
	High Press Restarts	selection	0	0 - 250
	Sensing Input	selection	Analogue	Analogue, Switched
	Cycle Protection	selection	Minimum Run Time	Minimum Run Time, Max Starts PerHr
	Low Limit Action	selection	OFF	OFF, Alarm, Shutdown
	HighLimit Action	selection	OFF	OFF, Alarm, Shutdown
	User Access Code	number	21	0 - 250

* "Transducer Zero", "Adjust Pressure" & "Averaging" are hidden when in "Switched" mode
* Pumps 2 - 6 are only visible if "Number of pumps" is set accordingly

Main Menu	Sub Menu	Units	Defaults	Range
JOCKEY PUMP				
	Jockey Pump	selection	----Off----	----Off----, ===On===
	*JP Cut In Press	unitless	250	0 - 9999
	*JP Cut Out Press	unitless	400	0 - 9999
	*JP Run On Time	seconds	2	0 - 999
	"JP In Delay Time	seconds	0	0 - 999

* JP Screens are only visible is "Jockey Pump" is set to " ===ON==="

Main Menu	Sub Menu	Units	Defaults	Range
OUTPUTS				
	Digital Output 1	selection	Shutdown Fault	Shutdown Fault, Lo Press Fault, Hi Press Fault, *Pump 1 - 6 Run, *Pump 1 - 6 Fault, System Paused, Low Alarm, High Alarm, Any Alarm, Any Pump Shutdwn, Any Pump Running, Trip Point Alternate Trip, Aux Output 1, Aux Output 2, Aux Output 3,
	Digital Output 2	selection	Any Pump Shutdown	
	Digital Output 3	selection	Any Alarm	
	*Digital Output 4	selection	Any Pump Running,	
	Analogue Output 1	selection	System Pressure	System Press

* If the Jockey Pump is set to "ON" then Digital Output 4 will not be available for other functions.
* Pump Run 2 - 6 are only visible if "Number of pumps" is set accordingly
* Pump Fault 2 - 6 are only visible if "Number of pumps" is set accordingly

Main Menu	Sub Menu	Units	Defaults	Range
INPUTS				
	Program Input 1	selection	System Pause,	*Alt 2 Settings
	Program Input 2	selection	Pump 1 Protection,	*Alt 3 Settings
	Program Input 3	selection	Pump 2 Protection,	*Cut In,
	Program Input 4	selection	Pump 3 Protection,	*Cut Out,
	Program Input 5	selection	High Limit,	Low Limit,
	Program Input 6	selection	Low Limit,	High Limit,
	Program Input 7	selection	No Flow,	System Pause,
	Program Input 8	selection	*Alt 2 Settings	*Pump 1 - 6 Protection,
	Program Input 9	selection	*Alt 3 Settings	*Pump 1 - 6 Stop,
	Program Input 10	selection	Reset,	*Pump 1 - 6 Manual Run,
	Program Input 11	selection	Cycle Pumps,	Fire Mode,
	Program Input 12	selection	Aux Input 1	Cycle Pumps,
				Reset,
				No Flow,
				Aux 1, Aux 2, Aux 3,
				*Pump 1 - 6 No Flow Prot,

* Alternate 2&3 setting only appear when operating in "Pressure", "Temperature", "Flow" or "Single Level" modes

* "Cut In" and "Cut Out" are only visible when operating in "Switched" Mode
NOTE: Also not visible when "Switched" "Multi level" is in operation

* Pump Protection 2 - 6 are only visible if "Number of pumps" is set accordingly

* Pump Stop 2 - 6 are only visible if "Number of pumps" is set accordingly

* Pump Manual Run 2 - 6 are only visible if "Number of pumps" is set accordingly

* Pump NoFlowProt 2 - 6 are only visible if "Number of pumps" is set accordingly

SYSTEM STATUS

System Pressure	unitless	display	0 - 9999
Flow Rate /Min	unitless	display	0 - 9999

System Pressure

System Pressure
XXXX

The System Pressure is the direct measurement of the pressure in the discharge pipeline of the system. It is read from the pressure transducer and is displayed on the Pressure Screen on the front of the switchboard.

The maximum operating pressure with the default pressure transducer is 1750kPa (250psi). Pressures greater than 75% of this figure require the use of an external pressure transducer rated to the operating pressure required.

This is the default display screen; it will display appropriate messages describing current conditions. These include in order of priority: Emergency Stop, Hi Press Shutdown, Lo Press Shutdown, No Flow Shutdown, Fault, Lo Flow Detected, Pause Activated.

After 25 minutes from the last key press the SWORDFISH + will revert to this screen automatically.

Flow Rate

Flow-Rate /Min
XXXXX*

The SWORDFISH + can operate on a calculated flow rate.

The Calculated flow rate uses information that is input into the Pump Flowrate screen to provide an estimation of the flow rate at any time. This calculation automatically compensates for the number of pumps operating - it is useful in determining the system capacity. This is a calculated flow and must be treated as such. The time base for this flow is in flow per ***MINUTES*** and is not adjustable.

FAULT HISTORY

FAULTS			
Fault 1	selection	None Logged	None Logged Lo Press Shutdwn, Hi Press Shutdwn, No Flow Shutdwn, *Pump 1 - 6 Shutdown *Pump 1 - 6 No Flow Power Off Power Glitch Auto Reboot
Fault 2	selection	None Logged	
Fault 3	selection	None Logged	
Fault 4	selection	None Logged	
Fault 5	selection	None Logged	

When a system fault is registered a “NEW FAULT” message will appear on the main screen. It will also be logged in the FAULT HISTORY menu. There is space for up to 5 faults to be logged which scroll down as new faults are received.

** NEW FAULT **

In the event of a new fault, which has been automatically reset, the default screen will display the message “New Fault”. Go to the FAULT HISTORY to view this fault. Faults that are active will remain live on the screen until the ENTER Key is pressed to clear the fault.

Last Fault (No.1
Lo Press Shutdwn

Faults will appear in the Fault sub menu in the following format with the most recent fault being Fault 1.

Fault 2
No Flow Shutdown

Note: The FAULT HISTORY menu is cleared when the system is first powered up.

“Pump 1 - 6 Shutdown” signifies that the corresponding “Pump protect 1-6” input has been activated for the period of the input delay time.

“Auto Reboot” denotes that the SWORDFISH + has automatically restarted due to an internal reset, whereas “Power Failure” records that the SWORDFISH + has recovered from a power supply disconnection. A very short disconnection of power will record a “Power Glitch” message, typically around 0.1seconds.

The FAULT HISTORY menu is always visible regardless of whether the Access Code is correct.
To reset the complete FAULT HISTORY by pressing ENTER then DOWN and then ENTER again when at Fault 1. Individual Faults can be reset by completing the same action while displaying the Fault screen to be reset.

PUMP DATA LOG

Main Menu	Sub Menu	Units	Defaults	Range
PUMP DATA LOG				
	Hours Run 1	hours	display	0 - 65535
	*Hours Run 2	hours	display	0 - 65535
	*Hours Run 3	hours	display	0 - 65535
	*Hours Run 4	hours	display	0 - 65535
	*Hours Run 5	hours	display	0 - 65535
	*Hours Run 6	hours	display	0 - 65535
	Pump Starts 1	number	display	0 - 65535
	*Pump Starts 2	number	display	0 - 65535
	*Pump Starts 3	number	display	0 - 65535
	*Pump Starts 4	number	display	0 - 65535
	*Pump Starts 5	number	display	0 - 65535
	*Pump Starts 6	number	display	0 - 65535
	Pump Starts Last Hr	number	display	0 - 65535
	Analogue Input 1	%	display	0.00 - 100.00
	Analogue Output 1	%	display	0.00 - 100.00
	Digital Input State	1 - 12	display	X for Active
	Digital Output State	1 -4	display	X for Active
	Curr & max retry	number	display	0 – 50 0 – 50
	Temperature	degrees C	display	0 - 999

* Hours Run 2-6 are only visible if "Number of pumps" is set accordingly
* Pump Start 2-6 are only visible if "Number of pumps" is set accordingly

Hours Run Pump 1-6

Hours Run Pump1
XXXXX

Each pump has an hour runmeter attached to record the actual run time for each pump. The hour log will accumulate all of the operation time for each pump in both AUTOMATIC and MANUAL modes.
To reset the time press ENTER then DOWN and then ENTER again.

Pump 1-6 Starts

Pump Starts 1
XXXXX

The SWORDFISH + registers the number of starts that each pump accumulates to assist in the tuning of the system. This number can assist in the selection of the Cut In and Cut Out pressures and the run time settings. The starts do not increment when selected in MANUAL as this is considered to be an override function.
To reset press ENTER then DOWN and then ENTER again.

Starts Last Hour

Starts Last Hour
XXXXX

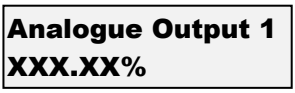
This registers the numbers of starts that the *TOTAL SYSTEM* had over the past hour. This is the accumulation of all of the Starts for all of the pumps and is designed to assist in trouble shooting. The new number is accumulated over a 10-min period and is updated at 10-minute intervals. To get a true hourly reading the system must have been running for at least 1 hour. After the first hour the last 6 previous 10-minute readings are added together to get the Starts last hour reading.

To reset press ENTER then DOWN and then ENTER again.

Analogue Input

This screen displays the actual Analogue Input reading in percentage.
It shows the actual possible full scale reading and is not zeroed or scaled to pressure. It is used to determine input functionality.

Analogue Output



This screen displays the actual Analogue Output reading in percentage. This output mimics the Analogue 1 Input and can be re-scaled in the configuration settings.

Digital Input State

This screen displays the state of the Digital inputs
X = energized

\- = de-energized
See INPUTS for configurable options for this item.

Digital Output State

This screen displays the state of the Digital outputs
X = energized

\- = de-energized
See OUTPUTS for configurable options for this item.

Curr & Max Retry

The number under "Curr" is the current number of times the main processor has not been able to communicate with the analogue system. If it is not at Zero it indicates that the analogue system has been subject to noise and may have had to restart itself. If this number continues to increment up to 20, then resets to 0, and continues incrementing again it indicates a major malfunction with the analogue system

The number under "Max Retry" is the maximum number of times the main processor has not been able to communicate with the analogue circuitry. If it is at 20 there may have been a major disruption in the analogue system and was unable to restart itself and the main processor has more than likely forced it to restart.

Temperature

Displayed is the current temperature in degrees C, read via the temperature sensor on the circuit board.

ACCESS CODE

Access Code	number	21	0 - 250

Press ENTER to edit the Access Code at this location. If correct this will then allow access to the "Sub Menus". Once the Access Code is input it will remain active for 25 minutes after the last key press. Standard security will then resume and access into the submenus will require re-entering of the Access Code.

Access Code
XXX

The system will then automatically lock the use of the keys which control the ON/OFF and AUTOMATIC and MANUAL Functions. This is designed to protect the system from tampering.

KEY PAD LOCKED
Enter Access Code

If a message KEPAD LOCKED appears on the screen enter the ACCESS CODE to allow access.

SETTINGS

SETTINGS			
*LoPress Shutdown		*150	0 - 9999
*LoPress Alarm		*150	0 - 9999
*Low Limit		*OFF	*OFF
Cut In Pressure		200	0 - 9999
Cut Out Pressure		450	0 - 9999
*HiPress Shutdown		650	0 - 9999
*HiPress Alarm		650	0 - 9999
*High Limt		*OFF	*OFF
Alt Cut In 2		250	0 - 9999
Alt Cut Out 2		500	0 - 9999
Alt Cut In 3		300	0 - 9999
Alt Cut Out 3		600	0 - 9999
*Trip Point Low		300	0 - 9999
*Trip Point High		400	0 - 9999

Low Pressure Shutdown
Low Pressure Alarm
Low Limit

LoPress Shutdown
XXXX

This is the alarm pressure point for low pressure. If any pump is running and the system falls below this pressure and remains there for the period of the "LoPressure Delay" time the system will act according to the setting in the "Low Limit Action" Sub menu.

- If Low Limit Action is set to OFF, then no action is taken.
- If Low Limit Action is set to Alarm, then an alarm is only logged.
- If Low Limit Action is set to Shutdown, then a shutdown is initiated.

For alarm and shutdown actions, an output relay can be set to the appropriate mode to turn it on.

An alarm message will show on the main screen showing that there is a low pressure shutdown fault. The fault will also be recorded in the FAULT HISTORY sub menu. To clear the fault and restart the system press the ENTER key.

Note: All pumps will be shutdown including manual pumps.
If Low Limit Action is set to OFF the Low Limit and then the Low Press Delay screens will then display ------OFF---- and can be not altered.

Cut In Pressure

The Cut In Pressure is the pressure at which the system will restart or the next pump will start. This pressure must be higher than the Low Pressure Shutdown. If the system is re-starting, then the restart timer must have timed out before the first pump will start. If there is a pump is already running, then the Cut In timer must have timed out before the next pump will start. Pumps may also be prevented from starting if the Max starts per hour setting has been exceeded.
A message will appear on the status screen letting you know that it has occurred.

(This option is set in- Configuration -> Excess Run Protection)

Cut Out Pressure

The Cut Out Pressure is the pressure at which the system will start to turn off pumps. This pressure must be higher than the Cut InPressure. The Cut Out timer must have timed out before the next pump will be turned off. Pumps may also be prevented from stopping if the Minimum run time for all pumps that are currently running, have not yet timed out.

(This option is set in- Configuration -> Excess Run Protection)

High Pressure Shutdown

This is the alarm pressure point for High Pressure . If any pump is running and the system rises above this pressure and remains there for the period of the “HiPressure Delay” time the system will act according to the setting in the “High Limit Action” Sub menu.

- If High Limit Action is set to OFF, then no action is taken.
- If High Limit Action is set to Alarm, then an alarm is only logged.
- If High Limit Action is set to Shutdown, then a shutdown is initiated.

For alarm and shutdown actions, an output relay can be set to the appropriate mode to turn it on.

If the High Limit Action is set to “Shutdown” then another option becomes available to automatically restart the system after a High Pressure shutdown. This is called “High

Press Restarts" and is located in the Configuration menu. It can be set at any value between 0 and 250 to suit the application.

Note: All pumps will be shutdown including manual pumps.
If High Limit Action is set to OFF then the High Limit and the High Press Delay screens will then display ------OFF---- and cannot be altered.

Alt Cut In 2 / Alt Cut Out 2

In cases where the Cut In and Cut Out settings need to be changed via a remote control signal, activating the Alternate 2 settings will force the Swordfish+ to operate on "Alt Cut In 2" & "Alt Cut Out 2" setting.

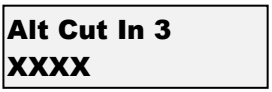
- Primary settings (Cut In - Cut Out)
- 2nd Settings (Alt Cut In 2 - Alt Cut Out 2)
- 3rd Settings (Alt Cut In 3 - Alt Cut Out 3)

In order to run the alternate settings program one of the inputs to Alt Setting 2 and activate the relevant input.
See Inputs for detailed description

Eg: If the standard systems has
Cut In……..400kPa
Cut Out…….....800kPa
Alt Cut In 2……..600kPa
Alt Cut Out 2……..1000kPa

When the Alt Settings 2 input is activated the actual system Cut In will go to 600kPa and Cut Out to 1000kPa.

Alt Cut In 3 / Alt Cut Out 3



In cases where the Cut In and Cut Out settings need to be changed via a remote control signal, activating the Alternate 3 settings will force the Swordfish+ to operate on "Alt Cut In 3" & "Alt Cut Out 3" setting.

- Primary settings (Cut In - Cut Out)
- 2nd Settings (Alt Cut In 2 - Alt Cut Out 2)
- 3rd Settings (Alt Cut In 3 - Alt Cut Out 3)

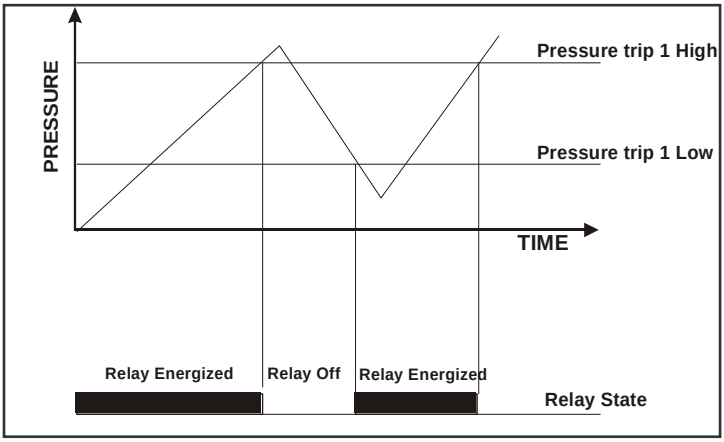
In order to run the alternate settings program one of the inputs to Alt Setting 3 and activate the relevant input.
See Inputs for detailed description
NOTE: These settings will also limit the adjustment of the High Pressure and Low Pressure settings. If Alt Cut In & Alt Cut Out 2 or 3 are not used, adjust these settings to be close to the "standard" CUT OUT, this should prevent them from limiting adjustment to the High Pressure and Low Pressure settings.

Trip Point Low

Trip Point Low
XXXX

SWORDFISH + has the ability to energize an output relay based on specific system pressure points. This can be useful for monitoring other functions through out the system that are not directly affected by the SWORDFISH + control. Trip Point High also has to be set, see below. See Output Relays section for more information on how to set this feature.

Note: The "Trip Point Low" and "Trip Point High" screens will only appear if an output is set to "Trip Point " within the OUTPUTS menu.



Trip Point High

Trip Point High
XXXX

The Trip Point High is the mating pair to the Trip Point low. If a single trip point is required set the High and Low trip points to the same value.
Note: The settings of Trip Point High must be greater or equal to Trip Point Low. The system constrains settings outside this range.

Note: The "Trip Point Low" and "Trip Point High" screens will only appear if an output is set to "Trip Point " within the OUTPUTS menu.

TIMING

TIMING			
*Lo Press Delay	seconds	120	*OFF, 0 - 250
*High Press Delay	seconds	4	*OFF, 0 - 250
In Delay Timer	seconds	4	0 - 999
Out Delay Timer	seconds	1	0 - 999
Restart Delay	seconds	0	0 - 999
No Flow Timer	seconds	0	0 - 250
Input Delay Timer	seconds	120	0 - 999
*Press Trip Low Delay	seconds	0	0 - 999
*Press Trip High Delay	seconds	0	0 - 999
*Min Pump Runtime	seconds	60	0 - 240
*Max Pump Starts	per Hour	60	0 - 240

Low Pressure Shutdown Delay

LoPressure Delay
XXX seconds

Set this time to delay a Low Pressure Shutdown. It must time out before the system will shut down in Low Pressure mode. The range for this is “0-250 sec”.
If the Low pressure shutdown needs to be turned OFF it can be done by accessing the “Low Limit Action” sub menu in the Configuration menu. If Low Limit Action is set to OFF the Low Limit and the Low Press Delay screens will then display ------OFF---- and can not be altered. If OFF is selected then the system will ignore any low-pressure shutdown commands. Be sure that you fully understand the repercussions of this setting as the Shutdown settings are designed to protect both the pump and the system from damage. The Low & High Pressure delay timers are independent of each other and can be set to suit individual needs.

High Pressure Shutdown Delay

HiPressure Delay
XXX seconds

Set this time to delay the High Pressure Shutdown. It must time out before the system will shut down in High Pressure mode. The range for this is “0-250 sec”.
If the High pressure shutdown needs to be turned OFF it can be done by accessing the “High Limit Action” sub menu in the Configuration menu. If High Limit Action is set to OFF the High Limit and the High Press Delay screens will then display ------OFF---- and can not be altered. If OFF is selected then the system will ignore any high-pressure shutdown commands. Be sure that you fully understand the repercussions of this setting as the Shutdown settings are designed to protect both the pump and the system from damage.

In Delay Timer

In Delay Timer
XXX seconds

The IN DELAY TIMER is used to delay the starting of additional pumps. When the system pressure drops below the Cut In Pressure the system starts the first pump according to the “restart” timer. Any additional pumps required will be started if the pressure remains below the Cut IN Pressure after the In Delay Timer has timed out. The In delay timer is used to start every pump apart from the first pump after a restart.
This timer is designed to assist in the reduction of Short Cycling and allowing the system to stabilise before additional pumps are started.

Out Delay Timer

When the pumps are called to turn off the delay for this is governed by the OUT DELAYTIMER. It delays the shutting down of additional pumps when the system pressure is above the Cut In and pumps are attempting to shut down. Take care in setting this timer as the increase in pressure due to this delay can cause pressure spikes.

Restart Delay

.

When the system pressure drops below the Cut In Pressure the first auto pump to start will be delayed by the RESTART DELAY

No Flow Timer

If a flow switch is fiited and connected to a programmable input which is programmed to “No Flow” and pumps are running there should be flow detected by the Flow Switch. If there is No flow the flow switch input is closed this timer delays a no flowshutdown by the given amount.

Input Delay Timer

The SWORDFISH + has the capacity to accept input signals for various processes. This timer sets the delay for reaction to those inputs. The specific inputs that are controlled by this timer are outlined in the “Programmable Input Options”

Pressure Trip Low Delay

This setting delays the activation of the relevant Output relay if programmed for Pressure Trip.

Pressure Trip High Delay

This setting delays the deactivation of the relevant Output relay if programmed for Pressure Trip.

Note: The screens “Pressure Trip Low Delay” and “Pressure Trip High Delay” are only visible if at least one output is set to “Trip point” in the OUTPUTS menu.

Min Pump Runtime

Min Pump Runtime
XXX seconds

This setting is used to prevent switchgear and pumps from failing due to excessive cycling. Each pump is prevented from stopping until its own Minimum run timer expires.

A message will appear on the status screen letting you know that it has occurred.

Min Run Time ON
Pump Stop X Secs

This method of protection should only be used if the reticulation system can withstand maximum pump head.

Maximum Pump Starts

Max Pump Starts
XXX per Hr

This setting is used to prevent switchgear and pumps from failing due to excessive cycling. Each pump is prevented from tarting if the Max starts per hour setting has been exceeded.

A message will appear on the status screen letting you know that it has occurred.

PUMP/S REACHED
MAX Starts PerHr

Note: The “Min Pump Runtime” and “Max Pumps Starts” screens are visible according to the setting of “ExcessRun Prot’n” sub menu in the “Configuration” Menu.

CONFIGURE

CONFIGURE			
Operating Mode	selection	Pressure	Pressure, Flowrate, Temperature, Single Level Multi Level.
Number of pumps	number	3	0 - 6
*Transducer Zero	unitless		0 - 9999
*Adjust Pressure	unitless		0 - 9999
*Averaging	number	20	0 - 50
Scale An Output	number	1000	
Pump Flow Rate	number	5	1-9999 /Min
Auto Rotation	selection	Full	Full, Pump 1 *2 - Pump 6, Every 24 Hours, Low Hours.
High Press Restarts	selection	0	0 - 250
Sensing Input	selection	Analogue	Analogue, Switched
ExcessRun Prot'n	selection	Minimum Run Time	Minimum Run Time, Max Starts PerHr
Low Limit Action	selection	OFF	OFF, Alarm, Shutdown
HighLimit Action	selection	OFF	OFF, Alarm, Shutdown
User Access Code	number	21	0 - 250

Operating Mode

Operating Mode
Pressure

Select the Control Parameter relevant to the operation. The options are:

- Pressure Control
- Flowrate Control
- Temperature Control
- Single Level Control
- Multi Level Control

When the relevant selection is made the menu screens will change to reflect the control parameters. This manual only covers the pressure control option, therefore no other options will be discussed.

Number of Pumps

Number of Pumps
X

Select the number of pumps in the system. The menus will change to suit the selection.

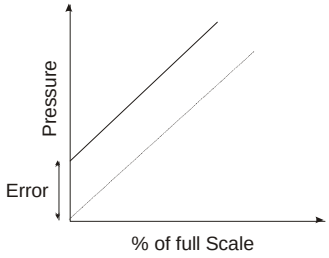
Note: Do not include the Jockey Pump when entering the number of pumps.

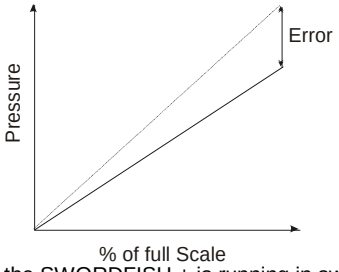
Transducer Zero

Transducer Zero
XXXXX kPa

The Transducer Zero adjusts the zero offset in the pressure sensor. Remove all pressure in the system and then trim the display by pressing ENTER and then the UP or DOWN keys to set the reading to “0”. There are buffers in the system so the transition to the new reading may take some time to settle, wait at least 5 seconds before accepting the adjustment.

If SWORDFISH + senses that the adjusted zero input is lower than can be accepted, a message will come up on the screen stating “VALUE TOO LOW”. If this message appears, increase the setting slowly by pressing ENTER and then UP, press ENTER again to confirm. Exit out of the menu to store the value.





Note: This screen will not be displayed if the SWORDFISH + is running in switched mode.

Adjust Pressure

The calibration of the analogue sensor is achieved by adjusting the pressure reading on this screen to match a reading from a pressure gauge.

Adjust Pressure
XXXXX

Once the system pressure has stabilised, press the ENTER key and then either UP or DOWN keys to match the reading on this screen to suit a pressure gauge reading. Once the readings are matched the system pressure is calibrated. Press ENTER again and then exit out of the menu to store the data.

There are buffers in the system so the transition to the new reading may take some time to settle, wait for 5 seconds before accepting the adjustment.

Note: This screen will not be displayed if the SWORDFISH + is running in switched mode

Averaging

To allow the system pressure to be displayed without significant pressure bouncing, the SWORDFISH + averages the readings taken.
To damp the Pressure Reading insert a high number.

Averaging
XX

Note: The “Transducer Zero”, “Adjust Pressure” and “ Averaging” screens are not visible if the “Sensing Input” sub menu in the “Configuration” Menu is set to Switched.

Note: This screen will not be displayed if the SWORDFISH + is running in switched mode

Scale An Output

This allows the analogue input to be re-scaled and sent to other devices. 1000 = 1:1 2000 = 2:1 (Output twice the input value)

Scale An Output
XXXX

Pump Flow Rate

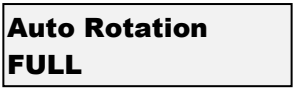
This figure is the flow rate of the pump at a nominated pressure. It is read from a manufacturers pump curve and input as a flow rate / minute. Any units can be used for this figure however the time units are fixed at MINUTES.

Each time the operating range of the controller is changed this figure must be modified to maintain a more accurate figure.

Auto-Rotation

This menu allows SWORDFISH + to call on one pump to be the lead pump or to allow for a new pump to be the lead pump after each time all of the pumps have shutdown.
Note: The lead pump is the name given to the first auto pump to start (if available). The options are Full,1,2,3,4,5,6, Every 24 Hours and Low Hours. If a number is selected then that pump will always be the lead pump. If Full is selected then the lead pump will cycle after system shutdowns or *PAUSE* events.

If set to “Every 24 Hours”, once every 24 hours the system will shutdown all auto pumps (including jockey) and force a cycle of the lead pump.



Selecting “Low Hours” will start the next available pump with the lowest hours according to the individual Hours Run meters as seen in PUMP DATA LOG. The aim of the setting is to get an even wear through all of your pumps.

Note: A forced rotation can be activated by setting one of the programmable inputs to “Cycle Pumps” and closing the relevant input terminals- see Programmable Inputs.

High Pressure Restarts

This setting allows the operator to set the number of times that the system can shutdown and then automatically restart after a High Pressure Shutdown.

The range is from 0-250. Select 0 to make the system shut down immediately after the High Pressure delay timer trips. This is the safest setting and the default for the system. After each automatic restart the fault is logged in FAULT HISTORY and the message “New Fault” appears on the main screen.

The restart number is based on a 1 hour time period. i.e. if the Restarts number is 5 then the system will allow 5 restarts in the 1 hour time frame starting from the time of the first HP Fault.

Sensing Input

Sensing Input
Analogue

The SWORDFISH + can accommodate a variety of inputs. It is divided in to two categories.

- **Analogue-** These are signals which change proportionally over time. Most sensors and transducer have an analogue output. Analogue is also divided in to two categories.
    - **Standard Analogue-** This is where a pressure rise will cause a rise in the output of the transducer.
    - **Reverse Analogue-** This is where a pressure rise will cause a fall in the output of the transducer. (These are very rare in pressure control applications)
- **Switched-** These are signals which change instantaneously. Typical switched products are: Floats, pressure switches and toggle switches.

Excess Run Protection

ExcessRun Prot'n
Min Run Time

There are two options to prevent excessive pump cycling or starting.

- **Min Run Time** If this setting is used then each pump is prevented from stopping until it's own Minimum Run Timer times out. This method of protection should only be used if the reticulation system can withstand maximum pump head. A message will appear on the status screen letting you know that it has occurred.

Min Run Time ON
Pump Stop X Secs

- **Max Starts perHr-** If this setting is used then each pump from starting if the Max starts per hour setting has been exceeded. The down side of this is that if all pumps have exceeded the number of starts per hour then the reticulation pressure will fall to zero. A message will appear on the status screen letting you know that it has

PUMP/S REACHED
MAX Starts PerHr

Low Limit Action

Low Limit Action
Shutdown

The Low limit action allows the user to select an appropriate action in the event of a sustained low pressure condition. There are three possible settings:

- **OFF** This setting completely turns OFF the Low Pressure. Be aware that if set to OFF there would be no Low Pressure protection for the system.
- **Alarm** This setting turns OFF the Low Pressure protection but will generate an alarm which can be used for telemetry . Be aware that if set to Alarm there would be no Low Pressure protection for the system
- **Shutdown** This setting turns ON the Low Pressure protection and also generates a fault alarm which can be used for telemetry. This is the safest option.

High Limit Action

The High limit action allows the user to select an appropriate action in the event of a sustained high pressure condition. There are three possible settings:

- **OFF** This setting completely turns OFF the High pressure. Be aware that if set to OFF there would be no High Pressure protection for the system.
- **Alarm** This setting turns OFF the High Pressure protection but will generate an alarm which can be used for telemetry . Be aware that if set to Alarm there would be no High Pressure protection for the system
- **Shutdown** This setting turns ON the High Pressure protection and also generates a fault alarm which can be used for telemetry. This is the safest option.

User Access Code

The access code is used to limit access to the settings menus.
The user access code has the range “off, 0 – 250”. Off will disable the access code and allow unlimited access. Once a number is selected then access to the settings screens or any other editable screen will require the inputting of this number to progress. To edit press enter and then up or down keys to edit the new number. Press enter again and exit the menu to store the changes.

JOCKEY PUMP

JOCKEY PUMP			
Jockey Pump	selection	----Off----	----Off----, ===On===
*JP Cut In Press	unitless	250	0 - 9999
*JP Cut Out Press	unitless	400	0 - 9999
*JP Run On Time	seconds	2	0 - 999
"JP In Delay Time	seconds	0	0 - 999

The Jockey pump is typically a smaller auxiliary pump that is outside the flow range of the main pumps. The jockey pump will turn on when there are no main pumps on and the pressure is below Jockey Cut In Pressure. If the jockey pump is enabled it automatically takes over Output relay 4 for its operation, therefore making the system capable of 1 Jockey pump plus 6 main pumps.

To enable the jockey pump and allow viewing of the rest of the jockey pumps screens change to Jockey Pump ON.

Jockey Pump
----------Off----------

Jockey Pump
=======On======

JP Cut In Pressure

The JP Cut In Pressure is the Pressure below which the pump defined as Jockey pump will restart.

JP Cut In Press
XXXX

JP Cut Out Pressure

The Set Point is the pressure that the Jockey Pump will be turned off.

JP Cut Out Press
XXXX

JP Run On Time

The Jockey pump can be forced to run on after the main system has started by the time detailed in this screen.

JP Run On Time
XXX seconds

JP In Delay

When the pressure drops below the JP Cut In Pressure and remains there the Jockey pump will start after this period. Given that no main pumps have started.

JP Restart Delay
XXX seconds

NOTE: IF THE JOCKEY PUMP IS TURNED "ON", RELAY 4 IS NO LONGER AVAILABLE FOR ANY OTHER FUNCTION.

OUTPUTS

OUTPUTS				
	Digital Output 1	selection	Shutdown Fault	Shutdown Fault, Lo Press Fault, Hi Press Fault, *Pump 1 - 6 Run, *Pump 1 - 6 Fault, System Paused, Low Alarm, High Alarm, Any Alarm, Any Pump Shutdwn, Any Pump Running, Trip Point Alternate Trip, Aux Output 1, Aux Output 2, Aux Output 3,
	Digital Output 2	selection	Any Pump Shutdown	
	Digital Output 3	selection	Any Alarm	
	*Digital Output 4	selection	Any Pump Running,	
	Analogue Output 1	selection	System Pressure	System Press

SWORDFISH + has four main programmable outputs that can be used to communicate with external sources such as Telemetry or Building Management Systems (BMS). As each system requires different combinations of information all output relays are configurable in software. All outputs are Voltage Free - Change Over contact outputs and capable of 5 amps 240 VAC.

You can view which outputs are currently activated within the PUMP DATA LOG menu, under Digital Output State. The status of the analogue outputs is also available within this menu.

Digital Output Options

No.	Option	Delay
1	Shutdown Fault,	As per delay timer
2	Lo Press Fault,	As per delay timer
3	Hi Press Fault,	As per delay timer
4	Pump 1 Run,	Instantaneously
5	Pump 2 Run,	Instantaneously
6	Pump 3 Run,	Instantaneously
7	Pump 4 Run,	Instantaneously
8	Pump 5 Run,	Instantaneously
9	Pump 6 Run,	Instantaneously
10	Pump 1 Fault,	As per delay timer
11	Pump 2 Fault,	As per delay timer
12	Pump 3 Fault,	As per delay timer
13	Pump 4 Fault,	As per delay timer
14	Pump 5 Fault,	As per delay timer
15	Pump 6 Fault,	As per delay timer
16	System Paused,	Instantaneously
17	Low Alarm,	As per delay timer
18	High Alarm,	As per delay timer
19	Any Alarm,	As per delay timer
20	Any Pump Shutdwn,	As per delay timer
21	Any Pump Running,	Instantaneously
22	Trip Point	As per delay timer
23	Alternate Trip,	Instantaneously
24	Aux Output 1	Instantaneously
25	Aux Output 2	Instantaneously
26	Aux Output 3	Instantaneously

- **Shutdown Fault**

This output is used to indicate that there has been an event that has shut down the system. This can be a High or Low-Pressure Shutdown, No Flow Shutdown.

- **Low Pressure Fault**

A shutdown based on a Low Pressure Shutdown.

- **High Pressure Fault**

A shutdown based on a High Pressure Shutdown.

- **Pump 1-6 Run**

Pump 1-6 running.

- **Pump 1-6 Shutdown**

Pump 1-6 shutdown on individual pump protection.

- **System Paused**

The “system pause” input is activated

- **Low Alarm**

If a Low Pressure circumstance has occurred then the output will turn on.

- **High Alarm**

If a High Pressure circumstance has occurred then the output will turn on.

- **Any Alarm**

If there are any Fault Re-starts active or general alarm that do not cause a system shutdown this output will activate.

- **Any Pump Shutdown**

If any pump is shutdown this will then will activate the relay.

- **Any Pump Running**

Any pump running will activate the relay.

- **Trip Point**

When the system pressure reaches the nominated Trip Point Low and High, this relay will energize or de-energize. See Pressure Trip in SETTINGS.

- **Alternate Trip**

Each time the system shuts down the energized state of the relay will change. E.g. If the relay on one cycle is closed during operation then the next cycle this relay will be open. The relay will change on the following: - Low Pressure Shutdown, High Pressure Shutdown, No Flow Shutdown and Pause.

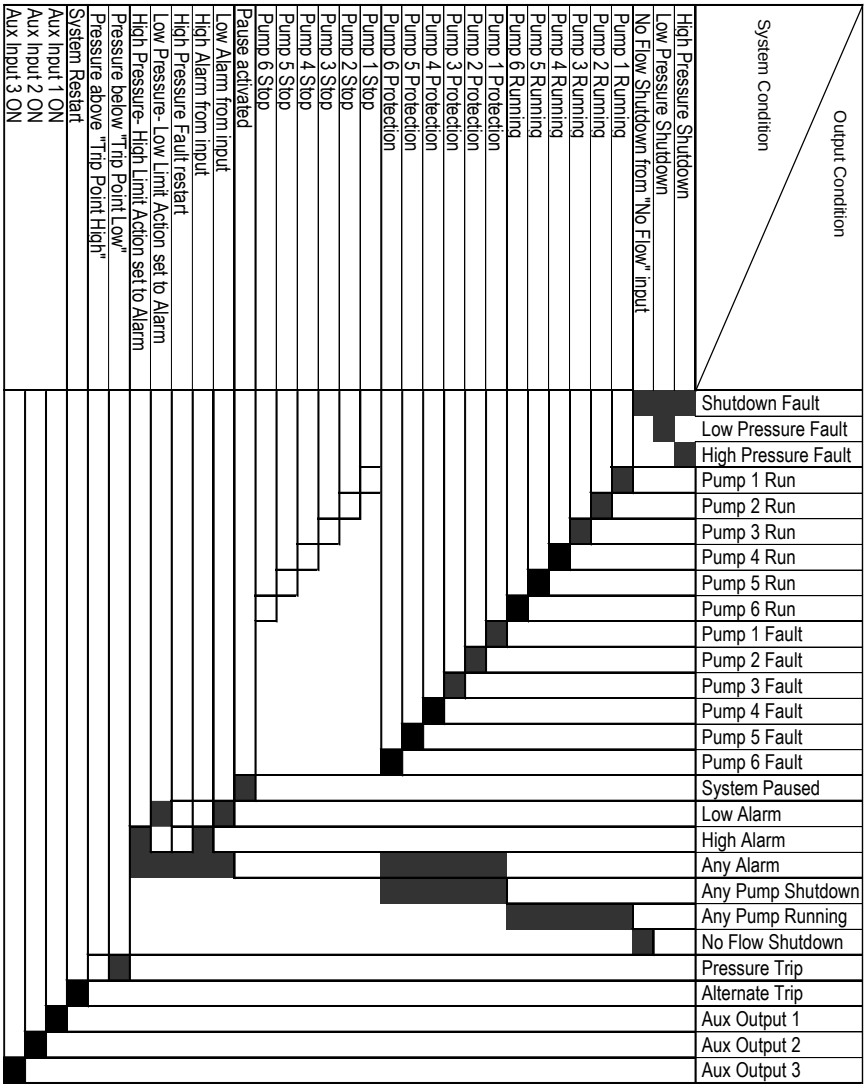
- **Aux Outputs 1 - 3**

Any output can be set to be an auxiliary output. Setting an output to become an auxiliary output allows the SWORDFISH + to use an input to turn on a Digital Output. To do this the input has to be set up to be an Auxiliary input. There are three auxiliary functions available.
Aux Input 1 operates Aux Output 1
Aux Input 2 operates Aux Output 2
Aux Input 3 operates Aux Output 3

*** RELAY RATINGS**

The relays are rated at 5 amp 250VAC. Consideration of inrush current, inductive loads and cycling must be taken into account when applying current to these relays.

Output Matrix



Select a system condition you want to operate an output.
Move across the horizontal line until a black box is found, then follow the vertical lines to see what output selection is required. Set any output to this selection and it will now operate according to the set system condition.
If only a white box is found it indicates that this function will turn the output off.
Some conditions can have more than one selection.

INPUTS

INPUTS			
Program Input 1	selection	System Pause,	*Alt 2 Settings
Program Input 2	selection	Pump 1 Protection,	*Alt 3 Settings
Program Input 3	selection	Pump 2 Protection,	*Cut In,
Program Input 4	selection	Pump 3 Protection,	*Cut Out,
Program Input 5	selection	High Limit,	Low Limit,
Program Input 6	selection	Low Limit,	High Limit,
Program Input 7	selection	No Flow,	System Pause,
Program Input 8	selection	*Alt 2 Settings	*Pump 1 - 6 Protection,
Program Input 9	selection	*Alt 3 Settings	*Pump 1 - 6 Stop,
Program Input 10	selection	Reset,	*Pump 1 - 6 Manual Run,
Program Input 11	selection	Cycle Pumps,	Fire Mode,
Program Input 12	selection	Aux Input 1	Cycle Pumps,
			Reset,
			No Flow,
			Aux 1, Aux 2, Aux 3,
			*Pump 1 - 6 No Flow Prot,

There are 12 main inputs with the SWORDFISH + that control the external sensing functions.
They all require ***VOLTAGE FREE*** contacts and as such should ***NOT HAVE ANY VOLTAGE APPLIED.***

- All inputs operate on a ***CLOSED CONTACT*** for registration. This contact needs to be made between the input common and the relevant input. There are three terminals for the input Common to allow for multiple connections.

You can view which inputs are activated by the leds on the front of the unit and also within the PUMP DATA LOG menu under the “Digital Input State” screens. See PUMP DATA LOG for more information.

PROGRAMMABLE INPUT OPTIONS

	Description Option	Delay time	Duration
0	Not selected		
1	Alt 2 Setting	1 second	Continuous
2	Alt 3 Setting	1 second	Continuous
3	Cut In	Cut In delay	Continuous
4	Cut Out	Cut Out delay	Continuous
5	Low Limit	Low Pressure dly	Continuous
6	High Limit	High Pressure dly	Continuous
7	System Pause	1 second	Continuous
8	Pump 1 Protection	Input delay	Continuous
9	Pump 2 Protection	Input delay	Continuous
10	Pump 3 Protection	Input delay	Continuous
11	Pump 4 Protection	Input delay	Continuous
12	Pump 5 Protection	Input delay	Continuous
13	Pump 6 Protection	Input delay	Continuous
14	Pump 1 Stop	Instantaneous	Continuous
15	Pump 2 Stop	Instantaneous	Continuous
16	Pump 3 Stop	Instantaneous	Continuous
17	Pump 4 Stop	Instantaneous	Continuous
18	Pump 5 Stop	Instantaneous	Continuous
19	Pump 6 Stop	Instantaneous	Continuous
20	Pump 1 Manual Run	Instantaneous	Continuous
21	Pump 2 Manual Run	Instantaneous	Continuous
22	Pump 3 Manual Run	Instantaneous	Continuous
23	Pump 4 Manual Run	Instantaneous	Continuous
24	Pump 5 Manual Run	Instantaneous	Continuous
25	Pump 6 Manual Run	Instantaneous	Continuous
26	Fire Mode	1 second	Continuous
27	Cycle pumps	1 second	Rising edge
28	Reset	1 second	Rising edge
29	No Flow	No Flow Prot Dly	Continuous
30	Aux Input 1	Instantaneous	Continuous
31	Aux Input 2	Instantaneous	Continuous
32	Aux Input 3	Instantaneous	Continuous
33	Pump 1 NoFlowProt	No Flow Prot Dly	Continuous
34	Pump 2 NoFlowProt	No Flow Prot Dly	Continuous
35	Pump 3 NoFlowProt	No Flow Prot Dly	Continuous
36	Pump 4 NoFlowProt	No Flow Prot Dly	Continuous
37	Pump 5 NoFlowProt	No Flow Prot Dly	Continuous
38	Pump 6 NoFlowProt	No Flow Prot Dly	Continuous

Not Selected
When this is selected the input will not respond to any activation.

Alt Setting 2 & 3

If an input is programmed as a means of selecting the Alternate Setting, then closing of the contact to either of these inputs will activate an alternate cut in and cut out. If two inputs are activated at the same time, then Alternate Setting 3 will be the selected option.

Program Input XX
Alt 2 Setting

Low Limit

An input can be programmed to function as a switched low limit even when the system is operating in Analogue mode. Closing of the contact on this input will start the action programmed for the low limit as set in the Configuration menu.

Program Input XX
Low Limit

High Limit

An input can be programmed to function as a switched high limit even when the system is operating in Analogue mode. Closing of the contact on this input will start the action programmed for the high limit as set in the Configuration menu.

Program Input XX
High Limit

System Pause

An external sensor can be used to PAUSE the system. When the system receives a PAUSE command the system will shut down.
The system turns off all running pumps and a message will be shown on the main screen.

Program Input XX
System Pause

PAUSE ACTIVATED

After the PAUSE input has been deactivated the system will restart under normal operations. If the Auto-rotation is selected to FULL the lead pump will rotate.

Pump 1-6 Protection

.
SWORDFISH + has inputs for each pump to allow for individual pump protection. In the event of a pump going into a fault condition the input for that pump should close. This will shut down the pump after the time set by the Input Delay Timer.

Program Input XX
PumpX Protection

Note: The pump will become available again when the Input contact is opened.

This protection is ideal for the following pump protection sensors:

- Temperature probes
- Thermal Overloads
- Moisture sensor for oil bath pump seals
- Any individual pump protection device.

Pump 1-6 Stop

.

Activation of this input will instantly stop the operation of the relevant pump. This can be used as an Off Override switch in the system or if the remote control of a pump is required.

Program Input XX
Pump X Stop

Note: This input will override the relevant “Pump 1-6 Manual Run” input if both are active.

Pump 1-6 Manual Run

.

Activation of this input will instantly start the relevant pump. All automatic control of the pump is ceased at this stage.

Program Input XX
PumpX Manual Run

This action can cause an alarm or shutdown condition. (See Manual operation)

Fire Mode

The FIRE MODE allows the system to ignore all shutdown protection features so the pump will continue running under all conditions.

Program Input XX
Fire Mode

The system will still operate as per normal turning on pumps when below the Cut In setting and Turning off pumps when above the Cut Out setting. The following protection features are disabled:

- High Pressure Shutdown
- Low Pressure Shutdown
- System Pause
- No Flow
- Individual Pump Protection
- Pump 1-6 Stop
- Pump 1-6 No Flow Protection

The operational consequences for activating Fire Mode are substantial so be sure to understand the repercussions of activating this Input.

It should only be used if the risk of the pump stopping is greater that letting it run to destruction.

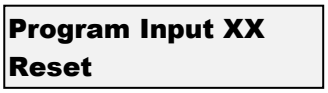
Hardware items such as circuit breakers, Thermal Overloads and any other switchgear protection is not effected by this mode and will continue to provide switchgear protection.

Cycle pumps

Activation of this input will shutdown and then cycle the pumps to the next available pump as the lead pump. If pump 1 started first on the last start-up, the toggling of this input will switch the lead pump to pump 2 instantly on receipt of this signal.

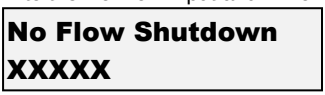
Reset

The reset input allows remote resetting of SWORDFISH + after a shutdown fault. If SWORDFISH + has shutdown due to a fault - for any reason - closing the reset contact will reset all current faults and restart the system.



No Flow

An input can be set up to monitor a flow switch. If the system detects that there is a No Flow signal from an external flow switch and there are pumps running, then the SWORDFISH + will display the message "Low Flow Detected". If this input remains on for the period of the No flow delay timer then the SWORDFISH + shut down all pumps.
This is optional and requires a flow switch to feedback into the No Flow Input and will only operate if there is at least 1 pump selected to AUTO.
Once the No Flow Delay Timer has expired then the screen message changes to:



Aux Inputs 1- 3

.
Any input can be set to be an auxiliary input.
Setting an input to become an auxiliary input allows the SWORDFISH + to use this input to turn on a Digital Output. To do this the output has to be set up to be an Auxiliary output. There are three auxiliary functions available.
Aux Input 1 operates Aux Output 1
Aux Input 2 operates Aux Output 2
Aux Input 3 operates Aux Output 3

Pump 1-6 No Flow Protection

Program Input XX
PumpX No FlowProt

SWORDFISH + has inputs for each pump to allow for individual pump no flow protection. In the event of an individual pump loosing prime or flow for some reason, the No Flow Protection input for that pump should close. This will shut down the pump after the time set by the No Flow Protection Delay Timer.
The pump will permanently disabled until reset by the operator or remotely via the reset input.
This protection is ideal for the following pump protection sensors.

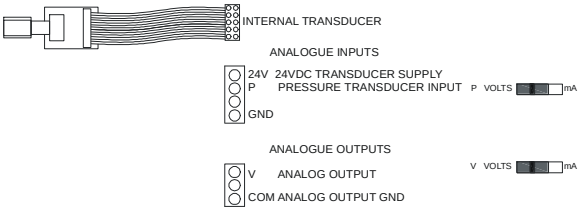
- Temperature probes
- Individual Loss of prime pressure switches
- Any individual pump protection device.

External contacts must be VOLTAGE FREE - any applied voltage can cause damage to the system.

ANALOGUE INPUTS

The built in transducer is fitted to the underside of the SWORDFISH + enclosure with a ¼" BSP female connection. This transducer is rated to 1700kPa (250 psi) with a maximum over pressure rating for spike pressure of 3150kPa (450psi). `

(The use of any other transducer apart from the standard one requires the disconnection of the ribbon cable connected to the standard transducer)

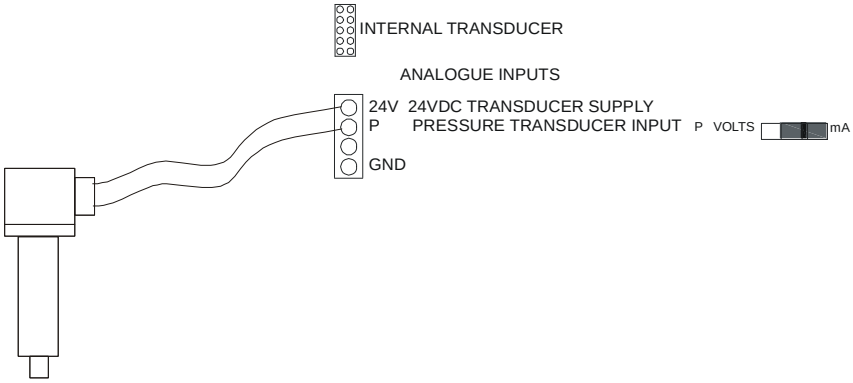


External Analogue Input

The analogue terminals are located on the left hand side of the PCB near the top.

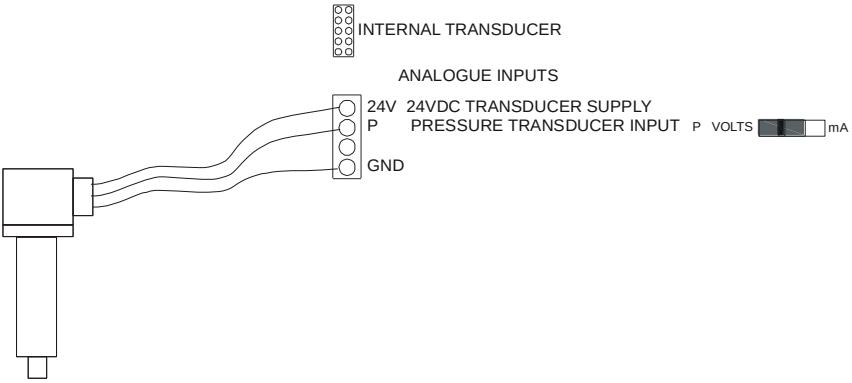
The use of 4 – 20mA and 0-10V transducers require the slide switches to be placed to match the input. This allows the system to read the correct input from the transducers.

Volts =0-5VDC,0-10VDC etc
mA= 0-20mA,4-20mA etc
4-20 mA is a standard analogue signal from a pressure transducer.



To use this input, note the wiring requirements on the PCB. A regulated 24VDC power supply is available on board for 2-wire configuration.

0-10 V transducers are set up for standard 3-wire operation.



PUMP PROTECTION

The SWORDFISH + has numerous safety features built into the system to protect the pumps from damage. Some of these shut down all operation and some are designed to halt operations until the system can stabilise. The user determines the selection of each of these.

Description	Screen Message	Action
High Pressure Shutdown	HiPress Shutdown	Shutdown - Restart Automatically or Manually
Low Pressure Shutdown	LoPress Shutdown	Shutdown - Manual restart
No Flow Shutdown	Low Flow Detected No Flow Shutdown	On first detecting a “No Flow Input” Shutdown- Manual Restart
Pause	Pause Activated	Halts the system until contacts opened again.
Individual pump shutdown	Pump X protection Logged as a Fault in the Fault Record	Pump 1-6 shutdown

High Pressure Shutdown

If the system pressure goes over the High Pressure setting for a period of time, the SWORDFISH + will shutdown the system until manually reset.
There is the option to allow a number of automatic restarts after this shutdown.
There are 0-250 restartspossible and are set in the “High Pressure Restarts” screen within the TUNING menu.

Low Pressure Shutdown

If the system drops under the specified Low Pressure setting for a period of time the SWORDFISH + will shutdown the system until manually reset. The retries are not available for this Fault.

Individual Pump Protection

SWORDFISH + has inputs for each pump to allow for individual pump protection. In the event of a pump going into a fault condition the input for that pump should close. This will shut down the pump after the time set by the Input Delay Timer.

The pump will automatically restart when the Input contact is opened.
This protection is ideal for the following pump protection sensors:

- Temperature probes
- Loss of prime pressure switches
- Thermal Overload
- Thermistor

ALL FAULTS CAN BE REMOTELY RESET FROM THE “RESET INPUT”

CALIBRATION OF ANALOGUE SENSORS

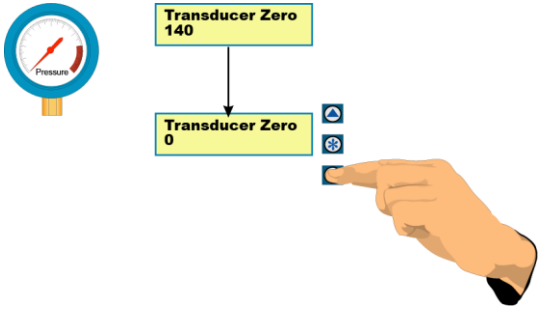
SWORDFISH + can accept most analogue signals from sensors and requires that a calibration routine be run to set both SCALING and ZERO OFFSET of these sensors. Go to the CONFIGURE Menu and press the Enter Key.

ZERO ERROR

The Zero Error routine should be done *BEFORE* using the “Adjust Pressure” screen.

The zero error offset is trimmed out on the “Transducer Zero” screen. Make sure that there is no pressure in the system or in the tube leading to the transducer.

On the “Transducer Zero” screen press ENTER to edit the data and then DOWN to make the reading go to “0”. Wait for 5 seconds for the reading to stabilise. Take care when running this procedure to reduce to the “zero” value slowly as the possibility of running past is high.

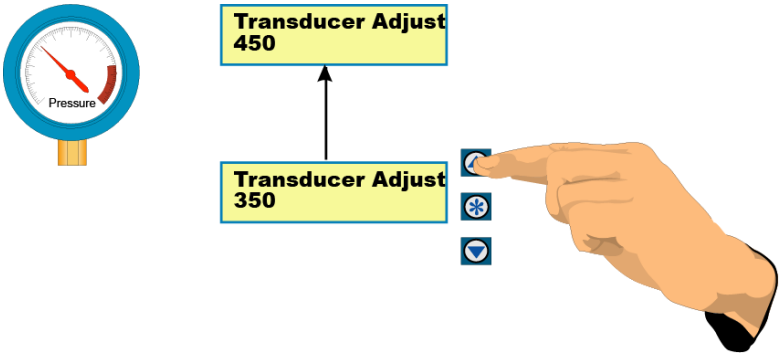


The pressure readings are averaged so the readings can lag behind the key presses. Always allow the system to stabilise prior to completing this procedure.
If the value input is lower than Zero a message stating, “VALUE TOO LOW” will appear on the screen. Press the UP key until a “zero” value appears.
Once completed press ENTER again and back out of the menu to initiate a store of the “zero” value.

PRESSURE ADJUSTMENT

For this routine it is necessary to have a reference pressure that can be used to compare the system pressure to the pressure that the SWORDFISH + senses.

To calibrate the scaling for the analogue sensor apply a pressure to the system and allow it to stabilise. This can be done by manually starting one pump and then closing the main isolation valve and shutting down the pump. This should hold system pressure and remove any fluctuations that are prevalent when pumps are running.



This pressure should be as close as possible to the normal system pressure, as the calibration routine works best with an end of scale reading.

Go to the “Adjust Pressure” screen. The pressure on this screen should match the pressure on a pressure gauge in the system. If it does not press ENTER and then either UP or DOWN to move the displayed pressure to match the gauge pressure.

There is a buffer that takes approximately 5 seconds to stabilise so wait for this period to make sure that the reading is stable before accepting or editing the settings.

Once the readings match and are steady then the scaling is calibrated. Press ENTER again and back out of the menu to initiate a store of the “Adjust Pressure” value.

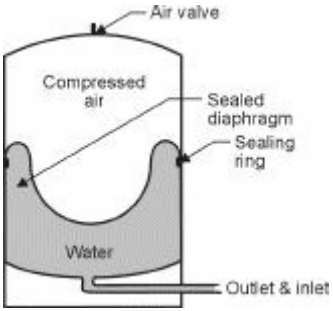
GENERAL

.

The basis for these calibrations is that the sensor used has a linear error if the instrument that is being used has a non-linear error then the system readings will be inaccurate. The standard transducer used with SWORDFISH + has these characteristics and also is fitted with temperature compensation to eliminate possible transducer drift with temperature.

With standard transducers you will be able to read pressures to an accuracy of ± 4% under normal conditions. Please note that the standard transducer is rated to 1750kPa (250 psi) - do not use the transducer if the system pressures are likely to go above this pressure. It is recommended that in cases of pressure in excess of 80% of the maximum pressure to consider an external transducer. This is due to the potential shock loads on the transducer which can damage the unit.

PRESSURE TANK REQUIREMENTS



As with all pressure systems a pressure tank is recommended for use in pressure systems. The pressure tank is used to:

- Reduce the effects of Water Hammer
- Provide supplemental pressure in the system to reduce the cycle time of the pump starts.

The size of the pressure tank is based on the number of starts required at very low flows.

Be sure to have a full diameter pipe between the reticulation and the pressure tank. Do not install any restrictors in this line.

PRE-CHARGE PRESSURE

Set the air pressure in the pressure tank at 2% below the Cut In Pressure. This must be done when there is no pressure in the system.

TANK SIZING

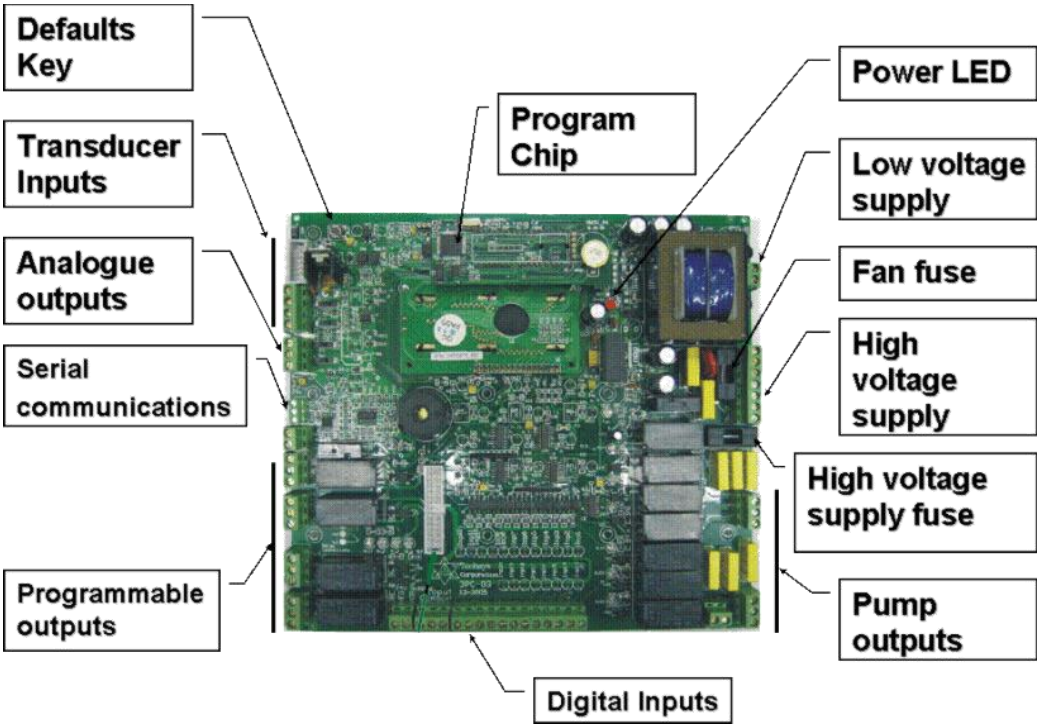
The size of the tank will determine how often the system will attempt to start in low flow situations.
Each tank manufacturer has tank sizing charts that detail the optimum size for each application. Contact your pump sales company for further information.

SPECIFICATIONS

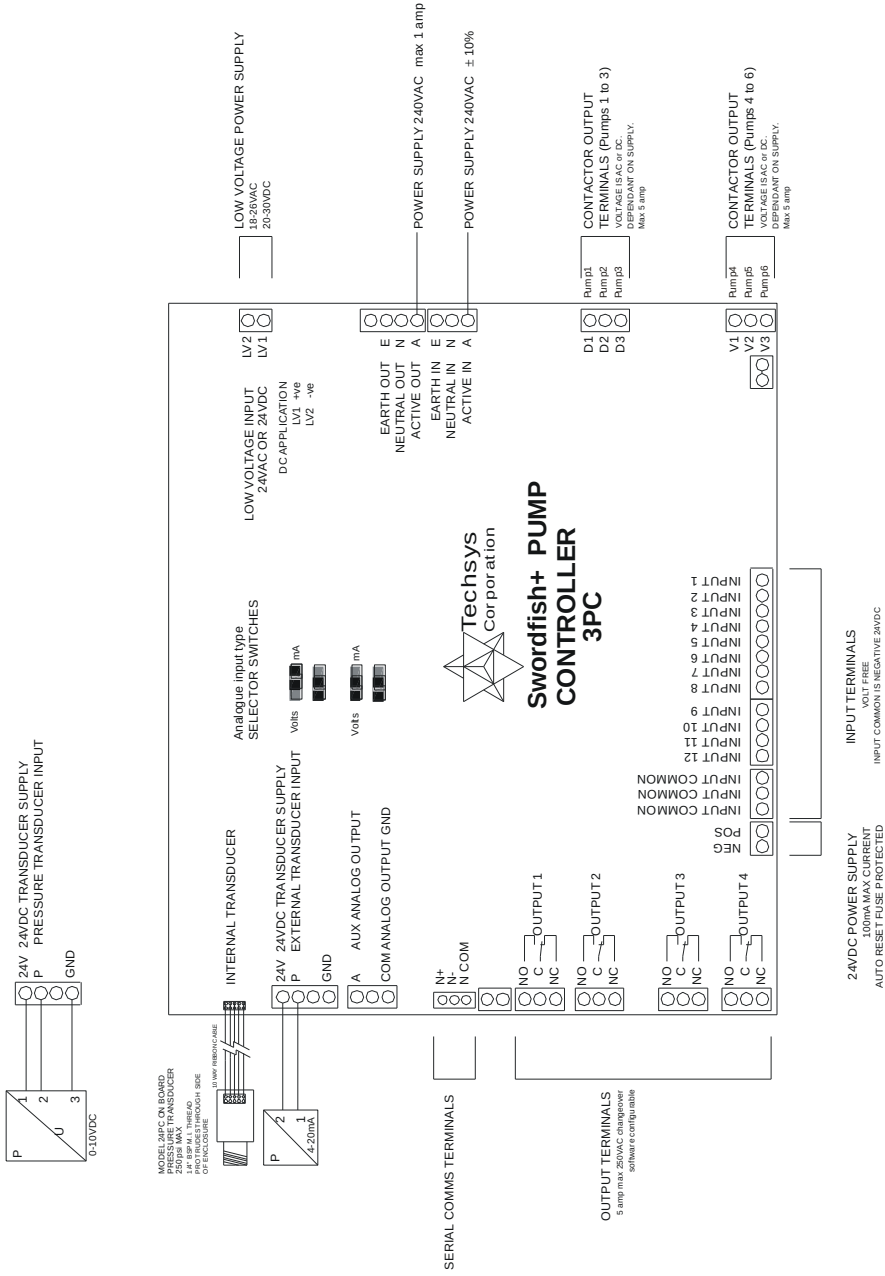
Item	Description
Power supply	Control - 240VAC 50-60Hz single phase 2 amp Single pole circuit breaker protected Optional Supply. - 24 VDC- 200mA min 500mA max (3pumps) 750mA max (6pumps). - 24 VAC- 200mA min 500mA max (3pumps) 750mA max (6pumps).
External transducer power supply	24 VDC- 100mA max. Auto reset fuse protected
EMC/ EMI filtering	Designed to minimize conducted and radiated emissions.
Standard Transducer	0-250mV ±4% accuracy uncompensated. 0-250 psi operating range Temp max 50 degC 500 psi burst pressure Temperature compensated
Time based functions	±5% of real time
Output Relays	5 amp 250VAC changeover software configurable
Switched inputs	Voltage free - internal supply 24VDC - read threshold - 2mA
Operating temperature	0 to 50 degC
Over voltage protection	Varistor protection Clamp voltage 275V - 4500 amps 1 amp - IEC127-2/3
Enclosure	IP54 not certified
Contactor	Rated voltage - 690Vac Coil - as per control Voltage cycles mech. - 10x 10^6 elec. - 2 x 10^6 cycles/hr - 3600 auxiliary contacts - 1 x NO Standard - IEC947
Motor circuit breakers	Standard - IEC947 – Start current 10x FLC
Wiring	Standard - AS3000
Input supply Voltage - 3 phase	230 - 440V
Input supply tolerance - 3 phase	-20% + 10%
Input frequency range	48 to 62 Hz

PCB HARDWARE & SPECIFICATIONS

The figure below shows the terminal configurations for the SWORDFISH +.



Detailed above are the locations for the components for the Swordfish+ Circuit Board


Swordfish+ PUMP CONTROLLER 3PC
Techsys Corporation
INTERNAL TRANSDUCER
Analogue input type SELECTOR SWITCHES
Volts
mA
LOW VOLTAGE INPUT 24VAC OR 24VDC
DC APPLICATION
LV1 +ve
LV2 -ve
LV2
LV1
LOW VOLTAGE POWER SUPPLY
18-26VAC
20-30VDC
24V 24VDC TRANSDUCER SUPPLY
P PRESSURE TRANSDUCER INPUT
GND
0-10VDC
MODEL 3PC ON BOARD PRESSURE TRANSDUCER
250 psi MAX
1.5 METRE CABLE FED THROUGH SIDE OF ENCLOSURE
10 WAY RIBBON CABLE
24V 24VDC TRANSDUCER SUPPLY
P EXTERNAL TRANSDUCER INPUT
GND
4-20mA
A AUX ANALOG OUTPUT
COM ANALOG OUTPUT GND
EARTH OUT E
NEUTRAL OUT N
ACTIVE OUT A
EARTH IN E
NEUTRAL IN N
ACTIVE IN A
POWER SUPPLY 240VAC max 1 amp
POWER SUPPLY 240VAC ± 10%
N+
N-
N COM
SERIAL COMMS TERMINALS
NO C NC OUTPUT 1
NO C NC OUTPUT 2
NO C NC OUTPUT 3
NO C NC OUTPUT 4
OUTPUT TERMINALS
5 amp max 250VAC changeover
software configurable
NEG
POS
INPUT COMMON
INPUT COMMON
INPUT COMMON
INPUT 12
INPUT 11
INPUT 10
INPUT 9
INPUT 8
INPUT 7
INPUT 6
INPUT 5
INPUT 4
INPUT 3
INPUT 2
INPUT 1
24VDC POWER SUPPLY
100mA MAX CURRENT
AUTO RESET FUSE PROTECTED
INPUT TERMINALS
VOLT FREE
INPUT COMMON IS NEGATIVE 24VDC
DO NOT CONNECT ANY EXTERNAL VOLTAGE
D1 Pump1
D2 Pump2
D3 Pump3
CONTACTOR OUTPUT TERMINALS (Pumps 1 to 3)
VOLTAGE ISAC or DC
DEPENDANT ON SUPPLY.
Max 5 amp
V1 Pump4
V2 Pump5
V3 Pump6
CONTACTOR OUTPUT TERMINALS (Pumps 4 to 6)
VOLTAGE ISAC or DC
DEPENDANT ON SUPPLY.
Max 5 amp

SPARE PARTS

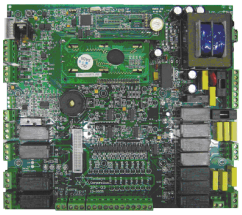
The typical spare parts required for SWORDFISH + are detailed in the table below.

Please refer to Techsys Corporation for confirmation of parts type and suitability for use with specific projects.

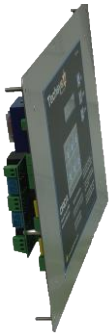
Part	Code
0-250mV Standard pressure transducer	24P-Trans
PCB Board	3PC
Retrofit panel	SW+-RF
Manual	SWORDFISH + Manual
Lexan	SWORDFISH + Lexan
SWORDFISH + PCB mounted on retrofit panel*	SWORDFISH +_RF-Kit

*Use the Swordfish+ retrofitting kit when upgrading an existing system or for fitting to new switchboard.
Includes:

- SWORDFISH + Base PCB mounted to panel
- Stainless Steel Retrofit panel
- SWORDFISH + Lexan



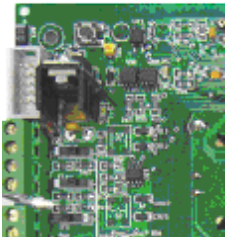
SWORDFISH + PCB BOARD



SWORDFISH + RETROFIT KIT

TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
Can't enable pumps	• Screen Stated – "KEY PAD LOCKED" • One of the Inputs is set to Pump STOP.	• Input Access Code- typically 21 • Check Input LED's for activation. • Check Input Menu for Pump Stop setting.
Pump won't start	• Pump not enabled. (Turned OFF) • Motor circuit breaker tripped or off • Control circuit breaker tripped or off • Pressure above Cut In pressure • System Pause Active	• Press pump mode switch for at least 1 second. • Reset circuit breaker. • Reset Circuit breaker • De-power and re-power the system. • Allow the system pressure to drop • Reset Input
Pump won't turn off	• Manual selected for that pump (Running LED flashing) • Pump Manual Run input active • Cut Out set too high	• Press pump mode switch once to turn OFF. • Remove input • Adjust Cut Out Pressure
No display screen	• Control circuit breaker tripped • High voltage has tripped the surge protection fuse • Temperature within the enclosure in excess of 60degC	• Reset Circuit breaker • Replace fuse on the PCB • Lower internal temperature
No pressure or wrong pressure displayed	• Incorrect Sensing Input selected • Calibration incorrect for sensor	• Change Sensing Input to suit sensor used • Calibrate sensor
Pumps cycling excessively	• IN delay too low • Pause Input tripping • Voltage being applied to the Inputs. • Cut In & Cut Out are incorrect.	• Adjust IN Delay timer • Check Pause input • Make sure that the Inputs are Voltage Free • Adjust Cut In lower or Cut Out higher

Pump shutting down on Pump Protection	• Fault in protection sensor	• Replace or adjust sensor
Controller powers on and off continuously	• Voltage being applied to the Inputs. • Excessive current being drawn from the external pressure sensor	• Make sure that the Inputs are Voltage Free • Check external sensor current 100mA max.
System Displays wont initialise Loading Data message cycles continuously	• System needs to be initialised.	• Press the "Commissioning Button" on the PCB whilst powering up the system to initialise the program 
System Pressure not displaying	• Transducer not connected properly. • Transducer type selection switch set incorrectly. • Analogue circuits not functional	• Check transducer connections. Refer to Analogue Input section. • Change switch to suit transducer type. • There are 2 LED's located on the front top right of the PCB. One is for Power which should be flashing – the other is for indication that the analogue circuit is operational, it should also be flashing. A SOLID light or NO light on either means the SWORDFISH + is inoperative.

INSTALLATION NOTES

General Installation information can be obtained from Techsys Corporation regarding the site-specific requirements however there are some “GOLDEN RULES” in site installation that should be followed.

Site Installation

- Standard SWORDFISH + requires a NEUTRAL
- Select the site most shaded and out of direct sunlight.
- Allow the airflow from the fans to be unimpeded.
- The earth needs to be close and not laid parallel with High Voltage cables

Inputs

- Use shielded wire for all inputs
- Connect the shield to EARTH and one end only
- Never apply voltage to the Inputs
- Take care in running inputs for long distances
- The inputs use a 24VDC signal as the carrier voltage- use compliant sensors.

Outputs

- 5 amp maximum switching load
- Check the programming on each output before trying to troubleshoot

Start-up

- CHECK ROTATION
- Calibrate transducer
- Input pressure settings

All these items are site related.

Site Record

Main Menu	Sub Menu		Date	
		/ /	/ /	/ /
Set Point & Actual Pressure				
Flow Rate /Min				
FAULT HISTORY	Fault 1			
	Fault 2			
	Fault 3			
	Fault 4			
	Fault 5			

PUMP DATA LOG	Flow Total			
	Hours Run 1			
	Hours Run 2			
	Hours Run 3			
	Hours Run 4			
	Hours Run 5			
	Hours Run 6			
	Pump Starts 1			
	Pump Starts 2			
	Pump Starts 3			
	Pump Starts 4			
	Pump Starts 5			
	Pump Starts 6			
	Pump Starts Last Hr			
	Curr & max retry			
	Temperature			
Access Code	21			

SETTINGS	LoPressure			
	Cut In Pressure			
	Cut Out Pressure			
	HiPressure			
	Alt Cut In 2			
	Alt Cut Out 2			
	Alt Cut In 3			
	Alt Cut Out 3			
	Trip Point Low			
	Trip Point High			

TIMING	LoPressure Delay			
	HiPressure Delay			
	IN Delay Timer			
	OUT Delay Timer			

Main Menu	Sub Menu		Date	
	Restart Delay			
	No Flow Timer			
	Input Delay Timer			
	Press Trip Low Delay			
	Press Trip High Delay			
	Min Pump Runtime			
	Max Pump Start			

CONFIGURE	Operating Mode			
	Number of pumps			
	Transducer Zero			
	Adjust Pressure			
	Averaging			
	Scale An Output			
	Pump Flow Rate			
	Auto Rotation			
	Hi Press Restart			
	Sensing Input			
	Cycle Protection			
	Low Limit Action			
	High Limit Action			
	User Access Code			

JOCKEY PUMP	Jockey Pump			
	JP Cut In Press			
	JP Cut Out Press			
	JP Run On Time			
	JP In Delay Time			

OUTPUTS	Digital Output 1			
	Digital Output 2			
	Digital Output 3			
	Digital Output 4			

INPUTS	Program Input 1			
	Program Input 2			
	Program Input 3			
	Program Input 4			
	Program Input 5			
	Program Input 6			
	Program Input 7			
	Program Input 8			

Main Menu	Sub Menu		Date	
	Program Input 9			
	Program Input 10			
	Program Input 11			
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Commissioned by……..Date……

Agent……

Contact details……

Panel Serial Number ……

NOTES

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