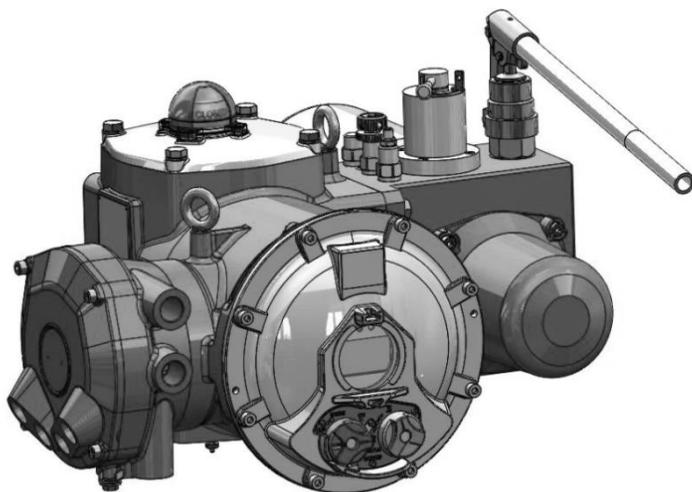




**BERNARD®
CONTROLS**

Invest in Confidence



FSE RANGE



Start Up Guide

SUG_19002_EN - Ind. A
Art : 5100705

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Definitions



NOTE:

Advisory and information comments provided to assist maintenance personnel to carry out maintenance procedures.



WARNING

If not observed, user incurs a high risk of severe damage to product and/or fatal injury to personnel.



CAUTION

If not observed, user may incur damage to product and/or injury to personnel.

1 Introduction

Thank you for choosing BERNARD CONTROLS product. FSE range Actuators are self-contained; electro-hydraulic actuators which are particularly well suited for applications requiring critical control and high reliability.

There are two major components to the FSE range:

- the actuator which mounts onto the driven device (a valve), consists of the cylinder (in case of double acting) or cylinder with spring module (in case of single acting) ;
- the electronic control module which consists of feedback module, electronics, hydraulic tank, motor & power supply. This combination of mechanical, hydraulic and electronic technologies produces actuators that ensure our customers get top class actuating.

The actuator is constructed for direct mounting on valves according to ISO-standards.

All electronics are protected in watertight or explosion-proof enclosure. FSE range Actuators is available in double acting or spring return configurations for quarter turn applications. They can be configured to mount in any position, including remote mounting of control module. Torque requirements up to 600,000 N·m can be accommodated.

FSE range includes local manual control, indication feedback via dry contacts and 4-20mA feedback signal; or optional digital control via Modbus, Foundation Fieldbus, Profibus or DeviceNet. FSE range can be supplied for operation with any single phase, three phases or 24VDC power supply.

Each product is fully inspected after the production to offer you the highest quality. In order to fully utilize the product, we strongly recommend users to read this manual carefully and understood.

This manual provides information on installation, operation and maintenance and related instructions for the **BERNARD CONTROLS** electro-hydraulic actuator (FSE).

- The aim of this literature is to support the use of products in correct manner, and all the technical information provided in the catalogue.
- The manual should be given to the end user.
- The manual can be changed or revised without any prior notice. Any changes in product's specification, structure, and/or any components may not result in immediate revised version of the manual.
- The manual should not be duplicated or reproduced for any purpose without any consent from BERNARD CONTROLS.

Manufacturer Warranty

- For the safety, it is vital to follow instructions in the manual. It is not BERNARD CONTROLS's liability for any damages which caused by users' negligence.
- It is not BERNARD CONTROLS's liability for any damages or accidents which resulted by any alteration or modification of the product and parts. If alteration or modification is necessary, please contact BERNARD CONTROLS directly.
- BERNARD CONTROLS warrants the product from the date of original retail purchase of the product for one (1) year, except otherwise stated.
- BERNARD CONTROLS warranty will not cover the products that have been subjected to abuse, accident, alteration, modification, tampering, negligence, misuse, faulty installation, lack of reasonable care, repair or service in any way that is not contemplated in the documentation for the product, or if the model or serial number has been altered, tampered with, defaced or removed; damages that occurs in shipment, failure due to power surge, and cosmetic damage. Improper or incorrectly performed maintenance or report voids this Limited Warranty.
- For detailed warranty information, please contact BERNARD CONTROLS

1.1 Safety information



READ THESE INSTRUCTIONS CAREFULLY BEFORE INSTALLING AND USING THE PRODUCT

Products supplied by BERNARD CONTROLS, in its "as shipped" condition, are intrinsically safe if the instructions contained within this Service Instruction are strictly adhered to and executed by well-trained, equipped, prepared and competent personnel.

The following documents should also be consulted:

- a) IEC/EN60079-14 standard (electric installations in gaseous explosive atmosphere),
- b) IEC/EN60079-17 standard (inspection and maintenance operations in dangerous areas),
- c) Decrees, ministerial orders, laws, directives, standards, procedures and any other document relative to the area where the actuator has to be installed.

BERNARD CONTROLS S.A. or BERNARD CONTROLS Inc. cannot be judged responsible for the non-respect of these rules.

Our equipment complies with IECEx and ATEX Standard and is therefore IECEx and ATEX marked.

They have been designed to be used in explosive atmospheres:

- **Group II - category 2 in presence of vapor, fog or gas (G).
Use in zone 1 or 2 for gas**

Please check the compatibility between the indications written on the identification plate and the explosive atmosphere type, the ambient and the admissible surface temperature of the installation area.

The actuator installation and maintenance must be carried out by qualified, trained and certified personnel.

Please carefully read this whole document before mounting and starting-up the actuator.

Marking

	ATEX Explosionproof enclosure “d”	IECEX Explosionproof enclosure “d”
Name and address of the manufacturer	BERNARD CONTROLS 4 rue d’Arsonval - 95505 Gonesse France	
Actuator type	FSE	
Serial number	Serial n° YYAXXXX.ZZZ	Serial n° n° YYAXXXX.ZZZ
Certificate number	Pending	Pending
Specific marking	-	-
N° of notified audit body	1354	1354
Gas marking	Ex db h IIB T5 Gb	Ex db h IIB T5 Gb
Dust marking	Ex h tb IIIB T100°C Db IP65	Ex h tb IIIB T100°C Db IP65
Ambiant temperature	-20°C +60°C	-20°C +60°C

Start-up



WARNING - DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT

To avoid any risk of explosion, the actuator electric control and power supply must be switched off before opening the cover.

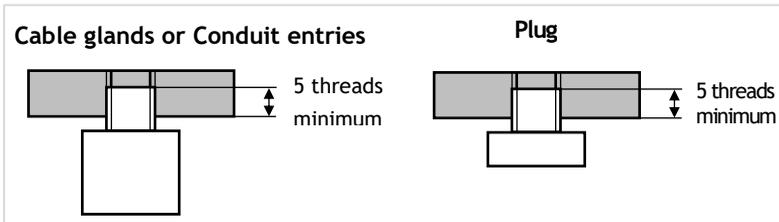


- Be careful not to damage the joint surfaces of the cover either at the opening and closing of the cover, when repositioning the cover onto the actuator body.
- When closing the cover, check the joints cleanliness.
- Tighten each cover screw.

The fastening screws shall be stainless steel socket head cap screws of property class A2-70 and yield stress 450 MPa.

In case of use in explosive dust atmosphere, check that cover tightness gaskets are intact and make sure not to degrade the gaskets while closing the cover.

Cable entries shall provide a level of protection equal or higher than the one indicated on the actuator identification plate. Only suitable certified Ex db, Ex tb IP 65 cable gland to be used. If one of them is not used, seal it with a certified and suitable metal plug for the type of protection specified.



A connection to the earth must be wired using the actuator external grounding plug. Internal and external groundings must be connected.



Remove all plastic plugs of unused conduit entries and replace by a certified metal plug. Plastic plugs are not explosion-proof and are used for shipping only.

Waterproofness

Because the NPT cable gland thread is not IP68, it's necessary to mount it with a thread sealant for ex: Loctite 577 (Henkel). In case of ISO thread, sealing is assured by an O-ring or by a thread sealant as noticed above.

Operation



Never leave the cover open, in order to avoid any risk of water inlet.

In case of use in explosive dust atmosphere, check that cover tightness O-rings are intact and make sure not to damage the seals while closing the cover.

Maintenance

Regularly check that the actuator explosion-proof enclosure has not been degraded by a mechanical shock or any other type of aggression.

Do not bring any modification of any kind to the actuator.

The user shall ensure a regular cleaning of the product housing to avoid dust build-up. Wipe surface of polycarbonate indicator cover used for indicator with moist/wet cloth.

The actuator mechanical parts are greased and do not need any specific maintenance. In case of a disassembly/re-assembly operation, make sure that all moving parts are correctly greased in order to prevent any electric spark.

User must refer to the manufacturer before carrying out any repairs or refurbishment to the equipment.

The gap specified in the approved drawing must never be exceeded.

Installation area

This actuator is an explosion-proof equipment and can be used in the following areas:

Protection class	Category	Division	Atmosphere
Ex db, Ex tb	2 (EPL Gb/Db)	Zone 1 or 2	G Gas / D Dust

EPL (Equipment Protection Level): b=high level Gas (G) and Dust (D).

Zone 1 (gas) & 21 (dust): the explosive atmosphere is likely to occur occasionally in normal operation.

Zone 2 (gas) & 22 (dust): the explosive atmosphere is not likely to occur in normal operation but if it does occur, it will persist for a short period of time only.



This device has not been designed to be operated in an area where explosive atmosphere occurs frequently or during long periods (IEC 60079-10-1-zone 0).

Groups

This actuator has been designed for the surface industries.

Zone Group	Typical atmosphere
IIB	Ethylene
IIIB	Flamable dust

For other gases, please consult a notified body.

Temperature

The temperature class corresponds to the actuator maximum surface temperature.

Class	Max surface temperature
T5	100°C



Check group and temperature class on the actuator tag.

Special operation conditions including incorrect practices

Covers opening

Removing the covers is authorized only when the actuator power supply is switched off and no explosive atmosphere is present. It is important not to degrade the explosion-proof protections (surfaces, cable entries, joints ...). Use the notches or bosses in order to keep seals and cover integrity.

1.2 Specifications of the actuator

Enclosure

The design of self-contained electrohydraulic actuator(FSE)/electric fail safe actuator construction conforms to EN 60079-0:2012+A11:2013; EN 60079-1:2014; EN 60079-31:2014 for gas group IIB, dust group IIIB and ingress protection of IP65 as per IS/IEC 60529:2001.

The FSE has been built in accordance with the following standards:

- IEC 61508:2010 ; SIL3 Capable

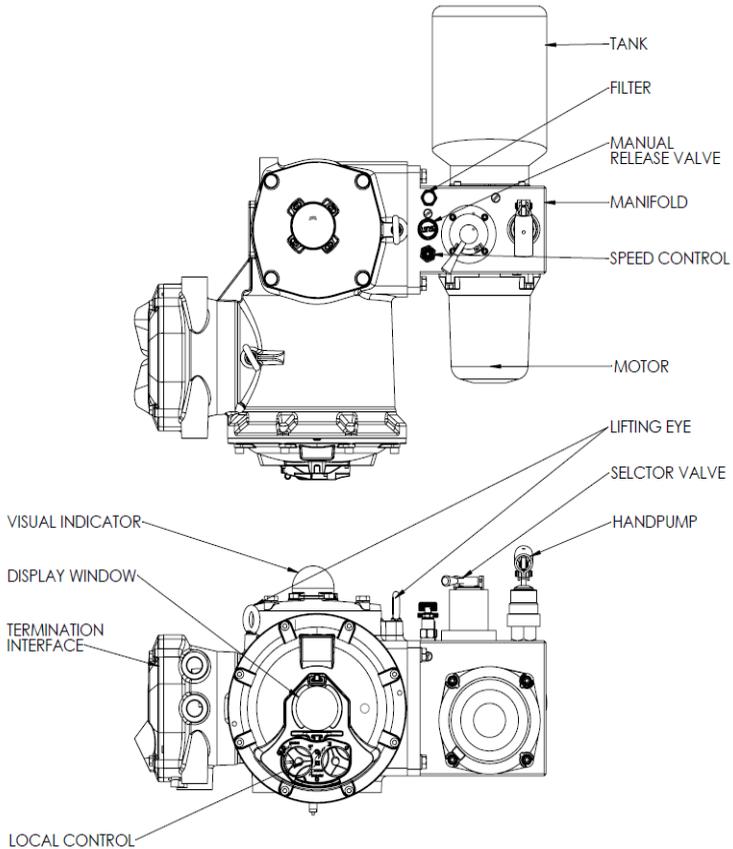
Ambient Temperature Range

- T amb. = -20 °C to +60 °C

Enclosure Materials

- Main body: Cast Aluminum alloy LM6 ;
- ON /OFF Indicator dome - Polycarbonate and ABS.

1.2 Identifying Actuator Parts



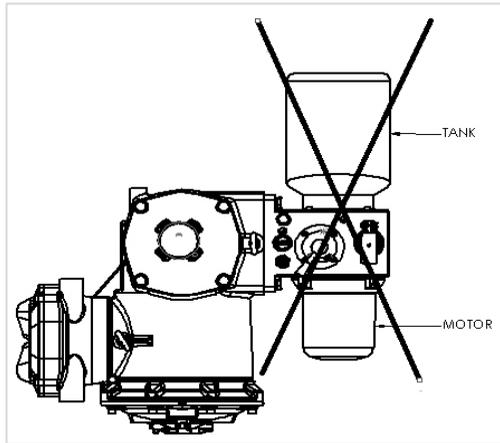
1.3 Installation and mounting information

WARNING



For the protection of personnel working on BERNARD CONTROLS actuators, this procedure should be reviewed and implemented for safe installation, disassembly and reassembly. Close attention should be noted to the WARNINGS, CAUTIONS and NOTES contained in this procedure.

FSE actuators allow many different mounting orientations. However it is NOT permitted to mount the FSE assembly vertically as the motor becomes inline directly beneath the oil tank as shown in figure.



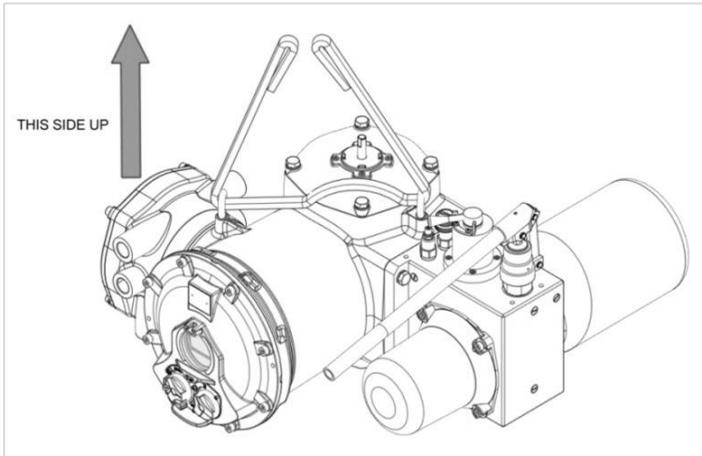
- Ensure that the actuator will not be exposed to pressure in excess to the maximum rating as indicated on the actuator nameplate or technical documents.
- Ensure that the valve is secure before fitting the actuator as the combination may be top heavy and therefore unstable.
- Ensure that throughout the installation that there are no leaks of the supply media.
- Ensure that the maximum operating temperature as indicated on the nameplate is not exceeded during operation, transportation or storage of the actuator.
- The environment and surrounding should not affect or limit the operational safety of the product.
- Product should not be installed in hazardous area that is not compatible with the gas group and temperature class indicated on the nameplate.

- If it is necessary to lift the FSE assembly, then use certified slings to lift the FSE assembly with the help of lifting eyebolts as shown in the figure.



WARNING

Use the lifting eye bolts for lifting the FSE assembly only.



- **Valve installation:** Before fitting an actuator onto a valve, care to be taken to ascertain the position of the valve and orientation of the actuator accordingly.

While bolting the actuator to the valve flange; the position of the stop bolts should be checked to ensure full opening and closing of the valve. If the end positions are not suitable, the stop bolts may be adjusted by loosening and screwing the bolts properly until desired position is obtained. When desired position is obtained; retighten the nuts.

- **Electrical Connections:** Always refer to the job specific wiring diagrams for connection instructions.

1.4 Service information

Normal recommended service interval for this actuator series is 5 years.



NOTE

Storage time is counted as part of the service interval.

This procedure is applicable with the understanding that all hydraulic pressure has been removed from the actuator.

Remove all piping and mounted accessories that will interfere with the module that are to be worked on.

Use a non-hardening thread sealant on all pipe threads.



CAUTION

Apply the thread sealant as per the manufacturer's instructions.

All parts should be thoroughly inspected for excessive wear, stress cracking and pitting. Attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding and rotating motion.

BERNARD CONTROLS recommends that disassembly of the actuator modules should be done in a clean area on a workbench.

Before installation on the valve, the actuator needs to be stroke for several times to ensure the desired function and safety.

WARNING



Compressed Springs

All springs within the FSE range of actuators are pre-compressed. Springs must not be removed from the actuator.

WARNING



Hydraulic Fluid

FSE actuators are filled with hydraulic fluid

Should there be a requirement to change the fluid, then first ensure that the system is depressurized, and the appropriate protective clothing including gloves and safety glasses are worn.

WARNING



Motor Temperature

Under normal operation the temperature of the actuator's motor cover surfaces can exceed 60 °C above ambient.

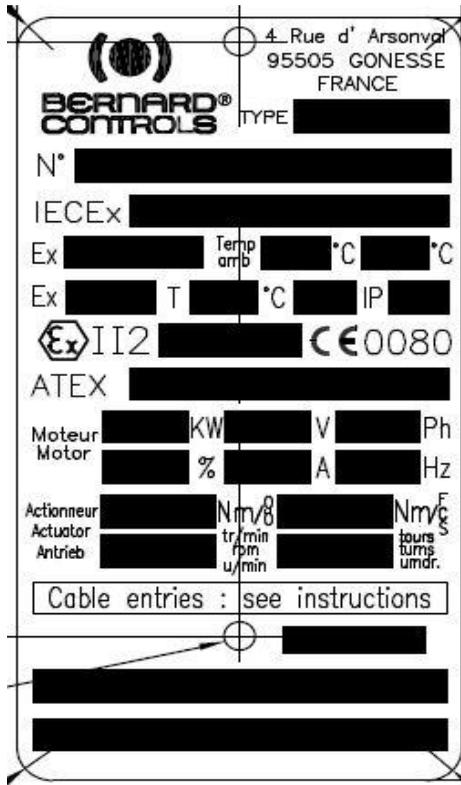
WARNING



Enclosure Materials

- Power Unit: Aluminum
- Display Window: Toughened Glass
- External Fasteners: Stainless Steel-Class A2-70
- Actuator Body: Aluminum
- Drive Shaft: Stainless Steel
- Piping: Stainless Steel
- Paint Finish: PU type of 90 micron DFT

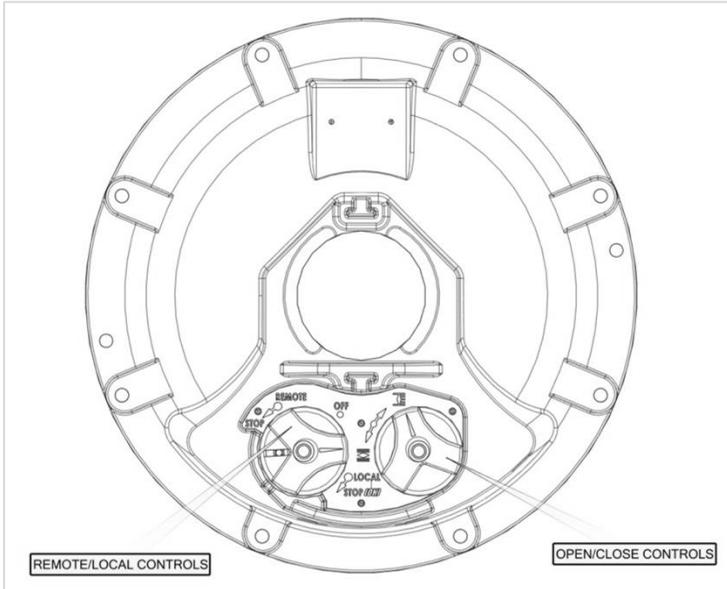
1.5 Identification of FSE actuator



DRSAHY-100-EH	VOL	VTR	PT1	*	SER	JB	S1	*	OR1	HMOR	*
1. Actuator Size											
2. Oil Tank Indicator											
3. Temperature Indicator											
4. Pressure Transmitter											
5. Accumulator											
6. On off											
7. Junction Box											
8. Main Power/ Control Signal											
9. Cable Entries											
10. Operating Temperatures											
11. Mounting											
12. Hydraulic Override											
13. Communication											

2 OPERATION

Operation by the local and remote selector switch



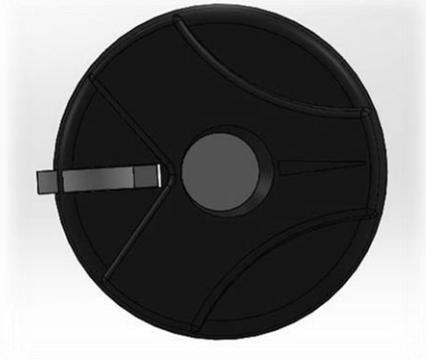
- **Local/Remote Selection:** Local/Remote selection is via two rotary switches located on the control module. Rotate fully anti-clockwise is the remote control position. Rotate fully clockwise is the local control position. The mid position is offline, prohibiting the local or remote control of the actuator. When Remote/Local control is changed in the course of travel, the actuator will stop in its current position until new command is received.
- **Local Operation:** The Local/Remote selector switch must be pointing to Local position to manually operate the actuator. The Open/Close selector switch is disabled when the Local/Remote selector switch is set for Remote operation.

- **Open/Close Selection:** Open/Close selection is via another rotary switch located on the control module. Rotate fully anti-clockwise to open or clockwise to close from the centre detent position. Direction of travel may be reversed during the stroke.
- **Local position Indicator:** Local position indication is available via LCD display visible through a window in the control module cover. The display is also used for configuration & fault indication which will be discussed in the modulation and configuration section.
- **Remote Operation:** The Local/Remote selector switch must be in the Remote position to operate the actuator remotely. The open close selector switch is disabled when the Local/Remote selector is set for Remote operation.

The local control of FSE actuator by rotary switches is as follows:

Red Rotary Switch

- The RED switch is to select the local control, remote control or offline control of the actuator.
- In Local Control rotate the red switch clockwise to stop the actuator and in Remote Control rotate the red switch anticlockwise to stop the actuator.



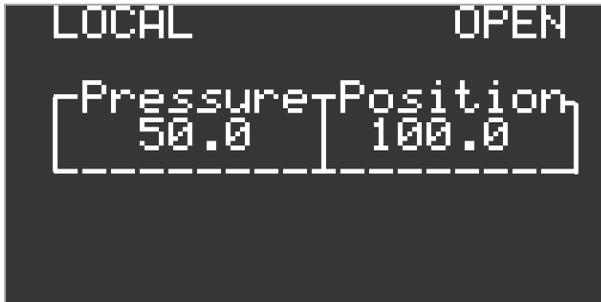
Blue Rotary Switch

- The blue switch is used to open and close the actuator in Local control.
- The blue switch is also used to navigate through the menu in offline control.
- In offline control rotate the switch clockwise to scroll down the menu options or to change the value of parameters.
- Rotate the switch anti - clockwise to select the sub-options or store the changed value of the parameters which will be enter key press.



3 Modulation and configuration of FSE for ON/OFF application

3.1 Home Screen



Press on enter key in off mode, the device will ask for password.

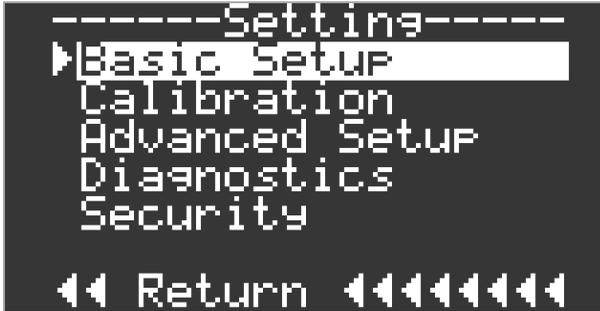


NOTE



The password is exactly of 4 alpha-numeric characters. In edit mode, the blinking character can be scrolled and on enter key press, it will accept the displayed character and move to the next character. If the password set in Change password menu is default i.e. no password, then after 4 enter key press, the password is accepted as OK displaying the main menu. If the entered password is incorrect then the display goes back to home screen above

On entering correct password (default = no password), it will enter into setting mode.

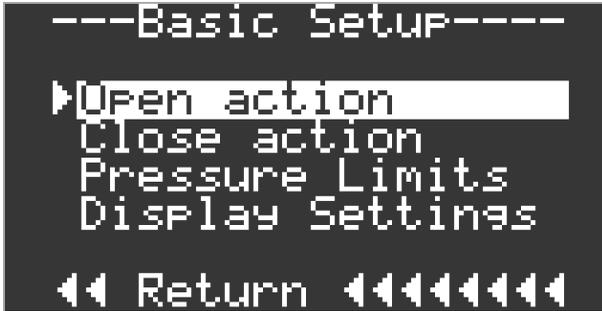


3.2 Basic Setup

3.2.1 Basic Setup Setting Tree

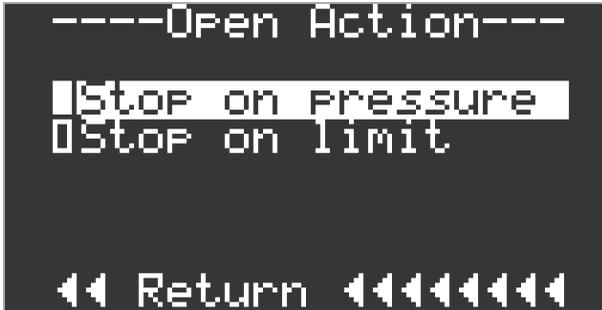
You can find in the following menu sections all the basic settings.

Open action	Stop on pressure Stop on limit	
Close action	Stop on pressure Stop on limit	
Pressure Limit	Open Open Mid Close Close Mid	
Display Settings	Home screen	Position Position/pressure
Calibration	Set open limit	Electrical Set limit
	Set close limit	Electrical Set limit
Full Stroke	Open time	Standard Minimum Maximum
	Close time	Standard Minimum Maximum
	ESD time	Standard Minimum Maximum
Partial Stroke	Position	Setup Open time Close time



3.2.2 Open Action

The Actuator can be configured to stop on pressure or stop on limit.



- Stop on Pressure

The actuator will move the valve to electrical open limit and then further to mechanical end stop.

- Stop on Limit - Default

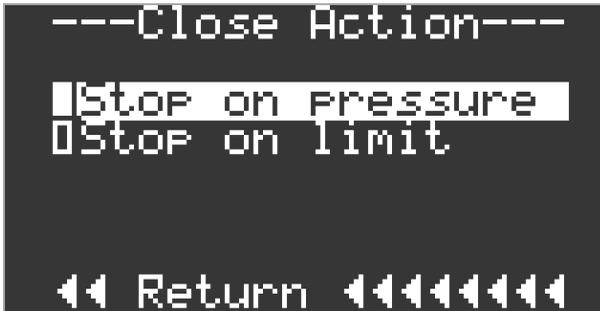
The actuator will move the valve to electrical open limit and stop.



NOTE:

Filled checkbox indicates selected option.

3.2.3 Close Action



The Actuator can be configured to close on pressure or close on limit.

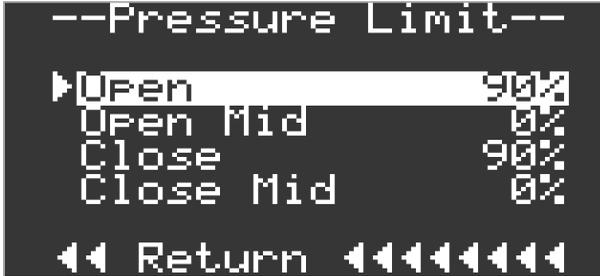
- Stop on Pressure

The actuator will move the valve to electrical close limit and then further to mechanical end stop.

- Stop on Limit - Default

The actuator will move the valve to electrical close limit and stop.

3.2.4 Pressure Limit



Set the cut-off pressure limit for moving from electrical limit to mechanical end stop.

- Open

This value is defined in % of maximum available pressure for system, in reference to limit set for pressure relief valve, while moving from open electrical limit to mechanical end stop.

Default Value is 90%

NOTE:



Press on enter key, it will enter into edit mode. Scroll key will allow to change value in incremental direction and it will roll over once it reaches maximum allowable set value. Once set, pressing enter key will accept the new value and exit edit mode.

- Open Mid

This value is defined in % of minimum/maximum available pressure for system, while moving for close electrical limit to open electrical limit. If value set to 0%, it by default it will consider value set in “Open” under pressure limit parameter.

Default Value is 0%

- Close

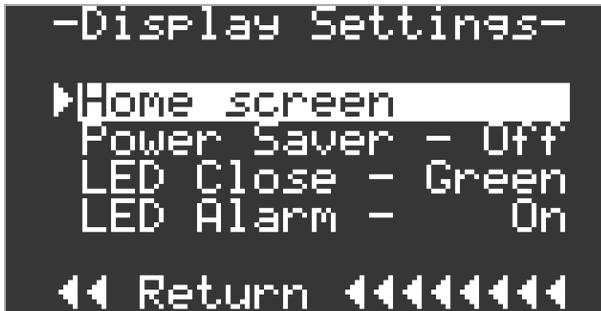
This value is defined in % of maximum available pressure for system, in reference to limit set for pressure relief valve, while moving from close electrical limit to mechanical end stop

Default Value is 90%

- Close Mid

This value is defined in % of minimum/maximum available pressure for system, while moving for open electrical limit to close electrical limit. If value set to 0%, it by default it will consider value set in “Close” under pressure limit parameter.

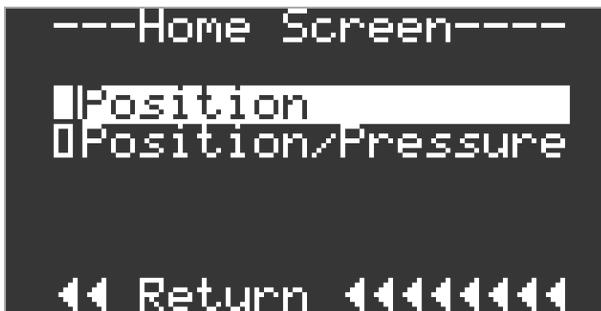
Default Value is 0%



3.2.5 Display Setting

Under display settings various parameters and LED function can be altered.

Home Screen



Different type of home screen can be selected based on application.

- Position

Display indicates valve position along with status and alarms.

- Position/Pressure- Default

Display indicates valve position and pressure along with status and alarms

Power Saver

LCD has backlight to maximize readability in low light conditions. It may be switch off when not required.

- Off - Default

Backlight is permanently on when the system is powered up.

- On

The backlight is switch off when actuator is not in operation. The backlight will turn on, whenever local selector switch or electrical command or manual operation is performed. After 60 seconds of idle or no operation, it will automatically switch off.

LED Close

LED represents Open and Close condition of the actuator/valve.

- Green

The Green LED illuminate at the close limit, whereas Red LED for open limit.

- Red - Default

The Red LED illuminate at the close limit, whereas Green LED for open limit.

LED Alarm

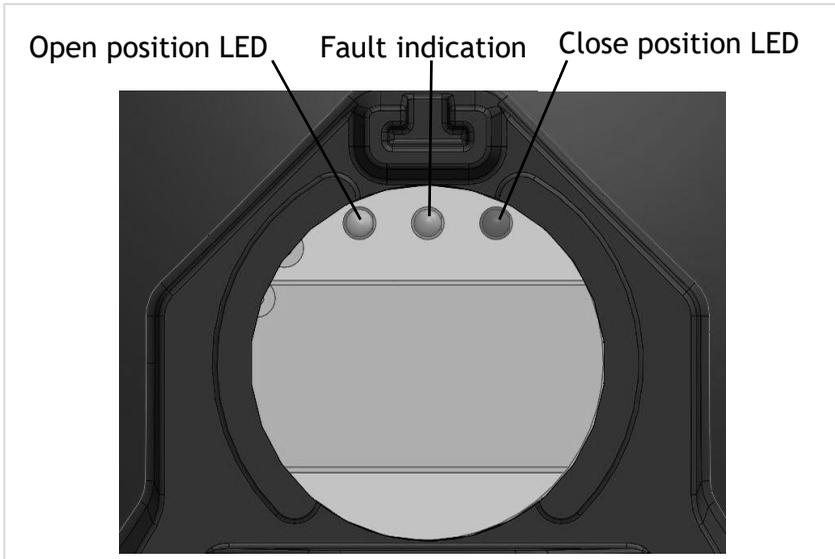
LED Alarm represents Mid Position, alarms and error condition whenever diagnose.

- On - Default

The Blue LED illuminate continuously to indicate an active alarm or error.

- Off

The Blue LED is deactivated.

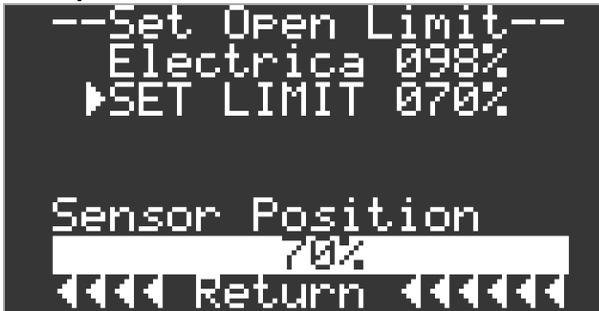


3.2.6 Calibration

Total travel of the actuator/valve can be configured to desired electrical limits and mechanical end stops.

```
----Calibration---  
▶ Set open limit  
  Set close limit  
  Full Stroke  
  Partial Stroke  
◀ Return ◀◀◀◀◀◀◀
```

Set Open Limit



- Electrical

This parameter is set to determine open electrical limit with reference to mechanical end stop. Once open mechanical end stop limit is recorded, electrical limit will be scaled by % set in this parameter.

Default Value is 98%

- Set Limit

Open limit can be set by moving actuator to open mechanical end stop and accepting limit in this parameter

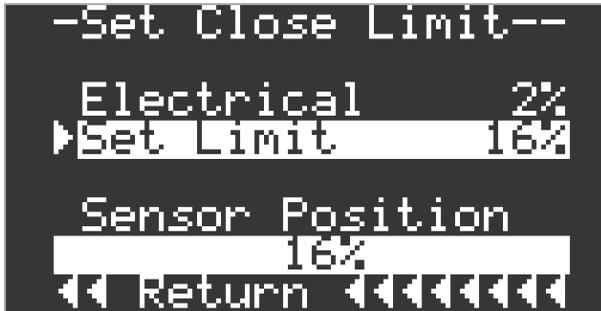
While setting open limit, position sensor valve should be less than 93%.

NOTE:



Actuator should be in open mechanical end stop position and not in close mechanical end stop. On enter key press, it will enter in edit mode. Move the actuator/valve to open mechanical end stop. In complete physical open condition, press enter key to accept the current sensor position value as mechanical open limit.

Set Close Limit



- Electrical

This parameter is set to determine close electrical limit with reference to mechanical end stop. Once close mechanical end stop limit is recorded, electrical limit will be scaled by % set in this parameter.

Default Value is 2%

- Set Limit

Close limit can be set by moving actuator to close mechanical end stop and accepting limit in this parameter

While setting close limit, position sensor valve should be more than 7%.

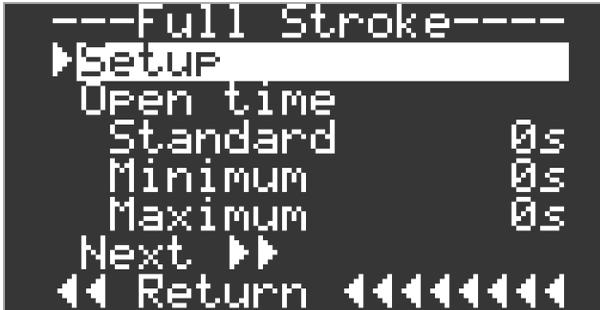
NOTE:



Actuator should be in close mechanical end stop position and not in open mechanical end stop. On enter key press, it will enter in edit mode. Move the actuator/valve to close mechanical end stop. In complete physical close condition, press enter key to accept the current sensor position value as mechanical close limit.

3.2.7 Full Stroke

This function will perform full stroke setup. Initializing full stroke setup will stroke valve multiple times from open to close or vice versa. It will record position and pressure with reference to time. This result are used as reference for future full Stroke test and comparison.



Setup

Full stroke test setup can be initialized by entering into function.

- Standard

This will display standard operating time of actuator from close mechanical end stop to open mechanical end stop

Display unit is seconds (s)



NOTE:

This field is not editable. If “0” is displayed, setup is not performed yet.

- Minimum

This will display minimum allowable operating time of actuator from close mechanical end stop to open mechanical end stop

Minimum open time = Standard Open time - 10% of Standard Open time

Display unit is seconds (s)

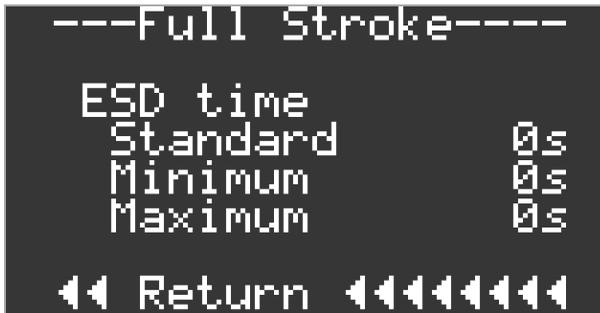
- Maximum

This will display maximum allowable operating time of actuator from open mechanical end stop to close mechanical end stop

Maximum close time = Standard close time + 10% of Standard close time

Display unit is seconds (s)

ESD Time



Full stroke test will display ESD value only in case of ESD triggered is controlled by internal microcontroller.

- Standard

This will display standard operating time of actuator from open mechanical end stop to close mechanical end stop, when ESD is initiated.

Display unit is seconds (s)



NOTE:

This field is not editable. If “0” is displayed, setup is not performed yet of ESD is not internally triggered.

- Minimum

This will display minimum allowable operating time of actuator from open mechanical end stop to close mechanical end stop.

Minimum ESD time = Standard ESD time - 10% of Standard ESD time

Display unit is seconds (s)

- Maximum

This will display maximum allowable operating time of actuator from open mechanical end stop to close mechanical end stop.

Maximum ESD time = Standard close time + 10% of Standard ESD time

Display unit is seconds (s)

3.2.8 Partial Stroke

This function will perform partial stroke setup. Initializing partial stroke setup will stroke valve multiple times from open to close or vice versa. It will perform a preliminary test and record the result for comparison. It is mandatory to perform full stroke setup prior to partial stroke setup.

```
--Partial Stroke--  
▶ Position          80%  
  Setup  
  Open Time        0s  
  Close Time       0s  
◀◀ Return ◀◀◀◀◀◀◀◀
```

- Position

This parameter determines the step height of partial stroke test. Actuator will move from open limit to set position and move back to open limit.

Default value is 90%

- Open Time

This will display operating time of actuator from open limit to set position.

Display unit is seconds (s)

 NOTE:
This field is not editable. If “0” is displayed, setup is not performed yet.

- Close Time

This will display operating time of actuator from set position to close limit.

Display unit is seconds (s)

3.3 Advance Setup

3.3.1 Advance Setup Setting Tree

You can find in the following menu section all the advanced settings.

Digital output	Monitor relay Relay contact 1 State 1 ... State 6	See detail in §0
Analogue output	Analogue feedback	4...20mA 20...4mA
Local control	Stop command	Delay Fail safe
Remote control	Stop command	Open contact Close contact Stop contact
Security	Change password Restore default Factory reset	
Diagnostics	Control	Status Alarm Log
Control	Local control	Open Close Stop Local Remote
	Remote control	Open Close ESD Maintain Partial stroke
	Relay control	Relay 1 to relay 6

Status	Open limit Close limit Moving Motor running Solenoid 1 Solenoid 2
Alarms	Thermostat Stall ESD active Manual mode Position sensor Pressure sensor
Log	Time Log Event Log
Event Log	ESD inactive Manual Thermostat Stall pos.

Digital Output

You can access any relay settings following **Advance setup > Digital Output**.

Then select the relay you want to set to assign a function among the following list. Each available setting is described in the current section.

Monitor relay		Standard Fault only
Relay contact 1 to Relay contact 4	Close limit	FST active
	Open limit	FST pass
	Closing	FST fail
	Opening	Remote selected
	ESD active	Manual mode
	Motor running	Alarm active
	Thermostat trip	PST active
	Stop selected	PST Pass
	Local selected	Over pr. limit
	Remote selected	Over pr. mid
	Manual Mode	Pressure limit
	Alarm active	Stall limit
	PST active	Stall mid
	PST pass	Stall
	PST fail	EEPROM error
	State 1 to State 4	

All relay contact output can be configured from this sub menu

```

--Digital Output--
▶ Monitor relay
  Relay contact 1
  State 1
  Relay contact 2
  State 2
  Next ▶▶
  ◀◀ Return ◀◀◀◀◀◀◀◀
  
```

```
--Digital Output--  
▶Relay Contact 3  
  State 3  
  Relay contact 4  
  State 4  
  
◀◀ Return ◀◀◀◀◀◀◀◀
```

Monitor relay

```
--Monitor Relay--  
  
■ Standard  
□ Fault only  
  
◀◀ Return ◀◀◀◀◀◀◀◀
```

It provides remote indication of actuator status.

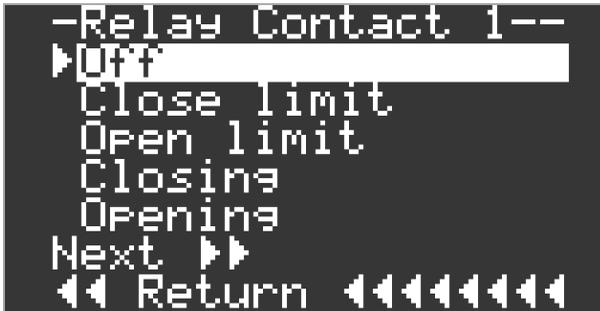
- Standard

This provides indication for actuator available for remote control of operation. It monitors power supplies, faults, motor thermostats and remote selector. Loss of any one or more will de-energize the monitor relay indication.

- Fault only

This provides indication for actuator available for remote control of operation. It monitors power supplies, faults, and motor thermostats. Loss of any one or more will de-energize the monitor relay indication.

Relay Contact 1 ~ 4



These parameters are used to determine the digital output based on function. The direction of action can be adapted to normally open or normally close depending upon the Sub-parameters, State of Contact 1-4.

- Off - Default

The function is disabled.

- Close Limit

The contact relay will change state when actuator moves within electrical close limit of actuator.

- Open Limit

The contact relay will change state when actuator moves within electrical open limit of actuator.

- Closing

The contact relay will change state when actuator moves towards close limit of actuator.

- Opening

The contact relay will change state when actuator moves towards open limit of actuator

- Moving

The contact relay will change state when actuator moves in any direction.

```
-Relay Contact 1--
█ ESD active
Motor running
Thermostat trip
Stop selected
Local selected
Next ▶▶
◀◀ Return ◀◀◀◀◀◀◀◀
```

- ESD active

The contact relay will change state when ESD is active.

- Motor Running

The contact relay will change state when motor is running.

- Thermostat Trip

The contact relay will change state when motor thermostat.

- Stop Selected

The contact relay will change state when stop selector is active.

- Local Selected

```
-Relay Contact 1--
█ Remote selected
Manual mode
Alarm active
PST active
PST pass
Next ▶▶
◀◀ Return ◀◀◀◀◀◀◀◀
```

The contact relay will change state when local selector is active.

- Remote Selected

The contact relay will change state when remote selector is active.

- Manual Mode

The contact relay will change state when actuator is switch for manual operation.

- Alarm Active

The contact relay will change state when any alarm is generated.

- PST active

The contact relay will change state when partial stroke test is active.

```
-Relay Contact 1--
PST fail
FST active
FST pass
FST fail
Temperature limit
Next ▶▶
◀◀ Return ◀◀◀◀◀◀◀◀
```

- PST Pass

The contact relay will change state when partial stroke test is successfully completed.

- PST Fail

The contact relay will change state when partial stroke test fails or is cancelled on demand.

- FST active

The contact relay will change state when full stroke test is active.

- FST Pass

The contact relay will change state when full stroke test is successfully completed.

- FST Fail

The contact relay will change state when full stroke test fails or is cancelled on demand.


```

--Relay Contact 1--
| Stall
| EEPROM error

◀◀ Return ▶▶▶▶▶▶▶▶
    
```

The contact relay will change state when actuator stalls in mid position.

- Stall

The contact relay will change state when actuator stalls in any position.

- EEPROM error

The contact relay will change state when an EEPROM error is corrupt or CRC check fail is detected.



NOTE:

The same settings are applicable for Contact Relay 1 to 4.

- State 1 ~ 4

```

-----State 1-----
| Normally close
| Normally open

◀◀ Return ▶▶▶▶▶▶▶▶
    
```

These parameters are used to define direction of action, open or normally close.

- Normally Close - Default
- Normally Open

3.3.2 Analogue Output

```
Analogue feedback-
| 4...20 mA
| 20...4 mA
◀◀ Return ▶▶▶▶▶▶▶▶
```

These parameters are used to set the feedback function of the Position transmitter module.

- 4...20 mA - Default

It provides remote indication of actuator position. 4 mA is for close limit and 20 mA is for open limit.

- 20...4 mA

It provides remote indication of actuator position. 20 mA is for close limit and 4 mA is for open limit.

Local Control

```
---Local Control---
▶ Stop Command
  Delay
  Fail Safe
◀◀◀ Return ▶▶▶▶▶▶▶▶
```

This parameter used to set the function of local control.

- Stop Command

Set the action to respond to local open and local close command.

- Off

Actuator will not self-maintain the position. It will operate only while open or close signal is applied.

- On - Default

Actuator will self-maintain the position till, stop command is applied or it reaches position and pressure limits.

Delay

To prevent unintended or accidental operation, time delay can be set.

- Off

Actuator will respond immediately to local commands.

- On - Default

Local command should be held at least for 2 seconds before actuator responds.

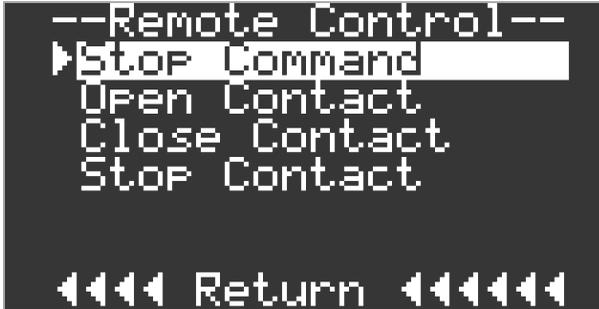
Failsafe

Set the action to respond to local open and local close command

- Off - Default
- Actuator will respond normally to local commands.
- On

Local command should be maintained to maintain the required position. As soon as the local selector returns to neutral position, the actuator will return to failsafe position.

3.3.3 Remote Control



This parameter is used to set the function of remote control mode.

- Stop Command

Set the action to respond to remote open and local close command.

- Off

Actuator will not self-maintain the position. It will operate only while open or close signal is applied.

- On - Default

Actuator will self-maintain the position till, stop command is applied or it reaches position and pressure limits.

- Open Contact

Select Open Contact menu and press enter key to set NO/NC option setting for Open Contact in Remote Control

- NC

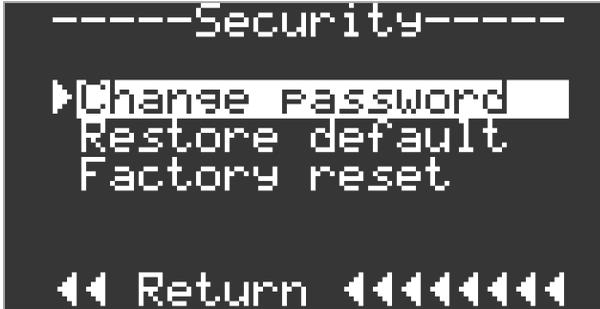
The Open command will be taken when Open Contact is changed from close to open

- NO - Default

The Open command will be taken when Open Contact is changed from open to close

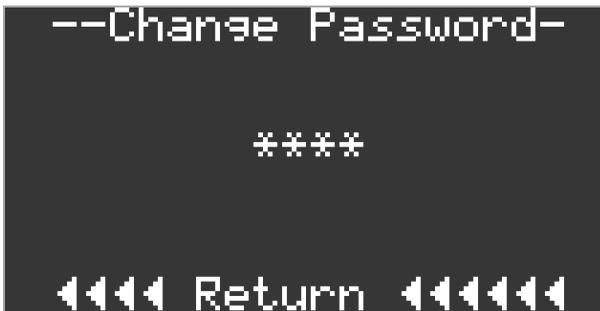
For Close Contact and Stop Contact menu follow the same as mentioned in Open Contact menu.

3.3.4 Security



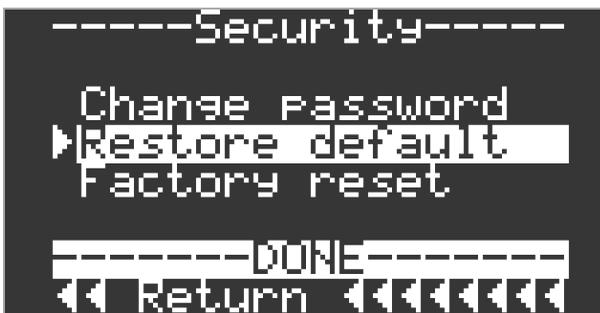
- Change Password

No password is assigned as default password. User can change the password to any alpha numeric password to a fix length of 4 characters.



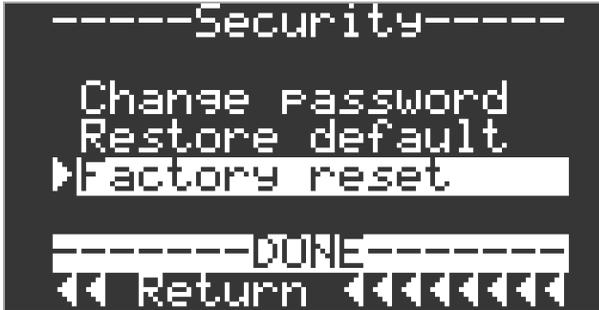
- Restore default

This parameter will restore default values of all functions

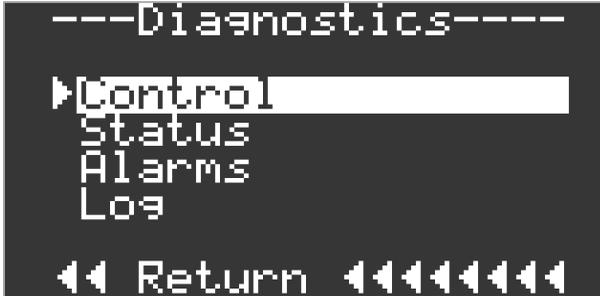


- Factory Reset

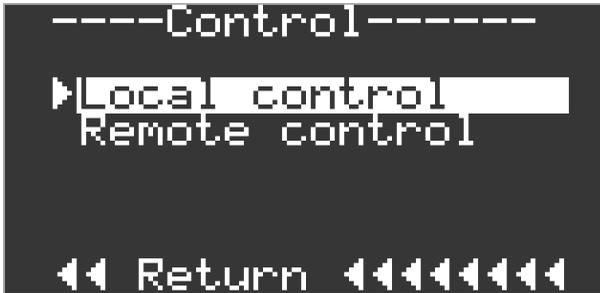
This parameter will restore default values of all functions and revert calibration.



3.3.5 Diagnostics

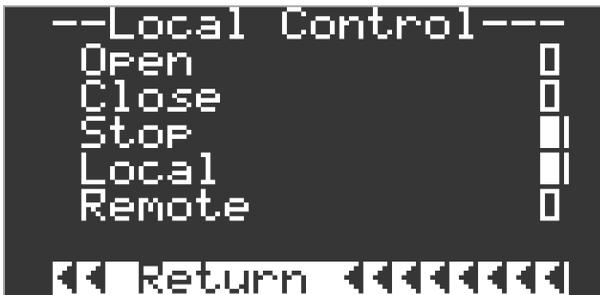


Control



This function displays the signal status from each input. As the input changes the corresponding status changes. This status function is useful for testing of controls.

- Local Control



It provides indication of local inputs

- Remote Control

```

--Remote Control--
Open                0
Close               0
ESD                 0
Maintain            0
Partial stroke     0
  
```

◀◀ Return ▶▶▶▶▶▶▶▶

It provides indication of local inputs.

- Relay control

```

--Relay Control--
Relay 1             0
Relay 2             0
Relay 3             0
Relay 4             0
Relay 5             0
Relay 6             0
  
```

◀◀ Return ▶▶▶▶▶▶▶▶

It provides indication of relay state

Status

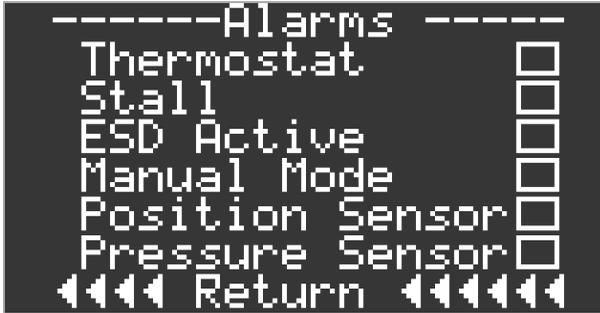
This function displays the status from controller.

```

-----Status-----
Open limit          0
Close limit         0
Moving              0
Motor running       0
Solenoid 1          0
Solenoid 2          0
  
```

◀◀ Return ▶▶▶▶▶▶▶▶

Alarms



This function displays the alarms and warning based on status from controller

Log

This function displays time log and event log.



- Time log

This function displays the time elapsed in hours during which the actuator remains ON.

```
Time Elapsed
55 hrs
◀◀ Return ▶▶▶▶▶▶▶▶
```

- Event log

When that event occurs, this function displays that event with its corresponding time log. In this function, all the previous events are stored with time log and the latest events are stored last in first out.

```
---Event Log---
ESD INACT.    5hr
MANUAL        4hr
THERMOSTAT    3hr
STALL POS.    2hr
◀◀ Return ▶▶▶▶▶▶▶▶
```

Following are the events that are logged in this function along with their description

- ESD Inactive

The message “ESD Inactive” is displayed on the home screen and in the event log it is displayed a “ESD INACT.” with the time log.

This event occurs when ESD Input is not present i.e. emergency shut-down is activated. If any relay is configured for alarm or for ESD then, that relay is turned ON. Also all control outputs and Monitor relay is turned OFF.

- Thermostat trip

The message “Thermostat trip” is displayed on the home screen and in the event log it is displayed a “THERMOSTAT” with the time log.

This event occurs when motor thermostat trip occurs. If any relay is configured for alarm or for thermostat trip then, that relay is turned ON. Also all control outputs and Monitor relay is turned OFF.

- Max. limit not reached

The message “Max. limit not reached” is displayed on the home screen and in the event log it is displayed a “MaxLimit” with the time log.

This event occurs when after Open command the valve position has reached open limit but actuator pressure has not reached the Set limit probably due to wrong pressure setting. If any relay is configured for alarm then, that relay is turned ON. Also all control outputs and Monitor relay is turned OFF.

- Stall position

The message “Stall position” is displayed on the home screen and in the event log it is displayed a “STALL POS.” with the time log.

This event occurs when, after Open or close output signal, the valve does not move as per the output signal. Then after 10 secs. display indicates stall position, if pressure feedback has changed but position feedback has not changed. If any relay is configured for alarm or for stall then, that relay is turned ON. Also all control outputs and Monitor relay is turned OFF.

- Stall pressure

The message “Stall pressure” is displayed on the home screen and in the event log it is displayed a “STALL PR.” with the time log.

This event occurs when, after Open or close output signal, the valve does not move as per the output signal. Then after 10 secs. display indicates stall pressure, if both pressure & position feedback has not changed. If any relay is configured for alarm or for stall then, that relay is turned ON. Also all control outputs and Monitor relay is turned OFF

- Limits to be set

The message “Limits to be set” is displayed on the home screen and in the event log it is displayed a “LIMIT SET” with the time log.

This event occurs when, calibration is not done.

- PST Fail

The message “PST fail” is displayed on the home screen and in the event log it is displayed a “PST FAIL” with the time log.

This event occurs when, PST test fails. If any relay is configured for alarm or PST fail then, that relay is turned ON. Also Monitor relay is turned OFF.

- PST Pass

The message “PST Pass” is displayed on the home screen and in the event log it is displayed a “PST PASS” with the time log.

This event occurs when, PST test is passed. If any relay is configured for PST pass then, that relay is turned ON.

- PST OK

The message “PST OK” is displayed on the home screen and in the event log it is displayed a “PST OK” with the time log.

This event occurs when, PST setup is completed.

- PST Retry

The message “PST Retry” is displayed on the home screen and in the event log it is displayed a “PST RETRY” with the time log.

This event occurs when, PST setup is failed.

- PST in progress

The message “PST in progress” is displayed on the home screen and in the event log it is displayed a “PST PROG.” with the time log.

This event occurs when, PST test is in progress.

- PST Fail

The message “PST fail” is displayed on the home screen and in the event log it is displayed a “PST FAIL” with the time log.

This event occurs when, PST test fails. If any relay is configured for PST fail then, that relay is turned ON. Also Monitor relay is turned OFF.

- FST Pass

The message “FST Pass” is displayed on the home screen and in the event log it is displayed a “FST PASS” with the time log.

This event occurs when, FST test is passed. If any relay is configured for FST pass then, that relay is turned ON.

- FST OK

The message “FST OK” is displayed on the home screen and in the event log it is displayed a “FST OK” with the time log.

This event occurs when, FST setup is completed.

- FST Retry

The message “FST Retry” is displayed on the home screen and in the event log it is displayed a “FST RETRY” with the time log.

This event occurs when, FST setup is failed.

- FST in progress

The message “FST in progress” is displayed on the home screen and in the event log it is displayed a “FST PROG.” with the time log.

This event occurs when, FST test is in progress.

- Position underrange

The message “Position underrange” is displayed on the home screen and in the event log it is displayed a “POS. UR.” with the time log.

This event occurs when, position is below negative electrical close limit tolerance.

If any relay is configured for alarm then, that relay is turned ON. Also Monitor relay is turned OFF.

- Position overrange

The message “Position overrange” is displayed on the home screen and in the event log it is displayed a “POS. OR.” with the time log.

This event occurs when, position is 100 percent + open electrical limit tolerance.

If any relay is configured for alarm then, that relay is turned ON. Also Monitor relay is turned OFF.

- Pressure overrange

The message “Pressure overrange” is displayed on the home screen and in the event log it is displayed as “PRES.OR.” with the time log.

This event occurs when actuator pressure is detected to be greater than maximum pressure setting.

If any relay is configured for alarm or pressure then, that relay is turned ON. Also Monitor relay is turned OFF.

- Manual

Home screen displays manual mode. And in the event log it displays “MANUAL” with the time log.

This event occurs when actuator is switched to manual mode.

- Temperature overrange

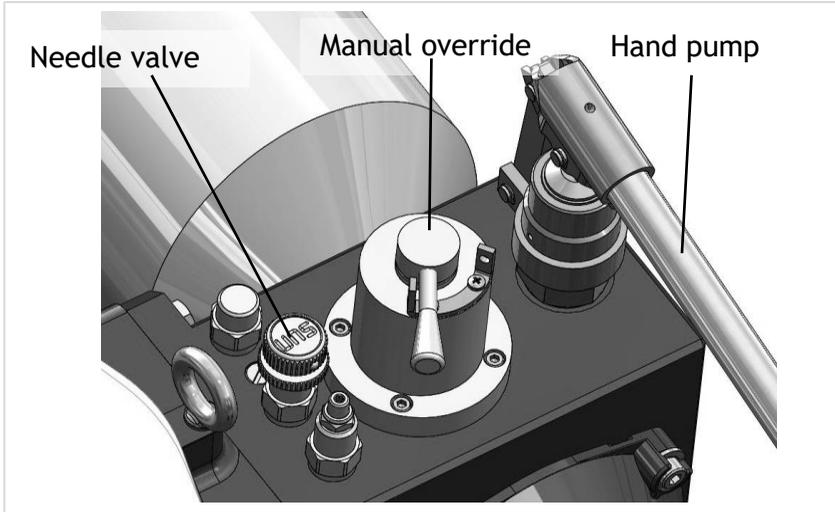
The message “Temperature overrange” is displayed on the home screen and in the event log it is displayed as “TEMP. OR.” with the time log.

This event occurs when ambient temperature is detected to be greater than 80°C.

If any relay is configured for alarm or pressure then, that relay is turned ON. Also Monitor relay is turned OFF.

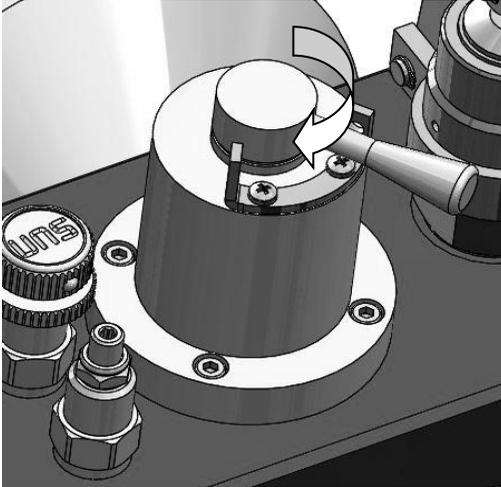
3.4 Operation by Hydraulic Manual Override

An optional, manually operated override is available to operate the actuator in the event of a loss of electrical supply to pump/motor. When supplied, a pump with a handle is located on or near the power unit. The procedure for manual override is as follows as per the following two cases:



When the valve is open

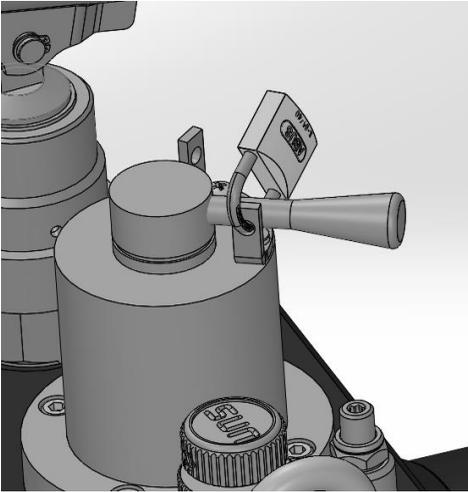
- Firstly turn the manual override lever towards the manual override indication/needle valve.



- Then open the needle valve and by doing so the oil will be drained off to the reservoir and the valve will close.

When the valve is closed

- Firstly turn the manual override lever towards the manual override indication.
- Ensure that the needle valve is closed.
- Now insert the hand pump handle into the hand pump lever and insert the coupling pin to fix the handle to the lever.
- Pump the oil manually using the hand pump provided on the enclosure by moving the handle (hand pump) up and down.
- Thus the oil will flow to the actuator and actuate the valve to its open position.
- To prevent the unauthorised access to the manual override, a lock is provided to the lever as shown in the figure so as to restrict its motion.



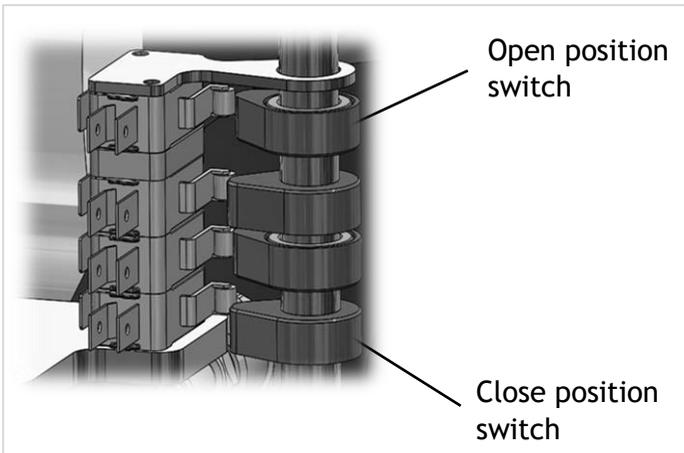
WARNING



- The actuator cannot be operated electrically when in manual operation mode and will not respond to emergency shutdown (ESD) signals until electrical operation mode is selected again.

3.5 Adjustment for limit switches

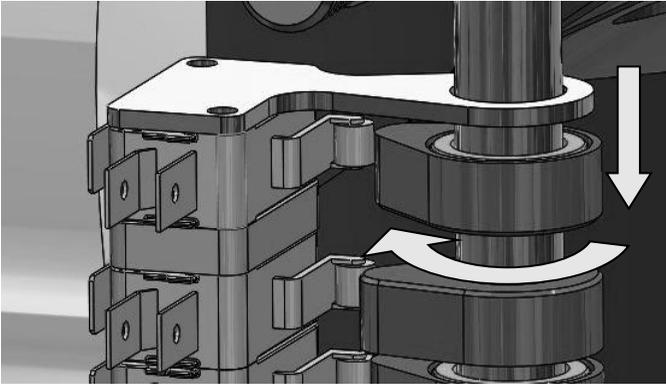
- The cams actuating the limit switch are mounted on the shaft which is coupled to the actuator shaft directly and the actuator shaft in turn is connected to the valve. So as the valve opens/closes the actuator shaft rotates thereby rotating the cam shaft thus actuates the mechanical switches mounted inside the enclosure.
- Open and Close limit switches are pre-set at the factory to correspond to the actuator mechanical stop. They can be manually set and accessed by removal of top cover. The uppermost switch is for Open position switch and lowermost is the Close position switch.



- Switch cam adjustment is carried out by fingertip rotation in either direction. Cams are compression spring loaded and are held in desired position.

3.6 Open Switch Adjustment

- Move the valve/Actuator to the fully open position and locate the uppermost switch cam. To locate the cam, push the cam down and rotate until the uppermost switch operates; and release the cam. The switch is now set.

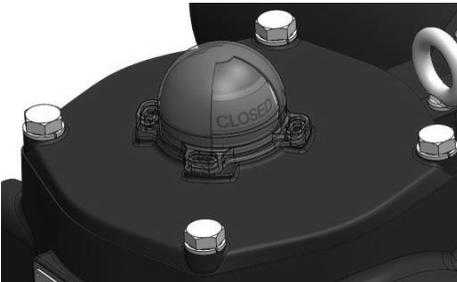


3.7 Close Switch Adjustment

- Move the valve/Actuator to the fully closed position and locate the lower switch cam. Lift the cam up and rotate until the lower switch operates; and release the cam. The switch is now set.

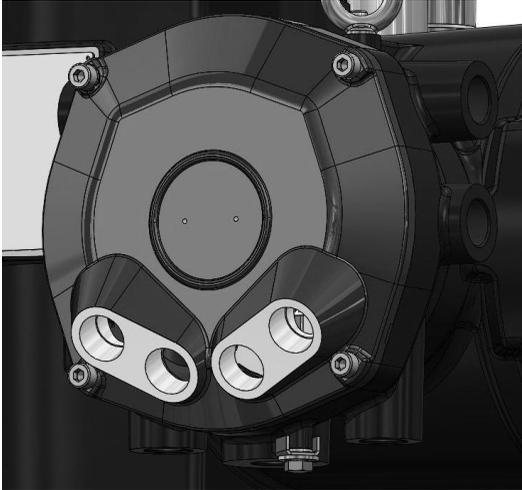
3.8 Open and close indicators

- In addition to the limit switches, the open and close dome indicators are also provided to indicate the valve position.
- These local indicators are mounted on the top cover and are coupled to the same shaft on which the cams are mounted.



4 Removal of terminal block and Cable Connections

4.1 Removal of terminal cover



- There are 7 cable entries through the terminal cover which have a thread specification as per the ordering code mentioned on the nameplate for installing the cable gland.
- To carry out the wiring connection first remove the terminal cover by unbolting the bolts with the help of suitable Allen key. During its removal ensure that the O-rings does not get damaged.
- The earth symbol on the electrical module indicates the internal earth connection.
- On the other hand the hex bolt with a C clamp is provided for external earth connection.

CAUTION



- Use Ex 'd', IP 65 certified cables, cable glands and plugs
- Use cable size of 10mm² for connecting the earthing terminals



WARNING



- Do not open the terminal cover when an explosive atmosphere is present.
- Ensure that the power supply is cut off before removing the terminal cover.

5 FSE for ON/OFF Application

5.1 Preconditions

- Power fail to stayput
- ESD fail close

5.2 Description

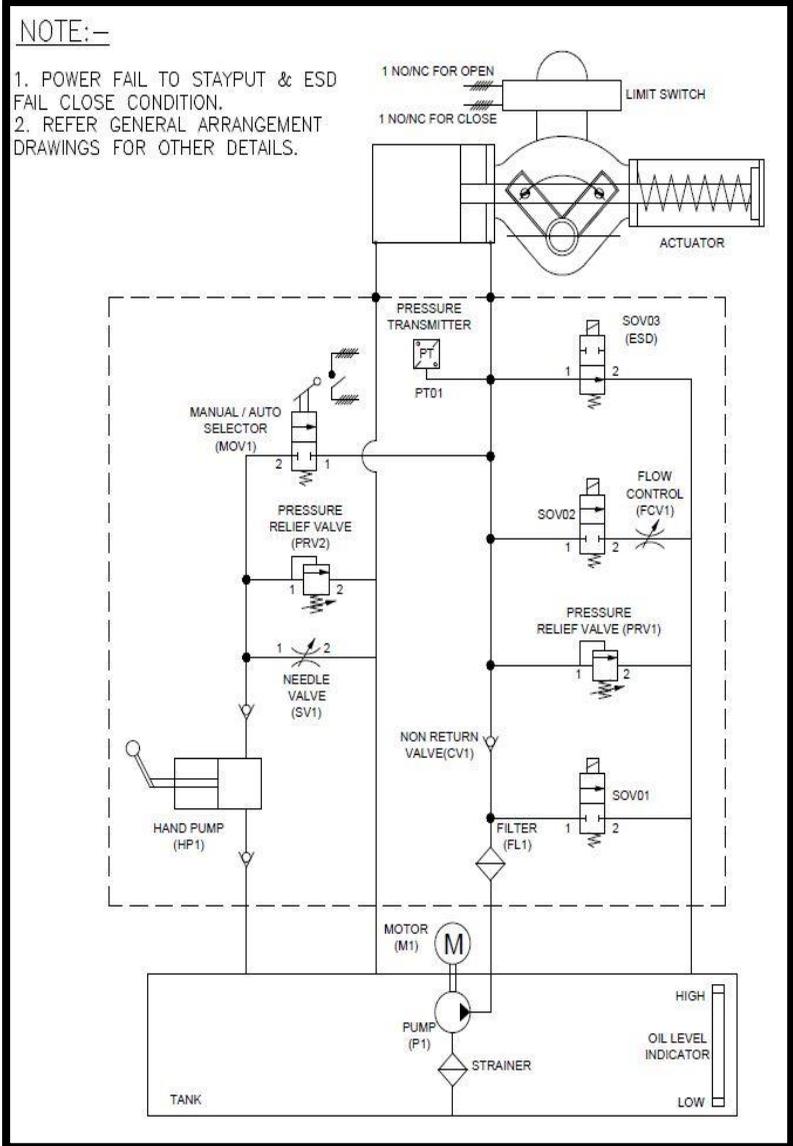
- SOV01: DCV used for priming the pump.
- SOV02: DCV used to close the actuator in the auto mode.
- SOV03: DCV used as the ESD valve.
- FCV1: Flow control valve used to control the actuator closing speed.
- MOV01: The selector valve used to switch between manual and auto mode.
- PT01: Pressure transducer used to transmit system pressure to the PLC.
- PRV1: Pressure relief valve used to control the system pressure.
- HP1: Hand pump to be used for manual operation.
- SV1 : needle valve to close the actuator in manual mode

5.3 Operation

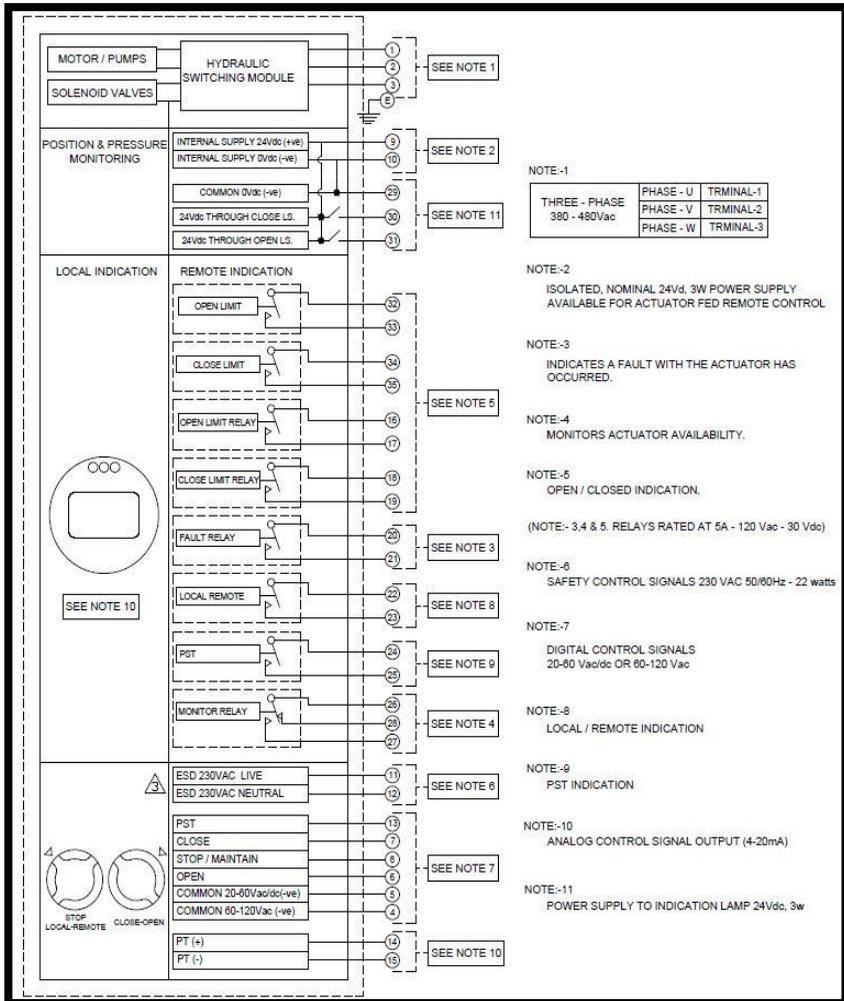
- Initially SOV03 (ESD valve) is energized.
- During the opening cycle the motor drives the pump and SOV01 is energized allowing the pump to build up full speed at zero load.
- After the pump has built up speed the SOV01 is de-energized allowing the oil to flow to the actuator, thus opening the actuator.
- To close the actuator in the auto mode SOV02 is energized allowing the oil to flow back to the tank.
- In case of power failure all valves except the ESD valve (SOV03), get de-energized and the actuator remains in its position (Stayput).

- In case of ESD fail the SOV03 is de-energized and the actuator closes.
- In case the actuator needs to be opened during power failure the MOV01 (selector valve) is switched to the manual mode & then the actuator can be opened using the hand pump by pumping manually. But before operating the hand pump, ensure that the needle valve is shut off.
- To close the actuator in manual mode, open the needle valve so that oil can be drained back to the tank.

Hydraulic circuit diagram



Electrical circuit diagram



6 Maintenance and Troubleshooting

6.1 General maintenance

Every BERNARD CONTROLS actuator has been fully tested before dispatch to give years of trouble-free operation provided it is installed and commissioned in accordance with the instructions given in this publication. The FSE actuator's non-intrusive enclosure provides complete protection for the actuator components. Covers should not be removed for routine inspection as this may be detrimental to the future reliability of the actuator. All electrical power supplies to the actuator must be isolated before any maintenance or inspection is carried out. Electrical supplies must be isolated before actuator covers are removed.

6.1.1 Routine Maintenance should include the following:

- Ensure tightness of the bolts
- Check the actuator enclosure for damage, loose fasteners.
- Ensure there is not an excessive build-up of dust or contaminant on the actuator
- If the fluid level is low, visually inspect the actuator and tighten any hydraulic fittings that may be leaking.
- Check the operating speeds in both the open and closed directions by conducting a full stroke test.
- Fully open the actuator. Leave the actuator for 30 minutes and check that the actuator has not drifted off the open limit. Routine maintenance should include the following after 5 years of service:
 - The hydraulic fluid and filter should be replaced after 5 years if the actuator is operating a modulating valve and 10 years if operating an isolating valve.
 - The actuator seals should be replaced after 5 years if the actuator is operating a modulating valve and 10 years if operating an isolating valve.

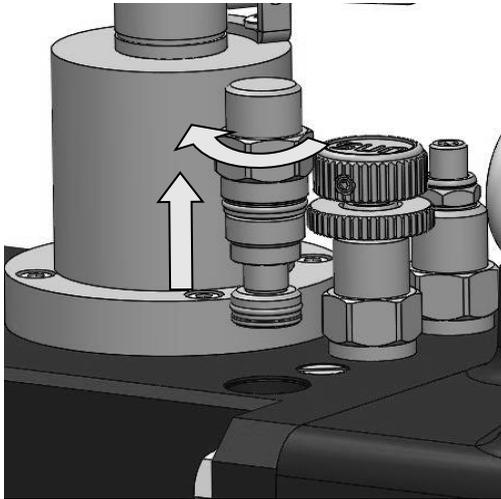
6.2 Replacement of the filter

- To replace the filter, unscrew the filter with the help of a suitable spanner.
- After completely removing the filter from the manifold, clean the filter cartridge and visually inspect the same and its O-rings for any damage.
- Replace the O-ring and/or filter cartridge in case of any damage as per the model no. engraved over its enclosure.



NOTE:

The COT of O-ring(NBR) is in the range of $-20\text{ }^{\circ}\text{C}$ to $+100\text{ }^{\circ}\text{C}$



6.3 Replacement of the hydraulic fluid

- Check for any loss of hydraulic fluid. This can be done by removing the oil fill plug when the electrical power is cut off from the actuator. The fluid level should be at maximum level as per the dip stick marking.
- If the level is low, hydraulic fluid can be refilled in the oil tank by removing the oil plug.
- Ensure that the oil is filtered by passing it through a suitable filter before filling it into the tank.
- Also ensure that the suitable grade of mineral oil is used as a hydraulic fluid.