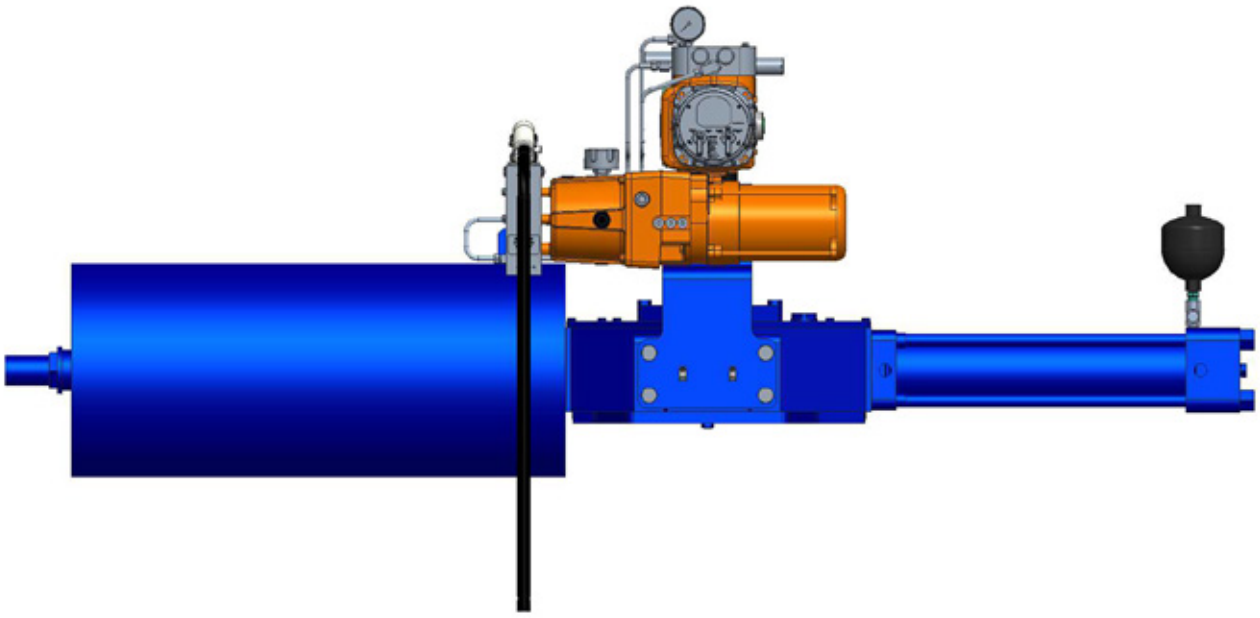
Installation, Operation and Maintenance Manual
VCIOM-15345-EN Rev. 5
March 2025

Biffi EHO (Electro-Hydraulic Operated)

Spring-Return Actuator



BIFFI

Revision Details

Revision	Date	Description	Prepared	Checked	Approved
5	March 2025	Added Section 12.5	Hakon Espvic	Massimiliano Franco	Ontario Engineering Department
4	December 2024	New display and features	Jamie Lorentz	Massimiliano Franco	Ontario Engineering Department
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Section 1: Introduction

1.1 Scope

This manual is offered as a guide to be used along with locally approved and safe practices to install, operate, service and maintain the Biffi™ EHO Actuator. Carefully follow the instructions in this manual and make sure you install the actuator correctly and according to your requirements.

1.2 General Information

1.2.1 Overview

The Biffi EHO is a self-contained, quarter-turn, valve actuator that combines proven technologies from Emerson's valve actuation portfolio. The actuator has been designed for critical shutdown applications where reliability is crucial. The Biffi EHO utilizes a dependable spring-return actuator for the fail-safe stroke combined with an integral hydraulic power pack and electronic control module.

The Biffi EHO accepts a wide range of single-phase, three-phase or DC power sources. A hydraulic hand pump can be used to stroke the actuator during commissioning or in the event of an emergency power loss.

Electronic modules are contained within an explosion proof, IP68 enclosure and all electronic components are isolated from the customer connection terminals.

The Biffi EHO provides a compact design with actuator and control components that have been field proven for decades in critical service applications.

The Biffi EHO is designed for modulating ESD applications and comes with alert, alarm, diagnostic, and self-calibration features.

1.3 Safety Information

Safety notices in this manual detail precautions the user must take to reduce the risk of personal injury and damage to the equipment. The user must read these instructions in their entirety. Failure to observe these safety notices could result in serious bodily injury, damage to the equipment, void of the warranty. Take special notice of all tags, warning labels and instructions presented on the actuator. These may provide more specific and significant information regarding the actuator than this general manual.

It is the responsibility of the user to ensure proper safety practices are utilized. Always take necessary precautions and use proper protective equipment when dealing with compressed gasses, compressed hydraulic fluid, pinch points and electricity.

Safety notices are presented in this manual in three forms (Warning, Caution and Notice) as follows:

⚠ WARNING

Alerts user of potential danger; failure to follow the warning notice could result in serious personal injury or death.

⚠ CAUTION

Identifies precautions the user must take to avoid personal injury or equipment damage.

NOTICE

Highlights information critical to the user's understanding of the Biffi EHO valve actuator installation or operation.

Refer to the Biffi OLGA-H, OLGAS-H for Hydraulic RPHD or RPHS Installation, Operation and Maintenance (IOM) Manual for additional details. If requested, the cover holes are protected by a weather protection LOCTITE® SI 5366 (or equivalent transparent silicon base product), easily removable with a screw if requested special service maintenance. After the reassembly activity, remember to refill the weather protection product in the holes.

1.4 Abbreviation Definitions

Abbreviations used in this manual and their definitions are listed in Table 1.

Table 1. Abbreviation Definitions

Abbreviation	Definition
IOM	Installation Operation Manual
ESD	Emergency Shutdown
FS	Fail-Safe
SR	Spring-Return
DA	Double-Acting
MAWP	Maximum Allowable Working Pressure
MOP	Maximum Operating Pressure
STC	Separate Terminal Chamber
PST	Partial Stroke Test
FST	Full Stroke Test
LDM	Local Display Module
RDM	Remote Display Module
CBM	Circuit Breaker Module
PCB	Printed Circuit Board
LS	Limit Switch
PS	Pressure Switch
NC	Normally Closed
NO	Normally Open
CCW	Counterclockwise
CW	Clockwise
OL	Overload
PPE	Personal Protective Equipment
GA	General Arrangement Drawing
SOV	Solenoid Valve
NO	Normally Open
NC	Normally Closed
CAM	Communication Adapter Module

Section 2: Installation

2.1 Preparation

2.1.1 Delayed Usage

If for any reason the actuator is not to be installed immediately, Biffi recommends the following procedures. Failure to comply, with recommended procedures, could lead to actuator malfunction and possibly void the warranty. For storage procedures exceeding one year, consult Biffi for further recommendations.

As shipped from the factory, the Biffi EHO actuator is an inherently weatherproof unit, providing that all compartment covers and cable entry plugs remain intact. The actuator should be immediately stored in a clean, dry warehouse, free from vibration and rapid temperature changes, until it can be installed and energized.

If the actuator must be stored outside, store it off of the ground at an elevation sufficient to prevent it from being immersed in water or buried in snow. Check for any unpainted or exposed metal surfaces and make sure they are protected with a coating of grease to prevent any corrosion. Cover the actuator to prevent damage from site debris.

2.1.2 Tools and Materials Required

To complete these procedures, you will need the following documentation for the Biffi EHO actuator and the items are indicated in Table 2.

- General Arrangement Drawing
- Bill of Material
- Hydraulic System Schematic
- System Wiring Diagram

Table 2. Tools and Material Requirements

Tools and Material Requirements
Primary Power Source for the Biffi EHO (check the Biffi EHO System Electrical Diagram for requirements)
Supplemental quantity of hydraulic fluid, if needed (See Section 2.7, Hydraulic Fluid and Biffi EHO specification, for required fluid type)
Nitrogen Source (if an Accumulator is supplied with the Biffi EHO)
Hand Tools: complete complement of open end (SAE and metric) wrenches, screwdrivers Philips and flat blade and a set of hex wrenches
Chains and lifting straps that are inspected and certified for the weight of the Biffi EHO actuator (check shipping weights)
Sealant for all cable and conduit entries (approvable by the National Electric Code or your country standard and applicable local codes)

2.2 Valve Preparation

2.2.1 Remove valve gearing if equipped.

2.2.2 If valve is equipped with stops, remove valve stem extension housing. Examine the valve stops to ensure no foreign material is present that would restrict normal travel of the valve. Some valves are equipped with inspection ports in the valve housing for ease in examining the stops.

2.2.3 Check alignment of stem key slot to the position of the valve. Normally with the valve in the open position, the key slot is in line with the run of the pipeline. With the valve in the closed position, the key slot should be 90° to the run of the valve.

2.2.4 The Biffi EHO actuator may be mounted to the valve at any time regardless of whether or not the valve is under pressure.

2.3 Actuator Preparation

2.3.1 Once the Biffi EHO actuator is uncrated and cleaned for installation, check to ensure there will be no interference with piping or other structure when the actuator is properly mounted to the valve.

NOTICE

At this point, check to see that when the actuator is mounted to the valve and in its final orientation, the outboard end of the power cylinder positioned below the Hydraulic Reservoir Breather. If this is not possible, contact Biffi for further instructions on piping to elevate the breather. Refer to the standard manual of relevant Biffi actuator, RPH or OLGA-H Series.

2.3.2 Check that all mounting materials such as fasteners, adapters, brackets etc. are on hand and ready for use.

2.3.3 Check the actuator and valve to see that they are in the same relative position, that is either open or closed. If the actuator has to be moved, use the hand pump provided. For hand pump operation, remove the plug in the reservoir and install the breather (refer to Section 4.4, Hand Pump Operation).

2.3.4 If the unit is equipped with an optional piston style accumulator, it is critical that the accumulator is precharged with nitrogen prior to operating the equipment. Refer to Section 2.8 for precharging instructions.

NOTICE

All spring-return Biffi EHO actuators are supplied with a thermal compensating device for protection from thermal-expansion of the hydraulic fluid. This thermal compensating device is preset at the factory and will not need servicing during installation or start-up of the actuator.

NOTICE

Failure to precharge the accumulator may cause the accumulator to not function properly.

⚠ CAUTION

Be aware while preparing to and lifting the actuator, the Thermal Compensating Device contains high-pressure nitrogen. Use care not to damage the Thermal Compensating Device or its attachments.

2.4 Lifting the Biffi EHO Actuator

NOTICE

All Biffi EHO OLGA-H/OLGAS-H-Series or RPHD/RPHS-Series Considerations
When handling any Biffi EHO OLGA-H/OLGAS-H Series or RPHD/RPHS Series be aware of tubing, accessories, hand pump, accumulators, local display module and control enclosures. Straps and chains can become entangled and cause damage to these components. Never use chains on the spring cartridge as it may warp and cause the actuator not to function correctly or may cause personal injury.

NOTICE

Do not use hydraulic tubing and electrical cable for lifting.

⚠ CAUTION

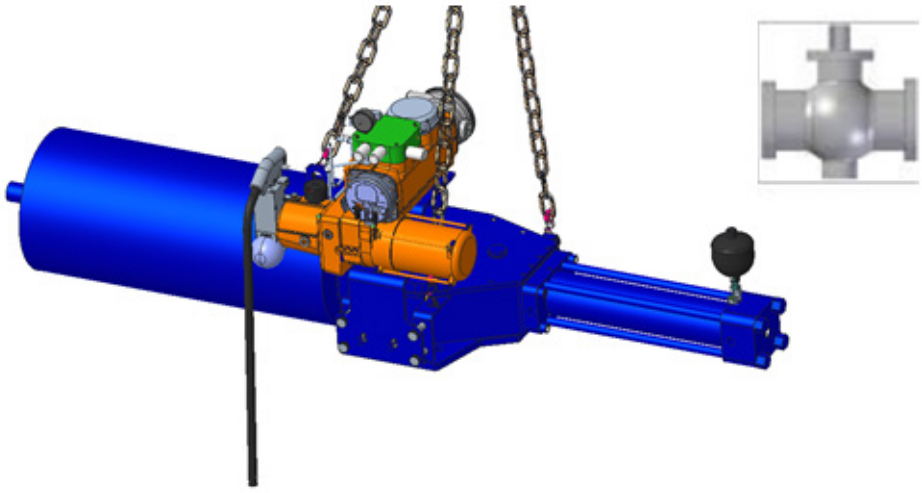
Be sure to use appropriately rated crane/hoist and straps/chains to raise and lower the actuator.

2.4.1 OLGA-H/OLGAS-H and RPHD/RPHS-Series Actuators

2.4.1.1 Horizontal Actuator, Vertical Valve Stem

The OLGA-H/OLGAS-H Series actuators mounting on a horizontal pipeline with a vertical valve stem should be supported using the 3 lifting point (two on the scotch yoke mechanism and one on the spring container). A strap may be attached to the stabilization tab on the spring module to balance the unit while lifting. The weight of the actuator must be supported by the proper lifting point, not the stabilization tab, see Figure 1.

Figure 1. OLGA-H and OLGAS-H Actuators with Horizontal Pipeline and Vertical Stem



⚠ CAUTION

Never lift the actuator with a valve attached. Always handle actuator/valve assemblies by attaching lifting equipment to the valve only.

⚠ CAUTION

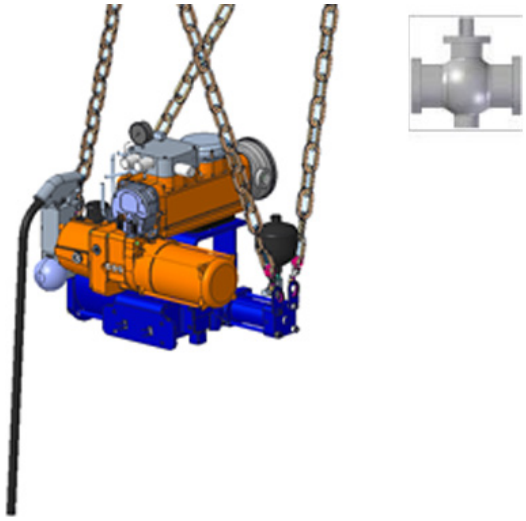
Please note that other mounting positions are available. If needed, please contact the factory.

⚠ CAUTION

Please pay attention to the thermal accumulator during the EHO handling.

The RPHD/RPHS Series actuators mounting on a horizontal pipeline with a vertical valve stem should be supported using the 4 lifting point (two on the cylinder and two on the spring container). The weight of the actuator must be supported by the proper lifting point, not the stabilization tab, see Figure 2.

Figure 2. RPHD and RPHS Actuators with Horizontal Pipeline and Vertical Stem



⚠ CAUTION

Never lift the actuator with a valve attached. Always handle actuator/valve assemblies by attaching lifting equipment to the valve only.

⚠ CAUTION

Please note that other mounting positions are available. If needed, please contact the factory.

⚠ CAUTION

Please pay attention to the thermal accumulator during the EHO handling.

2.4.1.2 Horizontal Actuator, Horizontal Valve Stem

The OLGA-H/OLGAS-H Series actuators mounted on a horizontal pipeline with a vertical valve stem should be supported using the 3 lifting point (two on the scotch yoke mechanism and one on the spring container). A strap may be attached to the stabilization tab on the spring module to balance the unit while lifting. The weight of the actuator must be supported by the proper lifting point, not the stabilization tab.

The RPHD/RPHS Series actuators mounted on a horizontal pipeline with a vertical valve stem should be supported using the 4 lifting point (two on the cylinder and two on the spring container). The weight of the actuator must be supported by the proper lifting point, not the stabilization tab, Motor pump must be installed with horizontal.

⚠ CAUTION

Never lift the actuator with a valve attached. Always handle actuator/valve assemblies by attaching lifting equipment to the valve only.

⚠ CAUTION

Please note that other mounting positions are available. If needed, please contact the factory.

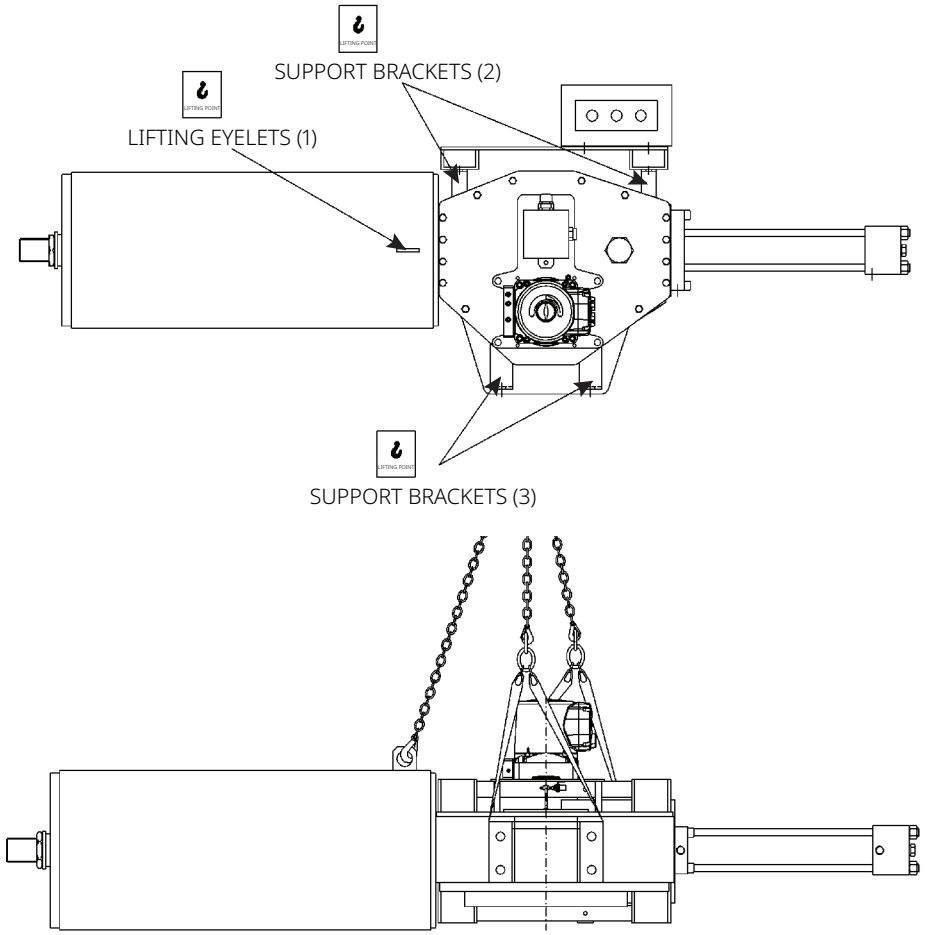
⚠ CAUTION

Please pay attention to the thermal accumulator during the EHO handling.

2.4.1.3 Vertical Actuator, Horizontal Valve Stem

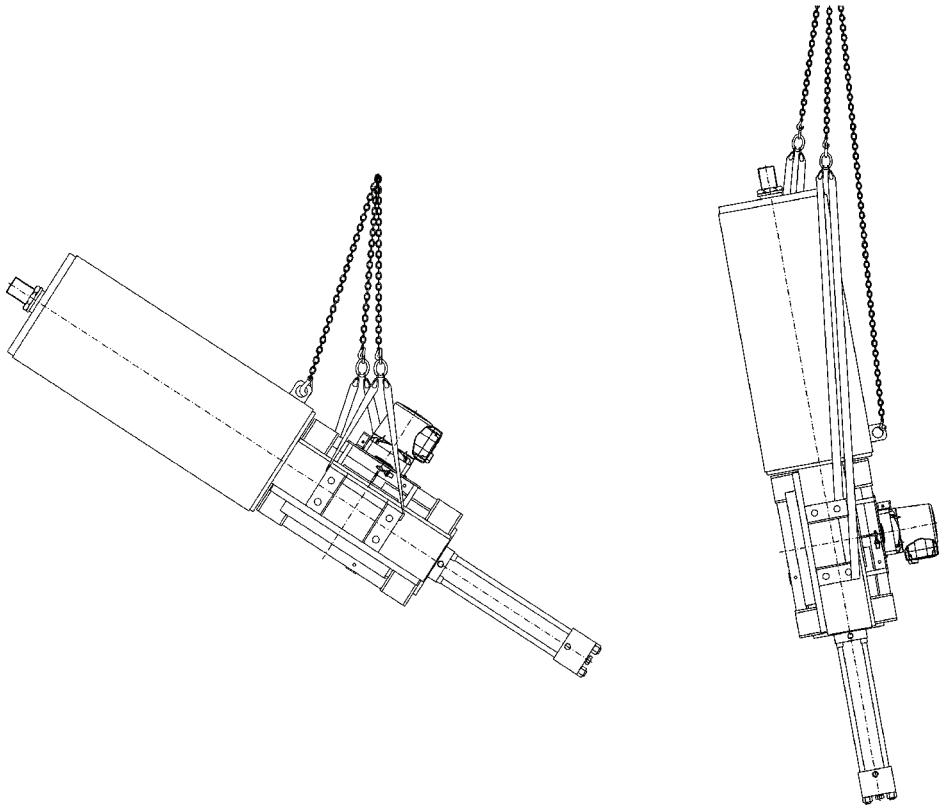
Properly connect the actuator lifting eyelets (1) with chains, and use suitable slings to connect support brackets (2) and (3).

Figure 3. Support Bracket Points



Balance the weight and lift the actuator until it can be rotated into its final mounting position, with either the cylinder or spring container positioned on top, as shown in Figure 4.

Figure 4. Actuator Moving Setup



⚠ CAUTION

Never lift the actuator with a valve attached. Always handle actuator/valve assemblies by attaching lifting equipment to the valve only.

⚠ CAUTION

Please note that other mounting positions are available. If needed, please contact the factory.

⚠ CAUTION

Please pay attention to the thermal accumulator during the EHO handling.

2.5 Installing the Biffi EHO Actuator on the Valve

The actuator will be bolt-mounted directly to a bracket or adaptor that will be bolted securely to the mounting flange top works of the valve.

2.5.1 Check to see that the dimensions of the bracket or adaptor are suitable for use with the valve mounting flange and stem.

2.5.2 Check valve direction of rotation and the actuator direction of rotation to see they match (for example: CW = close, CCW = open).

2.5.3 Check to see the actuator and valve are in the same relative position (see Section 2.3.3).

2.5.4 Check all mounting surfaces, they must be clean and free of debris to permit proper fit up.

2.5.5 Prior to mounting, grease the coupling bore and the bore of the actuator.

NOTICE

Do not apply grease to the mounting flange surfaces on the valve or the adaptor.

2.5.6 Install the stem key and grease it (keys may be held in place with tape).

2.5.7 Install the coupling onto the stem and stem key.

2.5.8 Install the coupling key and grease it.

2.5.9 Carefully align the coupling and key to the bore and keyway in the actuator and slide the actuator onto the coupling until the adapter (bracket) bottoms out on the valve bonnet.

NOTICE

Ensure the adapter seats out on the valve bonnet, without interference, before installing fasteners.

2.5.10 Use the required fasteners to firmly attach the adapter to the valve bonnet. Tighten the fasteners to their manufacturer's recommended maximum torque (dry or lubricated).

2.6 Setting the Stroke Limit Stops

2.6.1 The Biffi OLGA-H/OLGAS-H or RPHD/RPHS actuator is provided with bidirectional travel stops allowing 80° to 100° total travel (±5° adjustment at each end of the 90° stroke).

2.6.2 Actuators are shipped from the factory with the travel stops adjusted for approximately 90° rotation. Generally, it is necessary to make slight travel stop adjustments once the actuator is installed on the valve. Refer to the valve manufacturer's recommendations for specific requirements.

2.6.3 When the valve has internal stops, the actuator stops must be set so that the load is applied to them, not the valve stops.

2.6.4 If adjustment is required, use the hand pump to move the actuator off the stop at the Fail-Safe Position before attempting to turn the adjusting screw (refer to Section 4.4, Hand Pump Operation).

⚠ CAUTION

Do not adjust actuator's stop at the fail-safe position, with the spring force against the stop. Always use the hand pump to move the actuator off the stop before attempting to turn the adjusting screw.

2.6.5 With the fail-safe position stop set, use the hand pump to move the actuator to the other end of the stroke and check the stop position. If adjustment is required, slowly open Manual Bypass Valve (Lockable) (19) just enough to allow the actuator to spring-return off the stop before adjusting.

2.7 Hydraulic Fluid

Biffi Electro-Hydraulic Operated actuators are shipped with the reservoir filled to operation level. Before commissioning and periodically afterwards, check to see the fluid level is correct. The oil fill cap is provided with a dipstick marked with a green and a red mark. When the optional accumulator is drained of fluid and the actuator is at fail-safe position, the oil should be at the green mark. The reservoir also has a sight gauge for the purpose of seeing fluid is present. Should fluid need to be added or replaced, use only factory approved hydraulic fluid.

This specification covers hydraulic fluids which are approved by engineering for use in Biffi Electro-Hydraulic Operated actuator in a temperature range from -40 to 60 °C / -40 to 140 °F.

2.7.1 Approved Fluids

- Standard Fluid (use with -29 to 60 °C / -20 to 140 °F applications)
  - ENI® ARNICA 22/32
  - ConocoPhillips Megaflow® AW HVI Hydraulic Oil
  - Shell® Tellus S2 V 22/32
  - Mobil DTE 10 Excel® 22/32

Use an equivalent or better product in compliance with the oil proposed in the actual scope of supply by Biffi. Your oil supplier can verify and propose an alternative product at your responsibility.

- Low Temperature Fluid (use with -40 to 60 °C /-40 to 140 °F applications)
  - SYNTRASS-CS 500
  - Shell AEROSHELL 41 Fluid
  - Mobil Univis® HVI 13

Although other brands of fluid matching the same specifications may be used, always check with the factory before substituting any other fluid to maintain the warranty and ensure trouble-free operation.

2.8 Accumulator (Optional)

2.8.1 Introduction

The Biffi EHO actuator may be equipped with an accumulator for modulating valve control or to enable manual operation of the actuator if there is a loss of electrical power. Accumulators always have the nitrogen pressure drained for shipping.

When using this procedure, refer to the Biffi EHO actuator general arrangement drawing and hydraulic schematic for the unit being worked on. Schematics shown in this document are for illustration purposes only.

⚠ WARNING

This unit contains high-pressure hydraulic fluid and nitrogen gas. Exercise caution when performing any type of maintenance. Wear proper safety attire and required personal protective equipment, including safety glasses.

2.8.2 Accumulator Pre-charge

A. Locate Isolation Valve (25) (Nitrogen Blow Down and Fill) for the Customer Nitrogen Fill Connection, called out on the General Arrangement Drawing and Hydraulic Schematic.

B. Close the Isolation Valve (25) (Nitrogen Blow Down and Fill) and remove the pipe plug from the adaptor.

NOTICE

The adaptor is tapped with a 1/4-NPTF thread.

C. Ensure 3-way Isolation Valve (22) is turned fully counterclockwise.

D. Slowly open Isolation Valve (Accumulator drain) (24) and drain all the fluid back to the reservoir.

E. Connect a nitrogen supply to the Customer Nitrogen Fill Connection at Isolation Valve (25) (Nitrogen Blow Down and Fill).

F. Open the Isolation Valve (25) (Nitrogen Blow Down and Fill) and charge the Accumulator, to the pre-charge pressure as specified by the Pressure versus Temperature Graph on the General Arrangement Drawing.

NOTICE

For temperatures that do not appear on the graph, the formula to calculate the pre-charge pressure shown on the General Arrangement Picture Assembly should be used.

NOTICE

Recheck the pre-charge pressure after a time interval sufficient to insure the nitrogen pressure is equal to the ambient temperature (a minimum of 4 hours). Adjust the pre-charge pressure as required to conform to the Pressure versus Temperature graph.

G. After the nitrogen filling is complete, close the Isolation Valve (25) (Nitrogen Blow Down and Fill).

H. Disconnect the nitrogen supply and remove the female pipe adaptor from Isolation Valve (25) (Nitrogen Blow Down and Fill).

I. Install the straight thread plug and O-ring, shipped as an accessory, into Isolation Valve (25) (Nitrogen Blow Down and Fill).

NOTICE

The straight thread plug must be installed, after filling is complete, to prevent accidental leakage of nitrogen from Isolation Valve (25) (Nitrogen Blow Down and Fill).

J. Close Isolation Valve (24).

Figure 5. Typical EHO Optional Accumulator System

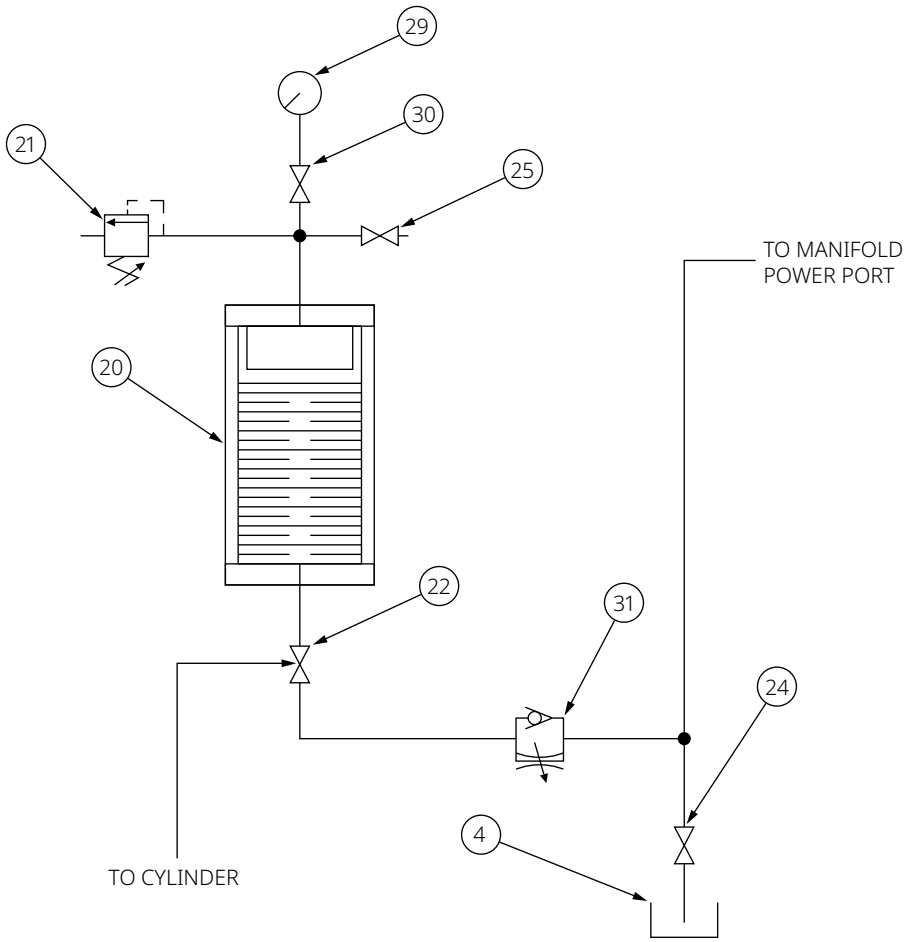


Table 3. Typical EHO Optional Accumulator System

Part Number	Part Name
A	Reservoir
B	Accumulator
C	Nitrogen Relief Valve
D	3-way Isolation Valve
E	Isolation Valve (Accumulator Drain)
F	Isolation Valve (Nitrogen Blow Down and Fill)
G	Nitrogen Pressure Gauge
H	Nitrogen Gauge Isolation Valve
I	Speed Control

2.8.3 Pre-charge Verification

Check the nitrogen pre-charge in the accumulator periodically to ensure the accumulator is at full potential. Follow the steps below and record final readings for reference.

A. Shut off the hydraulic power supply to the accumulator.

B. Ensure 3-way Isolation Valve (D) is turned fully counterclockwise.

C. Slowly open Isolation Valve (Accumulator drain) (E) and drain all the fluid back to the reservoir.

D. Read the pressure at the nitrogen pressure gauge (G) and compare it to the Oil/Temperature Chart shown on the General Assembly Drawing for the job being checked.

E. If the pre-charge is low, add nitrogen to increase the pressure to the requirements listed on the GA Oil/Temperature Chart. See Section 2.8.2, Accumulator Pre-charge, if the pre-charge is high relieve pressure to equal the GA Oil/Temperature Chart.

F. Record Information below.

G. With bypass valve closed, reconnect the hydraulic power supply and bring the accumulator back up to full pressure.

H. Check the entire nitrogen circuit for leaks using a liquid leak detector such as Snoop® (manufactured by Swagelok®). As the unit is self-contained, only a zero leak rate is acceptable. Corrective action must be taken for any leaks found.

2.8.4 Check Thermal Compensating Accumulator

The nitrogen pre-charge should be checked in the Thermal Compensating Accumulator annually. To accomplish this, use a commercially available charging kit and follow the instructions supplied with the kit.

⚠ WARNING

This unit contains high-pressure hydraulic fluid and nitrogen gas. Exercise caution when performing any type of maintenance. Wear proper safety attire and required personal protective equipment, including safety glasses. Ensure the accumulator has been drained of all hydraulic and nitrogen pressure before attempting any repair.

2.8.5 Nitrogen Pre-charge Maintenance Record

Serial Number: _____

Tag Number: _____

Date	Initial Pre-charge	GA Chart Requirement	Final Pre-charge	Nitrogen Leak Test	Signed

Section 3: Electrical Connections

3.1 Remove Separate Terminal Chamber (STC) Cover

⚠ WARNING

Always verify electrical power is disconnected before removing the STC cover.

3.1.1 Remove cover with a strap wrench, drift, or pinch bar by rotating the cover counterclockwise.

Figure 6. Remove STC Cover Turning Counterclockwise

Figure 7. Lay Cover Aside

3.2 Sealing Cable/Conduit Entries

Seal the cable and conduit entries in accordance with the National Electric Code or your country standard and applicable local codes. All conduit entries should be sealed against the site environment. All unused conduit entries must be sealed with threaded metal plugs.

3.3 Recommended Terminal Connections

The Biffi Electro-Hydraulic actuator terminal block connectors are wire binding screw connectors with rising captive plates. Connections can be made one of three ways:

- Strip and connect bare wire
- Strip and install wire ferrule
- Strip and install crimp-on insulated or non-insulated ring or fork-tongue connectors for either M3 control signal terminal block screws or M4 power terminal screws.

3.3.1 Loosen terminal block connectors L1, L2, L3 and GND screws with a common or Phillips head screwdriver.

3.3.2 If bare wire is being used, strip insulation a maximum of 1/2 in. / 12 mm.

3.3.3 Insert wire or wire lug under terminal block connector screw clamps and tighten.

Figure 8. Power Terminal Connection Length of Bare Wire Strip

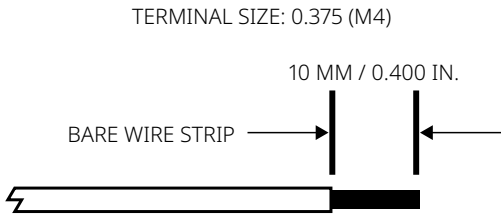
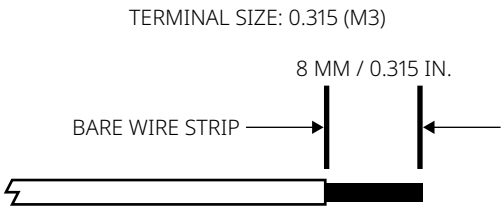


Figure 9. Control Terminal Connection Length of Bare Wire Strip



3.4 Separate Terminal Chamber (STC) Connections

3.4.1 Connect the main power supply cables, including an Earth/Ground (refer to the job specific Wiring Diagram).

3.4.2 Use the barrier strip clamp screws to connect the control wiring (refer to the job specific Wiring Diagram).

3.4.3 Ensure all connections are hand tight, including any unused terminals.

NOTICE

The main power supply and ground wire connections are screw size M4. The control connection screw size is M3.

3.5 Replace Terminal Chamber Cover

3.5.1 Clean electrical enclosure threads thoroughly and lightly grease with dielectric grease before closing.

3.5.2 Replace the cover by reversing the order of the steps to remove the cover.

3.6 External Earth/Ground Connections

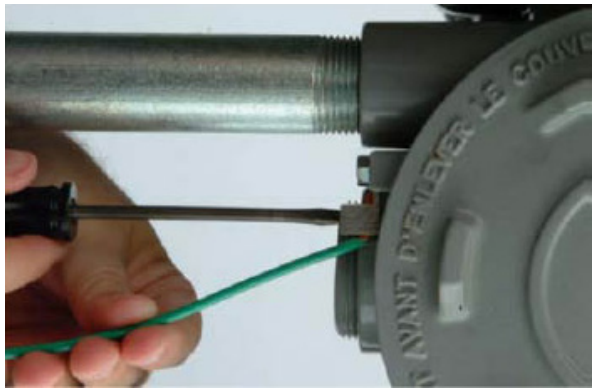
External connection points are provided on the operator for attaching earth/ground in accordance with local electric codes for installation cables.

Connect the external earth/ground connection as follows.

3.6.1 Using a slotted tip screwdriver, back out the 5/16 in. set screw.

3.6.2 Connect 14 AWG or larger earth/ground wire, tighten set screw.

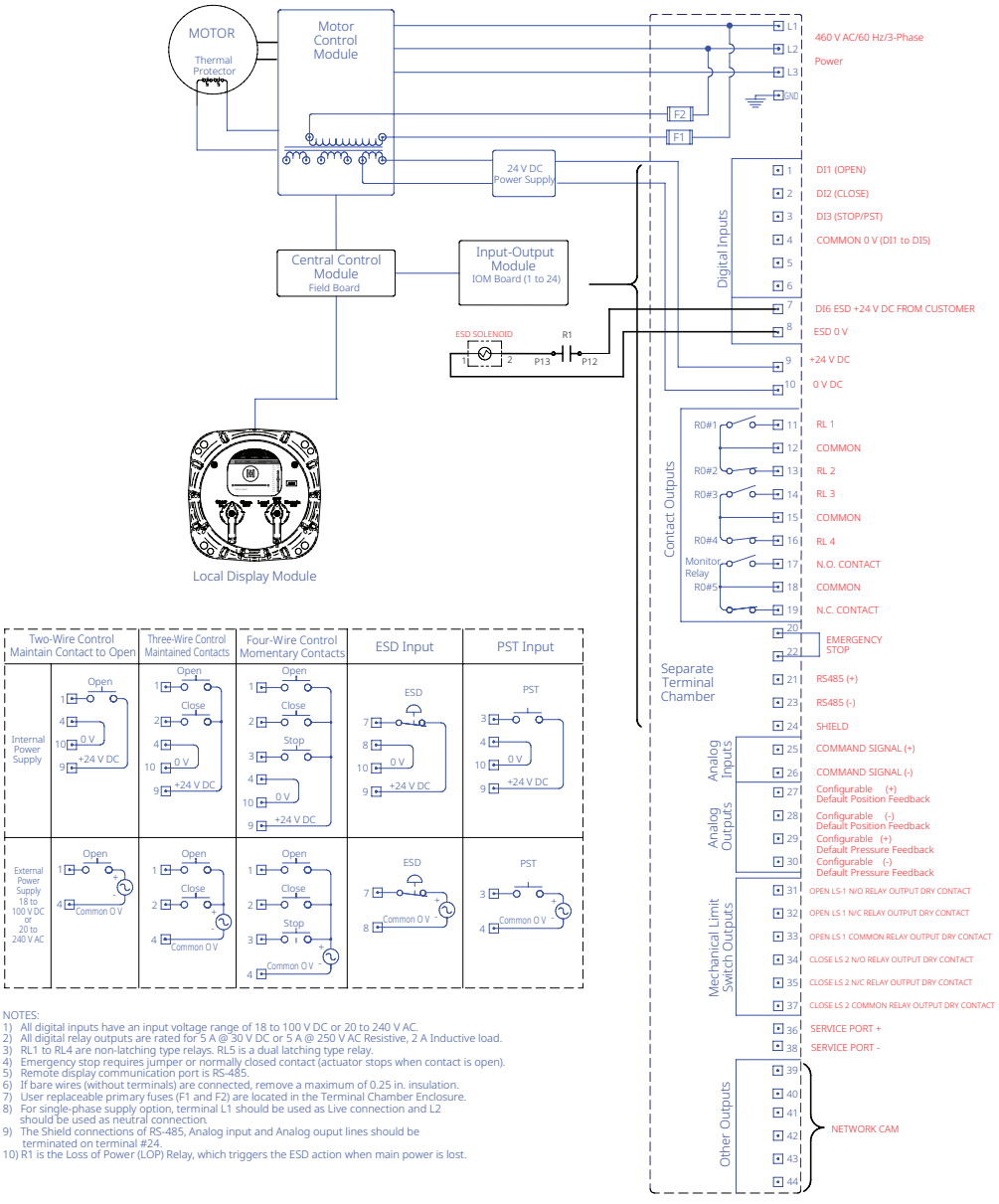
Figure 10. External Earth/Ground Connection



3.7 Discrete Controlled Inputs Connection

The actuator can be controlled by discrete inputs: two-wire control, three-wire control and four-wire valve control. Connections for these discrete inputs may be found on the job specific wiring diagram. Generic connection diagrams for each type of control may be found in Figure 11. See Section 3: Electrical Connections, for general electrical connection requirements.

Figure 11. STC Wiring Diagram



NOTES:
1) All digital inputs have an input voltage range of 18 to 100 V DC or 20 to 240 V AC.
2) All digital relay outputs are rated for 5 A @ 30 V DC or 5 A @ 250 V AC Resistive, 2 A Inductive load.
3) RL1 to RL4 are non-latching type relays. RL5 is a dual latching type relay.
4) Emergency stop requires jumper or normally closed contact (actuator stops when contact is open).
5) Remote display communication port is RS-485.
6) If bare wires (without terminals) are connected, remove a maximum of 0.25 in. insulation.
7) User replaceable primary fuses (F1 and F2) are located in the Terminal Chamber Enclosure.
8) For single-phase supply option, terminal L1 should be used as Live connection and L2 should be used as neutral connection.
9) The Shield connections of RS-485, Analog input and Analog ouput lines should be terminated on terminal #24.
10) R1 is the Loss of Power (LOP) Relay, which triggers the ESD action when main power is lost.

Legends:

PUSHBUTTON N.O. TYPE
PUSHBUTTON N.C. TYPE
EXTERNAL VOLTAGE SOURCE
EMERGENCY SWITCH - N.C. TYPE

Section 4: Set-up/Start-up Procedure

In addition to this set-up/start-up procedure, the following documentation will be necessary to fulfill all set-up and start-up requirements.

1. General Arrangement drawing
2. Bill of Material
3. Schematic drawing
4. Wiring Diagram drawing

When using these instructions, refer to the schematic diagram, wiring diagram, general arrangement drawings for the Biffi EHO and the certified bills of material.

Numbers in **[ ]** correspond to components labeled on the wiring diagram.
Numbers in **( )** correspond to components labeled on the schematic diagram.
Information in **(( ))** is descriptive.

When the Biffi EHO is delivered to the job site, it has been both pressure and function tested. The oil reservoir was filled to operation level when it shipped from factory.

4.1 Preparation

4.1.1 Safety First

Hydraulic Pressure

⚠ WARNING

Ensure that test personnel and witnesses are properly informed of the hazards involved with high pressures and the proper safety barriers are employed. Never check for leakage using your fingers or hands. Fluid under high pressure can inject into the skin and cause severe damage or death. Always use an implement such as a piece of paper.

Safety Equipment

⚠ WARNING

All personnel in the testing area must always wear safety glasses.

4.1.2 Material and Equipment for Start-up and Set-up

To complete this procedure, you will also need the following materials and equipment:

Table 4. Required Material and Equipment

Required Material and Equipment
Miscellaneous fittings, adapters and Hand Tools: complete complement of open end ((SAE and metric)) wrenches, screw drivers Philips and flat blade and a set of hex wrenches
Primary Power Source for the Biffi EHO ((check the Biffi EHO System Electrical Diagram for requirements))
Supplemental quantity of hydraulic fluid, if needed ((See Section 2.7, Hydraulic Fluid, and Biffi EHO specification for required fluid type))
Nitrogen Source ((if an Accumulator is supplied with the Biffi EHO))

4.2 Initial Check of the Unit

4.2.1 Check to ensure all hydraulic tube fittings are tight. Vibration during shipment may have loosened connections.

4.2.2 Visually inspect the unit to make sure tubing, hand valves, gauges and other equipment have not been damaged.

4.2.3 Using the Schematic drawing, verify that the Flow Control Valves (7) are fully opened ((turn stem completely counterclockwise)).

4.2.4 Ensure Manual Bypass Valve (19) (Lockable) is closed.

4.2.5 Ensure Isolation Valve (24) (Accumulator drain) is closed ((if applicable)).

4.2.6 Ensure Isolation Valve (25) (Nitrogen Blow Down and Fill) is closed ((if applicable)).

4.2.7 Check the nitrogen pre-charge on the thermal compensating accumulator prior to operation. Do not operate without a charge or the bladder may be damaged.

4.3 Initial Connections

Electrical connections should have been made to the STC (Separate Terminal Chamber). If power is not connected, follow the instructions under Section 3, Electrical Connections, before continuing. If an ((optional)) Circuit Breaker Module is provided, ensure it is turned to OFF.

⚠ CAUTION

Before the actuator is stroked, check to see it has been filled with fluid to the proper level, see Section 2.7, Hydraulic Fluid.

4.4 Hand Pump Operation

4.4.1 Check the Reservoir (4) to see the hydraulic fluid is at the proper level.

4.4.2 Close Hand Pump Isolation Valve (8).

NOTICE

Hand Pump Isolation Valve (8)
Remove the Protective Cap. Loosen the stem retaining nut by turning counterclockwise. Using a 5/32 in. ((4 mm)) hex wrench, turn the stem counterclockwise for open or clockwise for close.

4.4.3 Use the handle supplied with the pump to raise the pump clevis. This will draw hydraulic fluid from the reservoir (4) into the hand pump.

4.4.4 Pull the pump handle down to discharge the hydraulic fluid into the cylinder of the actuator (1). Repeat until you see the hand pump is working correctly.

4.4.5 Repeat operating the handle until the actuator has completed its power stroke.

4.4.6 Push hand pump bypass valve (16) located on the bottom of the hand pump and pull the pump handle down, retracting the pump ram back into the pump body.

4.4.7 Slowly open manual bypass valve (19) (lockable) to allow the actuator to spring-return to its fail-safe position.

4.4.8 After the actuator has returned to its fail-safe position and pressure has been released, close manual bypass valve (19) (lockable).

4.4.9 Open the hand pump isolation valves (8) to return to automatic operation.

4.4.10 Check reservoir (4) to see the hydraulic fluid is at the proper level.

NOTICE

The manual bypass valve (lockable) (19) must be closed to enable any mode of operation. The hand pump isolation valve (8) must be open for normal operation.

4.5 Hydraulic Test

The system has been hydrostatic and function tested at the factory before shipping. This test is to discover if any leaks have developed in the hydraulic fittings during shipment.

4.5.1 Open hand pump isolation valve (8) and ensure manual bypass valve (19) (lockable) is closed.

4.5.2 Using the supplied handle, stroke hand pump (13) four or five times and stop. Allow the unit to remain under pressure for a few minutes and check all fittings for leakage.

4.5.3 If any leakage is found, release the pressure by slowly opening manual bypass valve (19) (lockable). Repair any leakage and repeat the pressure test from Section 4.4.1.

4.5.4 Push hand pump bypass valve (16) located on the bottom of the hand pump and pull the pump handle retracting the pump ram back into the pump body.

4.5.5 Open the hand pump isolation valves (8) ((See NOTICE above)).

4.5.6 Check reservoir (4) to see the hydraulic fluid is at the proper level.

4.6 Check Rotation

4.6.1 Turn on the electrical supply to the unit. If an ((optional)) circuit breaker module is supplied, turn the circuit breaker to ON.

4.6.2 Turn the LOCAL/OFF/REMOTE Selector Switch to LOCAL.

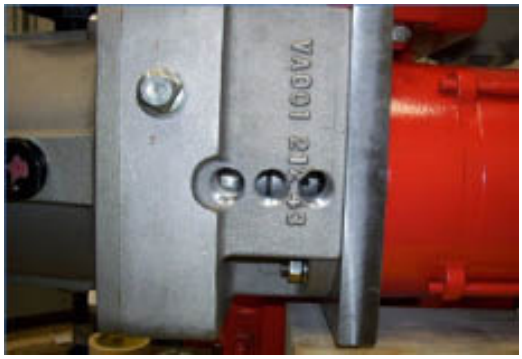
NOTICE

On spring-return units, fail-safe close units OPEN with the power cylinder and spring-return CLOSE. Fail-safe open units CLOSE with thepower cylinder and spring-return OPEN. The Biffi EHO contains phase correction software that will correct the rotation of the motor if the motor is wired to the power supply incorrectly.

4.6.3 Ensure flow control valves (7) are adjusted fully counterclockwise for maximum flow.

4.6.4 Open inspection port on side of unit to observe the rotation of the motor/pump shaft.

Figure 12. Inspection Port for Motor Rotation



4.6.5 While observing the inspection port for motor rotation, turn and release the OPEN/CLOSE selector knob to power stroke the actuator and immediately turn the selector knob to OFF position. Verify the motor rotation is consistent with the decal on the motor tag looking from the back of the motor.

4.6.6 If needed, correct motor rotation.

NOTICE

If the Biffi EHO actuator is supplied with optional ESD, before operating a motor-powered stroke, a customer supplied ESD signal must be present and solenoid valve (17) energized.

4.6.7 Use the OPEN/CLOSE control knob to power stroke the actuator. The electric motor (2) will start to run driving hydraulic pump (3). The hydraulic pump (3) draws fluid from reservoir (4) and pushes it into the Biffi OLGA-H/OLGAS-H or RPHD/RPHS hydraulic cylinder (1). as the actuator strokes, the spring will compress in the spring-return module.

4.6.8 At the end of the power stroke, toggle the LOCAL/OFF/REMOTE selector knob to OFF. Slowly open manual bypass valve (lockable) (19) and allow the actuator to spring-return back to the start position.

4.6.9 Shut off the electrical power going to the unit, if an (optional) circuit breaker module is supplied, turn the circuit breaker to OFF.

4.7 Self-Calibration

NOTICE

Self-calibration must be performed once the Biffi EHO is mounted to the valve or if the stop bolts have been adjusted on the actuator.

Self-calibration establishes the position range of the Biffi EHO. The EHO has the ability to automatically find its precise full open and full close set points after adjustments to the mechanical stops is completed. Self-calibration must be performed after the Biffi EHO is securely installed on the valve and before the Biffi EHO performs normal operations.

4.7.1 To start Self-Calibration, the Biffi EHO must be in the setup menu. Refer to Section 8.1, Entering the Setup Menu and Section 8.2, Change Settings, for instructions on how to enter the setup menu, enter the passcode and navigate the setup menu.

4.7.2 Navigate the setup menu to enter Calibration and select self-calibration.

4.7.3 Prior to starting self-calibration, the Biffi EHO has the following self-calibration settings that must be confirmed first:

4.7.3.1 Self-Calibration Cycle Count – Default Setting is 2 - Set the number of full cycles for the Smart EHO to cycle during self-calibration. One cycle is defined as one open and one close stroke. The parameter can be set to 2 or 3.

4.7.3.2 Pressure Unit – This parameter is factory set - Set the pressure unit for the Smart EHO. The parameter can be set to psi, bar, kPa. Psi is the default setting.

4.7.3.3 Pressure Spike During Hydraulic Stroke – This parameter is factory set – Set the maximum hydraulic pressure of the Biffi EHO during self-calibration. This setting is only for motor-based Biffi EHOs. Depending on the Pressure Units set in Section 4.7.3.2, this parameter can vary in its display:

- 10 to 50 (psi - in multiples of 100)
- 7 to 35 (barg - in multiples of 10)
- 7 to 35 (kPa - in multiples of 1000)

⚠ WARNING

The Pressure Unit and Pressure Spike During Hydraulic Stroke is factory set based on valve torque and safety factor provided. These parameters do not need to be adjusted during commissioning.

4.7.4 Once the self-calibration settings have been confirmed, self-calibration can now begin by selecting Start Self-Calibration. Once the self-calibration pre-checks are checked, the unit will begin self-calibration.

4.7.5 Once self-calibration starts, the Smart EHO will stroke the valve based on the self-calibration Cycle Count and set the open and close limits based on the pressure limits set by the Pressure Spike and Operating Pressure set. During self-calibration, the display will show a graph of the pressure versus position while the unit strokes. In the event a self-calibration needs canceled, toggle the Local/Remote Selector Switch to BACK to abort the calibration.

4.7.6 Once self-calibration is complete, the display will show either pass, fail, or aborted and update the self-calibration Status appropriately.

NOTICE

If self-calibration fails, check for any alarms displayed on the LCD display.
If any alarms are displayed, correct each alarm before starting self-calibration again.
See Section 8.5 Alarms, for the list of alarms and the causes of the alarms.
If the self-calibration continues to fail with no alarms active, please contact a Biffi representative.

4.8 Limit Switch Adjustment (Optional)

NOTICE

Kindly remove the weather protection LOCTITE SI 5366 (or equivalent transparent silicon base product) from the holes with a screw to proceed with the cap removal procedure quickly. After the activity, remember to refill the product.

If limit switches are supplied with the Biffi EHO, the limit switches will be factory set. The purpose of the limit switches are for position feedback and further adjustment of the limit switches are typically not required.

4.8.1 To complete limit switch adjustment, the actuator will need to be stroked from a fully closed position to a fully open position several times. In the following instructions, the electric motor is used to power stroke the actuator. If it is not safe or possible to use the electric motor at this time, use the hand pump to power stroke the actuator.

4.8.2 The limit switch adjustments are found in a covered compartment in line with the valve stem and on the opposite side of the control box. Remove the limit switch compartment cover by loosening the four corner bolts retaining it. All covers have tapped holes for jackscrews to aid in removing the cover. Use the retaining screws in these holes to lift the cover evenly at each corner. Use caution to not allow the cover to bind during removal.

Figure 13. Remove Cover for Limit Switch Chamber

⚠ WARNING

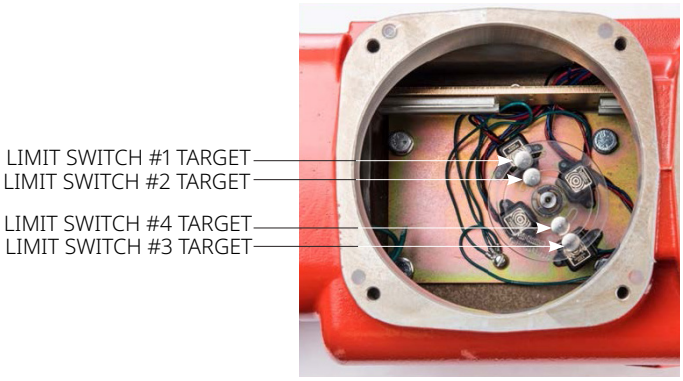
If the actuator is being installed in a hazardous area, use extreme care. This procedure requires the limit switch cover to be open while electrical power is connected to the unit. Follow these steps only when the atmosphere is free of explosive gases.

4.8.3 Fail-Safe Close Limit Switch Adjustment

4.8.3.1 The Open and Close Limit Switches, shown in Figure 14, are operated by targets mounted in a plastic disk that rotates with the actuator stroke. To adjust a target, push down on it and slide it in a clockwise or counterclockwise direction.

Figure 14. View of Limit Switch Targets

ILLUSTRATION SHOWS 4 LIMIT SWITCHES.
THE BIFFI EHO HAS OPTIONS FOR 2 OR 4 LIMIT SWITCHES.



NOTICE

The switch targets will be labeled to identify the switch they operate.

4.8.3.2 With the actuator in the fail-safe close position, rotated fully clockwise, the target for CLOSE LS-2 will need to be adjusted.

4.8.3.3 Reconnect electrical power to the unit.

4.8.3.4 Push down on the target for CLOSE LS-2 and move clockwise until it is off of the switch in the clockwise direction. Refer to the wiring diagram for terminal connections for limit switch confirmation and continuity check.

4.8.3.5 Now, push down and slide the Target for CLOSE LS-2 counterclockwise until continuity is verified. It is important to always adjust a target in the opposing direction of the valve travel to get an accurate setting.

4.8.3.6 With the LOCAL/OFF/REMOTE selector switch set to LOCAL, toggle the control selector knob to OPEN and allow the actuator to travel to the open position rotated fully counterclockwise.

4.8.3.7 Push down and slide target for OPEN LS-1 counterclockwise until it is off the switch in the counterclockwise direction.

4.8.3.8 Now, push down and slide the Target for OPEN LS-1 clockwise until continuity is verified.

4.8.3.9 Toggle the control selector knob to CLOSE and allow the actuator to rotate clockwise to the fully closed position and check to see CLOSE LS-2 is operated; verify continuity. Cycle the actuator open and closed a few times checking the setting of CLOSE LS-1 and OPEN LS-2.

4.8.4 Fail-Safe Open Limit Switch Adjustment

4.8.4.1 With the actuator in the fail-safe open position, rotated fully counterclockwise, the target for OPEN LS-1 will need to be adjusted.

4.8.4.2 Reconnect electrical power to the unit.

4.8.4.3 Push down on the target for OPEN LS-1 and move counterclockwise until it is off of the switch in the counterclockwise direction. Refer to the wiring diagram for terminal connections for limit switch confirmation and continuity check.

4.8.4.4 Now, push down and slide the target for OPEN LS-1 clockwise until continuity is verified. It is important to always adjust a target in the opposing direction of the valve travel to get an accurate setting.

4.8.4.5 With the LOCAL/OFF/REMOTE selector switch set to LOCAL, toggle the CLOSE selector knob and allow the actuator to travel to the close position rotated fully clockwise.

4.8.4.6 Push down and slide target for CLOSE LS-2 counterclockwise until it is off the switch in the clockwise direction.

4.8.4.7 Now, push down and slide the target for CLOSE LS-1 clockwise until continuity is verified.

4.8.4.8 Toggle the control selector knob to OPEN and allow the actuator to rotate counterclockwise to the fully open position and check to see OPEN LS-2 is operated; verify continuity. Cycle the actuator open and closed a few times, checking the setting of CLOSE LS-1 and OPEN LS-2.

4.8.5 Four Limit Switch Models

4.8.5.1 If your unit utilizes four switches LS-3 OPEN and LS-4 CLOSE, adjust in the same manner except you will need to use a continuity tester on the terminal strip to detect switch operation. Look at these switches on the wiring diagram for exact configuration.

4.9 Function Test with Local Controls

NOTICE

If the Biffi EHO actuator is supplied with optional ESD before operating a motor powered stroke, a customer supplied ESD signal must be present and solenoid valve (17) energized.

4.9.1 Ensure the hand pump isolation valve (8) is open and check to see manual bypass valve (lockable) is closed.

4.9.2 Use the OPEN/CLOSE selector knob to power stroke the actuator. The electric motor will start to run, driving the hydraulic pump. The hydraulic pump draws fluid from the reservoir and pushes it into the Biffi OLGA-H/OLAS-H or RPHD/RPHS hydraulic cylinder. As the actuator strokes, the spring will compress in the spring-return module. at the same time, the hydraulic pump will also start charging the accumulator(optional). The hydraulic pump will continue to charge the accumulator till the accumulator is fully pressurized as per setting on the pressure switch. The hydraulic pump motor will stop once the accumulator is fully charged. This accumulator pressure will be used for power strokes of the actuator until the accumulator pressure drops to below the pre-determined setpoint. The hydraulic pump motor restarts again to recharge the accumulator until it reaches the setpoint of the pressure switch.

NOTICE

When the actuator power is connected, the hydraulic pump motor does not start immediately if the accumulator pressure is below the pre-determined setpoint. The motor runs only after there is a command to open or close the actuator.

4.9.3 Toggle the OPEN/CLOSE selector knob to stroke the actuator to the fail-safe position. A 2-way N.C. Solenoid Valve energizes venting the fluid in the power cylinder to the reservoir. At the full fail-safe position, the closing solenoid will automatically de-energize.

4.9.4 The spring-return module will stroke the actuator to the fail-safe position.

4.9.5 Check all hydraulic lines and fittings for leakage, repair as needed.

4.9.6 Toggle the OPEN/CLOSE selector knob to power stroke the actuator. If equipped with an accumulator, fluid will be discharged into the hydraulic cylinder to stroke the actuator. If not equipped with an accumulator, the motor will start and pump fluid into the hydraulic cylinder to stroke the actuator. The actuator travels to the fully power stroked position.

4.9.7 Toggle the OPEN/CLOSE selector knob to return the actuator to its fail-safe position.

4.9.8 Cycle the actuator open and closed a few times to ensure operation.

4.9.9 While the motor is running, toggle the selector knob to STOP. The motor and actuator will stop. When the selector knob is in STOP position, the accumulator does not charge even if it goes below the charging pressure.

4.9.10 Toggle the OPEN/CLOSE selector knob to fully power stroke the actuator.

4.9.11 Return the actuator to its original position.

4.9.12 Turn the LOCAL/OFF/REMOTE selector switch to REMOTE.

4.9.13 Rotate the OPEN/CLOSE selector knob to OPEN Position. The actuator must remain at rest.

4.9.14 Turn the LOCAL/OFF/REMOTE selector switch to LOCAL. Rotate the OPEN/CLOSE selector switch to CLOSE and OPEN positions to ensure control returned to the LOCAL control mode.

4.9.15 The functional test of the electro-hydraulic actuator is now complete. The Biffi EHO actuator is now operational and ready for service.

4.10 Other Options

Other options such as solar panels and battery packs may have been supplied with this order. Refer to supplemental start-up procedures supplied with these options for start-up and test.

Section 5: Communication Protocols

Digital control networks can interface with several different network protocols through the use of a Communication Adaptor Module (CAM), and currently, Modbus®, FOUNDATION™ Fieldbus, and HART® protocols are supported. All networks offer real-time data acquisition, diagnostics and alarms.

5.1 Modbus RTU

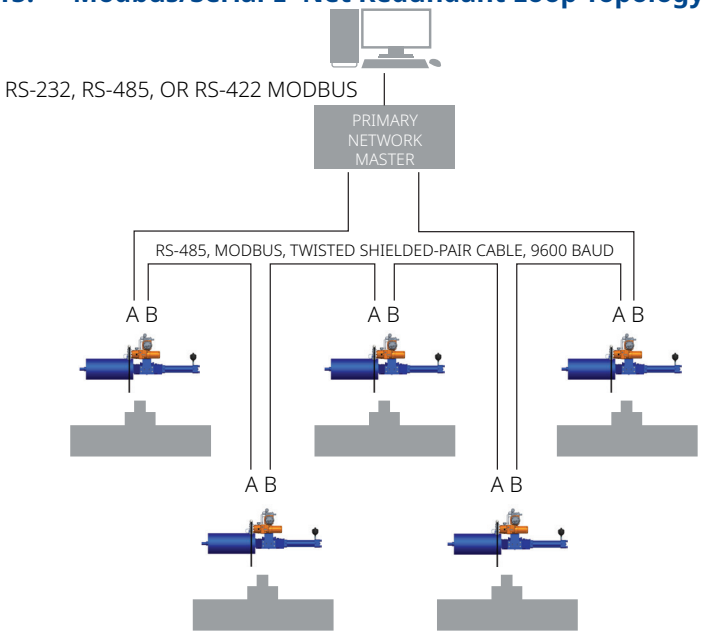
All standard Modbus function codes are supported. Up to 254 actuators can be installed in a single network, and the overall length of network cabling can be extremely long without degrading network performance or response time. Length of cable between each actuator, or between controller and first actuator in network, can be up to 1500 m / 5000 ft and there is no need to use separate repeaters. Total network distance can be up to 320 km / 200 miles.

Fully redundant networks comprising a serial loop topology are a standard feature, and no single cable fault, open-circuit, short-circuit, or ground fault will cause a loss of communication to any actuator. Hot-standby, redundant network masters are a standard option.

5.1.1 Serial E>Net Redundant Loop Topology

- Two data paths to each device from network master
- Open-circuit and short-circuit protected
- Redundant cabling included
- Long cable distances can be installed
- Maximum distance between valves can be up to 1500 m / 5000 ft
- Total network distance can be up to 320 km / 200 miles
- Maximum number of valves in network can be 254
- Redundant “hot-standby” network master option available

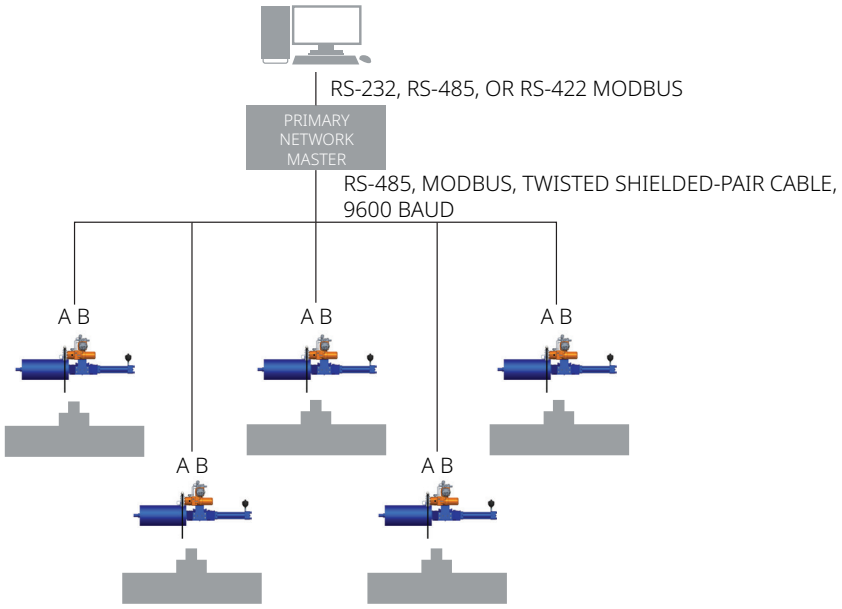
Figure 15. Modbus/Serial E>Net Redundant Loop Topology



5.1.2 Multi-drop Bus Topology

- Only one data path to each device from network master
- No short-circuit or ground fault protection in network
- Open-circuit protection only to the first cable fault
- No redundancy included
- Maximum network cable length is only 1200 m / 4000 ft
- Maximum number of valves in network is 32
- Repeaters required to extend the network

Figure 16. Modbus/Multi-drop Topology



5.1.3 STC Terminal Connections

Table 5. STC Pin Connections

STC PIN Connections	Modbus Connections
39	CHA +
40	Shield
41	CHA -
42	Shield
43	CHB +
44	CHB -

5.2 HART

The EHO actuators are capable of offering HART7 communication protocol over the widely used 4 to 20 mA analog channels. The HART CAM interface board certified by the FieldComm group (previously HART Communication Foundation or HCF) is capable of offering Point-to-Point, Multi-drop and WirelessHART® communication topologies. Networks may extend up to 3000 m with Point-to-Point topology; and from 250 to 2000 m when 1 to 10 devices are connected using Multi-drop topology. The WirelessHART supports up to 100 devices when connected to one gateway manufactured by Emerson, extending the number of devices when multiple gateways are installed.

Table 6. HART Pin Connections

STC Pin	HART Connections
41	HART 0+ (AO+)
42	HART 0- (AO-)
43	HART I+
44	HART I-
24	Shield

Figure 17. HART Topology

5.3 FOUNDATION Fieldbus

EHO actuators supporting FOUNDATION Fieldbus H1 protocol are fully certified by the FieldComm Group and provide direct connection to the fieldbus with guaranteed interoperability with other certified devices. Each network can comprise up to 32 devices, with power for devices being provided via network cabling (assuming intrinsically safe devices are not connected to the same network). Networks may extend up to 1900 m / 6000 ft long, and repeaters may be used to extend the distance or to incorporate more than 32 devices.

Figure 18. FOUNDATION Fieldbus Topology

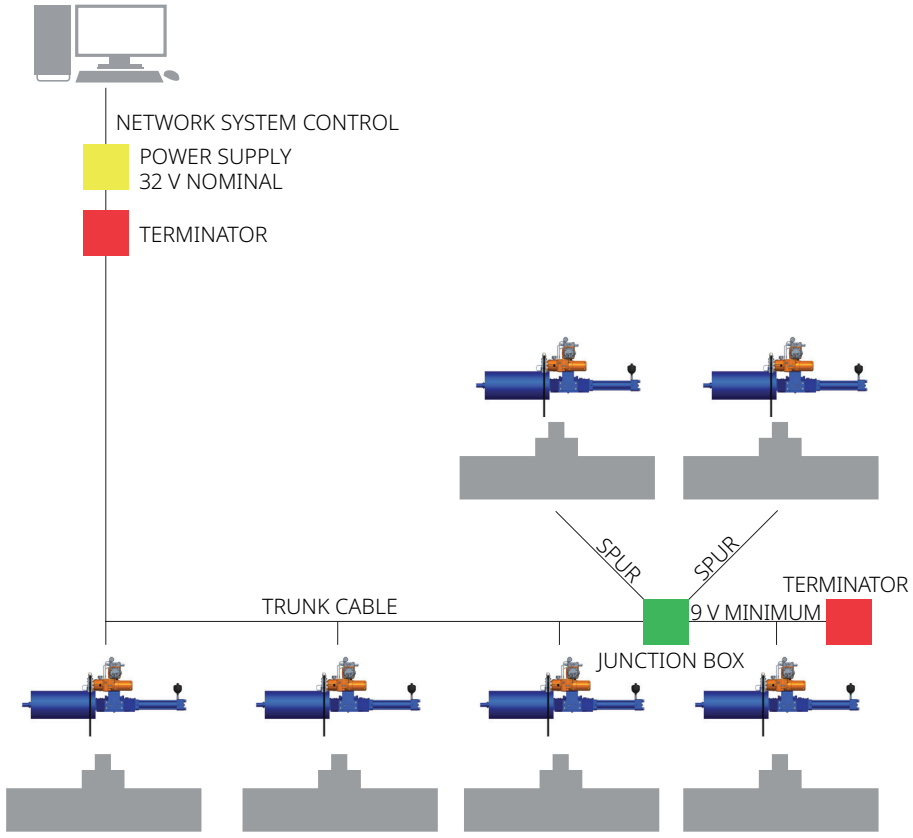


Table 7. FOUNDATION Fieldbus Pins

Pin Connections	Fieldbus Connections
43	FIELDBUS +
44	FIELDBUS -
42	Shield

Section 6: Operation

After initial start-up and commissioning procedures have been accomplished, the Biffi EHO actuator provides a simple self-contained means of operation for a quarter-turn valve. In case of a power failure, the actuator can be operated by the use of the supplied hand pump.

6.1 Hydraulic Power System

The hydraulic system, powered by an electric motor, contains manifold based valves and controls with minimal piping. The system will drive the actuator to the OPEN/CLOSE position as selected by operation personnel.

6.2 Fluid Reservoir

The self-contained, Biffi Electro-Hydraulic actuator includes a fluid reservoir sized to contain the hydraulic fluid required to operate the actuator cylinder and controls. The standard unit has a sight gage to ensure presence of fluid and a dipstick measure attached to the fill/breather cap to more accurately gauge the quantity of fluid contained.

6.3 Main Components and Options

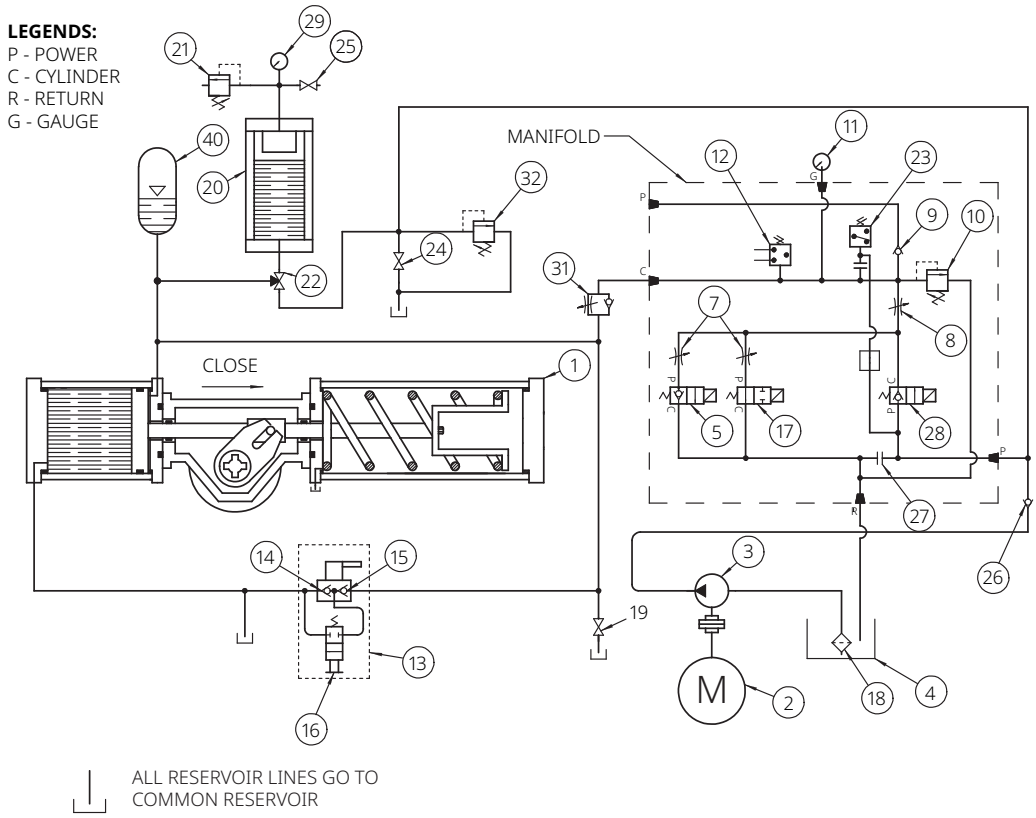
NOTICE

Item numbers correspond to the Hydraulic Schematic Drawing. Diagram shown in manual is generic and you should reference the diagram supplied with your actuator prior to installation.

- (1) Biffi OLGA-H/OLGAS-H or RPHD/RPHS Series hydraulic spring-return actuator.
- (2) Electric motor
- (3) Hydraulic pump
- (4) Fluid Reservoir
- (5) 2-way Normally close solenoid valve: Energized by the controller when an operator pushes the local CLOSE button or when receiving a remote discrete CLOSE signal.
- (6) Redundant 2-way Normally close solenoid valve: Energized by the controller when an operator pushes the local CLOSE button or when receiving a remote discrete CLOSE signal.
- (7) Flow control valves: There are two flow control valves, with two options: Adjustable speeds for slow close or fast close, or one adjustable closing solenoid with an adjustable ESD solenoid.

- (8) Hand pump isolation valve: The hand pump isolation valve is used to isolate the solenoid valves when using hand pump to OPEN/CLOSE the actuator.
- (9) Check valve.
- (10) Relief valve: A pressure relief valve is provided to protect the actuator and control system from over-pressurization caused by the pump or thermal expansion of the hydraulic fluid.
- (11) Hydraulic pressure gauge: A pressure gauge to indicate the hydraulic system pressure.
- (12) Pressure Transmitter: Provides an analog signal for customer remote readout.
- (13) Hand pump: The hydraulic hand pump is used to open the actuator during power loss.
- (17) ESD 2-way N.O. solenoid valve: The ESD solenoid valve is constantly energized closed during the normal operation. Upon loss of electric power to solenoid (17), the valve will de-energize allowing the actuator to spring-return to fail-safe position.
- (19) Manual bypass valve (lockable): A bypass valve that provides a means to manually stoke the actuator to its fail-safe position.
- (20) Hydraulic accumulator (optional): An accumulator will provide hydraulic power to operate the actuator.
- (21) Nitrogen relief valve (optional): A relief valve to protect the accumulator and system from over pressurization due to thermal expansion.
- (22) 3-way isolation valve (optional): Used with accumulator for actuator override.
- (23) Pressure switch: Used for a positive end-of-stroke signal during the power stroke.
- (24) Isolation valve (accumulator drain): An isolation valve that can be used to drain off the hydraulic fluid under pressure in the accumulator.
- (25) Isolation valve (nitrogen blow down and fill).
- (28) 2-way N.C. solenoid valve for accumulator: Can be used to power stroke the actuator with a remote customer signal.
- (29) Nitrogen pressure gauge: A pressure gauge to indicate the nitrogen system pressure.
- (31) Accumulator speed control: Use to control the actuator speed while power stroking utilizing solenoid (28).

Figure 19. Electric Single-Way with Emergency Shutdown



NOTES:
1. BIFFI ACTUATOR (SHOWN IN OPEN POSITION)
2. ELECTRIC MOTOR
3. HYDRAULIC PUMP
4. OIL RESERVOIR
5. SLOW CLOSE 2-WAY N.C. SOLENOID VALVE
7. FLOW CONTROL VALVES
8. HAND PUMP ISOLATION VALVE
9. CHECK VALVE
10. RELIEF VALVE
11. PRESSURE GAUGE
12. PRESSURE TRANSMITTER
13. HAND PUMP
14. SUCTION CHECK VALVE
15. DISCHARGE CHECK VALVE
16. HAND PUMP BYPASS
17. ESD 2-WAY N.O. SOLENOID VALVE
18. SUCTION STRAINER
19. MANUAL BYPASS VALVE (LOCKABLE)
20. HYDRAULIC ACCUMULATOR
21. NITROGEN RELIEF VALVE
22. 3-WAY ISOLATION VALVE
23. PRESSURE SWITCH
24. ISOLATION VALVE (ACCUMULATOR DRAIN)
25. ISOLATION VALVE (NITROGEN BLOW DOWN AND FILL)
26. CHECK VALVE (ACCUMULATOR)
27. INTERNAL PLUG
28. 2-WAY N.C. SOLENOID VALVE FOR ACCUMULATOR
29. NITROGEN PRESSURE GAUGE
30. --
31. SPEED CONTROL
32. HYDRAULIC ACCUMULATOR RELIEF VALVE
40. THERMAL COMPENSATING ACCUMULATOR

FUNCTIONS:

OPEN FEATURE:
A. ENERGIZE SOLENOID (17).
B. POWER ELECTRIC MOTOR (2), ACTUATOR STROKES OPEN

SLOW CLOSE FEATURE:
A. ENERGIZE SOLENOID (5).
B. DE-ENERGIZE SOLENOID (5) AT END OF ACTUATOR CLOSING STROKE.

ELECTRIC FAIL-SAFE FEATURE:
A. SOLENOID (17) AND IS CONSTANTLY ENERGIZED CLOSED.
B. UPON LOSS OF ELECTRIC TO SOLENOID (17), THE ACTUATOR (1) WILL STROKE CLOSED

MANUAL HAND PUMP FEATURE:
A. CLOSE ISOLATION VALVE (8).
B. STROKE HAND PUMP (13) UNTIL THE OPEN STROKE IS COMPLETE.

ACCUMULATOR OPENING MANUAL OVERRIDE (OPTIONAL)
A. CLOSE ISOLATION VALVE (8) IF ESD (17L SOLENOID IS IN FAILED OPEN MODE.
B. OPEN ISOLATION VALVE (22), ACCUMULATOR STROKES ACTUATOR OPEN.

ACCUMULATOR OPENING REMOTE OVERRIDE (OPTIONAL)
A. ESD (17) SOLENOID IS IN ENERGIZED STATE.
B. ENERGIZE SOLENOID (28), ACCUMULATOR STROKES ACTUATOR OPEN.

6.4 Functional Description

The following is a functional description of the Biffi Electro-Hydraulic actuator and a brief explanation of the main components. Throughout this explanation, numbers which appear in [ ] correspond to components labeled on the wiring diagram. Numbers in ( ) correspond to components labeled on the schematic diagram. Information in (( )) is descriptive.

NOTICE

Refer to the hydraulic schematic specified for the actuator being worked on to determine what options were supplied.

6.4.1 Power Stroke ((OPEN/CLOSE))

During a normal power cycle, the motor drives the hydraulic pump. Hydraulic fluid from the pump is forced into the accumulator which can hold the fluid under pressure. This fluid under pressure from the accumulator is used in actuator's hydraulic power cylinder and moves the actuator to the OPEN/CLOSE position which compresses the spring in the spring-return module.

6.4.2 Spring-Return Stroke

In an on/off application, the normally close solenoid valve (5) is energized open by the controller. The hydraulic fluid flows back to reservoir (4) from actuator cylinder forced by the spring in the spring-return module. The spring forces the actuator to the fail-safe position.

6.4.3 ESD Operation ((Optional))

In an ESD application, the ESD 2-way normally open solenoid valve (17) is constantly held energized, as long as a customer supplied electrical ESD signal is present. In case of electrical ESD signal loss, ESD Solenoid Valve (17) will de-energize. Hydraulic fluid will flow from the actuator's hydraulic cylinder, forced by the spring-return module, through speed control (7), through normally open ESD 2-way valve (17) and return to the reservoir (4).

6.4.4 Electric Fail-Safe ((Optional))

The Biffi EHO control can be configured to stroke the actuator to fail-safe position upon loss of electrical power.

6.4.5 Power Stroke of Accumulator Based Actuator (OPEN/CLOSE/Modulation) (Optional)

During a normal power cycle, the motor drives the hydraulic pump. Hydraulic fluid from the pump is forced into the accumulator and pressurizes the accumulator. hydraulic power cylinder moves the actuator to the OPEN/CLOSE position which compresses the spring in the spring-return module.

For the next power cycle, the pressure from the accumulator is used instead of the pump. When the accumulator pressure goes beyond the set limit, the accumulator pressurizes automatically until the power is reset or the selector switch is turned to OFF position. After power reset or selector switch turned from OFF to LOCAL or REMOTE Position, the accumulator charges only after the command to actuator operation.

6.4.6 Accumulator Opening Manual Override ((Optional))

1. Close isolation valve (8) to isolate the solenoid valves if valve (17) is in failed open mode.
2. Turn the handle of Isolation Valve (22) 180° to the right, the accumulator will power stroke the actuator to OPEN/CLOSE position.
3. Close isolation valve (22) by turning 180° to the left. The actuator spring-return moves to full OPEN/CLOSE position. Open isolation valve (8).

6.4.7 Manual Hand Pump Power Stroke

1. Close hand pump isolation valve (8).
2. Stroke hand pump (13) until the OPEN/CLOSE stroke is complete.
3. Open hand pump isolation valve (8) when the hand pumping is complete.

NOTICE

If equipped with ESD, DO NOT open hand pump isolation valve (8) before the customer supplied ESD Signal is present.

4. To stroke the actuator to the fail-safe position, if required, slowly open manual bypass valve (lockable) (19).

NOTICE

Manual bypass valve (lockable) (19) must be closed to enable any mode of operation. Hand pump isolation valve (8) must be open for normal operation.

6.5 Actuator Operation Channels

6.5.1 Two-Wire Control with Maintained Contact to Open or Close

Two-wire control mode uses only one contact to control the actuator with that contact often being controlled by a relay. Actuator can be configured to OPEN valve either when contact is closed (digital signal high) or when the contact is open (digital signal low). Momentary contact mode (seal-ins activated) is not possible for two-wire control: the actuator will reverse direction as soon as remote input changes state.

6.5.2 Three-Wire Control with Maintained Contact or Momentary Contact

Three-wire control mode uses two contacts to OPEN or CLOSE the valve. In this mode, the valve cannot be stopped in mid-travel except when an inhibit/interlock, ESD or emergency STOP signal is present at terminals.

6.5.3 Four-Wire Control with Momentary Contact and Mid-Travel Reversal

Four-wire control mode uses three contacts to OPEN, CLOSE or STOP valve in mid-travel. Default configuration for STOP input is active on close contact.

6.5.4 Network Control Mode

In Network Control Mode, Modbus commands are used to operate the actuator and read the status registers of the actuator. Actuator Mode needs to be set to Network Mode for communication with the HOST System.

6.5.5 Analog Control Mode

Analog Mode with electro-mechanical reversing contactor, is capable of handling position and process control via a 4 to 20 mA input signal, and includes a 4 to 20 mA feedback signal of position derived from a non-contacting position sensor. Units are available for either three-phase or single-phase power supplies.

Table 8. Control Overview

	2-Wire Control	3-Wire Control	4-Wire Control	Analog	Network
Open	Available	Available	Available	Available	Available
Close	Available	Available	Available	Available	Available
Stop	Not Available	Not Available	Available	Available	Available
Partial Stroke	Available	Available	Not Available	Available	Available
ESD	Available	Available	Available	Available	Available
Diagnostics *	Available	Available	Available	Available	Available

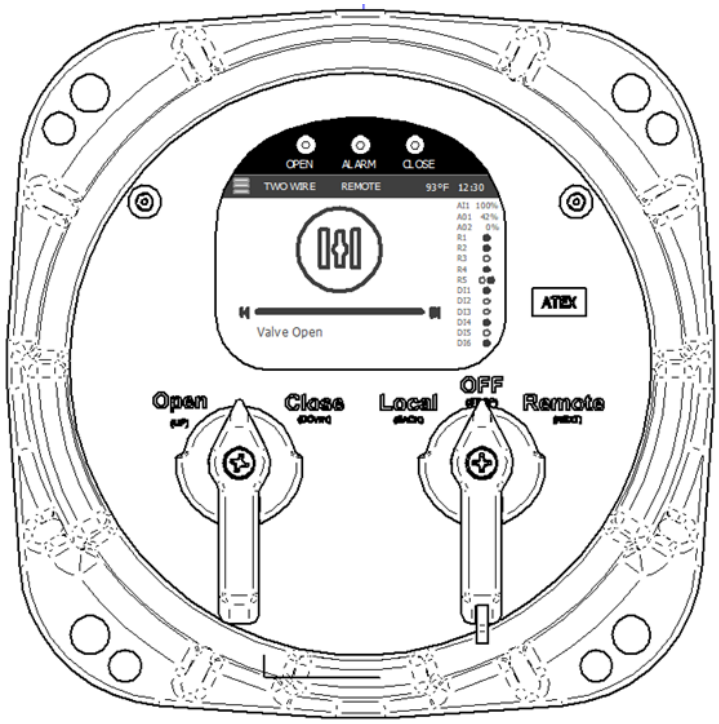
NOTE:
* Requires network card to be installed.

Section 7: Local Display Module (LDM)

The Local Display Module consists of the following as shown in Figure 20:

- Three LED Indicator Lights: OPEN, ALARM, and CLOSE
- TFT LCD Display
- Selector Knobs: OPEN/CLOSE selector knob and LOCAL/OFF/REMOTE selector switch

Figure 20. Local Display Module (LDM)



7.1 Positions and Functions of Selector Knob

Table 9. Selector Knob

Selector Knob	Rotate	Control Mode Function
OFF (Stop)	Return position	Stop movement: Prevents motor operation
REMOTE (Auto)	Clockwise	Remote control: Allows control from remote location
LOCAL (Hand)	Counterclockwise	Local operation: Allows control from the local control knob

Table 10. Control Knob

Selector Knob	Rotate	Control Mode Function
CLOSE	Clockwise	Actuator moves to close position
OPEN	Counterclockwise	Actuator moves to open position
Default	-	No Action

Table 11. Default Actuator Position LEDs

Actuator Position LEDs	Valve Closed	Valve Closing Mid Stroke	Stopped	Valve Opening Mid Stroke	Valve Open	Alarm
Red	ON	Blinking	OFF	OFF	OFF	OFF
Green	OFF	OFF	OFF	Blinking	ON	OFF
Yellow	OFF	OFF	OFF	OFF	OFF	Flashing

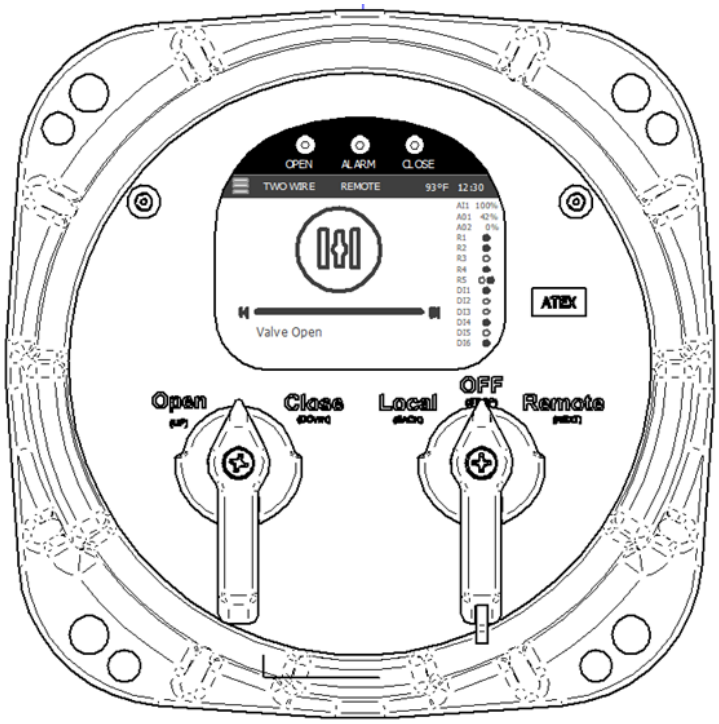
Section 8: Customizing Biffi EHO Settings

The SETUP mode must be entered to modify any configuration settings.

8.1 Entering the Setup Menu

8.1.1 Place the LOCAL/OFF/REMOTE selector switch to the OFF position.

Figure 21. Viewing the Setup Menu (1)

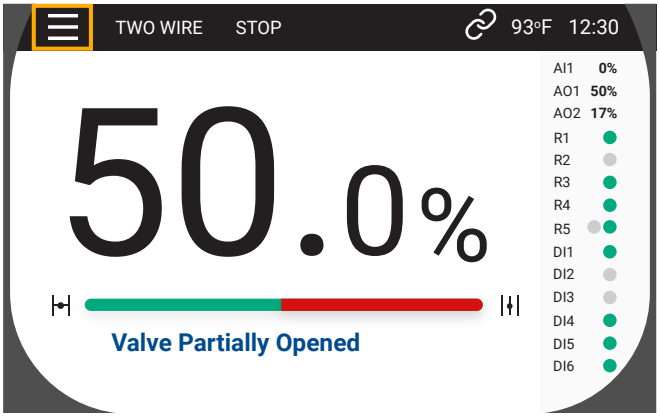


NOTICE

The functionality of the LOCAL/OFF/REMOTE selector switch changes to BACK/NEXT once the setup menu is entered. The OPEN/CLOSE selector switch changes functionality to UP/DOWN when the unit is in the setup menu. When the LOCAL/OFF/REMOTE is in the OFF position, the OPEN/CLOSE selector switch can be used to navigate the home screen menu.

8.1.2 While the LOCAL/REMOTE selector knob is in OFF, toggle the UP/DOWN selector knob to UP (OPEN) to display the yellow selection box on the display.

Figure 22. Viewing the Setup Menu (2)



8.1.3 To enter setup mode, select the Setup Icon (3 horizontal bars) in the top left of the display by toggling UP/DOWN selector to DOWN (CLOSE).

8.1.4 To exit setup mode and return to normal operation, toggle the LOCAL/REMOTE selector knob to BACK (LOCAL) until the home screen is displayed.

NOTICE

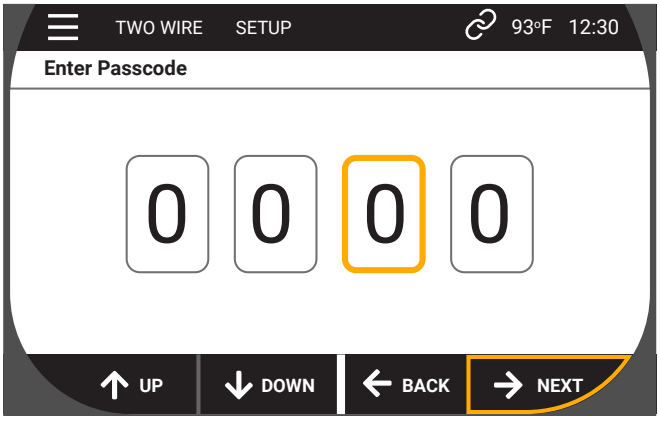
When using the LOCAL/REMOTE knob, always return it to the center position after toggling BACK/NEXT.

8.2 Change Settings

Once the setup menu has been entered, the Biffi EHO configurations can begin to be changed.

8.2.1 Generally, to navigate through the Biffi EHO settings, use the UP/DOWN selector knob to move through the menu. To change a setting, a toggle of NEXT with the LOCAL/REMOTE selector knob will enter the setting for editing.

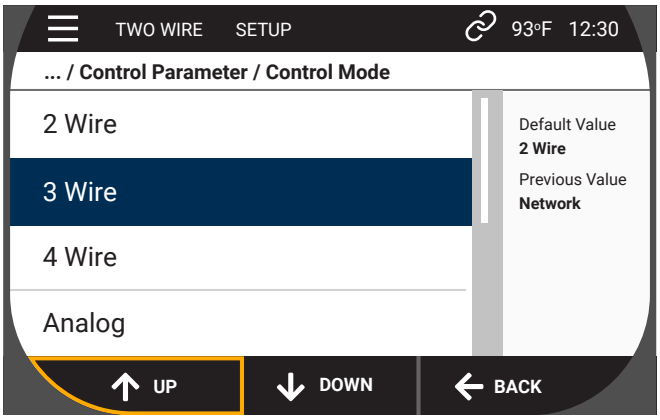
Figure 23. Change Settings (1)



8.2.2 When entering a setting to change it, a passcode will be required. Settings that are critical to the unit require the factory passcode to change the setting. All other settings can be changed using the user passcode.

8.2.3 To enter the passcode, use the UP/DOWN selector switch to change the value. To move to the next value, toggle the BACK/NEXT selector switch.

Figure 24. Change Settings (2)



8.2.3.1 Once the last digit is at the correct value, enter the passcode then toggle the NEXT using the BACK/NEXT selector switch. If the password is correct, the setting will be entered allowing it to be changed.

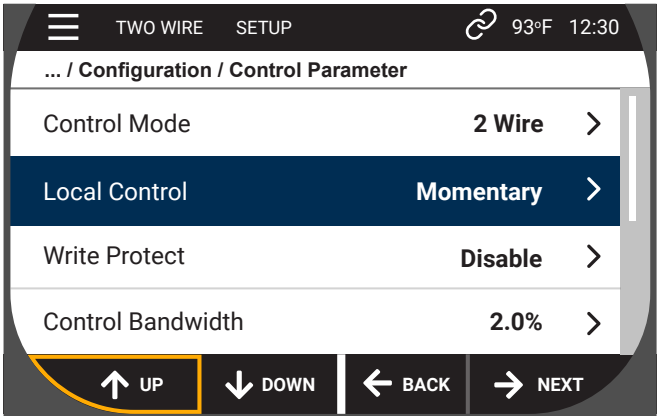
8.2.3.2 Using the UP/DOWN selector switch, move up or down to the desired setting. If this setting is a numerical value, the UP/DOWN can be held in one position to achieve the desired value quicker.

8.2.3.3 For settings with a list of options, highlight the desired setting with the blue selection box, then toggle BACK using the BACK/NEXT selector switch to exit and save the setting.

8.2.3.4 For numerical settings, use the UP/DOWN selector switch to achieve the desired value. Once at the desired value, toggle BACK using the BACK/NEXT selector switch to exit and save the setting.

8.2.3.5 The setting is changed to the value or selection upon exiting the setting and now reflected in the menu.

Figure 25. Change Settings (3)



8.3 Menu Tree

1. Settings
- **1.1** Device specification
  - **1.1.1** Serial number
  - **1.1.2** Model code
  - **1.1.3** Device tag
  - **1.1.4** Manufacture date
  - **1.1.5** Firmware revision
    - **1.1.5.1** CPU1 firmware revision
    - **1.1.5.2** CPU1 firmware date
    - **1.1.5.3** CPU2 firmware revision
    - **1.1.5.4** CPU2 firmware date
    - **1.1.5.5** Bootloader firmware revision
    - **1.1.5.6** Bootloader firmware date
  - **1.1.6** Hardware revision
    - **1.1.6.1** CPU 1 revision
    - **1.1.6.2** CPU 2 revision
    - **1.1.6.3** Interface board revision
    - **1.1.6.4** Display board revision
- **1.2** Electric specification
  - **1.2.1** Supply voltage
  - **1.2.2** Frequency
  - **1.2.3** Phase
  - **1.2.4** Starter
- **1.3** Motor specification
  - **1.3.1** Motor tag
  - **1.3.2** RPM
  - **1.3.3** Motor running current
  - **1.3.4** Stall amps
- **1.4** Device settings
  - **1.4.1** Pressure unit
  - **1.4.2** Temperature unit
  - **1.4.3** Actuator variant
  - **1.4.4** Actuator close direction
  - **1.4.5** Valve close direction
  - **1.4.6** Automatic brightness

- **1.5** Features enable/disable
  - **1.5.1** Partial stroke test
  - **1.5.2** Hardwire ESD
    - **1.5.2.1** Hardwire ESD
    - **1.5.2.2** Hardwire ESD feedback
  - **1.5.3** Host ESD
  - **1.5.4** Setpoint tracking
  - **1.5.5** Logjam
  - **1.5.6** Coarse SOV
- **1.6** Alarm suppress
  - **1.6.1** Lost analog input alarm
  - **1.6.2** Low oil alarm
  - **1.6.3** Lost communication alarm
- **1.7** Reset
  - **1.7.1** Factory reset

2. Configuration

- **2.1** Control parameter
  - **2.1.1** Control mode
  - **2.1.2** Local control
  - **2.1.3** Write protect
  - **2.1.4** Control bandwidth
  - **2.1.5** Operating pressure
  - **2.1.6** Thermal accumulator pre-charge
- **2.2** Alarm configuration
  - **2.2.1** Valve stall delay
  - **2.2.2** Hydraulic fault delay
  - **2.2.3** CPU reset alarm
  - **2.2.4** Communication alarm
    - **2.2.4.1** Lost communication alarm delay
    - **2.2.4.2** Communication fail action
  - **2.2.5** ESD alarm
    - **2.2.5.1** Hardwire ESD completion
    - **2.2.5.2** Lost communication ESD
    - **2.2.5.3** Host ESD action
    - **2.2.5.4** Hardwire ESD reset action
    - **2.2.5.5** ESD override motor
  - **2.2.6** Analog alarm
    - **2.2.6.1** Lost analog input action
    - **2.2.6.2** Lost analog alarm delay

2.3 Discrete input
- **2.3.1** Discrete input1
  - **2.3.1.1** DI1 setting
  - **2.3.1.2** DI1 function
- **2.3.2** Discrete input2
  - **2.3.2.1** DI2 setting
  - **2.3.2.2** DI2 function
- **2.3.3** Discrete input3
  - **2.3.3.1** DI3 setting
  - **2.3.3.2** DI3 function
- **2.3.4** Discrete input4
  - **2.3.4.1** DI4 setting
  - **2.3.4.2** DI4 function
- **2.3.5** Discrete input5
  - **2.3.5.1** DI5 setting
  - **2.3.5.2** DI5 function
- **2.3.6** Discrete input6
  - **2.3.6.1** DI6 setting
  - **2.3.6.2** DI6 function

2.4 Discrete output
- **2.4.1** Relay 1
  - **2.4.1.1** Relay 1 function
  - **2.4.1.2** Relay 1 setting
- **2.4.2** Relay 2
  - **2.4.2.1** Relay 2 function
  - **2.4.2.2** Relay 2 setting
- **2.4.3** Relay 3
  - **2.4.3.1** Relay 3 function
  - **2.4.3.2** Relay 3 setting
- **2.4.4** Relay 4
  - **2.4.4.1** Relay 4 function
  - **2.4.4.2** Relay 4 setting
- **2.4.5** Relay 5
  - **2.4.5.1** Relay 5 function
  - **2.4.5.2** Relay 5 setting

2.5 Feedbacks
- **2.5.1** LED colors
- **2.5.2** Limit switch A
- **2.5.3** Limit switch B

- **2.6** Analog input
  - **2.6.1** Setpoint for lost AI
  - **2.6.2** Analog input polarity
- **2.7** Analog output
  - **2.7.1** Analog output 1 source
  - **2.7.2** Analog output 2 source
  - **2.7.3** Analog output polarity
- **2.8** Network setup
  - **2.8.1** Network adapter
  - **2.8.2** Network address
  - **2.8.3** Baud rate
  - **2.8.4** Parity
  - **2.8.5** Stop bits

3. Calibration

- **3.1** Self-calibration
  - **3.1.1** Start self-calibration
  - **3.1.2** Cycle count
  - **3.1.3** Pressure spike
  - **3.1.4** Self-calibration Status
- **3.2** Analog input
  - **3.2.1** Analog input 1 calibration
- **3.3** Analog output
  - **3.3.1** Analog output 1
  - **3.3.2** Analog output 2

4. Diagnostic

- **4.1** Active alarms
- **4.2** Partial stroke test
  - **4.2.1** Start PST
  - **4.2.2** PST status
  - **4.2.3** PST travel range
  - **4.2.4** PST pause time

8.4 EHO Configuration Menu

NOTICE

Feedback Only Factory Set parameters cannot be changed. If an attempt is made to change a Feedback Only Factory Set parameter, all LEDs on the LDM will blink for 2 seconds and the parameter's value will remain unchanged.

Table 12. Configuration Table (1)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
Passcode	Default User Passcode: 0 0 0 0	-	-	-
1.	**Settings**	**-**		
1.1.	**Device specification**	-		
1.1.1.	**Serial number** Serial number for customer and factory reference.	FEEDBACK ONLY	-	-
1.1.2.	**Model code** Model code of the device for reference only.	FEEDBACK ONLY	-	-
1.1.3.	**Device tag** The name of the device when communicating.	FEEDBACK ONLY	-	-
1.1.4.	**Manufacture date** Manufacturing date of the unit. Note: This is when the unit was built in the factory, not the date of commissioning.	FEEDBACK ONLY	-	-
1.1.5.	**Firmware revision** Revision of the CPU's firmware for factory reference.	-		
1.1.5.1.	**CPU1 firmware revision**	FACTORY FEEDBACK ONLY	-	-
1.1.5.2.	**CPU1 firmware date**	FACTORY FEEDBACK ONLY	-	-
1.1.5.3.	**CPU2 firmware revision**	FACTORY FEEDBACK ONLY	-	-
1.1.5.4.	**CPU2 firmware date**	FACTORY FEEDBACK ONLY	-	-
1.1.5.5.	**Bootloader firmware revision**	FACTORY FEEDBACK ONLY	-	-
1.1.5.6.	**Bootloader firmware date**	FACTORY FEEDBACK ONLY	-	-
1.1.6.	**Hardware revision** Hardware revision of circuit boards for factory reference.			
1.1.6.1.	**CPU 1 revision**	FACTORY FEEDBACK ONLY	-	-
1.1.6.2.	**CPU 2 revision**	FACTORY FEEDBACK ONLY	-	-
1.1.6.3.	**Interface board revision**	FACTORY FEEDBACK ONLY	-	-
1.1.6.4.	**Display board revision**	FACTORY FEEDBACK ONLY	-	-

Table 13. Configuration Table (2)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
1.2.	**Electric specification** Information of the electrical power to the unit.	-	-	-
1.2.1.	**Supply voltage** Main power setting set by factory. Note: This is factory set and for firmware feedback only. Changing the supply voltage setting does not allow for a different voltage to be applied to the unit.	SETTING	115, 208, 380/415, 460, 575, 220, 230, 280, 400, 415, 550, 660, 690, 24 V DC, 90 V DC	115 V
1.2.2.	**Frequency** Factory set power supply frequency configuration.	SETTING	DC, 50 Hz, 6 0Hz	DC
1.2.3.	**Phase** Factory set power supply phase configuration.	SETTING	1-Phase, 3-Phase	1-Phase
1.2.4.	**Starter** Factory set starter type for reference only.	SETTING	DC, Solid State, Electro-Mechanical	DC
1.3.	**Motor specification** Motor information for factory reference.	-		
1.3.1.	**Motor tag** Motor MFG number for factory reference only.	FEEDBACK ONLY	-	-
1.3.2.	**RPM** Factory set motor rotations per minute.	FEEDBACK ONLY	-	-
1.3.3.	**Motor running current** Motor's full load amps (FLA) set by factory.	FEEDBACK ONLY	-	-
1.3.4.	**Stall amps** Motor MFG number for reference only.	FEEDBACK ONLY	-	-
1.4.	**Device settings**	-		
1.4.1.	**Pressure unit** Set the pressure unit for the Biffi EHO.	SETTING	psi, bar, kPa	psi
1.4.2.	**Temperature unit** Temperature unit for the temperature displayed on the LDM.	SETTING	Fahrenheit, Celsius	Celsius
1.4.3.	**Actuator variant** Factory set parameter to define the actuator type.	SETTING	SR ON/OFF, SR Modulation, DA ON/OFF, DA Modulation	-
1.4.4.	**Actuator close direction** Note: This will be factory set.	FEEDBACK ONLY	-	-
1.4.5.	**Valve close direction** Configure the close and open position of the valve. Note: This will be factory set. This parameter impacts fail-safe position, PST Start Position, Host ESD Action and Display Logic (OP/CL and LED Color).	SETTING	CW, CCW	CW
1.4.6.	**Automatic brightness** When enabled, the screen will dim its brightness when the outside conditions are dark.	SETTING	Enable/Disable	Enable
1.5.	**Features enable/disable**	-		
1.5.1.	**Partial stroke test** Enable the PST on the Biffi EHO.	SETTING	Enable/Disable	Enable
1.5.2.	**Hardwire ESD** Configure the settings for the ESD controls. Note: This is a software ESD action. The software ESD action will be initiated by the software of the electronics. The hardwired ESD is independent from the software ESD.	-		

Table 14. Configuration Table (3)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
1.5.2.1.	**Hardwire ESD** Enables or disables the ESD alarm functionality. Note: This will be factory set.	SETTING	Enable/Disable	Enable
1.5.2.2.	**Hardwire ESD feedback** Hardwire ESD completion time is not applicable when this parameter is enabled. Note: This will be factory set.	SETTING	Enable/Disable	Enable
1.5.3.	**Host ESD** Enable host system to provide a command to take the Biffi EHO to the fail-safe position.	SETTING	Enable/Disable	Enable
1.5.4.	**Setpoint tracking** Enable or Disable Setpoint Tracking feature.	SETTING	Enable/Disable	Disable
1.5.5.	**Logjam** Enabling Logjam will give the actuator three attempts to stroke the actuator in the direction of a valve stall in the event of a valve stall alarm. On each attempt, the actuator will reverse position in the opposite direction 5% before the actuator reattempts stroking the actuator in the valve stall direction.	SETTING	Enable/Disable	Disable
1.5.6.	**Coarse SOV** Biffi EHO - May have an optional coarse SOV. It will be enabled/disabled during factory configuration.	SETTING	Enable/Disable	Disable
1.6.	**Alarm Suppress**	-		
1.6.1.	**Lost analog input alarm** Enable an alarm if analog input signal is lost. The actuator must be configured as Analog Control mode and must also be in remote mode.	SETTING	Enable/Disable	Enable
1.6.2.	**Low oil alarm** This parameter is factory set. If oil level switch is present, this parameter can be used to enable or disable the "Low Oil" Alarm	SETTING	Enable/Disable	Disable
1.6.3.	**Lost communication alarm** The actuator will raise the alarm when there is no communication between the host and the actuator.	SETTING	Enable/Disable	Disable
1.7.	**Reset**			
1.7.1.	**Factory reset** Resets: LED Colors, Local Control, relay 1 function, relay 2 function, relay 3 function, relay 4 function, relay 5 function, relay 1 setting, relay 2 setting, relay 3 setting, relay 4 setting, relay 5 setting, valve stall delay, Logjam, self calibration cycle count, pressure unit, Self-Calibration Pressure Spike, Thermal Accumulator Pre-charge, baud rate, parity, LSA, LSB, Partial Stroke Test, PST Travel Range, PST Pause Time, Hardwire ESD, Lost Communication ESD, Host ESD, ESD override Motor, analog output 1 Source, analog output 2 Source, Lost Analog, Lost Analog Input Action, Setpoint for Lost AI, Lost Analog Alarm Delay, analog input polarity close, analog output polarity close, Setpoint Tracking	COMMAND	-	-

Table 15. Configuration Table (3)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
2.	**Configuration**	-		
2.1.	**Control parameter**	-		
2.1.1.	**Control mode** Set the method of remote control. See wiring diagram for remote control configurations.	SETTING	2-Wire, 3-Wire, 4-Wire, Analog, Network	2 Wire
2.1.2.	**Local control** Set the Biffi EHO's local control OPEN/CLOSE selector switch to momentary or maintained. Momentary is described as a quick toggle of the OPEN/CLOSE selector knob will complete the stroke. Maintained is described as holding the OPEN/CLOSE selector knob to complete the stroke. If the OPEN/CLOSE selector knob is released, the actuator will stop in that position.	SETTING	Momentary, Maintained	Momentary
2.1.3.	**Write protect** By enabling write protect, the user can prevent the actuator from configuration changes through HART and FOUNDATION Fieldbus Communication.	SETTING	Enable/Disable	Disable
2.1.4.	**Control bandwidth** Set the Biffi EHO position control minimum resolution in %.	SETTING	0.5 to 5.0%	0.50%
2.1.5.	**Operating pressure** Set the maximum hydraulic operating pressure of the Biffi EHO during standard operation. If the hydraulic pressure exceeds the Operating Pressure setting, an Over Pressure Alarm will be displayed. Note: This value must be set to be equal to the maximum operating pressure on your actuator's general arrangement drawing.	SETTING	2300 to 5000 psi	1000
2.1.6.	**Thermal accumulator pre-charge** Note: This will be factory set and must be set to be equal to the thermal accumulator pre-charge pressure on your actuator's general arrangement drawing. Set the Thermal Accumulator Pressure value.	SETTING	500-Operating Pressure	1000
2.2.	**Alarm configuration**	-		
2.2.1.	**Valve stall delay** Set the Biffi EHO's time duration (in seconds) to move the valve position 1% before a valve stall alarm is initiated.	SETTING	5 to 30 seconds	20 seconds
2.2.2.	**Hydraulic fault delay** Set the Biffi EHO's time duration (in seconds) to run without building pressure before a Hydraulic Fault alarm is initiated.	SETTING	5 to 30 seconds	10
2.2.3.	**CPU reset alarm** Alarm will be active when CPU power has been lost. This alarm will be active upon power restoration and must be reset to clear the alarm. Note: This alarm is not critical to the unit and is for feedback only.	COMMAND	Enable/Disable	Enable
2.2.4.	**Communication alarm**	-		
2.2.4.1.	**Lost communication alarm delay** Delay before activating alarm for loss of communication.	SETTING	5 to 60 seconds	5
2.2.4.2.	**Communication fail action** This determines the position the actuator will go upon loss of communication alarm.	SETTING	Stay Put, Fail-Safe	Stay Put

Table 16. Configuration Table (4)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
2.2.5.	**ESD alarm**	-		
2.2.5.1.	**Hardwire ESD completion** Time allowed for the actuator to close through external ESD before displaying a valve drift alarm. If the actuator completes the ESD stroke within this time limit the actuator will display an ESD alarm. Only applicable when Hardwire ESD Feedback is disabled. Note: This will be factory set.	SETTING	3 to 60 seconds	20
2.2.5.2.	**Lost communication ESD** Enable the Biffi EHO to go to fail-safe position on loss of communication. Follows the same delay as Lost Communication Alarm Delay.	SETTING	Enable/Disable	Disable
2.2.5.3.	**Host ESD action** Action to be taken if Enable ESD from Lost Communication or Enable ESD from Host is enabled. Note: This will be factory set.	SETTING	Stay Put, Fully Open, Fully Close	Stay Put
2.2.5.4.	**Hardwire ESD reset action** In Remote Mode actuator shall Move to configured position once Hardwired ESD power is restored.	SETTING	Disable, Stay Put, Fully Open, Fully Close	Disable
2.2.5.5.	**ESD override motor** Configure the Biffi EHO to allow the host to override a Motor Thermal Alarm with a software ESD command.	SETTING	Enable/Disable	Enable
2.2.6.	**Analog alarm**	-		
2.2.6.1.	**Lost analog input action** Configure the actuator to move to a configurable position when analog input signal is lost. The actuator must be set up for analog input and the configurable position can be configured only through the DCMlink.	SETTING	Stay Put, Analog Setpoint	Analog Setpoint
2.2.6.2.	**Lost analog alarm delay** If Analog Signal is disconnected, then Lost Analog Alarm would be generated after this delay.	SETTING	0 to 60 seconds	1 second
2.3.	**Discrete input**	-		
2.3.1.	**Discrete input 1**	-		
2.3.1.1.	**DI1 setting** Note: Not configurable over LDM.	FEEDBACK ONLY	Active on Close Contact, Active on Open Contact	-
2.3.1.2.	**DI1 function** Note: This is factory set and cannot be changed.	FEEDBACK ONLY	Open	Open
2.3.2.	**Discrete input 2**	-		
2.3.2.1.	**DI2 setting** Note: Not configurable over LDM.	FEEDBACK ONLY	Active on Close Contact, Active on Open Contact	-
2.3.2.2.	**DI2 function** Note: This is factory set and cannot be changed.	FEEDBACK ONLY	Close	Close
2.3.3.	**Discrete input 3**	-		
2.3.3.1.	**DI3 setting** Note: Not configurable over LDM.	FEEDBACK ONLY	Active on Close Contact, Active on Open Contact	-
2.3.3.2.	**DI3 function** DI3 is a Stop input if control mode is set to four wire. If control mode is two or three wires, DI3 will be a PST input. Note: This is factory set and cannot be changed.	FEEDBACK ONLY	Stop/PST	Stop/PST

Table 17. Configuration Table (6)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
2.3.4.	**Discrete input 4**	-		
2.3.4.1.	**DI4 setting** Note: Not configurable over LDM.	FEEDBACK ONLY	Active on Close Contact, Active on Open Contact	-
2.3.4.2.	**DI4 function** Note: This is factory set and cannot be changed.	FEEDBACK ONLY	Low Oil Alarm	Low Oil Alarm
2.3.5.	**Discrete input 5**	-		
2.3.5.1.	**DI5 setting** Note: Not configurable over LDM.	FEEDBACK ONLY	Active on Close Contact, Active on Open Contact	-
2.3.5.2.	**DI5 function** Note: This is factory set and cannot be changed.	FEEDBACK ONLY	N/A	N/A
2.3.6.	**Discrete input 6**	-		
2.3.6.1.	**DI6 setting** Note: Not configurable over LDM.	FEEDBACK ONLY	Active on Close Contact, Active on Open Contact	-
2.3.6.2.	**DI6 function** Note: This is factory set and cannot be changed.	FEEDBACK ONLY	Hardwire ESD	Hardwire ESD
2.4.	**Discrete output**	-		
2.4.1.	**Relay 1**	-		
2.4.1.1.	**Relay 1 function** Set Biffi EHO's configurable relays to provide various actuator status indication.	SETTING	LSO, LSC, Switch A, Switch B, Opening, Closing, Moving, Local, Stop, Remote, Valve Drift, Valve Stall, Overpressure, Power Monitor, Phase Monitor, Motor Thermal, Hardwire ESD, Host ESD, Emergency Stop, ESD Active, Lost Analog, Hardwire Fail, Actuator Fail, SOV Fail, Hydraulic Fail, Self-Calibration Fail, Unit Alarm, Generic	LSO
2.4.1.2.	**Relay 1 setting** Configure Relay 1 to provide either a continuous or flashing signal if Relay 1 Function is met. Flashing will be in 1 second intervals.	SETTING	NC Continuous, NC Flashing, NO Continuous, NO Flashing	NC Continuous

Table 18. Configuration Table (8)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
2.4.2.	**Relay 2**	-		
2.4.2.1.	**Relay 2 function** Set Biffi EHO's configurable relays to provide various actuator status indication.	SETTING	LSO, LSC, Switch A, Switch B, Opening, Closing, Moving, Local, Stop, Remote, Valve Drift, Valve Stall, Overpressure, Power Monitor, Phase Monitor, Motor Thermal, Hardwire ESD, Host ESD, Emergency Stop, ESD Active, Lost Analog, Hardwire Fail, Actuator Fail, SOV Fail, Hydraulic Fail, Self-Calibration Fail, Unit Alarm, Generic	LSC
2.4.2.2.	**Relay 2 setting** Configure Relay 2 to provide either a continuous or flashing signal if Relay 2 Function is met. Flashing will be in 1 second intervals.	SETTING	NC Continuous, NC Flashing, NO Continuous, NO Flashing	NC Continuous
2.4.3.	**Relay 3**	-		
2.4.3.1.	**Relay 3 function** Set Biffi EHO's configurable relays to provide various actuator status indication. Note: Partial Stroke Test (20) PASS indication will be available on this relay only.	SETTING	LSO, LSC, Switch A, Switch B, Opening, Closing, Moving, Local, Stop, Remote, PST Pass, Valve Drift, Valve Stall, Overpressure, Power Monitor, Phase Monitor, Motor Thermal, Hardwire ESD, Host ESD, Emergency Stop, ESD Active, Lost Analog, Hardwire Fail, Actuator Fail, SOV Fail, Hydraulic Fail, Self-Calibration Fail, Unit Alarm, Generic	Switch A
2.4.3.2.	**Relay 3 setting** Configure Relay 3 to provide either a continuous or flashing signal if Relay 3 Function is met. Flashing will be in 1 second intervals.	SETTING	NC Continuous, NC Flashing, NO Continuous, NO Flashing	NC Continuous

Table 19. Configuration Table (10)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
2.4.4.	**Relay 4**	-		
2.4.4.1.	**Relay 4 function** Set Biffi EHO's configurable relays to provide various actuator status indication. Note: Partial Stroke Test (20) FAIL indication will be available on this relay only. Note: Generic (Host Control) - Host can activate, deactivate, or control the relay.	SETTING	LSO, LSC, Switch A, Switch B, Opening, Closing, Moving, Local, Stop, Remote, PST Fail, Valve Drift, Valve Stall, Overpressure, Power Monitor, Phase Monitor, Motor Thermal, Hardwire ESD, Host ESD, Emergency Stop, ESD Active, Lost Analog, Hardwire Fail, Actuator Fail, SOV Fail, Hydraulic Fail, Self-Calibration Fail, Unit Alarm, Generic	Switch B
2.4.4.2.	**Relay 4 setting** Configure Relay 4 to provide either a continuous or flashing signal if Relay 4 Function is met. Flashing will be in 1 second intervals.	SETTING	NC Continuous, NC Flashing, NO Continuous, NO Flashing	NC Continuous
2.4.5.	**Relay 5**	-		
2.4.5.1.	**Relay 5 function** Relay 5 as Host Control: 1. Purpose: To change the status of the Relay over Communication protocol. 2. Condition to Turn Relay Status NO to NC: determined by Host system logic where the host system may send a command over Communication protocol (Modbus/HART/ FF. etc.) to the Status of the Relay 5. Relay 5 as Monitor Relay: 1. Purpose: The purpose of Relay 5 "Monitor Relay" is to indicate the Actuator is suitable to operate remotely. 2. Condition to turn Relay Status NO to NC: One or more than one of the following events/Alarms is true - Selector Knob not in Remote, Motor Thermal Alarm is Active, Actuator Fail is Active, Over Pressure Alarm is Active, Valve Stall is Active, Lost Analog Signal is Active. Relay 5 as Unit Alarm: 1. Purpose: The purpose of this Relay Functionality "Unit Alarm" is to monitor any alarm active in the Actuator (Except CPU Reset Alarm). 2. Condition to Turn Relay Status NO To NC: Any one or more than one Alarm in EHO Irrespective of Selector Knob position (Local/ Remote/OFF). Relay 5 as Lost Main Power must be set to continuous (Resets upon Main Power Restoration): 1. The Relay would set on Main Power ON. The Relay Set/Reset irrespective of Actuator Status and knobs position. Open contact on loss of main power connect to terminals 17 and 18. Close contact on loss of main power connect to terminals 18 and 19.	SETTING	Generic, Monitor Alarm, Unit Alarm, Lost Main Power	Unit Alarm
2.4.5.2.	**Relay 5 setting** Configure Relay 5 to provide either a continuous or flashing signal if Relay 5 Function is met. Flashing will be in 1 second intervals. Flashing will not work for loss of main power option.	SETTING	Continuous, Flashing	Continuous

Table 20. Configuration Table (11)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
2.5.	**Feedbacks**	-		
2.5.1.	**LED colors** Change color of LEDs used to indicate actuator status (Open/Close/Opening/Closing).	SETTING	Close Red, Close Green	Close Red
2.5.2.	**Limit switch A** Set the Biffi EHO's limit switch range in %. The limit switch will be triggered on between 0% and the limit switch trigger setpoint. Any position greater than the limit switch trigger setpoint, the limit switch will be triggered off.	SETTING	0 to 100% (Open)	25% Open
2.5.3.	**Limit switch B** Set the Biffi EHO's limit switch range. The limit switch will be triggered on between the limit switch trigger setpoint and 100%. Any position less than the limit switch trigger setpoint, the limit switch will be triggered off.	SETTING	0 to 100% (Open)	75% Open
2.6.	**Analog input**	-		
2.6.1.	**Setpoint for lost AI** Configure the actuator to move to a setpoint (0% to 100%) if Analog signal is lost.	SETTING	0 to 100%	30%
2.6.2.	**Analog input polarity** Configure the analog input signal to be reversed to 20 to 4 mA for close - open.	SETTING	4 mA Closed, 4 mA Open	4 mA Closed
2.7.	**Analog output**	-		
2.7.1.	**Analog output 1 source** Configure the Analog Output1 Source to provide feedback on various parameters from the actuator to the host system. Note: When Analog Output 1 source is configured as Network, the host system feeds the actuator a 4 to 20 mA value which is replicated over the Analog Output 1 channel.	SETTING	Position, Setpoint, Network, Hydraulic Circuit	Position
2.7.2.	**Analog output 2 source** Configure the Analog Output 2 Source to provide feedback on various parameters from the actuator to the host system. Note: When Analog Output 2 source is configured as Network, the host system feeds the actuator a 4 to 20 mA value which is replicated over the Analog Output 1 channel.	SETTING	Position, Setpoint, Network, Hydraulic Circuit	Hydraulic Circuit
2.7.3.	**Analog output polarity** Configure the analog output signal to be reversed to 20 to 4 mA for zero-span. Note this will reverse the analog signals configured in Analog Output 1 and Analog Output 2.	SETTING	4 mA Closed, 4 mA Open	4 mA Closed

Table 21. Configuration Table (12)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
2.8.	**Network setup**	-		
2.8.1.	**Network adapter** Set the communication protocol for the Biffi EHO. Note: This will be factory set.	SETTING	None, Modbus E>NET, Modbus, Modbus TCP/IP, Control Linc, Device Net, FF Block Mode, FF Mod. Mode, Profibus, HART Block Mode, HART Mod. Mode	Modbus E>NET
2.8.2.	**Network address** Set the node address/slave address for the Biffi EHO. A unique node address/slave address must be assigned for each Biffi EHO in a multi-actuator network.	SETTING	0 to 253	1
2.8.3.	**Baud rate** Set the baud rate for the Biffi EHO.	SETTING	4800, 9600, 19200, 38400, 57600, 115200	19200
2.8.4.	**Parity** Set the parity for the communication port in the Biffi EHO.	SETTING	Even, Odd, None	None
2.8.5.	**Stop bits** Number of stop bits in communication protocol.	SETTING	1 to 2	1
3.	**Calibration**	-		
3.1.	**Self-calibration** Self-calibration establishes the position range of the Biffi EHO actuator. The EHO has the ability to automatically find its precise full open and full close set points after adjustments to the mechanical stops is completed. Pressure related self-calibration parameters are set at the factory and should not require adjustment.	-		
3.1.1.	**Start self-calibration** Initiate the Biffi EHO to start the self-calibration procedure.	COMMAND	-	-
3.1.2.	**Cycle count** Set the number of full cycles for the Biffi EHO to cycle during self-calibration. One cycle is defined as one open and one close stroke.	SETTING	2 to 3	2
3.1.3.	**Pressure spike** Set the maximum hydraulic pressure of the Biffi EHO during self-calibration. Note: This setting is for motor-based Biffi EHO's only.	SETTING	500 to 5000 psi	1000 psi
3.1.4.	**Self-calibration status** Indicates whether the last self-calibration passed, failed, or aborted.	STATUS	-	-
3.2.	**Analog input**	-		
3.2.1.	**Analog input 1 calibration** Calibrate Analog Input Channel with External Current Source. External current source needs to be connected to source 4 mA then 20 mA equivalent signal when the Display indicates. The signal has to be in the range 3.6 to 22 mA.	COMMAND	-	-
3.3.	**Analog output**	-		
3.3.1.	**Analog output 1** Calibrate Analog Output 1 Channel 4 mA equivalent and 20 mA equivalent.	COMMAND	-	-
3.3.2.	**Analog output 2** Calibrate Analog Output 2 Channel 4 mA equivalent and 20 mA equivalent.	COMMAND	-	-

Table 22. Configuration Table (12)

Menu Location	Parameter	Prameter Type	Parameter Options	Default Value
4.	**Diagnostic**	-		
4.1.	**Active alarms** Displays all the alarms present in system. The alarms need to be scrolled manually.	-		
4.2.	**Partial stroke test** Unit will stroke partially closed from open to diagnose any issues.	-		
4.2.1.	**Start PST** Initiate the local partial stroke test using the LDM.	COMMAND	-	-
4.2.2.	**PST status** Status of the last PST. This would indicate if the last PST passed, failed, or aborted.	STATUS	-	-
4.2.3.	**PST travel range** Configure the percent range the Biffi EHO will stroke the valve during the partial stroke test.	SETTING	1 to 30% (Close)	30%
4.2.4.	**PST pause time** Configure the time the Biffi EHO will pause at the position at the of the partial stroke test before returning to the position prior to initiating the partial stroke test.	SETTING	1 to 30 seconds	5 seconds

8.5 Alarms

To find the list of active alarms, navigate to the menu location 4.1 Active Alarms in the setup menu. To enter and navigate the setup menu, see Section 8.1, Entering the Setup Menu.

Table 23. Alarm Table (1)

Menu Name	Default Action
Alarms	N/A
Solenoid Valve Alarm Alarm will activate when a coil failure in the solenoid has been detected.	Stay Put ESD (hardwire, host) function remains active
Pressure Transmitter Alarm Alarm will activate when the signal from the pressure transmitter has been lost.	Stay Put ESD (hardwire, host) function remains active
Encoder Alarm Alarm will activate when the signal from the position encoder has been lost.	Stay Put ESD (hardwire, host) function remains active
Over Pressure Alarm Alarm will activate when the hydraulic pressure of the Biffi EHO exceeds the configured maximum operating pressure. Note: alarm will clear when pressure goes below maximum operating pressure.	Stay Put - Accumulator No Action - Motor-based Note: in description, explain no action/stay put No action = can still control
Partial Stroke Test Fail Alarm Alarm will activate when another alarm occurs during the partial stroke test, or if the partial stroke test is aborted by the user remotely or locally.	Action taken based on Failure Alarm Stay put when aborted by user until another command is given
Lost Communication Alarm Alarm will activate when the communication signal is lost. The alarm is disabled by default.	Stay Put
Valve Stall Alarm Alarm will activate when Biffi EHO fails to move upon command. If log jam is enabled, the Biffi EHO will initiate log jam sequence. If log jam sequence is unsuccessful in moving the valve, the Valve Stall Alarm will activate.	Stay Put
Hardwired ESD Alarm Alarm will activate when ESD event occurs with its associated ESD signal.	Fail-Safe Position
Host Command ESD Alarm Alarm will activate when ESD command is sent over a communication protocol from the host system to the Biffi EHO. The alarm will remain until the ESD command is removed. (Note to self): This uses the coarse solenoid to go to the fail-safe position.	Fail-Safe Position
Phase Monitor Alarm Alarm will activate when the phase sequence is incorrect. This only applies to three phase power systems. (Note to self): Phase 3: if the phase sequence is reversed, the Biffi EHO will correct the rotation.	Stay Put
Motor Thermal Alarm Alarm will activate when the thermostat within the windings of the motor exceeds the recommended operating temperature. The motor will stop running. Once the motor temperature returns to the recommended operating temperature, the [ta] alarm will automatically clear. Note: The Hydraulic Power Unit Fault Alarm[Ha] alarm will also activate if the Biffi EHO has not moved to the desired position given to the actuator. After the [ta] alarm is cleared, the unit will require an additional movement command to clear the [Ha] alarm.	On/Off: Stay Put(until [ta] alarm is cleared) Modulating: Continues stroke with Modulating Accumulator with remaining pressure
Emergency Stop Alarm Alarm will activate if an optional emergency stop switch breaks continuity between terminals 20 and 22.	Stay Put

Table 24. Alarm Table (2)

Menu Name	Default Action
Valve Drift Alarm Alarm will activate when the Biffi EHO detects the valve has moved more than the bandwidth setting configured in Position Control Bandwidth [Pb]. The Biffi EHO will attempt to re-position the valve to the original desired set position. If the Biffi EHO successfully positions itself back to the original desired set position, the alarm will deactivate.	Go To Set Position
Power Monitor Alarm Alarm will activate when the Biffi EHO loses power.	Go To Loss of Power Position
Lost Analog Input Alarm Alarm will activate when Biffi EHO is configured for analog control in Control Mode [CO] Configuration 3 and the analog signal is lost. Enable Lost Analog Input 1 Alarm [Ae] must be enabled to activate the Lost Analog Input Alarm.	Alarm Reports Only. Action will be taken per Lost Analog Input Action [AL] configuration
Invalid Analog Input Range Alarm Alarm will activate when the analog input signal is not within the analog 4 to 20 mA input range. Note: Will accept 3.6 to 22 mA before giving the alarm	Stay Put
Hydraulic Power Unit Fault Alarm Alarm will activate when a movement command is given to the Biffi EHO and the pressure and position of the Biffi EHO does not change as expected within 10 seconds. The alarm will also activate when the motor does not operate as expected. (Note to self): This alarm is associated to the solenoids, pump and motor group, relief, accumulator failure, pump unable to build pressure, leak in the hydraulic system, motor is reversed in three-phase power).	Stay Put (until all alarms are cleared and next command is given)
Actuator Fail Alarm Alarm will activate when the motor thermal contact trips, position encoder fails, or phase sequence is incorrect.	Alarm Reports Only
Limit Not Set Alarm Alarm will activate if the travel limits have not been configured. Self-calibration must be performed to deactivate this alarm.	Alarm Reports Only
Electronic Fault Alarm will be activated if there is a failure in any of the following: 1) Encoder communication 2) DAC communication 3) ADC communication 4) IOM Board SPI communication 5) Field Board SPI communication 6) EEPROM communication 7) RDM 8) Network CAM 9) Digital Inputs 10) Reversible Contactor 11) CPU Hardware	Stay put
Battery Low Alarm Alarm will be activated if RTC Battery Voltage drops below the permissible limit.	Alarm Reports Only
Beyond Limits Alarm will be generated if Actuator moves beyond permissible limits.	Alarm Reports Only
Low Oil Alarm Alarm will activate if the Oil level drops below the permissible limit.	Alarm Reports Only
Motor Over Run Alarm Alarm will activate if the motor runtime exceeds the duty cycle of the motor.	Motor Run Stop Alarm Reports Only

Section 9: Troubleshooting

⚠ WARNING

To prevent personal injury, the actuator must be in spring-return, fail-safe position and all hydraulic pressure drained, including an optional accumulator, before opening any tube lines or attempting replacement operations below.

Of all the system components, the actuator itself is least likely to malfunction and require the most time and effort to service.

Table 25. Troubleshooting

Symptoms	Possible Reason
Biffi EHO does not turn on	1. Ensure voltage is adequate to the unit. 2. Check to see that the electrical power is connected to the correct terminals. 3. Branch circuit fuse blown out.
Biffi EHO is on, but alarm is flashing on the LCD display	1. Consult Section 8.5 for alarm details. 2. If operator is unsure how to clear the alarm, please contact factory for assistance.
Biffi EHO is on, but motor does not run	1. Ensure the Local/Off/Auto switch is in the proper position. 2. Ensure the customer field power wiring is an adequate size. 3. Power supply is insufficient. 4. Check to see if thermal overload is tripped. 5. Check Signal Integrity when operated Remotely.
Biffi EHO motor runs, but fails to develop sufficient pressure to open the valve	1. Low fluid level in reservoir. 2. Wrong motor shaft rotation. 3. Manual bypass valve (19) is open. 4. Hand pump isolation valve (8) is closed (if optional accumulator is provided). 5. ESD solenoid is not energized because signal power is insufficient. 6. The relief valve is cracking open. Check to ensure setting set to factory setting.
Biffi EHO will not return to the fail-safe position	1. Ensure the Local/Off/Auto switch is in the proper position when initiating the open/close command. 2. Hand pump isolation valve (8) is closed; preventing ability to stroke to the fail-safe position. 3. Ensure the closing and ESD speed control valves are open.

Should any issue be experienced besides the symptoms noted above, please consult factory.

Important check points for automatic operation of the Biffi EHO:

1. Ensure oil level is at the proper level.
2. Ensure bypass valve (19) is closed.
3. Ensure hand pump isolation valve (8) is open.
4. Check to see that the ESD (optional) signal power is on.

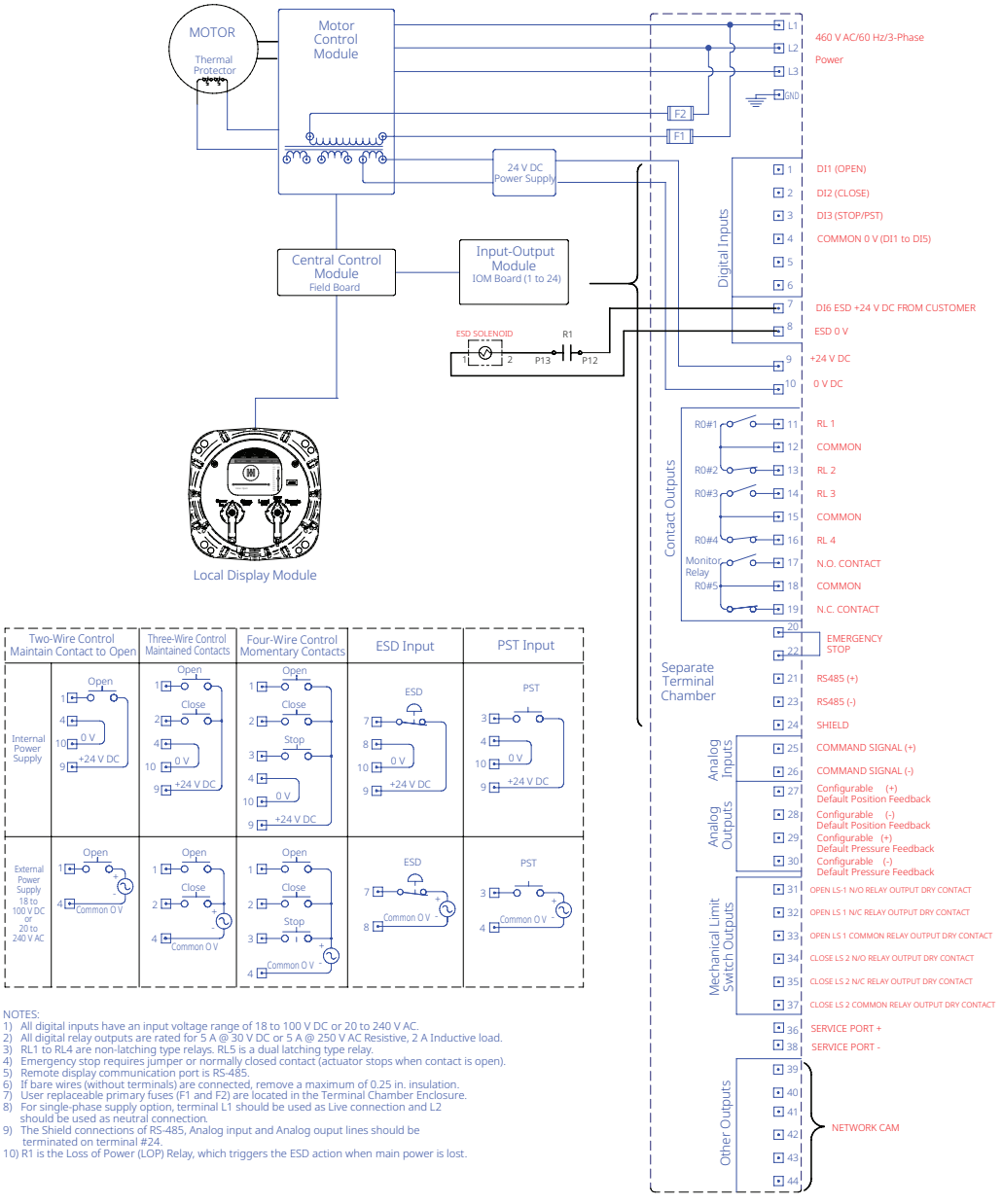
Section 10: Hazardous Area Classification and SIL Certification

- CSA, Canadian Standard Association Certification Class I, Division I, Groups, C and D. Group B configuration available upon request.
- FM, Factory Mutual Certification Class I, II, and III, Groups C, D, E, F, G, Division I, T4. Group B configuration upon request.
- ATEX Directive Exd IIB T4.
- IECEx Certificate of Conformity Ex d IIB T4.
- This product is only intended for use in large-scale fixed installations excluded from the scope of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2).
- SIL II or SIL III Certifications (depending on Biffi EHO configuration).

Section 11: General Wiring Diagram

11.1 Sample Wiring Diagram

Figure 26. Wiring Diagram



NOTES:
1) All digital inputs have an input voltage range of 18 to 100 V DC or 20 to 240 V AC.
2) All digital relay outputs are rated for 5 A @ 30 V DC or 5 A @ 250 V AC Resistive, 2 A Inductive load.
3) RL1 to RL4 are non-latching type relays. RL5 is a dual latching type relay.
4) Emergency stop requires jumper or normally closed contact (actuator stops when contact is open).
5) Remote display communication port is RS-485.
6) If bare wires (without terminals) are connected, remove a maximum of 0.25 in. insulation.
7) User replaceable primary fuses (F1 and F2) are located in the Terminal Chamber Enclosure.
8) For single-phase supply option, terminal L1 should be used as Live connection and L2 should be used as neutral connection.
9) The Shield connections of RS-485, Analog input and Analog ouput lines should be terminated on terminal #24.
10) R1 is the Loss of Power (LOP) Relay, which triggers the ESD action when main power is lost.

LEGENDS:

PUSHBUTTON N.O. TYPE
PUSHBUTTON N.C. TYPE
EXTERNAL VOLTAGE SOURCE
EMERGENCY SWITCH - N.C. TYPE

Table 26. Terminal Assignment Based on Network Interface Type

Network Interface Type	Terminal Number	Signal Description
MODBUS	39	Channel A +
	40	Shield
	41	Channel A -
	42	Shield
	43	Channel B +
	44	Channel B -
HART	41	Output +
	42	Output -
	43	Input +
	44	Input -
FIELDBUS	42	Shield
	43	FIELDBUS +
	44	FIELDBUS -

NOTE:
If the HART interface cable has Shield connection, the Shield should be connected to Terminal #24.

11.2 Applicable Operating Diagram

This section contains the preliminary list of schematics that are representing the principle of functioning.

Figure 27. General Arrangement Hydraulic Schematic Drawing (SHARB001)

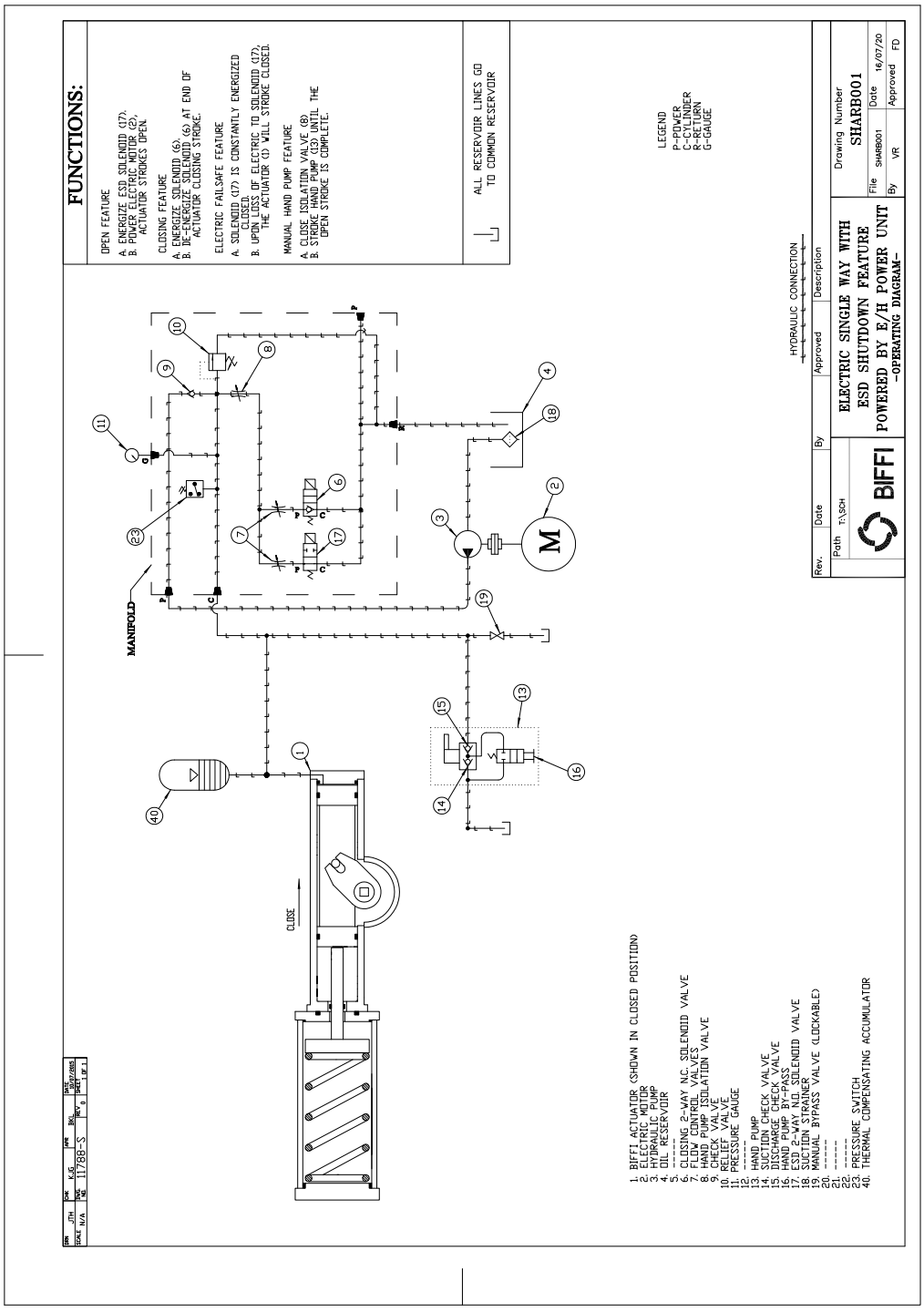


Figure 28. General Arrangement Hydraulic Schematic Drawing (SHARB002)

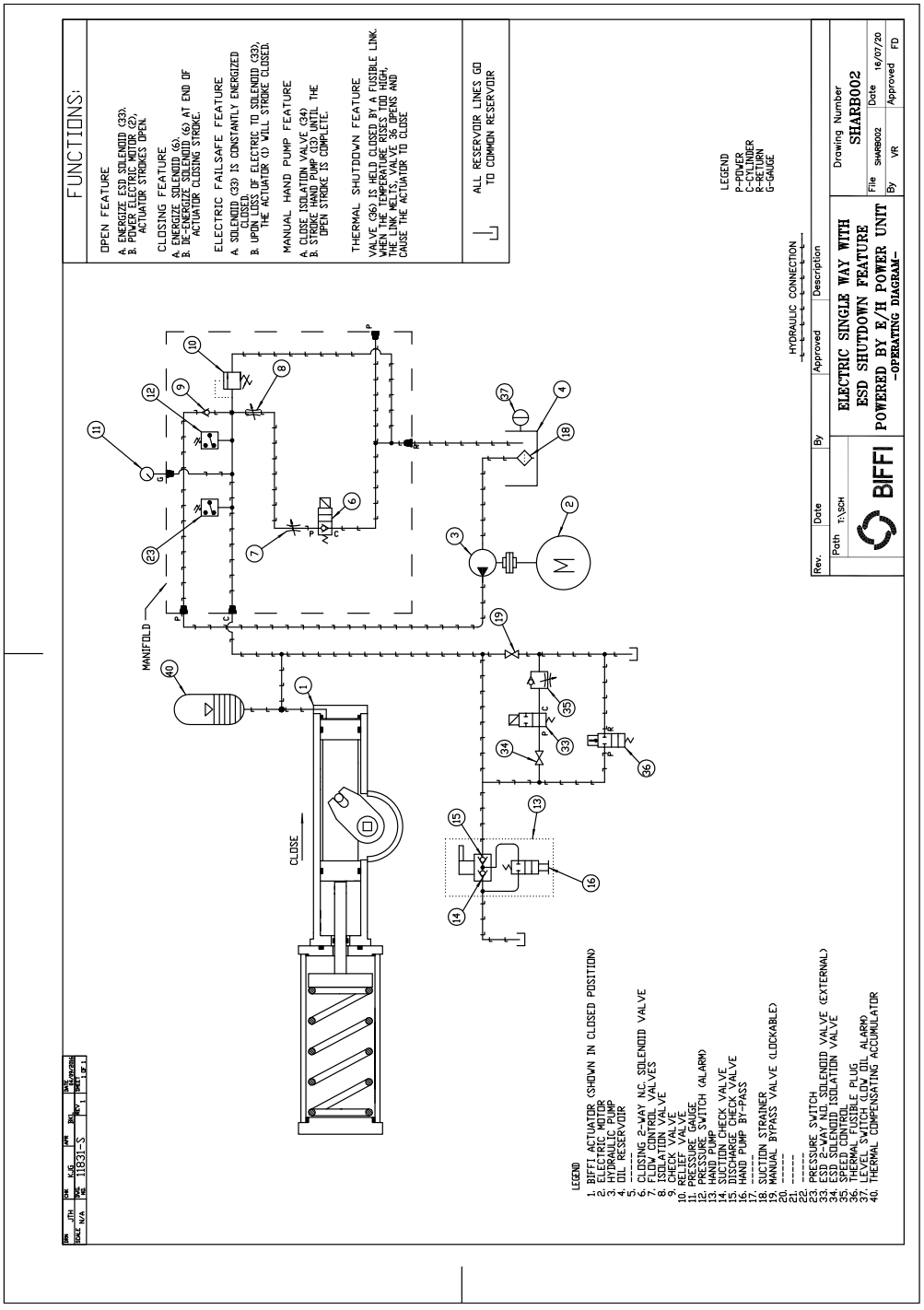


Figure 29. General Arrangement Hydraulic Schematic Drawing (SHARB003)

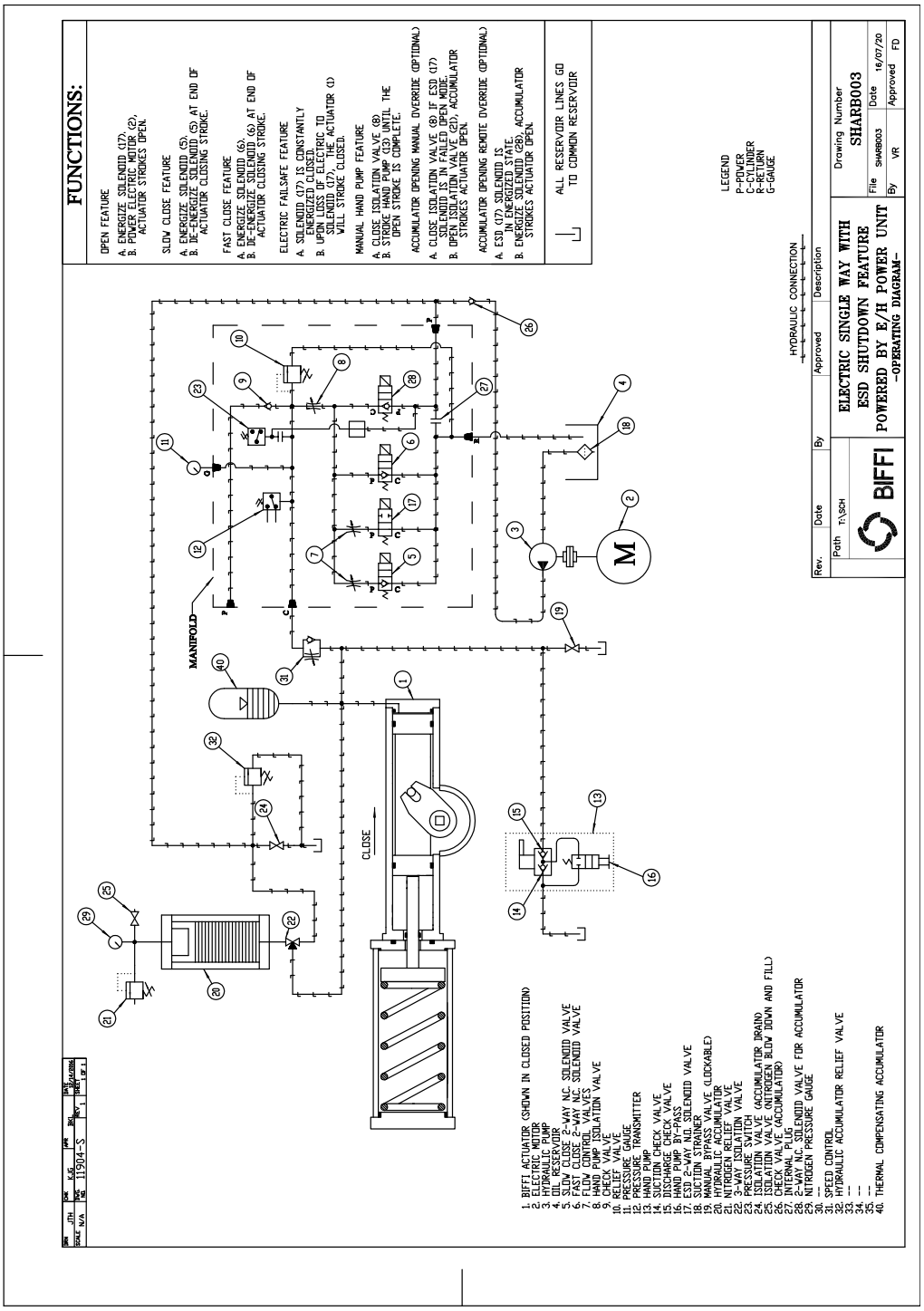


Figure 30. General Arrangement Hydraulic Schematic Drawing (SHARB004)

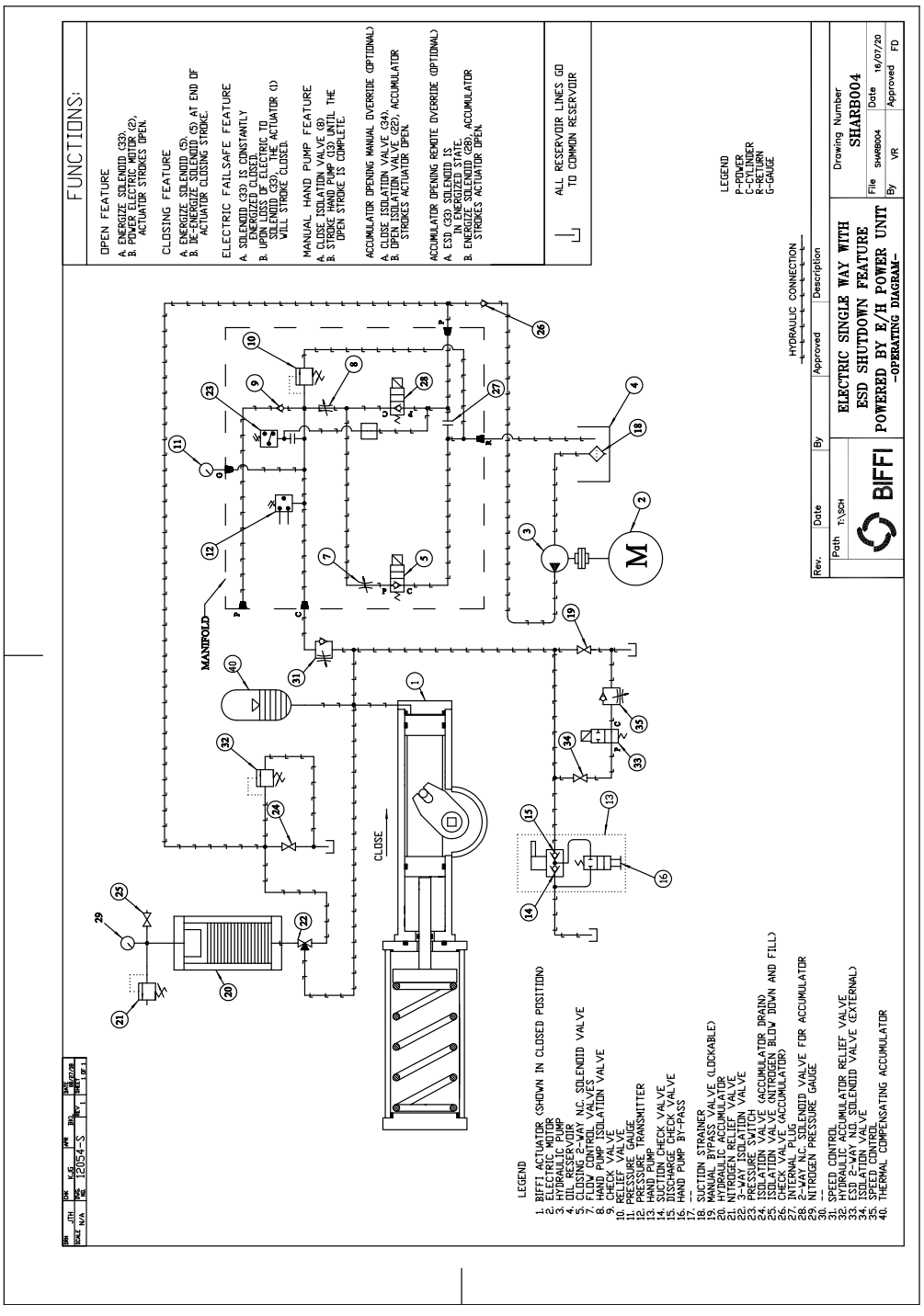


Figure 31. General Arrangement Hydraulic Schematic Drawing (SHARB005)

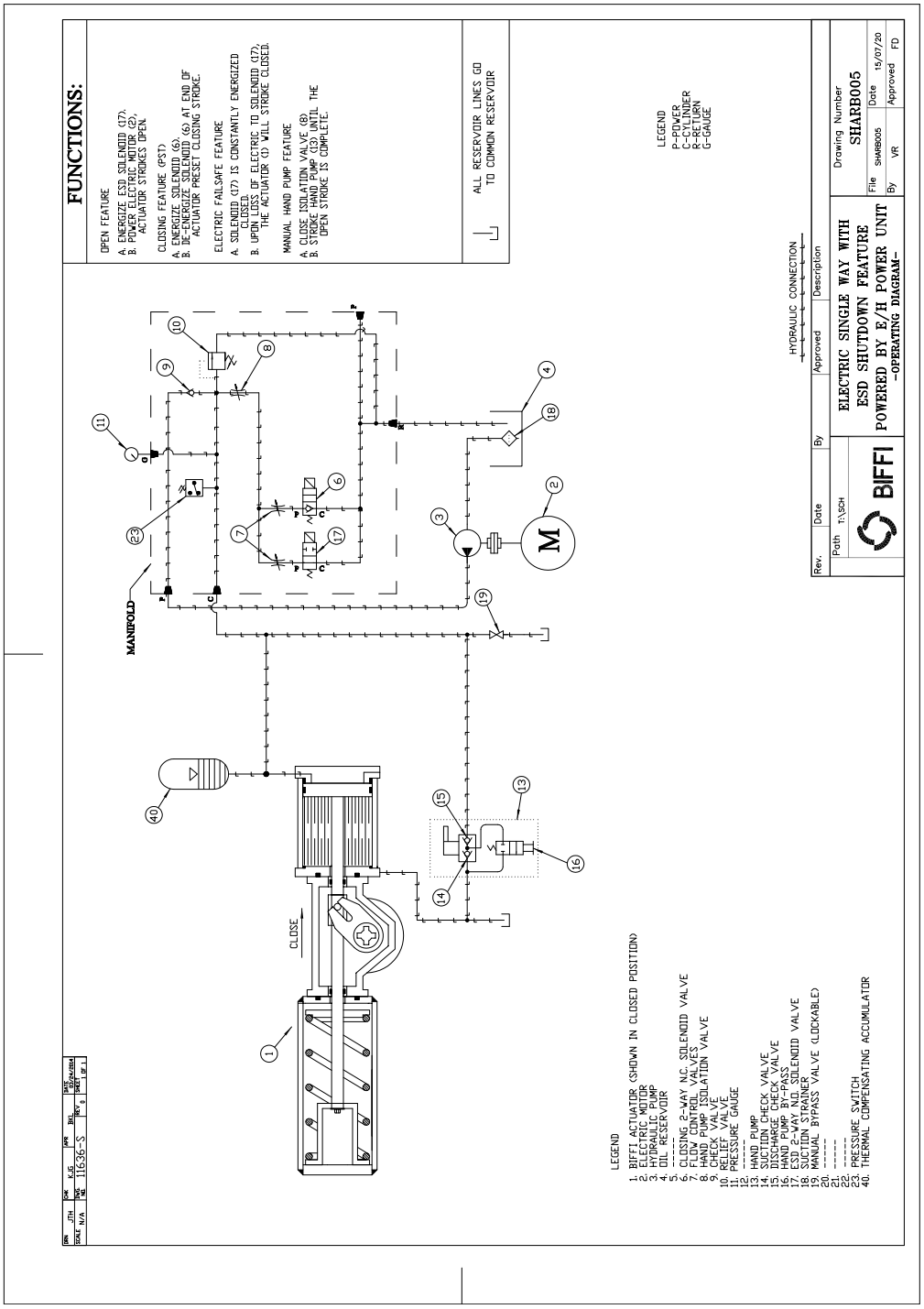


Figure 32. General Arrangement Hydraulic Schematic Drawing (SHARB006)

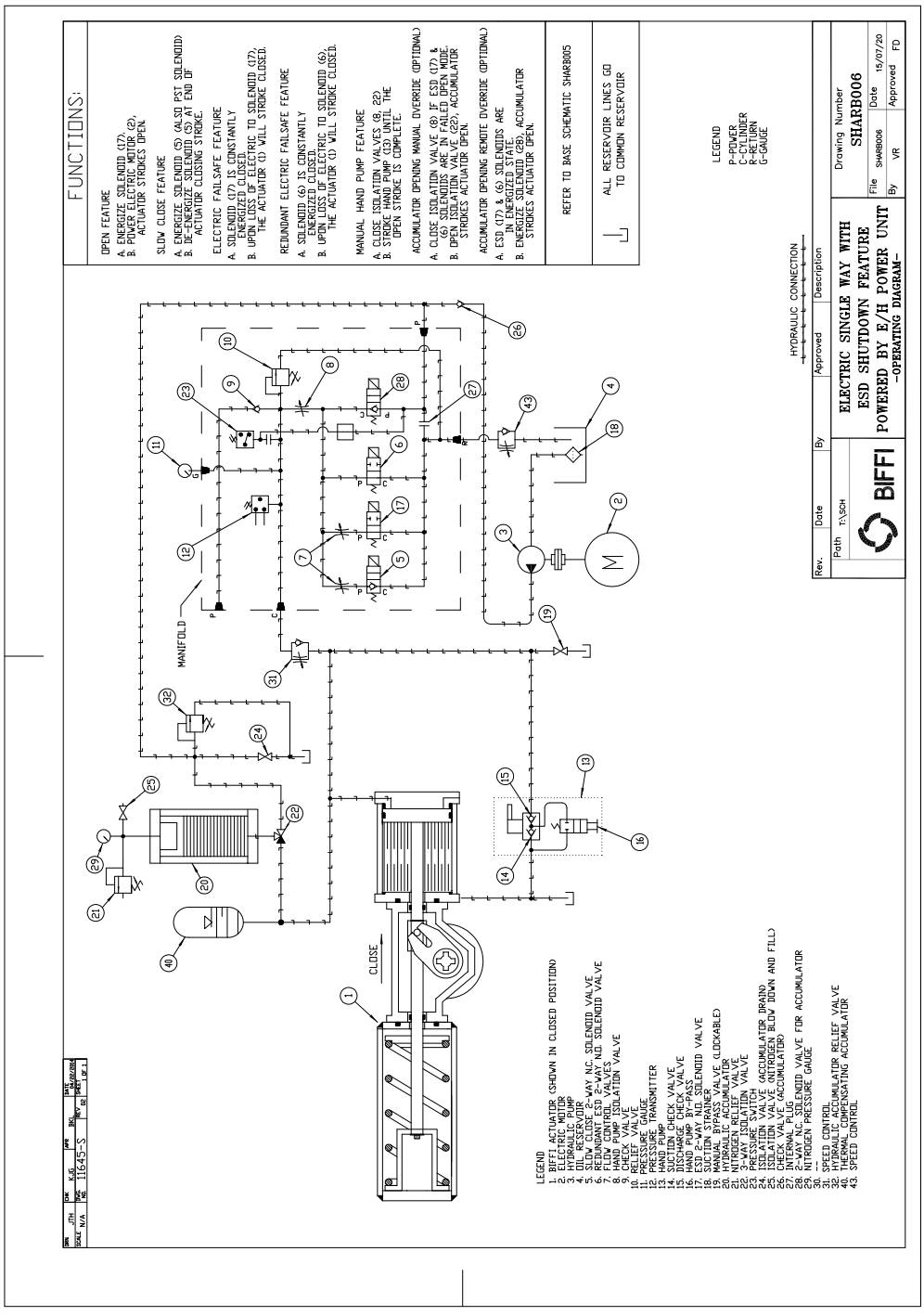


Figure 33. General Arrangement Hydraulic Schematic Drawing (SHARB007)

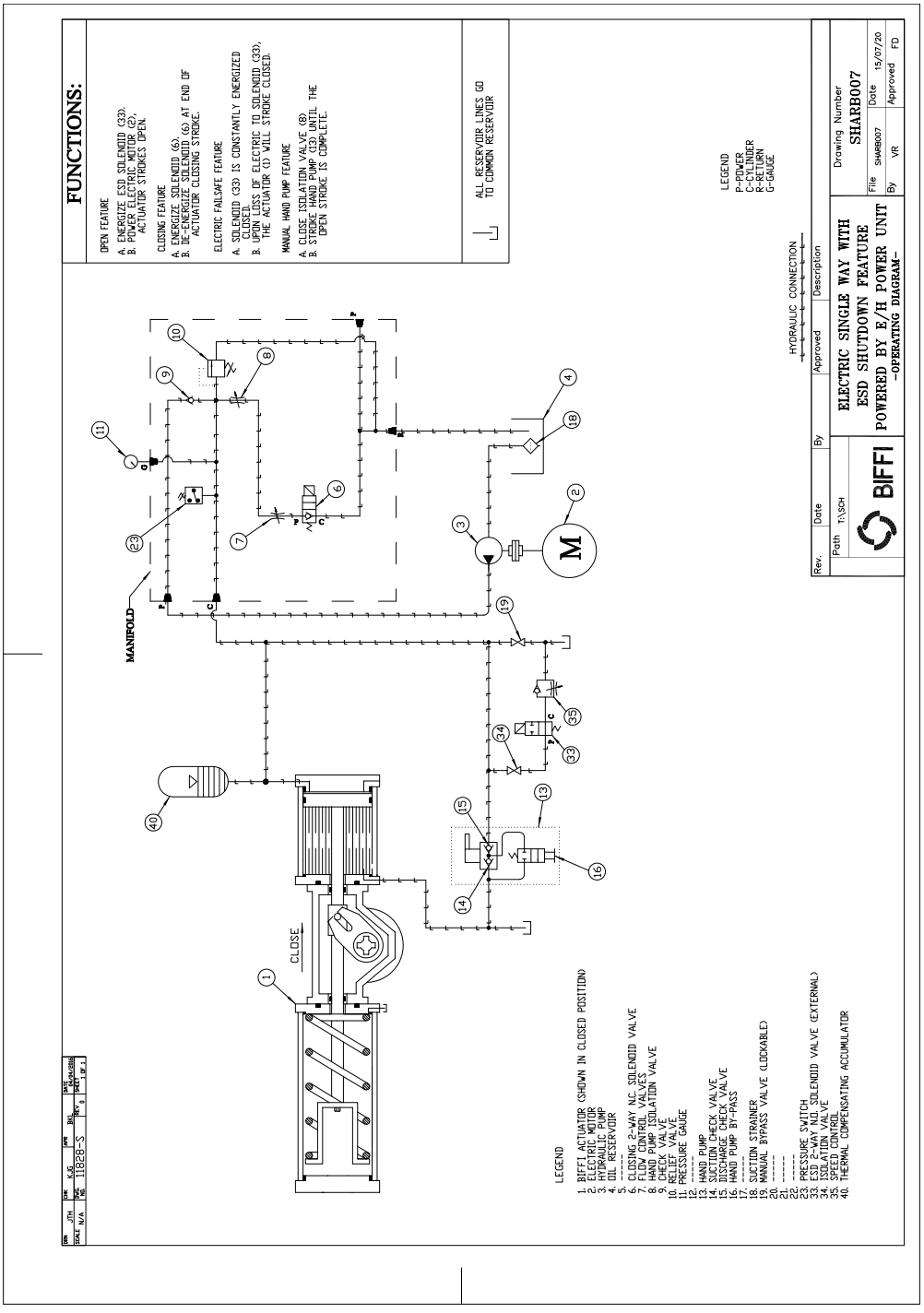


Figure 34. General Arrangement Hydraulic Schematic Drawing (SHARB008)

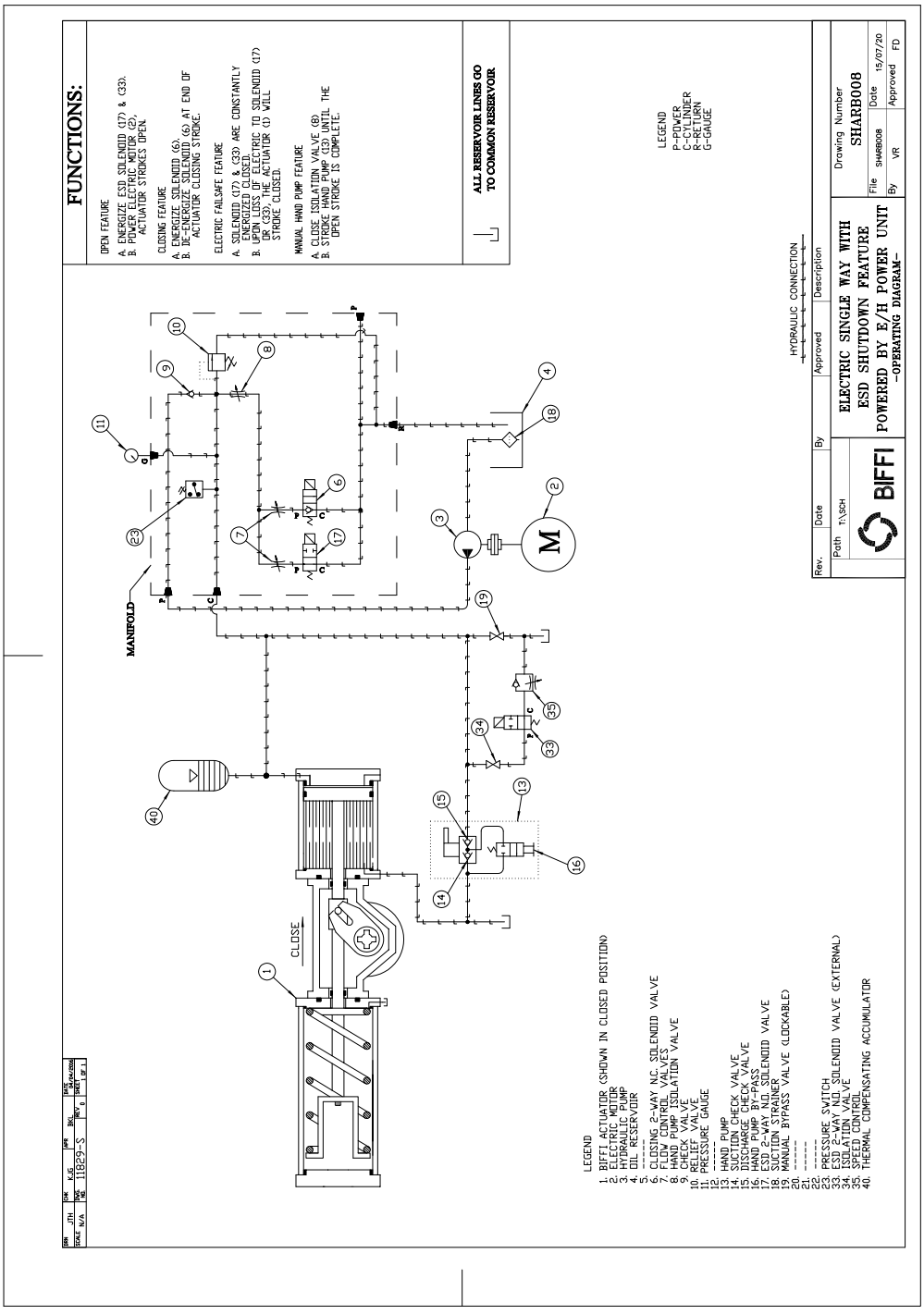


Figure 35. General Arrangement Hydraulic Schematic Drawing (SHARB009)

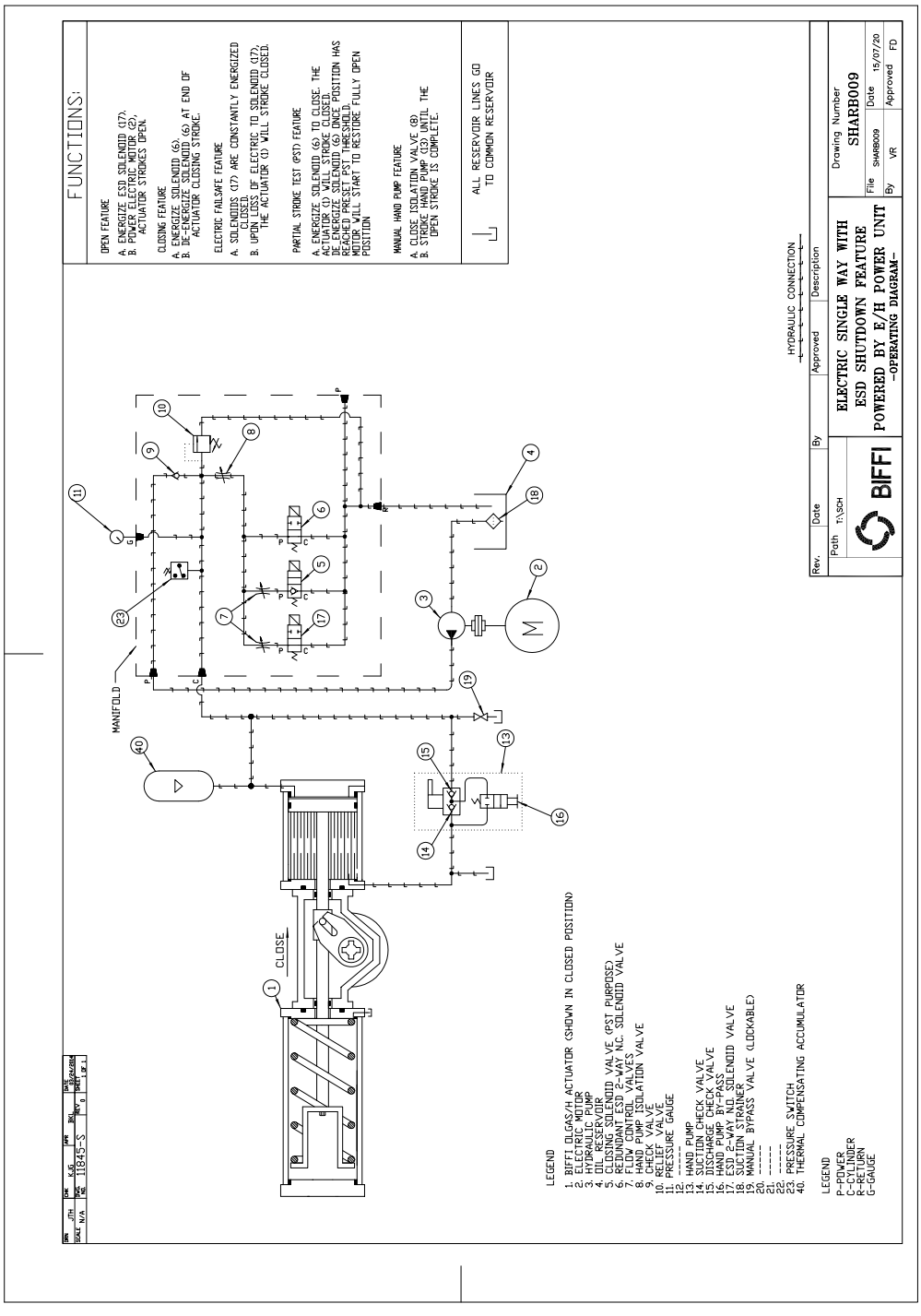


Figure 36. General Arrangement Hydraulic Schematic Drawing (SHARB010)

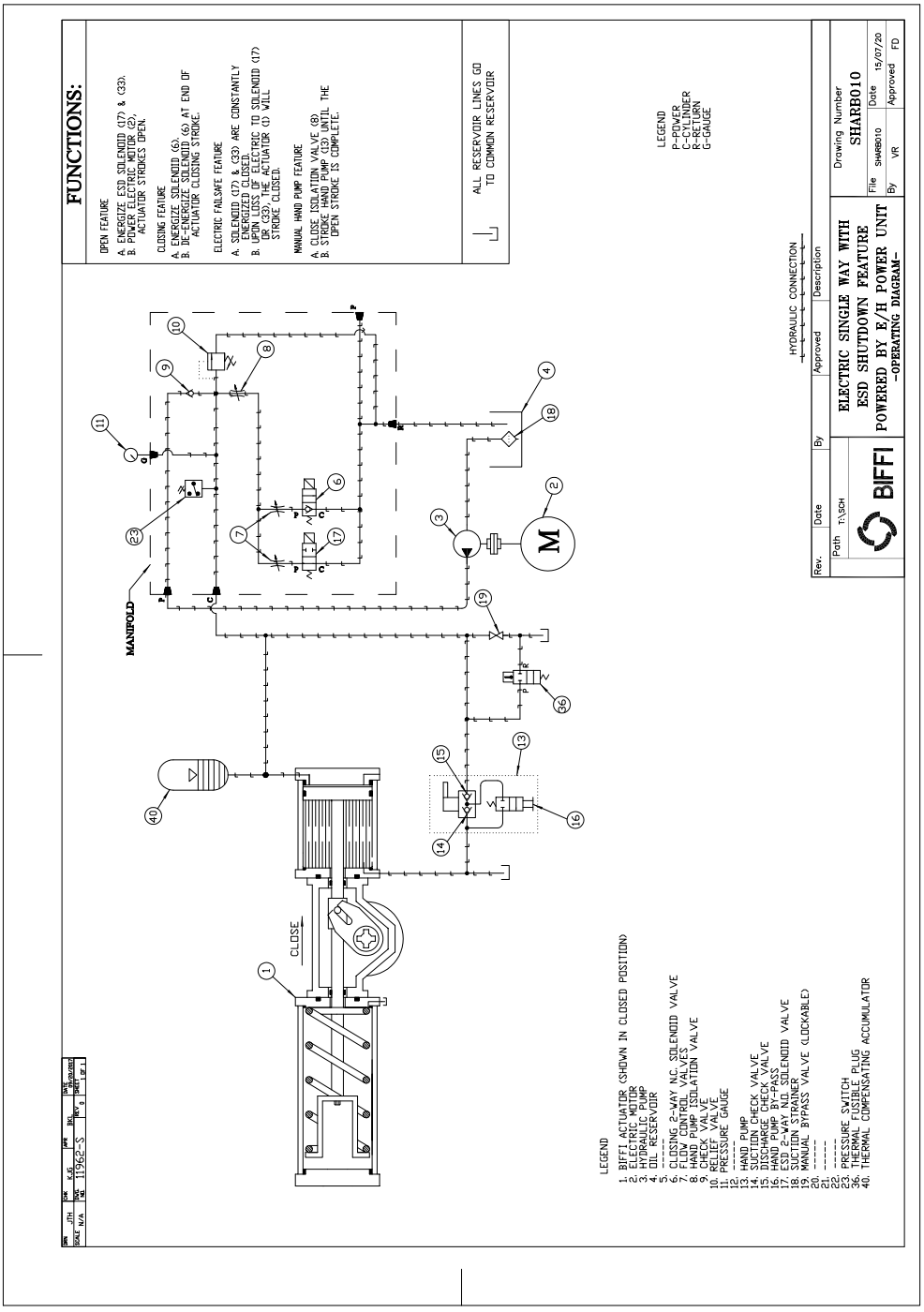


Figure 37. General Arrangement Hydraulic Schematic Drawing (SHARB011)

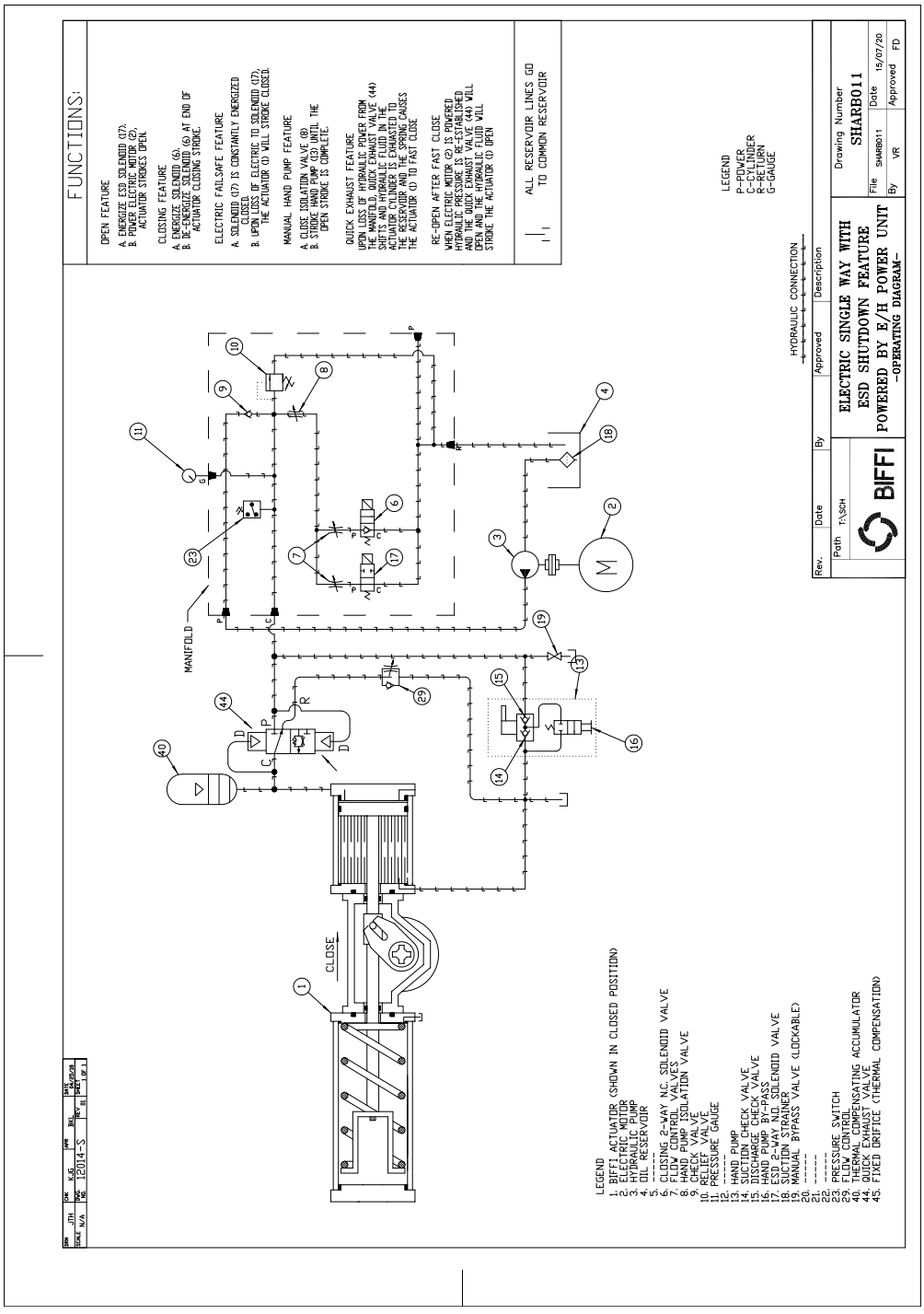
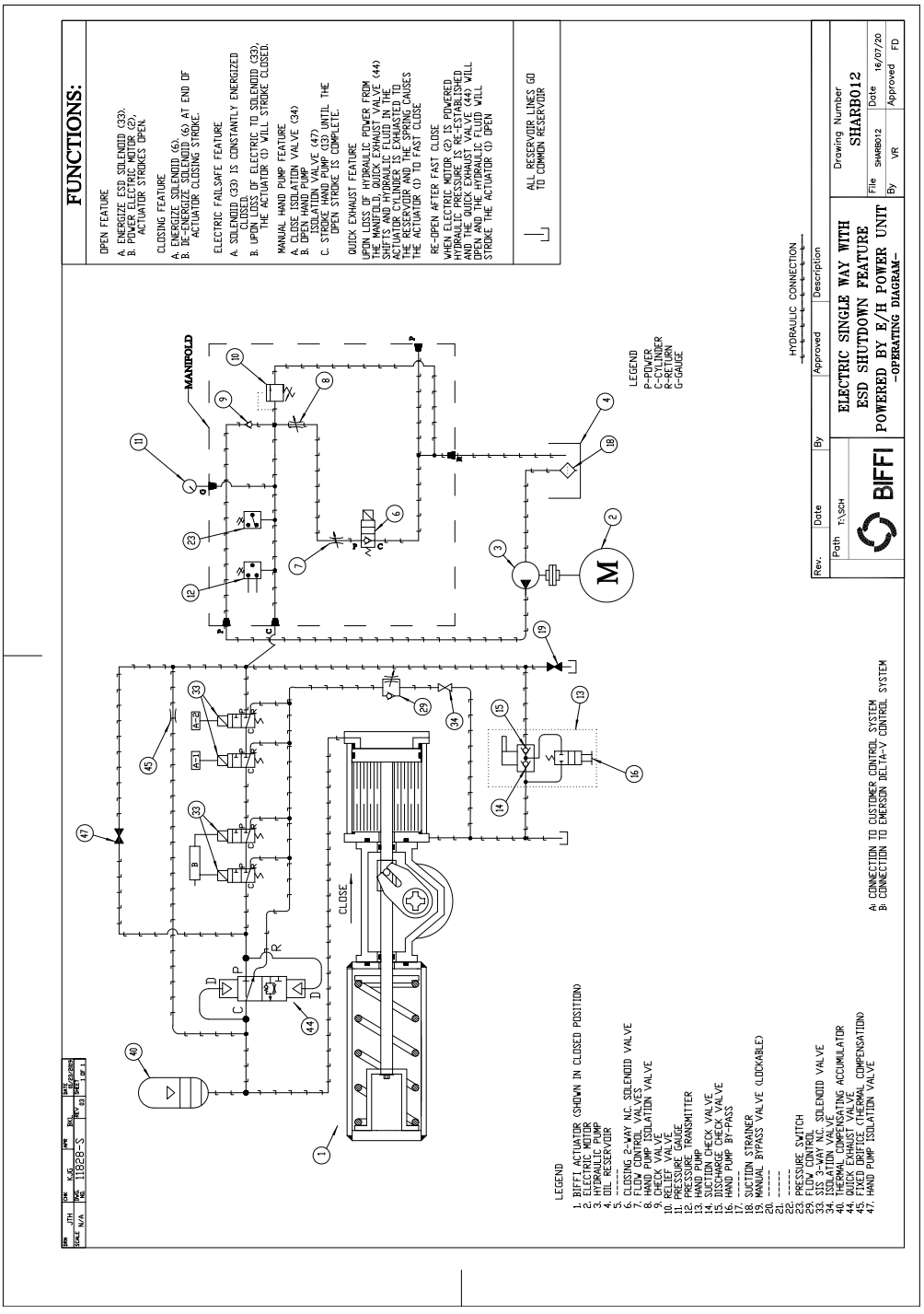


Figure 38. General Arrangement Hydraulic Schematic Drawing (SHARB012)



Section 12: Maintenance

12.1 Storage Procedures

The actuator should be immediately stored in a clean, dry warehouse, free from vibration and rapid temperatures changes, until it can be installed and energized.

If the actuator must be stored outside, it should be stored off of the ground at an elevation sufficient to prevent it from being immersed in water or buried in snow, and covered to prevent damage from site debris.

If the actuator is not attached to a valve, the preferred orientation is with the motor and electrical compartment horizontal.

Care should be taken to plug all open ports on the actuator and all controls to keep out foreign contaminates.

Refer also to the standard manual of the relevant Biffi actuator, RPH or OLGA-H Series.

12.2 Service Interval

Routine maintenance is generally unnecessary. Normally, recommended service interval for Biffi actuators is five years or maximum actuator seal life cycle, whichever occurs first.

NOTICE

Storage time is considered as part of the Service Interval time.

It is recommended that service kits be ordered approximately three (3) months prior to scheduled maintenance to assure availability.

12.3 Lubrication Requirements

NOTICE

Lubricant other than listed below should not be used without prior written approval of Biffi Product Engineering.

For normal duty, the scotch yoke mechanism of the actuator is lubricated "for life". In case of high load and high frequency of operation, it may be necessary to periodically restore lubrication; it is advisable to apply a generous coating of grease on the contact surfaces of the yoke and bushings, on the yoke link grooves, on the sliding blocks, on the guide bar.

For this operation, it is necessary to disassemble the mechanism cover. In larger actuators, the lubrication can be performed through the inspection holes of the cover after removing the plugs.

The following grease is used by Biffi for standard working temperature and suggested for re-lubrication:

ENI MU/EP/2 *

To be used in standard temperature conditions: -30 to +85 °C

NLGI (National Lubricating Grease Institute) consistency:	2
Worked penetration:	280 dmm
ASTM Dropping Point:	185 °C
Base oil viscosity at 40 °C:	160 mm^2/s
ISO Classification:	L-X-BCHB 2
DIN 51 825:	KP2K - 20
Equivalent to:	Use an equivalent or better product in compliance with the grease proposed in the actual scope of supply by Biffi. Your grease supplier can verify and propose an alternative product at your responsibility.

Mobilgrease 33 or Equivalent **

To be used in low temperature conditions: -60 to +100 °C

Notes:

* If the service is not special (i.e., oxygen, hydrogen or other mentioned during the offer stage).

** Use an equivalent or better product in compliance with the grease proposed in the actual scope of supply by Biffi. Your grease supplier can verify and propose an alternative product at your responsibility.

NOTICE

Hydraulic fluids other than those listed below should not be used without prior written approval of Biffi Product Engineering.

Table 27. Hydraulic Oil List by Biffi Italia s.r.l. for Refilling in Different Working Conditions **

Standard Temperature Conditions (-30 to +85 °C):	
Producer	ENI®
Name	Arnica 22
Viscosity at 40 °C	20.9 mm^2/s
Viscosity at 100 °C	4.73 mm^2/s
Viscosity index ASTM	153
Flash point	192 °C
Pour point	-42 °C
Specific weight (at 15 °C)	0.857 kg/l
Equivalent oils:	Use an equivalent or better product in compliance with the oil proposed in the actual scope of supply by Biffi. Your oil supplier can verify and propose an alternative product at your responsibility.
Low Temperature Conditions (until -46 °C):	
Manufactured	Shell®
Name	AeroShell Fluid 41
Viscosity at -54 °C	2300 cST
Viscosity at -40 °C	491 cST
Viscosity at 40 °C	14.1 cST
Viscosity at 100 °C	5.30 cST
Viscosity index (ISO 2909)	>200
Flash point	105 °C
Pour point	<-60 °C
Specific weight (or equivalent)	0.87 kg/dm^3
Low Temperature Conditions (until -60 °C):	
Manufactured	* SYNTESIS
Name	* SYNTRASS-CS 500
Viscosity at -60 °C	580 cST
Viscosity at -30 °C	39 cST
Viscosity at 20 °C	5.8 cST
Viscosity at 50 °C	2.1 cST
Flash point	152 °C
Pour point	-68 °C
Specific weight (or equivalent)	0.897 kg/dm^3

NOTE:
* Refer to Fiorenzuola plant to receive a quotation for this oil.
** The proposed list is for a standard case. Kindly refer to and use the oil specified in the delivered scope of supply.

12.4 Recommended Annual Inspection

It is recommended the following components and features of the Biffi EHO to be evaluated at least once a year.

- Check hydraulic fluid levels
- Check the pressure gauge
- Check bolts and fittings for tightness
- Check for external oil leaks
- If an accumulator is provided, check the nitrogen blanket
- Check hand pump operation functions properly
- If/When possible, perform a function test (See Section 4.9 for instructions on how to perform a function test)
- Check the breather on the hydraulic reservoir

Qualified service personnel are available upon request for problems, which our customers do not wish to handle. If the requirement should arise, please feel free to contact your local Biffi service provider.

12.5 Specific Conditions of Use

1. All replacement fasteners shall meet the minimum requirements detailed below:

- The M8 fasteners used to secure each cover to the electronics enclosure and the RDM cover to the RDM enclosure shall be of property class (or 'grade') 8.8.
- The fasteners used to secure the motor enclosure to the electronics enclosure, the electronics enclosure to the gear box and the end caps to the motor frame shall of property class (or 'grade') 5.
- The HMA shall be secured to the electronics enclosure by M8 x 1.25, 316 stainless steel bolts.

In all of the above cases, when fasteners are fully tightened into the threaded holes without the use of a washer, at least one full thread shall remain free at the base of the hole.

2. The flameproof joints shall not be repaired.

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