Troubleshoot and Repair Manual for the REXA Xpac Series 3

REXA Electraulic™ Actuators and Drives

Serial # ....
Model # ....
Application ....
Tag # ....

REXA Xpac Series 3
Troubleshoot and Repair
Original Instructions
Revision 2
06/2020 - Present
ISO 9001

Table of Contents

Table of Contents

Fundamental Safety Information

REXA Actuators produce extremely high forces, have hydraulic lines under pressure and have dangerous electrical power input levels. In addition to these standard characteristics, optional actuator constructions possess other hazards such as coil and disk springs under compression and high pressure accumulator bottles.

Warnings

Based on these hazards, the following could occur if this safety information is not observed:

- Serious physical injury
- Death
- Damage to actuator or other equipment

Always observe the safety information listed in this documentation.

Warning Labels

Hazardous Voltage

Turn Off and Lock Out system power before servicing. Do Not Operate this equipment from any power source that does not match the voltage rating stamped on the equipment. Refer to the manufacturer's identification nameplate for operational requirements.

General Warning

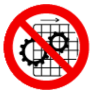
Refer to Installation Manual before servicing.

Attention

Important information provided. Do No Use this equipment for any purpose not described in this manual.

Crush or Pinch Point Hazard

Turn Off and Lock Out system power before servicing. Warn of actuator movement if Spring Fail Unit.



Guard Warning

All Guards MUST be in place before operation. Failure to do so may result in injury or damage to equipment.

Tripping, Slipping and Falling Hazards

These hazards can be avoided by cleaning spilled hydraulic oil in a timely manner.

- Airborne noise greater than 80 dB, ear protection suggested.
- Using the actuator for uses other than what it is intended may result in injury or death. Use the actuator for its intended purpose ONLY.
- Do not use the actuator should it be damaged in shipping or installation. Contact REXA at 508-584-1199.

Residual Risks

This section is to help identify the risks associated with the Actuator System. These items are identified as:

Actuator & Driven Device Connection:

The point at which the actuator couples to the driven device poses the risk of injury due to pinch or crush point. Use appropriate Lock-Out / Tag-Out procedures when connecting Actuator to the driven device.

Manual Override Handwheel Assembly:

The Manual Override Handwheel Assembly is to remain declutched until it is required. The Motor Shaft Cover MUST be in place during normal operation. Failure to do so poses a risk of injury.

Manual Override Handwheel Assembly:

When the Manual Override, Handwheel Assembly is used, adhere to proper Lock-Out / Tag-Out procedures.

Feedback Cover:

Feedback Cover MUST be in place during operation. Failure to do so may result in injury. Use proper Lock-Out / Tag-Out procedures before accessing feedback housing.

Shock Hazard:

Wire Cover must be in place during operation. Use proper Lock-Out / Tag-Out procedures before removing cover.

Shock Hazard:

Control Enclosure Cover must be closed during normal operation. Failure to do so may result in injury. Use proper Lock-Out / Tag-Out procedures before accessing Control Enclosure.

Shock Hazard:

Hazardous voltage levels are present in the actuator. Only qualified service and installation personnel should install or adjust this device.

Alignment:

Ensure that the actuator shaft is in line with the valve plug stem. Misalignment could damage the actuator and driven device or cause injury to installation personnel.

Avoid Accidental Starting:

When installing the actuator, insure that line power to the unit is shut off. When power is applied, the actuator may immediately respond to the control signal. Inadvertent motion could damage the actuator and driven device or cause injury to installation personnel.

Important:

When machining the control enclosure, thoroughly clean any metal chips or residue from the enclosure before applying power.

Hydraulic OIl:

The standard oil used in REXA Actuators or drives is Castrol EDGE® SAE 5W-50 motor oil. The introduction of other fluids may cause damage to the unit.

Spring under tension:

REXA Actuators, denoted by an E, R or U as the last character in the model number, contain a spring under tension. Failure to properly remove this force before disassembly can cause serious injury to maintenance personnel. Contact REXA for disassembly instructions.

Relieving Internal Pressure:

When the electric power is off or the motor is not turning, hydraulic pressure remains locked within the cylinder and / or accumulator. This internal pressure must be relieved before disconnecting any hydraulic fitting. Open the bypass cylinder (3 / 16" hex) located on the power module for fail in place units and manually override all solenoid valves that are closed.

NOTE: Reservoir lines may contain up to 60 psi (4 bar) that cannot be relieved.

NOTE: Accumulators will still contain up to 2 000 psi (138 bar) of nitrogen gas that cannot be relieved.

Accumulator Fail Option:

REXA Actuators denoted by an A as the last character in the model number contain an accumulator charged with high-pressure nitrogen. These actuators also have an automatic recharging cycle for the accumulator. Failure to properly follow installation instructions may cause serious injury to maintenance personnel and / or damage to equipment.

NPT Plug and Conduit Connections:

During assembly, Loctite® 767 compound—or its equivalent—must be used on threads of all NPT plug and conduit connections to ensure a watertight seal.

When to Lock-Out / Tag-Out

Lock-out / Tag-out before servicing.

Most equipment is installed along with safe switches allowing the equipment to be disabled for minor repair. In general, these switches provide adequate protection for minor repair, which is routine, repetitive, and necessary to the normal use of the equipment. Lock-Out / Tag-Out procedures should be used for the following situations.

- Major repairs or overhaul.
- When working alone, out of visual contact of the controlling switch.
- Anytime there is danger of injury from an unexpected release of energy.
- Any situation that threatens an employees safety.

NOTE: Always follow local & plant procedures.

Procedures: Lock-Out / Tag-Out

The following are minimum recommended procedures to be followed for Lock-Out / Tag-Out:

Notify all affected areas and employees of the impending Lock-Out situation, the reason for it, and estimated start and duration times.

1. Equipment shutdown and isolation: Place all switches in the "off" or "safe" position. Disconnect sources of power, ensuring all sources of both primary and secondary power to the equipment are interrupted.

2. Dissipate residual energy. Shutting down equipment does not mean there is no energy left in it. Check for trapped pressure, compressed spring or residual electricity in the system.

3. Lock-Out or Tag-Out all in-line points of control. In most cases, there may be more than one place, or more than one lock, if several people are working on the equipment.

4. Lock-Out verification: Take nothing for granted. Verify that the locked-out switch or control cannot be overridden. Test the equipment to be certain that the locked-out switch is de-energized, and not simply malfunctioning. Test all control points and modes to be sure that the equipment does not start.

5. Perform the work scheduled. Try to foresee all possible hazards. Ensure the new / repair work does not bypass the Lock-Out and reactivate the system.

6. Lock and / or tag removal. All locks and tags are to be left in place until all work is completely finished. This is especially true when more than one employee is working on the equipment. A lock is never to be removed except by the person who placed it there.

7. Equipment start-up. Make a final safety check before restarting equipment, to be certain it is safe to operate. Make sure of the following:

    a. All tools and other items have been removed.

    b. All machine guards are returned to their proper position. All electric, hydraulic, pneumatic or other systems are properly reconnected.

    c. All employees are clear of equipment.

Many of the Lock-Out / Tag-Out procedures appear to be common sense, and they are. Following them will ensure safe operation calibration, maintenance and repair of equipment and / or processes, without dangerous surprises or injury.

Education and Discipline

The key to worker safety is education. The purpose of this document is for everyone to understand the importance of Lock-Out / Tag-Out and how to recognize when it is in use. By educating all employees the importance of following proper safety procedures, we ensure a safer working environment. As with all safety procedures, a fair uniform enforcement of discipline must be in place. Employees are responsible for their own safety, the safety of their fellow employees and the safety of the facility.

Product Compliance

Information

Inclusion of the following symbols indicates that the supplied REXA actuator complies with applicable standards:

For the U.S. and Canada: A CSA mark with the indicators "C" and "US" means that the product is certified for both the U.S. and Canadian markets, to the applicable U.S. and Canadian standards.

CLASS I DIVISION 2 GROUPS A, B, C and D

CLASS I DIVISION 1 GROUPS C and D

IECEx scheme is a single globally accepted certification framework based on ISO and IEC International Standards relating to Equipment, Services and Persons in areas relating to Explosive Atmospheres.

CLASS I ZONE 1: Ex db [ia IIC] IIB T3

CLASS I ZONE 2: Ex nA [ia] IIC T3 Gc*
(coming soon)

**Note: For Zone 2, the [ia] portion is optional since the actuator portion of the assembly could be located in Zone 1.*

The ATEX Directive 2014/34/EU covers equipment and protective systems intended for use in potentially explosive atmospheres. The Directive defines the essential health and safety requirements and conformity assessment procedures, to be applied before products are placed on the EU market.

CLASS I ZONE 1: Ex II 2G Ex db [ia IIC] IIB T3
(coming soon)

CLASS I ZONE 2: Ex II 3G Ex nA IIC T3 Gc

This mark indicates that the product is certified for European markets and complies with the applicable Directives for hazardous protection concepts as well as the Essential Health & Safety Requirements.

Note: for IECEx and ATEX, the 'X' marking following the certificate number is used as a means of identifying that essential information for the installation, use and maintenance of the equipment must be followed as detailed in the following sections.

SPECIFIC CONDITIONS OF USE (Zone 1) IECEx CSA 16.0041X

General

1. Ambient Temperatures below -10°C: use field wiring suitable for minimum ambient temperature
2. Cable entry devices and blanking elements shall be certified for protection type "d"; suitable for IP ratings and correctly installed
3. Unused apertures shall be closed with suitable blanking elements
4. End User shall ensure adequate earthing or equipotential bonding is suitable for the installation of the metallic conduit

X3 Electronic Assembly

5. **SUPPLY DISCONNECT DEVICE:** End User shall provide a Supply Disconnect Device with the proper rating to comply with IEC61010. The supply disconnecting device shall disconnect (isolate) the Electronic Enclosure / Actuator from the power supply source when engaged.
6. **TRANSIENT SUPPRESSION DEVICE:** End user shall provide transient suppression of the supply terminals limiting to 140% of the rated supply
7. Electronic enclosure shall be positioned such that the risk of impact to the window is low
8. **CONDUIT ENTRY SEALS:** End user shall seal all Electronic Enclosure ½" NPT and ¾" NPT conduit ports within 50.8mm [2.0"] of entry using listed fittings and sealing compounds
9. **FASTENERS:** only M16X2.0X60MM Stainless Steel hex bolts are to be used
10. **LITHIUM CELL:** shall be replaced by certified REXA service personnel using only the following type of cell:
    a. Rayovac BR2335, Lithium Carbon-Monofluoride (BR) Coin Cell. Rated 300mAh @ 3.0V. Operating Ambient: -40°C to 85°C
11. **FUSE REPLACEMENT** table is as follows:

FUSE REPLACEMENT TABLE

System Description	Standard Fuse (A)	Alternate Configuration Fuse (A)	Fuse Type
D Module, 230 VAC	10	20	Type 'aM'; 500V, IR 120kA, 10mm x 38mm
B Module, 115 VAC	6	10	
C Module, 115 VAC	10	16	
2C Module, 115 VAC	16	NA	
1/2D Module, 230 VAC	10	20	
1/2D Module, 115 VAC	20	32	
B Module, 230 VAC	4	10	
C Module, 230 VAC	6	12	
2B Module, 230 VAC	10	NA	
2C Module, 230 VAC	12	NA	
2B Module, 115 VAC	10	NA	

X2 or X3 Actuator Assembly

12. **CONDUIT ENTRY SEALS:** End user shall seal all Actuator ½" NPT and ¾" NPT conduit ports within 457mm [18.0"] of entry using listed fittings and sealing compounds

13. **SURFACE CLEANING:** Actuator Assembly includes a non-metallic outer protective coating which may be cleaned with a damp cloth.

14. **FASTENERS:** shall be replaced only with the corresponding grade of fastener as follows:

ACTUATOR FASTENERS REPLACEMENT TABLE:

Stepper Motor Mounting Screws (secures motor to power module) • US SHCS 1/4-20UNC-2A X 0.875 • Material is 18.8SS • Min Yield Strength =207 Mpa [30ksi], Min Tensile Strength=517MPa [75ksi]
Servo Motor Mounting Screws (secures motor to power module) • US SHCS 1/4-20UNC-2A X 1.25 • Material is 18.8SS • Min Yield Strength =207 Mpa [30ksi], Min Tensile Strength=517MPa [75ksi]
Latch Cover Hex Bolt (secures threaded cover onto power module) • US SHCS 1/4-20UNC-2A X 5/8 • Material is 18.8SS • Min Yield Strength =207 Mpa [30ksi], Min Tensile Strength=517MPa [75ksi]

15. **THREADED FLAMEPATHS:** CUSTOMER TO ENSURE FINAL INSTALLATION COMPLIES WITH THE FOLLOWING TABLE:

FP #	Flamepath Description	Design Thread	Thread Pitch	Required Threads Engaged	Design Thead Length	Design Threads Engaged	Security Method
1,4	Threaded Cover	3.75-10UNS-2A	1/10UNC	≥ 5	Min: 14.78 Max: 15.24	Min: 5 Max: 6	¼-20UNC-2A Socket Hex bolt with mechanical latch provided on the power module
3,6	¾" and ½" NPT Actuator Power Module Entries	3/4"-14 NPT 1/2"-14 NPT	1/14	≥ 5	Min: 12.24 Max: N/A	Min: 11.76 Max: N/A	At least 5 threads to be fully engaged to internal NPT threads on power module. Internal threads gauge flush to 2 turns large with an L1 gauge

SPECIFIC CONDITIONS OF USE (Zone 1) SIRA 17ATEX1231X

X3 Electronic Assembly

1. CONDUIT ENTRY SEALS: End user shall seal all Electronic Enclosure ½" NPT and ¾" NPT conduit ports within 50.8mm [2.0"] of entry using listed fittings and sealing compounds
2. FASTENERS: only M16X2.0X60MM Stainless Steel hex bolts are to be used
3. LITHIUM CELL: shall be replaced by certified REXA service personnel using only the following type of cell:
   a. Rayovac BR2335, Lithium Carbon-Monofluoride (BR) Coin Cell. Rated 300mAh @ 3.0V. Operating Ambient: -40°C to 85°C

X2 or X3 Actuator Assembly

4. CONDUIT ENTRY SEALS: End user shall seal all Actuator ½" NPT and ¾" NPT conduit ports within 457mm [18.0"] of entry using listed fittings and sealing compounds
5. SURFACE CLEANING: Actuator Assembly includes a non-metallic outer protective coating which may be cleaned with a damp cloth.
6. FASTENERS: shall be replaced only with the corresponding grade of fastener as follows:

ACTUATOR FASTENERS REPLACEMENT TABLE

Stepper Motor Mounting Screws (secures motor to power module) • US SHCS 1/4-20UNC-2A X 0.875 • Material is 18.8SS • Min Yield Strength =207 Mpa [30ksi], Min Tensile Strength=517MPa [75ksi]
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Latch Cover Hex Bolt (secures threaded cover onto power module) • US SHCS 1/4-20UNC-2A X 5/8 • Material is 18.8SS • Min Yield Strength =207 Mpa [30ksi], Min Tensile Strength=517MPa [75ksi]

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3,6	¾" and ½" NPT Actuator Power Module Entries	3/4"-14 NPT 1/2"-14 NPT	1/14	≥ 5	Min: 12.24 Max: N/A	Min: 11.76 Max: N/A	At least 5 threads to be fully engaged to internal NPT threads on power module. Internal threads gauge flush to 2 turns large with an L1 gauge

SPECIFIC CONDITIONS OF USE (Zone 2) IECEx CSA 17.0013X

General

1. Ambient Temperatures below -10°C: use field wiring suitable for minimum ambient temperature
2. Cable entry devices and blanking elements shall be certified for protection type "d"; suitable for IP ratings and correctly installed
3. Unused apertures shall be closed with suitable blanking elements
4. End User shall ensure adequate earthing or equipotential bonding is suitable for the installation of the metallic conduit

X3 Electronic Assembly

5. SUPPLY DISCONNECT DEVICE: End User shall provide a Supply Disconnect Device with the proper rating to comply with IEC61010. The supply disconnecting device shall disconnect (isolate) the Electronic Enclosure / Actuator from the power supply source when engaged.
6. TRANSIENT SUPPRESSION DEVICE: End user shall provide transient suppression of the supply terminals limiting to 140% of the rated supply
7. Electronic enclosure shall be positioned such that the risk of impact to the window is low
8. LITHIUM CELL: shall be replaced by certified REXA service personnel using only the following type of cell:
   a. Rayovac BR2335, Lithium Carbon-Monofluoride (BR) Coin Cell. Rated 300mAh @ 3.0V. Operating Ambient: -40°C to 85°C
9. FUSE REPLACEMENT table is as follows:

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<tr><th>System Description</th><th>Standard Fuse (A)</th><th>Alternate Configuration Fuse (A)</th><th>Fuse Type</th></tr>
<tr><td>B Module, 115 VAC</td><td>6</td><td>10</td><td rowspan="8">Type 'aM'; 500V, IR 120kA, 10mm x 38mm</td></tr>
<tr><td>B Module, 230 VAC</td><td>4</td><td>10</td></tr>
<tr><td>C Module, 115 VAC</td><td>10</td><td>16</td></tr>
<tr><td>C Module, 230 VAC</td><td>6</td><td>12</td></tr>
<tr><td>2B Module, 115 VAC</td><td>10</td><td>N/A</td></tr>
<tr><td>2B Module, 230 VAC</td><td>10</td><td>N/A</td></tr>
<tr><td>2C Module, 115 VAC</td><td>16</td><td>N/A</td></tr>
<tr><td>2C Module, 230 VAC</td><td>12</td><td>N/A</td></tr>
<tr><td>1/2D Module, 115 VAC</td><td>20</td><td>32</td><td>Standard: Type 'aM'; 500V, IR 120kA, 10mm x 38mm
Alternate: Type 'aM'; 400V, IR 120kA, 10mm x 38mm</td></tr>
<tr><td>1/2D Module, 230 VAC</td><td>10</td><td>20</td><td rowspan="2">Type 'aM'; 500V, IR 120kA, 10mm x 38mm</td></tr>
<tr><td>D Module, 230 VAC</td><td>10</td><td>20</td></tr>
<tr><td>Dual 1/2D Module, 115 VAC</td><td>32</td><td>N/A</td><td>Type 'aM'; 400V, IR 120kA, 10mm x 38mm</td></tr>
<tr><td>Dual 1/2D Module, 230 VAC</td><td>20</td><td>N/A</td><td rowspan="2">Type 'aM'; 500V, IR 120kA, 10mm x 38mm</td></tr>
<tr><td>Dual D Module, 230 VAC</td><td>20</td><td>N/A</td></tr>
<tr><td>D, P9, 230 VAC</td><td>25</td><td>N/A</td><td>Type 'aM'; 400V, IR 120kA, 10mm x 38mm</td></tr>
<tr><td>D, P40, 230 VAC</td><td>50</td><td>N/A</td><td>Type 'aM'; 690V, IR 120kA, 22mm x 58mm</td></tr>
</table>

X2 or X3 Actuator Assembly

10. SURFACE CLEANING: Actuator Assembly includes a non-metallic outer protective coating which may be cleaned with a damp cloth.

11. FASTENERS: shall be replaced only with the corresponding grade of fastener as follows:

ACTUATORS FASTENERS REPLACEMENT TABLE:

Stepper Motor Mounting Screws (secures motor to power module) • US SHCS 1/4-20UNC-2A X 0.875 • Material is 18.8SS • Min Yield Strength =207 Mpa [30ksi], Min Tensile Strength=517MPa [75ksi]
Servo Motor Mounting Screws (secures motor to power module) • US SHCS 1/4-20UNC-2A X 1.25 • Material is 18.8SS • Min Yield Strength =207 Mpa [30ksi], Min Tensile Strength=517MPa [75ksi]
Latch Cover Hex Bolt (secures threaded cover onto power module) • US SHCS 1/4-20UNC-2A X 5/8 • Material is 18.8SS • Min Yield Strength =207 Mpa [30ksi], Min Tensile Strength=517MPa [75ksi]

SPECIFIC CONDITIONS OF USE (Zone 2) SIRA 17ATEX4360X

General

1. Unused apertures shall be closed with suitable blanking elements

X3 Electronic Assembly

2. **TRANSIENT SUPPRESSION DEVICE:** End user shall provide transient suppression of the supply terminals limiting to 140% of the rated supply
3. Electronic enclosure shall be positioned such that the risk of impact to the window is low
4. **LITHIUM CELL:** shall be replaced by certified REXA service personnel using only the following type of cell:
    a. Rayovac BR2335, Lithium Carbon-Monofluoride (BR) Coin Cell. Rated 300mAh @ 3.0V. Operating Ambient: -40°C to 85°C
5. **FUSE REPLACCEMENT** table is the same table used in the section above per Zone 2 certificate IECEx CSA 17.0013X.
6. **FASTENERS:** shall be replaced only with the corresponding grade of fastener as follows:

ACTUATOR FASTENERS REPLACEMENT TABLE:

Stepper Motor Mounting Screws (secures motor to power module) • US SHCS 1/4-20UNC-2A X 0.875 • Material is 18.8SS • Min Yield Strength =207 Mpa [30ksi], Min Tensile Strength=517MPa [75ksi]
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EU DECLARATION OF CONFORMITY

CE

We, REXA Inc.,

Hereby declare under our sole responsibility, the following products to be in compliance by design according to the relevant essential health and safety requirements and harmonized standards mentioned. The Technical File may be produced by our EU representative below. In case of alteration of the product, not agreed upon by us, this declaration will lose its validity.

Manufactured: 4 Manley Street
West Bridgewater, MA 02379 USA

EU Authorized Representative: Koso Kent Introl Limited Armytage Road, Brighouse, West Yorkshire HD6 1QF
Contact: Brian Richmond (QHSE Director) or Peter Dix (Technical Director)
Telephone: +44(0)1484 710311 Fax: +44(0)1484 407407

Brand Name: REXA

Product Description: X-Pac, X2 and X3 Series Electraulic (Self-Contained Electro-Hydraulic) Actuator and Drive Systems

Models: Linear, Rotary and Drive Units
Servo or Stepper Units

Applicable Directives: Machinery Directive 2006/42/EC including Low Voltage Directive (LVD) 2014/35/EU

Electromagnetic Compatibility Directive (EMC) 2014/30/EU

Pressure Equipment Directive (PED) 2014/68/EU; applies where applicable, to accumulator systems

Radio Equipment Directive (RED) 2014/53/EU, applicable to optional Bluetooth feature

RoHS Directive 2011/65/EU; met by design, by exclusion of hazardous / restricted substances

Applicable Harmonized Standards:

Health/Safety: Machinery Directive 2006/42/EC Annex I, EN60204-1:2006+A1:2009/AC 2010, EN ISO 12100:2010, EN61310-1:2008, EN61310-2:2008

EMC: EN61326-1:2013, EN61000-6 Part -2:2005 and -4:2007+A1:2011; EN55011:2009+A1:2010

PED: Directive 2014/68/EU; designed as 'Sound Engineering Practice' Equipment

EU Declaration of Conformity

According to: Directive 2014/34/EU

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Contact: Brian Richmond (QHSE Director) or Peter Dix (Technical Director)
Telephone: +44(0)1484 710311 Fax: +44(0)1484 407407

Brand Name: REXA

Product Description: Electraulic (Self-Contained Electro-Hydraulic) Actuator and Drive Systems;
X3 Electronic Assembly and X2 or X3 Actuator Assembly

Models: Linear, Rotary and Drive Units
Servo or Stepper Units

Designation: CE Ex Ex db [ia IIC] IIB T3 -40C ≤ Ta ≤ 65C

Applicable Directives: Machinery Directive 2006/42/EC including Low Voltage Directive (LVD) 2014/35/EU

Electromagnetic Compatibility Directive (EMC) 2014/30/EU

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EMC: EN61326-1:2013, EN61000-6 Part -2:2005 and -4:2007+A1:2011; EN55011:2009+A1:2010

ATEX: EN 60079-0:2012/A11:2013; EN 60079-1:2014; EN 60079-11:2011

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EU Declaration of Conformity

According to: Directive 2014/34/EU

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Brand Name:	REXA
Product Description:	X-Pac, X2 and X3 Series Electraulic (Self-Contained Electro-Hydraulic) Actuator and Drive Systems
Models:	Linear, Rotary and Drive Units Servo or Stepper Units
Designation: CE Ex	II 3G Ex nA IIC T3 Gc -40C ≤ Ta ≤ 65C Cert: SIRA 17ATEX4360X
Applicable Directives:	Machinery Directive 2006/42/EC including Low Voltage Directive (LVD) 2014/35/EU Electromagnetic Compatibility Directive (EMC) 2014/30/EU Pressure Equipment Directive (PED) 2014/68/EU; applies where applicable, to accumulator systems Radio Equipment Directive (RED) 2014/53/EU, applicable to optional Bluetooth feature RoHS Directive 2011/65/EU; met by design, by exclusion of hazardous / restricted substances

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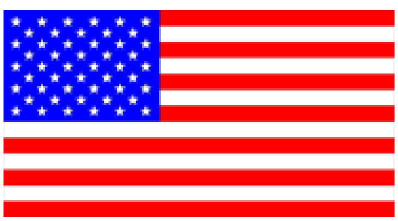
ATEX:	EN 60079-0:2012/A11:2013, EN 60079-15:2010
PED:	Directive 2014/68/EU; designed as 'Sound Engineering Practice' Equipment

Declaration of Noise Emission

The REXA inc., Incorporated Model REXA Electraulic™ Actuator System Sound Pressure Levels per EN ISO 11202 is as follows:

Model No: As above	Serial No: On Nameplate	Year of Construction: 2017	
		Operating	Idle
L_{pAm} (Operator Position)		81 dB (A)	66 dB (A)
L_{pAm} (Bystander Position)		84 dB (A)	67 db (A)
Peak C-weighted instantaneous SPL in the Operator's position $L_{pC\ peak}$		88 dB (c)	--
Sound power emitted where the equivalent continuous A-weighted SPL exceeds 80 dB (A).		8.8 Bel	--
The average difference between the extraneous noise level and the sound intensity level at each measuring point is:		$L_{pAm\ \Delta}$= 16 dB (A)	
Ambient Correction Factor K3A calculated according to EN ISO 11204 Appendix A.		4 dB(A)	
Measurements were made at a height of 1.5 m and 1 m from the Operator Position and all four sides of the equipment.			
The figures quoted are emission levels and are not necessarily safe working levels. While there is a correlation between the emission and exposure levels this cannot be used reliably to determine whether or not further precautions are required. Factors that influence the actual level of exposure of the workforce include characteristics of the work room, the other sources of noise, etc. such as the number of machines and other adjacent processes. Also, the permissible level of exposure can vary from country to country. This information, however, will enable the user of the machine to make a better evaluation of the hazard and risk.			



REXA Inc.
4 Manley Street
West Bridgewater, MA USA

CE

Waiver Of Translations Agreement

We, REXA Inc.,

Hereby declare exclusion of the responsibility at the time of sale to provide translated documentation of REXA products. This includes and is not limited to the following documents:

- Installation and Operation Manual (IOM)
- Interconnect, layout and wiring schematics and drawings
- Technical Service and Repair Manual

This document also waives the responsibility of translations of the following system components and markings:

- Human Machine Interface (HMI Keypad Display) textual read-out of system parameters and status display
- Modification of keypad display symbols to ISO characters
- Internal labeling and identification symbols and statements
- Individual wire and component marking identification is not required. The fully assembled factory wired panel is only serviced by REXA personnel and not the end user. However, end - user terminations are readily identified.

Translations of the above mentioned may be made by the end user and/or the authorized representative listed on this document. Any of which may be translated must bear the statement 'Translation of Original Instructions' within the document(s) header or footer.

EU Authorized Representative: Koso Kent Introl Limited Armytage Road, Brighouse, West Yorkshire HD6 1QF

Contact: Brian Richmond (QHSE Director) or Peter Dix (Technical Director)

Telephone: +44(0)1484 710311 Fax: +44(0)1484 407407

Waiver of Mains Supply Disconnect/Emergency Stop Agreement

We, REXA Inc.,

Hereby declare it the responsibility of the installer of this equipment to provide a suitable disconnect for the Control Panel supplying power to the system.

The disconnect must:

- Be suitable for the Voltage and Full Load Ampere Rating of all downstream equipment supplied by the Panel;
- The supply disconnecting device shall be one of the following types:
    - Switch-disconnector with fuses, in accordance with IEC 60947-3, utilization category AC-23B or DC-23B
    - As above, except one that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector.
    - A circuit breaker suitable as an isolation device per IEC 60947-2
    - Any other switching device in accordance with an IEC product standard that also meets the isolation requirements of IEC 60947-1 and is appropriate for on-load switching of the largest motor or other inductive loads;
- Be approved for use as a disconnect for the country in which the system is installed.
- Be provided with a Lock Out Tag Out capability in the Off (Down) position.
- The Handle must be RED in color to indicate it is suitable as an E-Stop device.

If assistance is required in specifying an appropriate device, please contact our engineering department for recommendations.

1. General Information

1.1 Factory Support

REXA is a full service company. We have a fully staffed service department with factory trained and certified service personnel for both factory and on site repair. For repair, service, sales, warranty or parts order, you may contact the factory at the following:

REXA, Inc.	Phone: (508) 584-1199
4 Manley Street	Fax: (508) 444-3694
West Bridgewater, MA 02379	Web: www.rexa.com

NOTE: It is important to have the model number, serial number, and build code for both the electronics and the actuator in addition to the serial number for the actuator so we can provide better service.

This information can be found on the metal tags on the actuator and on the front panel of the electronics. Reference the sections below on Actuator Identification for a more detailed explanation.

1.2 Actuator Identification

The model number, mechanical build code, electronics build code and serial numbers are all used to identify an individual actuator and electronics.

The model number will provide a general description of the actuator and electronics as a set. The model number also provides the information required to correctly define what sections of this manual applies to a particular actuator. The build code provides more detailed information of the components used in the construction of the actuator. Finally the serial number will allow the factory to determine any special considerations or features your actuator may have that make it unique.

Since most applications are custom, this is the only identification that fully allows us to identify the unit. The factory requires these numbers whenever service or information is requested. Supplying the model number, both mechanical and electrical build codes, and the serial number will ensure the quickest and most accurate response to your request. These numbers can be found on the ID tags located on the actuator and on the serial tag on the electronics. Figure 1.2-1 and 1.2-2 shows typical ID tags.

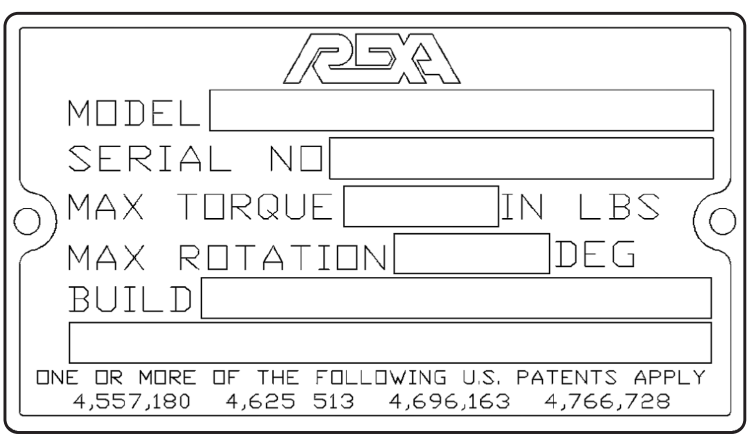


Figure 1.2-1 Mechanical ID Tag

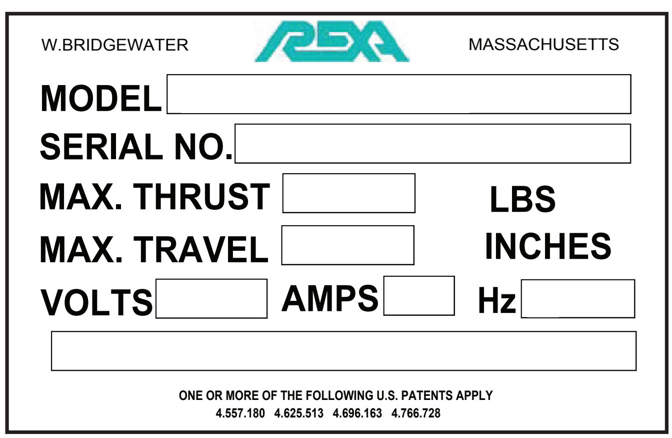


Figure 1.202 Electronics ID Tag

1.2.1 Model Number

The basic model number is a generic description of the actuator. Figure 1.2.1 shows a break down of the model number tree.

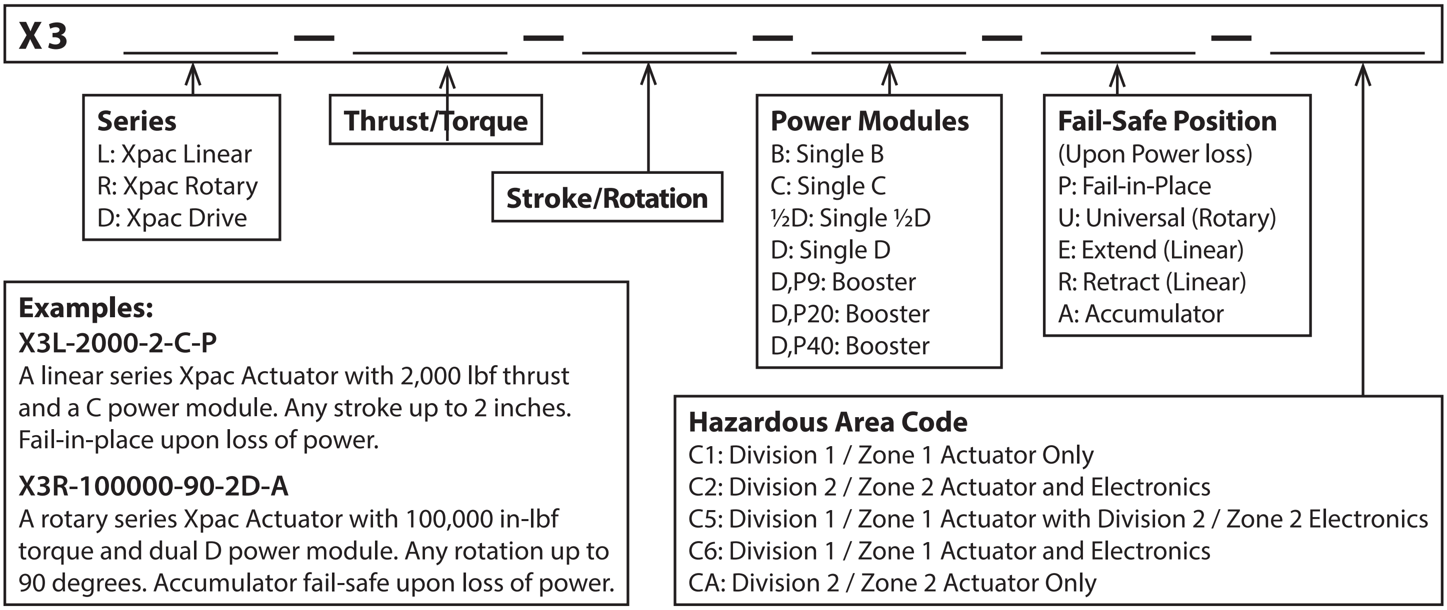


Figure 1.2.1 Model Number

1.2.2 Serial Number

Serial numbers are assigned to every job at Rexa. Job specific information as well as sales and engineering information are stored under a specific serial number. A typical serial number will look like: C1800000. The C18 indicates the year of manufacture and the next five digits correspond to the unique order number.

1.2.3 Build Code

The build code is a catalog number we use to designate in complete detail the construction of the actuator. From this number all configurations can be defined. There are two different categories of build numbers; one is for the mechanical sub-assembly, and the second is for it's corresponding electronics sub-assembly. Within the mechanical sub-assembly there is a build number for Rotary and Drive actuators, and a separate build number for Linear actuators. The build numbers are shown in the IOM "H. Build Numbers" on page 11.

1.3 General Specifications

1.3.1 Recommended Fluids and Lubricants

Intended Use	Specifications
Operating oil, standard	Castrol EDGE® with Syntec SAE 5W-50 Motor Oil
Operating oil, biodegradable	RSC FUTERRA HF 100 or equivalent
Anti-Seize Compound	Bostik Never-Seez® or equivalent
O-ring Lubricant	Parker Super-O-Lube or equivalent
Thermal Grease	Thermalcote™ or equivalent
Molybdenum Disulfide Grease	Mobilgrease® XHP 222 or equivalent
Parts Cleaner	ZEP® Brake Wash or equivalent

1.3.2 Operating Temperatures

Table 1.3.2-1 Linear Actuators *

	Actuator Construction	Standard			High Temp.
Temperature Range[1]	Type L Linear Cylinder	-5 °F to +200 °F	-30 °F ‡ to +200 °F	-76 °F to +200 °F	-5 °F to +250 °F
		(-20 °C to +93 °C)	(-34 °C to +93 °C)	(-60 °C to +93 °C)	(-20 °C to 121 °C)
	Type C Linear Cylinder	+10 °F to +200 °F	-10 °F to +200 °F	-76 °F to +200 °F	-5 °F to +250 °F
		(-12 °C to +93 °C)	(-23 °C to +93 °C)	(-60 °C to +93 °C)	(-20 °C to 121 °C)
	Installation Requirements	None	1 inch thermal insulation 2	Heat tracing & 1 inch thermal insulation 2	None
Electronics		Separate Control Enclosure with CPU, motor driver, power supply, transient protection and termination.			
Temp. Range		-40 °F to +140 °F (-40 °C to +60 °C)		-40 °F to +120 °F (-40 °C to +50 °C)	
Motor Type		Stepper		Servo	

1. *High ambient temperatures affect oil viscosity which may affect actuator rated output.*

2. *These items are not supplied by Rexa.*

Table 1.3.2-2 Rotary Actuators & Drives *

	Actuator Construction	Standard			High Temp.
Temperature Range[1]	Type R Rotary or D Drive Cylinder	+10 °F to +200 °F	-10 °F to +200 °F	-76 °F to +200 °F	-5 °F to +250 °F
		(-12 °C to +93 °C)	(-23 °C to +93 °C)	(-60 °C to +93 °C)	(-20 °C to +121 °C)
	Installation Requirements	Standard oil & cartridge heater	1″ of thermal insulation 2	Heat tracing & 1″ therm 2	Optional High Temp. Construction
Electronics		Separate Control Enclosure with CPU, motor driver, power supply, transient protection and termination.			
Temp. Range		-40 °F to +140 °F (-40 °C to +60 °C)		-40 °F to +120 °F (-40 °C to +50 °C)	
Motor Type		Stepper		Servo	

1. *High ambient temperatures affect oil viscosity which may affect actuator rated output.*

2. *These items are not supplied by Rexa.*

* *All CSA electronics, stepper units and servo units are rated -40 °F to +104 °F (-40 °C to +40 °C).*

1.4 Maintenance Schedule

The REXA actuator requires minimal routine maintenance consisting primarily of visual inspections. However, as with any mechanical device, components will wear out. The frequency of use and the operating conditions are both factors that will dictate the maintenance schedule (see below). The following is a recommended list of visual inspections and their frequency.

NOTE: With time and experience, a predictable schedule of maintenance and replacement of seals may be developed.

Quarterly

Perform a visual inspection of the actuators for damage, correct oil level, obstruction and hazards. Repair items found damaged during this inspection in accordance with company procedures. During this inspection, check the following items at a minimum:

- Visual inspection for damage
- Oil level is correct

Note: Ambient temperature swings will affect the oil indicator position.

- Tubing and fittings are tight, not touching or rubbing
- Mounting hardware and fasteners are tight
- Record system stats (strokes, error codes, and gauge pressures)

Maintenance Schedule

Items such as seals, O-rings, wear bands, bushings, seats and valves will from time to time need to be replaced. Since factors such as pressure, actuator travel, contaminants, temperature and output all play a role in determining how frequently preventive maintenance is required, this document should only be used as a guide. Actual maintenance history logs for the specific application should be generated for a better indicator of when preventive maintenance is required.

For example, a linear cylinder seal for a 2 000 lb thrust actuator will wear out three times faster if the cycle stroke is six inches vs. two inches and, conversely, will last four times longer if the stroke is half inch vs. two inches. Seal life is also dictated by the pressure the seal is holding. As the pressure increases, so do the forces between the seals and the rods and bores they are sealing. As these forces increase so do the friction forces between these components causing a seal under pressure to exhibit more wear than one under less pressure. It is important to understand the application and its influence on the actuators' components when determining the frequency of preventive maintenance for each unit.

The soft goods—or seals—in each REXA actuator have been selected to provide a design life of at least ***2,000,000 strokes or 20,000,000 dither cycles***. This equates to four years of service in a typical process control system. Seal design life estimates are based on the following assumptions:

- The actuator will only be loaded to its full output during 5% of its total travel—this is the case in 90% of control applications when the actuator is seating a valve.
- If the full load of the actuator is required over a greater percentage of the stroke, then required maintenance will be increased.
- Excessive loads—such as those exhibited when a cylinder "dead ends"—can cause excessive stress and premature wear.

2. Problem Identification

2.1 Interface Issues

Resolutions

2.1.1 I Forgot My Password; How Do I Get Into Setup?

Parameter password has been added to the Outputs menu following parameter Pos Xmitter. If a value (other than the default value of 00000) is entered as the password, future entry into Setup mode will require the user to enter the password value. Contact factory if you lost your password.

2.1.2 Warning Relay Open

WARNING: The output is in the "alarm" state whenever ALARM is in the "alarm" state or when the actuator detects a problem but can otherwise continue to operate.

Detectable problems include:

- Accumulator low or bad pressure detected during "normal operation" or following a failed recharge cycle. (See "3.1 Accumulator Low / Bad Pressure" on page 14).
- Drive fault active. Multiple drive units can usually continue to operate (with reduced performance) when one motor driver is bad, so a "warning" is issued. (See "3.2 Drive Fault" on page 14)
- Seat Load Cylinder reached its "Seated" position but the valve was not required to be seated (SLC stop). (See "3.3.1 SLC Reads Seated Before Actuator is On Valve Seat" on page 14)

2.1.3 Alarm Relay Open

The CPU board has two solid state relay "alarm" outputs; an ALARM and WARNING. The output is in the "alarm" state whenever the actuator is unable to follow the control signal / control scheme as defined in the Signals menu. An "alarm" occurs if the actuator is switched to Local Manual but not Remote Manual. An alarm relay change may be followed by an error code. (See "2.1.4 Error Code in Display" on page 14).

2.1.4 Error Code in Display

The following are the error messages which appear on line 1 in place of `Status:OK` when one or more errors are detected. If more than one error is active, each is displayed at 1 second intervals in a repeating fashion. All errors are cleared by: 1. Cycling the main power; 2. Pushing the reset switch; 3. Entering the Setup mode; or 4. By means identified in the "Cleared by" sections which follow. To fix some of these alarm code errors it may be necessary to refer to the Trouble Shooting and Repair manual.

`MFB bad`

Cause: The actuator's main feedback is below 2 mA.

Indicators: Alarm and Warning Relays open. Only warning if redundant. Alarm when both MFB Bad and Rdnt FB Bad have failed.
MFB bad is displayed.
Actuator will not move.

Cleared by: Self clearing when Feedback > 2 mA.

Rdnt FB bad

Cause: The actuator's redundant feedback is below 2 mA.

Indicators: Alarm and Warning Relays open. Only warning if redundant. Alarm when both MFB Bad and Rdnt FB Bad have failed.
Rdnt FB bad is displayed.
Actuator will not move.

Cleared by: Self clearing when Feedback > 2 mA

CS bad

Cause: The analog Control Signal is below 2.5 mA

Indicators: Alarm and Warning relays open
CS bad is displayed
Actuator will move to Failsafe position

Cleared by: Self clearing when Control Signal > 2.5 mA.

Clock Bat

Cause: Indicates 10 year timer has expired

Indicators: Clock Bat displays

Cleared by: Replace clock battery (located on power board) and reset battery timer in the calibrate menu.

Stall

Cause: After five attempts the actuator was unable to move 1% (0.1% in 5 seconds) of stroke within the defined Stall time. The "Seated" position was reached on the Seat Load Cylinder while the position of the main cylinder was greater than 1% above Position Lo.

Indicators: Alarm and Warning relays open.
Stall is displayed.
Actuator will not move.

Cleared by: Any control signal change which effects movement in the opposite direction of the stall will clear the stall error.

Direction

Cause: The actuator was detected moving in the wrong direction.

Indicators: Alarm and Warning relays open.
Dir error is displayed.
Actuator will not move.

Cleared by: Cleared by cycling main power on, by pushing the reset switch, or entering the Setup mode.

PSrv Fault

Cause: Fault line from primary servo motor indicating fault state Indicator: Warning relay opens.

Display: PServoFlt.

Set up Mode: Actuator will move only if additional motors are available.

Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when a servo motor is present when running system configuration in set up mode.

DSrv Fault

Cause: Fault line from dual servo motor indicating fault state.

Indicator: Warning relay opens.

Display: DServoFlt.

Set up Mode: Actuator will move only if additional motors are available.

Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when a 2nd servo motor is present when running system configuration in Setup Mode and it is configured to be "Dual" motor.

ASrv Fault

Cause: Fault line from accumulator servo motor indicating fault state --- not supported in X3-Beta.

Indicator: Warning relay opens Display: AServoFlt.

Set up Mode: Actuator will move only if additional motors are available.

Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when a 2nd servo motor is present when running system configuration in Setup Mode and it is configured to be an "Accumulator".

PStpFault

Cause: Fault line from main stepper motor indicating fault state.

Indicator: Warning relay opens.

Display: PStepFlt.

Set up Mode: Actuator will move only if additional motors are available.

Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when a main stepper motor is present when running system configuration in Setup Mode.

DStp Fault

Cause: Fault line from stepper motor 2 indicating fault state.

Indicator: Warning relay opens.

Display: DStepFlt.

Set up Mode: Actuator will move only if additional motors are available.

Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when a 2nd stepper motor is present when running system configuration in set up Mode & it is configured to be "Dual" stepper.

AStp Fault

Cause: Fault line from stepper motor 2 indicating fault state.

Indicator: Warning relay opens.

Display: AStepFlt.

Set up Mode: Actuator will move only if additional motors are available.

Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when a 2nd stepper motor is present when running system configuration in set up Mode & it is configured to be "Accumulator".

SBst Fault

Cause: Fault line from Servo booster motor indicating fault state.

Indicator: Warning relay opens.

Display: SBoostFlt.

Set up Mode: Actuator will move only if additional motors are available.

Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when a servo motor is connected to the booster servo connection when running system configuration in set up mode.

IBst Fault

Cause: Fault line from Induction motor indicating fault state.

Indicator: Warning relay opens.

Display: IBoostFlt.

Set up Mode: Actuator will move only if additional motors are available.

Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when an induction motor is connected when running system configuration in set up mode and there is a primary stepper or servo motor connected.

Ind Fault

Cause: Fault line from Induction motor indicating fault state .

Indicator: Warning relay opens.

Display: PInducFlt.

Set up Mode: Actuator will move only if additional motors are available Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when an induction motor is connected when running system configuration in set up Mode & no other motors are present.

DBst Fault

Cause: Fault line from Induction motor indicating fault state.

Indicator: Warning relay opens.

Display: IBoostFlt.

Set up Mode: Actuator will move only if additional motors are available.

Manual Mode: Actuator will move only if additional motors are available.

Auto Mode: Actuator will move only if additional motors are available.

Cleared by: CPU to issue driver reset immediately.

Option Feature: Turned on only when an induction motor is connected when running system configuration in set up mode and there is a primary stepper or servo motor connected.

+15 Fail or -5 Fail

Cause: The (+) or (-) 15 volt power supply is out of range if it exceeds a (+) or (-) 10% error band.

Indicators: Alarm and Warning relays open.
(+/-)15 fail or -5 fail is displayed.
Actuator will not move.

Cleared by: CPU will attempt to clear fail error until fault condition is corrected.

APres bad

Cause: The accumulator's pressure transducer {Accum Pres} is out of range if the 4 - 20 mA signal is less than 3 mA or greater than 21 mA.

Indicators: Warning relay opens.
Pressure bad is displayed.
Actuator continues to operate normally.

Cleared by: Cleared when transducer signal is greater than 3 mA or less than 21 mA.

APres low

Cause: The accumulator pressure {Accum Pres} is below the value set in parameter Warn Pres.

Indicators: Warning relay opens.
Pres low is displayed.
Actuator continues to operate normally.

Cleared by: Successful Accumulator recharge cycle.

Accum Tmr

Cause: The primary motor did not complete the recharge cycle within the Recharge Time of 10-999 sec.

Indicators: Alarm relay opens.
AccPrimeT is displayed.

Cleared by: Successful Accumulator recharge cycle.

OpPres bad or ClPres bad

Cause: The open or close pressure transducer is out of range. The transducer is considered out of range if the 4-20 mA signal is less than 3 mA..

Indicators: Warning relay opens.
Op or Cl Pres bad is displayed.
Actuator continues to operate normally in Auto mode..

Cleared by: Transducer signal being greater than 3 mA.

SLC Fb bad

Cause: The Feedback signal from the Seat Load Cylinder is less than 2 mA.

Indicators: Alarm and Warning relays open.
Slc Fb bad is displayed.

Actuator will not move.

Cleared by: Self clearing when Feedback > 2 mA.

SLC Stop

Cause: The actuator has detected a "Seated" position from the seat load cylinder feedback, but the main cylinder is more than 0.2% from its "Seated" position.

Indicators: Warning relay opens.
Slc stop is displayed.
The actuator continues with normal operation; however, the main cylinder may not seat properly.

Cleared by: Any control signal change which effects movement in the opposite direction in which the stop occurred will clear the error.

ClkBatt Low

Cause: Indicates low voltage in clock battery.

Indicators: Clock Bat displays.

Cleared by: Replace clock battery (located on power board) and reset battery timer in calibrate menu.

InvalidHW

Cause: The motor and input signal connection does not match the initial factory system configuration.

Indicators: Warning relay opens.
InvalidHW is displayed.

Cleared by: Correct motor and input signal connections.

Invalid PST

Cause: The actuator was not at 100% when a PST command was initiated.

Indicators: Warning relay open. Inval PST is displayed.

Cleared by: A power cycle, CPU reset, successful subsequent PST event.

PST TimeElp

Cause: The time for the actuator to go from 100% to the PST target and back to full open exceeded the PST time.

Indicators: Warning relay open. PST Time Elp is displayed.

Cleared by: A power cycle, CPU reset, successful subsequent PST event.

Delta Alarm

Cause: Indicates delta pressure exceeded alarm limit.

Indicators: Alarm and warning relays open. Pressure Output is displayed.

Cleared by: Actuator output returning to below alarm range.

Delta Warn

Cause: Indicates delta pressure exceeded warning limit.

Indicators: Warning relay open. Pressure Output is displayed.

Cleared by: Actuator output returning to below warning range.

AC High

Cause: Indicates incoming voltage is above 127 Volts for 115 VAC power board or above 254 Volts for 230 VAC power board.

Indicators: Warning relay open. Voltage Hi is displayed.

Cleared by: Voltage returning within range (+/- 10% of power board rating).

AC Low

Cause: Indicates incoming voltage is below 104 Volts for 115 VAC power board or below 194 Volts for 230 VAC power board.

Indicators: Warning relay open. Voltage Low is displayed.

Cleared by: Voltage returning within range (+/- 15% of power board rating).

2.1.5 Motor Driver Fault

A motor driver has detected a problem and sent an error code to the CPU.

The drive fault is relayed to the CPU through the fault input terminal (P118 for stepper, P111 for servo). The fault input is 5 VDC, and is only present when there is a problem.REXA actuators use two styles of motor driver, Stepper and Servo.

To identify which driver you have, you must first locate the model number on the REXA identification tag located on the Electronics enclosure, or the actuator.

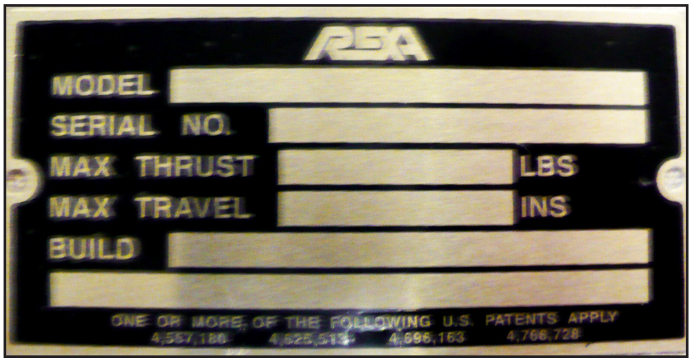


Photo 2.1.5-1 Mechanical ID Tag

Located in the model number of the REXA is the module type. An example would be an X3L2000-4-C-P. The module type determines which style of driver you have. In this example, the driver type is C. (Refer to “1.2 Actuator Identification” on page 21 for more information.)

Once the drive type is determined go to the corresponding TS&R section:

“3.2.1 Stepper Motor Driver” on page 21

“3.2.2 Omega Series Servo Motor Driver” on page 21

2.1.6 No Display, Unusual Display (ex., Letters Missing, Sections Burnt Out, Etc.)

The REXA display is a VACuum fluorescent emissive display with keypad. The display could burn out if left on for long periods of time. To avoid this, the display is dimmed after one hour of no keypad use, but may be turned back on by pressing any key.

If the 20 position ribbon cable between the CPU and display comes loose or is plugged in backwards, the display will go out. The power indicator light may remain on, but the display will be blank. If the 5 VDC input from the Quad Power Supply is lost, the display will go blank. (See “4.E.14 External VACuum Fluorescent Display (VFD)” on page 21).

2.1.7 Actuator Will Not Respond to HART Command

REXA actuators have an optional HART interface that allows them to communicate through the HART 5.0 protocol. When this option is installed a two-wire 4 to 20 mA current loop runs between the control station and the REXA actuator. If the actuator is not responding to this control signal, reference TS&R section 3.11, Control Signal Bad.

Through the universal HART command two dynamic variables (PV position of the actuator and SV differential pressure in the actuator) are transferred back to the control system. If these two variables are not being sent back, reference "2.7 Calibration" on page 21.

2.1.10 Actuator Will Not Respond to Analog Command

REXA actuators have a standard analog control scheme built into the main CPU board that allows the actuator to position using a two-wire 4 to 20 mA current loop. If the actuator is not following a change in the analog control signal current or is reading a **CS bad** in the display, reference "3.9 Control Signal" on page 22.

2.1.11 Actuator Will Not Respond to 1 Cont (On / Off) Command

REXA actuators have an optional contact input board that allows the actuator to be controlled through a single contact using the bias voltage from the Contact Input board, or a distinct voltage signal. The control is a 2 wire signal that carries AC or DC voltages that range from 24V to 120V. This voltage is interpreted by the REXA controller in accordance with the setup parameter Signal Type = 1 Cont.

If the actuator will not respond to the Contact signals, reference "3.10 Contact Input Signal" on page 22.

2.1.12 Actuator Will Not Respond to 2 Cont (Manual Control) Command

REXA actuators have an optional contact input board that allows the actuator to be controlled through 2 contacts using the bias voltage from the Contact Input board, or 2 distinct voltage signals. The control is a 3 or 4 wire signal that carries AC or DC voltages that ranges from 24 V to 120 V. This voltage is interpreted by the REXA controller in accordance with the setup parameter Signal Type = 2 Cont.

If the actuator will not respond to the Contact signals, reference "3.10 Contact Input Signal" on page 22".

2.2 Accessories

2.2.1 External Push Buttons Don't Work

The Electrical sub-assembly is equipped with an external door-mounted, 5 button membrane switch and display assembly. The switches interface with the Actuator (whether it is setup in calibration, local control, or scroll through parameters) while in the Auto mode.

- If the actuator is powered up in Auto mode without pushing any buttons, the display will dim to half intensity. The first button push will "wake up" the display to full intensity. The button must be pushed a second time to activate its function.
- A menu or parameter may not be accessible in the current mode of operation. See "6 Modes of Operation & Control Parameters" on page 22 of the IOM.
- To access modes of operation, 2 buttons must be pressed simultaneously. See "6 Modes of Operation & Control Parameters" on page 22 of the IOM.
- The ribbon cable connecting the membrane switch assembly to the interface circuit board may be disconnected. See "3.11 Display Problems" on page 22.
- If you are trying to Calibrate Signal Lo and Signal Hi with the buttons, see "6 Modes of Operation & Control Parameters" on page 22 of the IOM.
- +5 Vdc internal to the Control enclosure may be too low. (Contact the REXA factory.)

2.2.2 Internal Keypad Buttons Don't Work

The Electrical sub-assembly is optionally equipped with an internal, CPU mounted, 5-button keypad switch and display assembly. The switches are used to interface with the Actuator (whether it be setup in calibration, local control, or scroll through parameters) while in the Auto mode.

- If the actuator is powered up in Auto mode without pushing any buttons, the display will dim to half intensity. The first button push will "wake up" the display to full intensity. The button must be pushed a second time to activate its function.
- A menu or parameter may not be accessible in the current mode of operation. See "6 Modes of Operation & Control Parameters" on page 22. To access modes of operation, 2 buttons must be pressed simultaneously.
- If you are trying to move the actuator in Local or Calibrate mode and the actuator will not move, see "3.13 Control Issues" on page 22.
- Are you trying to Calibrate Signal Lo and Signal Hi with the buttons? See the IOM "6 Modes of Operation & Control Parameters" on page 23.
- +5 Vdc internal to the Control enclosure may be too low. (Contact the REXA factory.)

2.2.3 Drill Drive / Handwheel Doesn't Work

The handwheel is mounted to the actuator's motor. To operate, you must engage the handwheel by pushing the handwheel toward the motor; the hand wheel / drill drive is disengaged via internal spring. One half-revolution may be required for proper engagement. The handwheel will declutch by moving outwards when the spring is released.

- The hand wheel can take several turns before you see movement from the actuator. See the IOM "M. Manual Operators" on page 23.
- Servo units do not allow for operation of the handwheel while the actuator is powered up. A holding current is present to prevent movement of the motor.
- Units with standard solenoids and/or accumulator systems must have the override handles locked to operate the handwheel. See the IOM "M. Manual Operators" on page 23.
- For the online accumulator actuators, follow the sequence of steps in the IOM "C2. Online Recharge Accumulator Fail-Safe" on page 23.
- If the Manual bypass valve is open, the hand wheel will not operate.

2.2.4 Manual Hand Pump Doesn't Work

The Manual hand pump is a piston style pressure device with directional knob located underneath the assembly.

- Make sure the directional knob is in the up or down position.
- The hand pump can take several pumps before you see movement from the actuator See the IOM "M. Manual Operators" on page 23.
- Units with solenoids and accumulator systems must have the override handles locked to operate the hand pump. See the IOM "M. Manual Operators" on page 23.
- For the online accumulator actuators, follow the sequence of steps in the IOM "C2. Online Recharge Accumulator Fail-Safe" on page 23.
- If the Manual bypass valve is open, the hand pump will not operate.

2.2.5 Gauges Don't Work

Most REXA units have several gauges installed. Module gauges show cylinder pressure, and accumulator systems are equipped with accumulator system gauges. Both the power module and recharge module gauges have shut off valves located beneath the gauge. If the gauge is not reading, ensure gauge isolation valves are open. If the gauge is still not reading, you may have a bad gauge, and it should be replaced.

2.2.6 Pressure Limiting Protection Not Working (Unit Building Too Much Pressure)

The REXA pressure limiting valves are located on the power module underneath the motor junction cavity cover. The valves are factory set per specification. If the valves are tightened (CW rotation) then the internal pressure of the REXA unit will increase. The valves are adjustable and can be reset in the field.

CAUTION: If the actuator is connected to the driven device during adjustment, the equipment can become damaged

2.2.7 Torque or Thrust Data Not Accurate (From Transducers)

Some REXA units are equipped with pressure transducers to relay internal pressure electronically. Accumulator units use the pressure transducer to relay accumulator charge pressure, Hart units use pressure transmitters to relay cylinder pressure as well. The pressure transmitter is loop powered and sends a 4 to 20 mA signal. See "2.3.5 How Do I Test My 4-20 mA Pressure Transmitter?" on page 24.

2.2.8 Mechanical Limit Switches Not Functioning

REXA actuators have optional independent mechanical limit switches to provide redundant indication of the actuator's position. These limit switches are wired directly from the actuator cylinder to the DCS and are independent of the REXA electronics. Switch ratings and specifications can be found in the IOM "A. Mechanical Limit Switches" on page 24.

For repair / replace information on the switches for a rotary actuator, reference the IOM "A.2 Rotary" on page 24.

For repair / replace information on the switches for a linear actuator reference the IOM "A.1 Linear" on page 24.

2.3 Control Issues

2.3.1 Actuator Moves to Wrong Position

The REXA unit moving to the wrong position could be caused by:

- Control signal loss
  - The REXA unit may be programmed to move open, closed or in place on loss of control signal. See "3.13.1 Actuator Hunting – Electrical Noise" on page 24.
- Wiring errors
  - Incorrect wiring of the motor can cause incorrect or interrupted motor phase pulses causing the motor to travel briefly in the wrong direction. Check wiring per your REXA drawing.
  - Incorrect wiring of the feedback can cause the actuator to travel in the wrong direction. Check wiring per your REXA drawings.
- Manual bypass or Solenoid
  - If the bypass valve or solenoid is open, the REXA unit cannot build pressure. It is possible for the process or driven device to push the actuator in the wrong direction if these pressure relieving devices are open.

2.3.2 Actuator "Hunting" (Dithering During Control)

The occurrence known as "hunting" can be caused by several different issues.

Electrical noise issues:

If the REXA feedback or control signal is constantly in flux the cabling may be installed incorrectly. "3.13.1 Actuator Hunting – Electrical Noise" on page 24.

Gain / acceleration settings may be incorrect. Every REXA unit is tuned per power module and cylinder combination. Additional tuning may be required for faster pumps / motors and smaller cylinders.

2.3.3 Actuator "Drifts" Away From Applied Load

The REXA actuator is designed and specified to meet the required thrust or torque per a specific application. If the actuator is pushed by the process, then the following steps should be taken:

- Confirm your actuator has the required thrust or torque to overcome the process requirements. The actuator's model number will determine the rated thrust or torque. "3.13.2 Actuator Torque / Thrust Requirements" on page 24.
- Ensure bypass and solenoid valves are shut and tight.
- Ensure Pressure limiting valves are set per the unit's specification.
- A failed piston seal in the cylinder or a failed flow match valve on the drive train assembly can cause the REXA cylinder to lose internal pressure. See "3.13.3 Actuator Drifting" on page 24.

2.3.4 Position Feedback Doesn't Match Actual Position

The REXA's position transmitter output is digitally calibrated by the CPU during programming of the high and low positions. If your transmitter needs further calibration, see TS&R section 3.15.6, Position Transmitter calibration.

2.3.5 How Do I Test My 4-20 mA Pressure Transmitter?

"3.1 Accumulator Low / Bad Pressure" on page 25.

2.3.6 No Position Feedback Signal

The REXA position transmitter is capable of transmitting a 4 to 20 mA output by using loop or internal power. Refer to your wiring diagram for proper termination information.

2.3.7 Electrical Limit Switches Are Not Functioning

The REXA Control enclosure is equipped with two single-pole, single-throw, solid state relays that give limit indication. The position of that indication is set by parameters Relay #1 and Relay #2 in the Outputs menu, "6 Modes of Operation & Control Parameters" on page 25 of the IOM. Refer to your wiring diagram for proper termination points. The relays are configured to be "open contact" when Main power is not applied. Also, the contact for Relay #1 will be open when actuator position is above the position given by parameter Relay #1, and will close when below the set point. The contact for Relay #2 will be open when actuator position is below the position given by parameter Relay #2 and will close when above the set point.

- If relays are not operating, be sure the actuator is above (Relay #2) or below (Relay #1) set points.
- Is the corresponding LED for each relay illuminating? If yes, check wiring terminations.
- Is the actuator position within the Relay set point, including deadband?
- The relays should have no more than 1.5 Ω resistance when the contact is closed. If it is greater (or the contact measures open when it should be closed), refer to "3.13.5 Electrical Limit Switches" on page 25.

2.3.8 Actuator Will Not Seat, I Can Not Get Full Travel.

The REXA actuator is designed and specified to meet the required travel for a specific application. If the actuator can not fully stroke the driven device, the following steps should be taken:

- Confirm the actuator is properly calibrated, setting the PL and PH position values to the process requirements.
- Confirm the bypass on the gauge manifold is properly closed.
- Confirm your actuator has the required travel or rotation for the application. See "3.13.2 Actuator Torque / Thrust Requirements" on page 25.

- All REXA actuators have adjustable pressure limiting valves. Ensure that your actuator is generating enough pressure to overcome the process requirements. See "3.12 Pressure Relief Valves" on page 25.
- For TOO HIGH or TOO LOW indication on the display, see "3.13.6 Too High / Too Low on Display" on page 25.
- Ensure no mechanical restriction or binding is causing the actuator to stop travel.

  Rotary Unit- Some rotary units have adjustable travel stops. Rotary SPRING FAIL stop may need to be set.

  Linear Units- Engagement of valve stem into elastic coupling may be too deep. Check engagement and make changes if required. The engagement of the valve stem into the actuator should be 1.5 times the diameter of the stem. If the stem engagement can not be corrected, contact your local REXA representative.
- Packing arrangement or anti-rotation may be interfering with actuator stroke.

2.3.9 Actuator Does Not Meet Stroke Speed Requirements

- The REXA actuator is designed to meet a specific speed requirement. Refer to "3.13.2 Actuator Torque / Thrust Requirements" on page 26, for stroke times for your equipment. If your actuator is not meeting these requirements, you may need to adjust the HS setting in the parameter menu. See "6 Modes of Operation & Control Parameters" on page 26 of the IOM.

2.3.10 Booster Pump

- Booster Pumps are an optional accessory installed on some actuators. They are used to increase the speed of the actuator. Booster pumps will turn on when the desired change in position is greater than the "Boost Pump" setting under the drives menu. To adjust this parameter, reference "6 Modes of Operation & Control Parameters" on page 26 of the IOM.

2.3.11 Only One Module on 2D or 2C Units Functions

- REXA units with specific speed requirements sometimes use multiple modules to meet that specification. Dual module units require 2 sets of motors, drivers and cables. Refer to your specific wiring diagram to make sure you have the correct interconnect for your actuator. For redundant units, a separate electronics is required. If an error code is displayed on either driver, see "3.2.3 Driver Fault" on page 26.

2.3.12 Surrounding Equipment Disrupted by Actuator Operation

Some REXA actuators use large motors that require high voltage and current. If the cables for the REXA actuator are run close to surrounding equipment or control cables, it is possible for noise to be induced onto the control lines of this equipment.

2.3.13 Servo Motor Turning at Low RPM When Not Commanded to Move

When the actuator reaches its set point, the motor will come to a complete stop. The FMV holds the load in place which allows the power consumption of the unit to be very low. Since there are no moving components, it extends the life of the actuator. If the motor continues to rotate after the actuator has reached its new position, reference "3.13.1 Actuator Hunting – Electrical Noise" on page 26.

2.3.14 Actuator Slows Down and "Resets" Before Getting to Target Position

Within the actuator CPU there is a timer that will shut down the motor and cause the system to reset if the actuator is not achieving a certain speed. There are numerous reasons why the actuator may be having a speed issue, and they range from tuning to having an actuator that is undersized for a given load.

- The "Gain" setting may be too low. This will cause the motor to slow down too much before it reaches the set point.
- If the actuator pressure is above 2400 psi when this is occurring, reference "3.12 Pressure Relief Valves" on page 26.

2.3.15 Actuator Overshoots Target Position and Returns

If the actuator does not slow down as it approaches the new target position, it will likely overshoot its new position. Within the sophisticated control scheme of the REXA electronics there are tuning parameters that will allow this overshoot to be tuned out.

- The "Gain" setting may be too high. Refer to the "6 Modes of Operation & Control Parameters" on page 26 of the IOM to ensure parameters are correct.

2.3.16 I Have Many Errors Logged in Historical Stats

The REXA electronics will keep a running count of error codes to log the problems the system encounters. This count is stored under the current stats and historical stats menus. The current stats can be reset in the setup menu, but the historical stats are a permanent running counter. Reference the error codes section to determine possible root causes. Close monitoring of the unit should be performed to determine the root cause of these failures. Reference the specific error codes section for more information.

2.4 Fail-Safe Issues

2.4.1 Accumulator Will Not Recharge

Both the standard accumulator and online recharge accumulator systems are self-contained and do not require external equipment to recharge the system after a trip. If your accumulators are not recharging:

- Ensure that the parameter **ACCUM DIR** (accumulator fail direction) is set to the proper end. See "C1.2 Accumulator Control Parameters" on page 27 of the IOM.
- The system requires additional oil to charge the accumulator; this oil is pulled from the collection bottle. There is a shut off valve located between the collection bottle and the accumulator bottle. This valve must remain OPEN.
- Some standard accumulator systems are designed to have more than one fail per recharge cycle. The accumulator system will only go through a recharge cycle if the pressure in the system falls below the warning pressure.
- Some accumulator systems use an external trip signal to activate the fail condition. See the IOM "C1.1.1 Trip Function" on page 27.
- The standard accumulator system uses two external solenoids to operate the accumulator system. The online recharge accumulator system uses a single solenoid with two PO check valves to operate the accumulator stem. See IOM sections "C1. Standard Accumulator Fail-Safe" on page 27 and "C2. Online Recharge Accumulator Fail-Safe" on page 27. The REXA CPU controls power to the solenoids as defined during manufacturing of the system. For information on the solenoids see "4.M.11 Solenoid" on page 27.

2.4.2 Actuator Does Not Recover After Fail-Safe Event

Some REXA actuators are equipped with a fail-safe system when necessary. Several different failsafe systems are available:

Control Signal Fail-Safe

- Check your **FAIL-SAFE** parameter setting. See "6 Modes of Operation & Control Parameters" on page 27 of the IOM.
- Some control systems use a 0 to 20 mA input signal; in this situation, the **FAIL-SAFE** parameter needs to be set to **OFF**. Less than 2.5 mA is a valid signal for 0 to 20 mA systems.

Spring Assist Fail-Safe & Surge Systems

- Spring fail-safe units have an electrical solenoid in place of the manual bypass. This solenoid assembly may need to be adjusted to operate properly. See "4.M.11 Solenoid" on page 27 for information.
- Surge systems have a trip input function that may need to be reset to continue normal operation. See "6 Modes of Operation & Control Parameters" on page 27 of the IOM.

Accumulator Fail-Safe System:

- Some accumulator systems have trip input function that may need to be reset to continue normal operation. See "6 Modes of Operation & Control Parameters" on page 27 of the IOM.

2.4.3 Unit Will Not Move to Fail-Safe Position

Some actuators have spring fail-safe or accumulator fail-safe systems to move the driven device to a previously specified position upon loss of power or trip activation signal. The REXA standard system fails-safe on loss of power and can be programmed to fail-safe to a specified position on loss of control signal. For additional information on the loss of control signal function, see "6 Modes of Operation & Control Parameters" on page 27 of the IOM.

If your equipment is spring fail-safe or accumulator fail-safe system design, it will be indicated on the model number of the actuator. See "1.2 Actuator Identification" on page 27. If your actuator has an –E, –R or –U in the model number, you have a mechanical spring installed to fail the actuator upon activation of a fail-safe event (loss of power or trip signal. If your actuator has an –A or -M in the model number, you have an accumulator system to fail-safe the actuator upon activation of a fail-safe event (loss of power or trip signal).

- Before troubleshooting the fail-safe system, make sure your solenoid manual overrides are in the correct position for fail-safe event, and all shut off valves are in the open position.

Standard REXA internal solenoid identification:"4.M.11 Solenoid" on page 28. High speed solenoid identification: "4.M.14 High Speed Solenoids" on page 28.

- Also, ensure no mechanical restrictions are preventing the actuator from reaching fail-safe position.

Trip input functions have additional parameters to determine the proper fail-safe position and trip input functions. See the IOM "6.1 Setup Mode" on page 28.

2.4.4 Actuator Does Not Meet Fail-Safe Speed Requirements

The REXA actuator is designed to meet the required fail-safe speed for a specific application. If the actuator can not fully stroke the driven device in the time specified, the following steps should be taken:

<u>Spring Fail-Safe Systems:</u>

- Standard solenoid (module mounted) units have no speed adjustment. To increase the fail-safe speed of a standard internal REXA solenoid, please contact your REXA representative.
- High speed solenoid units have a needle valve installed in line with the solenoid. Turn the needle valve CCW to increase fail-safe speed, CW to reduce fail-safe speeds. See "4.M.14 High Speed Solenoids" on page 28.

<u>Accumulator Fail-Safe Systems:</u>

- Some standard accumulator systems have a needle valve installed in line with the solenoid. Turn the needle valve CCW to increase fail-safe speed, CW to reduce fail-safe speeds.
- Some standard accumulator systems have a flow metering valve installed in line with the accumulator system. Adjust the metering valve to increase flow speed.
- The online recharge accumulator systems have a needle valve on the recharge module. Adjust the needle valve CCW to increase fail-safe speed, CW to reduce fail-safe speeds.
- To further increase the speed of the accumulator system fail speed, please contact your REXA representative.

2.4.5 Hydraulic Surge System Not Functioning

Hydraulic surge systems use a solenoid valve and spring or an online recharge accumulator system to achieve fast motion in the one direction, typically the fail-safe direction. This surge operation only occurs with a change in the control signal input as defined by the Surge Breakpoint parameter in the setup menu. Bi-direction surge with PST uses 3 solenoids in a surge control manifold to achieve fast motion in both directions along with PST functionality. Reference the IOM "G. Surge Control Option" on page 28.

2.4.6 Unit Moves to the Wrong Position for Trip

REXA actuators can be configured to fail to either end position or stay in its last position. The fail-to-end position is achieved either by the use of a coil spring or a pressurized accumulator bottle and can be triggered by a loss of power, control signal or independent trip signal.

- If the actuator trips to the wrong end, reference "3.14.1 Fail Direction" on page 28.
- If the actuator does not trip on loss of power, reference "3.14.2 No Trip on Loss of Power" on page 28
- If the actuator doesn't trip on loss of control signal, see "3.14.3 No Trip on Loss of Control Signal" on page 28.
- If the actuator doesn't trip on loss of trip signal, reference "3.14.4 No Trip on Loss of Trip Signal" on page 28.

2.4.7 No Accumulator Pressure Reading on Display, But There is Pressure on Gauge

The REXA CPU constantly monitors the accumulator pressure. The data is used to send a warning and alarm if the pressure drops to a level that a full fail safe trip can not be completed. This data is also used during an accumulator recharge to determine the maximum pressure the accumulator will be charged to. Reference "C2. Online Recharge Accumulator Fail-Safe" on page 29.

2.4.8 High Speed Solenoid is Extremely Hot to the Touch

REXA uses two high speed solenoid valve designs to control our trip functions. The type of solenoid used depends on if it is a standard accumulator or online recharge accumulator system. These solenoids can be either energized all the time or only during a failsafe event. If the unit has solenoids that are energized continuously, these valves will be hot to the touch. Typically, solenoids used on the standard accumulators will have a 60 °F (16 °C) temperature rise during normal operation while solenoids used on the online recharge system will be warm to the touch. If the solenoid valves are measured to have a higher temperature rise, reference "4.M.11 Solenoid" on page 29.

2.5 Oil Leaks

2.5.1 External Oil Leaks

Under normal operating conditions the REXA actuator will not use additional make-up oil. The REXA unit may show signs of oil weeping shortly after installation. When the actuator is exposed to an increase in temperature, the thermal expansion chamber may weep slightly until equilibrium is met. If it continues to weep or leak oil, please contact your local REXA representative.

2.5.2 The Oil Indicator is Low / Repeated Filling but No Visible Oil Leaks

When the oil level indicator is below the scribe mark, refer to "1.6 Oil" on page 29, for filling instructions. If the cycle of retracting and filling continues, the actuator could be leaking internally. The actuator will continue to function as long as the oil level is maintained, contact your local REXA representative.

2.5.3 Thermal Expansion Relief Leaks Oil

The actuator's thermal expansion pressure relief valve is set between 40 and 120 psi depending on the design of the equipment. Upon installation it is normal for the equipment to weep some oil from the thermal expansion pressure relief valve during temperature changes. If the leak persists, please contact your local REXA representative.

2.6 Miscellaneous

2.6.1 Water in Module

The REXA power module is rated to meet the requirements of NEMA 4X. It is important to see if the location of where the water is entering can be identified. Typically the largest root cause of water getting into the unit is from improper installation of the conduit and not using pipe thread sealant during installation.

- First check the conduit fitting to insure they are tight and pipe sealant has been used.
- For water in the module wire cavity or under the rotary housing, reference"3.15.1 Module / Motor" on page 29.
- For water under a linear feedback housing, reference "3.15.2 Electronics" on page 29.

2.6.2 Cylinder Binding

Most mechanical restrictions are either an application or mounting-related problem. Binding will be indicated by erratic motion, noticeable bending of the actuator stem or driven device, slower speed or restricted travel. These issues should be corrected immediately as they have the potential to shorten the life of the actuator bushings or valve packing. If you suspect you are having binding issues, please call the factory for assistance.

2.7 Calibration

2.7.1 Setting PL or PH and the Unit Reads "Too High" or "Too Low"

- When calibrating a REXA actuator, the end points are recorded as Position Lo and Position High. If during the set up procedure PL or PH is being set to a point that is too close to the mechanical end stop, the display will read "too high" or "too low". Reference "3.13.6 Too High / Too Low on Display" on page 30.
- If the actuator feedback changes when the unit runs, reference "3.13.1 Actuator Hunting – Electrical Noise" on page 30.
- If the actuator feedback doesn't change when stroking the actuator, reference "3.3.2 SLC Feedback Bad" on page 30.
- If the feedback only changes during a portion of the actuators stroke, reference "3.3.2 SLC Feedback Bad" on page 30.

2.7.2 Will Not Accept PL or PH Value

When calibrating a REXA actuator the end points are recorded as PL and PH. If during the set up procedure PL or PH are set too close together (within 10% of each other) the values will not be accepted.

- If the actuator feedback changes when the units is being run reference "3.13.1 Actuator Hunting – Electrical Noise" on page 30.
- If the actuator feedback doesn't change when stroking the actuator reference "3.3.2 SLC Feedback Bad" on page 30.
- If the feedback only changes during a portion of the actuators stroke reference "3.3.2 SLC Feedback Bad" on page 30.

2.7.3 Will Not Accept SL or SH Value

- The REXA actuator will allow calibration of the incoming control signal for precision control. The actuator will record the two control signal inputs that correspond to the low travel end points. If during the set up procedure SL or SH are out of range, they will not be accepted. Reference "3.9 Control Signal" on page 30.

3. Troubleshooting

3.1 Accumulator Low / Bad Pressure

Press bad

This error appears when the CPU does not receive an analog signal from the pressure transmitter.

1. Ensure the wiring to the transmitter is correct according to the drawing. It should be as follows.

Terminal Block	Interconnect	Transmitter
+15V	P7 Pin 9	Red
Acc+	P7 Pin 10	Black

   Shield should be landed at both the Electronic enclosure back panel and at the Transmitter terminal strip at the actuator.

2. Check the CPU by simulating a 4 to 20 mA signal; this can be done by removing the wires connected to the Transmitter and directly applying a 4 to 20 mA signal generator (see photos). Connect the positive end of your signal generator to Acc+ and the negative end to Acc-.

3. Begin by scrolling to the "Accum Pres" parameter under the Drives menu. Apply the recommended signal and take note of the display reading.

Signal (mA)	Display (psi) 3000 psi Transmitter	Display (psi) 5000 psi Transmitter
4	0	0
8	750	1250
12	1500	2500
16	2250	3750
20	3000	5000

   If these readings are correct, then the CPU is good.
   If these readings do not match, replace the CPU. See "4.E.4 CPU Assembly" on page 31.

4. If the CPU is working properly, the problem may be with the Pressure Transmitter.

   To test the Pressure Transmitter:

   a. Disconnect Pressure Transmitter Cable at the actuator junction box.

   b. Connect current source as shown; red lead to red, black lead to black.

   c. Turn dial on current source to full output (clockwise)

   d. Display should read mA signal that corresponds to pressure

   4 mA = 0 psi
   16.8 mA = 2400 psi
   20.0 mA = 3000 psi

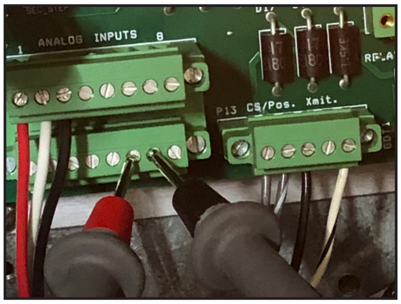


Photo 3.1-1Acc+ and Acc-

e. Pressure will not change as you move dial on current source as the current source is fixed (based on the pressure reading of the pressure transducer). To verify that the pressure transmitter is working properly, take pressure reading at a minimum of two pressure points, i.e. 0 psi and 2400 psi. Note that for the online recharge accumulators, the system can be manually recharged in Calibration Mode by pressing the arrow direction in the fail direction to pressurize the accumulator. To minimize the volume in the system, shutof the ball valve inline with the accumulator bottle. Use the accumulator bypass as needed to bleed off the system pressure.

f. The mA reading should correspond to pressure on the pressure gauge

0.00667 mA per 1 psi
2400 psi*0.00667 = 16 mA
If these readings don't match or no loop power can be sourced, then the Pressure Transmitter is bad. See "4.M.26 Transducer" on page 190.

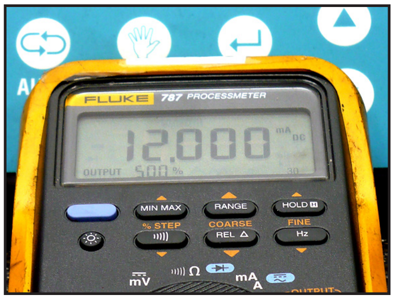


Photo 3.1-2 Signal generator

5. If both the CPU and Pressure Transmitter are working properly, the problem may be possible ground related with the Pressure Transmitter's ground wire which likely results in intermittent pressure readings. The pressure transducer has 4 wires, RED, BLACK, WHITE and SHIELD. Ensure that the bare conductor of the WHITE wire is not shorted against the SHIELD or against any metal object. The WHITE wire should have left the factory terminated, or cut and taped back so that it does not short out against any conductor.

Press Low

The "Press Low" error occurs when the accumulator pressure is below the warning pressure value (under the Drives menu).

1. Verify the system tag / documentation to determine the nitrogen precharge pressures (typically around1900 psi for standard accumulators and less for custom accumulators).

2. Start by initializing a re-charge cycle. Once a re-charge cycle has begun and display reads "Auto-Rchg", scroll up using the up arrow until the display reads "Accum Pres".

3. Hold down the Enter Key and observe the Accumulator Pressure rising once the oil pressure side exceeds the nitrogen pressure side. The increase in Pressure should be a steady pressure rise until the pressure has reached the recharge pressure value under the Drives menu. There should be at least a 200 psi differential between the "Rechrg Pres" and the "Warn Pres" values.

4. If the accumulator has started its recharge cycle and the "Accum Pres" is at 1900 lb (or very close to the initial pressure), allow the Actuator to perform its recharge cycle to determine if the problem has been solved.

   If the accumulator has started its recharge cycle much lower than the nitrogen precharge pressure, stop the recharge cycle by holding down the AUTO & MANUAL buttons at the same time. This will take the Actuator into setup mode for further evaluation of the problem.

5. Look at the Accumulator Pressure gauge located at the Actuator. This pressure should match the settings in the Drives Menu "Accum Pres". If the gauge is reading higher than what the transmitter shows, (between 1 900 and 2 400), go back to the **Pressure Bad** section and perform the same checks to determine if the problem is in the CPU or Transmitter.

6. If the Accumulator gauge and pressure transmitter are both reading the same value (i.e. 200 psi below the precharge pressure), then there was (1) a loss of Nitrogen from the Accumulator bottle or (2) the system is a special unit with lower nitrogen pressures than the standard units. Refer to the system documents to properly service these units. See "4.M.27 External Expansion Chamber And Accumulator Bottle" on page 194.

3.2 Drive Fault

3.2.1 Stepper Motor Driver

Stepper Motor Theory:

The REXA Stepper module uses a two-phase, brushless DC electromagnetic stepper motor. A sequence of voltage outputs from the stepper drive creates movement.

Photo 3.2.1-1 Stepper Motor

Stepper Driver Theory:

The stepper driver is a two-phase bi-polar micro-stepping drive with PWM control. It converts the directional pulses from the REXA CPU into current waveforms creating physical motor movement. The direction and speed of the motor is determined by input coming form the REXA CPU.

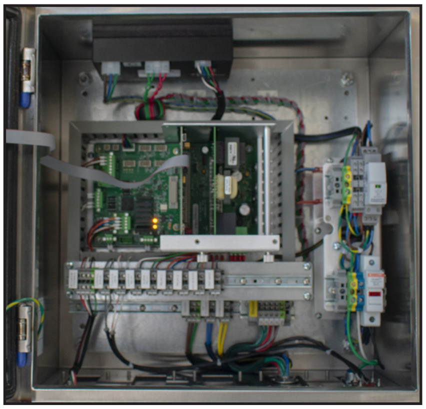


Photo 3.2.1-2
X3 Standard Stepper Electronics Enclosure

Photo 3.2.1-3
Stepper Driver, Potted Version for Hazloc Shown

Stepper Driver Input:

The stepper driver input is powered from the main AC incoming line voltage for AC input applications. Verify the incoming power at the main incoming fuse holder is either.

115VAC ± 10% for 115VAC power drivers or 230VAC ± 10% for 230VAC power drivers

Photo 3.2.1-4
115 VAC ± 10%

Photo 3.2.1-5
230 VAC ± 10%

Stepper Driver Output:

The stepper driver output depends on the input power supplied to the driver.

Maximum 6.3 Arms at 170 VDC for 115 drivers or Maximum 5.0 Arms at 340 VDC for 230 drivers

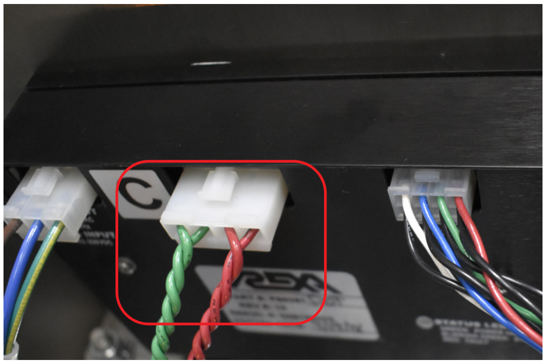


Photo 3.2.1-6 Driver Output Terminal

NOTE: Measured voltages may be lower based on motor type, driver type, high speed setting, interconnect cable length and gauge.

Speed Settings - RPM Versus Pulses

The frequency of the pulses is proportional to the Max Hi Speed setting in the SPEED menu. 0.9 degrees per step = 400 steps per 1 motor revolution = 6.67pps (pulses per second) = 1 RPM

Table 3.2.1 Speed Settings - RPM versus Pulses

Pulse Frequency	RPM	X3 Max Hi Speed Percentage (HS)
Start Speed 300 pps (300Hz)	45 rpm	3.75% N / A
2000 pps (2kHz)	300 rpm	25%
4000 pps (4kHz)	600 rpm	50%
6000 pps (6kHz)	900 rpm	75%
8000 pps (8kHz)	1200 rpm	100%
10000 pps (10kHz)	1500 rpm	125%

Stepper Driver Features:

- 0% Idle Current Reduction: motor current is reduced to 0% during idle if a step pulse is not received for one second. Current is restored to full value on next incoming pulse.
- LED Indicator:
    - Steady GREEN - power is ON
    - Blinking GREEN - power is on and step pulses are being supplied from the REXA CPU to the driver STEP input
    - Steady RED - driver fault
- Drive Fault Indication (Driver LED = Red):
    - Short Circuit - Motor Phase to Phase or Phase to Earth Ground.
    - Over Temp exceeds 90°C (195°F) heatsink temperature, self-clearing when driver cools down
- Enable: energize (+5VDC) to enable motor current. Driver does not accept STEP commands unless enabled.

Driver Fault:

If the pulse sequence is interrupted by a loss of current, a short to ground or to another phase, or an over temperature condition, a driver fault may result. Below is a list of possible causes and verification checks.

The X3 Interconnect Board has two separate logic connectors:

- P118 is "PRI_STEP" for Primary Stepper
- P128 is "SEC_STEP" for Secondary Stepper and / or Online Recharge Stepper. This series of checks can be applied to both connectors.

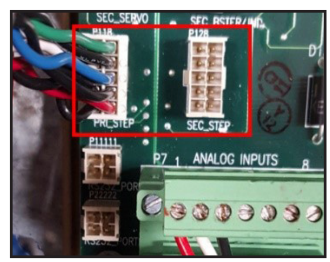


Photo 3.2.1-7
Stepper Logic Connections

Possible Causes of Driver Fault:

- **Incorrect voltage input to driver:** Verify main incoming power is within spec as detailed in the 'Stepper Driver Input' section above. Follow the wires from the driver's input to the terminal blocks, measure at that point with DMM.
- **No driver bus voltage:** Use DMM on VAC setting to measure the Green to Green / Black or the Red to Red / Black motor wires while the motor is running. Measured value depends on motor type (B-Size or C-Size) and driver type (115VAC or 230VAC driver). It is best to measure bus voltage on the DIN rail terminal blocks leaving the electronics enclosure (when possible) and again at the actuator power module terminal blocks. The high voltage bus is either present, or it is not.

- **Drive fault caused by a short circuit or wire break in the interconnect cabling:** Verify the integrity of the cabling by checking each wire for continuity to ensure there are no wire breaks or shorts. Use a DMM or Dielectric Tester to test the cables. If a problem is found with the interconnecting cables, replace the cable and re-check the unit.

- **Insulation breakdown or pinched wire causing bad motor:** Use a DMM to check to integrity of the motor by reading the resistance between each motor phase.

  Phase A: Wire pair Green (phase A) and Green / Black (phase A-)
  Phase B: Wire pair Red (phase B) and Red / Black (phase B-)

  Resistance should measure around 0.2Ω to 0.3Ω between each phase wire (A / A-, B / B-). Readings of 0.6 or higher, or 0.1 or lower indicate the motor is bad and must be replaced.

- **Over temperature motor:** There will be no power present at the driver (driver LED = OFF). This indicates the motor thermal switch has opened, cutting power to the driver which is wired in-series with the switch. Switch opens at 180°C ±5°C (356°F) and resets at 150°C ± 5°C (302°F). Keep in mind the switch is located on the motor windings and the actual motor surface may be slightly cooler. With power = OFF, measure the resistance across the two yellow motor thermostat wires, if open, then the motor overheated.

- **Over temperature driver:** Thermocouple or infrared heat gun may be used on the side heatsink case of the driver to determine if excessive driver heating is causing the protection to trip.

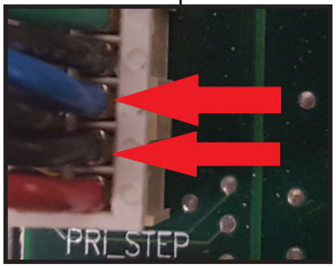


Photo 3.2.1-8
Blue/Black Wire

- **Not receiving Enable signal from REXA CPU:** Use fine tip probes with DMM to measure the contacts of the Blue / Black wire pair inside the logic connectors while connected to the X3 Interconnect Board. In Local / Manual Mode, depress the UP or DOWN arrow on the keypad and the value should be ≈ 5.0VDC while the buttons are depressed. When not depressed, it should read ≈ 0VDC. Driver LED will blink Green when buttons are depressed. If these values are not measured, the motor will not move and the CPU should be replaced.

- **Not receiving Step pulses from REXA CPU:** Step pulses are high frequency which cannot be measured with a DMM. However, as a raw indication that something is getting sent to the driver, measure the following:

  Use fine tip probes with DMM to measure the contacts of the Green / Black wire pair inside the logic connectors while connected to the X3 Interconnect Board. In Local / Manual Mode, depress the UP or DOWN arrow on the keypad and the value should be ≈ 0.5VDC while the buttons are depressed. When not depressed, it should read ≈ 0VDC. If Oscilloscope is available, individual pulses can be seen with a scale of 2Volts / division and timescale of 100µS / division. Pulses are seen when motor is moving at full speed. Attach the probe lead to the green wire and the ground clip of the probe lead to chassis ground. Driver LED will blink Green when buttons are depressed. If these values are not measured, the motor will not move and the CPU should be replaced.

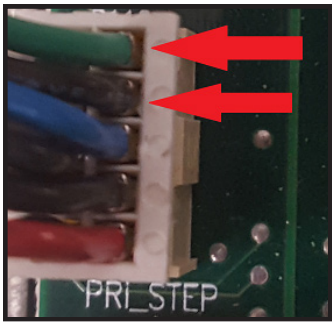


Photo 3.2.1-9
Green/Black Wire

- **Not receiving Direction signals from REXA CPU**: Use fine tip probes with DMM to measure the contacts of the Red / Black wire pair inside the logic connectors while connected to the X3 Interconnect Board.

  In Local / Manual Mode, depress the UP arrow on the keypad and the value should be ≈ 5.0VDC. Depress the DOWN arrow and the value should be ≈ 0VDC. Driver LED will blink Green when buttons are depressed. If these values are not measured, the motor will not move and the CPU should be replaced.

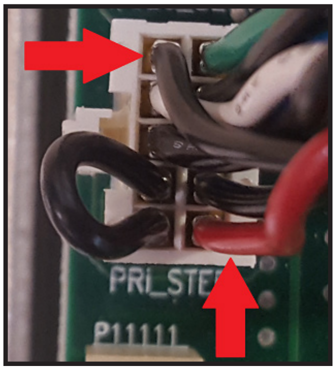


Photo 3.2.1-8
Blue/Black Wire

3.2.2 Omega Series Servo Motor Driver

Servo Motor Driver

To troubleshoot the servo driver, it is recommended that the REXA CPU be placed in the Local mode.

REXA's Omega Series Digital PWM Brushless Servo Amplifier offers the latest in high performance DSP control of brushless servo motors. The actuator unit operates in the VELOCITY Mode configuration. In this mode of operation, the servo driver module generates a tachometer signal which is used to close a velocity loop specific to the version of software loaded onto the driver and the corresponding motor type. The control of the velocity loop is via the REXA CPU. The signal from the CPU is an analog + / -3 Vdc signal. The slope and amplitude of this signal controls the acceleration, speed, and deceleration of the motor.

Troubleshooting the servo driver begins with the outputs from CPU to the driver. To initiate motor movement, the CPU sends signals to the driver: Place system in LOCAL mode to generate and verify these signals.

Input / Output Signals from CPU to REXA Servo Driver

- ENABLE OUT: Blue wire—Signal to driver from CPU to engage movement; 0 Vdc during normal operation, 5 Vdc present during fault or reset condition.
- FAULT IN: Red wire—Signal from driver to CPU to indicate problem with driver, motor or cabling; 0 Vdc during normal operation, 5 Vdc during fault condition.
- GND: Black wire—optically isolated ground for driver logic.
- MOT- / +: Green wire with Black ground—Analog signal from CPU to driver to indicate operation speed, +3 Vdc / -3 Vdc (1 mV = 1 RPM of motor speed).

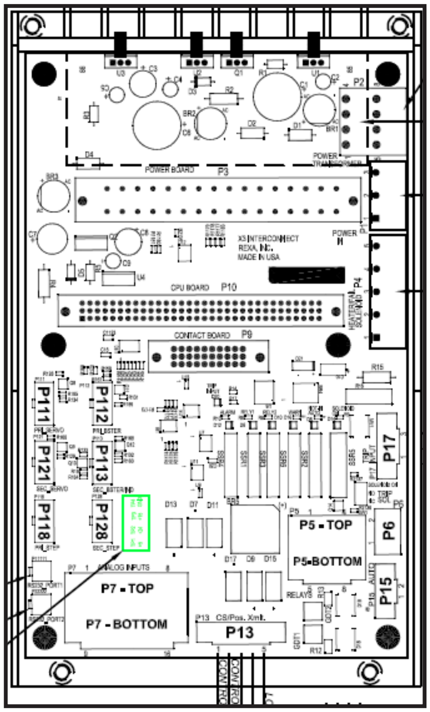


Photo 3.2.2-1

- MOT - / + NOTE: A MAX Hi Speed of 100% = 2.4 mV between these terminals, actual motor speed is 2 400 RPM.

  Measurements can be taken for each servo at locations P111 Main Servo, P112 Secondary Servo, P121 Primary Booster, P113 Secondary Booster

P111 (Primary Servo)

Pin	Description	Pin	Description
1	MOT1ENABLE(-)	6	GND
2	GND	7	SRV1_ID
3	MOT1FAULT(+)	8	NC
4	GND	9	NC
5	MOT1(+-3VDC)	10	NC

P112 (Primary Booster)

Pin	Description	Pin	Description
1	BOOST1ENABLE(-)	6	GND
2	GND	7	BSTR1_ID
3	MOTB1FAULT(+)	8	NC
4	GND	9	NC
5	BMOT(+-3VDC)	10	NC

P121 (Secondary Servo)

Pin	Description	Pin	Description
1	MOT2ENABLE(-)	6	GND
2	GND	7	SRV2_ID
3	MOT2FAULT(+)	8	NC
4	GND	9	NC
5	MOT2(+-3VDC)	10	NC

P113 (Secondary Booster or Induction)

Pin	Description	Pin	Description
1	BOOSTENABLE2(-)	6	GND
2	GND	7	BSTR2_ID
3	MOTB2FAULT(+)	8	NC or IND_EN_H
4	GND	9	NC or IND_ID
5	BMOT(+-3VDC)	10	NC or IND_FLT

3.2.3 Driver Fault

FAULT IN: Signal from driver on Pin 3, to CPU to indicate problem; 0 Vdc during operation, 5 Vdc during fault condition.

Driver Fault Code Identification

When a driver fault code is sent to the CPU from a driver, it will have a corresponding code on the driver display.

NOTE: While in AUTO mode, the CPU will send a "reset" signal to the driver in an attempt to clear the fault. The CPU will continue to send reset signals (approximately every 3 seconds) until the condition is corrected (until the fault is cleared). Removing the unit from AUTO mode will stop the reset signal and allow you to view the error code on the Omega display.

A diagnostic LED display is provided on each Omega driver, it is a 7-segment LED display. When the driver is not operating, one of the outer six segments is lit. Each of the six outer segments represents one of the six Hall states in a commutation cycle of the motor. During motor movement the display will show an O, all six segments lit (one at a time) in the direction the motor is turning. The Omega LED will show additional fault codes in the driver display, the fault codes below are shown on the drivers display when the CPU is not sending a reset signal to the driver.
A description of the error code and possible causes are listed below:

Fault code = S. Immediate short code. (Electronic Circuit Breaker, high speed)

- Motor phase line to line short, or line to ground (direct short)
- Electronic "noise" on resolver cable (interference)
- Bad motor power cable
- Seized or shorted motor

Fault code = L. Secondary short code, (Low speed ECB tripped)

- Green and Blue Resolver wires reversed or loose
- Motor seized
- Incorrect motor connected to driver
- Any driver, Red and Black wires reversed or loose

NOTE: For low and high speed short codes, be sure to inspect motor and cable integrity by use of a multi or MEG meter. Test for a short from phase to phase or from phase to ground. Also, inspect for wrong connection; i.e., blue and green wires swapped.

Fault code = E. Resolver error

- Resolver line break
- Resolver cable electrical noise (interference)

NOTE: To correct the resolver error code, inspect cable connections and / or damage or corrosion to the cables. Be sure to separate resolver (signal) cables from high power cables and other power sources (at least 3 meters [~10']).

Fault code = H. Driver Over-temperature (upper case H)

- Omega driver temperature is too high (185 °F [85 °C])

NOTE: An H error code indicates the ambient temperature (at electronics enclosure) is too high for the driver to operate (ambient temperature range for Omega drivers -40 °F to +150 °F [-40 to +65 °C]).

This is a recoverable error. The ambient temperature for the electronics must be brought back below the 150 °F (65 °C) threshold in order to keep the 185 °F (85 °C) temperature switch on the driver heat sink from opening. Since high temperatures will shorten the life of electrical components; the electronics should be installed in a controlled environment.

Fault code = h. Motor over temperature (lower case h).

- Motor temperature is over thermostat set point (340 °F [170 °C])

NOTE: The thermostat located in the motor has changed state. This is a normally closed switch. If the temperature of the motor is below 340 °F (170 °C), check thermostat cable connections (yellow / orange resolver wires).

Fault code = b. Over Voltage fault.

- Incoming power is over 252 VAC input power

NOTE: Check incoming power supply. Refer to actuator specification sheet for power requirements.

Fault code = Ξ (three horizontal bars). Power on commutation failed.

- Driver unable to ZERO motor position on start up

NOTE: Wiring errors (resolver / motor) can cause commutation errors. Check all motor and resolver wiring at every termination; specifically, white / brown motor reference pair.

Fault code = = (two horizontal bars). Invalid Hall state detected.

NOTE: Invalid Hall state is internal to the Omega driver. The drive has failed and will need to be replaced.

Fault code = 1. EEPROM checksum failed.

NOTE: Checksum failure is internal to Omega driver; the write cycle has been interrupted or incorrect data has been written. Recycling power may recover the drive, if not, the drive must be replaced.

Fault code = C. Clamp condition active.

NOTE: The REXA CPU has disabled the driver (fault relay) this will be followed by a reset signal from the CPU. There must be a corresponding condition for the CPU to clamp the driver. Check for drive faults, power problems (low or high incoming power) and resolver or control cable problems.

Fault code = F. Foldback condition active.

NOTE: A foldback error is a warning that an unusual amount of current is needed to move the motor. During this condition in which unusually high current is detected, the power supply shuts down to protect the system. This can be caused by a shorted motor (see S error checks), or an open or incorrectly wired red / black resolver pair (cosine pair).

Fault code = O. This is a status indication of normal operation; the motor is moving.

Fault code = 8. Reset code

NOTE: The CPU has sent a reset signal to the driver. See TS&R section "3.2.2 Omega Series Servo Motor Driver" on page 39.

Fault code = U. Driver power supply, bus Under Voltage The incoming power supply is low; check incoming power.

X3 Display Status Window Driver Code Identification

PServo = Primary Servo
DServo = Dual Servo
AServo = Online Accumulator
SBoost = Servo Booster
PInduction = Primary Induction Drive
IBoost = Induction Booster
PStep = Primary Stepper Drive
DStep = Dual Stepper
AStep = Online Accumulator

X3 Display Status Window Fault Code Identification

The X3 Display Status window will display the REXA Omega Drive Faults for two drive connected to the RS232 status P11111 and P22222 connectors on the X3 Interconnect Board.

NO_ERROR = 0 .... No Errors Present
_MAIN_FB_BAD .... Main FB Bad
DEV_RDNT_FB_BAD .... Redundant FB Bad
DEV_CS_BAD .... CS Bad
DEV_STALL .... Stall
DEV_DIR_ERROR .... Direction Error
DEV_PSERVO_FAULT .... PServo Fault
DEV_DBOOST_FAULT .... DBooster Fault
DEV_PSERVO_DC_BUS_UV .... PServo DC Bus UV
DEV_PSERVO_MOTOR_TEMP .... PServo Motor Temperature
DEV_PSERVO_RESOLVER .... Pservo Resolver Error
DEV_PSERVO_DRV_TEMP .... PServo Drive Temperature Error
DEV_PSERVO_MP_MISS_WIRE .... PServo MP Miswired
DEV_PSERVO_MP_SHORT .... PServo MP Short
DEV_DSERVO_FAULT .... DServo Fault
DEV_DSERVO_DC_BUS_UV .... DServo DC Bus UV
DEV_DSERVO_MOTOR_TEMP .... DServo Motor Temperature
DEV_DSERVO_RESOLVER .... DServo Resolver Error
DEV_DSERVO_DRV_TEMP .... DServo Drive Temperature Error
DEV_DSERVO_MP_MISS_WIRE .... DServo MP Miswired
DEV_DSERVO_MP_SHORT .... DServo MP Short
DEV_ASERVO_FAULT .... AServo Fault
DEV_ASERVO_DC_BUS_UV .... AServo DC Bus UV
DEV_ASERVO_MOTOR_TEMP .... AServo Motor Temperature
DEV_ASERVO_RESOLVER .... AServo Resolver Error
DEV_ASERVO_DRV_TEMP .... AServo Drive Temperature Error
DEV_ASERVO_MP_MISS_WIRE .... AServo MP Miswired
DEV_ASERVO_MP_SHORT .... AServo MP Short
DEV_PSTEP_FAULT .... PStep Fault
DEV_DSTEP_FAULT .... DStep Fault
DEV_ASTEP_FAULT .... AStep Fault
DEV_SBOOST_FAULT .... SBoost Fault
DEV_IBOOST_FAULT .... IBoost Fault
DEV_PINDUCTION_FAULT .... PInduction Fault
DEV_PLUS15_FAIL .... +15V Fail
DEV_MINUS5_FAIL .... -5V Fail
DEV_ACC_PRES_BAD .... Accumulator Pressure Bad
DEV_ACC_PRES_LOW .... Accumulator Pressure Low
DEV_OP_PRES_BAD .... OP Pressure Bad
DEV_CL_PRES_BAD .... CL Pressure Bad
DEV_SLC_FB_BAD .... SLC FB BAD
DEV_SLC_STOP .... SLC Stop
DEV_AC_HIGH .... Voltage High
DEV_AC_LOW .... Voltage Low
DEV_CLOCK_BATTERY_LOW .... Clock Battery Low
DEV_DRIFT .... Drift Error
DEV_OUTPUT_LIMIT_A .... Delta Pressure Alarm
DEV_OUTPUT_LIMIT_W .... Delta Pressure Warning
DEV_NO_PRIMARY_MOTOR .... No Primary Motor
DEV_PRIM_MOTOR_CONFLICT .... Primary Motor Conflict
DEV_ACCUM_CONFLICT .... Accumulator Conflict
DEV_INVALID_SYSTEM_CONFIG .... Invalid System Configuration
DEV_INVALID_HARDWARE .... Invalid Hardware
DEV_EEPROM_INIT .... EEPROM Initialization Error
DEV_FB_OFFSET .... FB1 and FB2 are Apart

3.2.4 Servo Motor Resistance Readings

	Resistance	Inductance	DC Bus
Omega Full D	1.4 Ohms	6.5 mH	280 V
Omega Half D 120	0.77 Ohms	3.25 mH	160 V
Omega Half D 240	0.77 Ohms	3.25 mH	280 V
Omega P9 Booster	0.40 Ohms	3.20 mH	340 V
Omega P40 Booster	0.08 Ohms	1.01 mH	320 V

Check motor resistance. Motor phase to phase (Orange, Blue and Grey, Open connection to Ground). Replace motor if readings are not as noted in table below.

3.2.5 DC Bus Voltage Check

The DC Bus Voltage = 1.414 × AC line voltage. This voltage cannot be measured with a multimeter. An Oscilloscope is the best method to measure the Phase to Phase voltage at the motor. A REXA Omega Maestro program on a PC can also read this voltage (contact the REXA service department). The picture below is 100 V per division (5 v / d × a 20X probe), 295 V is the DC Bus voltage for 208 VAC / 3- phase. For 240 VAC units, this voltage would be 340 V, and a 120 VAC unit would have 170 V DC Bus Voltage.

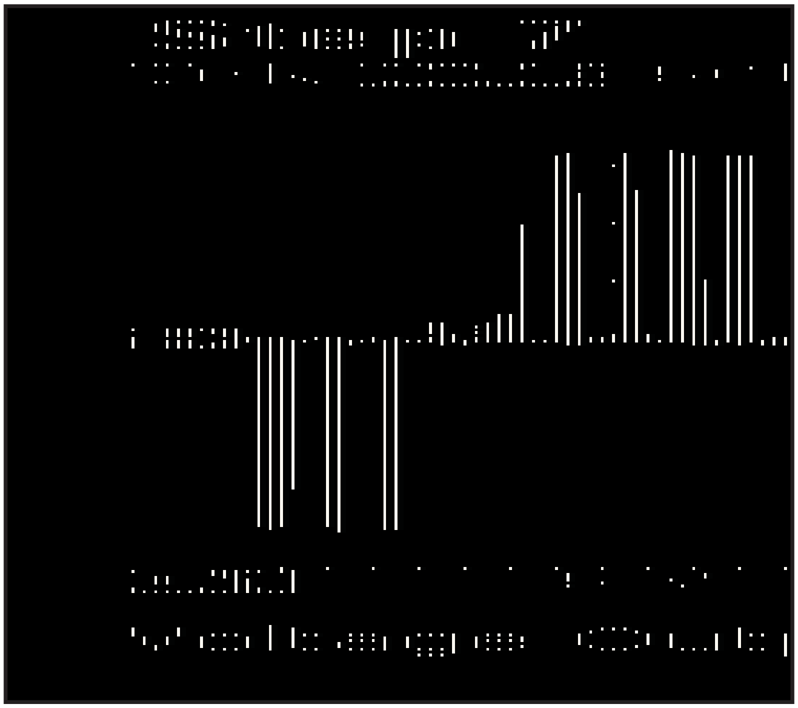


Figure 3.2.6–1 DC Bus Voltage

3.2.6 REXA Omega Drive Motor Wiring

Most installation problems are with wiring. The following shows standard motor power module:

Table 3.2.7-1 Omega Drive Motor Resolver Wiring

Color	Yellow / White	Red / White	Blue	Yellow	Red	Black
Function	Reference Ground	Reference	Sine	Sine Ground	Cosine	Cosine Ground

Table 3.2.7-2 Omega Drive Heater / Solenoid Wiring

Color	Brown	Brown	Green / Yellow	Blue	Blue
Function	Heater Switch	Heater Switch	Phase S	Solenoid Switch	Solenoid Switch

Table 3.2.7-3 Omega Drive Motor Wiring

Color	Orange	Blue	Gray	Green
Function	Phase T	Phase R	Phase S	Motor Case Ground

Table 3.2.7-4 Omega Drive Thermostat Wiring

Color	White	White
Function	Temperature Switch	Temperature Switch

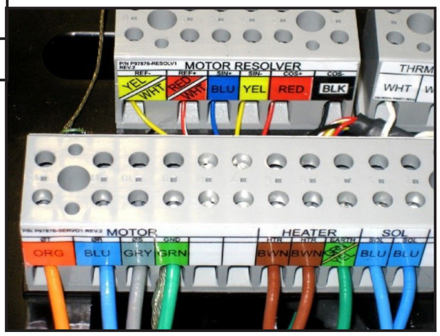


Photo 3.2.7 Standard Servo Motor Wiring at the Power Module

3.3 Seat Loading Cylinder Problems

The SLC acts as a mechanical elastic coupling. Instead of a mechanical coupling, the internal hydraulic pressure of the actuator (2 000 psi) is used to show that the valve is in its seated position. Refer to the "B. Stem Connection & Seat Loading Methods" on page 42.

3.3.1 SLC Reads Seated Before Actuator is On Valve Seat

Use the pressure gauges to verify that the pressure is above 2 000 psi. This will happen when the actuator is driven into its mechanical stop (not the valve seat). The split clamp will need to be adjusted.

- Remove the split clamp and drive the valve to its seated position.
- Drive the actuator to its seated position. Move the actuator back open approximately ¼".
- Install the split clamp by lining up the valve shaft threads and the actuator shaft threads.
- Calibrate the actuator in Setup (PL & PH).

If the actuator is at 50% stroke and reading seated:

- Try to drive the actuator open then back closed in Local mode.
- If the unit still cannot go further than 50%, remove the split clamp and stroke the actuator completely closed and open, building pressure (2 000 to 2 300) on both gauges.
- If the proper pressure is obtained, the valve shaft is stuck or something is keeping it from going closed.

3.3.2 SLC Feedback Bad

Verify the wires are all connected at the enclosure and actuator (Red +15, White SLC+ & Black SLC-).

Simulate a 4 to 20 mA signal at the enclosure on SLC+ and SLC-. If the error goes away, the problem is at the actuator or the actuator cable.

- Land the wires back and remove the FB cover on the SLC. Remove the white and black wire and simulate a 4 to 20 mA signal.
    - If the error goes away, the cables are good.

Two other components to check are the FB board and pot.

- Look to see if the red LED light is on the FB board; if not, check to see if the red and black wires can display 15 VDC.
    - If the 15 VDC is present and there is no LED light, change the feedback board (see TS&R section 4.E.16, Remote Mounted Feedback Board).
- Check the pot by using an Ohm meter. Using the orange and black wires to do so, you should read 0 to 5 000 ohms.

3.3.3 SLC Stop

SLC stop is simply the valve seat. In order to correctly connect the valve shaft and actuator shaft follow these steps:

- Make sure both shafts line up perfectly.
- Drive the valve to its seated position.
- Drive the actuator to its seated position. Move the actuator back open approximately ¼". Install the split clamp by lining up the valve shaft threads and the actuator shaft threads.
- Calibration of the actuator can be done in Setup (PL & PH).

3.4 Feedback Bad

When dealing with feedback issues it is always necessary to ensure you have proper supply voltage to the electronics and that all the wiring is properly landed. The supply voltage is proportional to the CPU power supply. If the actuator's incoming power supply is low, high or unstable, the CPU power will also be affected.

The REXA feedback system begins with a potentiometer located on the mechanical assembly, cabling that carries the signal from the actuator to the electronics and the CPU, which interprets and reports the position indication. The CPU operating voltage is provided by the Interconnect Board (IB). The incoming power is filtered / fused through the power board and stepped down through a chassis mount transformer. The IB then converts this to the various DC voltages required to operate CPU, display, the actuator internal feedback and the position transmission back to the operating control system.

Check all connections to ensure the landed wiring is not pinched down on the wire insulation, preventing a good connection.

If the actuator display reads FEEDBACK BAD, the following steps should be taken:

- Check wiring on a non-contacting feedback.
- Your wiring should be as follows: Red wire (supply voltage) is the +15 Vdc, White wire (4 to 20 mA signal) is the FB+, and the Black wire (reference) is FB-.
- These connections should be checked at every termination and junction box at every point between the CPU and the potentiometer.
- Refer to your wiring diagram for additional information.

To check the interconnect board voltages see the diagram in Figure(s) 3.4–1..

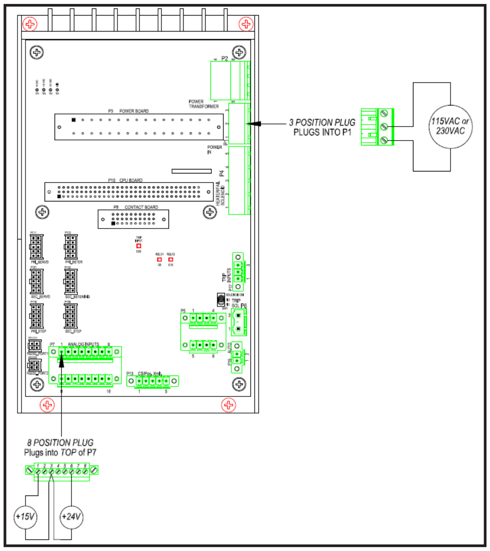


Figure 3.4-1 Interconnect Board Voltages

Once all interconnect board voltages are confirmed and wiring has been inspected, the next step to resolve the FEEDBACK BAD error is to simulate a feedback signal directly to the CPU board. This will determine if the problem is with the CPU or with the potentiometer.

- To check the main feedback (MFB) place the actuator in Local mode, and remove the + and – FB wires from P9 Pins 2 & 3. With a 4 to 20 mA source send a signal directly into the CPU at connector P9 Pins 2 (FB+) & 3 (FB-) of the interconnect board.
- If the CPU can register and report a feedback signal, then the problem lies in the potentiometer assembly. Replace the potentiometer. Refer to "4.M.21 Rotary Feedback" on page 43.
- If after simulating the feedback signal there is no change in feedback status, the problem lies with the CPU or interconnect board. See "4.E.4 CPU Assembly" on page 43.
- To check the redundant feedback (RFB) place the actuator in Local mode, and remove the + and – FB wires from P9 Pins 4 & 5. With a 4 to 20 mA source send a signal directly into the CPU at connector P9 Pins 4 (FB2+) & 5 (FB2-) of the Interconnect Board. The qualification of the results will be the same as above.

To check the feedback operation, see the diagram in Figure 3.4–2.

Some actuators may come with a separate feedback circuit board. The feedback circuit board is not needed for most standard

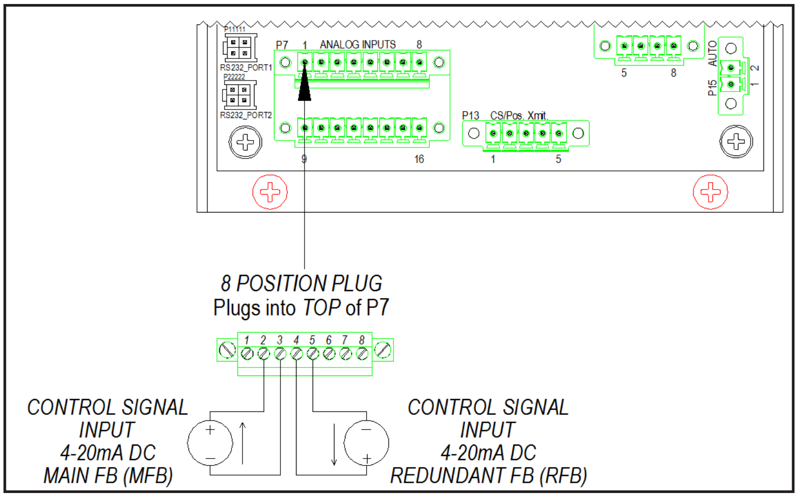


Figure 3.4-2 Feedback Input Testing

products (non-contacting potentiometer send a direct 4 to 20 mA signal to the CPU board). For units with a feedback board, additional terminations may result in a feedback bad error.

3.5 Mot Stall

Problem:

`Mot stall` means that five attempts to move the actuator 1% of stroke in the time set in Stall Time (See IOM section 6, Modes of Operation and Control Parameters) have failed or, with a Seat Load Cylinder, the "Seated" position was reached on the Seat Load Cylinder and the position of the main cylinder was greater than 1% above Position Lo.

In both situations, the actuator cannot match actuator position to control signal input. A stall error can be caused by multiple symptoms; the first step in troubleshooting the stall error is to identify the cause. The actuator will need to be removed from service but may not need to be completely removed from the installation.

If possible, isolate the actuator from the process and place the unit in the Local mode for troubleshooting. Follow the steps below to identify if the stalling problem is mechanical or electronic:

1. Check oil level. See IOM section 1.6.4 for oil filling instructions. If filling the system with oil solves the stalling problem, the unit can be put back into service. It should be closely monitored and serviced as soon as possible. See "2.5 Oil Leaks" on page 44, to locate a possible oil leak.
2. Check hydraulic system pressure. See "3.1 Accumulator Low / Bad Pressure" on page 44.
3. Check output of driver.
4. Check motor resistance.

Solution:

3.5.1 Motor Stall Hydraulic

A stall error can be caused by high system pressure or low system pressure. The actuator will only generate enough pressure to overcome the process forces. It is not unusual for the actuator to operate well below the rated 2 000 psi system pressure. With the unit in Local mode, stroke the actuator and observe the pressure gauges. If the actuator will not stroke via electronics, skip to "3.5.2 Motor Stall Electronic" on page 44.

- Use the handwheel / drill drive to confirm the mechanical system is operating.
- For Servo units, the system power must be off to operate with handwheel.
- For accumulator system handwheel operation see "C2. Online Recharge Accumulator Fail-Safe" on page 45.
- For spring fail system, see "M.3 Fail-safe Unit Operation" on page 45.
- If the system builds pressure quickly and can not move, skip to "3.1 Accumulator Low / Bad Pressure" on page 45.
- If the system builds no pressure, skip to "3.1 Accumulator Low / Bad Pressure" on page 45.

High Pressure Stall

A "high pressure" stall indicates the actuator either has to build too much pressure to operate the driven device, or the system is working too hard and can not follow the control signal. If one of the pressure gauges is over 2 200 psi, the actuator is operating at its limit. Some possible causes of this may be binding in the linkage, hitting against a mechanical stop (cylinder limit, blockage in valve etc.).

- To resolve a high pressure stall, remove the linkage and stroke the actuator to see if it will operate normally.
- If the actuator can stroke with no problems while not connected to the driven device, then the problem lies in the linkage.
- If the system still stalls while not connected to the driven device, check your calibrated low and high positions. See "6 Modes of Operation & Control Parameters" on page 45 of the IOM for additional calibration information.
- If the problem persists please contact your local REXA representative.

Low / No Pressure Stall

A "low pressure" stall can be any situation where the actuator can not build enough pressure to move the driven device. A low pressure stall can be caused by an open solenoid (see "4.M.11 Solenoid" on page 45) or manual bypass (see "C2. Online Recharge Accumulator Fail-Safe" on page 45 and "M. Manual Operators" on page 45), a failed suction check valve, improperly adjusted pressure relief valves or damaged cylinder piston seal.

- First verify the manual bypass and solenoid levers are in the correct position.
- Then verify the adjustable pressure relief valves have been set properly. See "4.M.7 Pressure Limiting Valve" on page 45 for additional information.
- If the unit will operate in one direction only, the suction check valves need to be replaced. See "4.M.9 Suction Check Valve" on page 45.
- If the unit can not build pressure in either direction, the piston may be worn and must be replaced. This will require the unit be taken out of service for repair.

3.5.2 Motor Stall Electronic

Electronic stall problems can be caused by the driver, cabling, speed / acceleration parameter settings or the motor itself. To confirm and replace the failed component, it is best to verify the operation of each component before replacing parts.

- Stall errors can be caused by a loose or corroded connection. Verify the system wiring for loose / corroded and correct connections at every termination from the motor, through all junction boxes, cabling and then to the driver.
- Gain and acceleration settings can cause motor stalls by operating too slow when nearing the actuators set point. Refer to "6.1 Setup Mode" on page 45.
- Refer to "3.2 Drive Fault" on page 45 for troubleshooting motor and driver components.

3.6 Direction Error

Wiring is the most common cause for the motor not to move (or move in the wrong direction). For both stepper and servo units it is essential that the motor is ground at the power module and at the REXA electronics.

- For stepper units make sure the motor is wired correctly at the power module and the REXA stepper electronics. Refer to "C2. Online Recharge Accumulator Fail-Safe" on page 46 for wiring schematic.

- For servo units, make sure that the motor wires and resolver wires are wired correctly at the power module and the REXA stepper electronics. Refer to "C2. Online Recharge Accumulator Fail-Safe" on page 46 for wiring schematic.

REXA Electronics:

Ensure the position high and position low is correctly calibrated. Refer to the IOM "6 Modes of Operation & Control Parameters" on page 46.

Make sure the deadband is calibrated according to the application. Refer to the IOM "6 Modes of Operation & Control Parameters" on page 46.

Feedback:

- Make sure the feedback wires are wired correctly and properly shielded at the actuator as well as ground at the REXA electronics. Refer to "C. Circuit Schematics" on page 46.

Mechanical

Bypass:

- Make sure that the bypass is closed by turning the bypass plug clockwise. If the bypass is opened while the actuator is in auto mode and / or in actuation, a direction error will be indicated on the display and the motor will stall as a result.

Solenoid:

- Make sure the lever on the solenoid is in its correct position according to the application; this applies to the power module solenoid and / or high speed solenoids.

Hand Pump - There are many ways the hand pump can cause a direction error:

- If the pump is being stroked while the actuator is running in the opposite direction of which the pump was stroked, then a direction error will be indicated.

- If the actuator is static in auto mode while the pump is stroked in any direction, a direction error will be indicated.

- If the direction knob on the pump is stuck in-between both pump directions, then the system will act as a bypass and cause a direction error to be indicated.

3.7 + 15VDC Fail or +5VDC Fail or +24VDC Fail

Measure the Following Points in Order:

1. Measure the test point TP3 to TP4 which should measure +15VDC. If it does not, continue to the following troubleshooting steps. TP1 to TP4 should measure +5VDC and TP2 to TP4 should measure +24VDC

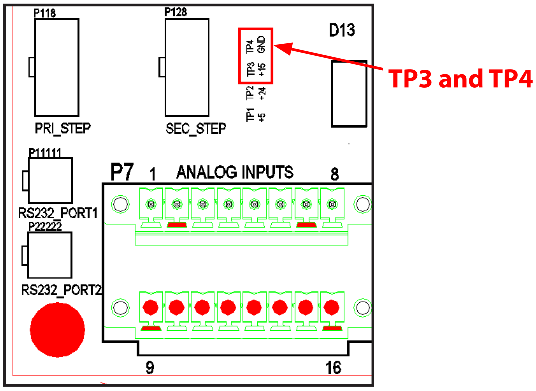


Figure 3.7-1 Test Points TP3 and TP4

2. Measure main AC incoming customer power at the REXA enclosure main fuse holder to be either:

115 VAC ± 10%

230 VAC ±10%

3. Measure the same AC voltage from Pin 1 to Pin 5 at the input side of the transient suppressor as shown:

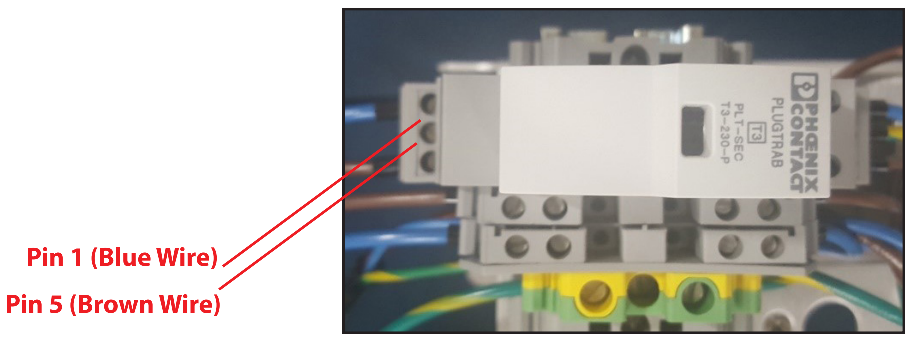


Figure 3.7-2 Surge Suppressor

DIAGNOSIS If power measures out of spec at this point, the line filter may need replacing.

4. Interconnect Board P1 –

   Customer source power 115VAC: Measure from Pin 1(L) to Pin 2(N), and also Pin 1 to Pin 3(G); these should measure 115VAC ±10%. Pin 2 to Pin 3 should measure <1V.

   Customer source power 230VAC: Measure from Pin1(L1) to in2(L2); these should measure 230VAC ±10%. Pin 1(L1) to Pin3(G) and Pin 2(L2) to Pin 3(G) should measure 115VAC

5. Interconnect Board P2 (bottom) – With power switched OFF (main fuse holder opened), disconnect the top connector from P2. Re-apply main power once top connector is disconnected.

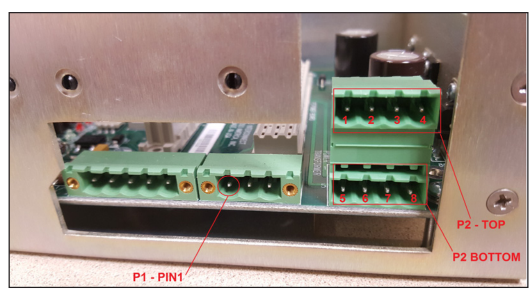


Figure 3.7-3 interconnect Board Side View

NOTE: Display will not power up, but the driver, power board and optional solenoids will have power flowing through them.

Customer source power 115VAC: Measure bottom connector P2 Pin 5(Blue) to Pin 6(Brown) and also Pin 7(Blue) to Pin 8 (Brown) should both measure 115VAC ±10%.

Customer source power 230VAC Measure bottom connector P2 Pin 5(Blue) to Pin 8(Brown) should measure 230VAC ±10%.

DIAGNOSIS If no voltage present at this point, then switch power OFF (main fuse holder opened), pull Power Board out of the chassis and check the main glass fuse is still good. A good fuse measures between 0.2Ω to 0.5Ω. An OL (open circuit) or a high Mega-ohm reading indicates a blown fuse. 115V Power Board fuse is F3, which is a 0.5A time-lag fuse. 230V Power Board fuse is F8, which is a 0.250A time-lag fuse.

6. Interconnect Board P2 (top) – With power switched off, make sure both connectors are plugged back in. Then re-apply main power and measure the following:

   Pin 1(orange) to Pin 2(yellow) should measure around 30VAC

   Pin 3(red) to Pin 4(black) should measure around 10VAC.

   DIAGNOSIS If 30VAC is not measured, then the transformer secondary supplying the circuitry that creates the +15VDC and +24VDC (non-isolated) is bad and the transformer needs to be replaced. If 10VAC is not measured, then the transformer's other secondary supplying the circuitry that creates the +5VDC is bad and the transformer needs to be replaced. If both voltages measure good, then the problem resides on the Interconnect Board's DC level circuitry i.e. possibly a voltage regulator or capacitor and the board must be replaced.

3.9 Control Signal

The Control Signal is typically a 4 to 20 mA modulating signal which commands the actuator to travel to a set point.

3.9.1 If Actuator Position Does Not Match Control Signal Input (Control Signal Calibration)

Calibrate the DCS's 4 to 20 mA control signal to the actuator control enclosure. The default values for parameters Signal Lo and Signal HI are 4.0 mA and 20.0 mA, respectively. If the DCS control signal is slightly different than these values, actuator position will not match incoming control signal. Parameters Signal Lo and Signal Hi cannot be changed by pressing the arrows. An active 4 to 20 mA signal must be applied.

Using the DCS control signal, access Signal Lo in the Calibrate menu and press the enter button for the "="to flash. Apply the signal that corresponds to command the actuator to travel to Position Lo, typically 4.0 mA. The actual current input will be displayed in mA and may vary slightly from the default value. Lock this value in by pressing the enter (↵) button, stopping the "=" from flashing.

- Apply the signal that corresponds to command the actuator to travel to Position Hi, typically 20.0 mA. The actual current input will be displayed in mA and may vary slightly from the default value. Lock this value in by pressing the enter (↵) button, stopping the "=" from flashing. The actuator position should now match the control signal input when in "auto" mode.

NOTE: Unknwn appears if control signal failure occurs while calibrating. Error appears, briefly, if an unacceptable value is entered. The unacceptable value is rejected and the previous value is retained.

NOTE: If Fail-safe does not = Off, input signal value must be greater than 2.5 mA and the span must be greater than 3.8 mA. Refer to "6 Modes of Operation & Control Parameters" on page 48 of the IOM.

NOTE: If Failsafe = Off, the span for Signal Hi must be greater than 3.8 mA or vice versa.

3.9.2 CS Bad Reading (Control Signal is Less Than 2.5 mA)

- Verify Signal Type = Analog in the INPUTS menu
- Verify Control Signal is greater than 2.5 mA
- Verify the polarity of the applied Control Signal. The control signal input is polarity protected and current will not flow if the polarity is not correct.
- If the polarity is correct, be sure the 4 to 20 mA loop from the Control system is operating.

Using an ammeter, and again verifying polarity, vary the 4 to 20 mA current from the control system and confirm that it is correct. If it is not correct, the hand held current source can be used until the control system problem is resolved. If at any time the DCS control signal is suspect, use a handheld current source to verify operation of the actuator.

Apply the control signal to the appropriate terminal blocks. Using a Digital Voltmeter, measure the dc voltage across the CS+ and CS– inputs on the CPU board.

The DC voltage should vary between 1.3 Vdc (for 4 mA input) to 4.0 Vdc (for 20 mA) input. If the voltage varies with change in Control Signal but the display still reads CS Bad, the CPU must be replaced. Replace the CPU. Reference "4.E.4 CPU Assembly" on page 49.

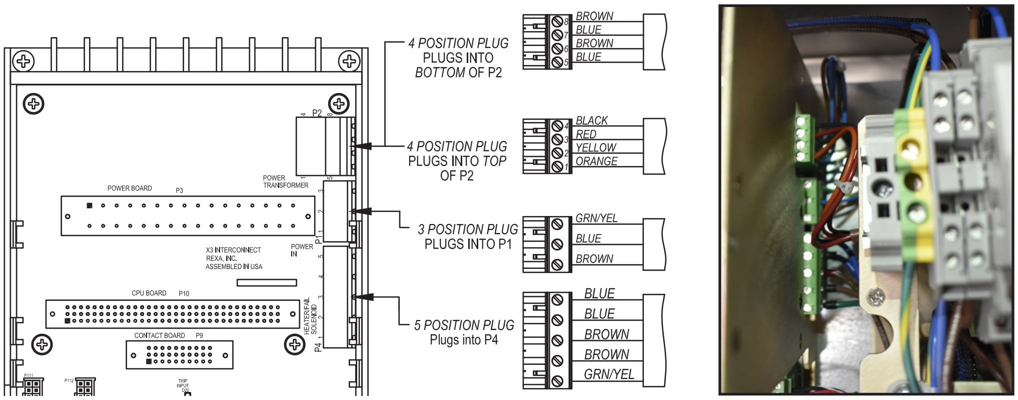


Figure 3.9-4 CPU Connections

3.9.3 Control Signal "Dithering" or Noisy

If the Control Signal from the DCS is varying at a high frequency on the REXA display, it may be contributed to a noisy signal or dithering built into the control system.

Verify that the control signal cable from the DCS is a shielded, signal type cable and the shield is landed to ground at the DCS only. In addition, be sure this signal cable is segregated from high voltage cables as they may induce voltage onto the signal causing it to vary.

Some control systems have a built in "dither signal" to operate with older actuators to always have them move. Be sure this function is disabled in your control system.

Should the above not remedy the problem, use a handheld current source to drive the control signal input.

- If the signal becomes quiet and the display is steady, you have verified the problem is with the incoming control signal and not the actuator input.
- If the display still varies with a steady input signal, the CPU must be replaced per "4.E.4 CPU Assembly" on page 49.

3.9.4 Actuator Travels to Position Lo or Position Hi When CS Bad Error Occurs

Verify the Failsafe parameter is set to the appropriate setting.

Fail-safe defines the position the actuator moves to via the motor if the Analog control signal falls below 2.5 mA.

Only in menu if **Signal Type = Analog**.
Select:

- **Inplac**: Actuator remains in current position.
- **Close**: Actuator goes to Position Lo.
- **Open**: Actuator goes to Position Hi.
- **Off**: Used for zero based control signal (i.e., 0 to 20 mA).

3.9.5 CS Bad Error Does Not Appear When Control Signal Drops Below 2.5 mA

- Verify Signal Type = Analog
- Verify Failsafe does not = Off

3.10 Contact Input Signal

Some applications use a Contact Input signal rather than a 4 to 20 mA modulating signal to position the actuator. The Contact Input signal should have amplitude from 24 to 120 V. There are two types on Contact signal inputs.

The first is a single contact, or ON / OFF signal. This is strictly for two position control of the actuator. When the signal is present on the OPEN input, the actuator will travel toward position as defined by parameter Position Hi. When the signal is not present, the actuator will travel toward the position defined by parameter Position Lo.

The second is two contacts, or "Manual" control of the actuator. The actuator will travel toward Position Lo as long as the "Close" Input is active. The actuator will travel toward Position Hi as long as the "Open" input is active. If neither input is active, the actuator will remain at the current position. If both inputs are active, the actuator will remain at the current position.

If Signal Type = 1 Cont or 2 Cont, the control signal parameters signal lo and signal hi are removed from the calibrate menu. The CS Bad error code will not be displayed in Auto mode. CS Bad only applies to a 4 to 20 mA Control Signal

If Signal Type = 1 Cont or 2 Cont Cannot be Accessed in the INPUTS Menu

For the Signal Type parameter to display 1 Cont or 2 Cont in the INPUTS menu, you must have the appropriate circuit board assembly installed. The circuit board is mounted atop the CPU as shown in Photo 3.10-1.

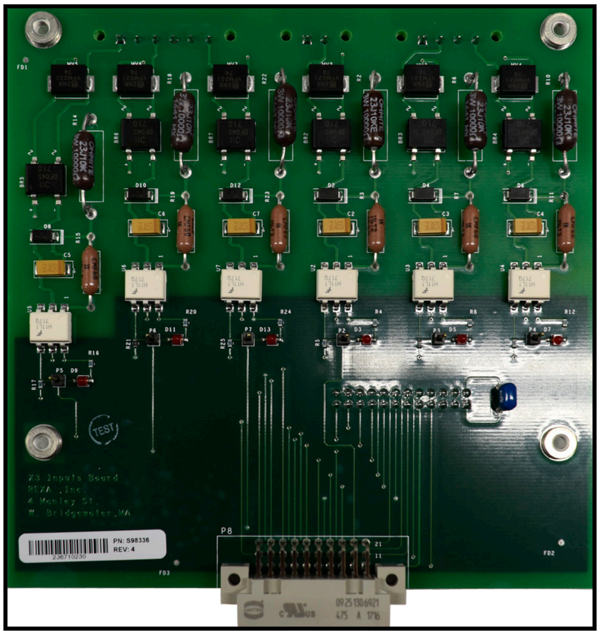


Photo 3.10-1 Contact Input Board

Using 1 Cont, Actuator Will Not Move.

- Verify the single contact is connected.

Contact Input signal is NOT polarity sensitive.

- Verify Signal Type = 1 Cont in the INPUTS menu

- Verify the signal amplitude is 24 V or greater, not to exceed 120 V.
- Verify the actuator is in "Auto" mode. 1 Cont control will not operate the actuator in Local or Setup modes.
- Verify circuit board is seated properly on the CPU mating 24-pin connector.
- Verify the inputs with a known good source. Disconnect all wires from the DCS to the input board. Using a hand-held current device, apply a 20 mA signal to terminal blocks or J3 pin1 and 2. The signal applied should really be a voltage signal not a 20mA signal, (some calibrators only put out 18vdc, 24vdc is minimum required voltage). The actuator should travel toward the position defined by parameter Position Hi, and the D5 LED should illuminate. Now remove the signal. The actuator should travel toward the position defined by parameter Position Lo. If this operation is successful, re-check the incoming signals from the DCS.
- If all the above do not solve the problem or the LED MO is not illuminating, the Contact In / Relay Out board must be replaced per 4.E.5 Contact Input Board Assembly on page 51.

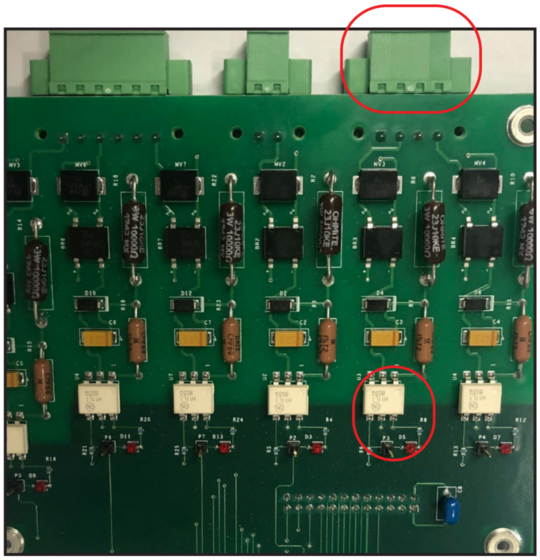


Figure 3.10-2 Contact Input Board Test Points

Using 1 Cont, Actuator Always Runs Toward Position Hi Even When no Signal is Applied.

Are the LEDs on when no signal is applied? This indicates leakage current, typical of solid state devices, coming from the control system. The input board is interpreting the input as active due to this leakage current, and the actuator will not move. The OFF state leakage current must be less than 1 mA. Diode clamps or RC snubber networks placed across mechanical relays and the semiconductor junctions of solid state switches will pass some current in the OFF state.

- If this leakage exceeds 1 mA, a resistor must be added across the input signal terminals to bypass the current.

Using 2 Cont, Actuator Will Not Move.

- Verify the 2 signals are connected in one of the configurations shown below.

Contact Input signal is NOT polarity sensitive.

- Verify Signal Type = 2 Cont in the INPUTS menu
- Verify the signal amplitude is 24 V or greater, not to exceed 120 V.
- Verify Actuator is in "Auto" mode. 2 Cont control will not operate the actuator in Local or Setup modes.
- Verify the circuit board is seated properly on the CPU mating 24-pin connector.
- Verify the LED D5 illuminates when a signal is applied.

Are both LEDs on when no signal is applied? This indicates current leakage—typical of solid state devices—coming from the control system. The input board is interpreting both inputs as active due to this leakage current, and the actuator will not move. The OFF state leakage current must be less than 1 mA. Diode clamps or RC snubber networks placed across mechanical relays and the semiconductor junctions of solid state switches will pass some current in the OFF state.

- If this leakage exceeds 1 mA, a resistor must be added across the input signal terminals to bypass the current.

Verify the inputs with a known good source. Disconnect all wires from the DCS to the input board. If a jumper is present, remove it. Using a hand-held current device, apply a 20 mA signal to terminal blocks or J3 pin1 and 2 for close. The actuator should travel toward the position defined by parameter Position Lo, and the D5 LED should illuminate. Apply the signal to terminal blocks J3 pin 3 and 4 for open. The actuator should travel toward the position defined by parameter Position Hi. If this operation is successful, re-check the incoming signals from the DCS.

- If all the above do not solve the problem, or the LEDs are not illuminating, the Contact In / Relay Out board must be replaced per "4.E.5 Contact Input Board Assembly" on page 52.

Using 2 Cont, actuator moves to Position Lo when OPEN signal is removed.

- Verify CLOSE signal is not active
- Verify Signal Type = 2 Cont and not 1 Cont.

3.11 Display Problems

3.11.1 Ribbon Connector

If the display is unresponsive or failing to display any characters then verify the following to isolate the potential cause.

Ribbon cable is disconnected

- When the ribbon cable is connected, the keypad display on the front of the enclosure will show the green power LED illuminated, and the display should read SETUP. If these two conditions are not present, the ribbon cable may be disconnected.
- Check that the ribbon cable is secured to CPU board connector P115. The red stripe on the ribbon cable should be facing Pin

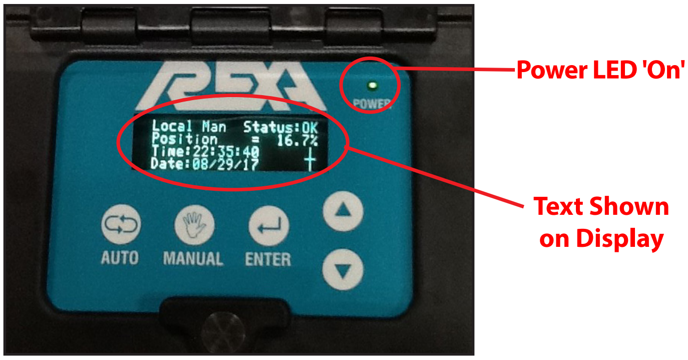
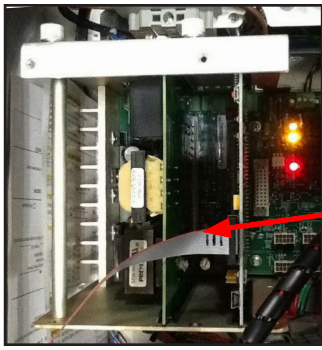


Figure 3.11.1-1 Power On LED

1 of connector P115 and the connector should be fully seated. The other end of the ribbon cable connecting to the display interface board should also be checked. The red stripe on the ribbon cable should be facing Pin 1 on connector P1 of the display interface board and the connector should be fully seated.



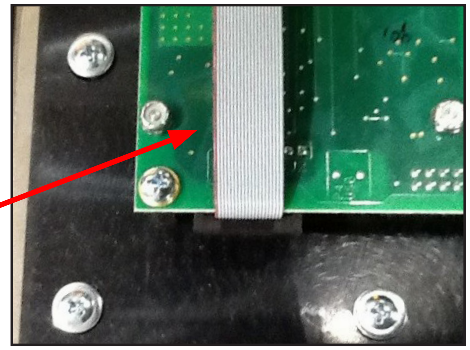


Figure 3.11.1-2 Ribbon to CPU **Figure 3.11.1-3 Ribbon to Interface Board**

When installing the ribbon cable verify that the notch of the connector aligns with the groove in the board connector.

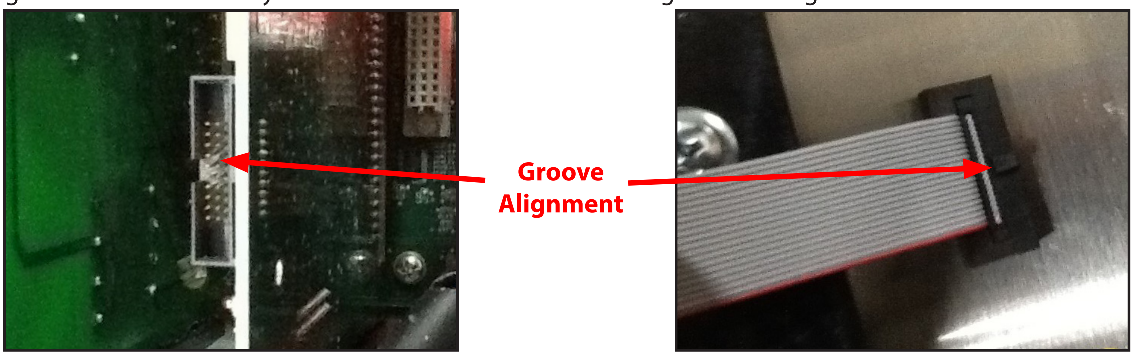


Figure 3.11.1-4 Ribbon Groove Alignment

Is power transmitting from CPU to the display?

- When there is no power the green LED on the keypad will not be illuminated.
- Before replacing CPU board, check +5 Vdc is present from Interconnect Board. Measure DC at test points TP1 (+5VDC) and

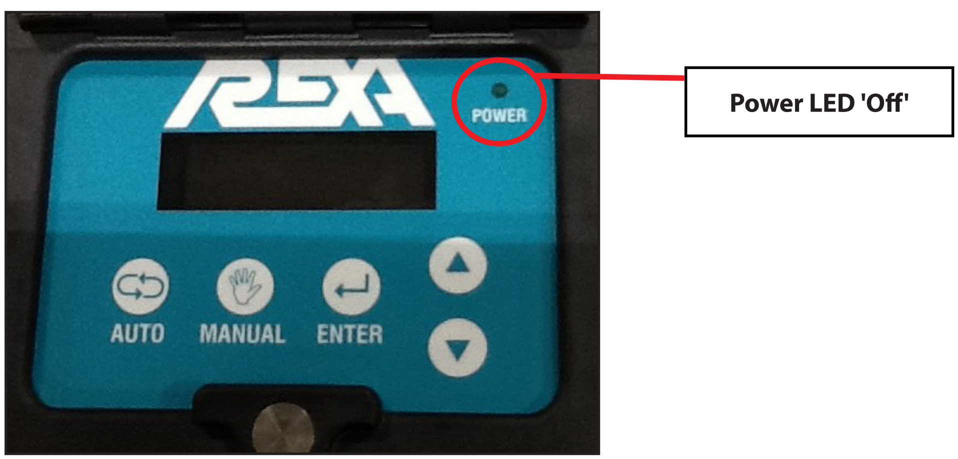


Figure 3.11.1-5 No Power Transmitting

TP4 (GND) near logic connect P128. Measure the dc voltage with a DMM between Pin 6 (+5 Vdc) and Pin 7 (Ground). A +5 Vdc should be present.

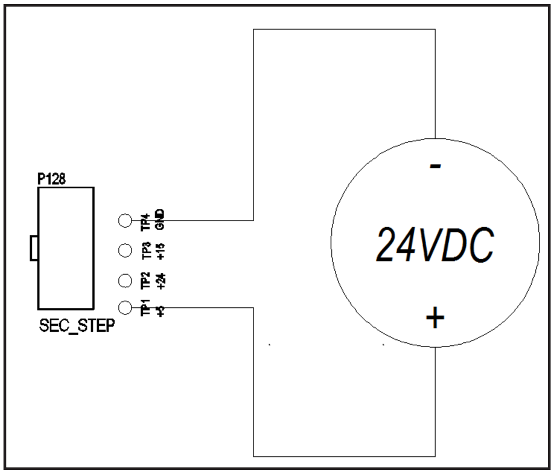


Figure 3.11.1-6 Power Board Voltage

Aside from the Interconnect board being faulty two other possible conditions could cause the +5V to be defective.

Condition 1: Fuse F3 (for 115VAC Power Board) or Fuse F8 (for 230VAC Power Board) is open.

With the system power 'OFF' disconnect the power board. Using a DMM measure across the fuse location and confirm if you have continuity. If there is no continuity replace the fuse, re-install the power board and confirm the 5VDC output. If continuity is present then this can be eliminated as a potential cause.

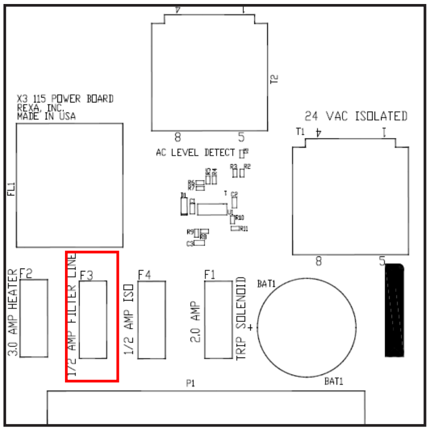


Figure 3.11.1-7 115 VAC Power Board

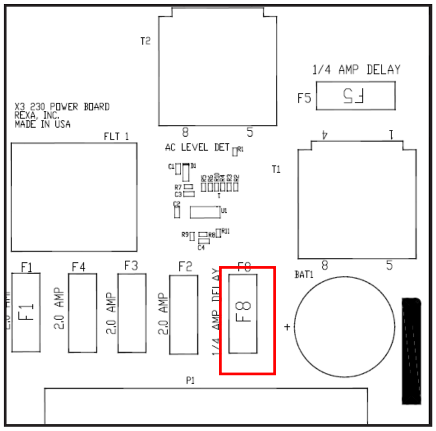


Figure 3.11.1-8 230 VAC Power Board

Condition 2: Controller transformer is faulty or the power board line filter not functional.

With the system power 'ON' take a DMM with long testing leads and measure across screw terminals 1 and 2 of the TOP connector of P2. Verify that it measures ~8VAC.

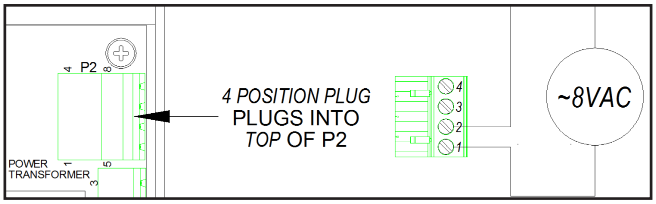


Figure 3.11.1-8 Top of P2 Connectors

Turn the system power 'OFF', disconnect the TOP connector of P2 and carefully put it aside. Re-apply power, take the DMM with long testing leads and measure across screw terminals 5 and 8 of the BOTTOM connector of P2. Verify that is measure ~115VAC or ~230VAC.

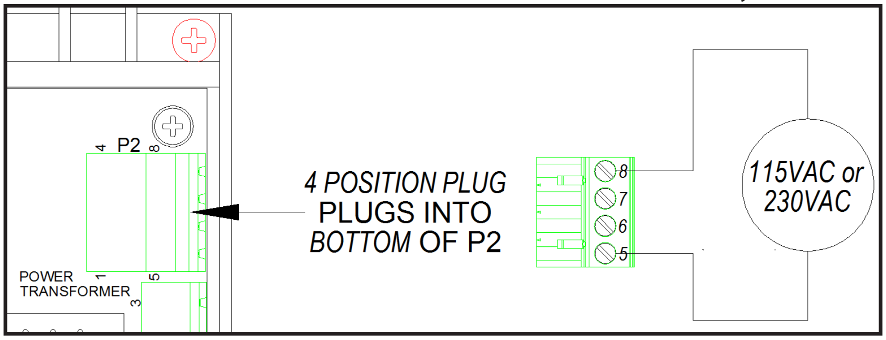


Figure 3.11.1-8 Bottom of P2 Connectors

NOTE: These measurements will correspond directly with your input voltage.

If it does not confirm the wiring to the transformer is present before replacing the Power Board. See "4.E.3 Power Supply Assembly" on page 55.

On CPU connector P115, disconnect the ribbon cable while powered. The exposed gold plated pins of the connectors can be measured to check if power is being output from CPU to the display. Using fine tip meter probes measure the DC voltage with a DMM between Pin 2 (+5 Vdc) and Pin 20 (Ground) of the P115 connector. If +5 Vdc is not present then CPU board may need replacement. See "4.E.4 CPU Assembly" on page 55.

NOTE: Avoid touching leads to any other pins while taking measurements as this may cause the other pins to short.

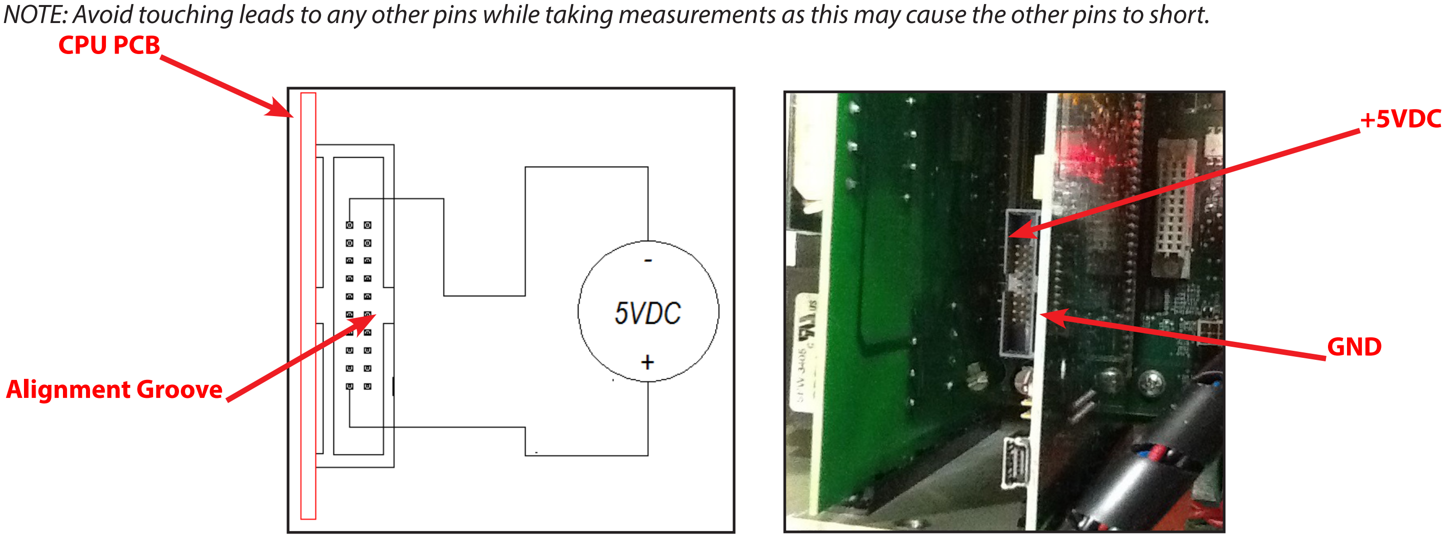


Figure 3.11.1-9 CPU Board

- If +5 Vdc is present at TP1 on the Interconnect Board and at connector P115 of the CPU Board and the display is still not functioning, then the ribbon cable should be replaced.

  If +5 Vdc power is present from above, but still no display read-out: External Display, then the external display needs to be replaced

- If the Green power LED is illuminated on the keypad display, but the VFD readout is not present, then the VFD display needs to be replaced. See "4.E.14 External VACuum Fluorescent Display (VFD)" on page 55.

Internal Display

- If the read-out is not present on the VFD display, but the push buttons work on the display interface board, then the VFD needs to be replaced. See "4.E.14 External VACuum Fluorescent Display (VFD)" on page 56.

3.11.2 Control Issues

Trying to move the actuator in Local or Calibrate mode and the actuator will not move

- Ensure the keypad display green power LED is illuminated.
- Ensure that the ribbon cable connecting the membrane switch assembly to the interface circuit board has not come loose and is seated properly. Gently pull on the Blue connector attached to P2 of the interface board and push it back into the connector to verify it is firmly seated.

NOTE: Only manipulate this connection via the board connector. Failure to do so could damage flex ribbon connections going to the controls membrane.

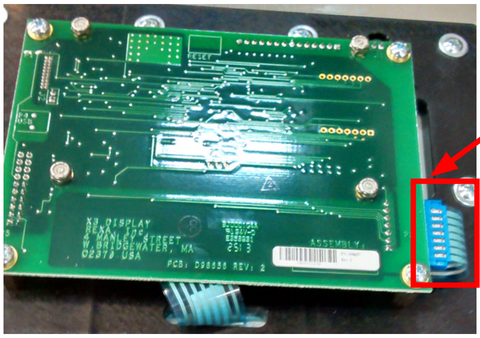


Figure 3.11.2-1 Display Ribbon

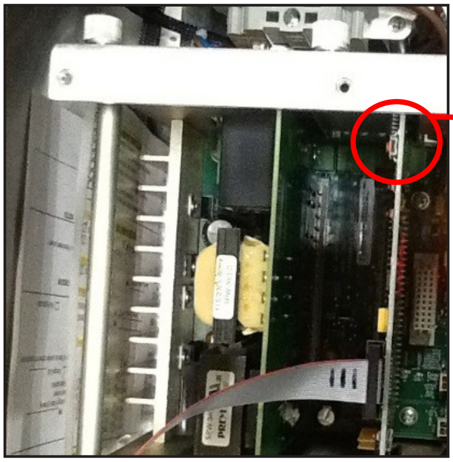


Figure 3.11.2-2 CPU Reset Button

- Reset the Electronics by pushing SW1 on the CPU board.

3.12 Pressure Relief Valves

3.12.1 Power Module Pressure Relief Valves

If the unit is not building enough pressure required by the application the following steps should be taken.

- Loosen the jam nut on the pressure relief valve in question. While in Calibration Mode, press the directional arrow (down for extend / clockwise, up for retract / counter clockwise) to run the actuator into a load or into the end stops to build pressure in the system. While depressing the directional arrow, turn the pressure relief valve clockwise to increase the set pressure. Let off on the directional arrow button while watching the pressure gauge settle to the pressure. Unless the pressure relief is already bottomed out, the pressure in the system should increase. Repeat this process while turning the pressure relief clockwise to increase pressure or counter clockwise to reduce pressure.

If the unit is creating more pressure than the application requires, the following steps should be taken to rectify this problem:

- Repeat the above step but turn the pressure relief counter clockwise. If the pressure relief cannot be reduced within 2 to 3 turns, follow the subsequent steps.
- Unscrew the adjustment cap on the pressure relief valve and check if the spring color is the correct color for the application (see IOM "O. Output Load Protection" on page 57). The wrong color spring can provide more or less pressure for the application.

If the spring in the pressure relief valve bonnet is correct, reapply the cap adjustment but do not tighten.

- Run the unit to see if the application is still building pressure on the pressure relief valve side that has been worked on.

If the actuator does not build pressure, the pressure relief valve is performing as designed. Pressure is not building because the valve stem is allowing fluid back into the system.

- Refer to IOM "O. Output Load Protection" on page 57 to reset the pressure relief valve to its factory setting.

NOTE: This process should be done to both pressure relief valves.

If the actuator continues to build pressure, unbolt the pressure relief valve bonnet from the power module refer to "4.M.7 Pressure Limiting Valve" on page 57.

If the valve stem is loose in the bonnet hole, check for contaminants in the pressure relief valve cavity.

- Place the pressure relief valve bonnet back into the pressure limiting cartridge cavity and refer to the IOM "O. Output Load Protection" on page 57 to reset the pressure relief valve.
- If the pressure relief valve continues to build too much pressure, refer to "4.M.7 Pressure Limiting Valve" on page 57.

If the valve stem is tight / stuck in the bonnet hole, order a pressure relief valve replacement kit.

- Reinstall as referenced in "4.M.7 Pressure Limiting Valve" on page 57, and refer to the IOM "O. Output Load Protection" on page 57 in the Installation and Operation Manual to reset the pressure relief valve.

3.12.2 Recharge Module Pressure Relief Valve

The online recharge module has a pressure relief valve to mechanically limit the recharge pressure in the accumulator. This pressure relief needs to be set in conjunction with the appropriate pressure relief on the power module to build pressure within the system as follows:

- On fail extend / clockwise units, set the pressure relief on the recharge module the same as the power module's extend / clockwise pressure relief.
- On fail retract / counter clockwise units, set the pressure relief on the recharge module the same as the power module's retract / counter clockwise pressure relief.
- Refer to the above sections to trouble shoot the pressure reliefs.

3.13 Control Issues

3.13.1 Actuator Hunting – Electrical Noise

The actuator will not stop moving around its target position. This is referred to as "hunting" for position. There are many different factors that may cause the actuator to hunt for position; one is electrical noise.

Electrical Noise on the Control Signal

If the actuator is in "auto" mode and the display is fluctuating greater than the deadband setting and the motor is turning, the cause may be electrical noise on the incoming control signal.

To determine if the control signal is unstable, you can observe the incoming control signal by using the Up or Down arrows to view parameter "Control Sig". If the mA is fluctuating, the Control Signal is noisy.

- Ensure the Control Enclosure has a solid earth ground connection. Refer to "4.E.1 Ground Loops" on page 58.
- Ensure the control signal cable from the DCS is a shielded cable.
- Ground the shield of the Control signal cable at the DCS end only.
- Ensure that the DCS does not have a built-in "dither" signal on the control signal output. This is found on some older control system / actuator combinations.
- Using a handheld current source, apply a 4 to 20 mA signal into the Control Signal input while observing the parameter Control Sig. If the display is steady, try operating the actuator with the hand-held device. If the actuator operates properly with the hand-held, the DCS signal is noisy and should be checked.

Electrical Noise on the Actuator Feedback Signal

If the actuator is in "auto" mode and the display is fluctuating greater than the deadband setting AND the motor is turning, the cause may be electrical noise on the feedback signal from the actuator. The feedback signal from the actuator is a 4 to 20 mA loop which tells the CPU the actuator position. If this loop is noisy, the actuator may "hunt" to find the target position. To determine if the feedback signal is unstable, you can observe the actuator feedback signal in the "setup" mode.

- Place the actuator into setup mode.
- Access the "deadband" parameter in the Control menu.
- Increase the deadband by 0.5%.
- Place actuator into "Auto" mode
- Does the actuator stop hunting? If so, the problem is most likely noise. If not, noise may not be the issue.
    - In the "Calibrate" menu, scroll down to parameter Position Lo.
    - Record the value for Position Lo.
    - Press the "enter" button. The "=" will flash.
    - The value for Position Lo will indicate the current position of the actuator.
      DO NOT PRESS ENTER.
- If the display is fluctuating, the feedback signal from the actuator is noisy.
    - Press the reset button on the upper right corner of the CPU. This will exit parameter Position Lo and default back to its previous value.
    - Ensure that the Control Enclosure has a solid earth ground connection. Refer to "4.E.1 Ground Loops" on page 58
    - Ensure the feedback signal cable from the actuator is a shielded cable.
    - Ground the shield of the feedback signal cable at the control enclosure end only.
    - Ensure the Feedback cable is in a signal level tray or conduit. Having the Feedback cable in a tray or conduit with high voltage cable can cause the signal to be noisy due to induced voltage on the feedback signal from neighboring cables.
    - Ensure the Green / Yellow ground wire in the module cable is terminated at both actuator and control enclosure. This wire equalizes the ground potential at the control enclosure and actuator, thus eliminating possible current flow on the feedback cable shield.
- Faulty Feedback Device?

If the actuator is hunting or dithering for position, and feedback and control signal noise have been ruled out, it is possible that the actuator feedback device is faulty. The feedback device may have a random spot within its stroke in which the feedback signal is intermittent, giving the appearance of a noisy signal. The linear actuator uses a conductive plastic potentiometer with a 4 to 20 mA feedback board, and the rotary and drive actuators use a non-contacting device that transmits a 4 to 20 mA signal. Refer to "3.4 Feedback Bad" on page 59 to troubleshoot feedback devices.

3.13.2 Actuator Torque / Thrust Requirements

REXA Actuators and Drives are a self contained Electraulic™ device that utilizes a reversible hydraulic pump, driven by the motor, to pressurize either side of a double acting cylinder.

The output thrust / torque of each cylinder is based on an internal pressure of 2000 psi. That 2000 psi pressure multiplied by the effective area of the cylinder equates to the output thrust / torque. Each X3 REXA standard power module is shipped from the factory with 2 pressure gauges; one to monitor each side of the cylinder.

The simplest way to ensure your actuator is producing the specified amount of torque / thrust is to observe the pressure gauges during operation. The gear pump will only produce as much pressure as needed to overcome the process forces. If the actuator is producing from 0 to 2200 psi without producing a stall error then it is operating within specifications. If the actuator stalls out or fails to produce over 2000 psi then consult "3.5.1 Motor Stall Hydraulic" on page 59.

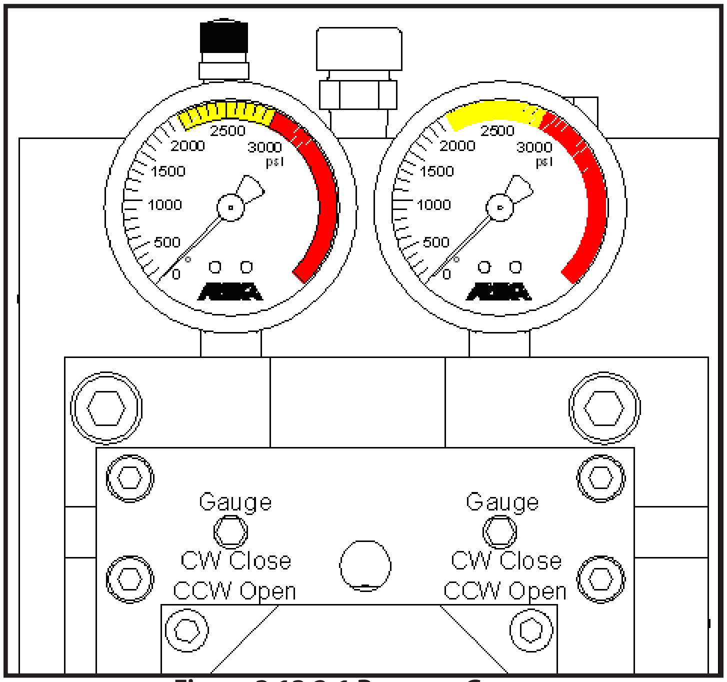


Figure 3.13.2-1 Pressure Gauges

3.13.3 Actuator Drifting

Actuator "drifts" away from applied load.

If your actuator is being "pushed" by the process, resolving this problem can be difficult and may require that the unit be removed from service.

The REXA actuator is designed to operate on 2000 psi internal oil pressure. At 2000 psi the cylinder is at its rated output. Each REXA unit has been designed to meet a specific application's thrust or torque requirement. If your REXA unit is operating above the 2000 psi limit, you may have an undersized cylinder for your application.

Every REXA X3 power module has adjustable pressure relief valves to protect the actuator from over-pressurizing. If these relief valves are shut off or not operating properly, the unit may build too much pressure and damage itself or the surrounding equipment. To verify the cylinder output, see the serial tag located on the electrical or mechanical assembly. Refer to "1.2 Actuator Identification" on page 59 , for additional information. Please contact your local REXA representative if you believe your cylinder is undersized.

If your actuator is correctly sized and still drifting away from the load, with the pressure gauges ON run the actuator in the direction of the load to see if internal pressure can be built.

- If no pressure builds but motor is turning, check the Manual bypass and / or override solenoids.
- If pressure builds but immediately drifts down, check the pressure relief valve setting. See "3.12 Pressure Relief Valves" on page 59.
- If pressure builds but drifts down slowly, the unit may have a leaking piston seal or problem with the flow matching valve. Contact your REXA representative.

3.13.4 Position Transmitter Calibration

Xmitter Low {Transmitter Low} is the parameter to calibrate the Output zero of the 4 to 20 mA Position Transmitter.

To calibrate the 4 mA Zero, connect a DMM to the Position Transmitter Output on the Interconnect Board. Set the DMM to read milliamperes (mA). Connect the Red lead of the DMM to the IB P13 Pos 4 terminal. Connect the black lead of the DMM to IB P13 Pos 5 terminal. Press Enter to access this setting. The Value displayed on the REXA display corresponds to Digital bits. Each increment or decrement of 4 bits will change the current output by one micro-amp (1 µA). The acceptable range for Xmitter Lo is 3.9 to 4.1 mA.

NOTE: The Position Transmitter will output the mA signal that corresponds to the actuator's current position until the Enter button is pressed and the " =" sign is flashing. When the " =" sign is flashing, the output will change to the "Zero" or Lo Calibration value.

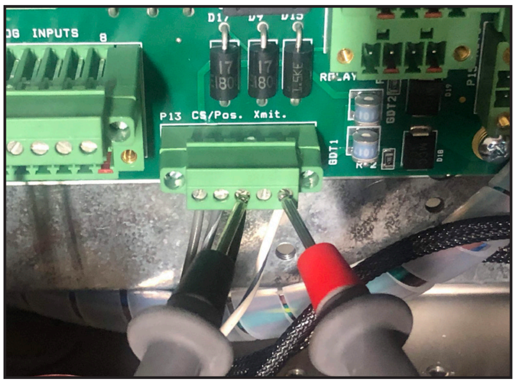


Photo 3.13.4-2 DMM Connection **Photo 3.13.4-3 DMM Display** **Photo 3.13.4-4 Xmitter Lo Readout**

Xmitter Hi {Transmitter Hi} is the parameter to calibrate the Output span of the 4-20 mA Position Transmitter. To calibrate the 20 mA Span, connect a DMM to the Position Transmitter Output on the Interconnect Board. Set the DMM to read milliamperes (mA). Connect the Red lead of the DMM to the IB P13 Pos 4 terminal. Connect the black lead of the DMM to IB P13 Pos 5 terminal. Press Enter to access this setting. The Value displayed on the REXA display corresponds to Digital bits. Each increment or decrement is steps of 4 bits and will change the current output by one micro-amp (1 µA).

Photo 3.13.4-5 Xmitter Hi Readout

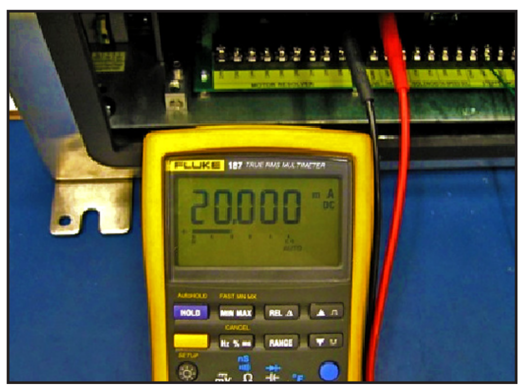


Photo 3.13.4-6 DMM Display

NOTE: The Position Transmitter will output the mA signal that corresponds to the current position of the actuator until the Enter button is pressed and the "=" sign is flashing. When the "=" sign is flashing, the output will change to the "Span" or Hi Calibration value.

Once the position transmitter calibration is complete, there is no need to re-calibrate the transmitter for changes in actuator span. Changing the actuator span will cause the transmitter to automatically re-calibrate its output.

3.13.5 Electrical Limit Switches

The Electrical Sub-Assembly is equipped with two SPST 1 Form A PhotoMos relays that are configured as electronic limit switches. The termination points for these relays are located on the Interconnect board assembly at P5, Relay 1: Pos 1 & 2, Relay 2: Pos 3 & 4.

Relay 2: Pos 3 & 4. The relays close based on the value of parameters RELAY #1 and RELAY #2 in the OUTPUTS menu. Refer to "6.1 Setup Mode" on page 61 of the IOM.

Electrical limit switch rating = 200 VAC / Vdc, 1 A

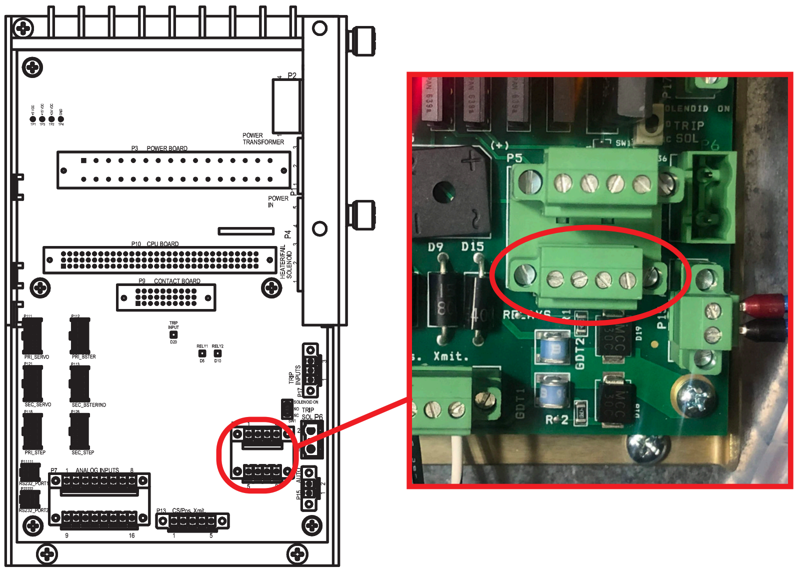


Photo 3.13.5-1 Relay Block

Can the Electrical Limit Switches be Configured Normally Open or Normally Closed?

- No. The relays are SPST, solid state devices with a Normally Open contact only. The relay contact is "open" when power is off or the relay is not within the "active" range determined by actuator stroke.

Do the Solid State Relays Have Leakage Current When in Off?

- The leakage current in the "off" state should be no greater than 10 mA. If it is greater, the relay is defective and the Interconnect board should be replaced per "4.E.4 CPU Assembly" on page 78.

  If RELAY 1 does not give a closed contact indication:

- **Is the actuator stroke below the value set in parameter Relay#1?**
  - If no, bring the actuator to within the active range of Relay #1 or adjust parameter Relay #1.
- **Is the LED D6 lit?**
  - If No, replace the Interconnect board according to section "4.E.4 CPU Assembly" on page 78.
  - LED D6 is lit, but I do not have a closed contact.

  Confirm the actuator is within the active range for Relay #1. Using an ohmmeter, measure the resistance across the terminals at P5 pins 1 and 2 for Relay 1. The "on" resistance of the relay should be approximately 0.7 Ω but no greater than 1.1 Ω. If the resistance is greater than 1.1 Ω or an open circuit, the relay is faulty and the Interconnect board should be replaced per "4.E.4 CPU Assembly" on page 78.

  RELAY 2 does not give a closed contact indication

- **Is the actuator stroke below the value set in parameter Relay #2?**
  - If not, bring the actuator to within the active range of Relay #2 or adjust parameter Relay #2.
- **Is the LED D10 lit?**
  - If No, replace the Interconnect Board according to TS&R section 4.E.4.
  - LED D10 is lit, but I do not have a closed contact.
  - Confirm the actuator is within the active range for Relay #2. Using an ohmmeter, measure the resistance across the terminals at P5 pins for 3 and 4 for Relay 2. The "on" resistance of the relay should be approximately 0.7 Ω but no greater than 1.1 Ω.
  - If the resistance is greater than 1.1 Ω or an open circuit, the relay is faulty and the CPU should be replaced per "4.E.4 CPU Assembly" on page 78.

3.13.6 Too High / Too Low on Display

The display reads Too Low or Too Hi, and you cannot calibrate your high / low position. The actual physical mechanical travel, of the REXA cylinder is recorded in the CPU. To prevent the unit from hitting the cylinder end during operation an electrical "cushion" is added.

- Back the actuator away from the cylinder end until the CPU allows the value to be set. If possible, disengage the driven device linkage slightly to allow the actuator more room to travel. If no changes can be made that will satisfy proper safe operation, contact your local REXA representative.

3.14 Trip Signal

REXA actuators can be configured to fail to either end position or stay in its last position. The fail to end position is achieved by either the use of a coil spring or a pressurized accumulator bottle. It can be triggered by a loss of power, control signal or independent trip signal.

3.14.1 Fail Direction

The Fail direction is factory configured—based on information provided—to fail to either calibrated end, but not both, and is not field reversible. Please contact your REXA representative.

3.14.2 No Trip on Loss of Power

The actuator does not trip on loss of power reference.

- If equipped with a high-speed solenoid, ensure the solenoid override lever is in Position A for normal actuator operation for both spring fail and accumulator systems. Refer to "M. Manual Operators" on page 62.
  - Ensure the Accumulator bottles are charged and the Shutoff and / or Needle valves are in their proper position. Refer to the IOM "C2. Online Recharge Accumulator Fail-Safe" on page 62.
- If equipped with a high speed solenoid manifold assembly that has an integral needle valve, ensure the needle valve is fully closed. Refer to the IOM "C2. Online Recharge Accumulator Fail-Safe" on page 62.
- If equipped with a REXA solenoid, a bypass control toggle lever will be present on the power module. Ensure that the lever is in its 'normal position'. Refer to the IOM "C2. Online Recharge Accumulator Fail-Safe" on page 62.
- Check software settings for Trip option and / or Accumulator option under Inputs menu. Refer to "6 Modes of Operation & Control Parameters" on page 62 of the IOM, for proper setting when using Trip function to fail on loss of power.
- Check trip fuses on power supply board with DMM. For 115 VAC fuse F1 is are for fail-safe solenoid. For 230 VAC fuses F2 and F3 are for fail-safe solenoid. Using a DMM, a good fuse will measure close to zero Ohms or show continuity. A blown fuse is an open circuit or will read infinity on the meter. See "4.E.17. Input Power Distribution Assembly" on page 62 to replace blown fuses on Triple Power Supply. See "4.E.3. Power Supply Assembly" on page 74 to replace the power board.

3.14.3 No Trip on Loss of Control Signal

The actuator doesn't trip on loss of control signal.

If Analog control signal falls below 2.5 mA, the actuator should move to fail safe position via motor.

- Check that the Failsafe option is enabled. Refer to the IOM "M.3 Fail-safe Unit Operation" on page 63.
- Ensure the accumulator bottles are charged and the shutoff valves are in position. Refer to "C2. Online Recharge Accumulator Fail-Safe" on page 63.

NOTE: Local and Remote Manual mode will override Failsafe position

3.14.4 No Trip on Loss of Trip Signal

The actuator doesn't trip on loss of trip signal reference

- Check that the trip signal (24–120 VAC / Vdc) is wired to the correct trip input terminal blocks. Ensure that any required jumpers are in place. Check that the Trip option and / or Accumulator option is enabled. Refer to "C2. Online Recharge Accumulator Fail-Safe" on page 63.
- Check trip fuses on power supply board with DMM. For 115 VAC fuse F1 is are for fail-safe solenoid. For 230 VAC fuses F2 and F3 are for fail-safe solenoid. Using a DMM, a good fuse will measure close to Zero Ohms or show continuity. A blown fuse is an open circuit or will read infinity on the meter. See "4.E.17. Input Power Distribution Assembly" on page 109.
- Refer to "3.12 Pressure Relief Valves" on page 63 for other possible causes

3.15 Water Ingress

3.15.1 Module / Motor

The Mechanical Sub Assembly (MSA) of the REXA Actuator is designed to thrive in the most hostile ambient environments. The MSA is rated NEMA 4X (protection against rain, snow, hose directed water and corrosion resistant). When properly installed your MSA should provide years of weather tight operation.

The MSA has multiple conduit entries. Each of the entries ship from the factory with a stainless steel plug installed with sealant around the threads to eliminate the possible ingress of water. If a plug is removed and replaced with a conduit fitting both local and National Electrical Codes (NEC) must be complied with to ensure proper installation and sealing.

The MSA also has a wire terminal cover that allows access to the module terminal strips. This cover incorporates an O-ring to form the seal against the environment. The ¼ inch bolts used to hold the cover on should be torqued to 120 lb·in to ensure the proper pressure on the O-ring.

Each motor should be equipped with either a hand wheel or a motor cover on the back end of the motor. These items are equipped with an O-ring to make sure the motor is sealed from any elements. If the back end of the motor is left unsealed, water or other elements may cause damage to the motor or wire terminals.

3.15.2 Electronics

The Electrical Sub Assembly (ESA) of the REXA actuator, although typically remote mounted from the MSA, is also rated for outdoor use. The standard steel enclosure is rated NEMA 4X (protection against rain, snow and hose directed water). When properly installed your ESA should give you years of weather tight operation.

The closing mechanism on the ESA is a single point quarter turn latch that requires the use of a tool for opening. When properly closed the cover is compressed against the gasket to form a seal against the environment.

All electrical connections to the ESA should be made at the gland plate found at the bottom of the enclosure. The gland plate can be removed, drilled for the different entry points, and then re-installed with the gasket in place. When installing conduit fittings both local and National Electrical Code (NEC) must be complied witih to ensure proper installation and sealing.

4.E Electrical Repair

4.E.1 Ground Loops

4.E.1.1 What is a Ground Loop?

A Ground Loop can be present in a system when points nominated as Grounds are at different potentials, and there is more than one electrical path connecting these Grounds, and signal lines are connected in such a way that circulating ground currents are able to flow through one or more signal conductors.

The resulting current that flows in the loop can be very large — in extreme cases hundreds of amps — but is more commonly less than 500 mA. The voltage drop along the wire that is part of the measurement circuit is impressed on the signal voltage thus causing the error. Because this current is variable, it cannot be "calibrated out."

4.E.1.2 Why Ground Anyway?

Three reasons for grounding measurement systems:

- The first is safety. Should a high voltage accidentally come into contact with the measurement system, the measurement system would become dangerous. A grounded measurement system would cause a fuse to "open" thus rendering the system safe.
- The second reason for grounding is to ensure the measuring system is operating within its operating voltage range. If the system were not grounded, the system could be charged to high voltage levels by static electricity or insulation leakage. At some point, the system's insulation would break down, possibly causing measurement errors in the process.
- A third reason grounds may be introduced into a system is due to sensor needs. For example, to obtain the best possible thermal contact and response time, a thermocouple may be welded to the object of interest — hence grounding the thermocouple. Another example is the pH electrode — it is in electrical contact with the fluid being measured.

4.E.1.3 Solutions (or a Single Ground is a Good Ground)

1. **Eliminate the loop**

The simplest and most effective method to avoid ground loop problems is to ensure the measurement system is connected to a single ground point. Eliminate the loop. However, this is not always possible as sensors must sometimes be grounded; communications links with computers introduce additional grounds, or electrical safety demands multiple grounds. But there are solutions:

2. **Use Differential Inputs**

The use of differential inputs (as opposed to single ended inputs) is effective in overcoming ground loop errors as no current passes down the two measurement wires. However, differential inputs are only as good as their common mode rating. If the ground voltage difference exceeds the rating the errors will be introduced.

3. **Shield Grounds**

If shielded wires are used, the shielding should be grounded at one end of the cable only, preferably the measurement system end. If grounded at both ends, ground current will flow through the shield and inductively induce noise into the signals wires (which should be twisted to minimize this effect). Also, it is possible that injecting the loop current into the shield connection points may cause errors in the measuring device or the sensor.

4. **Isolation at the sensor**

If possible, electrically isolate all the wiring associated with the sensor from the area in which the sensor is installed. This may need to include power supplies. The preferred grounding point is at the measuring device. Sometimes it is not possible to isolate the sensors or its wiring. In these cases it is necessary to isolate at the measuring device by providing a fully isolated input for that sensor. If there is only one such sensor in the system, it may be possible to use its ground as the system's ground.

5. **Isolation at the measuring device input**

Providing isolation at each of the measuring device's inputs is the best but most expensive solution. Typically such isolation will double the equipment cost. Also, isolation has its limitations — speed and accuracy are often sacrificed to contain the costs.

6. **Isolation at the measuring device output**

In small systems a cost effective solution is to provide isolation at the measuring devices output interface such as RS232, Ethernet, USB or modem.

7. **Isolation (floating) of the measuring device**

An unconventional but occasionally practical method of isolation in a small setup is to isolate the entire measuring device by allowing it to operate off batteries. The method can provide almost any level of isolation required, but if used to isolate very high voltages, extreme care must be taken against forgetful contact.

The simple rule still applies — a single ground is a good ground. Sometimes you may have no choice where the ground may be placed (as with a grounded thermocouple grounded for good thermal contact and response time), but remove ALL other grounds.

4.E.1.4 Causes of Ground Potential Differences

Understanding the cause of ground potential differences can be of some help in minimizing their impact on the measuring system and also in negating effects such as corrosion.

- Electric trains and trams —

  Electric traction systems often use the tracks as a the return path for the current drawn from overhead power lines.

- Ground returns in electrical power systems
- Ground returns in marine power plants
- Lightning strike
- Galvanic corrosion prevention systems
- Inductively induced currents

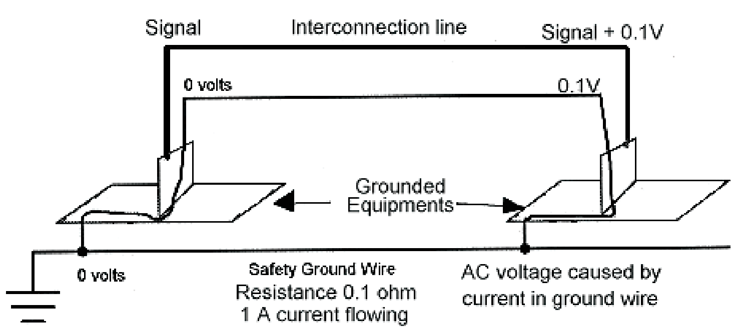


Figure 4.E.1.4 Ground Loop

4.E.1.5 Ground loops and REXA Equipment

- Related to signal wires (Feedback, pressure transmitter)
- Earth ground connection between actuator and electronics
- Signs of ground loop problems:
    - Noisy/unstable feedback, control or pressure transmitter signal
    - High voltage measurement between Earth Ground and Neutral conductors at the control enclosure power input.

4.E.1.6 What fixes a ground loop?

Typically, a ground loop is fixed by cleaning up the interconnecting wiring to have:

- Shields terminated at ONE end of the cable only
- Shields connected to the backplane of the electronics enclosure
- AC Ground from the AC source brought to the control enclosure and actuator rather than ground to building steel only
- Good earth ground connections

NOTE: Ground loops can be difficult to solve and require patience and thorough site evaluation and every installation is different. Take it one step at a time

4.E.2 Component Replacement

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

NOTE: Assumed starting position is facing the upright electronic unit with the enclosure door open.

4.E.2.1 B/C Single Stepper Enclosure

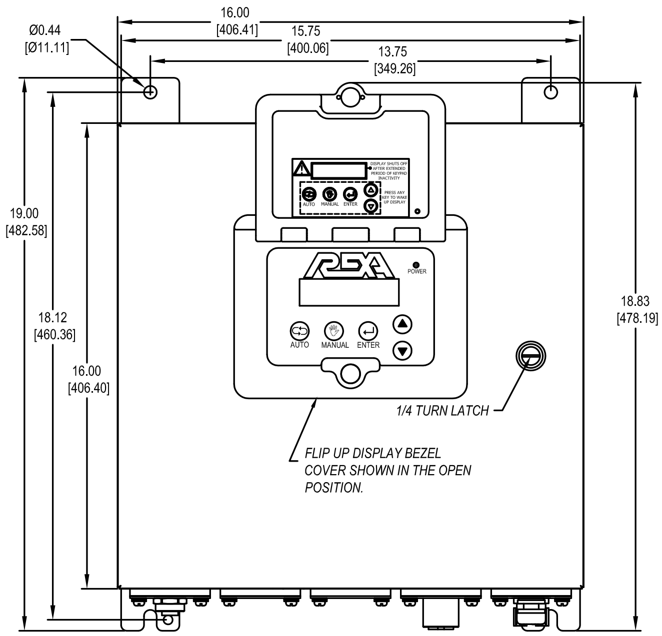


Figure 4.E.2.1-1 B/C Single Stepper Enclosure Dimensions

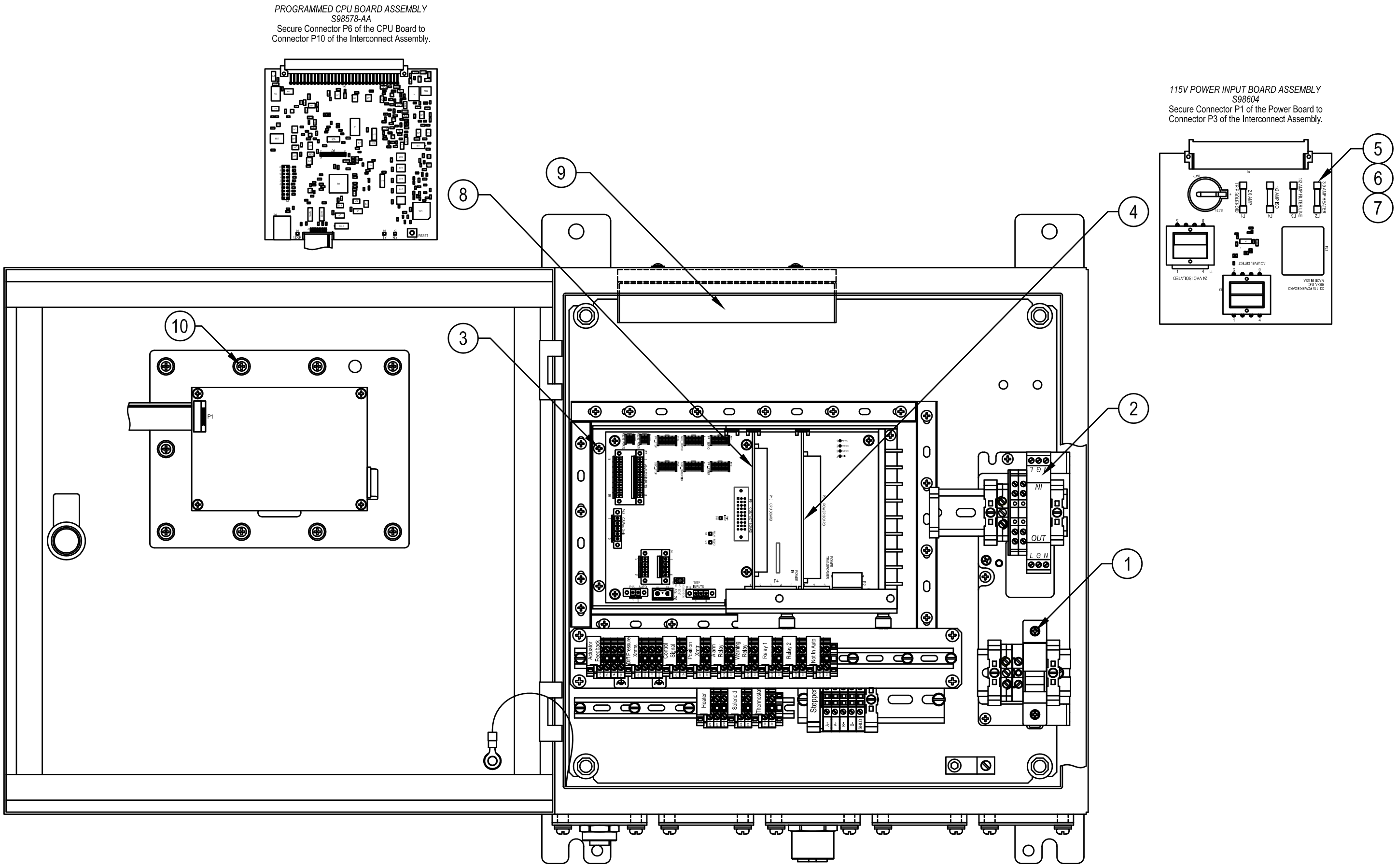


Figure 4.E.2.1-2 B/C Single Stepper Enclosure Component Identification

Table 4.E.2.1-1 B/C Single Stepper Enclosure Component Identification		
Item #	**Description**	**QTY**
1	B-Elec = Fuse, 5 Amp, Class CC (13/32" x 1/12") C-Elec - Fuse, 10Amp, Class CC (13/32" x 1/12")	1
2	Surge Suppressor, 115VAC, 20A	1
3	X3 Interconnect Board Assembly	1
4	X3 115V Power Input Board Assembly	1
5	Fuse, 2amp, 5mm x 2omm, Ferrule Type, Fast Acting, Global Certified, UL/CSA/CE	1
6	Fuse, 3amp, 5mm x 20mm, Ferrule Type, Fast Acting, Global Certified, UL/CSA/CE	1
7	Fuse, 1/2amp, 5mm x 20mm, Ferrule Type, Slow Blo, Global Certified, UL/CSA/CE	2
8	CPU Board, X3, Programmed	1
9	Stepper Driver, 115V, General Locations	1
10	External Display Assembly, X3, Bluetooth, Programmed	1

4.E.2.2 ½D Single Servo Enclosure

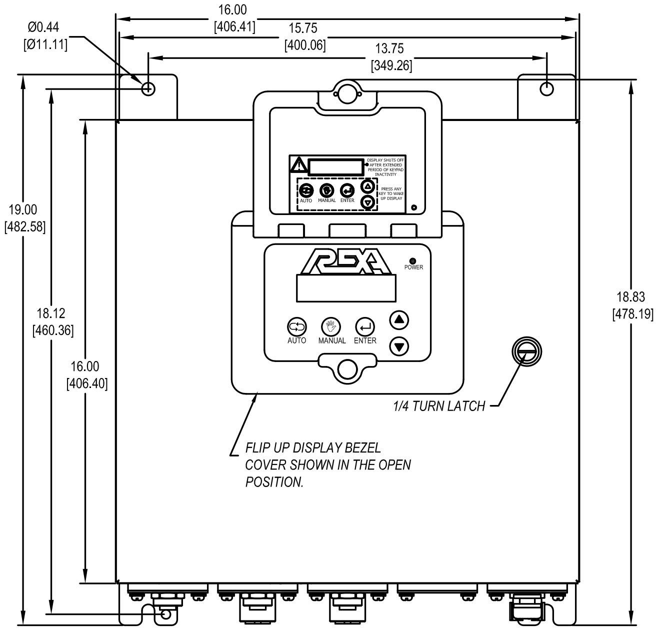


Figure 4.E.2.2-1 ½D Single Servo Enclosure Dimensions

Table 4.E.2.2-1 ½D Single Servo Enclosure Component Identification		
Item #	**Description**	**QTY**
1	Fuse, 20 Amp, Class CC (13/32" x 1 1/2")	1
2	Surge Suppressor, 115 VAC, 20A	1
3	X3 Interconnect Board Assembly	1
4	X3, 115 Power Input Board Assembly	1
5	Fuse, 2amp, 5mm x 20mm, Ferrule Type, Fast Acting, Global Certified, UL/CSA/CE	1
6	Fuse, 3amp, 5mm x 20mm, Ferrule Type, Fast Acting, Global Certified, UL/CSA/CE	1
7	Fuse, 1/2amp, 5mm x 20mm, Ferrule Type, Slow Blo, Global Certified, UL/CSA/CE	2
8	CPU Board, X3, Programmed	1
9	Motor Driver, 1/2D-Pump, 115V, Programmed	1
10	External Display Assembly, X3, Bluetooth, Programmed	1

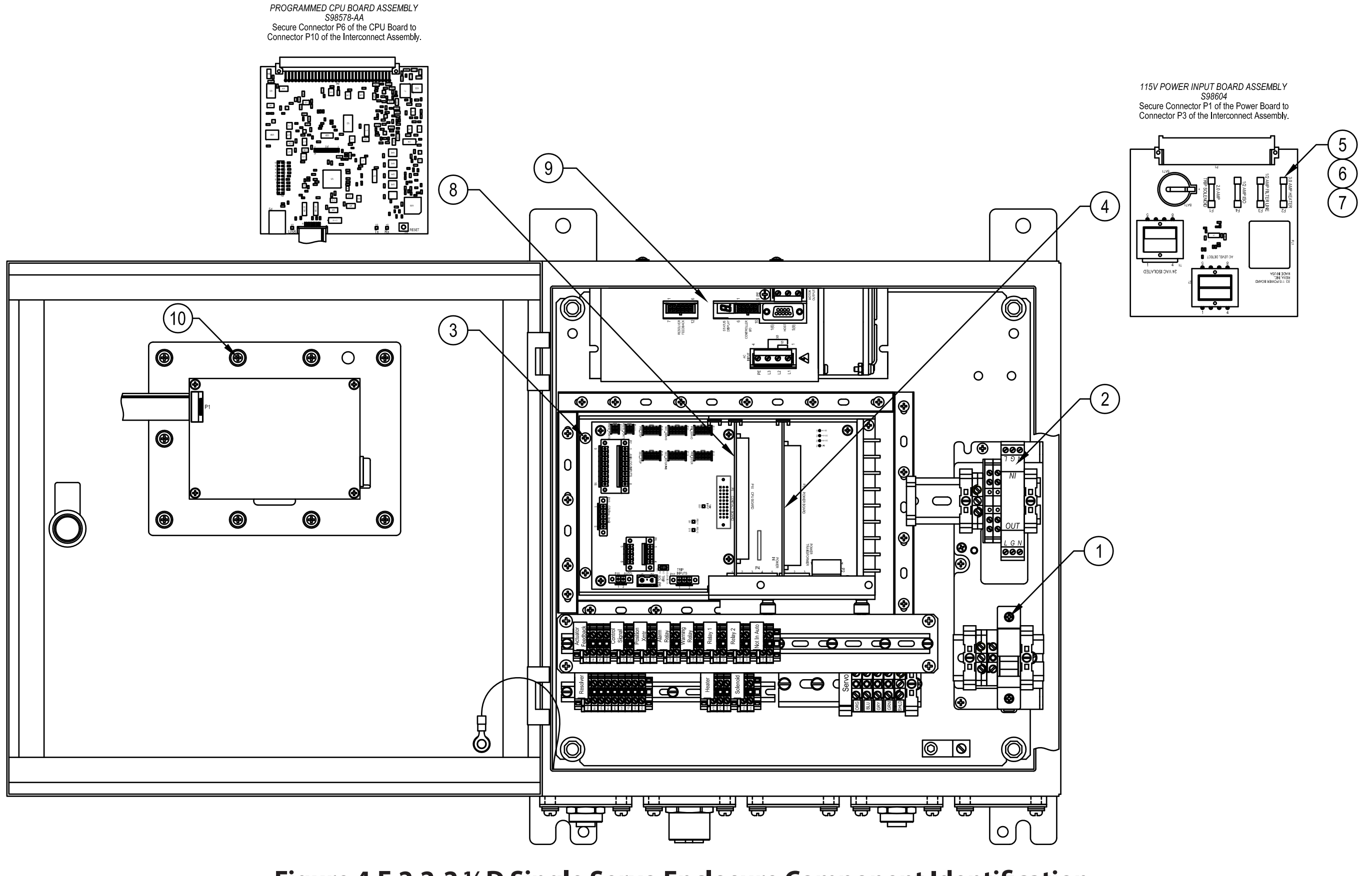


Figure 4.E.2.2-2 ½D Single Servo Enclosure Component Identification

4.E.2.3 D Single Servo Enclosure

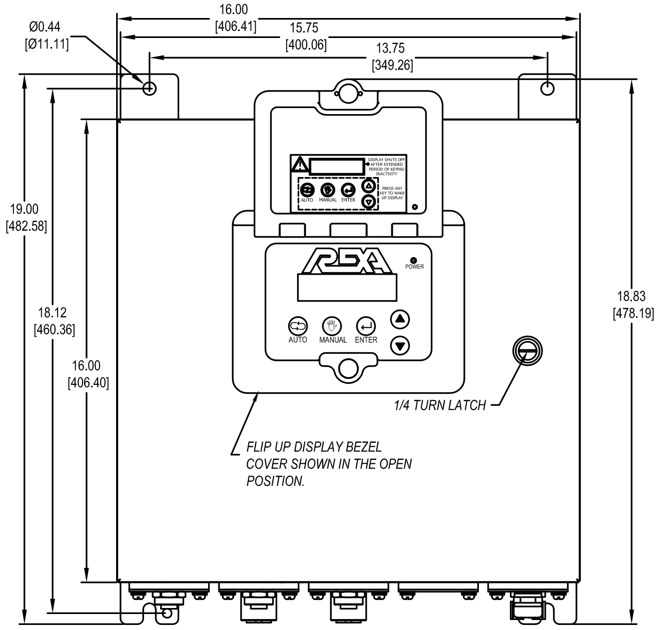


Figure 4.E.2.3-1 D Single Servo Enclosure Dimensions

Table 4.E.2.3-1 D Single Servo Enclosure Component Identification		
Item #	**Description**	**QTY**
1	Fuse, 10amp, Class CC (13/32" x 1 1/2").	2
2	Surge Suppressor, 230VAC, 26A.	1
3	X3, Interconnect Board Assembly.	1
4	X3, 230V Power Input Board Assembly.	1
5	Fuse 2amp, 5mm x 20mm, Ferrule Type, Fast Acting, Global Certified, UL/CSA/CE.	4
6	Fuse, 1/4amp, 5mm x 20mm, Time Lag, Low Breakage Capacity, Global Certified.	2
7	CPU Board, X3, Programmed.	1
8	Motor Driver, D-Pump, 230V, Programmed.	1
9	External Display Assembly, X3, Bluetooth, Programmed	1

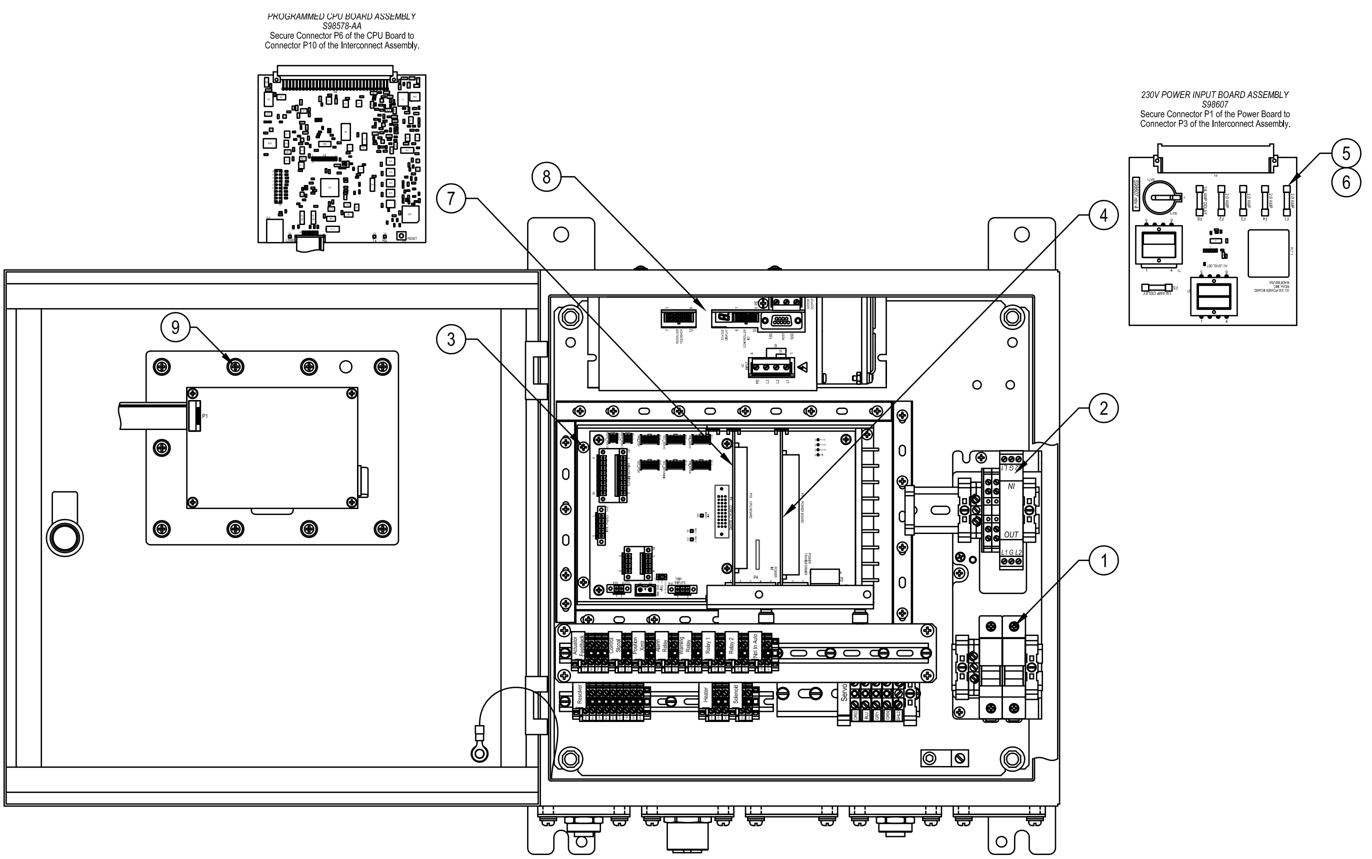


Figure 4.E.2.3-2 D Single Servo Enclosure Component Identification

4.E.2.4 Dual Servo Enclosure

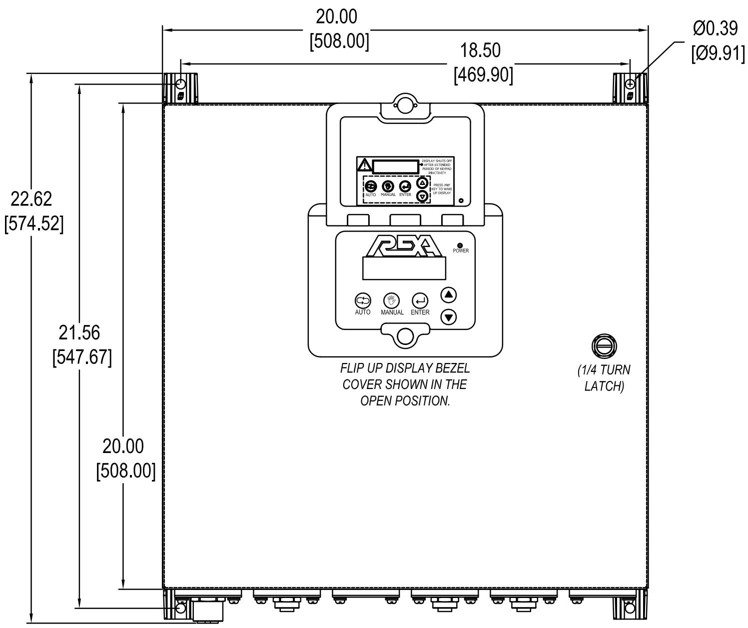


Figure 4.E.2.4-1 Dual Servo Enclosure Dimensions

Table 4.E.2.4-1 Dual Servo Enclosure Component Identification		
Item #	**Description**	**QTY**
1	Fuse, 20amp, Class CC (13/32" x 1 1/2")	2
2	Surge Suppressor, 230VAC, 26A	1
3	X3, Interconnect Board Assembly	1
4	X3, 230V Power Input Board Assembly	1
5	Fuse, 2amp, 5mm x 20mm, Ferrule Type, Fast Acting, Global Certified, UL/CSA/CE	4
6	Fuse 1/4amp, 5mm x 20mm Time Lag, Low Breakage Capacity, Global Certified	2
7	CPU Board, X#, Programmed	1
8	Motor Driver, D-Pump, 230V, Programmed	2
9	External Display, Assembly, X3, Bluetooth, Programmed	1

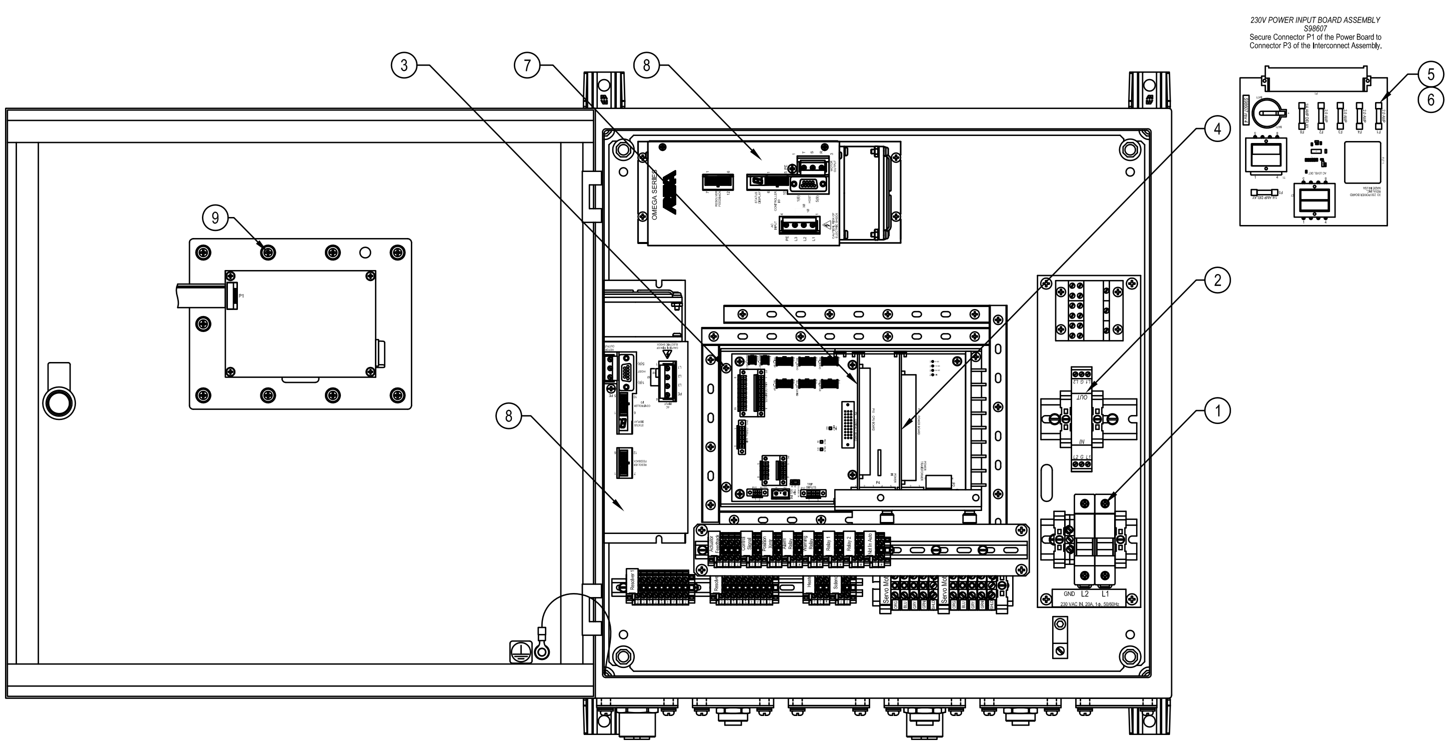


Figure 4.E.2.4-2 Dual Servo Enclosure Component Identification

4.E.2.5 D,P9 Booster Pump Enclosure

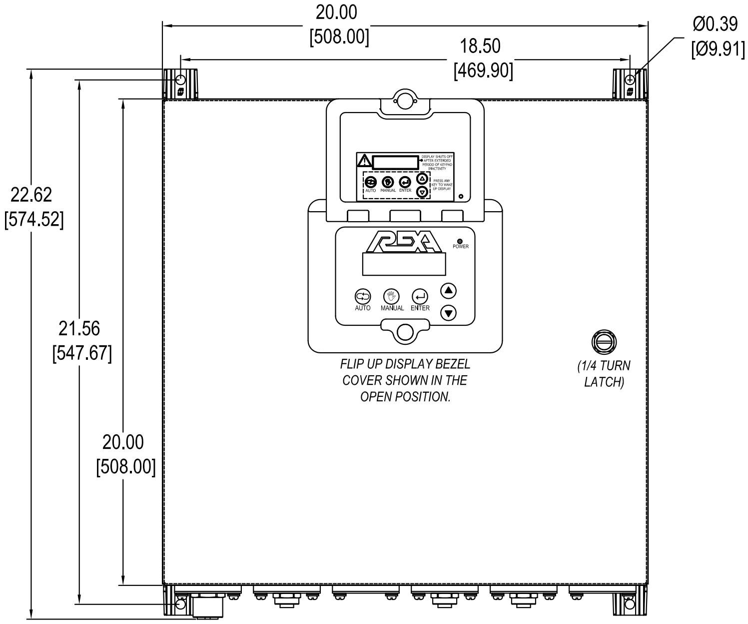


Figure 4.E.2.5-1 D,P9 Booster Pump Enclosure Dimensions

Table 4.E.2.5-1 D,P9 Booster Pump Enclosure Component Identification		
Item #	**Description**	**QTY**
1	Fuse, 25 amp, Class CC (13/32" x 1 1/2")	3
2	Surge Suppressor, 230VAC, 3Ø, P9	1
3	X3, Interconnect Board Assembly	1
4	X3, 230V Power Input Board Assembly	1
5	Fuse, 2amp, 5mm x 20mm, Ferrule Type, Fast Acting, Global Certified, UL/CSA/CE	4
6	Fuse 1/4amp, 5mm x 20mm Time Lag, Low Breakage Capacity, Global Certified	2
7	CPU Board, X3, Programmed	1
8	Motor Driver, D-Pump, 230V, Programmed	1
9	Motor Driver, P9, 230V, Programmed	1
10	External Display, Assembly, X3, Bluetooth, Programmed	1

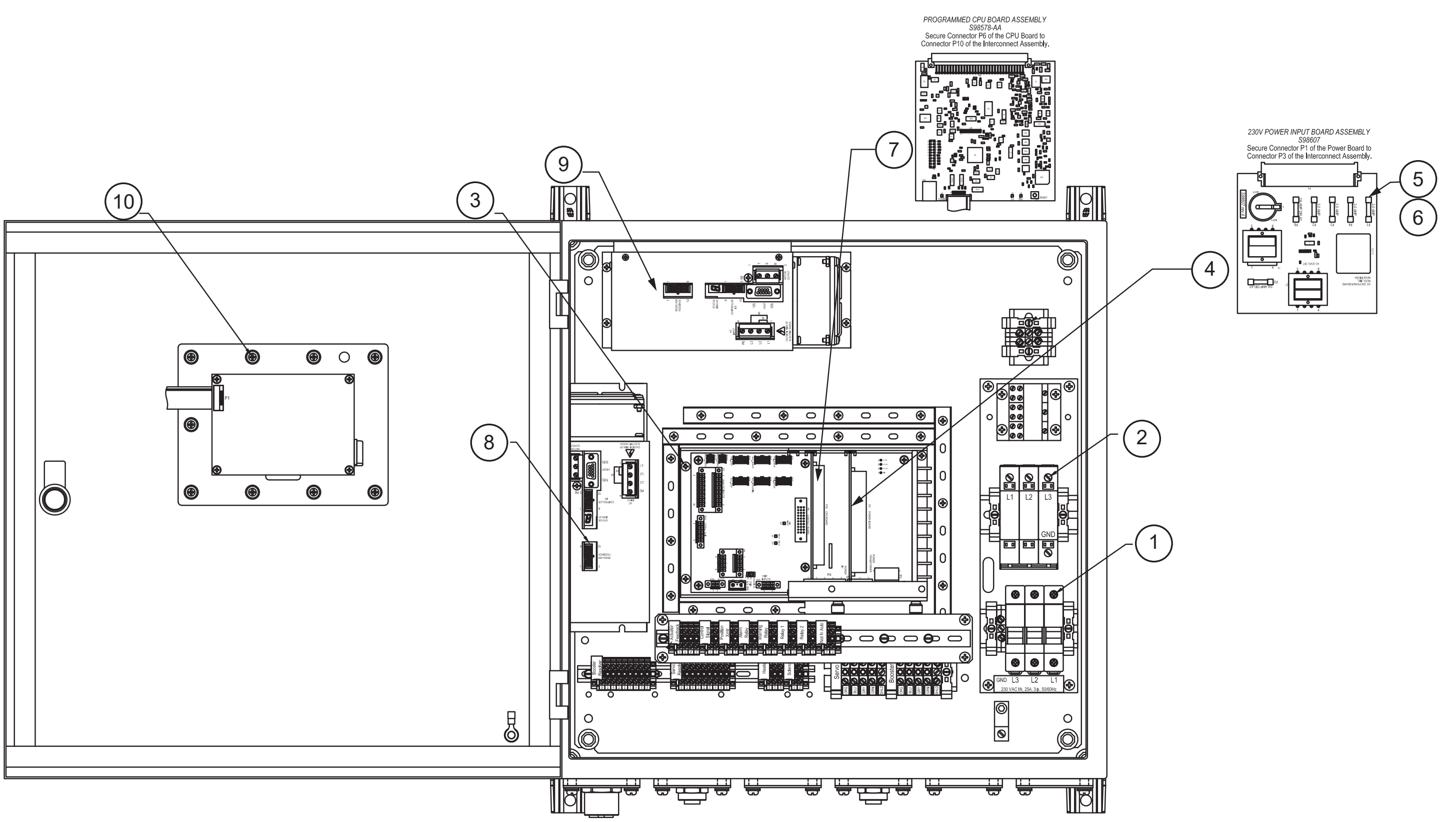


Figure 4.E.2.5-2 D,P9 Booster Pump Enclosure Component Identification

4.E.2.6 D,P20 Booster Pump Enclosure

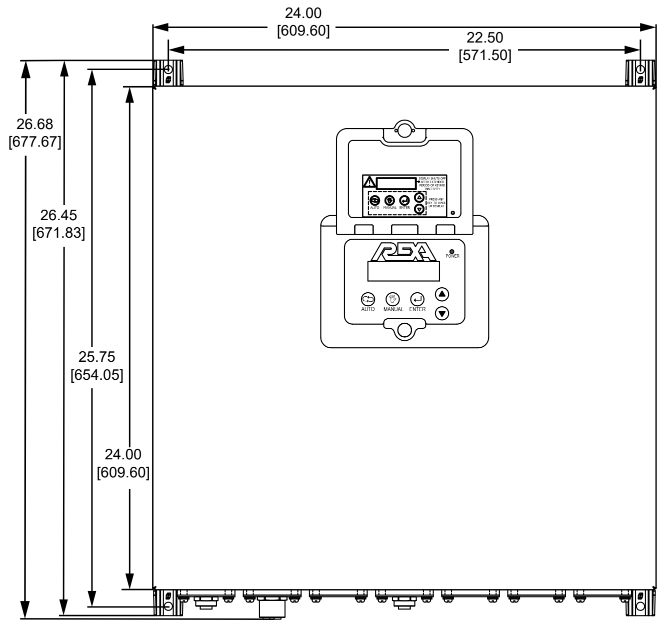


Figure 4.E.2.6-1 D,P20 Booster Pump Enclosure Dimensions

Table 4.E.2.6-1 D,P20 Booster Pump Enclosure Component Identification		
Item #	**Description**	**QTY**
1	Fuse, 30amp, Class CC (13/32" x 1 1/2")	3
2	Surge Suppressor, 230VAC, 3Ø, P9	1
3	X3, Interconnect Board Assembly	1
4	X3, 230V Power Input Board Assembly	1
5	Fuse, 2amp, 5mm x 20mm, Ferrule Type, Fast Acting, Global Certified, UL/CSA/CE	4
6	Fuse 1/4amp, 5mm x 20mm Time Lag, Low Breakage Capacity, Global Certified	2
7	CPU Board, X3, Programmed	1
8	Motor Driver, D-Pump, 230V, Programmed	1
9	Motor Driver, P20, 230V, Programmed	1
10	External Display, Assembly, X3, Bluetooth, Programmed	1

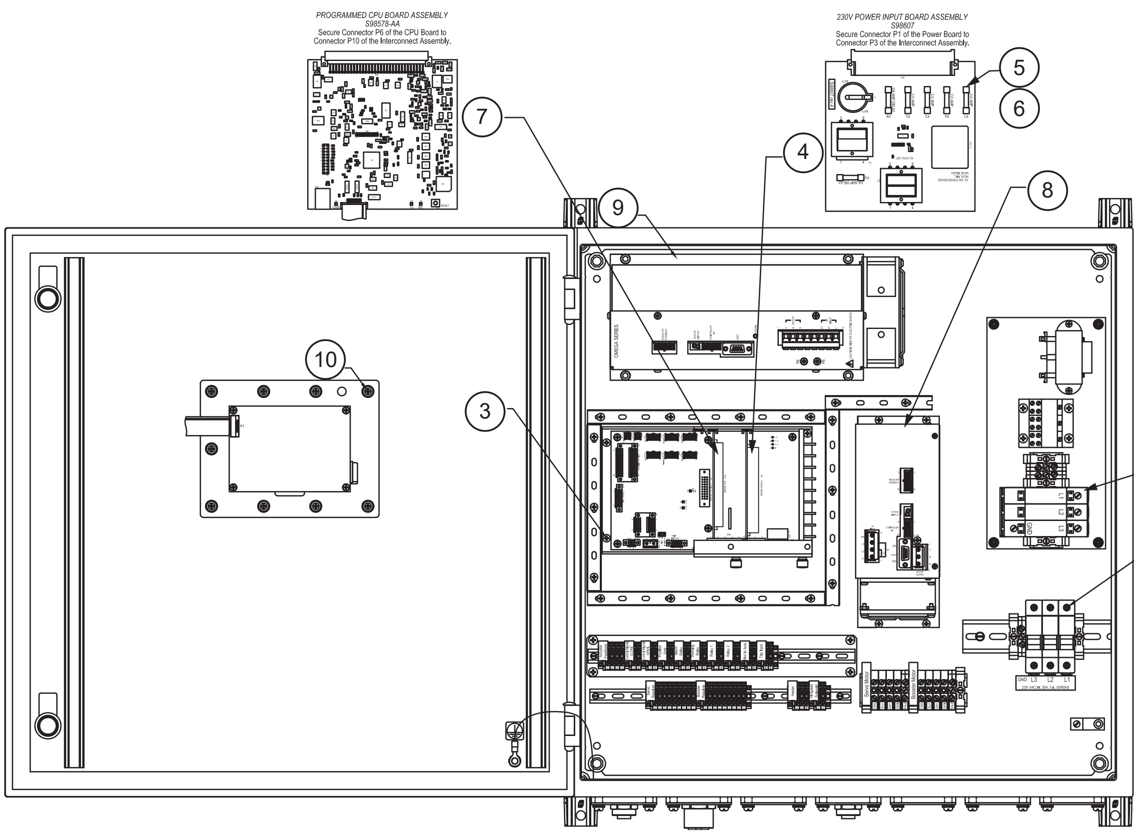


Figure 4.E.2.6-2 D,P20 Booster Pump Enclosure Component Identification

4.E.2.7 D,P40 Booster Pump Enclosure

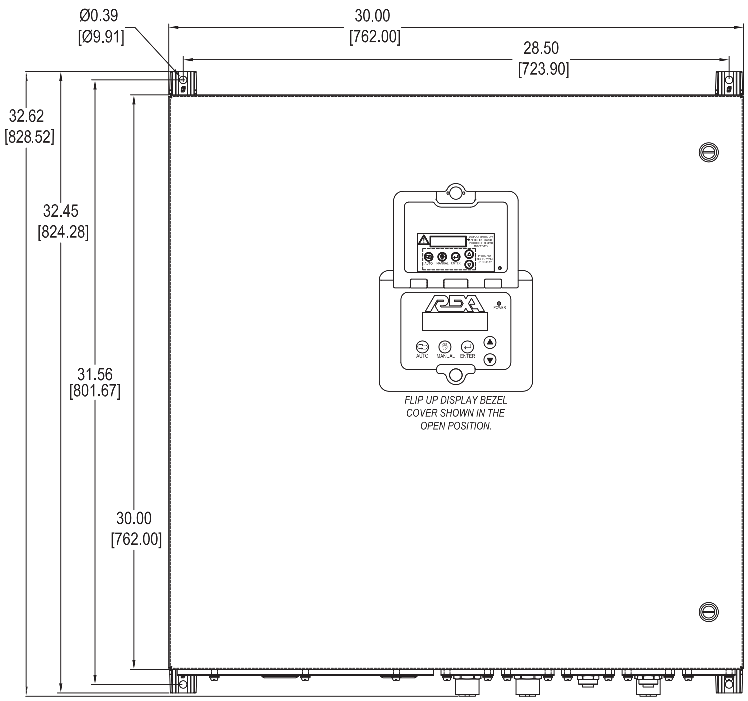


Figure 4.E.2.7-1 D,P40 Booster Pump Enclosure Dimensions

Table 4.E.2.5-1 D,P40 Booster Pump Enclosure Component Identification		
Item #	**Description**	**QTY**
1	Fuse, 50 amp, Class J (1 1/16" x 2 3/8")	3
2	Surge Suppressor, 230VAC, 3Ø, P40	1
3	X3, Interconnect Board Assembly	1
4	X3, 230V Power Input Board Assembly	1
5	Fuse, 2amp, 5mm x 20mm, Ferrule Type, Fast Acting, Global Certified, UL/CSA/CE	4
6	Fuse 1/4amp, 5mm x 20mm Time Lag, Low Breakage Capacity, Global Certified	2
7	CPU Board, X3, Programmed	1
8	Motor Driver, D-Pump, 230V, Programmed	1
9	Motor Driver, P40, 230V, Programmed	1
10	External Display, Assembly, X3, Bluetooth, Programmed	1

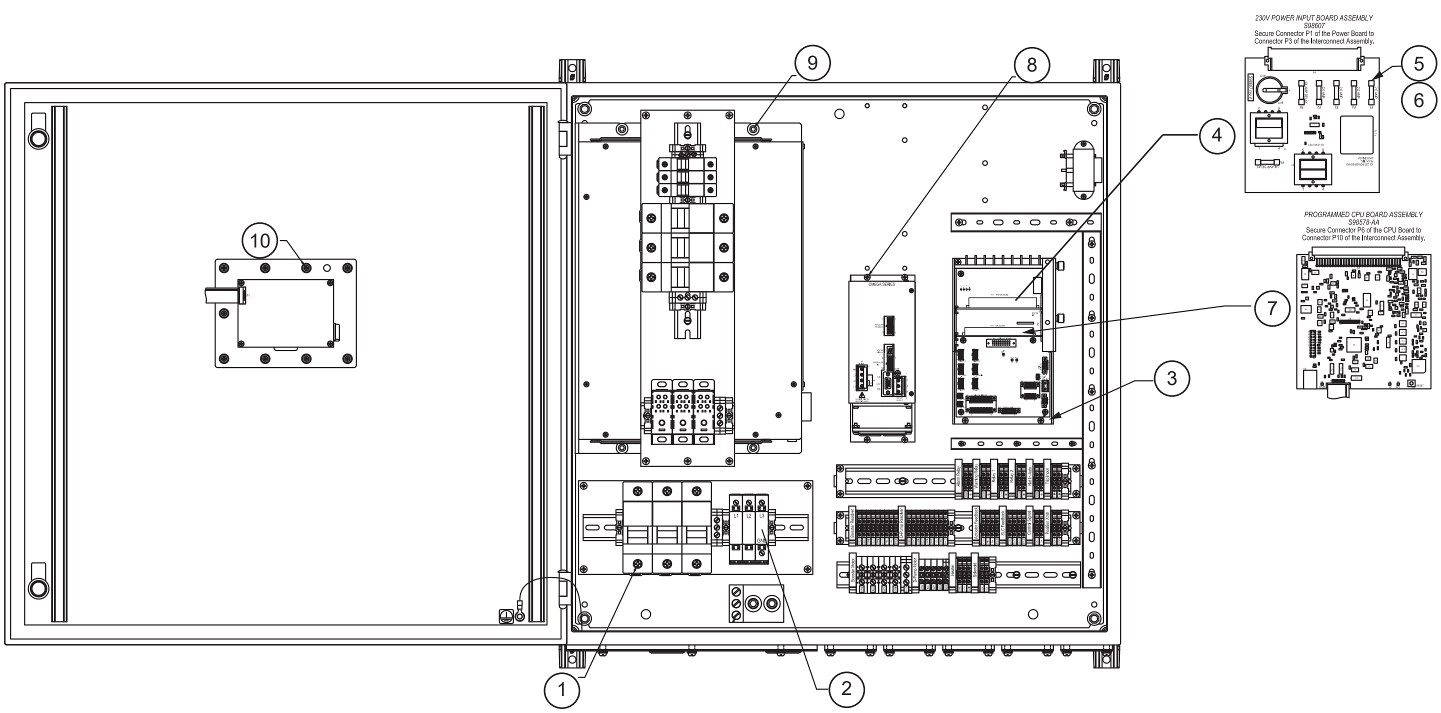


Figure 4.E.2.7-2 D,P40 Booster Pump Enclosure Component Identification

4.E.3 Power Supply Assembly

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

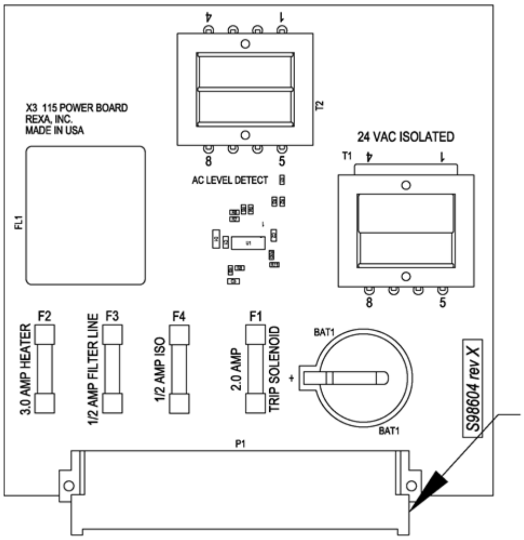


Figure 4.E.3-1 115VAC Power Supply Assembly

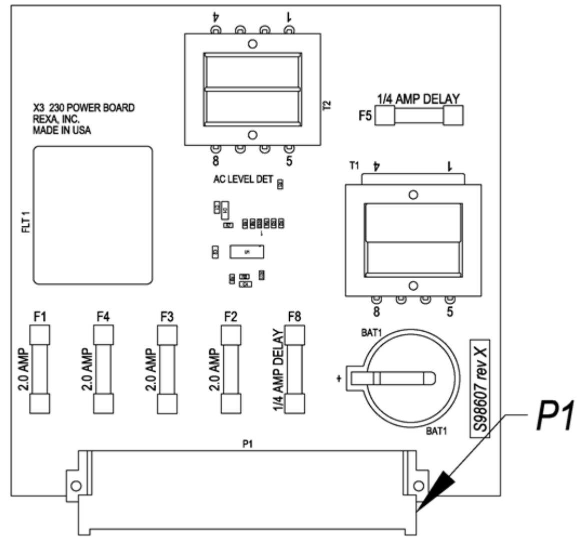


Figure 4.E.3-2 230VAC Power Supply Assembly

4.E.3.1 REMOVAL

NOTE: Any option boards that will interfere with the board removal will need to be removed first prior to proceeding. Please refer to the appropriate board removal steps in this section for the associated instructions.

1. Loosen the front thumb screw (TS1) on the PCB retaining bracket until it is no longer threaded into the interconnect card cage. Next loosen the rear thumb screw (TS2) just enough so the retaining bracket can move freely.

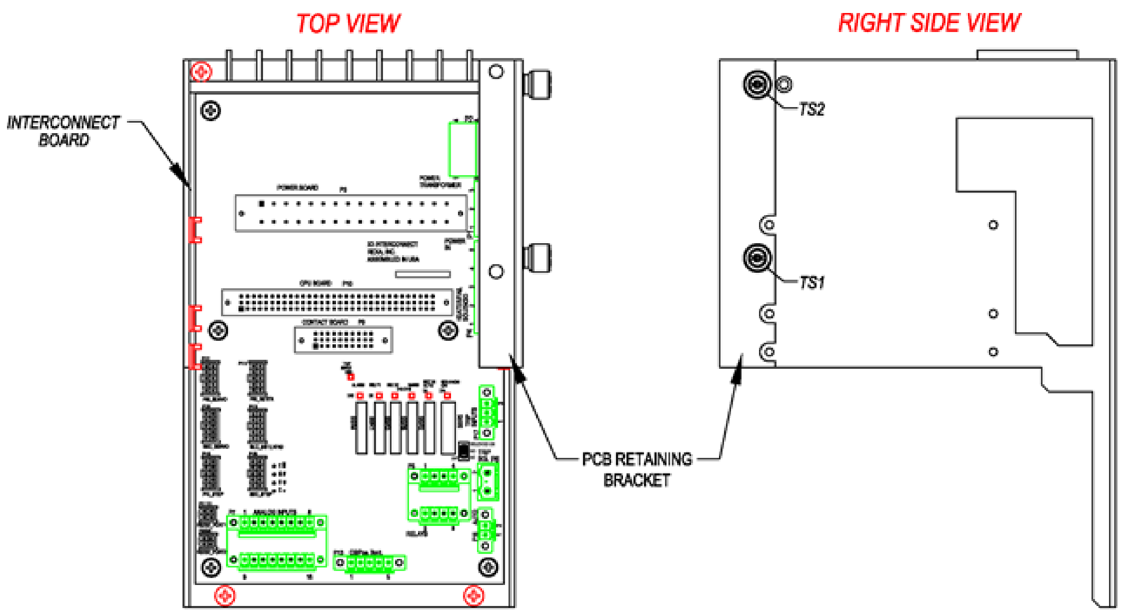


Figure 4.E.3.1-1 Interconnect Board Bracket Removal

NOTE: The thumb screws are shipped from the factory using Loctite. A Philips head screw driver may be needed to break this initial hold.

2. Flip the retaining bracket to the upward orientation.

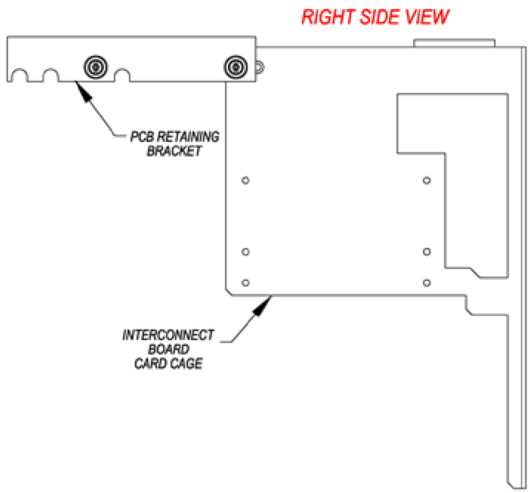
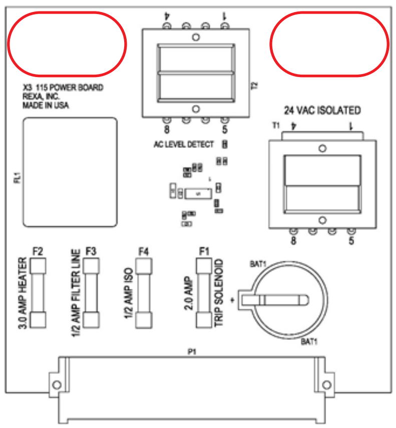


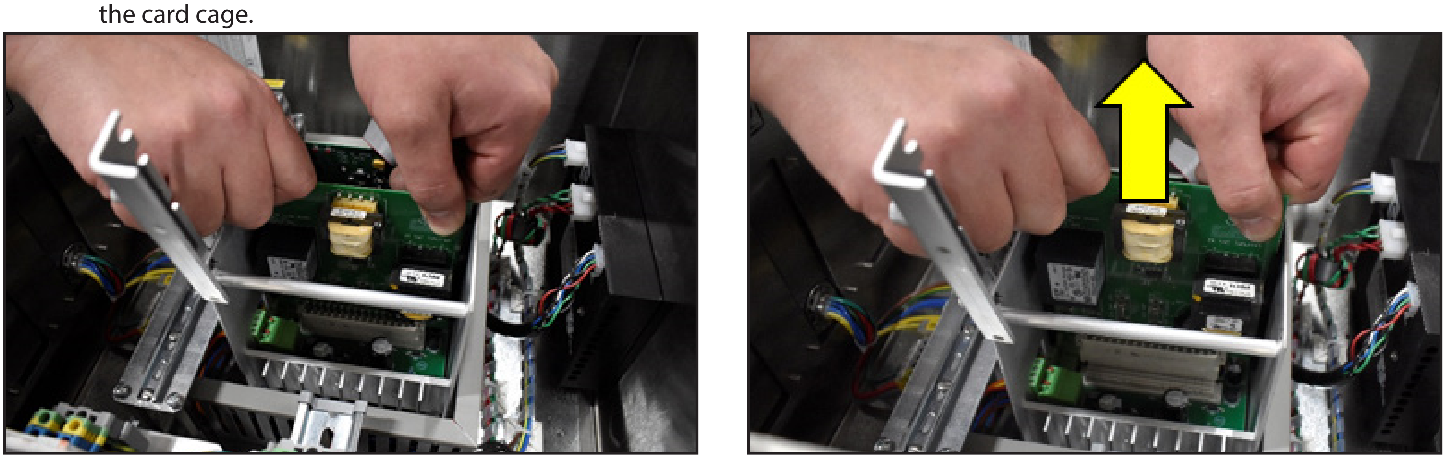
Figure 4.E.3.1-2 Retaining Bracket Removal

3. Firmly grasp the board by the areas outlined in red being sure to avoid grabbing any of the larger components.



Figures 4.E.3.1-3 Power Board Unseating

4. Using even pressure pull up on the board until connector P1 unseats from the interconnect board and the PCB is clear of the card cage.



Figures 4.E.3.1-4 Power Board Unseating

4.E.3.2 REPLACEMENT

1. With the back of the board facing the front of the Interconnect Board align the PCB with the indicated card guides.

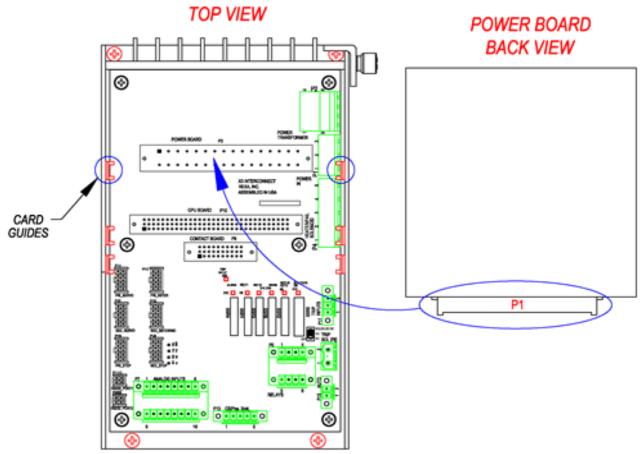
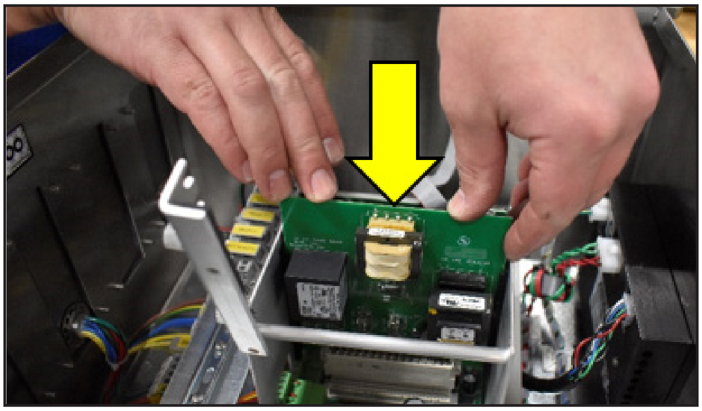
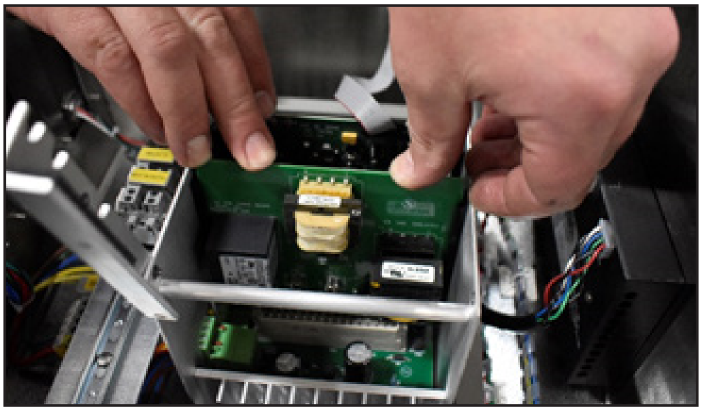


Figure 4.E.3.2-1 Power Supply Placement

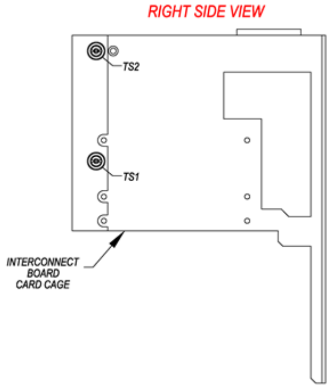
2. Slide the PCB down the card guides until mating connector P3 of the Interconnect board is reached. Next firmly press down on the top edge of the PCB until the board is seated in the connector.





Figures 4.E.3.1-3 Power Board Unseating

3. Flip the retaining bracket down to its original position and firmly secure screws TS1 and TS2 to the card cage.



Figures 4.E.3.1-3 Retaining Bracket Placement

4.E.4 CPU Assembly

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

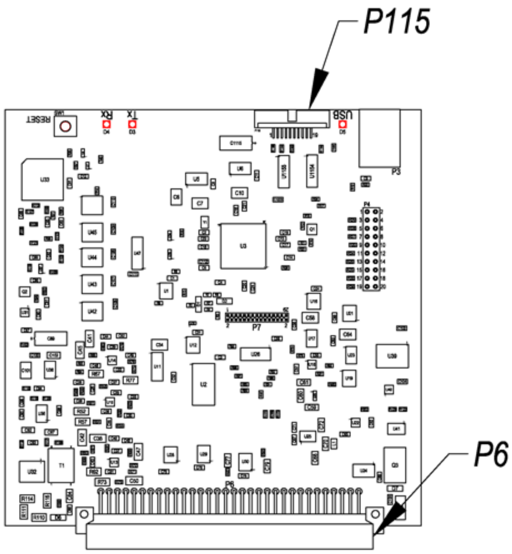


Figure 4.E.4-1 CPU Assembly

4.E.4.1 Removal

NOTE: Any option boards that will interfere with the board removal will need to be removed first prior to proceeding. Please refer to the appropriate board removal steps in this section for the associated instructions.

1. Loosen the front thumb screw (TS1) on the PCB retaining bracket until it is no longer threaded into the interconnect card cage. Next loosen the rear thumb screw (TS2) just enough so the retaining bracket can move freely.

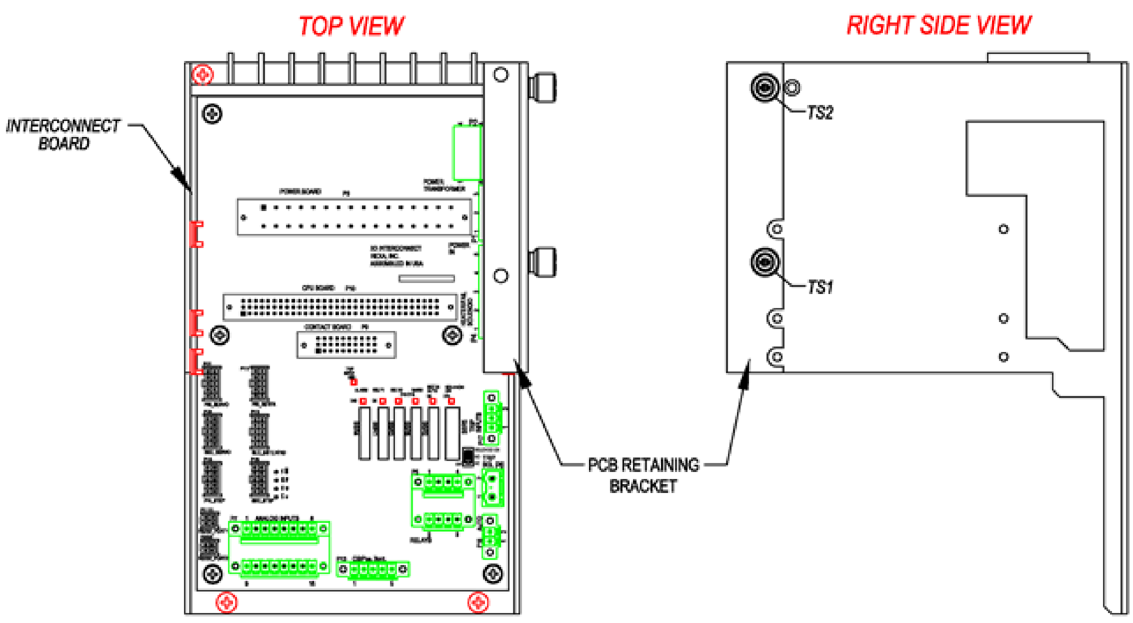


Figure 4.E.4.1-1 Interconnect Board Bracket Removal

NOTE: The thumb screws are shipped from the factory using Loctite. A Philips head screw driver may be needed to break this initial hold.

2. Flip the retaining bracket to the upward orientation.

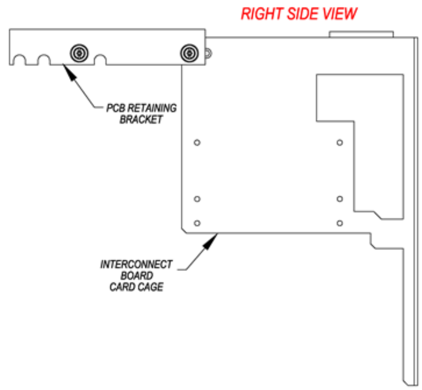


Figure 4.E.4.1-2 Retaining Bracket Removal

3. Disconnect the display ribbon cable from connector P115 of the CPU board.

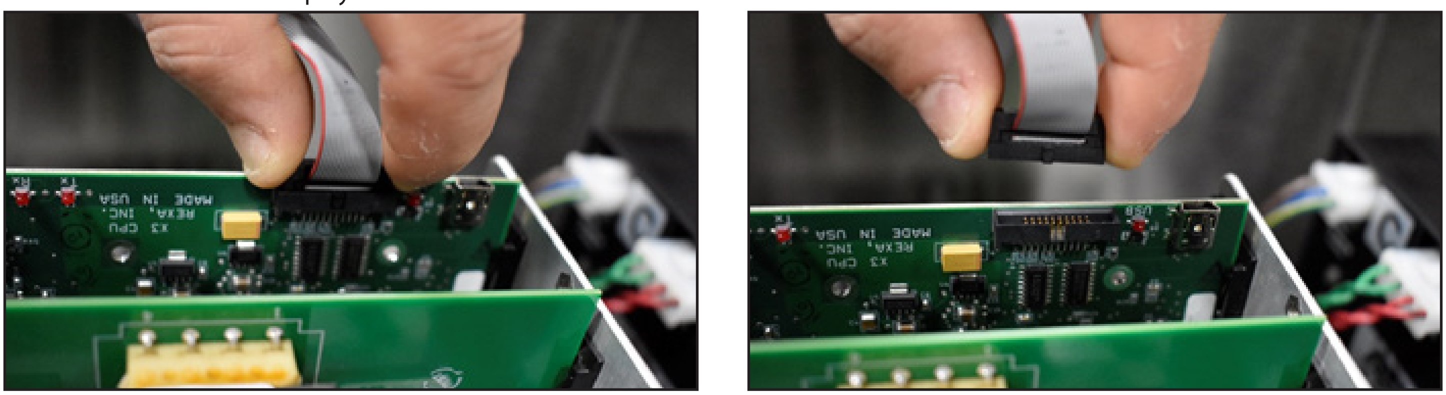


Figure 4.E.4.1-3 Disconnecting Display Ribbon

NOTE: Do not pull on the ribbon cable to unseat this connector.

4. Firmly grasp the board by the areas outlined in Red being sure to avoid grabbing any of the larger components.

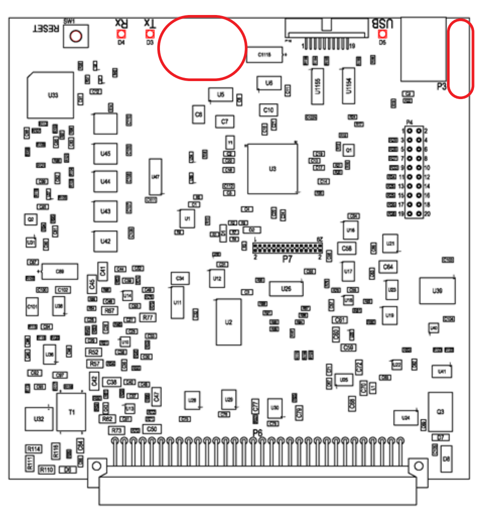
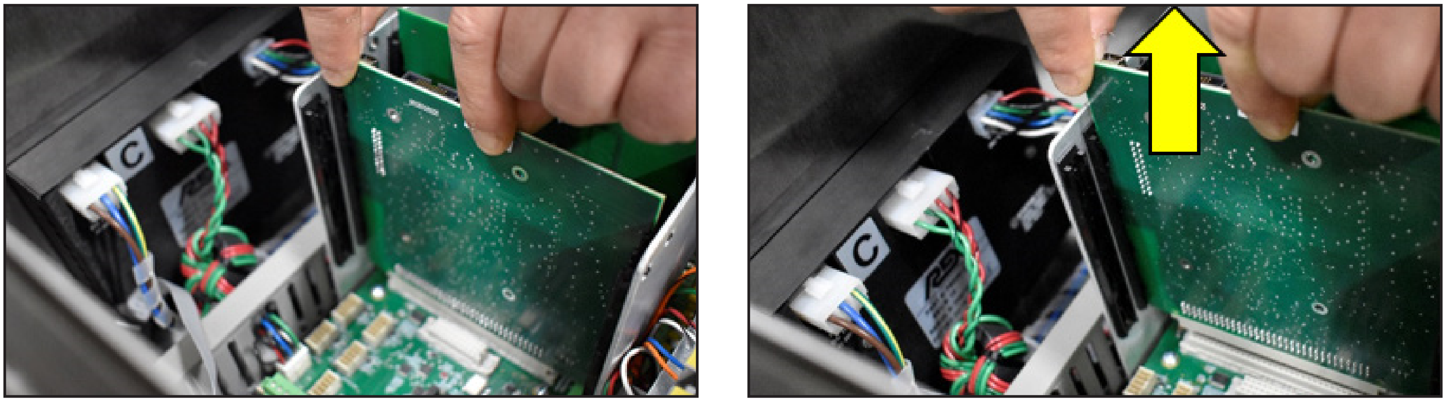


Figure 4.E.4.1-4 CPU Board Unseating

5. Using even pressure pull up on the board until connector P6 unseats from the Interconnect Board and the PCB is clear of the card cage.



Figures 4.E.4.1-5 CPU Board Unseating

4.E.4.2 Replacement

1. With the back of the board facing the front of the Interconnect Board align the PCB with the indicated card guides.

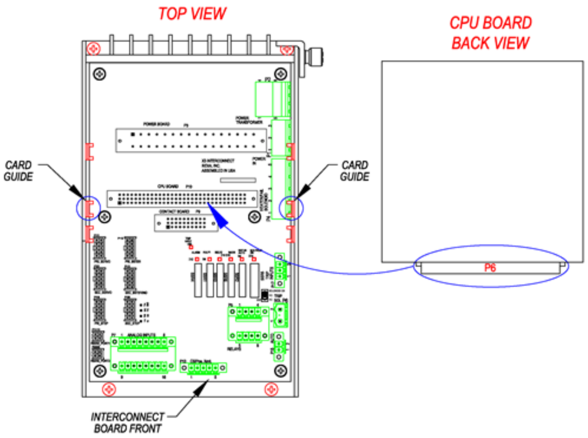


Figure 4.E.4.2-1 CPU Board placement

2. Slide the PCB down the card guides until mating connector P10 of the Interconnect Board is reached. Next firmly press down on the top edge of the PCB until the board is seated in the connector.

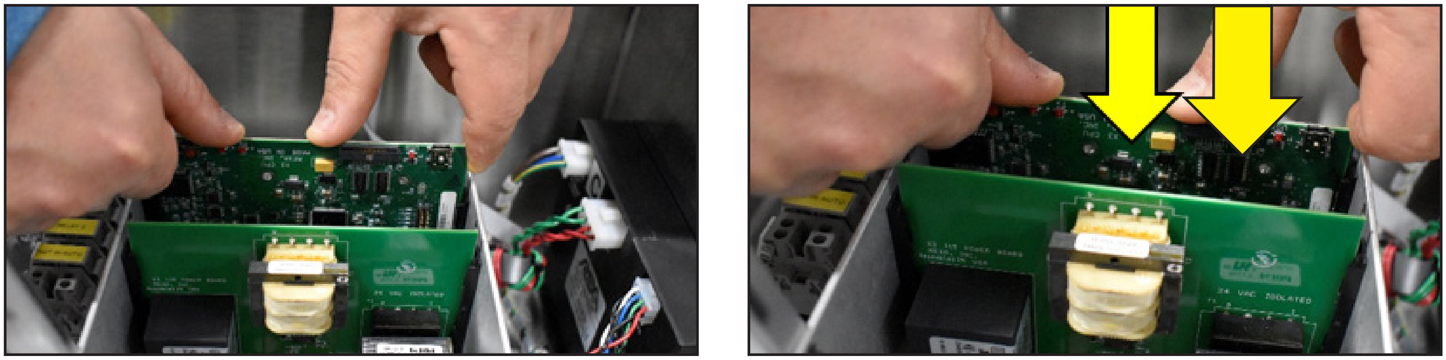


Figure 4.E.4.2-2 CPU Board Install

3. Aligning the tab of the display ribbon cable with the notch in connector P115 of the CPU Board insert the connector.

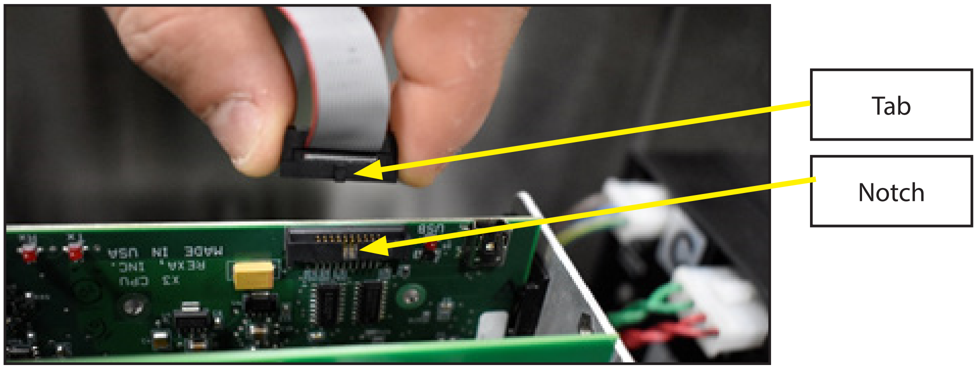


Figure 4.E.4.2-3 CPU Board Connector Install

NOTE: The Red Stripe of the Ribbon cable should be oriented to Pin 1 of connector.

4. Flip the retaining bracket down to its original position and firmly secure screws TS1 and TS2 to the card cage.

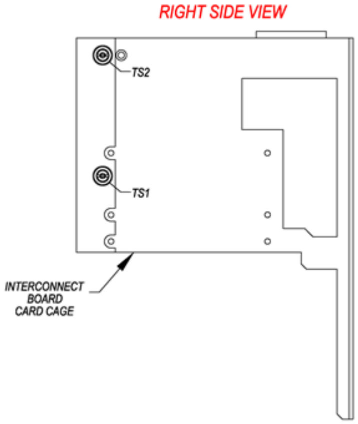


Figure 4.E.4.2-4 Retaining Bracket Placement

4.E.5 Contact Input Board Assembly

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

NOTE: Assumed starting position is facing the upright electronic unit with the enclosure door open.

4.E.5.1 Removal

NOTE: Any option boards that will interfere with the board removal will need to be removed first prior to proceeding. Please refer to the appropriate board removal steps in this section for the associated instructions.

1. Loosen the front thumb screw (TS1) on the PCB retaining bracket until it is no longer threaded into the interconnect card cage. Next loosen the rear thumb screw (TS2) just enough so the retaining bracket can move freely.

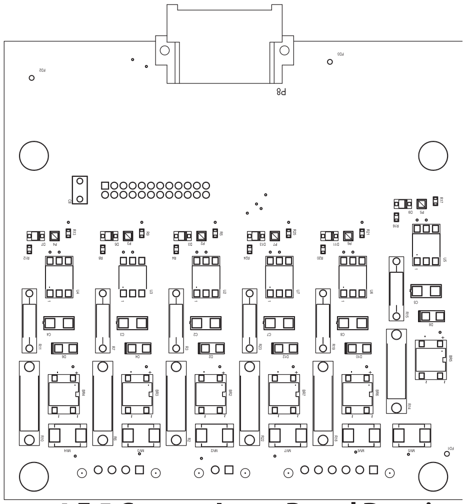


Figure 4.E.5 Contact Input Board Drawing

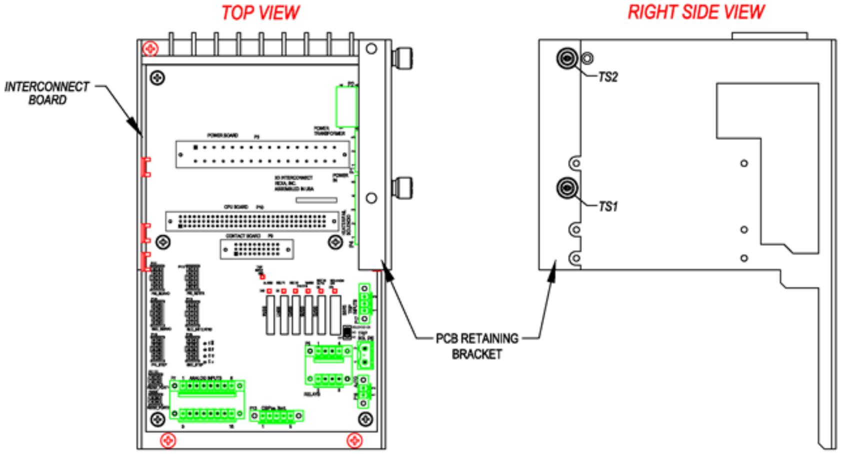


Figure 4.E.5.1-1 Interconnect Board Bracket Removal

NOTE: The thumb screws are shipped from the factory using Loctite. A Philips head screw driver may be needed to break this initial hold.

2. Flip the retaining bracket to the upward orientation.

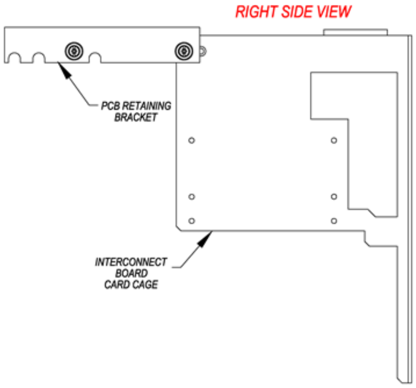
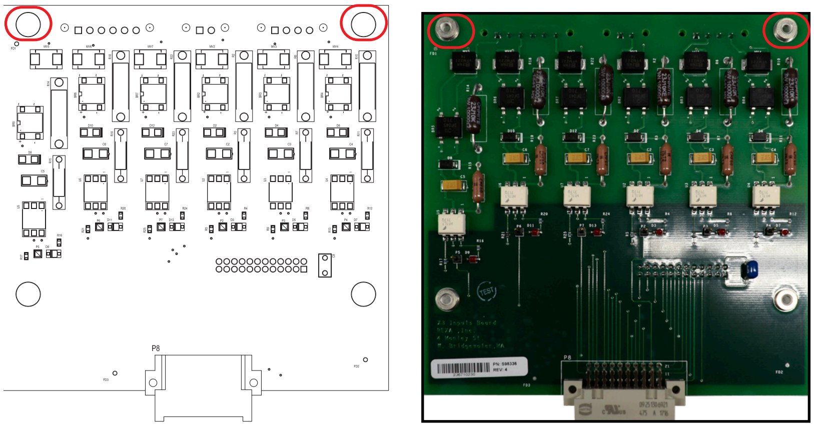


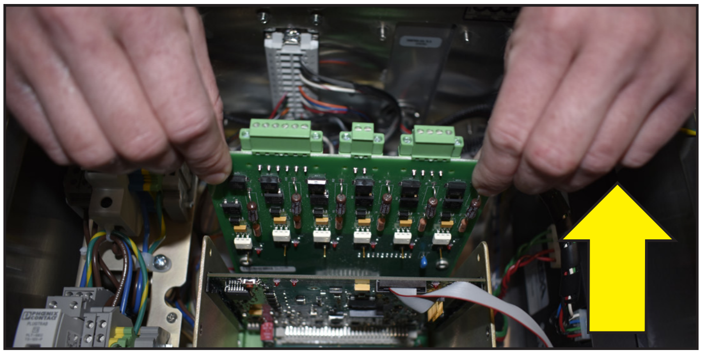
Figure 4.E.5.1-2 Retaining Bracket Removal

3. Firmly grasp the board by the areas outlined in red being sure to avoid grabbing any of the larger components.



Figures 4.E.5.1-3 Contact Input Board Unseating

4. Using even pressure pull up on the board until connector P1 unseats from the interconnect board and the PCB is clear of the card cage.



Figures 4.E.5.1-4 Contact Input Board Unseating

4.E.5.2 Replacement

1. With the back of the board facing the front of the Interconnect Board align the PCB with the indicated card guides.

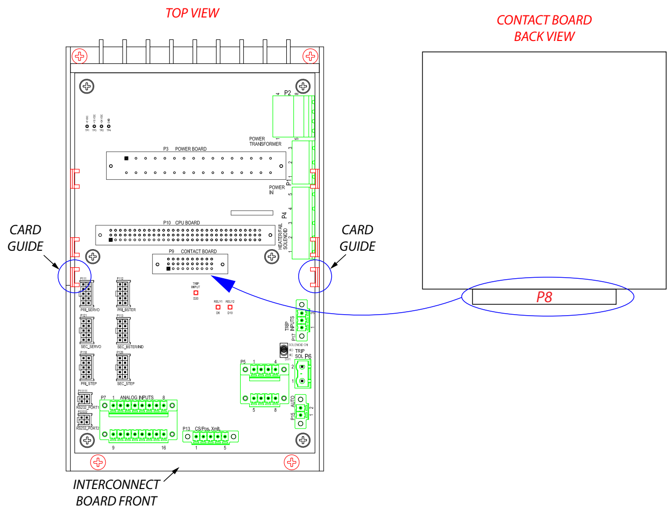


Figure 4.E.5.2-1 Contact Input Board placement

2. Slide the PCB down the card guides until mating connector P9 of the Interconnect board is reached. Next firmly press down on the top edge of the PCB until the board is seated in the connector.

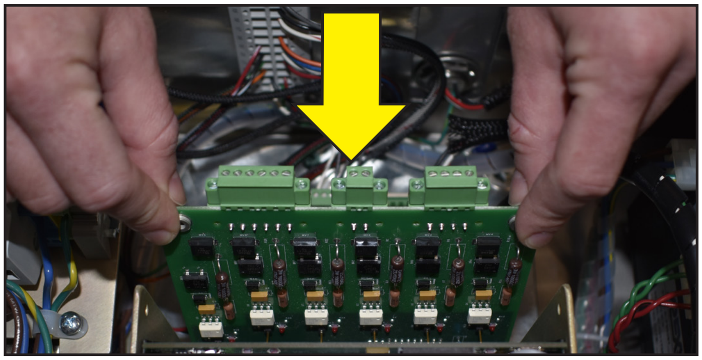
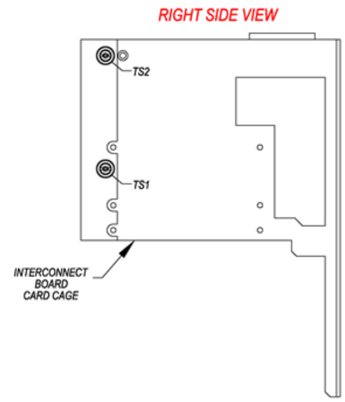


Figure 4.E.5.2-2 Contact Input Board Install

3. Flip the retaining bracket down to its original position and firmly secure screws TS1 and TS2 to the card cage.



Figures 4.E.5.2-3 Retaining Bracket Placement

4.E.6 Contact Output Board Assembly

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

NOTE: Assumed starting position is facing the upright electronic unit with the enclosure door open.

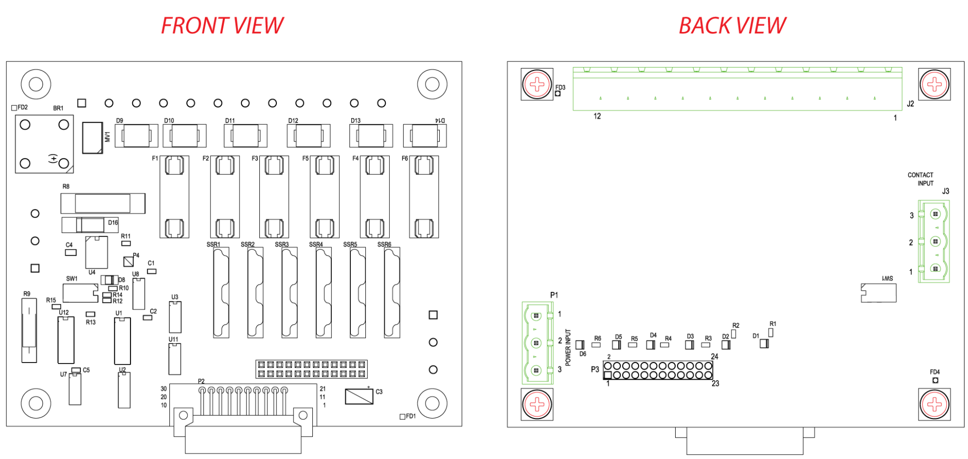


Figure 4.E.6 Contact Output Board Drawing

4.E.6.1 Removal

NOTE: Any option boards that will interfere with the board removal will need to be removed first prior to proceeding. Please refer to the appropriate board removal steps in this section for the associated instructions.

1. Loosen the front thumb screw (TS1) on the PCB retaining bracket until it is no longer threaded into the interconnect card cage. Next loosen the rear thumb screw (TS2) just enough so the retaining bracket can move freely.

NOTE: The thumb screws are shipped from the factory using Loctite. A Philips head screw driver may be needed to break this initial hold.

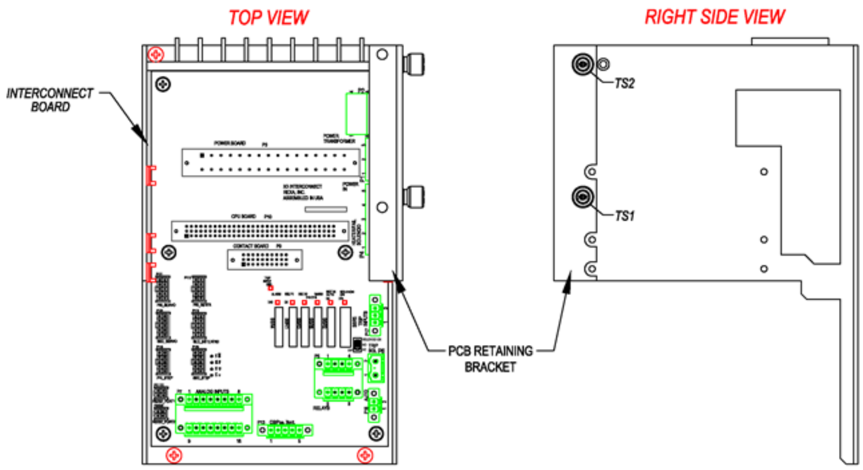


Figure 4.E.6.1-1 Interconnect Board Bracket Removal

2. Flip the retaining bracket to the upward orientation.

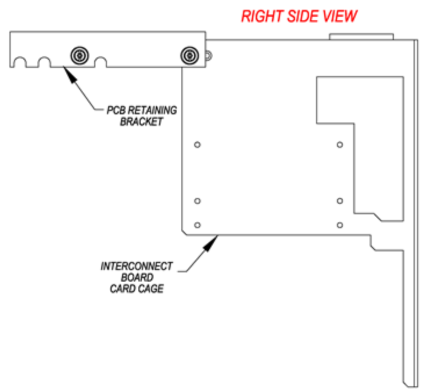
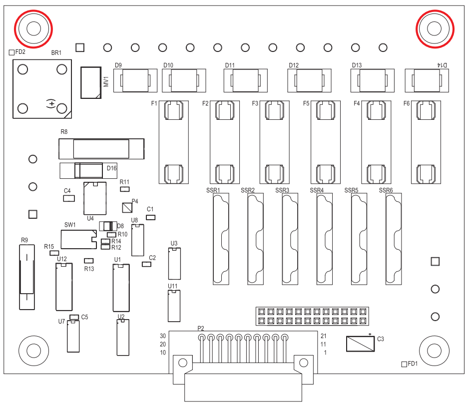


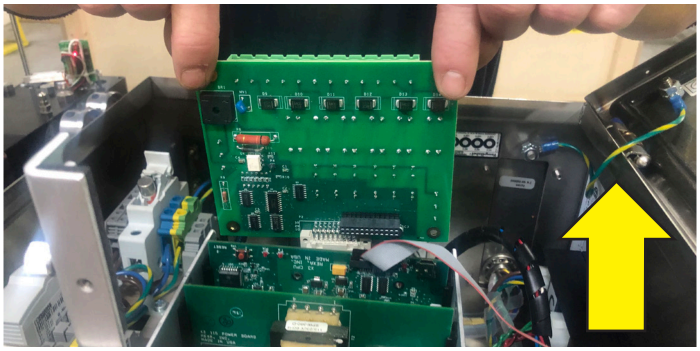
Figure 4.E.6.1-2 Retaining Bracket Removal

3. Firmly grasp the board by the areas outlined in red being sure to avoid grabbing any of the larger components.



Figures 4.E.6.1-3 Contact Output Board Unseating

4. Using even pressure pull up on the board until connector P2 unseats from the interconnect board and the PCB is clear of the card cage.



Figures 4.E.6.1-4 Contact Output Board Unseating

4.E.6.2 Replacement

1. With the back of the board facing the front of the Interconnect Board align the PCB with the indicated card guides.

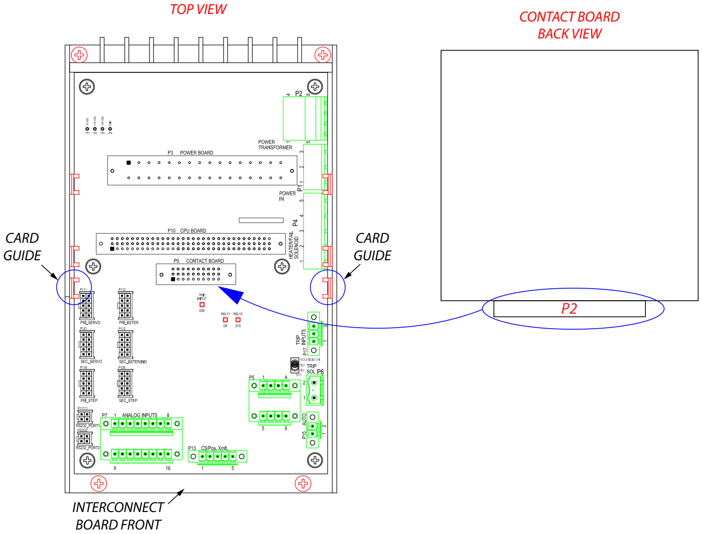


Figure 4.E.6.2-1 Contact Input Board placement

2. Slide the PCB down the card guides until mating connector P9 of the Interconnect board is reached. Next firmly press down on the top edge of the PCB until the board is seated in the connector.

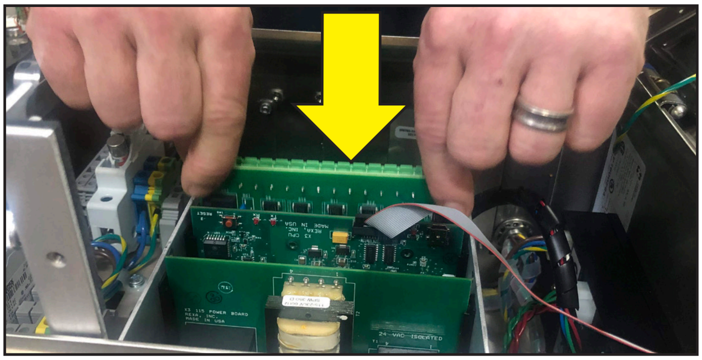
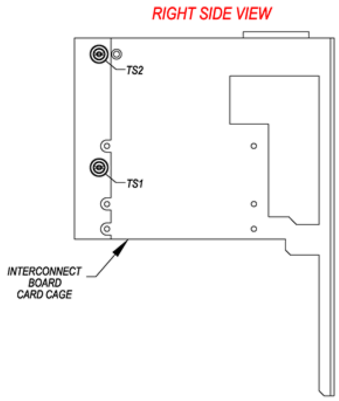


Figure 4.E.6.2-2 Contact Output Board Install

3. Flip the retaining bracket down to its original position and firmly secure screws TS1 and TS2 to the card cage.



Figures 4.E.6.2-3 Retaining Bracket Placement

4.E.7 Remote Feedback Board Assembly

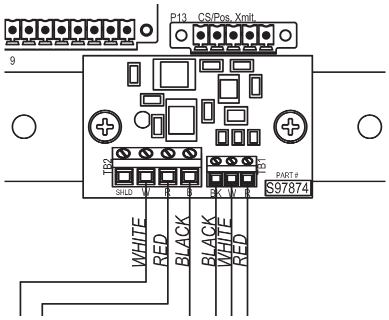
CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

NOTE: Assumed starting position is facing the upright electronic unit with the enclosure door open.

4.E.7.1 Removal

NOTE: Any option boards that will interfere with the board removal will need to be removed first prior to proceeding. Please refer to the appropriate board removal steps in this section for the associated instructions.

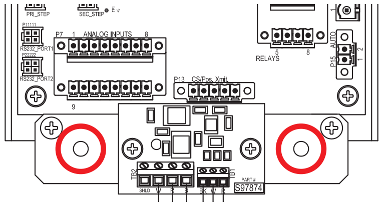
1. With a flat head screw driver loosen the terminal connections on connectors TB1 & TB2. Remove the Wires



Figures 4.E.7.1-1 Wiring Removal

NOTE: Group the wires accordingly before pushing aside to ensure the wire colors do not get mixed.

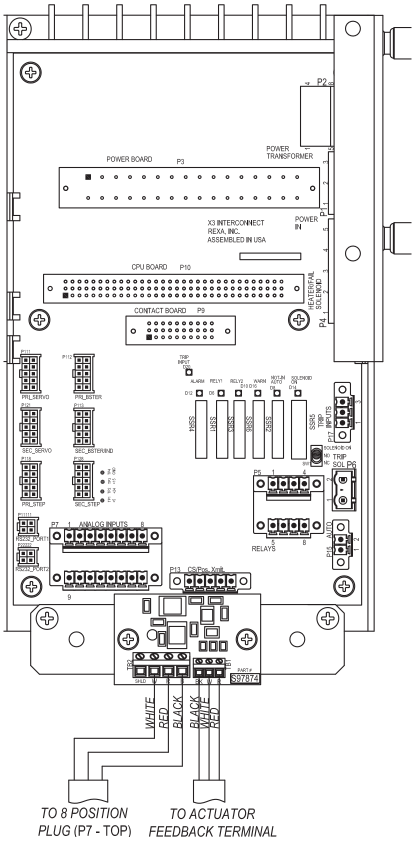
2. Using a small Philips head screw driver loosen and remove the 2 screws securing the feedback board to the adapter plate and put the board aside.



Figures 4.E.7.1-1 Feedback Board Removal

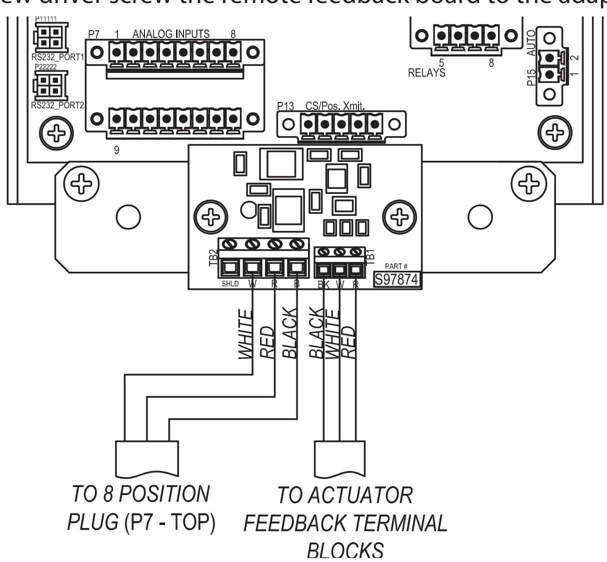
4.E.7.2 Replacement

1. With the back of the board facing the front of the Interconnect Board place the remote feedback board on the adapter.



Figures 4.E.7.2-1 Feedback Board Assembly

2. Using a small Philips head screw driver screw the remote feedback board to the adapter.



Figures 4.E.7.2-2 Wiring Connections

3. Reconnect wires and tighten the terminal connections with a flat head scrwe drivers.

4.E.8 Interconnect Board Assembly

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

NOTE: Assumed starting position is facing the upright electronic unit with the enclosure door open.

4.E.8.1 Removal

1. Loosen the front thumb screws on the PCB retaining bracket until they are no longer threaded into the interconnect card cage.

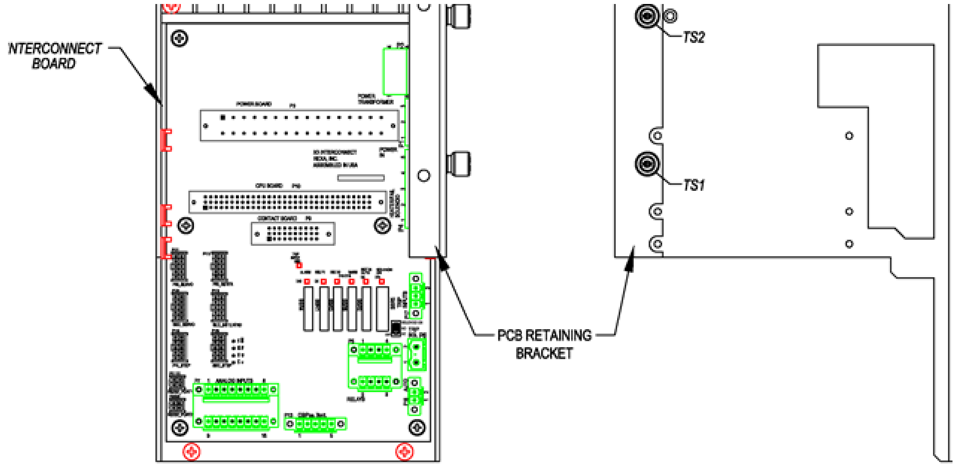


Figure 4.E.8.1-1 Interconnect Board Bracket Removal

NOTE: The thumb screws are shipped from the factory using Loctite. A Philips head screw driver may be needed to break this initial hold.

2. Remove the retaining bracket.

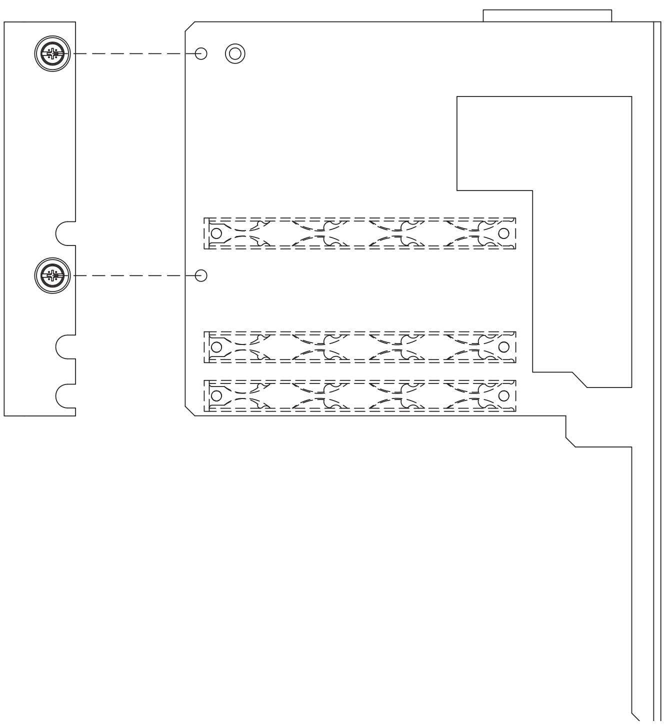


Figure 4.E.8.1-2 Retaining Bracket Removal

3. Remove the Power Board by following Steps 3-4 in section 4.E.3.1 of the TS&R.

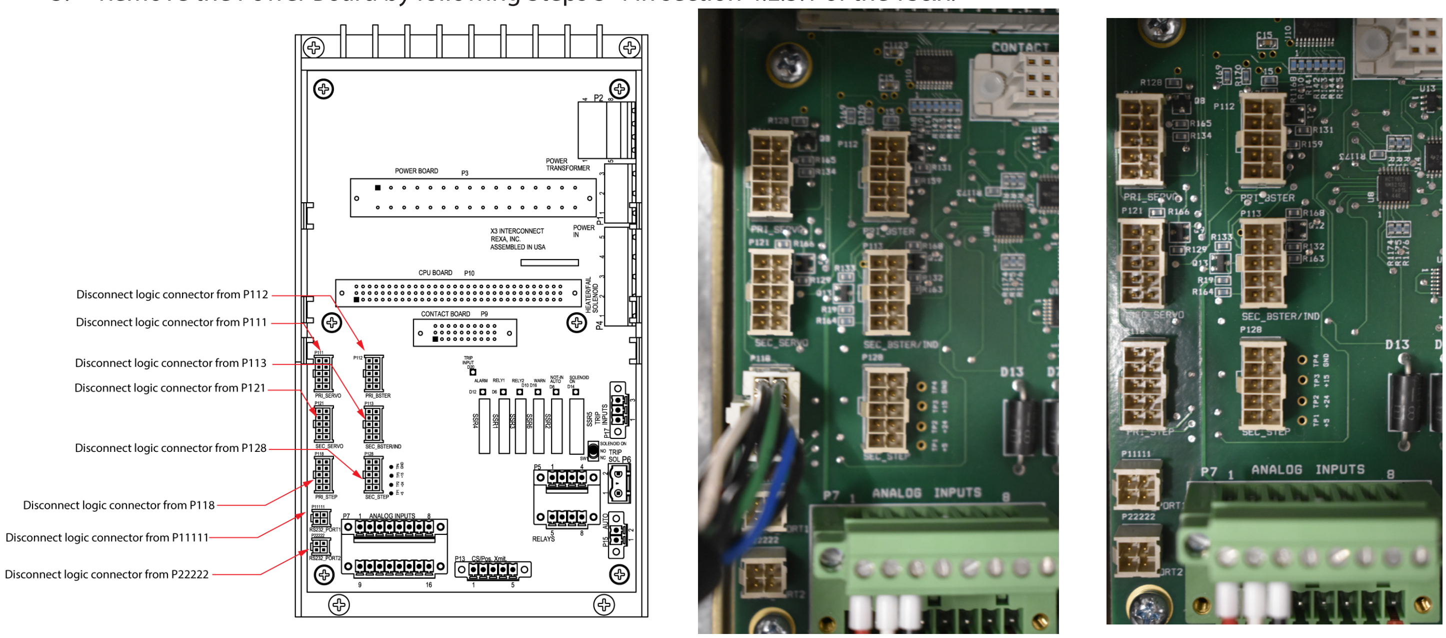


Figure 4.E.8.1-3 Logic Connector Removal

4. Remove the CPU Board by following Steps 3-5 in section 4.E.4.1 of the TS&R.

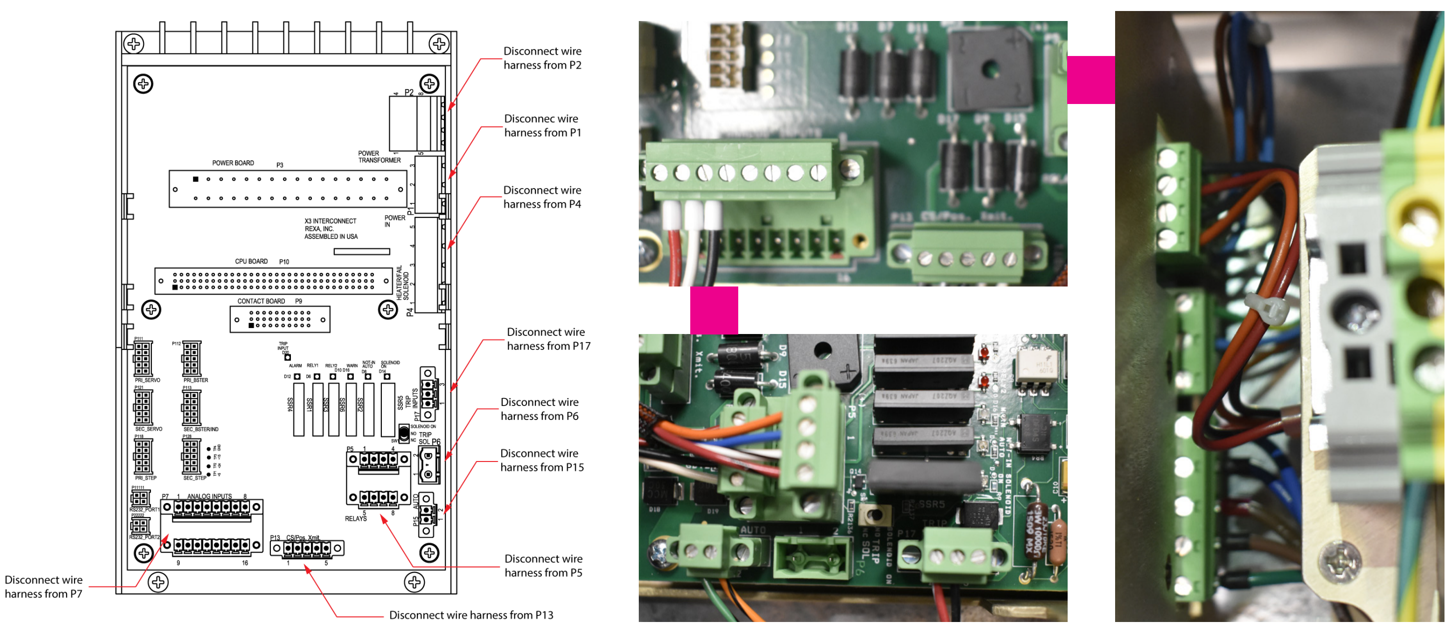


Figure 4.E.8.1-4 Cable Wiring Removal

5. If equipped, remove the Inputs Board Assembly by following Steps 3-4 in section 4.E.5.1 or 4.E.6.1 of the TS&R.

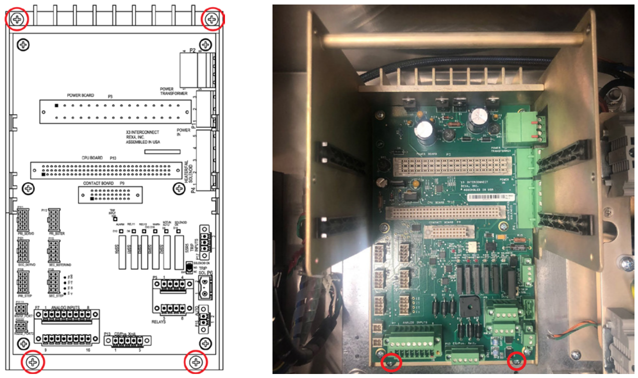


Figure 4.E.8.1-5 Screw Removal

6. If equipped, remove the Remote Feedback Board by following section 4.E.7.1 of the TS&R.

7. If equipped, remove the input and/or outputs board(s), following Section 4.E.6.1.

8. Make note of any wires harnesses that are connected to locations P5, P6, P7 or P13.

Figure 4.E.8.1-6 Interconnect Assembly Removal

9. Make note of any logic connectors that are connected to locations P111, P112, P121, P113, P118, P128, P11111, or P22222.

10. Disconnect all logic connectors and move the connectors aside.

    a. Depress latching mechanism at the front of the connector and while firmly holding the white plastic housing, pull up until the cable is unseated.

Note: Do not pull from the wires as this may cause damage to the connector pins.

11. Disconnect all wire harnesses and move the connectors aside.

    b. With a small flat head screw driver loosen the two securing screws at both ends of the connector. Firmly grasp the green plastic housing of the connector and pull up until the connector is unseated.

Note: Do not disconnect the individual wires from the connector.

12. Remove the four screws outlined in red.

13. Firmly grasp the interconnect board assembly and remove from the back plane of the control enclosure.

4.E.8.2 Replacement

1. Loosen the front thumb screws on the PCB retaining bracket until they are no longer threaded into the interconnect card cage.

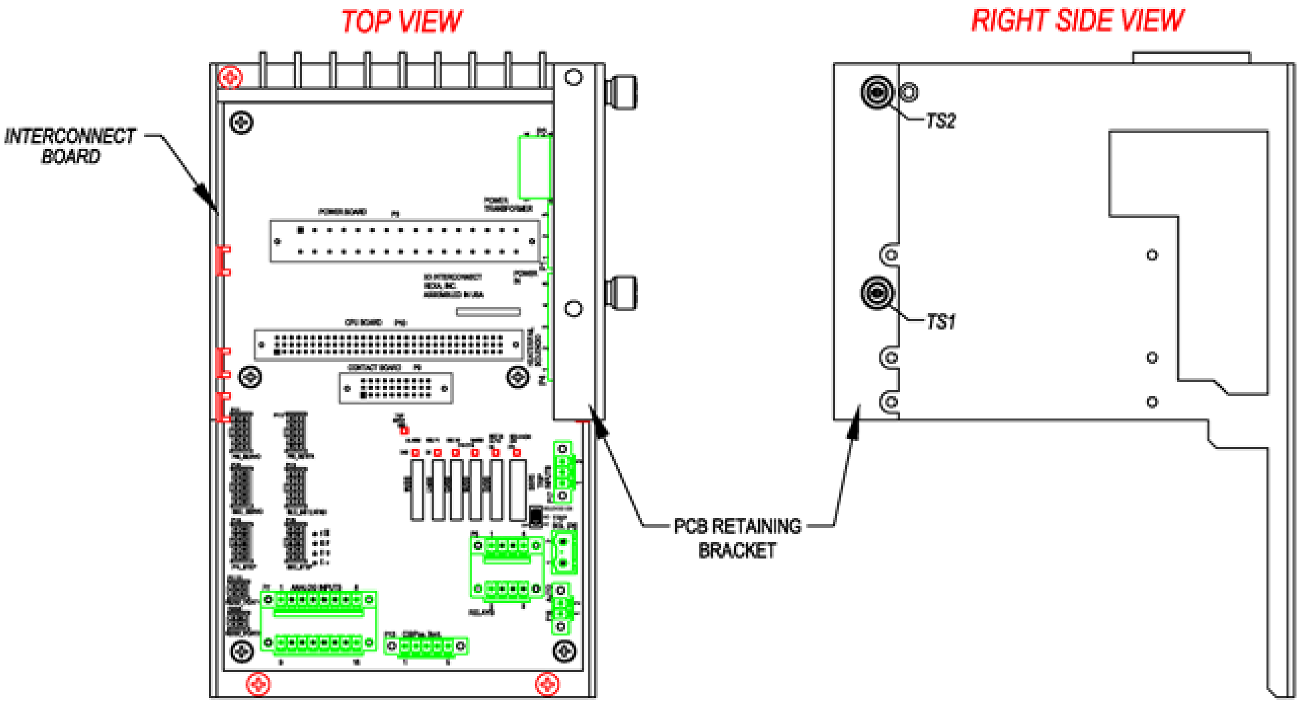


Figure 4.E.8.2-1 Interconnect Board Bracket Removal

NOTE: The thumb screws are shipped from the factory using Loctite. A Philips head screw driver may be needed to break this initial hold.

2. Screw new interconnect board into backplane of the control enclosure.

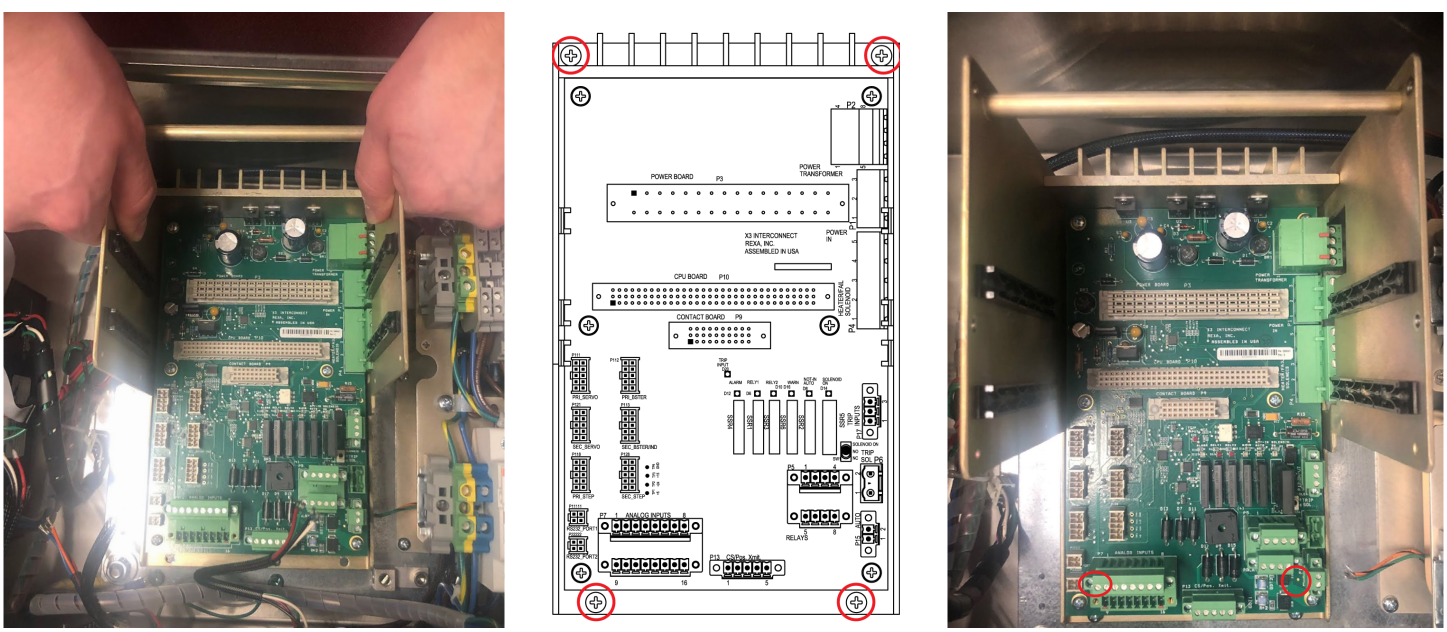


Figure 4.E.8.2-2 Interconnect Assembly Placement

3. Reconnect previously noted wire harnesses.

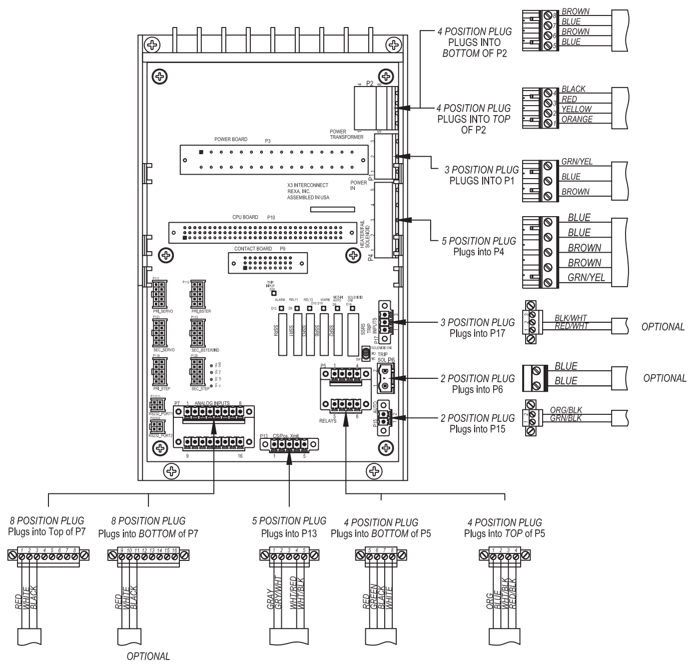


Figure 4.E.8.2-3 Interconnect Assembly Wiring

Table 4E.8.2-1 Logic Connection Identification	
Actuator Type	**Logic Connection**
Single Stepper	P118
Dual Stepper	Drive 1: P118
	Drive 2: P128
Single Servo	P111 & P11111
Dual Servo or Single Booster Pump	Drive 1: P111 & P11111
	Drive 2: P121 & P22222
Stepper with Stepper Accumulator Online Recharge Fail-Safe	Stepper Drive: P118
	Recharge Drive: P128
Servo with Stepper Accumulator Online Recharge Fail-Safe	Servo Drive: P111 & P11111
	Recharge Drive: P128
Servo with Servo Accumulator Online Recharge Fail-Safe	Servo Drive: P111 & P11111
	Recharge Drive: P113 & P22222
Dual Servo or Booster Pump with Stepper Accumulator Online Recharge Fail-Safe	Drive 1: P111 & P11111
	Drive 2: P121 & P22222
	Recharge Drive: P128
Booster Pump with Servo Accumulator Online Recharge Fail-Safe	Servo Drive: P111 & P11111
	Booster Drive: P112 & P22222
	Recharge Drive: P113

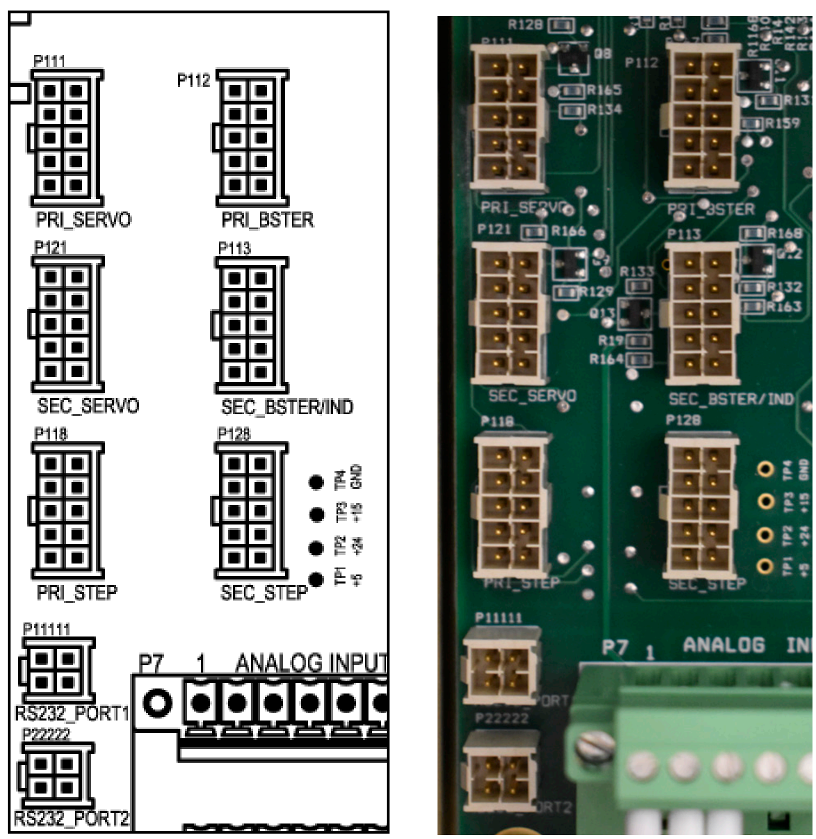


Figure 4.E.8.2-3 Logic Connector Reconnection

4. Reconnect logic connectors using by following guide.

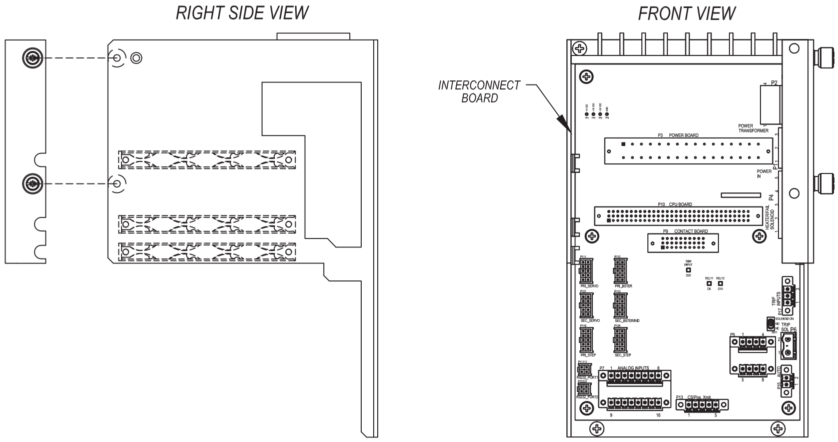


Figure 4.E.8.2-4 Retaining Bracket Replacement

5. Reconnect the CPU Board following Steps 1-3 in section 4.E.4.2 of the TS&R.

6. Reconnect the Power Board following Steps 1-2 in section 4.E.5.2 of the TS&R.

7. Reconnect the Remote Feedback Board following section 4.E.7.2 of the TS&R.

8. If equipped, reconnect the input and/or outputs board(s), following Section 4.E.6.2.

9. Secure the PCB retaining bracket to the outside right wall of the interconnect board card cage.

4.E.9 Stepper Motor Driver

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

NOTE: Assumed starting position is facing the upright electronic unit with the enclosure door open.

4.E.9.1 Removal

1. Disconnect the AC Power connector (Left), the Motor Power connector (Middle) and the Driver Logic connector (Right).

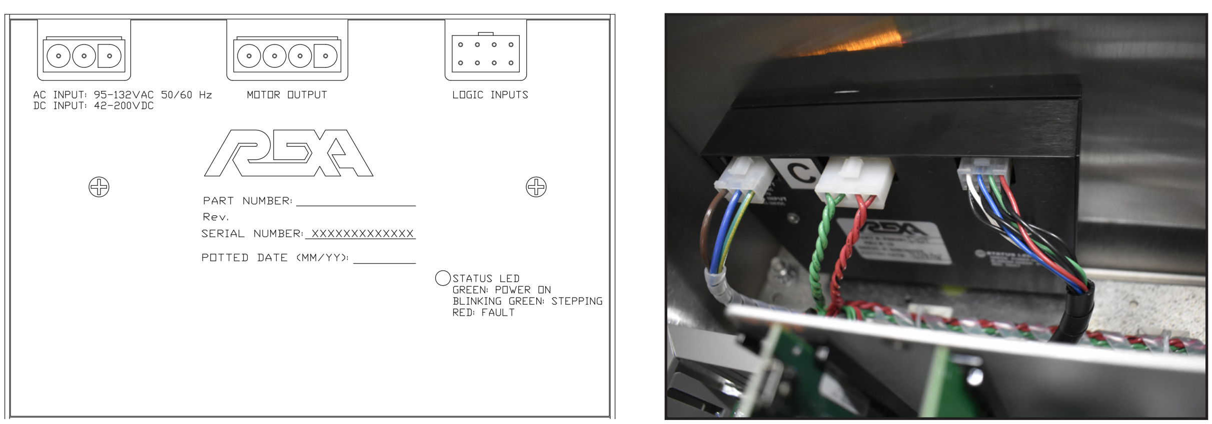


Figure 4.E.9.1-1 Single Stepper Wiring Configuration

2. Locate the four driver mounting screws and nylon washers on the top of the control enclosure. Remove this hardware using a 1/8" Allen wrench. This hardware will be required to install the replacement driver. Tag the driver as defective and completely remove from control enclosure.

Figure 4.E.9.1-2 Mounting Screw Location

4.E.9.2 Replacement

1. Apply a thin layer of thermal coat to the back of the driver.

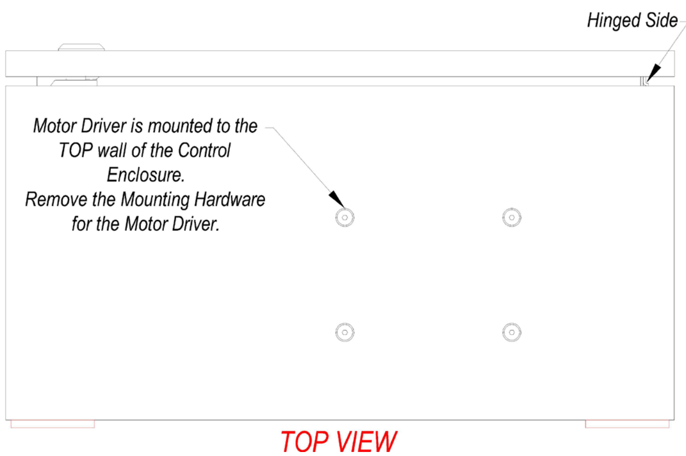


Figure 4.E.9.2-1 Driver Placement

2. Mount the replacement driver to the top of the control enclosure using the four screws and nylon washers that were removed from the defective driver.

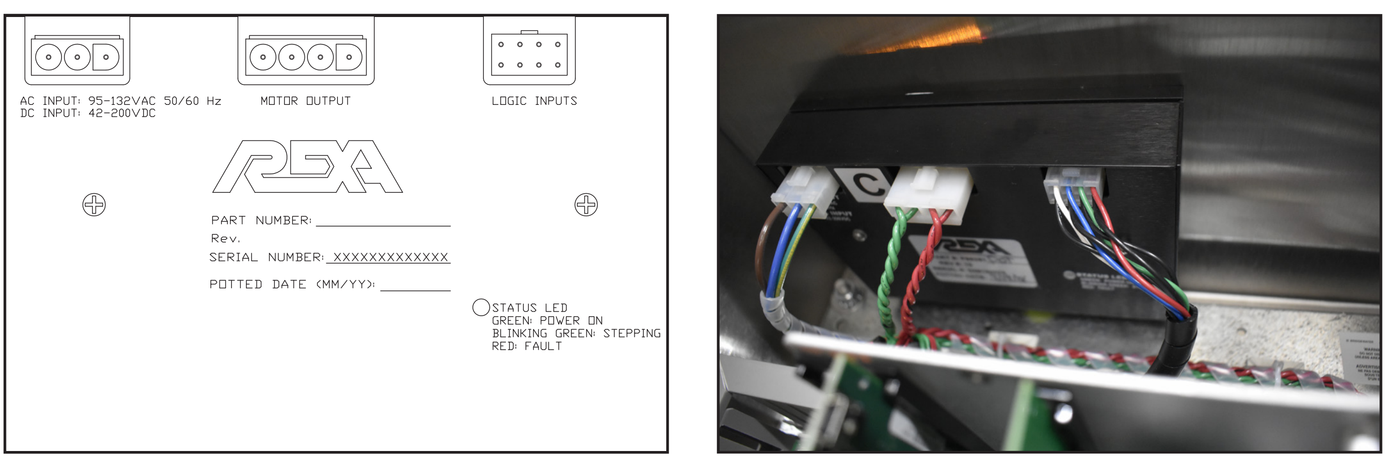


Figure 4.E.9.2-2 Single Stepper Wiring Configuration

3. Plug the AC Power (left), Motor Power (middle) and Driver Logic (right) connectors into the driver in their respective locations

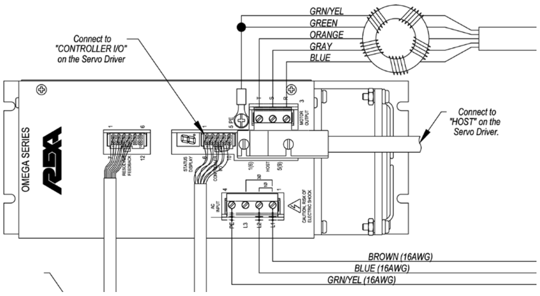
4.E.10 Servo Motor Driver

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

4.E.10.1 Removal

1. Cut away any wire ties that may be securing any cables to the tie down bases applied to the Servo Driver.

2. Disconnect the "Controller I/O", "Resolver Feedback" and "HOST" on the driver.



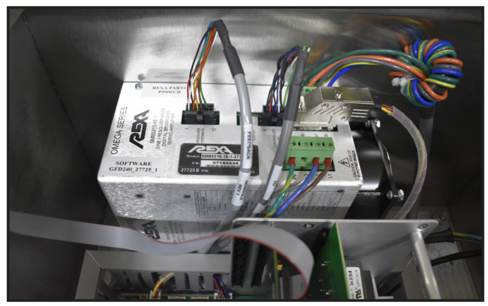


Figure 4.E.10.1-1 Servo Drive Cable Connections

3. Remove "AC Input", "Motor Output" cable wires from the driver.

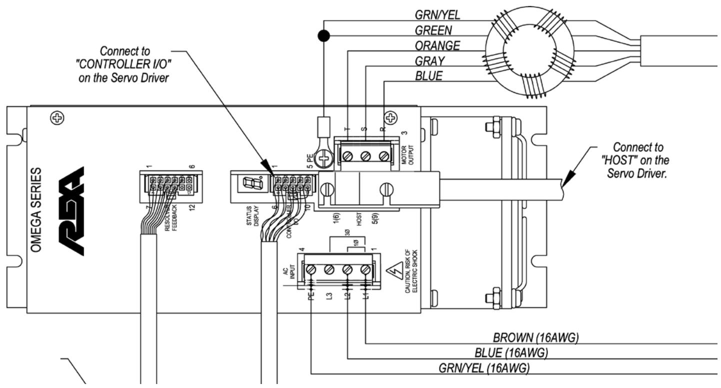


Figure 4.E.10.1-2 Servo Drive Cable Wiring

4. Locate the four driver mounting screws and nylon washers on the top of the control enclosure. Remove this hardware using a 1/8" Allen wrench. This hardware will be required to install the replacement driver. Tag the driver as defective and completely remove from control enclosure.

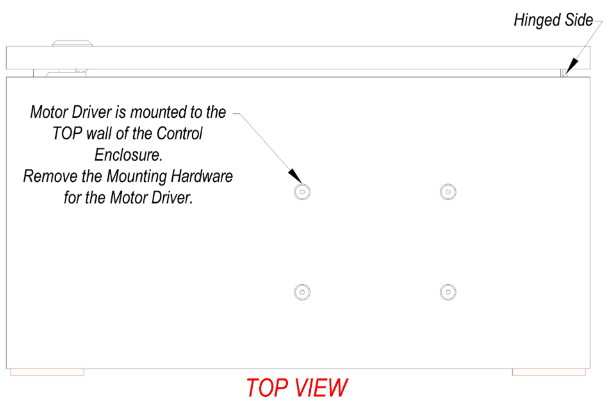


Figure 4.E.10.1-3 Mounting Screw Removal

4.E.10.2 Replacement

1. Mount the replacement driver to the top of the control enclosure using the four screws and nylon washers that were removed from the defective driver.

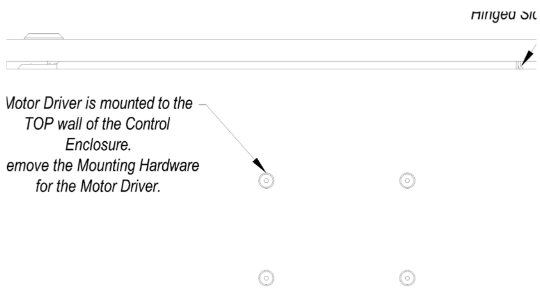


Figure 4.E.10.2-1 Mounting Screw Placement

2. Reconnect the "Controller I/O" cables. Plug in the "Motor Output" connector and secure the Green/Shield wire to the ground screw. Plug in the "AC Input" connector.

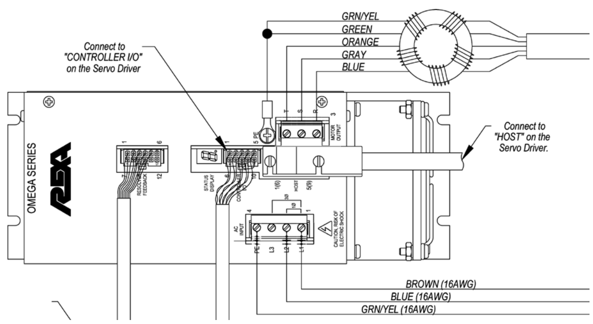


Figure 4.E.10.2-2 Servo Drive Cable Wiring

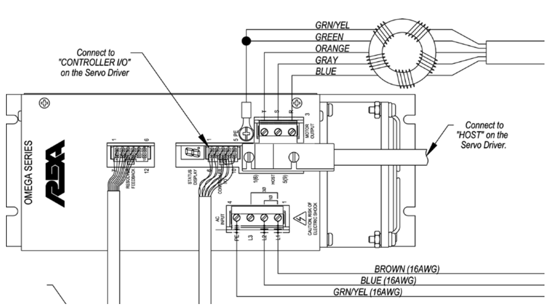
4.E.11 D,P9 Booster Pump Driver

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

4.E.11.1 Servo Driver Removal

1. Cut away any wire ties that may be securing any cables to the tie down bases applied to the Servo Driver.

2. Disconnect the "Controller I/O" on the driver.



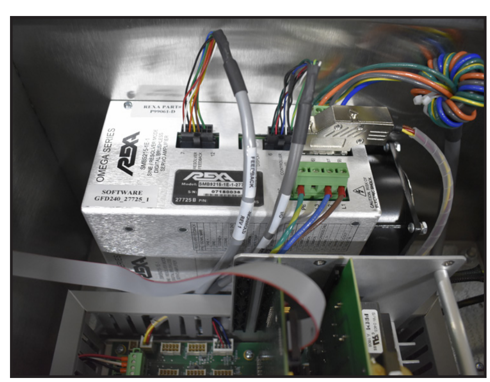


Figure 4.E.11.1-1 Servo Drive Cable Connections

3. Remove "AC Input", "Motor Output" cable wires from the driver.

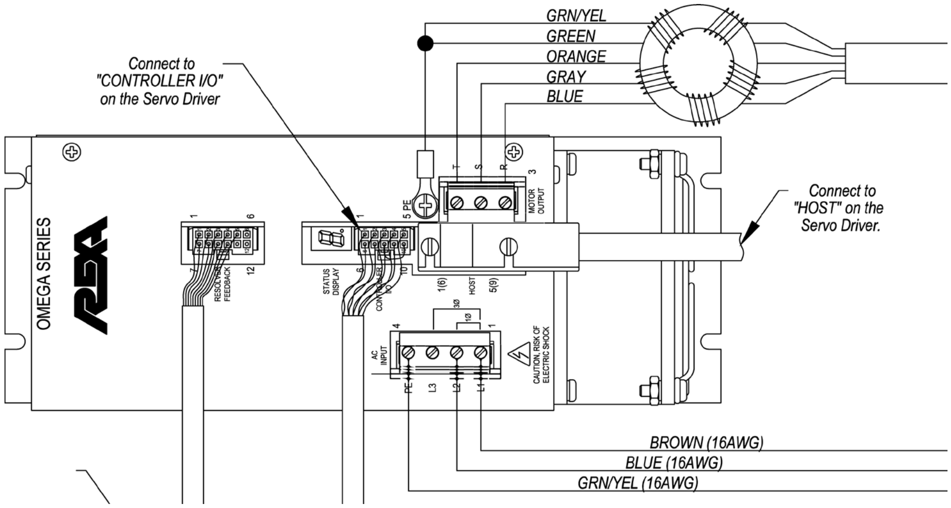


Figure 4.E.11.1-2 Servo Drive Cable Wiring

4. Locate the four driver mounting screws and nylon washers on the side of the control enclosure. Remove this hardware using a 1/8" Allen wrench. This hardware will be required to install the replacement driver. Tag the driver as defective and completely remove from control enclosure.

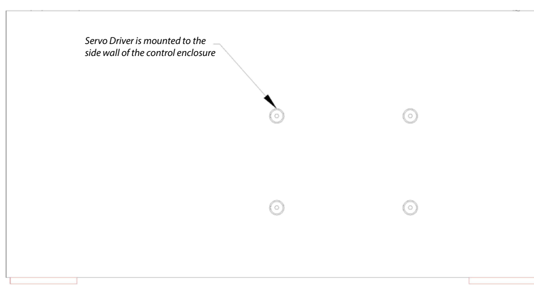


Figure 4.E.11.1-3 Mounting Screw Removal

4.E.11.2 Servo Driver Replacement

1. Mount the replacement driver to the side of the control enclosure using the four screws and nylon washers that were removed from the defective driver.

2. Reconnect the "Controller I/O" cables. Plug in the "Motor Output" connector and secure the Green/Shield wire to the ground screw. Plug in the "AC Input" connector.

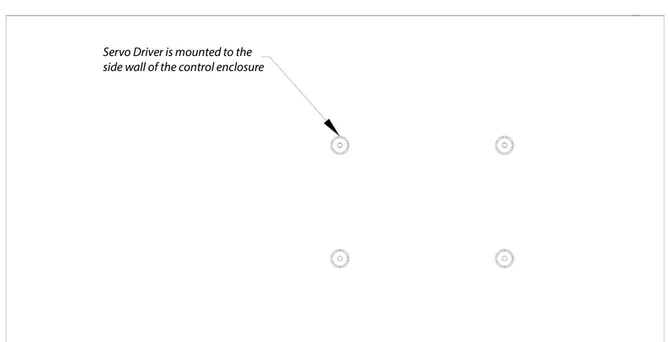


Figure 4.E.11.2-1 Mounting Screw Placement

4.E.11.3 P9 Booster Driver Removal

1. Cut away any wire ties that may be securing any cables to the tie down bases applied to the Servo Driver.

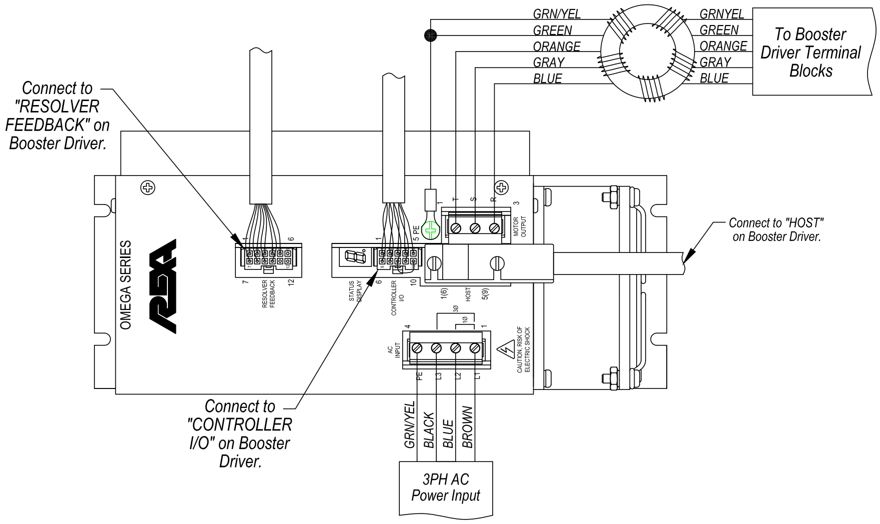


Figure 4.E.11.2-2 P9 Drive Cable Wiring

2. Disconnect the "Controller I/O" on the driver.

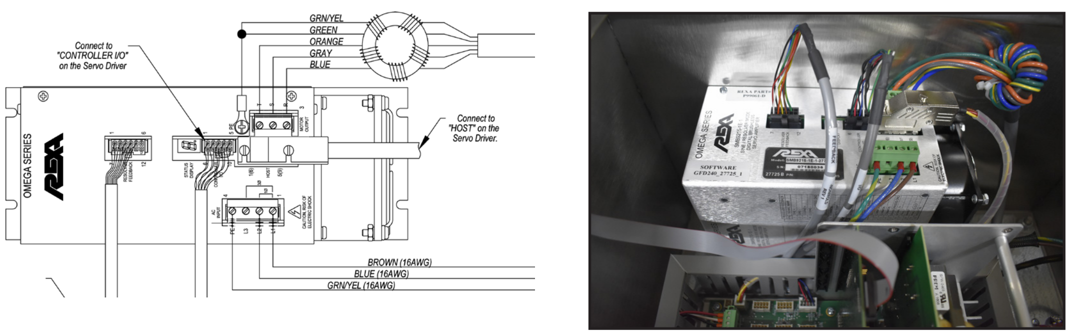


Figure 4.E.11.3-1 P9 Booster Drive Cable Connections

3. Remove "AC Input", "Motor Output" cable wires from the driver.

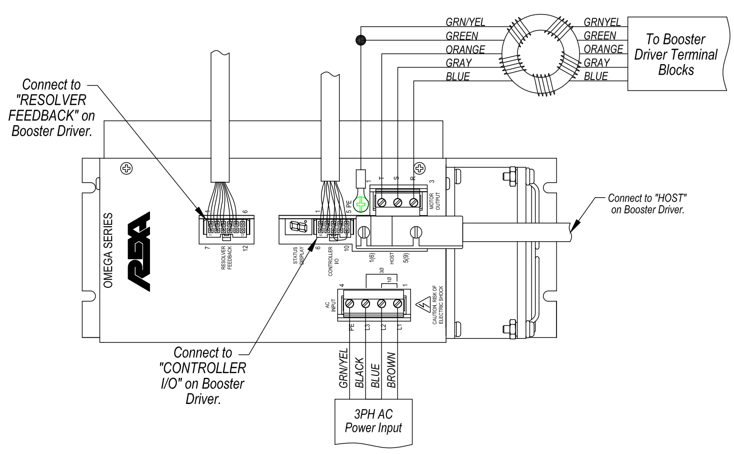


Figure 4.E.11.3-2 P9 Booster Drive Cable Wiring

4. Remove the four 8-32 x 0.50" Philips head screws securing the driver to the panel. This hardware will be required to install the replacement drive. Tag the driver as defective and completely remove the control enclosure.

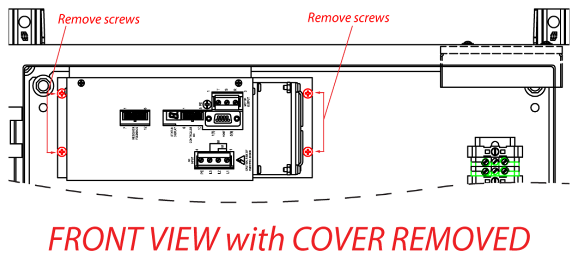
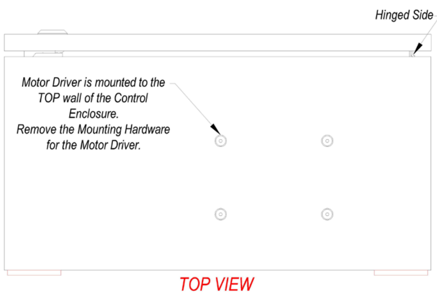


Figure 4.E.11.3-3 P9 Booster Drive Cable Wiring

5. Locate the four driver mounting screws and nylon washers on the top of the control enclosure. Remove this hardware using a 1/8" Allen wrench. This hardware will be required to install the replacement driver. Tag the driver as defective and completely remove from control enclosure.

4.E.11.4 P9 Booster Driver Replacement

1. Secure the replacement Driver to the panel using the 8-32 x 0.50" Phillips head screws removed from the defective driver. Mount the replacement driver to the top of the control enclosure using the four screws and nylon washers that were removed from the defective driver.



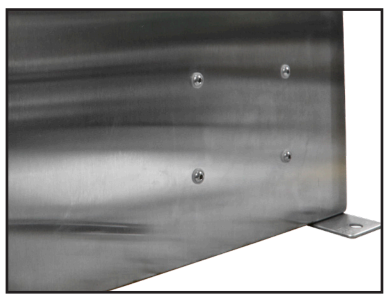


Figure 4.E.11.4-1 Mounting Screw Placement

2. Reconnect the "Controller I/O" cables. Plug in the "Motor Output" connector and secure the Green/Shield wire to the ground screw. Plug in the "AC Input" connector.

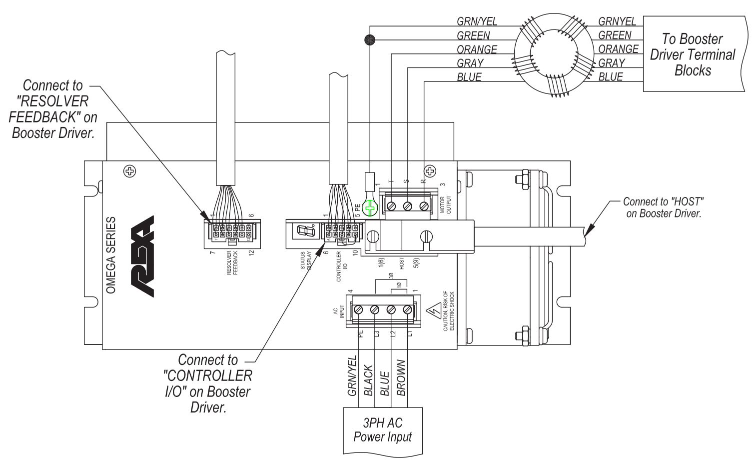


Figure 4.E.11.4-2 P9 Booster Drive Cable Wiring

4.E.12 D,P20 Booster Pump Driver

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

4.E.12.1 Servo Driver Removal

1. Cut away any wire ties that may be securing any cables to the tie down bases applied to the Servo Driver.

2. Disconnect the "Controller I/O" on the driver.

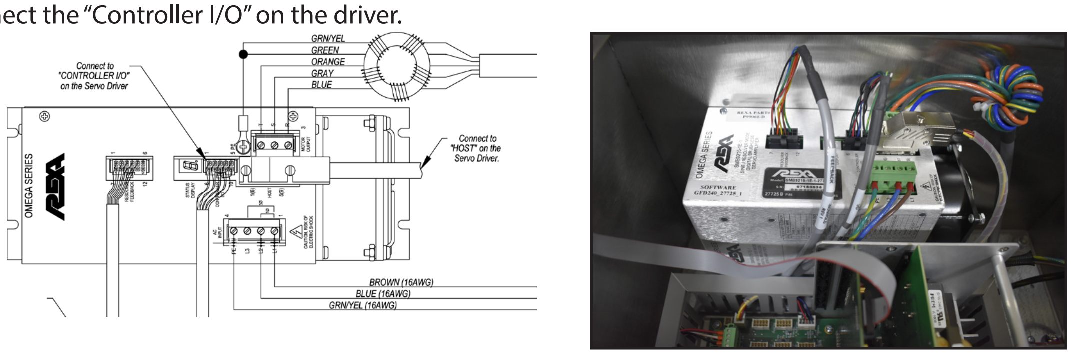


Figure 4.E.12.1-1 Servo Drive Cable Connections

3. Remove "AC Input", "Motor Output" cable wires from the driver.

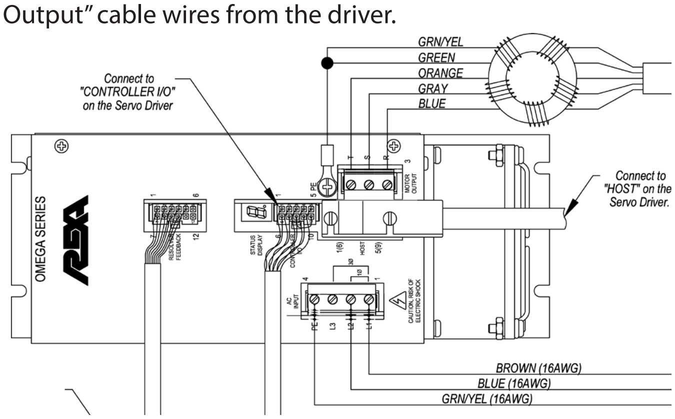


Figure 4.E.12.1-2 Servo Drive Cable Wiring

4. Remove the four 8-32 x 0.50" Philips head screws securing the driver to the panel. This hardware will be required to install the replacement drive. Tag the driver as defective and completely remove the control enclosure.

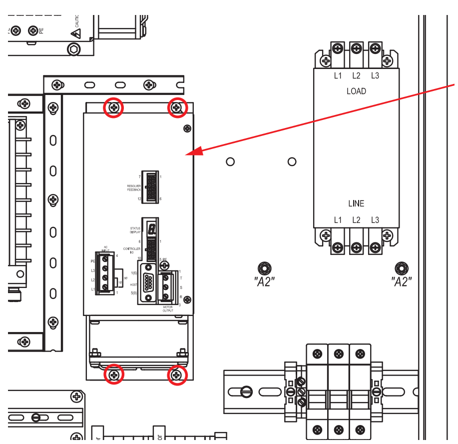


Figure 4.E.12.1-4 Servo Drive Removal

4.E.12.2 Servo Driver Replacement

1. Secure the replacement Driver to the panel using the 8-32 x 0.50" Phillips head screws removed from the defective driver. Mount the replacement driver to the back of the control enclosure using the four screws and nylon washers that were removed from the defective driver.

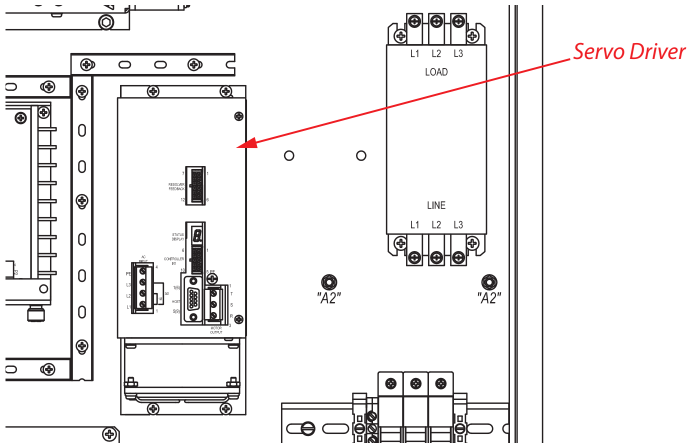


Figure 4.E.12.2-1 Servo Drive Placement

2. Reconnect the "Controller I/O" cables. Plug in the "Motor Output" connector and secure the Green/Shield wire to the ground screw. Plug in the "AC Input" connector.

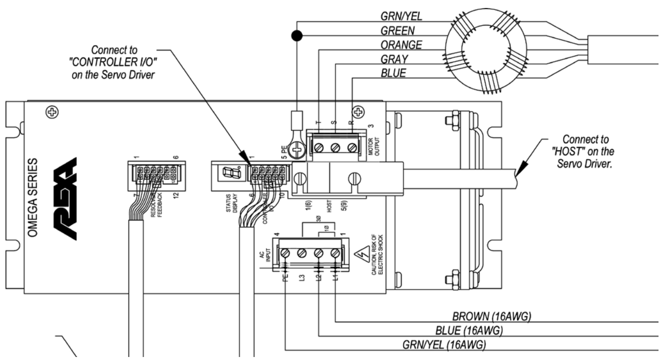


Figure 4.E.12.2-2 Servo Drive Cable Wiring

4.E.12.3 P20 Booster Driver Removal

1. Cut away any wire ties that may be securing any cables to the tie down bases applied to the Servo Driver.

2. Disconnect the "Controller I/O" on the driver.

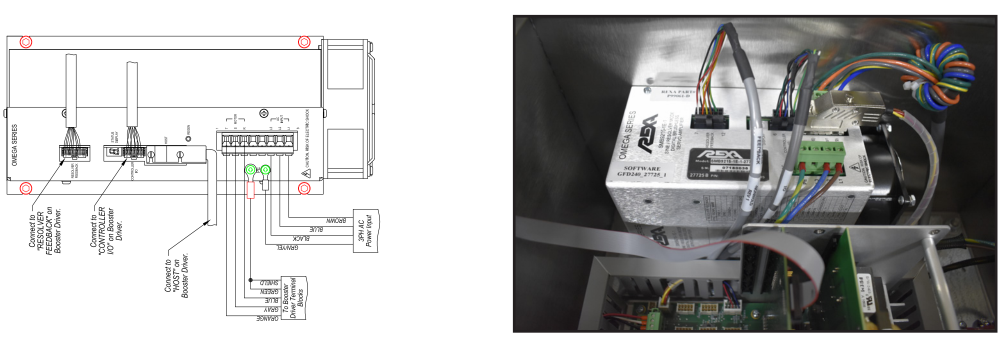


Figure 4.E.12.3-1 P20 Booster Drive Cable Connections

3. Remove "AC Input", "Motor Output" cable wires from the driver.

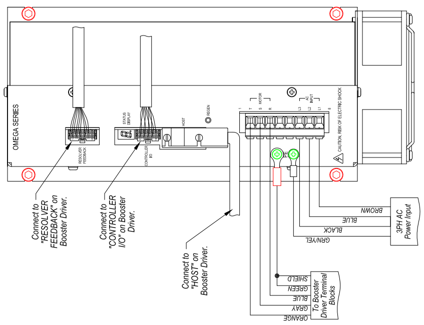


Figure 4.E.12.3-2 P20 Booster Drive Cable Wiring

4. Remove the four 8-32 x 0.50" Philips head screws securing the driver to the panel. This hardware will be required to install the replacement drive. Tag the driver as defective and completely remove the control enclosure.

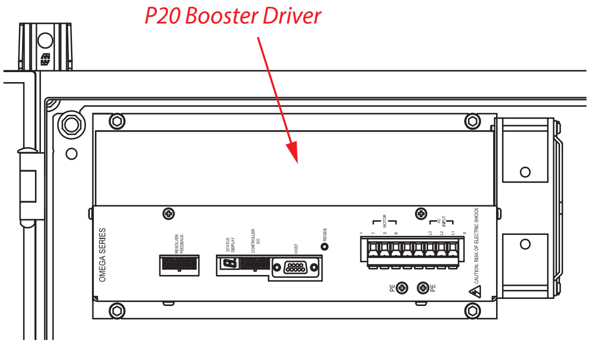


Figure 4.E.12.3-3 P20 Booster Drive Removal

4.E.12.4 P20 Booster Driver Replacement

1. Secure the replacement Driver to the panel using the 8-32 x 0.50" Phillips head screws removed from the defective driver. Mount the replacement driver to the top of the control enclosure using the four screws and nylon washers that were removed from the defective driver.

2. Reconnect the "Controller I/O" cables. Plug in the "Motor Output" connector and secure the Green/Shield wire to the ground screw. Plug in the "AC Input" connector.

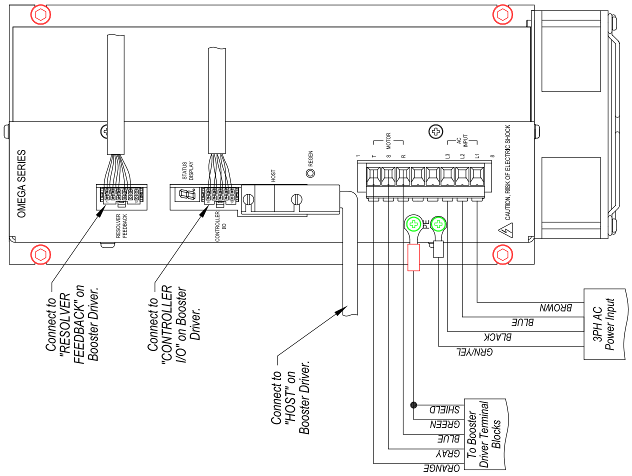


Figure 4.E.12.4-2 P20 Booster Drive Cable Wiring

4.E.13 D,P40 Booster Pump Driver

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

4.E.13.1 Servo Driver Removal

1. Cut away any wire ties that may be securing any cables to the tie down bases applied to the Servo Driver.

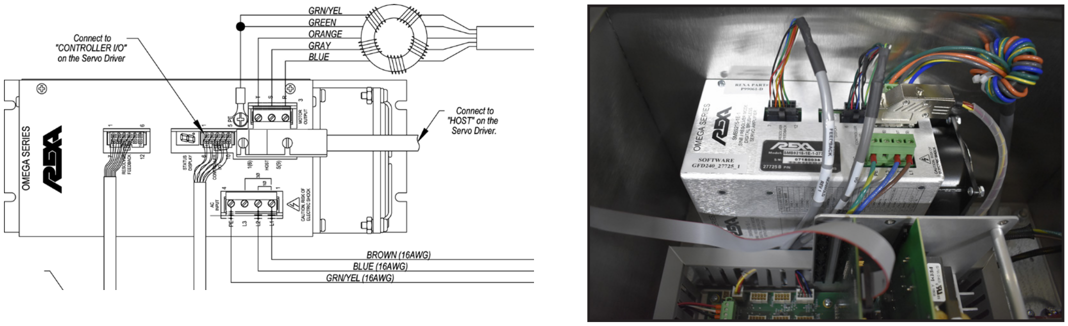


Figure 4.E.13.1-1 Servo Drive Cable Connections

2. Disconnect the "Controller I/O", on the driver.

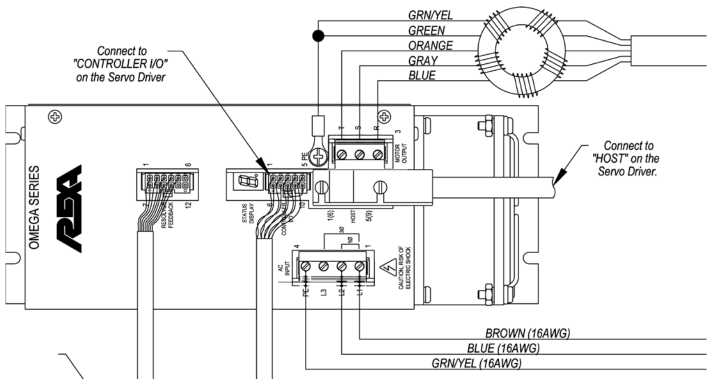


Figure 4.E.13.1-2 Servo Drive Cable Wiring

3. Remove "AC Input", "Motor Output" cable wires from the driver.

4. Locate the four driver mounting screws and nylon washers on the panel. Remove this hardware using a 1/8" Allen wrench. This hardware will be required to install the replacement driver. Tag the driver as defective and completely remove from control enclosure.

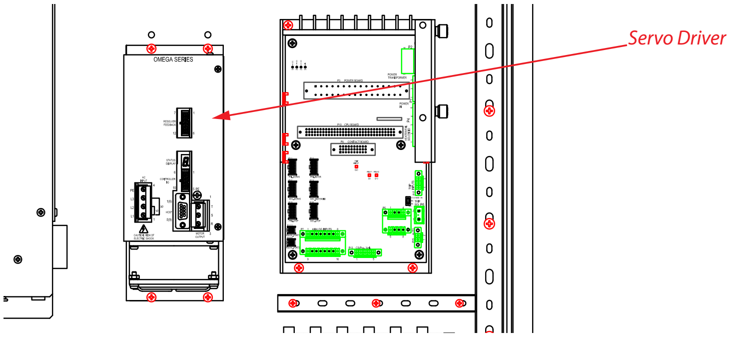


Figure 4.E.13.1-3 Servo Drive Removal

4.E.13.2 Servo Driver Replacement

1. Mount the replacement driver to the panel using the screws and nylon washers that were removed from the defective driver.

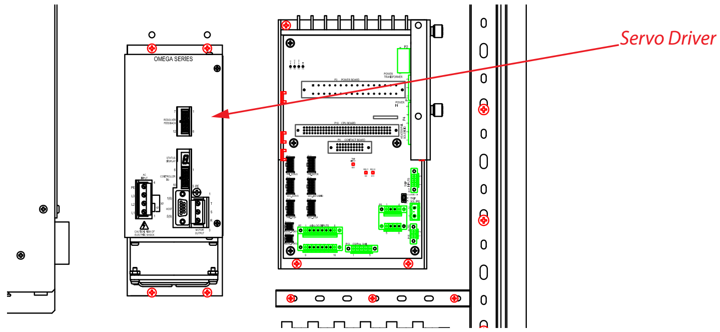


Figure 4.E.13.2-1 Servo Drive Placement

2. Reconnect the "Controller I/O" cables. Plug in the "Motor Output" connector and secure the Green/Shield wire to the ground screw. Plug in the "AC Input" connector.

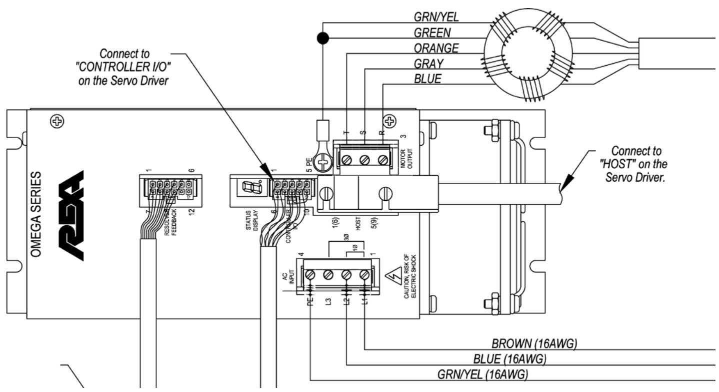


Figure 4.E.13.2-2 Servo Drive Cable Wiring

4.E.13.3 P40 Booster Driver Removal

1. Remove the six 10-32 x 0.50" Philips head screws supporting the plate over the driver and flip the plate towards the front of the box.

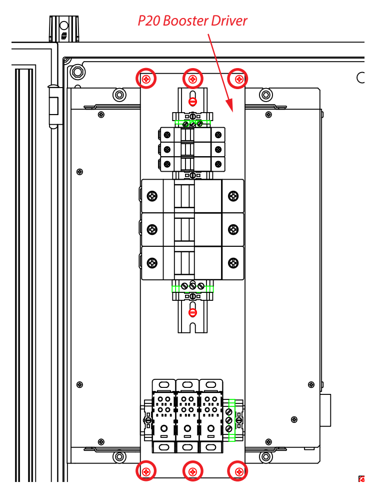


Figure 4.E.13.3-1 Input Power Plate Removal

2. Remove the four 1/4-20 X 0.75" mounting screws supporting the driver to the panel using an Allen wrench.

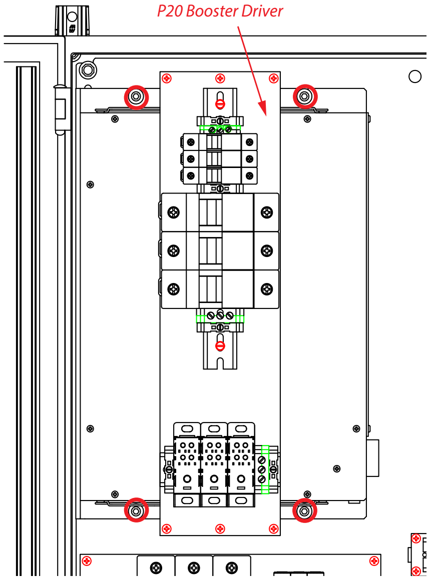


Figure 4.E.13.3-2 P40 Booster Driver Removal

3. Disconnect cables from the driver and remove from the box.

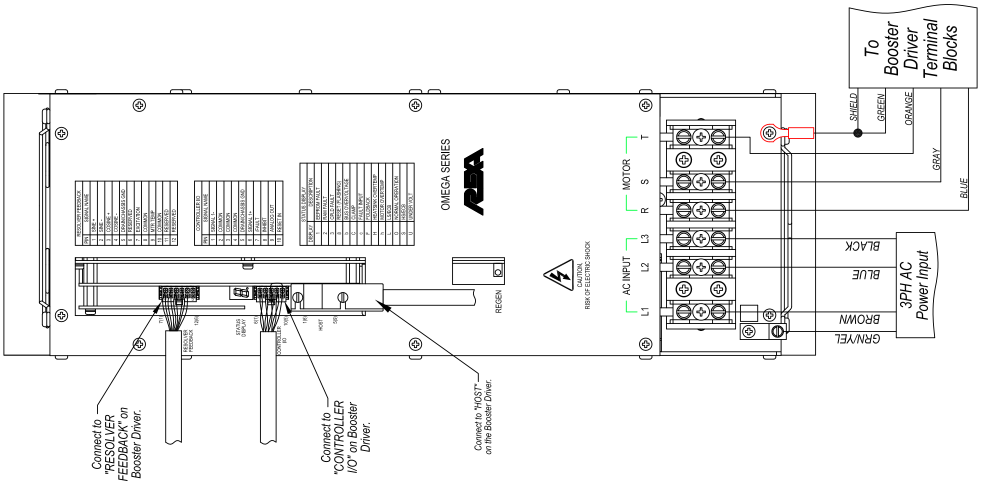


Figure 4.E.13.3-4 P40 Drive Cable Wiring

4.E.13.4 P40 Booster Driver Replacement

1. Secure the replacement Driver to the panel using an Allen wrench and the four screws, washers and lock washers the were originally securing the driver to the panel.

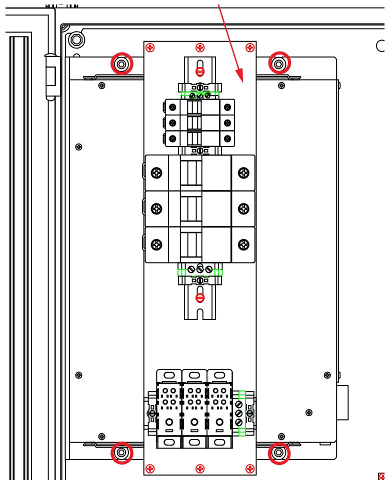


Figure 4.E.13.4-1 P40 Booster Driver Placement

2. Flip the plate back over the driver and screw the six 10-32 x).5" Philips head screws back into place.

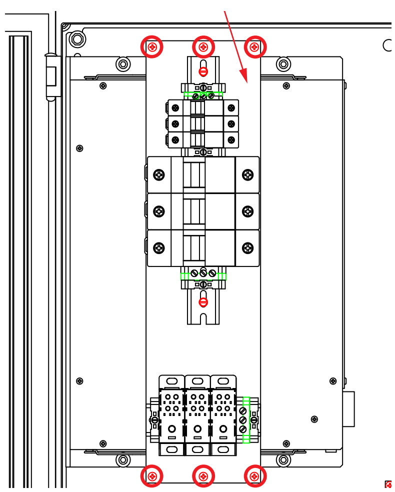


Figure 4.E.13.4-2 Input Power Plate Placement

3. Reconnect the cables to the driver.

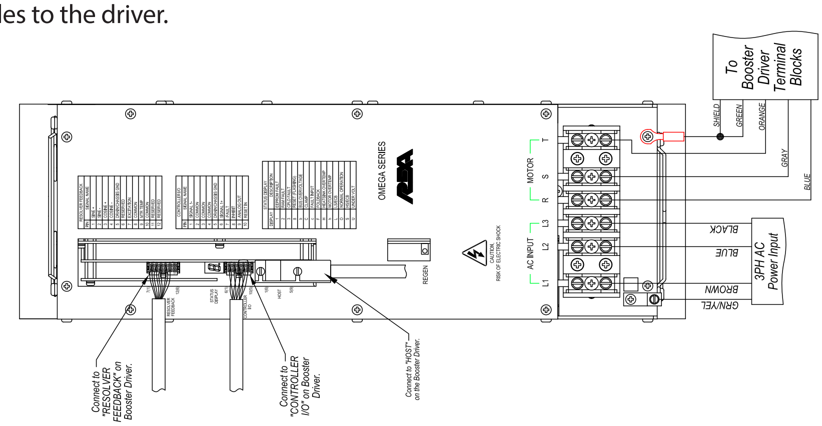


Figure 4.E.13.4-2 P40 Drive Cable Wiring

4.E.14 External Vacuum Fluorescent Display (VFD)

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

*NOTE: Assumed starting position is facing the upright electronic unit with the enclosure door open.**

4.E.14.1 Removal of the External VFD:

The External Display Assembly is mounted to the cover of the control enclosure.

1. Disconnect the Ribbon Cable from the Display Interface connector P1.

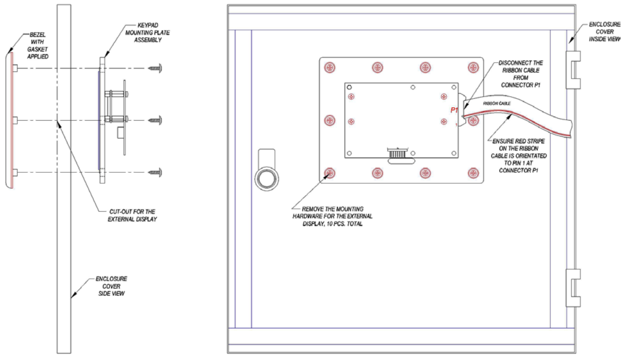
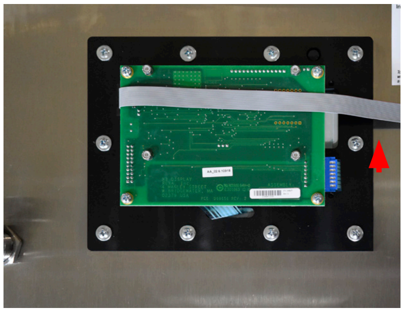
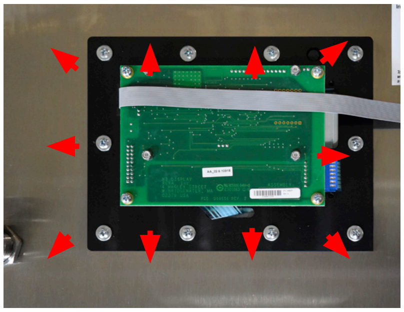


Figure 4.E.14.1-1 External VFD Removal Drawing

2. Remove the 10 screws that secure the External Display to the enclosure's cover.





4.E.14-2 VFD **4.E.14-3 Ribbon Cable Position** **4.E.14-4 Screw Removal**

3. Tag the Display as defective and completely remove it from the cover of the control enclosure.

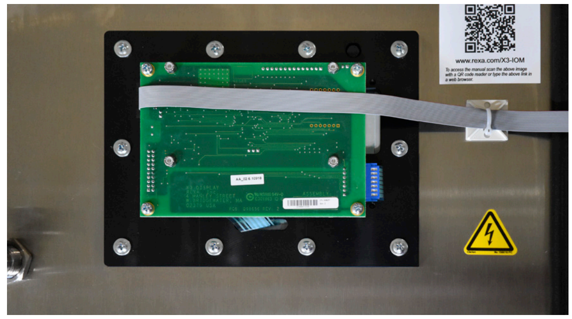
4.E.14.2 Replacement of the display assembly:

1. Apply the gasket to the bezel then place through the cut-out on the outside of the enclosure cover. Secure the Keypad mounting plate assembly to the bezel using the hardware provided.

4.E.14.2-1 Bezel and Display Front and Back View

2. Connect the ribbon cable to the back of the display assembly location P1. The red stripe on the ribbon cable should be orientated to pin 1 on connector P1.

4.E.14.2-2 Assembled VFD



4.E.14.2-3 Connected VFD

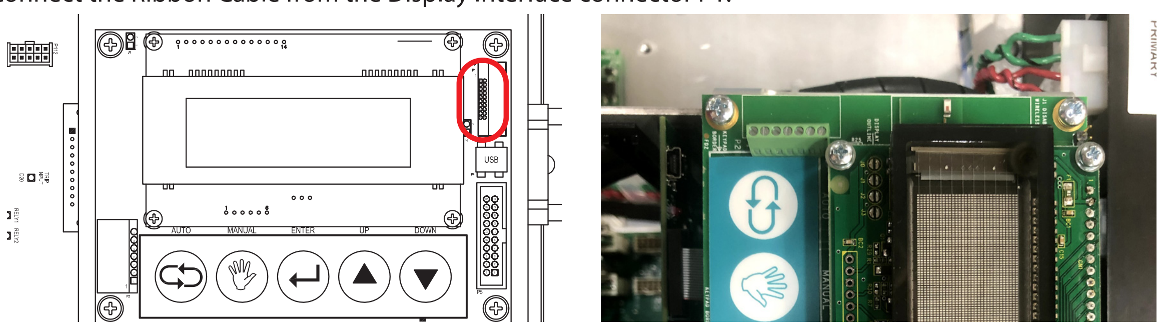
4.E.15 Internal Vacuum Fluorescent Display (VFD)

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

*NOTE: Assumed starting position is facing the upright electronic unit with the enclosure door open.**

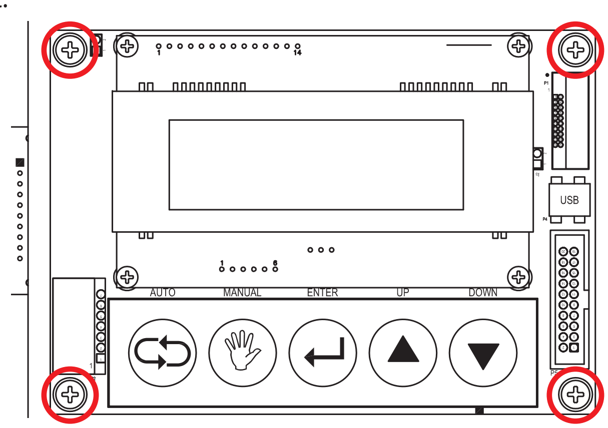
4.E.15.1 Internal VFD Removal

1. Disconnect the Ribbon Cable from the Display Interface connector P1.



4.E.15.1-1 Connected Internal VFD

2. Remove the four 6-32 x .375", Philips pan head screws that secure the internal display to the mounting bracket. The screws will be used for replacement.

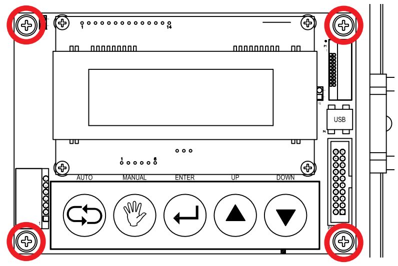


4.E.15.1-2 Internal VFD Screw Removal

3. Tag this board assembly as defective and remove from the control enclosure.

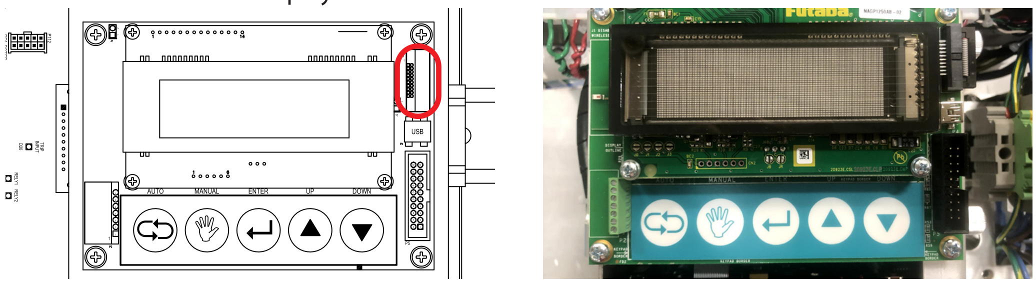
4.E.15.2 Internal VFD Replacement

1. With the replacement internal VFD facing front, screw in the four 6-32 x .375", Philips pan head screws into the mounting bracket.



4.E.15.2-1 Internal VFD Screw Placement

2. Connect the ribbon cable to the display interface connector P1.



4.E.15.2-2 Connected Internal VFD

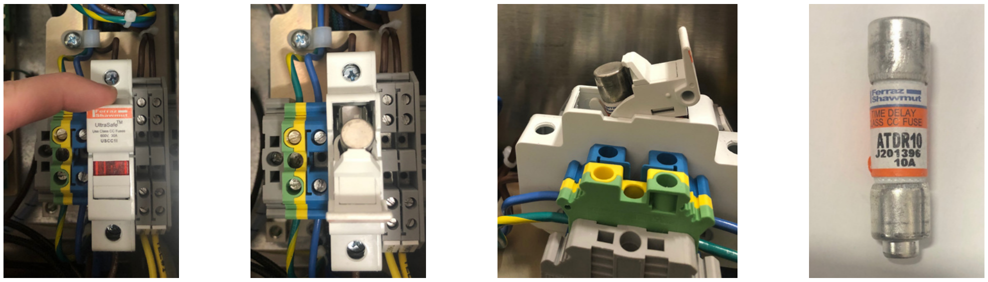
4.E.16. Replacing Fuses

CAUTION: MAKE SURE THE UNIT IS TURNED OFF AND POWER IS DISCONNECTED BEFORE REPLACING ANY COMPONENTS!

*Note: Assumed starting position is facing the upright electronic unit with the enclosure door open.**

Note: The placement of the fuse(s) differs. With a Bussman fuse holder the flat end of the fuse will go in first and the nipple end will be facing out. With a Ferraz Shawmut fuse holder the nipple end goes in first and the flat end is facing out. If the fuse in use is CE Approved, both ends will be flat and it may be inserted either way.

4.E.16.1 Fuse Removal



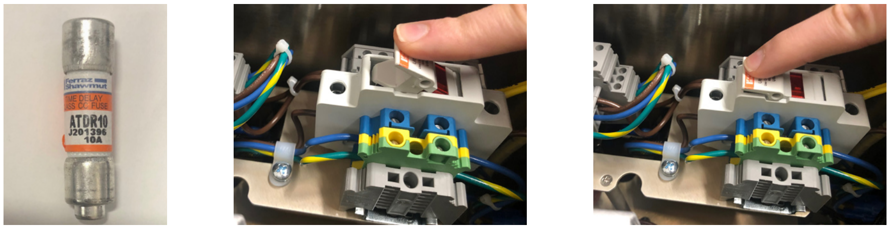
4.E.16.1 Fuse Removal

1. Locate and pull open the fuse holder to reveal the fuse(s) inside and note its placement in the holder.

2. Remove the fuse(s) from the fuse holder. It may sometimes be necessary to use needle nose pliers or a similar tool to remove the fuse.

3. Note the amperage before discarding the spent fuse. Ensure that the replacement fuse(s) are of the same amperage and voltage rating. Do not confuse the spent fuse with the functioning replacement fuse.

4.E.16.2 Fuse Replacement

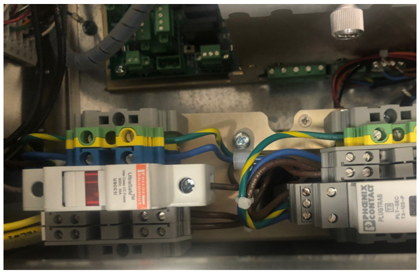


4.E.16.2 Fuse Replacement

1. Locate and ensure that the amperage and voltage ratings are the same as the fuse that is being replaced.
2. Position the replacement fuse in the holder the same way that the previous fuse was installed.
3. Close the fuse holder.
4. Return power to the unit.
5. If the unit powers up properly then the fuse replacement was successful and is now complete.

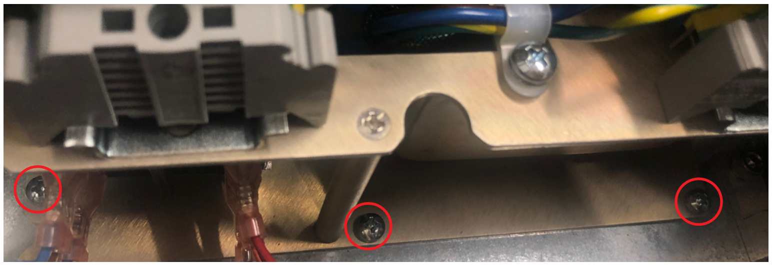
4.E.17. Input Power Distribution Assembly

4.E.17.1 Assembly Removal



4.E.17.1-1 Input Power Distribution Assembly

1. Disconnect any wires externally connected to the Input Power Distribution Assembly. Refer to figures 4.E.17.2-1-5 for your input power distribution assembly wiring.

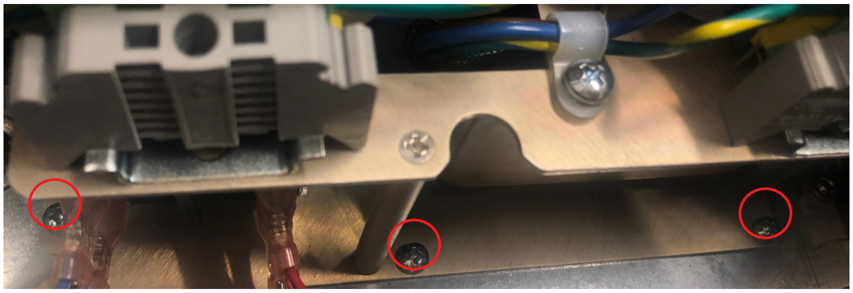


4.E.17.1-2 Philips Pan Head Screw Removal

2. Remove the three 8-32 x 0.5", Philips pan head screws that secure the input power assembly to the base plate. The screws will be used for replacement.

4.E.17.2 Assembly Replacement

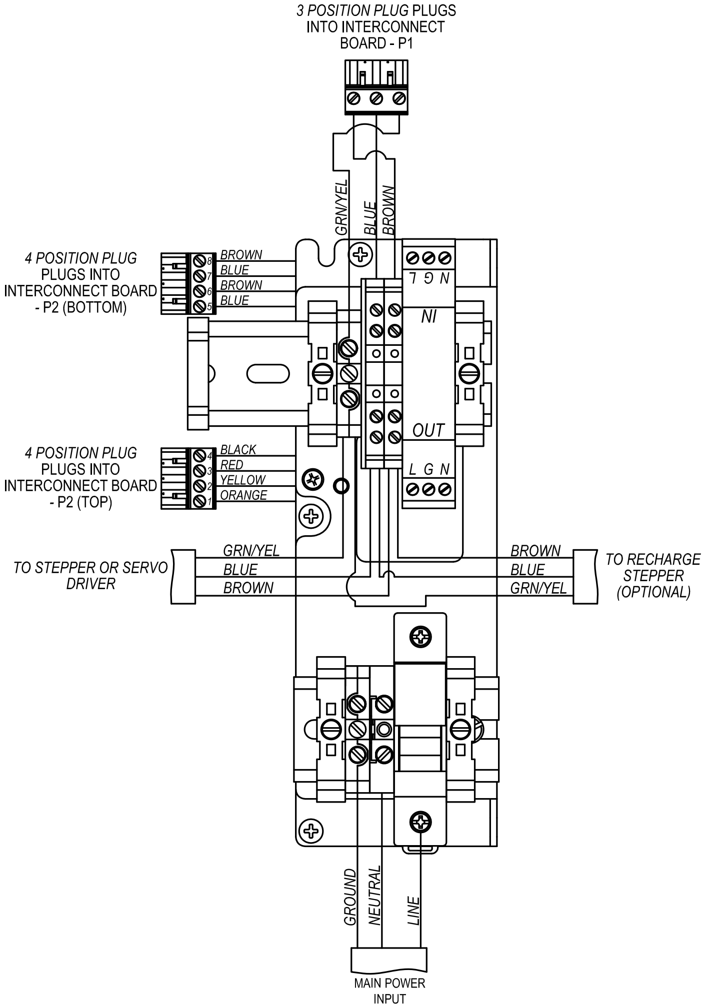
1. With the fuse and surge suppressor facing front screw in three 8-32x0.5", Philips pan head screws securing input power assembly to the base plate.



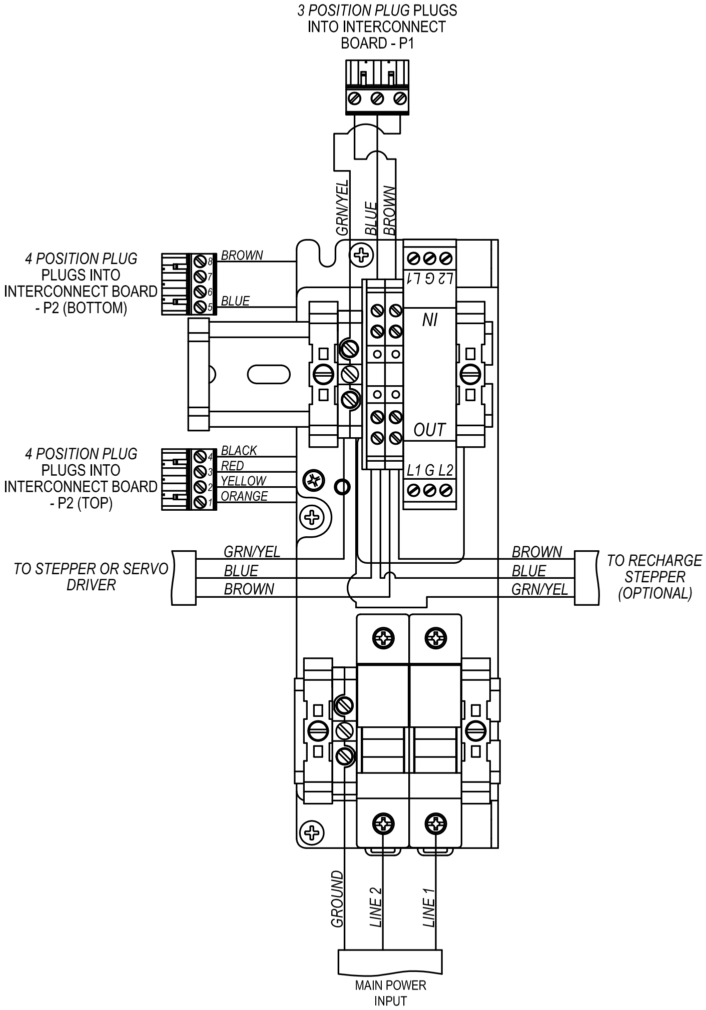
4.E.17.2-1 Philips Pan Head Screw Placement

2. Screw in the two 6-32 x .375", Philips flat head screws securing the input power assembly to the side wall of the enclosure.

    a. Standard Input Power Distribution Assemblies:

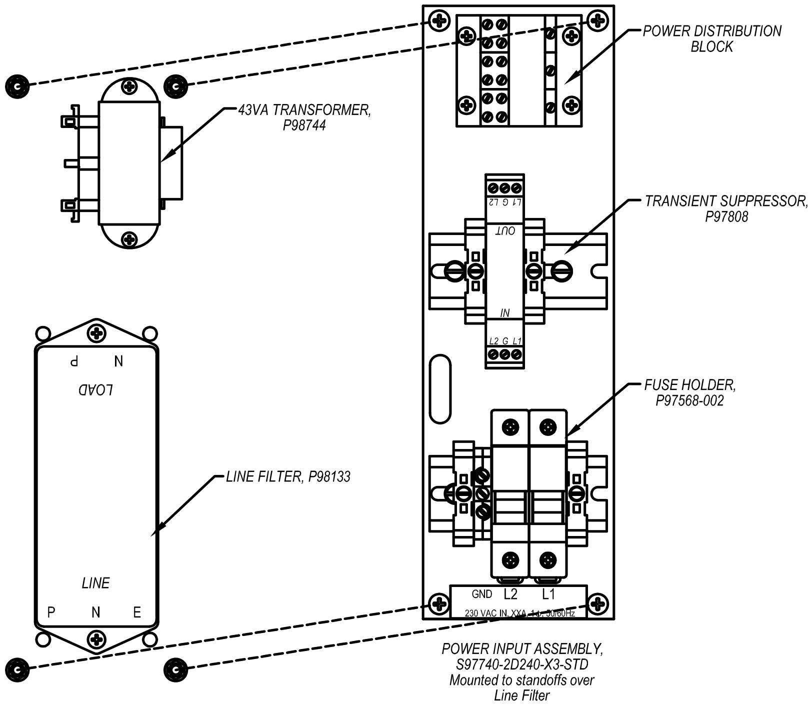


4.E.17.2-4 115VAC Power Input Assembly

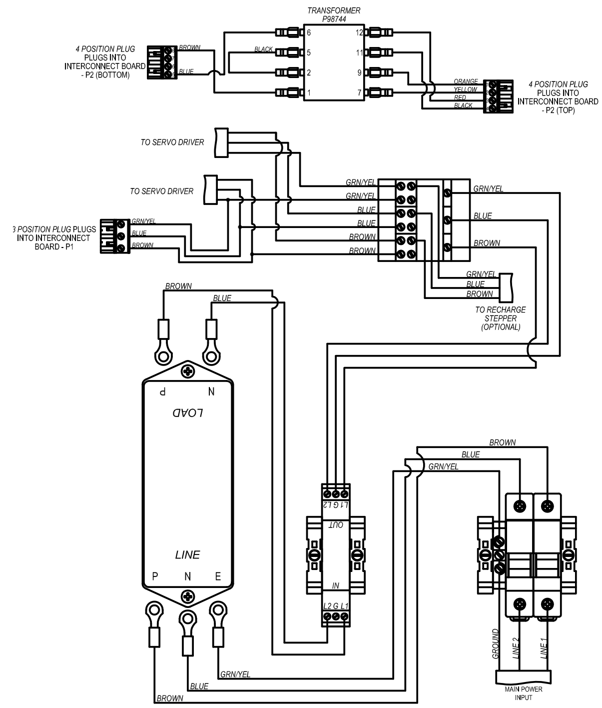


4.E.17.2-5 230VAC Power Input Assembly

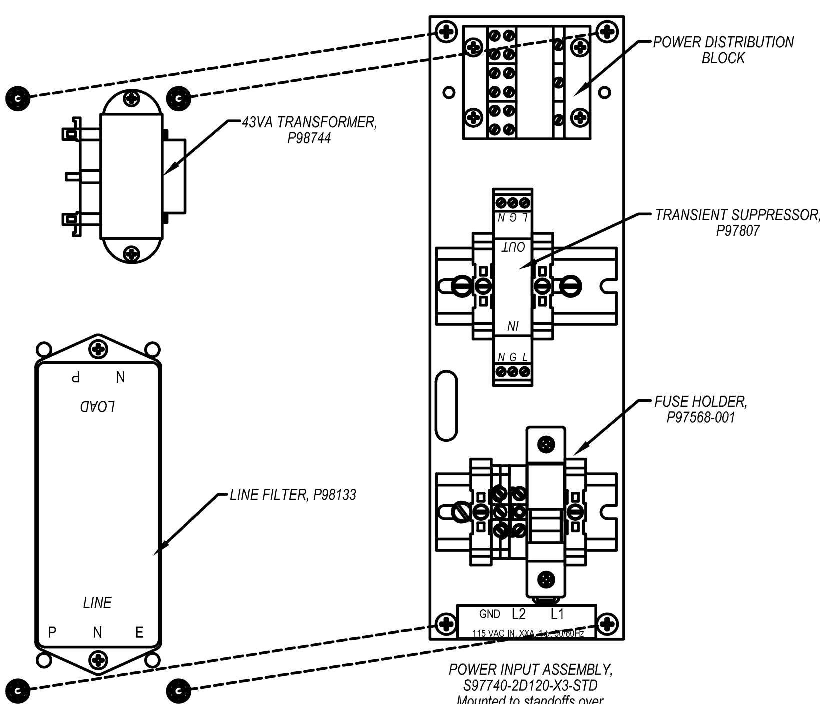
b. Large Input Power Distribution Assemblies:



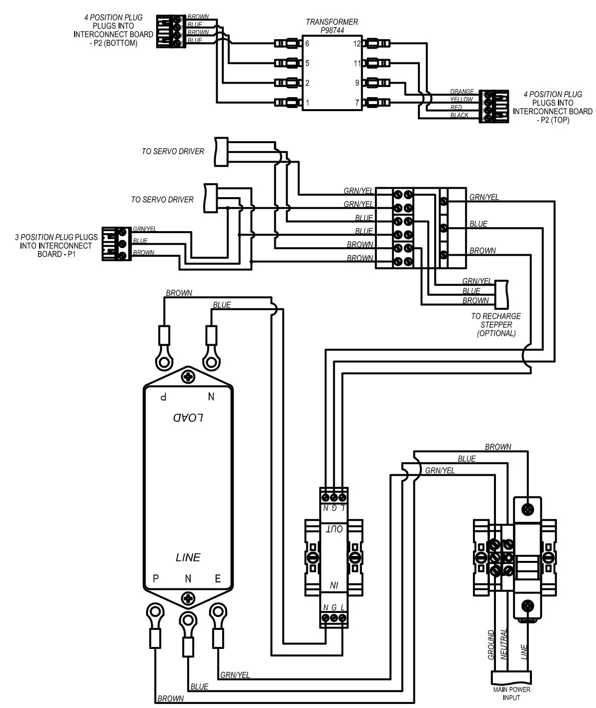
4.E.17.2-6 230VAC Input Power Assembly for Dual ½D and 2D Systems



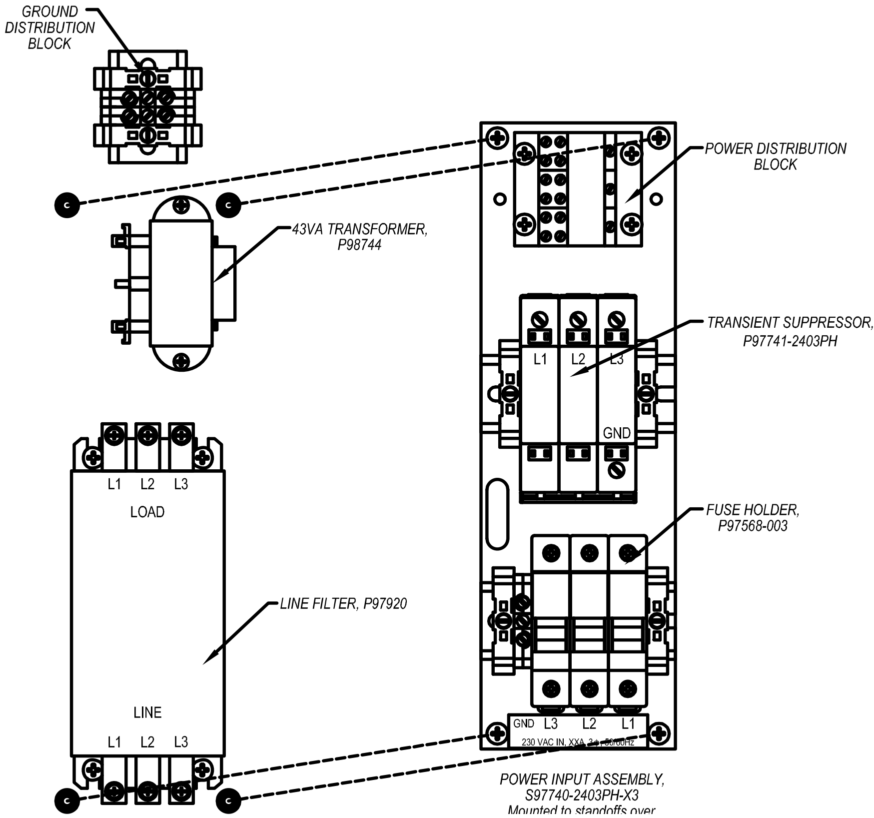
4.E.17.2-7 230VAC Input Power Wiring Reference for Dual ½D and 2D Systems



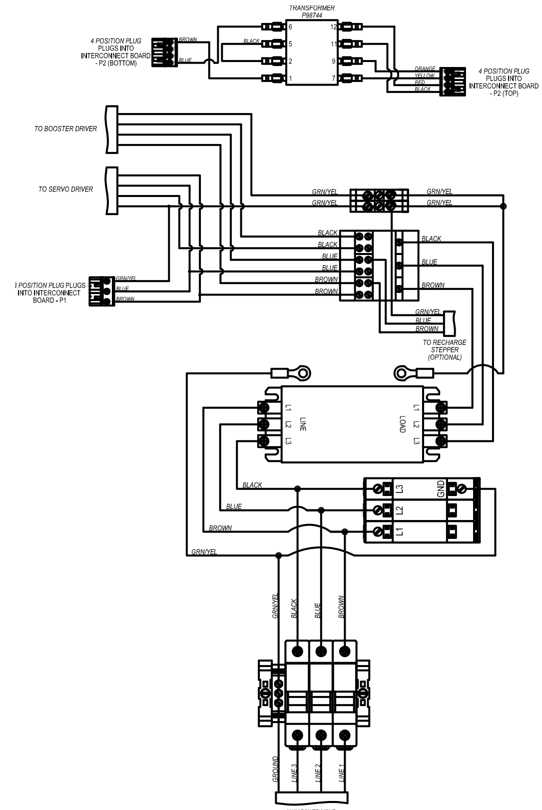
4.E.17.2-8 115VAC Input Power Assembly for Dual ½D and 2D Systems



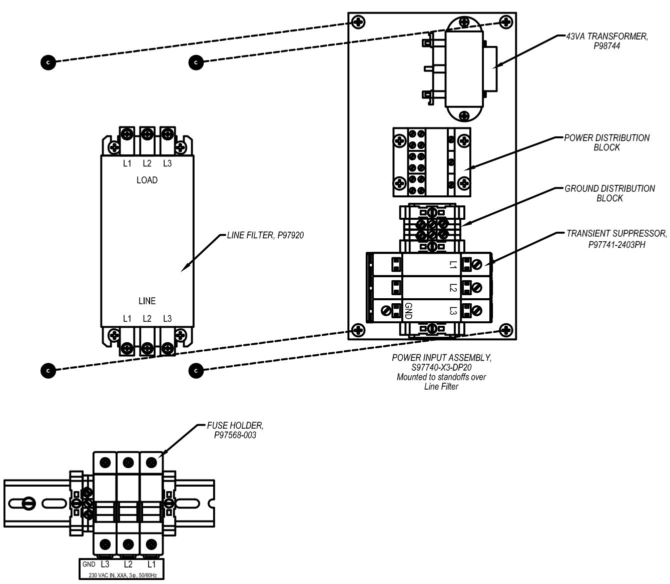
4.E.17.2-9 115VAC Input Power Wiring Reference for Dual ½D and 2D Systems



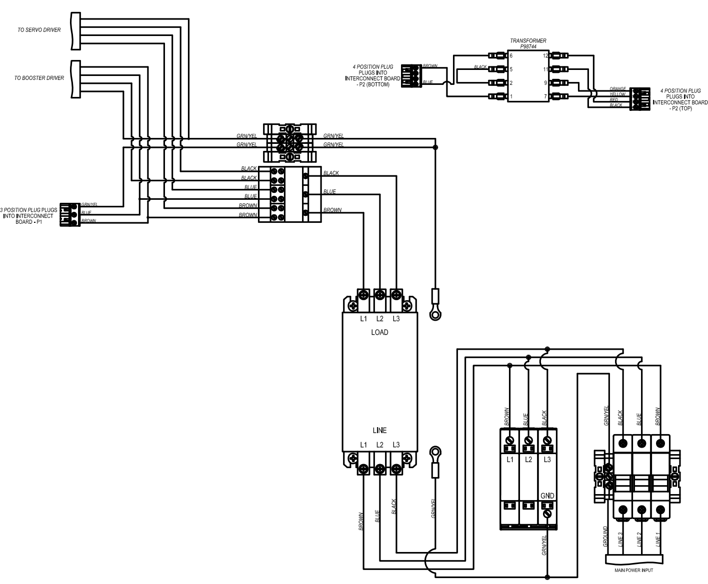
4.E.17.2-10 230VAC Input Power Assembly for D,P9 Systems



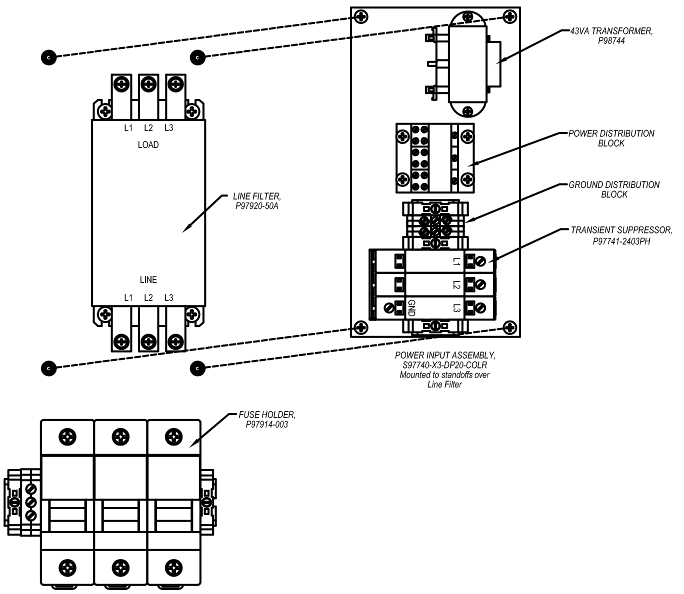
4.E.17.2-11 230VAC Input Power Wiring Reference for D,P9 Systems



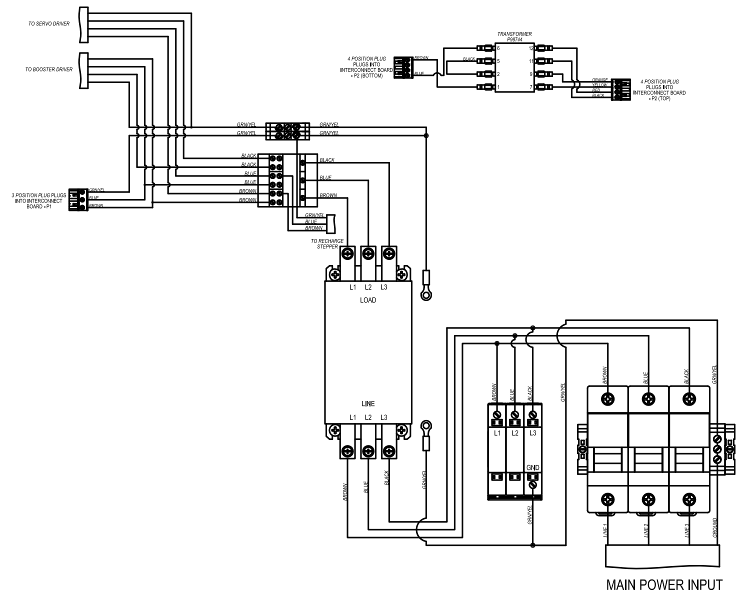
4.E.17.2-12 230VAC Input Power Assembly for D,P20 Systems



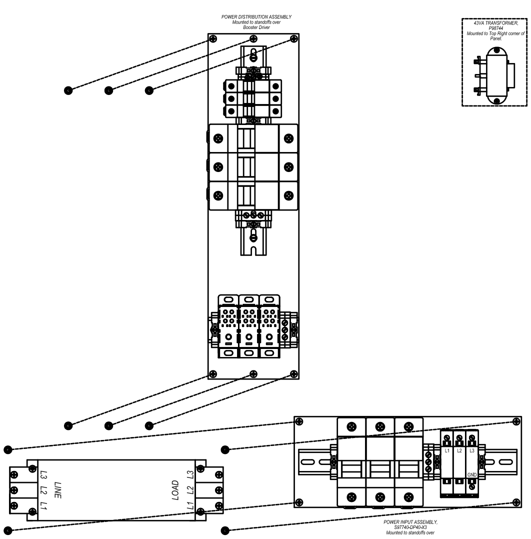
4.E.17.2-13 230VAC Input Power Wiring Reference for D,P20 systems



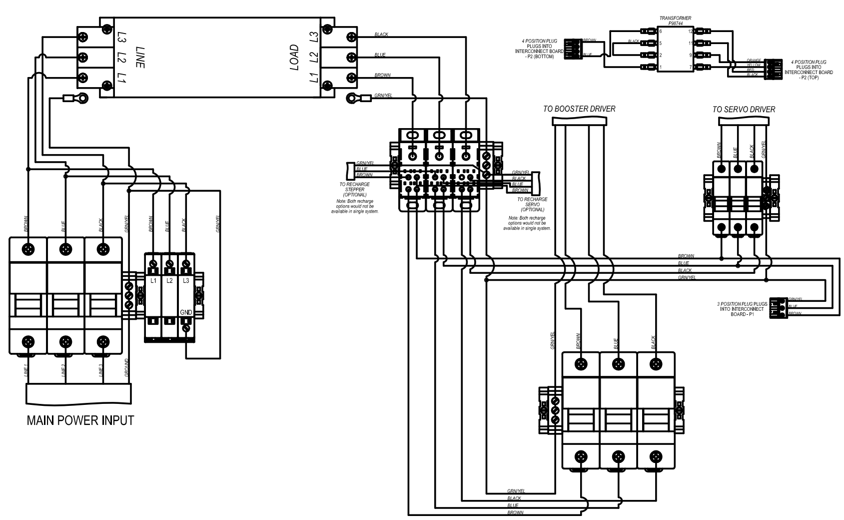
4.E.17.2-14 230VAC Input Power Assembly for D,P20 with Accumulator Systems



4.E.17.2-15 230VAC Input Power Wiring Reference for D,P20 with Accumulator Systems



4.E.17.2-16 230VAC Input Power Assembly for D,P40 Systems



4.E.17.2-17 230VAC Input Power Wiring Reference for D,P40 systems

4.M. Mechanical Repair

4.M.1 Component Identification

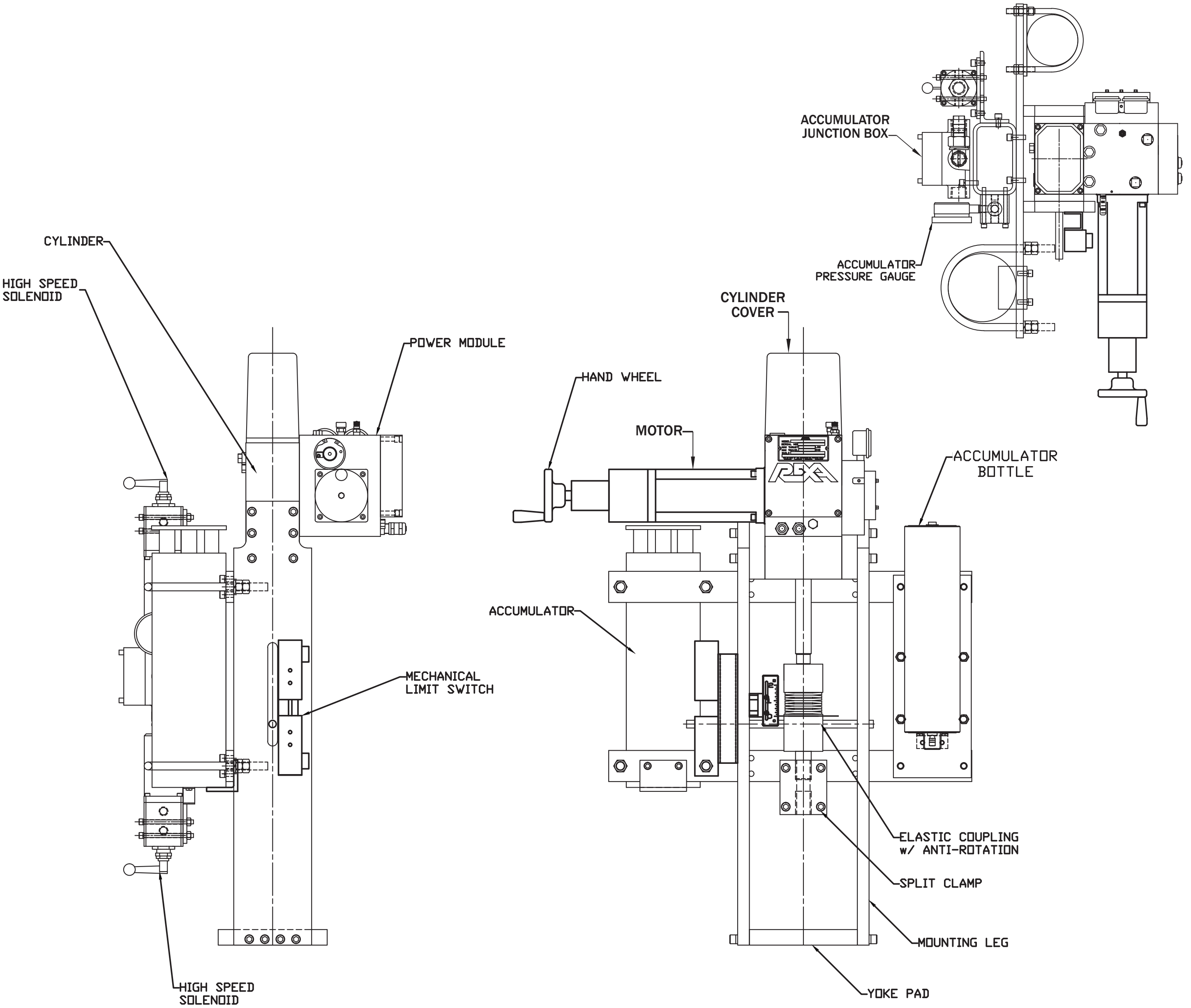


Figure 4.M.1-1 REXA Linear Cylinder Component Identification

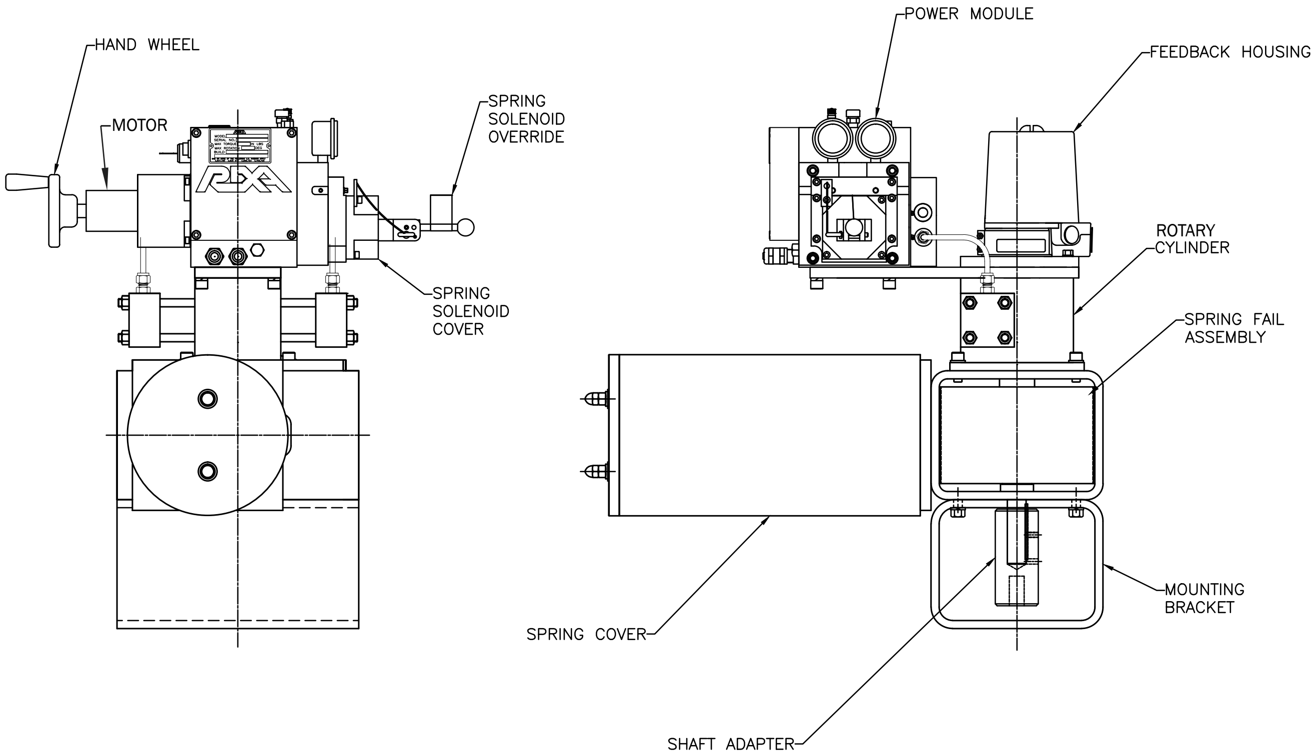


Figure 4.M.1-2 REXA Rotary Cylinder with Spring Fail

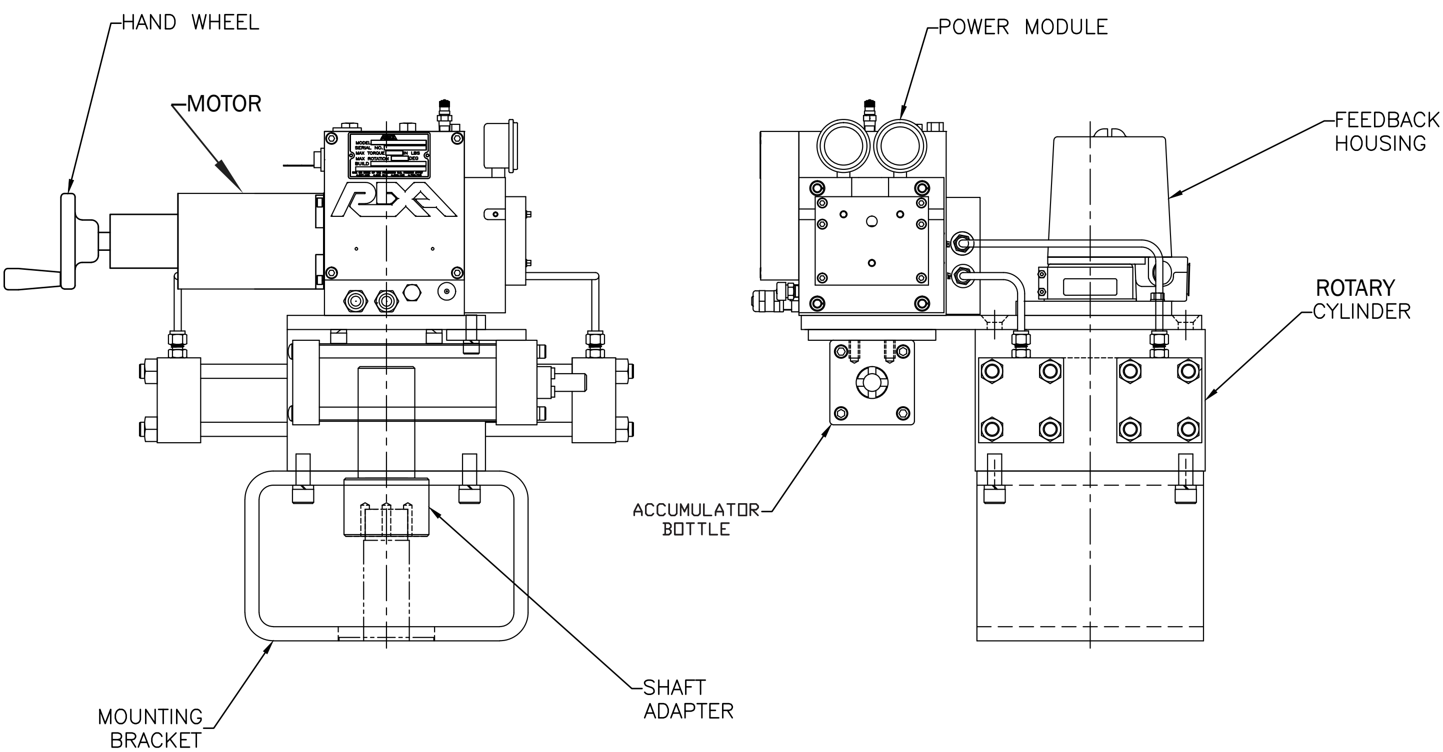


Figure 4.M.1-3 REXA Rotary Cylinder Fail in Place

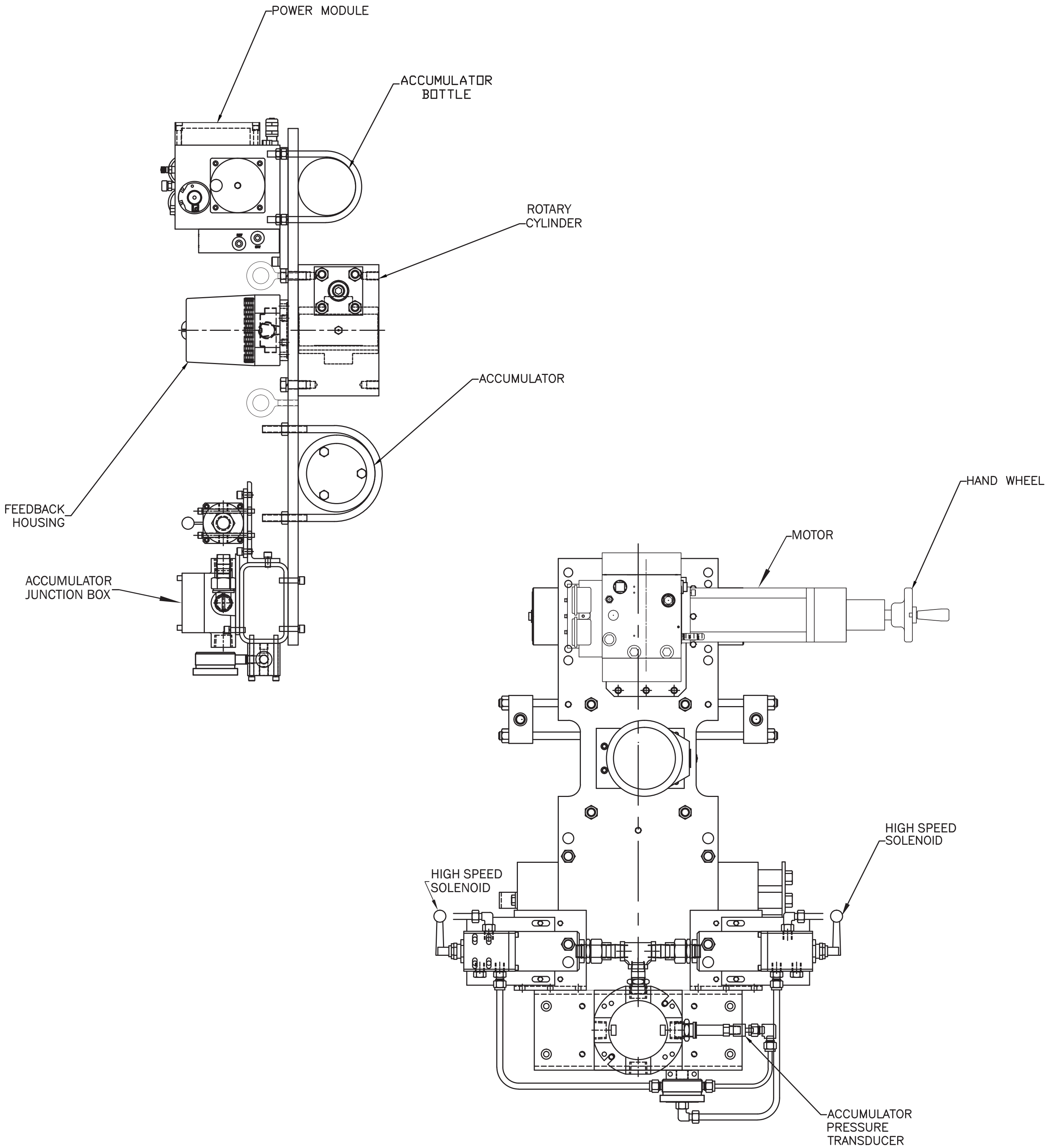


Figure 4.M.1-4 REXA Rotary Cylinder with Standard Accumulator Package

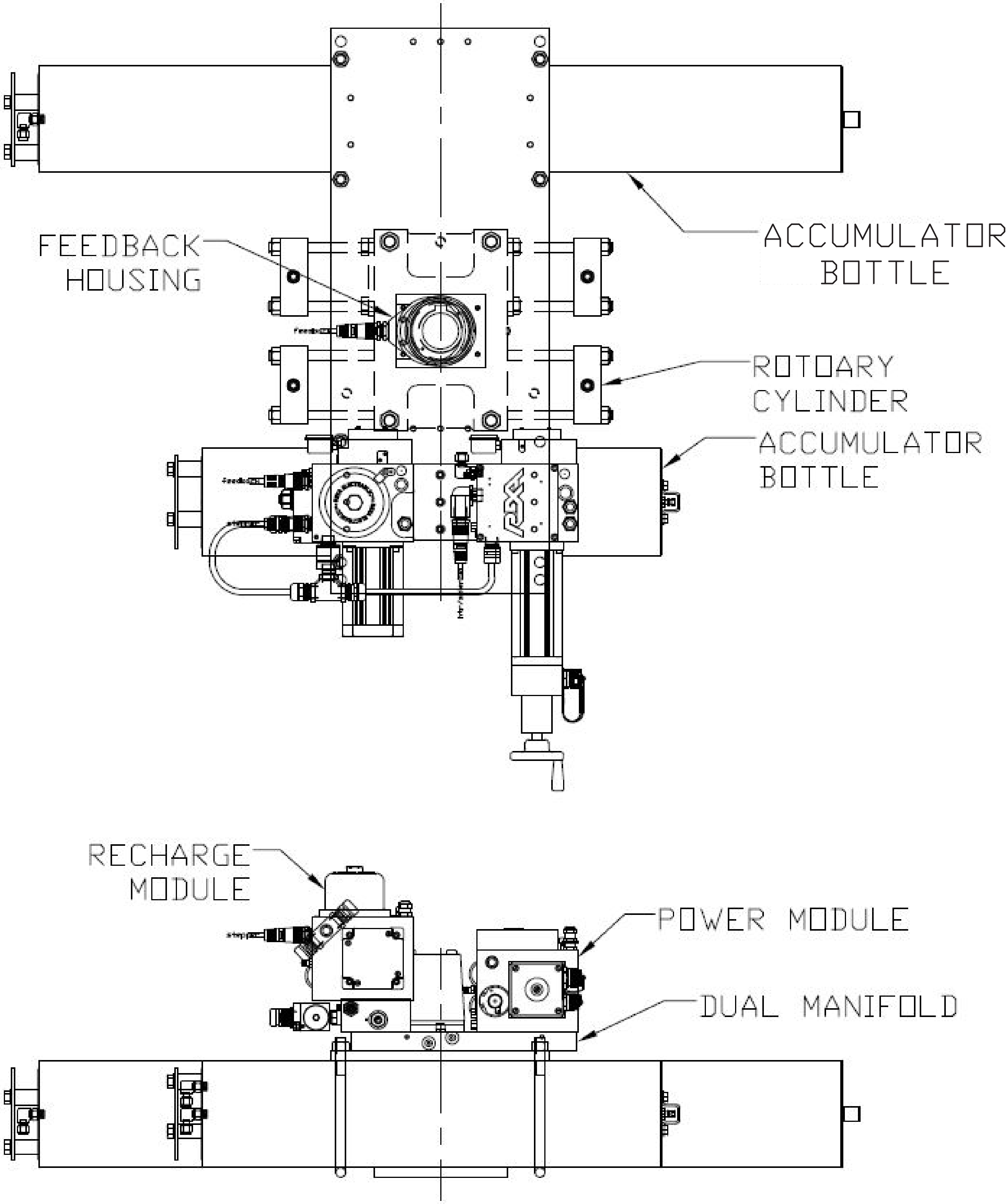


Figure 4.M.1-5 REXA Rotary Cylinder with Online Accumulator Package

4.M.1 Component Identification

4.M.2 Overview

All REXA Xpac actuators consist of a motor, a pumping system and a housing assembly referred to as the Power Module. There are many different configurations of REXA Xpac actuators. Two characterizing features are the size and number of Power Modules. All REXA Power Modules have many common parts and repair procedures.

The details for identifying all REXA models by our labeling system can be found in the Section 1.2.1 of this manual. Also, please note that each actuator will have at least one power module, but in some cases there are multiple power modules on one actuator assembly. To visually identify the size of the power module, see Figures 4.M.2-1, 2, 3 & 4. The key identifying features are the shape and length of the motor.

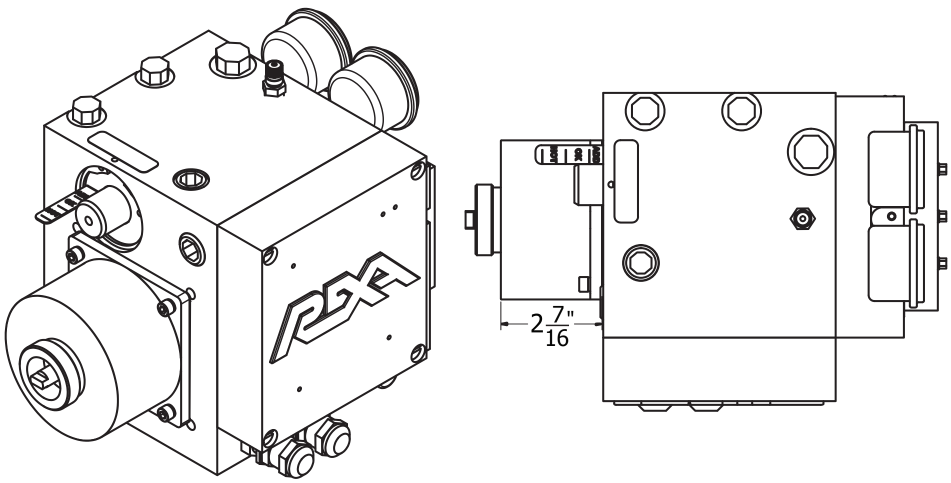


Figure 4.M.2-1: B Power Module

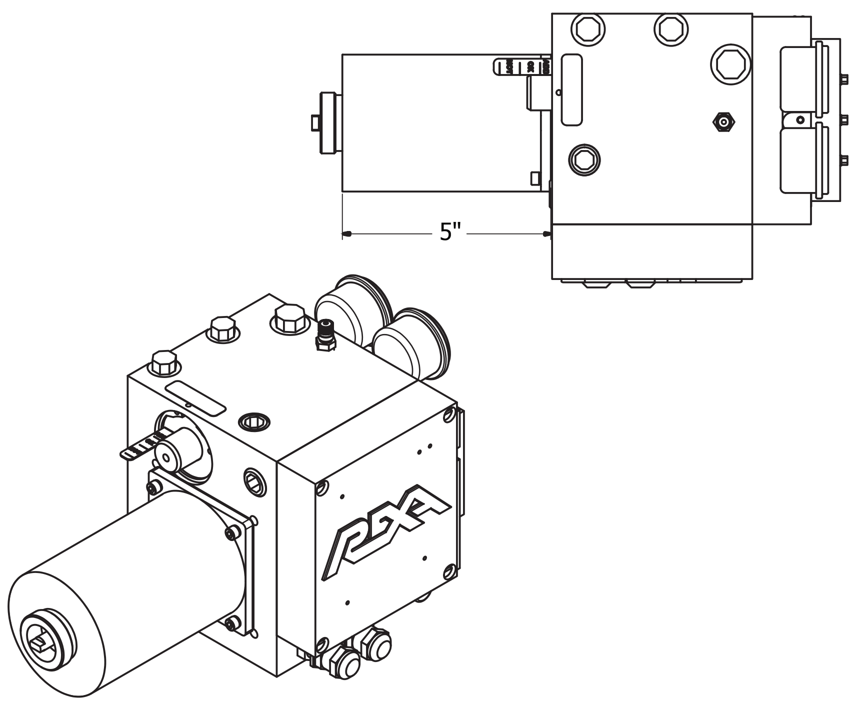


Figure 4.M.2-2: C Power Module

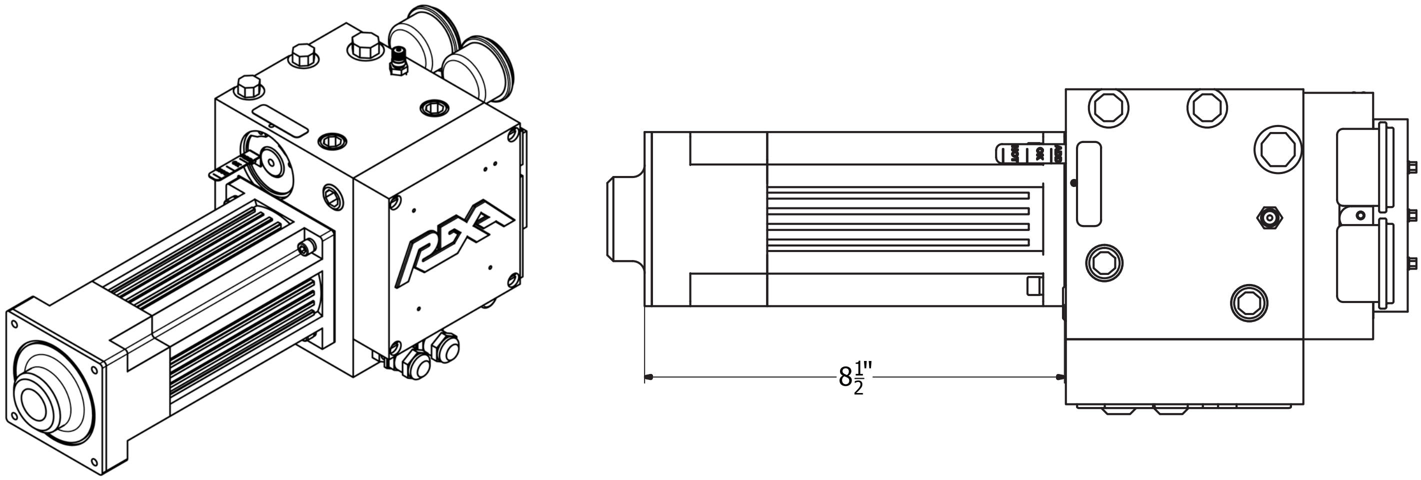


Figure 4.M.2-3: ½ D Power Module

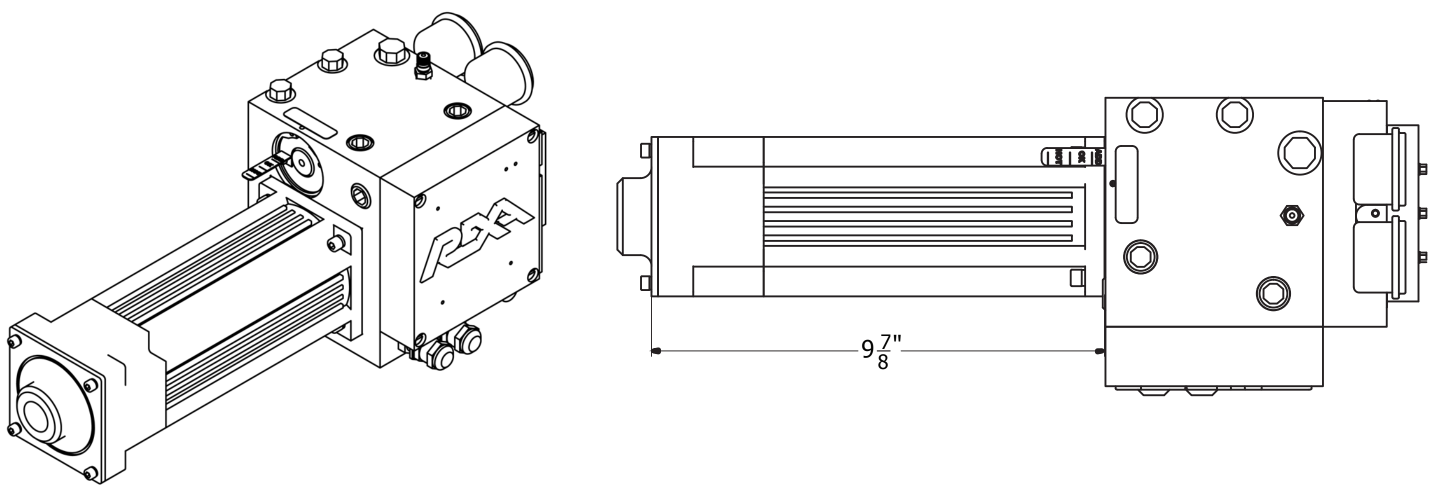


Figure 4.M.2-4: D Power Module

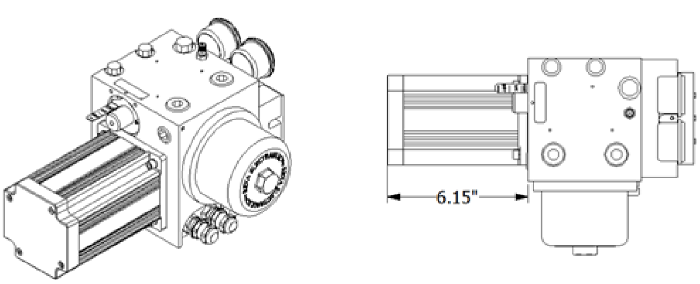


Figure 4.M.2-5 C Power Module Explosion Proof

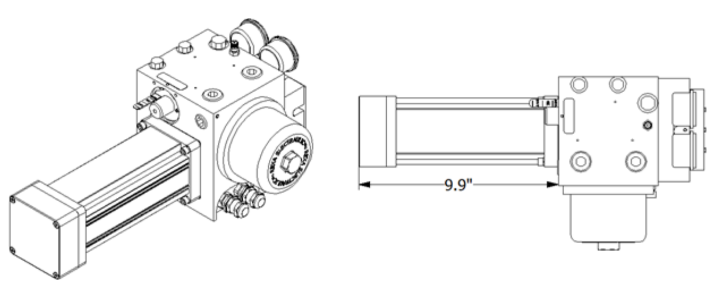


Figure 4.M.2-6 D Power Module Explosion Proof

NOTE: With the exception of pump and motor sizing, all REXA Power Modules share many of the same components encountered during a rebuild. For this reason, we will refer to rebuilding only one module in this guide, and point out the differences between different-sized Power Modules as needed.

4.M.3 Power Module Removal

CAUTION: All external loads must be removed from the actuator before any service is performed.

NOTE: Tag and Lock-Out the unit for repair in accordance with local procedures. Repair of the power module will require removing the unit from service.

It may be possible for certain repairs to be performed without removing the units from the installation site. Extra hazards may result from this type of repair and are not covered in the scope of this manual. Consult the factory for further information.

NOTE: Due to the large number of custom applications of REXA actuators this manual doesn't show the exact steps to removing the power module but rather the general procedure that should be followed.

4.M.3.1 Removal

1. Ensure that all pressure gauges read zero before disconnecting any pressure lines. One way to do this is by turning the bypass counterclockwise.

   NOTE: On some modules the dual gauges on the module may not read zero, but it is safe to proceed if they are both reading equal values.

2. Ensure that power has been turned off to the unit.

3. An oil drain bin should be ready to catch any oil that may drain from disconnecting lines.

4. Disconnect the external conduit and wiring running to the power module.

   NOTE: Oil is under low pressure in the thermal expansion chamber and will squirt out when port plugs are removed.

5. Disconnect either port plug with the oil drain pan underneath. (Refer to Figure 4.M.3.1.) The oil level indicator should recede, forcing out oil from the removed port. If the indicator does not recede it may be necessary to push it in.

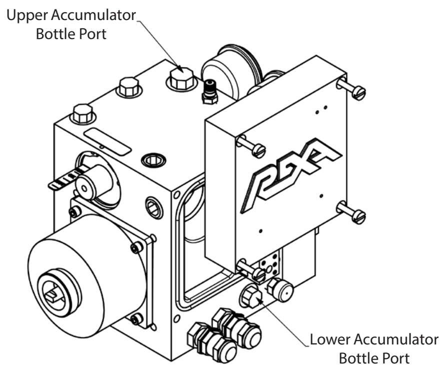


Figure 4.M.3.1-1 Power Module

6. Re-install the port plug.

7. Disconnect any external plumbing to the module.

8. Remove the mounting screws from the module. This should allow you to completely remove the module for repair.

9. Place the module over the oil drain pan and remove the lower port plug on the module.

10. Remove the upper plug on the module; this will allow the remaining oil to drain from the lower port.

4.M.4 Expansion Chamber Rebuild (All Size Modules)

Parts Required: Power Module Seal Kit.

Kit to include: Cover Seal, Cover O-ring, Expansion Chamber, and other Power Module Seals.

CAUTION: Spring under compression, 20 lb pre-load.

NOTE: All B, C, 1 / 2D and D size non-explosion proof modules share the same expansion chamber components and rebuild procedures. For the C and D explosion proof modules, the expansion chamber piston should seldom need replacement in the field. In the event that it will need replacement, the motor will need to be backed out slightly to remove the cover. See section 4.M.6 removal of explosion proof motor.

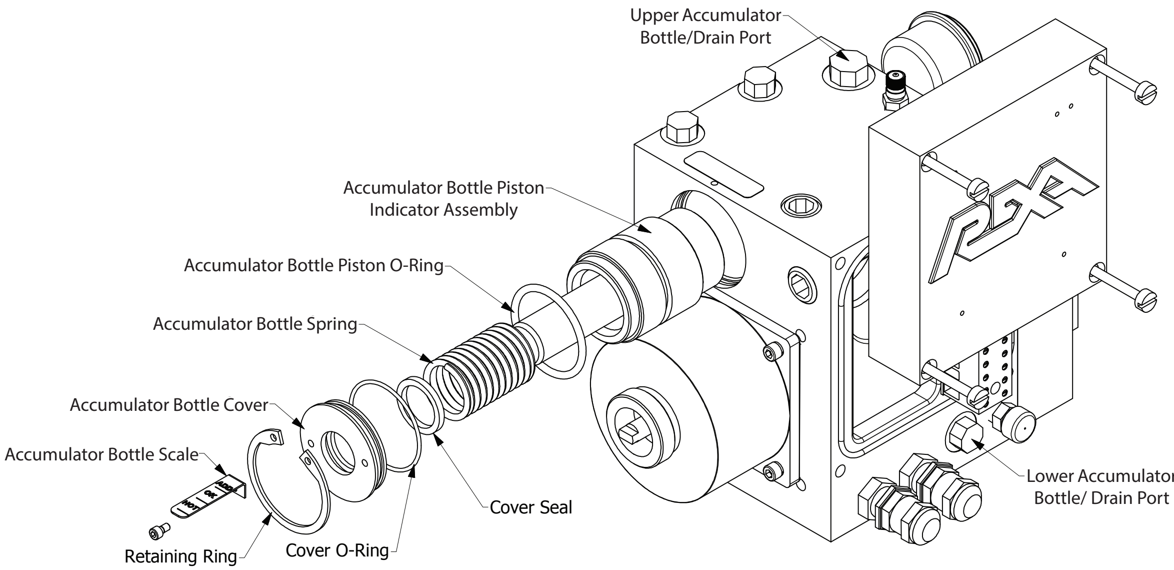


Figure 4.M.4-1 Expansion Chamber Rebuild

4.M.4.1 Disassembly

CAUTION: Use care when removing the retaining ring as this releases pre-loaded spring and cover.

1. Make sure actuator has been drained of oil and both drain plugs have been removed.

2. Remove the oil level indicator scale.

3. Remove the retaining ring. It may be necessary to tap in on the cover to allow the retaining ring to release.

4. Use two 6-32 screws and thread them into the two tapped holes in the reservoir cover.

5. Pull the reservoir cover off using the two 6-32 screws. While doing so, be cautious; the thermal expansion chamber has a spring load.

6. Remove the spring.

7. Remove the thermal expansion chamber piston assembly by pulling on the indicator.

8. Remove and discard the cover O-ring. Remove and discard the cover seal Remove and discard the piston O-ring.

4.M.4.2 Cleaning and Inspection

1. Clean all components in a solvent / parts washer to remove all dirt and contaminants.
2. Clean out the thermal expansion cavity and be careful not to introduce any contaminants to the system.
3. Inspect bore for scratches. If they are deep enough to be felt, replace power module body.
4. If a full rebuild is being performed proceed to the removal sections for the relevant motor before re-assembly.

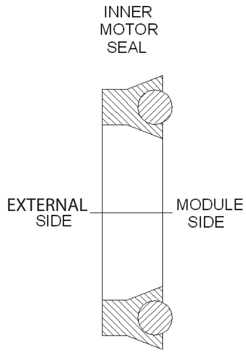


Figure 4.M.4.3-1 Inner Motor Seal

4.M.4.3 Re-Assembly

1. Lubricate the two new O-rings and the new cover seal.
2. Slide the new piston O-ring over piston indicator assembly.
3. Slide assembly back into the cavity.
4. Place the spring over the indicator on the assembly.
5. Install the new cover O-ring in the O-ring groove on the outside of the cover.
6. Fit the new cover seal into the groove.

   NOTE: The O-ring side of the seal must face away from the module body.

7. Re-install the cover and retaining ring. It is necessary to hold the spring compressed while installing the retaining ring.

4.M.5 Non-Explosion Proof Module Motor Replacement or Seal Replacement

Parts Required: Appropriate Motor Seal Kit.

Kit to include 2 motors seals and the motor gasket.

NOTE: All modules share similar motor mounting procedures and components. For simplicity the diagram below shows a B Module.

4.M.5.1 Disassembly

1. Ensure the actuator has been drained of oil and top drain plug has been removed.

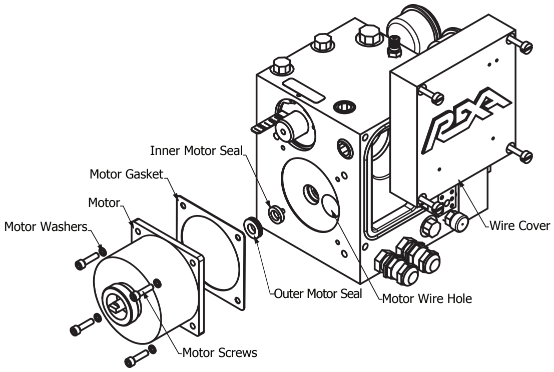


Figure 4.M.5-1 Motor Replacement

2. Remove the four screws holding the wire cover on.
3. Locate and disconnect the motor wires from the terminal block under wire cover.

4. Remove the four motor screws and four lock washers.

5. Pull the motor straight out.

   NOTE: It may be necessary to lightly tap the sides of the motor with a rubber mallet to break the seal between the motor and module body.

6. Peel off the motor gasket and remove both motor seals. These three items can be thrown out after you have located the replacement parts in your rebuild kit.

4.M.5.2 Cleaning and Inspection

1. Clean off the motor face and casting face. Remove any remaining gasket material and sealant.

2. If a full rebuild is being performed proceed to the removal sections for the relevant power train before re-assembly.

4.M.5.3 Re-Assembly

1. Coat both new motor seals with petroleum jelly and insert as shown below into the module. Seal will not function properly if installed backwards.

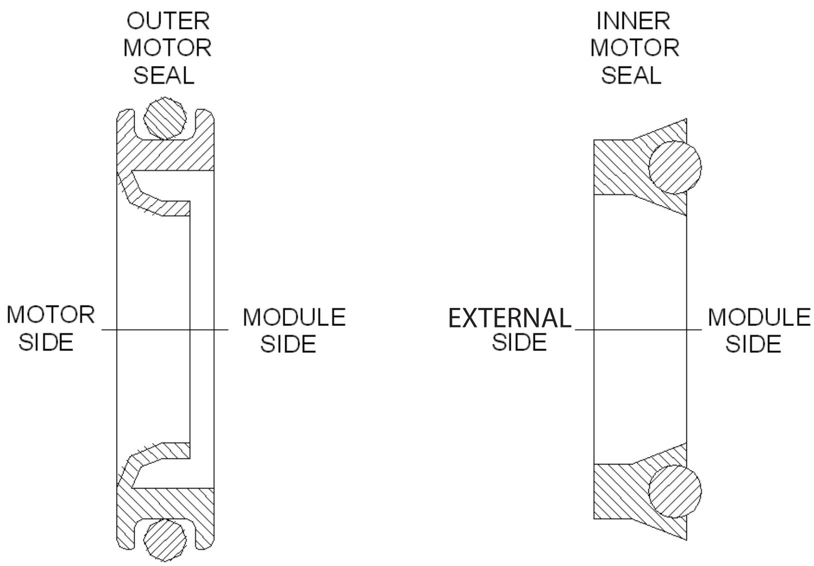


Figure 4.M.5.3-1 Motor Seals

2. Apply sealant on base of the motor area of the module, and around the motor and mounting through-holes.

3. Place the gasket on the motor after installing sealant.

4. Orientate the motor shaft so that it engages with the pump coupling in the module.

5. Feed the wires into the motor wire hole on the module and slide the motor back into place. The motor should sit flush to the casting. Turn the motor shaft back and forth to ensure it is aligned with the pump coupling.

⚠ **CAUTION: Do not force the motor in place or tighten the mounting screws before turning the motor shaft, or damage will occur.**

6. Apply blue Loctite® and install the four motor washers. Torque the screws in place to 50 lb·in.

7. Re-wire the motor to match the wire colors. For detailed wiring diagram, refer to "C. Circuit Schematics" on page 123.

8. Reinstall the wire cover and torque the screws in place to 50 lb·in.

4.M.5.2 Explosion Proof Module Motor Replacement or Seal Replacement

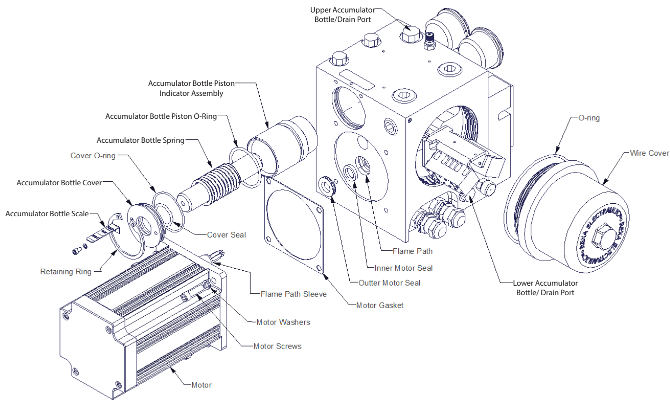


Figure 4.M.5.2-1 Explosion Proof Power Module Assembly

NOTE: Motor & Module assembly is designed to be explosion proof per CSA and IEC requirements when Motor's Flame Path Sleeve is inserted into the Module's Flame Path. Prior to installation of the motors, inspect Motor's Flame Path Sleeve and Module's Flame Path to ensure no evidence of surface imperfections such as nicks and / or scratches deeper than 75 Uin by 0.04 inches in length. Do not using sharp tools to minimize possible damage to these critical areas during assembly of the motor onto the module.

4.M.5-2.1 Disassembly

1. Ensure the actuator has been drained of oil and top drain plug has been removed.
2. Remove the cover by unthreading it from the power module.
3. Locate and disconnect the motor wires from the terminal block under the wire cover.
4. Remove the four motor screws and four lock washers.
5. Pull the motor straight out.

   NOTE: It may be necessary to lightly tap the sides of the motor with a rubber mallet to break the seal between the motor and module body.

4.M.5-2.2 Re-Assembly

1. Coat both new motor seals with petroleum jelly and insert as shown below into the module. Seal will not function properly installed backwards.
2. Apply sealant on boss of the motor area of the module, and around the motor and mounting through-holes.
3. Place the gasket on the motor after installing sealant.
4. Orientate the motor shaft so that it engages with the pump coupling in the module. (See Figure 4.M.5.3 Motor Seals)
5. Feed the wires and flame path sleeve into the motor wire hole on the module and slide the motor back in place.

CAUTION: Do not force the motor in place or tighten the mounting screws before turning the motor shaft, or damage will occur.

⚠ Apply blue Loctite® and install the four motor washers. Torque the screws in place to 50 lb•in.

7. Re-wire the motor to match the wire colors. For detailed wiring diagram, refer to "C. Circuit Schematics" on page 124.
8. Reinstall the wire cover and torque the cover to 30 ft-lb.

4.M.6 Fill and Overfill/Expansion Relief Valves

NOTE: All B, C, 1 / 2D and D size modules share the same external valves replacement procedures.

4.M.6.1 Disassembly

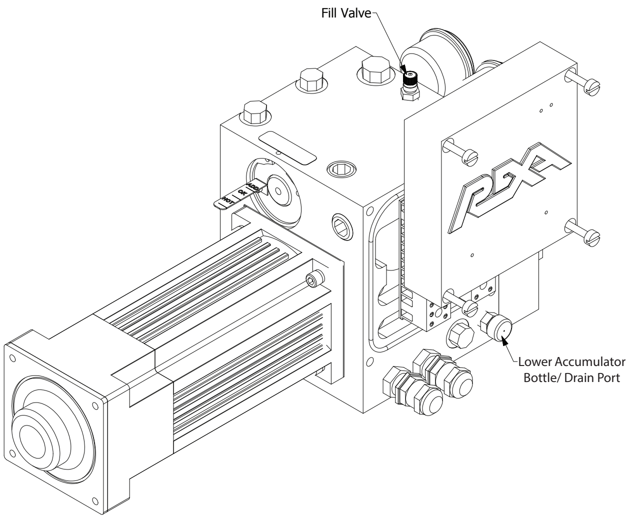


Figure 4.M.6-1 External Valves

1. Remove the overfill/expansion relief valve and the fill valve.
2. Clean out any sealant that may be left.

4.M.6.2 Re-Assembly

1. Coat the threads of the new overfill valve and the fill valve with thread sealant.
2. Screw both valves in place as shown above.

4.M.7 Pressure Limiting Valve

NOTE: If the power module is still attached to the actuator system then make sure all pressure is relieved by turning the bypass counter clockwise. Refer to Figure 4.M.1-1: Linear Cylinder Component Identification. Not doing so may result in damage to unit and or injury to self.

Table 4.M.7 -1

Parts List					
Item	**Description**	**Qty**	**Item**	**Description**	**Qty**
1	Valve Bonnet	1	7	Quad Ring	1
2	Valve Stem	1	8	Star Washer	1
3	Spring Seat	1	9	Valve Seat Retainer	1
4	Spring	1	10	Cap Lock Nut	1
5	Spring Cap	1	11	O-ring - 106	1
6	O-ring - 015	1	12	Valve Seat	1

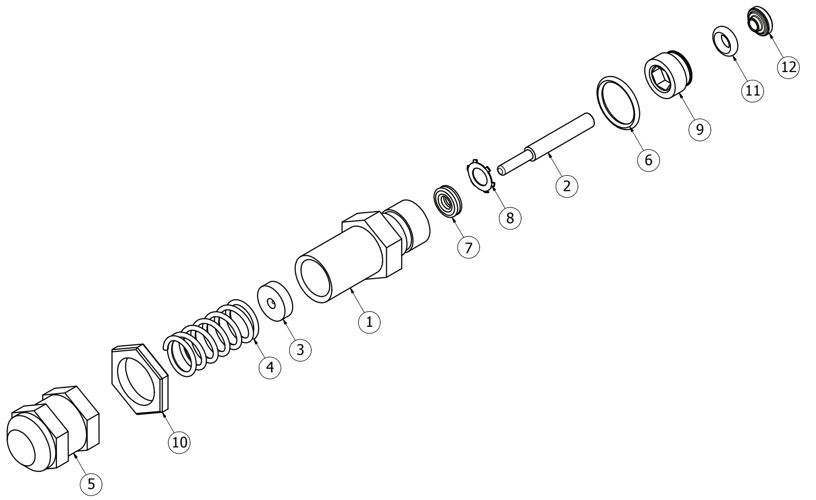


Figure 4.M.7-1 Pressure Limiting Valve

4.M.7.1 Disassembly

1. Loosen the spring cap (5) by turning the cap lock nut (10) clockwise and remove both items.
2. Remove the spring (4) and the spring seat (3).
3. Remove the valve bonnet (1) from the pressure relief cavity of the power module. On the power module side, remove the valve stem (2) and O-ring (6).
4. Using a pick, remove the star washer (8) and the quad ring (7) from the power module side of the pressure relief.
5. Using an allen wrench, remove the valve seat retainer (9).
6. Using a pick, remove the O-ring (11) inside the power module along with the valve seat (12).
7. The pressure relief O-rings (6 & 11) and quad ring (7) can be thrown out after you have located the replacement parts in your rebuild kit.

4.M.7.2 Cleaning and Inspection

1. Clean all components in a brake wash to remove dirt and contaminants.
2. Clean out pressure relief cavity and be careful not to introduce any contaminants into the system
3. Inspect for any metal files or gall marks in the pressure relief cavity

4.M.7.3 Re-Assembly

1. Lubricate the new O-rings (6 & 11) and quad ring (7) before reinstalling.
2. Install the valve seat (12) and O-ring (11) into the power module cavity.
3. Using an allen wrench, place the valve seat retainer (9) into the cavity and torque to 25 lb•in.
4. Install the quad ring (7) and star washer (8) into the power module side of the valve bonnet (1).
5. Apply multi-purpose grease to the tip of the valve stem (2) and insert the valve stem (2) into the power module side of the valve bonnet (1).
6. Install the O-ring (6) onto valve bonnet (1) and insert the valve bonnet (1) into the power module. Torque the valve bonnet (1) to 25 lb•in.
7. Insert the spring seat (3) and spring (4) inside the valve bonnet (1). Install the cap lock nut (10) and spring cap (5) to the outside of the valve bonnet (1).

   NOTE: Refer to "O. Output Load Protection" on page 126 for adjustment range (psi) and spring color.

4.M.8 Drive Train Removal

Parts Required: Module Rebuild Kit

NOTE: All B, C, 1 / 2D and D size modules share the same rebuild procedures. Only the pump internals and coupling shafts are different.

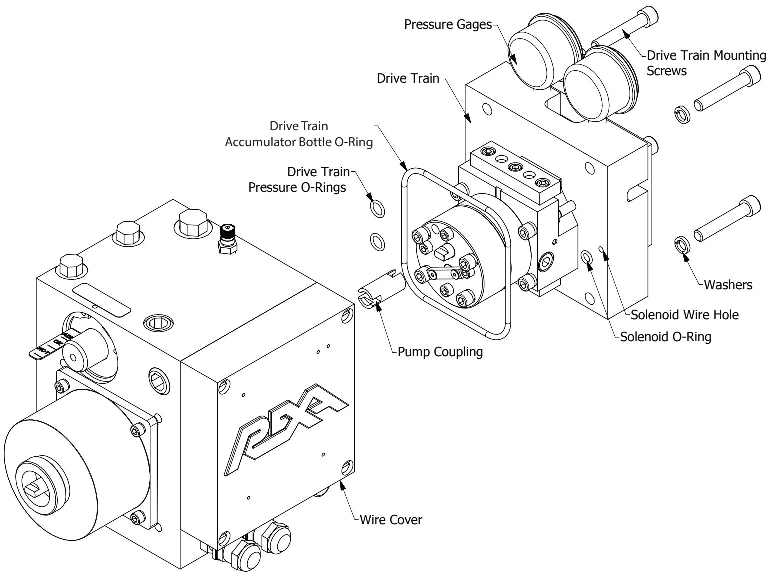


Figure 4.M.8-1 Drive Train

4.M.8.1 Disassembly

1. Ensure the oil has been drained from the module prior to disassembling the power train.
2. For spring fail units only:
    a. Remove four screws holding wire cover on.
    b. Disconnect two white solenoid wires.
3. Remove the four drive train mounting screws and lock washers.
4. Pull the power train assembly straight out.
5. Remove the drive train pressure O-rings, wire cavity O-rings and drive train O-ring.
6. Remove the pump coupling.

4.M.8.2 Cleaning and Inspection

1. Clean out the inside of the module body. It is best if the power train and the motor are completely removed and the body can be completely sprayed out with contact cleaner.
2. Proceed with the drive train rebuild prior to assembly if performing a full rebuild.

4.M.8.3 Re-Assembly

1. Drop the pump coupling shaft into the shaft hole in the module. The B, C, and D shafts can be installed either side first because they are symmetrical. The ½ D shaft will only go in one way. Check the fit of the shaft to the pump for correct orientation.
2. Place the new O-rings into the O-ring grooves of the module. Place a few dabs of petroleum jelly or grease over the O-ring to hold it in place.
3. Align the pump shaft orientation to the coupling so they mate up during installation. Slide the power train assembly back into the module. It is necessary to rotate the motor shaft to allow the pump coupling to align properly.

CAUTION: Do not force the drive train in place or tighten the mounting screws before turning the motor shaft, or damage will occur!

4. Apply blue Loctite® on the drive train screws and install the four lock washers. Torque screws in place to 190 lb·in.

5. For spring fail only:

    a. Feed solenoid wires into the module.

    b. Reconnect both wires to the terminal strip under the wire cover. There is no polarity, so either wire can go to either solenoid terminal.

    c. Reinstall wire cover. Torque wire cover bolts to 50 lb·in.

4.M.8.4 Power Train Rebuild

Parts Required: Module Rebuild Kit

NOTE: All B, C, 1 / 2D and D size modules share the same rebuild procedures. Only the pump internals and coupling shafts are different.

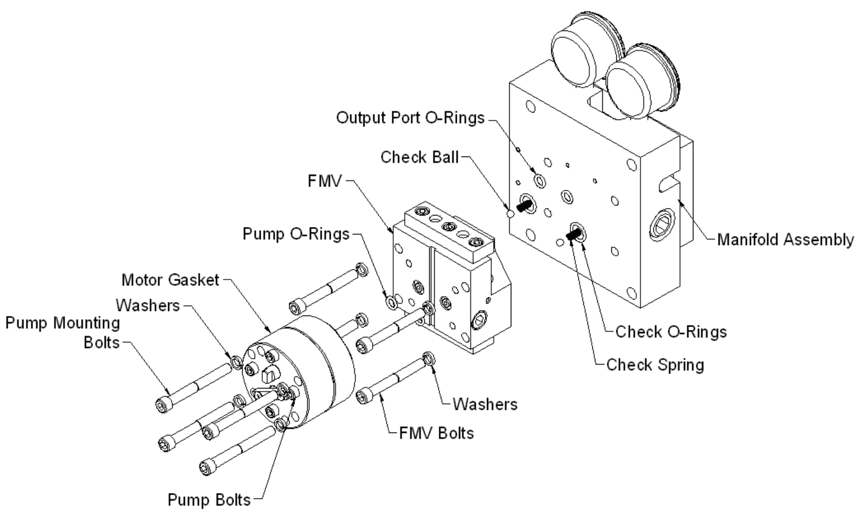


Figure 4.M.8.4-1 Drive Train Rebuild

4.M.8.5 Disassembly

1. Remove the four 1 / 4-20 pump mounting bolts and lock washers. Do not remove the #10-32 pump screws holding the pump together!

2. Separate the pump from the rest of the assembly. Place it driven shaft up. Take extreme care to protect the drive shaft of the pump once it is unbolted. Laying it on its output shaft will cause damage and it will need to be replaced. The pumps are not serviceable and should never be opened or cleaned.

3. Remove both pump O-rings from the face of the flow match valve (FMV).

4. Remove the four 1 / 4-20 flow match valve screws and lock washers.

CAUTION: There are check balls and springs between the two faces. Be careful not to lose these components while separating the flow match valve from the manifold.

5. Remove the four O-rings from the flow match valve face.

4.M.8.6 Cleaning and Inspection

1. The outer surfaces of these components can be cleaned in solvent. Extreme care must be taken to ensure no contaminants enter the pump or flow match valve during cleaning.
2. Turn the pump shaft 360°. It should be free to turn with no binding felt. Replace pump if the shaft will not turn or binding is felt.
3. Continue to the suction check valve replacement and manifold rebuild before reassembly if a full rebuild is being preformed.

4.M.8.7 Re-Assembly

1. Place new O-rings into the O-ring groove of the flow match valve face. Place a few dabs of petroleum jelly over the O-ring to hold them in place.
2. Insert a check ball then a check spring into each hole on the flow match valve.
3. Align the flow match valve to the manifold as shown in Figure 4.M.8.4. The gauges are on the top side along with the corner cutouts of the flow match valve. Apply blue Loctite® on the flow match screws and install the 4 lock washers. Torque the 4 screws in place to 100 lb·in.

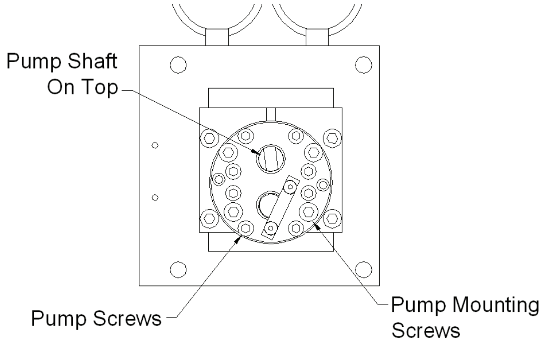


Figure 4.M.8.7-1 Flow Match Valve Face

4. Align the pump to the flow match valve as shown Figure 4.M.8.7. Note the location of the pump driven shaft. Apply blue Loctite® on the pump screws and install the four lock washers. Torque the screws in place to 100 lb·in.

4.M.9 Suction Check Valve

Parts Required: Suction Check Rebuild Kit

NOTE: All B, C, 1 / 2D and D size modules share the same rebuild procedures.

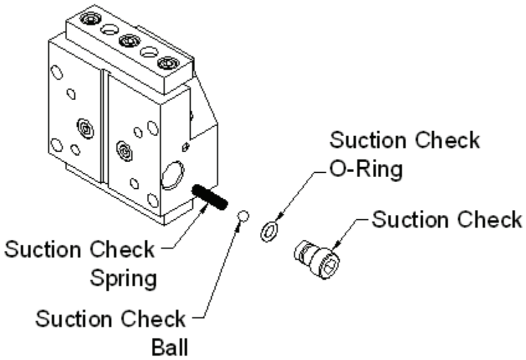


Figure 4.M.9-1 Suction Check Valve

4.M.9.1 Disassembly

1. Unthread the suction check valve.
2. Remove the suction check valve O-ring
3. Remove the suction check ball and the suction check spring from the flow match body.

4.M.9.2 Cleaning and Inspection

1. The suction check cavity can be cleaned with brake wash but care must be taken not to introduce any contaminants into the valve.

4.M.9.3 Re-Assembly

1. Slide the new suction check spring into the valve cavity of the flow match valve.
2. Set a new suction ball onto the spring.
3. Install a new suction check O-ring into the groove on the suction check. Thread in the suction check valve and torque to 250 lb·in.

4.M.10 Standard Manifold Rebuild

Parts Required: Module Rebuild Kit

NOTE: All B, C, 1 / 2D and D size modules share the same rebuild procedures; however, slow speed spring fail units are different. High temperature units also share the same procedure; however, high temperature kits are available with different materials.

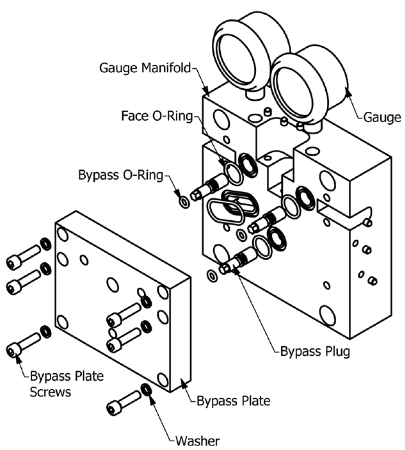


Figure 4.M.10-1 Manifold

4.M.10.1 Disassembly

1. Unthread the six bypass plate screws.
2. Remove the bypass plate.
3. Unthread all three bypass plugs from the bypass plate.
4. Remove the four face O-rings from the gauge manifold.
5. Remove the gauges—if they are being replaced—at this time. If the unit is a high temperature unit it will not have gauges installed…the ports will be plugged.

4.M.10.2 Cleaning and Inspection

Clean the bypass plate and the gauge manifold with brake wash. Ensure no contaminants are allowed to enter the ports of the gauge manifold.

4.M.10.3 Re-Assembly

1. Install new bypass plug O-rings into the O-ring groove of the bypass plug. Lubricate the O-rings with petroleum jelly. Repeat this for all three plugs. Be careful to avoid sliding the O-ring over the threads of the bypass plug, which can cause damage to the O-ring.

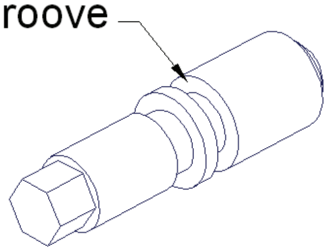


Figure 4.M.10.3-1 O-Ring Grooves

2. Thread the three bypass plugs into the bypass plate. Once the hex protrudes through the plate enough, use a hex head screw driver and thread the plug until it bottoms into the plate.

   NOTE: If this is not done, the plugs will keep this plate from mounting properly in the following steps.

3. Install the four face O-rings into the O-ring grooves of the gauge manifold. Use petroleum jelly or grease to hold the O-rings in place.

4. Align the bypass plate with the gauge manifold, apply blue Loctite® on the bypass plate screws and install the washers. Torque to 50 lb·in.

4.M.11 Solenoid

Parts Required: Solenoid Rebuild Kit

NOTE: All B, C, 1 / 2D and D size modules share the same rebuild procedures. High temperature units also share the same procedure; however, high temperature kits are available with different materials.

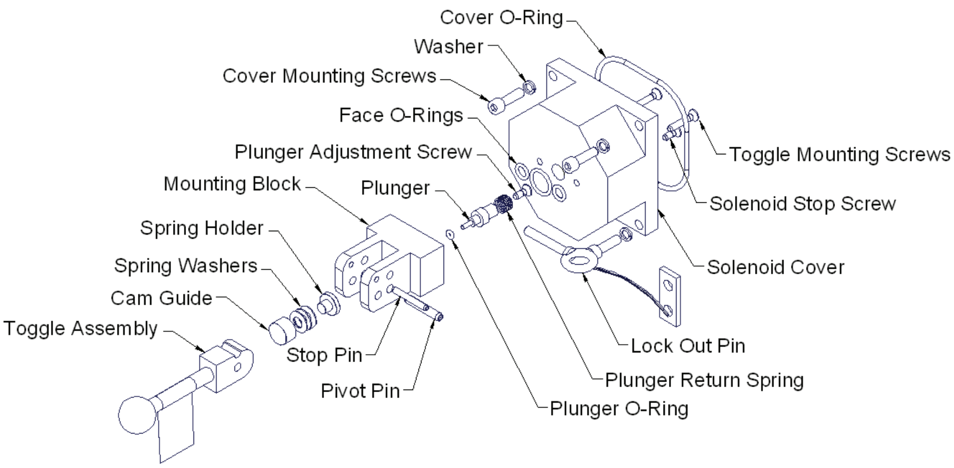


Figure 4.M.11-1 Solenoid Cover

4.M.11.1 Disassembly (Solenoid Cover)

1. Remove the cover mounting screws and washers.
2. Remove the solenoid cover and cover O-ring.
3. Remove the two toggle mounting screws and O-rings
4. Remove the three face O-rings.
5. Remove the plunger return spring, plunger and plunger O-ring.
6. Tap out the Pivot Pin in order to remove the toggle assembly, cam guide, spring washers and spring holder.

4.M.11.2 Cleaning and Inspection (Solenoid Cover)

Clean all components with brake wash.

4.M.11.3 Re-Assembly (Solenoid Cover)

1. Locate the three new spring washers from the rebuild kit. Install them onto the spring holder as shown below. Note the "bow" location of the spring washers in the diagram, installing the springs in the wrong orientation will cause the bypass not to function.

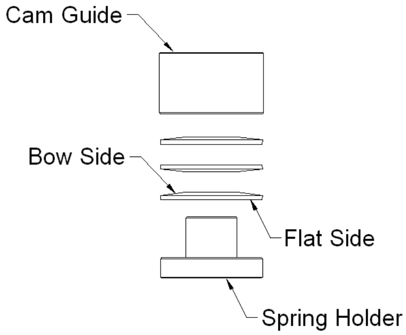


Figure 4.M.11.3-1 Spring Washers

2. Install the Cam guide over the springs and onto the spring holder as shown above.
3. Place the spring assembly into the mounting block, spring holder side first.

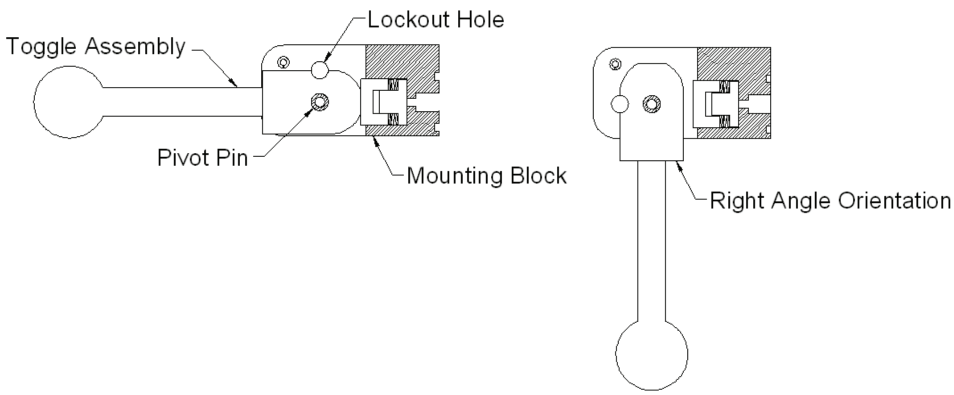


Figure 4.M.11.3-2 Toggle Assembly

4. Align the toggle assembly as shown above into the mounting block; note the location of the Lock-Out hole. Press the new pivot pin in place.

5. Lubricate the new O-rings. Slide the plunger O-ring over the small diameter of the plunger, and down to the first shoulder as shown below.

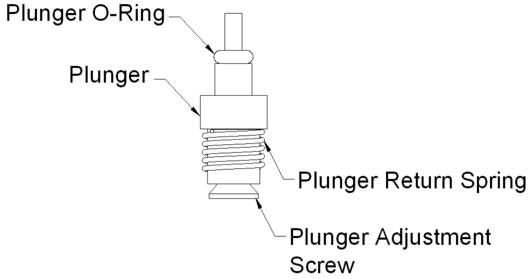


Figure 4.M.11.3-3 Plunger

6. Slide the plunger return spring over the plunger as shown above and install the plunger adjustment screw into the bottom of the plunger until tight.

7. Insert the plunger assembly into the mounting block as shown below.

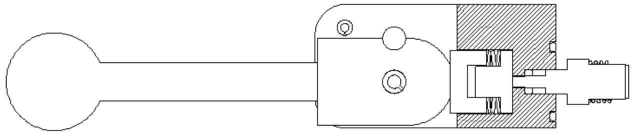


Figure 4.M.11.3-4 Mounting Block

8. Place the three face O-rings into the O-ring grooves of the mounting block. Coat the O-rings with petroleum jelly to hold them in place during assembly.

9. Continue onto the setup, TS&R section 4.M.12.

4.M.11.4 Disassembly (Solenoid Manifold)

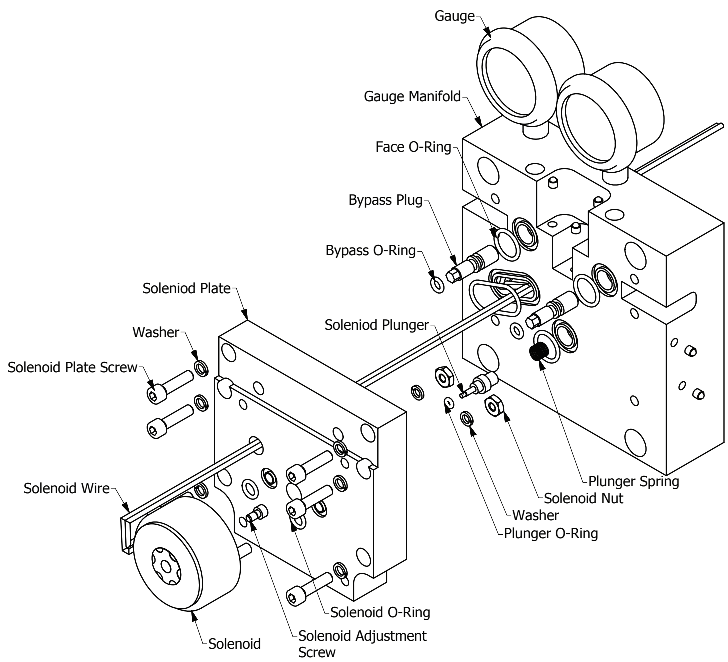


Figure 4.M.11.4-1 Solenoid Manifold

NOTE: Mark position of solenoid wires on terminal strip. There is no polarity, so either wire can go to either solenoid terminal.

1. Ensure power is off. Remove solenoid wire from terminal strip.
2. Remove the solenoid plate screws and the solenoid plate.
3. Locate and remove all four face O-rings and the plunger spring.
4. Remove the solenoid plunger and the plunger O-ring.
5. Unthread both bypass plugs from the solenoid plate.
6. Remove both bypass O-rings from the bypass plugs.
7. Remove the solenoid nuts, solenoid O-rings and the solenoid.
8. If the solenoid is replaced remove the solenoid adjustment screw.

4.M.11.5 Cleaning and Inspection (Solenoid Manifold)

Clean all components with brake wash.

4.M.11.6 Re-Assembly (Solenoid Manifold)

1. Install the solenoid adjustment screw into the solenoid if a new solenoid is being installed.
2. Place the solenoid O-rings into the grooves on the solenoid plate. Coat the O-rings with petroleum jelly or grease to hold them in place.
3. Install the solenoid so that the two mounting studs slide through the O-ring holes. Thread solenoid wires through solenoid manifold.
4. Install the washers and solenoid nuts to hold the solenoid in place.
5. Install new bypass plug O-rings into the O-ring groove of the bypass plug. Lubricate O-rings with petroleum jelly. Repeat this for both plugs. Be careful to avoid sliding the O-ring over the threads of the bypass plug which can cause damage to the O-ring.

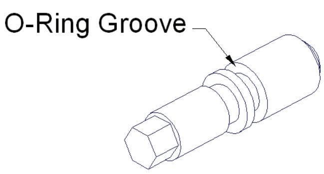


Figure 4.M.11.6-1 Bypass Plug

6. Thread both bypass plugs into the solenoid plate. Once the hex protrudes through the plate enough, use a hex head screw driver and thread the plug in until it bottoms into the plate. If this is not done the plugs will keep this plate from mounting properly later in the following steps. Feed solenoid wires through solenoid plate and engage manifold according to Figure 4.M.11.4.
7. Install the four face O-rings into the O-ring grooves of the gauge manifold. Use petroleum jelly to hold the O-rings in place.
8. Coat the plunger O-ring with petroleum jelly for lubrication. Slide this O-ring over the solenoid plunger as shown below. Slide the plunger spring over the solenoid plunger as shown below.

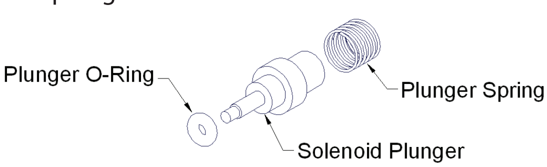


Figure 4.M.11.6-2 Solenoid Manifold Plunger

9. Insert the solenoid plunger assembly into the center hole of the solenoid plate. It will slide in O-ring side first. Feed solenoid wires through power module to heater cavity junction box. Terminate accordingly.

10. Making sure the plunger spring stays in place, align the solenoid plate to the gauge manifold, apply blue Loctite® on the solenoid plate screws and install the washers. Torque to 50 lb·in.

4.M.12 Solenoid Set Up

1. Press in on the solenoid plunger and measure the gap between the plunger and solenoid body using feeler gauges. The gap should measure 0.015 inches. If this measurement is out of specification it will be necessary to remove the plunger and readjust the solenoid adjustment screw.

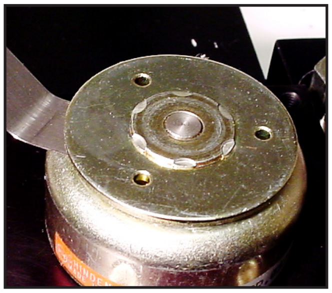


Photo 4.M.12-1 Plunger Gap

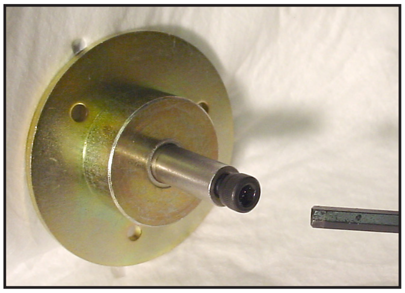


Photo 4.M.12-2 Plunger

2. Toggle the cover / latch assembly into the latched position shown below (the lever in the vertical position).

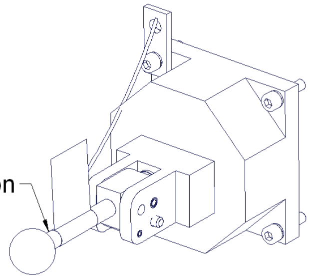


Figure 4.M.12-3 Cover / Latch Assembly

3. Remove plunger adjusting screw, apply blue Loctite®, and replace screw. Re-apply power to the actuator.

4. With the solenoid energized, place the cover / latch assembly over the solenoid, aligning the notch in the cover with the solenoid wires.

   a. Measure the gap between the bottom of the cover and the solenoid mounting plate. The gap should measure .020 inches. The best way to measure the gap is to insert one .020 feeler gauge under one edge of the cover and press down on the cover directly over the gauge. Now insert the other .020 feeler gauge under the cover directly opposite the first gauge as shown below.

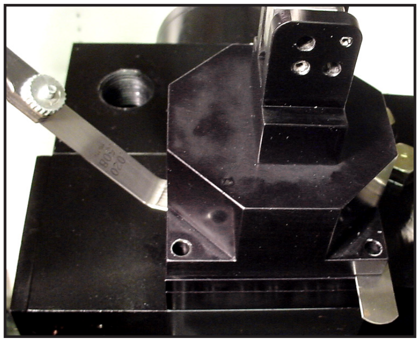


Photo 4.M.12-4 Cover / Mounting Plate

b. Adjust the gap to .020 inches by removing the cover and turning the screw directly in the center of the cover cavity in or out until the desired gap is achieved. Re-adjust as required to achieve the proper gap.

c. Place the lever in the unlatched position and attach the cover.

d. Remove the cover and re-set the gap in step b.

e. Reinstall the cover with the lever in the unlatched position.

NOTE: A Padlock with 3/16" diameter shank may be used in place of the tethered pin to prevent unauthorized toggling of the lever.

f. Install the tethered pin to lock the handle in place.

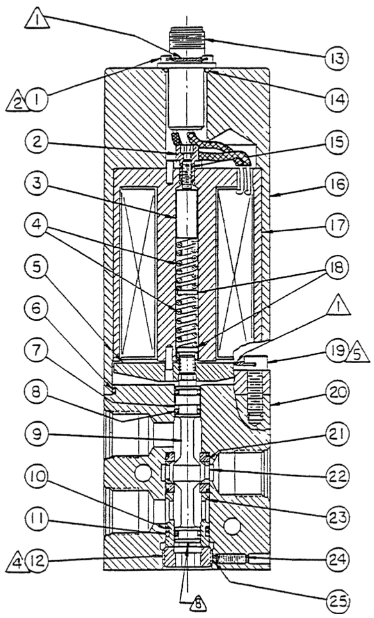


Figure 4.M.14-1 Solenoid Cutaway

Table 4.M.14-1 Solenoid Cutaway

ID No.	Description	ID No.	Description
1	Screws	14	O-ring
2	Set screw	15	Set screw
3	Spring pad	16	Coil housing
4	Springs	17	Coil Assembly
5	Armature	18	Spring pads
6	O-ring	19	Socket head screws
7	Backup rings	20	Valve body
8	O-rings	21	Seat assemblies
9	Poppet	22	Cage
10	O-rings	23	Guide
11	Backup rings	24	Set screw
12	Retainer	25	Locking pad
13	Electrical connector		

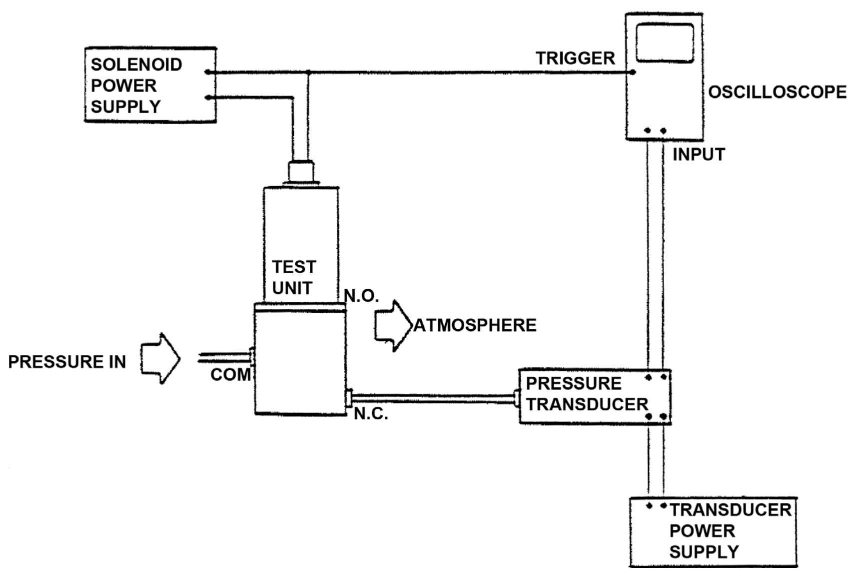


Figure 4.M.14-2 High Speed Solenoid Layout

4.M.13 Solenoid Testing

1. Stroke the unit against the spring until the end of stroke is reached. Remove power to trip the solenoid. The actuator should begin to move immediately, except in the case of a B module Class 1 Division 2 which can take up to 10 seconds to begin moving.

2. Reapply power to the actuator and immediately stroke the unit fully against the spring. Solenoid must re-engage immediately upon power up. If it does not, proceed to the next step for adjustment of the solenoid open travel stop.

Setup of the Open Stop

a. Remove the cover / latch assembly. Back out the adjustment screw in the cover cavity ¼ turn and retest. Continue to adjust at ¼ turn intervals and retest as required until the re-latching of the solenoid is immediate.

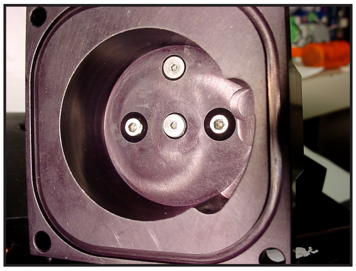


Figure 4.M.13-1 Latching Cover

Verification of Manual Latching Operation

b. In LOCAL mode stroke the actuator against the spring to the end of travel. Record current position. Manually latch the solenoid and turn power off.

c. Observing the CPU display may test rotary units drift. No drift is to be allowed for 5 minutes.

4.M.14 High Speed Solenoids

This section describes installation of Repair Kit Parts and subsequent testing on this solenoid valve. The repair kit allows users of solenoid valve to update the subject valve to the latest configuration at their own discretion.

Installation of Repair Kit Parts into existing solenoid valves is available. However, for those valve users choosing to perform their own installation, the following information is provided.

4.M.14.1 Description of Valve

1. Solenoid valve is a 3 way, 2 position solenoid valve.

2. When the solenoid coil is de-energized the NO port is connected to the COM port, and the NC port is closed. Sealing force on the NC seat is provided by springs within the solenoid assembly. When the solenoid coil is energized the NC port is connected to the COM port, and the NO port is closed. Sealing force on the NO seat is provided by the energized solenoid coil.

4.M.14.2 Equipment Requirement

1. Regulated pressure source, 0 to 3 000 psig clean air.

2. Electric power supply to match solenoid voltage, 2 amperes minimum.

3. Torque wrench, audible adjustable, 5 to 150 lb·in.

4. Torque wrench, dial style, memory pointer, 0 to 30 lb·in.

5. Pressure transducer, fast response, 0 to 3 000 psig.

4.M.14.3 Disassembly

1. Remove four socket head screws (19) securing solenoid assembly to valve body (20). Orient whole unit with solenoid below valve body when pulling two sections apart as there are loose parts within solenoid.
2. After completing above procedure, note relative distance between armature (5) and valve body for later use. Remove armature from poppet. Hold armature while turning poppet counterclockwise utilizing slot in opposite end of poppet from armature.
3. Loosen set screw (24) 2 to 3 turns. Do not remove set screw or locking pad (25) unless replacement is necessary. Remove retainer (12).
4. To remove internal valve components, push against threaded end of poppet until components can be removed from valve body. Check inside valve body for possibility of an O-ring remaining, and remove.
5. Discard all items from valve for which replacement parts are included in the Repair Kit.

4.M.14.4 Cleaning and Examination of Parts

1. Clean metal valve components using commercial cleaning solvents or detergent solutions. DO NOT wash solenoid assembly.
2. Visually inspect all metal parts for nicks, scratches, or other damage that can affect valve performance. Examine the bores in valve body (20) and guide (23) for nicks and scratches that can affect a-ring sealing.

4.M.14.5 Initial Assembly

1. O-rings are lightly lubricated with Monsanto MCS 352 or BAC 5001 or DAC ACO-DPM 5073.
2. Assemble cage (22), seat assemblies (21), O-rings (8), backup rings (7), O-rings (10). Guide (23), and backup rings (11) onto poppet (9) with the exception of one O-ring (10) used on seat assembly nearest threaded end of poppet. Place this one O-ring into its final location within valve body (20).
3. Insert poppet and associated components into valve body. Using 3 / 8 hex wrench secure retainer (12). Torque retainer 8 to 10 lb·ft. Tighten set screw (24) to secure retainer.
4. Apply small amount of anti-seize compound to threads on poppet (9). Thread armature assembly (5) onto poppet to approximate location of preceding section 4.M.14.3, step #2.
5. Remove four screws (1) securing electrical connector (13). Raise connector sufficiently to access space beneath. Using 5 / 64 hex wrench, turn set screw (15) 3 to 4 turns counterclockwise, from electrical connector end.
6. Assemble spring pad (3), springs (4), and spring pads (18) into coil assembly (17). While aligning pin extending from coil assembly with hole in armature assembly, place valve body assembly onto coil housing (16). Pin must align with hole to avoid damage. Secure coil housing (16) to valve body (20) (orientation optional) using four cap screws (19). Torque 55 to 57 lb·ft.

4.M.14.6 Adjustment and Final Assembly

1. Cap COM port. Connect air pressure source to NO port NC port open to atmosphere. Energize solenoid coil via electrical connector pins A and B, polarity optional, with approximately 24 Vdc. Turn poppet (9) counterclockwise until air just starts to flow from NC port. Then turn poppet clockwise until air flow just ceases. DE•ENERGIZE COIL. Turn poppet an additional 1 / 8 to 1 / 4 turn clockwise.
2. Using 5 / 64 hex wrench, turn set screw (15) clockwise until solenoid pull-in voltage is 70% of rated voltage.
3. NC port open to atmosphere with muffler. Increase air pressure at NO port to 3 000 psig. Cycle valve fifteen times minimum using 70% of the valves rated voltage. Valve operation shall be sharp and without hesitation.

4.M.14.7 Final Tests

1. Cap COM port. Connect air pressure source to NO port. NC port open to atmosphere. Energize solenoid coil via electrical connector pins A and B. Turn poppet (9) counterclockwise until air just starts to flow from NC port. Then turn poppet clockwise until air flow just ceases. DE-ENERGIZE COIL. Turn poppet an additional 1 / 8 to 1 / 4 turn clockwise.

2. Using 5 / 64 hex wrench, turn set screw (15) until solenoid pull-in voltage is nearly 70% of rated voltage. Turn clockwise to increase voltage, counterclockwise to lower voltage.

3. Secure electrical connector (13) to coil housing (16) with four screws (1). 2 Torque screws 8 to 10 inch-pounds.

4. Pull-In Voltage Test

    a. Cap NO port. NC port open to atmosphere with muffler. Apply 3000 psig air to COM port. Starting at zero volts, gradually increase voltage to solenoid until valve actuates. Valve shall actuate at or below 70% of rated voltage. Remove pressure and voltage.

5. External Leakage and Proof Pressure Test

    a. Cap NO and NC ports. Solenoid coil de-energized. Apply 4500 psig air to COM port for one (1) minute. There shall be no signs of external leakage or damage.

    b. Cap NO and NC ports. Energize solenoid coil with 24 Vdc. Apply 4500 psig air to COM port for one (1) minute. There shall be no signs of external leakage or damage. Remove pressure and voltage.

6. Internal Leakage Test

    a. Cap NO port. Solenoid coil de-energized. Apply 3000 psig air to COM port. Leakage at NC port not to exceed 1 bubble in 2 minutes. Reduce pressure to zero.

    b. Cap NC port. Energize solenoid coil with 24 Vdc. Apply 3000 psig air to COM port. Leakage at NO port not to exceed 1 bubble in 2 minutes. Reduce pressure to zero.

7. Testing completed.

4.M.15 Hand Wheel / Drill Drive

Parts Required: Hand Wheel Kit

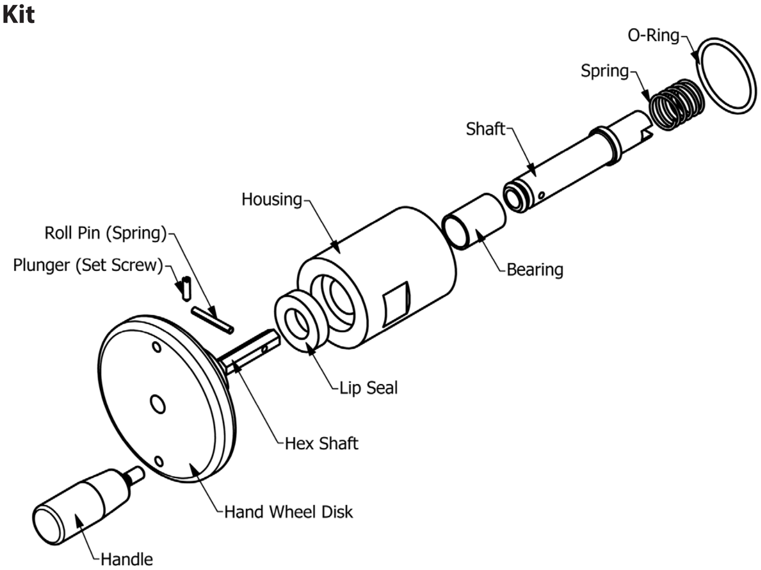


Figure 4.M.15-1 Handwheel / Drilldrive

4.M.15.1 Disassembly

1. Refer to Figure 4.M.15 and remove the hand wheel from the back end of the motor by unscrewing the housing.
2. Remove the spring.
3. Remove the O-ring.

4.M.15.2 Re-Assembly

1. Replace the spring.
2. Replace the O-ring.
3. Screw hand wheel back onto the end of the motor.

4.M.16 Hand Pump

The manual hydraulic pump needs only the cylinder side of the hydraulic circuit and the FMV check valves to be in working order. If the gear pump or suction check valves fail, the manual hydraulic pump will still provide a means for manual operation.

4.M.16.1 Removal

1. Turn off power to the unit. Open bypass and confirm that there is no internal pressure.
2. Clamp the oil level indicator. Refer to TS&R Appendix F for information on indicator clamping.
3. Place an oil drain pan under the hand pump.
4. Remove any tubing connected to the hand pump and mounting plates.
5. Unscrew the bolts that connect the hand pump to the mounting plate.
6. Remove the mounting plate from the hand pump.

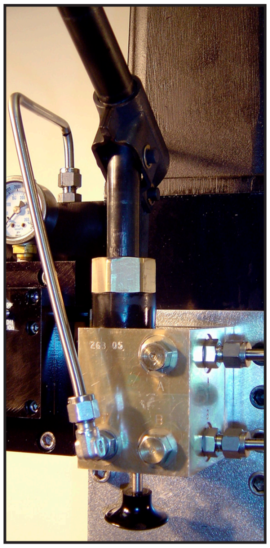


Photo 4.M.16-1
Manual Hand Pump

4.M.16.2 Replacement

1. Attach the mounting plate to the new hand pump.
2. Replace hand pump and mounting plate assembly to the original position.
3. Re-attach the tubing to the hand pump.
4. Unclamp oil level indicator and bleed the unit.
5. To operate the hand pump, insert lever into the piston assembly and pump the handle up and down.
6. To reverse the direction of the pump either push in or pull out on the black knob located on the bottom of the pump.

   NOTE: It is not advisable to leave the lever in the piston assembly when the hydraulic pump is not in use.

4.M.17 Recharge Module

Actuators with online accumulator recharge systems will have a recharge module in addition to the main power module(s). The online accumulator may be bolted onto a dual manifold or it may be a stand-alone recharge module. The recharge module design principles are similar to the power module consisting of a motor, a pumping system and a housing assembly with a threaded on cover.

The key identifying features to distinguish the online recharge module from the explosion proof power modules are (1) the flow control manifold/solenoid assembly bolted onto the power module; and/or; (2) the single pressure relief valve below the threaded on cover; the recharge module does not have an integral oil level.

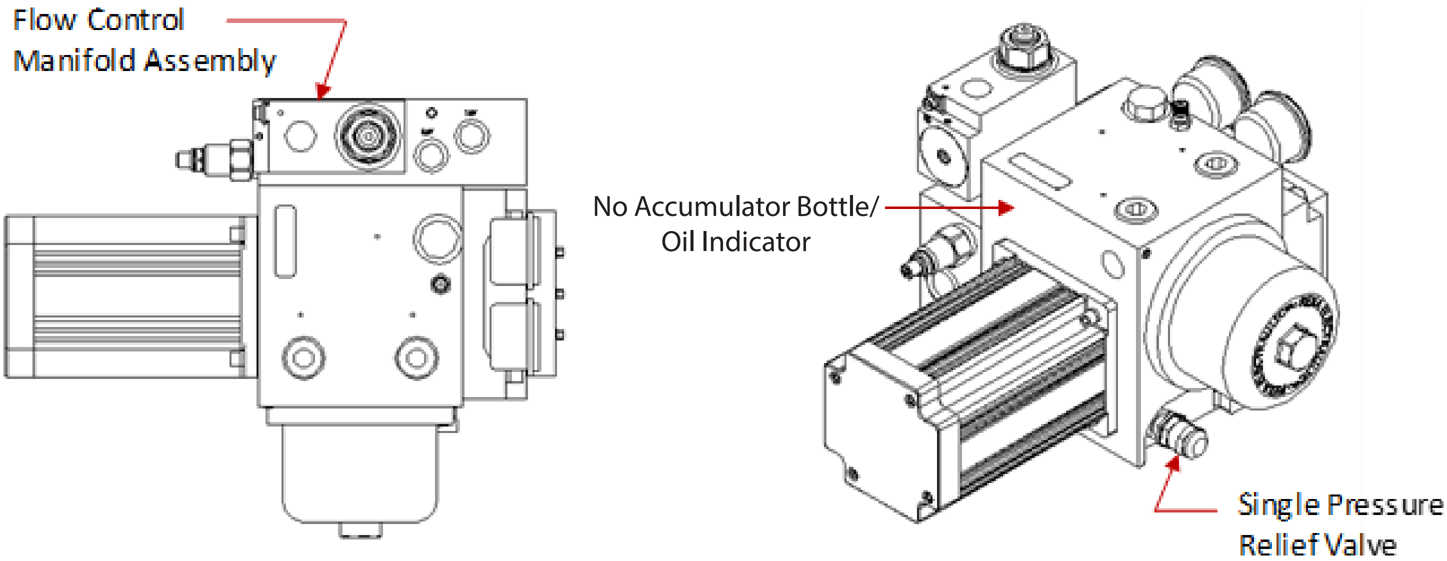


Figure 4.M.17-1 0.3C Recharge Module

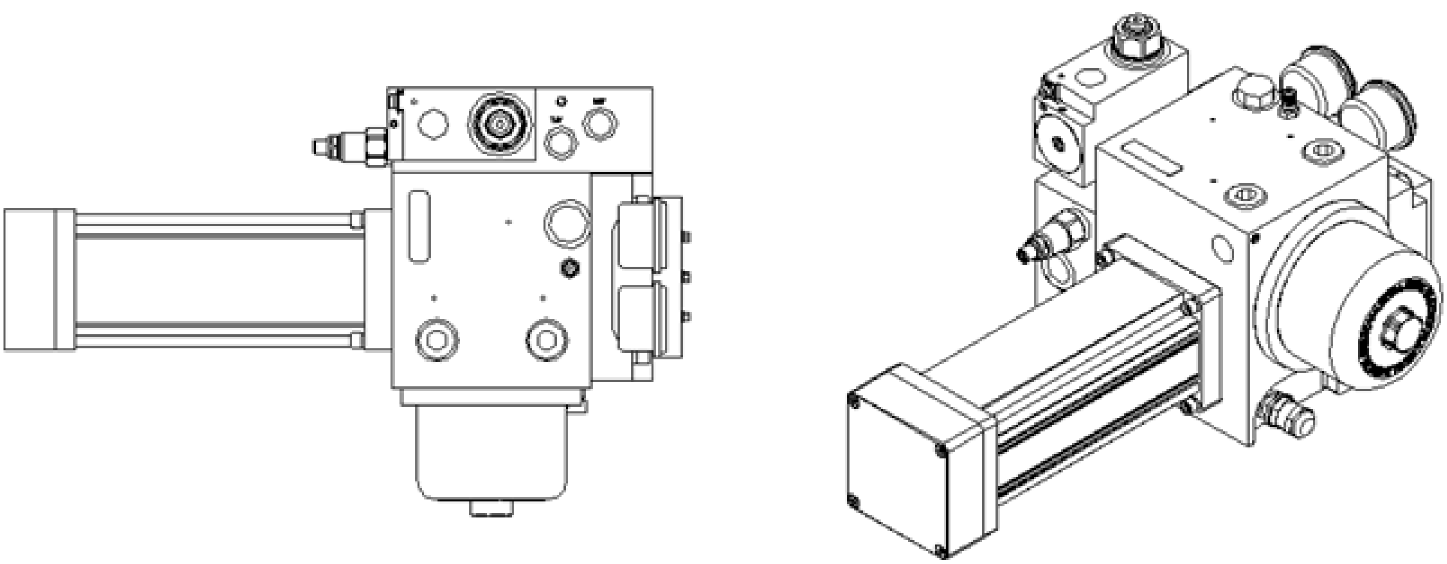


Photo 4.M.17-2 D Recharge Module

Service of the motor, motor seals, module, electrical compartment and threaded on cover assembly are the same as the explosion proof power modules. Subassemblies that are different are the drive train and flow control manifold assemblies which will be covered in detail in the subsequent sections.

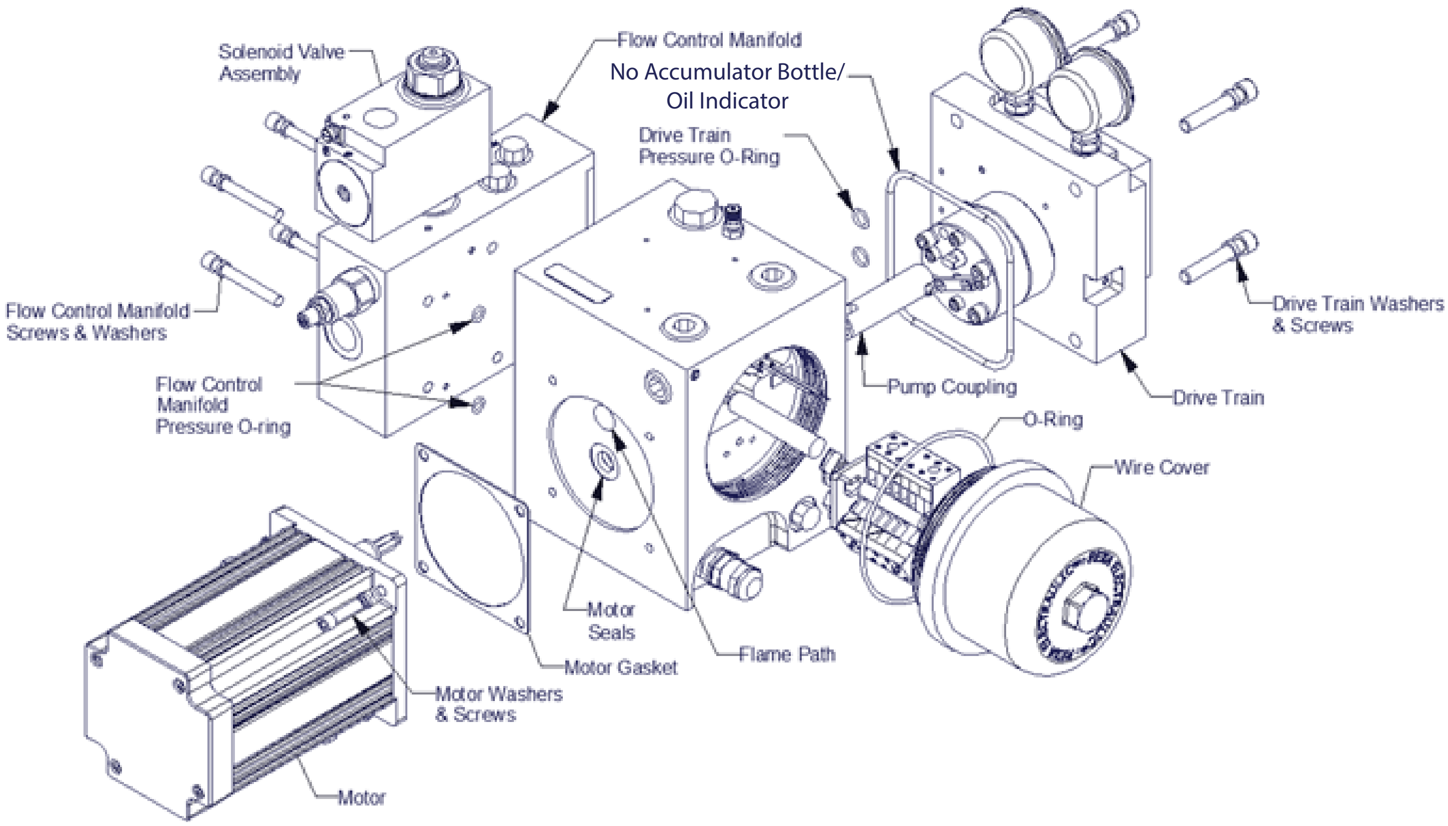


Photo 4.M.17-3 Recharge Module Assembly

The recharge module drive train's design is similar to the standard REXA power module drive train, except the flow match valve is eliminated since the online recharge motor is required to only spins in one direction to recharge the accumulator. The pump is bolted directly onto the gage block manifold which has an integral suction check and check valve. A long pump coupling connects the motor shaft output to the pump drive shaft.

4.M.17.1 Recharge Module Drive Disassembly

1. Ensure the oil has been drained from the recharge module prior to disassembling of the recharge module drive train.
2. Remove the 0.312-18 recharge module drive train mounting screws and lock washers.
3. Pull the power train assembly straight out.
4. Remove the drive train pressure O-rings and drive train O-ring.
5. Remove the pump coupling.

4.M.17.2 Cleaning and Inspection

1. Clean out the inside of the module body. It is best if the motor is completely removed and the body can be completely sprayed out with contact cleaner.
2. Proceed with the recharge module drive train rebuild prior to assembly if performing a full rebuild.

4.M.17.3 Re-Assembly

1. Drop the pump coupling shaft into the shaft hole in the module. The 0.3C and D pump shaft will only go in one way. Check the fit of the shaft to the pump for correct orientation.

2. Place the new O-rings into the O-ring grooves of the module. Place a few dabs of petroleum jelly or grease over the O-ring to hold it in place.

3. Align the pump shaft orientation to the coupling so they mate up during installation. Slide the power train assembly back into the module. It is necessary to rotate the motor shaft to allow the pump coupling to align properly.

CAUTION: Do not force the drive train in place or tighten the mounting screws before turning themotor shaft, or damage will occur!

4. Apply blue Loctite® on the drive train screws and install the four lock washers. Torque screws in place to 190 lb·in [22 Nm].

Recharge Module Flow Control Manifold Removal & Assembly:

4.M.17.4 Flow Control Manifold Disassembly

1. Ensure the oil has been drained from the recharge module prior to removing the flow control manifold.

2. If the recharge module is attached to a dual manifold, remove the recharge module from the dual manifold. Then remove the four 0.250-20 flow control mounting screws and lock washers.

3. Pull the recharge flow control manifold straight out to detach from the recharge module manifold.

4. Remove the recharge flow manifold O-rings.

4.M.17.5? Cleaning and Inspection

1. Inspect and clean the mounting interfaces. Inspect the o-rings for signs of tear.

2. Proceed with the control manifold rebuild prior to assembly if performing a full rebuild.

4.M.17.6 Re-Assembly

1. Place the new O-rings into the O-ring grooves of the module. Place a few dabs of petroleum jelly or grease over the O-ring to hold it in place.

2. Apply blue Loctite® on the flow control manifold screws and install the four lock washers. Torque screws in place to 125 lb·in (14 N-m).

4.M.17.7 Recharge Module Drive Train Rebuild

Parts Required: Recharge Module Rebuild Kit

NOTE: 0.3C and D size recharge modules share the same rebuild procedures. Only the pump internals and pump coupling shafts are different. The illustration below will focus only on the 0.3C recharge module.

4.M.7.8 Disassembly

1. Remove the four 1/4-20 pump mounting bolts and lock washers. Do not remove the #10-32 pump screws holding the pump together!

2. Separate the pump from the rest of the assembly. Place its driven shaft facing up. Take extreme care to protect the drive shaft of the pump once it is unbolted. Laying it on its output shaft will cause damage and it will need to be replaced. The pumps are not serviceable and should never be opened or cleaned.

3. Remove both pump O-rings from the face of the Online Recharge Gauge Manifold.

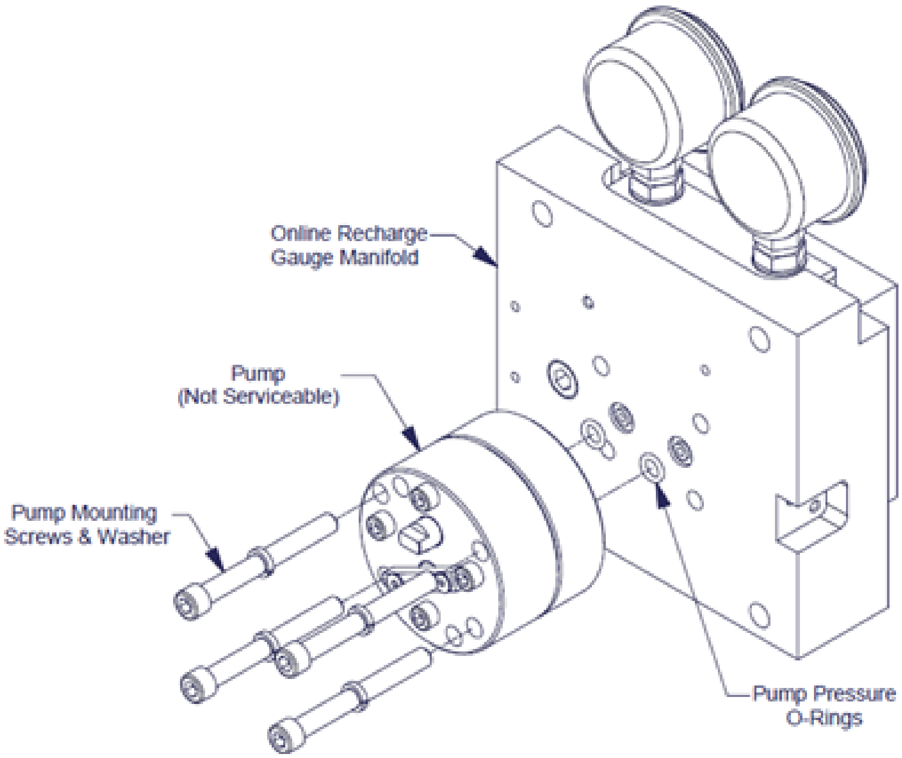


Photo 4.M.17.8-1 Online Recharge Gauge Manifold

4. Remove both pump O-rings from the face of the Online Recharge Gauge Manifold.

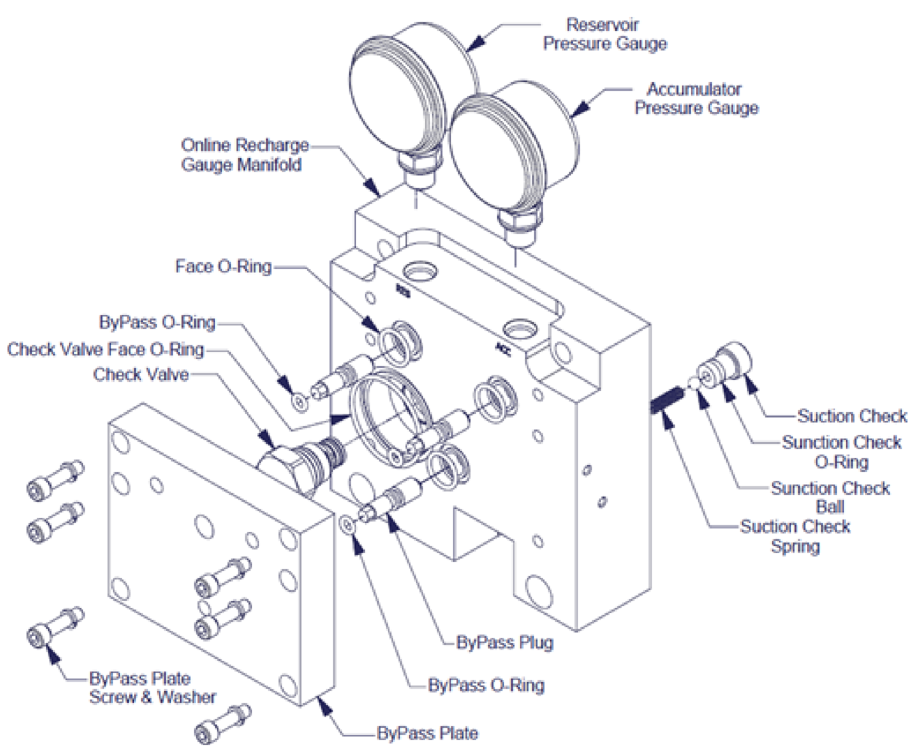


Photo 4.M.17.8-2 Online Recharge Gauge Manifold with O Rings

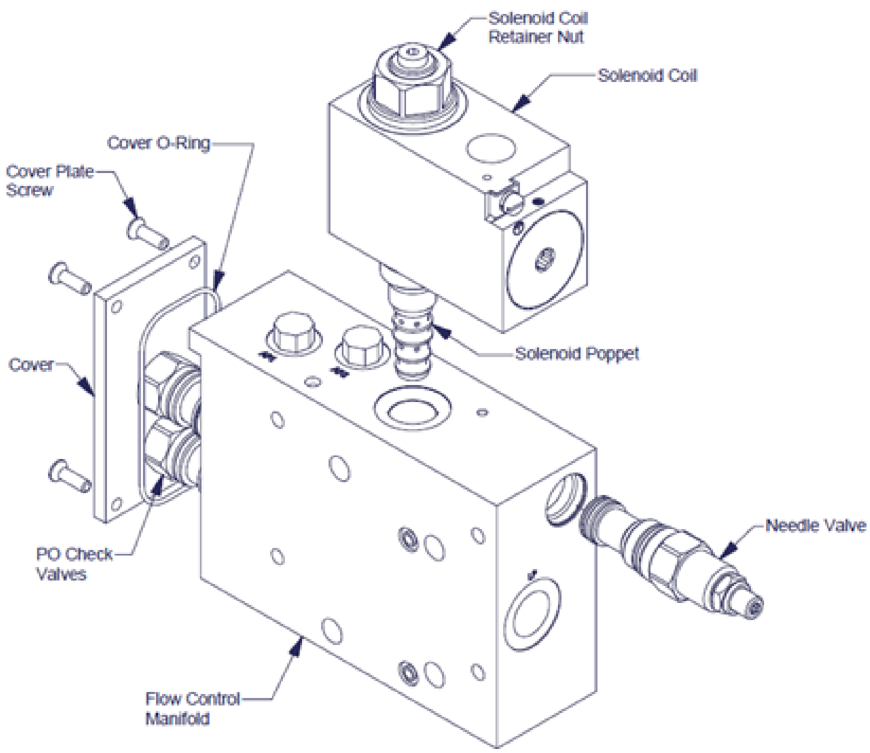


Photo 4.M.17.8-3 Online Recharge Solenoid Manifold

4.M. 17.9 Cleaning and Inspection

1. The outer surfaces of these components can be cleaned in solvent. Extreme care must be taken to ensure no contaminants enter the pump or the gauge manifold during cleaning.

2. Turn the pump shaft 360°. It should be free to turn with no binding felt. Replace pump if the shaft will not turn or binding is felt.

3. Continue to the suction check valve replacement and manifold rebuild before reassembly if a full rebuild is being performed.

4.M. 17.10 Re-Assembly

1. Insert a check ball then a check spring into suction check valve bore on the gage manifold. Torque the suction check to 200 in-lb. Ensure that the head of the suction check valve is flushed or recessed into the gauge manifold; otherwise the suction check valve will prevent the pump from mounting flushed against the gauge manifold

2. Place new O-rings into the O-ring grooves of the gage manifold where the pump is attached. Place a few dabs of petroleum jelly over the O-ring to hold them in place.

3. Align the pump to the gauge manifold as shown Figure 4.M.?.?. Note the location of the pump driven shaft. Apply blue Loctite® on the pump screws and install the four lock washers. Torque the screws in place to 100 lb·in. Note that the pump needs to sit flushed against the gauge manifold.

4. The bypass plate disassembly and reassembly is the same as that on the standard power module. Refer to Figure 4.M.?.?. If performing a complete rebuild, replace the check valve and check valve o-ring. Lubricate the check valve o-rings and face seal o-rings with petroleum jelly. Thread the check valve in the gauge manifold and torque the check valve to 20-25 ft-lb.

5. Replace all by-pass o-rings and face o-rings. Reassemble the by-pass plate onto the gauge manifold. Install the washers, apply blue Loctite® on the bypass plate screws and torque to 50 lb-in.

4.M.17.11 Recharge Module Flow Control Manifold Rebuild

Parts Required: Recharge Module Rebuild Kit?

4.M.17.12 Disassembly

1. Remove the #10-32 FHSS cover plate screws to access the pilot to open (PO) check valves.
2. Remove the cover plate o-rings.
3. Untorque the PO check valves and pull straight out.
4. Untorque the needle valve and pull straight out.
5. Loosen and remove the solenoid coil retaining nut and retaining nut o-ring.
6. Slide the solenoid coil straight up and set aside.
7. Untorque and remove the solenoid poppet and solenoid coil o-ring.

4.M. 17.13 Cleaning and Inspection

1. The outer surfaces of these components can be cleaned in solvent. Extreme care must be taken to ensure no contaminants enter the flow control manifold during cleaning. In addition, the solvent material must be compatible to the o-rings and other soft seals of the components.
2. Inspect all o-rings on the PO checks, needle valve, and solenoid poppet for signs of o-ring tear. An o-ring tear in any of these components can result in system leaks and/or actuator drifts.
3. Replace the damaged components with a new component and proceed to re-assembly.

4.M. 17.14 Re-Assembly

1. Lubricate all o-rings and soft seals on the PO checks, needle valve, and solenoid poppet.
2. Manually thread the PO checks into the flow control manifold. Torque to 30-35 ft-lb [41-47 Nm].
3. Lubricate and insert the cover o-ring into the o-ring groove. Place the cover over the flow control manifold. Secure the cover in place by manually tightening the cover screws wetted with blue Loctite® or equivalent.
4. Install the needle valve. Torque the needle valve to 30-35 ft-lb [41-47 Nm].
5. Install the solenoid poppet. Torque the solenoid poppet to 22-26 ft-lb [30-35 Nm].
6. Install the solenoid coil o-ring. Slide the housing over the solenoid poppet.
7. Install the retaining nut o-ring and retaining nut. Torque the retaining nut to 4-5 ft-lb [5-7 Nm].
8. Place new O-rings with a dab of petroleum jelly into the recharge module o-ring grooves.

Align the flow control manifold assembly with the recharge module and secure in place with the flow manifold washers and screws. Ensure to apply blue Loctite® on the ¼-20 screws. Torque the screws to 125 lb-in.

4.M.18 Commercial Linear Cylinders

The cylinder consists of a double rod end through shaft cylinder. There are two bushings with seals, a wiper, shank, piston disk, piston seals and cylinder body. The sizes range from 2000–10000 lb greater than 6″ stroke and greater than 10000 lb with almost any stroke size required.

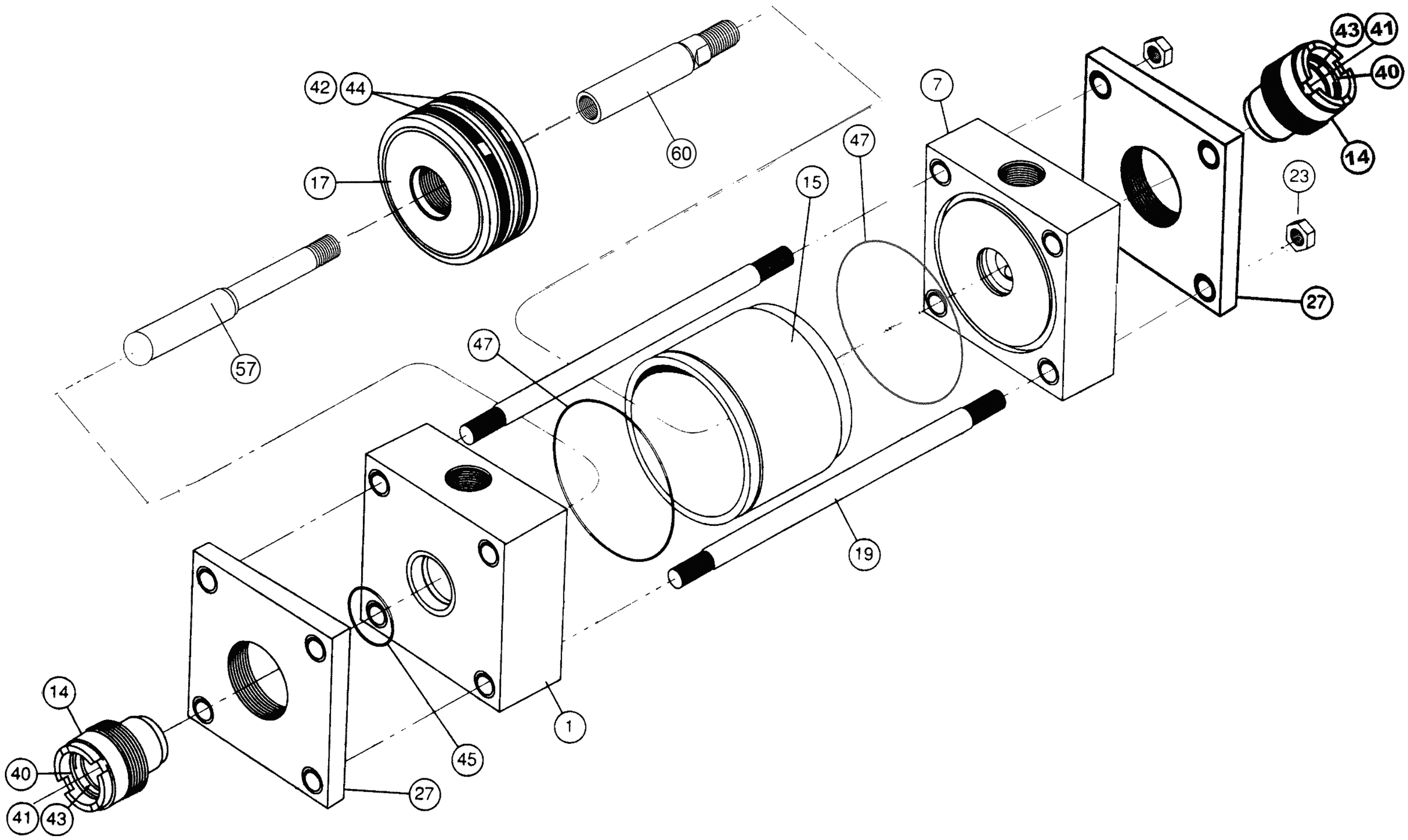


Figure 4.M.18 Commercial Linear Cylinder

Table 4.M.18-1 Parts List

Item No.	Description	Qty	Item No.	Description	Qty
1	Head, Ported, Non-cushioned	1	41	Lipseal, Gland	2
7	Cap, Ported Non-cushioned	1	42	Lipseal, Piston	2
14	Gland	2	43	Backup Washer, Gland	2
15	Cylinder Body	1	44	Backup Washer, Piston	2
17	Piston Body, Lipseal Type	1	45	O-ring, Gland to Head Seal	2
19	Tie Rod	4	47	O-ring, Cylinder Body End Seal	2
23	Tie Rod Nut	4	57	Piston Rod	1
27	Retainer	2	60	Piston Rod Extension	1
40	Wiper Seal, Gland	2			

4.M.18.1 Disassembly

NOTE: Tag-Out and Lock-Out the unit for repair in accordance with local procedures. Repair of the cylinder will require removing the unit from service.

Seals Replacement

CAUTION: While assembling and disassembling the cylinder, be aware of oil discharging from unprotected ports.

1. Clamp the oil level indicator piston to prevent oil from discharging from power module when removing. Remove tubing feeding the cylinder.
2. Remove the fasteners holding the feedback arm to the cylinder shaft. Remove all plates, fasteners and legs as necessary to free the cylinder from the assembly. Remove the cylinder from the unit.
3. Loosen and remove the four tie rod nuts (23).
4. Remove the retainer plate (27).
5. Remove the bronze gland (14) on the retainer plate (27) by unscrewing counter clockwise.

   NOTE: Residual oil will drain at this point.
6. Remove the cap assembly (7).
7. Remove the piston and piston rod assembly (57, 17, 60).
8. Remove the cylinder body (15).

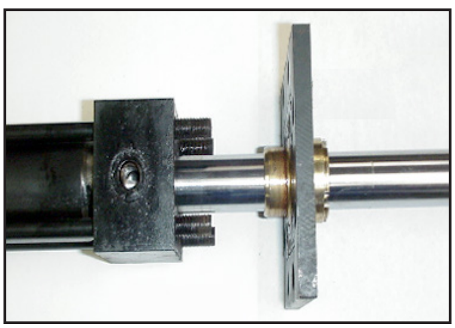


Photo 4.M.18.1-1: Retainer Plate

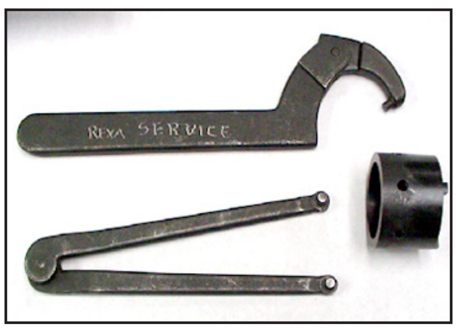


Photo 4M.18.1-2: Tools for Gland Removal and Installation

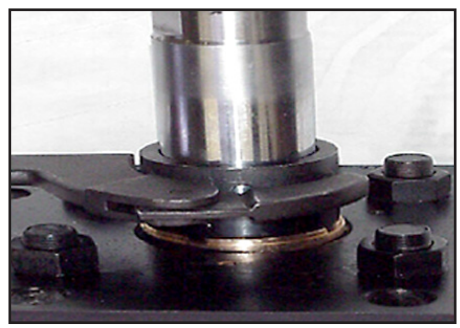


Photo 4M.18.1-3: Parker Tool for Gland Removal

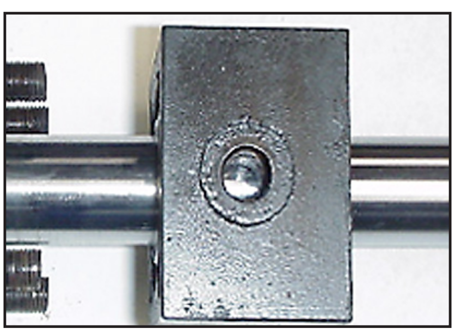


Photo 4M.18.1-4: Cap / Head Assembly

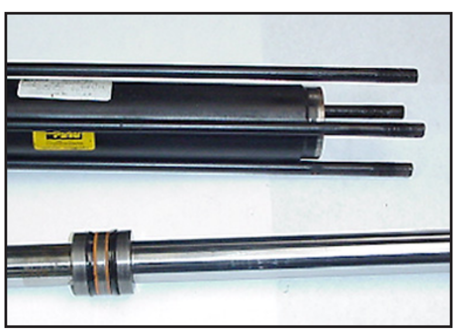


Photo 4M.18.1-5: Piston Rod Assembly

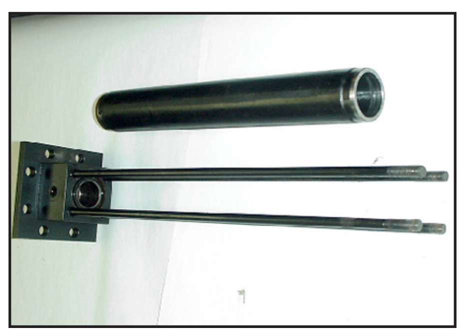


Photo 4M.18.1-6: Cylinder Body

9. Remove the head assembly (1). Tie rods may be left installed in the retainer.

10. Remove the seals from the piston disk (17) and inspect the disk for wear and damage. Replace as necessary.

11. Inspect the cylinder body (15) for wear and damage. Replace as necessary.

12. Remove the seals (40, 41 & 43) from the glands (14) and inspect the gland for wear and damage. Replace as necessary.

13. Remove and discard the following O-rings: two glands to head seals (45) and two cylinder body end seals (47). Inspect the O-ring seating surface for damage. Replace as necessary.

NOTE: Lubricate all surfaces, seals and O-rings prior to assembly.

4.M.18.2 Reassembly

1. Place one new set of piston lipseals (42) and back-up washer (44) on one side of the piston disk with the open end toward the shaft end.

2. Slide the piston disk assembly (57, 17, 60) into the cylinder body (14). Slide the piston disk assembly to the end of the body to expose the seal groove with no seals. Do not slide the piston disk assembly all the way out of the cylinder body.

3. Place the other new piston lipseal (42) and back-up washer (44) on the piston disk. Slide the piston disk assembly (57, 17, 60) back into the cylinder body (15).

4. With both glands, install new wiper seal (40), gland lipseal (41) and gland backup washer (43) into the gland.

5. Install new cylinder body end seal O-ring (47) into head (1) and cap (7). Also install new gland to head seal (45).

6. Install gland (14) to retainer (27). Ensure that the gland is installed only two turns. If required, install tie rods to retainer so that the tie rod ends are flush to the retainer.

7. Install head (1) to retainer (27). Slip the cylinder body (15) with piston disk assembly (57, 17, 60) over the tie rods (19) and onto the head.

8. Install cap (7) to cylinder body (15).

9. Install retainer plate (27) to cap (7).

10. Thread the tie rod nuts onto the tie rods. Torque the tie rod nuts (23) in accordance with Table 4.M.17.2.

11. Tighten gland (14) so that the top of the gland to the retainer is 0.25".

12. Install power module, tubing and feedback items. Install unit to valve.

Table 4.M.18.2-1 Torque (lb·ft)

Size	Cylinder Bore	Rod Size	Tie Rod (lb·ft)
L2000	1.5"	1"	18
L5000	2.5"	1.75"	45
L10000	3.25"	2"	120
L15000	4"	2.5"	131
L20000	4"	1.75"	131
L40000	6"	3"	528
L60000	7"	3"	800
L80000	8"	3.5"	1168

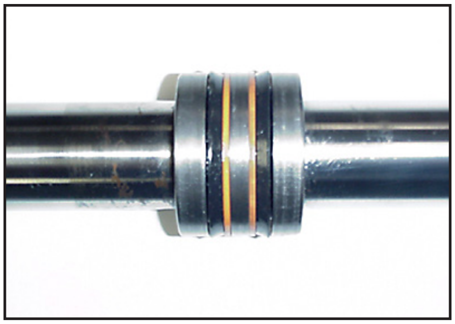


Photo 4M.18.1-7: Piston Disk Assembly

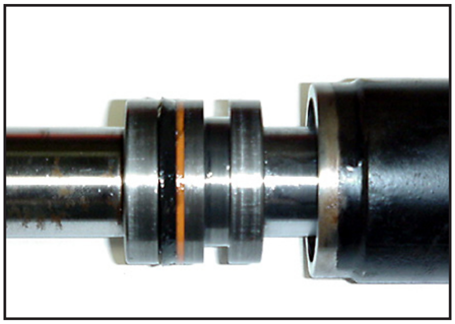


Photo 4M.18.1-8: Piston Disk With One Set of Seals Into Cylinder

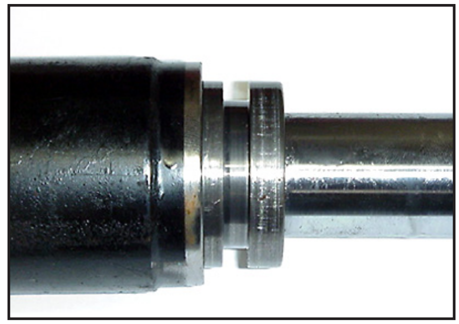


Photo 4.M.18.1-9: Piston Disk Ready for Second Set of Seals

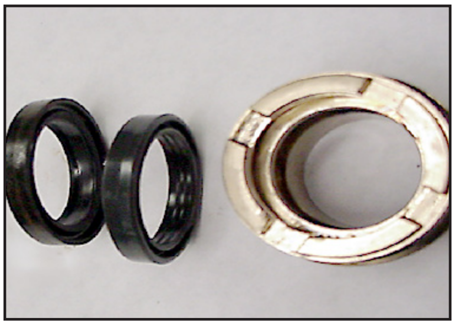


Photo 4M.18.1-10: Gland and Seals

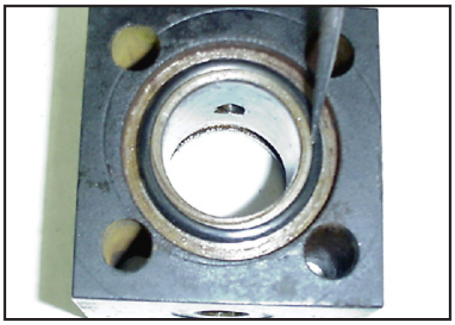


Photo 4M.18.1-11: Head / Cap Seals

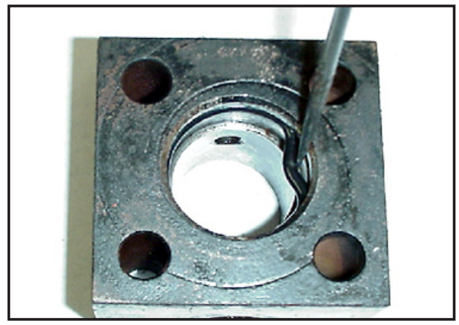


Photo 4M.18.1-12: Head / Cap Seals

4.M.19 REXA Linear Cylinders

The current linear block cylinder line consists of five models. These models can reach force outputs up to 10 000 lb. Each of these models comes in different stroke options typically 2", 4" and 6". To identify the model / size of your cylinder reference the model number. The first digit will be an L signifying it is a linear stroke. The next three to five digits before the dash is the thrust output. For more details on Model numbering refer to TS&R section 1.2.1. You can also confirm the output by measuring the shank diameter and reference table 4.M.19-1.

4.M.19.1 Cylinder Removal Procedure for All REXA Block Cylinders

NOTE: Tag-Out and Lock-Out the unit for repair in accordance with local procedures. Repair of the linear cylinder will require removing the unit from service.

Due to the large number of custom applications of REXA actuators this manual doesn't show the exact steps to separate the power module but rather the general procedure that should be followed.

Table 4.M.19-1 Shank Diameter (in).

Shank Diameter	Cylinder Size
9 / 16"	L500
9 / 16"	L2000
1"	L4000
1-5 / 16"	L10000

1. Remove any external loads or springs attached to the unit before attempting any service. In some cases the power will be needed to remove these loads.

⚠ **CAUTION: Failure to properly remove loads on the actuator can result in injury or death.**

2. Clamp the oil level indicator to prevent oil from draining out of the power module when disconnecting tubing. Be careful not to damage indicator.
3. Clean the module thoroughly. It is important that no contaminants enter the internals of the actuator.
4. Remove the power module from the cylinder.
5. Remove the cylinder from its mounting.

4.M.18.2 L500 and L2 000 Cylinder Rebuild Procedure For ¾ Inch, 2 Inch, 4 Inch and 6 Inch Stroke Units

Parts Required: Cylinder Seal Kit

A. Feedback Removal

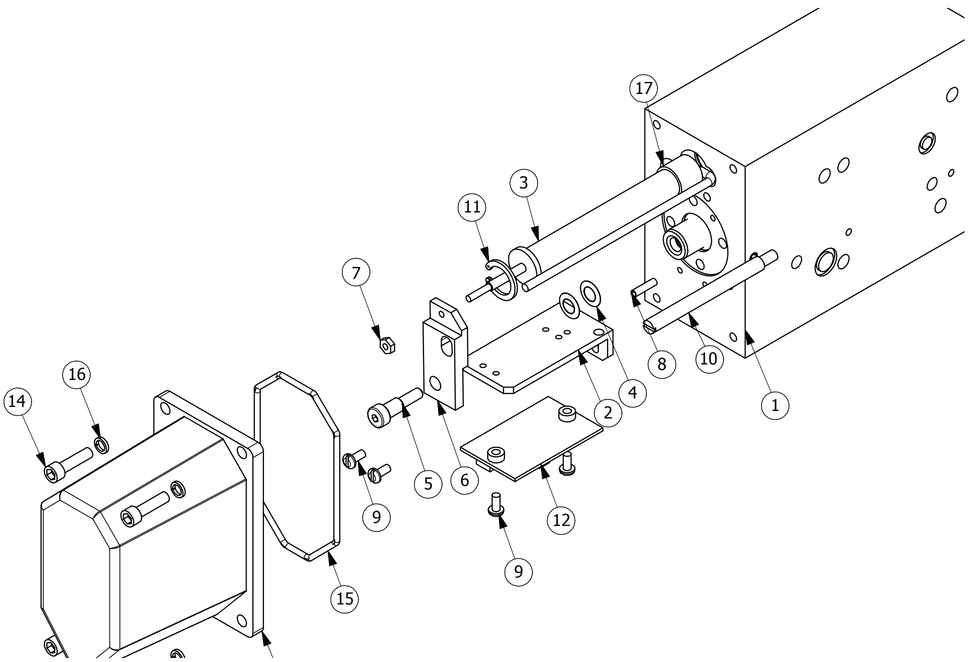


Figure 4.M.19.2-A L500 & 2 000 Feedback Removal

Table 4.M.19.2-A Parts List

Item No.	Description	Qty
1	Cylinder Body	1
2	Bracket, Circuit Board Mounting	1
3	Potentiometer	1
4	Spring Washers	2
5	#10-32 Shldr Scr	1
6	Feedback Arm	1
7	Hex Nut Std #4-40 (SS)	1
8	Roll Pin (Spring)	1
9	SCR Pan HD SL #6-32NC	4
10	Anti-Rotation Rod	1
11	Retaining Ring	1
12	Circuit Board Assembly	1
13	Cover. Cylinder	1
14	SHCS #10-32 × .75	4
15	O-ring Viton - 150	1
16	#10 Lock Washer	4
17	Anti-Vibration Tape Foam	1

4.M.19.2-A.1 Disassembly

1. Refer to Figure 4.M.18.2-A and remove the 4 SHCS (14) and lock washers (16).
2. Remove the feedback cover (13) and O-ring (15). The O-ring can be thrown out once the replacement is identified from the rebuild kit.
3. Record all termination points. Disconnect all wires connected to the circuit board (12)
4. Remove the 2 SCR pan head screws (9) to remove the circuit board (12).
5. Remove the 2 SCR pan head screws (9) to remove the circuit board bracket (2)
6. Remove the shoulder screw (5) and hex nut (7). Remove the 2 spring washers (4). While holding the potentiometer (3) rod, unscrew the feedback arm (6).
7. Remove the retaining ring (11), anti rotation rod (10), and the potentiometer (3).
8. Proceed to bushing rebuild Section B to continue disassembly.

4.M.19.2-A.2 Reassembly

1. Apply the bottom of the potentiometer with anti-vibration foam (17) then slide the potentiometer (3) into the potentiometer (3) hole in the cylinder (1). Ensure that the cable slides into its slot. Snap the retaining ring (11) into the ring groove above the pot.
2. Screw the feedback arm (6) onto the potentiometer (3). Thread the hex nut (7) on. Anytime the pot is removed you will need to adjust the pot height.
3. Align the 2 spring washers (4) to the end of the shank. Thread the potentiometer (3) into the feedback arm (6) over the spring washers (4). Install the shoulder screw (5).
4. Screw in the anti rotation rod (10).
5. Align the circuit board bracket (2) with its mounting hole on the cylinder and install the two SCR pan HD SL (9).
6. Rewire all wires back to the circuit board (12).
7. Install a new O-ring (15) into the cover (13). Petroleum jelly can be used to prevent the O-ring from falling out.
8. Place the cylinder cover (13) with the O-ring (15) back over the cylinder and install the 4 SHCS (14) with washers (16).

B. Bushing Rebuild

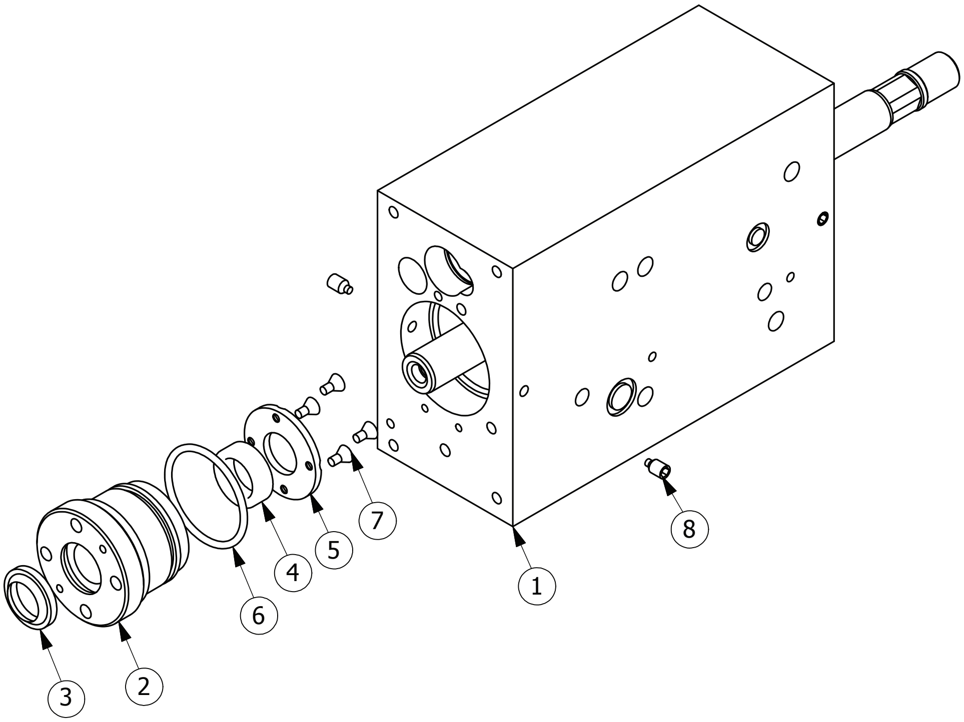


Table 4.M.19.2-B Parts List

Item	Description	Qty
1	Cylinder Body	1
2	Bushing	2
3	Rod Wiper	2
4	Rod Seal	2
5	Bushing End Cover	2
6	O-ring Viton - 026	2
7	SCR Flat HD Hex #4-40	8
8	Nylon Tipped Set Screw	4

Figure 4.M.19.2-B L500 & 2000 Bushing Rebuild

⚠ **CAUTION: While assembling and disassembling the cylinder, beware of oil discharging from unprotected ports.**

4.M.19.2-B.1 Disassembly

NOTE: To prevent damage, use a dead blow hammer or soft face mallet.

1. Refer to Figure 4.M.18.2-B and remove the two set screws (8).
2. Using a spanner wrench, remove the bushing. (2).
3. Lightly tap the opposite end of the shaft to force the bushing out.
4. Use a pick to remove the rod wiper (3) and O-ring (6). These items can be thrown out once the replacement parts are located from the rebuild kit.
5. Use an allen wrench to remove the 4 SCR flat HD HEX (7) from the bushing end cover (5) and remove the rod seal (4).
6. Repeat steps 1-5 on the opposite end.

   NOTE: If there is a spacer sleeve on the piston rod it needs to be reassembled on the same side or damage and improper operation may result.

4.M.19.2-B.2 Cleaning and Inspection

1. Clean the bushings (2) in solvent and dry.
2. Inspect the bushing (2) bore for damage. If any visual marks can be felt in the bushing (2) bore then the bushing (2) will need to be replaced.
3. Continue to section C to complete disassembly.

4.M.19.2-B.3 Reassembly

1. Install the new rod wiper (3) with the pointed edge out. Install the new O-ring (6) into the O-ring groove on the outside of the bushing (2).
2. Install the new rod seals (4) into the seal groove. The open side must face the cylinder body. Installing these backwards will cause the seals to fail.
3. Lubricate the O-ring (6) and seals (3 & 4) prior to installation.
4. Place the bushing end cover (5) back over the end of the bushing (2) and bolt the 4 hex head screws (7) back into the bushing (2).
5. Slide the bushing (2) into the cylinder body (1).
6. Tighten with spanner wrench.
7. Place Loctite® onto the two set screws (4) and install into the cylinder body. Turn the screws 1-¼ turns once you feel the screw contact the bushing (2).
8. Slide the piston assembly into the cylinder bore. Ensure the orientation of the output end. Lightly tap the assembly in if necessary.
9. Repeat steps 1- 7 for the opposite end of the cylinder.
10. Go back to the feedback reassembly in Section A to complete the rebuild.

C. Shank Rebuild

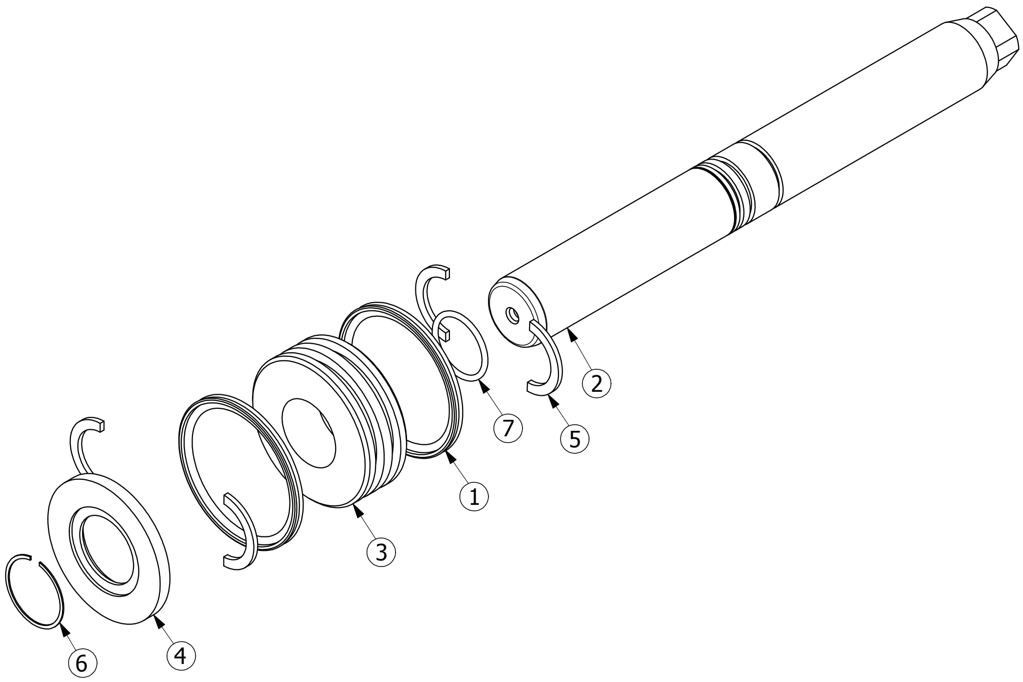


Table 4.M.19.2-C Parts List

Item	Description	Qty
1	Piston Seal	1
2	Shank	2
3	Piston	2
4	Split Ring Retainer	2
5	Split Ring	2
6	Retaining Ring	2
7	O-ring Viton - 22	8

Figure 4.M.19.2-C L500 & 2 000 Shank Rebuild

CAUTION: While assembling and disassembling the cylinder, beware of oil discharging from unprotected ports.

4.M.19.2-C.1 Disassembly

1. Refer to Figure 4.M.18.2-C and remove the retaining ring (6). Care must be taken not to scratch the shaft finish.
2. Slide the split ring retainer (4) off exposing the first set of split rings (5).
3. Separate the split rings (5) and slide the piston disk (3) off. The second set of split rings (5) should now fall off.
4. Remove the O-ring (7) from the piston shank (2) and both piston seals (1) from the piston disk (3). These three items can be thrown out once you have located the new replacements from your rebuild kit.

4.M.19.2-C.2 Cleaning and Inspection

1. Clean the piston shaft (2), piston (3), split ring retainer (4), split rings (5) and the retaining rings (6) in brake wash and dry. Ensure no residue or contaminants remain.
2. Inspect the piston shaft (2) for scratches. If you can detect scratches by running your finger nail around the shaft then the shaft will need to be replaced. Reference Table 4.M.18.2-C when ordering replacement parts.
3. Inspect the piston disk (3) for any burs around the outer surface that would scratch into the cylinder bore. If burs are found replace the piston disk.
4. Clean the cylinder bore in brake wash and dry. Be very cautious not to get contaminants into the ports. If any contaminates get into the system they could cause drifting problems.
5. Inspect the bore for wear or scratches. If the anodizing has worn through or any scuff marks can be felt replace the cylinder body. Ensure any new cylinders have ball plugs installed before reassembly.

4.M.19.2-C.3 Reassembly

1. Lubricate the new O-ring. Slide the O-ring (7) into the O-ring groove of the shank (2). O-ring groove is located between the two identical split ring grooves.
2. Slide the new piston seals (1) into the piston disk (3).

   NOTE: The O-ring side of the seals must face away from each other. Improper orientation will cause the seals to leak.
3. Install one set of split rings (5) into the lower split ring slot of the shank (2).
4. Slide the piston (3) on from the top insuring the counter bore fits over the split ring (5).
5. Install the second set of split rings (5) into the upper slot on the shank (2).
6. Slide the split ring retainer (4) over the second set of split rings (2).

   NOTE: The split ring retainer can only go on one way and should set flush to the piston disk (3).
7. Install the retaining ring (6).
8. Lubricate the new piston seals (4). Go to the bushing rebuild reassembly Section B to continue the rebuild.

4.M.19.3 L4 000 Cylinder Rebuild Procedure for ¾ Inch, 2 Inch and 4 Inch Stroke Units

Parts Required: Cylinder Seal Kit

A. Feedback Removal

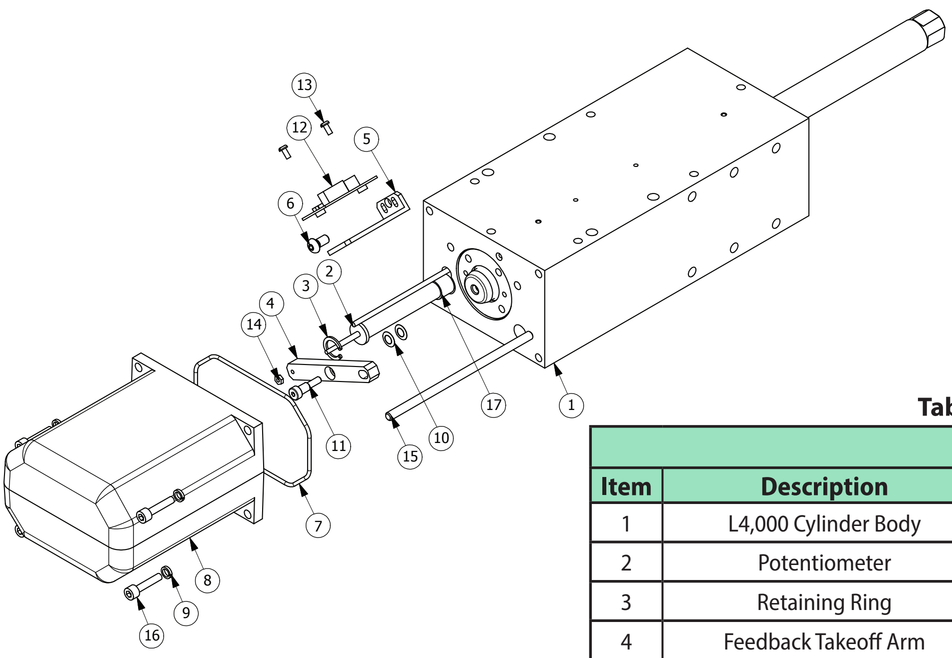


Figure 4.M.19.3-A L4 000 Feedback Removal

Table 4.M.19.3-A

Parts List					
Item	**Description**	**Qty**	**Item**	**Description**	**Qty**
1	L4,000 Cylinder Body	1	10	Spring Washers	1
2	Potentiometer	1	11	#10-32 Shldr Scr	1
3	Retaining Ring	1	12	Circuit Board Assembly	1
4	Feedback Takeoff Arm	2	13	SCR Pan HD SL #6-32NC	1
5	Bracket, Circuit Board Mounting	1	14	Hex Nut Std #4-40 (SS)	4
6	SBCHS ¼-20	1	15	Anti-Rotation Rod	1
7	O-ring Viton - 156	1	16	SHCS .25-20	4
8	L4,000 Cylinder Cover	1	17	Anti-Vibration Tape Foam	1
9	Spring Lock Washer	4			

4.M.19.3-A.1 Disassembly

1. Refer to Figure 4.M.18.3-A and remove the 4 ¼-20 screws (16) and the 4 lock washers (9).
2. Remove the cylinder cover (8) and O-ring (7). The O-ring can be thrown out once the replacement is identified from the rebuild kit.
3. Disconnected all wires to the circuit board (12) and remove the 2 SCR pan head screws (13) to remove the circuit board (12)
4. Remove the SBHCS ¼-20 (6) to remove the circuit board bracket (5)
5. Remove the shoulder screw (11) and hex nut (14). Remove the 2 spring washers (10). While holding the potentiometer (2) rod, unscrew the feedback arm (4).
6. Remove the retaining ring (3), anti-rotation rod (15) and the potentiometer (2).
7. Jump to bushing rebuild Section B to continue disassembly.

4.M.19.3-A.2 Reassembly

1. Reapply anti-vibration tape foam (17) to the base of the potentiometer (2) and slide the potentiometer (2) into the potentiometer hole in the cylinder (1). Ensure the cable slides into its slot. Snap the retaining ring (3) into the ring groove above the potentiometer (2).
2. Screw the feedback arm (4) onto the potentiometer (2). Thread the hex nut (14) on.
3. Align the 2 spring washers (10) to the end of the shank. Spin the feedback arm (4) over the spring washers (10) and line up the holes. Install the SH shoulder screw (11).
4. Screw in the anti-rotation rod (15).
5. Align the circuit board bracket (5) at a 45° from the edge and install the SBHCS SS screw (6).
6. Align the circuit board (12) with its mounting hole on the circuit board bracket (5) and install the 2 SCR pan head screw (13).
7. Rewire all connecting wires to the circuit board (12).
8. Install a new O-ring (7) into the cover (8). Petroleum jelly can be used to hold the O-ring from falling out.
9. Install the 4 SHCS SS ¼-20 (16) and the 4 lock washers (9).

B. Bushing Rebuild

CAUTION: While assembling and disassembling the cylinder, beware of oil discharging from unprotected ports.

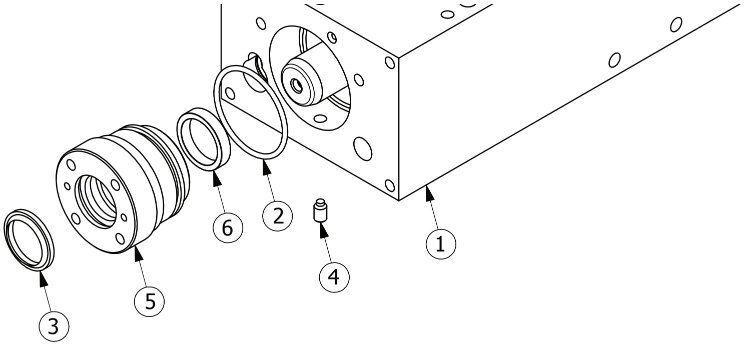


Figure 4.M.19.3-B L4,000 Bushing Rebuild

Table 4.M.19.3-B Parts List

Item	Description	Qty
1	L4 000 Cylinder Body	1
2	O-ring Viton - 133	2
3	Rod Wiper	2
4	Nylon Tipped Set Screw ¼-20	4
5	L4 000 Bushing	2
6	Rod Seal	2

4.M.19.3-B.1 Disassembly

NOTE: To prevent damage, use a dead blow hammer or soft face mallet.

1. Stroke the cylinder by striking it with a dead blow hammer from end to end with the open SAE ports over an oil drain bucket.
2. Refer to Figure 4.M.18.3-B and remove the two set screws (4).
3. Use a spanner wrench to remove the bushing (5).
4. Lightly tap the opposite end of the shaft to force the bushing (5) out.
5. Use a pick to remove the rod wiper (3), O-ring (2) and the rod seal (6). These items can be thrown out once the replacement parts are located from the rebuild kit
6. Repeat steps 2-5 on the opposite end.

   NOTE: If there is a spacer sleeve on the piston rod, it needs to be reassembled on the same side or damage and improper operation may result.

4.M.19.3-B.2 Cleaning and Inspection

1. Clean the bushings (5) in brake wash and dry.
2. Inspect the bushing (5) bore for damage. If any marks can be felt in the bushing (5) bore then the bushing (5) will need to be replaced.
3. Continue to Section C to complete disassembly.

4.M.19.3-B.3 Reassembly

1. Lubricate the O-ring (2) and seals (3 & 6) prior to installation.
2. Install the new rod wiper (3) with the pointed edge out. Install the new O-ring (2) into the O-ring groove on the outside of the bushing (5).
3. Install the new rod seals (6) into the seal grooves. The O-ring side must face the cylinder body. Installing these backwards will cause the seals to fail.
4. Slide the bushing (5) into the cylinder body (1).
5. Screw in the bushing (5) into the cylinder body (1) and tighten with spanner wrench.
6. Use Loctite® on the 2 set screws (4) and install it into the cylinder body (1). Turn the screws 1 turn once you feel the nylon bottom contact the bushing retainer.
7. Slide the piston assembly into the cylinder bore (observe the orientation of the output end).
8. Repeat steps 1- 6 for the opposite end of the cylinder.
9. See the feedback reassembly Section A to complete the rebuild.

C. Shank Rebuild

CAUTION: While assembling and disassembling the cylinder, be aware of oil discharging from unprotected ports.

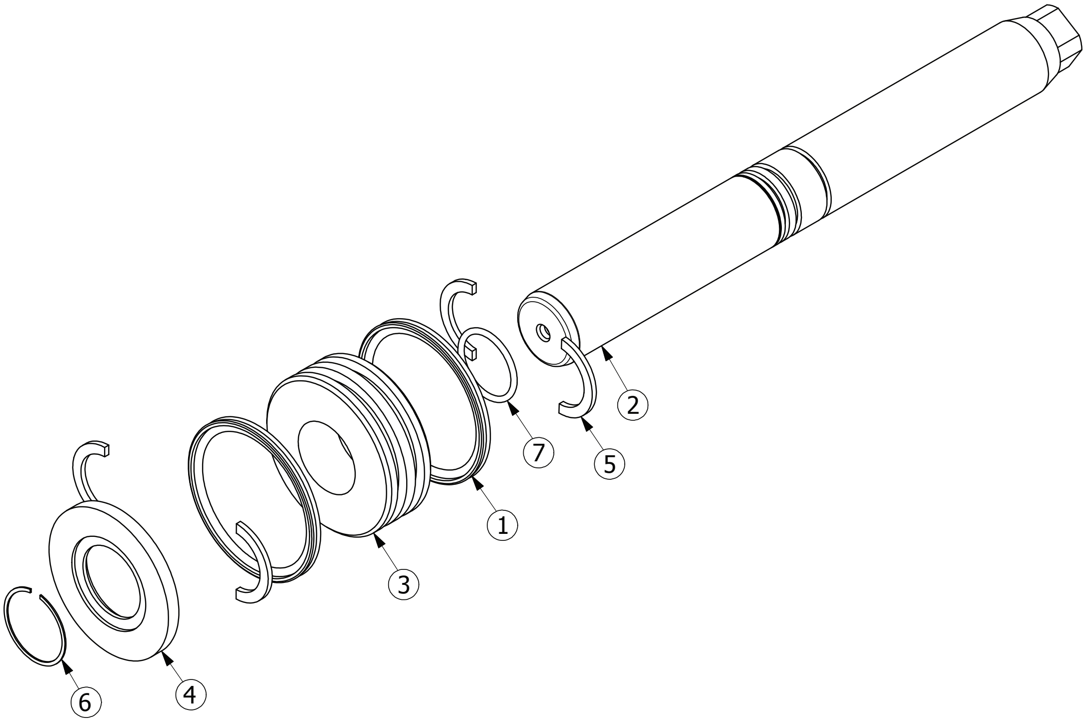


Table 4.M.19.3-C Parts List

Item	Description	Qty
1	Piston Seal	2
2	Shank	1
3	Piston	1
4	Split Ring Retainer	1
5	Split Ring	4
6	Retaing Ring	1
7	O-ring Viton - 22	1

Figure 4.M.19.3-C L4 000 Shank Rebuild

4.M.19.3-C.1 Disassembly

1. Refer to Figure 4.M.18.3-C and remove the retaining ring (6). Care must be taken not to scratch the shaft finish.
2. Slide the split ring retainer (4) off exposing the first set of split rings (5).
3. Separate the split rings (5) and slide the piston disk (3) off. The second set of split rings (5) should now fall off.
4. Remove the O-ring (7) from the piston shank (2) and both piston seals (1) from the piston disk (3). These three items can be thrown out once you have located the new replacements from your rebuild kit.

4.M.19.3-C.2 Cleaning and Inspection

1. Clean the piston shaft (2), piston (3), split ring retainer (4), split rings (5) and the retaining rings (6) in solvent and dry. Ensure no residue or contaminants remain.
2. Inspect the piston shaft (2) for scratches. If you can detect scratches with your finger then the shaft (2) will need to be replaced. Reference Table 4.M.18.3-C when ordering replacement parts.
3. Inspect the piston disk (3) for any burs that would scratch into the cylinder bore. If burs are found replace the piston disk.
4. Clean the cylinder bore in brake wash and dry. Be very cautious not to get contaminants into the ports. If any contaminates get into the system they could cause drifting problems.
5. Inspect the bore for wear or scratches. If the anodizing has worn through or any scuff marks can be felt replace the cylinder body. Reference Figure 4.M.18.3-C. Ensure that any new cylinders have ball plugs installed before reassembly.

4.M.19.3-C.3 Reassembly

1. Lubricate all O-rings and seals prior to assembly. Slide the new O-ring (7) into the O-ring groove of the shank (2).
2. Slide the new piston seals (1) into the piston disk (3). The O-ring sides must face away from each other. Seals leak with improper orientation.
3. Install one set of split rings (5) into the lower split ring slot of the shank (2).
4. Slide the piston (3) on from the top insuring the counter bore fits over the split ring (5).
5. Install the second set of split rings (5) into the upper slot on the shank (2).
6. Slide the split ring retainer (4) over the second set of split rings (5).

   NOTE: The split ring retainer can only go on one way and should be flush to the piston disk (3).
7. Install the retaining ring (6).
8. Go to the bushing rebuild reassembly and feedback reassembly to complete the rebuild.

4.M.19.4 L10 000 Cylinder Rebuild Procedure for 2 Inch and 6 Inch Stroke Units

Parts Required: Cylinder Seal Kit

A. Feedback Removal

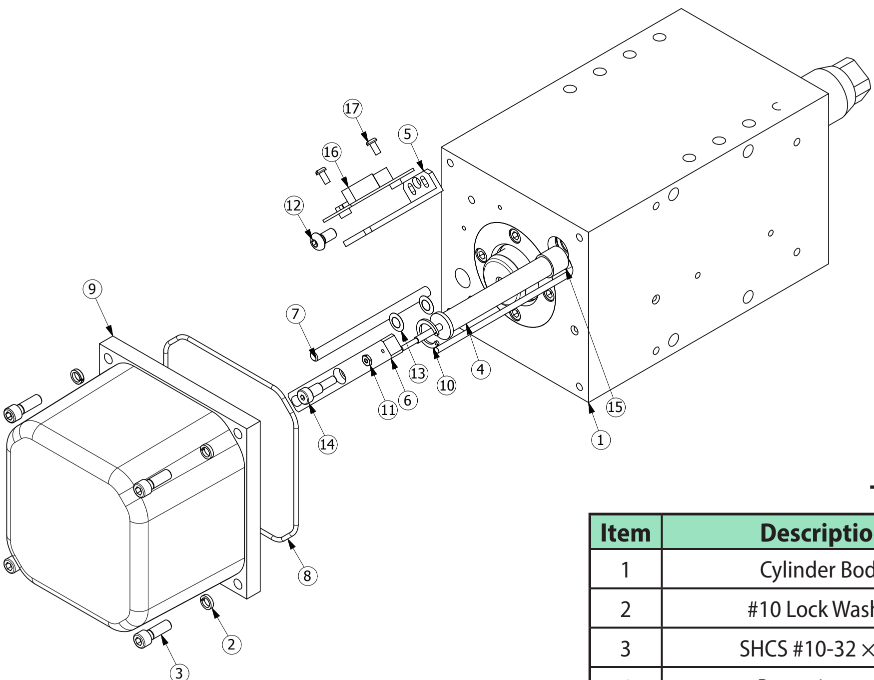


Figure 4.M.19.4-A L10 000 Feedback Removal

Table 4.M.19.4-A Parts List

Item	Description	Qty	Item	Description	Qty
1	Cylinder Body	1	10	Retaining Ring	1
2	#10 Lock Washer	4	11	Hex Nut Std #4-40 (SS)	1
3	SHCS #10-32 × .75	4	12	BHCS SS 0.25 × 20	1
4	Potentiometer	1	13	Spring Washers	2
5	Bracket, Circuit Board Mounting	1	14	#10-32 Shldr Scr	1
6	Feedback Arm	1	15	Anti-Vibration Tape Foam	1
7	Anti-Rotation Rod	1	16	Circuit Board Assembly	1
8	O-ring Viton - 150	1	17	SCR Pan HD SL #6-32NC	2
9	Cover, Cylinder	1			

4.M.19.4-A.1 Disassembly

1. Refer to Figure 4.M.18.4-A and remove the 4 SHCS ¼-20 screws (3) and lock washers (2).
2. Remove the cover (9) and O-ring (8). The O-ring can be thrown out once the replacement is identified from the rebuild kit.
3. Mark termination points and disconnect from the circuit board (16). Remove the 2 pan head (17) to remove the circuit board (16).
4. Remove the BHCS SS ¼-20 (12) screw from the circuit board bracket (5).
5. Remove the shoulder screw (14) and hex nut (11). Remove the 2 spring washers (13). Hold the potentiometer (4) rod and unscrew the feedback arm (6).
6. Remove the retaining ring (10), anti-rotation rod (7) and the potentiometer (4).
7. Continue to bushing rebuild to continue disassembly.

4.M.19.4-A.2 Reassembly

1. Apply anti-vibration tape foam (15) to the base of the potentiometer (4) and slide the potentiometer (4) into the potentiometer hole in the cylinder (1). Ensure the cable slides into its slot. Snap the retaining ring (10) into the ring groove above the potentiometer (4).
2. Screw the feedback arm (6) onto the potentiometer (4). Thread the hex nut (11) on.
3. Align the 2 spring washers (13) to the end of the shank. Spin the feedback arm (6) over the spring washers (13) and line up the holes. Install the SH shoulder screw (14).
4. Screw in the anti-rotation rod (7).
5. Align the circuit board bracket (5) at a 45° from the edge and install the BHCS SS screw (12).
6. Align the circuit board (16) with its mounting hole on the circuit board bracket (5) and install the 2 SCR pan head screw (17).
7. Rewire all connecting wires to the circuit board (16).
8. Install a new O-ring (8) into the cover (9). Petroleum jelly can be used to prevent the O-ring from falling out.
9. Install the 4 SHCS ¼-20 (3) and the 4 lock washers (2).

B. Top Bushing Rebuild

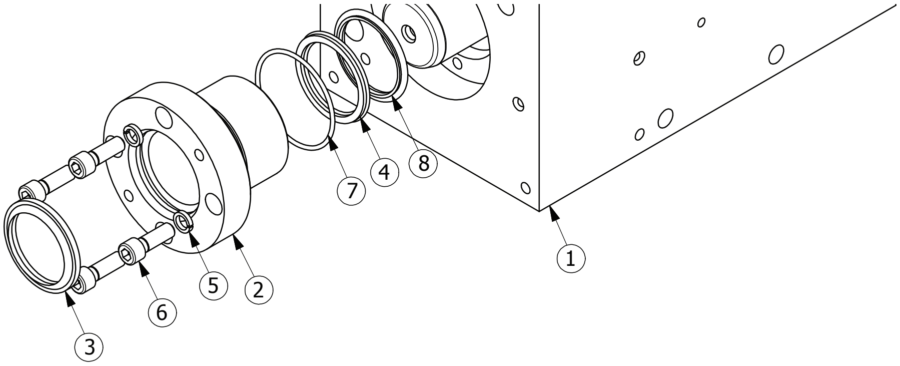


Figure 4.M.19.4-B L10 000 Top Bushing Rebuild

Table 4.M.19.4-B Parts List

Item	Description	Qty
1	L10 000 Cylinder Body	1
2	L10 000 Cylinder Bushing	1
3	Rod Wiper	2
4	SQB Rod Seal	2
5	Lockwasher	8
6	SHCS SS ¼-20	8
7	O-ring Viton - 029	1
8	Rod Buffer	2

CAUTION: While assembling and disassembling the cylinder, beware of oil discharging from unprotected ports.

4.M.19.4-B.1 Disassembly

NOTE: To prevent damage, use a dead blow hammer or soft face mallet.

1. Stroke the cylinder by striking it with a dead blow hammer from end to end with the open SAE ports over an oil drain bucket. Read caution above.
2. Refer to Figure 4.M.18.4-B and remove the four ¼-20 screws (6) and four lock washers (5).
3. Screw two of the ¼-20 screws (6) into the threaded holes of the bushing (2) to force it out.
4. Use a pick to remove the rod wiper (3), O-ring (7) the SQB rod seal (4), and the rod buffer seal (8). These items can be thrown out once the replacement parts are located from the rebuild kit.

4.M.19.4-B.2 Cleaning and Inspection

1. Clean the bushing (2) in brake wash and dry.
2. Inspect the bushing (2) bore for damage. If any visual marks can be felt by touch in the bushing (2) bore then the bushing (2) will need to be replaced.
3. Continue to Section C to complete disassembly.

4.M.19.4-B.3 Reassembly

1. Lubricate the O-ring and seals prior to installation.
2. Install the new rod wiper (3) with the pointed edge out. Install the new O-ring (7) into the O-ring groove on the outside of the bushing (2).
3. Install the new SQB rod seal (4) and rod buffer (8) into the seal grooves. The open side of the SQB rod seal (4) must face the cylinder body. Installing these backwards will cause the seals to fail.
4. After the end cap and shaft sections have been completed, slide the bushing (2) over the shank and into place. Ensure the screw holes line up. Install the four ¼-20 screws (6) and four lock washers (5). Use blue Loctite on the screws and torque to 100 lb•in.
5. Slide the piston assembly into the cylinder bore. Lightly tap it in if necessary. Note that the output end goes in last.
6. Go back to the end cap rebuild reassembly in Section C to continue the rebuild.

C. End Cap Rebuild

CAUTION: While assembling and disassembling the cylinder, beware of oil discharging from unprotected ports.

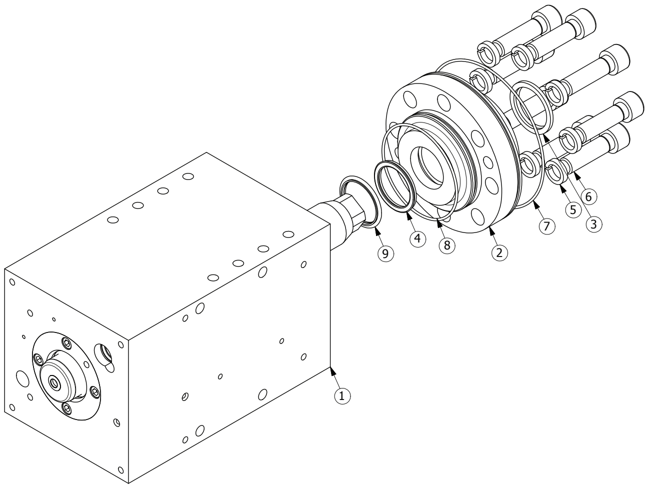


Figure 4.M.19.4-C End Cap Rebuild

Table 4.M.19.4-C Parts List

Item	Description	Qty
1	L10 000 Cylinder Body	1
2	L10 000 Cylinder Bottom Cylinder End Cap	1
3	Rod Wiper	2
4	SQB Rod Seal	2
5	Lockwasher	8
6	SHCS SS ½-13	8
7	O-ring Viton - 040	1
8	O-ring Viton - 047	1
9	Rod Buffer	2

4.M.19.4-C.1 Disassembly

1. Refer to Figure 4.M.18.4-C and remove the eight ½ - 13 screws (6) and eight lock washers (5).

   NOTE: To prevent damage, use a dead blow hammer or soft face mallet.

2. Lightly tap on the opposite end of the shaft to drive the end cap (2) out. The Shaft assembly should also come out; reference the Shaft Rebuild in Section D for rebuild.

   NOTE: If there is a spacer sleeve on the piston rod, it needs to be reassembled on the same side or damage and improper operation may result.

3. Use a pick to remove the rod wiper (3), O-ring (7 & 8), and SQB rod (4) and rod buffer (9) seals. These items can be thrown out once the replacement parts are located from the rebuild kit.

4.M.19.4-C.2 Cleaning and Inspection

1. Clean the end cap in brake wash and dry.
2. Inspect the end cap (2) for damage. If any visual marks can be felt, then the end cap (2) will need to be replaced.
3. Continue to the Piston Shank Rebuild in Section D before reassembly.

4.M.19.4-C.3 Reassembly

1. Lubricate O-rings and seals prior to installation.
2. Install the new rod wiper (3) with the pointed edge out. Install the new O-rings (7 & 8) into the appropriate O-ring grooves.
3. Install the new SQB rod (4) and rod buffer (9) seals into the seal grooves. The open side of the SQB rod seal (4) must face the cylinder body. Installing these backwards will cause the seals to fail.
4. Slide end cap (2) over the piston rod and into the cylinder (1). Use 2 SHCS SS 1 / 2-20 screws (6) without washers to pull it into place.
5. Install the eight ½ - 13 screws (6) and eight lock washers (5). Use Blue Loctite® on the screws and torque to 65 lb•ft.

6. Go to the Feedback Rebuild Reassembly in Section A to finish the rebuild.

D. Shank Rebuild

CAUTION: While assembling and disassembling the cylinder, beware of oil discharging from unprotected ports.

4.M.19.4-D.1 Disassembly

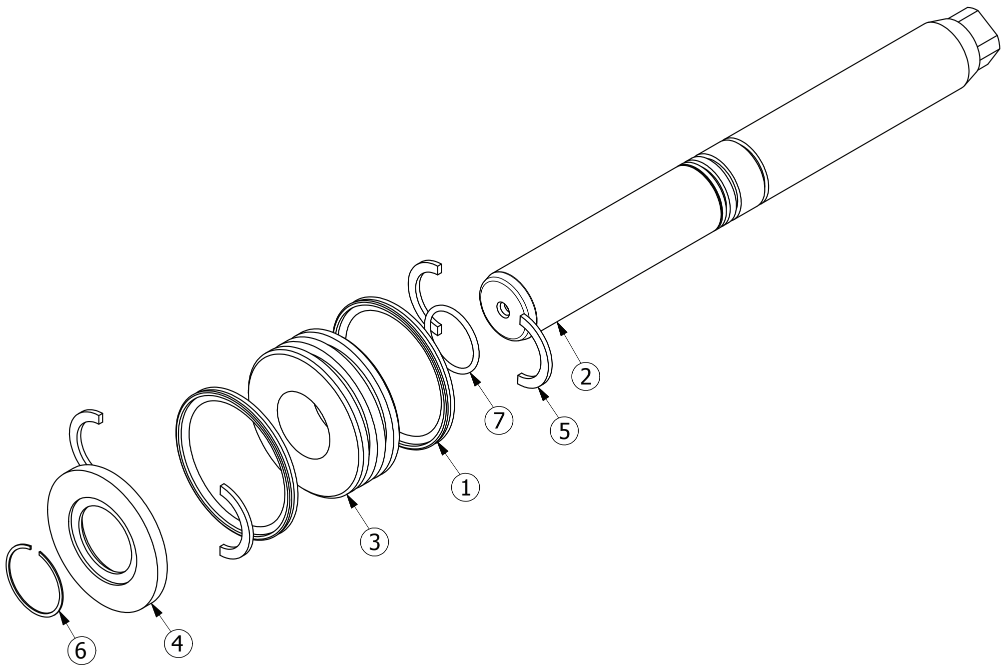


Table 4.M.19.4-D Parts List

Item	Description	Qty
1	Piston Seal	2
2	Shank	1
3	Piston	1
4	Split Ring Retainer	1
5	Split Ring	4
6	Retaing Ring	1
7	O-ring Viton - 22	1

Figure 4.M.19.4-D L10 000 Shank Rebuild

1. Refer to Figure 4.M.18.4-D and remove the retaining ring (6). Care must be taken not to scratch the finish of the shank.
2. Slide the split ring retainer (4) off exposing the first set of split rings (5).
3. Separate the split rings (5) and slide the piston disk (3) off. The second set of split rings should now fall off.
4. Remove the O-ring (7) from the shank (2) and both piston seals (1) from the piston disk (3). These three items can be thrown out once you have located the new replacements from your rebuild kit.

4.M.19.4-D.2 Cleaning and Inspection

1. Clean the piston shaft (2), piston (3), split ring retainer (4), split rings (5) and the retaining rings (6) in solvent and dry. Ensure no residue or contaminants remain.
2. Inspect the piston shaft (2) for scratches. If you detect scratches with your finger nail (2) the shaft (2) needs to be replaced.
3. Inspect the piston disk (3) for burs on the outer surface that scratch into the cylinder bore. If burs are found replace the piston disk (3).
4. Clean the cylinder bore in brake wash and dry. Be very cautious not to get contaminants into the ports. If any contaminates get into the system they could cause drifting problems.
5. Inspect the bore for wear or scratches. If the anodizing has worn through or any scuff marks can be felt, replace the cylinder body. Ensure the new cylinder has ball plugs installed before reassembly.

4.M.19.4-D.3 Reassembly

1. Lubricate the new O-ring.
2. Slide the new O-ring (7) into the O-ring groove of the shank (2). Slide the new piston seals (1) into the piston disk (3).

   NOTE: The O-ring side of the seals must face away from each other. Improper orientation will cause the seals to leak.
3. Install one set of split rings (5) into the lower split ring slot of the shank (2).
4. Slide the piston (3) on from the top insuring the counter bore fits over the split ring (5).
5. Install the second set of split rings (5) into the upper slot on the shank (2).
6. Slide the split ring retainer over (4) the second set of split rings (5).

   NOTE: The split ring retainer can only go on one way and should set flush to the piston disk (3).
7. Install the retaining ring (6).
8. Lubricate the new piston seals (1).
9. Go to end cap rebuild reassembly, top bushing rebuild reassembly and feedback reassembly to complete.

4.M.20 Rotary Cylinder

The actuator consists of a pinion and one or two racks located within the housing. Pressurization of alternate cylinder port(s) result in shaft rotation. The gear chamber is filled with Moly grease containing a minimum Molybdenum Disulfide (MSO2) content of 3%. In the event that maintenance is required, the following steps should be used as a guide:

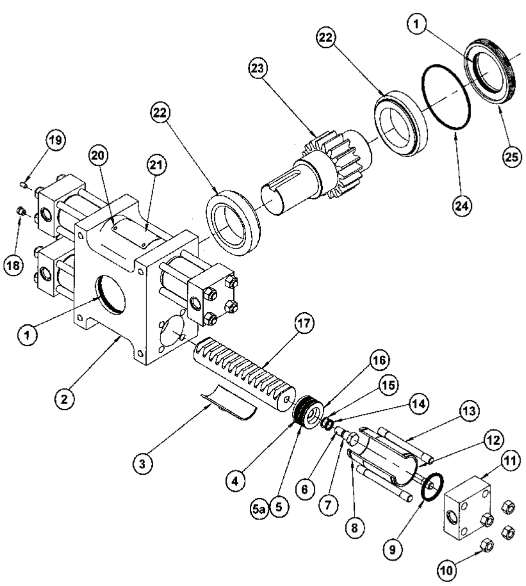


Figure 4.M.20-1 Rotary Cylinder

Table 4.M.20-1 Parts List

Item No.	Description	QTY Single Rack	QTY Double Rack	Item No.	Description	QTY Single Rack	QTY Double Rack
1*	O-ring Pinion	2	2	13	Tie Rod	8	16
2	Housing	1	1	14*	O-ring, Rack Bolt	2	4
3	Rack Bearing	1	2	15*	Back-up Ring, Rack Bolt	2	4
4*	Wear Ring	2	4	16	Piston	2	4
5*	Piston Seal	2	4	17	Rack	1	2
5a*	Back-up Ring	2	4	18	Relief Valve	1	1
6	Nylon Slug	2	4	19	Locking Screw	1	1
7	Rack Bolt	2	4	20	Drive Screw	4	4
8*	O-ring Cylinder	2	4	21	Name Plate	1	1
9*	O-ring End Cap	2	4	22	Bearing	2	2
10	Tie Rod Nut	8	16	23	Pinion	1	1
11	End Cap	2	4	24*	O-ring, Bearing Retainer	1	1
12	Cylinder Tube	2	4	25	Bearing Retainer	1	1

1. Item with an asterisk denote items supplied with seal kit
2. Item 5a applies to Viton O-rings only.
3. Item 1 quantity differs by 2 due to design change (previous design / current design)

4.M.20.1 Assembly and Disassembly Procedures

NOTE: Tag-Out and Lock-Out the unit for repair in accordance with local procedures. Repair of the rotary actuator will require removing the unit from service.

4.M.20.1- A Inspection & Replacement of End Cap Seals (9)

1. Open the manual bypass to relieve internal pressure, check gauges before proceeding.
2. Remove the actuator from the driven device.
3. Clamp the actuator's oil level indicator piston (some units may have external expansion chambers) and remove the hydraulic tubing feeding the cylinder.
4. Remove all fasteners, feedback, mounting, and motor / pump assemblies as necessary to free the cylinder from the assembly.
5. Remove the tie rod nuts / bolts (10) from the tie rods (13).
6. Pull end cap (11) free from the cylinder tube (12).
7. Inspect and / or replace end cap O-ring (9). Lubricate the seal and end cap with 5W-50 oil before re-installing.
8. Replace end cap(s) (11) on cylinder tube (12) and assemble tie rod nuts (10) to tie rods (13).
9. Torque the tie rod nuts / bolts per the Torque Table.

4.M.20.1- B. Inspection & Replacement of Wear Rings, Piston Seals and Cylinder O-Ring

1. Perform steps A1 and A2.
2. For 50 000 lb·in and greater models:
   a. Remove Rack bolt (7).
   b. Screw two threaded rods into the tapped holes in piston (16) and pull free from cylinder tube (12).
3. For models less than 50,000 lb·in:
   a. Pull cylinder tube (12) free from housing (2).
   b. Remove rack bolt (7).
4. Inspect piston (16) and replace piston seal (5).
5. Inspect and / or replace wear ring (4), (used on R2 500 lb·in and above actuators only).
6. Inspect and / or replace cylinder O-ring (8).
7. Place cylinder tube (12) over rack and press in housing (2).
8. Slide piston (16) with piston seal and wear rings into the cylinder tube (12) until it contacts the rack (17).

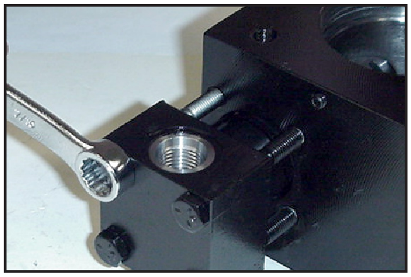


Photo 4.M.20.1-A-1 Tie Rod Nuts/Bolts

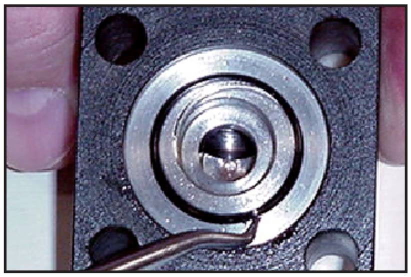


Photo 4.M.20.1-A-2 End Cap O-Ring

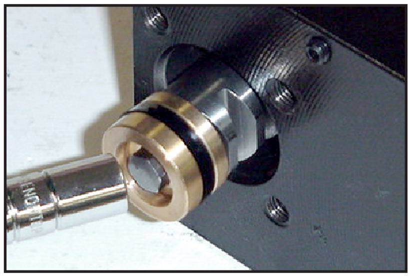


Photo 4.M.20.1-B-1 Rack Bolt

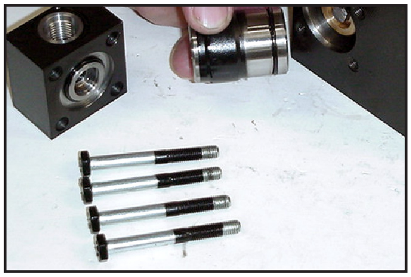


Photo 4.M.20.1-B-2 Cylinder Tube

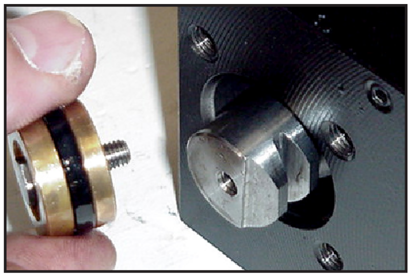


Photo 4.M.20.1-B-3 Piston

Photo 4.M.20.1-B-4 Cylinder O-Ring

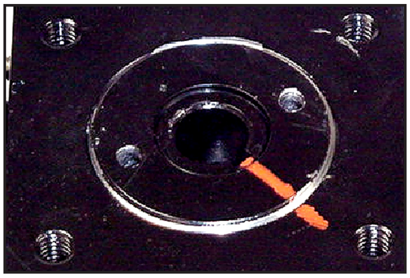


Photo 4.M.20.1-C-1 Match Marking

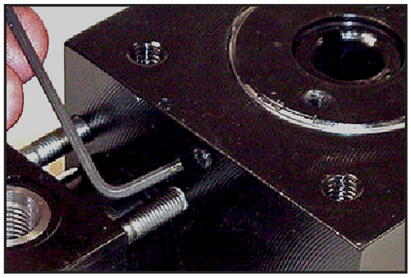


Photo 4.M.20.1-C-2 Lock Screw

CAUTION: Nylon slug (6) is designed to prevent rack bolt from vibrating loose during operation. Ensure that it is on the rack bolt (7); replace if required.

9. Replace rack bolt (7) and torque per the torque table.
10. Replace end cap (11) and tie rod nuts (10), torque per Table 4.M.19: Torque.

4.M.20.1- C. Inspection and Replacement of Pinion and Bearing Retainer O-Rings

CAUTION: Before beginning, make match marks to enable re-establishment of correct timing. Failure to loosen the lock screw will damage threads on the bearing retainer.

1. Loosen lock screw (19).
2. Using a spanner wrench, remove the bearing retainer (25) by turning counter-clockwise. Remove the bearing retainer O-ring (24).
3. Remove upper bearing (22), pinion (23) and lower bearing (22).
4. Inspect and / or replace pinion O-ring (1) located at the "front" or blind-side of the housing (2).
5. Reinstall lower bearing (22), pinion (23) making sure match marks line up, and upper bearing.
6. Inspect and / or replace bearing retainer O-ring (24).
7. Apply Moly grease to bearing retainer threads (25) and reinstall into housing (2).
8. Torque bearing retainer (25) per the torque table.
9. Install and tighten locking screw per Table 4.M.19: Torque.

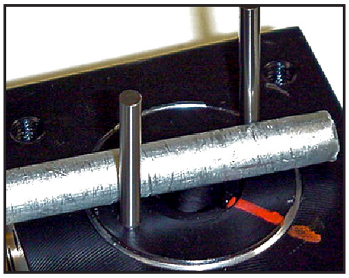


Photo 4.M.20.1-C-3 Bearing Retainer

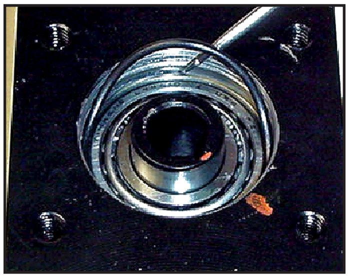


Photo 4.M.20.1-C-4 Bearing Retainer O-ring

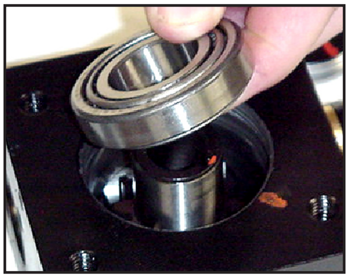


Photo 4.M.20.1-C-5 Upper Bearing

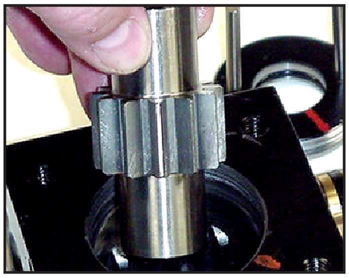


Photo 4.M.20.1-B-4 Cylinder O-Ring

4.M.20.1- D. Complete Disassembly of Cylinder

1. Perform steps B1 through B3.
2. Perform steps C1 through C3.

CAUTION: Make match marks to re-establish correct timing.

3. Push the rack (17) from either end to remove from housing.

4.M.20.1- E. Reassembly of Cylinder

1. Perform C4 through C10. Refill gear chamber with Moly Grease.
2. Perform B4 through B10.

4.M.21 Rotary Feedback

The Rotary Valve Position Monitor (VPM) or Feedback assembly consists of a Aluminum housing containing a non-contacting (Touchless) analog sensor. The sensor is coupled to the rotary cylinder by means of a magnetic induction and transmits the actuator position to the CPU.

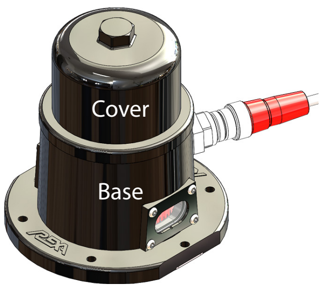


Photo 4.M.21-1 Rexa VPM

4.M.21.1 Identification

The Rotary Valve Position Monitor (VPM) has one(1) sensor and up to four (4) optional SPDT Rotary Limit Switches:

Sensor

The touchless sensor, mounted on a bracket, has 3 wires; Blue/white for output, Black for ground and Red for supply, all connected to a terminal block.

Input: 14.8 – 30 VDC Output: 4-20 mA

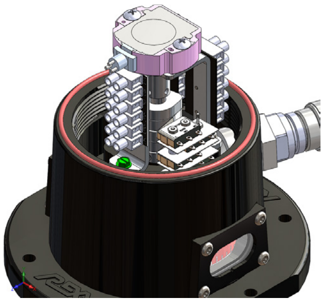


Photo 4.M.21-2
Sensor, Terminal & Switches

Switches

Type: Hermetically Sealed, Single Pole, Double Throw (DPDT), Positive Pressure

Rating: 3.0 AMPS @ 28 VDC, 1.0 AMP @ 115 VAC

Environmental: CSA/IEC, Class1, Div.2 or Zone 2, IP66 (NEMA 4),

Connection: Directly via terminal Blocks

4.M.21.2 Rotary Touchless Sensor

Any adjustment to the Rotary sensor will require removing the unit from service. Tag-out and lock-out the unit for repair in accordance with local procedures. If the actuator has a spring fail option, take note of the CPU display when the actuator is in the fail position.

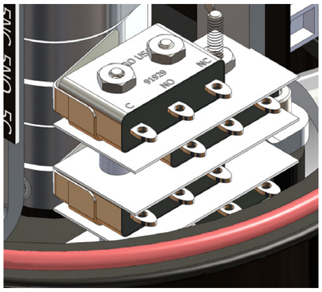


Photo 4.M.21-3
Limit-Switches 11HM1

4.M.21.3 Disassembly

Dis-assembly

1. Put the electronics into the “SETUP” mode under calibration, scroll down to either “PL” or “PH”, depending on which end of the travel. If the actuator is somewhere in the middle, either position may be selected

2. Record the reading from the display before disconnecting power. If not reading is present, then move the actuator to either full open or full closed position. A record of this number has been recorded on the data sheet inside the electronic enclosure.
3. Disconnect the incoming power
4. Unscrew the cover of the feedback housing to expose the sensor (Figure 1).
5. Disconnect the three wires coming from the sensor (Figure 6)
6. Remove the two screws holding the sensor to the mounting bracket and remove the sensor (Figure)
7. Remove the magnet holder by loosening the 4 set screws.(Figure 8)

4.M.21.4 Reassembly

8. Re-install a new magnet holder and secure loosely.
9. Re-install a new sensor on the mounting bracket and secure it with the two M4x07 screws.
10. Re-wire the sensor wires (Red, Blue/white and black) as labeled.
11. Zip-tie the three wires to the post of the potentiometer mounting plate.
12. Screw the feedback housing cover back on and tighten securely.
13. Re-connect incoming power to the unit
14. For calibration, refer to IOM section 6, Modes of operation and control parameters.

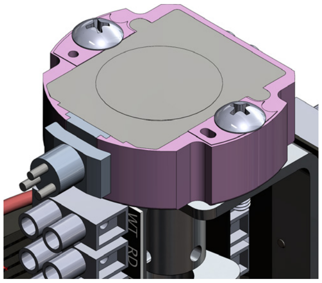


Photo 4.M.21-4
Rotary Touchless Sensor

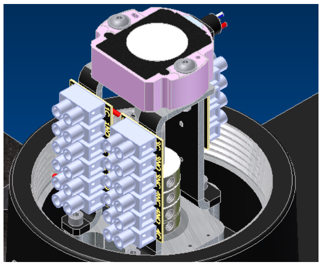


Photo 4.M.21-5
Sensor & Terminal Blocks

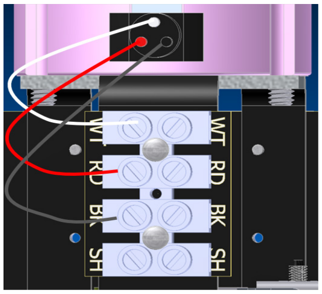


Photo 4.M.21-6
Sensor Wires & Terminal

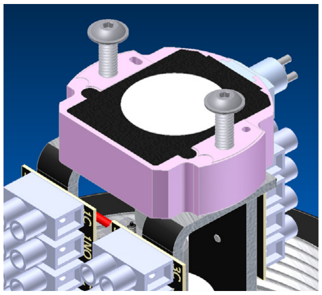


Photo 4.M.21-7
Sensor & M4x0.7 Screws

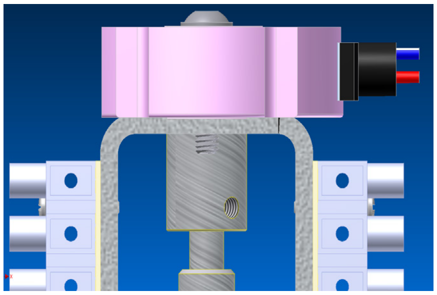


Photo 4.M.21-8
Magnet Holder & Screws

Photo 4.M.21.4-3 Upper Set Screw

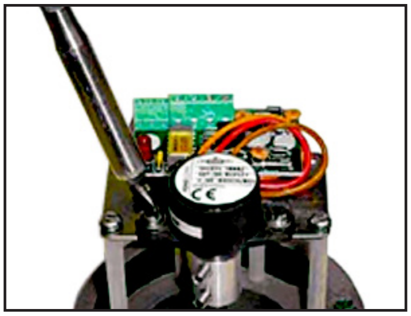


Photo 4.M.21.4-4 Mounting Screws

4.M.22 - Linear Feedback

General

Depending on the type of actuator application, there are three different types of linear potentiometers; each type is designated to a particular application. Note, in some cases the steps maybe the same if retrofitting a contacting potentiometer to a non-contacting potentiometer.

Identification

REXA Linear Cylinder Potentiometer

The REXA block cylinder is equipped with a contacting potentiometer located inside the cylinder block. For the disassembly and reassembly of the REXA block cylinder refer to TS&R 4.M.18.

Contacting Linear Potentiometer

Typically, contacting linear potentiometers are on applications that have a 23-inch stroke or less; but some applications use a non-contacting potentiometer. To determine whether the potentiometer is contacting or non-contacting, observe the color of the marker. The contacting potentiometer uses a black marker which slides on the sensor track.

Non-contacting Linear potentiometer

Non-contacting linear potentiometers are usually on applications that are over 23-inch stroke, but in some 23-inch stroke or less applications a non-contacting potentiometer is utilized. To determine whether the potentiometer is contacting or non-contacting, observe the color of the marker. The non-contacting potentiometer uses a yellow marker which slides on the sensor track.

4.M.22.1 Contacting Linear Potentiometer

General

Any adjustments to the linear potentiometer will require removing the unit from service. Tag-Out and Lock-Out the unit for repair in accordance with local procedures. If the actuator has a spring fail option, take note of the CPU display when the actuator is in the failed position.

4.M.22.1-A Disassembly

1. Put the electronics into "SETUP" mode and under calibration, scroll down to either "PL" or "PH", depending on which end of the travel. If the actuator is somewhere in the middle, either position may be selected.
2. Record the reading from the display before disconnecting power. If no reading is present, then move the actuator to either the full open or full closed position. A record of this number has been recorded on the data sheet inside the electronics enclosure.
3. Disconnect all the wires attached to the feedback board.
4. Unscrew the 2 SHCS and the set screw from the anti-vibration bracket and then remove the bracket.
5. Remove the anti-rotation rod.
6. Unscrew the shoulder screw from the cylinder shaft.
7. Detach the anti-rotation arm from the marker coupling.
8. Remove the sensor track by unscrewing the 4 SHCS from the 2 sensor brackets and removing the track from the potentiometer bracket.

4.M.22.1-B Reassembly

1. Attach the sensor track to the potentiometer bracket (wires should be on the top of the sensor) using the 2 sensor brackets and the 4 SHCS.
2. Attach the anti-rotation arm to the marker coupling.
3. Reinsert the shoulder bolt and feedback spacer.
4. Screw the anti-rotation rod back into position through the designated hole in the anti-rotation arm.
5. Place the anti-vibration bracket back into position and screw in the 2 SHCS and set screw.
6. Rewire the sensor wires to the feedback board according to the wire schematic.
7. For calibration refer to IOM section 6, Modes of Operation and Control Parameters.

4.M.22.2 Non - Contacting Linear Potentiometer / Retrofit

General

Any adjustments to the linear potentiometer will require removing the unit from service. Tag-Out and Lock-Out the unit for repair in accordance with local procedures. If the actuator has a spring fail option, take note of the CPU display when the actuator is in the failed position.

4.M.21.2-A Disassembly

1. Put the electronics into "SETUP" mode and under calibration, scroll down to either "PL" or "PH", depending on which end of the travel. If the actuator is somewhere in the middle, either position may be selected.

2. Record the reading from the display before disconnecting power. If no reading is present, then move the actuator to either the full open or full closed position. A record of this number has been recorded on the data sheet inside the electronics enclosure.

3. Disengage all the wires connecting to the feedback board. Unscrew the 2 pan head screws and remove the feedback board.

4. Unscrew the 2 SHCS and the set screw from the anti-vibration bracket and then remove the bracket.

5. Remove the anti-rotation rod.

6. Unscrew the shoulder screw from the cylinder shaft.

7. Detach the anti-rotation arm from the marker coupling.

8. Remove the sensor track by unscrewing the 4 SHCS from the 2 sensor brackets and removing the track from the potentiometer bracket.

4.M.22.2-B Reassembly

1. Attach the sensor track to the potentiometer bracket (wires should be on the top of the sensor) using the 2 sensor brackets and the 4 SHCS.

2. Attach the anti-rotation arm to the marker coupling. Note the replacement retrofitting sensor; the marker will be yellow.

3. Reinsert the shoulder bolt and feedback spacer.

4. Screw the anti-rotation rod back into position through the designated hole in the anti-rotation arm.

5. Place the anti-vibration bracket back into position and screw in the 2 SHCS and set screw.

6. Mount the terminal strip in the location where the feedback board was mounted.

7. Rewire the sensor wires to terminal strip as labeled or view wiring schematic.

8. For calibration refer to IOM section 6, Modes of Operation and Control Parameters.

4.M.22.3 Non -Contacting Linear Potentiometer

4.M.22.3-A Disassembly

1. Run the actuator so that the cylinder is at its end stop.

2. Turn off power to the unit.

3. Unscrew the fourteen pan head screws to remove the two piece non-contacting potentiometer cover (Photo 4.M.21.3-1).

4. Disconnect the non-contacting potentiometer wires from the terminal strip inside the junction box. Remove the cable from the junction box. (Photo 4.M.21.3-2)

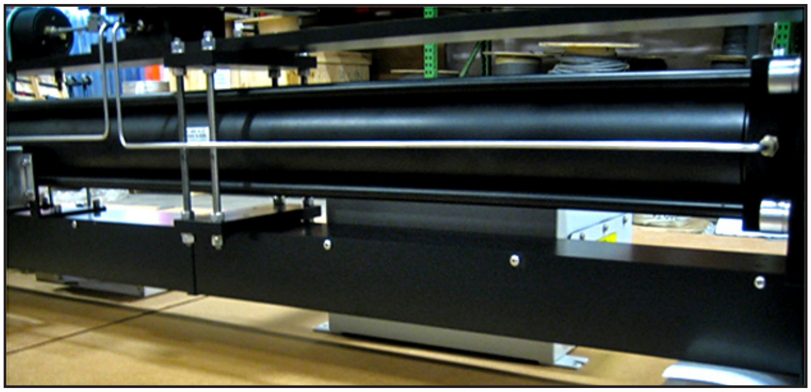


Photo 4.M.22.3-1 Non-Contacting Potentiometer Cover

5. Loosen the hex nut on the magnet sensor to disengage the coupling from the feedback tie rod (Photo 4.M.21.3-3).

6. Remove the magnet sensor from the sensor track. This can be done by sliding the magnet sensor down to the bottom of the sensor track.

7. At the top of the sensor track, remove the sensor tie rod guide by unscrewing the two 1 / 4-20 hex bolt and washers (Photo 4.M.21.3-4).

8. Unscrew the four 10-32 SHCS and lock washers and remove the sensor track mounts and track (Photo 4.M.21.3-5).

4.M.22.3-B Reassembly

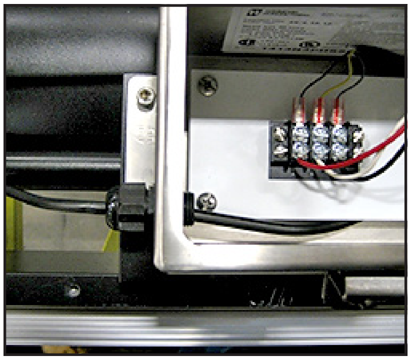


Photo 4.M.22.3-2
Terminal Strip / Wire Connections

Photo 4.M.22.3-3
Magnet Sensor

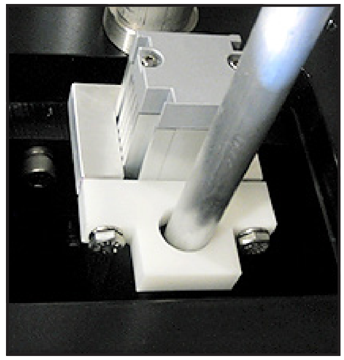


Photo 4.M.22.3-4
Sensor Tie Rod Guide

Photo 4.M.22.3-5
Sensor Track & Mounts

1. Reinstall the four 10-32 SHCS and lock washer to the brackets for the sensor track.

2. Mounting the sensor track onto the brackets. Once aligned, tighten the 10-32 SHCS on the brackets.

3. Three inches from the top of the sensor track, reinstall the tie rod guide by installing the two hex head bolts and washers to clamp down the feedback tie rod guide to the sensor track.

4. Reinstall the sensor magnet by sliding the sensor magnet onto the sensor track with the coupling facing the feedback tie rod.

5. Reengage the magnet sensor coupling to the feedback tie rod and tighten the hex nut.

6. Rewire the non-contacting potentiometer cables to the junction box as shown Photo 4.M.21.3-2 or in wiring schematic.

7. Make sure there is a loop before any wire hole entries as shown in Photos 4.M.21.3-6 and 7. Use zip-ties to secure the cable.

8. Reinstall the two piece non-contacting sensor cover and reinstall the fourteen pan head screws as shown in Photo 4.M.21.3-1.

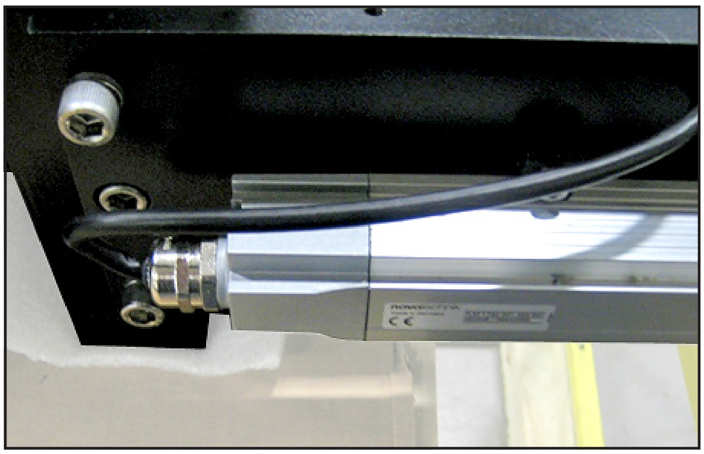


Photo 4.M.22.3-6

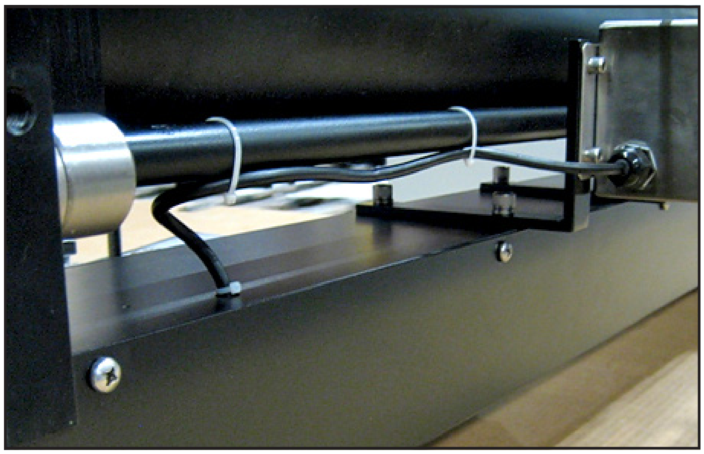


Photo 4.M.22.3-7

4.M.23 Elastic Coupling

General

The elastic coupling is used to apply a controlled load at the seated position with linear (L series) actuators. The elastic coupling is attached to the actuator between the stem and the driven device. Some valves are down seating and require a compression coupling. Valves that are up seating require a tension coupling.

NOTE: An arbor or hydraulic press will be required to disassemble the elastic coupling. Ensure the press is in good working order and has sufficient force to handle the loads in the elastic couplings.

Identification

REXA offers two types of elastic couplings. One has an open frame construction, which is the downseating coupling. See Photo 4.M.22-1. The second type has a closed frame construction, and is the upseating style. See Photo 4.M.22-2.

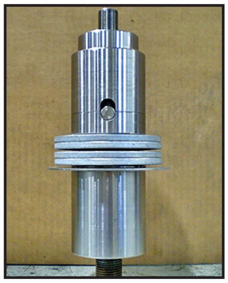


Photo 4.M.23-1
Downseating Coupling

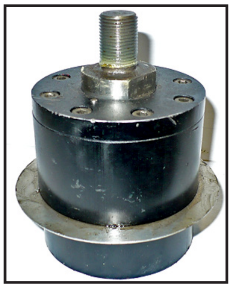


Photo 4.M.23-2
Upseating Coupling

4.M.23.1 Open Spring Compression (Downseating) Load Type Elastic Coupling

Table 4.M.22.1 Parts List

Item	Qty	Description
1	10	Spring Washers
2	1	Spring Stop
3	1	Actuator Stem Adapter
4	1	Load Pin
5	1	#8-32 Set Screw
6	1	Stroke Indicator
7	1	Spacer

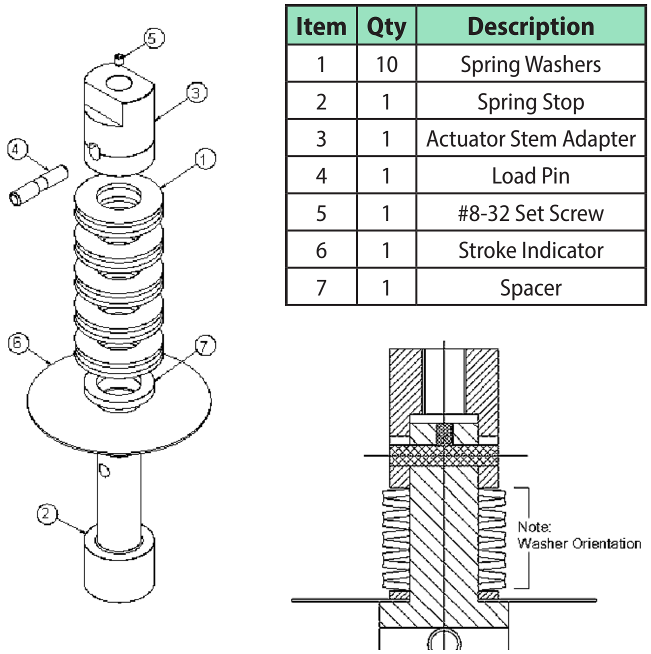


Figure 4.M.23.1

NOTE: Repair of the elastic coupling will require removing the unit from service. Tag-Out and Lock-Out the unit for repair in accordance with local procedures.

4.M.23.1-A Disassembly

1. Remove any external loads from the actuator. The pressure gauges both should read zero.
2. Remove the elastic coupling from the valve stem and actuator shaft by unthreading it from each end, or removing the split clamp from the valve end.
3. Remove the set screw (5) located in the thread hole of the actuator stem adapter (3).
4. Compress the elastic coupling until the load pin (4) moves to the center of the hole in the actuator stem adapter (3). This removes the internal spring load from the load pin (4).
5. Push the load pin (4) out of the assembly.
6. Slowly release the pressure on the coupling and note the arrangement of the spring washers (1).
7. Replace or modify components as necessary.

4.M.23.1-B Reassembly

1. Reassemble by placing the stroke indicator (6), spacer (7), spring washer (1) stack and actuator stem adapter (3) over the spring stop (2).
2. Line up the spring stop (2) hole with the actuator stem adapter (3) slot. Compress the spring washers (1) until the hole and slot line up.
3. Insert the load pin (4) into the hole. Make sure the flat on the pin is facing the set screw hole.
4. Slowly release the pressure on the spring washers (1).
5. Install the set screw using a thread lock.

4.M.23.2 Closed Spring Tension (Upseating) Load Type Elastic Coupling

NOTE: Repair of the elastic coupling will require removing the unit from service. Tag-Out and Lock-Out the unit for repair in accordance with local procedures.

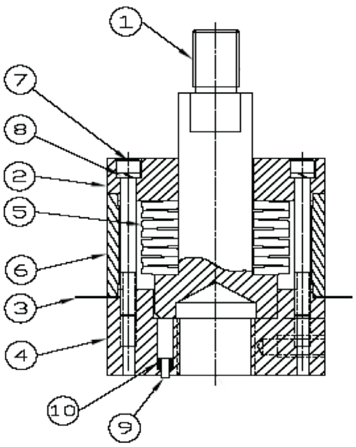


Figure 4.M.23.2

Table 4.M.23.2 Parts List

Item	Qty	Description
1	1	Stem Adapter
2	1	Upper Cap
3	1	Stroke Indicator Disc
4	1	Lower Cap
5	8	Disc Spring
6	1	Spacer
7	8	Socket Hd Cap Screw
8	8	Lockwasher - Hi Collar
9	1	Travel Indicator
10	1	Spring

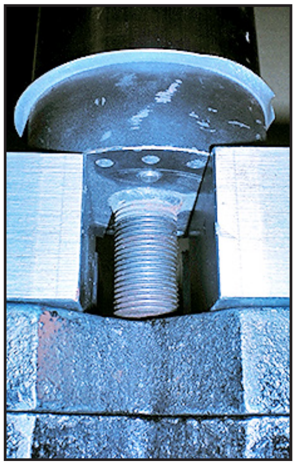


Photo 4.M.23.2-1
Indicator Pin

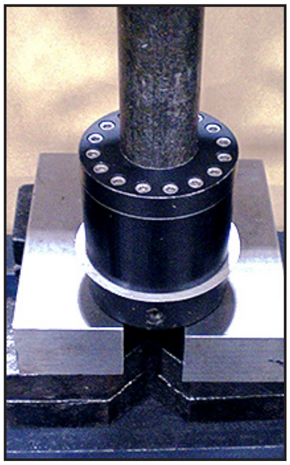


Photo 4.M.23.2-2
Top Plate Against Load

4.M.23.2-A Disassembly

1. Remove any external loads from the actuator. The both pressure gauges should read zero.
2. Remove the elastic coupling from the valve stem and actuator shaft by unthreading it from each end, or removing the split clamp from the valve end.

   NOTE: Do not damage the indicator pin during this procedure. Use shims or provide the press base plate with proper clearance holes. See Photo 4.M.22.2-1 for reference.
3. Place coupling in press, use tube stock to hold the top plate against the load. See Photo 2.M.22.2-2 for reference.
4. Remove bolts holding the coupling assembly together.
5. Slowly release the pressure on the coupling.
6. Remove the top plate, stem adaptor, cylindrical wall and note the arrangement of the spring washers. Also remove the seating indicator and spring which is under the stem adaptor.
7. Replace or modify components as necessary.

4.M.23.2-B Reassembly

1. Reassemble by placing the stroke indicator, indicator spring, spring washer stack, cylindrical wall and actuator stem adapter onto the valve step adapter.
2. Line up top plate with bolt holes in valve stem adaptor.
3. Compress the elastic coupling until all the parts fit together then tighten the loading bolts in a start pattern.
4. Install the set screw using a thread lock.

   NOTE: Coupling design may differ on some models. Please contact REXA for details if your coupling differs from the designs described above. Have serial and model number ready before contacting the factory.

4. M.24 Seat Load Cylinder

The Seat Load Cylinder (SLC) is a hydraulic cushion that replaces the elastic coupling on larger REXA Actuators. This procedure will take you through the removal, disassembly and repair of the SLC.

Photo 4.M.24 Seat Load Cylinder

CAUTION: Spring under tension; take care when removing hydraulic lines and mechanical spring.

4.M.24.1 Removal from Actuator

1. Place the REXA actuator in the Set Up or Local mode.
2. Power the REXA unit down and follow local Lock-out / Tag-out procedures.
3. Open manual bypass and pressure gauge isolation valves.
4. Verify system pressure is relieved; shut off isolation valves on both hydraulic lines connecting the SLC.

   NOTE: Record the termination of the feedback wiring.
5. Remove SLC feedback cover, disconnect wires and conduit from the assembly.

6. Leaving the isolation valves connected to the actuator, remove hydraulic lines from the SLC.
7. While supporting the SLC assembly, remove the bolts holding the SLC to the mounting plate.

4.M.24.2 Disassembly

1. Remove shoulder bolts (19) from the spring button.
2. Remove screws (16) holding spring tube (1) to cylinder assembly.
3. Slide spring tube (1) off of the assembly.

   NOTE: Record the spring pre-compression length before proceeding.

4. Holding the stem extension (5) still, remove jam nuts (8) relieving the spring pressure.
5. Remove coil spring (3, 4) and spring buttons (7, 6). Some SLC assemblies have more than one spring.
6. The stem extension (5) has a tack weld holding the extension to the hydraulic cylinder. Cover all open hydraulic ports and carefully grind weld away to remove extension from hydraulic cylinder.
7. Remove mounting plates (9) and adaptor port (10) from cylinder assembly.

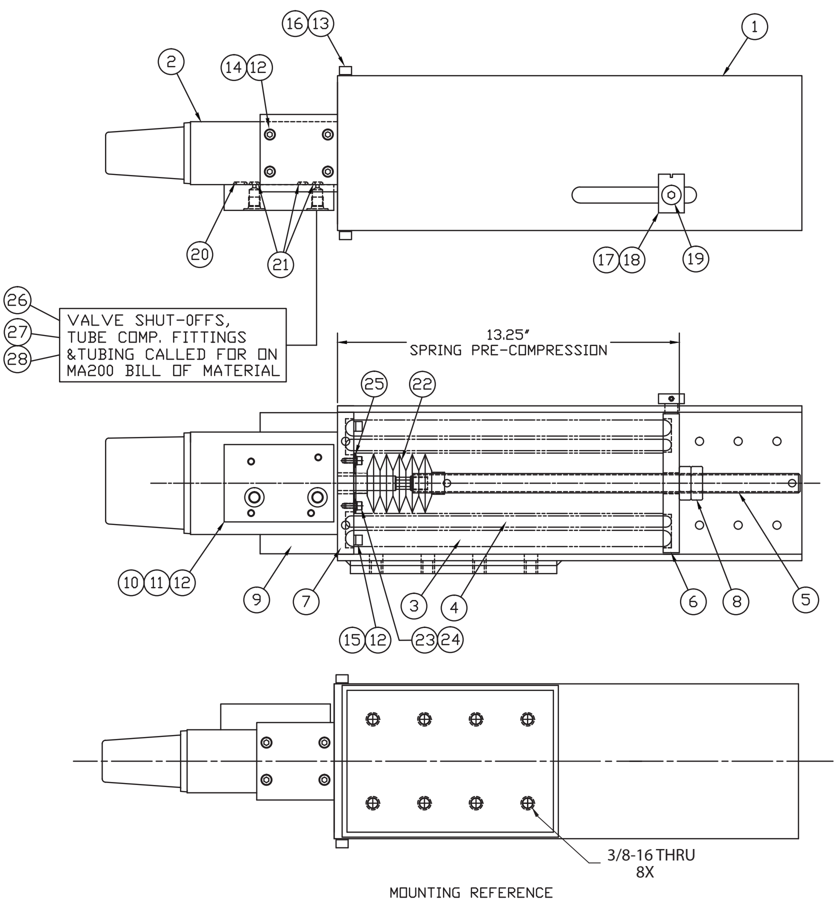


Figure 4.M.24.2 SLC

	ITEM	QTY	DESRCIPTION
	28	3	TUBE .250, .035 WALL
	27	2	TUBE CONN STR -4 COMP-4STR
	26	2	VALVE, SHUTOFF, SWAGELOK
	25	1	FLANGE, DUST BOOT
	24	3	LKWSHR HI #10 S.S. .047TK
	23	3	SHCS #10-32 x .437 S.S.
	22	1	DUST BOOT
	21	3	O-RING, VITON -010
	20	1	O-RING, VITON -012
	19	1	SHOULDER SCREW, Ø.5 X.5 LNG
	18	1	SET SCREW, #10-32 X .31
	17	1	INDICATOR
	16	4	CAP SCREW, 5/16-18 X 1.00
	15	4	CAP SCREW, 1/4-20 X 1.25
	14	8	CAP SCREW, 1/4-20 X 1.00
	13	4	HI-LOCK WASHER, 5/16"
	12	16	HI-LOCK WASHER, 1/4"
	11	4	CAP SCREW, 1/4-20 X 2.50
△2	10	1	BLEED PORT ADAPTER
	9	2	MOUNTING PAD
	8	2	JAM NUT, 3/4-10
	7	1	SPRING BUTTON, UPPER
	6	1	SPRING BUTTON, LOWER
	5	1	STEM EXTENSION, .75-10 UNC
	4	1	COMPRESSION SPRING
	3	1	COMPRESSION SPRING
△2	2	1	CYLINDER ASSY. L2K-2
	1	1	SPRING TUBE, STD MTG

Table 4.M.24.2 Parts List

4.M.24.3 Repair

REXA SLC assemblies come in L2 000 and L4 000 cylinder sizes. Refer to section 4.M.18 to repair the hydraulic cylinder assembly.

4.M.24.4 Reassembly

1. Replace mounting plates (9) and adaptor port (10) to cylinder assembly.
2. Thread stem extension (5) onto hydraulic cylinder stem. Use high grade thread locker to prevent the unthreading of shafts.
3. Install coil spring (3,4) and spring buttons (7,6).
4. Holding the cylinder stem (5) still, thread jam nuts (8) onto the stem extension (5). Use an anti-seize compound to prevent the assembly from galling.
5. Tighten jam nuts (8) until the spring is compressed to the proper length.
6. Install spring tube (1) and tube mounting bolts (16).
7. Install shoulder bolts (19) into the spring button.

4.M.24.5 Re-Installation

1. Re-install the SLC onto the mounting plate on the REXA unit.
2. Connect hydraulic lines.
3. Replace SLC feedback cover, connect conduit and feedback wiring.
4. Close manual bypass and purge system of air.
5. Verify operation of the SLC system. System pressure at the seated position should be 2 000 psi. Adjust spring tension as needed.

4.M.25 Booster Pump

4.M.25.1 Motor

NOTE: P9 and P40 size modules share similar motor mounting procedures and components

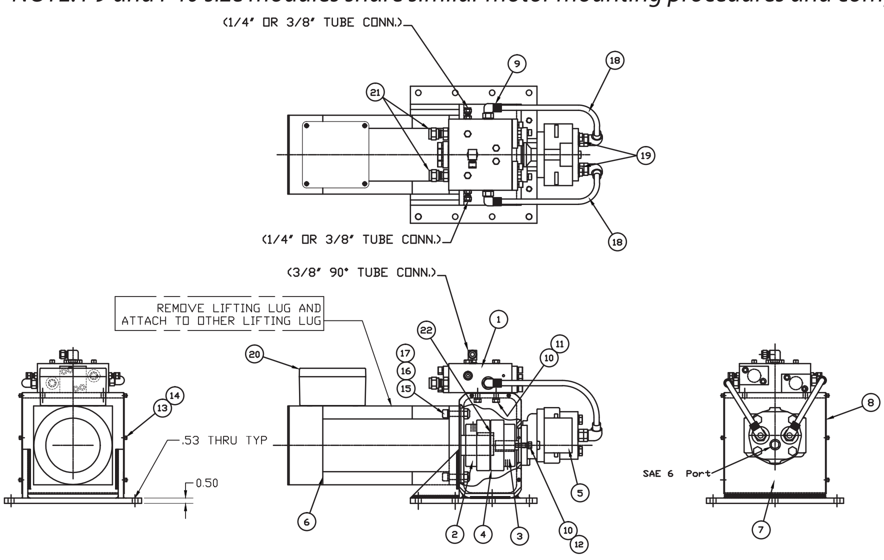


Figure 4.M.25.1 Booster Pump drawing (P40 shown)

Table 4.M.25.1 Parts List

ITEM	QTY	DESCRIPTION
22	1	KEY 14mm x .358 x 1.5 LONG
21	2	FITTING, TUBE 1/2" TUBE TO SAE -8 PORT
20	1	JUNCTION BOX ASSEMBLY
19	2	ADAPTER, SAE 16 MALE TO SAE 8 FEM
18	6ft	TUBING, 1/2"O.D.x.065 WALL ANN S.S.
17	4	PLN WASHER 1/2 (SS)
16	4	LOCK NUT 1/2-13 (SS)
15	4	SHCS 1/2-13 X 2.0 LONG (AS)
14	12	SHCS #10-32NF x .44 LONG (SS)
13	12	#10 HI-COL LKWSHR (SS)
12	2	HX HD BLT 3/8-24NF x 1.25 LONG (AS)
11	4	HX HD BLT 3/8-16NC x 1.5 LONG (SS)
10	6	3/8 LKWSHR REG (SS)
9	4	ELBOW 90°, STR TH'D, SAE 8 TO 1/2" TUBE
8	2	COVER, FOR MOUNTING BRACKET
7	1	BRACKET, MOUNTING P40 BOOST PUMP
6	1	MOTOR, SERVO, P40 SIZE, GLENTEK
5	1	PUMP, HYDRAULIC GEAR, GEARTEK, SIZE C65
4	1	HYTREL INSERT, MAGNALOY MOD #500
3	1	COUPLING, MAGNALOY MOD #500 (ø.875 SHAFT)
2	1	COUPLING, MAGNALOY MOD #500 (ø48mm SHAFT)
1	1	MANIFOLD SUB-ASSEMBLY

4.M.25.1.A Disassembly

1. Ensure that the power has been turned off from the unit.
2. Disconnect as necessary any conduit and wires to the motor from the terminal block
3. Ensure the actuator has been drained of oil and top drain plug has been removed.
4. Remove set screw from coupling (2).
5. Remove the four motor bolts and four lock washers.
6. Pull motor straight out.

4.M.25.1.B Reassembly

1. Orientate the motor shaft so that it engages with the pump coupling.

CAUTION: DO NOT FORCE THE MOTOR IN PLACE OR TIGHTEN THE MOUNTING SCREWS BEFORE TURNING THE MOTOR SHAFT OR DAMAGE WILL OCCUR!

2. Apply blue Loctite on motor bolts and install the four motor washers.
3. Replace set screw in the coupling (2).
4. Reconnect wires. Refer to "D. Booster Pump Configuration" on page 179 in the IOM for more information.

4.M.25.2 Pump

4.M.25.2.A Disassembly

1. Confirm that all pressure gauges read zero before disconnecting any pressure lines.
2. Ensure the actuator has been drained of oil and top drain plug has been removed.

   NOTE: An oil drain bin should be ready to catch any oil that may drain from disconnecting lines.

3. Disconnect tubing from the pump.
4. While supporting the pump, remove set screw from coupling (2).
5. Remove two bolts (12) and two lock washers.
6. Remove pump.

4.M.25.2.B Reassembly

1. Engage replacement pump with mounting bracket and coupling.
2. Apply blue Loctite on pump screws and install the motor washers.
3. Replace set screw in coupling.
4. Reconnect tubing, tighten adapters (19) and refill actuator with oil.
5. Before running motor, prime the pump by turning the coupling by hand approximately 5 rotations. This will move the oil throughout the pump and manifold.

4.M.25.3 Manifold

4.M.25.3.A Disassembly

1. Confirm that all pressure gauges read zero before disconnecting any pressure lines
2. Ensure the actuator has been drained of oil and top drain plug has been removed.

   NOTE: An oil drain bin should be ready to catch any oil that may drain from disconnecting lines.
3. Disconnect tubing from the manifold.
4. While supporting the manifold, remove four mounting bolts and take manifold off of mounting bracket.

4.M.24.3.B Reassembly

1. Secure the new manifold to the mounting bracket with the four mounting bolts.
2. Reconnect tubing, tighten adapters (19) and refill actuator with oil.
3. Before running motor, turn the coupling by hand approximately 5 rotations. This will move the oil throughout the pump and manifold.

4.M.26 Transducer

Identification

Below is a typical installation of a pressure transducer on a REXA actuator. The ¼" stainless steel tubing going to the transducer is the fluid side. The large, NPT wire end of the transducer threads into the transducer wiring box shown below.

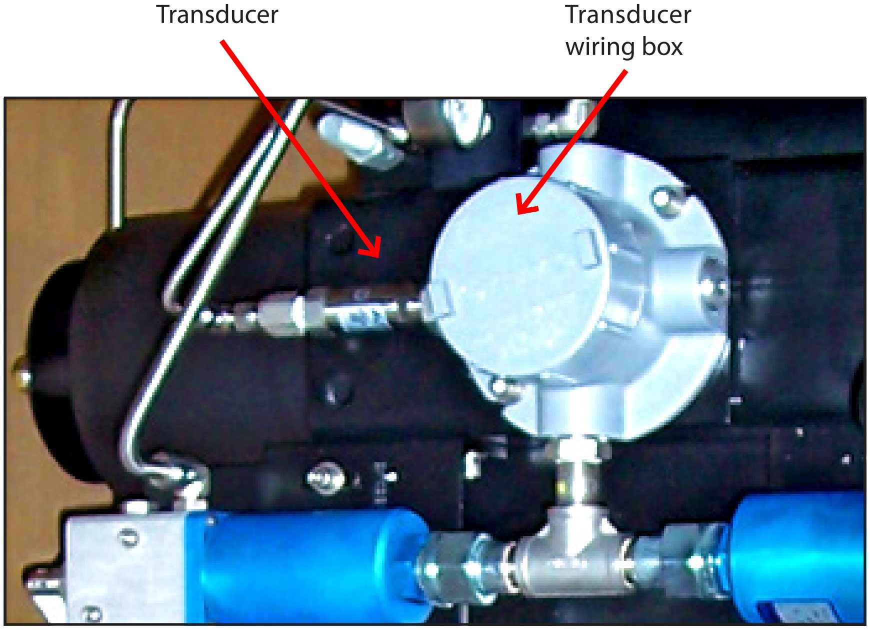


Figure 4.M.26 Transducer

CAUTION: The REXA pressure transducer may have up to 2500 psi of fluid pressure connected to it. Care must be taken during this repair.

4.M.26.1 Disassembly

1. If the unit is an accumulator fail system, then the unit must be in its fail safe position and the accumulator in its trip state.
2. Open the manual bypass by turning the "Bypass" hex counterclockwise on the power module's front face. With the accumulator in the trip state this will drain the accumulator pressure to 0 psi.

   NOTE: Ensure that the high pressure accumulator gauge located on the gauge block reads 0 psi before proceeding.
3. Turn off electrical power to the unit.
4. Close the manual override levers on the accumulator solenoids for accumulator fail units only. Refer to IOM "C2. Online Recharge Accumulator Fail-Safe" on page 181.
5. Remove the cover from the transducer wiring box and disconnect both leads going to the transducer.
6. Disconnect the ¼" hydraulic fitting from the base of the transducer after placing an oil catch pan under the unit.
7. Unthread the transducer from the transducer wiring box.

4.M.26.2 Reassembly

1. Apply thread sealant to the threads on both ends of the transducer. Thread the transducer into the transducer wiring box.
2. Reconnect the ¼" hydraulic fitting to the base of the transducer.
3. Re-wire the transducer into the transducer wiring box. Refer to "P. Interconnect Diagrams & Control Enclosure Drawings" on page 181 of the IOM for interconnect wiring diagrams.
4. Re-install the transducer wiring box cover.
5. Turn on electrical power to the unit.

4.M.27 External Expansion Chamber And Accumulator Bottle

Identification

REXA uses two types of expansion chambers depending on the oil volume required for the system. The first type is a spring loaded piston cylinder. It is identified by the gray body and stainless indicator rod protruding out one end. Depending on the system it may have one or two hydraulic lines coming off of the end cap.

CAUTION: The external expansion chamber is a pressure vessel that typically may have up to 60 psi of fluid pressure. Care must be taken during this repair.

The second type is a low pressure collection bottle. These are typically painted black and there will be two hydraulic ports side by side on one end cap as shown in Photo 4.M.26-2. Any bottles having only one hydraulic port to the end cap is a high pressure fail safe bottle.

CAUTION: The accumulator bottle is a pressure vessel that typically may have up to 2 500 psi of fluid pressure. Care must be taken during this repair.

Accumulator Identification

REXA uses piston type accumulator bottles for all the accumulator fail-safe units. An accumulator fail-safe actuator will have both an accumulator and a collection bottle. The accumulator bottle can be identified by having only one hydraulic port located in the end cap as shown in Photo 4.M.26-3. Following the hydraulic line from the bottle will lead you to a pressure gauge indicating the pressure in the accumulator bottle.

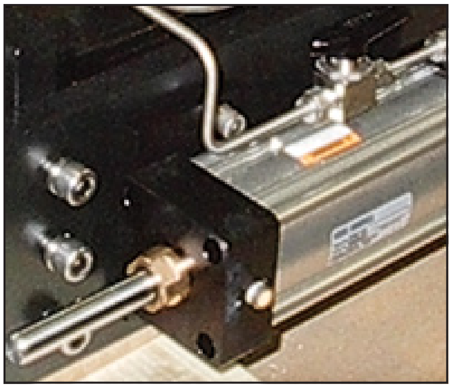


Photo 4.M.27-1 Piston Cylinder

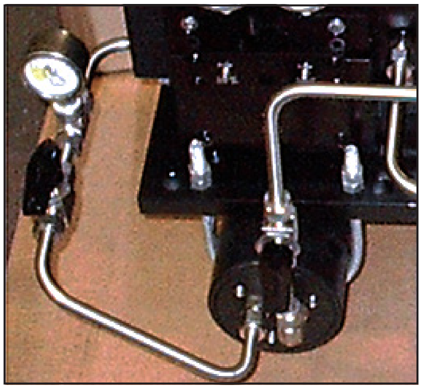


Photo 4.M.27-2 Accumulator Bottle

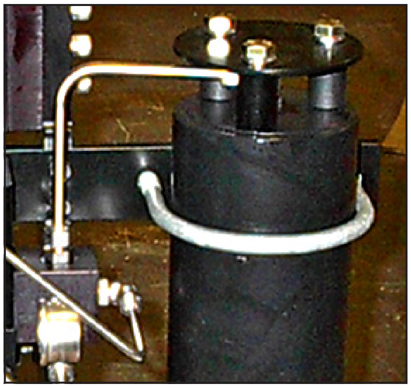


Photo 4.M.27-3 Hydraulic Port

4.M.27.1 Disassembly

1. If the unit is an accumulator fail system, then the unit must be in the fail safe position and the accumulator fail in the trip state.
2. Open the manual bypass by turning the "Bypass" hex counterclockwise on the power module's front face. With the accumulator in the trip state this will drain the accumulator pressure to 0 psi.

   NOTE: Ensure that the high pressure accumulator gauge located on the gauge block reads 0 psi before proceeding.
3. Close the manual override levers on the accumulator solenoids for accumulator fail units only. Refer to IOM "C2. Online Recharge Accumulator Fail-Safe" on page 182 more details.
4. For accumulator replacement – The bottle can now be safely removed.
5. On most collection bottles there will be a ¼-turn isolation valve. Close this isolation valve so that the handle is perpendicular to the valve body.
6. Clamp the oil level power module indicator. See TS&R Appendix F for information on indicator clamping.
7. Attach the REXA bleed kit to one of the open purge ports on the power module body. Refer to IOM "1.6 Oil" on page 182.
8. Place an oil catch pan under the bleed kit port; open the collection ¼-turn valves, remove the oil level indicator clamp and open the ¼-turn valve on the bleed kit. This will allow the system oil to drain.
9. Close off the ¼-turn valves going to the collection. It can now be safely removed.

4.M.27.2 Reassembly

1. Replace appropriate bottle.
2. Remove the bleed assembly.
3. Open up all isolating ball valves
4. Reference section 1.6 of the IOM for re-filling the actuator.

A. List of Recommended Tools

REXA offers the Standard Tool Kit; the Tube Bending Kit, and the Bleed Kit with Oil Gun. Actuator Bleed Kit-110/220VAC version motor/pump driven or 20VDC battery pack version, and Oil Gun are also available.

A.1 The Standard Tool Kit

The standard tool kit is contained in a rugged, high-visibility tool case which features convenient removable pallets and a combination lock for optimal security. The kit contains the following:

Description	Qty	Description	Qty
Hex Key Set, Ball End	13 pcs.	Combination Wrench Set	9 pcs.
Pick Set	4 pcs.	Strap Wrench Set	2 pcs.
Side Cutter/Needle Nose Pliers	1 ea.	2 lb. Rubber Hammer	1
Stranded Wire Stripper/Cutter	1	Mag Lite 2D Flashlight	1
Tongue and Groove 12" Channellock Pliers	1	Feeler Gauge	1
Adjustable Wrench Set	3 pcs.	Hacksaw With Blade	1
Retaining Ring Pliers	2 pcs.	Utility Knife	1
Nut Driver Set	7 pcs.	Tool Case	1
Screw Driver Set	8 pcs.	Test Probe, 5 Tip, Rated for 300 BV & 3A	2 pcs.
Mini Screw Driver Set	2 pcs.		

Photo A-1 Tool Kit

A.2 The Tube Bending Kit

The tubing kit contains the following:

Description	Qty
¼" Tube Bender	1
3⁄8" Tube Bender	1
Tube Cutter	1
Tube Deburring Tool	1

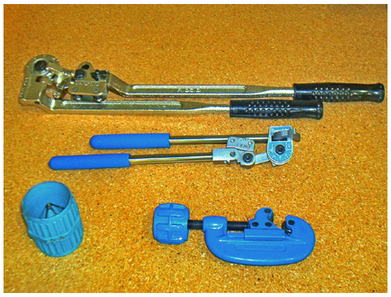


Photo A-2 Tube Bending Kit

A.3 The Bleed Kit

The bleed kit contains the following:

Description	Qty	Description	Qty
#4 Str. Fitting	2	Shutoff	2
AA .250 Tubing	4 ft	Plastic Tubing	20 ft
'T' Fitting	2	Insert	1
Gauge	2		

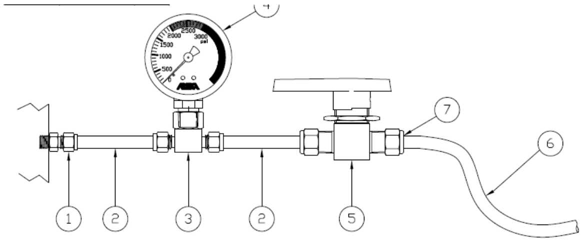


Photo A-3 Bleed Kit

A.4 Oil Gun Kit

The Oil Gun kit contains the following:

Description	Qty	Description	Qty
#4 Str. Fitting	2	Shutoff	2
AA .250 Tubing	4 ft	Plastic Tubing	20 ft
'T' Fitting	2	Insert	1
Gauge	2		

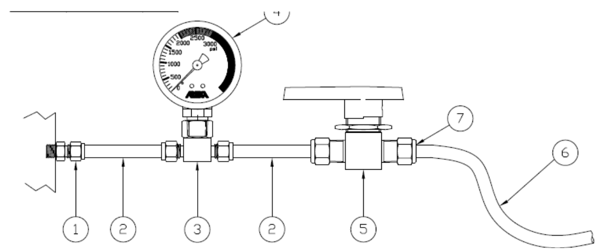


Photo A-4 Oil Gun Kit

A.5 110/220VAC Motor/Pump Bleed Kit

The 110/220VAC motor/pump bleed kit contains the following:

Description	Qty	Description	Qty
Tube .375 NPT,	1	Schrader Safety Chuck	1
Tube .250 Tee Union 3-Way	2	Tube Conn. -4 FLR -4 STR	2
Tube Conn. -4 FLR -6 STR	2	Hose Fitting -4, THD	6
Hose TFE Covered 919-4	12	Tube Conn. -4 FLR -4 NPT	1
Tube Conn. 4-6FTX-S	1	Adapter .250 Tube/ SAE #4 F	2
Gauge 0-5K PSI SAE	2	Swagelok Valve Shutoff	2
Demo Case 22"x18"x10"	1	Swagelok SS 4TA 1-4AN Tube	2
Swagelok SS 600-R-4	2	Grainger #2W463 Ft Switch	1
Rotary Gear Pump Cast Iron	1	Pwr Cord AC 18GA 12ft 3 pr grd	1
SS Pipe Fit, Hex 1/4 in F NPT	1	.25 Tube to #4	2
.25 Tube to #6	2	.25 Tube to #8 SAE/MS Thr. str.	2
.25 Tube to #10 SAE/MS Thr. str.	2	.25 Tube to #12 SAE/MS Thr. str.	2
.305-32 Thr. 1/8" NPT M	1	50ft Tygon Plasticizer .5" od ⅜" id	10

Photo A-5 110/220VAC Motor/Pump Kit

A.6 20VDC Motor/Pump Battery Pack Bleed Kit

The 110/220VAC motor/pump bleed kit contains the following:

Description	Qty	Description	Qty
Tube .375 NPT,	1	Schrader Safety Chuck	1
Tube .250 Tee Union 3-Way	2	Tube Conn. -4 FLR -4 STR	2
Tube Conn. -4 FLR -6 STR	2	Hose Fitting -4, THD	6
Hose TFE Covered 919-4	12	Tube Conn. -4 FLR -4 NPT	1
Tube Conn. 4-6FTX-S	1	Adapter .250 Tube/ SAE #4 F	2
Gauge 0-5K PSI SAE	2	Swagelok Valve Shutoff	2
Demo Case 22"x18"x10"	1	Swagelok SS 4TA 1-4AN Tube	2
Swagelok SS 600-R-4	2	Grainger #2W463 Ft Switch	1
Rotary Gear Pump Cast Iron	1	Pwr Cord AC 18GA 12ft 3 pr grd	1
SS Pipe Fit, Hex 1/4 in F NPT	1	.25 Tube to #4	2
.25 Tube to #6	2	.25 Tube to #8 SAE/MS Thr. str.	2
.25 Tube to #10 SAE/MS Thr. str.	2	.25 Tube to #12 SAE/MS Thr. str.	2
.305-32 Thr. 1/8" NPT M	1	50ft Tygon Plasticizer .5" od ⅜" id	10
Cordless grease gun & reserv.	1	Tube .250, .035 Wall	2

Photo A-6 20VDC Batter Pack Motor/ Pump Kit

B. Returning the Actuator for Repair

This section contains information on how to return a faulty actuator for repair or replacement.

B.1 Return Procedure

1. Call REXA at (508) 584-1199 during regular business hours to get a Returned Materials Authorization Number (RMA#).

NOTE: Do not attempt to return materials or other equipment without a valid RMA number. Returns received without a valid RMA number are not accepted and are returned to sender.

2. REXA is not responsible or liable for damage resulting from improper packaging or shipment.

3. Ship the actuator to:

    REXA

    4 Manley Street

    W. Bridgewater, MA 02379

    Attn: Repair Dept., RMA#

4. REXA will determine the failure and cost to repair. No work will be performed without your authorization. A minimum charge for diagnostic evaluation will apply.

ELECTRAULIC™ ACTUATION

RETURN MATERIALS REQUEST FORM

Dear valued customer,

Please fill out form below as complete and accurate as possible and return at your earliest convenience. The information provided is essential to our RMA process and will help us to resolve your issue in a timely manner. If there are any questions in filling out this form please contact us at 508-584-1199 or 281-944-4490.

Your REXA Support Team

Submitter Information		Date:	
Your Name:		Company:	
Phone:		E-mail:	

CUSTOMER BILLING ADDRESS	CUSTOMER SHIPPING ADDRESS
Address:	Address:
Contact:	Contact:
Tel:	Tel:
e-mail:	e-mail:

ITEMS REQUESTING TO BE RETURNED – Note: Multiple items can be returned under the same RMA number; however, REXA requests separate forms for each different item being returned.
NOTE: All actuators coming back for repair should be clean and free of any process contamination. If Actuators arrive at our facility and have not been cleaned then there will be a cleaning charge added to the order. Amount TBD.

Part # / Item		Qty		Source: (Check one)		Parts Order
						Inventory
						Existing Unit(s)

Parts Order # or Serial # (Enter serial # from actuator or electronics ID tag)	

Select Primary Reason for Return		Provide specific details as to why parts are being returned. Attach photos / documents if will support claim for the RMA
	Failed Component	
	Wrong Part	
	Overstock	
	Upgrade	
	Maintenance	
	Troubleshoot / Repair	

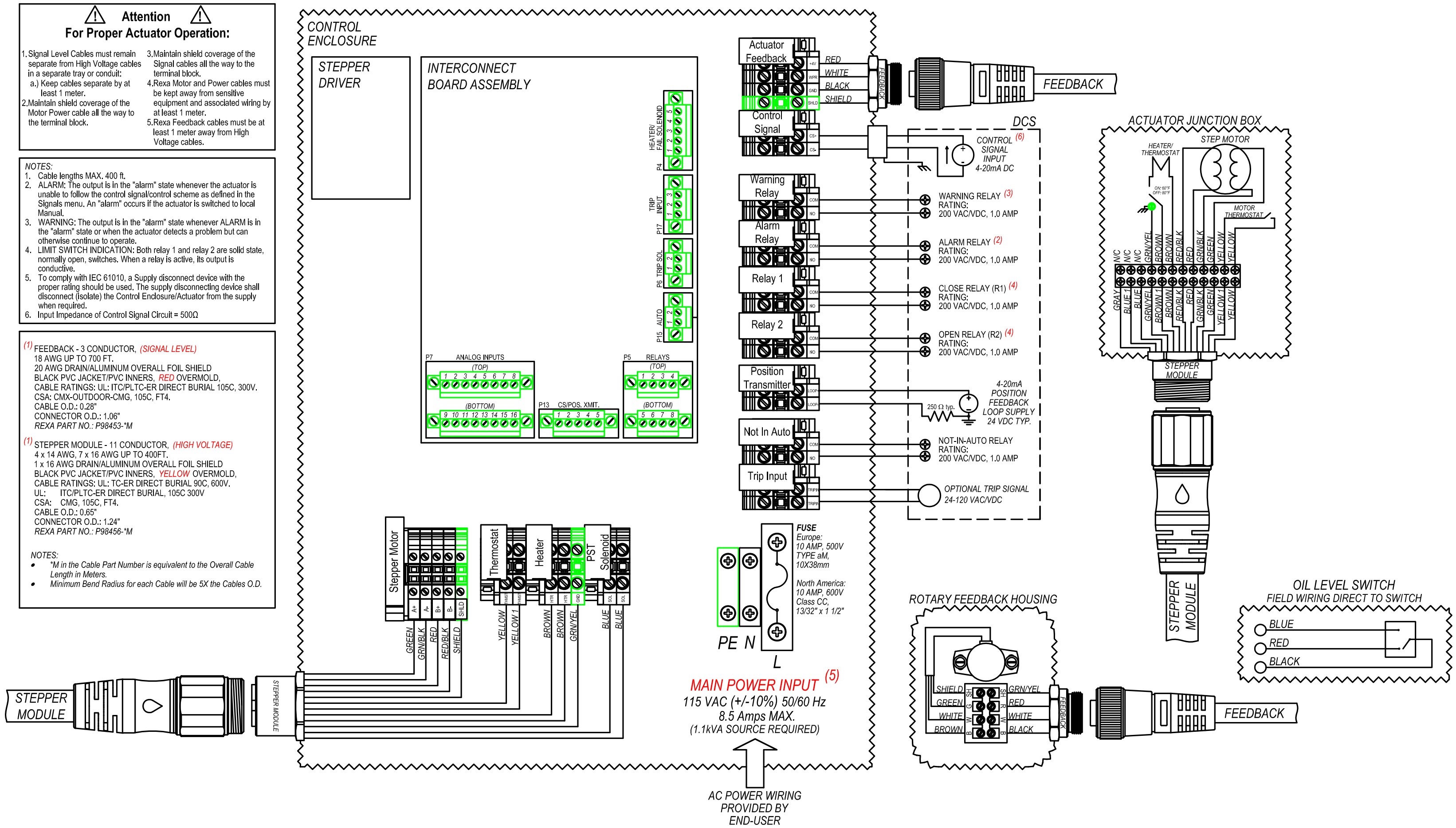
How long has part (or system) been in service?	0 – 3 Mo	3 – 6 Mo	6 – 12 Mo	12 – 24 Mo	> 24 Mo

Location of Actuator?		Indoor	X	Outdoor	Ambient Temp ^{0}F	

<u>Action Requested</u> (Select One)		Restock (fee may apply)
For warranty evaluations, a $250 PO is required below.		Repair / Upgrade (PO Required)
If confirmed to be warranty, the PO will not be charged.		Warranty Evaluation (PO Required)
Purchase Order #		

Expected Date Parts to be Returned	

C. Circuit Schematics



⚠ Attention ⚠
For Proper Actuator Operation:

1. Signal Level Cables must remain separate from High Voltage cables in a separate tray or conduit:
   a.) Keep cables separate by at least 1 meter.
2. Maintain shield coverage of the Motor Power cable all the way to the terminal block.
3. Maintain shield coverage of the Signal cables all the way to the terminal block.
4. Rexa Motor and Power cables must be kept away from sensitive equipment and associated wiring by at least 1 meter.
5. Rexa Feedback cables must be at least 1 meter away from High Voltage cables.

NOTES:

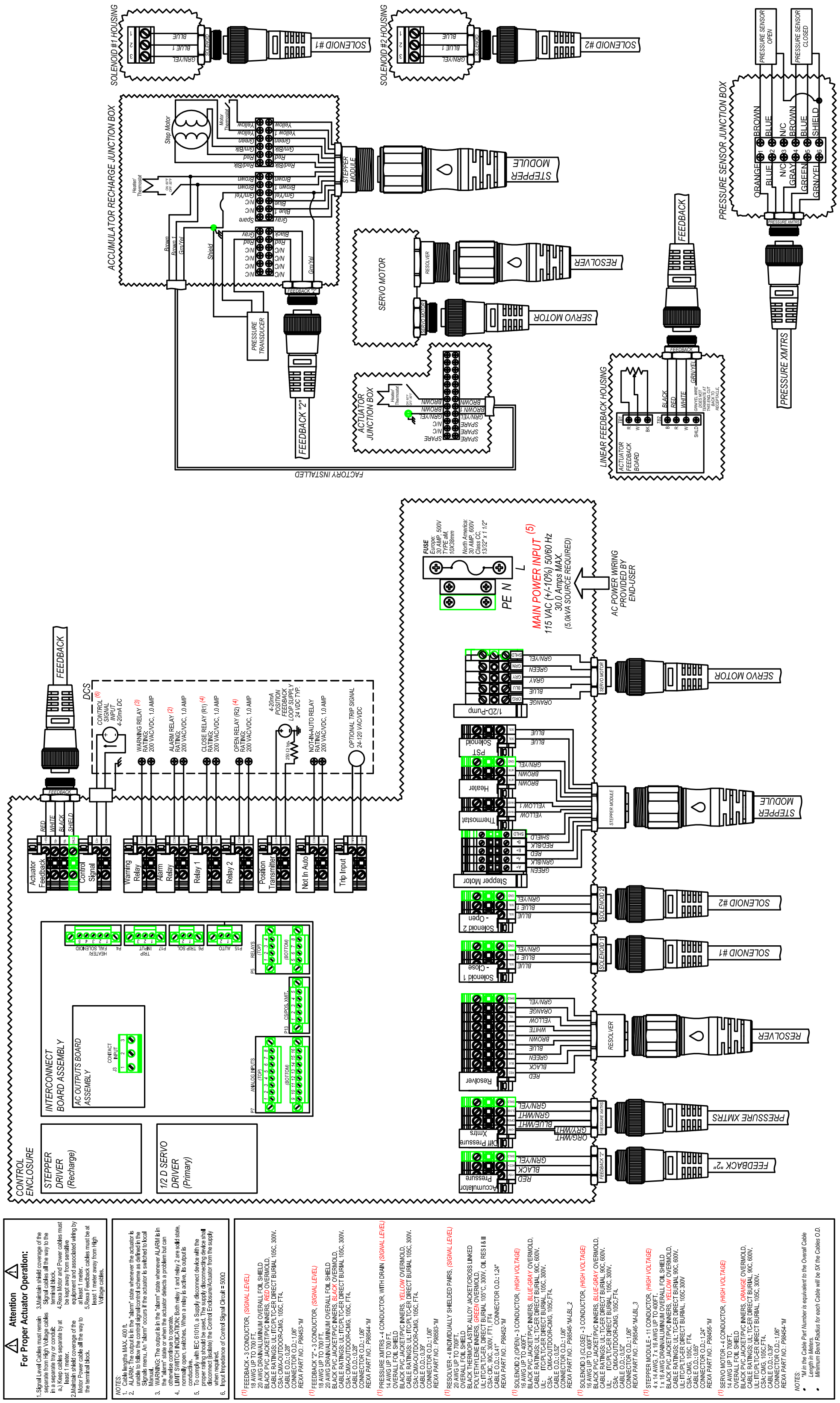
1. Cable lengths MAX. 400 ft.
2. ALARM: The output is in the "alarm" state whenever the actuator is unable to follow the control signal/control scheme as defined in the Signals menu. An "alarm" occurs if the actuator is switched to local Manual.
3. WARNING: The output is in the "alarm" state whenever ALARM is in the "alarm" state or when the actuator detects a problem but can otherwise continue to operate.
4. LIMIT SWITCH INDICATION: Both relay 1 and relay 2 are solid state, normally open, switches. When a relay is active, its output is conductive.
5. To comply with IEC 61010, a Supply disconnect device with the proper rating should be used. The supply disconnecting device shall disconnect (isolate) the Control Enclosure/Actuator from the supply when required.
6. Input Impedance of Control Signal Circuit = 500Ω

(1) FEEDBACK - 3 CONDUCTOR, *(SIGNAL LEVEL)*
18 AWG UP TO 700 FT.
20 AWG DRAIN/ALUMINUM OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *RED* OVERMOLD,
CABLE RATINGS: UL: ITC/PLTC-ER DIRECT BURIAL 105C, 300V.
CSA: CMX-OUTDOOR-CMG, 105C, FT4.
CABLE O.D.: 0.28"
CONNECTOR O.D.: 1.06"
*REXA PART NO.: P98453-*M*

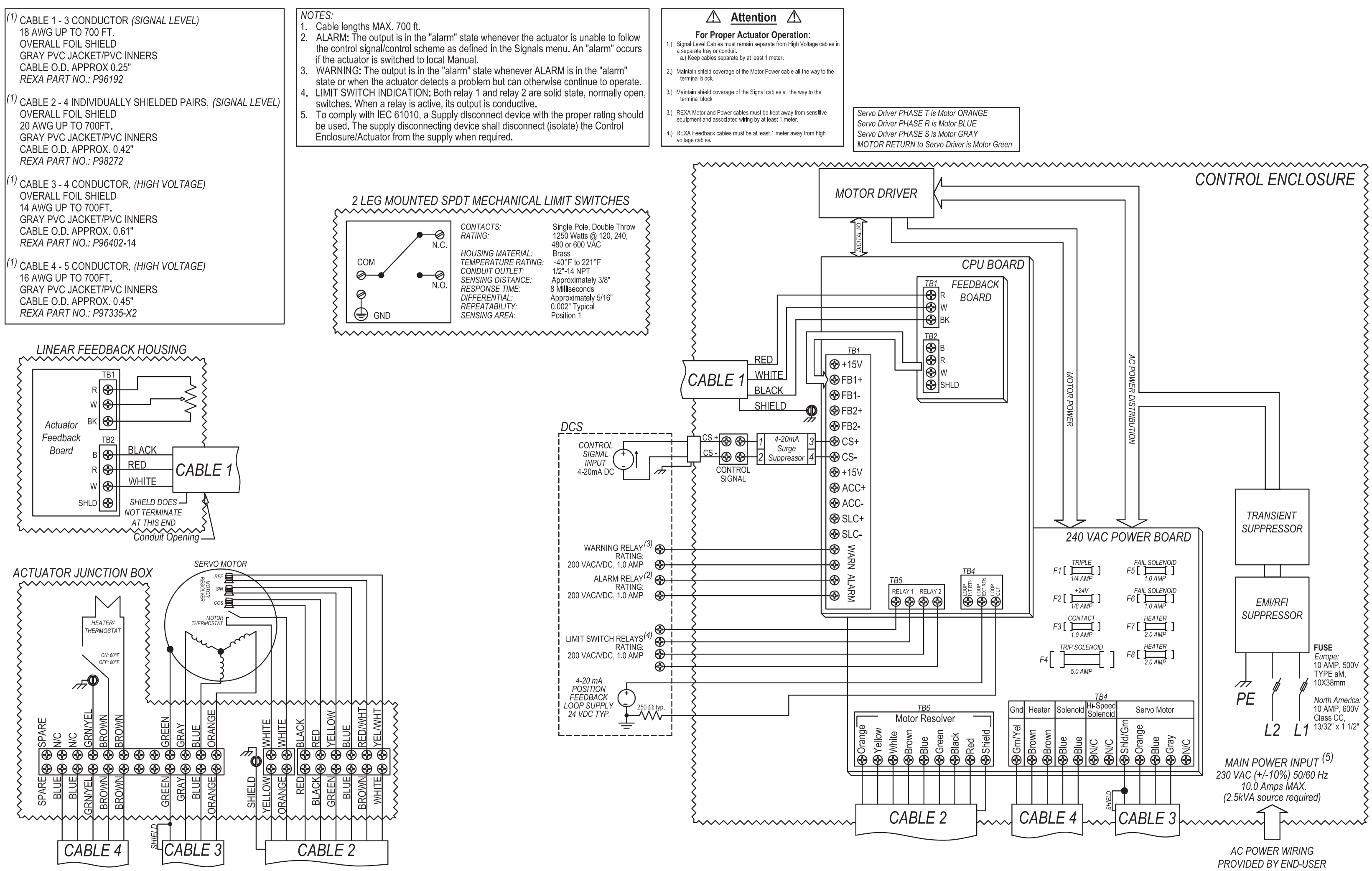
(1) STEPPER MODULE - 11 CONDUCTOR, *(HIGH VOLTAGE)*
4 x 14 AWG, 7 x 16 AWG UP TO 400FT.
1 x 16 AWG DRAIN/ALUMINUM OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *YELLOW* OVERMOLD,
CABLE RATINGS: UL: TC-ER DIRECT BURIAL 90C, 600V.
UL: ITC/PLTC-ER DIRECT BURIAL, 105C 300V
CSA: CMG, 105C, FT4.
CABLE O.D.: 0.65"
CONNECTOR O.D.: 1.24"
*REXA PART NO.: P98456-*M*

NOTES:
- **M in the Cable Part Number is equivalent to the Overall Cable Length in Meters.*
- *Minimum Bend Radius for each Cable will be 5X the Cables O.D.*

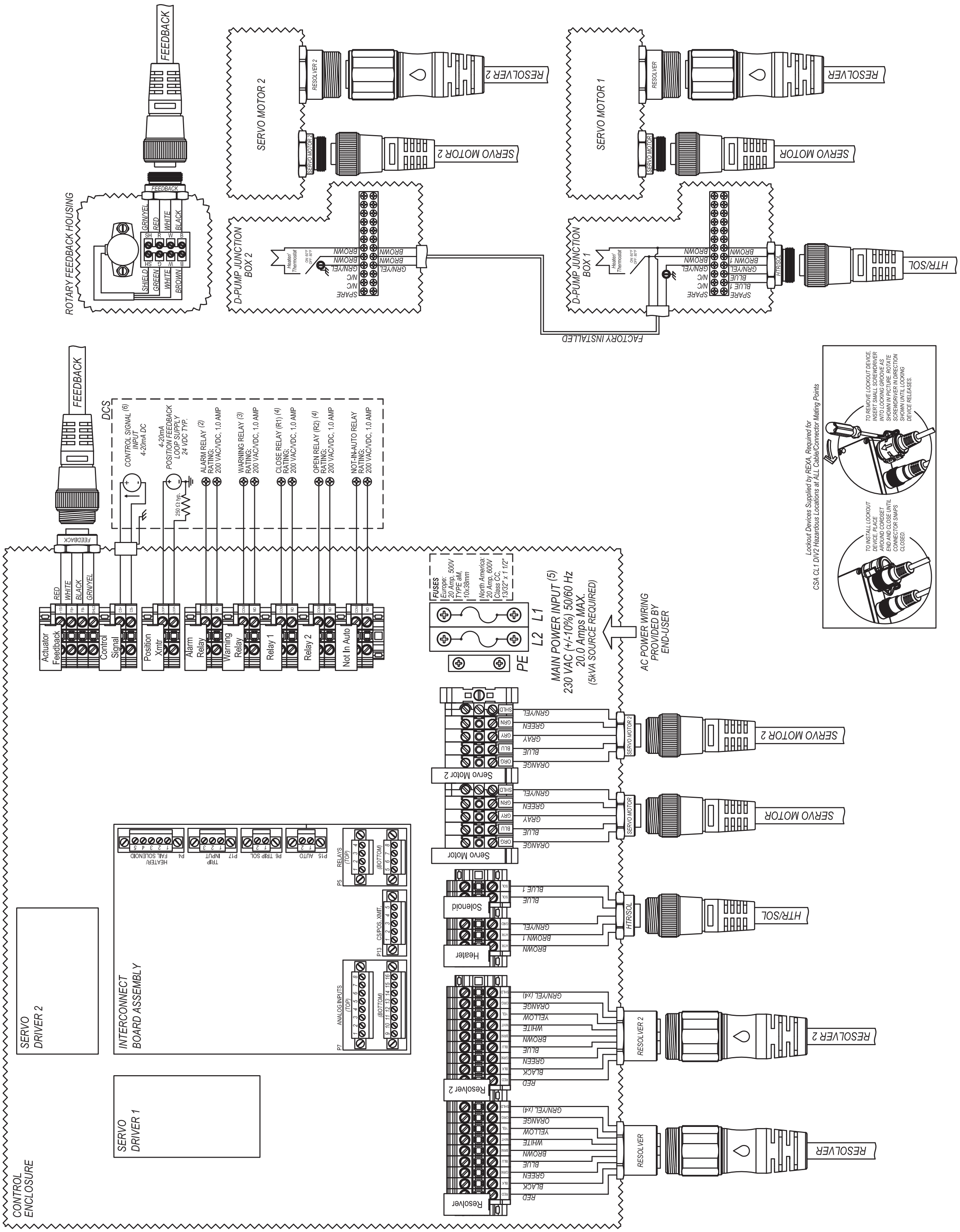
Stepper Wiring Diagram



½D Servo Wiring Diagram

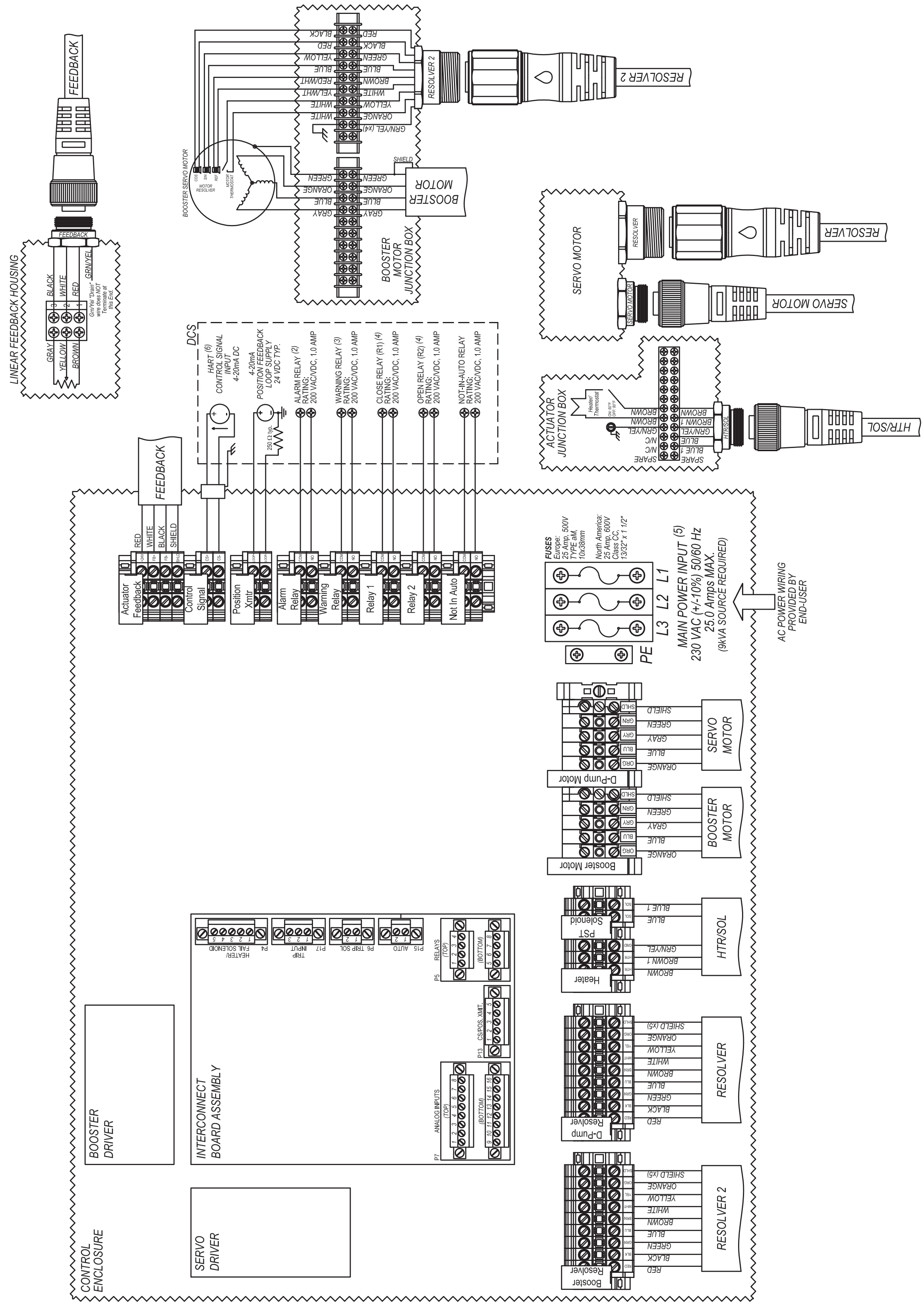


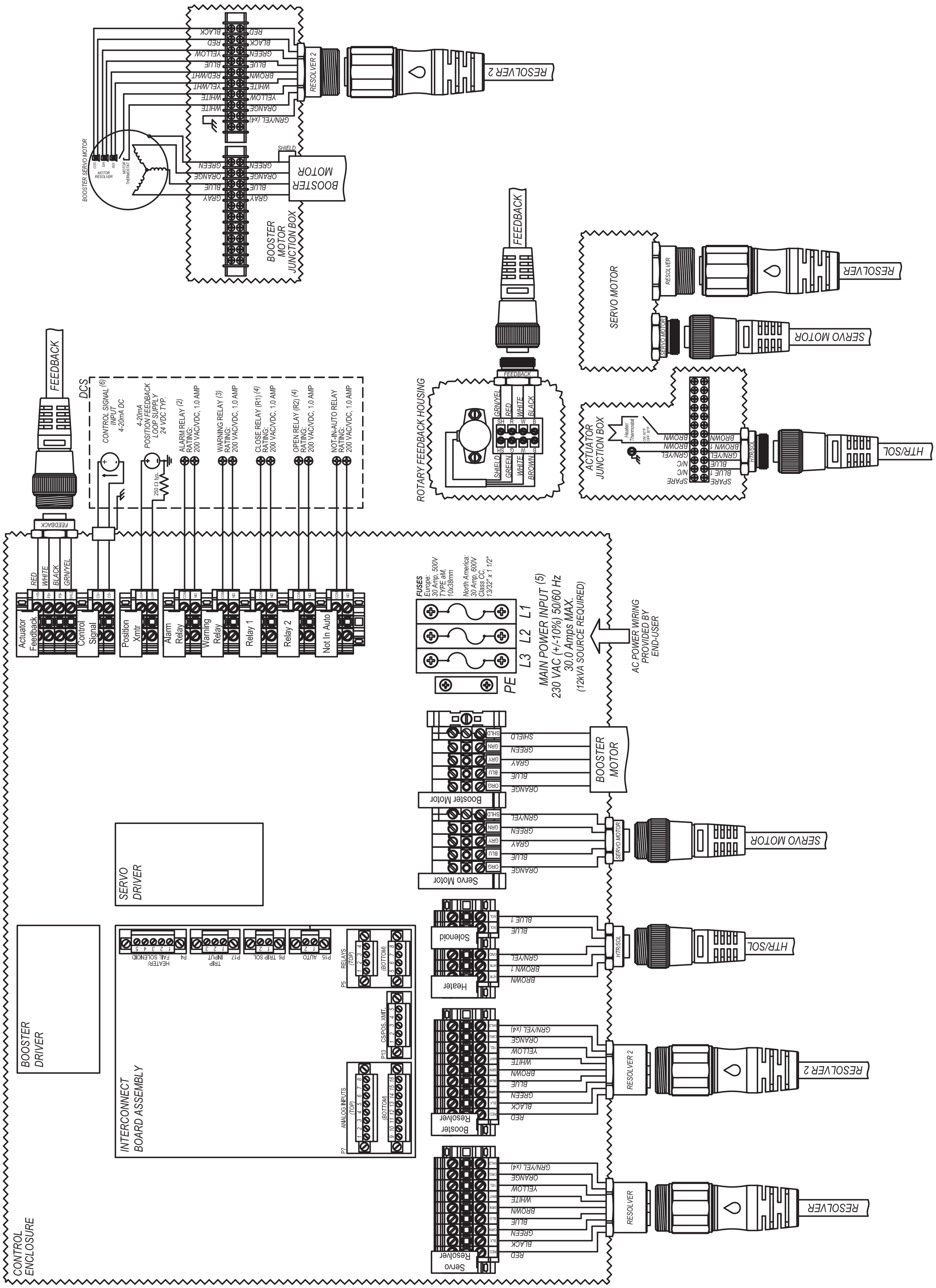
D Servo Wiring Diagram



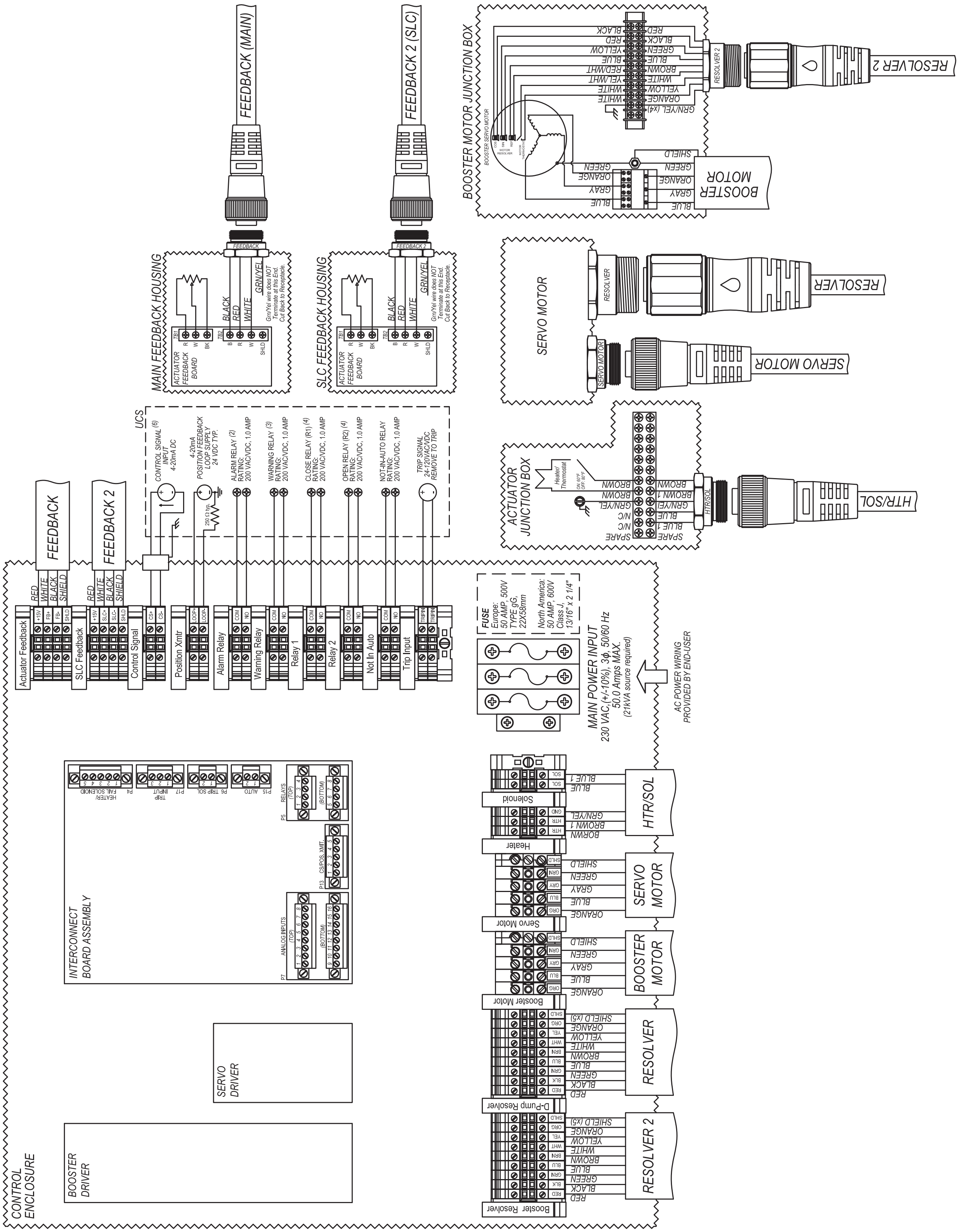
2D Servo Wiring Diagram

D,P9 Servo Wiring Diagram



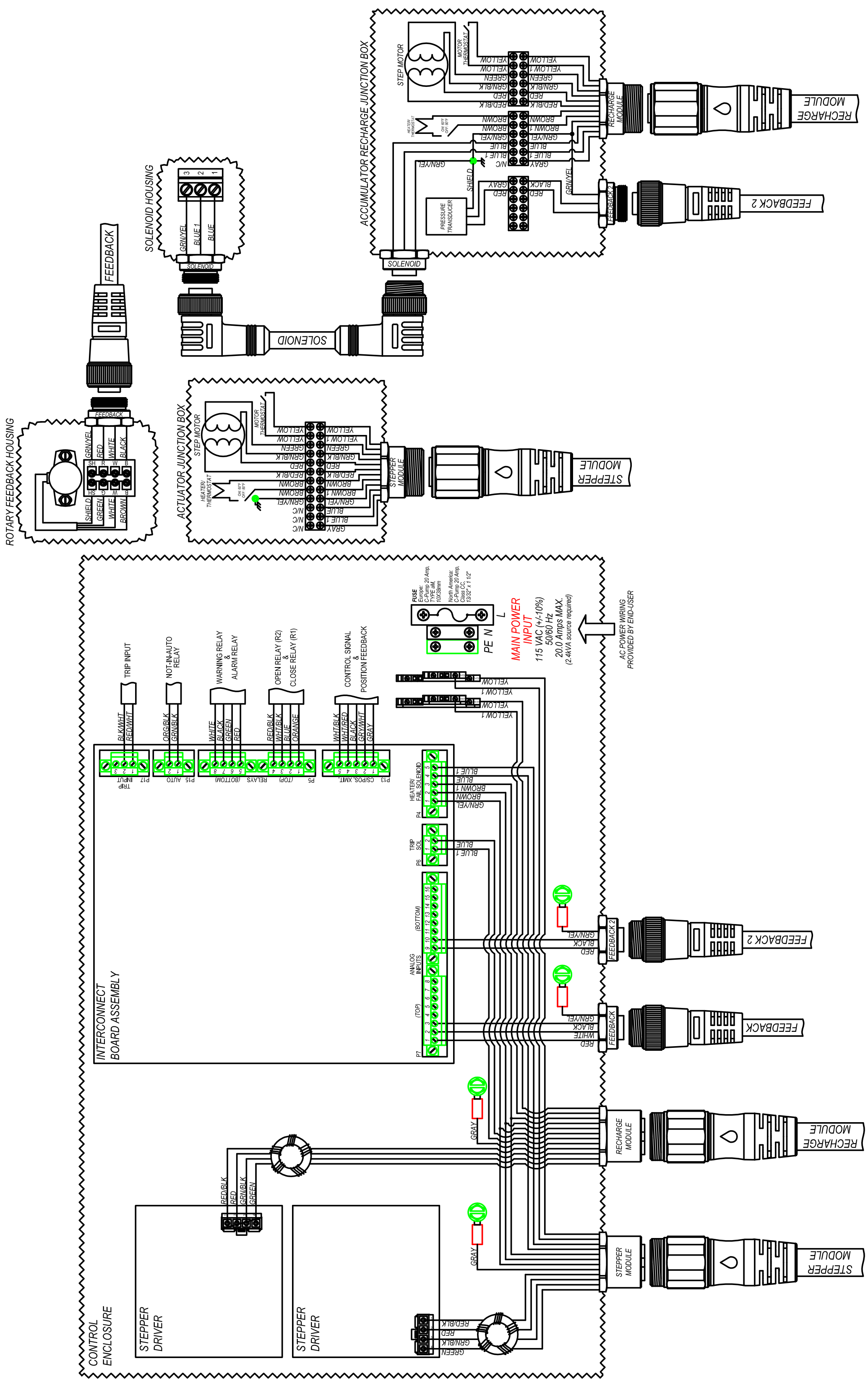


D,P20 Servo Wiring Diagram

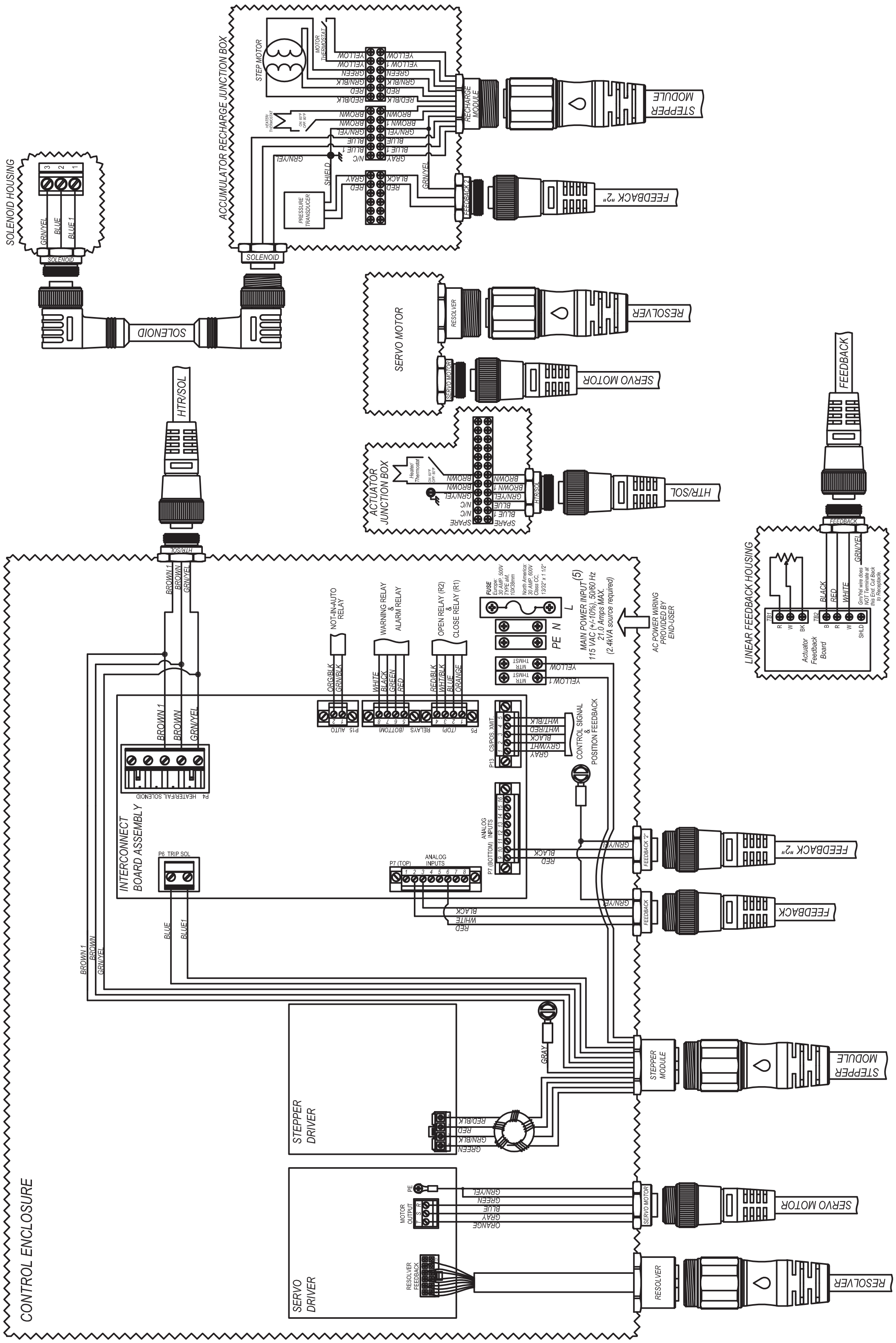


D,P40 Servo Wiring Diagram

Stepper With Accumulator Fail-Safe Option



½D Servo With Accumulator Fail-Safe Option



⚠ Attention ⚠
For Proper Actuator Operation:

1. Signal Level Cables must remain separate from High Voltage cables in a separate tray or conduit:
   a.) Keep cables separate by at least 1 meter.
2. Maintain shield coverage of the Motor Power cable all the way to the terminal block.
3. Maintain shield coverage of the Signal cables all the way to the terminal block.
4. Rexa Motor and Power cables must be kept away from sensitive equipment and associated wiring by at least 1 meter.
5. Rexa Feedback cables must be at least 1 meter away from High Voltage cables.

NOTES:

1. Maximum cable length: 400 ft.
2. ALARM: The output is in the "alarm" state whenever the actuator is unable to follow the control signal/control scheme as defined in the Signals menu. An "alarm" occurs if the actuator is switched to local Manual.
3. WARNING: The output is in the "alarm" state whenever ALARM is in the "alarm" state or when the actuator detects a problem but can otherwise continue to operate.
4. LIMIT SWITCH INDICATION: Both relay 1 and relay 2 are solid state, normally open, switches. When a relay is active, its output is conductive.
5. To comply with CEI/IEC 60204-1, a Supply disconnect device with the proper rating MUST be provided. The supply disconnecting device shall disconnect (isolate) the Control Enclosure/Actuator from the supply when required
6. Input Impedance of Control Signal Circuit = 650Ω.

(1) FEEDBACK - 3 CONDUCTOR, *(SIGNAL LEVEL)*
18 AWG UP TO 400 FT.
20 AWG DRAIN/ALUMINUM OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *RED* OVERMOLD,
CABLE RATINGS: UL: ITC/PLTC-ER DIRECT BURIAL 105C, 300V.
CSA: CMX-OUTDOOR-CMG, 105C, FT4.
CABLE O.D.: 0.28"
CONNECTOR O.D.: 1.06"
*REXA PART NO.: P98453-*M*

(1) FEEDBACK 2 - 3 CONDUCTOR, *(SIGNAL LEVEL)*
18 AWG UP TO 400 FT.
20 AWG DRAIN/ALUMINUM OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *BLACK* OVERMOLD,
CABLE RATINGS: UL: ITC/PLTC-ER DIRECT BURIAL 105C, 300V.
CSA: CMX-OUTDOOR-CMG, 105C, FT4.
CABLE O.D.: 0.28"
CONNECTOR O.D.: 1.06"
*REXA PART NO.: P98544-*M*

(1) RESOLVER - 4 INDIVIDUALLY SHIELDED PAIRS, *(SIGNAL LEVEL)*
20 AWG UP TO 400FT.
OVERALL FOIL SHIELD
BLACK THERMOPLASTIC ALLOY JACKET/CROSS LINKED POLYETHYLENE INNERS, *GREEN* OVERMOLD,
UL: ITC/PLTC-ER, DIRECT BURIAL 105°C, 300V, OIL RES I & II
CSA: CIC, 90C, 300V, FT1, FT4
CABLE O.D.: 0.41"
CONNECTOR O.D.: 1.24"
*REXA PART NO.: P98452-*M*

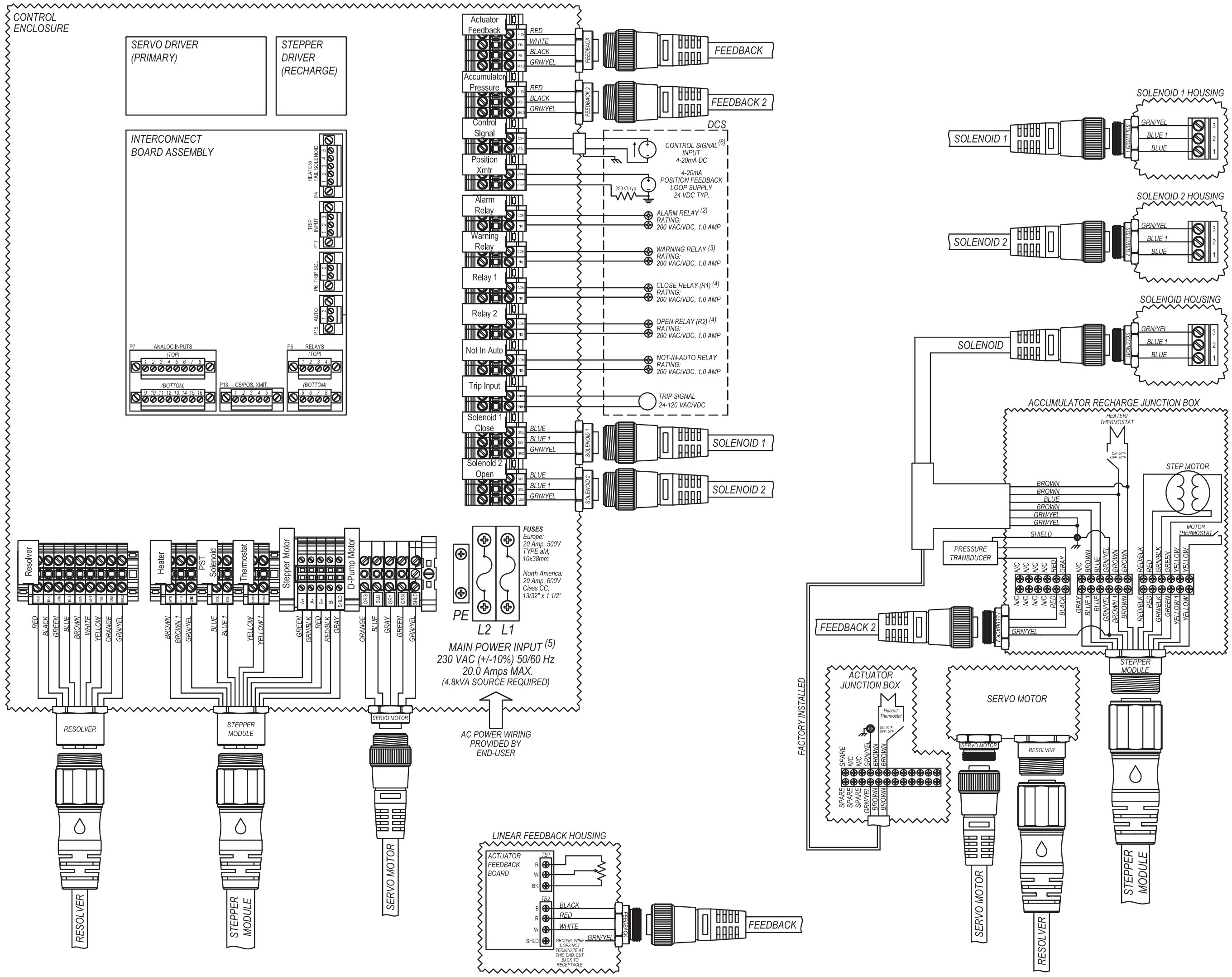
(1) SERVO MOTOR - 4 CONDUCTOR, *(HIGH VOLTAGE)*
14 AWG UP TO 400FT.
OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *ORANGE* OVERMOLD,
CABLE RATINGS: UL: TC-ER DIRECT BURIAL, 90C, 600V.
UL: ITC/PLTC-ER DIRECT BURIAL, 105C, 300V.
CSA: CMG, 105C,FT4.
CABLE O.D.: 0.39"
CONNECTOR O.D.: 1.06"
*REXA PART NO.: P98454-*M*

(1) STEPPER MODULE - 11 CONDUCTOR, *(HIGH VOLTAGE)*
4 x 14 AWG, 7 x 16 AWG UP TO 400FT.
1 x 16 AWG DRAIN/ALUMINUM OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *YELLOW* OVERMOLD,
CABLE RATINGS: UL: TC-ER DIRECT BURIAL 90C, 600V.
UL: ITC/PLTC-ER DIRECT BURIAL, 105C 300V
CSA: CMG, 105C, FT4.
CABLE O.D.: 0.65"
CONNECTOR O.D.: 1.24"
*REXA PART NO.: P98456-*M*

(1) SOLENOID 1 - 3 CONDUCTOR, *(HIGH VOLTAGE)*
16 AWG UP TO 400FT.
BLACK PVC JACKET/PVC INNERS, *BLUE-GRAY* OVERMOLD,
CABLE RATINGS: UL: TC-ER DIRECT BURIAL, 90C, 600V.
UL: ITC/PLTC-ER DIRECT BURIAL, 105C, 300V.
CSA: CMX-OUTDOOR-CMG, 105C,FT4.
CABLE O.D.: 0.52"
CONNECTOR O.D.: 1.06"
*REXA PART NO.: P98546-*M-LBL_1*

(1) SOLENOID 2 - 3 CONDUCTOR, *(HIGH VOLTAGE)*
16 AWG UP TO 400FT.
BLACK PVC JACKET/PVC INNERS, *BLUE-GRAY* OVERMOLD,
CABLE RATINGS: UL: TC-ER DIRECT BURIAL, 90C, 600V.
UL: ITC/PLTC-ER DIRECT BURIAL, 105C, 300V.
CSA: CMX-OUTDOOR-CMG, 105C,FT4.
CABLE O.D.: 0.52"
CONNECTOR O.D.: 1.06"
*REXA PART NO.: P98546-*M-LBL_2*

NOTES:
- **M in the Cable Part Number is equivalent to the Overall Cable Length in Meters.*
- *Minimum Bend Radius for each Cable will be 5X the Cables O.D.*



D Servo With Accumulator Fail-Safe Option

Attention

For Proper Actuator Operation:

1. Signal Level Cables must remain separate from High Voltage cables in a separate tray or conduit.
2. Maintain shield coverage of the Motor Power cable all the way to the terminal block.
3. Maintain shield coverage of the Signal cables all the way to the terminal block.
4. Rexa Motor and Power cables must be kept away from sensitive equipment.

NOTES:

1. Maximum cable length: 700 ft.
2. ALARM: The output is in the "alarm" state whenever the actuator is unable to follow the control signal/control scheme as defined in the Signals menu. An "alarm" occurs if the actuator is switched to local Manual.
3. WARNING: The output is in the "alarm" state whenever ALARM is in the "alarm" state or when the actuator detects a problem but can otherwise continue to operate.
4. LIMIT SWITCH INDICATION: Both relay 1 and relay 2 are solid state, normally open, switches. When a relay is active, its output is conductive.
5. To comply with CEI/IEC 60204-1, a Supply disconnect device with the proper rating MUST be provided. The supply disconnecting device shall disconnect (isolate) the Control Enclosure/Actuator from the supply when required
6. Input Impedance of Control Signal Circuit = 650Ω.

(1) FEEDBACK - 3 CONDUCTOR, *(SIGNAL LEVEL)*
18 AWG UP TO 700 FT.
OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *RED* OVERMOLD,
CABLE RATINGS: UL: ITC/PLTC-ER DIRECT BURIAL 105C, 300V.
CSA: CMX-OUTDOOR-CMG, 105C, FT4.
CABLE O.D.: 0.28"
CONNECTOR O.D.: 1.06"
*REXA PART NO.: P98599-*M*

(1) FEEDBACK 2 - 3 CONDUCTOR, *(SIGNAL LEVEL)*
18 AWG UP TO 400 FT.
20 AWG DRAIN/ALUMINUM OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *BLACK* OVERMOLD,
CABLE RATINGS: UL: ITC/PLTC-ER DIRECT BURIAL 105C, 300V.
CSA: CMX-OUTDOOR-CMG, 105C, FT4.
CABLE O.D.: 0.28"
CONNECTOR O.D.: 1.06"
*REXA PART NO.: P98630-*M*

(1) RESOLVER - 4 INDIVIDUALLY SHIELDED PAIRS, *(SIGNAL LEVEL)*
20 AWG UP TO 700FT.
OVERALL FOIL SHIELD
BLACK THERMOPLASTIC ALLOY JACKET/CROSS LINKED POLYETHYLENE INNERS, *GREEN* OVERMOLD,
UL:ITC/PLTC-ER, DIRECT BURIAL 105°C, 300V, OIL RES I & II
CSA: CIC, 90C, 300V, FT1, FT4
CABLE O.D.: 0.41"
CONNECTOR O.D.: 1.24"
*REXA PART NO.: P98559-*M*

(1) RESOLVER 2- 4 INDIVIDUALLY SHIELDED PAIRS, *(SIGNAL LEVEL)*
20 AWG UP TO 700FT.
OVERALL FOIL SHIELD
BLACK THERMOPLASTIC ALLOY JACKET/CROSS LINKED POLYETHYLENE INNERS, *GRAY* OVERMOLD,
UL:ITC/PLTC-ER, DIRECT BURIAL 105°C, 300V, OIL RES I & II
CSA: CIC, 90C, 300V, FT1, FT4
CABLE O.D.: 0.41"
CONNECTOR O.D.: 1.24"
*REXA PART NO.: P98626-*M*

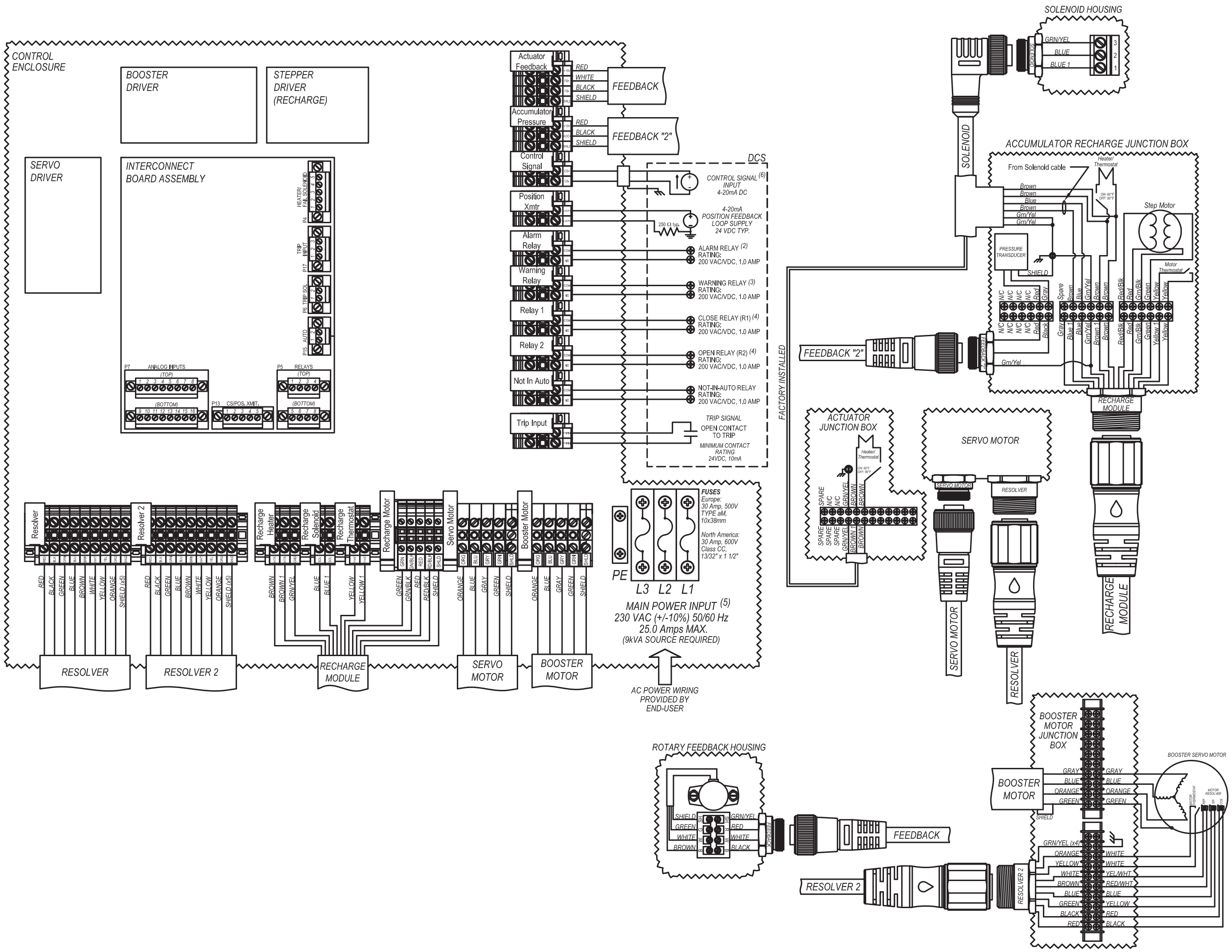
(1) RECHARGE MODULE - 11 CONDUCTOR, *(HIGH VOLTAGE)*
4 x 14 AWG, 7 x 16 AWG UP TO 400FT.
1 x 16 AWG DRAIN/ALUMINUM OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *BLACK* OVERMOLD,
CABLE RATINGS: UL: TC-ER DIRECT BURIAL 90C, 600V.
UL:ITC/PLTC-ER DIRECT BURIAL, 105C 300V
CSA: CMG, 105C, FT4.
CABLE O.D.: 0.65"
CONNECTOR O.D.: 1.24"
*REXA PART NO.: P99124-*M*

(1) SERVO MOTOR - 4 CONDUCTOR, *(HIGH VOLTAGE)*
14 AWG UP TO 700FT.
OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *ORANGE* OVERMOLD,
CABLE RATINGS: UL: TC-ER DIRECT BURIAL, 90C, 600V.
UL:ITC/PLTC-ER DIRECT BURIAL, 105C, 300V.
CSA: CMG, 105C,FT4.
CABLE O.D.: 0.39"
CONNECTOR O.D.: 1.06"
*REXA PART NO.: P98558-*M*

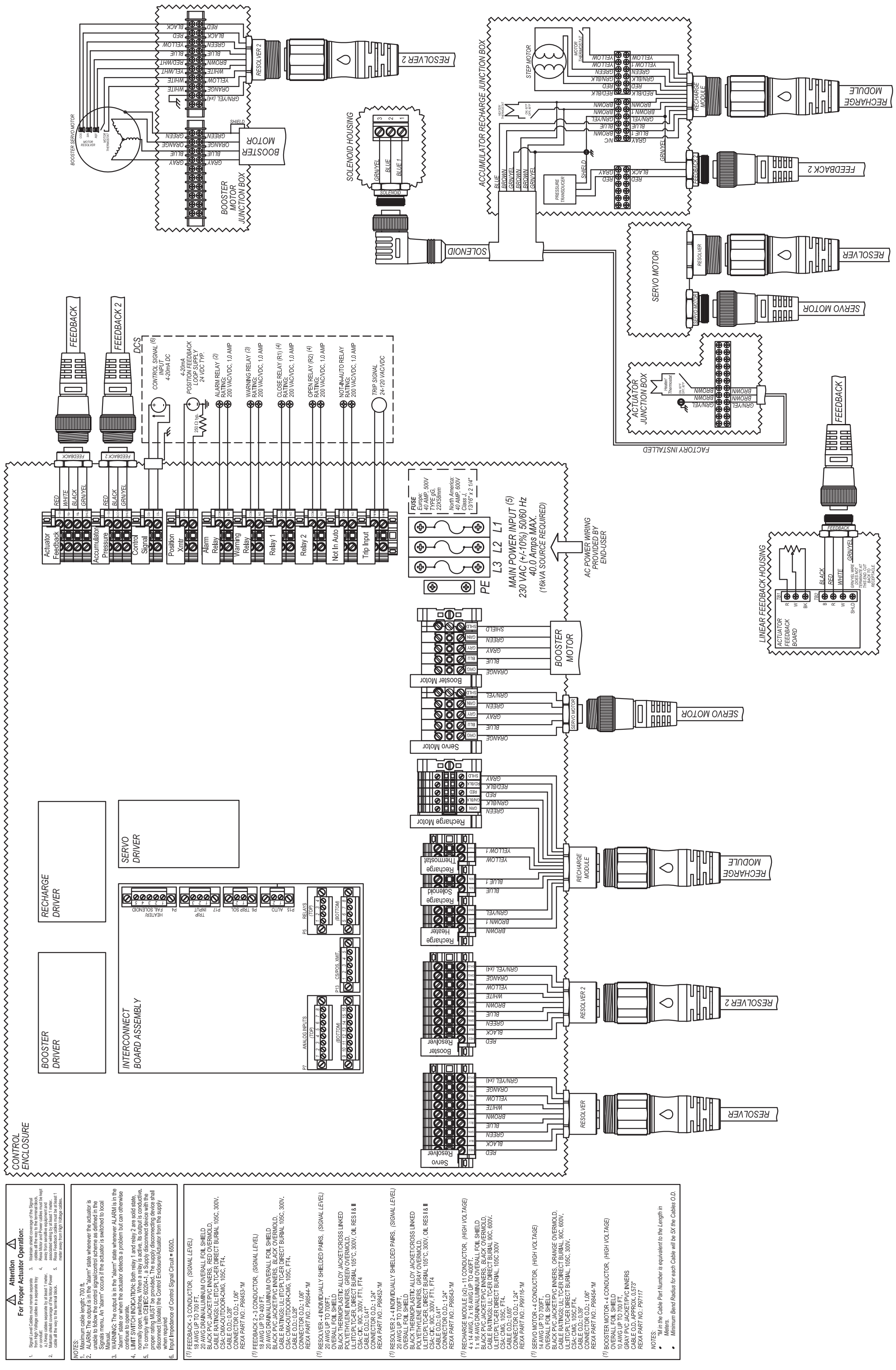
(1) BOOSTER MOTOR - 4 CONDUCTOR, *(HIGH VOLTAGE)*
OVERALL FOIL SHIELD
10 AWG UP TO 700 FT.
GRAY PVC JACKET/PVC INNERS
CABLE O.D. APPROX. 0.88"
REXA PART NO.: P97117

NOTES:

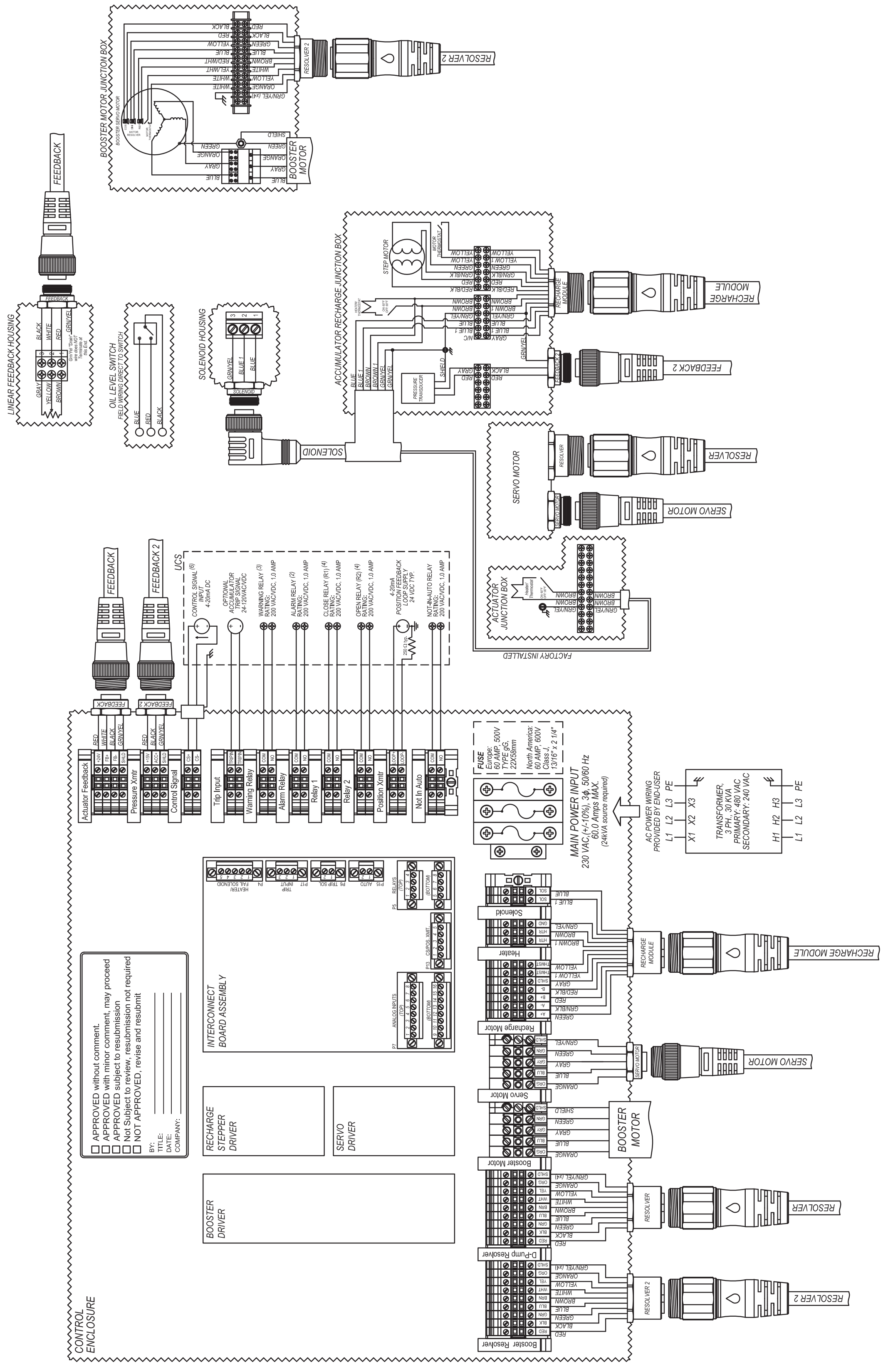
- **M in the Cable Part Number is equivalent to the Length in Meters.*
- *Minimum Bend Radius for each Cable will be 5X the Cables O.D.*



D,P9 Servo With Accumulator Fail-Safe Option

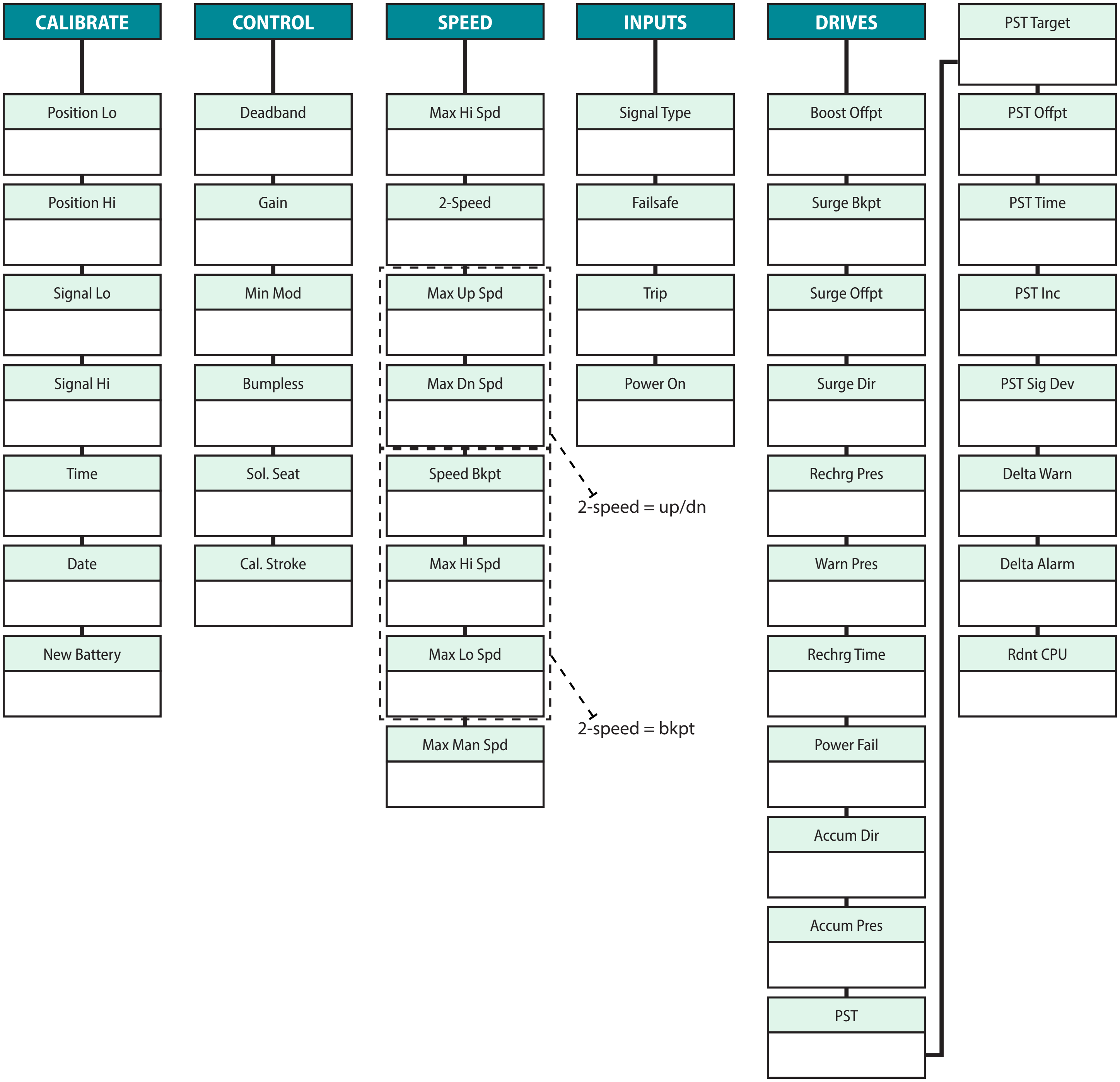


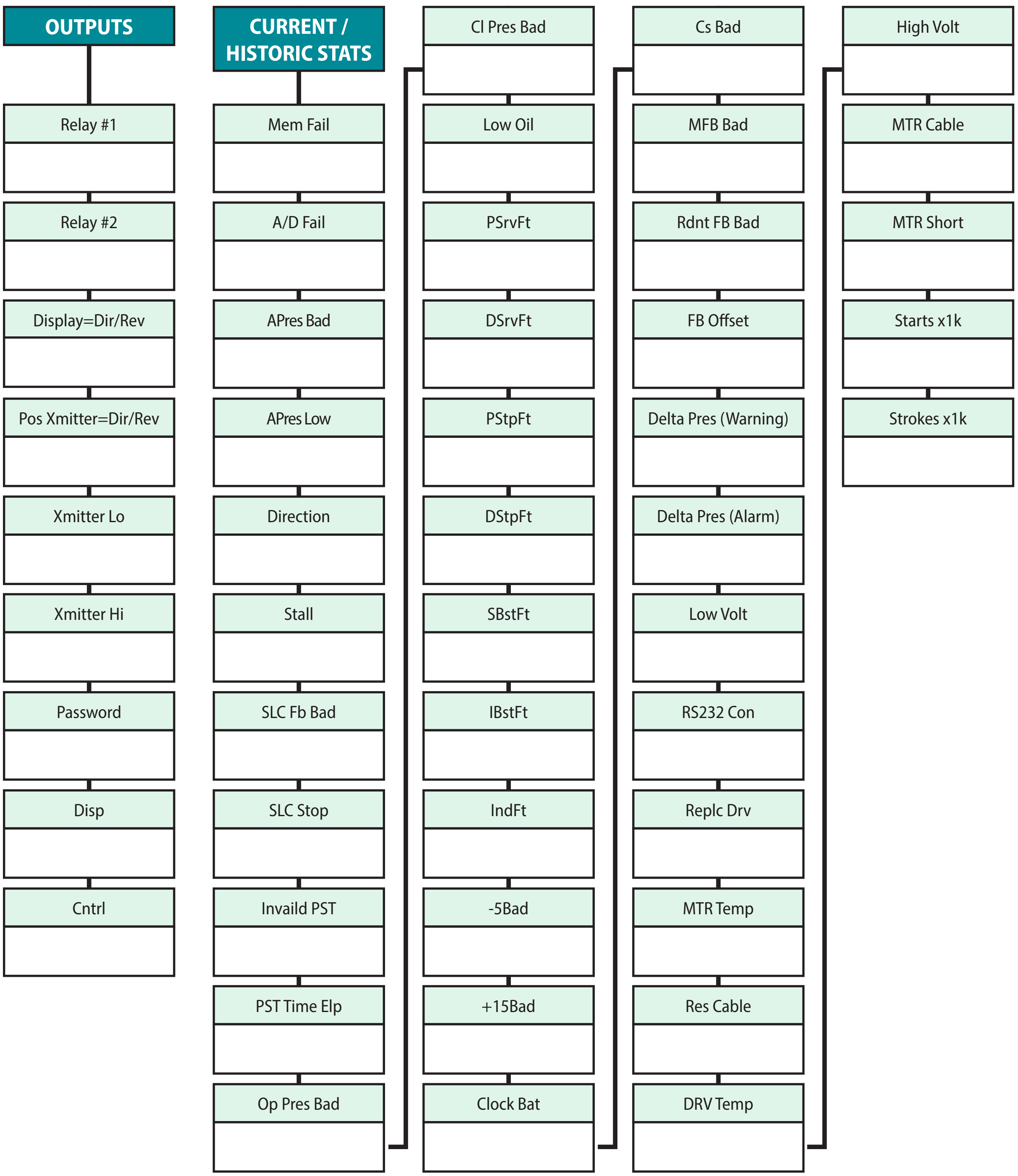
D,P20 Servo With Accumulator Fail-Safe Option



D,P40 Servo With Accumulator Fail-Safe Option

E. Parameter Sheet




OUTPUTS
Relay #1
Relay #2
Display=Dir/Rev
Pos Xmitter=Dir/Rev
Xmitter Lo
Xmitter Hi
Password
Disp
Cntrl
CURRENT / HISTORIC STATS
Mem Fail
A/D Fail
APres Bad
APres Low
Direction
Stall
SLC Fb Bad
SLC Stop
Invaild PST
PST Time Elp
Op Pres Bad
Cl Pres Bad
Low Oil
PSrvFt
DSrvFt
PStpFt
DStpFt
SBstFt
IBstFt
IndFt
-5Bad
+15Bad
Clock Bat
Cs Bad
MFB Bad
Rdnt FB Bad
FB Offset
Delta Pres (Warning)
Delta Pres (Alarm)
Low Volt
RS232 Con
Replc Drv
MTR Temp
Res Cable
DRV Temp
High Volt
MTR Cable
MTR Short
Starts x1k
Strokes x1k

Z. Servicing Hot Swappable Manifolds

Z.1 Scope & Purpose

This procedure outlines the function of the REXA hot-swap manifold S09243-4-XXX. The hot-swap manifold is designed to be used with dual power modules to allow for redundant operation of the REXA actuator on FIP (fail in place), Spring Fails, or Accumulator Fail/Surge systems. In the event of a power module malfunction, the hot-swap manifold can be used to hydraulically isolate the malfunctioning power module for repair/replacement while allowing the system to operate at ½ the speed using the remaining functional power module.

Z.2 Responsibilities

A REXA qualified technician, shall be responsible for servicing the REXA hot-swap system. Service technicians working on the hot-swap systems must be proficient in identifying and isolating (electrically and mechanically) the suspect power module for repair/replacement.

Z.3 Hot-Swap Manifold & Power Modules Components

REXA actuators with the hot-swap manifold can be used on FIP or Spring Fail applications and will comprise of an isolating manifold assembly S09243-4-XXX (where XXX is the solenoid's operating voltage) and two power modules. The two power modules used on the hot-swap application are the same in most cases and may be one of four possible designs: B, C, 1/2D or D.

Accumulator Fail/Surge applications may have an additional OAR (On-line Recharge) module that will be hydraulically tied into the system.

A depiction of the hot-swap manifold assembly without the power modules is illustrated below in Figure 1, with the critical components highlighted. For specific application requirements, refer to the job's specification sheet, mechanical, electrical and hydraulic schematics.

S09243-NNN-XX

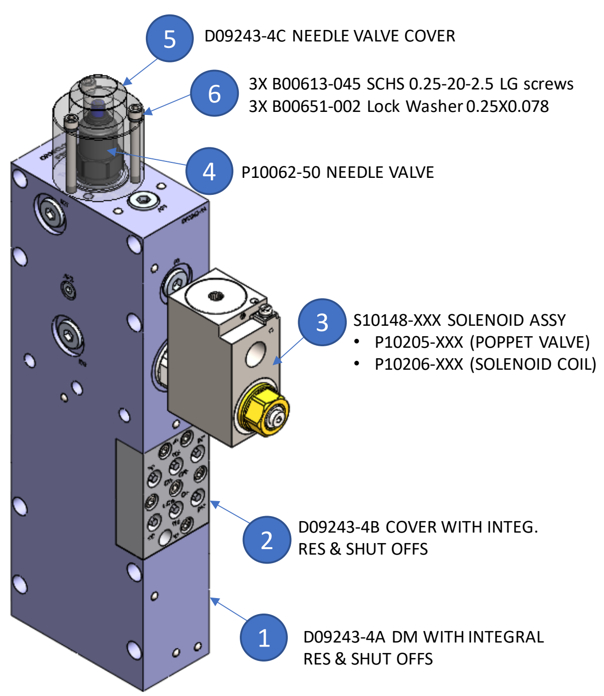


Figure 1: S09243-NNN-XXX hotswap manifold assembly.

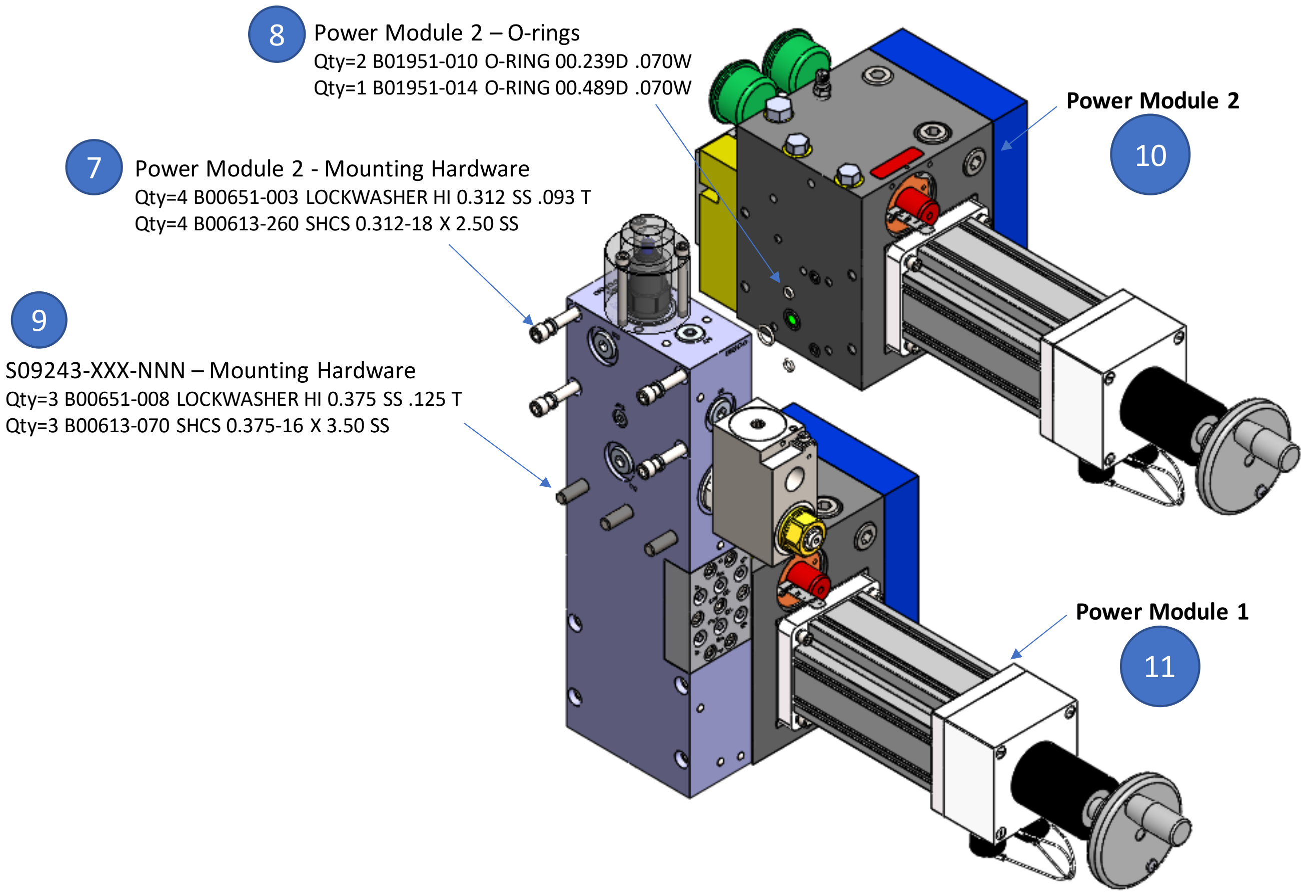


Figure 2: S09243-NNN-XXX hotswap manifold assembly with 1/2D power modules.

The S09243-4-XXX hot-swap manifold assembly with two 1/2D power modules, Power Module 1 and Power Module 2, is illustrated in Figure 2.

Z.4 Procedure

In case of a power module malfunction, the following procedures must be followed to isolate the power module for replacement.

CAUTION – Hot-swap manifolds are designed to allow for isolation and service of power modules on functional systems; inappropriate identification and service of the system may result in inadvertent system trips or severe personal injury.

1. Identify the malfunctioning power module, i.e. Item 10 (Power Module 2).

   NOTE: In the subsequent procedures, it is assumed that Power Module 2 is malfunctioning and requires replacement. If Power Module 1 needs replacement, follow the procedures below for Power Module 1 and the associated bypasses (EXT, RET, and RES) on the hotswap manifold (Figure 3).

2. Electrical power is supplied to the individual power modules through their own circuit breaker. To isolate power to Power Module 2, Open the enclosure mounted external switch on the electronic enclosure to electrically isolate power to Power Module 2.

3. Remove all electrical cables connected to the conduit entrance port(s) of Power Module 2. The 1/2D and D power modules will have 3 cables: power, resolver, and htr/sol.

   Note that the B and C power modules will have just one cable connection.

4. Hydraulically isolate the pressure lines from the S09243-NNN-XXX hot-swap manifold to Item 10 (Power Module 2) by turning OFF (CW) the EXT and RET bypasses on Item 2 (D09243-4B). Leave the RES bypass ON (CCW) until Step 6. See the illustration below in Figure 3.

   Note: Normal operation of the bypasses is all the way open (CCW) and a torque of 6lb-in is sufficient to completely close (CW) the hydraulic bypasses.

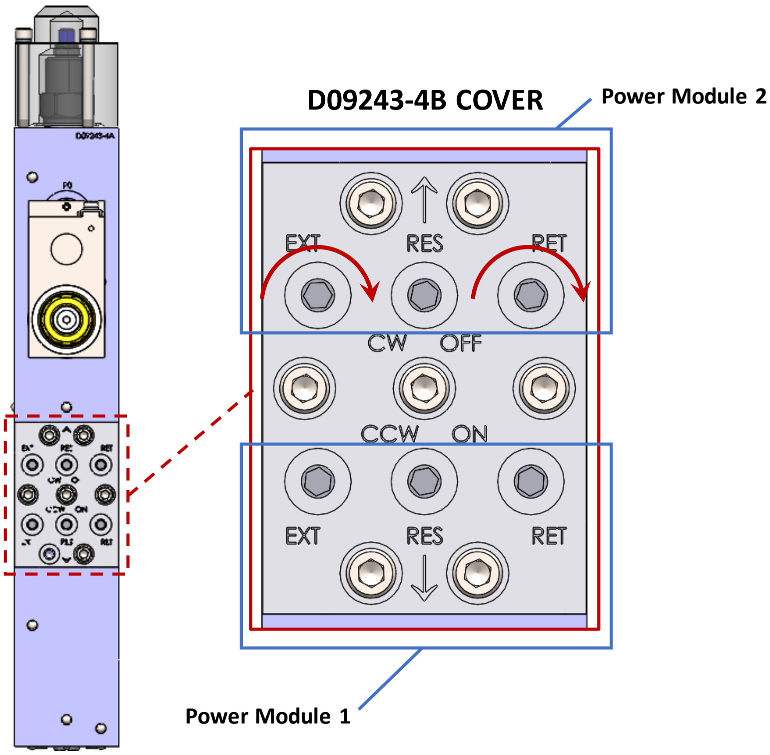


Figure 3: Power Module Bypasses – High pressure isolation bypasses (EXT & RET line shut off for Power Modules 1 & 2).

5. Identify pressure gauges, (Items 12E & 12R), on the power module to determine if there are trapped residual pressure within the pressure lines of Item 10 (Power Module 2). If there is trapped residual pressure (i.e. either Power Module 2 pressure gauges read 500 psi or higher), open up the bypass on Power Module 2 and back out one of the power module's output limiting valves (PLVs, Items 13E or 13R) to relieve oil pressure into the reservoir.

CAUTION - Only back out the PLVs such that the gauge pressure falls below 500 psi. In most cases it is safe to open up the isolated power module pressure lines despite a possible residual pressure of 500 psi given that amount of trapped oil does not have the volume or energy to induce injury.

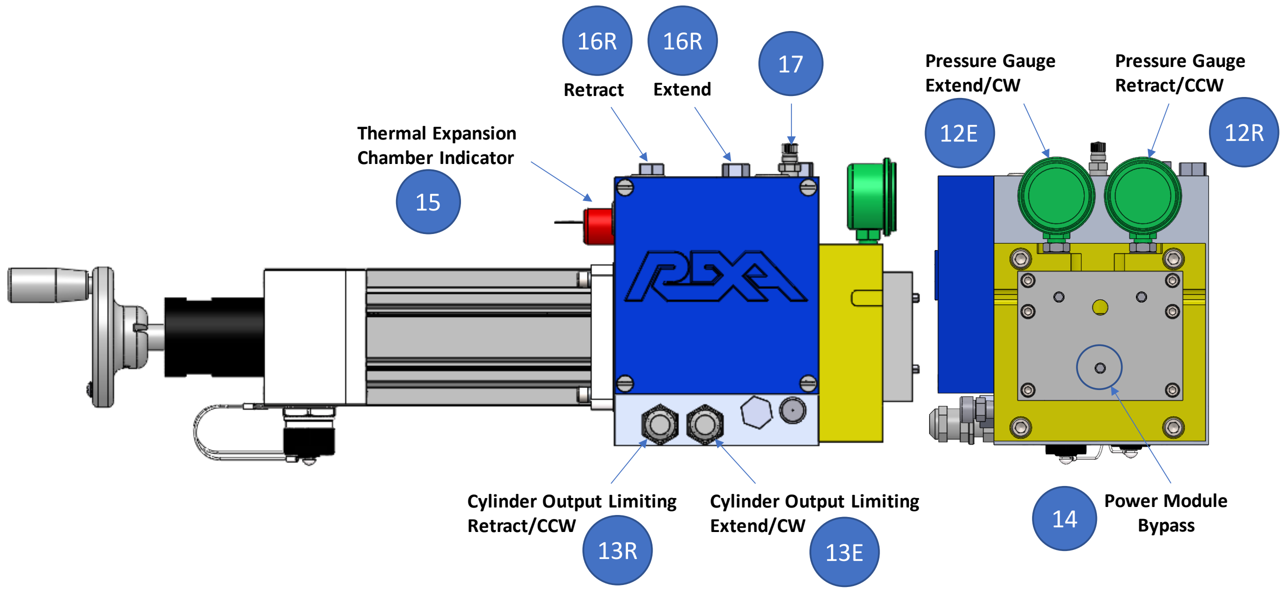


Figure 4: Power Module PLVS & Bypass.

6. Turn OFF the RES bypass per Figure 5 on the hot-swap manifold to isolate the reservoir supply line to Power Module 2 from the rest of the system.

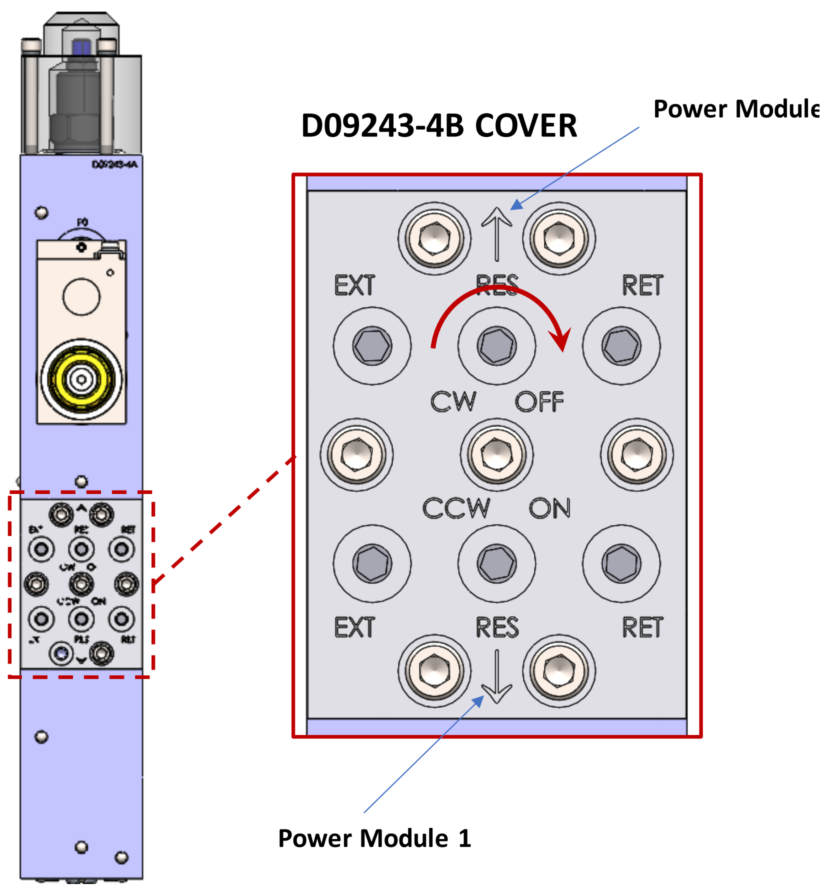


Figure 5: Power Module 2 high pressure isolation bypasses, RES shut off.

7. Verify that all bypasses on S09243-NNN-XXX hot-swap manifold for Power Module 2, EXT, RET, and RES are turned CW all the way to hydraulically isolate Power Module 2 from the rest of the system.

8. Remove Items 7 and 10 (Mounting Hardware & Power Module 2) as shown in Figure 2 and set the mounting hardware aside for reuse. Use caution when removing mounting bolts; ensure to support module during this step.

9. After repair/replacement of suspect module, install new O-rings (Item 8) illustrated in Figure 2. Use petroleum jelly or O-ring lubricant to keep O-rings in place.

10. Line up power module and reinstall the mounting hardware removed in Step 8. Apply thread locking compound and properly torque each B00613-260 screws (SHCS 0.312-18 X 2.50 SS) to 190 LB-IN [22 N-M] per standard bolting techniques.

11. Fill Power Module 2 with oil while isolated from the rest of the system; use proper oil fill gun or pump and operate the handwheel. Purge any entrapped air in the replacement power module through the power module purge ports, Items 15E & 15R, and Open or Close the power module bypass as needed to either equalize or build pressure to bleed the power module.

12. After the replacement power module has been purged of air, close the power module bypass and drive the power module in the Extend direction; set and lock the Extend PRV to its appropriate setting, i.e. 2600 psi for 100%-140% (FIP & Spring Fail) or 2800 psi for 100%-140% (ACC Fails). Repeat for the Retract side of the power module.

13. Fill the thermal expansion chamber of the new Power Module 2 such that the oil indicator, Item 15, extends to the center of the OK indicator position. To test whether there is still entrapped air in the replacement module, push in the indicator. If it is solid, then enough air has been purged out of the system. Conversely if the feel is a spongy response, then there is still trapped air in the system. If the latter, repeat Steps 11-13.

14. Leaving the three hot-swap manifold bypasses (EXT, RES, & RET) closed on Item 2, use the handwheel or drill drive to test the replacement power module to (1) ensure the system can build and hold pressure in both the EXT and RET directions and (2) both PLVs are properly set and locked.

15. After confirmation that the replacement Power Module 2 can build and hold pressure in both directions, open the RES, EXT, and RET bypasses on the hot-swap manifold (Item 2) all the way CCW as illustrated in Figure 6 to hydraulically connect the replacement power module to the rest of the system.

16. Reconnect the electrical connections (removed in Step 3) to Power Module 2. After apply power to Power Module 2 by Closing the external switch on the external enclosure mounted on the electronic enclosure. The system should resume operation at normal speeds.

REVISION HISTORY

Revision A – Released 03/04/2019 – Updated instructions and schematics to Rev 1 of S09243-NNN-XXX manifold.

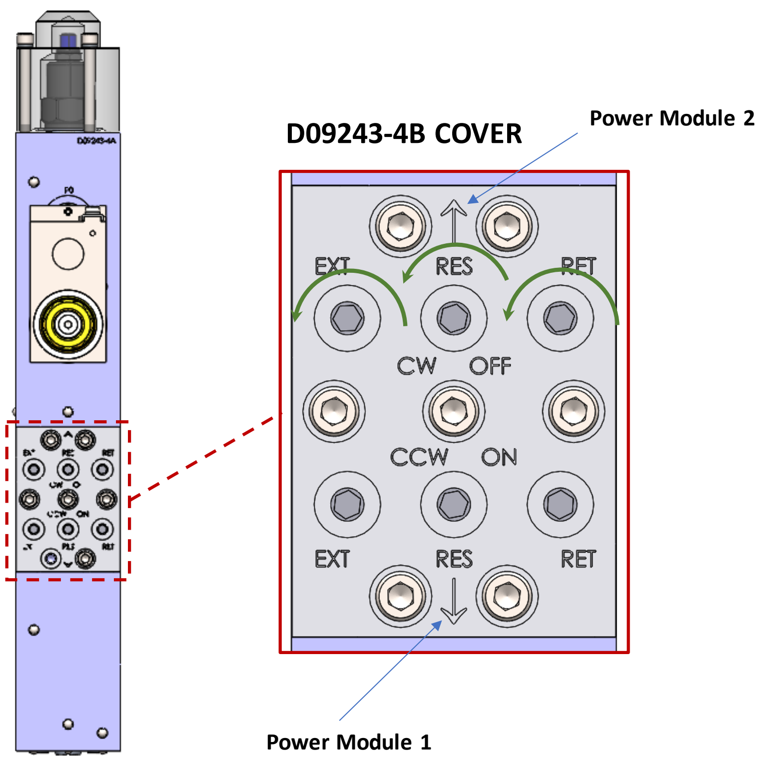


Figure 6: Power Module 2 Bypasses - CCW to connect Power Module 2 to the system hydraulics.