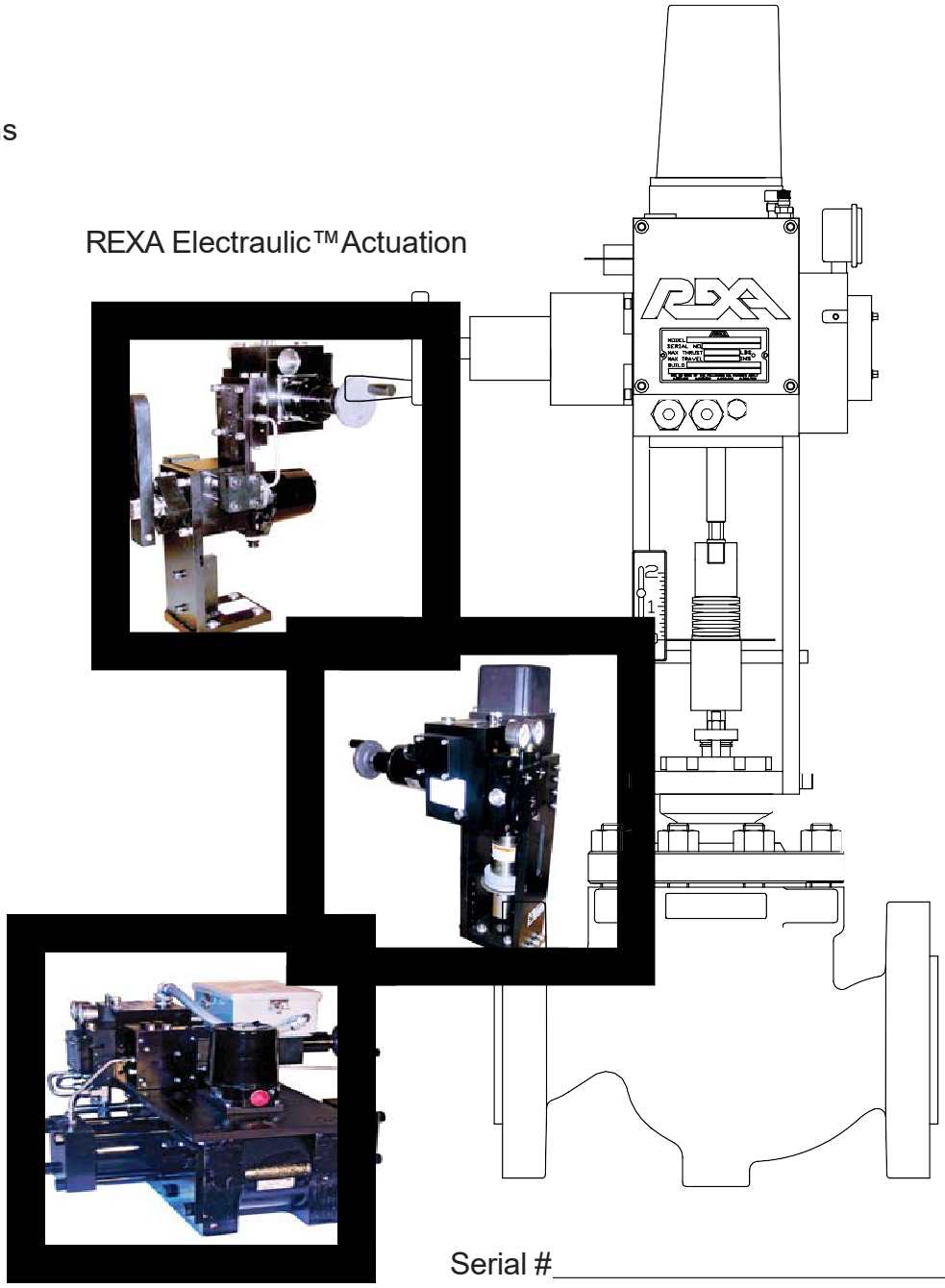
Installation and Operation Manual for the REXA Series 2 Xpac

IOM 3/2017
Original Instructions
ISO 9001: 2008

REXA Electraulic™ Actuation



Serial #_____
Model #_____
Application_____
Tag # _____

REXA • 4 Manley Street • W. Bridgewater, MA 02379 • (P) 508.584.1199 • (F) 508.584.2525

Contents

Fundamental Safety Information

REXA actuators all 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, Inc.

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 de-clutched 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 2000 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 shall 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:

1. Notify all affected areas and employees of the impending Lock-Out situation, the reason for it, and estimated start and duration times.
2. 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.
3. 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.
4. 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.
5. 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.

6. 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.

7. 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.

8. 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 to 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.

The REXA Actuator/Drive with Control Enclosure is certified by CSA for use in General Locations per EN 61010-1 and for Hazardous Locations Class 1, Division 2, Groups A, B, C and D or Class 1, Division 1, Groups C and D.

A CE mark indicates that the product is certified for European markets, and complies to the standards listed in the Declaration of Conformity.

EC DECLARATION OF CONFORMITY ACCORDING TO: MACHINERY DIRECTIVE 2006/42/EC EMC DIRECTIVE 2004/108/EC PED DIRECTIVE 97/23/EC (APPLIES WHERE APPLICABLE)

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 Jonathan Lodge (Technical Director)
Telephone: +44(0)1484 710311 Fax: +44(0)1484 407407

Brand Name: REXA (REXA)

Product Description: X-Pac and X2 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

EMC Directive 2004/108/EC

PED Directive 97/23/EC; applies where applicable, to accumulator systems

Applicable Harmonized Standards:

Health/Safety: Machinery Directive 2006/42/EC Annex I, EN60204-1:2006, EN ISO 12100:2010, EN61310-1:1995, EN61310-2:1995, EN ISO 13850:2006, IEC61010-1:2001

EMC: EN61326-1:2006, EN61000-6 Part -2:2005 and -4:2007; EN55011:2007: IEC61000-4-2:2008, IEC 61000-4-3:2010, IEC61000-4-4:2010, IEC61000-4-5:2005, IEC61000-4-6:2008, IEC61000-4-8:2009, IEC61000-4-11:2004

PED: Directive 97/23/EC; designed as ‘Sound Engineering Practice’ Equipment

ATEX DECLARATION OF CONFORMITY ACCORDING TO: DIRECTIVE 94/9/EC

We, REXA, Inc.,

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Manufactured: 4 Manley Street
West Bridgewater, MA 02379 USA

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

Designation: II 3G EEx nA II T3 $-40\,^{\circ}C \leq T_a \leq 65\,^{\circ}C$

Applicable Directives: ATEX Directive 94/9/EC

Machinery Directive 2006/42/EC including Low Voltage Directive

EMC Directive 2004/108/EC

PED Directive 97/23/EC; applies where applicable, to accumulator systems

Applicable Harmonized Standards:

Health/Safety: ATEX Directive 94/9/EC including Annex I and II; Machinery Directive 2006/42/EC Annex I, EN60204-1:2006, EN ISO 12100:2010, EN61310-1:1995, EN61310-2:1995, EN ISO 13850:2006, IEC61010-1:2001

EMC: EN61326-1:2006, EN61000-6 Part -2:2005 and -4:2007; EN55011:2007: IEC61000-4-2:2008, IEC 61000-4-3:2010, IEC61000-4-4:2010, IEC61000-4-5:2005, IEC61000-4-6:2008, IEC61000-4-8:2009, IEC61000-4-11:2004

ATEX: EN50021:1999

PED: Directive 97/23/EC; designed as ‘Sound Engineering Practice’ Equipment

DECLARATION OF NOISE EMISSION

The REXA, 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: 2011**		
	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} Δ = 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 02379 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 Jonathan Lodge (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 ABOUT REXA

REXA is located in West Bridgewater, Massachusetts, USA. We manufacture, sell and service the highest quality actuators and drives. The driving force of these units is a self-contained electrically driven hydraulic pumping system, thus the term Electraulic™ is coined. This Installation and Operation Manual is part of REXA's continuing commitment to supply only the highest quality products and services to our customers. Customer support is our top priority at REXA.

Please contact the factory if this manual or your Sales Representative fails to provide required information.

1.2 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:

2 General Information

REXA
4 Manley Street
West Bridgewater, MA 02379

Phone: (508) 584-1199
Fax: (508) 584-2525
Web: www.rexa.com

Note: *It is important to have the model code and build number 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 more detailed explanation.

1.3 ACTUATOR IDENTIFICATION

The model number, mechanical build number, electronics build number 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. These numbers also provide the information required to correctly define what sections of this manual applies to a particular actuator. The build number 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, both mechanical and electrical build numbers, 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 1.3 shows a typical ID tag.

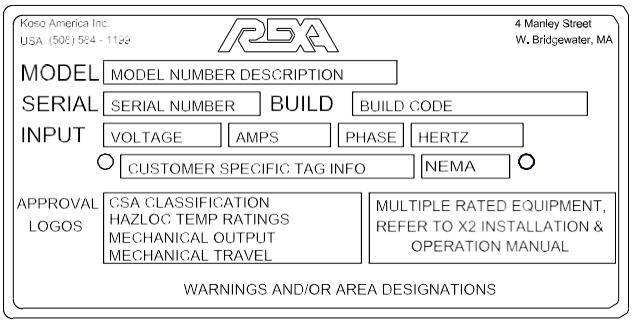
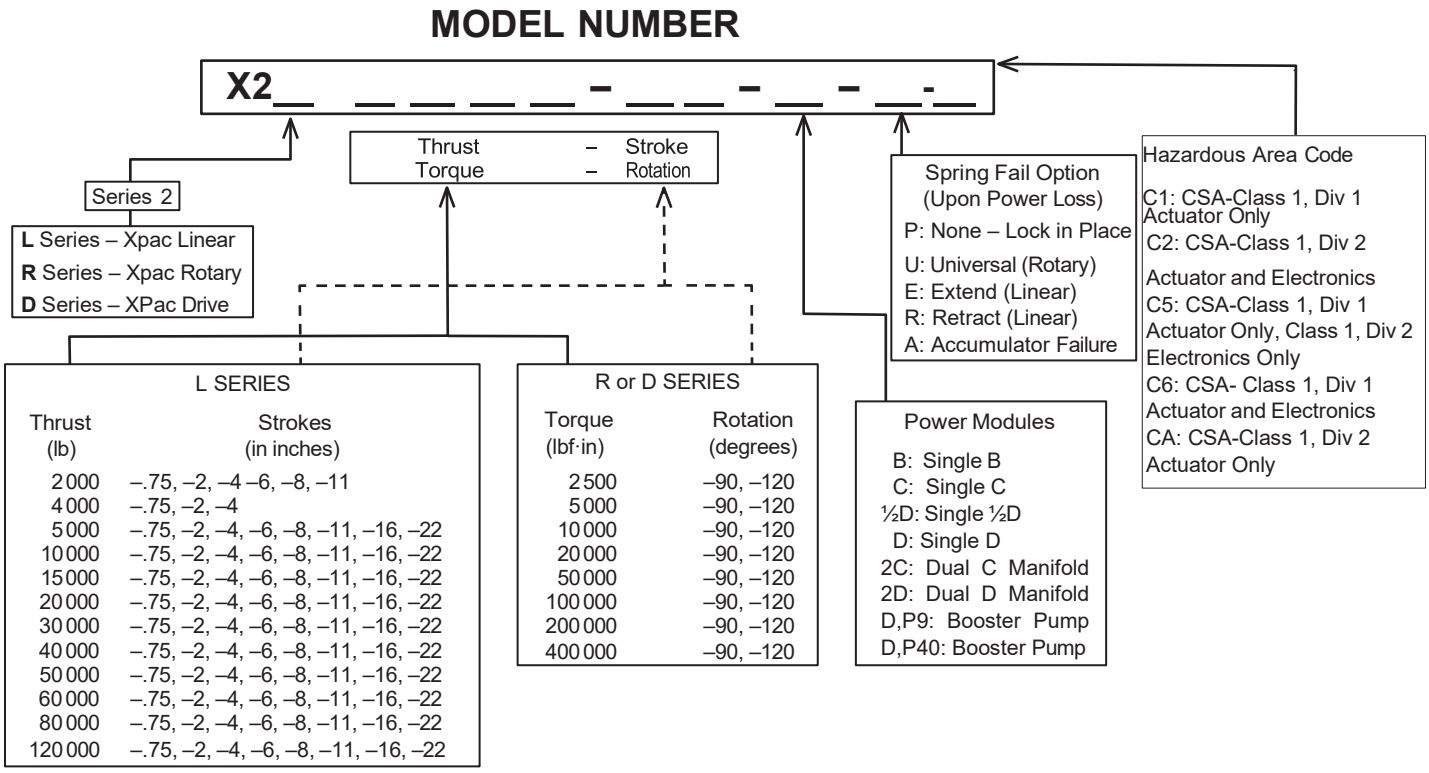


Figure 1.3 ID Tag

1.3.1 Model Number

The basic model number is a generic description of the actuator. Figure 1.3.1 shows a break down of the model number tree and how it works.



Model Numbers — Examples:

X2L4000-4-C-P

Is a Linear **L** Series 2 **Xpac** with 4 000 lb of thrust, stroke adjustable up to 4 inches, and C size power module. Lock in position upon loss of power.

X2R2500-90-B-U

A Rotary **R** Series 2 **Xpac** with 2 500 lbf·in of torque, rotation adjustable to 90 degrees, and B size Power module. Spring failure upon loss of power.

Figure 1.3.1 Model Number

1.3.2 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: **C060000**. The C06 indicates the year of manufacture and the next four digits correspond to the unique order number.

1.3.3 Build Number

The build number 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 Appendix H.

1.4 GENERAL SPECIFICATIONS

1.4.1 Recommended Fluids and Lubricants

Intended Use	Specifications
Operating fluid, all REXA Actuators	Castrol EDGE® SAE 5W-50 Motor Oil*
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

Note: In special applications the type of oil used is system dependant and the user should refer to the system documentation.

1.4.2 Operating Temperatures

The following is a general guideline; refer to Technical Memo TM19-2 for further information.

Table 1.4.2-1 Linear Actuators

Temperature Range[1]	Actuator Construction	Standard			High Temp.
	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 Temp. Range		Separate Control Enclosure with CPU, motor driver, power supply, transient protection and termination.			
		-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 1.4.2-2 Rotary Actuators & Drives

Temperature Range[1]	Actuator Construction	Standard			High Temp.
	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 Temp. Range		Separate Control Enclosure with CPU, motor driver, power supply, transient protection and termination.			
		-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 1.4.2-3 CSA Temperature Ratings

Power Module	*Operating Temperatures*				*T-Code*	*Duty* Cycle*	*Notes*
	Actuator		*Electronics*		*Actuator/Elec*		
B 115V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +140 °F	(-40 °C to +60 °C)	T3/T3C	S1	
B 230V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +104 °F	(-40 °C to +40 °C)	T3/T3C	S8	*4*
24V B	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +150 °F	(-40 °C to +65 °C)	T3/T3C	S1	
48V B	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +150 °F	(-40 °C to +65 °C)	T3C/T3C	S1	*5*
24V C	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +150 °F	(-40 °C to +65 °C)	T3C/TC3	S1	*6*
C 115V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +140 °F	(-40 °C to +60 °C)	T3/T3C	S1	
C 230V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +104 °F	(-40 °C to +40 °C)	T3/T3C	S8	*4*
2C 115V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +140 °F	(-40 °C to +60 °C)	T3/T3C	S1	
.5D 115V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +150 °F	(-40 °C to +65 °C)	T3C/T3C	S1	
.5D 230V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +150 °F	(-40 °C to +65 °C)	T3C/T3C	S1	
D 230V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +131 °F	(-40 °C to +55 °C)	T3C/T3C	S1	
Dual .5D 115V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +150 °F	(-40 °C to +65 °C)	T3C/T3C	S1	
Dual .5D 230V	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +150 °F	(-40 °C to +65 °C)	T3C/T3C	S1	
2D	-40 °F to +150 °F	(-40 °C to +65 °C)	-40 °F to +131 °F	(-40 °C to +55 °C)	T3C/T3C	S1	
D,P9**	-40 °F to +140 °F	(-40 °C to +60 °C)	-40 °F to +122 °F	(-40 °C to +50 °C)	T3C/T3C	S8	*1, 3*
D,P40**	-40 °F to +140°F	(-40 °C to +60 °C)	-40 °F to +122 °F	(-40 °C to +50 °C)	T3C/T3C	S8	*2, 3*

Notes

1. *Duty cycle for D,P9 PM motor is S1, booster motor will remain S8.*
2. *Duty cycle for D,P40 PM motor is S1, booster motor will remain at S8.*
3. *CSA duty cycle tested at 31.8% for continuous operation at maximum load and speed.*
4. *Uses internal 240 to 120 Vac step-down transformer P98246.*
5. *Uses 48 Vdc to 72 Vdc converter.*
6. *Uses 24 Vdc to 165 Vdc converter.*

** *Exclude from CSA Class 1, Div. 1, Groups C & D.*

S1 Duty: *Duty cycle S1 is defined as continuous operation at load.*

S8 Duty: *Duty cycle S8 is defined as periodic duty with rest period between operation, variable load/speeds.*

**Duty Cycle definitions taken from IEC 60034-1 applies to all rotating electrical machines.*

1.4.3 Relative Humidity

The equipment will operate correctly within an environment at 50% RH, +40 °C (+104 °F). Higher RH may be allowed at lower temperatures.

Measures shall be taken by the Purchaser to avoid the harmful effects of occasional condensation.

1.4.5 Transportation and Storage

This equipment will withstand, or has been protected against, transportation and storage temperatures of −25 °C (−13 °F) to +55 °C (+131 °F) and for short periods up to +70 °C (+158 °F).

It has been packaged to prevent damage from the effects of normal humidity, vibration and shock.

1.5 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. For additional information refer to TM9-2. 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.*

Monthly

Check the oil indicator for proper oil level. Add oil if necessary following the instructions in section 1.6.4. When oil is added, a visual inspection of the actuator is needed to determine where the loss of oil occurred and the necessary repair required.

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

Quarterly

Perform a visual inspection of the actuators for damage, oil leakage, 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:

- Mounting hardware and fasteners are tight
- Oil level is correct
- Tubing and fittings are tight
- Tubing is not touching or rubbing
- Power module fasteners are tight
- Actuator can hold position without re correcting
- Oil leaks
- Spring washer stack for damage (not all models)
- Check for moisture ingression or contaminants under the feedback housing, wire cover and in the electronics enclosure
- Ground wire connectivity
- Ensure the feedback signal on the actuator is stable
- Inspect wiring for cuts, abrasions or tears

1.6 OIL

The REXA Xpac Actuator is a sealed, self-contained, hydraulic positioning system in which oil is pumped from one side of a double acting cylinder to the other. An internal oil reservoir provides a source of make up oil for thermal expansion and is an integral component within the module. As the size of the actuator cylinders increase so does the need for additional make up oil, therefore larger systems will have external reservoir bottles in addition to the standard internal reservoir.

A closed-loop hydraulic system means that the oil in the actuator is isolated from the environment and immune to degradation with time as a result of exposure to moisture and other atmospheric elements. Since the hydraulic system is sealed and spring-loaded, it is also unaffected by the orientation in which the actuator is applied.

A periodic, visual inspection of the REXA Xpac Actuator is required in order to verify that the hydraulic system has not been compromised for any reason. Any external signs of a major oil leak or repeated refilling of the unit will indicate damage to the actuator that will require servicing of the unit and investigation for a cause.

1.6.1 Oil Level Inspection

1.6.2 Standard Units

There is a reservoir indicator on the actuator body located on the same face as the motor shown in Figures 1.6.2-1—1.6.2-3. It is used to display the oil level within the actuator. The indicator is a silver rod with a scale beside it reading “HOT”, “OK” and “ADD”. As the unit cools down and heats up the indicator will move in and out. At 70 °F the indicators ideal position will be in the middle of the “OK” region. The unit may be indicating near the “ADD” limit if the ambient temperature is lower and will indicate in the “HOT” region if the ambient temperature is elevated. The reservoir volume has been sized for 110 °F temperature swings. Reference Figures 1.6.2-1 through 1.6.2-3 showing the different indication levels.

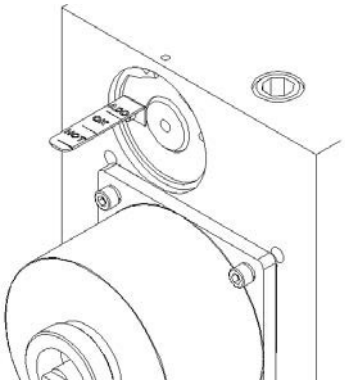


Figure 1.6.2-1 Add oil indication

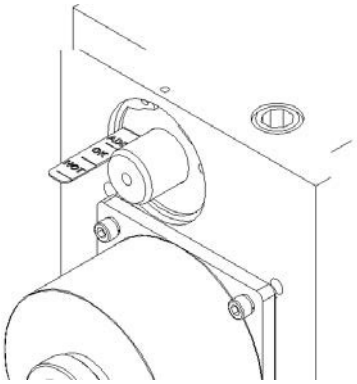


Figure 1.6.2-2 Full oil indication

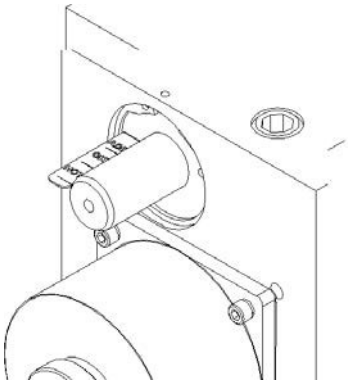


Figure 1.6.2-3 Oil Expansion

Larger units will require additional make up oil and an external reservoir will be plumbed in series with the internal reservoir. The internal reservoir will still show the oil level however there is also an indicator rod in the external reservoir. At an ambient condition of 70 °F it should be protruding out approximately 3-½ inches as measured from the base of the bushing shown in Figure 1.6.2-4.

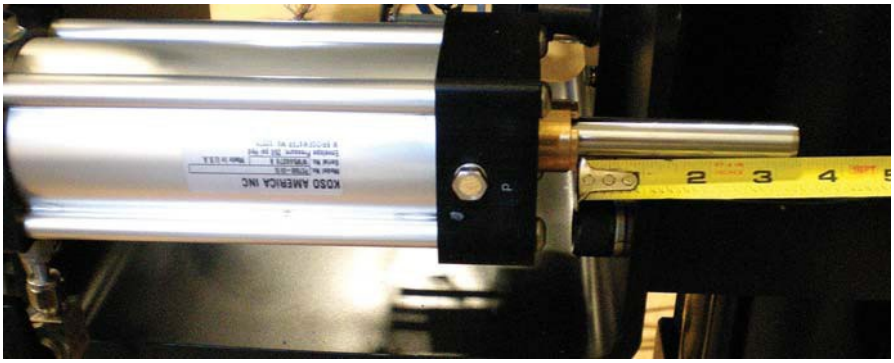


Figure 1.6.2-4 External Reservoir

1.6.3 Accumulator Fail

In an accumulator fail unit the reservoir contains oil for thermal expansion and also provides oil to charge the accumulator system. There are two different style accumulator reservoir bottles used depending on the size of the system. The first type uses a visual indicator rod as shown in Figure 1.6.2-4 and is typically used on smaller units. As the reservoir volume needs increase, a gas pressurized reservoir bottle is used and a pressure gauge is provided (Figure 1.6.3) to show the oil level.

Figure 1.6.3 Reservoir Gauge

In order to check the level of the oil in an accumulator system you must locate the “Auxiliary Reservoir Settings” label shown below. This can be found on the reservoir bottle.

Auxiliary Reservoir Settings

With the accumulator fully discharged, the accumulator pressure gauge must read 0 PSI. Fill until Indicator Extension is

XXX ± ½″

WARNING: Adding oil to the unit without verifying the Accumulator is at 0 PSI before filling will cause damage And potential injury or Death.

When accumulator is full @ XXX PSI. The indicator Extension should be @ XXX ± ½″

Auxiliary Reservoir Settings

With the accumulator fully discharged, the accumulator pressure must read 0 PSI. Fill until Reservoir pressure is

XXX ± 5 PSI

WARNING: Adding oil to the unit without verifying the Accumulator is at 0 PSI before filling will cause damage And potential injury or Death.

When accumulator is full @ XXX PSI. The reservoir Pressure should be @ XXX ± 5 PSI

1.6.4 Filling

If the addition of oil is required, it should be filled with Castrol EDGE® SAE 5W-50 motor oil (Figure 1.6.4-1). In special applications the type of oil used is system dependant and the user should refer to the system documentation. The actuator does not need to be taken out of service when adding oil.

Note: *Although Castrol Edge oil is recommended, oil of equal quality may be used.*

Figure 1.6.4-1 Castrol EDGE

REXA Xpac Actuators are filled through a standard Schrader-style Fill Valve located on a face of the Reservoir Assembly. Use any oil gun equipped with a Schrader-style fitting. The mating half of a Schrader-style fitting can be obtained at any auto parts store, purchased through a REXA Sales Rep, or purchased directly from REXA's Inside Sales Office. The following steps will guide a user to successfully fill a REXA Xpac Actuator with oil:

NOTE: DO NOT OVERFILL THE RESERVOIR. *While overfilling will not harm the actuator on non-accumulator units, overfilling will force oil from the Thermal Expansion Valve. Overfilling will also promote oil weeping from the relief valve due to thermal expansion. If an accumulator unit is over filled, the reservoir can be over pressurized and catastrophic seal damage can occur.*

PROCEDURE (9 steps):

1. Locate and Remove the fill valve cover (Figure 1.6.4-2).

Figure 1.6.4-2 Fill Valve with cover.

2. Fill the oil gun with oil (Figure 1.6.4-3).

Figure 1.6.4-3 Fill the oil gun.

3. To purge any air out of the oil gun, line and fitting; first, pump the handle a few times until the lever gets firm (Figure 1.6.4-4).

Figure 1.6.4-4 Purge the air.

4. Depress the small valve in the center of the Female Schrader fitting (on

the oil Pump) with a suitable device like a small screwdriver or punch until you get clean, air-free oil (Figure 1.6.4-5).

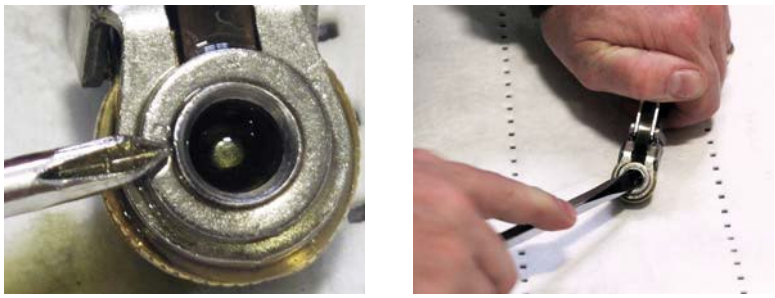


Figure 1.6.4-5 Oil Pump Valve.

5. Attach the oil fill gun to the actuator's Schrader fitting (Figure 1.6.4-6).

Figure 1.6.4-6 Fill Valve with Schrader fitting.

6. Add oil until the indicator is in the "OK" section of the scale (Figure 1.6.2-2). Reference the reservoir labels for correct filling of Accumulator units.
7. Remove the oil gun from the Fill Valve.
8. Re-install the fill valve cover.
9. Drain and store the Fill Gun in a clean place for future use.

1.6.5 Overfilling, Oil Weeping & Thermal Expansion

All REXA Xpac Actuators contain a Thermal Expansion Valve located next to the Schrader-style Fill Valve. If an actuator is overfilled with oil, it should be expected that oil will purge out of the Thermal Expansion Valve. Simply wipe-off whatever oil may be purged.

The Thermal Expansion Valve is built into every REXA Xpac Actuator in order to allow the actuator to relieve the Thermal Reservoir of excess oil pressure due to thermal expansion. Thermal expansion refers to the volumetric changes a fluid, such as oil, experiences given changes in environmental temperature.

It is not uncommon to discover trace amounts of residual oil collected around the Thermal Expansion Valve of an actuator if the unit has been overfilled. This residual oil is typically the result of oil weeping from the relief valve as the ambient temperature increases causing the oil to expand. As previously mentioned, the actuator is a closed-loop hydraulic system, and any increase in oil volume will be purged. On large oil volume actuators REXA adds an external auxiliary reservoir in order to compensate for the greater volume of oil that may expand due to increases in ambient temperature.

If the temperature is lowered, the reservoir indicator will retract as the oil volume decreases. Oftentimes, users will mistake the indicator retraction as a sign that the actuator has lost oil due to a service issue. If a user adds oil to the actuator at this time, oil will likely purge out of the Thermal Expansion Valve upon an eventual rise in ambient temperature. It is when oil is evidently leaking, or collected in large amounts somewhere on, or dripping off, a REXA Xpac Actuator that a service-related issue is likely, and oil filling is needed. For this reason, we ask users to perform periodic inspections with ambient temperature changes in mind.

1.6.6 Air Purging

As previously noted, all REXA Xpac Actuators are characterized by a closed-loop, hydraulic system that is responsible for their distinguished reputation as being unmatched in rigidity, precision and control. This is, in part, due to

the advantages of using hydraulics in place of pneumatic actuation. Air is a compressible medium that results in many inherent disadvantages, such as poor control and rigidity, when used in actuation.

In light of these facts, it is obvious that the presence of any air in the closed-loop hydraulic system of a REXA Xpac Actuator is extremely disadvantageous and detracts from performance of the actuator. Certain repair and replacement procedures will involve exposing the internal hydraulic system to the outside environment and may introduce unwanted air to the system. The presence of air in the hydraulic system is likely to cause problems such as unstable positioning. **For this reason, whenever the closed-loop hydraulic system of a REXA Xpac Actuator is opened to the atmosphere, it is imperative that necessary steps are taken to remove any air from the system.** When purging a REXA Xpac Actuator of air, there are two main areas of concern: the reservoir, and the hydraulic system.

1.6.7 Reservoir Purging

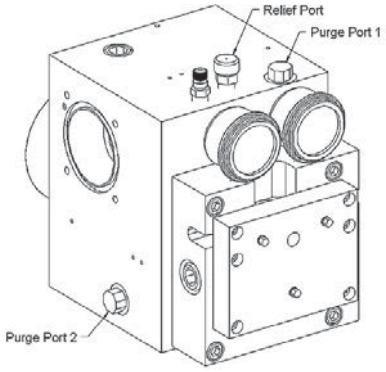


Figure 1.6.7-1 Reservoir Purging Ports

1. It is important to first identify if the reservoir has entrapped air. This can be done by pressing in on the reservoir indicator. If it does not feel "stiff," there is air in the reservoir system.

Note: *Be aware of external reservoirs or additional modules; press evenly on all reservoirs to check for entrapped air.*

2. Depending on the orientation of the actuator the highest purge point on the module must be identified, as any entrapped air will migrate to the highest point. Purge Port 1 and Purge Port 2 (Figure 1.6.7-1) are both at corners of the reservoir volume and most likely will be the highest points.

Note: *Some modules will have auxiliary reservoirs attached and plugged ports on those reservoir may be the highest points.*

3. Slowly unthread the highest purge point fastener and have an oil catch pan ready. It may not be necessary to fully remove these plugs as air will purge out with a few threads still installed.
4. Retighten the plug before proceeding.
5. Refill to the correct oil level.

Note: *Some actuator orientation will not allow for proper purging and the actuator may need to be removed and re-orientated for purging, then re-installed. The best position for purging is with purge port 1 facing up.*

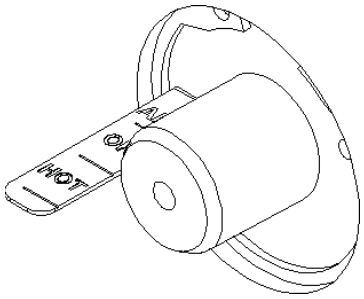


Figure 1.6.7-2 Full Indicator "OK"– flush with front face

1.6.8 Hydraulic System Purging

NOTE: *It is important to purge the reservoir before continuing.*

To purge the actuator of air, it is recommended that you use the REXA bleed kit (P/N: K09275) See Figure 1.6.8-2 for details.

1. Change the **Max Man Spd** to 30% or less. (Refer to section 6.1.5.)
2. Open the manual bypass to relieve internal pressure. (Refer to C.5.)

NOTE: *Some units can have a solenoid instead of a manual bypass; ensure that the solenoid is open before proceeding. (Refer to section 1.8.4.)*

3. Locate the best available pressure ports to bleed air from the system. The best position is the highest point that is accessible and will allow air to escape the system. Keep in mind that the porting may be located on the module, cylinder, manual hydraulic pump or SCL, etc.
4. Attach the REXA bleed kit (Figure 1.6.8-2) to the open ports Extend/CW and Retract/CCW. Follow the hydraulic lines to differentiate between pressure direction (Figure 1.6.8-1).

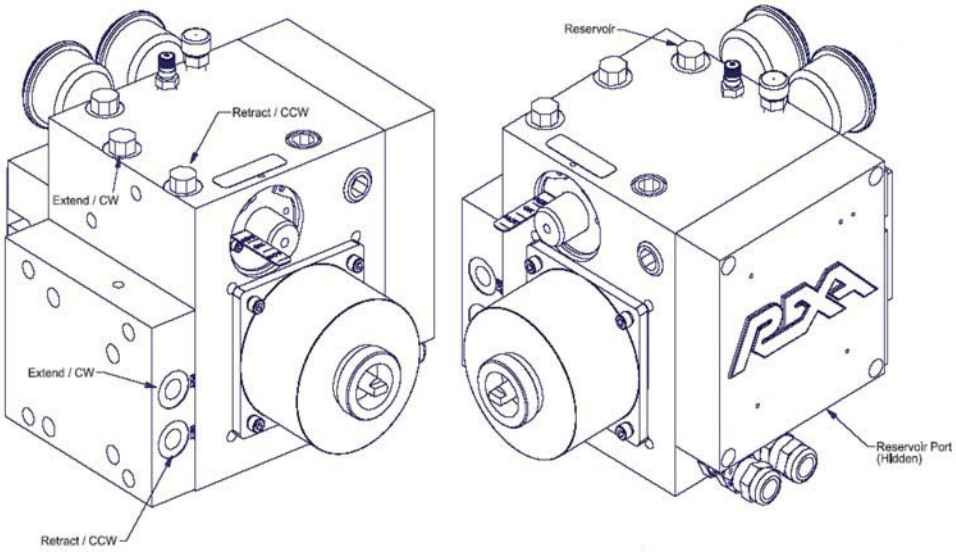


Figure 1.6.8-1 Extend/CW and Retract/CCW Ports

5. Run the actuator through its full stroke constantly pumping oil into the reservoir. **Do not let the reservoir run dry, or you will need to purge the reservoir and start over.**

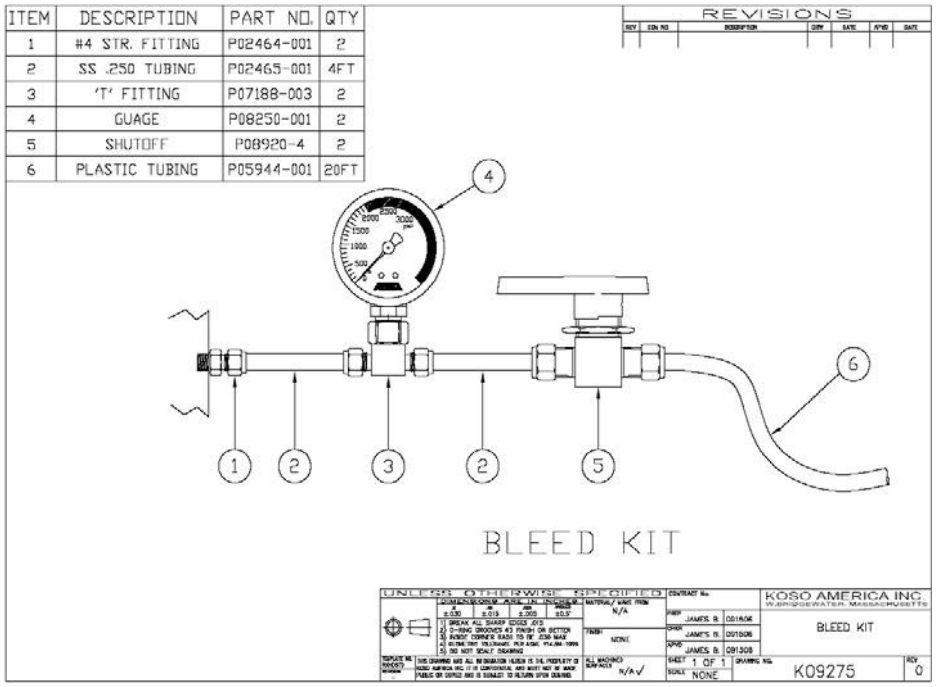


Figure 1.6.8-2 Bleed Kit (PN: K09275)

1.7 TOOL REQUIREMENTS (POWER MODULE ONLY)

All these common tools may be required during installation and maintenance.

- Flashlight
- Set of Flat Tip Screwdriver
- Standard Set of Allen Wrenches
- Set of Combination Wrenches
- Set of Picks
- 12″ Channel Lock Pliers
- 3⁄16″ Nut Driver
- 3⁄8″ Nut Driver
- Snap Ring Pliers
- Needle Nose Pliers
- Wire Strippers
- Wire Cutter
- Crimper
- Digital Volt Meter
- Oil Gun with Schrader Fill Assembly
- Soft Blow Hammer

1.8 THEORY OF OPERATION

1.8.1 Overview

The REXA **Xpac** is a microprocessor controlled, self-contained, Electraulic™ (electro-hydraulic) actuator or drive designed specifically for modulating service. Hydraulic, electronic and mechanical technologies are combined to achieve REXA's state-of-the-art line of actuators.

The patented Flow Match System is simply described as a highly efficient method of pumping hydraulic fluid (motor oil Castrol EDGE® SAE 5W-50) from one side of a double acting cylinder to the other. Once the correct position is reached, the motor shuts off. Power is not required to maintain actuator position. The hydraulics are controlled by a dedicated microprocessor contained within the control enclosure. Software designed for the **Xpac** allows the user to set actuator operation parameters.

Note: *Although Castrol Edge oil is recommended, oil of equal quality may be used.*

The **Xpac** consists of two major components, the actuator (cylinder, feedback and Electraulic power module) and the control enclosure. The actuator is installed on the driven device, while the enclosure is remotely mounted. Connecting the actuator and enclosure are the module cable and the feedback cable.

1.8.2 Actuator

The heart of the actuator is the Electraulic Power Module. Consisting of a motor, gear pump, flow match valve (FMV), make-up oil reservoir, heater, thermostat and bypass solenoid (spring fail units only), the Power Module delivers oil at a nominal 2000 psi to a hydraulic cylinder. Four different size modules, B, C, ½D and D, are available meeting hazardous area but non-explosion proof requirements. For applications requiring hazardous area and explosion proof approvals, two different power modules, C and D are available. The major functional difference between the sizes is pumping volume and thus, the maximum stroking speed of an actuator.

The B and C modules are driven with a stepper motor and therefore have a slower frequency response then the D series modules which are driven with

servo motors. More detailed information on the frequency response and flow rates can be found in product/technical memos. The only visible difference among all 4 sizes of modules is the motor.

There are three types of hydraulic cylinders. On smaller size linear actuators (thrust of 10 000 lb or less and strokes of 6 inches or less), the L series cylinder is manufactured from a solid block of aluminum. Larger size C series cylinders are made of a fabricated tie-rod construction. The third type, used on rotary (series R) and drive (series D) units, is a rack and pinion rotary design.

A position sensor, provides feedback position to the control electronics. The feedback assembly is sealed in a NEMA 4X cover and mounted within or adjacent to the cylinders. The connection of the position sensor is by direct mechanical means.

The B and C modules shown in Figure 1.8.2-1&2 are the two sizes of stepping motor modules. They both have cylindrical motor cases. The motor case lengths are depicted in Figure 1.8.2-1&2 for module identification purposes. With the exception of pump and motor size, these two modules share many of the same components so both modules will be depicted on one rebuild diagram for each of the applicable service sections.

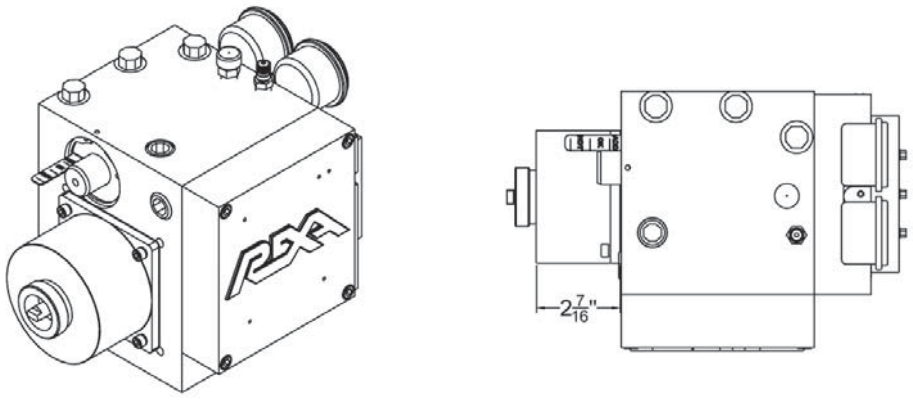


Figure 1.8.2-1 B Module

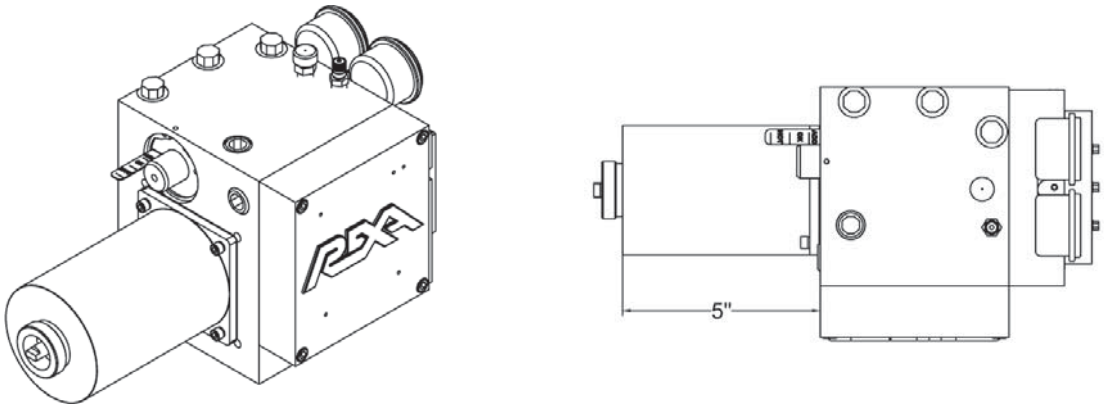
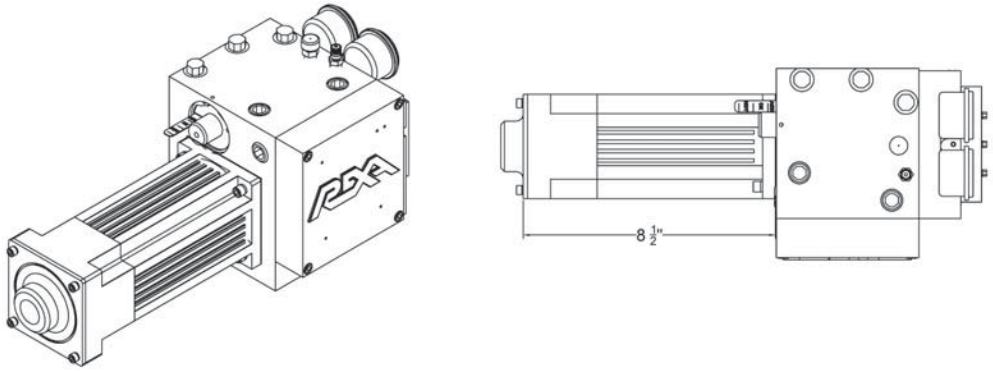


Figure 1.8.2-2 C Module

The 1/2D and D modules shown in Figure 1.8.2-3 are the two sizes of servo motor modules. They both have square case motors. The motor case lengths are depicted in Figure 1.8.2-3 for module identification purposes. Again, with the exception of pump and motor size, these two modules share many of the same components so both modules will be depicted on one rebuild diagram for each of the applicable service sections.

1/2D-Module



D-Module

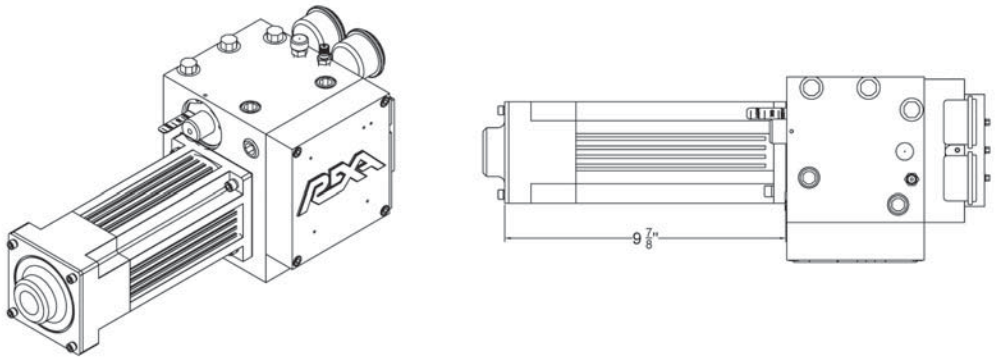
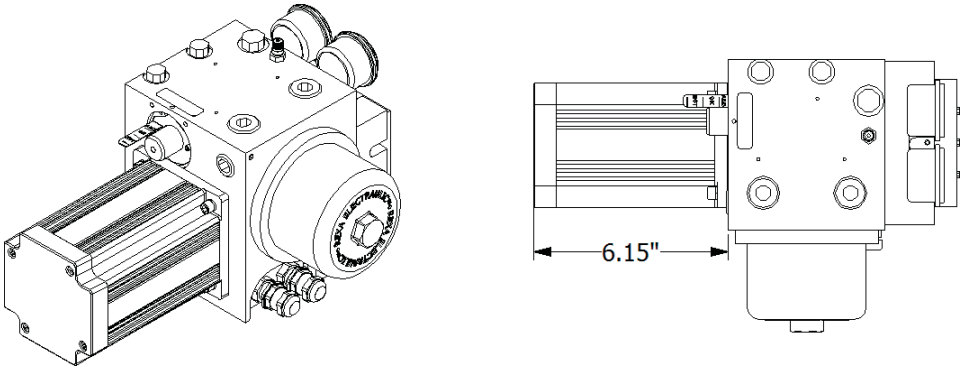


Figure 1.8.2-3 ½D, & D Module

The C and D explosion proof modules shown in Figure 1.8.2-4 are two sizes of power modules offered for applications requiring hazardous area and explosion proof approvals. The motor case lengths are depicted in Figure 1.8.2-4 for module identification purposes. With the exception of pump, motor size, and cover, these modules share many of the same componenets as the non-explosion proof modules so both modules will be depicted on one rebuild diagram for each of the applicable service sections.

C- Module



D-Module

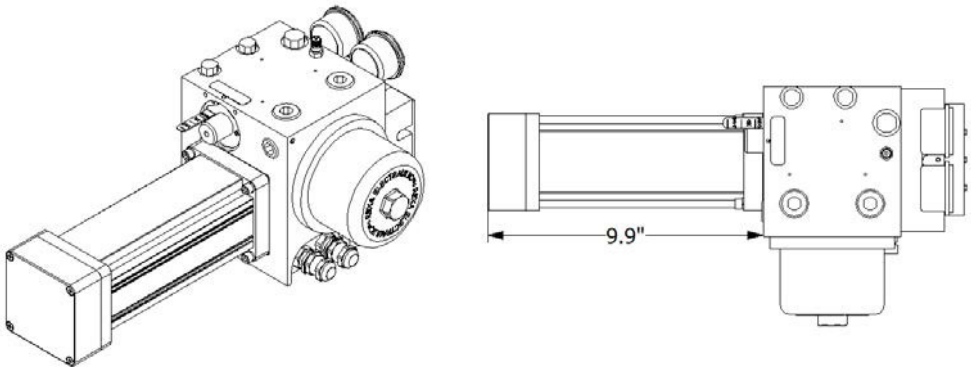


Figure 1.8.2-4 C & D Module

1.8.3 Control Sub-Assembly

The control sub-assembly consists of the enclosure, Central Processing Unit (CPU), Power Supply, Motor Drivers, Main Power Transient Suppression, and a termination area.

The control sub-assembly also provides the user interface. The enclosure mounted 2-line x 20 character/line Vacuum Fluorescent Display (VFD) and 5 button keypad will be the point for setup and calibration of the actuator as well as visual feedback of actuator status. The Keypad and Display can be optionally mounted inside the Control Enclosure should the installation warrant it.

The CPU consists of a microprocessor, an Analog-to-digital (A/D) converter, an isolated 4-20 mA Position Transmitter, Electronic (PhotoMOS) limit switches, as well as warning and alarm relays. The CPU will also accept optional I/O interface boards.

The power supply develops DC voltages from the incoming AC Power. The DC voltages, +5, +15, -15 and +24 Vdc, provide power to the CPU, actuator feedback circuit, the optional interface boards as well as optional loop supply (+24 Vdc) for the Position Transmitter.

The motor driver is the component that supplies power to the motor. It can either be a DC Stepper Motor Driver or an AC Servo Motor Driver, depending on the model actuator. The motor driver accepts command signals from the CPU and provides DC Step Pulses (Stepper Motor) or Pulse Width Modulated (PWM) DC Voltage (Servo Motor) to the module mounted motor to drive it in one direction or the other. There is one motor driver for each power module.

Field wiring is terminated inside the control enclosure. Refer to Tables 1.8.3-1 and 1.8.3-2 for Terminal Block ratings.

Figure 1.8.3 Typical Control Enclosure

Standard Painted-Steel Enclosure Specifications For Single Module Actuators:

UL 508 Types 12, 4
CSA Type 12, 4
Complies with NEMA Type 12 and 4

IEC 529, IP66 Construction

Refer to Appendix P for dimensions and alternative construction.

Table 1.8.3-1 Control Enclosure Terminal Blocks

MECHANICAL	
Termination Torque	10 lbf·in Max.
Operating Temperature	-40 °F to +221 °F (-40 °C to +105 °C)
MATERIAL	
Contact	Brass, Tin Plated
Screw	#6-32, Combo Head, with SEMS Washer
Insulator Body	Polycarbonate, UL 94V-0, Black
ELECTRICAL	
Voltage Rating	300 Vac
Current Rating	20 Amp
Wire Range	12-24 AWG

Table 1.8.3-2 Actuator Terminal Blocks

MECHANICAL	
Termination Torque	12 lbf·in Max.
Operating Temperature	-40 °F to +250 °F (-40 °C to +125 °C)
MATERIAL	
Contact	Copper Alloy
Screw	Screw M3, Slotted
Insulator Body	Polyamide PA, UL 94V-2, Gray
ELECTRICAL	
Voltage Rating	300 Vac
Current Rating	20 Amp
Wire Range	10-28 AWG

1.8.4 Operational Summary

The CPU converts an incoming control signal into a target position. The current position is determined through the feedback assembly mounted on the actuator. The difference between the target and current position is the error. If the error exceeds the user set deadband then the CPU will initiate corrective action by starting the motor.

A reversible hydraulic pump is driven by the motor. The pump can pressurize either side of a double acting cylinder through one of two sides of the Flow Matching Valves, FMV-1 and FMV-2. Each FMV side is comprised of a ported spool with an integral pilot operated check valve.

In the example in Figure 1.8.4-1; to move the cylinder piston to the left, the pump turns in the direction to pressurize FMV-2 through port A2. The spool in FMV-2 becomes unbalanced by the pressure differential and moves to the left, lifting its check valve, opening port D2 to port B2 and port A2 to port E2.

High pressure fluid flows through Port E2 to the right side chamber of the cylinder. Since the hydraulic circuit is closed, the same amount of oil that flows into the right side of the piston must be extracted from the left side. This allows oil movement without an active reservoir. This oil flows through the open check valve of FMV-2 and into pump suction.

By rotating the pump in the opposite direction, the FMVs operate in reverse to move the cylinder piston to the right. When the pump stops, both check valves close, and the hydraulic oil is locked within the cylinder. Motor operation is not required to maintain position.

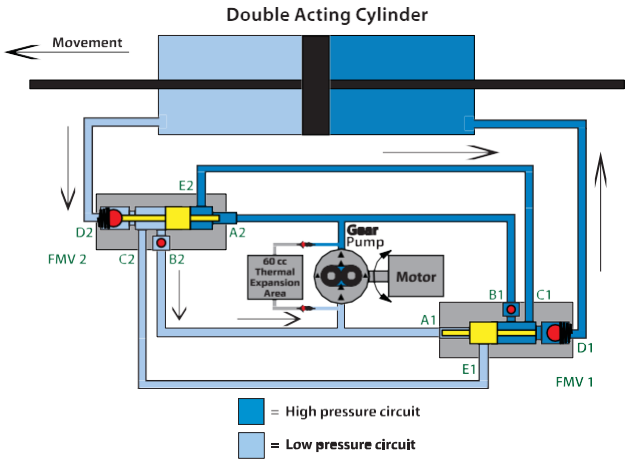


Figure 1.8.4-1 Hydraulic schematic

Each actuator has an internal hydraulic bypass circuit. This circuit creates a direct connection from one side of the hydraulic cylinder to the other. It is useful for relieving internal pressure in the actuator and allowing an external load to move the actuator. The nut labeled bypass on the actuator face as shown in Figure 1.8.4-2 controls this circuit. Turning this bypass in all the way puts the unit in its normal operation. Turning the bypass out 1 to 2 turns will open this bypass circuit.

Note: *This bypass nut is only on units without internal solenoids.*

Each pressure gauge on the actuator has its own on/off isolation valve (Figure 1.8.4-2). This valve should remain off unless pressure is being read from the gauge. This will protect the gauge from constant cycling, thus extending its life. When closing this valve you will create an internal pressure trap in the gauge; therefore, you should not expect to see 0 psi when off.

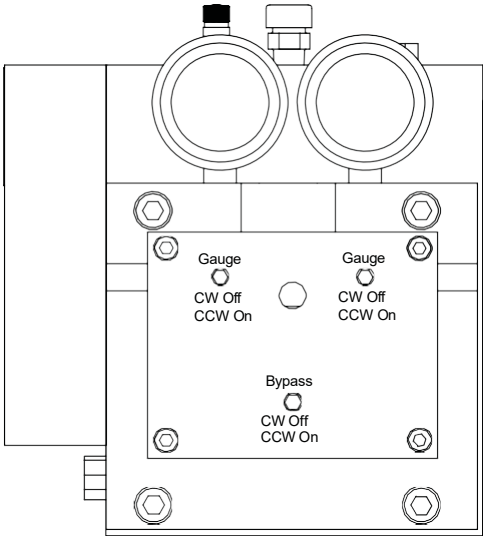


Figure 1.8.4-2 Bypass

2 Delivery

2.1 RECEIPT

REXA makes every effort to package products to avoid damage in shipping. Upon receipt inspect the crate and make note of any physical damage. If severe damage is present, then consideration should be given to rejecting the shipment and contacting the shipping company concerning in-transit damage claims.

2.2 STORAGE

If the actuator and control enclosure sub-assemblies are not immediately installed, provisions for storage must be made. The equipment should not be removed from the original containers and should be protected from the elements. The ambient environment must be:

Clean—no airborne particles or contaminants.
Non Corrosive—minute quantities of gases can concentrate in a confined area.
Dry—relative humidity must be sufficiently low to prevent moisture condensation on chilled metal components.
Temperature—recommended storage temperature is between 10 °F – 120 °F (–12 °C – 50 °C).

2.3 UNPACKING

The REXA Xpac actuator is shipped filled with oil and ready to be installed. It has been operated, tested and thoroughly inspected. After removing the actuator from the packaging, inspect it for any signs of mechanical damage that may have occurred during shipping. Immediately report any damage to the factory.

Compare the contents to the packing list included with every shipment. Immediately report any discrepancies to the factory.

2.3.1 Unpacking System, Lifting

If a piece of the system weighs between 40 – 79 lb (18 – 36 kg), the manual must tell the installer that a two-man lift is required.

If a piece of the system weighs between 80 lb and 129 lb (36 kg – 59 kg), a three-man lift must be used.

Above 129 lb (59 kg), a machine assist must be used (forklift or crane)

2.4 INSTALLATION REQUIREMENTS

2.4.1 Operational and Maintenance Clearances

Volts to Ground	Condition 1
0–600	900 mm (3 ft)

Exposed live parts are on one side and no live or grounded parts are on the other side of the working space. Or, exposed live parts on both sides are effectively guarded by wood or other suitable insulating materials. Insulated wire or insulated busbars operating at not over 300 V to ground shall not be considered as live parts.

2.4.2 Hazards Due to Height

Use Safety Harness when working aloft above 1.8 m and consult Plant Safety Policy for safety consciousness and harness requirements.

3 Electrical Installation

CONTROL ENCLOSURE OVERVIEW

The Block Diagram (Figure 3) on the following page gives a general overview of the Control Enclosure and Actuator installation.

Note: Not all actuators will have all the options shown in Figure 3.

3.1 CONTROL ENCLOSURE INSTALLATION

The Control Enclosure must be mounted in a location conducive to its operation. Ideally, it should be mounted in a Control Room environment. The Control Enclosure rating is as follows:

General Locations (Standard):

Environmental: NEMA 4 and 12, IP 66
Ambient Temperature: –40 to +130 °F (-40 to +55 °C)

Optional Construction:

Hazardous Locations: CSA Class 1, Div. 2, Groups A, B, C & D, T3-
Available Units: All units in Table 1.4.2-3 are available
Protection Method: Non-Incendive (non-sparking), limitation of surface temperatures
Ambient Temperature: –40 to +104 °F (-40 to +40 °C)
Hazardous Locations: CSA Class 1, Div.1, Groups C & D, T3
Available Units: All units in Table 1.4.2-3 are available except D-P9 AND D-P40
Protection Method: Explosion Proof and Intrinsically Safe
Ambient Temperature: Refer to Table 1.4.2-3

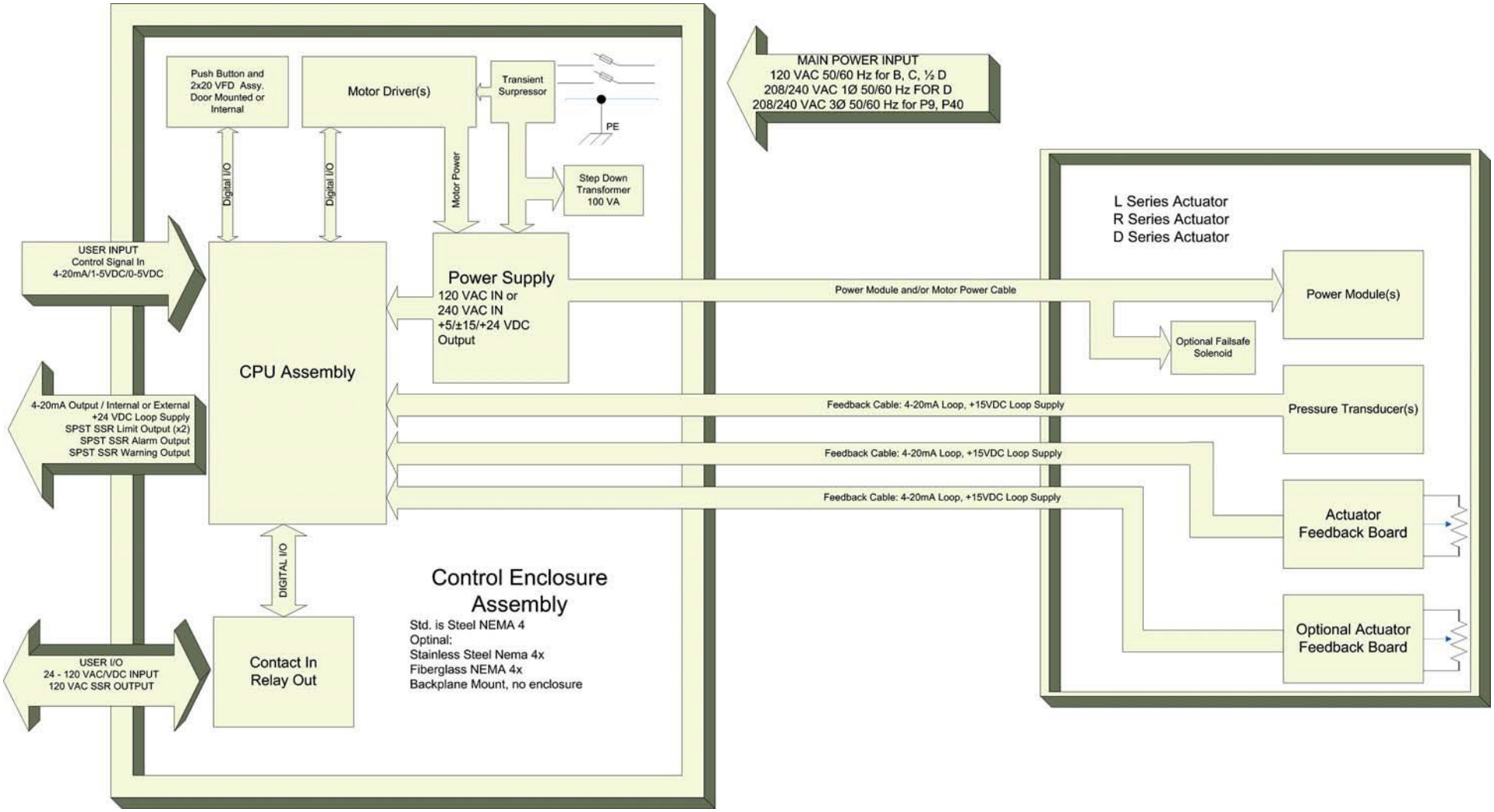


Figure 3 Electrical Installation Block Diagram

It is necessary to verify the enclosure door is closed tightly and any openings added are sealed to comply with the ratings given above.

Note: *Reaffirm with unit's tagging the Control Enclosure's intended location.*

3.2 MAIN POWER

The Main Power requirements for the Control Enclosure/Actuator vary according to model. The Main Power requirements are given as part of the Nameplate Information attached to the lower left corner of the control enclosure as shown in Figure 3.2. If no control enclosure is used, the nameplate will be attached to the backplane on which the Electronics is mounted.

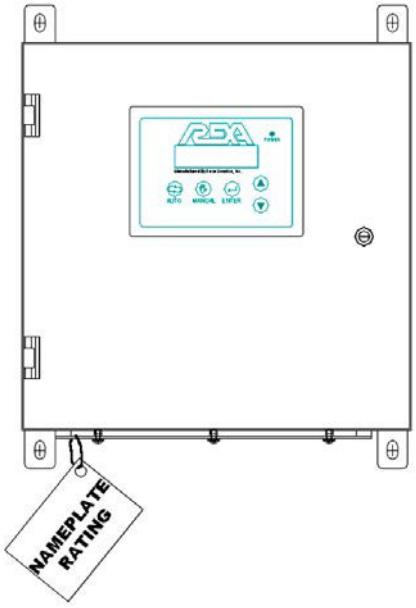


Figure 3.2 Control Enclosure

In general, the Main Power requirements are given in Table 3.2; however, the Nameplate rating takes precedence.

Table 3.2 Power Requirements

Module Size	Incoming Voltage*	Maximum Current Required	VA Rating
B Module	115 Vac ±10%, 50/60 Hz	4.0 amp	500
C Module	115 Vac ±10%, 50/60 Hz	8.5 amp	1 100
½ D Module	115 Vac ±10%, 50/60 Hz	20.0 amp	2400
D Module	230 Vac ±10%, 1Ø, 50/60 Hz	10.0 amp	2400
2D Module	230 Vac ±10%, 1Ø, 50/60 Hz	20.0 amp	4800
D,P9	230 Vac ±10%, 3Ø, 50/60 Hz	25.0 amp	9000
D,P40	230 Vac ±10%, 3Ø, 50/60 Hz	50.0 amp	21 000

** If another voltage is to be used, an External Step Up/Down Transformer of the proper size must be used.*

3.2.1 Supply Disconnect Device

To comply with IEC 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, a supply disconnect device with the proper rating MUST be installed. The supply disconnecting device:

a) Shall disconnect (isolate) the Control Enclosure/Actuator from the supply when required.

b) Shall be included in the building installation.

c) Shall be in close proximity and within easy reach of the Control Enclosure.

d) Shall be marked as the disconnecting device for the equipment.

Refer to the Nameplate Rating of the Control Enclosure sub-assembly for proper sizing of the required disconnect device.

It is the responsibility of the installer of this equipment to provide a suitable disconnect for the Control Panel supplying power to this equipment.

This 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:

(a) Switch-disconnector with fuses, in accordance with IEC 60947-3, utilization category AC-23B or DC-23B.

(b) 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.

(c) A circuit breaker suitable as an isolation device per IEC 60947-2.

(d) 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 this equipment 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.

3.2.2 Grounding

Protective Earth Ground

A dedicated Protective Bonding Conductor (Protective Earth, PE) must be provided. The conductor must be connected to the terminal labeled PE or ⏚. Protective bonding provides protection against electrical shock and should be provided at both Control and Actuator.

3.2.3 Grounding Symbols

PE —Protective Earthing


—Safety Earth Ground


—Noise Free (EMI) Ground


—Frame/Chassis Ground

3.2.4 Main Power Supply Wiring

It is the responsibility of the Installer of this equipment to supply suitable main power supply wiring. Consult the Manufacturer's Identification Nameplate on the Machine to determine Voltage and amperage requirements when determining the wiring size (mm2).

— The supply wiring must be approved for use in the country in which this equipment is installed or bear the <HAR> Mark.

— A separate bi-color ground wire that is green in color with a yellow stripe must be run in the hard-pipe conduit along with the supply wiring.

— The conduit must be grounded in accordance with the National wiring rules of the country where installed.

— The fittings installed where the service wiring enters the body of the panel must not reduce the panel Ingress Protection rating.

3.2.5 Cordage

It is the responsibility of the Installer of this equipment to supply a suitable length of heavy duty supply cordage. It should meet the following requirements:

— It must be approved for use in the country in which this equipment is installed or bear the <HAR> Mark.

— The maximum length of the cordage should not exceed the values established by the National Electric Code of the country in which it is installed.

— The outer jacketing of the cordage should be rated for exposure to water, oil and other similar substances.

— The Voltage and Ampere rating of this equipment, as noted on the Manufacturer's Identification Label, should be consulted when selecting the proper size (mm2) of the cordage.

— A suitable industrial style attachment plug should be selected for connecting to the branch circuit. As an alternative, the end that terminates at the building supply source may be permanently connected in accordance with local wiring rules.

— The supply cordage should be routed to the Control Cabinet in a manner that does not allow it to be stepped on, pinched, subject to abrasion, excessive bending, become a trip hazard or subject to other abuse.

— Refer to REXA interconnect drawings for details of interconnect cable requirements.

3.2.6 Fuse Identification / Replacement

Unit Description	Main Fuse (V, A, IR, Class)	Branch Fuse(s)
B, 115 Vac	600V, 5A, SCR 200k, Class CC	none
B, 230 Vac	600V, 5A, SCR 200k, Class CC	none
B, 24 Vdc	600V, 20A, SCR 200k, Class CC	DC/DC; 250V, 2A, SCR 100,1/4x1/4 TD Glass Tube
		Heater; 250V, 8A, SCR 200, 1/4x1/4 TD Glass Tube
		Solenoid; 250V, 5A, SCR 200, 1/4x1/4 TD Glass Tube
B, 48 Vdc	600V, 5A, SCR 200k, Class CC	DC/DC; 250V, 2A, SCR 100,1/4x1/4 TD Glass Tube
		Heater; 250V, 8A, SCR 200, 1/4x1/4 TD Glass Tube
		Solenoid; 250V, 5A, SCR 200, 1/4x1/4 TD Glass Tube
C, 115 Vac	600V, 10A, SCR 200k, Class CC	none
Dual C, 115 Vac	600V, 15A, SCR 200k, Class CC	none
C, 24 Vdc	600V, 50A, SCR 300k, Class J	DC/DC; 250V, 2A, SCR 100,1/4x1/4 TD Glass Tube
		Heater; 250V, 8A, SCR 200, 1/4x1/4 TD Glass Tube
		Solenoid; 250V, 5A, SCR 200, 1/4x1/4 TD Glass Tube
½ D, 115 Vac	600V, 20A, SCR 200k, Class CC	none
½ D, 230 Vac	600V, 10A, SCR 200k, Class CC	none
Full D, 230 Vac	600V, 10A, SCR 200k, Class CC	none
Dual D, 230 Vac	600V, 20A, SCR 200k, Class CC	none
D,P9, 230 Vac	600V, 25A, SCR 200k, Class J	none
D,P40, 230 Vac	600V, 50A, SCR 200k, Class J	D; 600VAC, 10A, SCR 200k, Class CC
		P40; 600VAC, 35A, SCR 200k, Class J

Power Supply	Fuse Location	Description	Voltage (V)	Amperage (A)	SC I/R (A)	Type	Size
230 V Power Supply	F1	Triple Power suuply	250	¼	35	GMC	5 × 20mm
	F2	24 Vdc Supply	250	⅛	35	GMC	5 × 20mm
	F3	Contact Input Board	250	1	35	GMA	5 × 20mm
	F4	Trip Solenoid	150	5	100 000	A15QS	Form 101
	F5	Fail Solenoid	250	1	35	GMA	5 × 20mm
	F6	Fail Solenoid	250	1	35	GMA	5 × 20mm
	F7	Heater	250	1	35	GMA	5 × 20mm
	F8	Heater	250	1	35	GMA	5 × 20mm
115 V Power Supply	F1	Triple Power suuply	250	½	35	GMC	5 × 20mm
	F2	24 Vdc Supply	250	¼	35	GMC	5 × 20mm
	F3	Contact Input Board	250	1	35	GMA	5 × 20mm
	F4	Trip Solenoid	150	5	100 000	A15QS	Form 101
	F5	Fail Solenoid	250	2	100	GMA	5 × 20mm
	F7	Heater	250	2	100	GMA	5 × 20mm
24/48 Power	Branch Fuse Protection	DC/DC; 250V, 2A, SCR 100, ¼×¼ Time Delay Glass Tube					

3.3 CABLES

Each Actuator and Control Sub-Assembly are interconnected by a set of cables. These cables are supplied by REXA. The following will help you identify the cables.

Feedback Cable (Stepper & Servo Motor Units)

The Actuator Feedback Cable carries the Actuator Feedback signal to the Control Sub-Assembly. The Feedback Cable (REXA P/N #P96192) specifications are:

Cable Type:	3 Conductors #18 AWG 16/30 STRANDED TINNED COPPER
Insulation:	COLOR CODE 1. RED 2. WHITE 3. BLACK
Jacket:	GRAY
Cable O.D.:	0.230-0.250″

Feedback Cable must be shielded.

Power Module Cable (Stepper Motor Units)

The Stepper Motor Actuators use a Power Module Cable to interconnect between the Control Sub-Assembly and Actuator. The Power modules function is to transfer motor power, Heater Power and Solenoid Power. The Power Module Cable (REXA P/N #P96191–X2) specifications are:

Cable Type:	4 TWISTED PAIR, 1 TWISTED TRIAD, #16 AWG 19/29 STRANDED TINNED COPPER
Insulation:	COLOR CODE PAIR 1 – RED WITH RED/BLACK PAIR 2 – GREEN WITH GREEN/BLACK PAIR 3 – BLUE WITH BLUE PAIR 4 – YELLOW WITH YELLOW TRIAD – BROWN & BROWN & GREEN/YELLOW
Jacket:	GRAY
Cable O.D.:	0.50-0.55″

If not using Power Module Cable Supplied by REXA**, it is important that the motor power conductors be twisted pairs to avoid adverse effects of radiated noise from the cable.**

Heater/Solenoid Cable (Servo Motor Units Only)

The Servo Motor Actuator uses a Heater/Solenoid Cable to interconnect between the Control Sub-Assembly and Actuator. The cable supplies power to the Power Module heater and Fail Safe Solenoid (for Spring Fail units). There is also a Ground Conductor. The Heater/Solenoid Cable (REXA P/N #P97335-X2) specifications are:

Cable Type:	1 TWISTED PAIR, 1 TWISTED TRIAD
Insulation:	COLOR CODE PAIR 1 – BLUE WITH BLUE TRIAD – BROWN & BROWN & GREEN/YELLOW
Jacket:	GRAY
Cable O.D.:	0.4-0.45″

Motor Resolver Cable (Servo Motor Units Only)

The Servo Motor Actuator uses a dedicated Motor Resolver Cable to interconnect between the Control Enclosure and Actuator. The cable supplies motor speed and position feedback to the Servo Amplifier. The Resolver Cable (REXA P/N #P96399) specifications are:

Cable Type:	Power Limited Tray Cable (PLTC), 20 AWG (7/28) stranded, tinned copper conductors, twisted pairs, individually shielded plus an overall foil shield (100% coverage), PVC jacket.
Pairs:	1. RED paired with BLACK 2. GREEN paired with BLUE 3. BROWN paired with WHITE 4. ORANGE paired with YELLOW
Characteristics:	Voltage Rating: 300 Volts Temp. Rating: -30 °C to +105 °C Flammability: Passes UL VW-1 Flame Test UL Type TC Sunlight Resistant Direct Burial Indoor/Outdoor Use
Cable O.D.:	0.41″ Max.

Resolver Cable must be shielded.

Motor Power Cable (Servo Motor Units Only)

The Servo Motor Actuator uses a dedicated Motor Power Cable to interconnect between the Control Enclosure and Actuator. The cable supplies power to the Servo Motor. The Servo Motor Power Cable (REXA P/N #P96402) specifications are:

Cable Type:	UL Type TC, (Tray Cable), 4 conductor, overall foil shield, #14 AWG 41×30 stranded tinned copper with #14 AWG drain wire pulled under foil tape.
Conductors:	1. ORANGE 2. GRAY 3. BLUE 4. GREEN
Characteristics:	Voltage Rating: 600 Volts Temp. Rating: -30 °C to +90 °C Flammability: Passes UL VW-1 Flame Test UL Type TC Sunlight Resistant Direct Burial Indoor/Outdoor Use
Cable O.D.:	0.61″

Motor Power Cable must be shielded.

Booster Cable (D,P9 and D,P40 Units Only)

The Booster Pump actuator uses a dedicated cable to interconnect between the Control Enclosure and Booster Pump motor.

D,P9 (REXA P/N #P97117)

Cable Type:	4 CONDUCTOR, OVERALL FOIL SHIELD, 10 AWG
Insulation:	COLOR CODE 1. ORANGE 2. BLUE 3. GRAY 4. GREEN
Jacket:	GRAY
Cable O.D.:	0.60-0.65″

D,P40 (REXA **P/N #P97882)**

Cable Type:	4 CONDUCTOR, OVERALL FOIL SHIELD, 8 AWG
Insulation:	COLOR CODE: Black, labeled 1. ONE 2. TWO 3. THREE 4. FOUR
Jacket:	BLACK
Cable O.D.:	0.70″

3.3.1 Cable Lengths

The length of cabling between the Control Enclosure and Actuator is limited. The following table gives the appropriate lengths for each type of cable and whether the actuator is using a Stepper or Servo type motor.

It is important to adhere to the length limits and conductor size for proper operation of the system.

Table 3.3.1 Cable Lengths

Cable	Used on Unit Type	Max. Length
Feedback Cable	Step or Servo	700 ft
Module Cable	Stepper	400 ft*
Motor Power Cable	Servo	700 ft
Resolver Cable	Servo	700 ft
Heater/Solenoid Cable	Servo	700 ft

** 400 ft limit is for 16 AWG Cable. Consult factory for longer lengths.*

3.3.2 Cable Routing

 **Important for proper operation.**

Cables between Control Enclosure and Actuator should be run in flex conduit, rigid conduit or dedicated cable tray. It is important to separate Low level signals from High Power cables. Please adhere to the following:

- Actuator Feedback and Resolver cables can be in the same tray or conduit.
- If Feedback and Resolver cables are run with other equipment cables, be sure those cables are signal level only. ***No high power Cables.***
- Power Module Cable(s) for Stepper Motor units can be in the same conduit with each other, but must be separate from the Feedback Cable.
- The Power Module cable is considered a High Power cable.
- Motor Power Cable(s) (Servo Motors) must be in their own conduit or tray. **Failure to do so may cause the high frequency of the PWM (Pulse Width Modulated) signal to affect surrounding equipment or actuator operation.**
- Heater/Solenoid Cable can be in the same conduit or tray with other AC signals.

3.4 CONDUIT AND CONDUIT FITTINGS

- Conduit and Conduit fittings suitable for the environment must be used. Failure to do so may cause ingress of contaminants or water into the enclosure.
- A removable gland plate is provided on the bottom of the Control Enclosure. The gland plate can be removed to machine the appropriate conduit openings. Be sure to reattach the gland plate securely with its gasket in place.

- Seal all conduit threads with Locktite 567™ or equivalent to prevent ingress of moisture.
- Be sure fittings are tightened securely.
- Must maintain IP66 for steel, IP67 for stainless and fiberglass electronics enclosures, as well as actuator assembly.

For applications requiring hazardous and explosion proof systems, conduit and conduit fittings must be properly installed to NEC (National Electrical Code) wire standards to meet the area classifications:

- CSA Class I Division 1, Groups C and D; -40C to 65C; T3
- ATEX II 2G EEX 'd' IIB, T3, -40C≤Tamb≤65C.
- Follow the National Electrical Code (NEC) and appropriate Local Codes for installation of Industrial equipment.

Refer to Appendix P for Interconnect Diagram.

WARNING: *The position transmitter used in the REXA CPU is extremely accurate and sensitive. Because of its high sensitivity, directly shorting this circuit with an ammeter can cause damage to the circuit. The load resistance of the DCS needs to be present to protect this circuit from a direct short. Without the load resistance (i.e., using an ammeter), premature failure of the Position Transmitter may occur. Refer to the Troubleshooting and Repair Manual for proper testing procedure.*

4 Mechanical Installation

The **Xpac** can operate any device requiring force and stroke or torque and rotation. These include louvers, dampers, variable speed drives and valves. While the instructions below are primarily focused on valves, they also apply to any device that may be controlled by the **Xpac**.

4.1 PRE-INSTALLATION CHECKLIST

Before installation of the actuator, check for the following:

- Ensure that the equipment was not damaged during shipping.
- Confirm that the electronic sub-assembly number and actuator serial number match.
- Verify that there is sufficient clearance for installation.
- Ensure that interconnect cables are present and are the proper length.
- Make certain that all the necessary equipment, tools and personnel are present for installation.
- Ensure all hydraulic tube fittings are tight.

4.2 R SERIES (ROTARY)

Generally, R Series actuators are shipped with a four bolt mounting pattern and stem connection. REXA can also provide custom mounting components to adapt to the device being controlled. Contact your sales representative for more details.

4.2.1 Rotary Mounting (Fail in Place)

The following operation requires the unit to be in the CLOSED position; If it is not, use the handwheel or manual hydraulic pump. Refer to Appendix M, Manual Operators, for information concerning the Handwheel or Manual Hydraulic Pump. If the unit is not supplied wtih a Handwheel or Manual Hydraulic Pump, the unit must be connected to the electronics and manual operation use to drive it to the CLOSED position. Refer to Manual Mode in section 6.

a) With the actuator separated from its mounting, rotate the driven device to the closed position.

Note: *Be aware that not all bolt patterns are square; refer to layout drawing for reference.*

b) Place the mounting bracket on the driven device.

c) Hand tighten fasteners.

d) Install the shaft coupling if applicable. Confirm the correct position of the shaft key position on both actuator and driven device.

Note: *Be sure to use anti-seize compound on mating surfaces.*

e) Carefully install actuator to the assembly; hand tighten fasteners.

Note: *If a discrepancy exists between mating connections, check orientation of assembly components.*

f) Check alignment of assembly. Ensure that the actuator face and mounting bracket are parallel, with no gaps.

g) Tighten fasteners in a star pattern.

4.2.2 Rotary Mounting (Universal Spring Fail)

The universal rotary spring package is a bolt on addition to the **REXA** R series actuator. The unit may rotate in either a clockwise or counterclockwise direction upon power loss. To complete this feature, a normally open solenoid valve is installed in the power module and usually wired to the input power. Please refer to Product Memo 4, Spring Fail, for additional information.

If the unit has a REXA solenoid valve it will have the toggle lever shown below. Toggling this lever will override the function of the solenoid. If the unit has no power and you need to use the Handwheel, Drill Drive or Manual Hydraulic Pump the lever must be in the solenoid override position as shown in Figure 4.2.2.

CAUTION:
Make sure the toggle lever is returned to its normal position when solenoid power is returned, or the spring fail function will not operate properly.

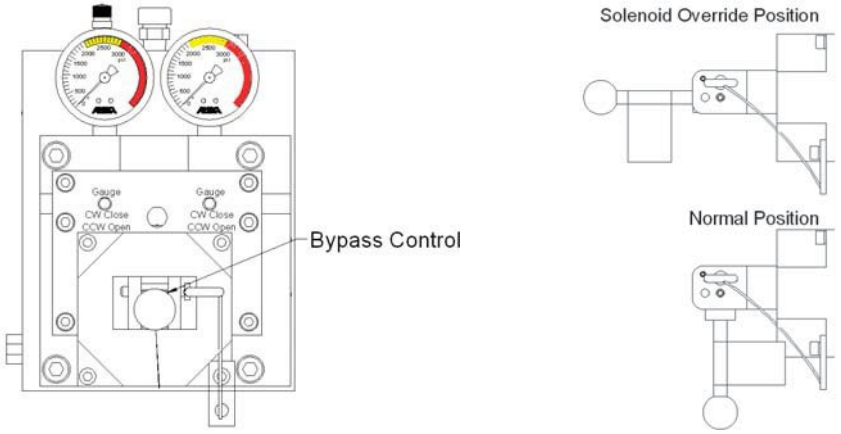


Figure 4.2.2 Solenoid Override Position

The spring package will be pre loaded (compressed) to a specified torque as indicated on the order. The pre loaded torque is set at an angle of 45° to

the spring axis. Installation of the driven device within 5° of this position is acceptable.

Actuators are usually shipped in the FAIL position. Refer to Appendix M, Manual Operators, for information concerning the Handwheel or Manual Hydraulic Pump.

CAUTION!

REXA actuators, denoted by an *E*, *R* or *U* in the model number, contain a spring under tension.

a) With the actuator separated from its mounting, rotate the driven device to the fail position.

Note: *Be aware that not all bolt patterns are square; refer to layout drawing for reference.*

b) Place the mounting bracket on the driven device.

c) Hand tighten fasteners.

d) Install the shaft coupling if applicable. Confirm the correct position of the shaft key position on both actuator and driven device.

Note: *Be sure to use anti-seize compound on mating surfaces.*

e) Carefully install actuator to the assembly; hand tighten fasteners.

Note: *If a discrepancy exists between mating connections, check orientation of assembly components.*

f) Check alignment of assembly. Ensure that the actuator face and mounting bracket are parallel, with no gaps.

g) Tighten fasteners in a star pattern.

4.2.3 Rotary Mounting Accumulator

Fail mode operation uses a piston type accumulator with nitrogen gas on one side of the piston and oil on the other. The accumulator is sized to provide full rated output at end of stroke during fail mode.

The following operation requires the unit to be in the CLOSED position; if it is not, use the handwheel or manual hydraulic pump. Refer to Appendix M, Manual Operators, for information concerning the Handwheel or Manual Hydraulic Pump. If the unit is not supplied with a Handwheel or Manual Hydraulic Pump, the unit must be connected to the electronics and manual operation used to drive it to the CLOSED position. Refer to Manual Mode in section 6.

a) With the actuator separated from its mounting, rotate the driven device to the closed position.

Note: *Be aware that not all bolt patterns are square; refer to layout drawing for reference.*

b) Place the mounting bracket on the driven device.

c) Hand tighten fasteners.

d) Install the shaft coupling if applicable. Confirm the correct position of the shaft key position on both actuator and driven device.

Note: *Be sure to use anti-seize compound on mating surfaces.*

e) Carefully install actuator to the assembly; hand tighten fasteners.

Note: *If a discrepancy exists between mating connections, check orientation of assembly components.*

f) Check alignment of assembly. Ensure that the actuator face and mounting bracket are parallel, with no gaps.

g) Tighten fasteners in a star pattern.

4.3 L SERIES (LINEAR)

REXA L series actuators utilize a sliding stem, piston-style cylinder. Mounting to the driven device is typically done with a bolted yoke assembly. Stem connections will vary by application. Refer to Appendix B for information on Stem Connection & Seat Loading Methods.

4.3.1 Linear Mounting (Fail in Place)

Actuators are usually shipped in the **RETRACTED** position. Refer to Appendix M, Manual Operators, for information concerning the Handwheel or Manual Hydraulic Pump. Refer to Appendix B, Stem Connections and Seat Loading Methods.

CAUTION!
When mounting linear actuators, take care to avoid mechanical misalignment that would cause side-load to the actuator output shaft. Be sure that the driven device is straight and true. Severe side-load will cause excessive wear to both the actuator and driven device.

a) With the actuator separated from its mounting, rotate the driven device to the retracted position.

b) Retract the actuator stem to a position that will allow mounting the actuator without contacting the valve stem. If the optional handwheel is not available, the unit must be connected to the electronics and manual operation used to drive it to the **CLOSED** position. Refer to Manual Mode in section 6.

c) Place the actuator onto the driven device's mating surface and loosely install the mounting hardware.

Note: *Loose set up allows for float and self-alignment.*

d) Extend the actuator stem until the coupling contacts the valve stem.

e) Thread the driven device stem into the coupling for a distance of at least one and one half times the stem diameter and use a lock nut against the coupling to prevent the stem from rotating out.

Note: *There are wrench flats machined on the actuator stem for this purpose. No damage will occur if the actuator stem is rotated.*

f) If the actuator is installed in a vertical position, manually stroke it to allow the stem connection to self-align.

g) Securely tighten the mounting connection. Visually inspect the stem for any noticeable indication of bending.

For all other orientations, support the actuator in a manner that prevents any noticeable indication of stem bending. Securely tighten the mating connection. Manually stroke the actuator and carefully observe the stem for any evidence of lateral (side to side) misalignment.

h) For verification, once the mounting hardware is tight and the actuator is installed, de couple the actuator shaft. If any movement of the actuator shaft can be seen during the process, loosen the mounting hardware, realign the actuator and repeat steps f, g and h.

4.3.2 Linear Mounting (Spring Fail)

The spring fail option for linear actuators consists of a spring mounted underneath the hydraulic cylinder and a normally open solenoid valve installed on top of the power module. The spring can be specified to extend or retract the stem upon power loss. It is not field reversible. The solenoid valve is usually wired to the input power.

If the unit has a REXA solenoid valve it will have the toggle lever shown in Figure 4.3.2. Toggling this lever will override the function of the solenoid. If the unit has no power and you need to use the hand wheel, drill drive or manual hydraulic pump the lever must be in the solenoid override position as shown in Figure 4.3.2. Note that the REXA solenoid valve option is only available for systems with B, C, 1/2D, and D power modules rated for hazardous but non-explosion proof environments.

CAUTION:
Make sure the toggle lever is returned to its normal position when solenoid power is returned, or the spring fail function will not operate properly.

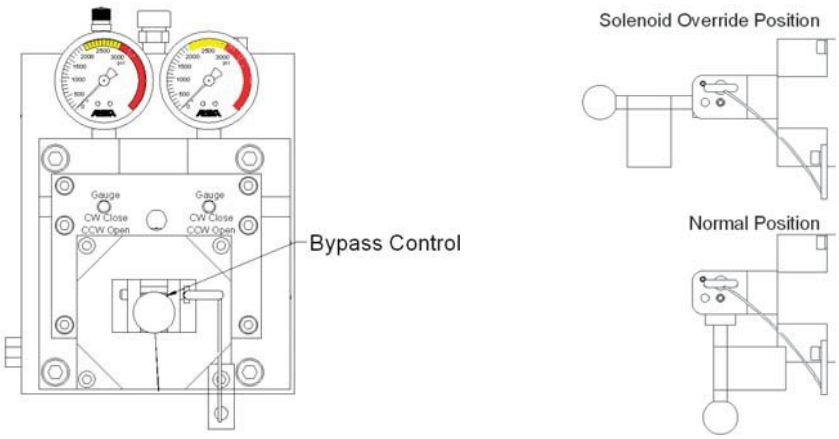


Figure 4.3.2 Solenoid Override Position

CAUTION!
REXA actuators, denoted by an *E*, *R* or *U* in the model number, contain a spring under tension.

4.3.3 Linear Mounting Accumulator

Fail mode operation uses a piston type accumulator with nitrogen gas on one side of the piston and oil on the other. The accumulator is sized to provide full rated output at end of stroke during fail mode.

Actuators are usually shipped in the **RETRACTED** position. Refer to Appendix M, Manual Operators, for information concerning the Handwheel or Manual Hydraulic Pump. Refer to Appendix B, Stem Connection and Seat Loading Methods.

CAUTION!
When mounting linear actuators, take care to avoid mechanical misalignment that would cause side-load to the actuator output shaft. Be sure that the driven device is straight and true. Severe side-load will cause excessive wear to both the actuator and driven device.

a) With the actuator separated from its mounting, rotate the driven device to the retracted position.

b) Retract the actuator stem to a position that will allow mounting the actuator without contacting the valve stem. If the optional handwheel is not available, the unit must be connected to the electronics and manual operation used to drive it to the CLOSED position. Refer to Manual Mode in section 6.

c) Place the actuator onto the driven device's mating surface and loosely install the mounting hardware.

Note: *Loose set up allows for float and self-alignment.*

d) Extend the actuator stem until the coupling contacts the valve stem.

e) Thread the driven device stem into the coupling for a distance of at least one and one half times the stem diameter and use a lock nut against the coupling to prevent the stem from rotating out.

Note: *There are wrench flats machined on the actuator stem for this purpose. No damage will occur if the actuator stem is rotated.*

f) If the actuator is installed in a vertical position, manually stroke it to allow the stem connection to self-align.

g) Securely tighten the mounting connection. Visually inspect the stem for any noticeable indication of bending.

For all other orientations, support the actuator in a manner that prevents any noticeable indication of stem bending. Securely tighten the mating connection. Manually stroke the actuator and carefully observe the stem for any evidence of lateral (side to side) misalignment.

h) For verification, once the mounting hardware is tight and the actuator is installed, de couple the actuator shaft. If any movement of the actuator shaft can be seen during the process, loosen the mounting hardware, realign the actuator and repeat steps f, g and h.

4.4 D SERIES (DRIVE)

By the addition of a rugged L-shaped mounting base, a lateral load bushing and a lever arm, the R series actuator becomes an excellent drive. Applications requiring long strokes or non-axial loaded rotary motion are effectively solved by this unit. Traditionally, a drive-type actuator is used for “DAMPER” control.

4.4.1 Drive Mounting

The base of a **REXA** drive contains a four-hole mounting pattern. These holes have been sized to accept the appropriate diameter bolt for the imposed load. Table 4.4.1 lists the base hole, minimum bolt diameter and recommended bolt torques. Standard bolting or threaded studs are acceptable, but material strength must be an SAE Grade 8. Hardened load washers and lock washers must be used. The Handwheel or Manual Hydraulic Pump is used to position the Drive Arm.

Table 4.4.1 Drive Base Bolting

Model	Hole Diameter	Min. Bolt Diameter	RECOMMENDED Bolt Torque Minimum	Maximum
D2 500/5 000	.56″	½″	20 lb·ft	30 lb·ft
D10 000/20 000	.81″	¾″	200 lb·ft	250 lb·ft
D50 000/100 000	1.00″	1″	650 lb·ft	700 lb·ft

Note: *Bolting to be SAE Grade 8.*

4.4.2 Drive Arm

Connection to the driven device (linkage) is by means of the drive arm. Standard arms are based upon actuator size. Each arm includes multiple connection points. See Figure 4.4.2-1. Custom arms are available upon request.

Figure 4.4.2-1 Drive Arm Assembly Reference Drawing

The connecting link and other linkage should be selected to withstand the maximum load imposed by the drive. This will vary depending upon the effective length of the arm. The following equation should be used to determine the minimum safe working load of the connecting linkage:

$$\text{Load} = \frac{\text{Rated Drive Torque}}{\text{Effective Lever}} \times$$

For most installations, the optimum alignment of the drive arm and the driven (damper) arm is when they are parallel to each other and perpendicular to the connecting linkage at mid-rotation. Refer to Figure 4.4.2-2. This is accomplished by a combination of linkage length and drive arm adjustments. A slotted spline connection between the drive arm and shaft provides multiple mating angles (5°-10° intervals).

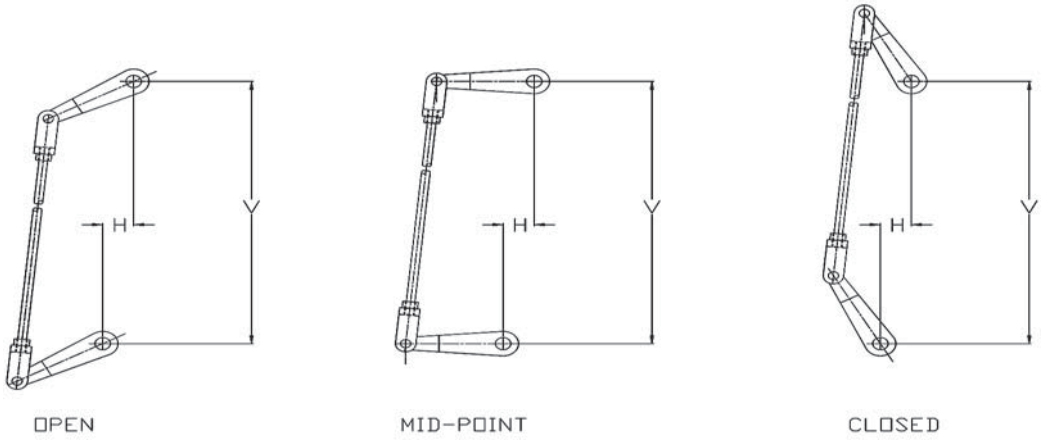


Figure 4.4.2-2 Drive Arm Alignment

5 Start-Up Considerations

5.1 START-UP CHECKLIST

At this time the actuator, electronics sub-assembly and driven device should be installed. Before applying power to the unit and calibrating the actuator the following items should be considered:

5.1.1 Inspection of Electronic Sub-Assembly Installation

Check the following:

- ☐ Inspect incoming voltage connection.
- ☐ Test for correct incoming voltage
- ☐ Control signal connections are secure.
- ☐ Outgoing signals are connected properly.
- ☐ Interconnection cable wiring is correct at electronic sub-assembly, actuator junction boxes and terminal blocks.
- ☐ Feedback cables are connected and shielded properly at actuator/ electronics.

- ☐ All ground wires are secured.
- ☐ All electrical connections are tightened properly.
- ☐ Conduit connections are secure and watertight with thread sealant.
- ☐ Electronics are free of tools and debris.
- ☐ Proper personnel has been notified for lock out/ tag out procedures.

5.1.2 Inspection of Mechanical Actuator Installation

Check the following:

- ☐ Oil level is correct.
- ☐ Motor and feedback wires are connected properly and securely.
- ☐ Actuator mounting fasteners are tight.
- ☐ Coupling/split clamp installed properly.
- ☐ All conduit connections are secure and watertight with thread sealant.
- ☐ All tools and equipment are clear of operating area.
- ☐ Safety related covers and labels are installed and clearly marked.
- ☐ Proper personnel has been notified for lock-out/tag-out procedures.

5.2 ALIGNMENT

Any noticeable bending of the actuator stem or driven device should be immediately corrected. Not only will operation be impaired, but damage to the actuator seals and bushings or driven device may occur. When mounting the actuator to the driven device the actuator shafts and couplings MUST align properly.

5.2.1 Lateral Alignment

Any misalignment needs to be corrected or it will reduce the life of the actuator and cause damage to the driven device.

In most cases, lateral alignment is corrected by stroking the actuator with the mounting or mating connection in a loosened condition. This will allow the connection to self-align. If there is insufficient clearance, then the appropriate bore diameters must be increased.

5.2.2 Longitudinal Alignment

LINEAR

Failure to reach full stroke is caused by a mechanical limitation within the actuator or driven device. Incorrect yoke leg lengths or thread engagement in the stem coupling may reduce the travel. In most cases, the required adjustment is small and can simply be made by changing the length of thread engagement of the stem coupling. Further adjustment can only be made by changing the length of the yoke legs.

If the actuator is installed in a vertical position, manually stroke it to allow the stem connection to self-align. Securely tighten the mounting connection. Visually inspect the stem for any noticeable indication of bending.

For all other orientations, support the actuator in a manner so that there is no noticeable indication of stem bending. Securely tighten the mating connection. Manually stroke the actuator and carefully observe the stem for any evidence of lateral (side to side) misalignment.

ROTARY (<90° Rotation)

Failure to reach the full 90° rotation is usually not binding, but rather an installation problem. With the actuator separated from the driven device, rotate the driven device to the closed position. Move the actuator in the same direction until the end of rotary piston travel is reached. The connections between the driven device and the actuator should be within 2-4 degrees. If a large discrepancy exists between the mating connections, the adapter may be incorrect.

DRIVE

Drive units can create an extraordinary amount of force. Any misalignment of the drive/driven arms, or incorrect linkage arrangements, can cause damage to the actuator or the driven device. All mechanical connections and stroke limits should be set carefully and inspected.

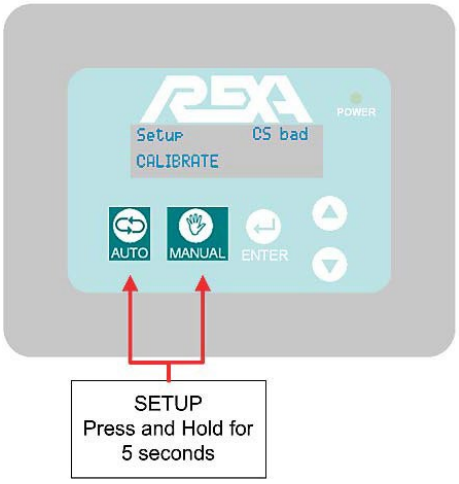
5.3 INITIAL CALIBRATION

Refer to Section 5.4, Rotary and Drive Spring Stops, and Section 5.5, Cylinder End Stops, prior to calibrating rotary or drive units with spring or accumulator fail option.

- Apply AC Power.
  Line 2 will display the CALIBRATE menu header.
- If not already in CALIBRATE, simultaneously press **AUTO**/**MANUAL** for 5 seconds.
- Scroll down to Position Lo with the ▼ arrow.
- Press the **ENTER** (↵) key. = will begin to flash. Value will change to current actuator position.
- Move the actuator with the ▲ or ▼ to the Position that corresponds to 4.0 mA.

Refer to Appendix B, Stem Connection & Seat Loading Methods.

- Press the **ENTER** (↵) key to lock in that value.



CAUTION!
The end point should not be set against a mechanical stop without a spring coupling or damage will occur.

Note: *If the actuator is stroked beyond the factory set cylinder limit, the display will show* **CylEnd** *while the down key is held. If the enter key is pressed, the display will show* **TooLow**. **Position Lo** *will need to be calibrated higher until this warning goes away.*

- Scroll down to **Position Hi** with the ▼ arrow.
- Press the **ENTER** (↵) key to lock in that value.
- Press the **ENTER** (↵) key. **=** will begin to flash. Value will change to current actuator position.
- Move the actuator with the ▲ or ▼ to the Position that corresponds to 20.0 mA.
- Press the **ENTER** (↵) key to lock in that value.

CAUTION!
The end point should not be set against a mechanical stop without a spring coupling or damage will occur.

Note: *If the actuator is stroked beyond the factory set cylinder limit, the display will show* **CylEnd** *while the up key is held. If the enter key is pressed, the display will show* **TooHi**. **Position Hi** *will need to be calibrated lower until this warning goes away.*

- Scroll down to **Signal Lo** with the ▼ arrow.
- Press the **ENTER** (↵) key. **=** will begin to flash.
- Apply the actual 4.0 mA Control Signal from the DCS. The value in the display will change; showing what is being read from the DCS.
- Press the **ENTER** (↵) key to lock in that value.
- Scroll down to **Signal Hi** with the ▼ arrow.
- Press the **ENTER** (↵) key. **=** will begin to flash.
- Apply the actual 20.0 mA Control Signal from the DCS. The value in the display will change; showing what is being read from the DCS.

The Actuator has now been calibrated. It is recommended at this point that all Current Status be reset to 0. Refer to Current Status menu section for procedure.

To enter the **Auto** mode:

- Simultaneously press **Auto** (↺) and **ENTER** (↵).
  Line 1 of the display will change to **Auto** followed by the **Current Status**.
  Line 2 will be blank.

- When the keys are released
  Line 2 will display the current **Position**.

5.4 ROTARY AND DRIVE SPRING STOPS

Spring stops provide the actuator the means to prevent over-travel during a fail safe condition. If the driven device does not limit over-rotation or over-travel, spring stops can be utilized for this purpose by turning the spring stop adjustment screw in or out to modify the actuator's final fail position.

To install a Spring Fail unit, position the spring lever to the 45° location by extending the spring stop as shown in Figure 5.4. Rotate the driven device to the required failure position. Adjust the spring stop to allow mating of the shafts and alignment of the mounting bolts.

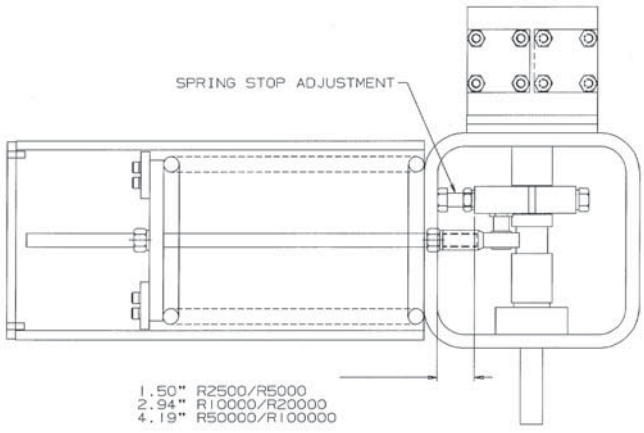


Figure 5.4 Universal Spring Alignment

Once mounted, the spring stops should be adjusted to a position that transfers torque onto the driven device at the fail position.

5.5 CYLINDER END STOPS

Cylinder end stops provide the actuator the means to prevent over-travel during a fail safe condition. If the driven device does not limit over-rotation or over-travel, cylinder end stops can be utilized for this purpose. These stroke adjusters can reduce cylinder rotation 0–5 degrees.

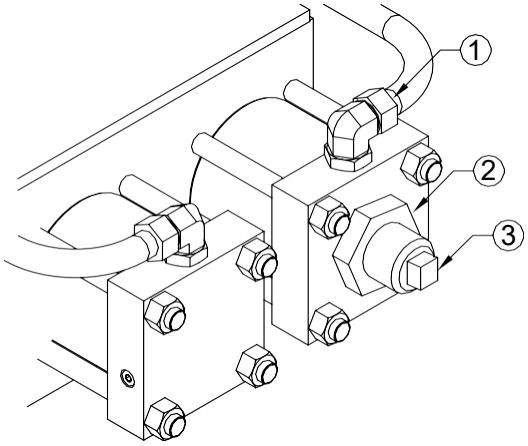


Figure 5.5 Stroke Adjustment

CAUTION!
Ensure that there is no hydraulic pressure in the system prior to cracking any hydraulic lines. All pressure gauges should read 0 psi.

Note: *Each actuator is tested and shipped from the factory with the thread seal and jam nut lightly torqued—enough to seal during factory acceptance testing. This procedure assures that the sealing rubber is undamaged and will properly seal once the stroke adjustor is fully adjusted in the field by the end user, and the threaded elements are firmly tightened to full torque.*

5.5.1 End Stop Adjustment

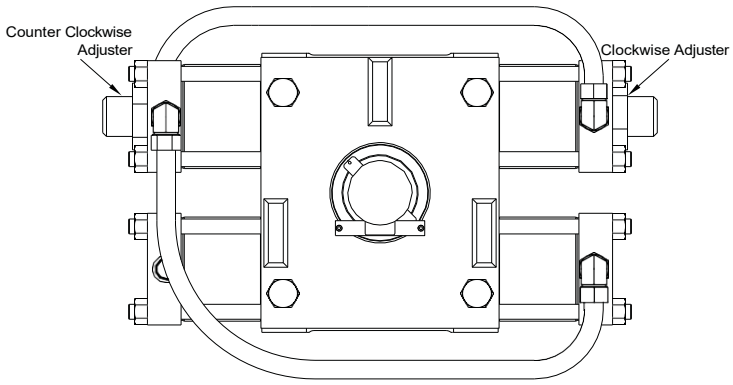


Figure 5.5.1-1 Cylinder End Stops

WARNING:
The Calibrated end points PL and PH must not be set with the actuator against the cylinder end stop.

1. Position the actuator in the desired final fail position slightly beyond the calibrated end stop. This can be done when calibrating PL and PH.

Note: *Failure to follow this step will lead to a potential situation where the electronics may try to drive the actuator beyond its physical limit, and a stall condition will result.*

2. Turn off the power breaker in the electronics.
3. Locate the correct stroke adjuster (refer to Figure 5.5.1-1).
4. Locate the hydraulic fitting (1) connected directly to the stroke adjuster cylinder cap as shown in Figure 5.5. Loosen this fitting to allow oil to escape during this adjustment process.
5. Loosen the jam nut (Figure 5.5.1-2) by turning counterclockwise. Back off this jam nut 4 to 5 turns and move the countersunk washer away from the thread seal and against the repositioned jam nut.

6. Using light oil and a small brush or squirt can, generously lubricate the thread seal rubber and the threads of the adjustment screw.

7. Carefully pry the thread seal washer away from the end cap and then pull and twist it back and forth to carefully slide it along the adjustment screw threads to gain adjustment clearance.

8. The actuator stroke adjustment can now be made using the threaded adjustment rod. This rod has a hollow hex in the end to allow easy adjustment.

WARNING:
As the stroke adjusters are turned in, fluid will be displaced and need to leak out of the system. Failure to exhaust fluid will damage internal components of the actuator.

9. The actuator is shipped from the factory with this adjustment rod threaded fully out to the end of travel to give the full rotation of the actuator. The adjustment screw can only be rotated clockwise (inward) from this shipped position.

Caution: *A mechanical lock at the end of the threads restricts inadvertent disassembly outward. Rotating the adjustment screw counterclockwise (outward) from this end position may cause damage to the hardware.*

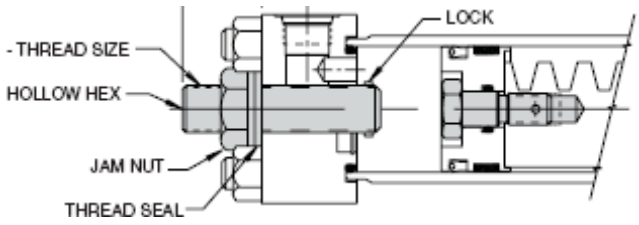


Figure 5.5.1-2 End Stop Detail

10. Use an allen wrench drive inserted into the hollow hex adjustment screw end to adjust the stroke adjustor. Rotate clockwise to decrease the stroke of the actuator. Each stroke adjustor provides a minimum of 5 degrees of actuator rotation adjustment.

11. The number of adjustment screw rotations needed to achieve the 5 degree rotational adjustment of the actuator depends on the size (model) of the actuator and the pitch of the adjustment thread on the adjustment screw. The Table 5.5.1 shows this relationship.

12. After final positioning of the adjustment screw to achieve the desired actuator rotation, readjust the position of the thread seal along the adjustment screw threads to contact the end cap. Caution: use generous lubrication during this step to assure no damage to the rubber seal by the threads.

13. Reposition the countersunk washer and the jam nut and torque the jam nut to the requirements of the Table 5.5.1.

14. Tighten the hydraulic fitting that was loosened in step 4.

Table 5.5.1 Stroke Adjustor

Model	One Turn Adjustment (degrees)	Jam Nut Final Torque (lb·ft)
R2 500/R5 000	3.3	50
R10 000/R20 000	2.0	150
R50 000/R100 000	2.0	300
R200 000/R400 000	1.2	375

5.5.2 R200 000/R400 000 End Stroke Adjustments

R200 000/R400 000 actuators do not use an external thread seal arrangement. The seal is contained internally while the jam nut and adjustment screw drive is located externally. Refer to Figure 5.5.2. An external drive square is provided on the adjustment screw end and can be driven by using a standard wrench. No special lubrication of the threads is needed during adjustment.

The unit is shipped from the factory with the stroke adjustor positioned at the full outward position as described above. Adjustment is made by disconnecting the hydraulic line to vent out any displaced fluid, loosening the jam nut several turns counter clockwise and then using the square drive to position the adjustor

to provide the desired actuator stop position. The total adjustment range is 5 degrees minimum. Table 5.5.1 shows the adjustment achieved from one turn of the adjustor.

The jam nut is repositioned after adjustment is complete and torqued to the final tightness value specified.

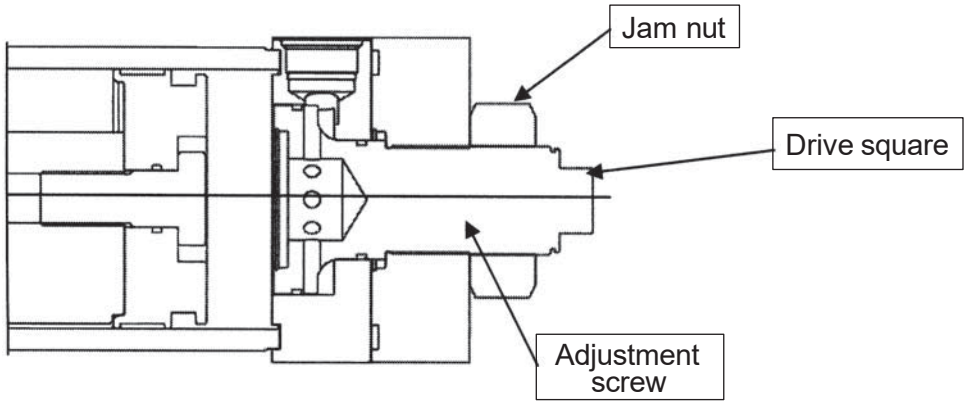


Figure 5.5.2 R200 000/R400 000 Stroke Adjuster

6 Modes of Operation & Control Parameters

The user interface is a 2-line, 20 character/line vacuum fluorescent emissive display with a membrane keypad. The display may suffer phosphor burnout if a static display is left on for a long period of time. To avoid this, the display is dimmed after one hour of no keypad usage. The display may be turned back on by pressing any key. If, while in Auto or Local Manual mode, an alarm condition is detected, the entire display will blink on and off until acknowledged by an operator pressing any key.

The electronics can be put into 3 different modes of operation. They are:

- Setup
- Automatic (Auto)
- Manual (Local Man, RemoteMan)

Each mode can be entered as shown in Figure 6:

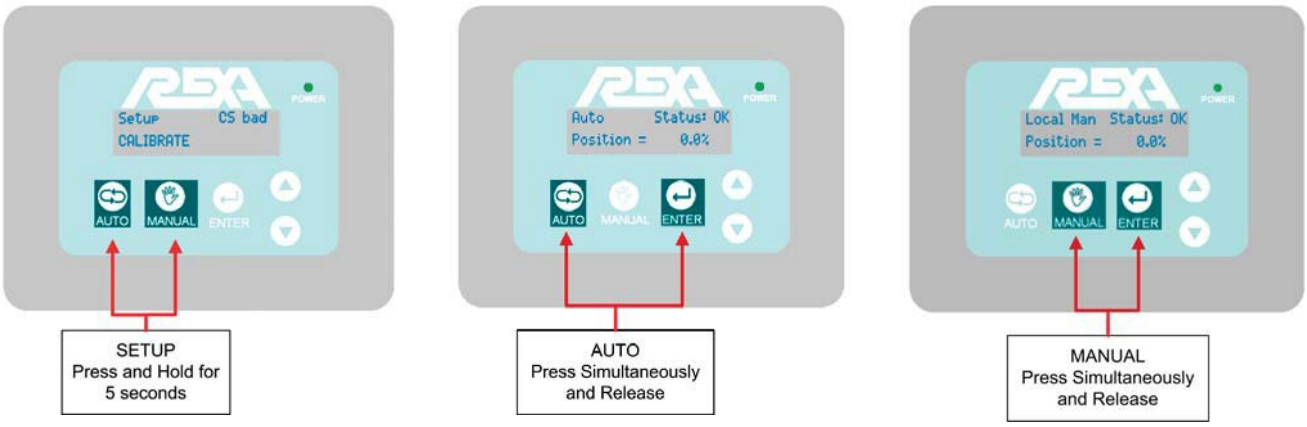


Figure 6 Modes of Operation

6.1 SETUP MODE

The Setup mode is the means of setting the control parameters of the actuator such as actuator span, speed, etc. Most parameters are factory set and provide excellent actuator performance. However, some applications may require fine tuning of the actuator.

The eight menus and accompanying control parameters are covered in the following sections. To access and change the Control Parameters (See Figure 6.1.1), the electronics must be in the Setup mode.

Password protection of the Setup mode is optional. The default value of 0000 indicates no password is required. If any other value is set as the password, the user will be prompted to enter it prior to entering the Setup mode.

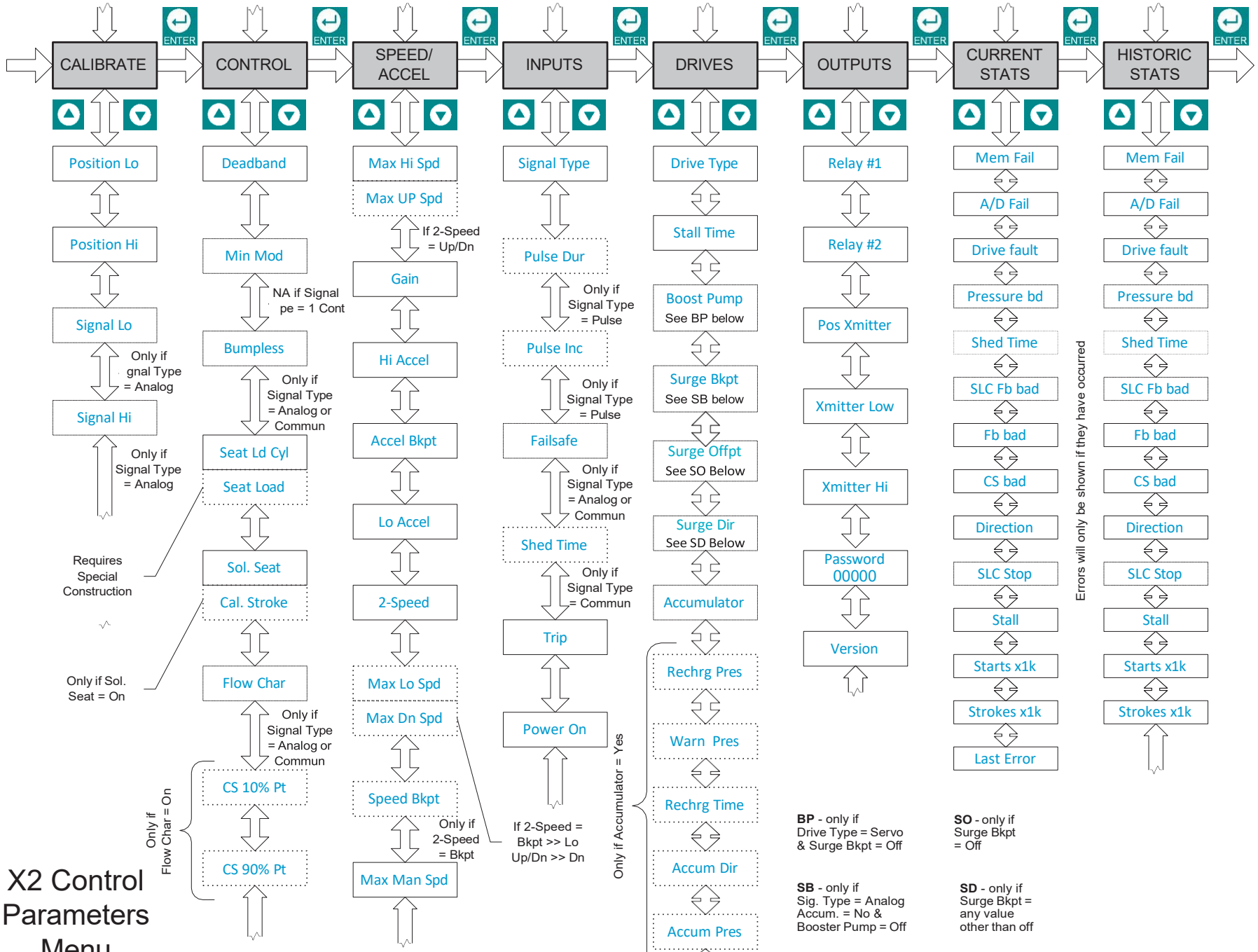
6.1.1 Menu Navigation

To get the electronics in Setup mode, simultaneously press **AUTO** (⟲) and **MANUAL** (✋) for 5 seconds.

Note: *The actuator will no longer follow a control signal when in setup mode.*

To scroll from column to column, you must have the column header in the display and press **ENTER** (↵). This will scroll from left to right and then repeat.

To scroll up and down a column, use the ▲ and ▼ arrows.



X2 Control Parameters Menu

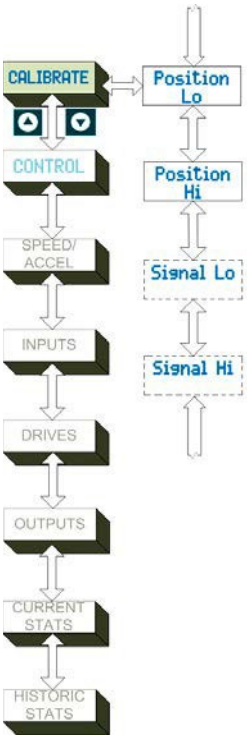
Figure ***6.1.1 Control Parameter Menus***

6.1.2 Changing a Parameter

To access and change a parameter, the Parameter ID must be visible on the display, i.e. Position Lo. Pressing the ↵ button will cause the "=" sign to blink. The parameter is now accessible to change. Use the ▲ and ▼ arrows to change the value of the parameter. To accept the new value, press the ↵ button. The "=" sign will stop flashing. When a value is entered for any parameter, **updating** is briefly displayed.

Pressing the ▲ or ▼ arrow in parameters **Position Lo** and **Position Hi** will cause the Actuator to move.

Parameters **Signal Lo** and **Signal Hi** cannot be changed by pressing the arrows. An active 4-20 mA signal must be applied. The actual signal in milliamperes will be displayed.



6.1.3 CALIBRATE Menu

The **CALIBRATE** menu consists of the following parameters:

Note: *When changing Position Lo and Position Hi, the actuator will move.*

Position Lo defines the actuator position corresponding to Signal Lo setting. When Signal type is set to Contact Inputs, Position Lo defines the actuator position corresponding to the Close Input.

Note: *The span between Position Lo and Position Hi must be greater than 10%.*

Position Hi defines the actuator position corresponding to the Signal Hi setting. If the Signal type is set to Contact Inputs, Position Hi defines the actuator position corresponding to Open Input.

Note: *If a value for Position Lo is entered that is within 10.0% of the current value of Position Hi, the value is accepted, and parameter Position Hi is displayed. If the display shows the = blinking, it is ready to be set to a value more than 10.0% different than Position Lo. The menu will alternate between Position Lo and Position Hi until a span greater than 10% is achieved. Similar action occurs when setting Position Hi. While uncommon, if Driver Type (see Drives Menu) does not match the actuator, a continuous loop between Position Hi and Position Lo will occur.*

Signal Lo is the Input Signal, typically 4 mA, that corresponds to Position Lo.

Signal Hi is the Input Signal, typically 20 mA, that corresponds to Position Hi.

Signal Lo and Signal Hi are only visible in the menu if Signal Type = Analog.

Range: **0.0** to **25.0** mA

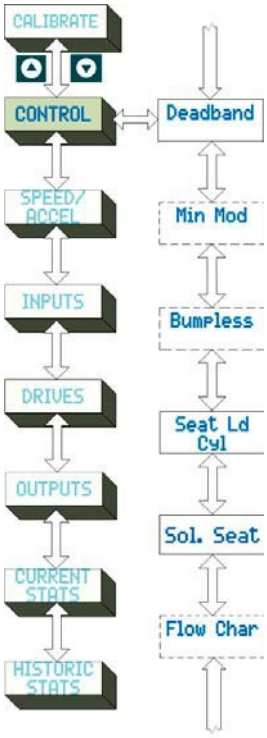
Note: **Unknwn** *appears if control signal failure occurs while calibrating.*
Error *appears, briefly, if an unacceptable value is entered. The unacceptable value* is rejected and the previous value is retained.

Note: *If Failsafe 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 INPUTS menu.*

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

Refer to INPUTS menu for Failsafe information.

Refer to section Initial Calibration (Start-Up Considerations) for additional information on Position Lo, Position Hi, Signal Lo and Signal Hi settings.



6.1.4 CONTROL Menu

The **CONTROL** menu provides the following:

Deadband sets the maximum deviation allowed between Input Signal and current position before actuator movement in Auto mode.

Units: **%** of calibrated stroke

Range: **0.05** to **5.00** % of calibrated stroke`

The deadband should not be set any smaller than the process requires. Check to ensure the actuator is not reacting to noise in the control signal, but to actual signal changes.

Min Mod {Minimum Modulating} defines a set-point in the actuator stroke below which the actuator will not modulate. Min Mod sets the upper limit of a no-modulating band with respect to Position Lo. This may be used to minimize seat wear.

Not in menu if parameter Signal Type = 1 Cont.

Operational in both Auto and Local Man/RemoteMan

Units: **%** of calibrated stroke (Refer to INPUTS Menu.)

Range: **Off** or **0.1** to **99.9** % of calibrated stroke

Bumpless {Bumpless Transfer} sets the total time the actuator takes to travel from its current position to a new target control position when the actuator is switched from either **Manual** or **Setup** into **Auto.** This feature is designed as a safeguard in the event the control signal was changed while the actuator was not in **Auto** mode. When the unit is switched into **Auto** and the **Bumpless** parameter is On, the actuator seeks the new target position

at less than normal speed. The actuator will take 100 small steps to reach the new target position in the time set as the bumpless parameter. A delay will be defined between each step until the actuator reaches the new target position.

This feature only appears in the menu if the incoming control signal parameter **Signal Type** is set to **Analog** or **Commun**.

- If Bumpless is set to any value other than Off when the actuator is switched to Auto and the deviation between the incoming control signal and the actuator's current position is LESS than ten times the dead band parameter, the operation of the actuator is the same as **Bumpless** = Off.

- If Bumpless is set to any value other than Off when the actuator is switched to Auto and the current deviation between the incoming control signal and the actuator's current position is GREATER than ten times the dead band parameter, the operation of the actuator is to:

  Divide the **Bumpless** time parameter by 100 to define the time interval between actuator steps. These steps are how the actuator will track to its new control position.

  Divide the deviation between the current actuators position and the new control signal position by 100. This defines the size of each step.

Once the actuator reaches the control signal set point the actuator will resume normal operation.

Only in menu if Signal Type=Analog and Accumulator=No, and Booster Pump= No.

See INPUTS and DRIVES menus.

Units: Seconds

Range: **Off** or, from **10** to **990** seconds

Seat Ld Cyl {Seat Load Cylinder}: Specifies whether or not the actuator employs a seat load cylinder. This yes or no option is set at the factory.

Refer to Appendix B, Stem Connection & Seat Loading Methods, for additional information.

Seat Load {Seat Load Switching}: Specifies that the actuator does not employ a seat load cylinder (Off) or that a seat load cylinder is employed and the value entered is the transition point at which the seat load cylinder is engaged/disengaged via solenoid action.

Sol. Seat {Solenoid Seating}: Uses software to allow the stored energy of a failsafe actuator to provide the seating force. Can only be used on linear failsafe actuators where the fail direction is the same as the seating direction. Replaces the elastic coupling and seat load cylinder for these applications.

Cal. Stroke {Calibrated Stroke}: When Sol. Seat = On, **Cal. Stroke** can be set from **.3"** to **99.9"** in 0.1 inch increments.

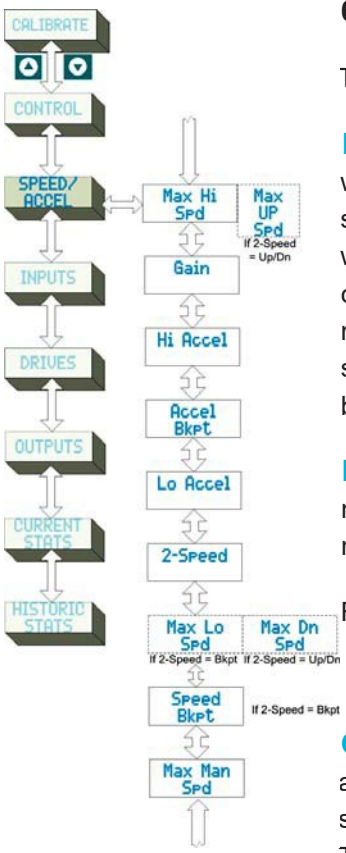
Flow Char {Flow Characterization}: The actuator is designed to have a linear relationship between Control Signal and stroke (10% CS, 10% stroke, etc.) The ability to modify this characteristic can assist in loop tuning or linearization of a control scheme. Changing this actuator characteristic can have a profound effect on the behavior of the control loop and should only be undertaken wtih a thorough understanding of the effect. The stroke position can be modified at 10% control signal intervals. The only restriction is that each stroke position must be at least 2.5% from its neighbors.

CS 10% Pt thru **CS 90% Pt** {Control Signal 10% Point thru Control Signal 90% Point): When Flow Char= On, parameters CS 10% Pt thru CS 90% Pt are added to the CONTROL menu. Each of these 9 parameters specifies the desired actuator position when the Analog control signal is equal to the corresponding point. Operation between Setpoints is linear.

Units: **%** of calibrated stroke

Range: CS 10% Pt: **2.5** to CS 90% Pt **97.5**
Each calibrated stroke must be at elast 2.5% distant from the adjacent position.

Ex.; If CS 10% Pt= 2.5 when a 10% Control Signal is applied, the actuator will travel 2.5% of calibrated stroke.



6.1.5 SPEED/ACCEL Menu

The **SPEED/ACCEL** menu displays the following:

Max Hi Spd {Maximum High Speed} specifies the maximum motor speed when operating in the Auto mode when 2-Speed is set to Off or to Bkpt. This speed parameter will go above 100%, but the output of a stepper module will be reduced if setting it beyond this value. The motor may run into stall conditions. Conversely, turning the speed down below 100% will allow the motor to make more torque if a stalling condition exists. When running a stepper module near the low temperature specification the speed may need to be lowered to avoid occasional stalls

Max Up Spd {Maximum Up Speed} is in the menu when operating in Auto mode when 2-Speed is set to Up/Dn. Max Up Spd specifies the maximum motor speed when moving from Position Lo toward Position Hi.

Range: 5 to 125 % of actual motor speed, but no greater than Max Hi Spd.

Gain: In the Auto mode Gain is used to determine how motor speed is adjusted as the actuator approaches the target position. The higher the Gain setting, the closer the actuator will get to the target position before decelerating. The lower the Gain setting, the further away the actuator will be from the target position when it begins to decelerate. This value is typically factory set; however, it may be changed should the application warrant it.

Range: 1 to 250

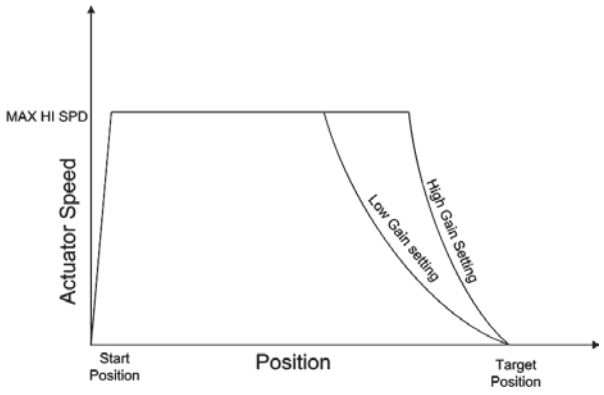


Figure 6.1.5 Gain

Hi Accel {High Acceleration}:
Drive Type = Step

Hi Accel defines the rate at which the motor speed will be increased or decreased until maximum speed is achieved for all modes of operation. It may be replaced by Lo Accel if dual acceleration is used in combination with Gain to define the rate of motor speed decrease until it reaches the target position.

Hi Accel allows the actuator to use two separate acceleration rates. If the actuator is to make a large move, increase the acceleration rate to get to the new Setpoint as quickly as possible. If the actuator is modulating and requires small step changes, a slower acceleration eliminates overshoot. The acceleration breakpoint allows the value for Hi Accel for changes in Setpoint that are greater than Accel Bkpt and Lo Accel for changes in Setpoint that are less than Accel Bkpt value. Acceleration Breakpoint defines the maximum deviation for which Lo Accel is used in place of Hi Accel. Set Hi Accel for large changes and Lo Accel for small changes.

Hi Accel {High Acceleration}:
Drive Type = Servo

Hi Accel defines the rate at which motor speed will be increased until maximum motor speed is reached for all modes of manual stroking.

(Manual stroking = Local Man, RemoteMan, and when setting Position Lo/Hi in Setup mode.)

Range: **Lo Accel** to **99** (Can NOT be set below value set in Lo Accel)

Accel Bkpt {Acceleration Breakpoint} defines maximum deviation for which Lo Accel is used in place of Hi Accel.

> ***Note:*** *If deviation between signal and position is < or = to Accel Bkpt, Lo Accel is used in place of Hi Accel.*
>
> ***Note:*** *If deviation between signal and position is > than Accel Bkpt, only Hi Accel is used.*

Range: **0.1** to **5.0**

Note: *If Lo Accel = Hi Accel or if Accel Bkpt = 0.1, dual acceleration is nullified.*

Lo Accel {Low Acceleration} defines an optional low rate of acceleration for small deviations (< Accel Bkpt) in Auto mode.

Range: **1** to **Hi Accel** (Can NOT be set above value set in Hi Accel)

2-Speed defines status of optional two speed operation.

Select: **Off, Up/Dn** or **Bkpt**

Default: Off

When **2-Speed = Off, Max Hi Spd** specifies maximum motor speed when operating in Auto.

When **2-Speed = Up/Dn, Max Dn Spd** defines motor speed as unit moves toward parameter Position Lo. **Max Hi Spd** is changed to **Max Up Spd** and defines motor speed as unit moves toward parameter Position Hi.

Note*: When operating in Auto, Local Man, or RemoteMan and traveling toward the position specified by parameter Position Hi, Max Up Spd sets the speed limit.*

Note*: When operating in Auto, Local Man, or RemoteMan and traveling toward the position specified by parameter Position Lo, Max Dn Spd sets the speed limit.*

Note*: When operating in Setup, Max Man Spd sets the speed limit.*

When **2-Speed = Bkpt, Max Lo Spd** and **Speed Bkpt** are added to the menu.

Note*: Max Hi Spd defines motor speed between Spd Bkpt and Position Hi*

Note: *Max Lo Spd {Maximum Low Speed} defines maximum low speed between Spd Bkpt and Position Lo.*

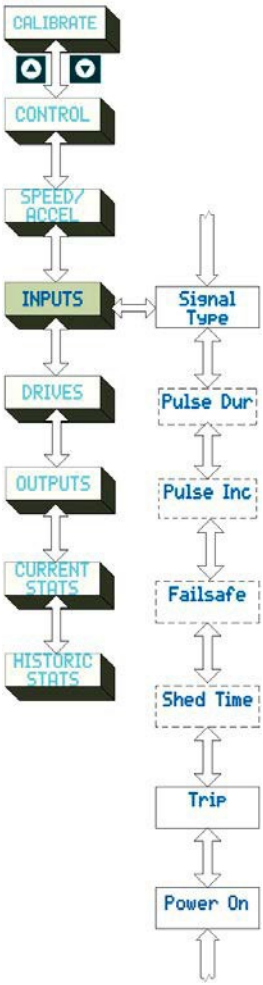
***Note**: Speed Bkpt {Speed Breakpoint}: Provides a speed transition point.*

Range: **0.1** to **99.9**

Max Man Spd {Maximum Manual Speed} defines the maximum motor speed when operating in Setup. Sets the maximum motor speed when operating in Local Man or RemoteMan *only* if 2-speed = Off.

Range: **5** to **125** (but no greater than Max Hi Spd)

Default: **80**



6.1.6 INPUTS Menu

The **INPUTS** menu consists of the following parameters:

Signal Type: Selects the main control signal(s) for the Auto mode. Allows the user to define the type of control signal being sent to the actuator.

Select **Analog**, **1 Cont**, **2 Cont**, **Pulse**, or **Commun**.

> ***Note:*** *1 Cont, 2 Cont and Pulse are only included in the Inputs menu if Contact/ Pulse Inputs Board is installed. Refer to Appendix E, Pulse Operating System, and Appendix Q, Contact Input Options, for additional information.*

When **Signal Type = Analog**, the main control signal is the 4-20 mA analog input. This selection provides the full modulating capability of the actuator.

When **Signal Type = 1 Cont** (one contact), "two position" operation—open/closed position—is selected. The applied signal defines actuator position. If the Open input is active (powered), the actuator goes to Position Hi. If the Open input is not active (un-powered), the actuator goes to Position Lo.

When **Signal Type = 2 Cont** (two contacts), "manual modulation" operation is selected. The main input signals are the Main contacts Open and Close inputs of the Contact Input Board. If both inputs are active or inactive, the actuator remains in its current position. If only the Open input is active, the actuator travels towards Position Hi. If only input Close is active, the actuator travels towards Position Lo.

> ***Note:*** *Actuator will continue to move in desired direction as long as a signal is present or until target is reached.*

When **Signal Type = Pulse,** "pulse" operation is selected.

Pulse Dur {Pulse Duration} sets the minimum time that the Pulse Input must remain active in order to be recognized as a valid signal. A continuous signal may be measured as multiple pulses.

Ex.; With pulse Duration set at 50 milliseconds, a 100 millisecond pulse equals two pulses.

Units: **ms** (milliseconds)

Range: **10** to **999** milliseconds

Pulse Inc {Pulse Increment} sets the amount of actuator travel for each valid pulse received. It only appears in menu if Signal Type= Pulse

Range: **0.1** to **5.0** % of calibrated stroke

The input signals are the Main Contacts Open and Close inputs of the Contact Input Board. If only input Open is active and meets the requirements of Pulse Dur, the value set in Pulse Inc is added to (direct acting) or subtracted from (reverse acting) the current position to become the new target position. The actuator then seeks this new position. If only input Close is active and meets the requirements of Pulse Dur, the value set in Pulse Inc is subtracted from (direct acting) or added to (reverse acting) the current position to become the new target position. The actuator then seeks this new position. If both inputs are active or inactive, the actuator holds its current position.

Pulse input has the ability to control the actuator by an Open or Close pulse signal. Each Input signal must meet the minimum pulse duration. For a period of time it will be recorded as a number of pulses based on defined pulse duration.

Target position can be adjusted based on the number of pulses and defined pulse increments. The motor will then move in desired direction until new target position has been reached.

When **Signal Type = Commun,** the full modulating capability of the actuator is also provided. However, the controlling signal is the Setpoint Parameter which may be written via one of the communication interfaces(HART or Foundation Field Bus™).

> ***Note:*** *When set to Commun, parameters Failsafe and Shed Time are added to this menu.*

Failsafe 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.

0% to **100%**: Actuator goes from 0% to % set.

Off: Used for zero based control signal, i.e., 0-20 mA. "Off" will appear above a setting of 100%.

Default: Inplac.

Note: *Local and Remote Manual will override the Failsafe position.*

Shed Time specifies the maximum amount of time allowed between writes to parameter Setpoint before the action specified in parameter Failsafe is taken. When set to OFF, no action is taken.

Only in menu if **Signal Type = Commun**

Trip parameter defines the active state of the AUX CLOSE input on the Contacts Inputs Board. This secondary input is used to override the main input to cause actuator movement with the aid of a solenoid/spring package or with an accumulator. This Failsafe position is factory configured to either calibrated end, but not to both, and is not field reversible.

When **Trip = Off**, trip function is not used

When **Trip = Unpwrd**, and AUX CLOSE input is NOT powered, go to end point (Trip = Logic ø)

When **Trip = Pwrd**, and AUX CLOSE input is powered, go to end point (Trip = Logic I)

Note: *Trip = Unpwrd/Trip = Pwrd is only selectable if Contact Inputs Board is installed.*

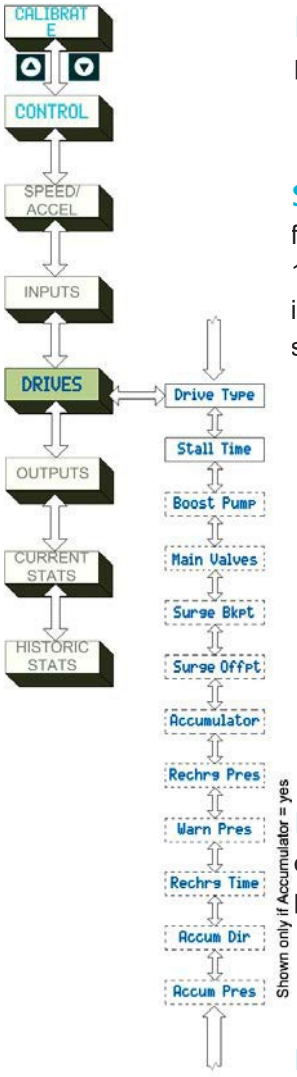
Power On parameter defines the mode the Control Enclosure will be in when Main Power is applied.

When **Power On = Last**, (the default), on power up or reset, the actuator will return to its previous operating mode (Auto, Local or Setup).

When **Power On = Local**, on power up or reset, if the previous mode was Auto, the actuator will enter Local mode instead.

6.1.7 DRIVES Menu

The DRIVES menu consists the following parameters:



Drive Type defines the type of motor, stepper or servo, provided with the power module(s) and is factory set to **Step** or **Servo**.

Stall Time defines the maximum time, **1** to **50 Sec** (seconds), allowed for the actuator to travel 1% of calibrated stroke before a stall is assumed. If 1% travel is not detected in the time set, the motor drive is stopped, the drive is reset and a restart attempted. A maximum of five retries are allowed before a stall error (alarmed) is declared.

Note: *Stall Time also sets the point at which the Booster Pump will turn off.*

Note: *If Stall Time = 1-5 seconds, the Booster Pump will turn off 2.5% away from the target position.*

Note: *If Stall Time = 6 -10 seconds, the Booster Pump will turn off 1.0% away from the target position.*

Note: *If Stall Time > 10 seconds, the Booster Pump will turn off 0.5% away from the target position.*

Boost Pump: {Booster Pump Breakpoint} defines the minimum deviation, **5.0** to **99.9%** of calibrated stroke or **Off,** between current position and Control Signal for the booster pump to turn on.

Note: *Only in menu if* ***Drive Type = Servo****, and* ***Surge Bkpt = Off****.*

Note*: If no Boost Pump,* ***Boost Pump = Off***

Main Valves sets the maximum deviation allowed before the main valves are opened. This is a special parameter; used only with actuators which use an accumulator for all motive force (no power module).

***Note**: The main valve off point is set by parameter Stall Time.*

***Note**: Main Valves is only visible in the Drives menu if Foundation field bus is installed. Requires special construction.*

Surge Bkpt {Surge Breakpoint} defines in **%** calibrated stroke the minimum deviation between the current position and the new target set by the incoming Control signal, required to operate the surge solenoid. When the deviation exceeds the setting, the Surge Relay output is activated and kept active until the current position matches the current control signal. The Surge Relay controls a solenoid valve allowing the actuator to travel quickly in the surge direction when activated.

Only in menu if Signal Type = Analog, Accumulator = No and Booster Pump = No.

***Note:** Surge Bkpt is only included in the SPEED/ACCEL menu if Contact/ Pulse Inputs Board is installed.*

Refer to Appendix G, Surge Control Option, for additional information.

Surge Offpt{Surge Offpoint} will only appear in the DRIVES manu when the **Surge Bkpt** has a value other than off. **Surge Offpt** is defined in percentage of calibrated stroke. This percentage will define a distance the actuator will be away from its new target position when it changes the state of the surge solenoid during a surge event. On system with high speed trips this will allow the controller to change states of the solenoid to anticipate hitting the new target position and eliminate overshoot during a surge event. With **Surge Offpt** set to off the actuator will command the surge solenoid to change state when it reaches its new target position during a surge event. This will result in some overshoot of the new position as the actuator will continue to travel while the solenoid changes states. **Surge Offpt** has a settable range of 0% to Surge On pt.

Surge Dir {Surge Direction} is displayed whenever **Surge Bkpt** is set to any value other than off. **Surge Dir** is settable to either “To PL’’ or “To Ph” which specifies the direction of action.

Accumulator defines whether or not an accumulator system is present, Accumulator action is controlled by parameter Trip; refer to INPUTS menu. Factory set to **Yes** or **No.**

If **Accumulator = Yes,** he following 5 parameters are in the menu.

Rechrg Pres {Recharge Pressure} adjusts the pressure level at which an accumulator recharge cycle ends. Factory set in **#** (psi), from **Warn Pres + 100** up to **Warn Pres + 3000** psi.

Warn Pres {Warning Pressure} adjusts the pressure at which an accumulator low pressure warning is issued. Factory set from **1000** psi up to **Rechrg Pres - 100** psi.

> ***Note**: The Warning relay deactivates and the status display will indicate* **Pres Low** when the accumulator pressure drops below the value set in **Warn Pres.**

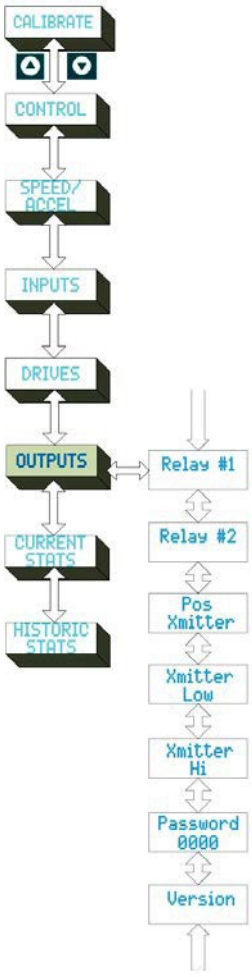
Rechrg Time {Recharge Time} adjusts the maximum time allowed for a recharge cycle to complete. A recharge cycle ends when either the **Rechrg Pres** setting is reached or the **Rechrg Time** expires. In either case, the actuator resumes tracking the control signal. Recharge Time is factory set.

Accum Dir {Accumulator Direction} defines the direction the accumulator will cause the actuator to travel during a Trip. This parameter is factory set based on information provided. This parameter is necessary to inform the CPU as to which direction, **Pos Lo** (Position lo) or **Pos Hi** (Position Hi), to operate the motor during a recharge cycle after a Trip.

Accum Pres {Accumulator Pressure}: This parameter cannot be set. It is the “live” pressure reading from the accumulator pressure transducer.

Units: **#** (psi)

Range: **0** to **3000**
Unknwn if “pressure bad” error



6.1.8 OUTPUTS Menu

The OUTPUTS menu consists of the following parameters:

Relay #1
Relay #2
Pos Xmitter
Xmitter Low
Xmitter Hi
Password
Version

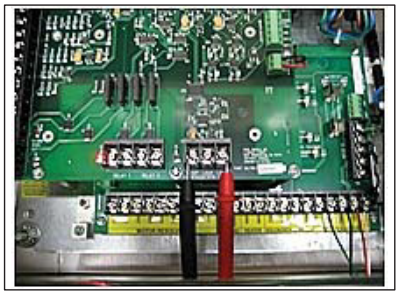
Relay #1 defines the point in % of calibrated stroke at which relay output 1 is active. The relay will be active when the actuator position is = or < the value set in **Relay #1**

Relay #2 defines the point in % of calibrated stroke at which relay output 2 is active. The relay will be active when the actuator position is = or > the value set in Relay #2

Pos Xmitter {Position Transmitter} defines the action of the position transmitter output as being direct acting, **Dir** or reverse acting, **Rev.**
When set to direct acting, a 4 mA output corresponds to Position Lo.
When set to reverse acting, a 4 mA output corresponds to Position Hi.

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

To calibrate the 4mA Zero, Set a digital multi-meter, DMM, to read milliamps (mA) DC. Connect the DMM to the Position Transmitter Output on the CPU. Connect the Red lead of the DMM to the LOOP OUT terminal. Connect the black lead of the DMM to LOOP INT RTN 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 and will increment or decrement 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 actuators 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.*

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, Set a digital multi-meter, DMM, to read milliamps (mA) DC. Connect the DMM to the Position Transmitter Output on the CPU. Connect the Red lead of the DMM to the LOOP OUT terminal. Connect the black lead of the DMM to LOOP INT RTN 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 increment or decrement the current output by one micro-amp (1 µA).

Note: *The Position Transmitter will output the mA signal that corresponds to the actuators current position 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.*

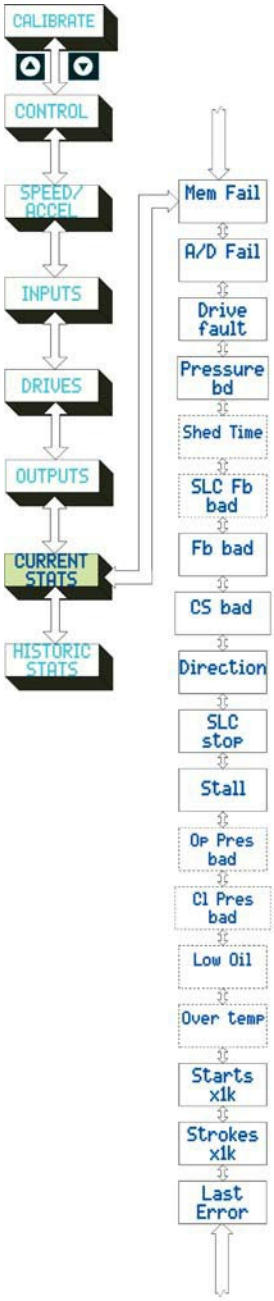
Note: *Xmitter Hi and Xmitter Lo values are not transmitted over the bus in Foundation Fieldbus units.*

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 span to automatically re-calibrate its output.

Password {Password} defines the password required to enter the Setup mode in order to change any control parameters. The default value of **0000** indicates no password is required. If a value is entered into Password other than the default value, future entry into Setup mode will require that the user enter the Password value prior to gaining access to the Setup menus.

Version {Software version} displays the version of software.

Example: **Version X01_0_AA_xxxx**



6.1.9 CURRENT STATS Menu and HISTORIC STATS Menu

The CURRENT STATS and HISTORIC STATS menus both provide error counters and usage indicators. The two menus provide identical information, the difference being that the CURRENT STATS parameters can be reset to 0 in the Setup mode where as the HISTORIC STATS cannot. Also, the CURRENT STATS can be viewed (but not altered) in Auto mode. HISTORIC STATS can only be viewed in Setup mode.

The error counters are provided as an aid to diagnosing a problem. They are particularly useful in identifying intermittent problems since they record ALL instances of detected errors, rather than just those which result in an “alarmed” condition. They are also useful in identifying problems associated with actuator “tuning”.

Note: *Refer to the TS&R Manual for trouble shooting support.*

The error counters generally operate in the Auto mode (inclusive of Local Man / RemoteMan) only. Errors detected in Setup are not recorded. If the Auto mode is entered from Setup with an existing error, the error is not counted. The only exception to the “Auto mode only” rule is the Mem Fail counter which operates only in Setup mode.

Usage indicators only record in Auto mode.

The CURRENT STATS error counters and usage indicators may be reset to zero by the following;

While in Setup and the counter/indicator to be reset is on display:

Press (**E**)nter – the equals sign begins blinking

Press (**D**)own – the value field resets to zero

Press (**E**)nter – the new count is now zero

Note: *If the (**U**)p key is pressed prior to step 3, the old count is returned to the display and will be retained if the (**E**)nter key is then pressed.*

Mem fail indicates the number of times that the Setup parameter memory failed to erase/write a parameter value properly.

A/D fail indicates the number of times the A/D converter failed to respond to a command.

Drive fault indicates the number of times a drive fault was detected.

Pressure bd {Accumulator pressure bad} indicates the number of times that the Accumulator pressure transducer was detected out of range. The transducer is considered out of range if the 4-20 mA signal is less than 3 mA or greater than 21 mA.

Shed Time indicates the number of times that a Setpoint update did not occur within the time set in parameter Shed Time.

SLC Fb bad {Seat Load Cylinder Feedback bad} indicates the number of times that the feedback from the seat load cylinder (4-20mA) was below 2 mA.

Fb bad {Actuator feedback} indicates the number of times that the actuator's feedback was below 2 mA.

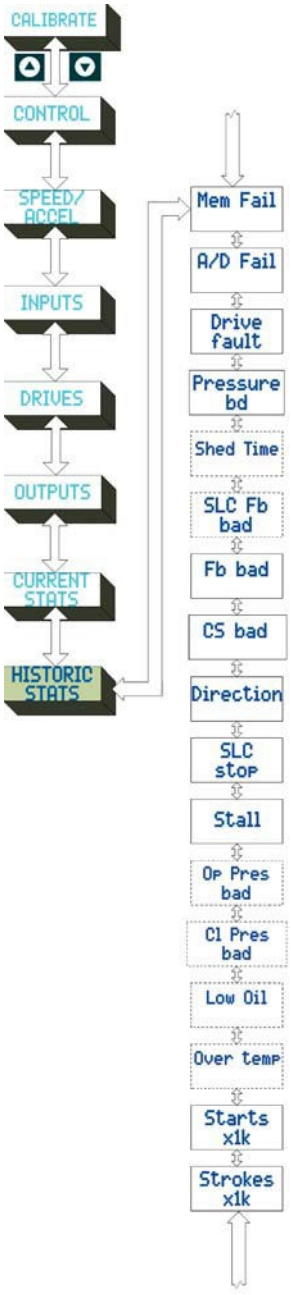
Cs Bad {Analog control signal bad} indicates the number of times the analog control signal was below 2.5 mA

Direction {Direction error} indicates the number of times the motor was stopped because the actuator was detected moving in the wrong direction.

SLC stop {Seat Load Cylinder stop} indicates the number of times the actuator stopped at the "Seated" position of the seat load cylinder but the control signal did not require the valve to be seated (control signal was > 0.2%)

Stall indicates the number of times the motor was stopped because the **Stall Time** was reached prior to achieving 1% of travel.

***Note**: For units with a Seat Load Cylinder, **Stall** will indicate the number of times the "Seated" position was reached while position of the main cylinder was greater than 1% above Position Lo.*



The following four counters support non-standard hardware configurations:

Op Pres bad indicates the number of times that the open side pressure transducer was detected out of range. The transducer is considered out of range if the 4-20 mA signal is less than 3 mA.

Cl Pres bad indicates the number of times that the close side pressure transducer was detected out of range. The transducer is considered out of range if the 4-20 mA signal is less than 3 mA.

Low Oil indicates the number of times the reservoir level switch detected a low oil condition.

Over Temp indicates the number of times the oil temperature switch detected an over temperature condition.

The following two parameters are usage counters; each indicates the number of times an event counter reached a count of 1 000. Event counters are located in volatile memory. Each power-on/reset causes the loss of any partial 1 000 counts. Entry into Setup followed by a return to Auto mode preserves partial 1 000 counts.

Starts x1K indicates the number of times the motor was started while in Auto.

***e.g.*, Starts x1K=2** *is 2 000 starts.*

Strokes x1K indicates the number of times the actuator traveled a distance equal to its calibrated stroke divided, by 1 000.

***e.g.*, Strokes x1K=2** *is 2 000 strokes.*

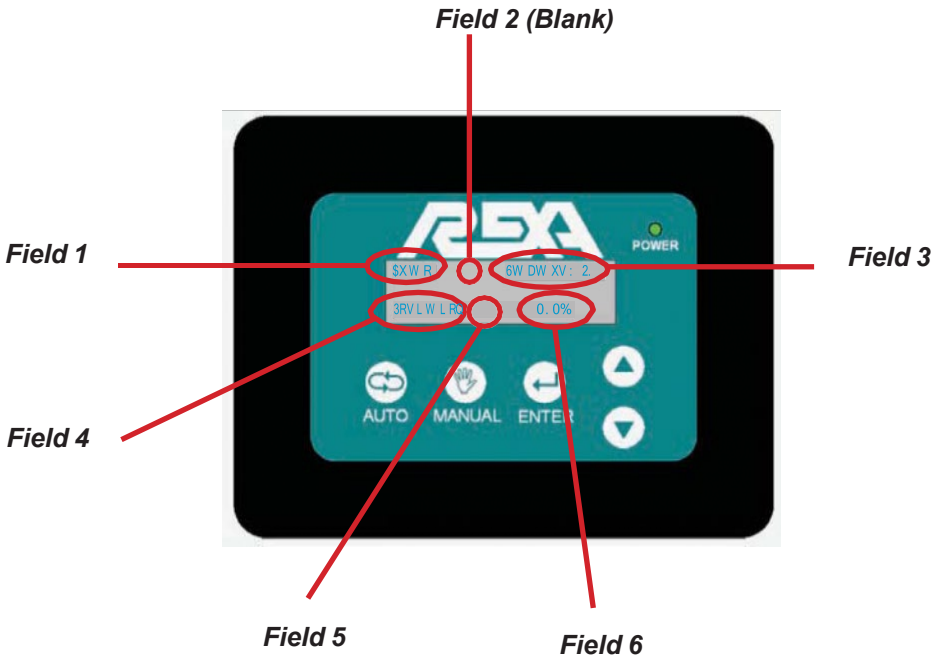
Last Error is not a counter; it indicates the last error detected. May be manually reset to **None** in Setup {press (**E**)nter while **Last Error** is on display}. It is automatically reset to **None** from reset/power on. The following may appear in the value field (field 6) if a **Last Error** occurs:

Fb bad
Cs bad
Dir er
Stall
DrvFlt
Pwr 15
PresBd
Shed
Op bad
Cl bad
Lo Oil
HiTemp
SLC Fb
SLCstp
ADfail
MemBad

6.2 AUTO MODE

Auto is the mode in which the actuator will automatically follow the control signal. When the deviation between current position and control signal is greater than the dead band setting, the actuator will move to decrease that error.

6.2.1 Display Fields in Auto Mode



Field 1 displays the Operating mode.

Field 2 is left blank to separate Fields 1 and 3.

Field 3 displays the unit status.

Field 4 displays the parameter position or alternate.

Field 5 separates fields 4 and 6 with “space = space”.

Field 6 shows the value for the parameter.

6.2.2 Display Information

Auto *(Field 1)* indicates the unit is in Auto mode, standard operation.

Auto–Bt *(Field 1)* indicates Auto mode with Bumpless transfer in progress. Refer to the CONTROL menu.

Auto–mm *(Field 1)* refers to Auto mode with minimum modulating active. Refer to the CONTROL menu.

Auto–Rchg *(Field 1)* indicates the unit is in Auto mode with accumulator Recharge cycle in progress. Refer to the DRIVES menu.

Auto–Trip *(Field 1)* indicates the unit is in Auto mode with the Trip input active.
Refer to the INPUTS menu.

Status:OK *(Field 3)* or an error/warning message indicates the status of the unit. Refer to the CURRENT STATS menu.

Position *(Field 4)* identifies the value displayed in Field 6.

Value *(Field 6)*: **Low** if current position is more than 0.5% below Position Lo

0.0 to **100.0** if current position is between Position Lo and Position Hi

High if current position is more than 0.5% above Position Hi

Note: *Lo or Hi value indicates overtravel past Position Hi or Position Lo settings; typically due to spring/accumulator driven operation.*

If set up for Reverse Acting:

Value *(Field 6)*: **Low** if current position is more than 0.5% **above** Position Lo

0.0 to **100.0** if current position is between Position Lo and Position Hi

High if current position is more than 0.5% **below** Position Hi

Position value may display the following in the situations stated:

Unknwn *(Field 6)* if the feedback signal from the actuator to the Control enclosure is not present.

Seated *(Field 6)* if the seat load cylinder is at the "seated" position

6.2.3 Parameter Viewing

In Auto mode the Control Parameters may be viewed (but not altered) by using the ▲ or ▼ keys.

The first press of the ▼ key displays the "Live Control Signal"; successive presses of the ▼ key steps the display down through the CALIBRATE menu.

The first press of the ▲ key displays the current Deviation. Successive presses of the ▲ key steps the display up through the CURRENT STATS menu. A 5-second timer reverts the display back to current position if no ▲/▼ key presses are detected. Holding the ↵ key down holds the current parameter on display indefinitely.

Control Sig {Live Control Signal} *(Field 4)* identifies the value of the analog control signal. The display is 0 -100 % for easy comparison with the position display.

Value *(Field 6)*: **None** when parameter Signal does not equal Analog.

Low when current signal is more than 0.5% below Signal Lo.

0-100% Active 4-20 mA signal is applied and is in between Signal Lo and Signal Hi.

High when current signal is more than 0.5% above Signal Hi.

Unknwn when control signal is not applied.

Deviation (Field 4): Identifies the value in Field 6 as the difference, in % of calibrated stroke, between the actuator's current position and the actuator's target position. The value is prefixed with "-" if the current position is less than the target and with "+" if above the target position.

Value (Field 6): **0.0** to **99.9%** of calibrated stroke

Unknwn when the feedback signal from the actuator to the Control enclosure is not present.

6.3 MANUAL MODE

Local Man indicates the manual operation of the actuator locally through the Control Enclosure keypad. Once the Local Manual mode is entered, the current status will be displayed along with position.

To enable local control, the status must be active. The actuator may be stroked throughout its calibrated range. To do so, press ↵. The = sign in Field 5 will begin blinking. Use the ▲ and ▼ keys to stroke the actuator. Pressing ↵ again prevents operation of the unit with the ▲/▼ keys.

When stroking the actuator in Local Manual mode, parameter **Max Man Spd** sets the maximum speed of travel.

While in the Local Manual mode (= sign not blinking), the ▲ and ▼ keys may be used to examine (but not change) any Setup parameter.

RemoteMan allows manual operation from a remote-station control unit. The actuator can be stroked throughout its calibrated range. Once the Remote Manual mode is entered, the current status will be displayed along with Position.

The RemoteMan mode is only accessible if the Contacts Input board is installed. Refer to Appendix R, Remote Manual Control and Appendix Q, Contact Input Options.

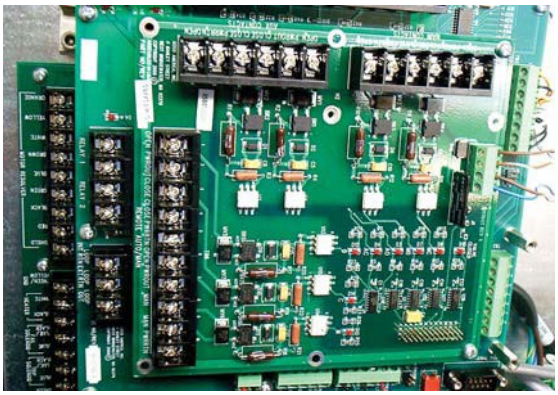


Figure 6.3 Contacts Input Board

A. MECHANICAL LIMIT SWITCHES

The mechanical limit switches are independent devices installed on the yoke of the linear units and in the feedback housing area of rotary or drive units. Electrical connections are made directly to the switches independent of REXA electronics. Position will be indicated regardless of actuator power status.

A.1 LINEAR

A.1.1 General Specifications

Quantity: 2 or 4

Type: Single Pole, Double Throw (SPDT), Form C.

Rating: 5 amp @ 24 Vdc, 0.5 amp @ 125 Vdc,
10 amp @ 110 Vac - resistive

Differential Travel (Hysteresis): 5/16”

Environmental: NEMA 4, FM/CSA CL.I, DIV.1 & 2,
GRP. A, B, C & D.

Connection: ½”-14 NPT, screw terminals

Optional DPDT Limit Switches

Quantity: 2 or 4
Type: Double Pole Double Throw (DPDT), Form CC
Rating: 3 amp @ 24 Vdc, 0.5 amp @ 125 Vdc,
10 amp @ 110 Vac - resistive
Differential Travel (Hysteresis): ¼″
Environmental: NEMA 4, FM/CSA CL.I, DIV.1 & 2,
GRP. A, B, C & D.
Connection: ½″-14 NPT, screw terminals

A.1.2 Linear Wiring

Remove the access plate by unscrewing the four slotted screws on the bottom of the unit. Thread the cable through the ½″ NPT fitting and connect to the appropriate Normally Open (NO), Normally Closed (NC) and Common (C) screw terminals. The cable should be grounded in accordance with Local and National Electrical Code. Make sure that the gasket is in place and tightly seal the cavity.

A.1.3 Linear Adjustment

Loosen the two mounting screws approximately 1½ to 2 turns and slide the entire switch to the required position. Securely retighten the screws.

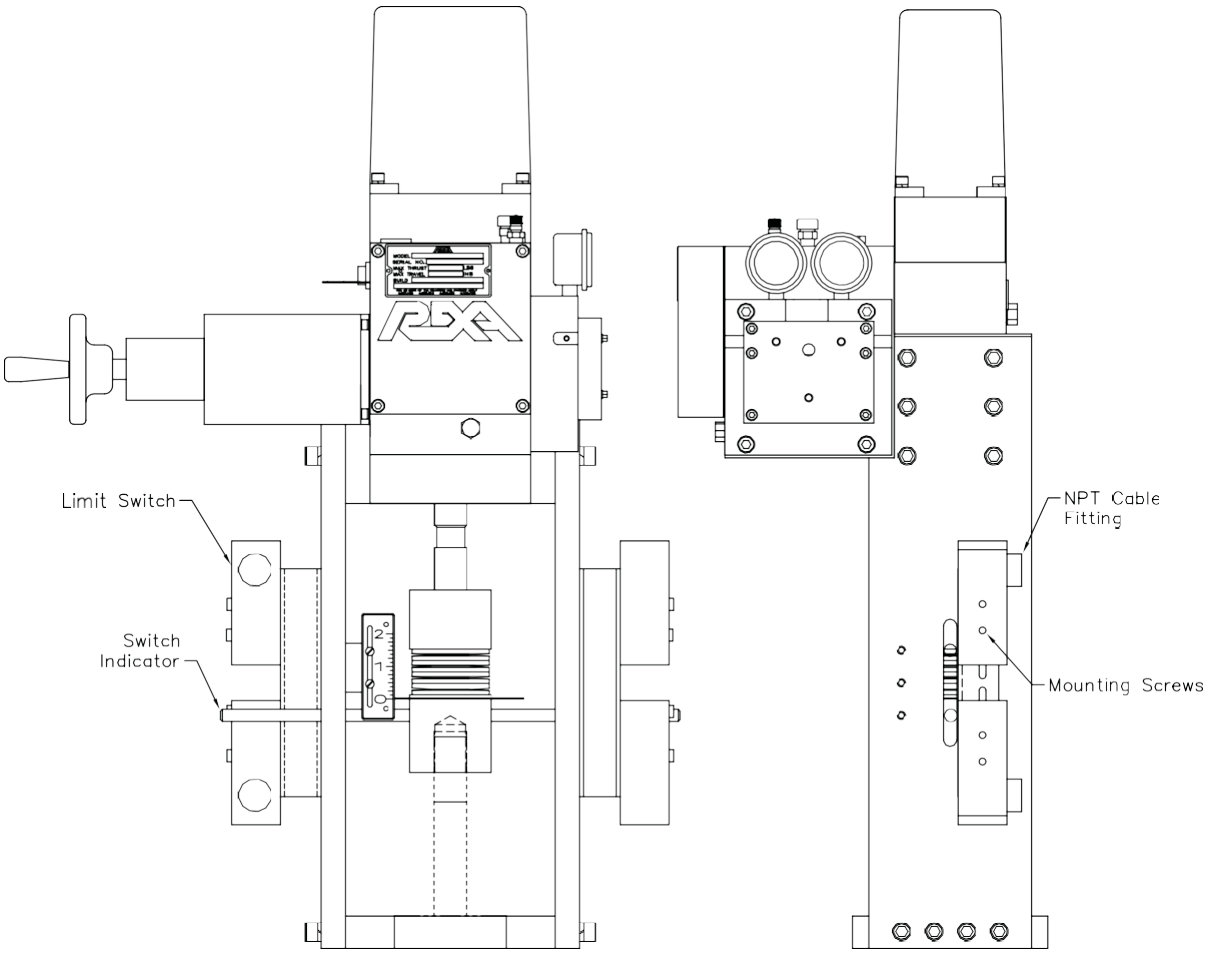


Figure A.1 Linear Limit Switches

A.2 ROTARY

A.2.1 General Specifications

Quantity: 2 or 4
Type: Single Pole, Double Throw (SPDT)
Rating: 10 amp @ 24 Vdc, 0.5 amp @ 125 Vdc,
10 amp @ 110 Vac - resistive
Differential Travel (Hysteresis): 5½"
Environmental: NEMA 4, FM/CSA CL.I, DIV.1 & 2,
GRP. A, B, C & D (optional).
Connection: Within the feedback housing (½"-NPT) screw terminals

Optional DPDT Rotary Limit Switches

Quantity: 2
Type: Double Pole, Double Throw (DPDT), Hermetically Sealed
Rating: 0.3 amp @ 125 Vdc, 0.15 amp @ 250 Vdc,
10 amp @ 125 or 250 Vac
Differential Travel (Hysteresis): 5½"
Environmental: NEMA 4, FM/CSA CL.I, DIV.1 & 2,
Connection: Directly to screw terminal on the switch.

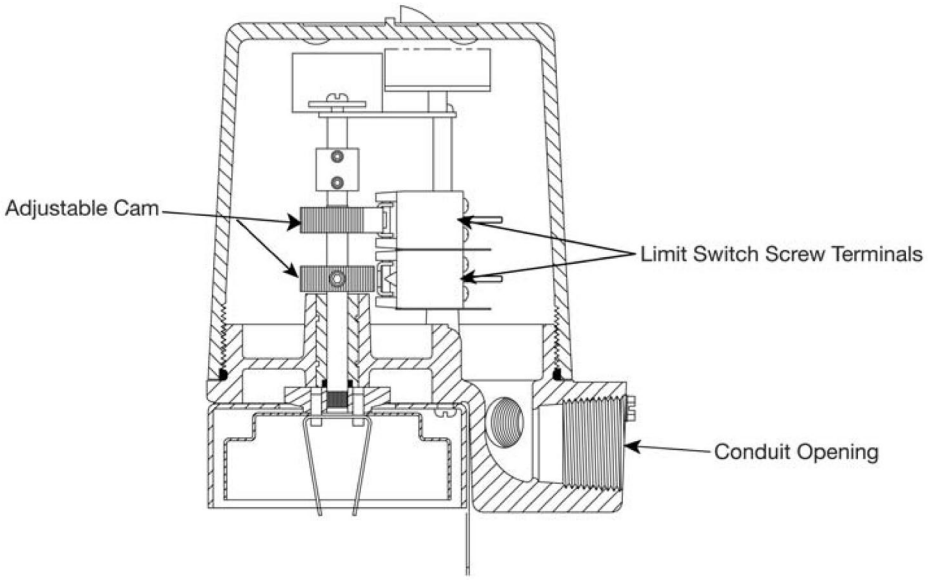


Figure A.2 Rotary Limit Switch Schematic

A.2.2 Rotary Wiring

Remove the cylinder feedback cover (over the cylinder pinion) by unscrewing. Refer to Figure A.2.3. Take care to keep threads clean and free from damage. Thread the cable through the ½" NPT fitting and make connections directly to the microswitches. Refer to Figure A.2. The cable should be grounded in accordance with Local and National Electrical Code.

A.2.3 Rotary Adjustment

For adjustment, the switch cam can be relocated by loosening the set screw and repositioning. Make sure that the O-ring gasket is in place and tightly seal the cavity. (See Figure A.2.3)

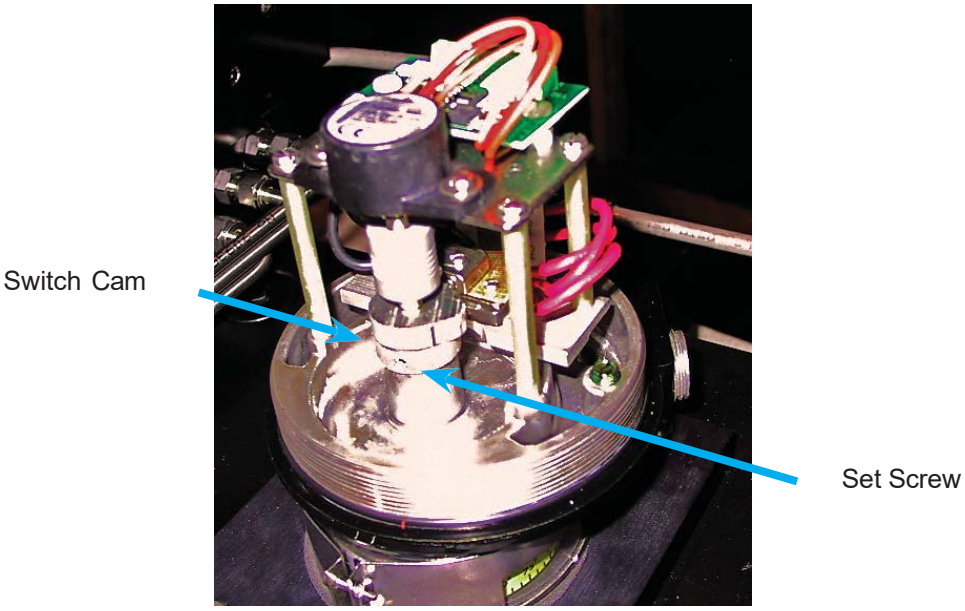


Figure A.2.3 Rotary Limit Switch

B. Stem Connection & Seat Loading Methods

B.1 THEORY OF OPERATION

Actuators which must come up against a hard stop require a spring loaded element between the actuator and driven device. This spring loaded element provides a controlled loading without over stressing mating parts. Its purpose is the same as torque limit switches found on gear motor actuators but without the inherent adjustment difficulties and potential for faulty calibration.

B.2 ELASTIC COUPLING

For applications that extend or retract against a hard stop, linear **Xpac** actuators are provided with an “elastic coupling” for connecting the driven device to the actuator. The elastic coupling contains a set of disc springs which are pre-compressed to approximately 80% of the rated thrust for fail-in-place units and 50% of the rated thrust for spring fail actuators.

The coupling provides a visual indication of compression (seat load) and should be compressed to its rated mark when the driven device is at the end of travel. At that point, the load on the driven device is approximately the net rated output

of the actuator. Lower rated couplings are available for applications that require reduced seat load.

The force indicator on the elastic coupling is a pin captured in a slot on the side of the coupling. As the coupling compresses, the pin slides in the slot. A scribed line marks the rated output position.

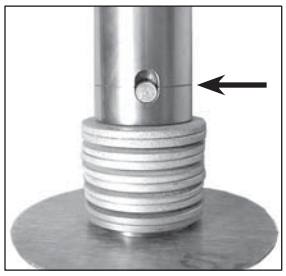


Figure B.2-1 Preloaded Coupling

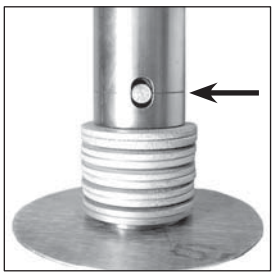


Figure B.2-2 Rated Load Coupling

Enclosed spring couplings (not shown) have a small telltale pin protruding from the top or bottom. As the coupling compresses, the pin is drawn into the coupling. When the pin is flush with the coupling, it is at its rated output.

Note: *The output of each coupling may be verified through the pressure gauges.*

Note: *To translate pressure gauge readings into actuator output, use the following formula:*

$$\left(\frac{\textit{Pressure gauge reading}}{\textit{2 000 psi}}\right) \times \textit{actuator rated output} = \left[\textit{actual output}\right.$$

For additional output calculation data, refer to Appendix O.

B.3 SEAT LOADING CYLINDER

On larger size units the forces are too great to use a mechanical elastic coupling. Instead, a smaller Seat Loading Cylinder (SLC) with a spring load is hydraulically connected to the actuator cylinder as shown Figure B.3.

The Seat Loading Cylinder utilizes a pre-compressed load equivalent to 80% (1 600 psi) of the nominal working pressure (2 000 psi). As the power module

pumps hydraulic fluid into the actuator cylinder, the output shaft will begin to extend. Once the force on the extension shaft reached the preset 80% of the actuator's rated output, the pressure in the top of the actuator cylinder will reach the limit that begins to compress the spring on the seat load cylinder. This will occur when the driven device reaches its end of stroke. As the pressure builds within the actuator cylinder, oil flows into the SLC, designated by the high pressure flow arrow and retracts the SLC shaft. When the spring is compressed to the full nominal working pressure, the position feedback of the SLC will trigger the power module to shut off. The rated actuator output is now applied to the driven device and retained within the cylinders by the Flow Matching Valves.

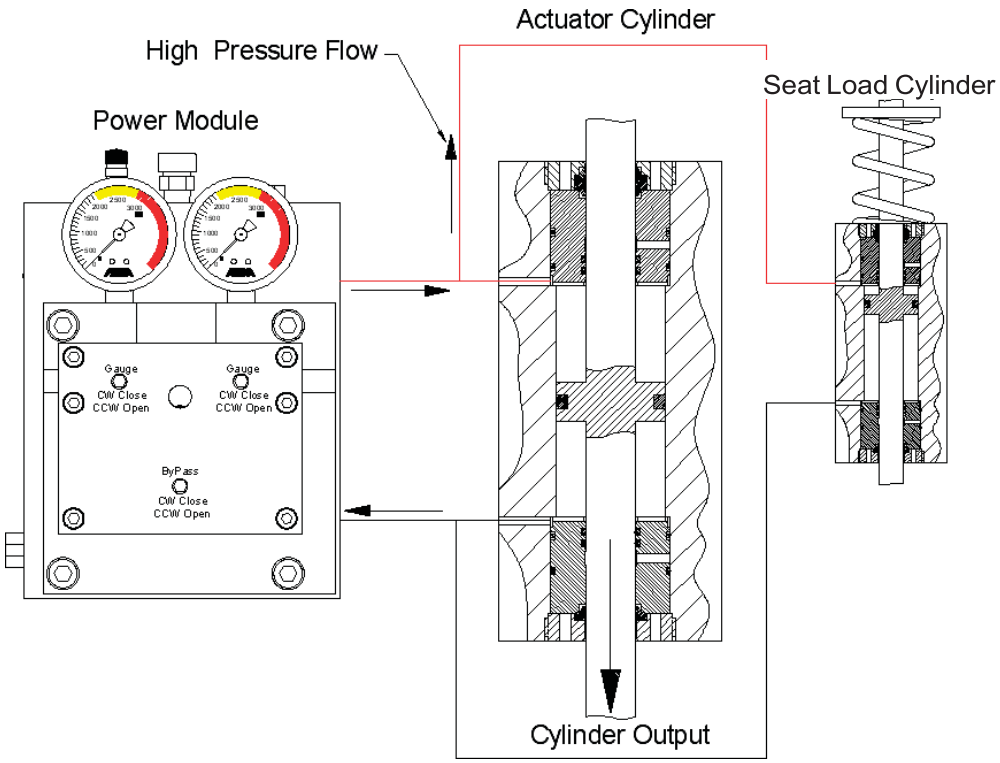


Figure B.3 Seat Loading Cylinder

B.3.1 Mechanical Installation

The Seat Loading Cylinder is mounted to the side of the main cylinder at the factory. All hydraulic piping and spring preload will be complete. Mechanical installation is not required.

B.3.2 Electrical Installation

Operation of the Seat Loading Cylinder requires the connection of a feedback cable between the SLC and the control enclosure. The standard cable consists of a red, white and black wire and a tinned copper ground wire. Each individual wire is 18 AWG. The feedback cable is not restricted by distance.

The SLC Feedback Connections are terminated inside the Control Enclosure at the CPU Board Assembly, TB1, +15, SLC+ and SLC-. Refer to Figure B.3.4-1.

The feedback connection is made directly to the screw terminals on the feedback printed circuit board. Remove the four cap screws cover using care not to damage the internal components. Feed the cable through the ½ inch NPT opening. Wiring connection is made directly to the feedback printed circuit board per Figure B.3.2. Replace the cover on the cylinder and securely fasten. Refer to the Electrical Installation section.

Table B.3.2 SLC Connections

SLC—½ inch NPT on cylinder (Screw Termination)

Signal name	Wire colors	Terminal
+15 Vdc	Red	15V
Feedback (+)	White	4-20
Feedback (-)	Black	GND

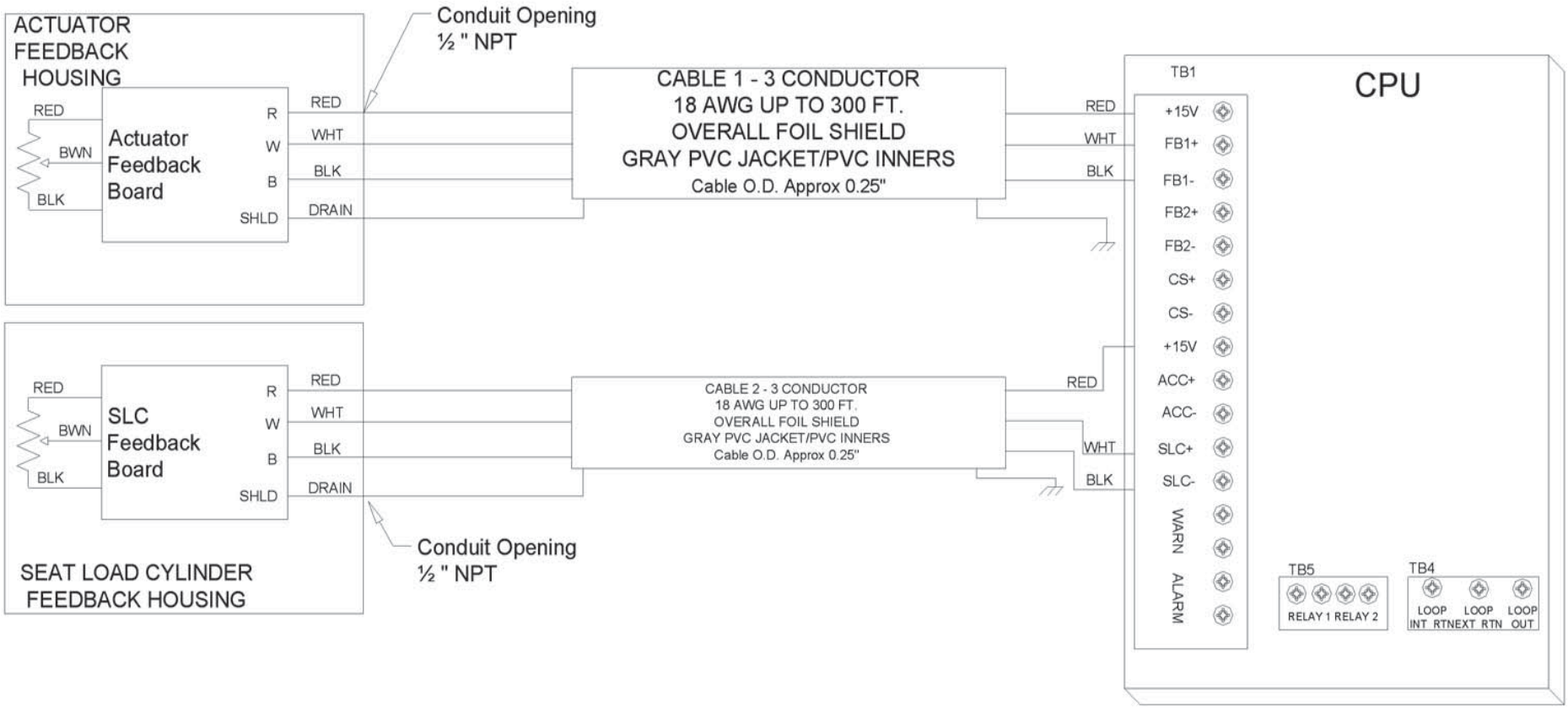


Figure B.3.2 SLC Feedback Board

B.4 SOLENOID AUTO-SEATING

For linear valve applications that require fail-safe in the same direction as the seated position, the elastic coupling and seat load cylinder are considered to be redundant and unnecessary. Using an elastic coupling on a spring fail or accumulator fail REXA is like using a spring in series with another spring. For these applications REXA handles the seat loading with software that automatically controls the solenoid operation as the actuator positions close to the seat. This control menu parameter is called Solenoid Seat (**Sol. Seat**). The software concept is similar in operation to the Min Mod functionality. Rather than use the motor to drive to the seat, once the actuator reaches a position close to the seat the solenoid valve(s) open and the remaining travel is accomplished by using the stored energy (spring or accumulator) to drive the valve into the seat.

B.5 CALIBRATION

Operation of the actuator is the same as a unit with an elastic coupling. The only difference is at the seated position. Instead of compressing a coupling, the spring on the SLC is compressed until the indicator on the SLC leg is at the seated point. See Figure B.5-1.

Position Lo is set by moving the stem to the corresponding low signal position. If the signal low position is the “SEAT” position, the seat load cylinder flag must line up with the “SEAT” indicator mark on the spring housing cover. The “SEAT” indicator mark is factory set for each application. The preset tension of the spring should not be changed without consulting the REXA factory.

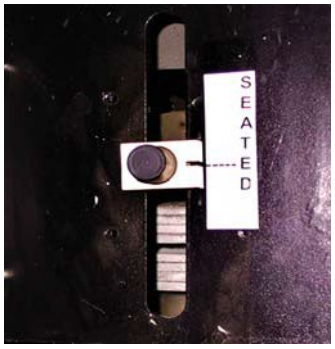


Figure B.5-1 SLC Indicator–Seated

With **Position Lo** on the display, press the (E)NTER key. = will begin to blink. Using the Scroll Up and Scroll Down keys, position the actuator to the desired point and press (E)NTER again. The displayed value will be recorded as the Position Low endpoint.

Position Hi is set by moving the stem to the corresponding high signal position. If the signal high position is the “SEAT” position, the seat load cylinder flag must line up with the “SEAT” indicator mark on the spring housing cover. The “SEAT” indicator mark is factory set for each application. The preset tension of the spring should not be changed without consulting the REXA factory.

With **Position Hi** on the display, press the (E)NTER key. = will begin to blink. Using the Scroll Up and Scroll Down keys, position the actuator to the desired point and press (E)NTER again. The displayed value will be recorded as the Position Hi endpoint.

When calibration is complete, and *before* returning to “AUTO” mode, depress the RESET button located on the right side of the REXA CPU board. This will set the new seated value as the SLC target. See Figure B.5-2.

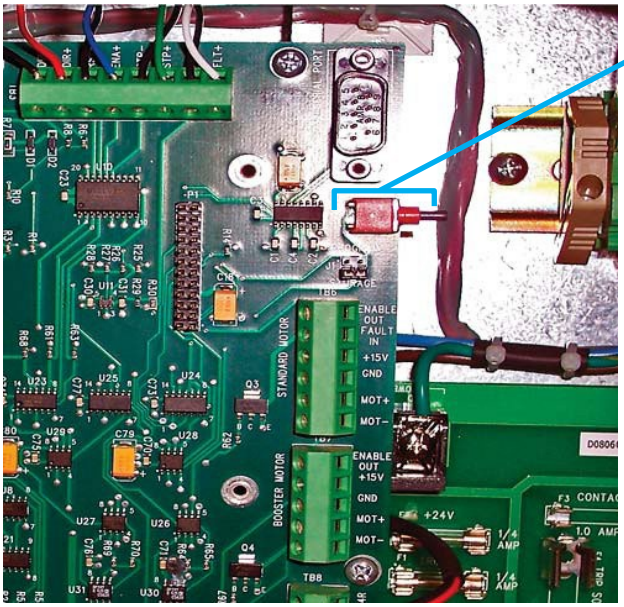


Figure B.5-2 Reset Switch

C. Accumulator Fail

C.1 THEORY OF OPERATION

System operation is based on a piston type accumulator with nitrogen gas on one side of the piston and oil on the other.

C.1.1 Trip Function

Refer to Figure C.1.1-A, Trip Condition, to follow the fluid flow path during a trip. The arrows indicate the flow direction

Under a trip condition or loss of electric power, two solenoid valves open simultaneously. One solenoid allows oil under pressure from the accumulator to be released and enter the failure side of the actuator driving it in the fail direction. The other solenoid allows the oil displaced from the opposite side of the cylinder into an auxiliary reservoir. To control the fail speed a needle valve is installed on the outlet of the second solenoid valve.

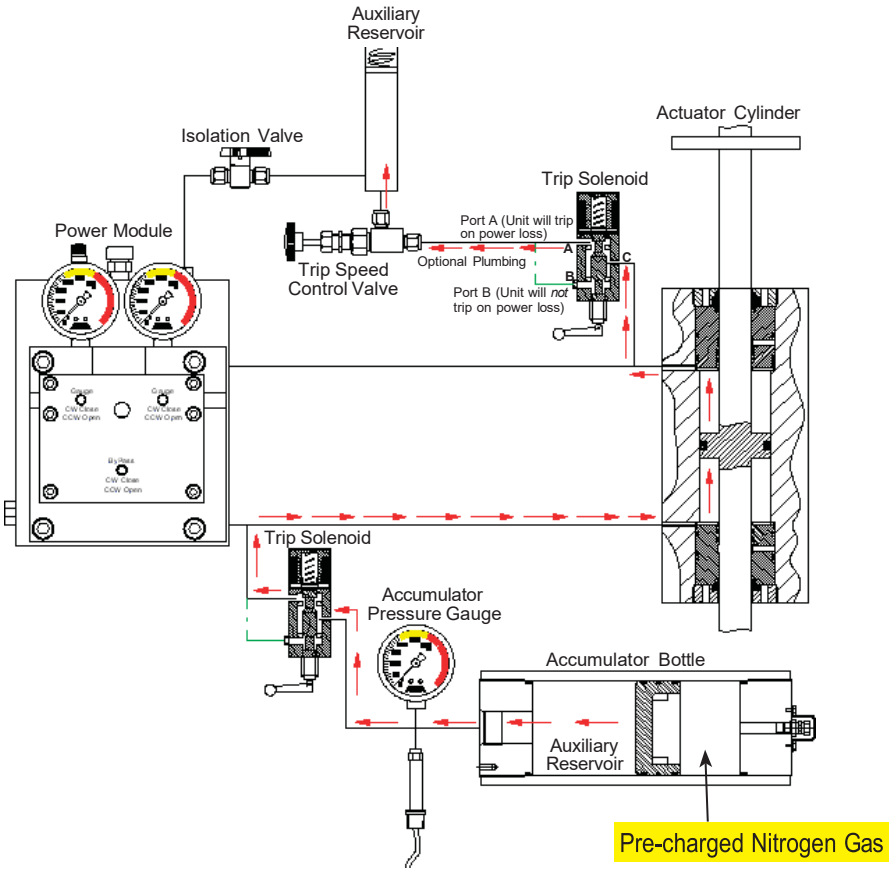


Figure C.1.1-A Trip Condition

C.1.2 Recharge Function

Reference Figure C.1.2-B to follow fluid path during recharge.

When the trip condition ends or power is restored, a pressure transducer signals the CPU of low pressure in the accumulator. This signal tells the CPU to run the power module in the direction required to drive the actuator in the fail direction. Since the actuator cylinder is already at the end of its travel, the oil being pumped from the reservoir by the power module will be allowed to flow into the accumulator. When the proper recharge pressure is reached, the CPU stops the power module and closes the solenoid valves. Normal operation is now resumed and the actuator will follow the control signal.

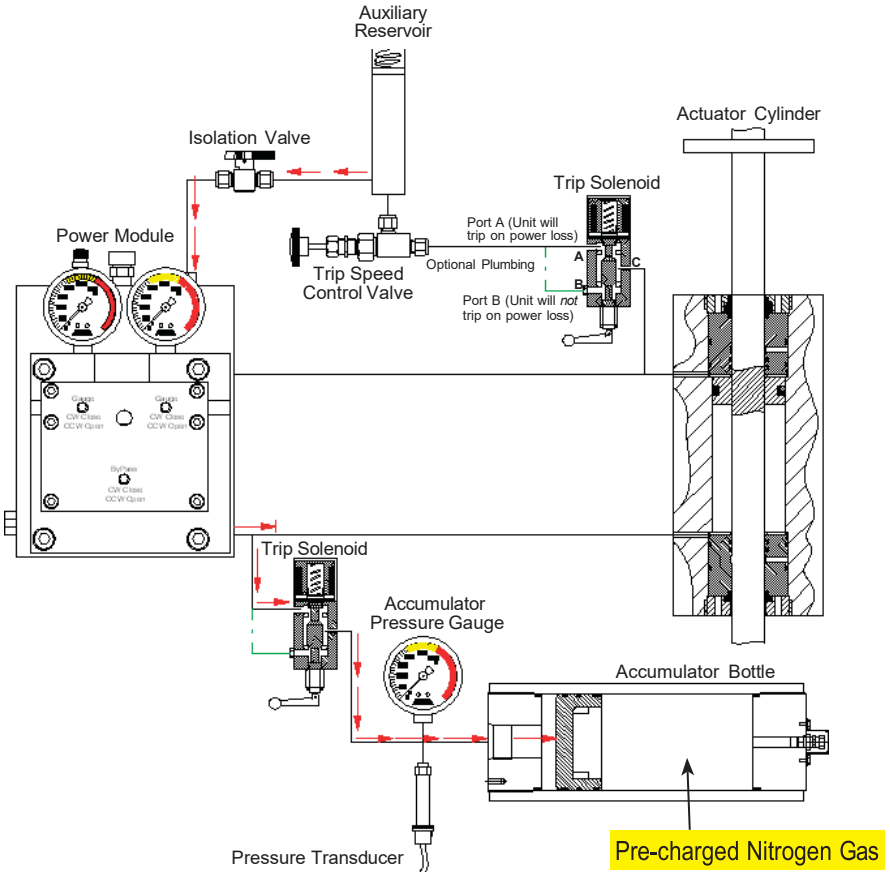


Figure C.1.2-B Recharge Condition

C.2 ACCUMULATOR CONTROL PARAMETERS

Five parameters in the electronics are used to control accumulator functions. These may be found under the Drives menu and are: **Rechrg Pres, Warn Pres, Rechrg Time, Accum Dr and Accum Pres**.

DRIVES Menu

The DRIVES menu provides the following:

Drive Type
Stall Time
Boost Pump
Accumulator
Rechrg Pres
Warn Pres
Rechrg Time
Accum Dir
Accum Pres

Reference the DRIVES Menu in Modes of Operation & Control Parameters.

C.3 RECHARGING

The recharge cycle will only occur **if**:

1. The CPU is in the ***Auto*** mode *when power is restored* after a loss of power or removal of trip signal,
   And
2. The pressure transducer output is less than **Rechrg Pres**

If CPU is NOT in Auto mode when power is restored or trip signal removed, the unit MUST be placed in Auto and the reset button pushed.

IMPORTANT!
All actuators are shipped in the failed or tripped condition. The actuator may initially power up in Setup mode. With the trip signal inactive (or not connected), put the actuator in Auto then either press the reset button or cycle power off and back on. The actuator will go through a fail cycle, a re-charge cycle and then return to following the control signal. If this operation is not performed, the actuator will follow the control signal, but the accumulator will remain uncharged, rendering the actuator incapable of performing a trip or fail operation. However, a low pressure warning will indicate insufficient pressure to perform a fail operation.

C.4 MANUAL OVERRIDE

Accumulator actuators with solenoid valves are supplied with manual override levers. This feature enables a way to manually change states of the solenoid valves with electrical power off or in trip mode. Units are shipped from the factory with the solenoid override levers in position A (Figure C.4-1).

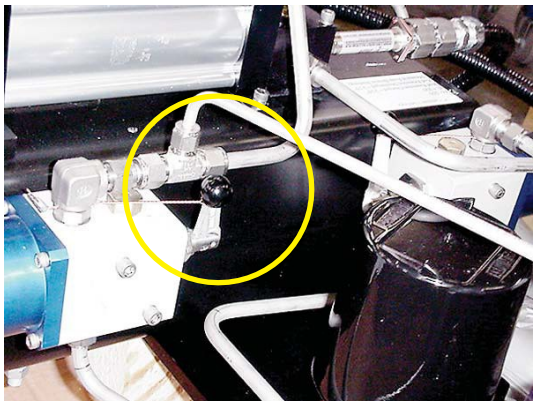


Figure C.4-1 Solenoid Manual Override Levers (Position A)

They must be in this position for normal operation of the actuator. To use the handwheel during a power off or trip situation *both* solenoid override levers must be moved to position B.

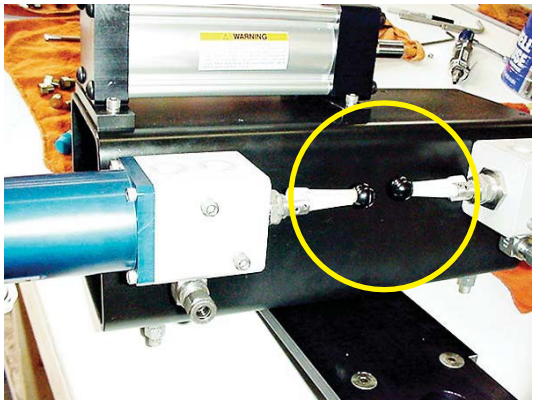


Figure C.4-2 Solenoid Manual Override Levers (Position B)

Once both overrides are moved to position B, the handwheel may be operated in a normal manner (Refer to Appendix M, Manual Operators). After handwheel use and prior to returning the actuator to normal service, (power restored or trip signal removed) *both* solenoid override levers must be returned to position A.

> ***NOTE:*** *When returning the levers to the normal open position the actuator will stroke in the trip direction.*

It is recommended that both override levers be safety wired in position A when the handwheel is not in use.

For operation of Manual Override, refer to Appendix M, Manual Operators.

WARNING!
After using the handwheel, the overrides must be returned to the A position or the unit will not operate correctly when power is restored or trip signal removed. If only one override is returned to the A position after a trip, damage to the power module may occur.

C.5 DISCHARGING

There will be times that it is necessary to fully discharge the oil-side of the accumulator system; such as when maintenance is being performed. To perform this task, do the following:

1. Remove power to the actuator.
2. If the unit is fail in place during power loss, place both solenoid valves in position B as shown in Figure C.4-2.
3. Open the manual bypass located on the front face of the module. Refer to Figure C.5.
4. Check to ensure that all the pressure gauges read 0 psi.

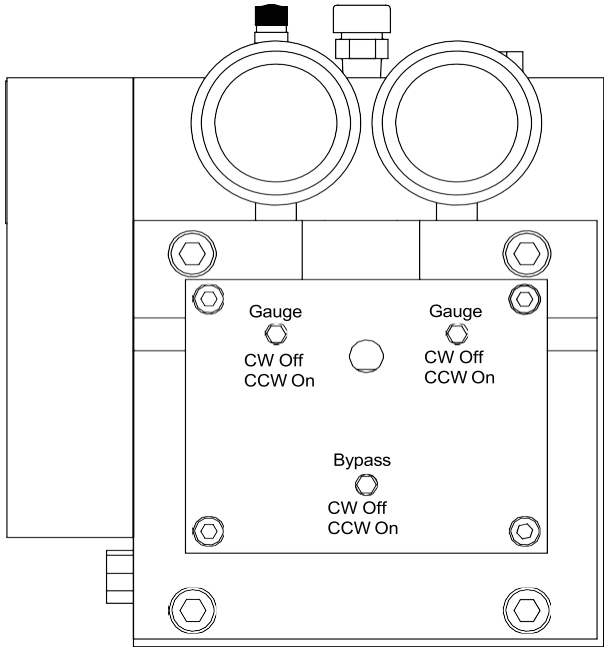


Figure C.5 Bypass Drawing

D. Booster Pump Configuration

D.1 THEORY OF OPERATION

Booster Pump Configurations utilize an **Xpac** power module and a large capacity “Booster Pump”. The power module provides fine positioning, while a volume booster pump provides the speed for large or coarse position changes. This dual pump operation allows REXA to extend its unique capabilities to very high thrust or torque units and high-speed operation without sacrificing position accuracy.

Two sizes of BOOSTER PUMPS are available: the P9 and the P40. The P9 is used in combination with the D size power module to provide 5 times the capacity of a D size power module or 2.5 GPM. A P40 with D size power module has the pumping capacity for 11 GPM.

D.2 MECHANICAL INSTALLATION

An **Xpac** with the Booster Pump Configuration has no special installation procedure. Therefore, the standard installation should be followed.

D.2.1 Control Enclosure

The major electrical components are located in a NEMA 4 enclosure. They have a wide temperature range[1] (-40 °F to 120 °F[1] [-40 °C to +49 °C]) and can be field installed at a convenient location. Avoid areas subject to excessive vibration or heat. To reduce the possibility of water incursion, we recommend that any fitting be pointed downward.

[1]Ambient temperature only. Direct solar heat load must be avoided.

D.3 ELECTRICAL INSTALLATION

The **Xpac** consists of two major components, the Electraulic actuator (cylinder and power module) and the control enclosure. The actuator is installed on the driven device, while the enclosure is remotely mounted. Connecting them are the motor power, resolver, feedback and module cables. Some cables may not be run within the same conduit or seal-tite flex hose. Preferred wiring procedures recommend that power voltages (motor power and module cables) be kept separate from low level signal lines (resolver and feedback cables). User connections of electric power and control signals are made at the enclosure.

Refer to Appendix P, Interconnect Diagrams.

! Important !

- Motor power and motor resolver cables for the power module and booster pump motors must be shielded! The shield of each is connected to the green ground screw on the back panel of the control enclosure only.
- The motor resolver signals are low level voltages. The motor resolver cables must be kept separate from the motor power cables or any other high power wiring. However, the resolver cables may be run with the feedback cable or other low power conductors.
- Failure to follow the above may inhibit the proper operation of the actuator.

D.4 CONTROL PARAMETERS

Refer to DRIVES menu, Modes of Operation & Control Parameters.

E. Pulse Operating System

E.1 THEORY OF OPERATION

The pulse operating system allows the use of a voltage input signal instead of the standard 4-20 mA signal. Pulses are not merely motor power commands, but change the target position. The actuator will continue moving until the actual position satisfies the target position. The motion (speed, acceleration, resolution) of the unit will be in accordance with the values set during calibration.

To receive the pulses, a contact input board is mounted on the CPU. This board accepts 3 or 4 wire signals in the range of 24 to 120 volts, AC or DC. The pulses are interpreted by the CPU based on the values set for the two pulse control parameter, *Pulse Duration* and *Pulse Increment*.

Refer to the CALIBRATE menu and the INPUTS menu for additional information.

E.2 INSTALLATION

Wiring for pulse input is performed at the contact inputs board located on top of the CPU. Terminal block TB3 provides six terminals to connect the HIGH signal and the LOW signal. Refer to Figure E.2-1, -2, for wiring options.

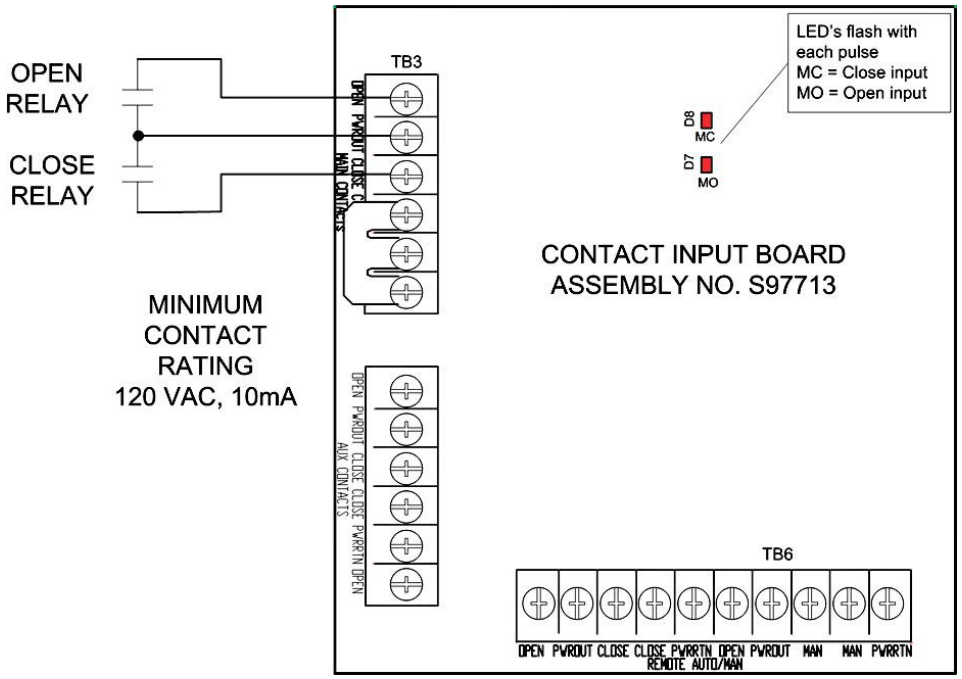


Figure E.2-1 Contact Input Board Wiring Options

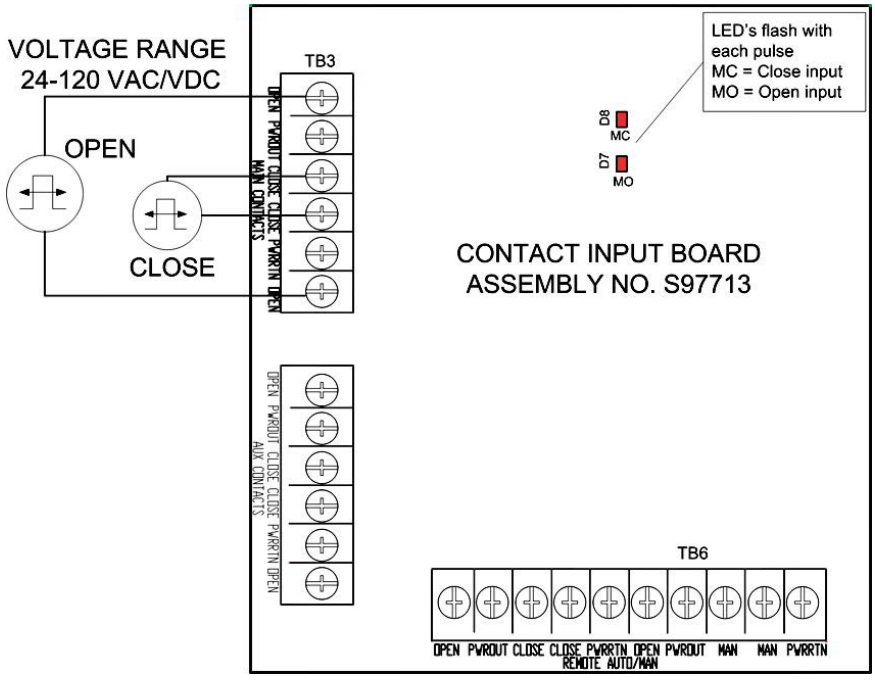


Figure E.2-2 Contact Input Board Wiring Options

E.3 SIGNAL INPUT RANGE

Voltage: OFF: 0 to 8 volts, AC or DC
ON: 22 to 120 volts, AC or DC
Undefined: 8 to 22 volts, AC or DC

Current: OFF: less than 1 mA
ON: 1.8 mA to 10 mA; proportional to voltage
Impedance: 12K ohms

Electromechanical or solid state switching devices may be used to activate the control signal. The following points should be observed:

ON state:

Most AC and many DC solid state switching devices require a minimum current flow in order to remain in the closed state. If this minimum current exceeds the input signal current at the activation voltage, the current flow may be increased by adding a shunt resistor across the input signal terminals of the pulse auxiliary board.

OFF state:

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 added across the input signal terminals will bypass the current.

E.4 PULSE CONTROL PARAMETERS

Refer to the CALIBRATE menu and INPUTS menu for additional information.

E.5 TUNING

On systems that utilize position feedback to control the pulse train, it is usually necessary to tune the *Pulse Increment* to replicate the actuator speed. The ideal *Pulse Increment* is determined by dividing the *Pulse Duration* (in seconds) by the total stroking time and multiplying by 100%.

$$\text{Pulse Increment} = \frac{\text{Pulse Duration}}{\text{Stroke Time}} \times 100\%$$

To allow for motor acceleration, round this value up to the next highest tenth of a percent.

F. Errors and Error Displays

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.

FB bad

Cause: The actuator's main Feedback is below 2 mA; either (+) or (-) **15 fail** is set, or **A/D fail** is set.

Indicators: Alarm and Warning opens.
FB bad is displayed.
Actuator will not move.

Cleared by: Self clearing when Feedback >2 mA, or when **15 fail** or **A/D fail** clears.

CS bad

Cause: The analog Control Signal is below 2.5 mA; either the (+) or (-) 15 fail is set, or A/D fail is set.

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, or when 15 fail or A/D fail clears.

Stall

Cause: After five attempts the actuator was unable to move 1% 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.

Dir error

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.

Drv fault

Cause: At least one motor drive has detected a problem.

Indicators: Warning relay opens.
Drv fault is displayed.
The actuator may or may not continue normal operation depending on actuator construction.

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

+15 fail or -15 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*** is displayed.
Actuator will not move.

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

Pres 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.
Pres bad is displayed.
Actuator continues to operate normally.

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

Pres 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.

Op Pres bad or Cl Pres 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.
SIc 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.

Key bad

Cause: A bad reading of the key pad has occurred.

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

Cleared by: Self clearing with a valid keypad reading.

Mem fail

Cause: A memory location containing a Setup parameter value has failed to erase/write.

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

Cleared by: Only cleared by cycling main power or pushing the reset switch.

No inp bd

Cause: 1. Signal Type is set to 1 Cont, 2 Cont, or Pulse when a contact input board is not installed or is faulty.

2. Trip is not Off.

Indicators: Alarm and Warning relays open.
No inp bd is displayed.
Actuator will not move.
Unit will go to Setup mode.

Cleared by: Changing the Signals menu parameter(s), or (with power off) installing the required board.

A/D fail

Cause: The A/D converter on the CPU Board has failed to respond.

Indicators: Alarm and Warning relays open.
A/D fail is displayed.
Actuator will not move.

Cleared by: Self clears if/when A/D responds.

G. Surge Control Option

G.1 THEORY OF OPERATION

High speed operation in one direction during upset conditions can best be handled with **REXA**'s Surge Control Option. This option gives the actuator the ability for fast operation in one direction. During normal movements actuator stroking speed is determined by Power Module speed capabilities. To obtain this second surge speed a coil spring drives the actuator when a solenoid valve opens. Four additional components are added to the standard actuator:

Mechanical Spring - provides the force to move the actuator in the surge direction.

Solenoid Bypass Valve - bypasses the actuator's normal hydraulic circuit.

Solid State Relay - interfaces the CPU with the solenoid.

Needle Valve - allows adjustment in Surge Control speed

The CPU will pulse the solenoid through the electronic relay to allow controlled high speed motion in the spring direction. Control of this feature is accomplished with the *Surge Breakpoint* (SG) parameter in the *Setup* menu.

If the change in control signal is less than the *Surge Breakpoint*, the actuator operates normally. If the change in control signal is greater than the *Surge Breakpoint* (and in the surge motion direction), then the solenoid opens and the actuator is driven by the spring to the new position.

If the actuator is overshooting during a surge event, the *Surge Offpt* parameter can be used to eliminate this overshoot. Reference the Drive Menu section in *Modes of Operation & Control Parameters* in the IOM for additional information regarding setting the *Surge Offpt* parameter. Increasing this *Surge Offpt* parameter will reduce the overshoot until the unit begins to slow down too much prior to hitting its target position. Figure G.1-1 illustrates the overshoot from a surge event. Increasing the *Surge Offpt* would be required to eliminate this issue. Figure G.1-2 shows the expected results when the *Surge Offpt* parameter is tuned properly. Figure G.1-3 shows an undershoot condition. Decreasing the *Surge Offpt* percentage will reduce the undershoot.

The *Surge Direction* parameter is displayed whenever *Surge Breakpoint* is set to any value other than off. *Surge Direction* is settable to either “To PL’’ or “To Ph” which specifies the direction of action.

Various configurations of the spring package may have been provided. The spring may be installed to open or close the driven device. Fail-safe position can either be lock in place or in the surge direction.

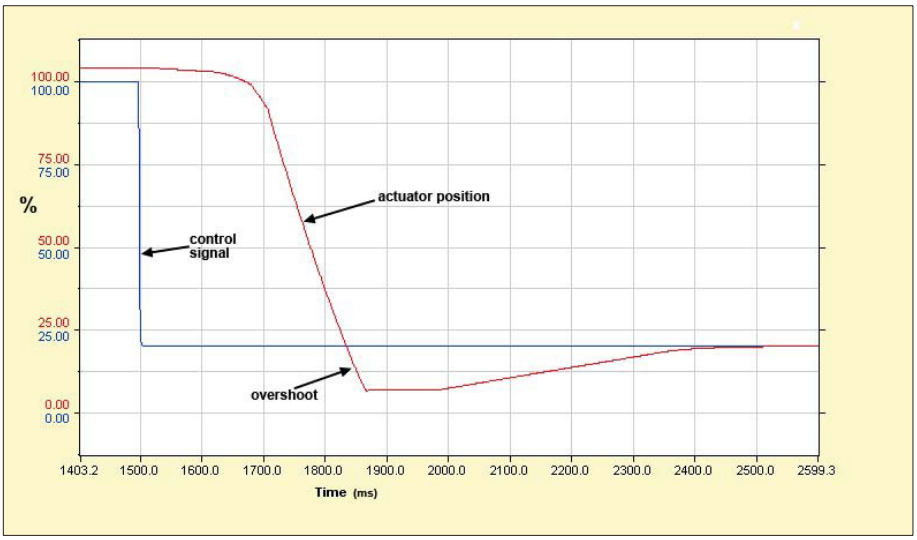


Figure G.1-1 Overshoot

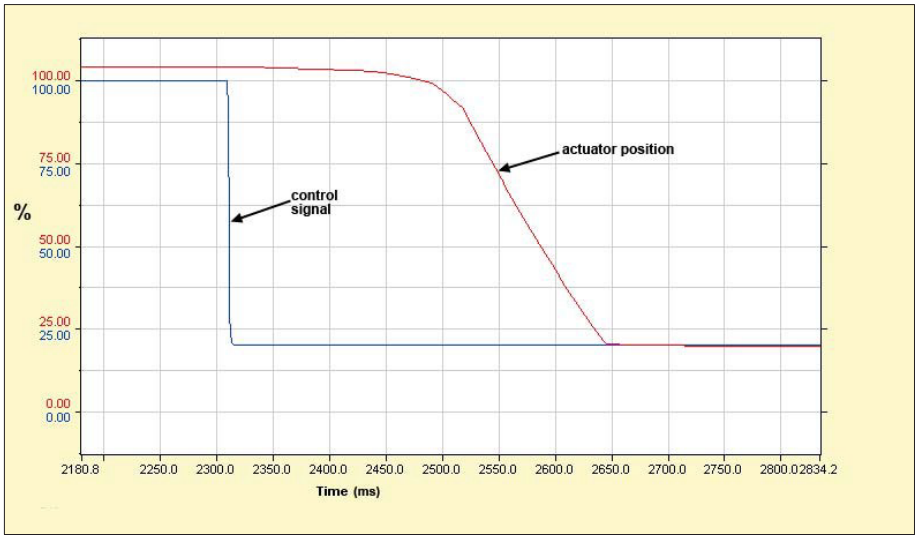


Figure G.1-2 Target position

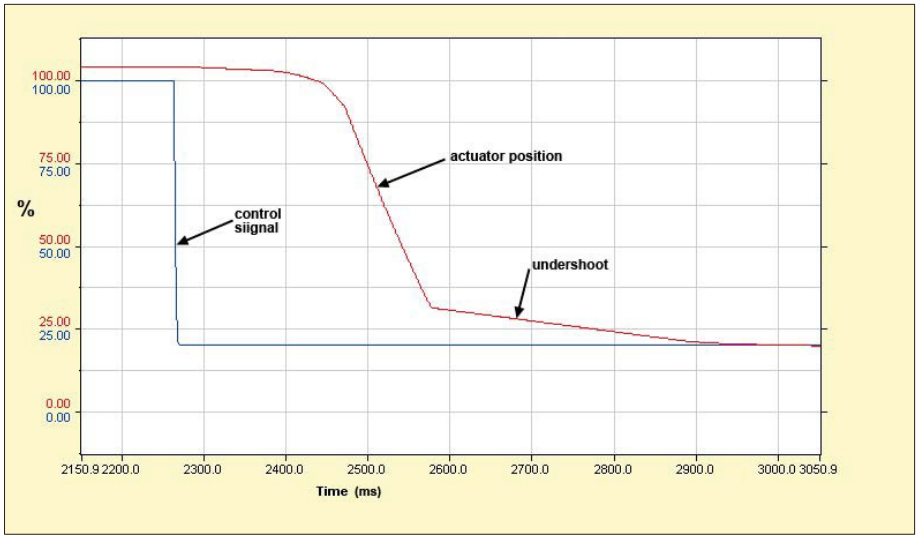


Figure G.1-3 Undershoot

G.2 INSTALLATION

The fast response solenoid is a 3-way configuration and piped external to the hydraulic cylinder. An adjustable needle valve is in line with the solenoid to allow custom adjustment of the surge speed to meet a particular installation.

The wires used for the surge solenoid are a pair of blue wires in the module cable. Connection for the solenoid within the control enclosure is made to TB4 of the power supply assembly as shown in G.2-1.

Refer to Figures G.2-1,-2,-3.

G.3 CALIBRATION

Refer to the CONTROL menu for additional information.

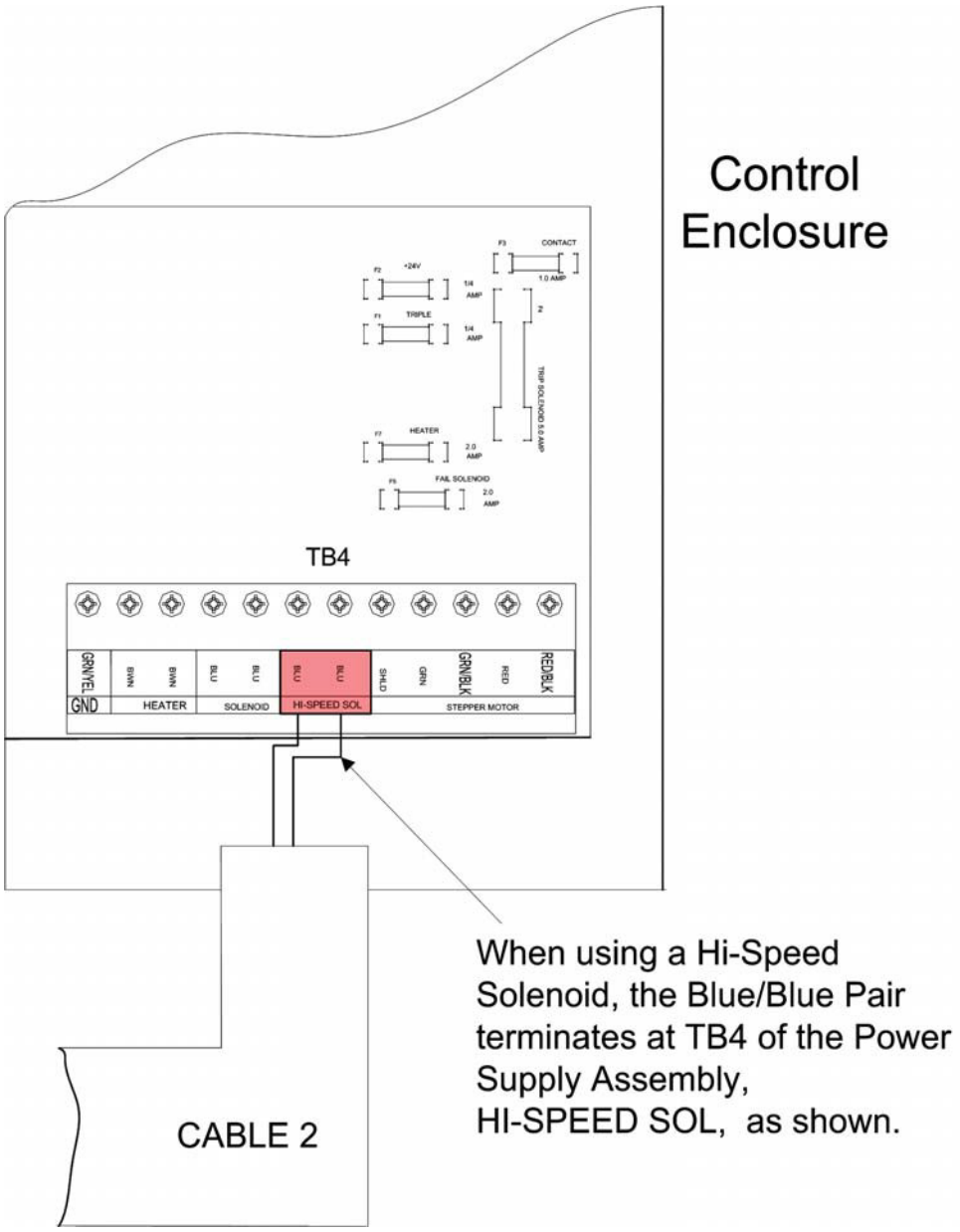
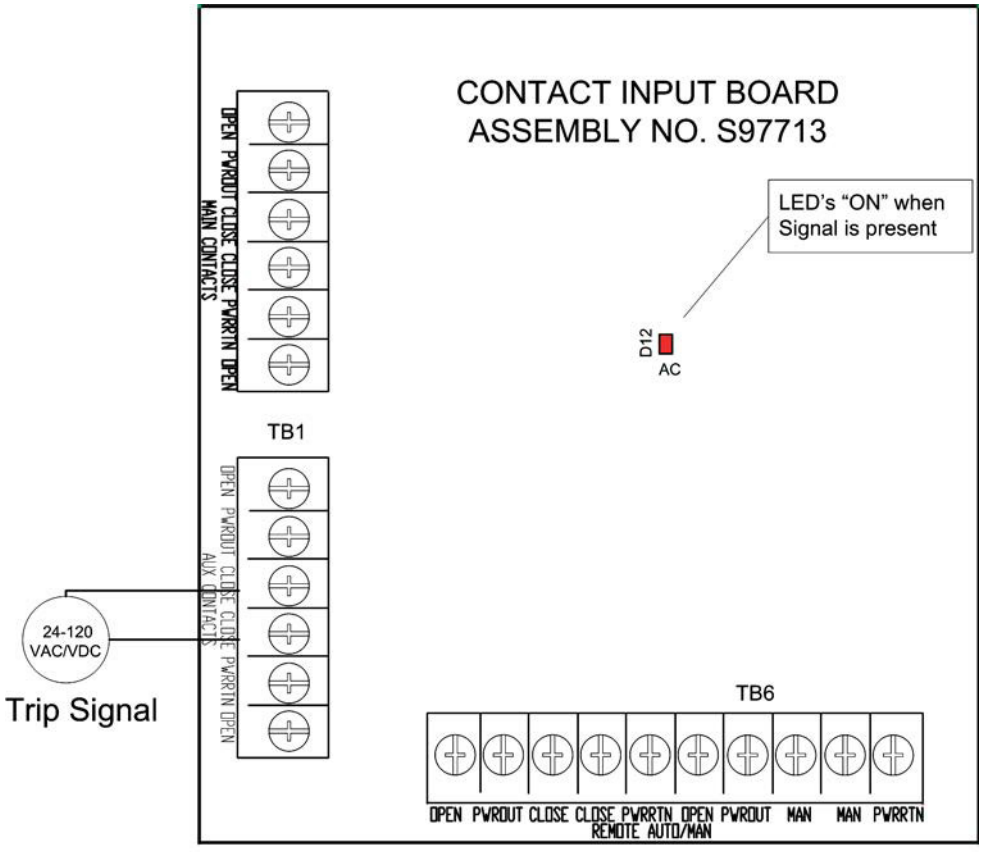


Figure G.3-1 Surge Solenoid Connection



When using a Hi-Speed Solenoid AND a "wet" Trip Signal Input, the user supplied Trip Signal is connected as shown above.

Figure G.3-2 Solenoid & "Wet" Trip Connection

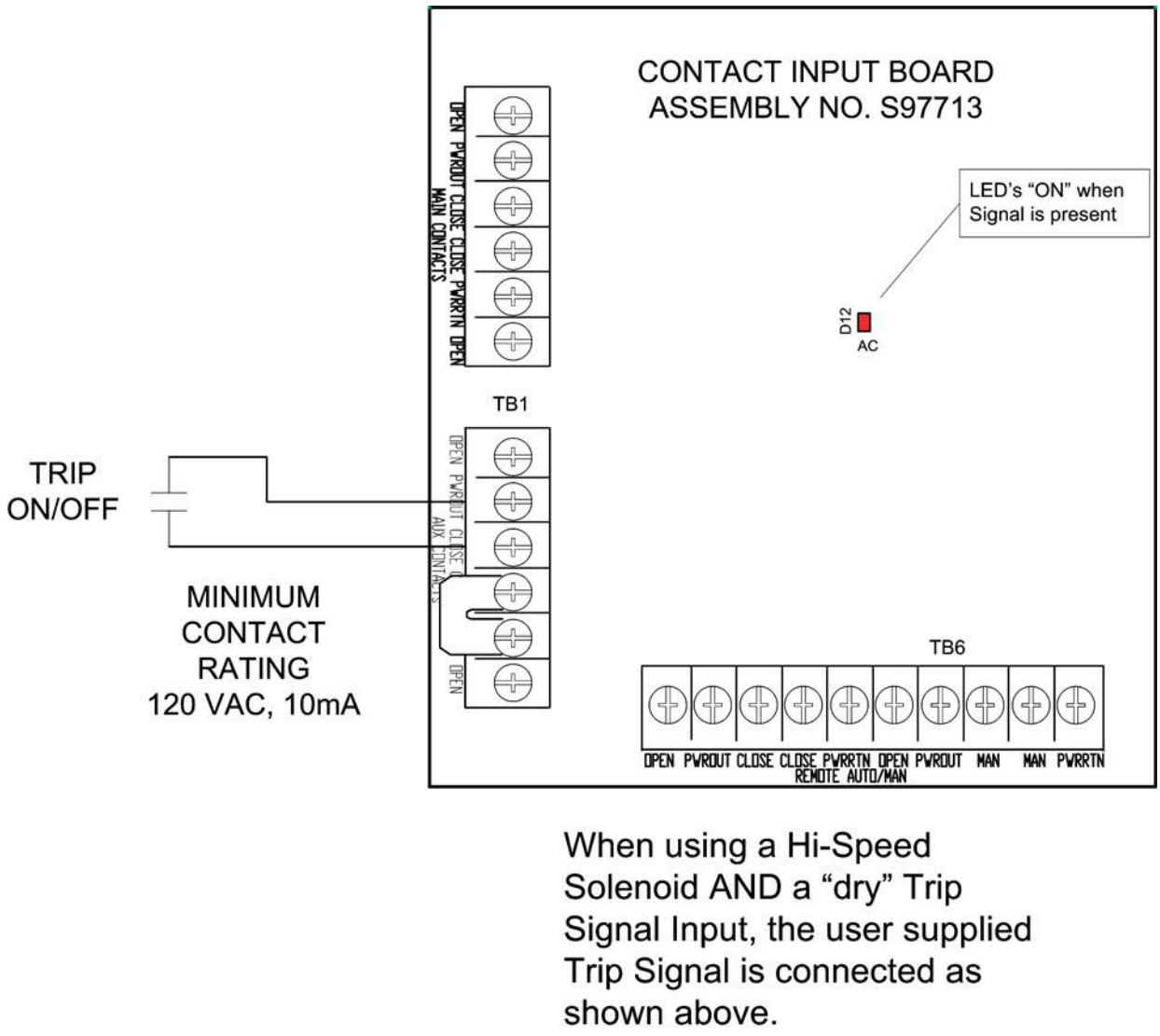
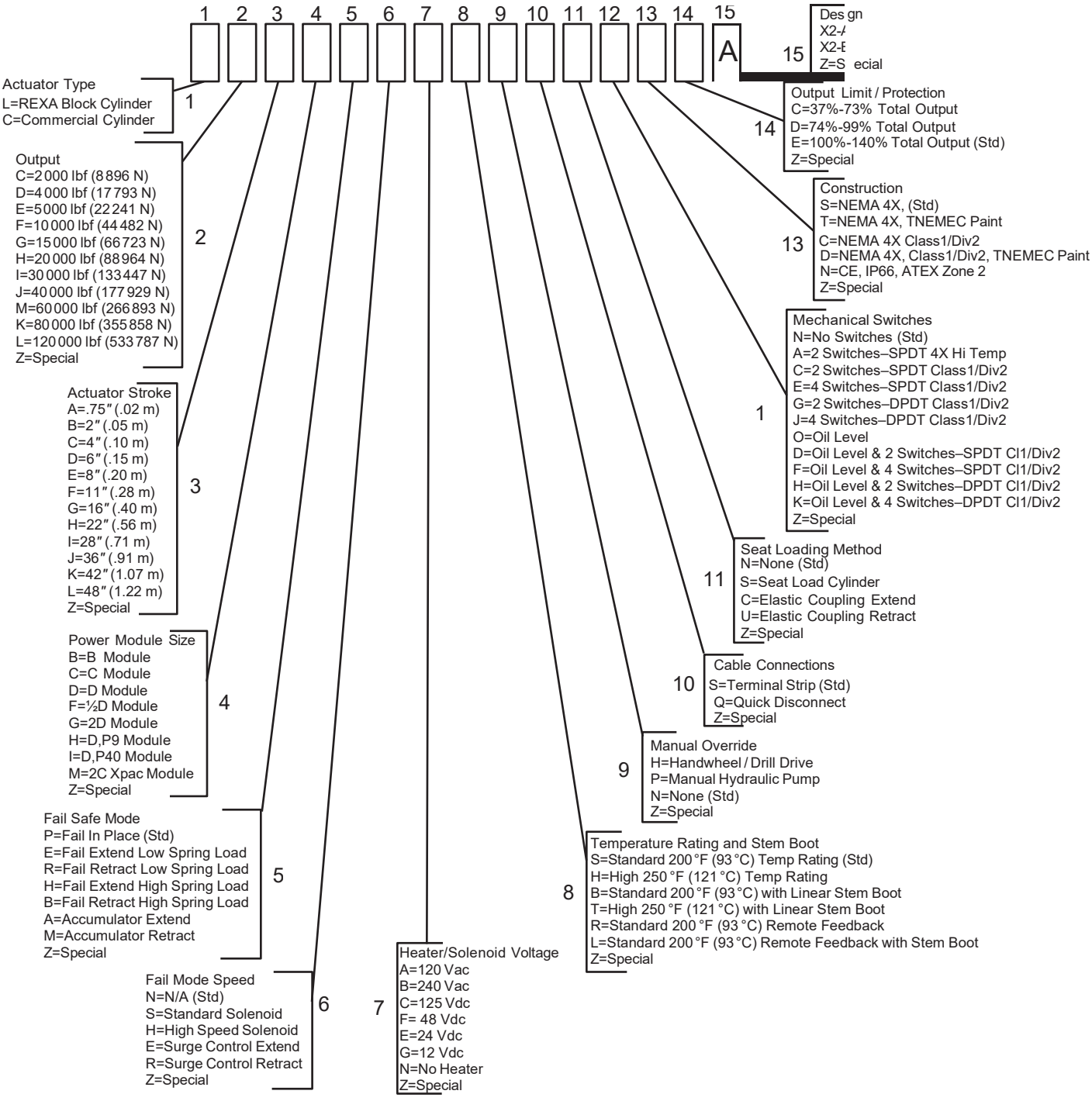


Figure G.3-3 Solenoid & "Dry" Trip Connection

H. Build Numbers

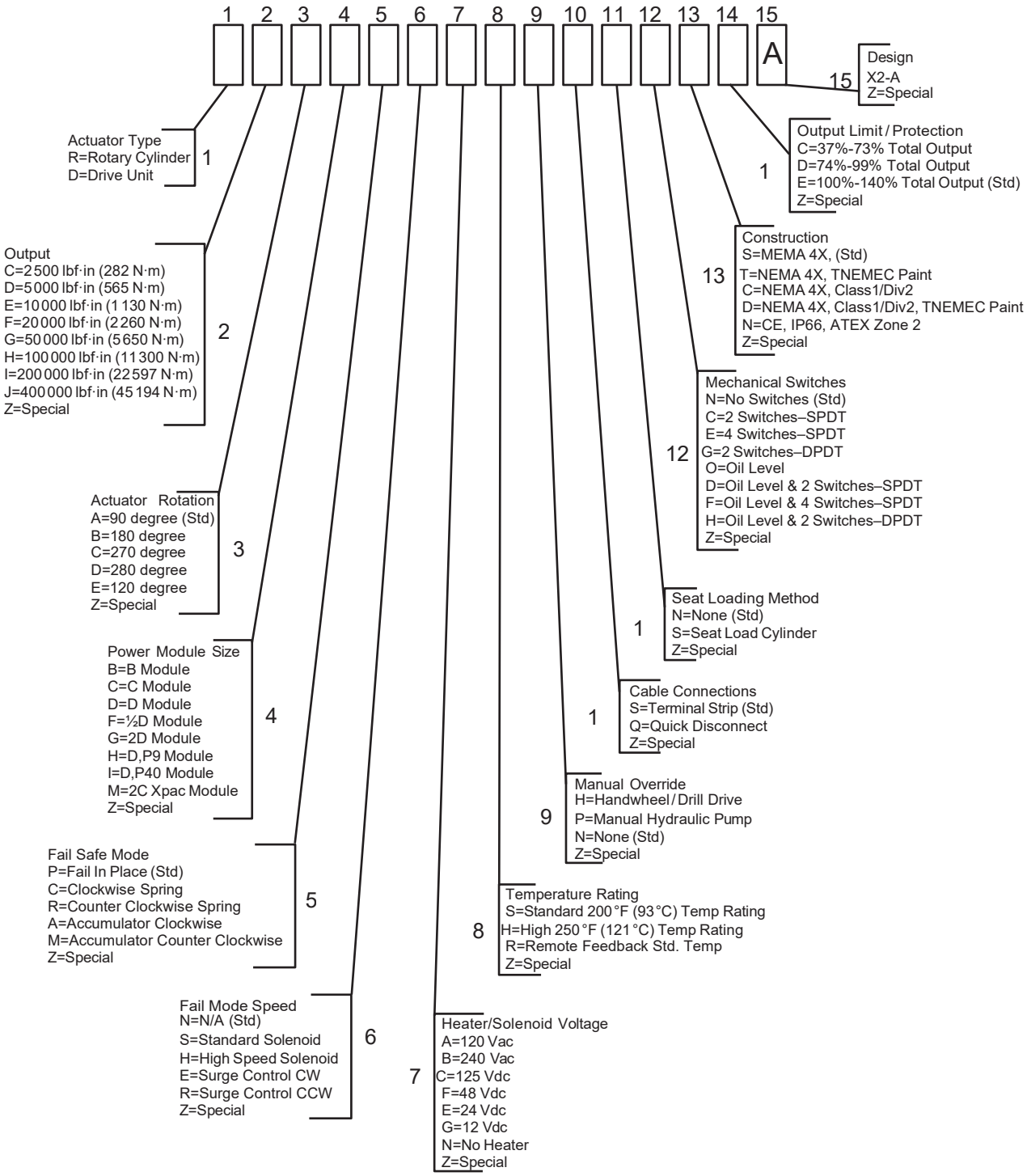
The build number is a catalog number REXA uses to designate in complete detail the construction of the actuator. From this number all configurations can be defined. There are two different categories of build numbers; one is for the mechanical sub-assembly, and the second is for it's corresponding electronics 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.

LINEAR SERIES ACTUATOR



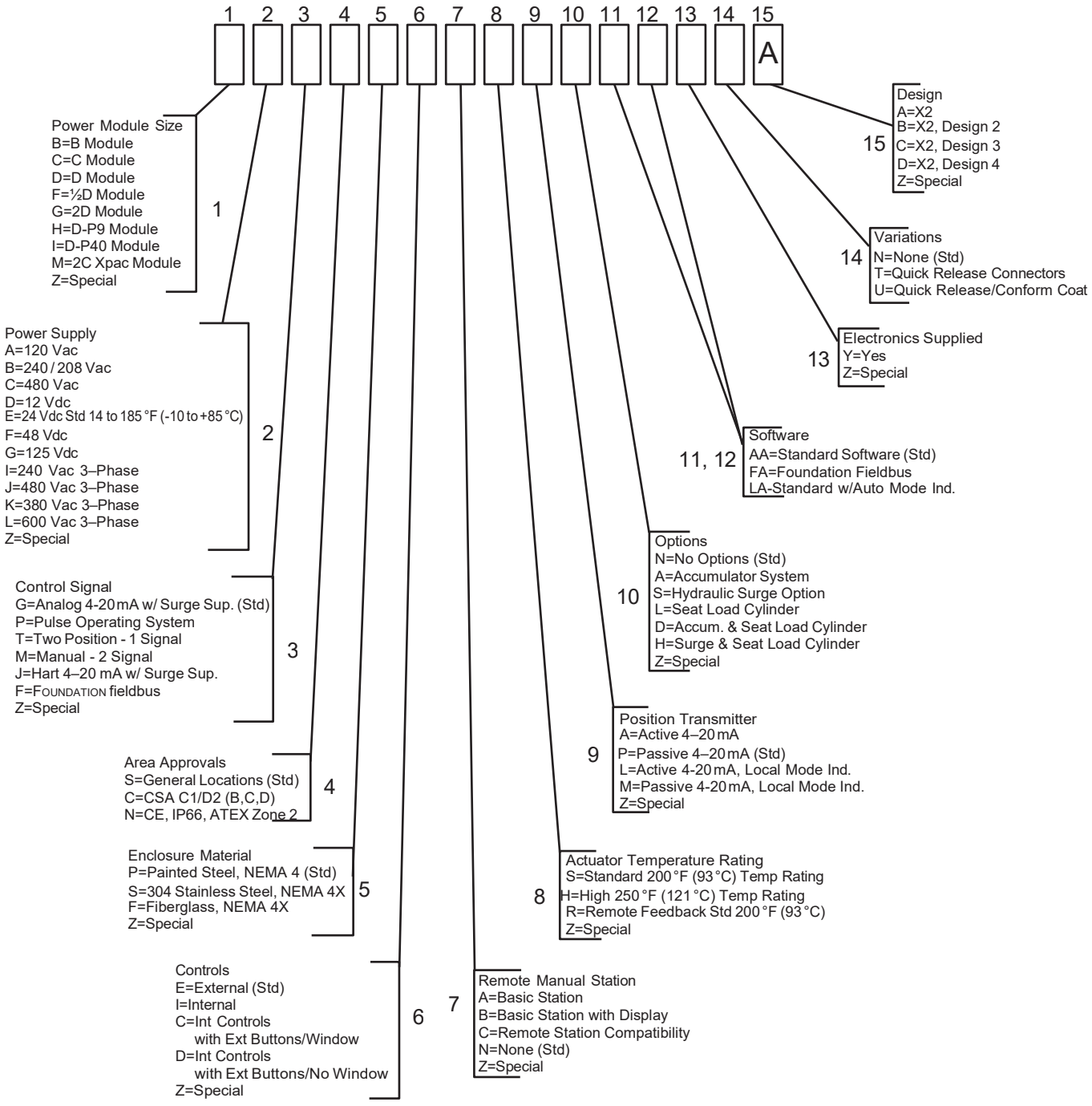
The most common codes are shown above. However, the Xpac 2 is an engineered product and REXA practices a policy of continuous improvement. As such, additional codes may be available or may be added without notice. Please contact the factory for information on any code not shown above.

ROTARY SERIES ACTUATOR



The most common codes are shown above. However, the Xpac 2 is an engineered product and REXA practices a policy of continuous improvement. As such, additional codes may be available or may be added without notice. Please contact the factory for information on any code not shown above.

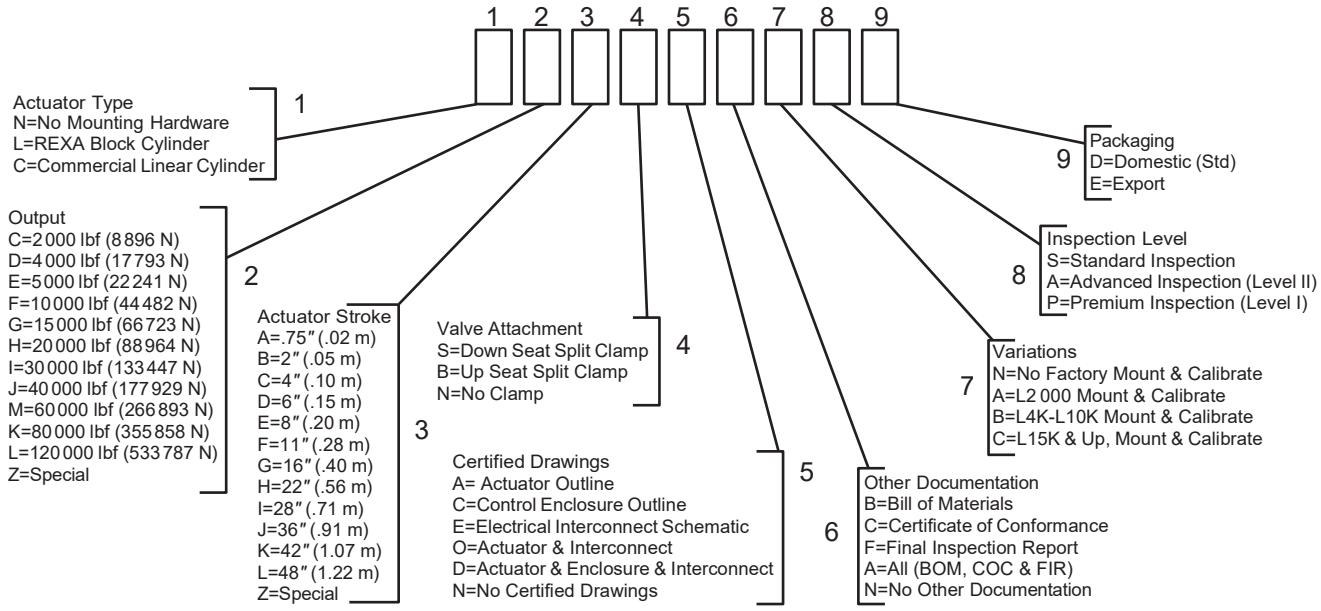
ELECTRONIC NUMBERING SYSTEM



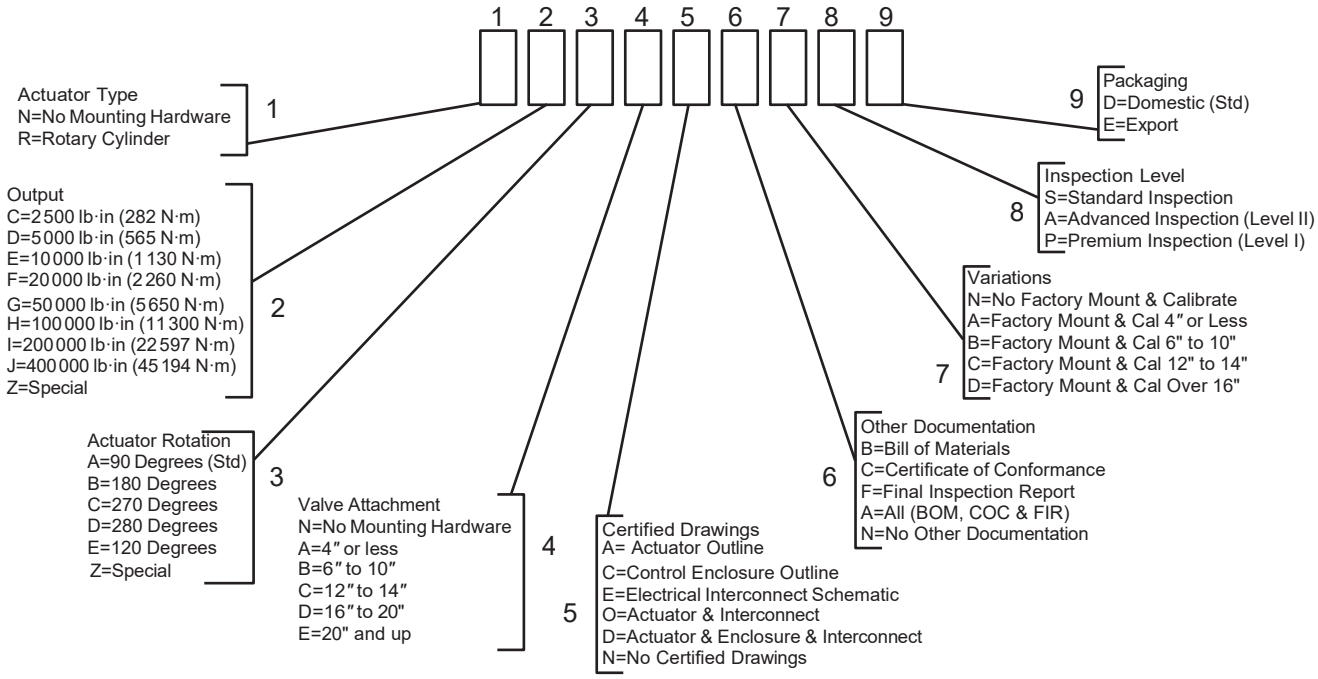
The most common codes are shown above. However, the Xpac 2 is an engineered product and REXA practices a policy of continuous improvement. As such, additional codes may be available or may be added without notice. Please contact the factory for information on any code not shown above.

MOUNTING SYSTEMS

Linear Series Actuator

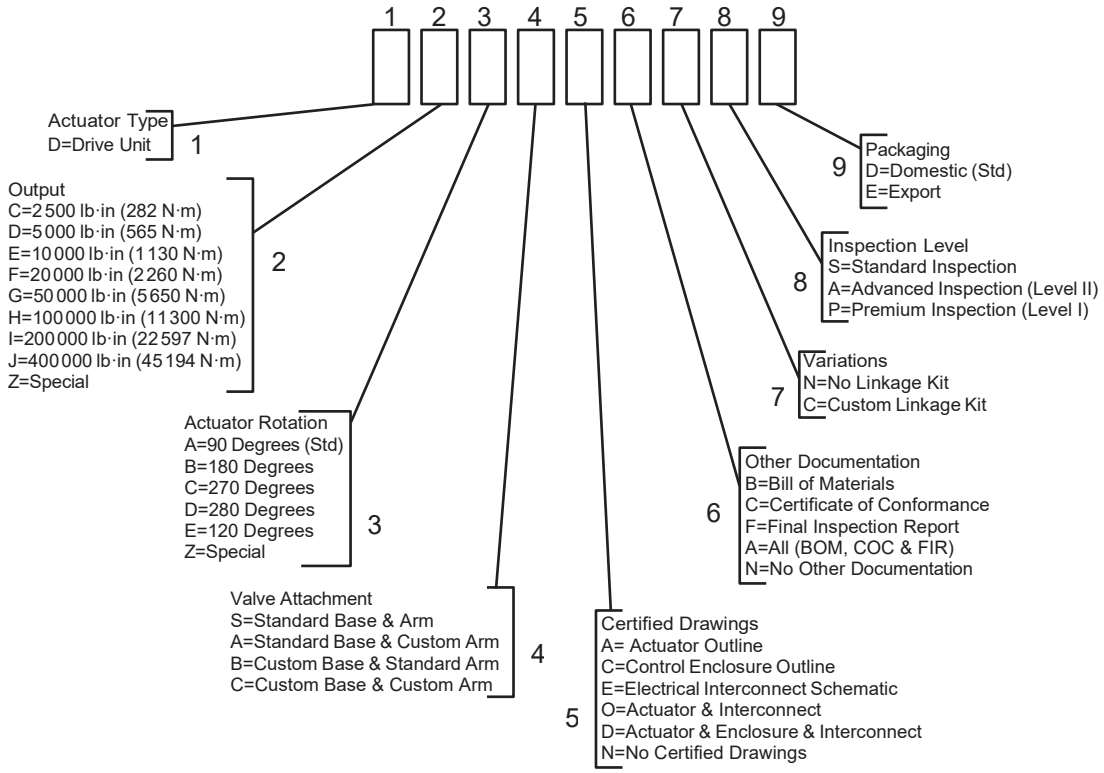


Rotary Series Actuator



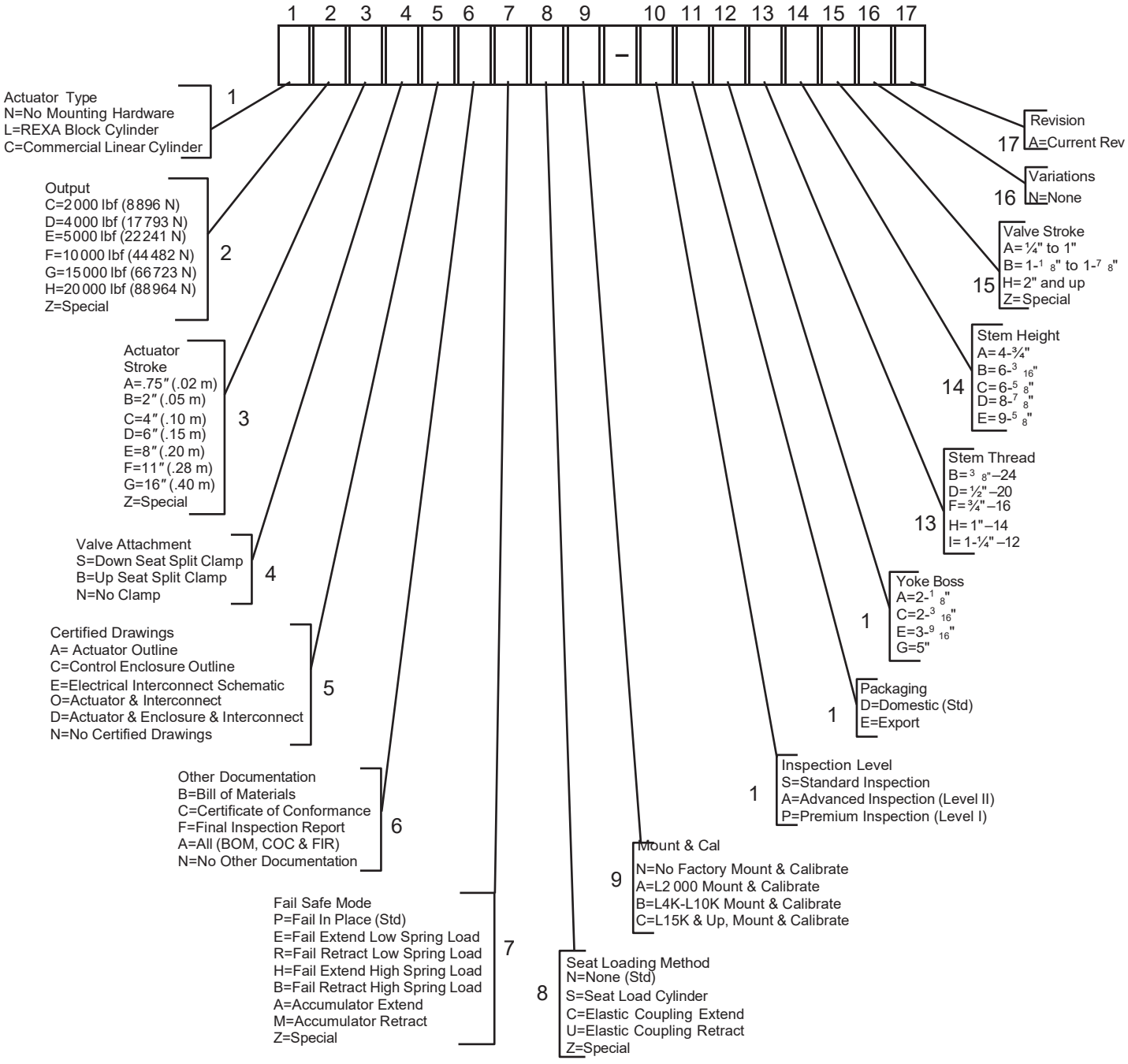
The most common codes are shown above. However, the Xpac 2 is an engineered product and REXA practices a policy of continuous improvement. As such, additional codes may be available or may be added without notice. Please contact the factory for information on any code not shown above.

Drive Series Mounting



The most common codes are shown above. However, the Xpac 2 is an engineered product and REXA practices a policy of continuous improvement. As such, additional codes may be available or may be added without notice. Please contact the factory for information on any code not shown above.

LINEAR FISHER MOUNTING



The most common codes are shown above. However, the Xpac 2 is an engineered product and REXA practices a policy of continuous improvement. As such, additional codes may be available or may be added without notice. Please contact the factory for information on any code not shown above.

K. Fieldbus

An **Xpac Series 2** actuator is represented on a Fieldbus network as a group of blocks through which the X2 actuator may be configured and operated. The blocks include:

- One Resource block
- One Analog Output block
- One Discrete Output block
- Two Analog Input blocks
- One Discrete Input block
- One Transducer block

The Resource block and the Input/Output blocks are standard Fieldbus blocks which implement the networking and control capability of a Fieldbus system. The Transducer block is a custom block which is designed specifically to connect an Xpac 2 actuator to a Fieldbus network. In a control application, the Transducer block reads and writes process variables from the actuator and passes these values to the network via the I/O blocks.

The Transducer block also provides access to all X2 actuator configuration (Setup) parameters (excluding stroke calibration parameters). Any configuration parameter which may be viewed or changed at the local Operator's Panel may also be viewed or changed over the Fieldbus network.

The Transducer block is also capable of gathering simultaneous data samples of X2 actuator Position, Setpoint, and (if implemented) Differential Pressure, and storing them for later retrieval. Two hundred samples of each variable are gathered in 20 groups of 10 samples of each variable. Data gathering may be initiated manually at any time, or automatically by a specified change in Setpoint. The rate at which the samples are gathered may also be specified.

All blocks have many named parameters. The standard Fieldbus blocks (Resource and I/O) contain only Fieldbus defined parameters which, in this document, are written as **FIELDBUS NAME** *(upper case lettering)* and when observed on a Fieldbus host are viewed in a similar manner. The Transducer block also contains Fieldbus defined parameters which are written and viewed as above. The Transducer block also contains X2 actuator specific custom parameters which may be viewed on a host in one of two ways; either as a default, software derived name or as a Device Description supplied name *(noted in brackets)*. In this document the custom parameters are written as **DEFAULT NAME {Device Description Name}** wherever the names *differ*. Parameter values where shown are in **bold** text

Resource block:

The Resource block provides device identification and some basic network communications parameters.

There are no X2 actuator specific parameters in this block.

Analog Output block (AO)

The AO block accepts analog values from the network and writes the value to the Transducer's block parameter Setpoint to control positioning of the X2 actuator.

The AO block also reads the Position of the X2 actuator from the Transducer block and passes the value to the network.

To use this block:

- Set the AO block parameter **CHANNEL** to **AO Setpoint**.

- Initialize the AO block parameter **SHED_OPT (NormalShed_NormalReturn** is sufficient).

- Set the Transducer block parameter **CONTROL_CHANNEL {Positioner Control Method}** to **CH1- Analog Output**

Analog Input blocks (AI)

The AI blocks read a process variable from the Transducer block and pass the value to the network as an analog value.

To use AI1 blocks and propagate Actuator Position:

- Set the AI1 block parameter **CHANNEL** to **AI1 Position**.

- Set the AI1 block parameter **L_TYPE** to **Indirect**.

- Set the AI1 block parameter **XD_SCALE:EU_100** to **100**
  :EU_0 to **0**
  :UNITS_INDEX to **%**.

- Set the AI1 block parameter **OUT_SCALE:EU_100** to **100**
  :EU_0 to **0**
  :UNITS_INDEX to **%**.

To use AI2 blocks and propagate Actuator Differential Pressure (if the feature is available):

- Set the AI2 block parameter **CHANNEL** to **AI2 Differential Pressure**.

- Set the AI2 block parameter **L_TYPE** to **Direct**.

- Set the AI2 block parameter **XD_SCALE:EU_100** to **3000**
  :EU_0 to **0**
  :UNITS_INDEX to **psi**.

- Set the AI2 block parameter **OUT_SCALE:EU_100** to **3000**
  :EU_0 to **0**
  :UNITS_INDEX to **psi**.

Discrete Output block (DO)

The DO block accepts discrete values from the network and forwards a value of 0% or 100% to the Transducer block parameter Setpoint to control positioning of the X2 actuator.

0x00 for a Setpoint of 0.0%

0x01 for a Setpoint of 100%

The DO block also reads the Position of the X2 actuator from the Transducer block and passes the value to the FF network as a discrete value.

0x00 if Position is less than 50.0%

0x01 if Position is equal to or greater than 50.0%

To use this block:

- Set the DO block parameter **CHANNEL** to **DO Setpoint**.

- Initialize the DO block parameter **SHED_OPT (NormalShed_Normal-Return** is sufficient).

- Set the Transducer block parameter **CONTROL_CHANNEL {Positioner Control Method}** to **CH4- Discrete Output**

Discrete Input block (DI)

The DI block reads the X2 actuator Position from the Transducer block and passes the value to the FF network as a discrete value.

0x00 if Position is less than or equal to 5%

0x01 if Position is greater than 5% and less than 95%

0x03 if Position is greater than 95%

To use this block:

- Set the DI block parameter **CHANNEL** to **DI Position**.

Transducer block

The Transducer block links the XPac X2 actuator to the Input/Output function blocks. It also provides access to all of the X2 actuator's configuration parameters. Other parameters which provide for control and observation of the X2 actuator are also included.

All parameters may be viewed at any time. To change any parameter, the block should be put in OOS (Out Of Service). To change any X2 actuator configuration parameter, the X2 actuator must also be in Comm Setup mode. The X2 actuator's current mode may be viewed using parameter **MODE_STATUS {Mode\Status Byte}**. The X2 actuator's current mode may be changed using parameter **OPERATING_MODE {Operating Mode}**.

X2 Actuator Configuration Parameters

The following lists all of the X2 actuator's configuration parameters. Details for each parameter may be found in the Setup section of this document. All of the listed parameters will always be visible over a fieldbus network. However, some parameters are not implemented in all X2 actuator Software versions, and some parameters may not be usable due to the current setting of other parameters. In either case, when a parameter is not usable it will have a value of "**1.#QNAN**". Any attempt to modify such a parameter will result in an error message.

CONTROL Menu

DEADBAND {Deadband}	**Deadband**
MIN_MODULATING {Minimum Modulating}	**Min Mod**
BUMPLESS {Bumpless Transfer}	**Bumpless**
SEAT_LOAD_CYLINDER {Seat Load Cylinder control}	**Seat Ld Cyl**
SEAT_LOAD {Seat Load Switching}	**Seat Load**
SOLENOID_SEAT {Solenoid Seating}	**Sol. Seat**
CALIBRATED_STROKE {Calibrated Stroke}	**Cal. Stroke**
FLOW_CHAR {Flow Characterization}	**Flow Char**
FLOW_CHAR_CS_10 {CS 10% Pt} thru	**CS 10% Pt** thru
FLOW_CHAR_CS_90 {CS 90% Pt}	**CS 90% Pt**

SPEED/ACCEL Menu

MAX_HI_SPEED {Max Hi Speed}	Max Hi Spd
MAX_UP_SPEED {Max Up Speed}	Max Up Spd
GAIN {Gain}	Gain
HI_ACCEL {Hi Accel}	Hi Accel
ACCEL_BKPT {Accel Breakpoint}	Accel Bkpt
LO_ACCEL {Lo Accel}	Lo Accel
TWO_SPEED {2 Speed}	2-Speed
MAX_LO_SPEED {Max Lo Speed}	Max Lo Spd
MAX_DN_SPEED {Max Dn Speed}	Max Dn Spd
SPEED_BKPT {Speed Breakpoint}	Speed Bkpt
MAX_MAN_SPEED {Max Man Speed}	Max Man Spd

INPUTS Menu

SIGNAL_TYPE {Signal Type}	Signal Type
PULSE_DURATION {Pulse Dur}	Pulse Dur
PULSE_INCREMENT {Pulse Inc}	Pulse Inc
FAILSAFE {Failsafe}	Failsafe
SHED_TIME {Shed Time}	Shed Time
TRIP {trip}	Trip
POWER_ON {Power On}	Power On

DRIVES Menu

DRIVE_TYPE {Drive Type}	Drive Type
STALL_TIME {Stall Time}	Stall Time
BOOST_PUMP_BKPT {Boost Pump}	Boost Pump
MAIN_VALVE_BKPT {Main Valves}	Main Valves

SURGE_BREAKPOINT {Surge Breakpoint}	Surge Bkpt
ACCUMULATOR {Accumulator}	Accumulator
ACCUM_HI_PRES {Recharge Pres}	Rechrg Pres
ACCUM_LO_PRES {Warn Pres}	Warn Pres
RECHARGE_TIME {Rechrg Time}	Rechrg Time
ACCUM_FAIL_DIR {Fail Dir}	Accum Dir
ACCUM_PRES {Accum Pres}	Accum Pres

OUTPUTS Menu

RELAY_1 {Relay #1}	Relay #1
RELAY_2 {Relay #2}	Relay #2
POS_XMTR {Position Transmitter}	Pos Xmitter
Password {Password}	Password
OPEN_PRES {Open Pres}	Open Pres
CLOSE_PRES {Close Pres}	Close Pres
SOFTWARE_VERSION {Controller Software Version}	Version

CURRENT STATS and **HISTORIC STATS** Menus:

MEM_FAIL {Memory fail Error Count}	Mem fail
A/D_FAIL {A/D fail Error Count}	A/D fail
DRIVE_FAULT {Drive fault Error Count}	Drive fault
PRESSURE_BAD {Accumulator pressure bad}	Pressure bd
SHED_TIME_ERROR {Shed Time error}	Shed Time
SLC_FB_BAD {SLC Feedback bad}	SLC Fb bad
FB_BAD {Feedback bad}	Fb bad
CS_BAD {Control signal bad}	Cs bad
DIRECTION {Direction error}	Direction
SLC_STOP {SLC stop}	SLC stop

STALL {Stall}	Stall
CL_PRESS_BAD {Close Pres bad}	Cl Pres bad
OP_PRESS_BAD {Open Pres bad}	Op Pres bad
LOW_OIL {Low Oil}	Low Oil
OVERTEMP {Over Temp}	Over Temp
STARTS_X1K {Starts x1K}	Starts x1K
STROKES_X1K {Strokes x1K}	Strokes x1K

Other X2 actuator parameters:

CONTROL_CHANNEL {Positioner Control Method}: This parameter specifies which output block is to provide the Setpoint to the Transducer block.

CH1-Analog Output: Selects the AO block as the Setpoint source.

CH4-Discrete Output: Selects the DO block as the Setpoint source.

OPERATING_MODE {Operating Mode}: This parameter is used to change the mode of operation of the X2 actuator.

Auto mode: Switches the X2 actuator to Auto mode for Setpoint tracking.

Comm Setup mode: Switches the X2 actuator to a Setup mode for configuration over the Fieldbus network.

Panel Setup mode and **Panel Local mode**: These modes are only selectable at the X2 actuator's local Operator's Panel and cannot be invoked over the Fieldbus network.

MODE_STATUS {Mode\Status Byte}: This parameter reports the current mode of operation of the X2 actuator.

Auto mode: The X2 actuator is following the Setpoint input. No X2 actuator configuration parameter may be modified while in Auto mode.

In **Comm Setup Mode**: The X2 actuator is holding position. Any X2 actuator configuration parameter may be modified over the Fieldbus network.

Panel Setup Mode: The X2 actuator is holding position. Any X2 actuator configuration parameter may be modified at the local Operators Panel.

Manual Mode (either **Local** or **Remote**): The X2 actuator is holding position but may be manually stroked at the local Operator's Panel or via a remote hand/auto station.

The **Mode\Status Byte** also reports the presence of the **Contact Input Board** if it is installed in the X2 actuator, and reports active status of the Trip input (override signal).

RESPONSE_CODE {Response Code}: When an X2 actuator configuration parameter is written, a response code is issued as part of the return message indicating the relative success or failure of the write operation.

Success: the data was accepted unconditionally.

Conditional success: the data sent was too large, too small or imprecise. The X2 actuator has corrected the data by rounding down, rounding up, or rounding off the value sent prior to writing.

Failure Not Available: The write attempt was rejected because the parameter is not used in this version of the X2 actuator or the parameter is currently not usable due to settings of other parameters. When a parameter is not available it is displayed with a value of "**1.#QNAN**".

Failure Wrong Mode: The write attempt was rejected because the X2 actuator was not in Comm Setup Mode.

Failure No Contact: The write attempt was rejected because the parameter requires use of the Contact Input Board which is not present in the X2 actuator.

POSITION: This parameter reports the X2 actuator's current position.

CONTROL_SIGNAL {Control Signal}: This parameter is not used with a Fieldbus network and should be ignored.

TARGET_POS {Target}: This parameter reports the current target position of the X2 actuator. Target position normally equals the Setpoint value but may be modified by use of other parameters such as Flow Characterization, Minimum Modulating, Bumpless Transfer, etc.

SETPOINT: This parameter reports the current value of the X2 actuator's Setpoint input.

DIFF_PRESSURE: This parameter reports the current differential pressure measured across the X2 actuator's hydraulic cylinder(s). It may be used to calculate thrust or torque by multiplying the value times the net working area of the hydraulic cylinder(s). When the differential pressure measuring feature is not implemented, this parameter's value will be "**1.#QNAN**".

ERROR_BYTE1 (error_byte1},

ERROR_BYTE2 (error_byte2},

ERROR_BYTE3 (error_byte3}: These parameters report any error conditions detected within the X2 actuator.

ERROR_BYTE1:

main feedback failure	FB bad
seat load cylinder feedback failure	SlcFb bad
control signal failure	CS bad
actuator direction error	Dir error
-15 volt power supply failure	-15 fail
+15 volt power supply failure	+15 fail
seat load cylinder stall	Slc stop
actuator stall	Stall

ERROR_BYTE2:

motor drive fault	Drv fault
accumulator pressure transducer bad	Pres bad
accumulator requires recharge flag	Pres low
bad keypad	Key bad
eprom erase/program failure	Mem fail
pulse/contact board missing	No inp bd
A/D failure	A/D fail
CPU failure	CPU fail

ERROR_BYTE3:

open direction pressure transducer bad	Op Pres bad
close direction pressure transducer bad	Cl Pres bad
oil over temperature	Over Temp
low oil	Low Oil
shed time exceeded	Shed Time

X2 Actuator Data Collection Parameters

COLLECTION_MODE {collection _mode}: specifies the method of initiating data gathering. Select:

MANUAL for operator initiated gathering

AUTO for initiating on a change in Setpoint

COLLECTION_CONTROL {collection_control}: used to **START** a manually initiated collection. **STOP** may be used to halt a collection prior to 200 samples of each parameter having been collected.

COLLECTION_DELTA_SP {collection_delta_sp}: when collection_mode is AUTO, specifies the change in Setpoint required to initiate collection.

Once automatically initiated, collecting will continue until 200 samples of each variable have been gathered.

COLLECTION_SAMPLE_RATE {collection_sample _rate}: specifies the rate at which samples of each variable will be collected in samples per second. Select **1, 2, 4, 5, 10, 20**.

COLLECTION_INDEX {collection_index}: when reading the collected variables, this specifies which group of 10 values to return. Select Group 1 for the 1st 10 values, Group 2 for values 11 through 20, etc., up to Group 20 for values 191 through 200. Unused samples or samples read prior to gathering will read zero.

COLLECTION_SETPOINT {collection_setpoint},

COLLECTION_POSITION {collection_position},

COLLECTION_DIFF_PRESSURE {collection_diff_pressure}: when read, these return 10 successive values of the named variable as specified by the collection_index. When the Differential Pressure measuring feature is not implemented, collection_diff_pressure will read "**1.#QNAN**".

Notes: *Data collection parameters.*

1. For each collection variable, the first sample of Group 1 is the value of the variable immediately prior to the initiation of collection. The second sample is the value of the variable one sample interval later. The third sample is the value of the variable a second sample interval later, etc.

2. When collection mode is set to AUTO, the first two samples of the setpoint variable show the change in setpoint which initiated the collection.

3. The variable differential pressure is collected using peak detection methods. During a sampling interval, differential pressure is continuously monitored and the largest value found during the sampling interval is reported as the value for that interval.

4. The differential pressure peak detector runs continuously. Therefore, the first sample of Group 1 for the collection variable differential pressure is the maximum value detected since the end of the last collection period. This value is generally not meaningful and can be discarded.

M. Manual Operators

The Xpac has two types of manual operators available: Declutchable Handwheel / Drill Drive and Manual Hydraulic Pump. Since both options utilize our hydraulic circuit for override operation, they will only function if the system is in working order.

CAUTION:
Before attempting to operate any manual override feature, make sure that the electric power is OFF.

M.1 DECLUTCHABLE HANDWHEEL

The handwheel is mounted to the motor output end of the actuator. To operate, depress and turn the handwheel. One half-revolution may be required before proper engagement, as the inside of the handwheel must engage with the motor shaft. The handwheel will declutch by moving outwards when released. Clockwise rotation of the manual operator will retract the stem on a linear unit and clockwise rotate the shaft (looking at the feedback housing) on a rotary unit.

HANDWHEEL REVOLUTIONS		
Power Module	**Linear** (To move one inch per 1000 lb of rated thrust)	**Rotary** (90° of rotation/1000 lb·in of rated torque)
B	~75	~200
C, ½D	~25	~65
D	~13	~33

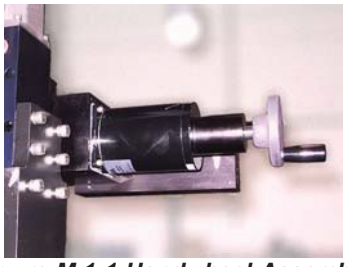


Figure M.1-1 Handwheel Assembly

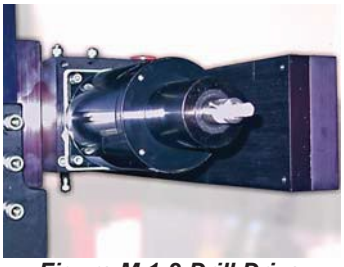


Figure M.1-2 Drill Drive

Figure M.1-3 Drill Drive with Drill

M.1.2 Declutchable Drill Drive

The drill drive is part of the handwheel assembly that can be used on standard B, C, 1/2D, and D power modules rated for hazardous but non-explosion proof environments to drive the unit. The handwheel can be removed by simply pulling on it to expose a 5/16" hex drive. To operate, connect an appropriate drill to the 5/16" hex. Push the drive in and turn. One half-revolution may be required before proper engagement, since the drive must contact a slot on the end of the motor shaft. Clockwise rotation of the manual operator will retract the stem on a linear unit and rotate the shaft clockwise (looking at the feedback housing) on a rotary unit. The drive will declutch by moving outwards when released.

Note: *The actuator's drive train and cylinder must be in proper working order to operate handwheel/drill drive.*

CAUTION:
Care must be taken to ensure the drill gun is limited to 2000 rpm. Running into a mechanical stop using a drill may damage the actuator and potentially the equipment it is attached to. As the actuator nears the end point, decrease drill speed so damage doesn't occur.

M.2 MANUAL HYDRAULIC PUMP

The manual hydraulic pump can be installed on all units and 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.

To operate the manual hydraulic pump, insert lever into the piston assembly and pump the handle up and down. To reverse the actuator direction, either push in or pull out the black, direction control knob located on the bottom of the assembly.

CAUTION:
After use of manual hydraulic pump, the directional control knob must be cycled to ensure proper operation of the actuator.

Note: *It is not advisable to leave the lever in the piston assembly when the hydraulic pump is not in use.*

MANUAL HYDRAULIC PUMP SPEEDS (# of pumps)	
Linear	**Rotary**
(To move one inch/1000 lb of rated thrust)	(90º of rotation/1000 lb·in of rated torque)
~1	~2.5

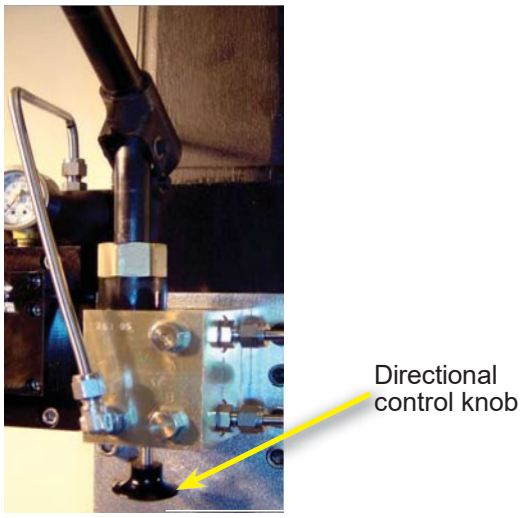


Figure M.2 Manual Hydraulic Pump

M.3 FAIL SAFE UNIT OPERATION

Fail Safe units, Spring Return and Accumulator, utilize solenoid valves in the fail safe operation. Upon loss of power these solenoids will change state. In order for manual operation, solenoids must be in position B for normally open solenoids. Manually override them so they appear as shown in Figure M.3.

Refer to Rotary Spring Fail and Linear Spring Fail sections under Mechanical Installation for additional information.

WARNING!
After using the handwheel, the overrides must be returned to their open position or the unit will not operate correctly when power is restored or trip signal removed. If only one override is returned to the open position after a trip, damage to the power module may occur. Changing the override(s) back may also cause the actuator to run to the fail safe position.

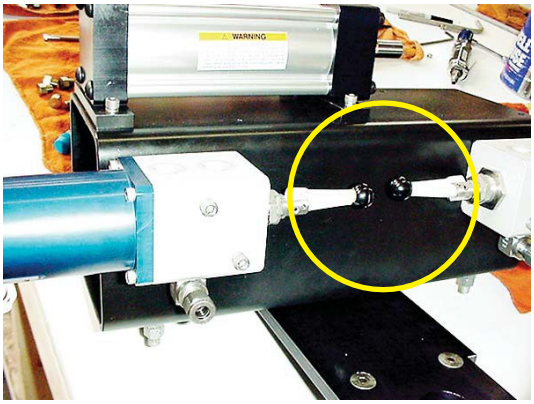


Figure M.3 Solenoid Manual Override Levers (Position B)

N. Digital Communications

N.1 HART® FIELD DEVICE SPECIFICATION

N.1 HART® FIELD DEVICE SPECIFICATION

HART® Field Device Specification:

REXA

Xpac Series X2 REXA Electrohydraulic Actuator

Author: Larry Schoonover

REXA

Version 1.0

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Scope

The Xpac Series X2 REXA Electrohydraulic Actuator complies with HART Protocol Revision 5.0. This document specifies all the device specific features and documents HART Protocol implementation details. The HART functionality of this Field Device is described sufficiently to allow its proper application in a process and its complete support in HART capable Host Applications.

To properly communicate with HART Protocol Revision 5.0 the REXA must be in Burst Mode. All DCS, PCS, and I/O modules must support HART Burst Mode. Refer to section 9.2.

1.2 Purpose

This specification is designed to compliment other documentation (e.g., the Xpac Series X2 REXA Electrohydraulic Actuator Installation Manual) by providing a complete, unambiguous description of this Field Device from a HART Communication perspective

1.3 Who should use this document?

The specification is designed to be a technical reference for HART capable Host Application Developers, System Integrators and knowledgeable End Users. It also provides functional specifications (e.g., commands, enumerations and performance requirements) used during Field Device development, maintenance and testing. This document assumes the reader is familiar with HART Protocol requirements and terminology.

1.4 Abbreviations and definitions

Abbreviations

ADC	Analog to Digital Converter
CPU	Central Processing Unit (of microprocessor)

EEPROM Electrically-Erasable Read-Only Memory

Definitions

Actuator A field device whose primary purpose is to vary its output thus affecting the connected process. An actuator typically uses the 4-20 mA Loop Current as a setpoint.

1.5 References

Hart Revision 5 specifications: HCF_SPEC-11, HCF_SPEC-54, HCF_SPEC-81, HCF_SPEC-99, HCF_SPEC-127, HCF_SPEC-151, HCF_SPEC-183, HCF_SPEC-307. Available from the HCF.

Xpac Series X2 REXA Electrohydraulic Actuator Installation Manual, Available from REXA.

2. DEVICE IDENTIFICATION

Manufacturer Name:	REXA	**Model Name(s):**	X2
Manufacture ID Code:	222 (DE Hex)	**Device Type Code:**	128 (80 Hex)
HART Protocol Revision	5.0	**Device Revision:**	1
Number of Device Variables	None		
Physical Layers Supported	FSK		
Physical Device Category	Actuator		

3. PRODUCT OVERVIEW

The X2 is an electrohydraulic actuator that is powered separately from the primary analog input signal. The actuator and its electronics do not draw current from the circuit which is used only for HART signaling.

The X2 is configured using the pushbuttons on the front panel of the device. The analogue input of this device is interpreted by the device as a setpoint. The setpoint can be treated linearly or characterized according to user input. The HART communication over the analog input is used primarily for monitoring of position, signal, and cylinder differential pressure (may not be available on all models).

4. PRODUCT INTERFACES

4.1 Process Interface

4.1.1 SENSOR INPUT CHANNELS

The X2 has sensors that measure actuator position, actuator differential pressure, and analog input signal. The measurements from these sensors are scaled by the device into engineering units and are available as variables using HART communication.

Other sensors are available as options but are not available using HART communication. These are described in the X2 manual.

4.2 Host interface

4.2.1 ANALOG INPUT 1: ACTUATOR SETPOINT

The two-wire 4-to-20mA current loop is connected to the X2 . Refer to the Installation Manual for connection details.

4.3 Local Interfaces, Jumpers And Switches

4.3.1 LOCAL CONTROLS AND DISPLAYS

The local controls and displays are described in the X2 manual.

4.3.2 INTERNAL JUMPERS AND SWITCHES

This internal jumpers and switches are described in the X2 manual.

5. DEVICE VARIABLES

This Field Device does not expose any Device Variables.

6. DYNAMIC VARIABLES

Two Dynamic Variables are implemented.

	Meaning	Units
PV	Position of the actuator	%
SV	Pressure differential	psi

7. STATUS INFORMATION

7.1 Device Status

Bit 4 (“More Status Available”) is set whenever any status bit is detected. Command #48 gives further detail.

7.2 Additional Device Status (Command #48)

Command #48 returns 6 bytes of status data, with the following status information:

Byte	Bit	Meaning	Class
0*	0	Invalid EEPROM state	Error
	1	Invalid EEPROM write	Error
	2	EEPROM write error	Error
	3	Not used	
	4	Not used	
	5	Not used	
	6	Not used	
	7	Not used	
1	0	Main feedback failure	Error
	1**	Seat load cylinder feedback failure	Error
	2	Control signal failure	Error
	3	Actuator direction error	Error
	4	-15v supply failure	Error
	5	15v supply failure	Error
	6**	Seat load cylinder stall	Warning
	7	Actuator stall	Error
2	0	Motor drive fault	Warning
	1**	Bad pressure reading	Warning
	2**	Accumulator requires recharge	Warning
	3	Bad keypad	Warning
	4	EEPROM erase failure	Error
	5	Pulse board missing	Error
	6	A/D failure	Error
	7	CPU failure	Error

3	0**	Open direction pressure bad	Error
	1**	Close direction pressure bad	Error
	2**	Temperature too high	Warning
	3**	Low oil	Warning
	4	Not used	
	5	Not used	
	6	Not used	
	7	Not used	
4	0	Local manual control	Information
	1	Remote manual control	Information
	2	Not used	
	3	Not used	
	4	Not used	
	5	Not used	
	6	Not used	
	7	Not used	
5		Not used	

*Byte 0 refers to the HART interface board. The remaining bytes refer to the controller board.

**Not available on all models.

"Not used" bits are always set to 0.

These bits are set or cleared by the self-test executed at power up, or following a reset command. They are also set (but not cleared) by any failure detected during continuous background self-testing.

8. UNIVERSAL COMMANDS

8.1 Supported Commands

Command Number: 0

Command Name: Read Unique Identifier

Command Type: Read

Sets Configuration Changed: no

Description: Returns the manufacturer and device information needed for other communication with the device. This command can be sent using short addressing (polling address) and thus can be used before knowing the full device address.

Request: no data

Response:

Byte 0: u8 - Device code for expansion – 254

Byte 1: u8 – Manufacturers code – 222 for REXA

Byte 2: u8 – Manufacturers device code – 128 for this device

Byte 3: u8 – Number of preambles required for this device – default is 5

Byte 4: u8 – Universal command revision – 5 for this device

Byte 5: u8 – Transmitter revision – 1 for this device

Byte 6: u8 – Software revision – 1 for this device

Byte 7: u8 – Hardware revision multiplied by 8 – 8 for this device (revision of 1)

Byte 8: u8 – Flags – 0 for this device

Bytes 9 – 11: u24 – Device ID

Command Errors: none

Command Number: 1

Command Name: Read Primary Variable

Command Type: Read

Sets Configuration Changed: no

Description: Returns the primary variable (position) and its units (%)

Request: no data

Response:

Byte 0: u8 – Position units code – 57 for this device which is the code for percent

Bytes 1-4: float – Primary variable – position for this device

Command Errors: none

Command Number: 2

Command Name: Read Current and Percent of Range

Command Type: Read

Sets Configuration Changed: no

Description: Returns the input signal in mA and the signal as a percent of the signal scale.

Request: no data

Response:

Bytes 0-3: float – Input signal in mA

Bytes 4-7: float – Input signal as a percent of range in percent

Command Errors: none

Command Number: 3

Command Name: Read Dynamic Variables

Command Type: Read

Sets Configuration Changed: no

Description: Returns the primary variable (position), the secondary variable (pressure differential) and the input signal. The units of the PV and SV are also returned.

Request: no data

Response:

Bytes 0-3: float – input signal in mA

Byte 4: u8 – Units code of the primary variable – 57 (percent) for this device

Bytes 5-8: float – The primary variable - position for this device

Byte 9: u8 – Units code of the secondary variable – 6 (psi) for this device

Bytes 10-13: The secondary variable – pressure differential for this device

Command Errors: none

Command Number: 6

Command Name: Write Polling Address

Command Type: Write

Sets Configuration Changed: yes

Description: Sets the polling address for the device.

Request:

Byte 0: u8 – Polling address. Can be 0 to 15. Since this device is controlled by the 4-20 signal, only polling address 0 should be used.

Response:

Byte 0: u8 – Polling address

Command Errors:

2 – Invalid parameter if the polling address is greater than 15

Command Number: 11

Command Name: Read Unique Identifier Associated with Tag

Command Type: Read

Sets Configuration Changed: no

Description: Returns device identification information if the device tag matches the tag sent in this command.

Request:

Bytes 0-5: ascii – The device tag which can be up to 8 text characters long.

Response: Note: the device only responds if the tag matches the tag saved in the device. If the tag does not match, the device does not respond at all.

Byte 0: u8 - Device code for expansion – 254

Byte 1: u8 – Manufacturers code – 222 for REXA

Byte 2: u8 – Manufacturers device code – 128 for this device

Byte 3: u8 – Number of preambles required for this device – default is 5

Byte 4: u8 – Universal command revision – 5 for this device

Byte 5: u8 – Transmitter revision – 1 for this device

Byte 6: u8 – Software revision – 1 for this device

Byte 7: u8 – Hardware revision multiplied by 8 – 8 for this device (revision of 1)

Byte 8: u8 – Flags – 0 for this device

Bytes 9 – 11: u24 – Device ID

Command Errors: none

Command Number: 12

Command Name: Read Message

Command Type: Read

Sets Configuration Changed: no

Description: Returns the “message” field saved in the device. The message field can be up to 32 text characters long.

Request: no data

Response:

Bytes 0-23: ascii – The message saved in the device up to 32 text characters long.

Command Errors: none

Command Number: 13

Command Name: Read Tag and Descriptor

Command Type: Read

Sets Configuration Changed: no

Description: Returns the tag field, the descriptor field, and the date field. All of these fields are user settable. These fields can be used in whatever manner the user wants.

Request: no data

Response:

Bytes 0-5: ascii – The tag, up to 8 text characters long

Bytes 6-17: ascii – The descriptor, up to 16 text characters long

Bytes 18-20: u8 – The date as 3 unsigned bytes. The first byte represents the day of the month (1 to 31), the second byte the month (1 to 12), and the third byte the year minus 1900 (e.g. 2006 would be 106).

Command Errors: none

Command Number: 14

Command Name: Read Primary Variable Sensor Information

Command Type: Read

Sets Configuration Changed: no

Description: This command is included only for compatibility with certain DCS systems. The data returned in this command is always constant.

Request: no data

Response:

Bytes 0-2: u24 – Sensor serial number – always 0 for this device

Byte 3: u8 – units code – 250 (not used) for this device

Bytes 4-7: float – upper limit – special code for not-a-number for this device

Bytes 8-11: float – lower limit – special code for not-a-number for this device

Bytes 12-15: float – minimum span – special code for not-a-number for this device

Command Errors: none

Command Number: 15

Command Name: Read Primary Variable Output Information

Command Type: Read

Sets Configuration Changed: no

Description: This command is included only for compatibility with certain DCS systems. The data returned in this command is always constant.

Request: no data

Response:

Byte 0: u8 - Alarm code – 250 (not used) for this device

Byte 1: u8 - Transfer function – 250 (not used) for this device

Byte 2: u8 - Primary variable units code – 57 (percent) for this device

Bytes 3-6: float - Upper range – always 100.0 for this device

Bytes 7-10: float - Lower range – always 0.0 for this device

Bytes 11-14: float – Damping value – always 0.0 for this device

Byte 15: u8 – Write protect code – 250 (not used) for this device

Byte 16: u8 – Private label code – 250 (not used) for this device

Command Errors: none

Command Number: 16

Command Name: Read Final Assembly Number

Command Type: Read

Sets Configuration Changed: no

Description: Returns the final assembly number stored in the device. This number is user settable and can be used for whatever the user wants.

Request: no data

Response:

Bytes 0-2: u24 – The final assembly number. The value can range from 0 to 16777215.

Command Errors: none

Command Number: 17

Command Name: Write Message

Command Type: Write

Sets Configuration Changed: yes

Description: Sets the message field in the device

Request:

Bytes 0-23: ascii – The message field, up to 32 text characters.

Response:

Bytes 0-23: ascii – The message field, up to 32 text characters.

Command Errors: none

Command Number: 18

Command Name: Write Tag and Descriptor

Command Type: Write

Sets Configuration Changed: yes

Description: Sets the tag field, the descriptor field and the date field in the device

Request:

Bytes 0-5: ascii – The tag, up to 8 text characters long

Bytes 6-17: ascii – The descriptor, up to 16 text characters long

Bytes 18-20: u8 – The date as 3 unsigned bytes. The first byte represents the day of the month (1 to 31), the second byte the month (1 to 12), and the third byte the year minus 1900 (e.g. 2006 would be 106).

Response:

Bytes 0-5: ascii – The tag, up to 8 text characters long

Bytes 6-17: ascii – The descriptor, up to 16 text characters long

Bytes 18-20: u8 – The date as 3 unsigned bytes. The first byte represents the day of the month (1 to 31), the second byte the month (1 to 12), and the third byte the year minus 1900 (e.g. 2006 would be 106).

Command Errors: none

Command Number: 19

Command Name: Write Final Assembly Number

Command Type: Write

Sets Configuration Changed: yes

Description: Sets the final assembly number in the device

Request:

Bytes 0-2: u24 – The final assembly number. The value can range from 0 to 16777215.

Response:

Bytes 0-2: u24 – The final assembly number. The value can range from 0 to 16777215.

Command Errors: none

---

9. COMMON-PRACTICE COMMANDS

9.1 Supported Commands

Command Number: 33

Command Name: Read Transmitter Variables

Command Type: Read

Sets Configuration Changed: no

Description: Returns up to 4 variables specified from the list of variables. For this device, possible variable codes are

0. Input Signal
1. Position
2. Pressure differential

Request: Note: fewer than 4 parameters can be sent and the response will be correspondingly shortened

Byte 0: u8 – the transmitter variable code for slot 0

Byte 1: u8 – the transmitter variable code for slot 1

Byte 2: u8 – the transmitter variable code for slot 2

Byte 3: u8 – the transmitter variable code for slot 3

Response:

Byte 0: u8 – the variable code for slot 0

Byte 1: u8 – the units code for the variable in slot 0

Bytes 2-5: float – the value of the selected variable in slot 0

Byte 6: u8 – the variable code for slot 1

Byte 7: u8 – the units code for the variable in slot 1

Bytes 8-11: float – the value of the selected variable in slot 1

Byte 12: u8 – the variable code for slot 2

Byte 13: u8 – the units code for the variable in slot 2

Bytes 14-17: float – the value of the selected variable in slot 2

Byte 18: u8 – the variable code for slot 3

Byte 91: u8 – the units code for the variable in slot 3

Bytes 20-23: float – the value of the selected variable in slot 3

Command Errors:

2 – Invalid parameter if the variable code is not 0, 1, or 2

Command Number: 38

Command Name: Reset Configuration Changed Flag

Command Type: Process

Sets Configuration Changed: yes (cleared)

Description: Clears the configuration changed flag for the HART master that sent the command.

Request: no data

Response: no data

Command Errors: none

Command Number: 48

Command Name: Read Additional Status

Command Type: Read

Sets Configuration Changed: no

Description: Returns the device specific status bytes. These bytes indicate:

Byte 0

Bit 0: Invalid EEPROM state

Bit 1: Invalid EEPROM write

Bit 2: EEPROM write error

Byte 1

Bit 0: Main feedback failure

Bit 1: Seat load cylinder feedback failure

Bit 2: Control signal failure

Bit 3: Actuator direction error

Bit 4: -15v supply failure

Bit 5: 15v supply failure

Bit 6: Seat load cylinder stall

Bit 7: Actuator stall

Byte 2

Bit 0: Motor drive fault

Bit 1: Bad pressure reading

Bit 2: Accumulator requires recharge

Bit 3: Bad keypad

Bit 4: EEPROM erase failure

Bit 5: Pulse board missing

Bit 6: A/D failure

Bit 7: CPU failure

Byte 3

Bit 0: Open direction pressure bad **

Bit 1: Close direction pressure bad **

Bit 2: Temperature too high **

Bit 3: Low oil **

Byte 4

Bit 0: Local manual control

Bit 1: Remote manual control

Byte 0 of the status codes refer to the HART interface board. The remaining bytes refer to the controller board. Bits that apply to options that are not in the delivered model will be set to 0.

** Not available on all models.

Request: no data

Response:

Bytes 0-4: u8 – status data, each bit identifying the condition defined above.

Byte 5: u8 – reserved

Byte 6: u8 – operating mode 1 – 0 for this device

Byte 7: u8 – operating mode 2 – 0 for in this device

Bytes 8-10: u24 – analog output saturated – 0 for this device

Bytes 11-13: u24 – analog output fixed – 0 for this device

Command Errors: none

Command Number: 107

Command Name: Write Burst Mode Variables

Command Type: Write

Sets Configuration Changed: yes

Description: Sets the variable codes that will be used in burst mode by command 33.

Request: Note: Fewer than 4 variable codes may be specified by sending only those needed.

Byte 0: u8 – Variable code for slot 0

Byte 1: u8 – Variable code for slot 1

Byte 0: u8 – Variable code for slot 2

Byte 3: u8 – Variable code for slot 3

Response:

Byte 0: u8 – Variable code for slot 0

Byte 1: u8 – Variable code for slot 1

Byte 0: u8 – Variable code for slot 2

Byte 3: u8 – Variable code for slot 3

Command Errors:

2 – Invalid parameter if any variable code is not 0, 1, or 2

Command Number: 108

Command Name: Write Burst Mode Command

Command Type: Write

Sets Configuration Changed: yes

Description: Sets which command will be used during burst mode

Request:

Byte 0: u8 – Burst mode command number. Must be 1, 2, 3, or 33

Response:

Byte 0: u8 – Burst mode command number. Must be 1, 2, 3, or 33

Command Errors:

2 – Invalid parameter if the burst command is not 1, 2, 3, or 33

Command Number: 109

Command Name: Burst Mode Control

Command Type: Write

Sets Configuration Changed: yes

Description: Turns burst mode on or off

Request:

Byte 0: u8 – Burst mode control. 0 turns burst mode off, 1 turns burst mode on.

Response:

Byte 0: u8 – Burst mode control.

Command Errors:

2 – Invalid parameter if burst mode control is not 0 or 1

9.2 Burst Mode

This Field Device supports Burst Mode.

10. DEVICE-SPECIFIC COMMANDS

10.1 Supported Device Specific Commands

Command Number: 140

Command Name: Clear Status

Command Type: Process

Sets Configuration Changed: no

Description: Clears the HART interface board status flags. Note however, that persistent status conditions may immediately be set again after clearing.

Request: no data

Response: no data

Command Errors: none

11. TABLES

Command Types

- Read – returns data from the device
- Write – sends data to the device
- Process – sends a command to the device

Data Types

- u8 – unsigned byte (8 bit number)
- s8 – signed byte
- u16 – unsigned short integer (16 bits)
- s16 – signed short integer
- u24 – unsigned 24 bit integer
- u32 – unsigned long integer (32 bits)
- s32 – signed long integer
- float – IEEE floating point number
- ascii – packed ascii (see Hart foundation documentation for details)

12. PERFORMANCE

12.1 Sampling Rates

Typical sampling rates for HART are shown in the following table:

Primary position sensor sample	500 ms
Pressure differential	500 ms
Analog input signal (4-20 mA)	500 ms

12.2 Power-Up

On power up, the transmitter goes through a self-test procedure (see section 12.4), which takes approximately 2 seconds. During this period, the device will not respond to HART commands other than HART command 0.

12.3 Reset

Command 42 (“Device Reset”) is not implemented. A device reset buttons is available inside the housing, which resets the main electronics board and the HART communications board.

12.4 Self-Test

The self-test procedure is executed at power up or after a device reset. The self-test includes:

- Microprocessor
- Configuration storage eeprom
- Analog-to-digital converter
- Digital-to-analog converter

This self-test takes about 2 seconds. During self-test following power-up or reset, the device will not respond to HART commands.

12.5 Command Response Times

Minimum	5 ms
Typical	20 ms
Maximum	150 ms

12.6 Delayed-Response

Delayed-response is not used.

12.7 Non-Volatile Memory

EEPROM is used to hold the device's configuration parameters. New data is written to this memory immediately on execution of a write command.

12.8 Modes

The actuator can be in auto, manual, or setup modes, however these modes are accessible only from the pushbuttons on the main panel. In setup mode, HART communication is disabled.

12.9 Write Protection

Write protect is not available.

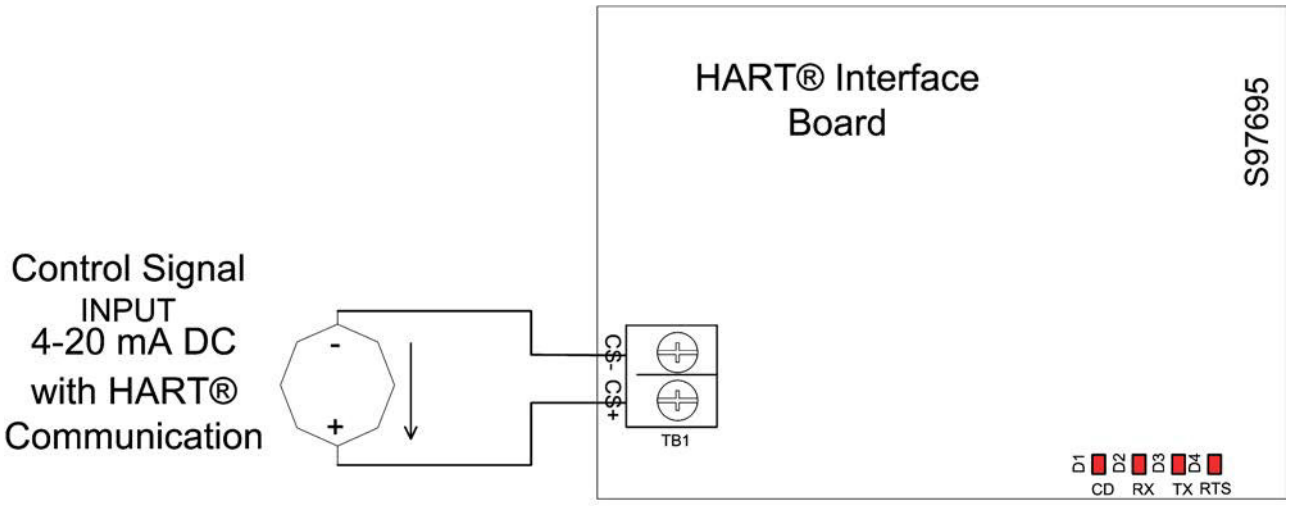
12.10 Damping

Damping is not used.

ANNEX A. CAPABILITY CHECKLIST

Manufacturer, model and revision	REXA, Xpac Series X2
Device type	Actuator
HART revision	5.0
Device Description available	No
Number and type of sensors	2 available from HART
Number and type of actuators	electrohydraulic
Number and type of host side signals	1: 4 - 20mA analog
Number of Device Variables	3
Number of Dynamic Variables	2
Mappable Dynamic Variables?	No
Number of common-practice commands	6
Number of device-specific commands	1
Bits of additional device status	24
Alternative operating modes?	Yes – but not settable from HART
Burst mode?	Yes
Write-protection?	No

ANNEX B. HART® INTERFACE BOARD CONNECTION

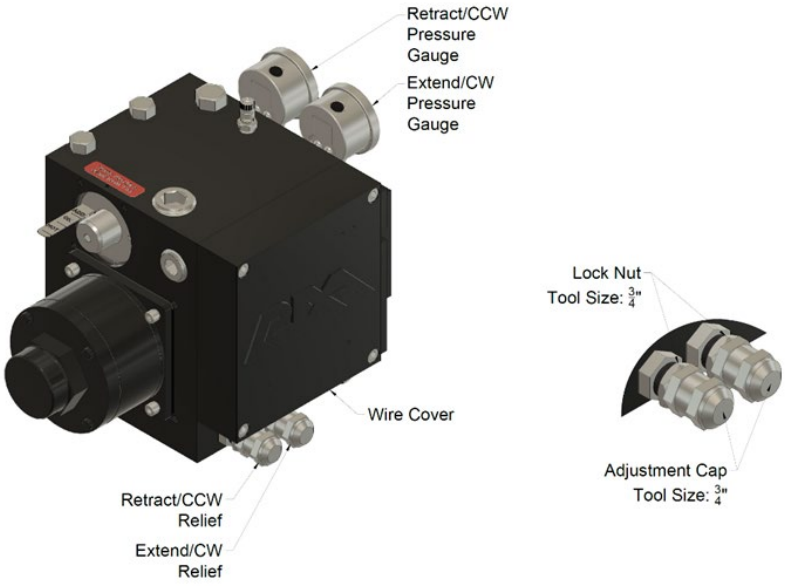


The HART® Communication option requires that the incoming 4-20mA Control Signal be connected at TB1, CS+ and CS-, of the interface board rather than at TB1 of the CPU Board

O. Output Load Protection

O.1 THEORY OF OPERATION

Each Xpac power module is equipped with two pressure limiting cartridges that provide output load protection to the device the actuator is attached to. These valves are located under the wire cover on the power module body.



Xpac Power Module

O.2 IDENTIFICATION

Each valve has a pressure label sticker indicating its range of adjustment. The range corresponds to the spring installed under the adjustment cap as noted in the table below.

Adjustment Range	
Adjustment Range (psi)	**2,250-3,000**
Spring Color	**Brown (Std)**

NOTE: When using standard relief springs, each ¼ turn is approximately a 300 psi change. Standard springs are 2,250 – 3,000 psi unless specified otherwise. The limiting cartridge is then factory set to 2,600 psi for fail in place and spring fail-safe configurations and set to 3,000 psi for accumulator fail-safe configurations. To translate pressure into actuator output, use the following formula:

$$\left(\frac{\text{Pressure Gauge Reading}}{2{,}000\ \text{psi}}\right) \times \left(\text{Actuator Rated Output}\right) = \left[\text{Actual Output}\right]$$

The pressure gauge reading can be obtained from the corresponding pressure gauge shown in the Adjustment Range table above. This value should be the delta between the two gauges when calculating actual output.

Adjustment:

- Loosen the lock nut while holding the adjustment cap in place.
- While running the actuator in a hard stop, read the corresponding gauge to the valve that is being adjusted.
- Turn the adjustment cap CW to increase the relief pressure and CCW to decrease the relief pressure.

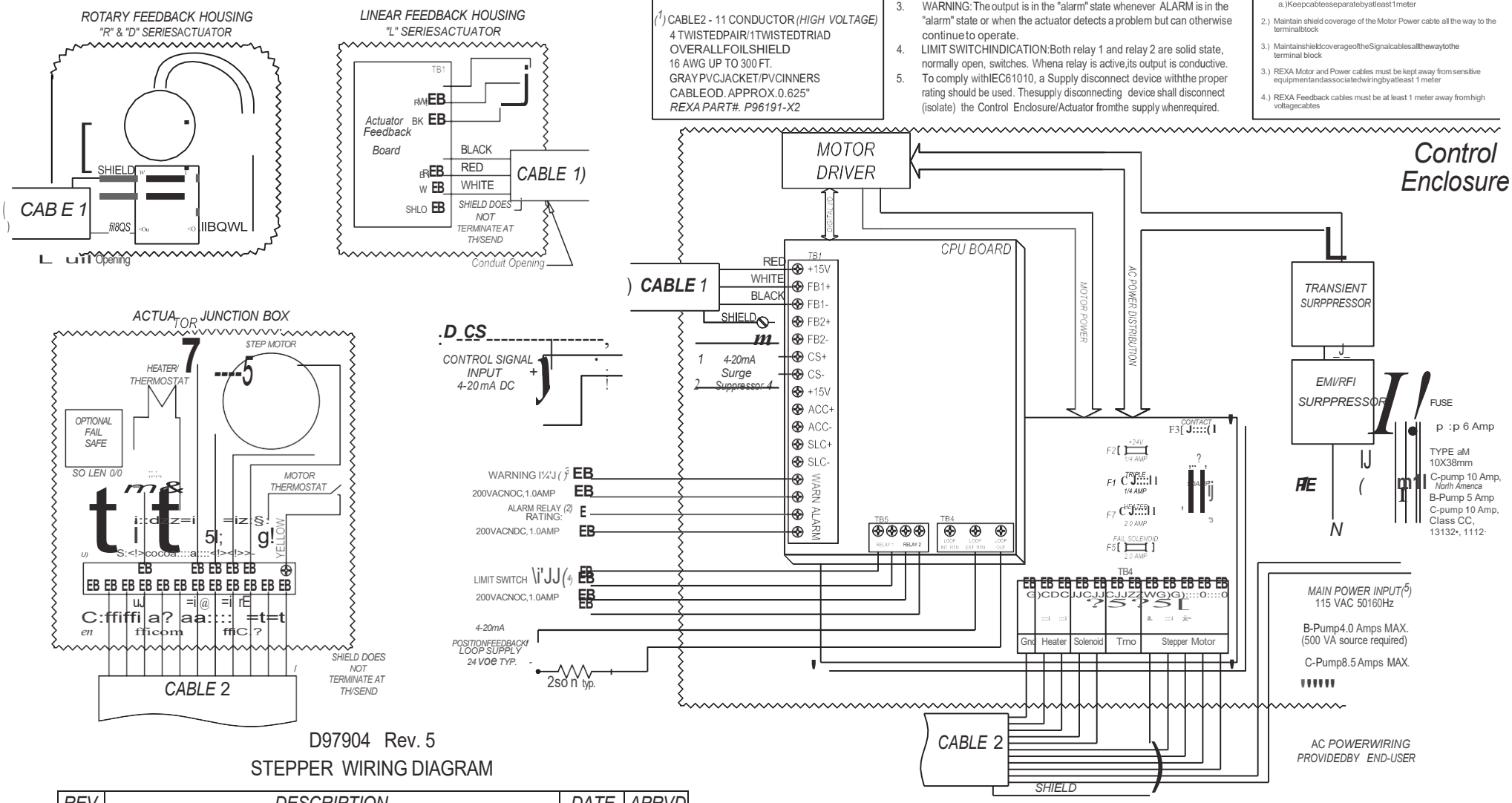
NOTE: The adjustment cap does not have a hard stop and will unthread.

- Tighten lock nut against the cap to 100 in-lbs (11 N·m) and test set pressure.

Spring Change:

- Loosen the lock nut.
- Unthread the adjustment cap.
- Replace the spring.
- Replace the adjustment cap.
- Follow the adjustment procedure above.

P. Interconnect Diagrams & Control Enclosure Drawings



(1) CABLE1 - 3 CONDUCTOR *(SIGNAL LEVEL)*
18 AWG UP TO 300 FT.
OVERALLFOILSHIELD
GRAY PVCJACKET/PVCINNERS
CABLEOD. APPROX0.25"
REXA PART#·P96192

(1) CABLE2 - 11 CONDUCTOR *(HIGH VOLTAGE)*
4 TWISTEDPAIR/1TWISTEDTRIAD
OVERALLFOILSHIELD
16 AWG UP TO 300 FT.
GRAY PVCJACKET/PVCINNERS
CABLEOD. APPROX.0.625"
REXA PART#. P96191-X2

NOTES:
1. Cable lengths above 300 ft. must increase AWG Consult Factory
2. ALARM: Theoutput is in the "alarm" state whenever the actuatoris 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 SWITCHINDICATION:Both relay 1 and relay 2 are solid state, normally open, switches. Whena relay is active,its output is conductive.
5. To comply withIEC61010, a Supply disconnect device withthe proper rating should be used. Thesupply disconnecting device shall disconnect (isolate) the Control Enclosure/Actuator fromthe supply whenrequired.

Lt. Attention Lt.

For Proper Actuator Operation

1.) Signal Level Cables must remain separate from High Voltage cables ir aseparatetrayorconduit a.)Keepcabtesseparatebyatleast1meter

2.) Maintain shield coverage of the Motor Power cabte all the way to the terminalbtock

3.) MaintainshieldcoverageoftheSignalcablesallthewaytothe terminal block

3.) REXA Motor and Power cables must be kept away from sensitive equipmentandassociatedwiringbyatleast 1 meter

4.) REXA Feedback cables must be at least 1 meter away fromhigh voltagecabtes

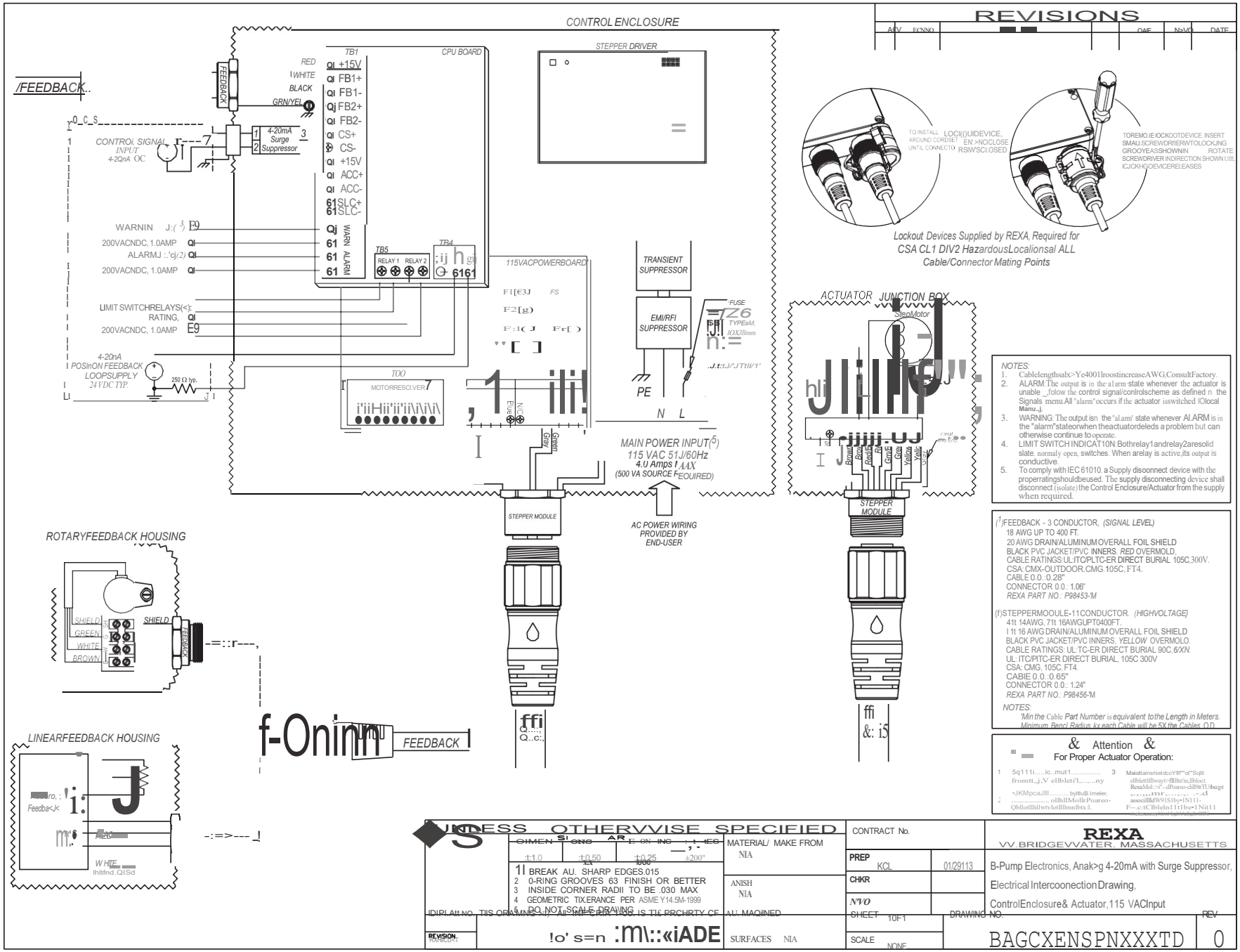
D97904 Rev. 5

STEPPER WIRING DIAGRAM

REV.	DESCRIPTION	DATE	APRVD
4	Added Control Signal Surge Suppressor.	1/6/10	KCL
5	Changed incoming power from 120V to 115V per ECN 12-005	03/17/14	DPT

D97904 — STEPPER WIRING DIAGRAM

B QUICK CONNECT CABLES



CONTROL ENCLOSURE

REVISIONS

REV	ECN NO	DRW	DATE	APVD	DATE

/FEEDBACK U=ml

DCS

CONTROL SIGNAL INPUT 4-20mA DC

4-20mA Surge Suppressor

FEEDBACK

RED
WHITE
BLACK
GRN/YEL

TB1

E& +15V
E& FB1+
E& FB1-
E& FB2+
E& FB2-
E& CS+
CS-
E& +15V
E& ACC+
E& ACC-
E& SLC+
E& SLC-
E&
E&
E&
E&

ALARM

CPU BOARD

STEPPER DRIVER

TB5 RELAY 1 RELAY 2

TB4 E&E&

115VAC POWER BOARD

TRANSIENT SUPPRESSOR

EMI/RFI SUPPRESSOR

FUSE

PE N L

WARNING f J:(JJ E9
200VACNDC, 1.0AMP E9
ALARMJf J: E9
200VACNDC, 1.0 AMP E9

LIMIT SWITCH RELAYS( ) E&
RATING· E9
200VACNDC, 1.0AMP E9

4-20mA POSITION FEEDBACK LOOP SUPPLY 24 VOE TYP.

250 Ω typ.

TB8 MOTOR RESOLVER

MAIN POWER INPUT(5)
115VAC50/60Hz
8.5 Amps MAX.
(1.1KVA SOURCE REQUIRED)

AC POWER WIRING PROVIDED BY END-USER

STEPPER MODULE

ACTUATOR JUNCTION BOX

EB EB(f)f"(f)(f)(f)(f)(f)

Brown Red/Blk Red Grn/Blk Green Yellow Yel/Blk

STEPPER MODULE

TO INSTALL LOCKOUTDEVICE, PLACE END AND CLOSE AROUND CORDSET UNTIL CONNECTORS SNAP SECURELY CLOSED

TO REMOVE LOCKOUTDEVICE, INSERT SMALL SCREWDRIVER INTO LOCKING GROOVE AS SHOWN IN PICTURE AND ROTATE SCREWDRIVER IN DIRECTION SHOWN UNTIL LOCKING DEVICE RELEASES.

Lockoul Devices Supplied by REXA, Required for CSA CL1 0/V2 Hazardous Localions al ALL Cable/Connector Mating Points

ROTARY FEEDBACK HOUSING

SHIELD
GREEN
WHITE
BROWN

FEEDBACK

LINEAR FEEDBACK HOUSING

Feedback Boaro

RED
WHITE

FEEDBACK

NOTES:
1. Cable lengths above 400 ft. must increase AWG, Consult Factory
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 whenever the actuator detects a problem but can otherwise continue to operate.
4. LIMIT SWITCH INDICATION: Both relay 1 and relay 2 are solKI state, normally open, switches. When a relay is active, it's output is conductive
5. To comply with IEC 61010, a Supply disconnect device with the proper ratings should be used. The supply disconnec Ung devices shall disconnect (isolate) the Control Enclosure/Actuator from the supply when required.

(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) 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:
1. Min the Cable Part Number is equivalent to the Length in Meters, Minimum Bend Radius for each Cable will be 5X the Cables O.D

& Attention &
For Proper Actuator Operation:

1 Signalle Cablesmus1remailseiwate igt,Vottagecable!blaseperatetray o.CLIOOd.it a)Keepcablesseparateb).atleas1'mete< 2 Mailtainshieldcoverageoftlie Mot'OfPower cableallhewaytothete-rmilaiblock
3 Mailtainshieldcoverageoftlie Signal fromI-callle-sallihewaytlihe'emilaiblock.
4 RexaiMotorandPowercablesmustBokept away&<.>'11sensftiv!equipmemand associatedwinngbyatleast1'meter.
5 RoxeFSedbad<cablesmJstbeatleast1 meterawayfromliighVolagecables.

UNLESS OTHERWISE SPECIFIED

	± 1.0	±0.50	±0.25	±2.00°

MATERIAL/ MAKE FROM NIA

FINISH N/A

1 BREAK ALL SHARP EDGES .015
2 0-RING GROOVES 63 FINISH OR BETTER
3 INSIDE CORNER RADII TO BE .030 **MAX**
4 GEOMETRIC TOLERANCE PER ASMEY14.5M-1999
5 DO NOT SCALE DRAV.,NG

TEMPIATE NO THIS DRAWING AND All INFORMAIOO HEREIN IS THE PRCHRTY OF All MACHINED SURFACES NIA

REVISION C:c"MERI:·:01 s ll :5Ji:I :f

CONTRACT No.

REXA
VV.BRIDGEVVATER, MASSACHUSETTS

PREP	KCL	01/29/13
CHKR		
APVD		

C-Pump Electronics, Analog 4-20mA with Surge Suppressor,
Electrical Interconnection Drawing,
Control Enclosure & Actuator, 115 VAC Input

SHEET 1 OF 1
SCAL NONE

DRAWING NO. CAGCXENSPNXXXTD

REV 0

D97904-.5D — ½D SERVO WIRING DIAGRAM

NOTES:

1. Cable lengths **MAX.** 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 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.

(1) CABLE 1 - 3 CONDUCTOR *(SIGNAL LEVEL)*
18 AWG UP TO 700 FT.
OVERALL FOIL SHIELD
GRAY PVC JACKET/PVC INNERS
CABLE O.D. APPROX 0.25"
REXA PART NO.: P96192

(1) CABLE 2 - 4 INDIVIDUALLY SHIELDED PAIRS, *(SIGNAL LEVEL)*
OVERALL FOIL SHIELD
20 AWG UP TO 700FT.
GRAY PVC JACKET/PVC INNERS
CABLE O.D. APPROX. 0.42"
REXA PART NO.: P98272

(I/ CABLE 3 - 4 CONDUCTOR, *(HIGH VOLTAGE)*
OVERALL FOIL SHIELD
14 AWG UP TO 700FT.
GRAY PVC JACKET/PVC INNERS
CABLE O.D. APPROX. 0.61"
REXA PART NO.: P96402-14

(I/ CABLE 4- 5 CONDUCTOR, *(HIGH VOLTAGE)*
16 AWG UP TO I00FT.
GRAY PVC JACKET/PVC INNERS
CABLE O.D. APPROX.0.45"
REXA PART NO.: P97335-X2

& Attention △

For Proper Actuator Operation:

1.) Signal level Cables must remain separate from High Voltage cables in a separate tray or conduit. (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!

3.) REXA Motor and Power cables must be kept away from sensitive equipment and associated wiring by at least 1 meter.

4.) REXA Feedback cables must be at least 1 meter away from high voltage cables

Servo Driver PHASE T is Motor ORANGE
Servo Driver PHASE R is Motor BLUE
Servo Driver PHASES is Motor GRAY
MOTOR RETURN to Servo Driver is Motor Green

ROTARY FEEDBACK HOUSING
'R" &'D' SERIES ACTUATOR

LINEAR FEEDBACK HOUSING
'L' SERIES ACTUATOR

CABLE 1

Conduit Opening

Actuator Feedback Board

TB1 TB2

BLACK WHITE

SHIELD NOT TERMINATE AT THIS END

CABLE 1

Conduit Opening

SERVOMOTOR

ACTUATOR JUNCTION BOX

SOLENOID

THERMOSTAT

ORANGE YELLOW WHITE BROWN BLUE GREEN BLACK RED SHIELD

CABLE 4 CABLE 3 CABLE 2

MOTOR DRIVER

CONTROL ENCLOSURE

CPU BOARD

CABLE 1

RED WHITE BLACK

TB1

+15V FB1+ FB1- FB2+ FB2- CS+ CS- +15V ACC+ ACC- SLC+ SLC- WARN ALARM

DCS

CONTROL SIGNAL INPUT 4-20mADC

4-20mA Surge Suppressor

WARNIN f1 ti:(JJ E9

200VACNDC, 1.0AMP EB

ALARMJf1 ti:(2) EB

200VACNDC, 1.0AMP EB

LIMIT SWITCH RELAYS(4):

2oovACNDc.%T! EB E9

4-20mA Position Feedback Loop Supply 24 VOe TYP.

2500typ.

TB5 TB4

RELAY 1 RELAY 2

LOOP LOOP LOOP

CONTACT

F3[t::::::IJ 10A.W

F2[ ] 1/4 AMP

F1[ ] 1/4 AMP

F7[ ] 2.5 AMP

FAILSOWKJID

F5[t::::I] 2.0AMP

TB6

ORANGE YELLOW WHITE BROWN BLUE GREEN BLACK RED SHIELD

MOTOR RESOLVER

TB4

Gm/Yel Brown Brown Blue Blue N/C N/C Shld/Gm Orange Blue Gray N/C

Gnd Heater Solenoid Hi-Speed Solenoid Servo Motor

SHIELD

TRANSIENT SUPPRESSOR

EMI/RFI SUPPRESSOR

PE N L

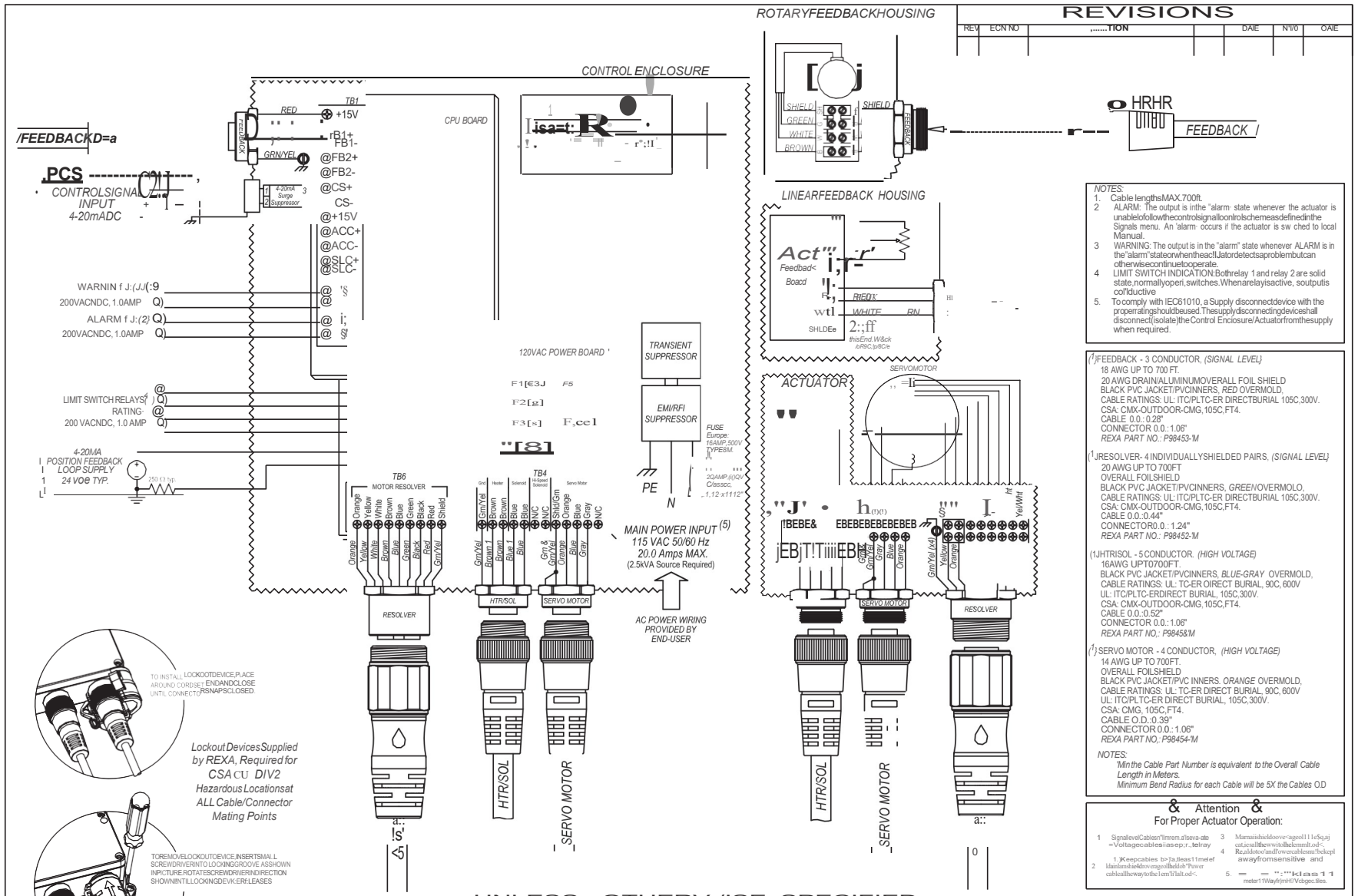
FUSE
Europe:
16AMP,f/YJV
TYPEaM,
10X38mm

20AMF,cOOV
Class CC,
13/32'x11/2'

MAIN POWER INPUT *(SJ*
115 VAC 50160 Hz
20.0 Amps MAX.
(2.4kVA source required)

AC POWER WIRING
PROVIDED BY END-USER

097904-.50 Rev. 8
1/20 SERVO WIRING DIAGRAM



NOTES:
1. Cable lengths MAX. 700ft.
2 ALARM: The output is in the "alarm" state whenever the actuator is unable to follow the control signal loon trol scheme as defined in the Signals menu. An "alarm" occurs if the actuator is sw ched to local Manual.
3 WARNING: The output is in the "alarm" state whenever ALARM is in the "alarm" state or when the act Uator 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, soutputis col"lductive
5. To comply with IEC61010, a Supply disconnect device with the proper ratings hould be used. The supply disconnecting device shall disconnect (isolate) the Control Enclosure/Actuator from the supply when required.

(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 0.0.: 0.28"
CONNECTOR 0.0.: 1.06"
REXA PART NO.: P98453-M

(1) RESOLVER- 4 INDIVIDUALLY SHIELDED PAIRS, (SIGNAL LEVEL)
20 AWG UP TO 700FT
OVERALL FOILSHIELD
BLACK PVC JACKET/PVC INNERS, GREEN OVERMOLD,
CABLE RATINGS: UL: ITC/PLTC-ER DIRECT BURIAL 105C,300V.
CSA: CMX-OUTDOOR-CMG,105C,FT4.
CABLE 0.0.:0.44"
CONNECTOR 0.0.: 1.24"
REXA PART NO.: P98452-M

(1) HTR/SOL - 5 CONDUCTOR. (HIGH VOLTAGE)
16AWG UP TO 700FT.
BLACK PVC JACKET/PVC INNERS, BLUE-GRAY OVERMOLD,
CABLE RATINGS: UL: TC-ER OIRECT BURIAL, 90C, 600V
UL: ITC/PLTC-ER DIRECT BURIAL, 105C,300V.
CSA: CMX-OUTDOOR-CMG,105C,FT4.
CABLE 0.0.:0.52"
CONNECTOR 0.0.: 1.06"
REXA PART NO.: P9845&M

(1) SERVO MOTOR - 4 CONDUCTOR, (HIGH VOLTAGE)
14 AWG UP TO 700FT.
OVERALL FOILSHIELD
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 0.0.: 1.06"
REXA PART NO.: P98454-M

NOTES:
'Min 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

& Attention &
For Proper Actuator Operation:
1 Signal level Cables in "I mrem. a Iseva-ate = Voltage cables: ias ep: r. , tel ray
1. ,)Keep cabies b>'a.lleas11melef Idanlumbu4trovenggeolBaldeb"Power cableallhewaytothe1em'Ti'lalt.od<.
2
3 Marnaiishieldoove<ageo1111e5q.aj cat,iesallthewwitchelemmll.od<.
4 Re,aldotoo'andFowercablesnu?bekepl awayfromsensitive and
5. = = ":'"klas11 meter'11Wayfi(mHi'Vcbgec.lies.

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES. MATERIAL/ MAKE FROM
-B
SURFACE FINISH
±1.0 ±0.50 XX ±0.25 ANGLES ±0.00°
NIA
1 BREAK ALL SHARP EDGES 0,S
2 0-RING GROOVES 63 FINISH OR BETTER
3 IN,,DE CORNER RADII TO BE .030 MAX
4 GEOMETRIC TOLERANCE PER ASME Y14.5M-1999
5 DO NOT SCALE DRA1MING
FINISH NIA
TEMPLATE MO. THIS DRAWING AND ALL INFORMATI HEREIN IS THE PROPERTY OF ALL MACHINED
REVISION CAM ERI ·!o' s r1':1o.:t: i:10:: SURFACES NIA

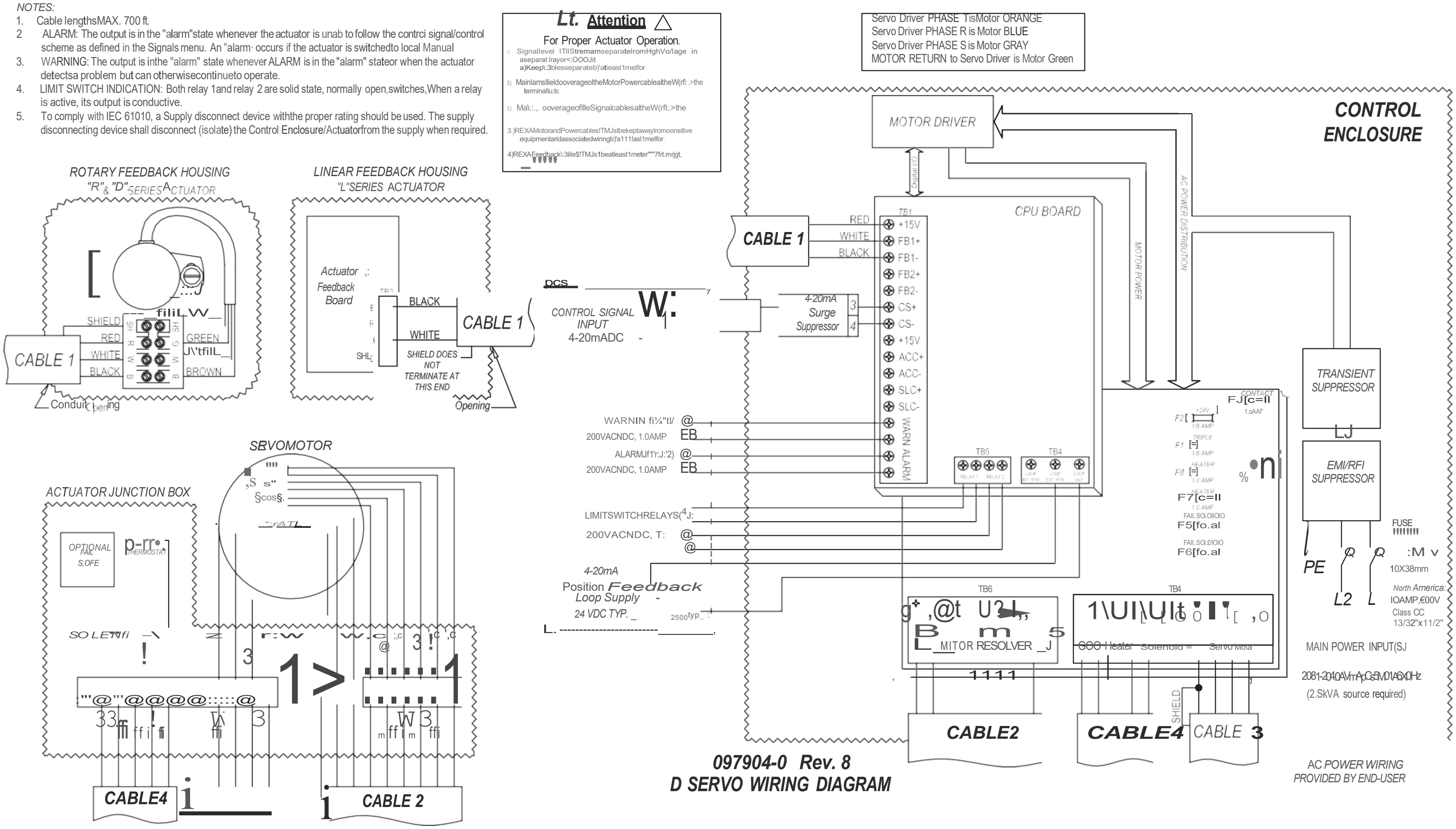
CONIRACTNo_
PREP
KCL 01129113
CHKR
APVD
SHEET 1 OF 1
SCALE NONE
DRAWING NO FAGCXENSPNXXXTD
REV 0

REXA
VV.BRIDGEVVATER. MASSACHUSETTS
112D-Pump Electronics, Analog 4-20mA with Surge Suppressor,
Electrical Interconnection Drawing,
Control Enclosure & Actuator, 115 VAC Input

½D QUICK CONNECT CABLES

D97904-D — D SERVO WIRING DIAGRAM

NOTES:
1. Cable lengths MAX. 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 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.



Attention
For Proper Actuator Operation.
Servo Driver PHASE T is Motor ORANGE
Servo Driver PHASE R is Motor BLUE
Servo Driver PHASE S is Motor GRAY
MOTOR RETURN to Servo Driver is Motor Green
CONTROL ENCLOSURE
MOTOR DRIVER
CPU BOARD
MOTOR POWER
AC POWER DISTRIBUTION
ROTARY FEEDBACK HOUSING
LINEAR FEEDBACK HOUSING
"L" SERIES ACTUATOR
CABLE 1
SHIELD
RED
WHITE
BLACK
GREEN
BROWN
Conduit
Actuator Feedback Board
SHIELD DOES NOT TERMINATE AT THIS END
Opening
CONTROL SIGNAL INPUT
4-20mADC
4-20mA Surge Suppressor
+15V
FB1+
FB1-
FB2+
FB2-
CS+
CS-
ACC+
ACC-
SLC+
SLC-
WARN ALARM
200VACNDC, 1.0AMP
LIMIT SWITCH RELAYS
4-20mA
Position Feedback
Loop Supply
24 VDC TYP.
TB5
TB4
TB6
TRANSIENT SUPPRESSOR
EMI/RFI SUPPRESSOR
FUSE
PE
L2
10X38mm
North America:
10AMP, 600V
Class CC
13/32"x11/2"
MAIN POWER INPUT
(2.5kVA source required)
AC POWER WIRING PROVIDED BY END-USER
ACTUATOR JUNCTION BOX
OPTIONAL FAIL SAFE
THERMOSTAT
SOLENOID
SERVOMOTOR
CABLE4
CABLE 2
CABLE2
CABLE 3
SHIELD
MOTOR RESOLVER
097904-0 Rev. 8
D SERVO WIRING DIAGRAM

CABLE 1 - 3 CONDUCTOR *(SIGNAL LEVEL)*
18 AWG UP TO 700 FT.
OVERALL FOIL SHIELD
GRAY PVC JACKET/PVC INNERS
CABLE O.D. APPROX 0.25'
REXA PART NO.: P96192

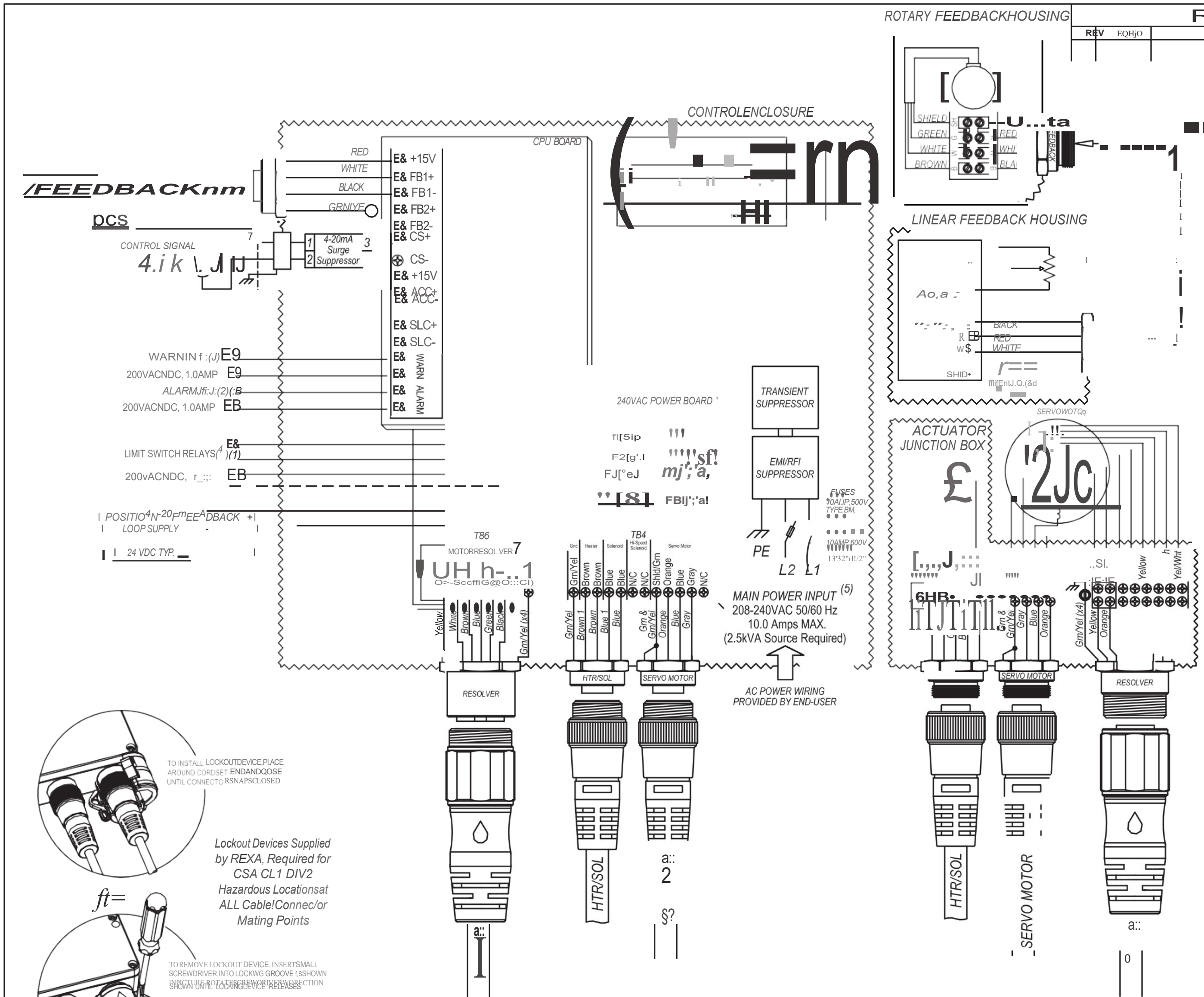
CABLE 2 - 4 INDIVIDUALLY SHIELDED PAIRS. *(SIGNAL LEVEL)*
OVERALL FOIL SHIELD
20 AWG UP TO 700FT.
GRAY PVC JACKET/PVC INNERS
CABLE O.D. APPROX. 0.42"
REXA PART NO.: P98272

CABLE 3 - 4 CONDUCTOR, *(HIGH VOLTAGE)*
OVERALL FOIL SHIELD
14 AWG UP TO 700FT.
GRAY PVC JACKET/PVC INNERS
CABLE O.D. APPROX. 0.61"
REXA PART NO.: P96402-14

CABLE 4 - 5 CONDUCTOR, *(HIGH VOLTAGE)*
16 AWG UP TO 700FT.
GRAY PVC JACKET/PVC INNERS
CABLE O.D. APPROX. 0.45"
REXA PART NO.: P97335-X2

REV	EQHjO	DESCRIPTION		OAlt	N'VO	DA[

REVISIONS



NOTES:

1. Cable lengths MAX. 700ft.
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 relay1 and relay2 are solid state, normally open switches. When a relay is active, its output is conductive.
5. To comply with IEC61010, a Supply disconnect device with the proper rating should be used. The supply discon device shall disconnect (isolate) the Control Enclosure/Actuator from the supply when required.

(1) FEEDBACK - 3 CONDUCTOR, *(SIGNAL LEVEL)*
18 AWG UP TO 700FT.
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) RESOLVER - 4 INDIVIDUALLY SHIELDED PAIRS, *(SIGNAL LEVEL)*
20 AWG UP TO 700FT
OVERALL FOIL SHIELD
BLACK PVC JACKET/PVC INNERS, *GREEN* OVERMOLD,
CABLE RATINGS: UL: ITC/PLTC-ER DIRECT BURIAL 105C, '300V.
CSA: CMX-OUTDOOR-CMG, 105C, FT4
CABLE O.D.: 0.44"
CONNECTOR O.D.: 1.24"
REXA PART NO.: P98452-M

(1) HTR/SOL - 5 CONDUCTOR. *(HIGH VOLTAGE)*
16 AWG UP TO 700FT.
BLACK PVC JACKET/PVC INNERS, *BLUE-GRAY* OVERMOLD.
CABLE RATINGS: UL: TC-ER DIRECT BURIAL, 90C, 600V.
UL: ITC/PLTC-ER DIRECT BURIAL, 105C, *3IXN.*
CSA: CMX-OUTDOOR-CMG, 105C, FT4.
CABLE O.D.: 0.52"
CONNECTOR O.D.: 1.06"
REXA PART NO.: P98455-M

(1) SERVOMOTOR - 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, *3IXN*
CSA: CMG, 105C, FT4.
CABLE O.D.: 0.39"
CONNECTOR O.D.: 1.06"
REXA PART NO.: P98454-M

NOTES:
Min 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.

⚠ Attention ⚠
For Proper Actuator Operation:

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES			
.X	.XX	.XXX	ANGLES
±1.0	±0.50	±0.25	±2.00°

1. BREAK ALL SHARP EDGES .015
2. O-RING GROOVES 63 FINISH OR BETTER
3. INSIDE CORNER RADII TO BE .030 MAX
4. GEOMETRIC TOLERANCE PER ASME Y14.5M-1999
5. DO NOT SCALE DRAWING

MATERIAL/ MAKE FROM: N/A
FINISH: N/A
ALL MACHINED SURFACES N/A

CONTRACT No.

REXA
W. BRIDGEWATER. MASSACHUSETTS

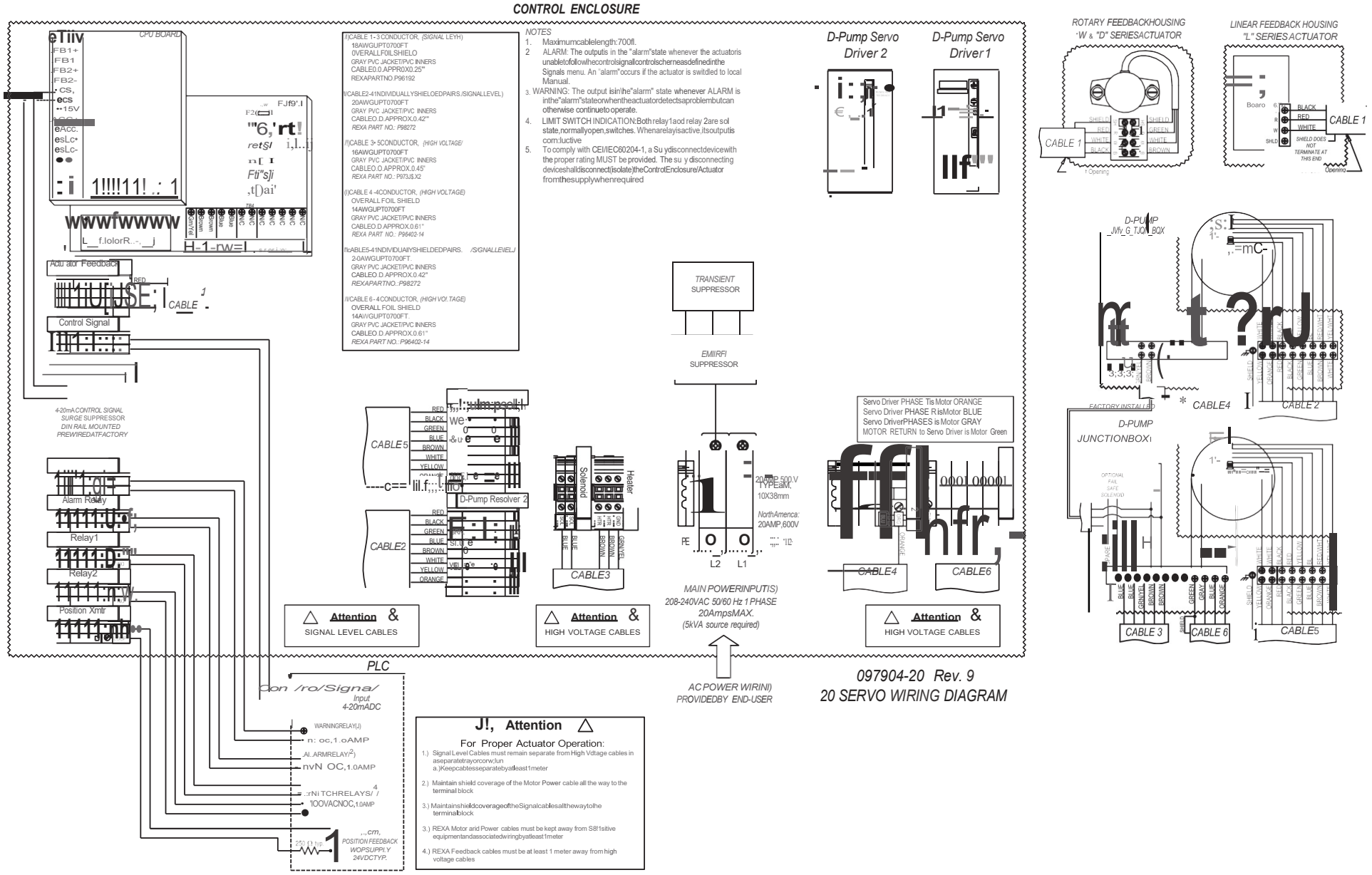
PREP	KCL	01/29/13
CHKR		
APVD		

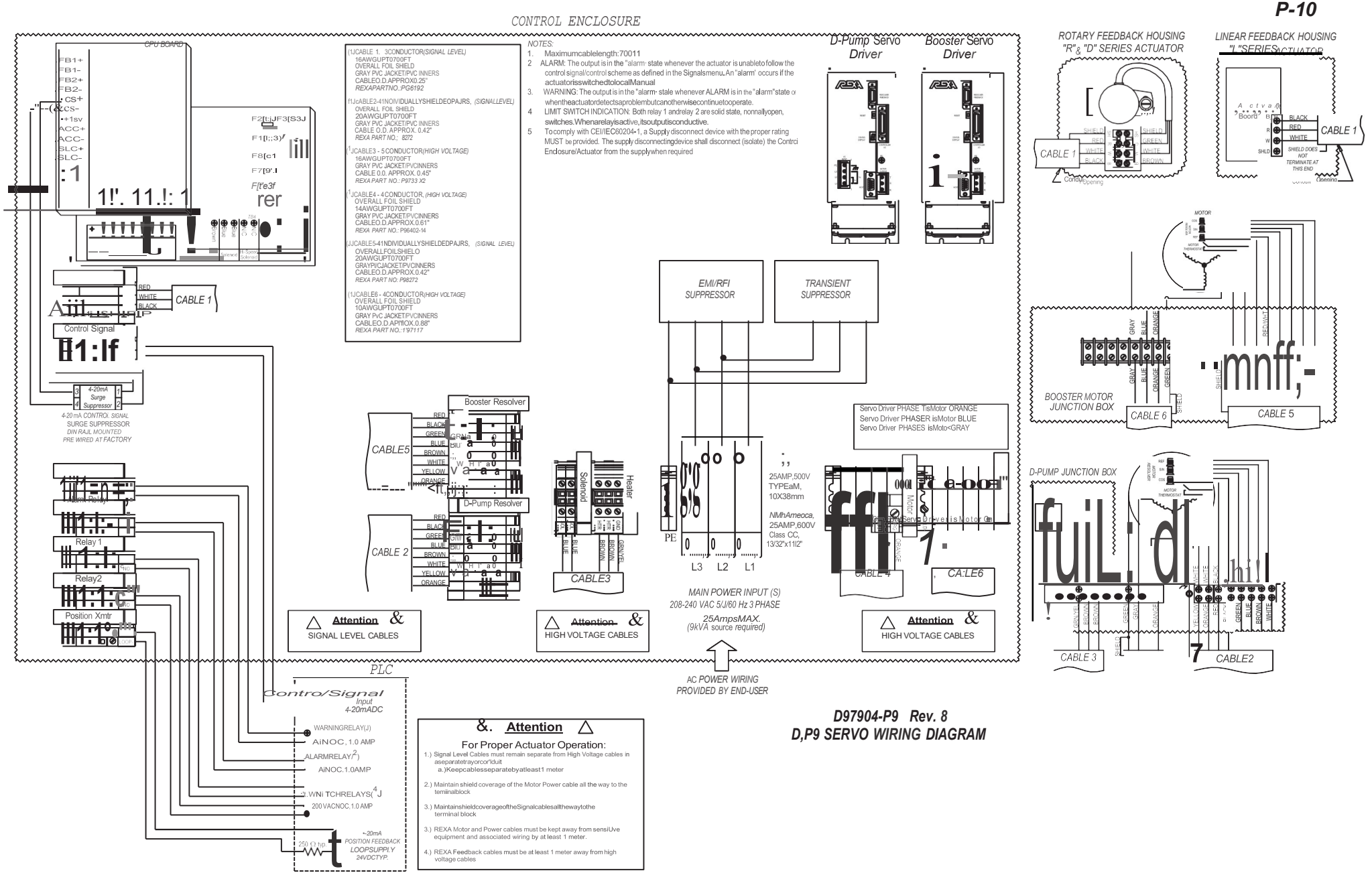
0-Pump Electronics, Analog 4-20mA with Surge Suppressor, Electrical Interconnection Drawing, Control Enclosure & Actuator, 208/240 VAC Input

SHEET 1 OF 1
SCALE NONE
DRAWING NO. DBGCXENSPNXXXTD
REV 0

D QUICK CONNECT CABLES

D97904-2D — 2D SERVO WIRING DIAGRAM

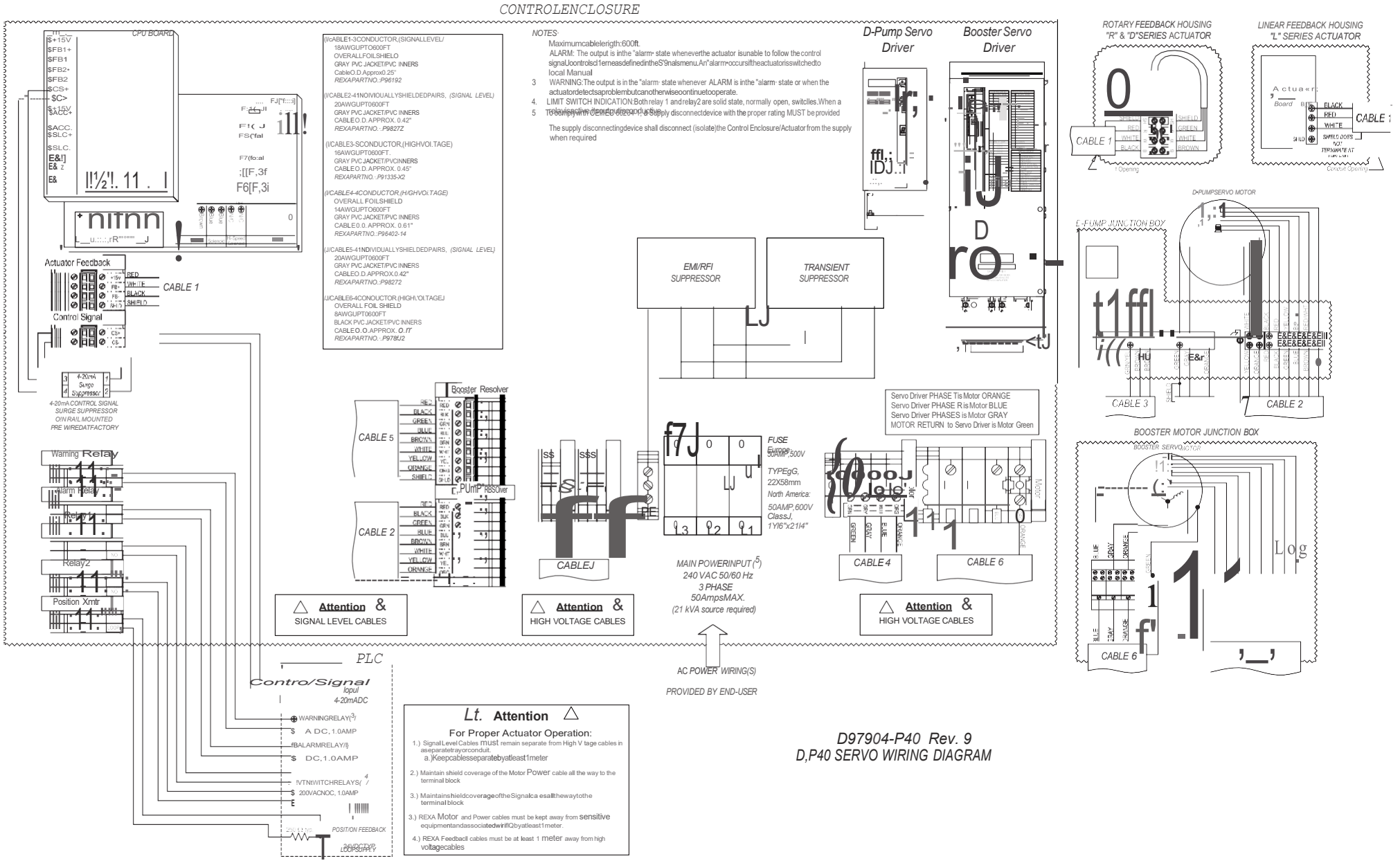




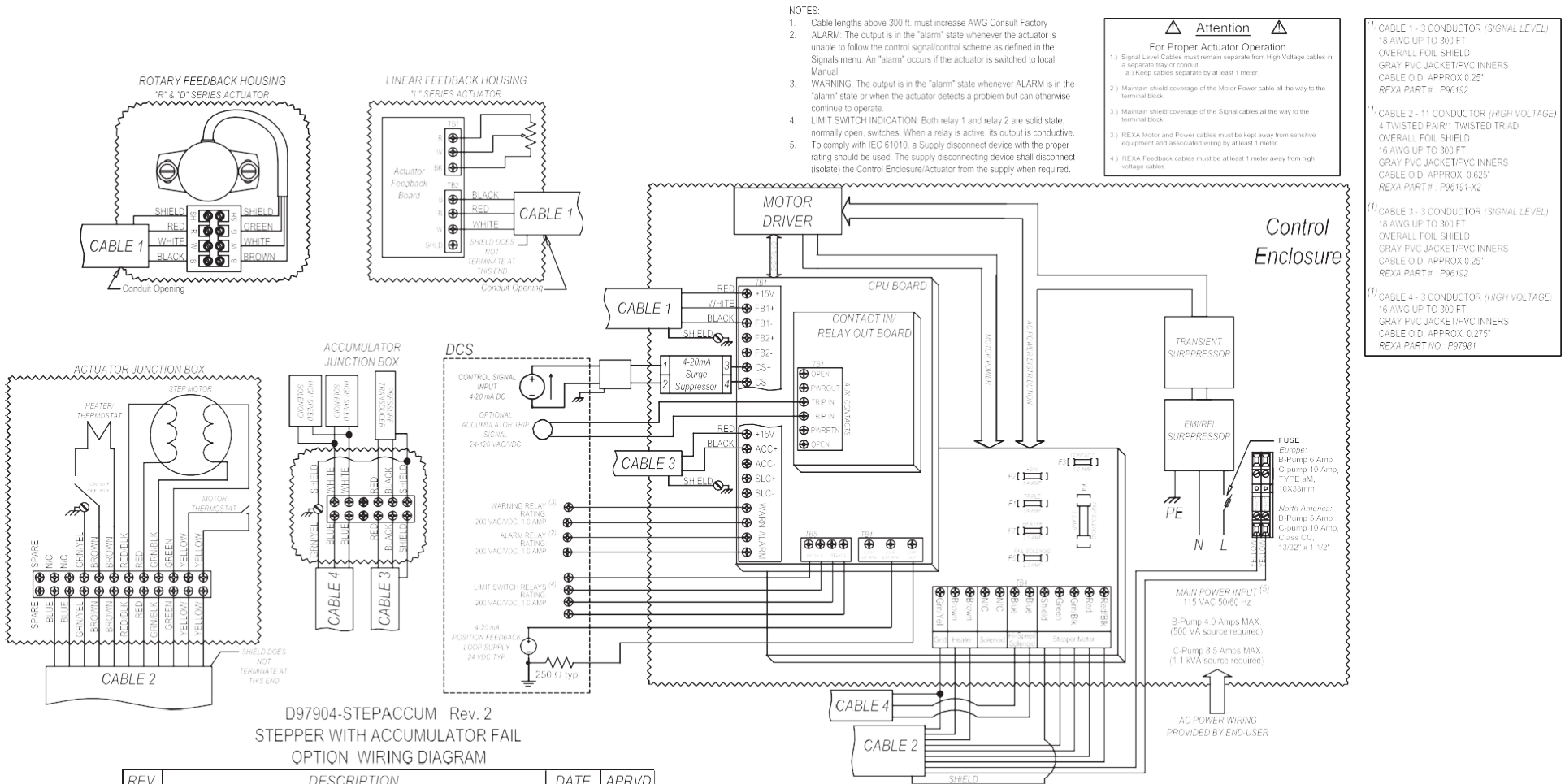
D97904-P9 Rev. 8
D,P9 SERVO WIRING DIAGRAM

D97904-P9 — D,P9 SERVO WIRING DIAGRAM

D97904-P40 — D,P40 SERVO WIRING DIAGRAM



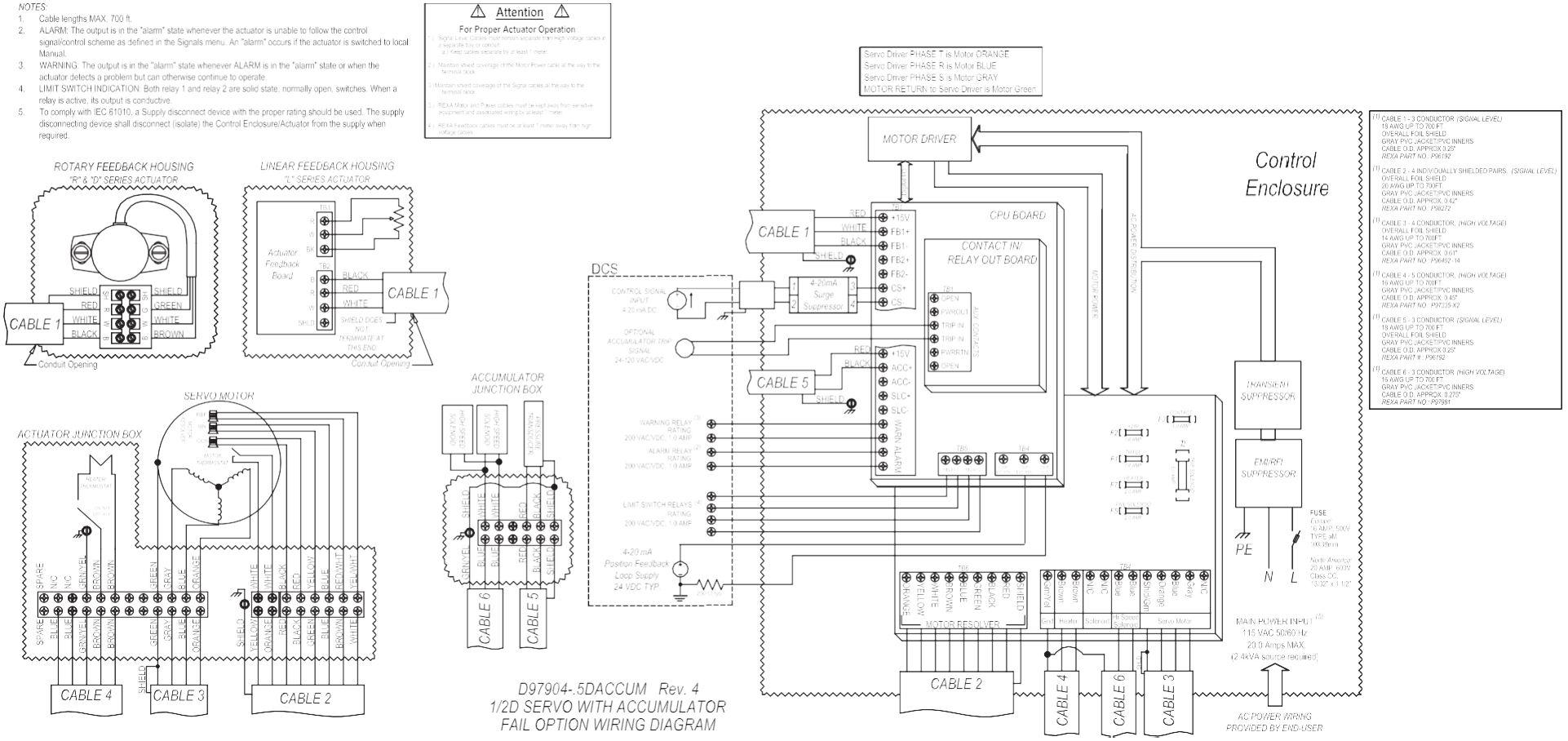
D97904-P40 Rev. 9
D,P40 SERVO WIRING DIAGRAM



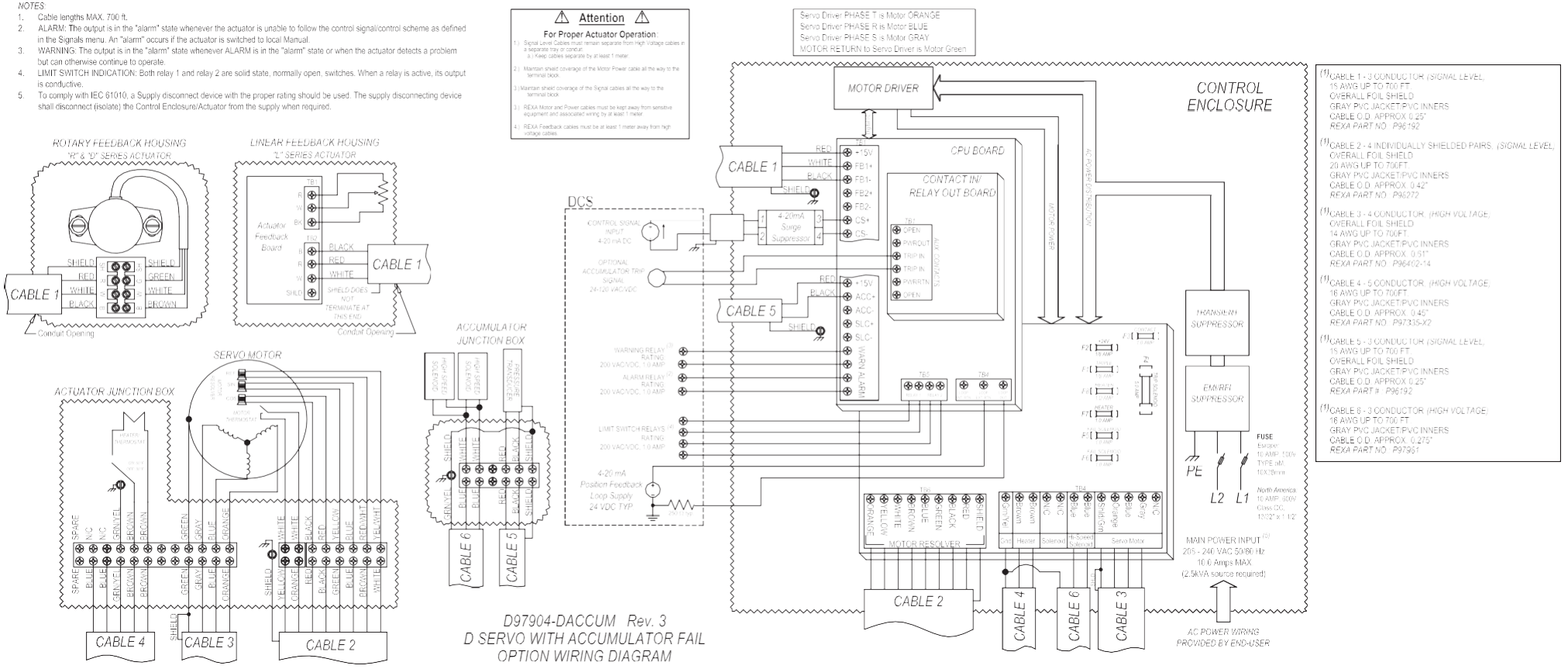
REV.	DESCRIPTION	DATE	APRVD
1	Added Control Signal Surge Suppressor. Added Jumper to Accumulator Junction Box. Added Rexa Part number & Signal level/High Voltage Designation	01/07/10	KCL
2	Changed incoming power from 120V to 115V per ECN 12-005	03/17/14	DPT

D97904-STEPACCUM — STEPPER WITH ACCUMULATOR FAIL OPTION

D97904-.5DACCUM — ½D SERVO WITH ACCUMULATOR FAIL OPTION



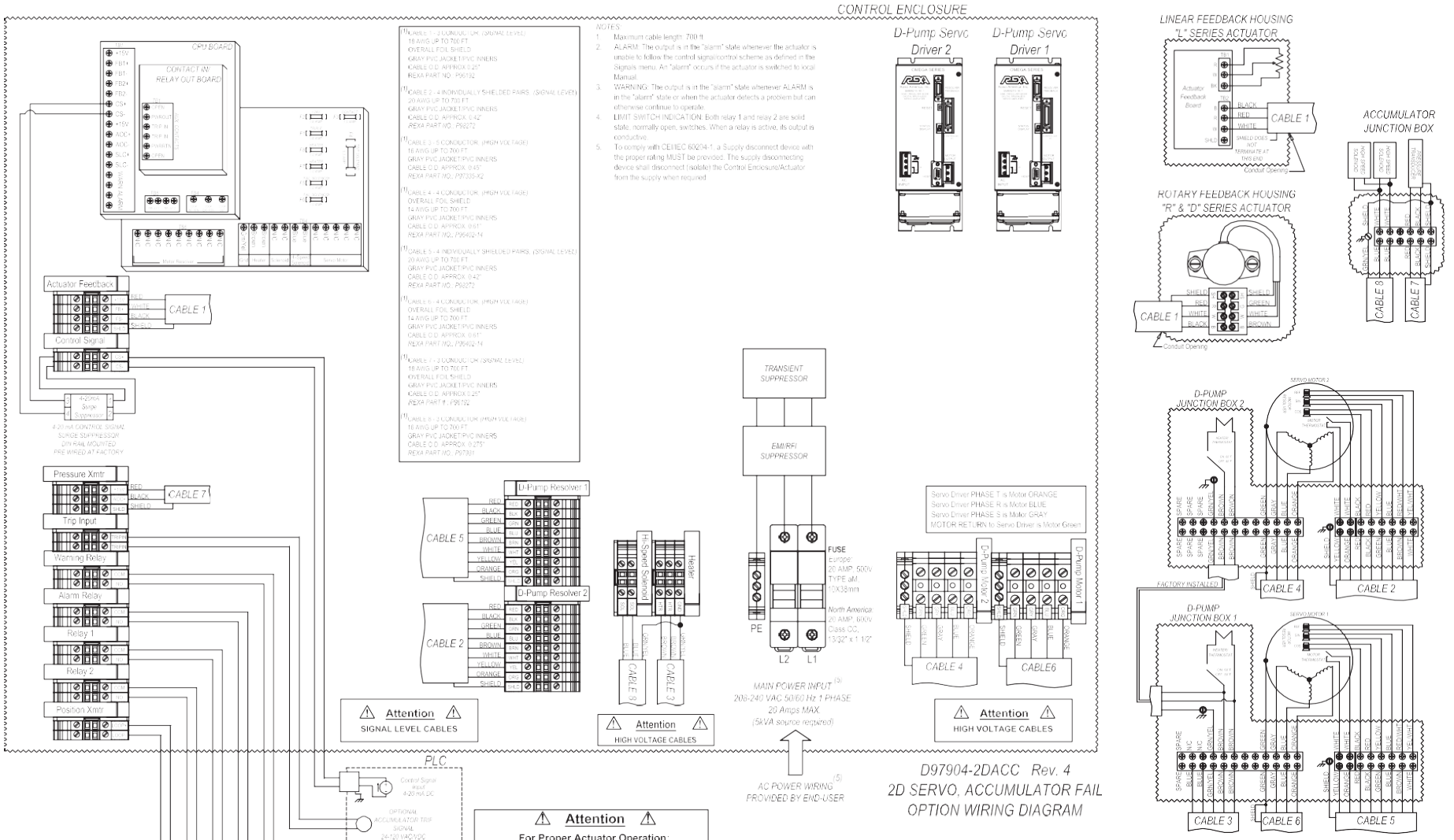
NOTES:
1. Cable lengths MAX. 700 ft.
2. ALARM: The output is in the "alarm" state whenever the actuator is unable to follow the control signal/control scheme as defined in the Signals menu. An "alarm" occurs if the actuator is switched to local Manual.
3. WARNING: The output is in the "alarm" state whenever 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 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.

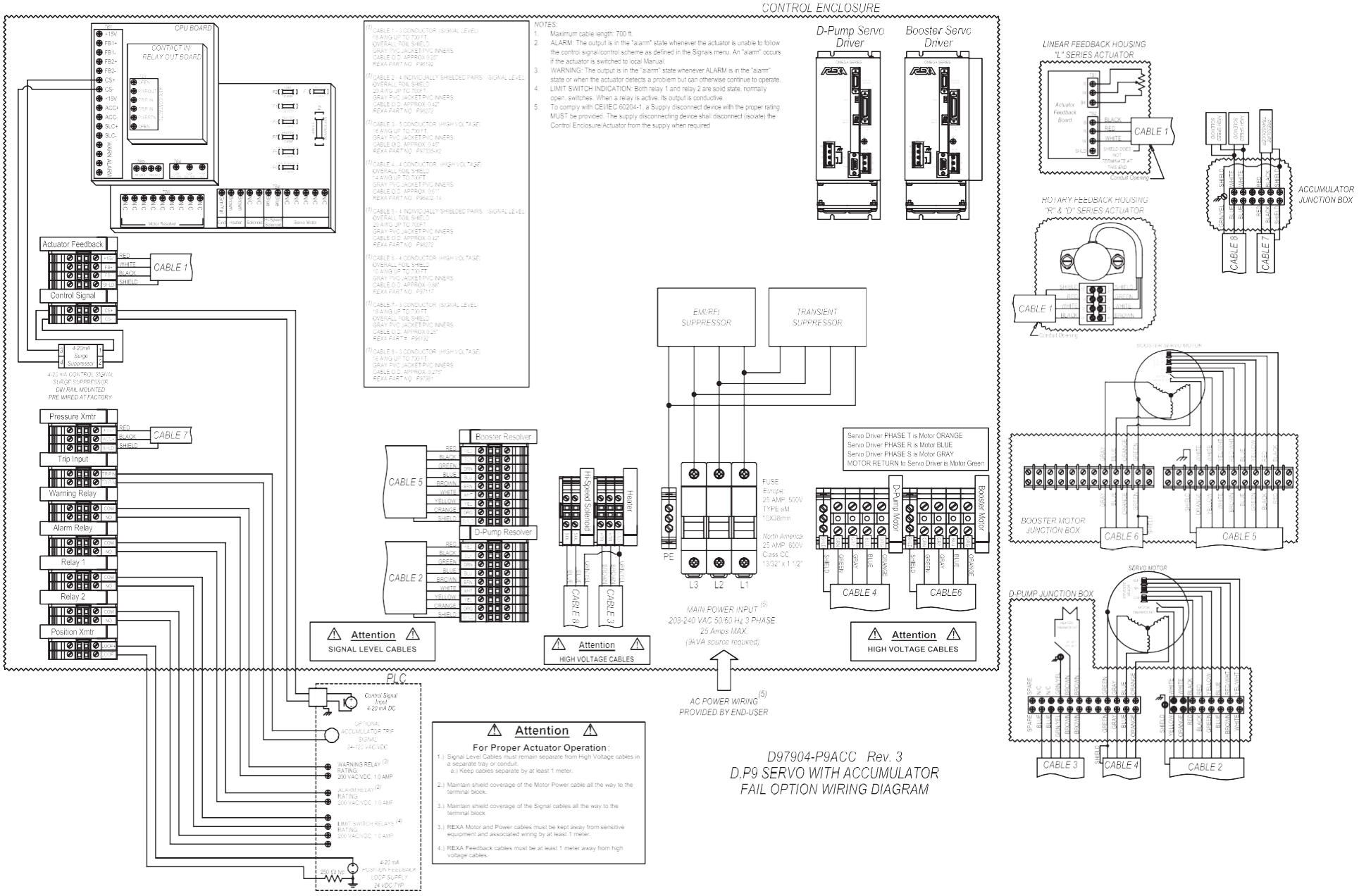


D97904-DACCUM Rev. 3
D SERVO WITH ACCUMULATOR FAIL
OPTION WIRING DIAGRAM

D97904-DACCUM — D SERVO WITH ACCUMULATOR FAIL OPTION

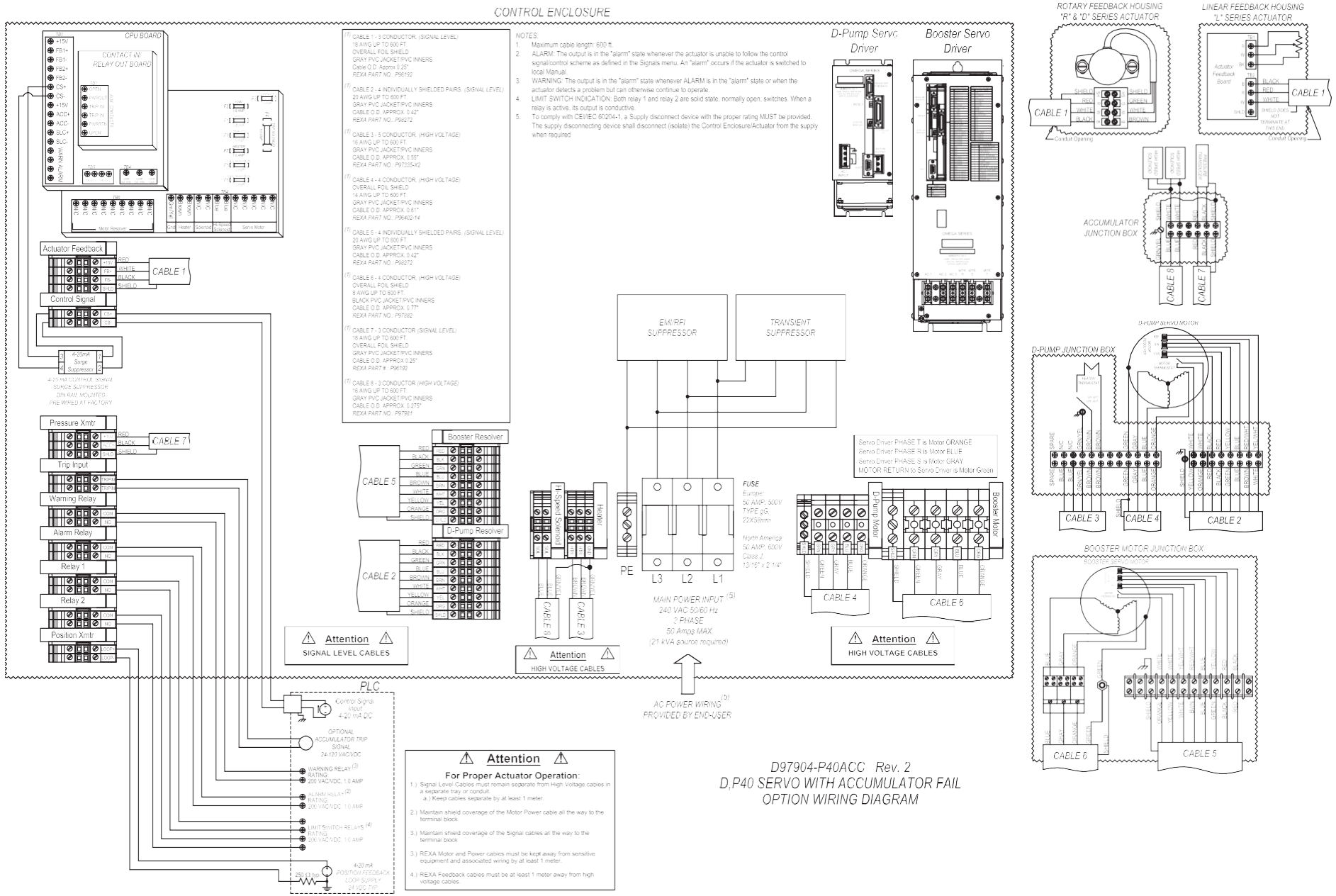
D97904-2DACC — 2D SERVO WITH ACCUMULATOR FAIL OPTION



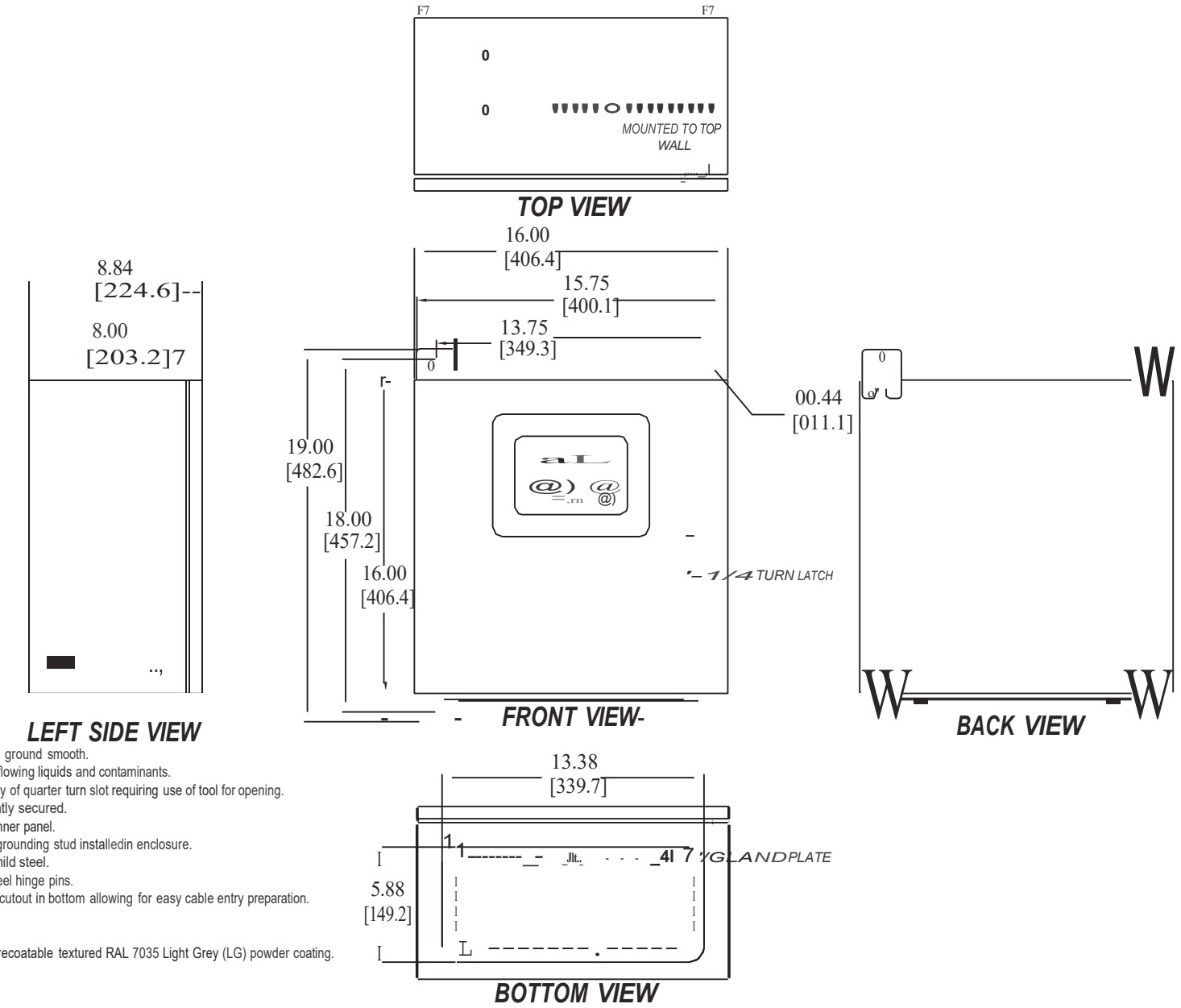


D97904-P9ACC — D,P9 SERVO WITH ACCUMULATOR FAIL OPTION

D97904-P40ACC — D,P40 SERVO WITH ACCUMULATOR FAIL OPTION



D97904-P40ACC Rev. 2
D,P40 SERVO WITH ACCUMULATOR FAIL OPTION WIRING DIAGRAM



B & C-PUMP CONTROL ENCLOSURE ORAWING

APPROVED FOR CSA CL1/DIV 2 WHEN USED AS PART OF ACTUATOR SYSTEM

STANDARDS

- UL 508 Type 12, 4
- CSA Type 12, 4
- Complies with
  NEMA Type 12 and 4
  IEC 529, IP65

CONSTRUCT/ON

Formed 14gaugesteel.
Smooth, continuously welded seams ground smooth.
Formed lip on enclosure to exclude flowing liquids and contaminants.
Door latches feature the added safety of quarter turn slot requiring use of tool for opening.
Oil resistant gaskets are permanently secured.
Collar studs provided for mounting inner panel.
Bonding stud provided on door and grounding stud installedin enclosure.
Quarter turn latches formed from mild steel.

- Formed steel hinge withstainless steel hinge pins.
  Removable steel gland plate covers cutout in bottom allowing for easy cable entry preparation.

FINISH

Cover and enclosure are finished in recoatable textured RAL 7035 Light Grey (LG) powder coating.

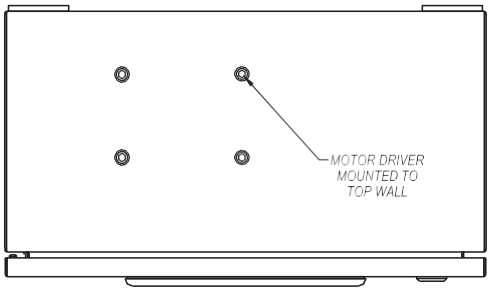
Approximate Weight withContents

37 lbs. (17 kgs.)

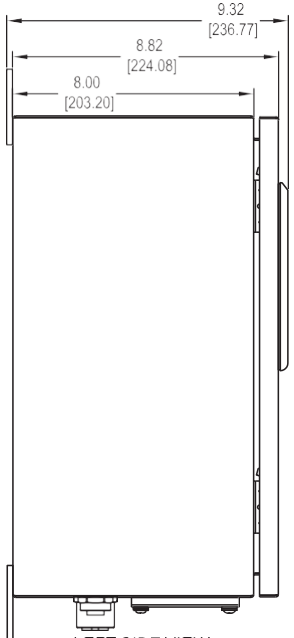
B AND C-PUMP CONTROL ENCLOSURE DRAWING

P98492 — CONTROL ENCLOSURE FOR QUICK CONNECT CABLES

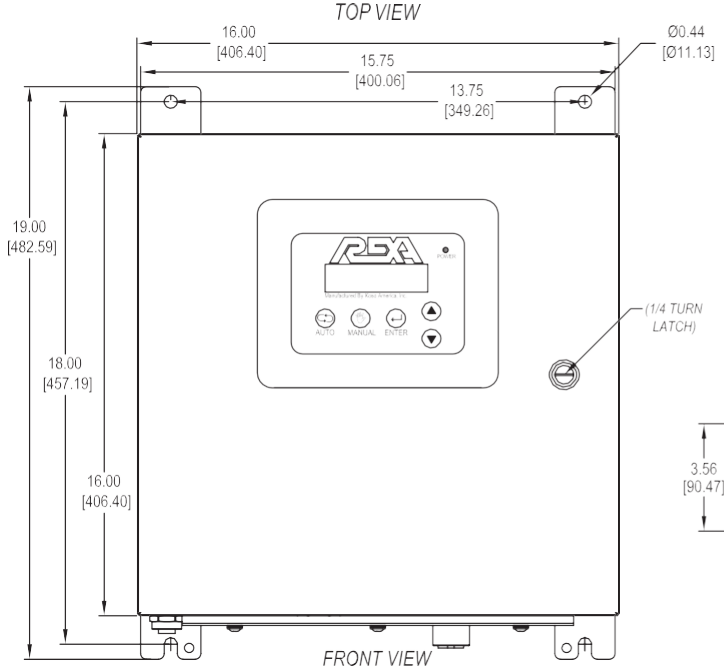
REVISIONS						
REV	ECN NO	DESCRIPTION	DRW	DATE	APVD	DATE



TOP VIEW



LEFT SIDE VIEW



FRONT VIEW

STANDARDS

- UL 508 Type 3R, 4, and 12
- CSA Type 3R, 4, and 12
- Complies with
  NEMA Type 3R, 4, and 12
  IEC 60529, IP66

CONSTRUCTION

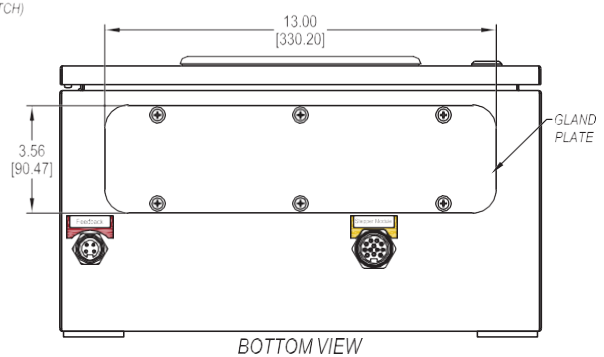
- Formed 16 gauge steel.
- Smooth, continuously welded seams ground smooth..
- Formed lip on enclosure to exclude flowing liquids and contaminants.
- Door latches feature the added safety of quarter turn slot requiring use of tool for opening.
- Doors may be easily removed for modifications and are interchangeable.
- Seamless poured-in place gasket.
- Collar studs provided for mounting inner panel.
- Bonding stud provided on door and grounding stud installed in enclosure.
- Hinges are constructed from 304 stainless steel.
- Hinge pins are stainless steel.
- Quarter turn latch is zinc diecast with black epoxy finish.
- Approximate Weight with Contents Installed is 37 Pounds (17 Kilograms).

FINISH

- Cover and enclosure are phosphatized and finished with a recoatable powder inside and out with RAL7035 textured light gray (LG).

Approximate Weight with Contents

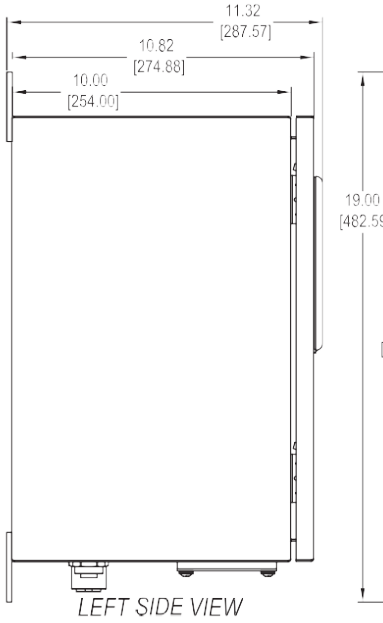
- 37 lbs. (17 kgs.)



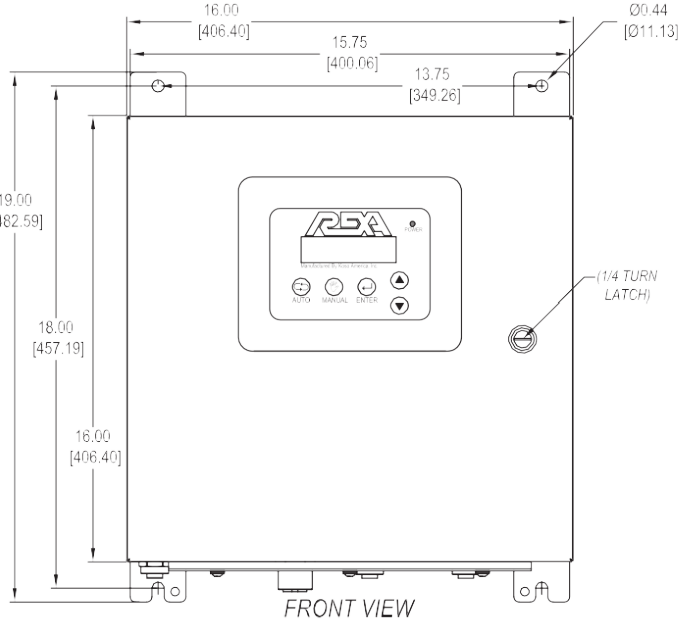
BOTTOM VIEW

UNLESS OTHERWISE SPECIFIED						
DIMENSIONS ARE IN INCHES				MATERIAL/ MAKE FROM	CONTRACT No.	REXA W.BRIDGEWATER, MASSACHUSETTS
X ± 1.0	X.X ± 0.50	X.XX ± 0.25	ANGLES ± 2.00°	SEE CONSTRUCTION		
1) BREAK ALL SHARP EDGES .015 2) O-RING GROOVES 63 FINISH OR BETTER 3) INSIDE CORNER RADII TO BE .030 MAX 4) GEOMETRIC TOLERANCE PER ASME Y14.5M-1999 5) DO NOT SCALE DRAWING				FINISH SEE FINISH	PREP KCL 09/28/12 CHKR DPT 09/28/12 APVD	Control Enclosure, Stepper Electronics, 16.0" x 16.0" x 8.0" Painted Steel, NEMA 4, Machined for Quick Connect Cables. Standard Connections: Feedback & Stepper Module
TEMPLATE NO. RXHDCERT REVISION	THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF KOSO AMERICA INC. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.			ALL MACHINED SURFACES N/A ✓	SHEET 1 OF 1 SCALE NONE	DRAWING NO. P98492 REV 0

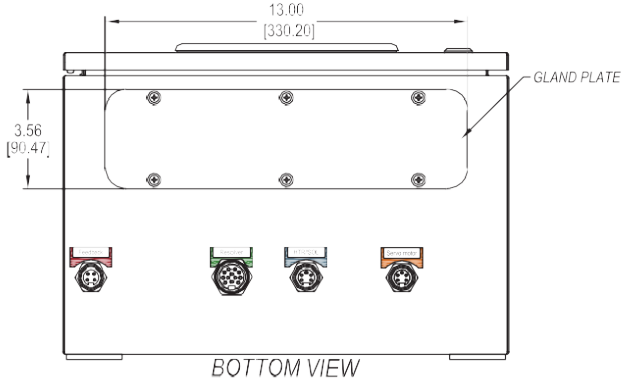
½D AND D CONTROL ENCLOSURE FOR QUICK CONNECT CABLES



LEFT SIDE VIEW



FRONT VIEW



BOTTOM VIEW

REVISIONS

REV	ECN NO	DESCRIPTION	DRW	DATE	APVD	DATE

STANDARDS

- UL 508 Type 3R, 4, and 12
- CSA Type 3R, 4, and 12
- Complies with
  NEMA Type 3R, 4, and 12
  IEC 60529, IP66

CONSTRUCTION

- Formed 16 gauge steel.
- Smooth, continuously welded seams ground smooth..
- Formed lip on enclosure to exclude flowing liquids and contaminants.
- Door latches feature the added safety of quarter turn slot requiring use of tool for opening.
- Seamless poured-in place gasket.
- Collar studs provided for mounting inner panel.
- Bonding stud provided on door and grounding stud installed in enclosure.
- Hinges are constructed from 304 stainless steel.
- Hinge pins are stainless steel.
- Quarter turn latch is zinc diecast with black epoxy finish.
- Approximate Weight with Contents Installed is 45 Pounds (21 Kilograms).

FINISH

- Cover and enclosure are phosphatized and finished with a recoatable powder inside and out with RAL7035 textured light gray (LG).

.Approximate Weight with Contents

- 42 lbs. (19 kgs.)

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
X. ± 1.0 | X.X ± 0.50 | X.XX ± 0.25 | ANGLES ± 2.00°

1) BREAK ALL SHARP EDGES .015
2) O-RING GROOVES 63 FINISH OR BETTER
3) INSIDE CORNER RADII TO BE .030 MAX
4) GEOMETRIC TOLERANCE PER ASME Y14.5M-1999
5) DO NOT SCALE DRAWING

MATERIAL/ MAKE FROM: N/A
FINISH: N/A
ALL MACHINED SURFACES: N/A ✓

TEMPLATE NO. Version 5.01
REVISION

CONTRACT No.

PREP	KCL	02/14/14
CHKR	DPT	02/14/14
APVD		

REXA
W.BRIDGEWATER, MASSACHUSETTS

Control Enclosure, Servo Electronics, 16.0" x 16.0" x 10.0",
Painted Steel, NEMA 4, Machined for Quick Release Cables,
Standard Connections: Feedback, Resolver, HtrSol & Servo Motor

SHEET 1 OF 1
SCALE NONE
DRAWING NO. P98493
REV 0

½D AND D PUMP CONTROL ENCLOSURE DRAWING

1/20 & O-PUMP CONTROL ENCLOSURE DRAWING

OVED FOR CSA CL1/DIV 2 WHEN 4S PART OF ACTUATOR SYSTEM

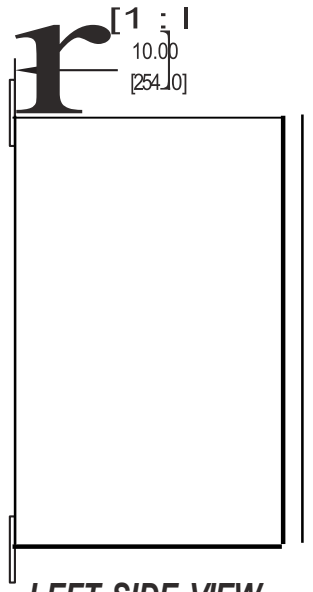
>*ARDS*
IL 508 Type 12, 4
:SA Type 12,4
:omplies with
NEMA Type 12 and 4
IEC 529, IP65

TRUCTION
armed 14 gauge steel.
,mooth, continuously welded seams ground smooth.
armed lip on enclosure to exclude flowing liquids and contaminants.
loor latches feature the added safety of quarter turn slot requiring use of tool for opening.
)il resistant gaskets are permanently secured.
:ollar studs provided for mounting inner panel.
,anding stud provided on door and grounding stud installed in enclosure.
luarter turn latches formed from mild steel.
armed steel hinge with stainless steel hinge pins.
:emovable steel gland plate covers cutout in bottom allowing for easy cable entry preparation.

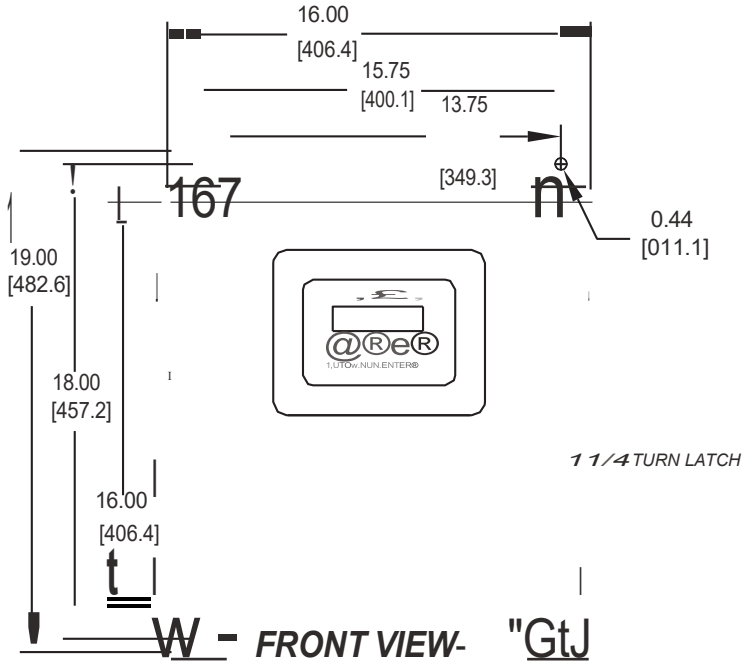
:over and enclosure are finished in recoatable textured RAL 7035 Light Grey (LG) powder coating

<imate Weight with Contents

2 lbs. (19 kgs.)

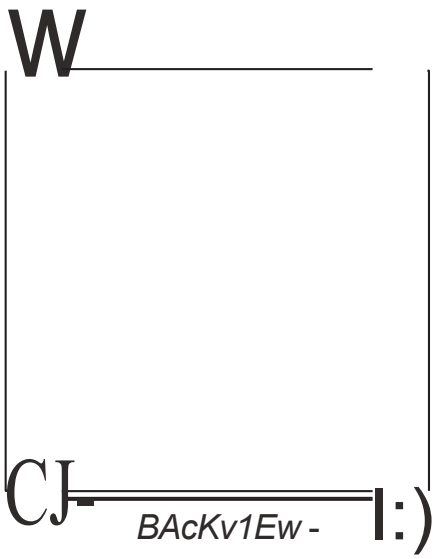


LEFT SIDE VIEW

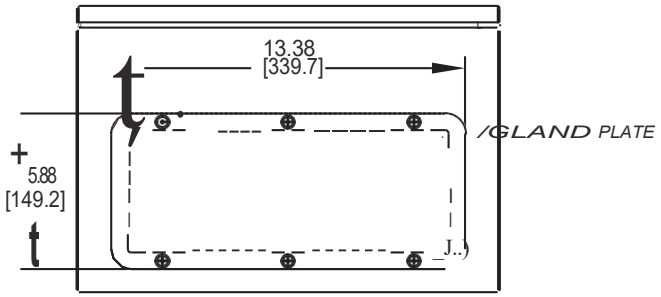


FRONT VIEW-

11/4 TURN LATCH

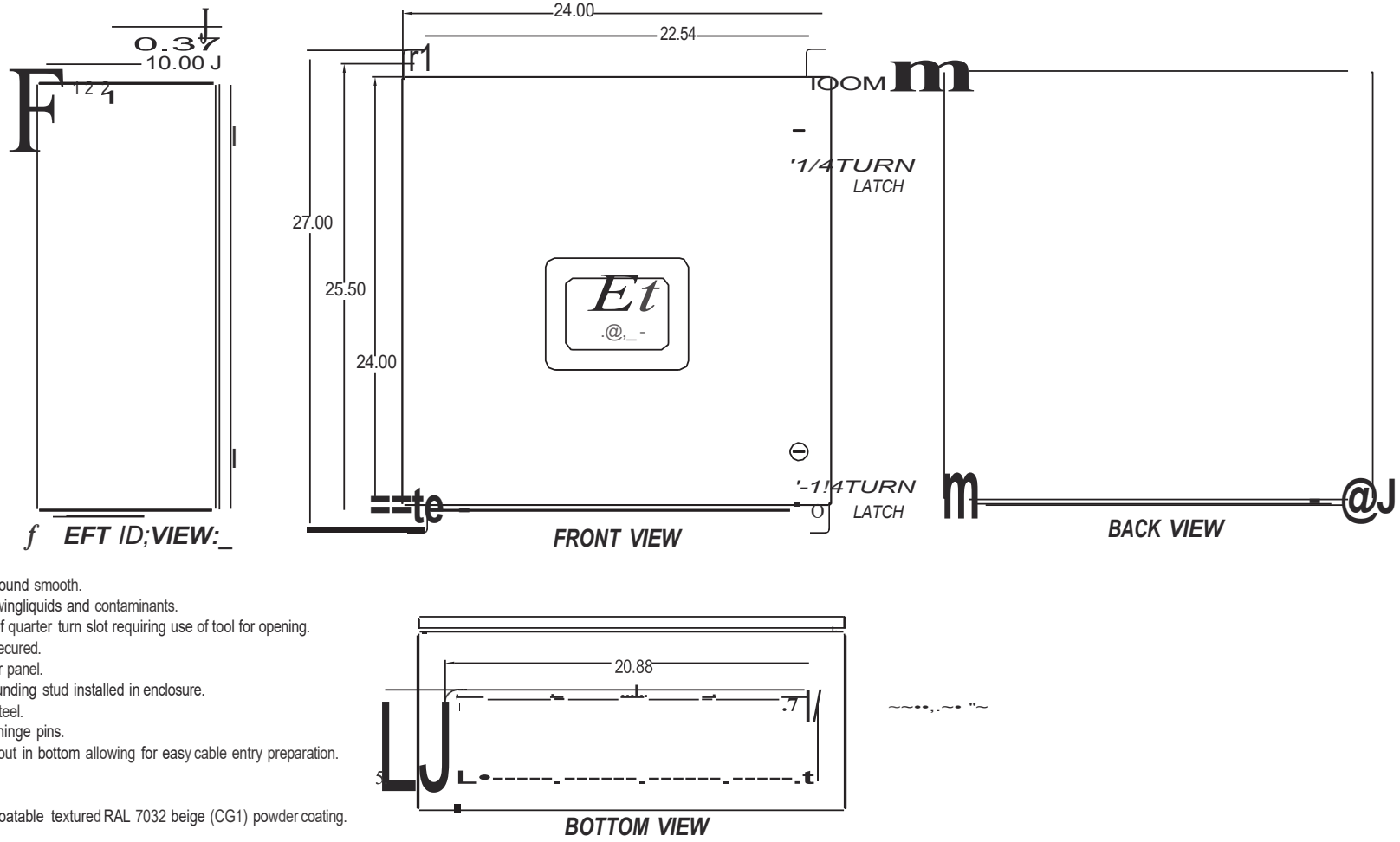


BAcKv1Ew -



/GLAND PLATE

BOTTOM VIEW



2D & DP9 CONTROL ENCLOSURE DRAWING

APPROVED FOR CSA CL1/DIV 2 WHEN USED AS PART OF ACTUATOR SYSTEM

STANDARDS

- UL 508 Type 12, 4
- CSA Type12, 4
- Complies with
  NEMA Type 12 and 4
  IEC 529, IP65

CONSTRUCTION

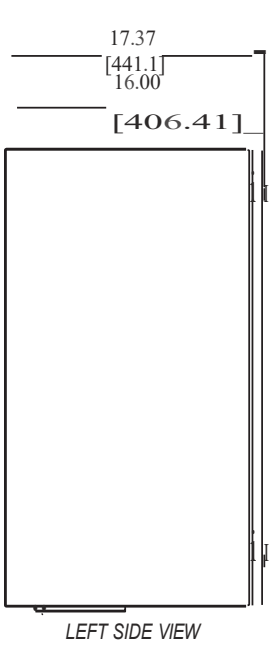
- Formed 14 or 16 gauge steel.
- Smooth, continuously welded seams ground smooth.
- Formed lip on enclosure to exclude flowingliquids and contaminants.
- Door latches feature the added safety of quarter turn slot requiring use of tool for opening.
- Oil resistant gaskets are permanently secured.
- Collar studs provided for mounting inner panel.
- Bonding stud provided on door and grounding stud installed in enclosure.
- Quarter turn latches formed from mild steel.
- Formed steel hinge withstainless steel hinge pins.
- Removable steel gland plate covers cutout in bottom allowing for easy cable entry preparation.

FINISH

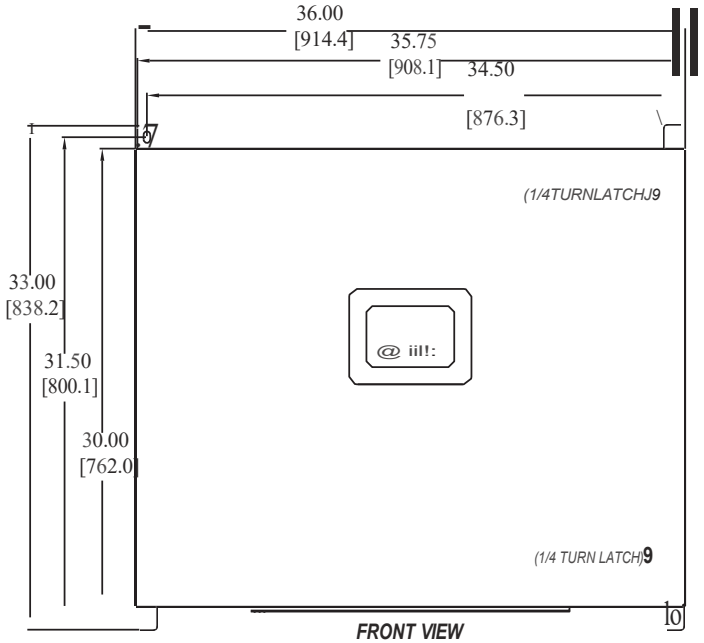
- Cover and enclosure are finished in recoatable textured RAL 7032 beige (CG1) powder coating.

2D & DP9 CONTROL ENCLOSURE DRAWING

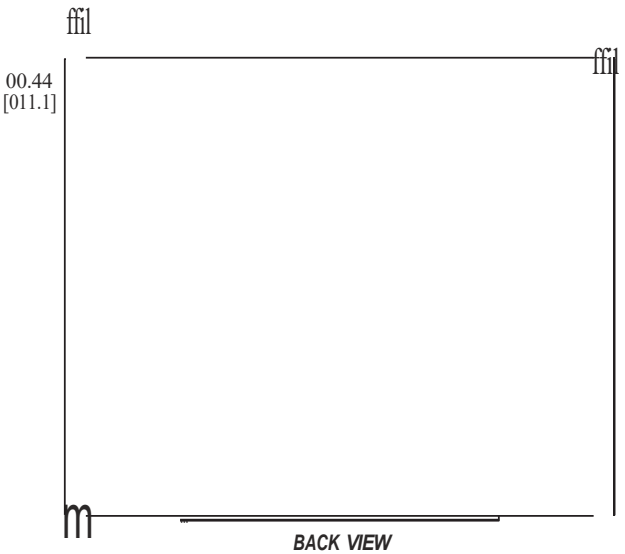
DP40 CONTROL ENCLOSURE DRAWING



LEFT SIDE VIEW



FRONT VIEW



BACK VIEW

DP40 CONTROLENCLOSURE DRAWING

APPROVED FOR CSA CL1/DIV 2 WHEN USEDAS PART OF ACTUATOR SYSTEM

STANDARDS

Type 3R. 4, and 12
CSA Type 3R, 4, and 12
Complies with
NEMA Type 3R, 4, and 12
IEC60529, IP66

CONSTRUCTION

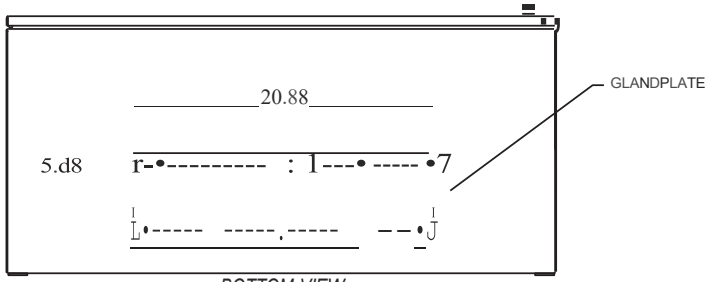
Formed 14 or 16 gauge steel.
Smooth, continuously welded seams ground smooth.
Door stiffeners are provided where required for increased strength and rigidity- designed to also permit additional mounting options.
Formed lip on enclosure to exclude flowing liquids and contaminants.
Door latches feature the added safety of quarter turn slot requiring use of tool for opening.
Oil resistant Closed Cell gaskets are permanently secured.
Collar studs provided for mounting inner panel.
Bonding stud provided on door and grounding stud installed in enclosure.
Hinges are constructed from 304 stainless steel.
Hinge pins are stainless steel.
Quarter turn latch is zinc diecast with black epoxy finish.

FINISH

--Cover and enclosure are phosphatized and finished with a recoatable powder inside and out with RAL7035 textured light gray (LG).

Approximate Weight with Contents

191 lbs. (90 kgs.)



BOTTOM VIEW

Q. Contact Input Options

CONTACT INPUTS

Note: *Refer to the INPUTS menu, Signal Type parameter in the Modes of Operation & Control Parameters section.*

Q.1 SIGNAL INPUT RANGE

Voltage: OFF: 0 to 8 volts, AC or DC
ON: 22 to 120 volts, AC or DC
Undefined: 8 to 22 volts, AC or DC

Current: OFF: less than 1 mA
ON: 1.8 mA to 10 mA; proportional to voltage

Impedance: 12K ohms

Electromechanical or solid state switching devices may be used to activate the control signal. The following points should be observed:

ON state:

Most AC and many DC solid state switching devices require a minimum current flow in order to remain in the closed state. If this minimum current exceeds the input signal current at the activation voltage, the current flow may be increased by adding a shunt resistor across the input signal terminals of the pulse auxiliary board.

OFF state:

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 added across the input signal terminals will bypass the current.

Q.2 1 CONT

The single contact (**1 Cont**) option of controlling the actuator is for ON/OFF applications. A single dry contact or live voltage is applied to the Contact Inputs Board.

The dry contact is biased by 120 Vac available from the Contact input board. A live voltage, 24 to 120 Vac/Vdc, is supplied by the end user.

When **Signal Type = 1 Cont** (one contact), “two position” operation—open/closed position—is selected. The applied signal defines actuator position. If the Open input is active (powered), the actuator goes to Position Hi. If the Open input is not active (un-powered), the actuator goes to Position Lo.

> ***Note:*** *Actuator will continue to move in desired direction as long as a signal is present or until target is reached.*

Typical wiring schemes are shown in Figure Q.2-1, -2.

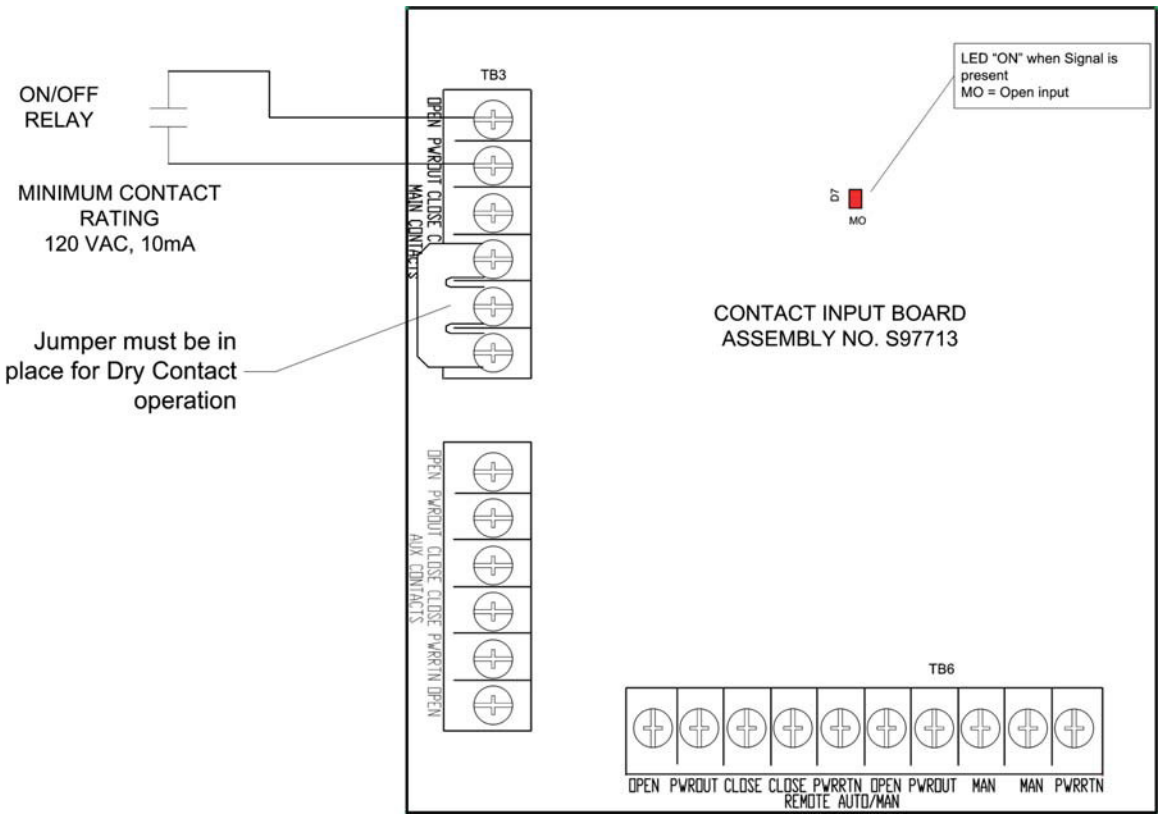


Figure Q.2-1 **1 Cont *"Dry" Input Board***

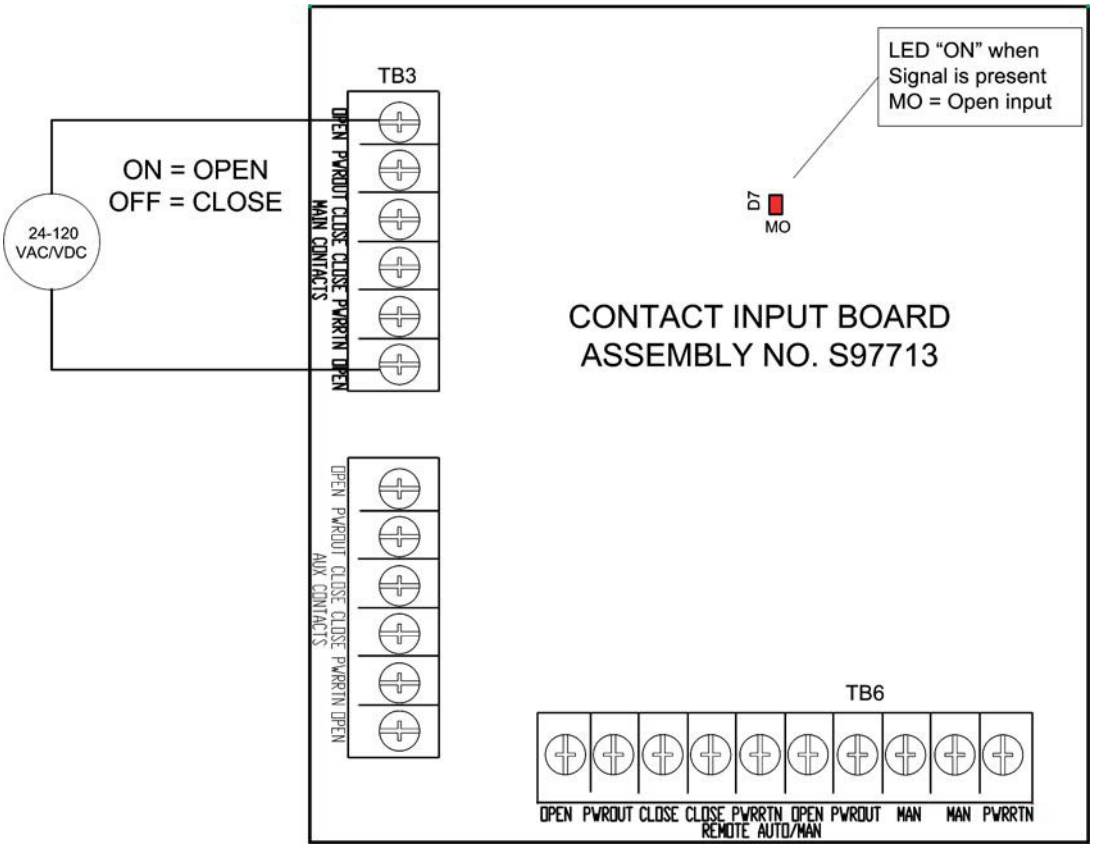


Figure Q.2-2* 1 Cont *"Wet" Input Board

Q.3 2 CONT

The dual contact (**2 Cont**) option of controlling the actuator is for manual modulation control, using two signals. Two dry contacts or two live voltages are applied to the Contact Inputs Board.

The dry contacts are biased by 120 Vac available from the Contact input board or live voltages, 24 to 120 Vac/Vdc, are supplied by the end user.

When **Signal Type = 2 Cont** (two contacts), "manual modulation" operation is selected. The main input signals are the Main contacts Open and Close inputs of the Contact Input Board. If both inputs are active or inactive, the actuator remains in its current position. If only the Open input is active, the actuator travels towards Position Hi. If only input Close is active, the actuator travels towards Position Lo.

Note: *Actuator will continue to move in desired direction as long as a signal is present or until target is reached.*

Typical wiring schemes are shown in Figures Q.3-1, -2.

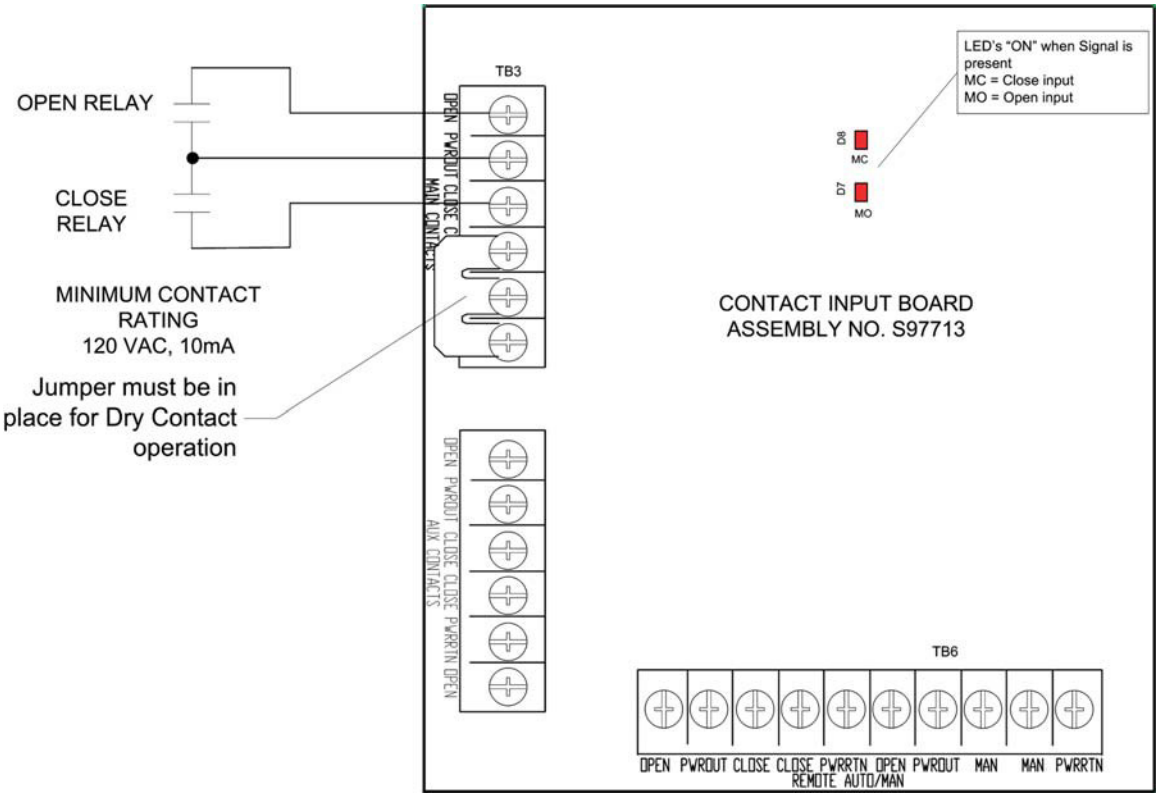


Figure Q.3-1 **2 Cont** ***"Dry" Input Board***

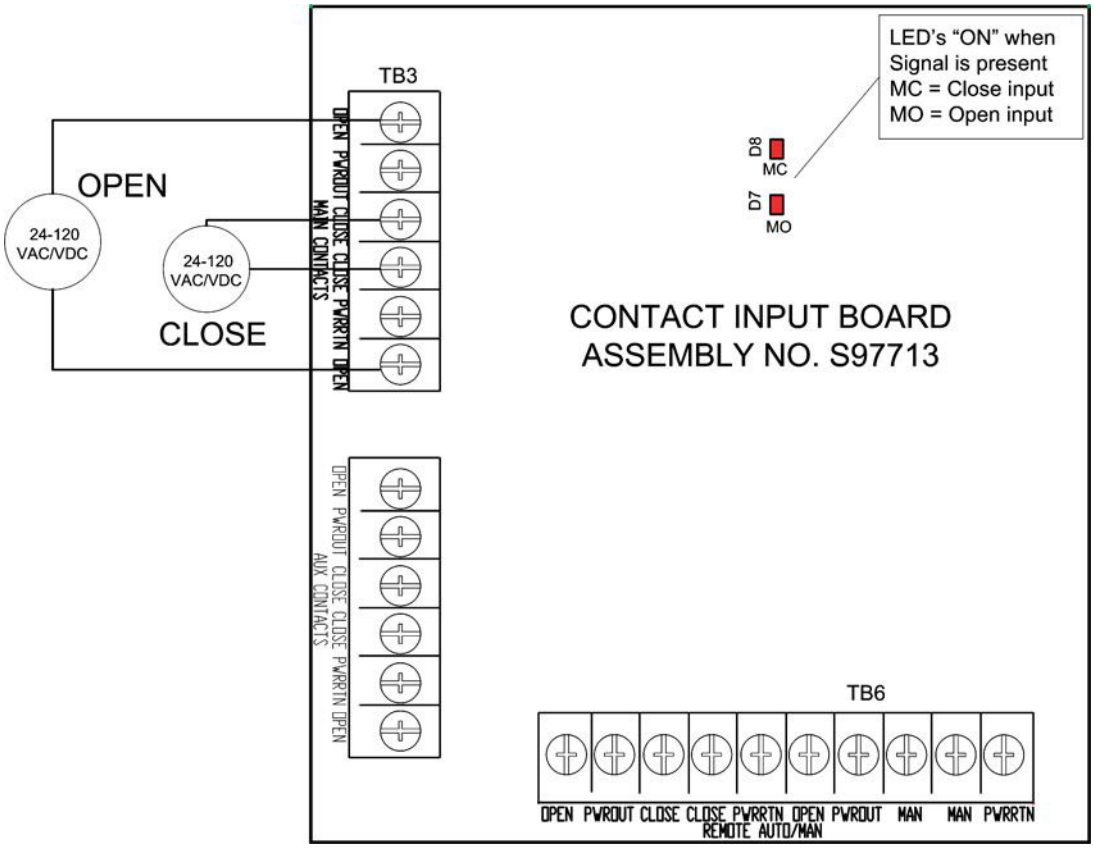


Figure Q.3-2* 2 Cont *"Wet" Input Board

R. Remote Manual Control

R.1 REMOTE MANUAL (RemoteMan)

The actuator may be equipped to connect to a remotely located manual station. The basic station includes one Remote/Auto: two-position maintained switch, and one Open/Off/Close: momentary spring-return-to-center switch. The two position switch is used to alternate between Auto and RemoteMan (remote manual) modes. In the RemoteMan mode, turning the momentary switch to Open or Close will move the actuator in the open or close direction. The spring-return-to-center (off) will stop the actuator at the position when the switch is released. As an additional option, a seven segment LED digital display may be connected to the standard position transmitter to display actuator position at the remote manual station.

RemoteMan allows the actuator to operate manually from a remote location. Once the Remote Manual mode is entered, the current status will be displayed along with Position.

The **RemoteMan** mode is only accessible if the Contacts Input board is installed on top of the CPU. Typical wiring schemes are shown in Figure R.1-1, -2.

The **RemoteMan** mode will be entered when the MAN Input of the Remote Auto/MAN Inputs is activated. The actuator is then controlled by activating the Open or Close Inputs of the Remote Auto/MAN Input.

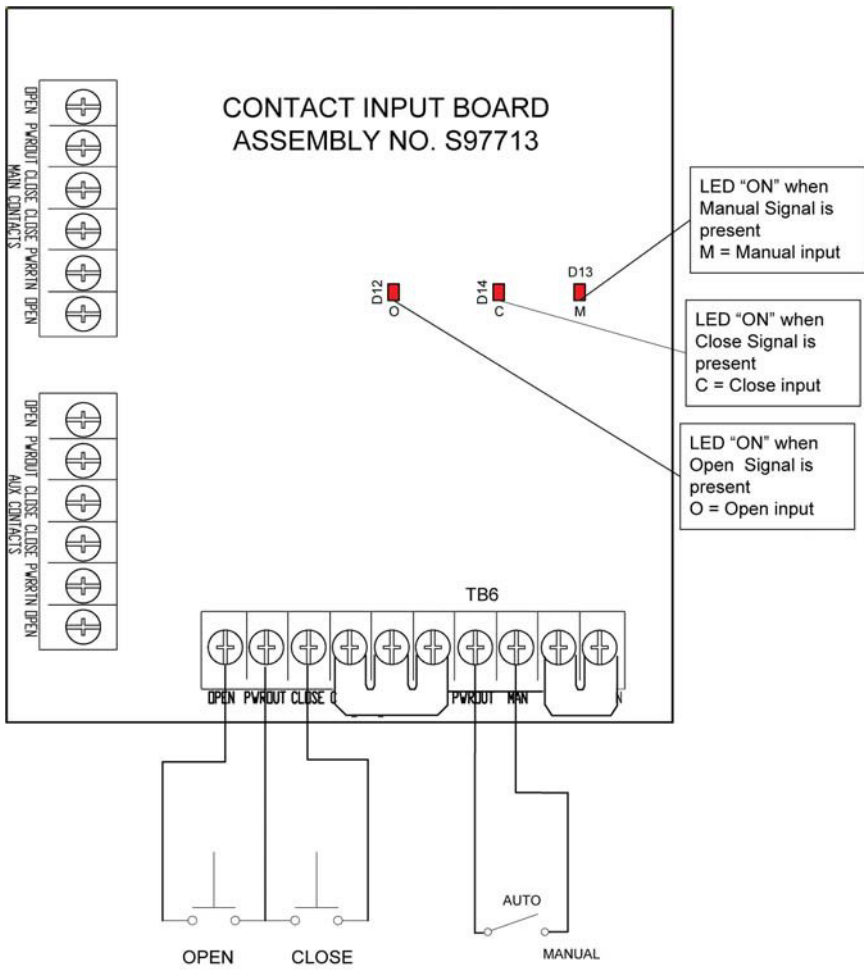


Figure R.1-1 "Dry" Contacts Input Board

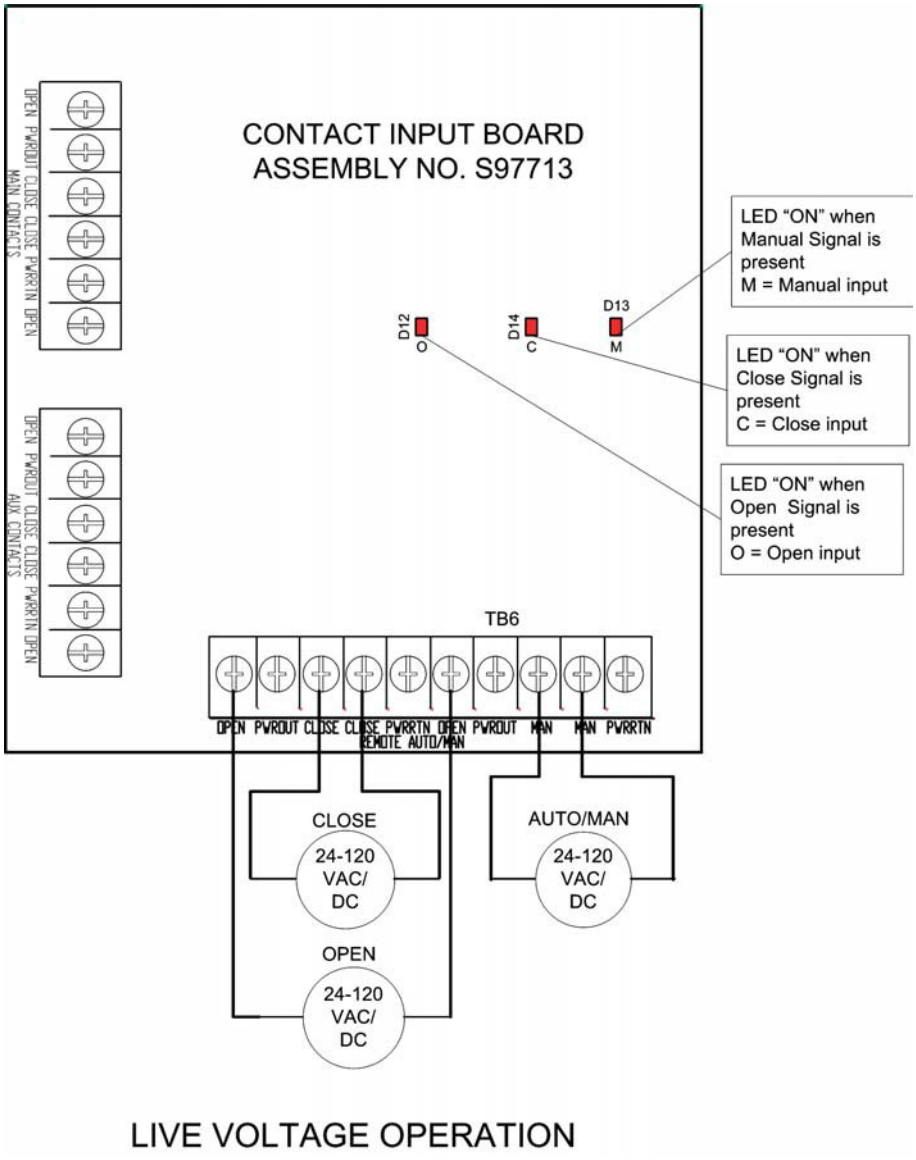


Figure R.1-2 "Wet" Contacts Input Board

S. Safety Manual for ESD SIL Compliance

S.1 GENERAL

This REXA actuator is a Type A device with a hardware fault tolerance (HFT) of 0. The REXA actuator has a safety trip function designed to meet or exceed the requirements of IEC 61508 for a SIL 3 capable designed process. The actuator has been designed and verified to withstand the worst case expected environmental conditions listed in the IOM and specification sheet.

This section of the manual covers the operating requirements for the end user to ensure their system is operated in compliance with the operating requirements needed to achieve safe operation of the equipment in accordance to the rated SIL level. The time in which an actuator will transition into a safe state is defined as the time required to trip on the REXA data sheet. This transition time must be reviewed against the process safety time to insure this product is appropriate for the application.

Any deviation to the installation, operation or maintenance from this appendix will void the IEC61508 SIL certification and may impact the ability of the actuator to accomplish its safety function. All product failures impacting functional safety should be reported back to REXA. The FMEDA report for failure rates, failure modes, and proof test information can be found in the REXA report KOS 13-10-03 R0001, titled FMEDA REXA,

Xpac.An example of the system and application environment in which the PRODUCT will be embedded once delivered is shown in the following drawing.

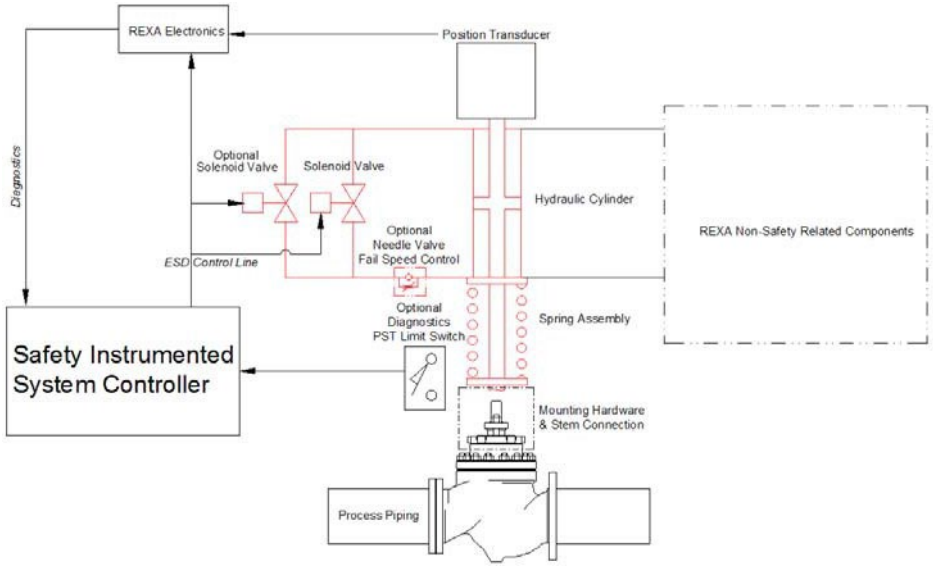


Figure 1: Example Safety Instrumented Function

S.2 SYSTEM SET UP

In order to properly set up the ESD control system the following measures must be taken:

1. The actuator needs to be calibrated to the driven device. Reference the Mechanical and Electrical installation section of this manual.

2. The actuator end points need to be set. Reference the section of this IOM on setting mechanical end stops.

S.3 SYSTEM OPERATION

The primary safety function of the actuator is to place the driven device in the process safe position when input to the actuator's solenoid valves is de-energized. The safety function that carries the SIL certification is an ESD trip function. This trip function is designed to ensure the actuator can be stroked in one direction to

either the full open or the full closed position. This function needs to be controlled directly from the user's SIS and not through the REXA control box. The ESD is certified for low demand fail safe applications.

3.1 The safety solenoids defined on the hydraulic schematic must be wired directly into the main safety system. It is possible for the REXA controller to control these solenoids but in order to minimize the number of components in the safety loop they must be wired directly into the safety system for SIL applications.

3.2 Since the safety solenoids are controlled directly by the safety system a trip relay must be installed to disable the REXA electronics during a safety event. This relay will insure the REXA electronics cannot react to the safety system taking control of the actuator.

3.3 This system has been designed to full stroke at rate which is shown on the actuator data sheet provided to by REXA for this specific order.

3.4 The useful life of this actuator is 10 years based on the duty cycle provided to REXA for this application. After recommended seal maintenance the actuators useful product life is 20 years.

3.5 The REXA actuator is available in normally open or normally closed ESD configurations.

3.6 A 24 hour mean time to repair should be assumed for safety availability calculations.

S.4 SAFETY CRITICAL COMPONENTS

4.1 Definition - Some of the components on this actuator are identified as safety critical. If the failure of any component would inhibit the safety function of this REXA actuator it is deemed a Safety critical component.

4.2 Only OEM supplied replacement parts can be used as suitable replacement parts for any component identified as Safety critical.

4.3 This actuator was supplied to meet a strict number of specifications and may not be modified in the field.

S.5 SYSTEM DIAGNOSTICS

5.1 Built into the REXA CPU are numerous diagnostics that can be found in the error codes section of this IOM. These error codes must be

monitored by the safety system through an alarm relay. The only critical alarmed feature that would indicate the system may not perform its intended trip function is the stall alarm.

5.1.1 Stall Alarm – If the actuator fails to move 1%, within the adjustable stall time setting, while positioning the alarm relay will open indicating an alarm event.

5.1.2 Partial stroke testing is performed to verify the actuator is capable of performing it's intended safety function. The actuator shall be designed to support proof test intervals of 1 year or greater while consuming less than 40% of the allowable PFDavg for SIL 2 SIF applications when PST is implemented. The control and design of this test should be in the scope of the control system. The REXA actuator will only follow the requested change in position as defined by the control loop. This PST percentage to activate needs to be calibrated within the scope of the plants SIS system. During a partial stroke test the control system must monitor the position transmitter to insure the actuator actually successfully performed this function. The control room supervisor needs to review and sign off on the results of the proof tests. This PST should be sufficient to achieve a greater than 65% SFF (Safe Failure Fraction). Key points to review during this test:

5.1.3 Verification from the REXA position transmitter that the actuator followed the change in the control position and performed its PST function.

5.1.4 Redundant verification from an optional PST limit switch can be provided, this limit switch needs to be wired directly into the SIS system.

5.2 The test results are to be recorded and stored for the life of the product.

5.3 In order to insure this system can maintain its "as designed" functionality the maintenance section of this IOM must be strictly adhered too.

S.6 SITE ACCEPTANCE TEST PROCEDURES

A cognizant engineering supporting the operation of the system is responsible for assigning individuals to conduct and record automated testing and proof testing of the equipment. The cognizant engineer is then responsible for reviewing the results.

6.1 Run the actuator open and verify stroking times meet the specification sheet.

6.2 Run the actuator close and verify stroking time meet the specification sheet.

6.3 Perform an ESD trip and verify stroking time meet the specification sheet.

6.4 Run the actuator to it's PST position to verify position feedback and the optional PST limit switch is functioning properly.

S.7 ENVIRONMENTAL REQUIREMENTS

7.1 The actuator has been designed and verified to withstand the worse case environmental conditions as listed in this IOM.

T. Position Transmitter

T.1 POSITION TRANSMITTER

The position transmitter provides a two-wire 4-20 mA signal that is proportional to actuator position. The transmitter's output is optically isolated from the electronics. Both an active and passive transmitter are available. A passive position transmitter is similar to other two-wire transmitters in that an external dc power source is required. An active two-wire transmitter with its own 24 Vdc power supply is available.

Note: *Position feedback can be changed in the field from active to passive or passive to active by rewiring the feedback as shown in Figures T.1-1 and T.1-2.*

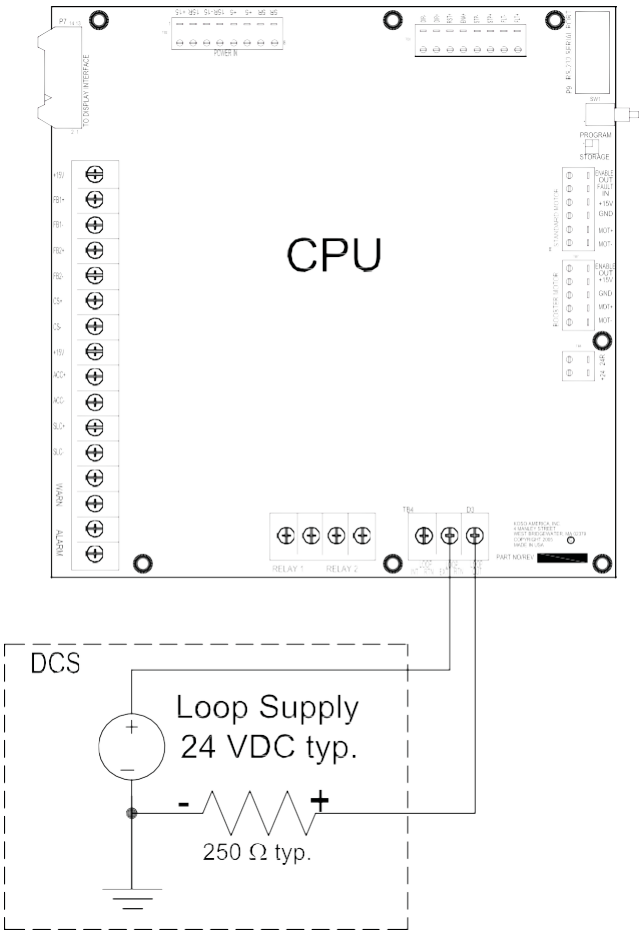
Refer to **OUTPUTS Menu (6.1.8)** in **Modes of Operation & Control Parameters** for calibration procedures.

	Passive	Active
Resolution	<0.1% of full stroke	
Maximum External Load	1000 ohms @ 36 Vdc	700 ohms @24 Vdc
Minimum Supply Voltage	10 + (0.02 x R_{LOAD}) Vdc	24 Vdc (internal supply)
Maximum Supply Voltage	36 + (0.004 x R_{LOAD}) Vdc	

Also included with the transmitter is an Alarm Relay. Whenever the actuator is unable to follow the applied control signal, the Alarm Relay will change state (de-energize). See PM14 for additional details.

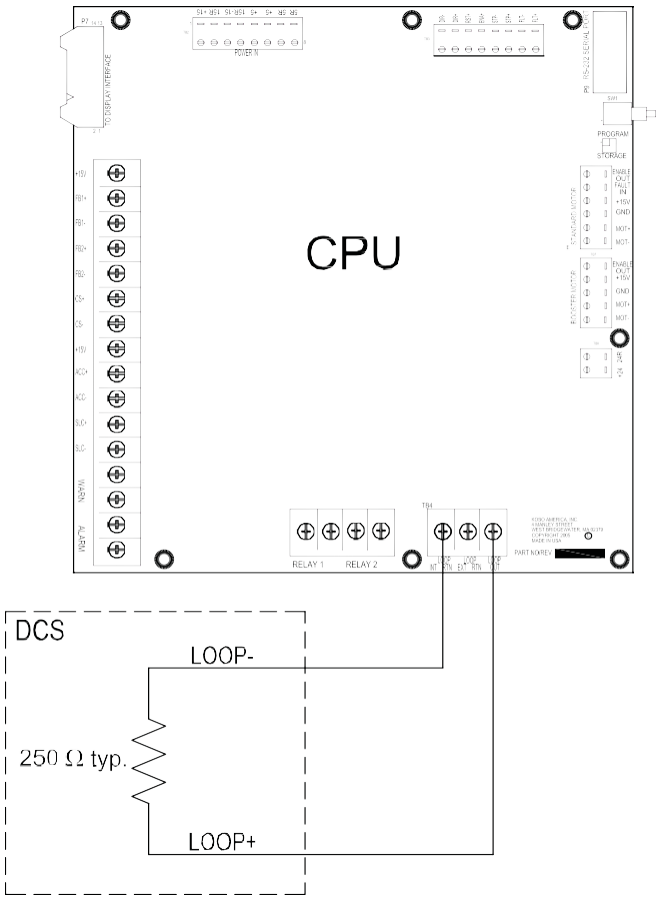
Alarm Relay:

Response: ½ second of any "fail to operate condition"
Alarm Contacts: SPST
Rating: 1 amp @ 30 Vdc, 0.3 amp @ 120 Vac - resistive
Connection: Terminal strip on the auxiliary board



PASSIVE POSITION TRANSMITTER FIELD CONNECTIONS

Figure T.1-1 Passive Position Transmitter Connections



ACTIVE POSITION TRANSMITTER
FIELD CONNECTIONS

Figure T.1-2 Active Position Transmitter Connections

U. ELECTRONIC RELAYS
—Limit Switch, Alarm and Warning

ELECTRONIC RELAYS

The electronic limit, alarm and warning relays are located on the CPU board. All wiring connections are made directly to this board at TB1 and TB5. An indicator LED shows the status (energized-ON) of each relay.

Two of the relays are configured in the Setup Mode to activate upon user defined stroke limits. The third relay is an alarm indicator and the fourth is a warning indicator.

U.1 Limit Switch Relays

LED D4 will illuminate when the Relay 1 is active; indicating the actuator position is at, or below, the value set in parameter Relay 1.

LED D5 will illuminate when the Relay 2 is active; indicating the actuator position is at, or above, the value set in parameter Relay 2.

U.2 Alarm and Warning Relay

LED's D6 and D7 on the CPU Board are always active and light when the actuator operates normally without any error and is following the control signal.

Once the actuator detects an error, or is put into "**LOCAL**" or "**SETUP**" mode, the Alarm and Warning Relays open and LEDs D6 and D7 will turn off.

When the CPU detects an error, which opens the Warning Relay only, LED D7 will turn off. The Warning relay is a signal from the control enclosure that means the REXA CPU detects a problem but can still operate and follow the Control Signal.

The Alarm relay is a signal from the control enclosure that means the REXA CPU detects a problem, or is in **LOCAL** or **SETUP** modes, and cannot follow the Control Signal.

General Specifications

Quantity:	4 (2 Limit, 1 Warning, 1 Alarm)
Type:	High Capacity PhotoMOS Relay
Rating:	1 amp @ 200 Vac/Vdc
Turn On time:	<3 mS
Differential Travel (Hysteresis):	0.1%
Connection:	Terminal strip on the CPU board

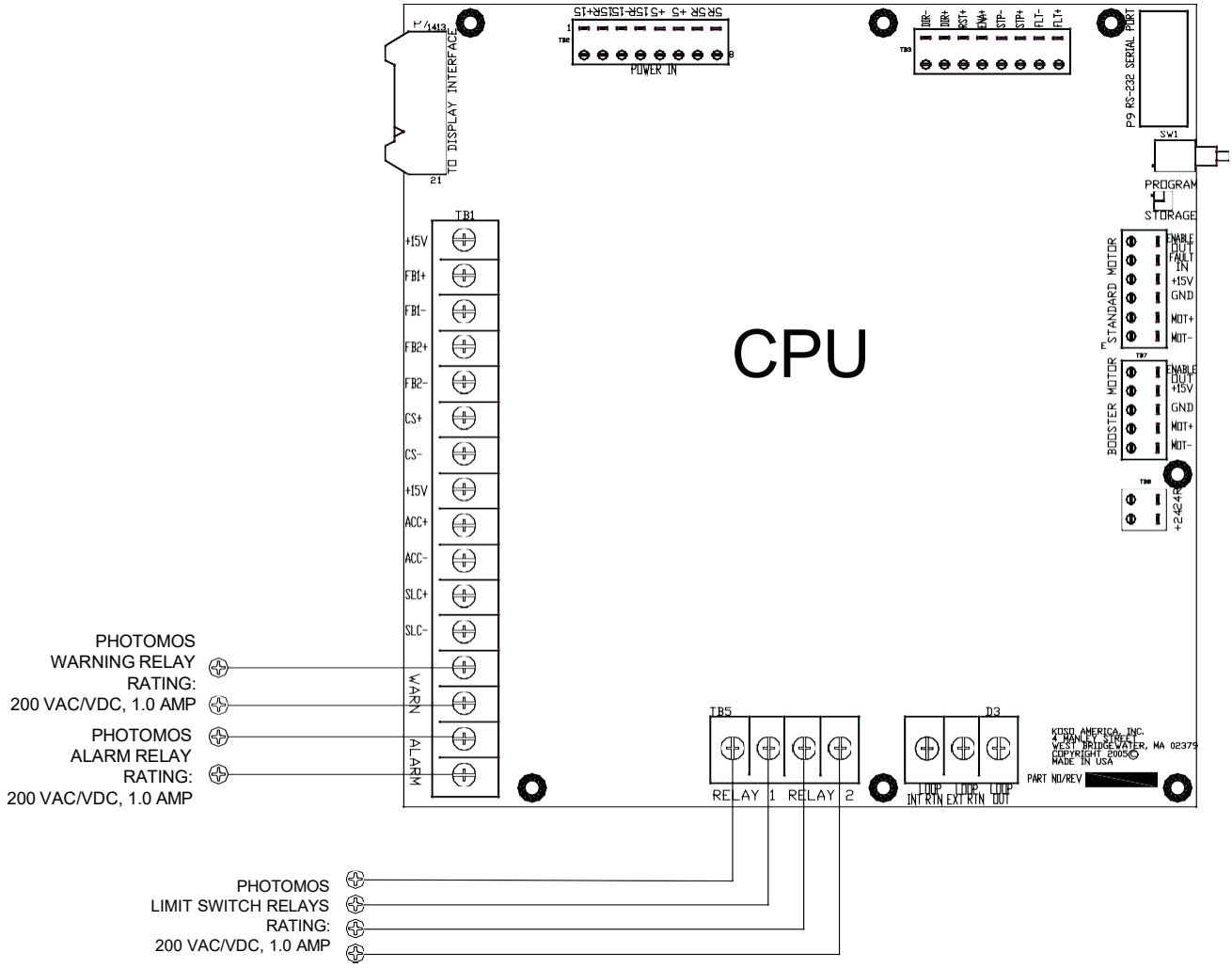


Figure U-1 CPU Board's Electronic Relays

V. Local Mode Indication Board

LOCAL MODE INDICATION BOARD

The Local Mode Indication Board is an optional circuit board mounted to the CPU as shown in Figure V-1.

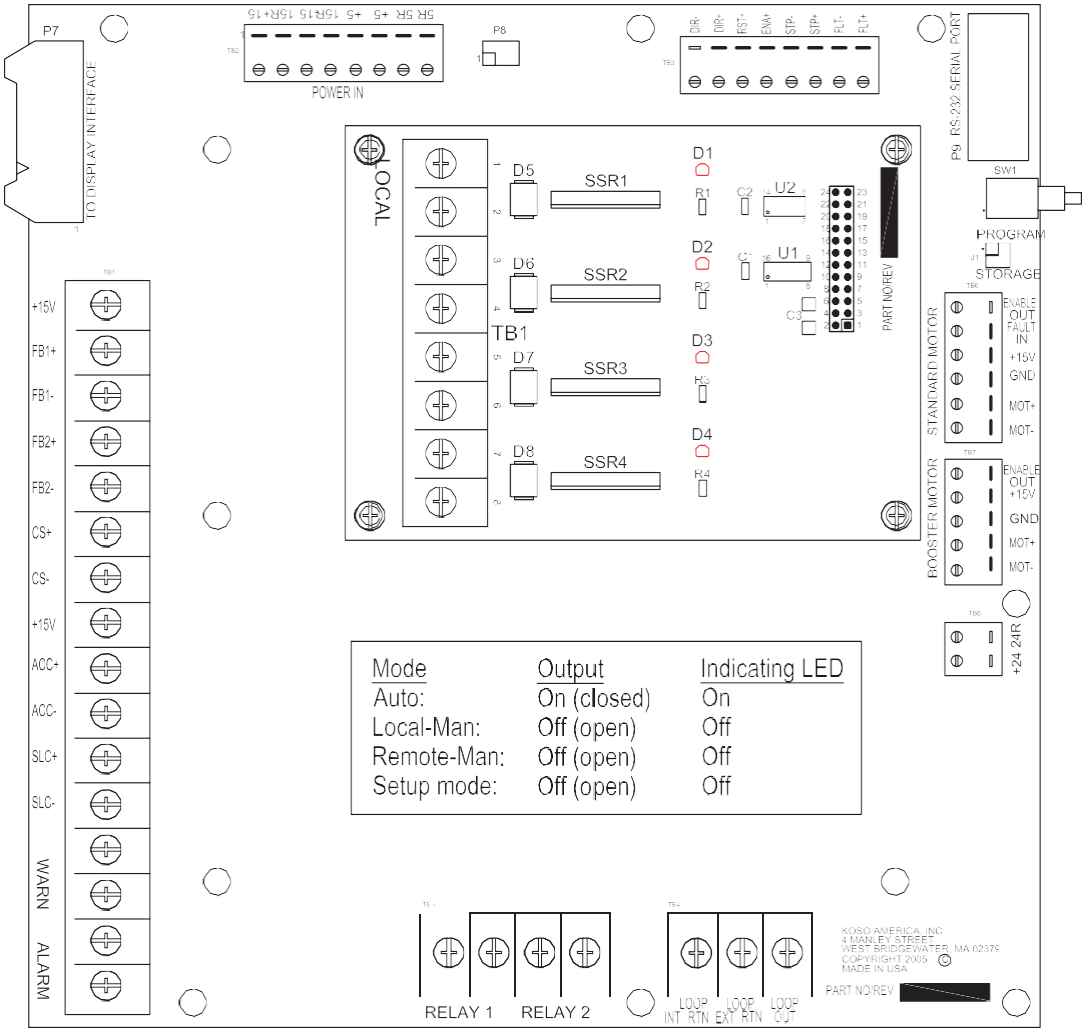


Figure V-1 Local Mode Indication Board

The Local Mode Indication board gives an independent Solid State relay closure when the CPU is in the "**Auto**" mode, and LED D1 will illuminate. When the CPU is put into one of the Local operation modes—whether it is "**Setup**" mode, "Local Man" mode or "**Remote Man**" mode—the contact will open, and LED D1 will turn off. The relay will NOT trigger when an Error code occurs.

The relay is the Photo-Mos type, SPST with a rating of 200 Vac @ 1 Amp.

W. Electronic Unit Ratings

Table W-1 Electronic Unit Ratings

Electronic Unit	Customer Input @ Circuit Breaker			Motor Power		Heater Power		Fail Solenoid		Circle Seal Solenoid	
	Voltage Input	**Phase**	**Input Fuse**	**Volts**	**Amps**	**Volts**	**Amps**	**Volts**	**Amps**	**Volts**	**Amps**
B, 24VDC	24VDC	-	20A	95VDC	6.3A	24VDC	8A	24VDC	5A	24VDC	5A
B, 48VDC	48VDC	-	15A	72VDC	6.3A	48VDC	5A	48VDC	2A	48VDC	5A
B, 115VAC	115VAC ±10%	1	5A	170VDC	6.3A	115VAC	2A	125VDC	1A	115VAC	5A
B, 230VAC	230VAC ±10%	1	5A	170VDC	6.3A	230VAC	1A	125VDC	1A	115VAC	5A
C, 24VDC	24VDC	-	50A	165VDC	6.3A	24VDC	8A	24VDC	5A	24VDC	5A
C, 115VAC	115VAC ±10%	1	10A	170VDC	6.3A	115VAC	2A	125VDC	2A	115VAC	5A
Dual C, 115VAC	115VAC ±10%	1	15A	170VDC	6.3A	115VAC	2A	125VDC	2A	115VAC	5A
1/2D, 115VAC	115VAC ±10%	1	20A	160VDC	6.0A	115VAC	2A	125VDC	2A	115VAC	5A
1/2D, 230VAC	230VAC ±10%	1	10A	280VDC	6.5A	230VAC	1A	246VDC	1A	115VAC	5A
Full D, 230VAC	230VAC ±10%	1	10A	280VDC	7.5A	230VAC	1A	246VDC	1A	115VAC	5A
Dual D	230VAC ±10%	1	20A	280VDC	7.5A	230VAC	1A	246VDC	1A	115VAC	5A
D, P9	230VAC ±10%	3	25A	280VDC, 340VDC	7.5A, 22.0A	230VAC	1A	246VDC	1A	115VAC	5A
D, P40	230VAC ±10%	3	50A	280VDC, 340VDC	7.5A, 55.0A	230VAC	1A	246VDC	1A	115VAC	5A

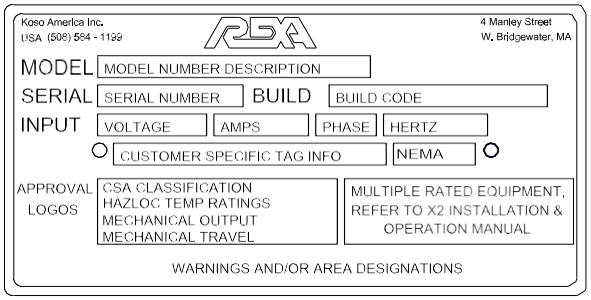
= N/A with CSA

Control Signal	Voltage	Amps
Standard 4-20mA control signal	36VDC max	4-20mA
Optional 10 - 50mA	36VDC max	10-50mA
Pulse control signal (1 or 2 contacts)	24VDC - 120VAC/VDC	1A
Low Coltage control	1-5VDC	20mA

Feedback Out	Voltage	Amps
	24VDC max	4-20mA

Position Transmitter Output	Voltage	Amps
	24VDC	4-20mA

Relays	Voltage	Amps
Warning	200VAC/VDC	1.0A
Alarm	200VAC/VDC	1.0A
Limit Switches	200VAC/VDC	1.0A



Electronics Enclosure Nameplate

Serial number contains date of manufacture information.

X. Redundant Construction

INTRODUCTION

The modular construction of the Xpac allows the duplication of the critical components without a major redesign or sacrificing operational characteristics. Two Power Modules, two complete control electronics and two feedback assemblies are used to operate a single hydraulic cylinder. Each module operates from its own controls and feedback. Wiring and setup are the same as for any standard REXA Actuator.

One module is designated as main and the other as backup. In this manner, the operation of the main system is indicated to the backup system via the Main system's Alarm relay Output. The functional difference between the modules is strictly in the response to a change in control signal.

- The Backup is sixteen times less sensitive than the Main, up to a maximum of 5%.

For instance, setting the dead band of each module to 0.1% would mean that the backup module is at 1.6%. A control signal change of less than 1.6% would result in only the main module taking action to change position. A change greater than 1.6% would have both modules operating. Regardless of the

change, positioning would still be 0.1% resolution. If the main module cannot respond (indicated by the alarm), then the backup module will automatically revert to fine control and position to the 0.1% setting.

This configuration has a redundancy of 90%. The only major component not duplicated is the hydraulic cylinder which is unlikely to suffer a catastrophic failure. Any size module can be upgraded. An R is added to the model number to indicate this enhancement (L2000-2-2B**R**-P).

X.1 MECHANICAL INSTALLATION

Mounting and installation procedures for the actuator or drive are the same as for a standard unit. The location of the mounting holes and shaft connections are not affected.

X.2 ELECTRICAL INSTALLATION

The two control electronics can be installed in a single enclosure or two separate enclosures. In either case, there are two complete sets which function, for the most part, independently.

Wiring is accomplished as two separate units. Each Power Module and feedback circuit is connected to a single electronics.

However, the Alarm relay of the Main Control Enclosure is connected to the Aux Contacts Open Input of the Backup Control Enclosure.

X.2.1 User Connections

Electrical power and control signal are wired in the conventional manner. However, consideration should be given to maintaining the redundancy down to the following user connections:

Power should be brought from two sources.

A single 4-20mA control signal is looped through both electronics.

X.2.2 Redundant Interconnections

The Alarm relay of the Main electronics is connected to the Auxiliary Open Contact of the Backup electronics. When the Backup detects the Main is in the 'alarm" state via this input, (Contact Input = no voltage detected), the Backup switches to its normal deadband setting until the alarm condition is cleared.

X.2.2.1 Alarm Indication

The alarm relay is used to indicate the online status of the Main Power Module. Power for the alarm is obtained from the Backup Actuator Main AC power.

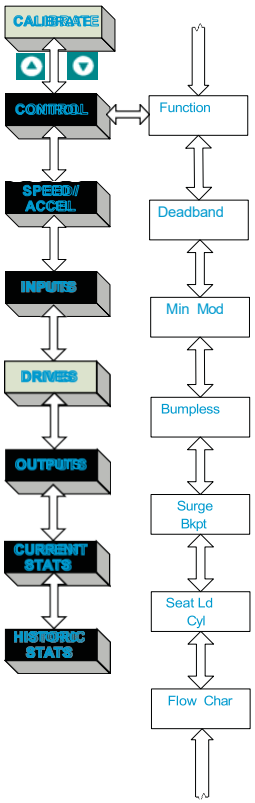
X.3 OPERATION

The operation is substantially unchanged from a standard unit. However, some mention should be made to the interaction of two independent Power Modules on the same cylinder. Both CPUs are looking at the actual position and comparing this to the target position set by the control signal. If the target position for one module is satisfied but not for the other, then one module will reposition the actuator. If the repositioning causes the first module to move outside of its target, then it will move the actuator back. This action would occur with the same signal and low dead band settings (< 0.5%). Such operation is alleviated by simultaneous calibration and the backup unit's deadband having an internal setting sixteen times that of the main unit.

Another extraordinary condition will happen if one module is put into **LOCAL MAN** and moved manually. The other unit will continue to track the control signal and move the actuator back. Placing both CPUs in **LOCAL MAN** and moving only one remedies this situation.

X.4 WIRING

Wiring is accomplished as two separate units. A Power Module and feedback circuit is connected to a single electronics.



X.5 CPU SET UP FOR MAIN AND BACKUP

Each CPU is set as either the MAIN or BACKUP when shipped from the factory as a complete unit. However, in the case where a CPU needs to be replaced, the CPU must be set to either be the MAIN or BACKUP. This is accomplished in the **CONTROL** menu, parameter **Function**, as shown.

The parameter **Function = Backup** can only be selected if the Contact Inputs Board, P/N S97713, is installed. If the CPU is put into **Auto** mode when **Backup** is selected and no input board is present, the error **No inp bd** will be displayed and the CPU will revert back to the Setup mode.

X.6 SIMULTANEOUS CALIBRATE

Both CPUs should be calibrated at the same time on a step by step basis. Follow the procedure indicated in Section 5.3. With the exception of the

Position Lo, Position High, all values in the **SETUP** Parameters should be identical.

Position Lo and **Position HI** should be set at the same time.

1. Access parameter **Position Lo** on both the Main and Back Up electronics, so that the "=" is flashing.
2. Operate the actuator, using the Main electronics, to the position that corresponds to 4 mA.
3. The % position value should change on both Control electronics.
4. The value on the Main electronics may be slightly different than the Back Up. That is acceptable.
5. Lock the value into **Position Lo** on the Main and Back Up by pressing "Enter" and stopping the "=" from flashing.
6. Access parameter **Position Hi** on both the Main and Back Up electronics, so that the "=" is flashing.
7. Operate the actuator, using the Main electronics, to the position that corresponds to 20 mA.
8. The value on the Main electronics may be slightly different than the Back Up. That is acceptable.
9. Lock the value into **Position Hi** on the Main and Back Up by pressing "Enter" and stopping the "=" from flashing.
10. Again, **Position Lo** and **Position Hi** of the Main Control enclosure may have slightly different values than the Back Up values; however, the physical position of the actuator is the same.

X.7 AUTO MODE DISPLAY

When in Auto mode, the CPU operating as the MAIN will display Auto-Main, and the CPU operating as the BACKUP will display Auto-Bkup. When there is no voltage present on the Backup's Auxiliary Open input, (Main is in Alarm state), the display on the Backup will change to Auto-Main until the alarm on the main is cleared.

X.8 REDUNDANT HIGH SPEED SOLENOIDS FOR SPRING FAIL OPERATION

Some actuators may be equipped with redundant hi-speed solenoids to offer a mechanical spring fail on loss of Main AC power.

Each solenoid is connected to its respective Control electronics.

The two solenoids are hydraulically connected in series with one another. Under normal operation, the solenoid valves are closed. This allows the actuator to operate with the motor and pump.

When Main AC Power is removed from BOTH Main and Back Up Control electronics, both solenoids will open, causing the spring to move the actuator to the Fail Safe position.

> ***Note:*** *Because the solenoids are hydraulically connected is series, if Main power to only one Controller is removed, the actuator will not travel to the fail position. Rather, it will maintain normal operation with the motor and pump. In addition, should solenoid become defective, the remaining solenoid allows for normal operation.*

(J cABLE1 • 3 CONDUCTOR *(SIGNAL LEVEL)*
18AWGUPT0300FT.
OVERALL FOIL SHIELD
GRAY PVC JACKET/PVC INNERS
CABLE 0.0. APPROX0.25"
REXA PART#: P96192

(f) CABLE2 -11 CONDUCTOR *(HIGH VOLTAGE)*
4 TWISTEDPAIR/1TWISTEDTRIAD
OVERALL FOILSHIELD
16 AWG UP TO 300 FT.
GRAY PVC JACKET/PVC INNERS
CABLE 0.D. APPROX.0.625"
REXA PART#: P96191-X2

(f) CABLE 3 • 3 CONDUCTOR *(SIGNAL LEVEL)*
18AWGUPT0300FT.
OVERALL FOILSHIELD
GRAY PVC JACKET/PVC INNERS
CABLE 0.0. APPROX 0.25"
REXA PART#: P96192

(J CABLE4 -11 CONDUCTOR *(HIGH VOLTAGE)*
4 TWISTEDPAIR/1TWISTEDTRIAD
OVERALL FOILSHIELD
16AWGUPT0300FT.
GRAY PVC JACKET/PVC INNERS
CABLE 0.D. APPROX.0.625"
REXA PART#: P96191-X2

NOTES
1. Cable lengths above 300 ft. must increaseAWG Consult Factory
2 ALARM:The output is in the "alarm· state whenever the actuatof is unabletofollowthecontrolsignal/controtschemeasdefinedinthe Signalsmenu.An"alarm'occursiftheactuatorisswitchedtolocal Manual.
3 WARNING: The output is in the "alarm· state whenever ALARM isinthe "alarm'stateorwhentheactuatordetectsaproblembutcanolherwise continue to operate.
4. LIMIT SWITCHINDICATION:Both relay 1and relay2aresolidstate, normallyopen,switches.Whenarelayisactive,rtsoutputisconductive
5 TocomplywithIEC61010,aSupplydisconnectdevicewithlheproper ratingshouldbeused.Thesupplydisconnectingdeviceshalldisconned (isolate)theControlEnclosure/Actualoffromthesupplywhlenrequired

Lh Attention
For Proper Actuator Operation
1.)...S.....C.-I.....
1 .)= = Jse coverage of the Motor Power cable all the way to the
I.)REX..._.on:i___ bo>...c_n.t._
REMF—nutboot-1melOr--hVll

MOTOR DRIVER
Control Enclosure
"MAIN" CPU BOARD
) CABLE1
RED
WHITE
BLACK
SHIELD
TRANSIENT SURPPRESSOR
EMI/RFI SURPPRESSOR
FUSE
F3[6J ,E,
OCS
WARNIN i t.U.
200VACNDC.1.0AMP
LIMITSWITCHI.,nf',JJ/ I :
200VACNDC.1.0AMP
4-?QmA POSITIONFIDBACK LOOPSUPPLY 24VDCTYP.
250 Ω typ.
MAIN POWER INPUT (S)
120VAC50/60Hz
B-Pump 4.0Amps MAX
(SOOVAU,eqc;red)
(CABLE
SHIELD
AC POWER WIRING PROVIDED BY EN(). LJSER
MOTOR DRIVER
"BACK-UP" CPU BOARD
GABLE 3
CONTACT IN/ RELAY OUT BOARD
CONTROL SIGNAL INPUT 4-20mADC
4-20mA Smi,: Suppressor
TRANSIENT SURPPRESSOR
EMI/RFI
F3[6) ,rn
WARNIN i t.JJ
200VACNDC.1.0AMP
MARMJi t2).
200VACNDC.1.0AMP
LIMITSWITCH Nyg/ /:
200VACNDC.1.0AMP
POSITIONFEEDBACK LOOP SUPPLY 24 VDCTYP.
250 Ω typ.
MAIN POWER INPUT (S)
120VAC50/60Hz
8-Pump 4.0 Amps MAX.
(CABLE
SHIELD
AC POWER WIRING PROVIDED BY ENO.USER
"MAIN" ACTUATOR JUNCTIONBOX
STEP MOTOR
HEATER/ THERMOSTAT
MOTOR THERMOSTAT
SPARE SPARE SPARE GRN/YEL BROWN BROWN RED/BLK RED GRN/BLK GREEN YELLOW YELLOW
SPARE BLUE BLUE GRN/YEL BROWN BROWN RED/BLK RED GRN/BLK GREEN YELLOW YELLOW
CABLE2
"MAIN" LINEARFEEDBACK HOUSING
ACTUATOR , : FEEDBACK BOARD
BLACK
RED
WHITE
SHLD
CABLE 1
SHIELD DOES NOT TERMINATE AT THIS END
CONDUIT OPENING
"BACK-UP" ACTUATORJUNCTIONBOX
CABLE4
"BACK-UP"LINEAR FEEDBACKHOUSING
ACTUATOR= FEEDBACK BOARD
CABLE 3

Figure X. Redundant Unit Interconnection Diagram