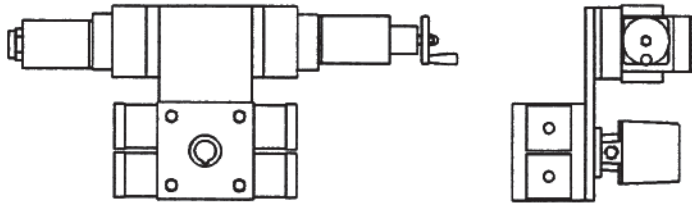


REXA Electraulic™ Actuators & Drives

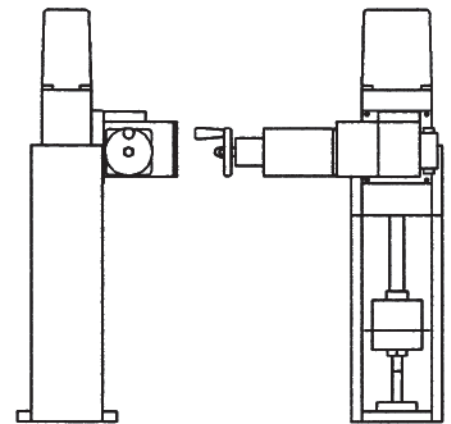
REVISIONS

INSTALLATION AND OPERATION MANUAL
NUMBER IOM-8-00

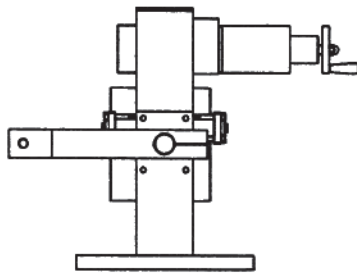
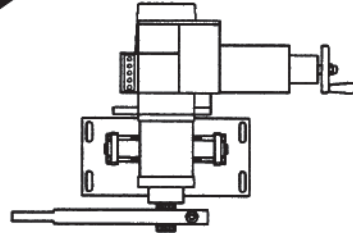
Actuator Serial Numbers:



R-SERIES
ROTARY



L-SERIES
LINEAR



D-SERIES
DRIVE

Xpac INSTALLATION AND OPERATION MANUAL

UNLESS OTHERWISE SPECIFIED				CONTRACT No.			KOSO AMERICA, INC. 4 Manley Street W. Bridgewater, MA 02379 tel: 508.584.1199 fax: 508.584.2525					
1) BREAK ALL SHARP EDGES .015 2) O-RING GROOVES 63 FINISH OR BETTER 3) INSIDE CORNER RADII TO BE .030 MAX				DIMENSIONS ARE IN INCHES						PREP	DCN	051198
				.X ±.03 .XX ±.015 .XXX ±.005 ANGLES ±2°						CHNR	AL	051198
THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF REXA CORPORATION. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.				MATERIAL						APVD	MC	051198
				FINISH			APVD	SL	051198			
MACHINE SURFACE 125/√				SIZE <input type="checkbox"/> NUMBER IOM 05/09			REV 5.1					
				SCALE FULL			SHEET					

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- 2D Size Control Enclosure
- Junction Box; ½D, D and 2D size—actuator end

* Please note that the page numbers for these figures refer to the individual Appendix indicated by the first letter.



SAFETY CONSIDERATIONS



SHOCK HAZARD:

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



ALIGNMENT:

Insure 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 Syntec SAE 5W-50 motor oil. Oil for special applications such as food grade would be noted on the serial plate. The introduction of other fluids may cause damage to the unit.



SPRING UNDER TENSION:

REXA actuators, denoted by an *E*, *R* or *U* 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 (fail in place units) or the motor is not turning, hydraulic pressure remains locked within the cylinder. This internal pressure must be relieved before disconnecting any hydraulic fitting. Open the cylinder bypass ($3/16$ " hex) located on the power module for fail in place units or remove electric power to the solenoid on spring fail units. See section 3.M2 of the Trouble Shooting and Repair Manual.



ACCUMULATOR FAILURE OPTION:

REXA actuators denoted by an A 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.

INTRODUCTION

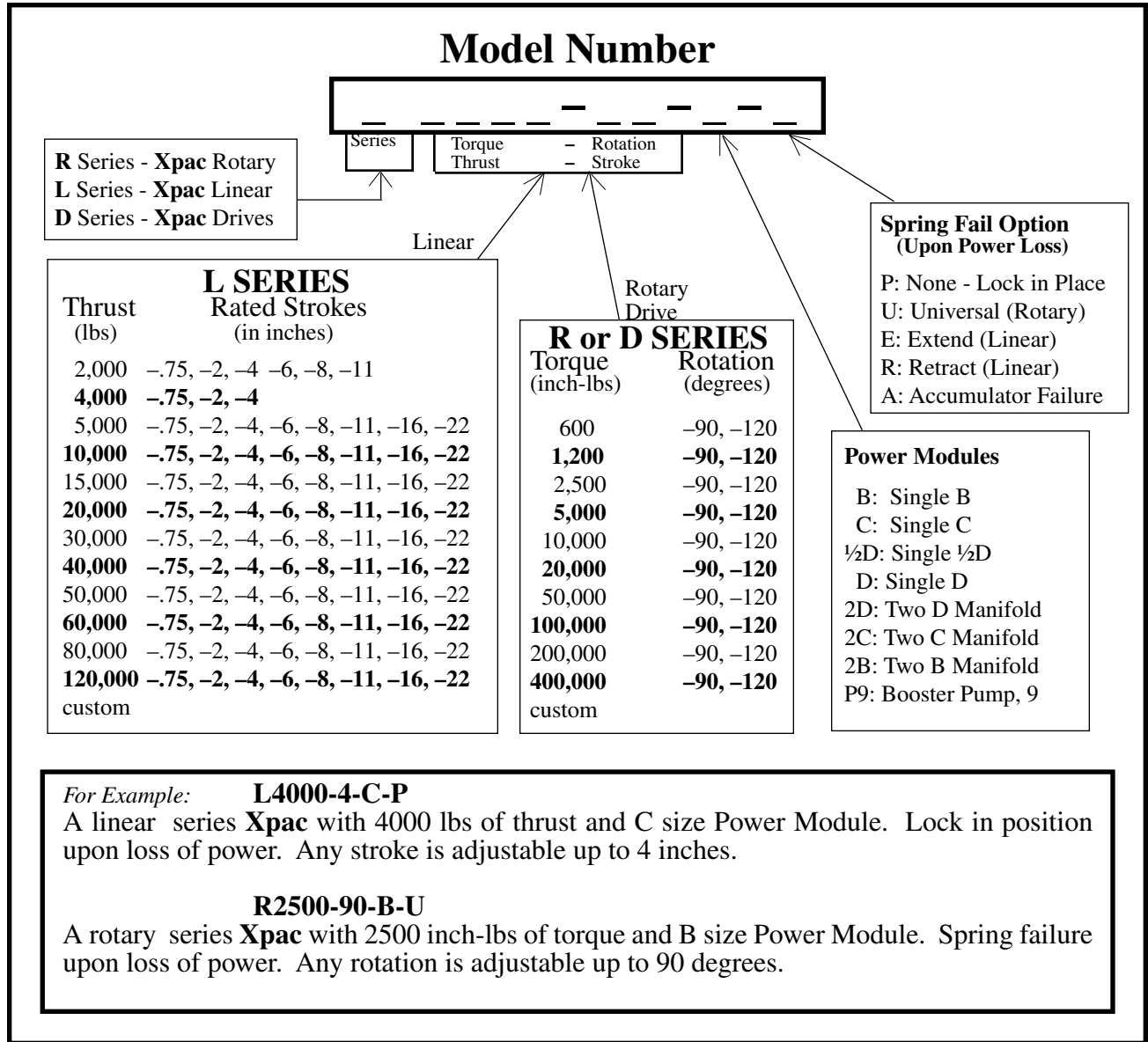
REXA Xpac actuators and drives are Electraulic (self-contained, electro-hydraulic) devices. They are controlled by a dedicated micro-processor located within the control enclosure and operated by a fluid power system in the power module. Suitable for 100% duty cycle service, the **Xpac** is ideal for any automatic control application.

The **Xpac** product line is offered in three different series. The R Series are quarter turn actuators designed to operate rotary devices (ball valves, butterfly valves, directly coupled louvers, etc.). The L Series are designed for linear applications. The D Series of drives are derived from the rotary actuator and designed to operate louvers and dampers.

When ordering spare parts or requesting information on a specific actuator, please have available the actuator serial number. This is located on a stainless steel name tag attached to the actuator.

Units supplied to the provisions of Class I, Division 2, Groups B, C & D or Class I, Division 1, Groups B, C & D require additional installation procedures to comply with agency approvals. Refer to Appendix D for details.

The model number provides a physical description of the mechanical portion of the actuator. The cylinder size, Power Modules and failure mode are described in this simple system.



1 THEORY OF OPERATION

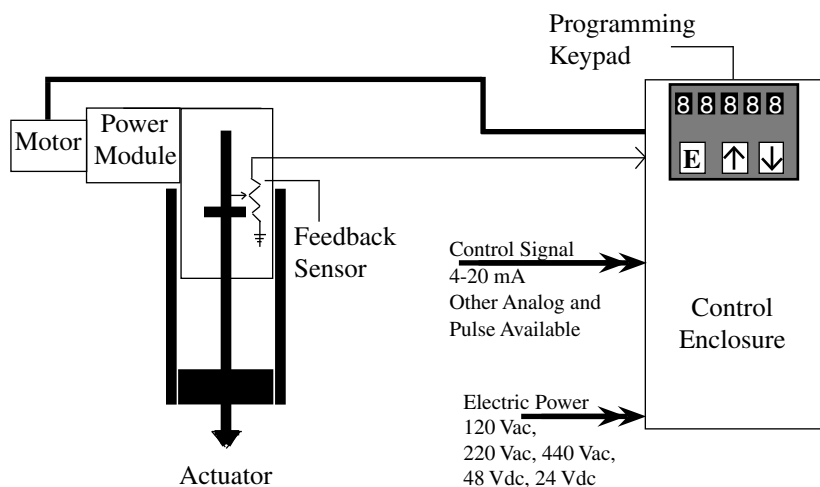
Overview

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 the state of the art in actuator design.

The patented Flow Match System is simply described as a highly efficient method of pumping hydraulic fluid (motor oil Castrol Syntec 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.

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 them are the module cable and the feedback cable.

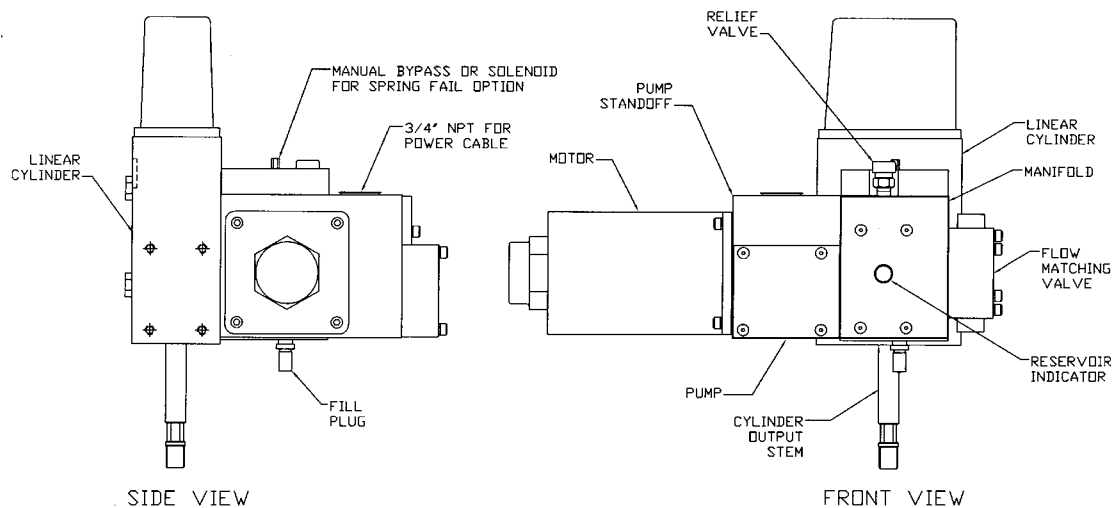
Figure 1.A Xpac



1.1 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 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. The functional difference between the sizes is strictly pumping volume and thus, the maximum stroking speed of an actuator. The only visible difference is the motor.

Figure 1.B



There are three types of hydraulic cylinders. On smaller size linear actuators (thrust of 10,000 lbs or less and strokes of 6 inches or less), the cylinder is manufactured from a solid block of aluminum. Larger size linear cylinders are made of a fabricated tie-rod construction. The third type, used on rotary and drive units, is a rack and pinion rotary design. An inherent requirement with the Flow Match System is equal displaced oil volumes on both sides of the cylinder. This allows oil movement without an active reservoir. Double rod construction on linear units and opposed cylinders on the rotary units meet this criteria.

To provide position information, a feedback assembly consisting of a resistive film potentiometer and a transmitter (4-20 mA) circuit board is used. The feedback assembly is sealed in a NEMA 4X area and mounted within or adjacent to the cylinders. The connection of the potentiometer is by direct mechanical means to the output shafts. Shock loading and vibration has no effect on readings and lost motion in the rotary rack and pinion is eliminated.

1.2 Control Enclosure

The control enclosure contains the position control processor (PCP), power supplies, fuses and filters, motor drivers and a termination area. The PCP consists of an 8-bit, 80C52 microprocessor, a 32 Kbyte EEPROM memory for program storage, a 2 Kbyte EEPROM memory for data storage, a 12-bit A/D converter, and a 3-button/5-digit display user interface. The PCP also provides two connectors which accept optional I/O interface boards.

The power supplies vary according to the type and quantity of power modules. Common to all types is the logic power supply which provides +5, +15, -15 VDC to the PCP and +15 VDC to the feedback assembly. For actuators built with B size power modules, the control enclosure includes an unregulated, 53 VDC power supply for the motor. For C, 1/2D and D size power modules, the power supplies are built into the motor drivers.

The control enclosure includes one motor driver for each power module. The motor driver converts the low power logic signals from the PCP into high voltage, high current motor power to the stepper motor (B or C) or servo-motor (1/2D or D).

1.3 Menu Calibration

The PCP is calibrated in the *Setup* mode by a simple routine. Speed, stroke, deadband and control signal are some of the parameters that can be configured by using the three button keypad and the display. Programmed parameters are retained in a permanent memory. For unusual or difficult applications, more sophisticated control capabilities such as flow characterization and water hammer suppression (two speed) are available. Access to the *Setup* mode can be restricted by a passcode.

1.4 Operational Summary

By using the stroke and signal ranges set during calibration, the PCP converts the incoming control signal into a target position. The current position is determined through the active feedback assembly mounted on the actuator. The difference between the target and current position is the error.

If the error exceeds the deadband (user set), then the PCP will initiate corrective action by starting the motor.

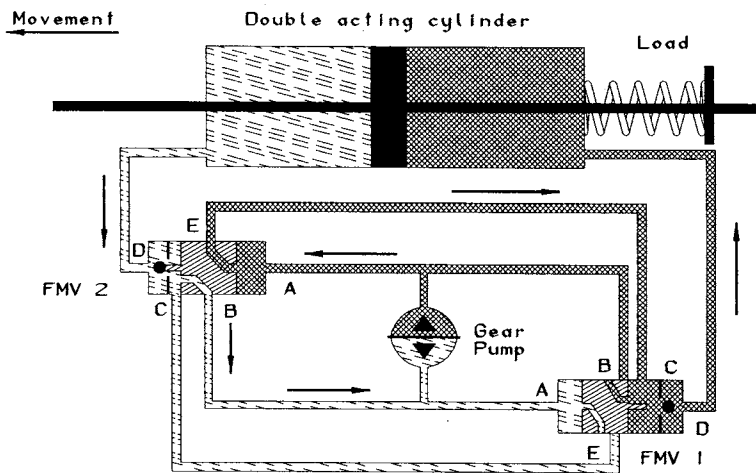
A reversible hydraulic pump is driven by the motor. The pump can pressurize either side of a double acting cylinder through one of two Flow Matching Valves, FMV-1 and FMV-2. Each FMV is comprised of a ported spool with an integral pilot operated check valve. The ports of both FMVs are sized exactly the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

To move the piston to the left, the pump turns in the direction to pressurize FMV-2 through port A. The spool in FMV-2 becomes unbalanced by the pressure differential and moves to the left, lifting its check valve, opening port D to port B and port A to port E.



High pressure fluid flows through Port E 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 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 rod to the right. When the pump stops, both check valves close. The hydraulic oil is locked within the cylinder. Motor operation is not required to maintain position.

Figure 1.C Hydraulic Schematic



Cylinder movement opposes the load

-  = High pressure circuit
-  = Low pressure circuit

1.5 Optional Equipment (see Appendices)

The Xpac is available with a substantial list of optional equipment. Most items can be field retrofitted. Consult your local sales representative for details.

1.5.1 Position Transmitter (see Appendix C.1)

The position transmitter provides a loop powered 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.

1.5.2 Manual Override (see Appendix C.2)

A declutchable handwheel connects to the outboard end of the motor shaft. Since the handwheel utilizes the same hydraulic circuit as the motor, the required torque is low. On actuators with high thrust or torque or long strokes, a $\frac{5}{16}$ " hex drill drive may be substituted for the handwheel or a 5:1 geared hand crank on a separate power module is available.

1.5.3 Limit Switches (see Appendix C.3)

Limit switches are either yoke mounted or PCP mounted. Yoke mounted switches are activated by the actuator shaft and function independently. The PCP mounted switches are activated electrically and include an alarm relay.

1.5.4 Alarm Relay (see Appendix C.4)

The PCP is able to perform various diagnostic functions. If the actuator cannot follow the control signal, the alarm relay will change state to provide remote indication. The alarm relay is included on the position transmitter and PCP mounted limit switches.

The alarm relay will change state upon power failure or removing the unit from automatic (Auto).

1.5.5 Surge Control (see Appendix S)

By utilizing a spring, solenoid and solid state relay, the Xpac can provide very high speed motion in one direction. The position can be to any intermediate point or strictly to the end (trip).

1.5.6 Pulse Input (see Appendix P)

In place of or in conjunction with the normal analog control signal, pulse or contact signals can provide control input to the actuator. Three or four wire, 24 to 120 volts, AC or DC, signals can be used.

1.5.7 Auxiliary Controls - External (see Appendix C.5.1)

To limit access to the control enclosure, a window (to view the position display) and external push-buttons can be provided. The push-buttons will only allow manual override of actuator position.

1.5.8 Auxiliary Controls - Remote (see Appendix C.5.2)

Manual operation of the actuator from a remote location is available with the remote control option. Three contact inputs are required: auto/remote (two position), open (momentary contact), and close (momentary contact). Power for the switches are supplied by the control enclosure. Manual stations are available from REXA.

1.5.9 Spring Failure

While still maintaining the control capability available in the standard Fail in Place version, the spring failure provides a high degree of safety. The spring is continuously engaged and is compressed or expanded during operation. A bypass valve which connects both sides of the hydraulic cylinder is kept closed by a normally open (NO) solenoid.

1.5.10 Accumulator Failure (see Appendix G)

Use of an accumulator eliminates the need to "oversize" the actuator as with a spring fail unit. The accumulator puts no load on the power module during normal operation so actuator size is reduced. REXA's unique accumulator technology uses the power module to recharge the accumulator, thus eliminating the need for a separate re-charge pump and associated plumbing. This feature allows all components of the accumulator system to be located on the actuator.

1.5.11 Stem Boot

Linear actuators installed at locations containing airborne particles may be subjected to accelerated seal wear. The normal motion of the stem can transport contaminants through the seals causing damage. A stem boot over the shaft offers protection from the environment.

1.5.12 Split Clamps

On linear actuators mounted at unusual angles or with reduced accessibility, a split clamp connection between the actuator and driven device is available. The difficulties of stem rotation, shaft insertion and jam nuts are eliminated.

2 DELIVERY

2.1 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. **REXA** makes every effort to properly package the product so that it is shipped and received without damage.

2.2 Storage

If the actuator and control enclosure are not immediately installed, provisions for storage must be made. The equipment should not be removed from the original containers. 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 (–12°C) and 120°F (50°C)

2.3 Unpacking

The **REXA Xpac** actuator is shipped completely 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.

3 OIL

The Xpac is a sealed, self-contained Electraulic actuator. During normal operation, the hydraulic oil is pumped from one side of a double acting cylinder to the other. An oil reservoir which provides a source of “make-up” oil is an integral component. Any external signs of a major oil leak may be indicative of damage to the Xpac and should be investigated.

The oil reservoir is sealed and spring loaded. Oil degradation from moisture or other external contaminates should not occur. Reservoir operation is unaffected by actuator orientation.

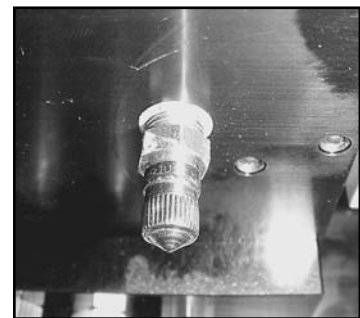
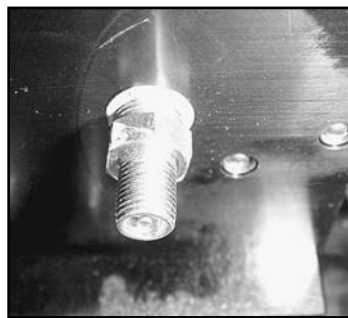
3.1 Level Check

There is a visual indicator on the side of the reservoir housing to show the oil level. The indicator is a red-colored rod which should be exposed between ¼ to ½ inches. The normal fill position is shown by a scribe mark around the rod. If the indicator protrudes less than ¼ inch beyond the housing, then the actuator should be filled with oil.

3.2 Filling

The actuator does not have to be taken out of service when filling with oil.

The underside of the Electraulic power module is provided with a standard pneumatic style Schrader fitting. The mating half can be obtained at any auto parts dealer. To fill the Xpac with oil, use a lever operated grease gun. Install the fitting on the grease gun. Fill the grease gun with clean Castrol Syntec SAE 5W-50 motor oil. An unusual application may require a different oil (refer to the actuator serial plate).



All air must be purged from the grease gun before attempting to add oil.

Pump the grease gun a few times to purge any air and hold the fitting on the oil fill valve of the Xpac. Pump oil into the reservoir. While pumping, observe the oil indicator. When the scribe marker or ½ inch is exposed, the reservoir is filled. A 10 micron filter screens the oil before it enters the reservoir.

A reservoir relief valve is installed on the top of the power module on fail in place units and next to the oil fill valve on spring failure units. If oil flows from this valve when filling, the reservoir has been overfilled. No damage will occur (see section 3.3). Wipe the unit down and proceed. The relief valve will re-seat.

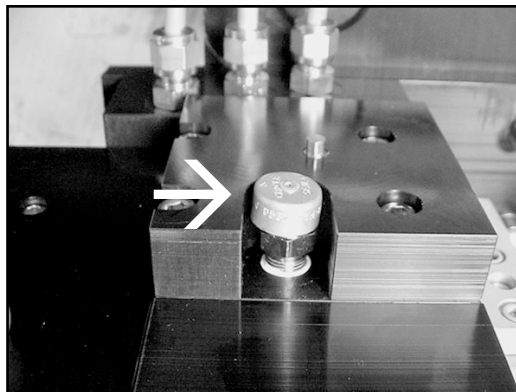
3.3 Oil Weeping (Thermal Expansion)

On large oil volume actuators, a separate auxiliary reservoir may be required. This reservoir is hydraulically linked to the internal reservoir and they function as one volume.

When the reservoir is overfilled, an increase in ambient temperature may cause a small amount of oil to weep from the relief valve. The actuator is a closed hydraulic system and an increase in oil volume must be purged. This action is a normal occurrence. If the temperature is lowered, the reservoir indicator will retract as the oil volume decreases. Overfilling the reservoir at this time will begin the weep cycle again. Review section 3.2 for the correct filling procedure.

RELIEF VALVES

Fail in Place



Spring Fail



On spring fail units the pressure relief valve can be found coupled with the oil fill valve.

4 MECHANICAL INSTALLATION

Installation of an accumulator failure is explained in Appendix G.

The Xpac can operate any device requiring force and stroke or torque and rotation within its range. 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 R Series (Rotary)

Unless otherwise specified, R Series actuators are shipped with a four bolt mounting pattern and female key (fail in place) or male key (spring failure) stem connection. Alternatively, REXA can provide custom mounting components to adapt to the device being controlled. Contact your sales representative for more details.

Most rotary valves rely on position to shut off and do not require additional seating torque beyond that required to operate against the pressure drop and to overcome friction. Exceptions include rotary eccentric plug type valves and elastomer lined butterfly valves. For these valves, apply additional rotation in the closed position to insure sufficient seating torque.

4.1.1 Fail In Place Installation

With the actuator separated from its mounting, rotate the valve shaft to the closed position. Move the actuator in the same direction until the end of rotary piston travel is reached. If the optional handwheel is not available, remove the motor cover and directly rotate the outboard end of the motor shaft. The connection between the driven device and the actuator should be within 2° to 4°. If a large discrepancy exists between the mating connections, the adapter may be incorrect.

4.1.2 Universal Rotary Spring Failure



CAUTION!

REXA actuators, denoted by an E, R or U 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.

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 Technical Memo 4, Spring Failure, for available sizes.

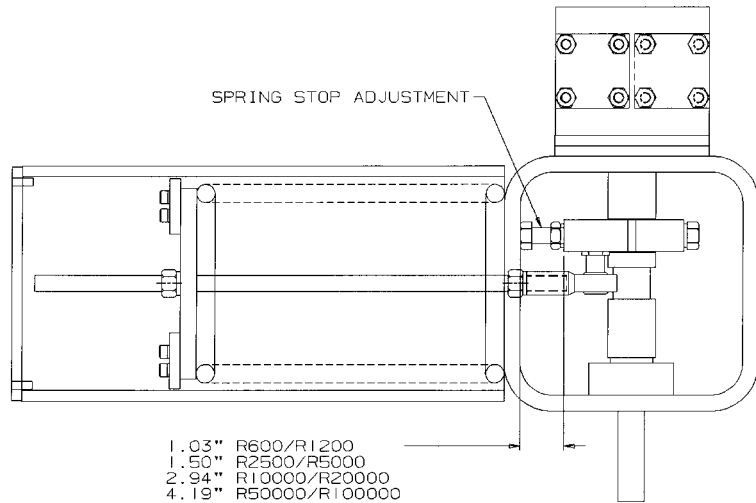
If the spring tension must be released, make note of the initial compression (distance) to insure correct output torque upon reassembly.

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.

Position the spring lever to the 45° location by extending the spring stop as shown in figure 4.A. 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 4.A Universal Spring Alignment



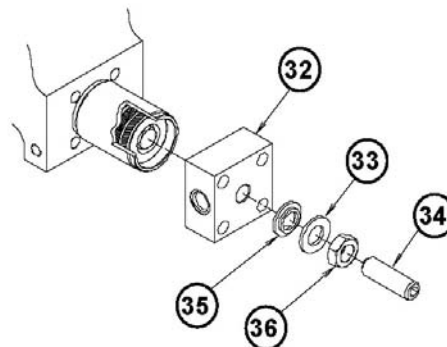
The driven device must be at the failure position before contacting the spring stop.

Once mounted, the spring stops should be withdrawn to a position that transfers torque onto the valve shaft at the failure position. If the construction of the valve does not limit over rotation, the spring stops can be utilized for this purpose.

4.1.3 Stroke and Adjust Option*

**Note:* Refer to page 46 for

Addendum: Cylinder End Stops. Figure 4.B Stroke Adjustment



CAUTION!

Before making any adjustment, turn off the hydraulic pressure.

To Adjust:

1. Loosen Jam Nut #36 (figure 4.B).
2. Turn Stroke Adjusters, #34, CW to reduce stroke, CCW to increase stroke.
3. Tighten Jam Nut, #36.
4. Resume system pressure.

4.2 L Series (Linear)

4.2.1 Elastic Coupling

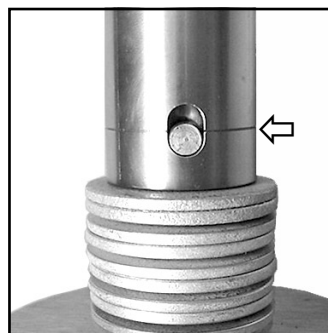
On actuator with thrusts of 40,000 lbs or greater, a Seat Loading Cylinder (SLC) is used in place of an elastic coupling. See Appendix F for details.

For valve installations, linear Xpac actuators are provided with an "elastic coupling" for connecting the valve stem to the actuator. The purpose of the elastic coupling is to provide a controlled seating force. It contains a set of disc springs pre compressed to approximately 80% of the rated thrust for fail in place units and 50% of the rated thrust for spring failure units.

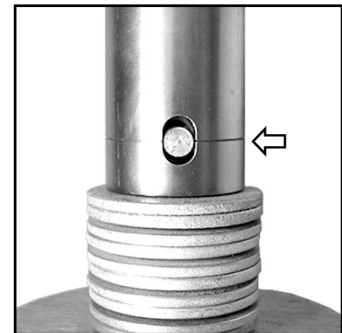
A reduced load coupling may be provided for a specific installation. Note would be made on the specification.

A telltale on the coupling provides a visual indication of compression (seat load). The coupling should be compressed to its rated mark when the valve is seated. At that point, the load on the valve seat is approximately the net rated output of the actuator. Lower rated couplings are available for applications that require reduced seat load.

There are two types of couplings; open spring and enclosed spring. The indicator on the open spring design 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.



Preloaded coupling



Rated load coupling

The enclosed spring coupling has a small telltale pin protruding from its top. As the coupling compresses, the pin is drawn into it. The pin is flush with the top of the coupling at the rated output.

4.2.2 Fail In Place Installation



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 valve stem is straight and not bent. Severe side load will cause excessive wear on the shaft seals and will result in oil leakage.

On some installations, it may be easier to rotate the entire actuator instead of just the stem.

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, remove the motor cover and directly rotate the outboard end of the motor shaft. Place the actuator onto the valve bonnet and finger tighten the mating connection.

The stem of the driven device may be larger than required for the actuator output. In such cases, reduced insertion length is permissible.

Extend the actuator stem until the coupling contacts the valve stem. Screw the valve 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. There are wrench flats machined on the actuator stem for this purpose. No damage will occur if the actuator stem is rotated.

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.

It is strongly recommended that a pipe stand or hanger be used to support actuators mounted in the horizontal orientation. Align the yoke legs so that the wider sides are perpendicular to the ground.

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.

4.2.3 Linear Spring Failure



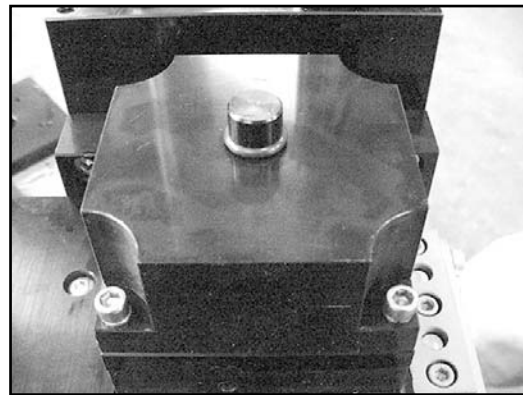
CAUTION!

REXA actuators, denoted by an *E*, *R* or *U* 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.

The spring failure 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.

The simplest manner to install a spring failure linear actuator is to override the solenoid valve and then follow the procedure for installing a fail in place unit (section 4.2.2). Protruding from the solenoid cover is a sealed button which when depressed will close the solenoid valve. By using a common bar clamp with an opening of at least 7 inches, the button may be locked in the depressed condition. The required clamping force is only 30-40 lbs. Do not over tighten the clamp as damage to the nylon valve seat will result in actuator drifting.



⚠ Caution!
Remove the clamping device from the solenoid button before placing the actuator into service. The spring failure will not operate with the button depressed.

4.3 D Series (Drive)

By the addition of a rugged 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.

4.3.1 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. Figure 4.C 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 3 or better. Hardened load washers and lock washers must be used.

Figure 4.C Drive Base Bolting

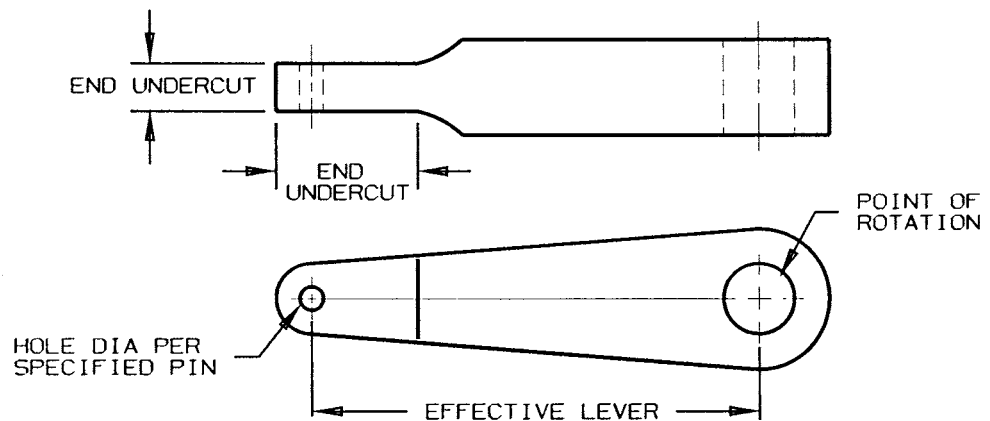
Model	Hole Diameter	Min. Bolt Diameter	RECOMMENDED Bolt Torque	
			Minimum	Maximum
D600/1200	.56"	1/2"	20 lb·ft	30 lb·ft
D2500/5000	.56"	1/2"	20 lb·ft	30 lb·ft
D10000/20000	.81"	3/4"	200 lb·ft	250 lb·ft
D50000/100000	1.25"	1 1/8"	700 lb·ft	800 lb·ft

Note: Bolting to be SAE Grade 3 or better.

4.3.2 Drive Arm

Connection to the driven device (linkage) is by means of the drive arm. It is usually supplied manufactured to the user's specified length, pin diameter and end undercut as shown in figure 4.D. The length of the arm is determined by the relationship between the required torque and rotation of the damper and the rated torque and rotation of the drive.

Figure 4.D Drive Arm



The safe working load assumes a maximum rotation from perpendicular (drive arm to connecting link) of ±60°. Operation at a greater angle will impose extreme loads and is not recommended.

The connecting link and other linkage is 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:

$$\text{Load} = \frac{\text{Rated Drive Torque}}{\text{Effective Lever}} \times 5$$

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. 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).

4.4 Control Enclosure

The major electrical components are located in a NEMA 4X or optionally in a CSA approved CL I, DIV 2, GRP B, C & D enclosure. They have a wide temperature range (figure 4.E) 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.

Panel and assembly drawings for size B, C and 2C power module configurations are provided in appendix A and for the ½D, D and 2D in Appendix X.

Figure 4.E Ambient Temperature¹

Power Module	Range
B, C & 2C	-40°F to 140°F
½D, D & 2D	-40°F to 120°F

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

5 ELECTRICAL INSTALLATION

B, C and 2C Power Modules

Electrical installation of 1/2D, D and 2D Power Modules is contained within Appendix X.

The **Xpac** consists of two major components, the Electraulic actuator (cylinder & power module) and the control enclosure. The actuator is installed on the driven device, while the enclosure is remotely mounted. Connecting them are the module cable and the feedback cable. Although these cables may be run within the same conduit or seal-tite flex hose, it is preferable that power voltages be kept separate from low level signal lines. User connections of electric power and control signals are made at the enclosure.

5.1 Module Cable

The standard cable consists of 3 twisted pairs and a twisted triad. A pair consists of a colored wire and a colored/black striped wire. These wires are used for the motor (red and green pairs), for the cartridge heater (black & white of the triad) included in most actuators and for the optional by-pass solenoid (blue pair). The green/yellow striped wire of the triad is the actuator ground.

All color coding refers to the standard (16 AWG) cable only.

Maximum length of the cable runs is determined by the resistance loss for a particular gauge. For proper operation, it is recommended that the following distances not be exceeded:

B size Power Module	AWG	Maximum Length
	16 (Standard)	150 feet
	14	225 feet
	12	350 feet
C size Power Module	AWG	Maximum Length
	16 (Standard)	300 feet
	14	500 feet
	12	750 feet

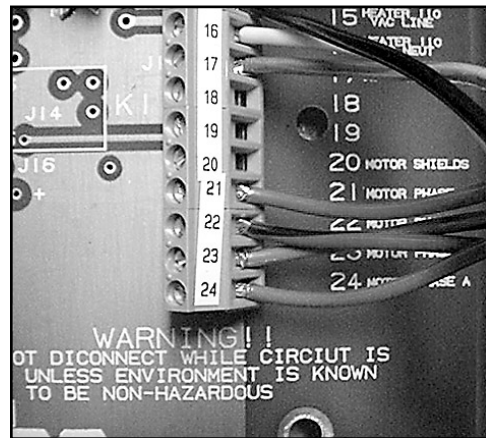
Shock hazard

 **Hazardous voltage levels are present in the module cable. Insure that the electrical power to the actuator is off before connecting the module cable.**

Be sure to cut off excess lengths of wire within the control enclosure. Dress the cables to minimize electrical interference between the power and signal lines. See section 7.2 for details.

5.1.1 Enclosure Termination

For B or C power modules connect the cable to the 24 PIN green terminal strip within the control enclosure per figure 5.A (p. 26). The motor module cable for an actuator with two C power modules is terminated by screw terminals located at the bottom of the enclosure (figure 5.B, p. 27).



For units supplied with screw terminals at the Power Module, see Appendix T.

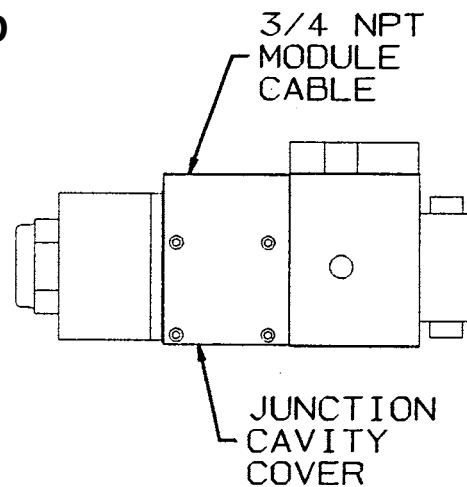
5.1.2 Actuator Termination

The module cable is terminated in the junction cavity by means of bullet connectors. The feed-through for the connections is a 3/4 inch NPT.

The O-ring should be properly seated with no cuts or other discontinuities.

Remove the four cap screws that retain the junction cavity cover (figure 5.D). Feed the module cable through the 3/4 inch NPT opening and into the cavity. Figure 5.C (p. 28) shows the wiring connections to the module. After insuring that the wires are not pinched by the cover, securely fasten the cover to the module.

Figure 5.D



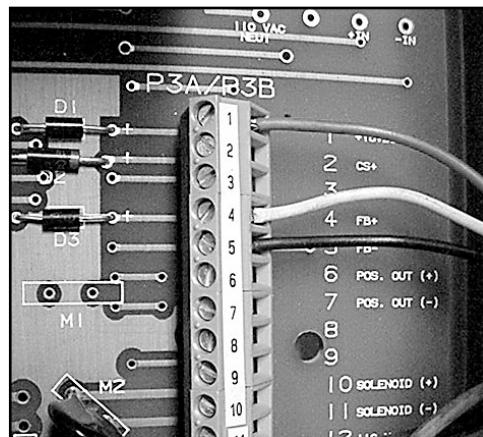
5.2 Feedback Cable

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.

5.2.1 Enclosure Termination

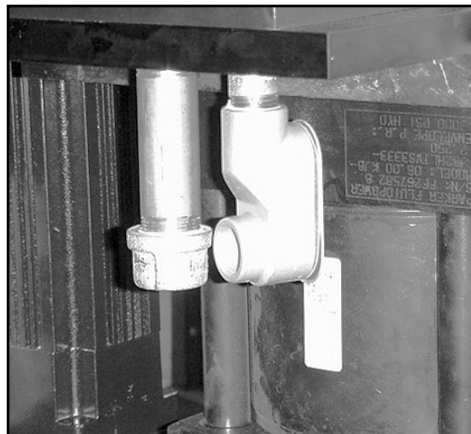
For best noise immunity, the feedback ground wire should be kept as short as is practical within the control enclosure. Do not terminate the ground wire at the actuator. See section 7.2 for details.

For B, C or 2C power modules, connect the feedback cable to the 24 pin green terminal strip within the control enclosure per figure 5.A (p. 26) or 5.B (p.27). Connect the copper ground wire to terminal 14, "Earth Ground."



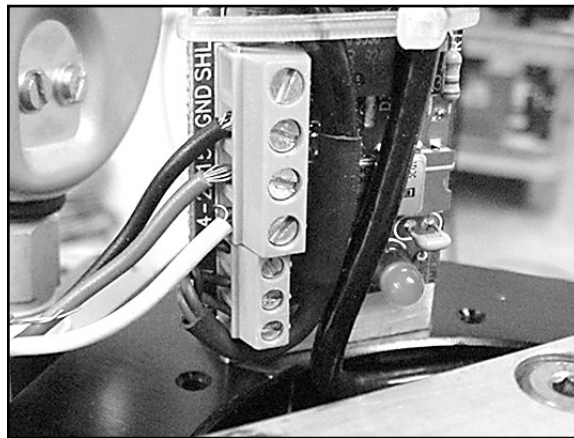
5.2.2 Actuator Termination

For L series actuators, there are two types of feedback termination. On units with tie rod hydraulic cylinders (thrusts greater than 10,000 lbs. or strokes greater than 6 inches), the connection is made in the *right angle junction box* located on the cylinder by means of bullet connectors. The feed through for the cable is a ½ inch NPT. Figure 5.C (p. 28) shows the wiring connections in the junction box.

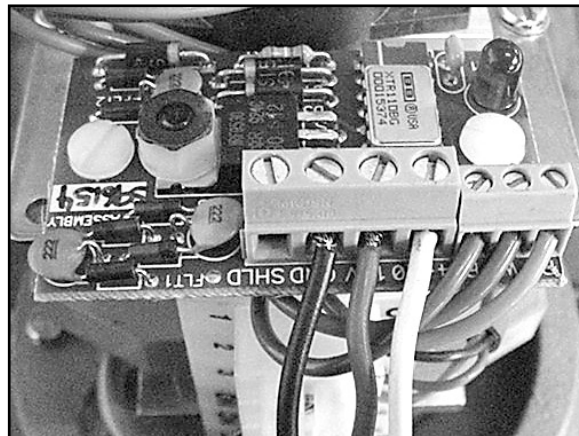


The O-ring should be properly seated in the cover with no cuts or other discontinuities.

On L series actuators with thrust of 10,000 lbs or less and strokes of 6 inches or less, the feedback connection is made directly to the screw terminals on the feedback printed circuit board. Remove the four cap screws that hold the upper cover. Carefully lift the cover in the direction away from the cylinder until it clears 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 5.C (p. 28). Replace the cover on the cylinder and securely fasten.



Termination for the R or D series actuators is made through a ¾ inch NPT opening in the feedback housing. The wiring connection is made directly to the screw terminals on the feedback printed circuit board. Figure 5.C (p. 28) outlines the wiring connections at the actuator.



5.3 User Connections

The minimum user connections to the Xpac are electric power and control signal. The standard power is 110 Vac \pm 10%, 60 Hz for the B, C and 1/2D size Power Modules. However, input voltages from 24 Vdc to 220 Vac (depending upon power module) may have been specified. The serial plate on the control enclosure indicates the power requirement.

Although the standard control signal is 4-20 mA, other analog, pulse or digital inputs may have been specified.

⚠ CAUTION!
When operating the electronics, use care to avoid static shock. Avoid direct contact with CMOS integrated circuits on the PCP Board.

5.3.1 Actuator Power

The selected wire gauge and the power source must be sufficient to insure that specified power is provided to the actuator terminals under the worst case operating conditions. Failure to observe this requirement may cause faulty operation or damage to the actuator.

The minimum wire gauge providing power must be of sufficient size to insure that rated voltage is supplied to the actuator. The power rating for each module is:

	Watts
B size Power Module	350
C size Power Module	700
2C size Power Modules	1400

Please see TM2 - Power Consumption for complete details.

Electrical installation of 1/2D, D and 2D Power Modules is contained within Appendix X.

Connections for 120 Vac, 220 Vac 24 Vdc, 48 Vdc and 125 Vdc power on B Power Modules or 120 Vac on single C power modules is made in the controls enclosure at the 24 PIN green terminal strip per figure 5.A (p. 26). 120 Vac power connection for an actuator with two C power modules is made by screw terminals located at the bottom of the enclosure (see figure 5.B, p. 27).

Connections for all other power sources are addressed in a specific addendum.

5.3.2 Control Signals

Analog control signals (4-20 mA, 1-5 Vdc, etc.) are connected to pins 2 and 3 of the 24 PIN green connector on all actuators.

Connections for pulse input signals are made on a separate auxiliary board located on top of the PCP. See Appendix P for details.

Connections for other electrical options are shown in the Appendices.

Figure 5.A: Control Enclosure Connections

B Power Module or C Power Module

Connector Position	Signal Name	Wire Color
1	+15Vdc	Red ¹
2	Control Signal (+)	User Supplied
3	Control Signal (-)	User Supplied
4	Feedback (+)	White ¹
5	Feedback (-)	Black ¹
6	Spare	--
7	Spare	--
8	Spare	--
9	Spare	--
10	Solenoid (+) ³	Blue ^{2,3}
11	Solenoid (-) ³	Blue/Black ^{2,3}
12	AC Line	User Supplied
13	AC Neutral	User Supplied
14	Earth Ground	User Supplied and Feedback Ground¹
15	Heater	Black ²
16	Heater	White ²
17	Actuator Ground	Green/Yellow ²
18	Spare	--
19	Spare	--
20	No Connection	--
21	Motor B	Red ²
22	Motor \bar{B}	Red/Black ²
23	Motor \bar{A}	Green/Black ²
24	Motor A	Green ²

Actuator electric power is always connected to Pins 12 & 13.

Notes: ¹ 3 conductor feedback and groundwire.

² 9 conductor module cable.

³ When equipped with optional spring failure.

Figure 5.B: Control Enclosure Connections

2C Power Module

Connector Position	Signal Name	Wire Color
--------------------	-------------	------------

MODULE CABLE

On actuators with two Power Modules, two module cables are provided. Connect one to each Power Module.

1	Motor 1 Phase A	Green ²
2	Motor 1 Phase \bar{A}	Green/Black²
3	Motor 1 Phase B	Red ²
4	Motor 1 Phase \bar{B}	Red/Black²
5	Earth Ground	Green/Yellow ^{2,4}
6		No Connection
7	Heater 1	Black ²
8	Heater 1	White²
9-14	Internal Connections	No Connection
15	AC Line	User Supplied
16	AC Neutral	User Supplied
17	Earth Ground	User Supplied
18	Spare	No Connection
19	Spare	No Connection
20	Spare	No Connection
21	Solenoid (+)	Blue ^{4,3}
22	Solenoid (-)	Blue/Black^{4,3}
23	Motor 2 Phase A	Green ⁴
24	Motor 2 Phase \bar{A}	Green/Black⁴
25	Motor 2 Phase B	Red
26	Motor 2 Phase \bar{B}	Red/Black
27	Act. Earth Ground	Green/Yellow ^{2,4}
28	Heater 2	Black⁴
29	Heater 2	White ⁴
30	Spare	No Connection

FEEDBACK CABLE - Connects to 24 Pin Green Terminal Strip

1	+15Vdc	Red ¹
4	Feedback (+)	White¹
5	Feedback (-)	Black ¹
14	Earth Ground	Feedback Ground¹

Notes: ¹ 3 conductor feedback and groundwire.

² 9 conductor for Module 1

³ When equipped with optional spring failure.

⁴ 9 conductor for Module 2

Figure 5.C: Actuator Connections

Signal Name	Cable Wire Colors	Actuator Wire Color
-------------	-------------------	---------------------

MODULE CABLE

Linear & Rotary Units - Junction Cavity (Bullet Connectors)

On actuators with two Power Modules, two module cables are provided. Connect one to each Power Module.

Motor Phase A-	Green ²	Green
Motor Phase A	Green/Black ²	Green/Black
Motor Phase B-	Red ²	Red
Motor Phase B	Red/Black ²	Red/Black
Heater	Black ²	Brown
Heater	White ²	Brown
Actuator Ground	Green/Yellow ²	Green/Yellow

If a spring failure is installed.

Only one solenoid is utilized on 2C Power Modules.

Solenoid (+)	Blue ^{2,3}	Blue ³
Solenoid (-)	Blue/Black ^{2,3}	Blue ³

FEEDBACK CABLE

L Series - right angle junction box (Bullet Connectors)

Do not terminate ground wire at the actuator.

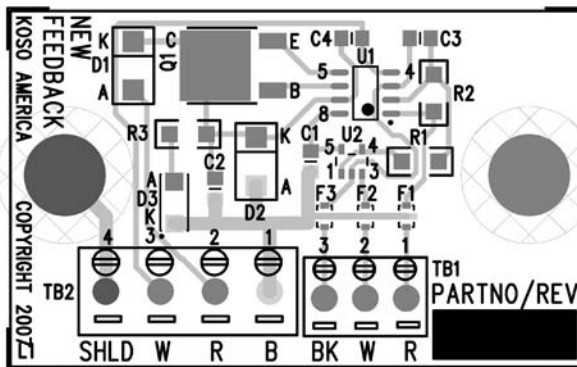
+15Vdc	Red ¹	Red
Feedback (+)	White ¹	White
Feedback (-)	Black ¹	Black

R or D Series - Feedback Enclosure (Screw Termination)

L Series - 1/2 inch NPT on cylinders (Screw Termination)

Do not terminate ground wire at the actuator.

		terminal name
+15Vdc	Red ¹	R
Feedback (+)	White ¹	W
Feedback (-)	Black ¹	B



Notes: ¹ 3 conductor feedback and groundwire.
² 9 conductor module cable.
³ When equipped with optional spring failure.

6 OPERATION

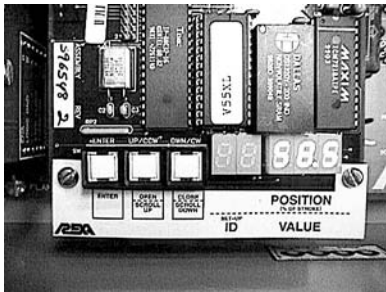
There are three modes in which the actuator operates; *Auto*, *LOCAL* and *SEtUP*. As long as power is applied, the actuator will be in one of these modes. If power is removed and later restored, the actuator will resume operation in the last active mode. In the *Auto* mode, the actuator responds to the control signal by automatically adjusting its position to match the control signal's target position. The *LOCAL* mode provides a means of manually adjusting the actuator's position. The *SEtUP* mode is used to calibrate the actuator to the application and to set operating parameters which govern the dynamics of actuator movement. Each mode is entered by simultaneously pressing and releasing two keys of the three button keypad:

To enter *Auto* mode, press (E)NTER and Scroll Down.

To enter *LOCAL* mode, press (E)NTER and Scroll Up .

To enter *SEtUP* mode, press Scroll Up and Scroll Down.

When a mode change is invoked, the actuator responds by briefly displaying the requested mode.



Two additional references are available to guide the user through the operation and calibration of an **Xpac**. They are the Operating Parameter Sheet affixed to the cover of the Control Enclosure and the Setup Quick Reference contained in the Appendix. After a basic understanding of the operation is gained, these two simple and straight forward sources should answer most questions.

6.1 Auto Mode

In the *Auto* mode, the actuator tracks the control signal. The actuator may be configured to operate with either an analog loop (usually 4-20 mA) or it may be driven by a pair of pulse signals. The control signal is continuously sampled and converted to an equivalent target position in terms of the actuator's calibrated stroke. When necessary, the actuator adjusts its position to match the target position.



POSITION



The *Auto* mode is distinguishable from the other modes by its display. The actuator's current position, in percent of calibrated stroke, is displayed in the three right most digits. The left two digits are blank. While converting the control signal and adjusting its position, the PCP monitors the operation of the actuator. If an error condition is detected, the display alternates between position and an identifying error code (see Section 8).

While in the *Auto* mode, setup parameters may be reviewed without taking the unit "off-line." The Scroll Up and Scroll Down buttons

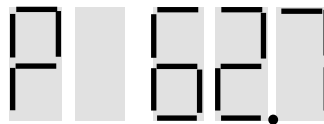
loop through each parameter and display the set value. The display will revert to position indication five seconds following the last scroll request.

6.2 LOCAL Mode

In the *LOCAL* mode, the actuator is under the control of the three button keypad. The actuator is off-line and does not respond to the control signal. When the *LOCAL* mode is entered the actuator's current position is displayed with the letter P labeling the display in the left most digit. The *LOCAL* mode provides three functions:



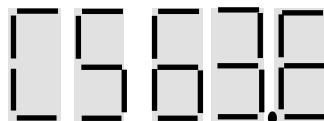
POSITION



MANUAL OPERATION

While the letter "P" is on display, the actuator may be manually positioned. To do so, press the (E)NTER key and the label will blink. Use the Scroll Up and Scroll Down keys to adjust the actuator to any position within the calibrated stroke. The actuator will use the parameters of *High Speed* (HS) and *High Acceleration* (HA) to rotate the motor. If *Low Speed* (LS) is enabled, the actuator will reduce speed at the appropriate position, Sb (see section C.6.3). The manual mode is exited by pressing the (E)NTER key.

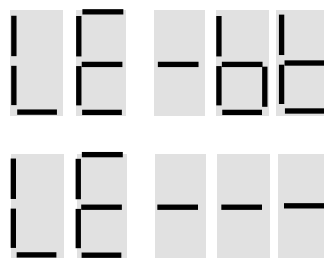
LIVE CONTROL SIGNAL



CONTROL SIGNAL

The other two functions available in the *LOCAL* mode are accessed by pressing the Scroll Down key when the label P is not blinking. The first depression of the Scroll Down key changes the display to indicate the live analog control signal, labeled CS. The control signal is displayed in percent of calibrated control signal span. If the analog signal is not present, such as when operating with pulse inputs, the display will read 0.0. The live control signal display is useful for troubleshooting purposes; for instance, adjusting the actuator's current position to match the control signal when overcoming a bumpless transfer error, E-bt.

LAST ERROR

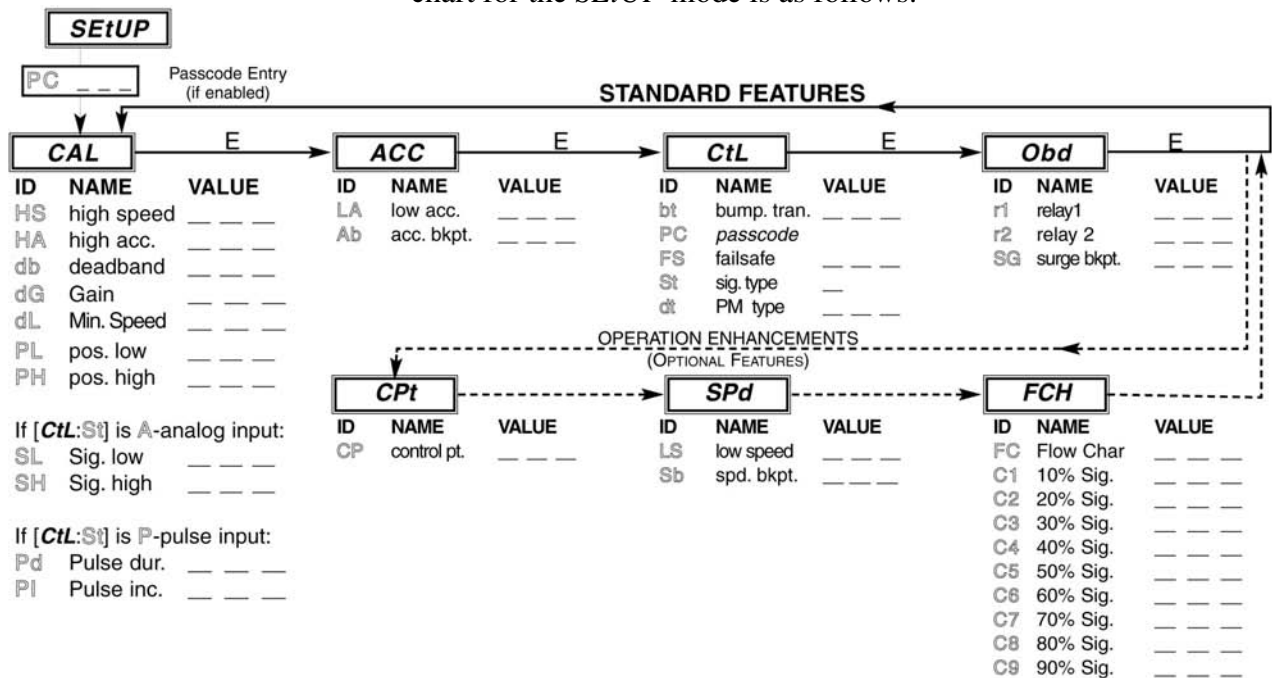


LAST ERROR

The last function available in the *LOCAL* mode is accessed by pressing the Scroll Down key when CS is on display. The label LE will appear along with the last error condition detected. This is again a troubleshooting aid. If no error has been detected since the last time the display was cleared, two dashes (--) will be displayed. To clear the last error, press the (E)NTER key. To return to the CS display, press the Scroll Up key. To return to the Position display, press the Scroll Up key a second time.

6.3 SETUP Mode

In the *SETUP* mode, the actuator is under the control of the three button keypad. The actuator is off-line and does not respond to the control signal. The *SETUP* mode provides the means to tune the actuator for your specific application. For convenience, the *SETUP* mode is divided into several groups of parameters. Each group is identified by a sub-menu heading. Sub-menus are selected by pressing the (E)NTER key. Once the desired sub-menu is displayed, the sub-menu is traversed by pressing the Scroll Down key. The first parameter of the sub-menu will be displayed. Subsequent use of the Scroll Down key, displays the next succeeding parameter until the end of the sub-menu is reached. The Scroll Up key does the reverse, redisplaying the previous parameter until the sub-menu heading is reached, at which point a new sub-menu may be selected. A flow chart for the *SETUP* mode is as follows:



A parameter that is on display may be changed by pressing the (E)NTER key. The parameter code will blink. Most values are changed by the use of the Scroll Up and Scroll Down keys. When the desired value is reached, press the (E)NTER key. The parameter code will stop blinking and the displayed value will be saved as the new value. Certain parameters are checked for validity when a new value is entered. If the new value is not valid when entered, the PCP will briefly display "error", then revert to the parameter display with the old value.

When the *SEtUP* mode is entered, the display briefly shows "*SEtUP*" followed by the first sub-menu, CAL. However, if a passcode has been entered to restrict access, the "*SEtUP*" message is followed by PC in the left two digits. At this point the passcode must be entered. To do so, press the (E)NTER key. PC will begin to blink and the three blank digits will change to 000. Use the Scroll Up and Scroll Down keys to select the passcode value. Press (E)NTER. If the entered value is correct, the CAL sub-menu will be displayed. If incorrect, "error" will be briefly displayed followed by PC.

6.3.1 CAL - Calibration Sub-menu

REXA V62 software now uses Proportional + Integral (PI) control in the positioning action of all drives. As the actuator approaches the target position, the motor will decelerate (Proportional Action) from a maximum speed to a minimum speed and then at a pre-selected point, begin accelerating (Integral Action) at a fixed rate. Tuning of the PI parameters will provide maximum response to a control signal change without overshoot.

The speed of the unit is equal to the *Gain* times the difference between the current and target positions. Upper limits on the speed remains the value set for *High Speed* and the lower limit is the value set for *Minimum Speed* (Figure 6.3A).

Integral action utilizes the values of *Acceleration Breakpoint* and *Low Acceleration* in the ACC Branch. The speed will increase at the value for *Low Acceleration*, but will not start this increase until it reaches the *Acceleration Breakpoint*.

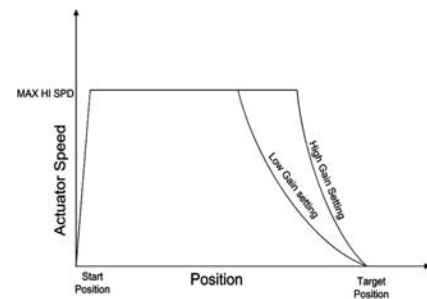


Figure 6.3A Gain

High Speed (HS) specifies the velocity, in percent of maximum, at which the actuator will move. *High Speed* may be set to any value from 5% to 125%. Stroking speed for a given size and power module is shown in Technical Memo #1, Stroking Speed.

Full actuator output is achieved for speed settings between 40% and 100% at normal operating temperatures. Speeds outside of this range may result in reduced actuator output (B & C size Power Modules). As a reminder, any value set in *High Speed* that is less than 40% or greater than 100% will cause HS to blink.

High Acceleration (HA) specifies the rate, in percent of maximum, at which the velocity will increase until the speed set in HS is achieved. Values from 1 to 99 may be set. For most applications, an acceleration of 99 is acceptable.

HI SPEED



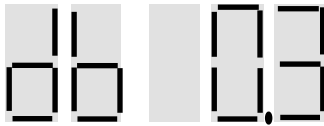
An optional speed configuration developed to reduce the effects of Water Hammer is available. Please see section C.6.3.

HIGH ACCEL.



The operation of high speed actuators with low deadband can cause oscillation around the target position. This effect is controlled by reducing the actuator acceleration. REXA has developed a unique dual-acceleration method to eliminate oscillation while continuing to provide a fast, responsive actuator. Sub-menu ACC explains the operation and activation of this feature.

DEADBAND



On linear actuators with elastic couplings or seat loading cylinders, the seated position is the rated compression of the coupling or the cylinder. See section 4.2.1 for an Elastic Coupling or Appendix F for Seat Loading Cylinder. 4.2.1

Deadband (db) specifies the maximum difference between the actuator's position and the control signal's target position before a change in actuator position is initiated. Values from 0.1% to 5% of variation in control signal (4-20 mA) may be selected.

PROPORTIONAL

Gain (dG) controls the point at which an actuator will begin to decelerate. Values from 5 to 200 may be selected. The higher the value, the closer the unit will be to the target position before the calculated motor speed begins to drop below High Speed. Recommended initial settings are shown in Figure 6.3B.

Minimum Speed (dL) specifies the lowest speed, in percent of Maximum Rated Speed (100%), that a power module will reach when decelerating to a new position. See Appendix X for additional details.

POSITION LOW



The span between Position Low and Position High must be at least 10% of rated stroke. If the selected position is not valid, the PCP will briefly display "error", then revert to the previously stored value.

Position Low (PL) specifies one endpoint of the actuator's calibrated stroke. With an analog control signal (typically 4-20 mA), *Position Low* corresponds to the desired actuator position when the value for the control signal is low (4 mA). Either end of the actuator travel (extended, retracted, CW, CCW) is acceptable. If a pulse input signal ([CtL:St]=P) is used, then *Position Low* and *Position High* designate the direction of movement for a Low or High input pulse (see [Appendix P](#)).

Position Low is set by moving the stem to the actual low signal position. With PL on the display, press the (E)NTER key. PL 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 HIGH



Position High (PH) specifies one endpoint of the actuator's calibrated stroke. With an analog control signal (typically 4-20 mA), *Position High* corresponds to the desired actuator position when the value for the control signal is high (20 mA). Either end of the actuator travel (extend, retract, CW, CCW) is acceptable. If a pulse input signal ([CtL:St]=P) is used, then *Position Low* and *Position High* designate the direction of movement for a low or high input pulse ([Appendix P](#)).

Position High is set by moving the stem to the actual high signal position. With PH on the display, press the (E)NTER key. PH 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 High* endpoint.

SIGNAL LOW



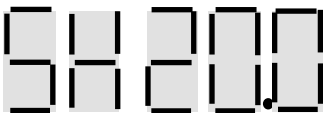
If the parameter *Failsafe* is not set to OFF ([CtL:FS]=OFF), then a low signal less than 2.5 mA is invalid. The PCP will briefly display "error" and revert to the previously stored value.

Signal Low (SL) specifies the analog control signal which corresponds with the actuator's *Position Low* endpoint. Although the low control signal will usually be 4 mA, any value from 0 to 16.2 mA is acceptable. A signal below 2.5 mA will only be allowed if the parameter *failsafe* is set to OFF ([CtL:FS]=OFF). The readout of the control signal is in milliamps with an accuracy of ± 0.1 mA.

Signal Low is set by applying a signal to the analog input. With SL on the display, press the (E)NTER key. SL will begin blinking and the display will indicate the signal level. Adjust the signal source to the low level and press (E)NTER again. The displayed value is recorded as *Signal Low (SL)*.

The *Signal Type* must be set to analog ([CtL:St]=A) for *Signal Low* or *Signal High* to be displayed.

SIGNAL HIGH



The span between *Signal Low* and *Signal High* must be at least 3.8 mA. If the input signal is not valid, the PCP will briefly display "error", then revert to the previously stored value.

Signal High (SH) specifies the analog control signal which corresponds with the actuator's *Position High* endpoint. Although the high control signal will usually be 20 mA, any value from 3.8 mA to 20 mA is acceptable. The readout of the control signal is in milliamps with an accuracy of ± 0.1 mA.

Signal High is set by applying a high signal to the analog input. With SH on the display, press the (E)nter key. SH will begin blinking and the display will indicate the control signal. Adjust the signal source to the high level and press (E)nter again. The display value is recorded as *Signal High (SH)*.

The *Signal Type* must be set to Analog ([CtL:St]=A) for *Signal Low* or *Signal High* to be displayed.

Pulse Duration (PD) specifies the minimum length in milliseconds, minus zero, plus 1 millisecond, that an input pulse must remain ON before it is recognized as a valid input pulse. See [Appendix P](#) for details.

Parameters *Pulse Duration* and *Pulse Increment* will only appear if an actuator uses a *Pulse Input Signal* ([CtL:St]=P).

Pulse Increment (PI) specifies the amount, in percent of stroke, that the actuator will adjust its target position for each valid input pulse. See [Appendix P](#) for details.

B/C Stepper Motor Software (V61SLSD1) with Gain Function: Recommended Initial Parameter Settings												
Model	B Power Module				C Power Module				2C Power Module			
L Series	dG	dL	LA	Ab	dG	dL	LA	Ab	dG	dL	LA	Ab
500	75	10	10	1.2	25	5	5	1.0	NA	NA	NA	NA
2000	125	10	20	1.3	50	10	10	1.1	25	5	5	1.0
4000	175	10	30	1.4	100	10	20	1.2	50	10	10	1.1
10000	200	10	40	1.5	150	10	30	1.3	75	10	20	1.2
15000	NA	NA	NA	NA	175	10	40	1.4	100	10	30	1.3
20000	NA	NA	NA	NA	200	20	40	1.5	125	10	40	1.4
30000	NA	NA	NA	NA	NA	NA	NA	NA	175	15	40	1.5
40000	NA	NA	NA	NA	NA	NA	NA	NA	200	20	40	1.6
R Series	dG	dL	LA	Ab	dG	dL	LA	Ab	dG	dL	LA	Ab
600/1200	50	10	10	1.1	20-30	5	5	1.0	NA	NA	NA	NA
2500	100	10	20	1.2	50	10	10	1.1	25	5	5	1.0
5000	150	10	30	1.3	100	10	20	1.2	50	10	10	1.1
10000	175	10	40	1.4	150	10	30	1.3	75	10	20	1.2
20000	200	20	40	1.5	175	10	40	1.4	100	10	30	1.3
50000	NA	NA	NA	NA	200	20	40	1.5	150	10	40	1.4
100000	NA	NA	NA	NA	NA	NA	NA	NA	200	20	40	1.5

FIGURE 6.3B

Parameters Low Acceleration and Accelerated Breakpoint have alternative function with a D Power Module. See Appendix X for details.

LOW ACCELERATION



Low Acceleration may not be set higher than High Acceleration ([ACC:LA] ≤ [CAL:HA]).

ACCEL.BREAKPOINT



In most installations, it is desirable to have this feature enabled. Although specific application may vary, typical values for LA is 40% and Ab is 1.0%.

6.3.2 ACC - Acceleration Sub-Menu

Low Acceleration (LA) is the rate at which the speed increases from the minimum (dL) until either *High Speed* or the target position is reached. Values from 1 to 99 may be selected. Recommended initial settings are shown in Figure 6.3B.

Acceleration Breakpoint (Ab) specifies the position at which the actuator will start accelerating from the *minimum speed* (dL). This position is the difference between the current position and the target position. Values from 0.1% to 5.0% difference may be selected. Recommended initial settings are shown in Figure 6.3B.

In LOCAL mode, both the actual position and control signal position may be reviewed.

BUMPLESS TRANSFER



6.3.3 CtL - Control Sub-Menu

Bumpless Transfer (bt) provides a means by which process upsets may be avoided when placing the actuator into the *Auto* mode. When *Bumpless Transfer* is set to ON and the actuator is switched to *Auto* from *LOCAL* or *SEtUP* or the actuator is Powered Up, the control signal is compared to the actuator's current position. If the control signal specifies a position within $\pm 5\%$ of the current position, the actuator goes on-line and begins responding to the control signal. If not, the actuator maintains its current position, and the display will alternate between E - bt and actual position.

A bumpless transfer error may be cleared by switching to *LOCAL* and manually moving the actuator to within 5% of the signal position. In the *Auto* mode, changing the signal position to within 5% of the actual position will immediately bring the actuator on-line.

When bt is set to OFF or if Pulse ([CtL:St]=P) is selected as the *Signal Type*, this feature is disabled.

To disable the passcode entry, set the passcode value to 000.

PASSCODE



Passcode (PC) specifies the three digit code used to gain access to the *SEtUP* menu. When *Passcode* is set to any non-zero value, re-entry into the *SEtUP* menu is prevented until the correct passcode is entered.

⚠ CAUTION!

When setting a passcode value, be sure to record the entered value in a safe and secure location. For security reasons, once a non-zero value is set, the passcode is not available for display.

The passcode only protects the calibration parameters in the *SEtUP* mode. It does not prevent taking the actuator off-line by invoking the *LOCAL* or *SEtUP* modes.

Setting a *Passcode* value is performed in a manner similar to setting the other parameters. The (E)NTER key is used to enable entry, the Scroll Up and Scroll Down keys will change the display to the desired value and the (E)NTER key pressed again will store the value. The passcode may be changed at any time. When performing calibration, it may be convenient to temporarily set the passcode to 000, perform the tasks and then reset the desired passcode.

FAILSAFE



Failsafe (FS) specifies the action to be taken if an analog signal (typically 4-20 mA) falls below a value of 2.5 mA. *Failsafe* may be set to one of the following:

- IP - Lock-in-place.
- PL - Move to the position specified by the parameter *Position Low*.

PH - Move to the position specified by the parameter
Position High.

OFF- Override this feature for use with 0-20 mA signals.
Control signals less than 2.5 mA are valid.

If the control signal becomes invalid, the actuator seeks the selected failsafe position, displays error code E-CS and de-energizes the alarm relay. After invoking the selected failsafe action, the actuator continues monitoring the control signal. If the signal returns to a valid value (greater than 2.5 mA), the actuator will clear the error code, turn off the alarm and resume tracking the control signal. However, if *Bumpless Transfer* is set to ON, the actuator may encounter a bumpless transfer error and not go on-line.

SIGNAL TYPE



Signal Type (St) specifies the input signal to which the actuator will respond. Selecting Analog (A) specifies a standard two-wire loop. Selecting Pulse (P) specifies a pulse input signal which is used in conjunction with the Pulse Input Board (See Appendix P). When Analog is selected, sub-menu CAL provides two setable parameters, SL and SH, which are used to calibrate the actuator to the analog signal. When Pulse is selected, sub-menu CAL provides two different setable parameters, Pd and PI, which are used to specify the pulse duration and the actuator position change for each input pulse.

POWER MODULE TYPE



Power Module Type (dt) defines within the control program characteristic features specific to the B, C or 1/2D and D size power module and cylinder combination. The value will typically be factory set. If a change must be made, simply enable the parameter by pressing the (E)NTER key and select the correct power module type and either 1, 2 or 3 depending upon the stroking rate of the actuator.

LINEAR

- If rate is Faster than 15 ^{sec}/inch (13, 10, etc.), select a 1.
- If rate is Between 15 ^{sec}/inch and 30 ^{sec}/inch (20, 24, etc.), select a 2.
- If rate is Slower than 30 ^{sec}/inch (40, 50), select a 3.

ROTARY

- If rate is Faster than 15 ^{sec}/90° (13, 8, etc.), select a 1.
- If rate is Between 15 ^{sec}/90° and 30 ^{sec}/90° (17, 25, etc.), select a 2.
- If rate is Slower than 30 ^{sec}/90° (40, 50), select a 3.

7 START-UP CONSIDERATIONS

*Note: Refer to page 47 for

Addendum: Cylinder End Stops. 7.1 Wiring

!IMPORTANT!

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.

The majority of problems encountered during initial start-up of REXA actuators involve wiring or electrical power. Although the wiring is simple and straight forward, the quantity of wires and color coding require reasonable care when making the connections. Any miswiring will keep the unit out of service or cause serious damage.

7.1.1 Module Cable (B or C) or Motor Cable (½D or D)

If motor phase wires are crossed or they are intermittent (loose connection), an E-dr Error will occur.

1. Verify that wiring is correct using section 5.1.
2. Visually inspect both ends of the cable for cut wires, short circuits, or loose connections.
3. Make sure clamped connections are made to the bare wire and not the insulation.
4. Using a digital multimeter, check the continuity of the motor phase wires from the connector to the stepper motor driver circuit board. Should any of these connections be open or intermittent, the cable connecting the driver to the mother board is seated improperly.

7.1.2 Feedback Cable

Mis-wiring of the feedback cable will cause the position display to remain constant during actuator motion or an E-Fb error to occur.

1. Verify that wiring is correct and secure using section 5.2.
2. Insure the feedback power (+15 VDC) is present at the feedback circuit board by the illuminated LED.
3. Make sure clamped connections are made to the bare wire and not the insulation.
4. Place an ammeter in series with the feedback wires. If the signal changes while moving the actuator, then the feedback is working properly.

7.1.3 Electrical Power

Failure to maintain specified voltages at the actuator may cause unit stall or complete shutdown. Keep in mind demands on your power buss. Are there intermittent power drains which will pull down the line? Have power cables been properly sized for the current and length of run? Review Section 5.3.1 for power requirements on the B, C and 2C Power Modules and Appendix X for power requirements on the D and 2D Power Modules.

7.2 Electrical Noise

Electrical noise can cause the actuator position to be unstable. That is, the motor will be constantly "hunting" for the target position. This is more likely for actuators with a tight deadband setting.

To determine if an actuator is being affected by electrical noise, place the PCP into *LOCAL* control mode (section 6.2). Press the (E)NTER key and the "P" label will begin flashing. Press and quickly release the Scroll Up or Scroll Down key to have the actuator change position by 0.1% of stroke. If the display jitters and toggles around the position, then there is probably noise on the feedback signal. If the display is steady, then scroll down to review the live analog control signal. Does the display jitter and toggle around the display value? If yes, then it may be that the control signal is noisy or the control signal is picking up noise from another source.

7.2.1 Provide A Good Earth Ground

The most important step in reducing noise is to provide a good earth ground at both the actuator and the control enclosure. A faulty ground will not allow noise to drain off the cables. The ground wire from the incoming power must be secure and true.

The motor power cable has a ground conductor (green/yellow). It must be terminated at both the actuator and the control enclosure. At the actuator, the cable should be terminated inside the junction cavity. At the enclosure, it should be terminated at "Actuator GND." If there is more than one Power cable, then the green/yellow ground conductor of each cable must be terminated.

Keep the feedback shield wire as short as possible within the control enclosure.

The shield drain wire of the feedback cable should be terminated at the control enclosure. Connect the shield to "Earth Ground". Although not common practice, the installation may justify connecting the shield at the actuator end also. This connection is made at the shield terminal on the feedback circuit board. Only ground the feedback cable at the actuator end after noting the effect of termination at the control enclosure.

Grounding the feedback at both points may introduce additional noise.

7.2.2 Options If Electrical Noise Is Still A Problem

ELECTRICAL POWER

The incoming power may have noise. Although the control enclosure incorporates main power filtering, the noise may be substantial enough to still affect the performance. If it is possible, try getting main power

from another circuit at the breaker panel. Otherwise, install a line filter. Be sure the filter is rated for the proper current and voltage.

CONTROL SIGNAL

Although milliamp control signals are generally not noisy, it is possible for this signal to be corrupted by an outside source. At the control enclosure, replace the normal control signal with a hand held, battery powered current source. If operation is stable, then better shielding of the control signal may be needed. The control signal should not be run within a conduit containing a main power feed or other high power cables. The shield of the control signal should be terminated at the control system ground and not at the control enclosure.

ACTUATOR POSITION FEEDBACK

If the feedback and motor power cable are in the same conduit, try removing one of the cables. The elimination or reduction of noise may indicate that separate conduits are required.

The key to quiet operation is a reliable earth ground and keeping the grounded shield as short as possible within the control enclosure.

7.2.3 Noise Pick-up On Surrounding Equipment

Although it is not common, there have been situations where noise is picked up on surrounding equipment from the **REXA** actuator. The noise is generated by the frequency at which the DC Motor Driver runs the stepper motor. Generally, the noise is eliminated by running the motor power cable in metallic conduit. Another possibility is noise being fed through the AC power line. This can be eliminated by changing the main power circuit or incorporating an AC line filter.

7.3 Mechanical Restriction/Binding

Most mechanical restrictions are an application or mounting related problem. Any binding will be indicated by erratic motion, slower speed or restriction of travel. The problem could lie in the actuator, the device being driven or misalignment between the two.

7.3.1 Lateral Misalignment

Any noticeable bending of the actuator stem or driven device (valve) stem should be immediately corrected. Not only is operation impaired, but damage to the actuator seals and bushings or the valve packing and stem may occur.

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.

7.3.2 Longitudinal Misalignment

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.

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.

7.4 Tuning

With a user selectable deadband as low as 0.05%, the **Xpac** can usually position the driven device finer than the instrumentation can detect. If the process does not demand this level of control, ease up on the deadband. Make sure that the control signal is driving the actuator and not random noise (section 7.2).

Oscillation about the target position can occur on high speed units that have a low deadband setting. This motion does neither the actuator nor the process any good. The Acceleration Sub-menu is designed to eliminate this motion. Proper operation for such cases is a single overshoot, followed immediately by a *Low Acceleration* (see section 6.3.2) reversal to the correct position.

In general, the **REXA** power modules will develop their nominal pressure (2000 PSI) over a wide range of temperatures (0° to 160° F) and speed settings (40% to 100%). It is only in the extreme where output drops below the ratings. Depending on the situation, **REXA** has available different remedies to insure adequate viscosity of the oil and thus insure nominal pump pressure.

7.5.1 Fail In Place Actuators

Fail in place actuators have the full output ratings available in both directions of motion.

7.5.2 Spring Return Actuators

Spring return actuators have the rated output minus the spring load available in the direction opposing the spring and the rated output plus spring load in the direction of the spring load. Upon power failure only the spring load is available. The spring range should be indicated on the specification. See TM4, *Spring Failure*, for details.

7.6 Temperature

Oil is used as the means to transfer rotary motion of the motor into mechanical thrust or torque. Because oil is essentially incompressible **REXA** actuators exhibit high stiffness and therefore can precisely position large loads. The viscosity of the oil is essential to the operation of the actuator. If the oil is heated the viscosity decreases until at some elevated temperature the thickness becomes too low for the gear pump to produce the necessary output pressure. Conversely if the oil is cooled, the viscosity increases until the torque required to pump the thickened oil stalls the motor. For this reason the specific oil used is temperature range dependent.

The chart (next page) shows the temperature ranges for the recommended automotive oil (Castrol Syntec SAE 5W-50). This is for a speed setting between 80% and 100%. A speed setting below 80% may allow operation at somewhat lower temperatures than specified. Three ranges are identified:

TR 1: *The standard oil and the cartridge heater;*

TR 2: *One inch of thermal insulation covering the entire unit is recommended;*

TR 3: *Heat tracing should be provided in conjunction with a one inch covering of thermal insulation.*

For electrical power sensitive installations, the cartridge heater is not required for the standard oil at ambient temperatures above 25°F.

Ambient Temperature Range for Various Configurations

L Series (thrust of 10,000 lbs or less and strokes of 6 inches or less)					
SAE 5W-50 (Standard –Castrol Syntec)					
TR3	TR2	TR1		High Temp. Option	
-76°F (-60°C)	-30°F (-34°C)	-5°F (-20°C)	+25°F (-4°C)	200°F (93°C)	300°F (150°C)
R & D Series					
L Series (thrust greater than 10,000 lbs or strokes longer than 6 inches)					
SAE 5W-50 (Standard –Castrol Syntec)					
TR3	TR2	TR1	High Temp. Option		
-76°F (-60°C)	-10°F (-23°C)	+10°F (-12°C)	+25°F (-4°C)	200°F (93°C)	300°F (150°C)

Please refer to TM19, Temperature Guidelines, for additional details.

*Note: Refer to page 47 for Addendum: Cylinder End Stops.

8 ERROR CODES

The PCP is able to provide various diagnostics for actuator malfunction. These ERROR CODES are two letters preceded by an E- on the five digit display. Except for loss of feedback, E-Fb, the display will alternate between the error codes and actual position. Anytime an error is active, the alarm relay (Appendix C.4) will change state. Please refer to the Trouble Shooting and Repair manual for corrective action.

8.1 Loss of Feedback, E-Fb

E-Fb will automatically clear when the feedback signal is within normal range.

The feedback circuit transmits the position of the actuator to the PCP. This signal should be between 4 mA and 20 mA and will change with actuator position. A signal below 4 mA will be interpreted as a feedback problem. Motion of the unit will cease, the alarm relay will trip and E-Fb will appear on the display.

Potential reasons for the error include: Loose wiring, triple power supply, feedback board, PCP I/O.

8.2 Stall, E-St

E-St will clear by "Stall Recovery", cycling electric power, pressing the PCP reset button (located in the upper left corner) or entering the LOCAL or SETUP modes.

If the actuator stops before reaching the target position, a stall condition, E-St, is indicated. Automatic corrective action consisting of five motor restarts will occur. Continued failure to resume motion will stop the unit, trip the alarm relay and alternate the display between E-St and actual position. Actuator stall may be cleared by "Stall Recovery"; that is, changing the incoming control signal to indicate a position opposite the direction of the stall point.

Potential reasons for the error include: incorrect calibration, mechanical restriction, insufficient output, heater.

8.3 No Control Signal, E-CS

E-CS will automatically clear when the control signal is within normal range.

If Fail Safe is active, [CtL:FS] = IP, PL or PH, and the control signal falls below 2.5 mA, a control signal failure, E-CS, will be indicated. The actuator will move to its programmed fail-safe position, the alarm relay will trip and the display will alternate between E-CS and actual position.

Potential reasons for the error include: loose wiring, loss of control signal, triple power supply, PCP I/O.

The Fail Safe feature can be turned of ([CtL:FS] = OFF). In such instances, E-CS has no meaning and will not occur.

E-bt will automatically clear when the control signal and actuator position are within 5%.

8.4 Bumpless Transfer, E-bt

Please review Section 6.3.3 for complete details.

8.5 Driver Fault, E-dF

E-dF will only clear when the driver fault signal is removed.

The motor drivers for the C and D size power modules have an output signal and red LED to indicate a fault. The PCP monitors the driver fault signal and will issue a reset command to the driver. If this fails to clear the fault, the alarm will change state and the display will alternate between E-dF and actual position.

DUAL POWER MODULE UNITS (2C OR 2D)

Failure of a single drive does not shut down the actuator. The display will indicate a driver fault, E-dF, and the alarm will change state, but the unit will continue to operate on one power module. The stroking speed is reduced by half.

Potential reasons for the error include: motor lead short, internal driver power fault, low incoming voltage, no power.

8.6 Incorrect Direction, E-dr

E-dr will clear by cycling electric power, pressing the PCP reset button (located in the upper left corner) or entering the LOCAL or SETUP modes.

If the actuator moves in the direction opposite to the PCP command, an incorrect direction error, E-dr, will be indicated. Motion of the unit will cease, the alarm relay will trip and the display will alternate between E-dr and actual position.

Potential reasons for the error include: loose wiring, motor driver.

8.7 Triple Power Supply, E-PS

E-PS will only clear when the power supply returns to normal range.

The PCP and feedback operate from a triple power supply (+5 Vdc, +15 Vdc, -15 Vdc) located on the motherboard. As long as the +5 Vdc is active, the PCP is able to monitor the +15 Vdc and -15 Vdc outputs. A reduction of 1.5 Vdc in either output will stop motion of the unit, trip the alarm relay and E-PS will appear on the display.

Potential reasons for the error include: loose wiring, triple power supply.

Addendum: Cylinder End Stops

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.

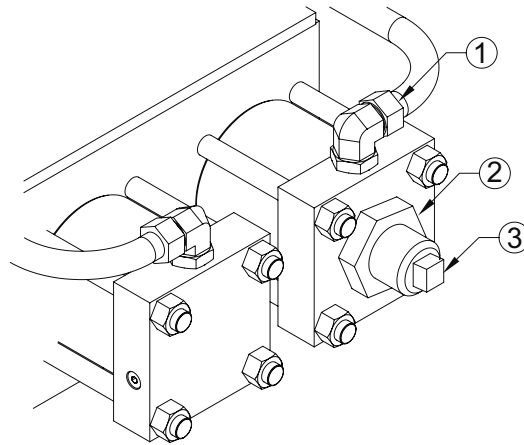


Figure 5.5 Stroke Adjustment



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 adjuster 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

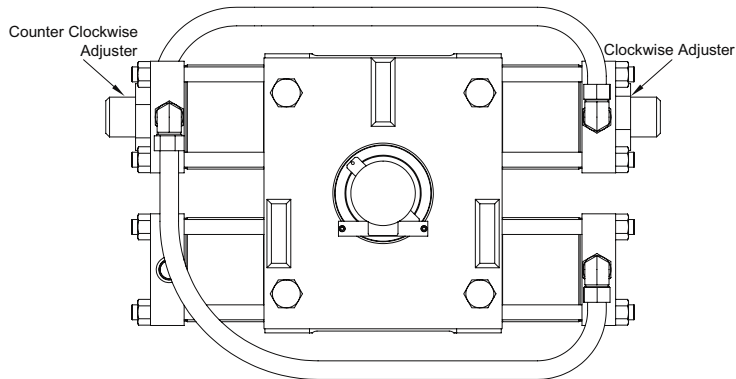


Figure 5.5.1-1 Cylinder End Stops



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.

- 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.

- 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.

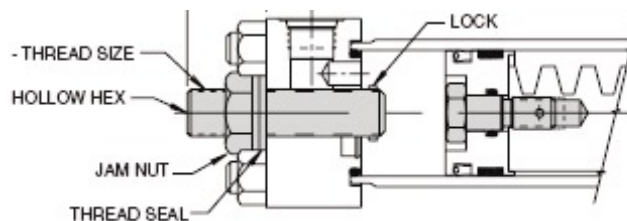


Figure 5.5.1-2 End Stop Detail

- Use an allen wrench drive inserted into the hollow hex adjustment screw end to adjust the stroke adjuster. Rotate clockwise to decrease the stroke of the actuator. Each stroke adjuster provides a minimum of 5 degrees of actuator rotation adjustment.
- 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.
- 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.
- Reposition the countersunk washer and the jam nut and torque the jam nut to the requirements of the Table 5.5.1.
- 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)
R600/R1 200	4.2	10
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.

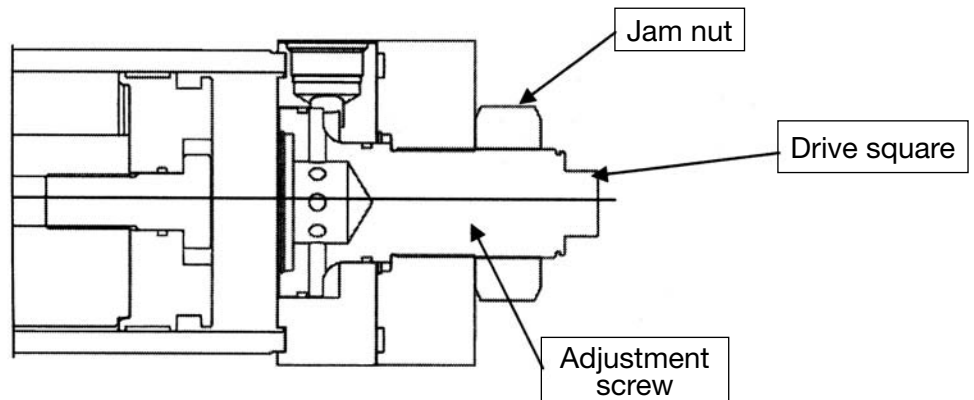


Figure 5.5.2 R200 000/R400 000 Stroke Adjustor

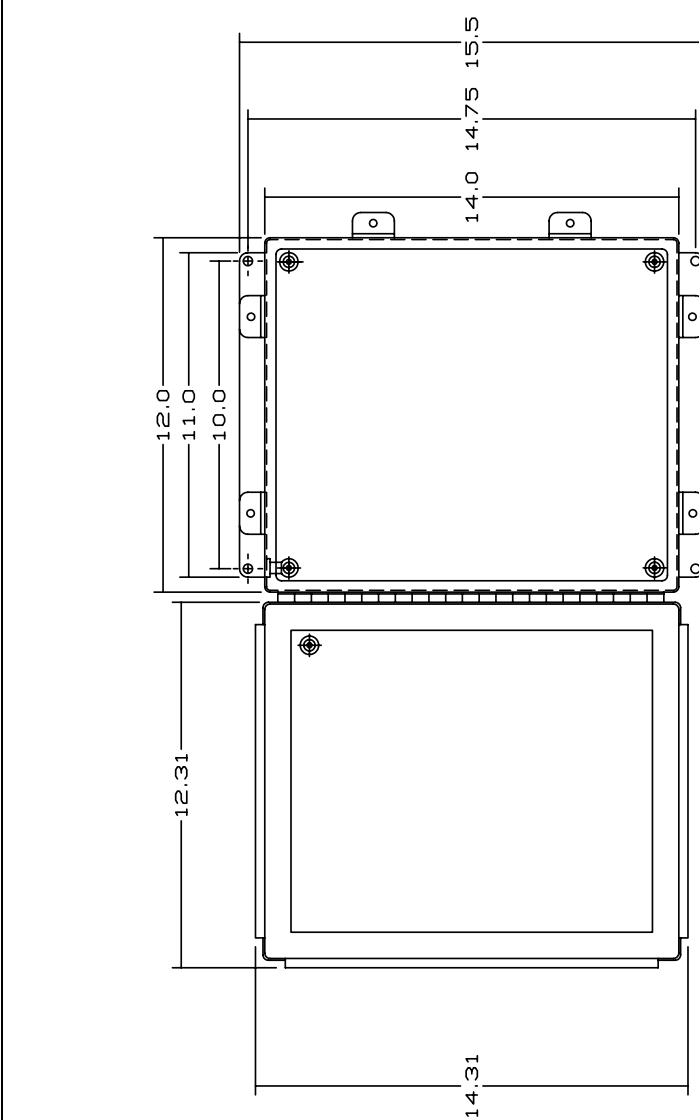
APPENDIX A

**Control Enclosures and Electrical Assembly Drawings
For B, C and 2C Power Modules**

EP96528	Rev5
A96525	Rev2
EP95837	Rev0
A96770	Rev1
EP96527	Rev2
A97217	Rev0
EP96526	Rev2
A97218	Rev0
D96935	Rev2

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
1	REVISED TITLE BLOCK	8/23/97	DPT
2	REVIEWED		M.B./CWS
3	DELETE 24VDC & 48VDC FROM TITLE BLOCK	4	062599 M.B./CWS
4	ADDED NOTE TO TITLE BLOCK TO INCLUDE FM CL. DIV2 LOCATIONS	4	012600 DPT
5	CHANGED TITLE BLOCK TO DELETE 'FM' AND ADD 'CSA'	4	2/11/04



ENCLOSURE SPECIFICATIONS

DIMENSIONS: . SEE OUTLINE DRAWING
 STANDARDS: . NEMA/IEEEMAC TYPE 4X
 CONSTRUCTION: . FORMED 16 GAUGE STEEL BODY WITH 14 GAUGE STEEL DOOR
 FINISH: . COVER AND ENCLOSURE ARE PHOSPHATIZED, PRIMED AND FINISHED IN ANST/ASA 61 GREY
 APPROXIMATE: . 21 lbs.

.56
 .313 DIA. 4 PLACES TYP.
 .875 DIA THRU (1/2" CONDUIT FITTING)
 1.32 DIA THRU (1" CONDUIT FITTING)
 3.75
 1.75
 6.0
 1.50

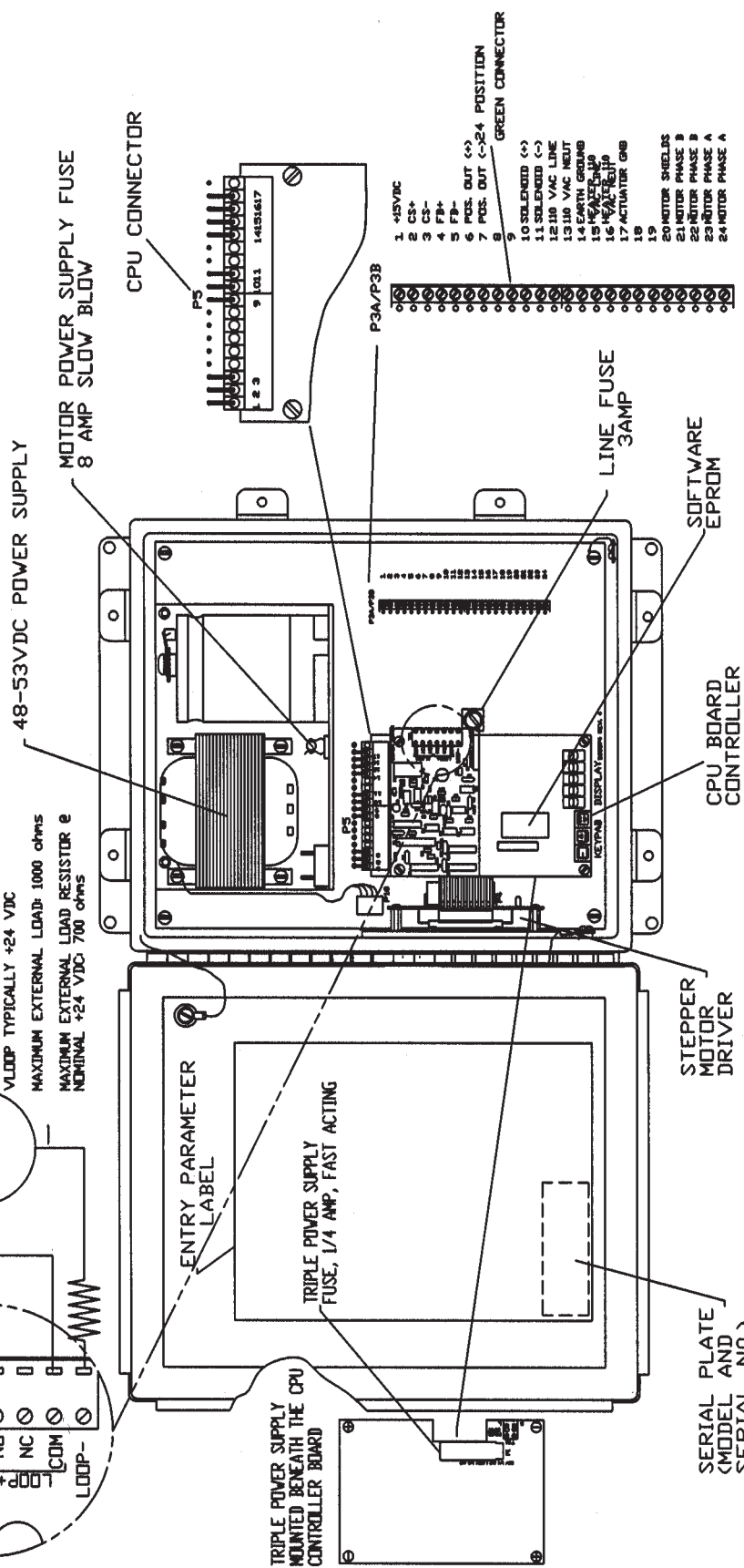
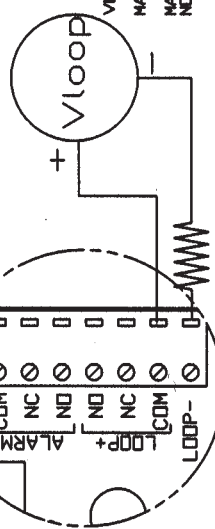
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT No.	
XX	XXX	PREP	DPT
±.01	±.003	CHKR	06/26/96
ANGLES ±5 DEG		APVD	
MATERIAL SEE ENC SPEC		APVD	
FINISH SEE ENC SPEC			
MACHINE SURFACE ✓			

REXAX		W. BRIDGEWATER, MASSACHUSETTS	
B SIZE CONTROL ENCLOSURE		14" X 12" X 6"	
NEMA 4X, STEEL, CSA APPROVED		FOR CL1, DIV2 LOCATIONS	
SIZE	NUMBER	REV	5
A	EP96528		
SCALE	NONE	SHEET	OF 1

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REVISIONS

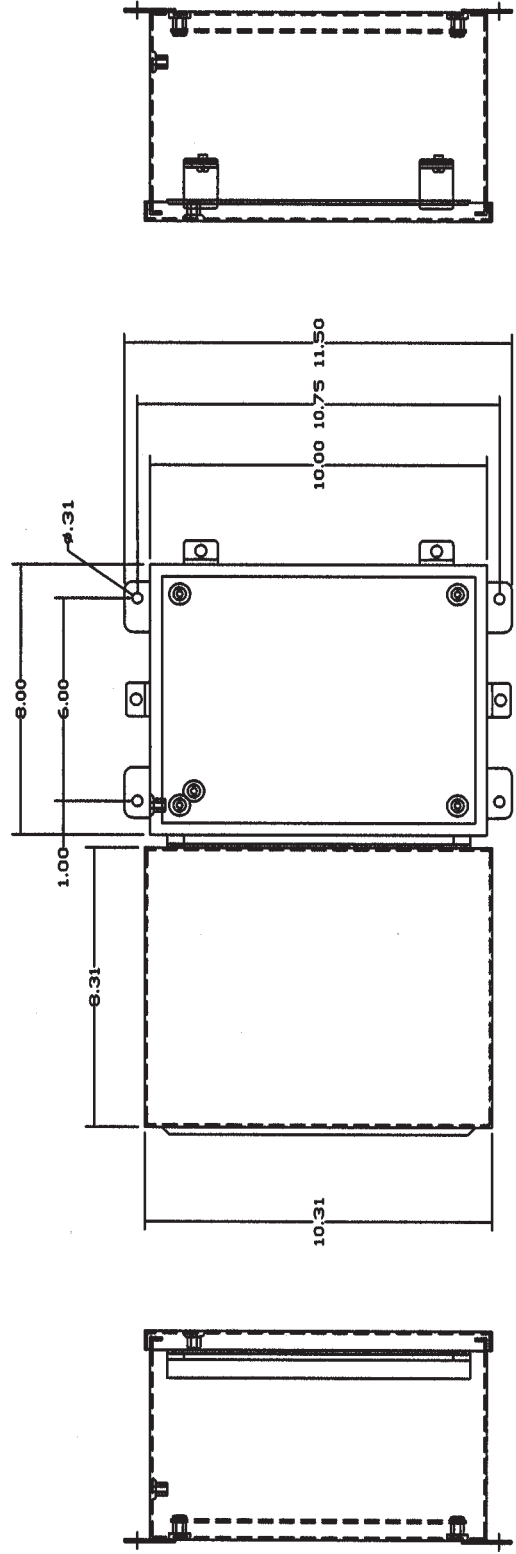
DISPOSITION= 1.REWORK 2.SCRAP 3.USE AS IS 4.RECORD CHANGE					
REV	DESCRIPTION	ECN NO	DISP	DATE	APVD
1	ADDED POS XMTN				
2	ADDED TRIPLE POWER SUPPLY				



UNLESS OTHERWISE SPECIFIED		CONTRACT No.	
DIMENSIONS ARE IN INCHES		PREP	DPT
X ±.03	XX ±.015	CHKR	06/25/96
MATERIAL		APVD	
FINISH		APVD	
MACHINE SURFACE			
1) BREAK ALL SHARP EDGES .015 2) O-RING GROOVES 63 FINISH OR BETTER 3) INSIDE CORNER RADII TO BE .030 MAX THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF REXA CORPORATION. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.		SIZE A	NUMBER A96525
		SCALE NONE	SHEET 1 OF 1
		W. BRIDGEWATER, MASSACHUSETTS B SIZE CONTROL ENCLOSURE ASSEMBLY REV 2	

EP95837

REVISIONS			
DISPOSITION=	1.REWORK	2.SCRAP	3.USE AS IS
4.RECORD CHANGE			
REV	DESCRIPTION	ECN NO	DISP
			DATE
			APVD



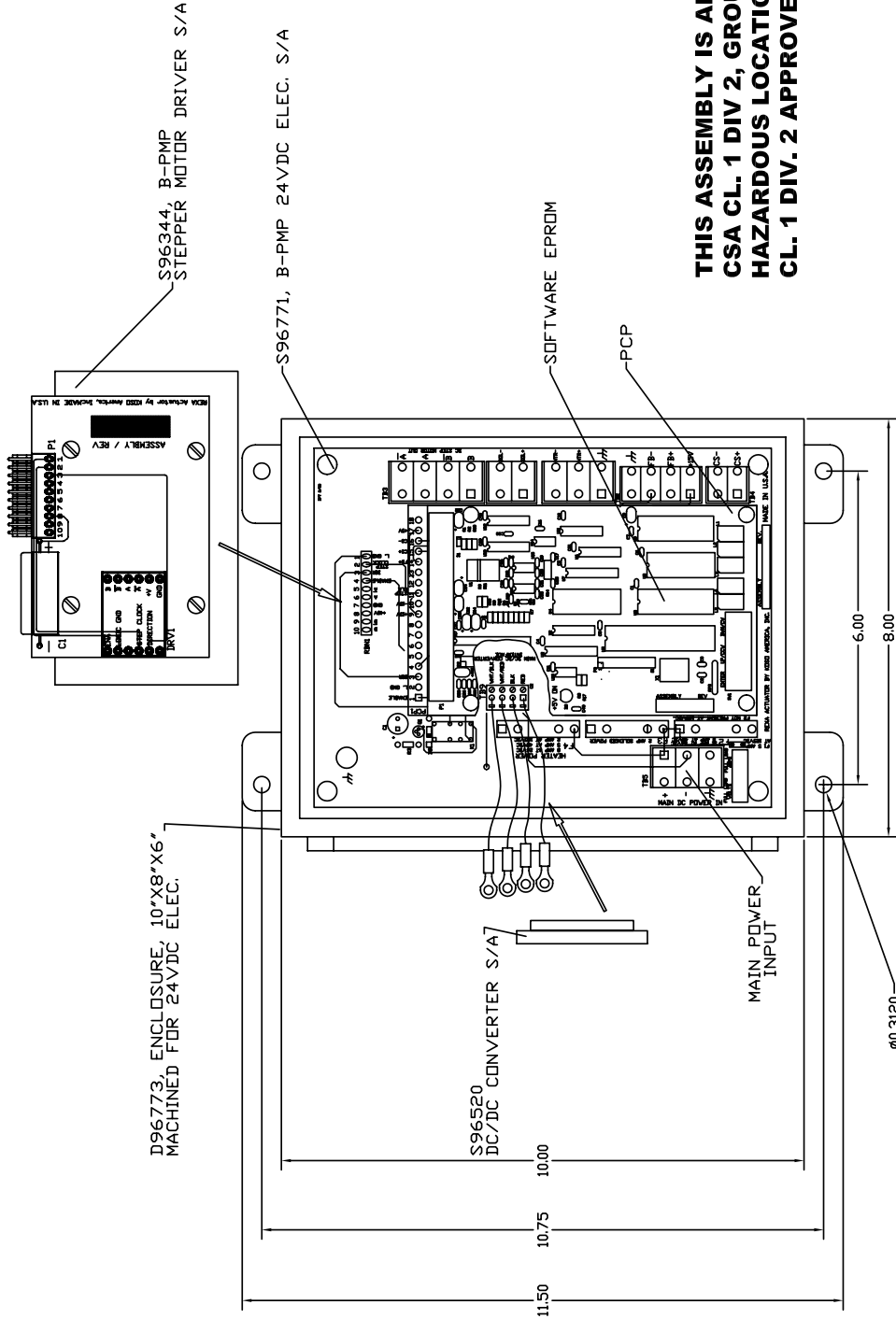
ENCLOSURE SPECIFICATIONS
 DIMENSIONS . SEE OUTLINE DRAWING
 STANDARDS . NEMA/CEMAC TYPE 4X
 CONSTRUCTION . FORMED 16 GAUGE STEEL BODY WITH 14 GAUGE STEEL DOOR
 FINISH . COVER AND ENCLOSURE ARE PHOSPHATIZED, PRIMER AND FINISHED IN ANS/ASA 61 GREY
 APPROXIMATE . 12 lbs.

UNLESS OTHERWISE SPECIFIED		CONTRACT No.	
DIMENSIONS ARE IN INCHES		PREP	DPT
.X	.XX	06/02/99	06/02/99
±.03	±.015	CHKR	CWS
	±.005	APVD	M. B.
MATERIAL		APVD	
SEE ENC SPEC		RAW STOCK	PROD.CODE
FINISH			
SEE ENC SPEC			
MACHINE SURFACE			
✓			
1) BREAK ALL SHARP EDGES .015		W. BRIDGEWATER, MASSACHUSETTS	
2) D-RING GROOVES .63 FINISH OR BETTER		B SIZE CONTROL ENCLOSURE	
3) INSIDE CORNER RADIUS TO BE .030 MAX		10" X 8" X 6"	
THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF REXA CORPORATION. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.		NEMA 4X, STEEL	
		12VDC, 24VDC, 48VDC, 125VDC	
		SIZE	REV
		NUMBER	0
		SCALE	1
		NONE	DF
		SHEET	1
			1



REV I S I O N S

DISPOSITION=	1.REWORK	2.SCRAP	3.USE AS IS	4.RECORDED CHANGE
REV	DESCRIPTION		ECN NO/DISP	DATE
1	ADDED CSA NOTE AND DIMENSIONS		4	4/16/03 DPT



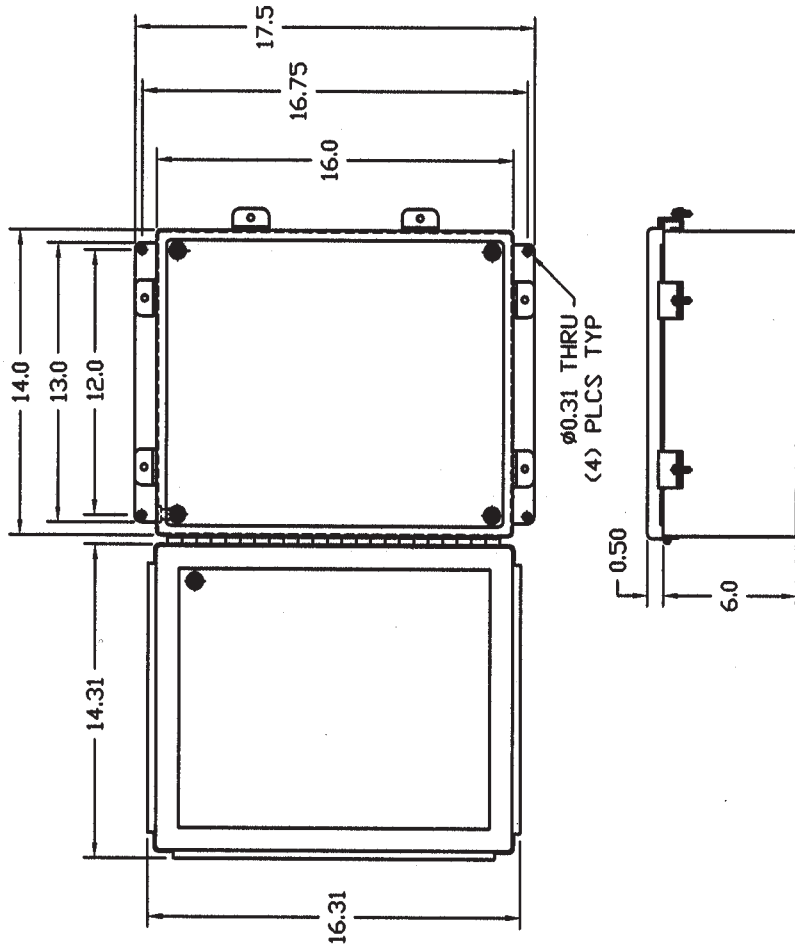
**THIS ASSEMBLY IS APPROVED FOR
CSA CL. 1 DIV 2, GROUPS B,C,D
HAZARDOUS LOCATIONS WHEN USED WITH
CL. 1 DIV. 2 APPROVED ACTUATOR**

UNLESS OTHERWISE SPECIFIED		CONTRACT NO.		R&A W. BRIDGEWATER, MASSACHUSETTS	
DIMENSIONS ARE IN INCHES	PREP	DPT	05/12/98	24 VDC B-PMP ELECTRONIC FINAL ASSY. MOTHER BOARD ELEC S/A, STEPPER DRIVER S/A AND DC/DC CONVERTER S/A	
.XX ±.015	CHKR	APVD		SIZE	REV 1
.XX ±.015	APVD			NUMBER	A96770
.XX ±.015	RAW STOCK			SCALE	1"=1.5"
MATERIAL	PROD. CODE	12		SHEET 1 OF 1	
FINISH	THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF REXA CORPORATION. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.				
MACHINE SURFACE	✓				

REVISIONS

REV	DESCRIPTION	ECN NO	DISP	DATE	APVD
1	DELETED CORRUPT FITTING HOLES/REVISED TITLE BLOCK	4		09/23/97	BPT
2	ADDED 2B SIZE ENCLOSURE TO TITLE	3		10/16/97	BPT

DISPOSITION= 1.REWORK 2.SCRAP 3.USE AS IS 4.RECORD CHANGE



ENCLOSURE SPECIFICATIONS

DIMENSIONS . . . SEE OUTLINE DRAWING
 STANDARDS . . . NEMA/EEMAC TYPE 4X
 CONSTRUCTION . . . FORMED 16 GAUGE STEEL BODY WITH 14 GAUGE STEEL DOOR
 FINISH . . . COVER AND ENCLOSURE ARE PHOSPHATIZED, PRIMED AND FINISHED IN ANSI/ASA 61 GREY
 APPROXIMATE WEIGHT . . . 26 lbs. (ELECTRONICS INSTALLED)

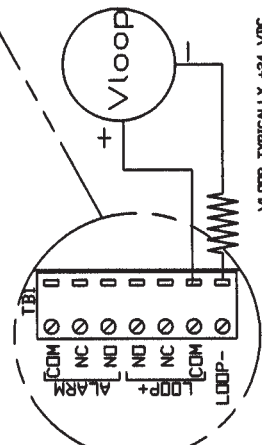
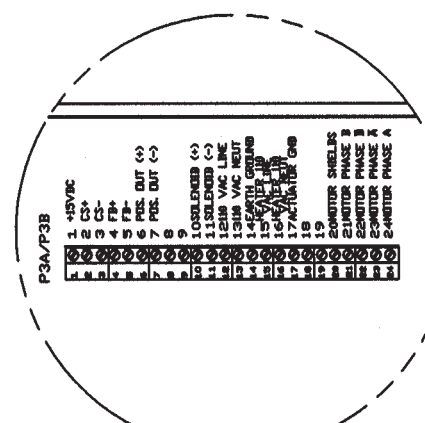
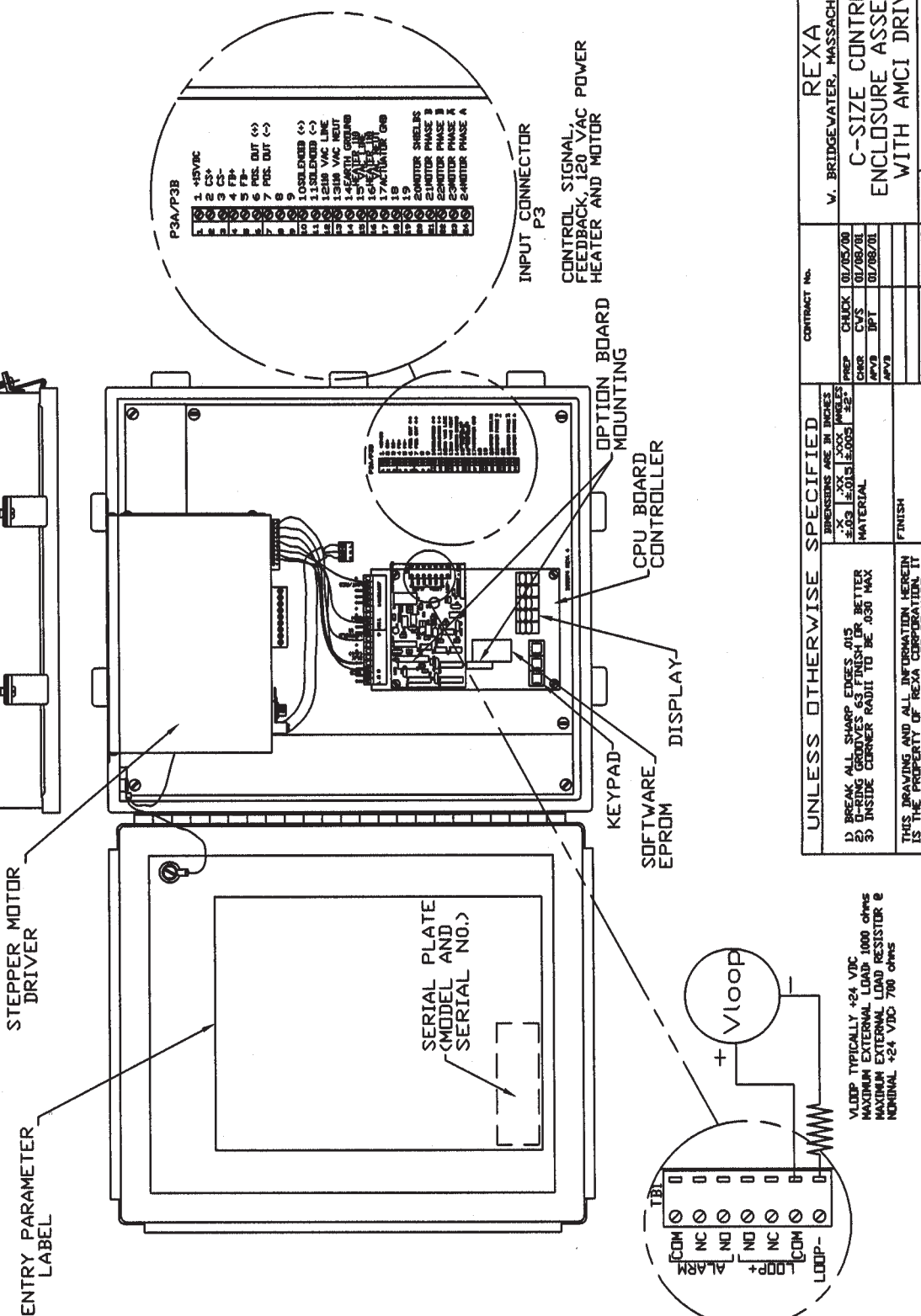
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT No.	
.XX	±.01	PREP	DPT
.XXX	±.003	CHR	
	±.5 DEG	APVD	
MATERIAL		APVD	
FINISH			
MACHINE SURFACE	✓		

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REXA	
V. BRIDGEWATER, MASSACHUSETTS	
C/2B SIZE CONTROL ENCLOSURE, NEMA 4X STEEL 16" X 14" X 6" 120 VAC	
SIZE	NUMBER
A	EP96527
SCALE	REV 2
NONE	SHEET 1 OF 1

REVOLUTIONS

REV	DISPOSITION	DESCRIPTION	DATE	BY



VLOOP TYPICALLY +24 VDC
 MAXIMUM EXTERNAL LOAD 1000 ohms
 MAXIMUM EXTERNAL LOAD RESISTOR @
 NOMINAL +24 VDC 700 ohms

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

.X	.XX	.XXX	ANGLES
±.03	±.015	±.005	±.2°

MATERIAL

FINISH

MACHINE SURFACE ✓

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CONTRACT No.

PREP CHECK 07/85/00

CHKR CYS 07/88/01

APVR JPT 07/88/01

REV 0

SCALE NONE

SHEET 1 OF 1

REXA
 V. BRIDGEWATER, MASSACHUSETTS

C-SIZE CONTROL
 ENCLOSURE ASSEMBLY
 WITH AMCI DRIVER

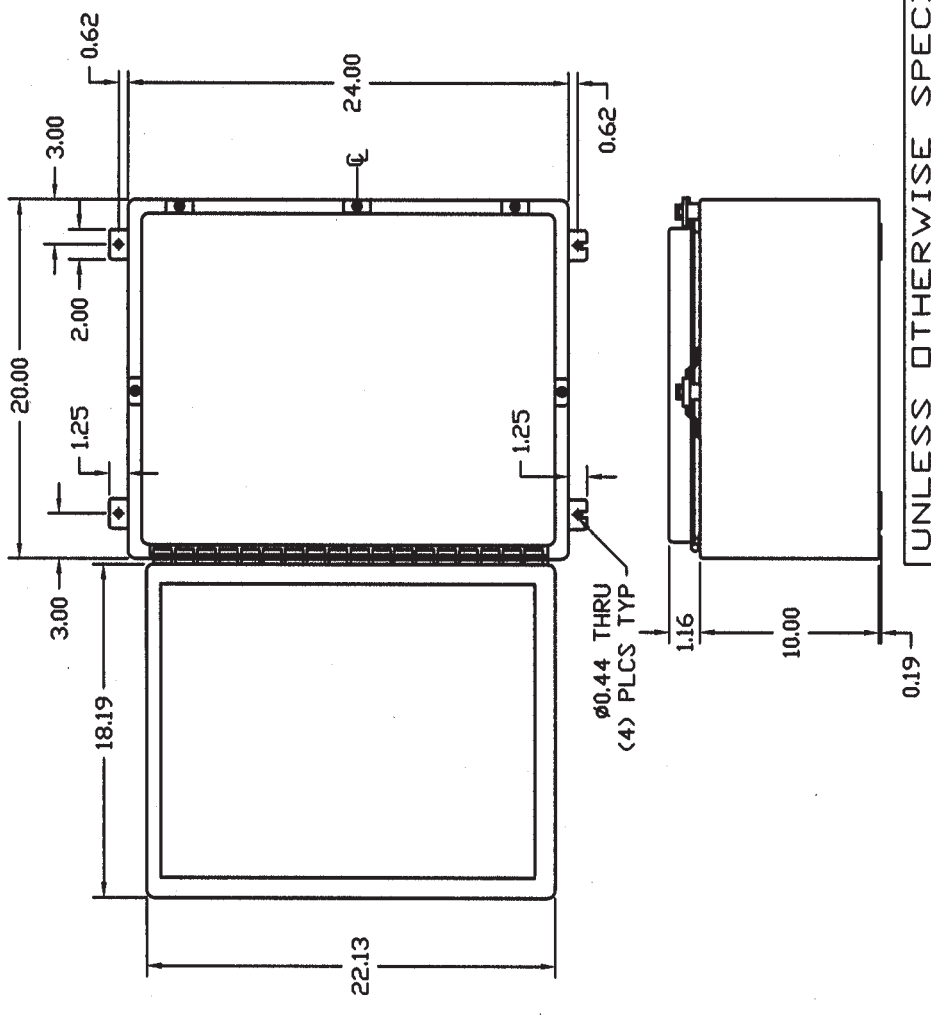
SIZE A NUMBER A97217 REV 0

REVISIONS

REV	DISPOSITION	1-REV'D	2-SCRAP	3-USE AS IS	4-RECORD CHANGE
REV	DESCRIPTION	ECN NO	DISP	DATE	APVD
1	RELEASED	3		6/26/96	DPT
2	REVIEWED PER M.B.	3		03/09/99	CVS

ENCLOSURE SPECIFICATIONS

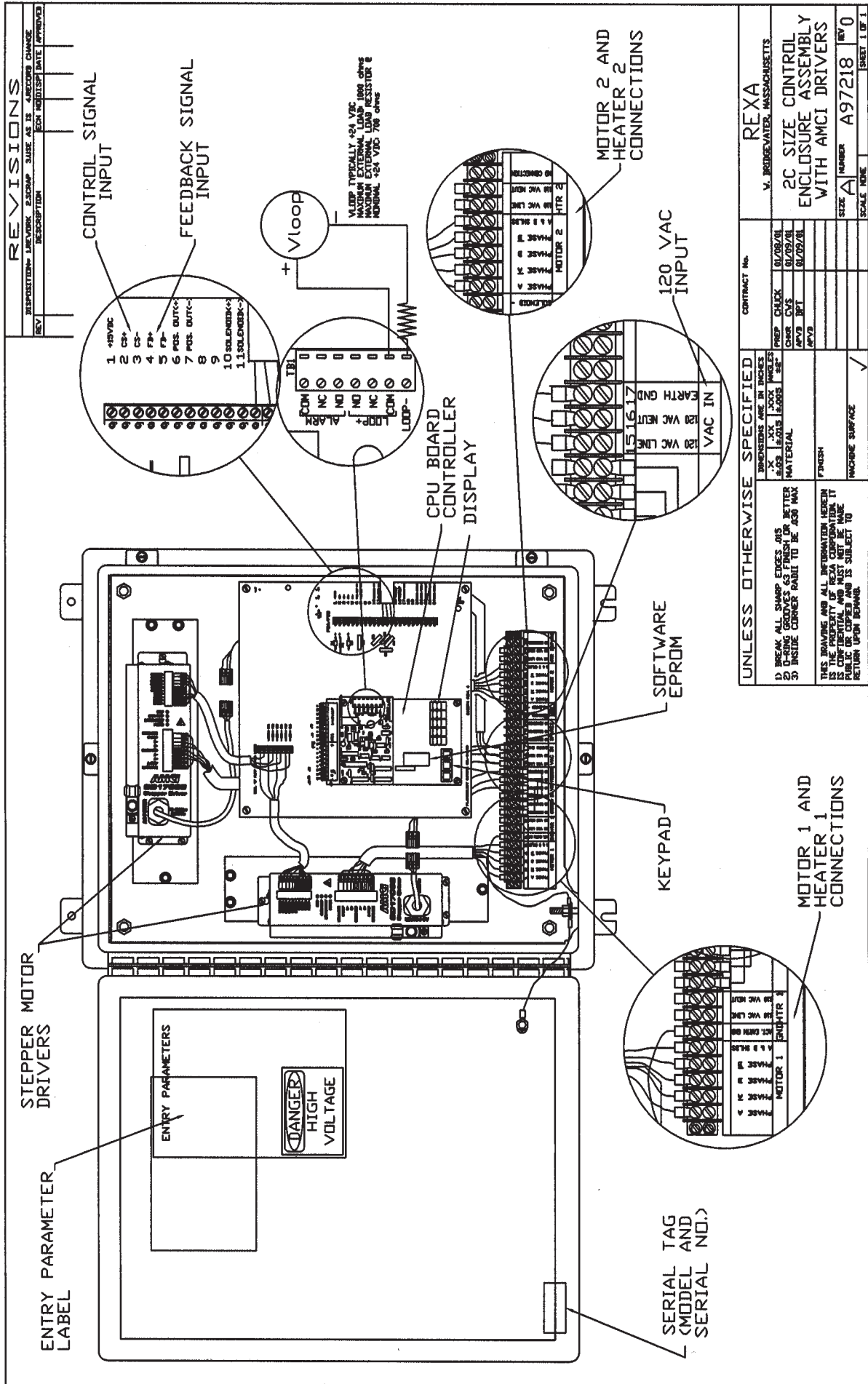
DIMENSIONS: SEE OUTLINE DRAWING
 STANDARDS: NEMA/IEEEMAC TYPE 4X
 CONSTRUCTION: FORMED 16 GAUGE STEEL BODY WITH 14 GAUGE STEEL DOOR
 FINISH: COVER AND ENCLOSURE ARE PHOSPHATIZED, PRIMED AND FINISHED IN ANSII/ASA 61 GREY
 APPROXIMATE WEIGHT: .66 lbs. (ELECTRONICS INSTALLED)

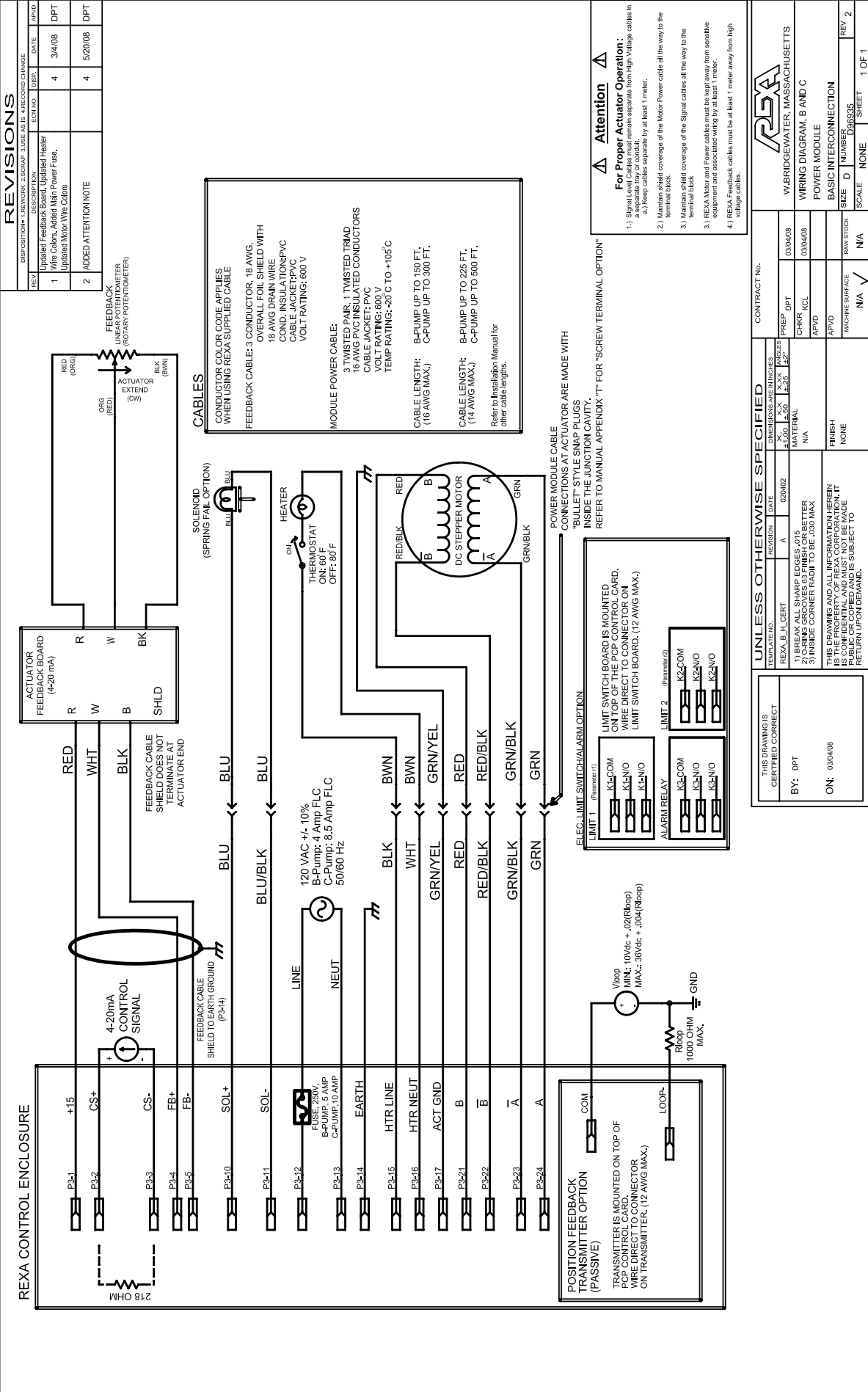


UNLESS OTHERWISE SPECIFIED

1) BREAK ALL SHARP EDGES .015 2) D-RING GROOVES 63 FINISH OR BETTER 3) INSIDE CORNER RADIUS TO BE .030 MAX	DIMENSIONS ARE IN INCHES	
	X ±.03 XX ±.015 XXX ±.005	ANGLES ±2°
MATERIAL	FINISH	
THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF REXA CORPORATION. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.		
MACHINE SURFACE		<input checked="" type="checkbox"/>

CONTRACT No.		REXA V. BRIDGEWATER, MASSACHUSETTS	
PREP	DPT	2C SIZE CONTROL ENCLOSURE 24" X 20" X 10", NEMA 4X, STEEL 120 VAC	
CHR	APVD	SIZE	NUMBER
APVD	EP96526	SCALE	NONE
SHEET 1 OF 1		REV 2	

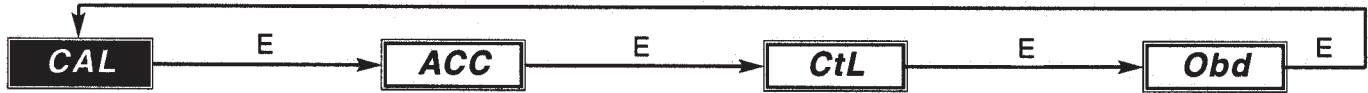




APPENDIX B

Quick Reference

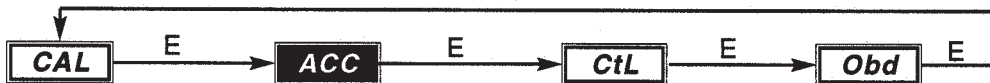
Use **SCROLL UP/SCROLL DOWN** to move through a branch. Press **ENTER** to enable a parameter (**ID** will flash). Modify the parameter's value by pressing **SCROLL UP/SCROLL DOWN**. Press **ENTER** again to lock in the value. When at a branch code (**CAL**, **ACC**, etc), pressing **ENTER** will jump to the next branch.



CAL - Mandatory Calibration Parameters

SCROLL UP	ID	NAME	VALUE	OPERATION
	HS	High Speed	5 >> 125	Motor speed in percent of Maximum. Use SCROLL UP/SCROLL DOWN to increase or decrease the speed. Full rated output is achieved for speeds between 40 and 100 at 70PF. HS cannot be set below the value for LS (See branch [SPd]).
	HA	High Acceleration	1 >> 99	Controls the rate at which the motor speed increases up to the speed set in HS. Use SCROLL UP/SCROLL DOWN to adjust. HA cannot be set below the value for LA (See branch [ACC]).
	db	Deadband	0.1 >> 5.0	The amount of control signal change in percent of span before there is a change in actuator position. Use SCROLL UP/SCROLL DOWN to adjust.
	PL	Position Low	0.0 >> 100	Stem position corresponding to the Low Control Signal (SL). This can be set at either end of the stroke. Use SCROLL UP/SCROLL DOWN to move the actuator to the desired position. At least 10% of rated stroke must separate the positions of PL and PH.
	PH	Position High	0.0 >> 100	Stem position corresponding to the High Control Signal (SH). This defines the full stroke of the equipment. Use SCROLL UP/SCROLL DOWN to move the actuator to the desired position. At least 10% of rated stroke must separate the positions of PL and PH.
	If a Milliamp control signal (Parameter [CtL:St] = A) is used.			
	SL	Low Control Signal	0.0 >> 22	The control signal corresponding to Position Low (PL), typically - 4 mA. However, it may be any signal that is <u>3.8 mA less than SH</u> . This signal must be input from an external source such as a handheld current transmitter or the actual low signal from the controller.
	SH	High Control Signal	0.0 >> 22	The control signal corresponding to Position High (PH), typically - 20 mA. However, it may be any signal that is <u>3.8 mA greater than SL</u> . This signal must be input from an external source such as a handheld current transmitter or the actual high signal from the controller.
	If a pulse control signal (Parameter [CtL:St] = P) is used.			
	Pd	Pulse Duration	5 >> 999	Minimum pulse time in milliseconds for the signal to remain ON in order to be recognized as a valid pulse. A long duration pulse will be interpreted as multiple single pulses.
	PI	Pulse Increment	0.1 >> 5	The incremental change of position (in percent of span) that the actuator will travel for each input pulse. The pulse duration must be at least as long as specified in PD.
	If a D size Power Module (Parameter [CtL:dt] = d) is used.			
	dG	Gain	5 >> 50	Sets the proportional gain of the D-size power module.
SCROLL DOWN	dL	Minimum Speed	5 >> 20	Sets the minimum speed of the D-size power module in percent of maximum speed.

Use **SCROLL UP** /**SCROLL DOWN** to move through a branch. Press **ENTER** to enable a parameter (**ID** will flash). Modify the parameter's value by pressing **SCROLL UP**/**SCROLL DOWN** Press **ENTER** again to lock in the value. When at a branch code (**CAL**, **ACC**, etc), pressing **ENTER** will jump to the next branch.



ACC - Adjusts the response of the actuator to changes in control signal.

SCROLL ID	NAME	VALUE	OPERATION
UP LA	Low Acceleration	1 >> 99	The acceleration rate used when the signal is less than the breakpoint, Ab. Use SCROLL UP / SCROLL DOWN to adjust. LA cannot be set above HA.
Ab	Acceleration Breakpoint	0.1 >> 5	The point in percent of signal change that determines whether the actuator will accelerate at the value in parameter LA or in parameter HA. If the signal change is less than the breakpoint, the value LA is used. If greater , the value HA (Branch [CAL]) is used. Use SCROLL UP / SCROLL DOWN to adjust.



CtL - Control Parameters

SCROLL ID	NAME	VALUE	OPERATION
UP bt	Bumpless Transfer	On, OFF	Preset to Off. Upon power on or switching to the Auto mode, the actuator's position and the control signal must be within 5% for the actuator to respond. Outside of this range, an E-bt error will flash. Use SCROLL UP / SCROLL DOWN to adjust.
PC	Passcode	User Defined	When activated, access to the Setup mode is restricted by requiring entry of the correct <i>Passcode</i> . Entering any three digit numeric code becomes the current <i>passcode</i> . Deactivate by entering a code of 000.
FS	Failsafe	IP, PL, PH, OFF	Upon loss of the control signal (less than 2.5 mA), the actuator may be set to: IP Lock-In-Place, PL - move to Position Low, PH - move to Position High, or OFF override this feature (for use with 0-20 mA control signals). Use SCROLL UP / SCROLL DOWN to select.
St	Signal Type	A, P	Configures the actuator for input signal type: A - Analog (usually 4-20 mA), P - Pulse. Use SCROLL UP / SCROLL DOWN to adjust.
DOWN dt	Power Module Type	b, c, d	Configures the actuator for power module type: the letter indicates the size.



Obd - Parameters required to operate certain auxiliary boards.

SCROLL ID	NAME	VALUE	OPERATION
UP r1	Relay 1	0 >> 100	Sets Relay 1's ON point in percent of stroke. For actuator positions below the value, the relay is energized (indicator LED is illuminated). Use SCROLL UP / SCROLL DOWN to adjust.
r2	Relay 2	0 >> 100	Sets Relay 2's ON point in percent of stroke. For actuator positions above the value, the relay is energized (indicator LED is illuminated). Use SCROLL UP / SCROLL DOWN to adjust.
DOWN SG	Surge Breakpoint	10 >> 100	The percentage change in control signal to activate the surge high speed override.

APPENDIX C

Optional Features

C.1	Position Transmitter.....	p. 1
C.2	Manual Override.....	p. 3
C.2.1	Declutchable Handwheel.....	p. 3
C.2.2	Declutchable Drill Drive	p. 3
C.2.3	Geared Hand Crank	p. 4
C.3	Limit Switches.....	p. 4
C.3.1	Mechanical	p. 4
C.3.2	Electronic	p. 4
C.4	Alarm Indication.....	p. 5
C.5	Auxiliary Control.....	p. 6
C.5.1	External Control Option	p. 6
C.5.2	Remote Manual Control.....	p. 7
C.6	Advanced Control Options	p. 7
C.6.1	0.05% Deadband	p. 8
C.6.2	Minimum Control Point.....	p. 8
C.6.3	Water Hammer (two speed operation)	p. 9
C.6.4	Flow Characterization.....	p. 10

C OPTIONAL FEATURES

To complement the standard capabilities found in the Xpac, various options are available to fulfill specific applications.

C.1 Position Transmitter

This passive transmitter can be field retrofitted in less than one-half hour.

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. The passive transmitter is similar to other two-wire devices in that an external DC power source is required.

If Rexa has supplied an active transmitter, then a 24vdc power supply has been installed in the control enclosure. The supply voltage indicated on the interconnect diagrams is not required. Maximum external resistor load is 700 ohms.

Also included in the transmitter is an Alarm Relay which may be used in series with the 4-20 mA signal loop or as an independent alarm circuit. The Alarm Relay will change state (de-energize) anytime the actuator is unable to follow the applied control signal.

SPECIFICATIONS

Transmitter:

Accuracy:

Linear <0.25% of full stroke

Rotary <0.25% of 90½ rotation

Resolution: <0.1% of full stroke or 90° rotation

Maximum External Load: 1000 ohms

Power Requirements:

Minimum Supply Voltage = 10 vdc + (.02 x external load resistor)

Maximum Supply Voltage = 36 vdc + (.004 x external load resistor)

Maximum external load resistor @ nominal 24 vdc = 700 ohms

Alarm Relay:

Response: ½ second of any "fail to operate condition"

Alarm Contacts: SPDT

Rating: 1 amp @ 30 vdc, 0.3 amp @ 120 vac - resistive

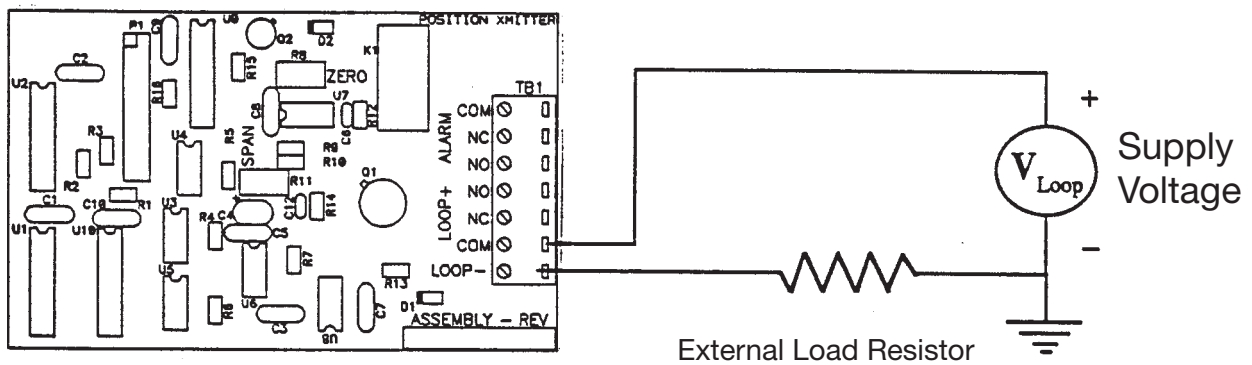
See section C.4 for details concerning the alarm relay.

CONNECTION

The position transmitter mounts to the top of the PCP. All wiring connections are made directly to this option board.

Non-Alarming Loop:

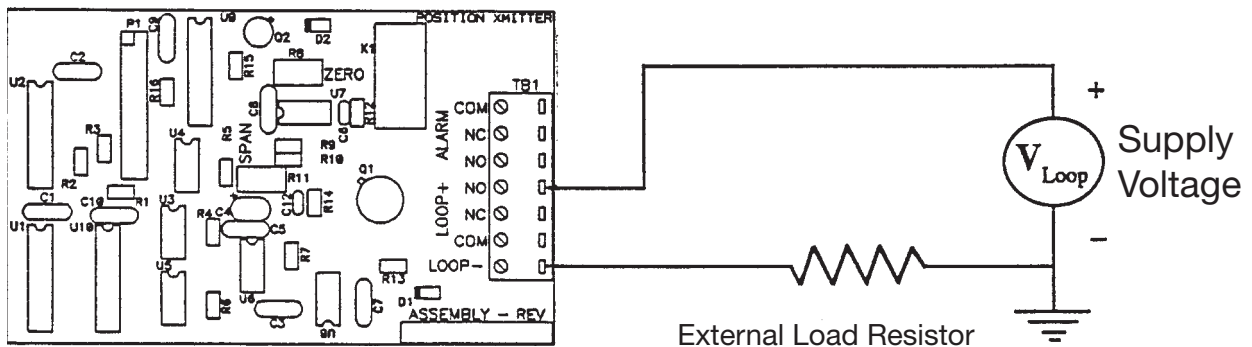
Determine the minimum and maximum supply voltage to power the external load. Insure that the actual supply voltage is between these values. Connect the negative side of the loop power to the "LOOP (-)." Complete the loop by connecting the positive side of the loop power to the "LOOP (+) COM."



Alarming Loop:

Determine the minimum and maximum supply voltage to power the external load. Insure that the actual supply voltage is between these values. Connect the negative side of the loop power to the "LOOP (-)." Complete the loop by connecting the positive side of the loop power to the "LOOP(+) NO."

The alarming loop feature can initiate failure to operate on a single two-wire pair. A 0.0 mA output will indicate a problem.



C.2 Manual Override

Operation of the spring failure inhibits movement by a manual override. Depress the button on top of the power module to manually close the solenoid. The solenoid must be in its normally open position before returning the Xpac to automatic operation. See section 4.2.3.

The **Xpac** has available three types of manual operators: Declutchable Handwheel, Declutchable Drill Drive and Geared Hand Crank. All of them make use of the actuator's hydraulic circuit. They will only function if this system is in working order. For standard actuators, 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.

Before operating any manual override, make sure that the electric power is OFF.

C.2.1 Declutchable Handwheel

The handwheel is mounted at the back of the motor on B & C size modules. To operate, push the handwheel in and turn. Since the handwheel must contact a slot on the outboard end of the motor shaft, up to one-half revolution may be required before proper engagement. The handwheel will declutch by moving outwards when released.

HANDWHEEL REVOLUTIONS

Power Module	Linear (to move one inch/1 000 lb of rated thrust)	Rotary (90° of rotation/1 000 lb-in of rated torque)
B	~75	~200
C	~25	~65

On D size Power Modules, a separate C size Power Module with a handwheel, drill drive or geared handcrank is added. See Appendix X.3.

C.2.2 Declutchable Drill Drive

The drill drive is mounted at the back of the motor on B & C size modules in place of the handwheel. To operate, connect the chuck of an appropriate drill (electric, battery or pneumatic) to the 5/16" HEX, push the drive in and turn. Since the drive must contact a slot on the outboard end of the motor shaft, up to one-half revolution may be required before proper engagement. The drive will declutch by moving outwards when released.

DRILL DRIVE REVOLUTIONS

Power Module	Linear (to move one inch/1 000 lb of rated thrust)	Rotary (90° of rotation/1 000 lb-in of rated torque)	Recommended Drill Size
B	~75	~200	.1 HP @ 500 RPM
C	~25	~65	.25 HP @ 500 RPM

C.2.3 Geared Hand Crank

The geared hand crank consists of a separate power module with a 5:1 gear reducer and crank arm replacing the motor. To operate, simply turn the crank. No clutch or engagement mechanism is required.

HAND CRANK REVOLUTIONS	
Linear (to move one inch/ 1000 lbs. of rated thrust)	Rotary (90° of rotation/ 1000 inch-lbs. of rated torque)
5	13

C.3 Limit Switches

Limit Switches provide a contact closure when an actuator or drive reaches a predetermined point in its stroke. Although the switches are typically set at the ends of stroke, most positions may be indicated. Two types are available: an independent mechanical switch or a PCP operated relay board.

C.3.1 Mechanical

The mechanical limit switches are independent devices and will provide a limit indication regardless of the electric power status of the unit. Up to four switches may be installed. On linear actuators, they are GO style proximity switches mounted to the yoke legs.

On rotary actuators or drives, four switches are also available. However, the first two are microswitches installed in the feedback housing, while additional switches are GO style mounted adjacent to the feedback housing.

For complete details, refer to Appendix E.

C.3.2 Electronic

The electronic limit switches utilize an auxiliary circuit board with three relays. All wiring connections are made directly to this board. 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 (K3) is an alarm indicator. This relay will change state (de-energize) anytime the actuator is unable to follow the applied control signal.

See section C.4 for details concerning the alarm relay.

GENERAL SPECIFICATION

Quantity: 2
 Type: Single Pole, Double Throw (SPDT)
 Rating: 1 amp @ 30 vdc, 0.3 amp @ 120 vac
 - resistive
 Differential Travel (Hysteresis): 0.1%
 Connection: terminal strip on the auxiliary board

CONNECTION

The electronic limit switch board mounts to the top of the PCP. All wiring connections are made directly to this auxiliary board. The common terminal and either the normally open or normally closed connection may be used.

A value for r1 less than r2 will simulate the normal operation of mechanical limit switches.

RELAY 1



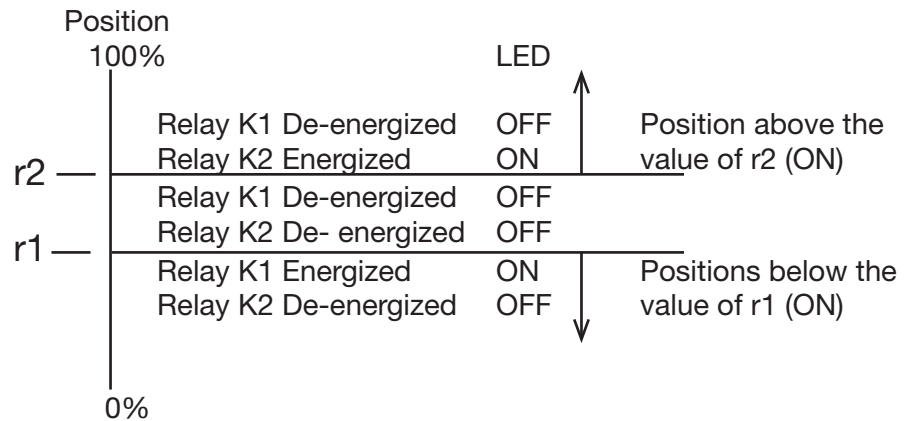
RELAY 2



Connections to the electronic limit switches used in an FM approved class I, DIV. 2, Groups A, B, C & D actuator must conform to document E 91001 in Appendix D.

OPERATION

The Relay auxiliary board is used in conjunction with the Option Board Sub-Menu (OBd). The activation point of each relay, in percent of calibrated stroke, is specified by the corresponding menu entry, r1 for relay K1, and r2 for relay K2. For relay K1, r1 specifies the actuator position below which K1 is energized. For K2, r2 specifies the actuator position above which K2 is energized. The following chart illustrates the relay states as a function of actuator position and the relative values of r1 and r2. K1 and K2 are operational in any mode, *Auto*, *LOCAL* or *SEtUP*. A red LED is illuminated when the relay is energized (ON).



C.4 Alarm Indication

The position transmitter and limit switch auxiliary boards contain an alarm relay. If the actuator is unable to follow the applied control signal, this relay will change state (de-energize). This includes error codes (see Section 8), placing the actuator in LOCAL or SEtUP and loss of power.

The relay on the position transmitter board may be wired in series with the transmitter. In this mode, an alarm would be indicated without an additional pair of wires. The transmitter output would drop to 0.0 mA to indicate an alarm.

Connections to the alarm relay in an FM approved Class I, DIV. 2 Groups A, B, C & D actuator must conform to documents E91001 and E91002 in Appendix D.

On the limit switch, a red LED indicates the status of the alarm relay. The PCP immediately energizes the relay upon the application of electric power. If the LED is illuminated, it indicates that the unit is in the *Auto* mode and responding to the applied control signal.

SPECIFICATION

Response: 1/2 second of any "fail to operate" condition.
Type: Single Pole, Double Throw (SPDT)
Rating: 1 amp @ 30 vdc; 0.3 amp @ 120 vac - resistive

CONNECTION

For the position transmitter option board with two-wire alarming loop, refer to section C.1 for connection.

All wiring connections are made directly to the auxiliary board mounted to the top of the PCP. The common terminal and either the normally open or normally closed connection may be used.

C.5 Auxiliary Control

Configuration and local operation of the actuator is accomplished by means of the three button keypad which is located on the PCP. Manual operation without access to the Control Enclosure is provided by either the external or remote option.

C.5.1 External Control Option

The indicator plates on the push-buttons may be reversed by unscrewing the outside retaining ring.

Installed in the cover of the Control Enclosure, the external control option consists of a window to view the LED position display, a two position rotary switch and two pushbutton switches. The rotary switch can place the actuator in manual or automatic mode. The two push-buttons are normally open, push to operate switches. One will extend (CCW) and the other retract (CW) the unit. Motion will only continue as long as either button is depressed.

On actuators equipped with an alarm relay (see section C.4), the relay will indicate that the actuator is not available to follow the control signal. If the bumpless transfer is set to ON ([CtL:bt]=ON), then the actuator's position and control signal must be within 5% before automatic control is resumed (see section 6.3.3).



C.5.2 Remote Manual Control

The actuator may be equipped to connect to a remotely located manual station. Operation of this option requires a two position switch (Auto/Manual) and two (normally open) push-button switches, extend (CCW) and retract (CW). Power for the switches is supplied by the Control Enclosure. Actual position is available through the position transmitter.

The user may provide the manual station, or two types of NEMA 4 manual stations are available from REXA:

- BB: Material: Fiberglass
 - one Remote/Auto switch, two position
 - one Open switch, Momentary, Push to operate
 - one Close switch, Momentary, Push to operate
 - Connection: Terminal strip
- Dx: Material: Fiberglass
 - one Remote/Auto switch, two position
 - one Open switch, Momentary, Push to operate
 - one Close switch, Momentary, Push to operate
 - Position indicator, 0-100%, includes Active Position Transmitter within the Control Enclosure
 - Connection: Terminal strip

On actuators equipped with an alarm relay (see section C.4), the relay will indicate that the actuator is not available to follow the control signal. If the bumpless transfer is set to ON ([CtL:bt]=ON), then the actuator's position and control signal must be within 5% before automatic control is resumed (see section 6.3.3).

C.6 Advanced Control Options

Four additional features are available within the SETUP mode to augment actuator operations. They are 0.05% deadband, minimum control point, water hammer (two speed), and flow characterization. On certain applications, these features can improve performance and increase valve life.

C.6.1 0.05% Deadband

The 0.05% deadband option will double the standard precision and provide resolution within one half the thickness of a piece of paper on a 2 inch rated stroke. The control of an Xpac actuator with this setting is remarkable. The positioning is smooth and continuous without resolution hop. Deadband (db) is set in the normal manner per Section 6.3.1. The minimum allowable setting is now 0.05%.

There are two potential problems, noise and oscillation, involved in such installations. Noise on the control and feedback signals may be interpreted as real values. Isolated signal lines, shielded cables and proper grounding are typical requirements for fine control.

Actuator oscillation around the control point will more easily occur at low deadband settings. The acceleration of the actuator can be adjusted to prevent continuous overshoot of position. A low acceleration rate can be set for a small change in control signal, while a much higher rate may be set for larger changes (see section 6.3.2).

C.6.2 Minimum Control Point

Most specialized anti-cavitation or low noise valves reduce the fluid energy by staged pressure reduction within a labyrinth cage. These designs are only effective if there is sufficient fluid flow through the resistive element. At plug lifts below a minimum control point, pressure reduction will occur between the plug and seat ring which may damage the valve.

The Minimum Control Point feature allows the setting of a point below which the actuator will not modulate. Any control signal that specifies a position below the minimum control point will result in the actuator moving to the fully closed position. Normal operation of the actuator will occur for control signals specifying a position above this point.

CpT - CONTROL POINT SUB-MENU

Before establishing a minimum control point, the stroke of the actuator must be set by entering *Position Low* (PL) and *Position High* (PH) in the Cal Sub-Menu.

If the value of PL or PH is changed, the minimum control point must be reset.

CONTROL POINT



Step over to the CpT Sub-Menu, and then step down to the *Control Point* parameter, CP. Using the Scroll Up/ Scroll Down keys, position the actuator to the desired point and press (E)NTER. The displayed value is the Minimum Control Point in percent of stroke.

For linear operation ([FCH:FC] = OFF), the control signal corresponding to this point is the sum of the value of *Signal Low* and

the product of the signal span (*Signal High - Signal Low*) and this percent of stroke.

$$CS_{Cpt} = SL + (SH - SL) \times \frac{CP}{100}$$

C.6.3 Water Hammer (two speed operation)

The phenomenon known as “Water Hammer” will occur in a pipeline when the flow of a liquid is suddenly stopped. A pressure pulse (exceeding the static process pressure) will propagate upstream from the blocking point. Considerable damage to piping and equipment may result. The magnitude of the pulse will depend upon the initial fluid velocity, the rapidity of the fluid stopping, the piping configuration and the fluid density.

Many applications may benefit from reduced speed near the seat.

The rapid closing of a control valve is a common cause of Water Hammer. During normal control it is often desirable for a control valve to behave in a quick responsive manner. As the valve is closed, this type of motion will rapidly stop the fluid flow and may cause damaging pulsations. The **REXA** two-speed operation allows the actuator to reduce speed as the valve plug nears its seat. The normal speed, the reduced speed near the seat and the point to change from reduced to normal speed can all be configured to meet a particular application.

LOW SPEED



The value for Low Speed may not be set above the value for High Speed. If low speed is not in use, its value should be set to 5%.

SPd - TWO SPEED SUB-MENU

Low Speed (LS) specifies the velocity, in percent of maximum speed, which the actuator will move at positions less than the value set in the *Speed Breakpoint (Sb)*. Whenever the current position exceeds the *Speed Breakpoint*, the value set in *High Speed (HS)* will be used. Setting *Low Speed* equal to *High Speed* will disable this feature.

Low Speed may be set to any value between 5% and the value set in *High Speed*. Full actuator output is achieved for speed settings between 40% and 100% at normal operating temperatures (-20°F to 160°F). Speeds outside of this range will result in reduced actuator output. As a reminder, any value set in *Low Speed* that is less than 40% or greater than 100% will cause the numeric characters to blink.

SPEED BREAKPOINT



Speed Breakpoint (Sb) specifies the transition point, in percent of stroke, from *Low Speed* to *High Speed*. Operation of the actuator at strokes below the *Speed Breakpoint* will be at the *Low Speed* setting. Operation of the actuator at strokes above the *Speed Breakpoint* will be at the *High Speed* setting. The actuator will accelerate and de-accelerate, as appropriate, when the motion causes the actual position to cross the *Speed Breakpoint*.

Speed Breakpoint may be set to any value between 0.0% and 100%. Setting *Speed Breakpoint* to 0.0% will cause the actuator to always use the value set in *High Speed*. Setting *Speed Breakpoint* to 100% will cause the actuator to always use the value set in *Low Speed*.

C.6.4 Flow Characterization

The **Xpac** is designed to have an inherent linear relationship between Control Signal and stroke (10% CS, 10% stroke, etc.) The ability to modify this characteristic can assist in loop tuning or linearizing a control scheme. Changing the **Xpac**'s characteristic can have a profound effect on the behavior of the control loop and should only be undertaken with a thorough understanding of the effect.

An 11 point, 10 line segment characterization provides the ability to simulate most common control curves or to linearize the actuator to within .05%. 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.

FLOW CHARACTERISTICS



C.S. 10% POINT



C.S. 20% POINT



C.S. 90% POINT



FCH - FLOW CHARACTERISTIC SUB-MENU

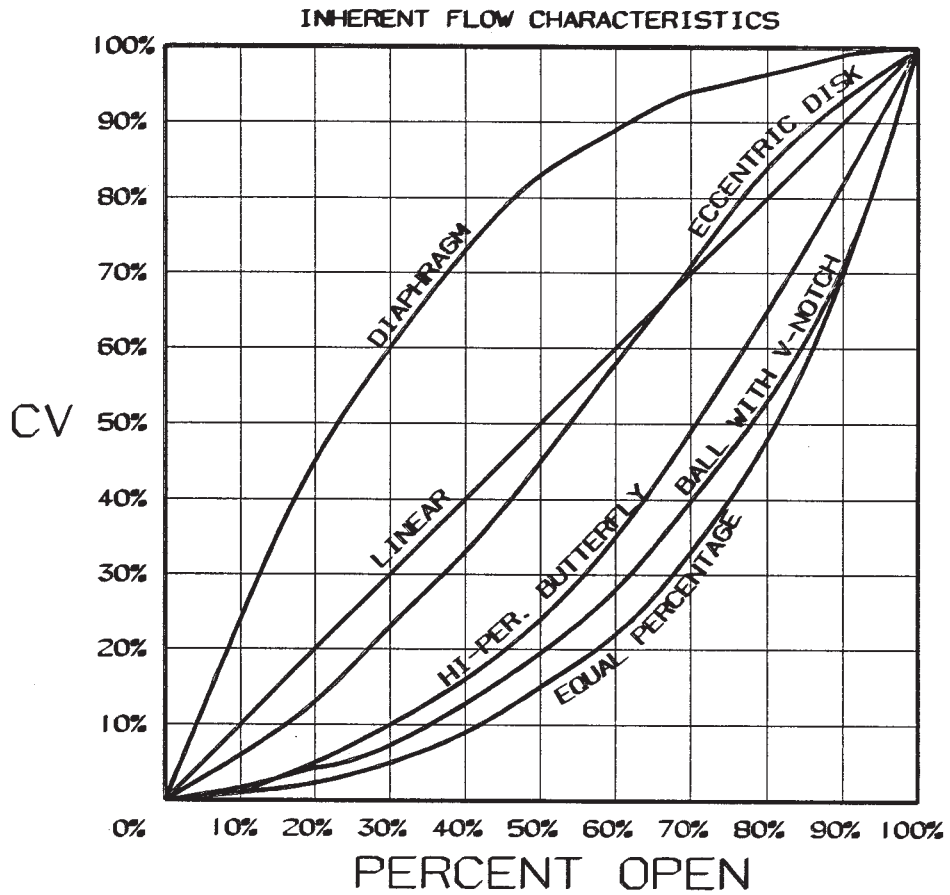
Flow Characteristic (FC) activates the characterization scheme. If this parameter is ON, then the position values in parameters C1 . . . C9 are followed. If this parameter is OFF, then the inherent linear curve is followed.

C1 through C9 denotes the actuator's position at 10% control signal (CS) intervals. C1 is the actuator's position at 10% CS, C2 is the actuator's position at 20% CS, C9 is the actuator's position at 90% CS. The endpoints are still defined by the values of *Position Low* (PL) and *Position High* (PH) in the CAL sub-menu.

TUNING

Before any attempt at modifying the flow characteristic is made, both a graphical representation and table of the values should be developed. Figure C.A shows typical inherent flow characteristics for the major valve styles and a table to convert these curves into inherent linear characteristics.

Figure C.A



C9 90%	97	97	95	87	64
C8 80%	94	93	90	77	48
C7 70%	90	89	84	68	38
C6 60%	86	84	78	61	30
C5 50%	81	78	71	54	22
C4 40%	75	70	64	46	18
C3 30%	67	62	55	37	13
C2 20%	57	51	44	27	8
C1 10%	42	34	30	15	4
CONTROL SIGNAL	EQUAL PERCENTAGE	BALL V-NOTCH	HI-PER. BUTTERFLY	ECCENTRIC DISK	DIAPHRAGM

INHERENT LINEAR CHARACTERIZATION OF TYPICAL VALVES

APPENDIX D

**Canadian Standards Association (CSA) Approved for Hazardous Area
Class I, Division 2, Groups A, B, C & D
and
Class I, Division 1, Groups B, C & D**

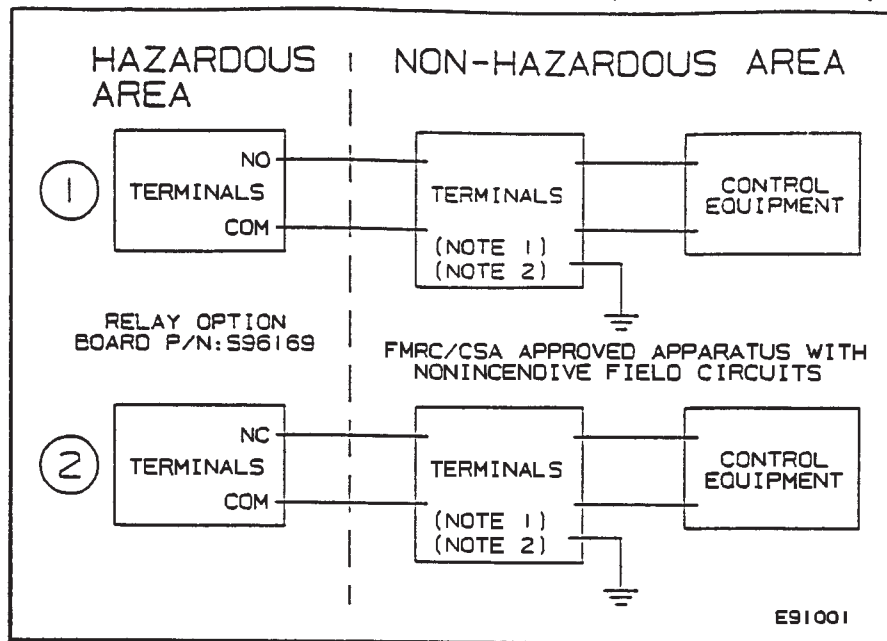
**D. CANADIAN STANDARD ASSOCIATION
(CSA) APPROVED
FOR
HAZARDOUS AREA
Class 1, Division 2, Groups A, B, C & D**

Factory Mutual requires adherence to the information contained in this appendix in order to maintain approval.

- I. A dedicated grounding conductor to the actuator grounding lug must be installed in accordance with article 250 of the National Electrical code and CEC.
- II. NEC or CEC listed hubs suitable for the intended location must be installed.
- III. Wiring of Connecting Cables must be performed in accordance with NEC and CEC, "Wiring Methods for Class I Divisions 2 locations."
- IV. Replacement parts must be supplied by KOSO AMERICA. Installation procedures and final testing must be in accordance with KOSO AMERICA's recommended practices.
- V. Wiring to the optional relay/alarm board (see electronic limit switches/alarm, Section C) must be in accordance to Drawing E91001.
- VI. Wiring to the optional position transmitter board (Section C) must be in accordance to Drawing E91002.

**ADDENDUM TO SUPPLEMENT REXA PRODUCTS
RELAY OPTION BOARD FOR USE IN HAZARDOUS LOCATIONS.
DOCUMENT NO. E91001**

This assembly is approved for use in a
HAZARDOUS (CLASSIFIED) LOCATION: Class 1, Division 2, Groups A,B,C & D



**Figure 1. For use with relays where Normally Open contacts are needed.
Figure 2. For use with relays where Normally Closed contacts are needed.**

The Relay Option Board consists of three (3) NC-NO-COM relays. Each relay connection shall be used as specified in this document.

NOTES

- For United States Installations, energy is to be limited by a CSA Approved apparatus with non-incendive field circuits. V_{oc} or V_t of the apparatus shall not exceed V_{max} of the Relay Option Board. I_{sc} or I_t of the apparatus shall not exceed I_{max} of the Relay Option Board. C_i of the Relay Option Board plus cable capacitance shall not exceed C_a of the Apparatus. L_i of Relay Option Board plus cable inductance shall not exceed L_a of the apparatus. Nonincendive field wiring parameters for Relay Option Board are as follows:

$$\begin{array}{lll} V_{max} = 30 & V_{dc} & C_i = 0 \mu F \\ I_{max} = 100 & mA & L_i = 0 \text{ mH} \end{array}$$

- For Canadian installations, energy to the hazardous location is to be limited by CSA certified apparatus with output parameters of 30 volts, maximum and 300 ohms, minimum.
- Install per the National Electrical Code (ANSI/NFPA 70) or Canadian Electrical Code, as applicable.
- Manufacturer's installation drawing for apparatus with nonincendive field circuits must be followed when installing this equipment.
- No revision to drawing without prior CSA Approval.

V_{oc} - The maximum open-circuit voltage.
 I_{sc} - The maximum short-circuit current.
 C_a - The maximum allowable connected capacitance.
 L_a - The maximum allowable connect inductance.

V_{max} - The maximum voltage the equipment can receive.
 I_{max} - The maximum current the equipment can receive.
 C_i - The maximum unprotected internal capacitance.
 L_i - The maximum unprotected internal inductance.

ADDENDUM TO SUPPLEMENT REXA PRODUCTS LOOP POWERED POSITION TRANSMITTER WITH ALARM RELAY FOR USE IN HAZARDOUS LOCATIONS.

DOCUMENT NO. E91002

This assembly is approved for use in a
HAZARDOUS (CLASSIFIED) LOCATION:

Class 1, Division 2, Groups A, B, C & D

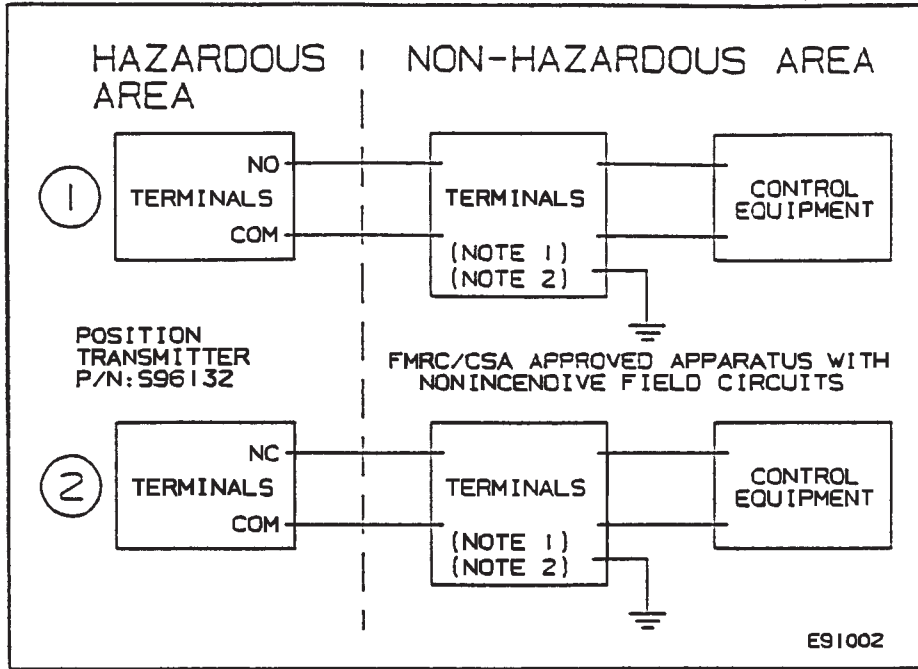


Figure 1. For use with the Alarm Relay or Loop where Normally Open contacts are needed.
Figure 2. For use with the Alarm Relay where Normally Closed contacts are needed.

The Position Transmitter incorporates a NO Alarming Loop and a NC-NO Alarm Relay on the board. The relay connections shall be used as specified in this document. The Non-Alarming loop voltage to power the Position Transmitter is not to exceed 30 Vdc.

NOTES

1. For United States Installations, energy is to be limited by a CSA Approved apparatus with non-incendive field circuits. Voc or Vt of the apparatus shall not exceed Vmax of the Relay Option Board. Isc or It of the apparatus shall not exceed Imax of the Relay Option Board. Ci of the Relay Option Board plus cable capacitance shall not exceed Ca of the Apparatus. Li of Relay Option Board plus cable inductance shall not exceed La of the apparatus. Nonincendive field wiring parameters for Relay Option Board are as follows:

Vmax = 30	Vdc	Ci = 0 μF
Imax = 100	mA	Li = 0 mH

2. For Canadian installations, energy to the hazardous location is to be limited by CSA certified apparatus with output parameters of 30 volts, maximum and 300 ohms, minimum.
3. Install per the National Electrical Code (ANSI/NFPA 70) or Canadian Electrical Code, as applicable.
4. Manufacturer's installation drawing for apparatus with nonincendive field circuits must be followed when installing this equipment.
5. No revision to drawing without prior CSA Approval.

Voc - The maximum open-circuit voltage.
 Isc - The maximum short-circuit current.
 Ca - The maximum allowable connected capacitance.
 La - The maximum allowable connect inductance.

Vmax - The maximum voltage the equipment can receive.
 Imax - The maximum current the equipment can receive.
 Ci - The maximum unprotected internal capacitance.
 Li - The maximum unprotected internal inductance.

**CANADIAN STANDARDS ASSOCIATION
(CSA) APPROVED
FOR
HAZARDOUS AREA
Class 1, Division 1, Groups B, C & D**

Factory Mutual requires adherence to the information contained in this appendix in order to maintain approval.

- I. A dedicated grounding conductor to the actuator grounding lug must be installed in accordance with article 250 of the National Electrical code and CEC code.
- II. NEC or CEC listed hubs suitable for the intended location must be installed.
- III. Wiring of Connecting Cables must be performed in accordance with NEC and CEC, "Wiring Methods for Class I Divisions 1 locations."
- IV. Replacement parts must be supplied by KOSO AMERICA. Installation procedures and final testing must be in accordance with KOSO AMERICA's recommended practices.
- V. Use wiring rated at least 75° C.
- VI. Feedback system uses approved intrinsic safety barriers located in the electronic enclosures.

APPENDIX E

Mechanical Limit Switches



E. MECHANICAL LIMIT SWITCHES

For heavy or inductive loads, arc suppression devices such as resistors and capacitors are recommended in order to extend contact life.

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

E.1 General Specifications

Linear

Quantity: 2 or 4

Manufacturer: General Equipment Go Switch

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): $\frac{5}{16}$ "

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

Connection: $\frac{1}{2}$ "-14 NPT, screw terminals

Rotary

Quantity: 2 only, or 2 of 4

Manufacturer: Proximity Controls

Type: Single Pole, Double Throw (SPDT)

Rating: 10 amp @ 24 vdc, 0.5 amp @ 125
vdc, 10 amp @ 110 vac - resistive

Differential Travel (Hysteresis): $5\frac{1}{2}$ "

Environmental: NEMA 4X, FM CL.I, DIV.1,
GRP. A, B, C & D (optional).

Connection: Within the feedback housing ($\frac{1}{2}$ "
NPT) screw terminals

Quantity: remaining 2 of 4

Manufacturer: General Equipment Go Switch

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): $\frac{5}{16}$ "

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

Connection: $\frac{1}{2}$ "-14 NPT, Screw Terminals

E.2 Wiring

E.2.1 Go Switches

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.

E.2.2 Proximity Controls Switch

Remove the cover by unscrewing. 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. The cable should be grounded in accordance with Local and National Electrical Code. Make sure that the O-ring gasket is in place and tightly seal the cavity.

E.3 Adjustment

E.3.1 Go Switches

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

E.3.2 Proximity Controls Switch

Remove the cover by unscrewing. Take care to keep threads clean and free from damage. For fine adjustment, the long set screws can be turned in to delay and shorten the signal or turned out to advance and lengthen the signal. For major adjustment, the entire cam can be relocated by loosening the short set screw and repositioned. Make sure that the O-ring gasket is in place and tightly seal the cavity.

APPENDIX F

Seat Loading Cylinder

F. SEAT LOADING CYLINDER

Linear actuators which must come up against a hard stop (valve seat) use a spring loaded element between the actuator and valve stems. This elastic coupling provides a controlled loading of the seat 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.

On larger size units (thrusts of 40,000 lbs or greater), the forces are too large to use a mechanical elastic coupling. Instead, a smaller Seat Loading Cylinder (SLC) with an extend spring applying force to its shaft is hydraulically connected to the main cylinder. The spring is precompressed to a load equivalent to 80% of the nominal working pressure. Hydraulic fluid will not begin entering the SLC until the pressure in the main cylinder rises above this value. This will typically only occur on the valve seat. As the pressure builds within the cylinders, oil flows into the SLC and retracts the shaft. When the spring is compressed to the full nominal working pressure, the power module will shut off. The rated actuator output is now applied to the driven device and retained within the cylinders by the Flow Matching Valves.

F.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.

F.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.

F.2.1 Enclosure Termination

The red wire, +15 VDC, and black wire, Feedback (-), are connected to the same terminals as for the main cylinder feedback cable. These wiring instructions can be found in Section 5.2 for the C or 2C Power Modules or Appendix X 2.3.1 for the D or 2D Power Modules. The white wire, Feedback (+), is connected to a screw terminal, P3-6, marked as "SLC Feedback (+).

The feedback cable of the Seat Loading Cylinder is in addition to the feedback cable for the main cylinder (Section 5.2). The two feedback cables may be run within the same conduit.

F.2.2 Seat Loading Cylinder Termination

For best noise immunity, the feedback ground wire should be kept as short as is practical within the control enclosure. Do not terminate the ground wire at the actuator. See section 7.2 for details.

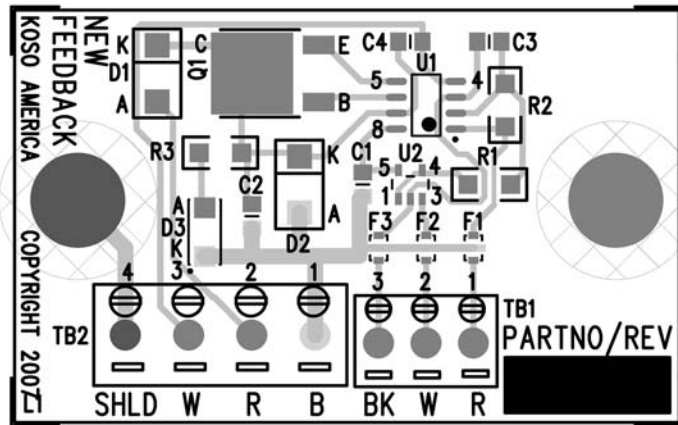
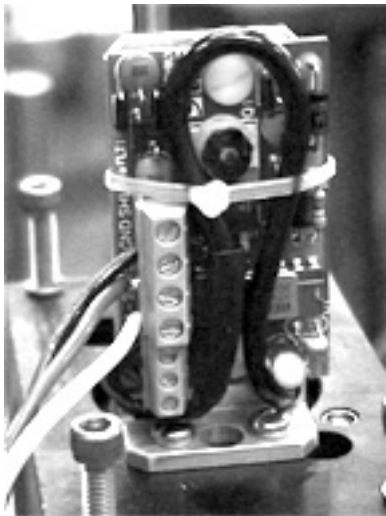
The feedback connection is made directly to the screw terminals on the feedback printed circuit board. Remove the four cap screws that hold the upper cover. Carefully lift the cover in the direction away from the cylinder until it clears the internal components. Feed the cable through the ½ inch NPT opening. Wiring connection is made directly to the feedback printed circuit board per figure F.A. Replace the cover on the cylinder and securely fasten.

Figure F.A SLC Feedback Board

SLC— ½ inch NPT on cylinder (Screw Termination)

signal name	wire colors	terminal
+15VDC	Red	R
Feedback (+)	White	W
Feedback (-)	Black	B

Do not terminate ground wire at the actuator



F.3 Calibration

Operation (Section 6) 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 (Section 4.2.1), the spring on the SLC is compressed until the indicator on the side is at the seated point.

APPENDIX G

Accumulator Failure

- G.1 Description of Operation
- G.2 Handwheel Operation
- G.3 Oil Filling and Level Check
- G.4 Nitrogen Filling & De-Pressurizing Instructions

Wiring Drawing

D97189 Rev1 p. G-5

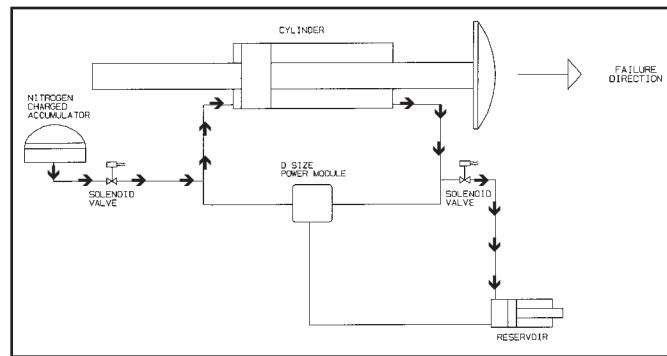
G. ACCUMULATOR FAILURE

G.1 Description of Operation

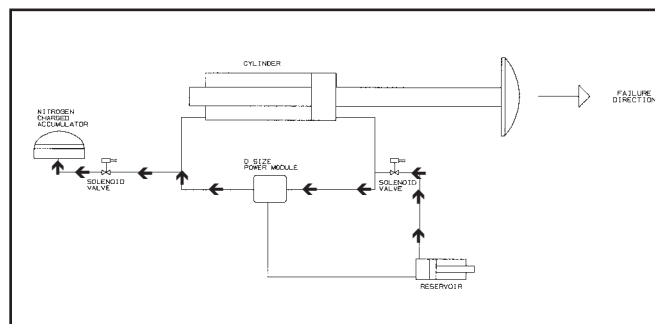
G.1.1 OPERATION

System operation is based on a piston type accumulator with nitrogen gas on one side of the piston and oil on the other. The accumulator is sized to provide a minimum of 2000-PSI oil pressure to the cylinder during failure, thus insuring that the actuator will always produce its rated output.

Upon loss of electric power or receipt of a trip signal, two solenoid valves open simultaneously, one allowing oil under pressure from the accumulator to enter the failure side of the actuator and the other allowing the oil displaced from the opposite side of the actuator into a holding reservoir (auxiliary cylinder).



When the trip signal ends or power is restored, a pressure transducer signals the PCP of low pressure in the accumulator. This signal tells the PCP to open both solenoids and run the power module in the direction required to drive the actuator in the fail direction. As the actuator is already at the end of travel in the fail position, oil will be drawn from the reservoir and pumped into the accumulator. When the proper recharge pressure is reached, the PCP stops the power module and closes the solenoid valves. Normal operation is now resumed.



These four parameters are factory set. Do not change without consulting REXA.

G.1.2 ADDED FUNCTIONALITY TO THE ELECTRONICS

Four new parameters have been added to the PCP to accommodate accumulator functions. These may be found under the **Obd** branch:

1&2. Parameters **rH** & **rl**. These are the reference pressure settings that the PCP compares to the output of the pressure transducer. **rH** is the high or limit pressure of the recharge cycle. **rl** is the minimum pressure allowed before a recharge cycle is performed. These parameters can be set in 100 psi increments.

3. Parameter, **Rt**, recharge time, allows the setting of the maximum time allowed for a recharge cycle. **Rt** is displayed as an integer with a settable range of 10 to 1000, in ten second steps, and represents the number of seconds allowed for a recharge cycle. A recharge cycle ends when either the pressure transducer output equals **rH** or the recharge time expires. In either case, the actuator resumes tracking the control signal.

4. Parameter **Fd** defines Fail direction. Fail direction is the direction the Accumulator will drive the actuator on an Accumulator trip condition. **Fd** has two settings, **PI** or **PH**. If the accumulator is configured to drive the unit toward **PI** on a trip condition, the **Fd** should be set to **PI**. Likewise, if the accumulator is configured to drive the unit toward **PH** on a trip condition, then **Fd** should be set to **PH**. This parameter is typically factory set.

Changing this parameter does not change the actual fail direction of the actuator. As with a spring fail unit, failure direction (extend, retract, CW, CCW) is a mechanical configuration. The correct failure direction must be specified when the unit is ordered.

The trip signal may be a 24 – 120 volts AC or DC input

The contact input (P1&P3) provides a trip signal input. When the trip signal is active, the PCP will de-energize the solenoids connected to the surge board, allowing the accumulator to drive the actuator to its fail position. The “trip” function operates without the aid of the motor. Loss of electrical power will also initiate a failure.

A second input to the PCP is provided by the 4-20 mA output of the pressure transducer on the accumulator. When the accumulator is fully charged, accumulator pressure will be equal to the **rH** set point. After a trip (or multiple partial trips) , accumulator pressure will fall below the **rl** parameter set point , indicating to the PCP the need to recharge the accumulator.

Relay K3 on the limit switch board will only indicate low accumulator pressure. All other alarm functions are available at the alarm relay on the position transmitter board.

If accumulator pressure should fall below **rl** during normal operation, relay K3 (alarm) will be de-energized. In this condition, the rated output of the actuator may not be available upon a failure.



G.1.3 RECHARGING

The recharge cycle will only occur if:

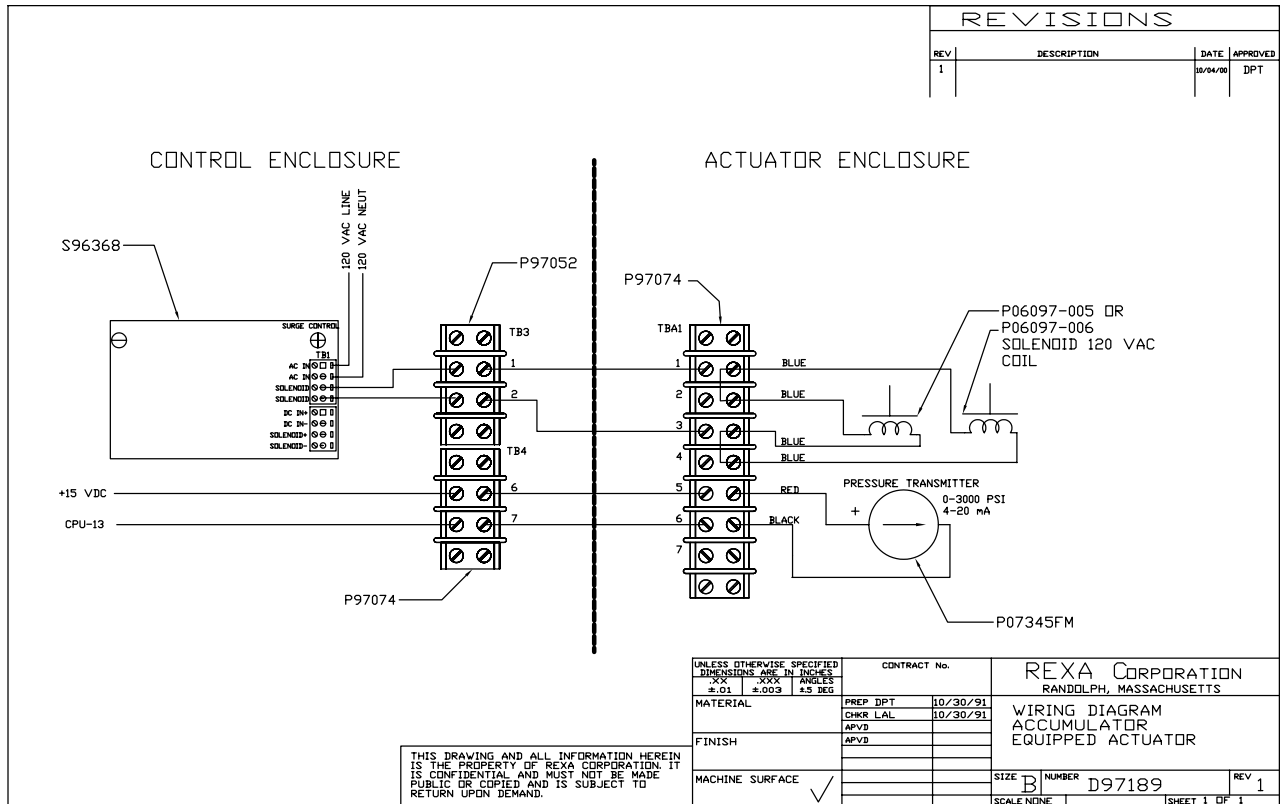
For normal operation, the accumulator does not require the addition of oil.

1. The PCP is in the **Auto** mode,
2. The pressure transducer output is less than **rl**
- 3a. Power is restored after a loss
or
- 3b. Trip signal is removed
or
- 3c. The PCP reset button (located in the upper left corner of the board) is pushed.

Recharging the accumulator is accomplished by running the motor in the trip direction (with the solenoids open), pulling oil out of the auxiliary cylinder and pumping it into the accumulator. When the transducer output equals **rH**, the motor is stopped and the solenoids are closed. The actuator will then begin tracking the normal control signal.

Note:

The actuator is 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 normally, but the accumulator will remain uncharged, rendering the actuator incapable of performing a trip or failure.*



G.2 HANDWHEEL OPERATION

Accumulator actuators are equipped with solenoid manual override levers. This feature enables use of the handwheel with electrical power off or in trip mode. Units are shipped from the factory with the solenoid override levers safety wired in the open position (see figure G1). *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 the closed position (see figure G2) .

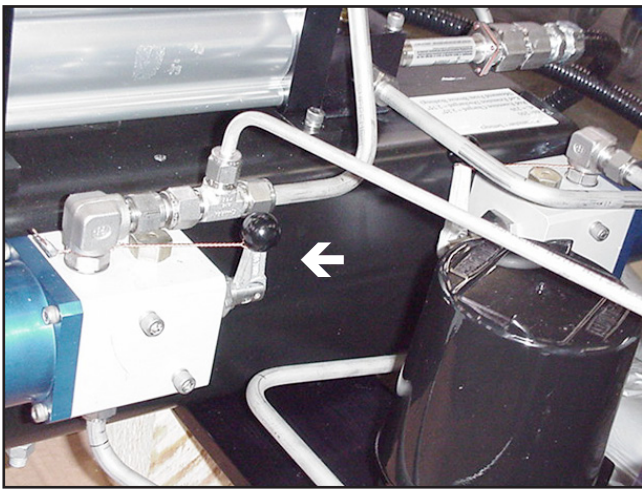


Figure G1
Solenoid override lever wired in the open position.

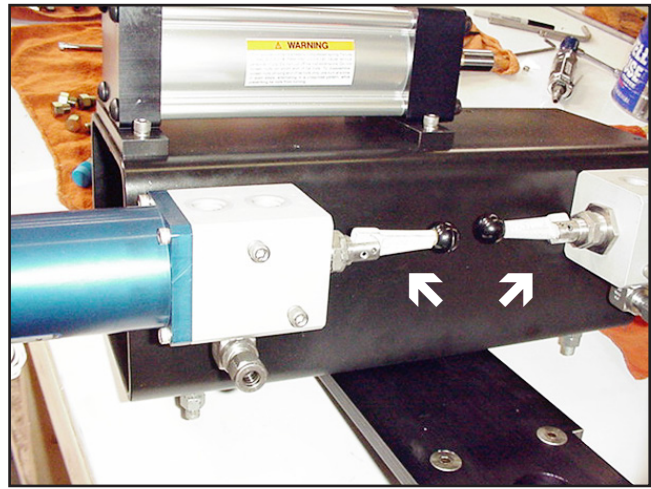


Figure G2
Both solenoids with override levers in the closed position for handwheel use.

Once both overrides are closed, the handwheel may be operated in a normal manner. 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 the open position. It is recommended that both override levers be safety wired in the open position when the handwheel is not in use.

WARNING!

AFTER USING THE HANDWHEEL, THE OVERRIDES MUST BE RETURNED TO THEIR OPEN POSITION (FIGURE 1) 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.

G.3 OIL FILLING AND LEVEL CHECK

G.3.1 OIL LEVEL CHECK

It is necessary to check the level after a recharge cycle as the unit may perform several partial stroke failures that will cause the rod to protrude beyond the normal (fully re-charged) position. *In normal service this unit should not require any additional oil.*

At the end of the accumulator reservoir is an oil indicator rod. After the unit has performed a recharge cycle, the auxiliary cylinder rod should protrude beyond the bronze bushing (see figure G3) with the unit at 68-70°F (21°C) according to the following:

R2500	1.6 in ± .1 in (53 mm ± 2 mm)
R5000	2.1 in ± .1 in (40 mm ± 2 mm)
R50000	3.7 in ± .1 in (94 mm ± 2 mm)
R200000	2.7 in ± .1 in (68 mm ± 2 mm)
L10000 (6 in stroke)	2.7 in ± .1 in (68 mm ± 2 mm)

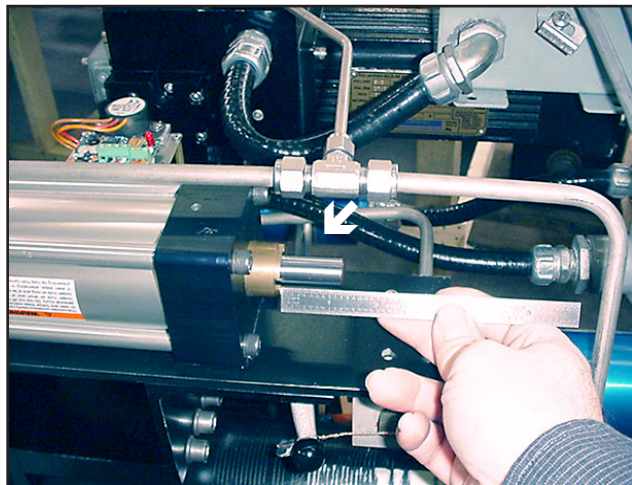


Figure G3

Measuring auxiliary cylinder rod protrusion

G.3.2 OIL FILLING

After repair or maintenance, *with the accumulator pre-charged and the unit in the failed position*, perform the following steps:

1. Loosen the tube fitting at the connection to the accumulator.
2. Fill and purge the unit in the normal manner until clear oil (no bubbles) drains out of the loosened fitting.
3. Tighten the fitting.

4. Loosen the tube fitting where it attaches to the auxiliary cylinder.
5. Continue filling and purging until clear oil drains out of the loosened fitting.
6. Tighten the loose fitting.
7. Continue adding oil until the auxiliary cylinder rod extends to the relevant dimension stated in section G.3.1, Oil Level Check.
8. Allow the unit to perform a recharge cycle (G.1.3) and check oil level.

G.4 NITROGEN FILLING & DEPRESSURIZING



CAUTION!

THE ACCUMULATOR CONTAINS HIGH PRESSURE NITROGEN GAS. FAILURE TO PROPERLY FOLLOW PROCEDURES MAY RESULT IN PERSONAL INJURY AND/OR DAMAGE TO EQUIPMENT.

REXA accumulators are shipped pre-charged from the factory. During normal use the accumulator should not require additional charging with nitrogen. If the accumulator pre-charge is suspected of being low or lost, the accumulator will need servicing or overhaul in order to determine the source of nitrogen loss. *REXA highly recommends returning the accumulator to the factory for service, overhaul and recharging due to the specialized skills and equipment required for these operations.*

G.4.1 ACCUMULATOR CHARGING INSTRUCTIONS

1. Remove gas valve guard and gas valve cap.
2. Back gas chuck "T" handle all the way out (counter clockwise) before attaching charging assembly to accumulator gas valve.
3. Close bleed valve.
4. Making sure not to loop or twist the hose, attach swivel nut to gas valve and tighten (10-15 in-lbs)
5. Turn gas chuck "T" handle all the way down (clockwise). This will depress core in gas valve.
6. Crack open nitrogen bottle valve and *slowly* fill accumulator. Shut off when gauge indicates 2000 psi.
7. Let the pre-charge set for 10 to 15 minutes. This will allow the gas temperature to stabilize. If the desired pre-charge is exceeded, close nitrogen bottle valve, then slowly open bleed valve. *Do not reduce pre-charge by depressing accumulator valve core with a foreign object!*
8. When finished charging accumulator, turn "T" handle all the way out on gas chuck then open bleed valve.
9. Hold gas valve to keep from turning, loosen swivel nut and remove assembly.
10. Replace gas valve cap (10-15 in-lb) and gas valve guard. Gas valve cap serves as a secondary seal.

G.4.2 ACCUMULATOR DEPRESSURIZATION INSTRUCTIONS

1. Remove gas valve guard and gas valve cap.
2. Back gas chuck "T" handle all the way out (counter clockwise) before attaching charging assembly to accumulator gas valve.
3. Close bleed valve.
4. Attach charging assembly to accumulator gas valve.
5. Turn gas chuck "T" handle all the way down (clockwise). This will depress core in gas valve.
6. Crack open bleed valve and *slowly* empty accumulator. Shut off when gauge indicates 0 psi. *Do not attempt to empty accumulator by depressing accumulator valve core with a foreign object!*
7. Remove charging assembly and replace gas valve cap and gas valve guard.

APPENDIX H

Booster Pump Configuration

BOOSTER PUMP CONFIGURATION

Introduction

Our philosophy of precise positioning, actuator mounted components, minimum power consumption and reduced maintenance directed product design to smaller size (1.5 horsepower) power modules. As users became more familiar with our capabilities, a need for larger pumping systems became evident. Although larger pumps were available, such capacity and speed would limit our fine positioning.

To solve this dilemma, REXA developed a dual pump operation, which utilizes a standard **Xpac** power module and a large capacity “Booster Pump”. The power module provides fine positioning, while a volume booster pump provides the speed. Duty cycle for the booster pump is low because it is only needed for gross position changes. Only the power module operates for small changes in position. This dual pump operation allows REXA to extend its unique capabilities to very high thrust or torque units and high-speed operation.

Two sizes of BOOSTER PUMPS are available: the P9 and the P40. The P9 is used in combination with the ½D size power module to provide 5 times the capacity of a D size power module or 2.5 GPM. A D size power module is used with the P40. The capacity for this system is 11 GPM equivalent to stroking 80,000 lbs. @ 1 inch per second or rotating a 50,000 inch-lbs. drive, 90° in one second.

Model number designation is shown as: – ½D, P9 –
– D, P40 –

H1 MECHANICAL INSTALLATION

An **Xpac** with the Booster Pump Configuration is installed in the same manner as an actuator with any other size Power Module (see Section 4).

H1.1 Actuator

Please refer to Section 4.1 for a rotary actuator, 4.2 for a linear actuator and 4.3 for a D series drive.

H1.2 Control Enclosure

The major electrical components are located in a NEMA 4X enclosure. They have a wide temperature range (-40°F to 120°F¹) 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.

Component layout of the control enclosure is shown on drawing A97134. Panel drawings for a ½D, P9 enclosure are shown on drawing P97119.

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



H2 ELECTRICAL INSTALLATION

For simplicity, reference is made to the Xpac actuator, L series or R series. All information is applicable to the Xpac drives, D series, as well.

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 and resolver cables, the feedback cable and the module cable. These cables may not be run within the same conduit or seal-tite flex hose. Preferred wiring procedures recommend that power voltages 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.

! 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.**

H2.1 Motor Power Cable

The standard cable consists of 4 conductor with an overall foil shield. For the Power Module (1/2D or D), each individual wire is 16 AWG. The wire for the Booster Pump is 10 AWG. Maximum length of cable run is 700 ft.



SHOCK HAZARD

Hazardous voltage levels are present in the motor power cable. Insure that the electrical power to the drive is off before connecting the motor power cable.

H2.1.1 Enclosure Termination

The motor cables are terminated to the screw connector terminal blocks in the top left section of the control enclosure (DWG A97134). Connect the cables by following DWG D97135 for the ½D,P9 or DWG D97135-P40 for the D,P40.

H2.1.2 Actuator Termination

The motor cables are terminated in the junction boxes attached to the motors as shown in Drawing S97132 for the Booster Pump motor and S96502 for the power module motor.

H2.2 Motor Resolver

The resolver cables provide motor commutation, velocity, position and temperature signals to their respective drivers. This information is used to sequence the motor power pulsing. Each cable is shielded and consists of eight conductor 20 AWG wires. The resolver is not restricted by distance.

H2.2.1 Enclosure Termination

The cables are terminated to screw connectors located at the right side of the enclosure. Connect the cables by following DWG D97135 for the ½D,P9 or DWG D97135-P40 for the D,P40.

H2.2.2 Actuator Termination

The resolver cables are terminated in the junction boxes attached to the motors as shown in Drawing S97132 for the Booster Pump motor and S96502 for the power module motor.

H2.3 Feedback Cable

The standard cable consists of a red, white and black wire and a shielded ground wire. Each individual wire is 18 AWG. The feedback cable is not restricted by distance.

H2.3.1 Enclosure Termination

The feedback cable is terminated to the three position terminal strip on the right side of the control enclosure. Connect the cable by following drawing: DWG D97135 for the ½D,P9 or DWG D97135-P40 for the D,P40. The shield drain wire should be terminated to the green ground screw on the metal backplane.

H2.3.2 Actuator Termination

Feedback termination at the actuator is the same as for other size power modules (section 5.2.2).



A cable consisting of 3 twisted pairs and a triad is supplied as the module cable. Only the triad and blue pair are used. Cutback the remaining wires ensuring no shorts are present.

The booster pump does not contain an integral heater. Insulation and heat tracing may be required at ambient temperatures below 20° F (-7°C). Refer to TM19 for details.

H2.4 Module Cable

A thermostatically controlled cartridge heater and solenoid power (optional; only connected on spring fail units) are installed in the ½D and D size power modules. The module cable supplies power for the heater (black and white) and solenoid (blue and blue/black) and contains the actuator ground (green/yellow).



SHOCK HAZARD

Hazardous voltage levels are present in the module cable. Insure that the electrical power to the drive is off before connecting the module cable.

H2.4.1 Enclosure Termination

The black and white wires of the triad and the two blue wires are connected to the terminal blocks located on the left side of the enclosure. Connect the wires by following drawing: DWG D97135 for the ½D,P9 or DWG D91735-P40 for the D,P40. The green/yellow ground wire should be terminated to the green ground screw on the metal backplane.

H2.4.2 Actuator Termination

The cable is terminated in the junction box of the ½D and D size power modules as shown on drawing S96502.

H2.5 User Connections

Minimum user connections to the actuator are the electric power and control signal. Connections for other option contained on the auxiliary boards (position transmitter, alarm, electronic limit switches) are detailed in Appendix C.

H2.5.1 Actuator Power

The minimum wire gauge providing power must be of sufficient size to insure that rated voltage is supplied to the unit. The ½D, P9 requires 240 VAC, -20%/+10%, 3 phase @ 50 amps for proper operation. The D, P40 requires 240 VAC, -20%/+10%, 3 phase @ 150 amps for proper operation.

Power connections are made at the bottom of the enclosure according to drawing A97134.

H2.5.2 Control Signals

The analog control signal (typically 4-20 mA) is connected to the low level signal terminal block located on the right side of the enclosure. Connect the cable by following DWG D97135 for the ½D,P9 or DWG D97135-P40 for the D,P40.

Pulse signals would connect to the Pulse Auxiliary Board located atop the PCP (see Appendix P).

H3 SETUP FEATURES

Please refer to Section 6 for a detailed explanation of REXA actuator operation. Section 6.3 should be thoroughly understood and followed before proceeding. The booster pump requires one new parameter. The D power module redefines two parameters (Low Acceleration and Acceleration Breakpoint) and requires two new parameters (gain and minimum speed) in the CAL branch.

H3.1 Booster Pump

Operation of the Booster Pump is only required for large changes in position. Small changes will be accomplished by the power module only. Parameter HS (section 6.3.1) sets both the Power Module and Booster Pump speeds.

Booster Pump Breakpoint (bP) specifies the value, in percent of calibrated stroke, between the control signal target position and the actuator's current position below which the booster pump will not turn on. If the difference exceeds the value set in bP, the Booster Pump will power up to increase the speed. Any value between 10% and 100% may be set. A 100% setting will disable Booster Pump operation. Parameter bP is the third item in submenu Obd.

In order to insure smooth final positioning, the Booster Pump is stopped before the target position is reached. This point is speed dependent and factory set as the Power Module Type (dt) as follows:

Consult with REXA personnel before adjusting the Power Module Type.

<u>dt value</u>	<u>Booster Pump stops</u>
d1	5% before target position
d2	2.5% before target position
d3	1% before target position

See section 6.3.3 for details.

H3.2 Power Module

A servo motor can accelerate and decelerate at phenomenal rates. For instance, the motor will accelerate from stop to 2400 RPM in one revolution. To take advantage of this capability, **REXA** has introduced Proportional + Integral (PI) control into the positioning action. As the actuator approaches the target position, the motor will decelerate (Proportional Action) from a maximum speed to a minimum speed and then at a pre-selected point, begin accelerating (Integral Action) at a fixed rate. Tuning of the PI parameters will provide maximum response to a control signal change without overshoot.

Gain and minimum speed will appear in the CAL Branch only if a D size Power Module is selected [(CtL:dt)=d1, d2 or d3].

The speed of the unit is equal to the *Gain* times the difference between the current and target positions. Upper limits on the speed remains the value set for *High Speed* and the lower limit is the value set for *Minimum Speed* (Figure H.1).

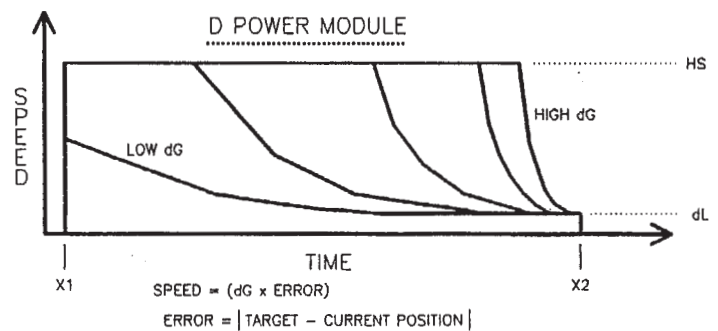
Integral action utilizes the values of *Acceleration Breakpoint* and *Low Acceleration* in the ACC Branch. The speed will increase at the value for *Low Acceleration*, but will not start this increase until it reaches the *Acceleration Breakpoint*.

PROPORTIONAL

Gain (dG) controls the point at which the actuator will begin to decelerate. Values from 5 to 50 may be selected. The higher the value, the closer the unit will be to the target position before the calculated motor speed begins to drop below *High Speed*. Recommended initial settings are shown in Figure H.2. The effect of this parameter on performance is indicated in Figure H.3.

Minimum Speed (dL) specifies the lowest speed in percent of maximum that the motor will reach under proportional control. Values from 5 to 20 may be selected. Recommended initial setting are shown in Figure H.2. The effect of this parameter on performance is indicated in Figure H.3.

Figure H.1 Speed Profile



INTEGRAL

Low Acceleration (LA) is the rate at which the speed increases from the minimum (dL) until either *High Speed* or the target position is reached. Values from 1 to 99 may be selected. Recommended initial settings are shown in Figure H.2. The effect of this parameter on performance is indicated in Figure H.3.

Low Acceleration and Acceleration Breakpoint provide different features for the B and C size power modules. See section 6.3.2.

Acceleration Breakpoint (Ab) specifies the position at which the actuator will start accelerating from the *minimum speed(dL)*. This position is the difference between the current position and the target position. Values from 0.1% to 5.0% difference may be selected. Recommended initial settings are shown in Figure H.2. The effect of this parameter on performance is indicated in Figure H.3.

**Figure H.2
Recommended Initial Parameter Settings**

A specific installation, low dead-band or specialized control criteria may require adjustment to the initial settings.

Model	1/2D and D size				2D size			
	Power Module				Power Module			
	dG	dL	LA	Ab	dG	dL	LA	Ab
L Series								
2000	10	5	10	0.5	5	5	5	0.5
4000 - 15000	25	10	20	1.0	20	5	10	1.0
20000 or larger	50	20	40	2.0	50	20	40	2.0
R or D Series								
1200, 2500, 5000	10	5	10	0.5	5	5	5	0.5
10000, 20000	25	10	20	1.0	20	5	10	1.0
50000 or larger	50	20	40	2.0	50	20	40	2.0

Figure H.3

Parameter	To increase response (Shorter Time To Target Position)	To reduce overshoot
	dG	INCREASE
dL	INCREASE	DECREASE
LA	INCREASE	DECREASE
Ab	INCREASE	DECREASE

APPENDIX P

Pulse Operating System

P. Pulse Operating System

Both Pulse inputs active simultaneously are ignored. Pulses received while in LOCAL or SETUP are also ignored.

The pulse operating system developed for the **Xpac** makes optimum use of the actuator's capabilities. Dual acceleration, minimum modulating and water hammer features are available. In addition, the error diagnosis and alarm function are active. This is accomplished by keeping the PCP in control. 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.

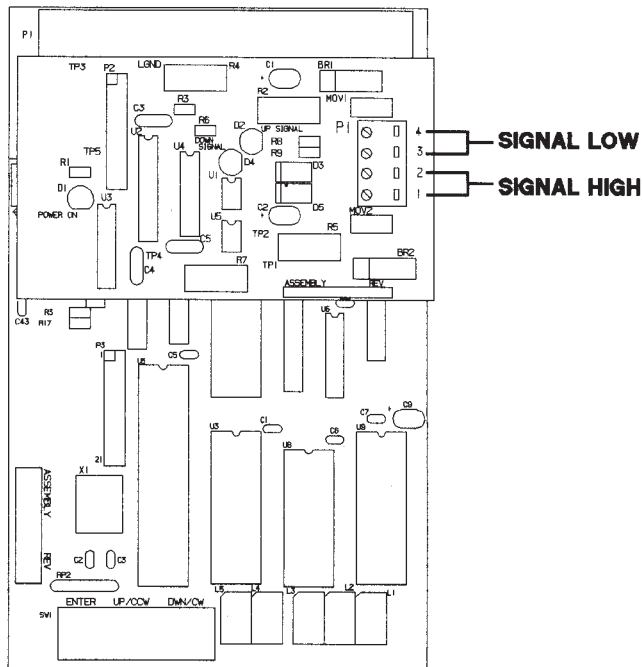
To receive the pulses, a pulse auxiliary board is added to the PCP. This board accepts 3 or 4 wire signals in the range of 24 to 120 volts, AC or DC. The pulses are interpreted by the PCP based on the values set for the two pulse control parameter, *Pulse Duration* and *Pulse Increment*.

INSTALLATION

Wiring for pulse input is performed at the pulse board located on top of the PCP. A green block provides four terminals to connect the HIGH signal (terminals 1 and 2) and the LOW signal (terminals 3 and 4). For 3-wire operation, terminals 2 and 4 should be jumpered together and connected to the common of the input signals.

Connections 2 & 3 on the main 24 pin terminal block are not used.

Pulse Auxiliary Board



PCP

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.

PULSE CONTROL PARAMETERS

When pulse control is indicated ([CtL:St]=P), the analog control signals (*Signal Low* and *Signal High*) will not appear in the CAL sub-menu. In their place will be the pulse control parameters (*Pulse Duration* and *Pulse Increment*).

Both Pulse inputs active simultaneously are ignored. Pulses received while in LOCAL or SEtUP are also ignored.

Enter SEtUP and step down the CAL sub-menu until the parameter Pd appears. Press the (E)NTER key to enable the parameter (the ID will begin to blink). The Scroll Up/Scroll Down keys will change the value. Press (E)NTER when complete. Access the *Pulse Increment* by pressing the Scroll Down key and repeat the setting procedure.

Pulse Duration (Pd) specifies the minimum length in milliseconds, minus zero, plus 1 millisecond, that an input pulse must remain ON before it is recognized as a valid input pulse. Any value from 5 milliseconds to 999 milliseconds may be set. Each valid input pulse changes the actuator's target position by the value specified in *Pulse Increment* (PI). If the resulting target position differs from the actuator's current position by an amount greater than the deadband, the actuator will move to the new position.

PULSE DURATION





Parameter Failsafe has no meaning with a pulse control signal.

The OFF time between successive input pulses must be greater than 1 millisecond. Long input pulses; that is, input pulses which remain ON for multiples of the value set in *Pulse Duration*, cause an equal number of incremental target position changes. Pulses which arrive in rapid succession are accumulated in the actuator by repeated adjustments to the target position.

The *Signal Type* must be set to Pulse ([CtL:St]=P) for *Pulse Duration* and *Pulse Increment* to be displayed.

PULSE INCREMENT



Pulse Increment (PI) specifies the amount, in percent of calibrated stroke, that the actuator will adjust its target position for each valid input pulse received. *Pulse Increment* may be set to any value from 0.1% to 5.0%

The *Signal Type* must be set to ([CtL:St]=P) for *Pulse Duration* and *Pulse Increment* to be displayed.

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%.

$$Pi = \frac{Pd}{Stroke\ Time} \times 100\%$$

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

APPENDIX R

Redundant Construction

R. 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 unit.

One module is designated as main and the other as backup. An alarm board is added to the main PCP and a status board is added to the backup PCP. In this manner, the operation of the main system is indicated to the backup system. The functional difference between the modules is strictly in the response to a change in control signal. The standby is eight times less sensitive than the primary.

The main PCP uses standard software. The backup PCP has unique software developed for redundant units.

For instance, setting the deadband of each module to .2% 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 .2% resolution. If the main module cannot respond (indicated by the alarm board), then the backup module will automatically revert to fine control and position to the .2% 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 (L2000-2-2BR-P).

R.1 Mechanical Installation

Mounting and installation procedures for the actuator or drive is the same as for a standard unit. The location of the mounting holes and shaft connections are not affected. Please refer to Section 4 for details.

R.2 Electrical Installation

Although the electronics are installed in a single enclosure (Figure R.1, p. 4), there are two complete sets which function for the most part independently.

Wiring is accomplished as two separate units. A Power Module and feedback circuit is connected to a single electronics. Please refer to Section 5 for a single B or single C connection and to Appendix X for a single D connection.

R.2.1 User Connections

Electrical power and control signal are wired in the conventional manner (Section 5.3). However, consideration should be given to maintaining the redundancy down to these user connections. Power should be brought from two sources. A single control signal looped through both electronics is possible, but two independent signals can be connected.

R.2.2 Redundant Interconnections

Each PCP has two auxiliary board I/O ports, upper and lower. The upper port is used to install the auxiliary boards required for redundant operation. The determination of main and backup is dependent only on these boards. The main power module would utilize the alarm board p/n S96169 and the backup will utilize status board p/n S96584. Exchanging the two different boards and operating software will reverse the main and backup modules.

User connections should only be made to auxiliary boards on the lower port.

Other auxiliary boards are installed on the lower port and connected in the conventional manner per Appendix C.

R.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 main actuator power. Interconnection wiring between the Status Boards and second module is shown in Figure R.2 (p. 5).

R.3 Operation

The operation (Section 6) 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 PCPs 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 deadband settings (< 0.5%). Such operation is alleviated by simultaneous SETUP and the backup unit's deadband having an internal setting eight times that of the main unit.

Another extraordinary condition will happen if one module is put into LOCAL and moved manually. The other unit will continue to track the control signal and move the actuator back. Placing both PCPs in LOCAL and moving only one remedies this situation.



R.4 Simultaneous SEtUP

Both PCPs should be calibrated at the same time on a step by step basis. Follow the procedure indicated in Section 6.3. With the exception of the Position Low (PL), Position High (PH), Control Point (CP), Signal Low (SL) and Signal High (SH), all values in the SEtUP Mode will be identical. The values for these parameters will be different because of separate feedback readings and variations in internal resistors.

Control point is an advanced control option and may not be available on a particular unit.

Position Low (PL), Position High (PH) and Control Point (CP) require repositioning of the actuator to set their values. Use only one module to move the actuator. When the correct position is reached, lock this position into both PCPs.

In the case of dual control signal, insure that both PCPs are receiving the correct high or low value setting. Variations of only .2 or .3 mA may cause control instability.

Figure R.1 Single Enclosure

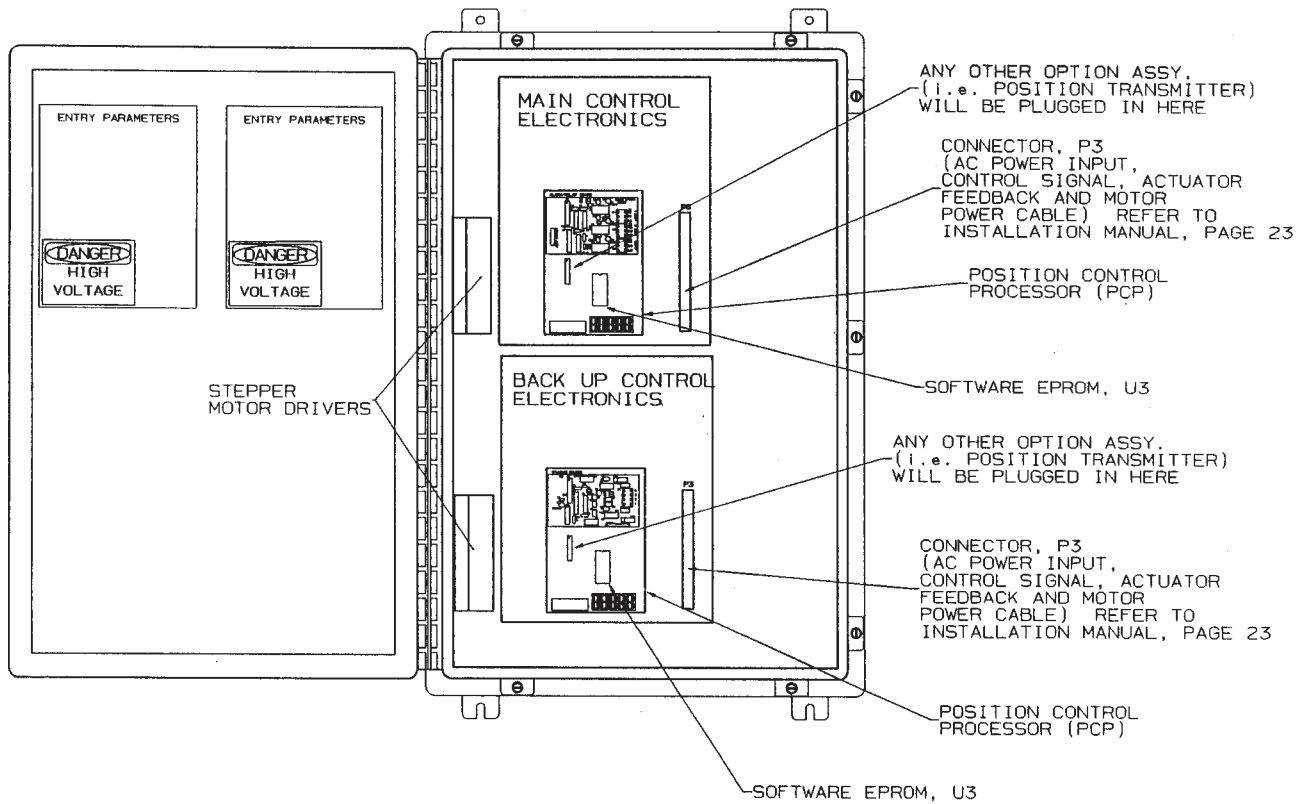
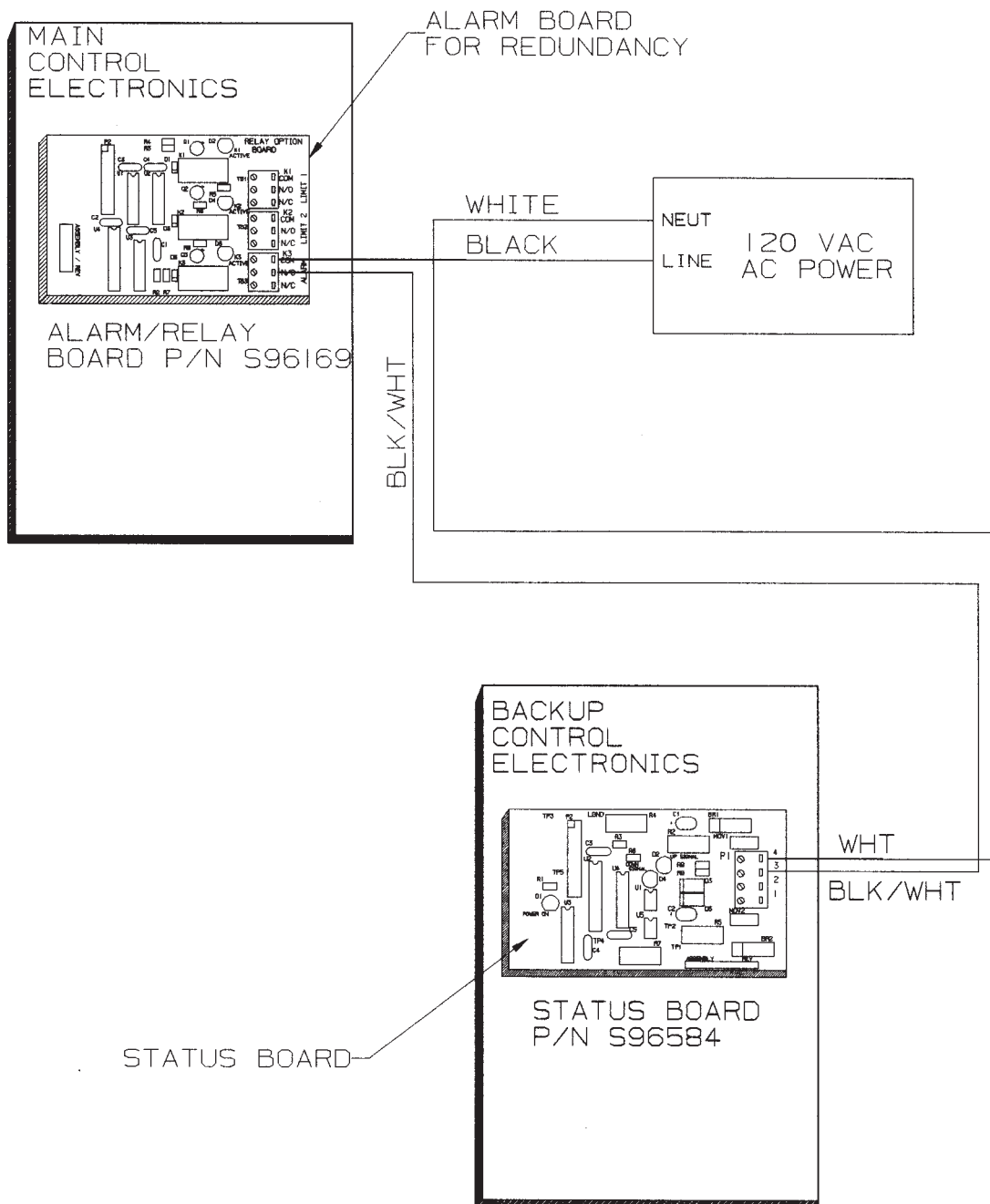


Figure R.2 Wiring Diagram



APPENDIX S

Surge Control Option

S. SURGE CONTROL OPTION

High speed operation in one direction during upset conditions can best be handled with the **REXA** Surge Control Option. The standard actuator is augmented with three additional components:

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

Solenoid Bypass Valve - bypasses the actuator's normal hydraulic circuit. Requires fast response, high capacity and zero leakage.

Solid State Relay - interfaces the PCP with the solenoid.

The PCP will pulse the solenoid through the electronic relay to allow controlled high speed motion in the spring direction. Spurious operation is prevented by the inclusion of a *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 moved at high speed to the new position.

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

Complete details can be obtained in Application Note #4, Surge Control Option.

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. Depending upon the failure on loss of power (in place or in the surge direction), the solenoid will be piped either Normally Open or Normally Closed.

The wires used for the surge solenoid are in place of the normal internal failure solenoid (blue pair of the module cable). Connection for the solenoid within the control enclosure is made directly to the Surge Auxiliary Board located on top of the PCP.

SURGE BREAKPOINT



SURGE BREAKPOINT

Only the Surge Breakpoint must be included during calibration of the SETUP parameters. Place the PCP into the SETUP mode and step over to the Option Board Sub-Menu, Obd. Push the DOWN key three times. The parameter should now read SG, *Surge Breakpoint*. Activate the parameter by pressing (E)NTER. Use the Scroll Up/ Scroll Down keys to set the breakpoint. The value set is the percent change in control signal to activate the surge high speed override.

APPENDIX T

Screw Terminals

T. SCREW TERMINALS

A screw terminal junction enclosure (figure T.1) can be added to the B or C size Power Modules. The cable connection is made to the terminals by #8 ring lugs. Connections for the feedback cable is unchanged (Section 5.2).

T.1 Termination

An O-ring seal is located within the enclosure cover. Make sure that it is properly seated with no cuts or other discontinuities before sealing.

Remove the four cap screws that retain the enclosure cover. Feed the module cable through the $\frac{3}{4}$ inch NPT opening into the terminal area. Figure T.2 shows the wiring connections to the screw terminals. After insuring that the wires are not pinched by the cover, securely fasten the cover to the module.

Figure T.1 Screw Terminal Junction Enclosure

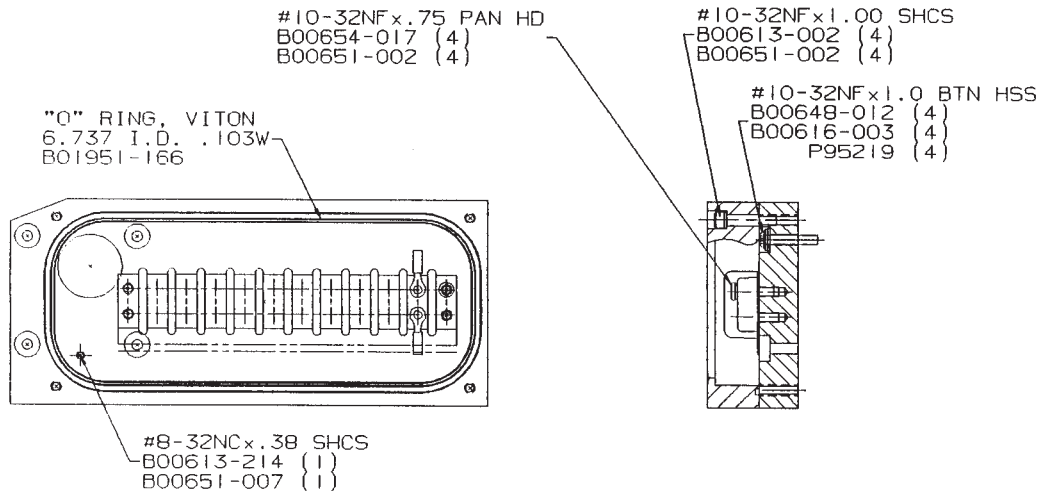
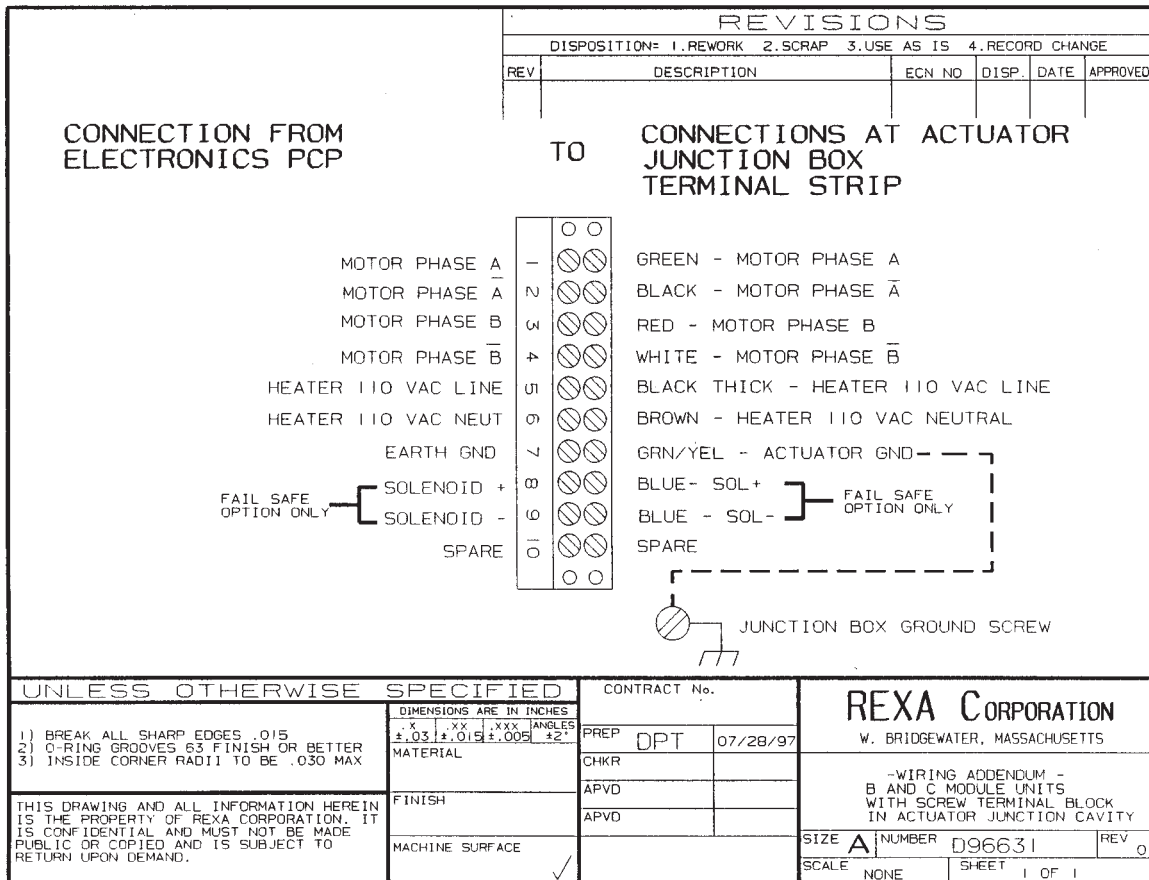


Figure T.2 Wiring Connections



UNLESS OTHERWISE SPECIFIED		CONTRACT No.		REXA CORPORATION W. BRIDGEWATER, MASSACHUSETTS
1) BREAK ALL SHARP EDGES .015 2) O-RING GROOVES 63 FINISH OR BETTER 3) INSIDE CORNER RADI1 TO BE .030 MAX	DIMENSIONS ARE IN INCHES X .XX .XXX ANGLES ±.03 / ±.015 ±.005 ±2°	PREP OPT 07/28/97	CHKR	
THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF REXA CORPORATION. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.	FINISH	APVD	APVD	-WIRING ADDENDUM - B AND C MODULE UNITS WITH SCREW TERMINAL BLOCK IN ACTUATOR JUNCTION CAVITY
MACHINE SURFACE ✓				SIZE A NUMBER D96631 REV 0
				SCALE NONE SHEET 1 OF 1

APPENDIX X

D Size Power Module

Control Enclosures and Electrical Assembly Drawings

D97103	Rev2
A97101	Rev0
EP97055	Rev0
A97099	Rev0
EP97076	Rev0
S96502	Rev4
D97097	Rev3
A97100	Rev0
D97096	Rev2



D SIZE POWER MODULE

Introduction

The D size power module is installed on larger size actuators and drives or applications requiring rapid operation. Its output as compared to the B and C size modules can be summarized as follows:

Power Module	Speed (Baseline -B)	Frequency Response (est. Corner Frequency)
2D	24	7.5 hz
D	12	7.5 hz
½D	6	7.5 hz
2C	6	2.5 hz
C	3	2.5 hz
B	1	2.5 hz

To accomplish this dramatic increase in performance, the D module utilizes a larger pump, a 2 horsepower servo motor and a 240 VAC servo driver. The ½D pump module utilizes a larger pump, a 1.0 horsepower servo motor and a 120 VAC servo driver. Although the ½D control enclosure (A97101) appears virtually identical to the D pump control enclosure (A97099), the output of the servo driver is programmed to accommodate the use of a smaller (1.0 hp) servo motor. All other components remain the same as the smaller power modules. The only physical difference is the square shaped motor (versus round for the B and C).

X1 MECHANICAL INSTALLATION

An **Xpac** with ½D, D or 2D size Power Modules is installed in the same manner as an actuator with any other size Power Module (see Section 4).

X1.1 Actuator

Please refer to Section 4.1 for a rotary actuator, 4.2 for a linear actuator and 4.3 for a D series drive.

X1.2 Control Enclosure

The major electrical components are located in a NEMA 4X enclosure. They have a wide temperature range (-40°F to 120°F¹) 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.

Panel drawings for a ½D and D enclosure are shown on drawing EP97055 and on drawing EP97076 for a 2D size enclosure.

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



X2 ELECTRICAL INSTALLATION

D Power Modules Only

For simplicity, reference is made to the Xpac actuator, L series or R series. All information is applicable to the Xpac drives, D series, as well.

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 and resolver cables, the feedback cable and the module cable. These cables may not be run within the same conduit or seal-tite flex hose. Preferred wiring procedures recommend that power voltages 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.

! IMPORTANT !

- **Motor power and motor resolver cables for the D power module 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 cable must be kept separate from the motor power cable or any other high power wiring. However, the resolver cable 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.**

Drawings D97103, D97096 and D97097 show the connections between the cable and the control enclosure for ½D, D and 2D size units. Connections between the cable and the actuator are shown on drawing S96502.

On 2D size units, there is a junction box located at each module. The motor and resolver cables for each motor must be individually connected. Only one module cable is required; the heater power is connected between boxes and the solenoid (on spring fail units only) will only be installed on one module.

X2.1 Motor Power Cable

The standard cable consists of 4 conductor, overall foil shield. Each individual wire is 14 AWG. Maximum length of the cable run is 700 ft.

⚠ SHOCK HAZARD
HAZARDOUS VOLTAGE LEVELS ARE PRESENT IN THE MOTOR POWER CABLE. INSURE THAT THE ELECTRICAL POWER TO THE DRIVE IS OFF BEFORE CONNECTING THE MOTOR POWER CABLE.

X2.1.1 Enclosure Termination

The motor cable is terminated to the screw connector at the left side of the enclosure. Connect the cable by following drawings: D97103 and A97101 for the ½D, D97096 and A97099 for the D or D97097 and A97100 for the 2D.

X2.1.2 Actuator Termination

The motor cable is terminated in the junction box as shown in drawing S96502.

X2.2 Motor Resolver

The resolver cable provides motor commutation, velocity, position and temperature to the driver. This information is used to sequence the motor power pulsing. The cable is shielded and consists of 4 shielded/ twisted pairs, 20 AWG. Maximum length is 700 ft..

X2.2.1 Enclosure Termination

The cable is terminated to screw connectors located at the left side of the enclosure. Connect the cable by following drawings: D97103 and A97101 for the ½D, D97096 and A97099 for the D or D97097 and A97100 for the 2D.

X2.2.2 Actuator Termination

The motor cable is terminated in the junction box as shown in drawing S96502.

X2.3 Feedback Cable

The standard cable consists of a red, white and black wire and a shielded ground wire. Each individual wire is 18 AWG. The feedback cable is not restricted by distance.

X2.3.1 Enclosure Termination

The feedback cable is terminated to the 3 position terminal strip within the control enclosure. Connect the cable by following drawings: D97103 and A97101 for the ½D, D97096 and A97099 for the D or D97097 and A97100 for the 2D. The shield drain wire should be terminated to the green ground screw on the metal backplane.

X2.3.2 Actuator Termination

Feedback termination at the actuator for the D size Power Module is the same as for the other size modules (section 5.2.2).

X2.4 Module Cable

A thermostatically controlled cartridge heater and solenoid power (optional; only connected on spring fail units) are installed in the power module. The module cable supplies power for the heater and solenoid and contains the actuator ground.

A cable consisting of 3 twisted pairs and a triad is supplied as the module cable. Only the triad and blue pair are used. Cutback the remaining wires ensuring no shorts are present.



SHOCK HAZARD

Hazardous voltage levels are present in the module cable. Insure that the electrical power to the drive is off before connecting the module cable.

X2.4.1 Enclosure Termination

The black and white wires of the triad are connected to the two position terminal block. Connect the cable by following drawings: D97103 and A97101 for the ½D, D97096 and A97099 for the D or D97097 and A97100 for the 2D. The green/yellow wire of the triad should connect to the green ground screw on the metal backplane.

X2.4.2 Actuator Termination

The cable is terminated in the junction box as shown in drawing S96502.

On 2D size units, there is a junction box located at each module. One module cable is required. The heater power should be connected between boxes and the solenoid will only be installed on one module.

X2.5 User Connections

The standard electric power is 240 VAC -20/+10% for D and 2D modules, 1 phase. 120 VAC power is available by using the optional separately mounted transformer.

The standard electric power for the ½D module is 120 VAC -20/+10%, 1 phase, drawing D97103.

The incoming control signal must be wired. The connections for auxiliary boards (position transmitter, etc.) are shown in Appendix C.

X2.5.1 Actuator Power

The minimum wire gauge providing power must be of sufficient size to insure that rated voltage is supplied to the units. The required power for a ½D size power module is 1200 VA, for a D size power module is 2200 VA and for a 2D is 4400 VA.

Power connections are made to the main circuit breaker as shown in drawings D97103, D97096 and D97097.

X2.5.2 Control Signals

The analog control signal (typically 4-20 mA) is connected to the two position terminal block. Connect the cable by following drawings: D97103 and A97101 for the ½D, D97096 and A97099 for the D or D97097 and A97100 for the 2D.

Pulse signals would connect to the Pulse Auxiliary Board located atop the PCP (see Appendix P).

X3 SETUP FEATURES

Please refer to Section 6 for a detailed explanation of REXA actuator operation. Section 6.3 should be thoroughly understood and followed before proceeding. In addition to the standard parameters, the D power module redefines two parameters (Low Acceleration and Acceleration Breakpoint).

A servo motor can accelerate and decelerate at phenomenal rates. For instance, the motor will accelerate from stop to 2400 RPM in one revolution. To take advantage of this capability, **REXA** uses Proportional + Integral (PI) control in the positioning action. As the actuator approaches the target position, the motor will decelerate (Proportional Action) from a maximum speed to a minimum speed and then at a preselected point, begin accelerating (Integral Action) at a fixed rate. Tuning of the PI parameters will provide maximum response to a control signal change without overshoot.

The speed of the unit is equal to the *Gain* times the difference between the current and target positions. Upper limits on the speed remains the value set for *High Speed* and the lower limit is the value set for *Minimum Speed* (Figure X.1).

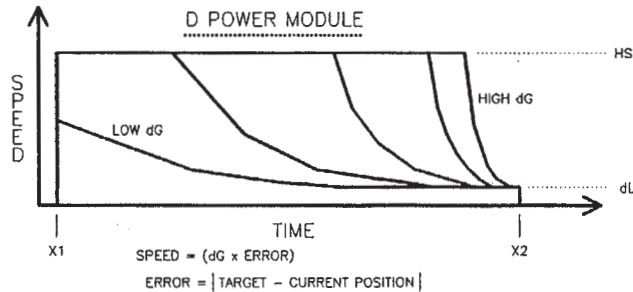
Integral action utilizes the values of *Acceleration Breakpoint* and *Low Acceleration* in the ACC Branch. The speed will increase at the value for *Low Acceleration*, but will not start this increase until it reaches the *Acceleration Breakpoint*.

PROPORTIONAL

Gain (dG) controls the point at which the actuator will begin to decelerate. Values from 5 to 200 may be selected. The higher the value, the closer the unit will be to the target position before the calculated motor speed begins to drop below *High Speed*. Recommended initial settings are shown in Figure X.2. The effect of this parameter on performance is indicated in Figure X.3.

Minimum Speed (dL) specifies the lowest speed in percent of maximum that the motor will reach under proportional control. Values from 5 to 20 may be selected. Recommended initial settings are shown in Figure X.2. The effect of this parameter on performance is indicated in Figure X.3 .

Figure X.1 Speed Profile



INTEGRAL

Low Acceleration (LA) is the rate at which the speed increases from the minimum (dL) until either *High Speed* or the target position is reached. Values from 1 to 99 may be selected. Recommended initial settings are shown in Figure X.2. The effect of this parameter on performance is indicated in Figure X.3.

Low Acceleration and Acceleration Breakpoint provide different features for the B and C size power modules. See section 6.3.2.

Acceleration Breakpoint (Ab) specifies the position at which the actuator will start accelerating from the *minimum speed*(dL). This position is the difference between the current position and the target position. Values from 0.1% to 5.0% difference may be selected. Recommended initial settings are shown in Figure X.2. The effect of this parameter on performance is indicated in Figure X.3.

Figure X.2
Recommended Initial Parameter Settings

Model	1/2D and D size Power Module				2D size Power Module			
	dG	dL	LA	Ab	dG	dL	LA	Ab
L Series								
2000	10	5	10	0.5	5	5	5	0.5
4000 - 15000	25	10	20	1.0	20	5	10	1.0
20000 or larger	50	20	40	2.0	50	20	40	2.0
R or D Series								
1200, 2500, 5000	10	5	10	0.5	5	5	5	0.5
10000, 20000	25	10	20	1.0	20	5	10	1.0
50000 or larger	50	20	40	2.0	50	20	40	2.0

A specific installation, low dead-band or specialized control criteria may require adjustment to the initial settings.

Figure X.3

Parameter	To increase response (Shorter Time To Target Position)	To reduce overshoot
	dG	INCREASE
dL	INCREASE	DECREASE
LA	INCREASE	DECREASE
Ab	INCREASE	DECREASE

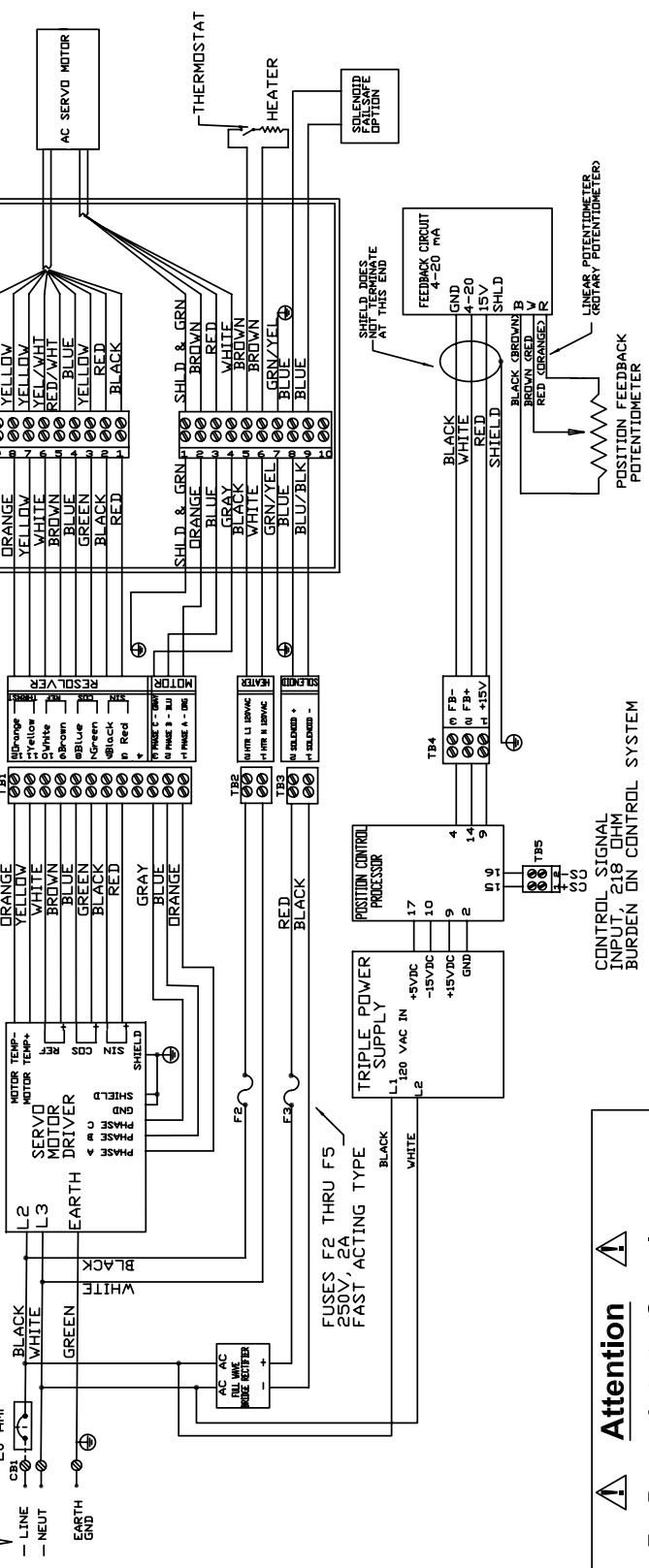
REVISIONS

DISPOSITION= 1.REWORK 2.SCRAP 3.USE AS IS 4.RECORD CHANGE					
REV	DESCRIPTION	ECN NO	DISP	DATE	APVD
1	REVERSED SIN/COS DESIGNATION ON MOTOR DRIVER ADDED RESOLVER SIGNAL POLARITY		4	5/16/00	DPT
= ADDED ATTENTION NOTE					
		4		5/20/08	DPT

⊕ DENOTES TERMINATION TO EARTH GROUND VIA ALUMINUM BACKPLANE

AC INPUT
120 VAC, -20/+10%
1 PHASE, 50/60 HZ,
10 AMP

CIRCUIT BREAKER
1 POLE 250 VAC
20 AMP



⚠ Attention

For Proper Actuator Operation:

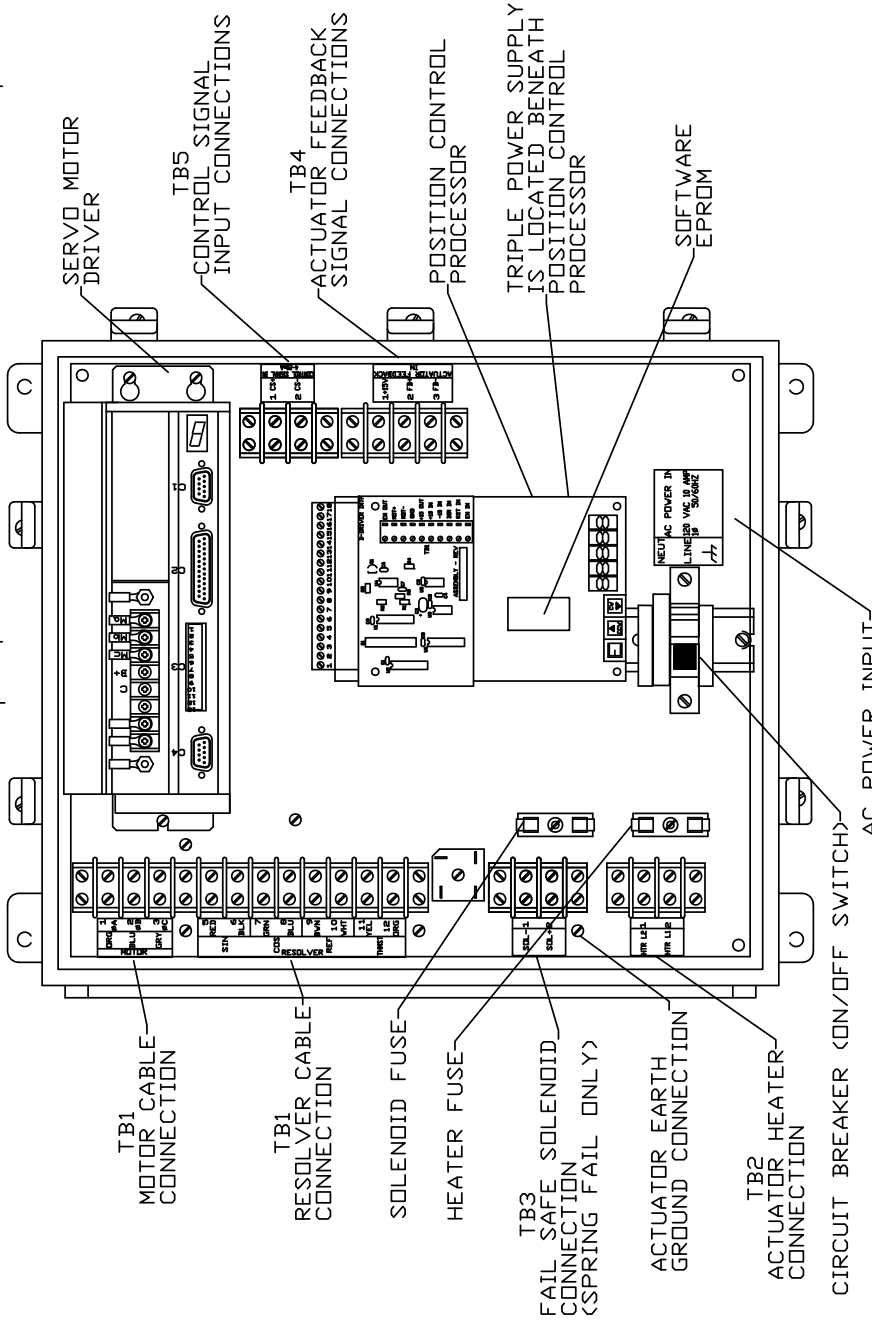
- 1.) Signal Level Cables must remain separate from High Voltage cables in a separate tray or conduit.
 - a.) Keep cables separate by at least 1 meter.
- 2.) Maintain shield coverage of the Motor Power cable all the way to the terminal block.
- 3.) Maintain shield coverage of the Signal cables all the way to the terminal block.
- 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.

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REXA	
W. BRIDGEWATER, MASSACHUSETTS	
CONTRACT No.	12/07/99
PREP	DPT
CHKR	CWS
APVD	12/07/99
APVD	
RAW STOCK	PRODCODE
	SIZE
	NUMBER
	D97103
SCALE	NONE
SHEET	1 OF 1
REV	2

REVISIONS

DISPOSITION= 1.REWORK 2.SCRAP 3.USE AS IS 4.RECORD CHANGE	
REV	DESCRIPTION
ECN NO	DISP. DATE
APVD	



UNLESS OTHERWISE SPECIFIED		CONTRACT No.	
		PREP	DPT
DIMENSIONS ARE IN INCHES		3/21/00	
X	.XX	XXX	ANGLES
±.03	±.015	±.005	±2°
MATERIAL		CHKR	ENG
FINISH		APVD	APVD
MACHINE SURFACE		RAW STOCK	RAW STOCK
✓		PROD:CODE	APVD
1) BREAK ALL SHARP EDGES .015		SIZE	NUMBER
2) D-RING GROOVES 63 FINISH OR BETTER		A97101	A97101
3) INSIDE CORNER RADII TO BE .030 MAX		SCALE	NONE
THIS DRAWING AND ALL INFORMATION HEREIN IS THE PROPERTY OF REXA CORPORATION. IT IS CONFIDENTIAL AND MUST NOT BE MADE PUBLIC OR COPIED AND IS SUBJECT TO RETURN UPON DEMAND.		W.BRIDGEWATER, MASSACHUSETTS	
		1/2D SIZE CONTROL ENCLOSURE ASSEMBLY	
		SHEET	1 OF 1



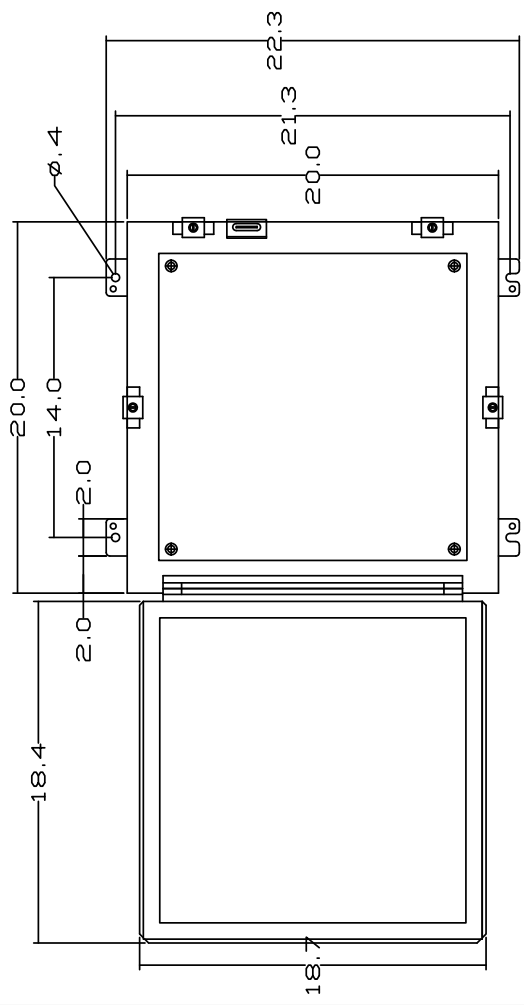
W.BRIDGEWATER, MASSACHUSETTS
1/2D SIZE CONTROL ENCLOSURE ASSEMBLY

SIZE NUMBER A97101 REV 0
SCALE NONE SHEET 1 OF 1

REVISIONS

DISPOSITION= 1.REWORK 2.SCRAP 3.USE AS IS 4.RECORD CHANGE

REV	DESCRIPTION	ECN NO	DISP.	DATE	APVD



ENCLOSURE SPECIFICATIONS

DIMENSIONS: . SEE OUTLINE DRAWING
 STANDARDS: . NEMA/EEMAC TYPE 4X
 CONSTRUCTION: . FORMED 16 GAUGE STEEL BODY WITH 14 GAUGE STEEL DOOR
 FINISH: . COVER AND ENCLOSURE ARE PHOSPHATIZED, PRIMED AND FINISHED IN ANSI/ASA 61 GREY
 APPROX. WEIGHT: 75 LBS.

UNLESS OTHERWISE SPECIFIED

1) BREAK ALL SHARP EDGES .015
 2) D-RING GROOVES 63 FINISH OR BETTER
 3) INSIDE CORNER RADII TO BE .030 MAX

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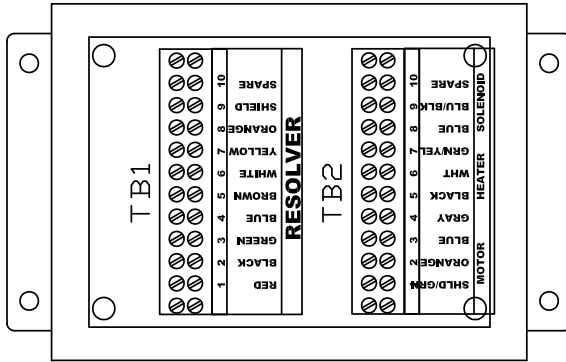
CONTRACT No.		02/11/00	
PREP	DPT		
CHKR			
APVD			
APVD			
RAW STOCK			
MACHINE SURFACE			

W. BRIDGEWATER, MASSACHUSETTS		CONTROL ENCLOSURE	
		2D SIZE, 20" X 20" X 8", NEMA TYPE 4, 4X STEEL	
SIZE	NUMBER	REV	
SCALE	NONE	EP97076	REV 0
SHEET	1	OF	1

REVISIONS

DISPOSITION= 1.REWORK 2.SCRAP 3.USE AS IS 4.RECORD CHANGE

REV	DESCRIPTION	ECN NO	DISP.	DATE	APVD
1	DELETED FEEDBACK CONNECTIONS FROM ASSEMBLY			10/15/97	DPT
2	MOTOR WIRE COLORS CHANGED			05/03/99	DPT
3	HEATER WIRES CHANGED FROM BLACK BROWN TO BWN, BWN			03/10/00	DPT
4	SWAPPED SIN/COS DESIGNATION			05/16/00	DPT



JUNCTION BOX
FOR ACTUATOR
CONNECTIONS

(SEE TABLE 1)

TABLE 1

#	WIRE COLOR	SIGNAL NAME	WIRE COLOR	SIGNAL NAME
1	BLACK	SIN	GREEN/YELLOW	MOTOR GROUND
2	RED		BROWN	PHASE A
3	YELLOW	COS	RED	PHASE B
4	BLUE		WHITE	PHASE C
5	RED/WHT	REF	BROWN	HEATER 240 VAC
6	YEL/WHT		BROWN	HEATER 240 VAC
7	YELLOW	MOTOR TEMP -	GREEN/YELLOW	ACTUATOR GROUND
8	YELLOW	MOTOR TEMP +	BLUE	SOLENOID + (OPTIONAL)
9	SHIELD		BLUE	SOLENOID - (OPTIONAL)
10	NO CONNECTION		NO CONNECTION	

UNLESS OTHERWISE SPECIFIED

1) BREAK ALL SHARP EDGES .015
 2) O-RING GROOVES 63 FINISH OR BETTER
 3) INSIDE CORNER RADII TO BE .030 MAX

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DIMENSIONS ARE IN INCHES	CONTRACT No.
X .XX .XXX ANGLES	PREP DPT 07/10/96
±.03 ±.015 ±.005 ±2	CHKR DMM 07/13/96
MATERIAL	APVD
FINISH	APVD
MACHINE SURFACE ✓	RAW STOCK
	PROD.CODE 12



W. BRIDGEWATER, MASSACHUSETTS

JUNCTION BOX S/A,
1/2D, D AND 2D SIZE
POWER MODULE, ACTUATOR END

SIZE	NUMBER	REV	SHEET
1/2D, D AND 2D	\$96502	4	1 OF 1
SCALE	NONE		

REVISIONS

REV	DESCRIPTION	ECN NO	DISP.	DATE	APVD
1	REVERSED SIN/COS DESIGNATION ON MOTOR DRIVER ADDED RESOLVER SIGNAL POLARITY		4	5/16/00	DPT
2	UPDATED POT WIRE COLORS, UPDATED CIRCUIT BKR TO FUSES ADDED ATTENTION NOTE		4	3/10/08	DPT
3			4	5/20/08	DPT

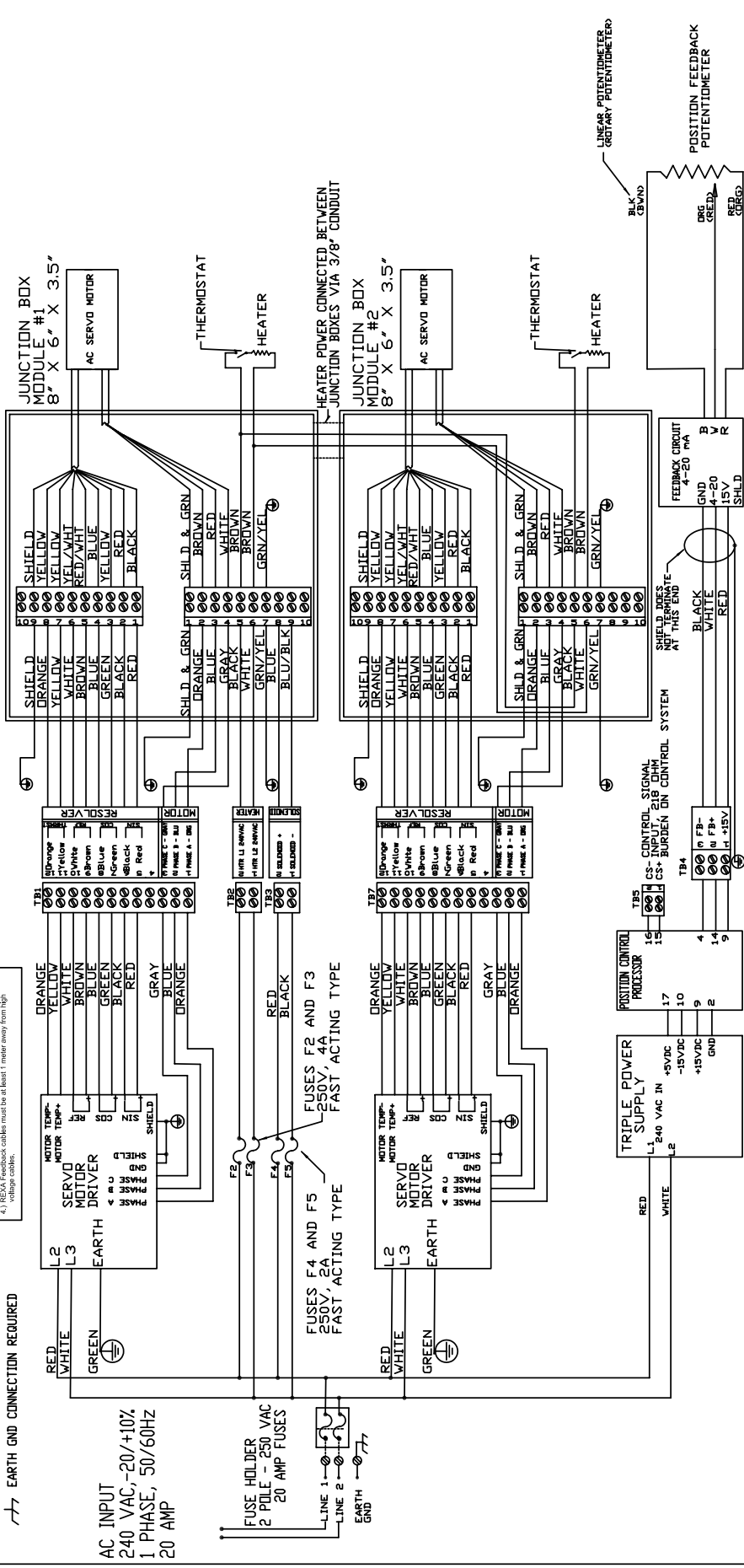
Attention

For Proper Actuator Operation:

- Signal Level Cables must remain separate from High Voltage cables in all areas.
- Yellow cables connect to at least 1 meter.
- Maintain shield coverage of the Motor Power cable all the way to the terminal block.
- Maintain shield coverage of the Signal cables all the way to the terminal block.
- REXA Motor and Power cables must be kept away from sensitive equipment and associated wiring by at least 1 meter.
- REXA Feedback cables must be at least 1 meter away from high voltage cables.

⊕ DENOTES TERMINATION TO EARTH GROUND VIA BACKPLANE

↗ EARTH GND CONNECTION REQUIRED



UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES

.X	.XX	.XXX	ANGLES
±.03	±.015	±.005	±.2°

MATERIAL

FINISH

MACHINE SURFACE ✓

CONTRACT No.

PREP DPT 02/08/00

CHKR CWS 02/08/00

APVD

APVD

RAW STOCK

PROD.CODE

W. BRIDGE WATER, MASSACHUSETTS

WIRING DIAGRAM
2D SIZE ELECTRONICS
ACTUATOR INTERCONNECTION
PANEL DESIGN

SCALE	NONE	NUMBER	D97097	SHEET	1 OF 1
SIZE			REV	3	

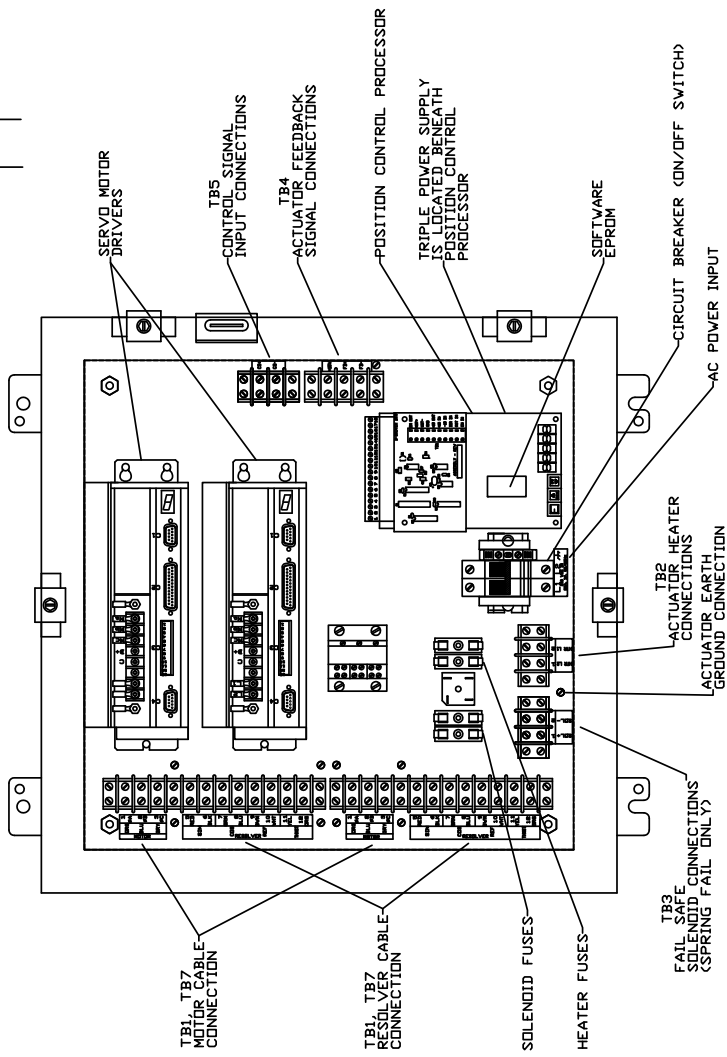
1) BREAK ALL SHARP EDGES .015

2) O-RING GROOVES .63 FINISH OR BETTER

3) INSIDE CORNER RADII TO BE .030 MAX

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REVISIONS				
DISPOSITION=	1.REWORK	2.SCRAP	3.USE AS IS	4.RECORD CHANGE
REV	DESCRIPTION	ECN NO	DISP	DATE
				APVD



UNLESS OTHERWISE SPECIFIED		CONTRACT No.	
DIMENSIONS ARE IN INCHES		PREP	3/21/00
X	.03 ±.01	DPT	CWS
XX	XXX	CHKR	APVD
ANGLES	±2°	APVD	APVD
MATERIAL		RAW STOCK	PRODD.CODE
FINISH		SIZE	NUMBER
MACHINE SURFACE		A97100	REV 0
		SCALE	NONE
		SHEET	1 OF 1

REVA
 W.BRIDGEWATER, MASSACHUSETTS
 2D CONTROL ENCLOSURE ASSEMBLY

1) BREAK ALL SHARP EDGES .015
 2) D-RING GROOVES .63 FINISH OR BETTER
 3) INSIDE CORNER RADII TO BE .030 MAX

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REVISIONS

DISPOSITION= 1:REWORK 2:SCRAP 3:USE AS IS 4:RECORD CHANGE

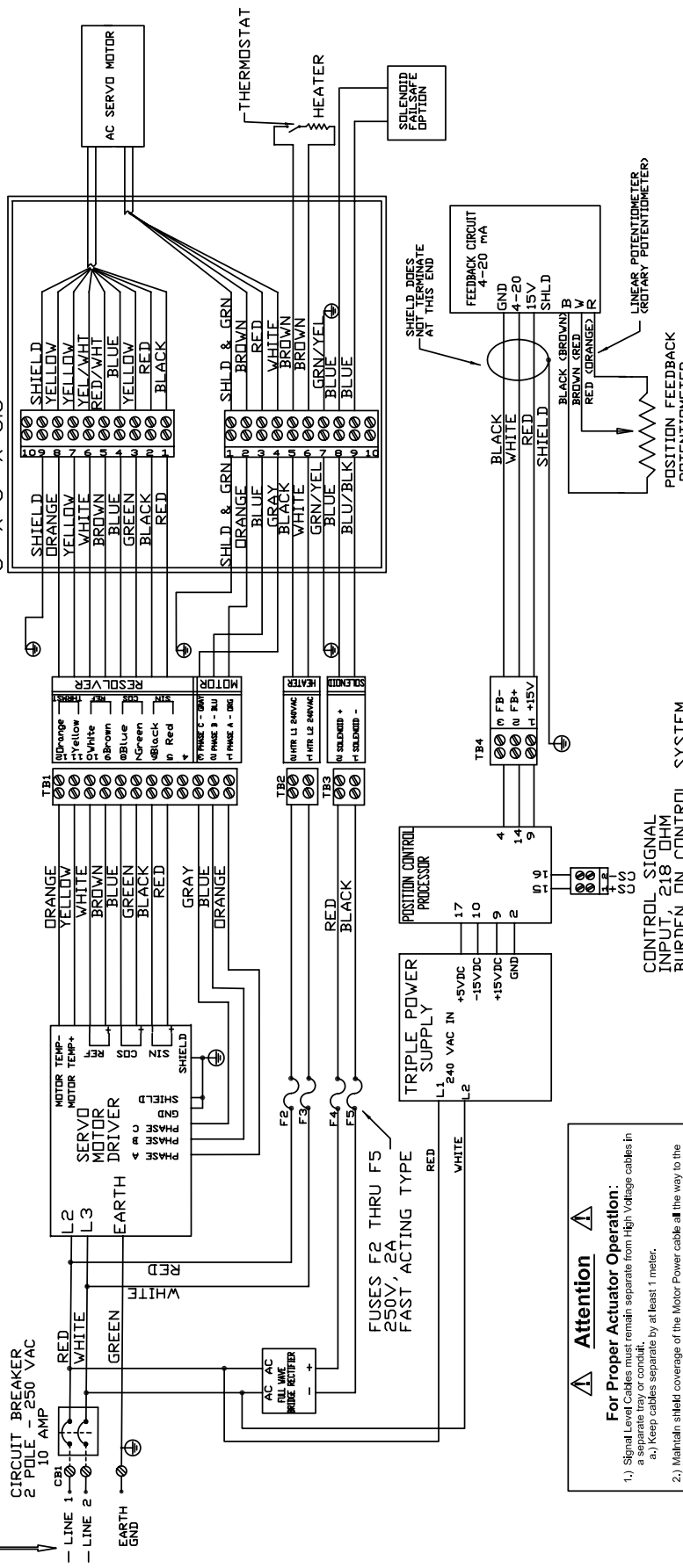
REV	DESCRIPTION	ECN NO	DISP	DATE	APVD
1	REVERSED SIN/COS DESIGNATION ON MOTOR DRIVER ADDED RESOLVER SIGNAL POLARITY		4	5/16/00	DPT
2	added attention note ADDED RESOLVER SIGNAL POLARITY		4	5/20/08	DPT

⊕ DENOTES TERMINATION TO EARTH GROUND
VIA ALUMINUM BACKPLANE

AC INPUT
240 VAC, -20/+10%
1 PHASE, 50/60 HZ,
10 AMP

CIRCUIT BREAKER
2 POLE, 250 VAC
10 AMP

JUNCTION BOX
MODULE #1
8" X 6" X 3.5"



Attention ⚠

For Proper Actuator Operation:

- Signal Level Cables must remain separate from high voltage cables in a separate tray or conduit.
 - Keep cables separate by at least 1 meter.
- Maintain shield coverage of the Motor Power cable all the way to the terminal block.
- Maintain shield coverage of the Signal cables all the way to the terminal block.
- REXA Motor and Power cables must be kept away from sensitive equipment and associated wiring by at least 1 meter.
- REXA Feedback cables must be at least 1 meter away from high voltage cables.

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CONTRACT No.		W. BRIDGE WATER, MASSACHUSETTS	
PREP	DPT	12/07/99	
CHKR	ENG	12/07/99	
APVD			
APVD			
RAW STOCK			
SIZE	PROD.CODE	NUMBER	REV
SCALE	NONE	D97096	2
SHEET		1 OF 1	



WIRING DIAGRAM
D SIZE ELECTRONICS
ACTUATOR INTERCONNECTION
PANEL DESIGN

