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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 REXA's state-of-the-art line of actuators.

The patented Flow Match System is simply described as a highly efficient method of pumping hydraulic fluid (motor oil Castrol 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 the actuator and enclosure are the module cable and the feedback cable.

ACTUATOR

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

The B and C modules are driven with a stepper motor and therefore have a slower frequency response then the D series modules which are driven with servo motors. More detailed information on the frequency response and flow rates can be found in product/technical memos. The only visible difference among all 4 sizes of modules is the motor.

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

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

CONTROL SUB-ASSEMBLY

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

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

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

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

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

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

Figure 1 Typical Control Enclosure

Standard Painted-Steel Enclosure Specifications for Single Module Actuators:

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

IEC 529, IP65 Construction

Table 1 Control Enclosure Terminal Blocks

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

Table 2 Actuator Terminal Blocks

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

OPERATIONAL SUMMARY

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

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

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

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

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

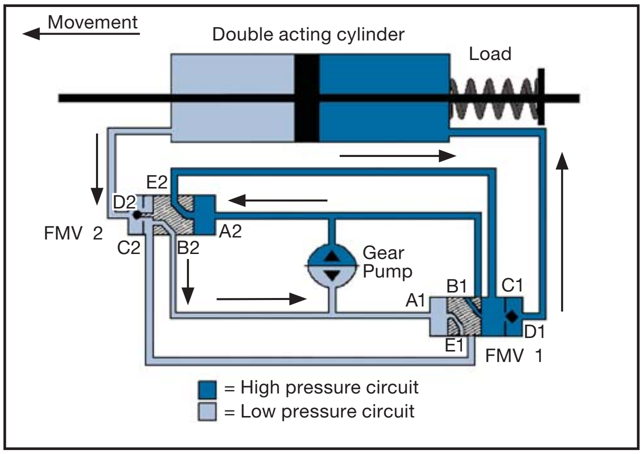

Figure 2 Hydraulic schematic

Each actuator has an internal hydraulic bypass circuit. This circuit creates a direct connection from one side of the hydraulic cylinder to the other. It is useful for relieving internal pressure in the actuator and allowing an external load to move the actuator. The nut labeled bypass on the actuator face as shown in Figure 3 controls this circuit. Turning this bypass in all the way puts the unit in its normal operation. Turning the bypass out 1 to 2 turns will open this bypass circuit.

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

Each pressure gauge on the actuator has its own on/off isolation valve. (See Figure 3.) This valve should remain off unless pressure is being read from the gauge. This will protect the gauge from constant cycling, thus extending its life. When closing this valve you will create an internal pressure trap in the gauge; therefore, you should not expect to see 0 psi when off.

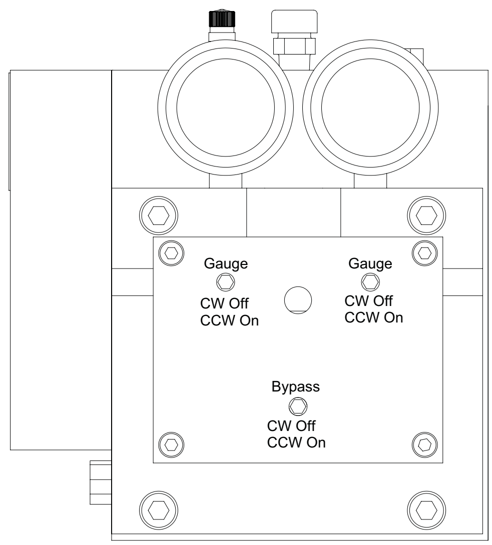

Figure 3 Bypass