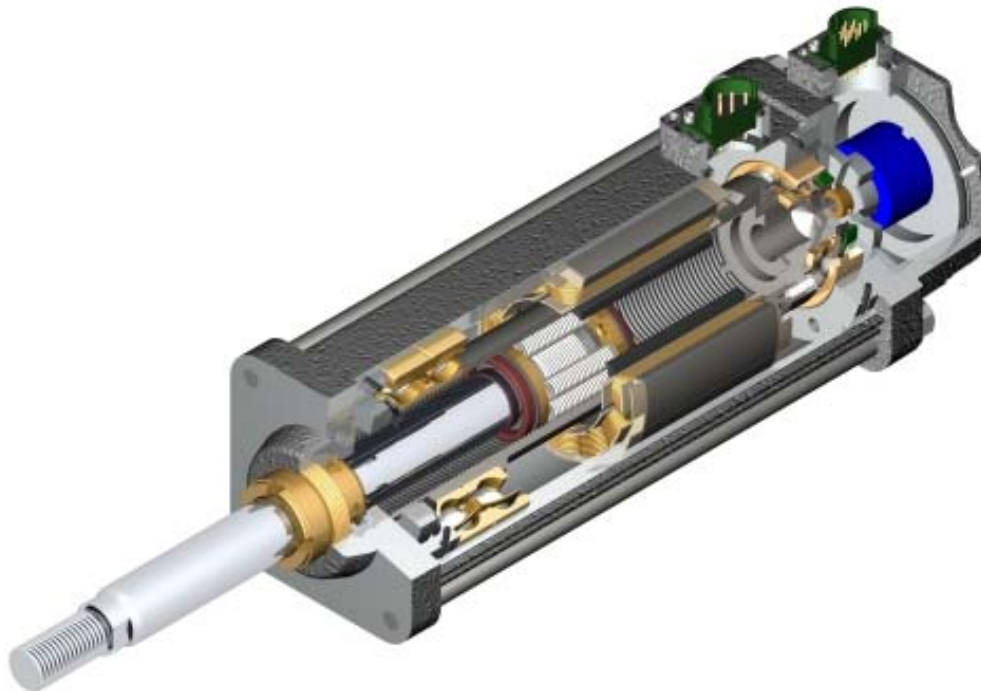


GSX and GS SERIES LINEAR ACTUATOR INSTALLATION AND SERVICE MANUAL



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Please visit www.exlar.com for information pertaining to connectors and cables.

1.0 INTRODUCTION

1.1 Warranty and Limitation of Liability

Products are warranted for two years from date of manufacture as determined by the serial number on the product label. Labels are generated and applied to the product at the time of shipment. The first and second digits are the year and the third and fourth digits represent the manufacturing week. Product repairs are warranted for 90 days from the date of the repair. The date of repair is recorded within Exlar Corporation's database tracked by individual product serial number.

Exlar warrants its product(s) to the original purchaser and in the case of original equipment manufacturers, to their original customer to be free from defects in material and workmanship and to be made only in accordance with Exlar's standard published catalog specifications for the product(s) as published at the time of purchase. Warranty or performance to any other specifications is not covered by this warranty unless otherwise agreed to in writing by Exlar and documented as part of any and all contracts, including but not limited to purchase orders, sales orders, order confirmations, purchase contracts and purchase agreements. In no event shall Exlar be liable or have any responsibility under such warranty if the product(s) has been improperly stored, installed, used or maintained, or if Buyer has permitted any unauthorized modifications, adjustments and/or repairs to such product(s). Seller's obligation hereunder is limited solely to repairing or replacing (at its opinion), at the factory any product(s), or parts thereof, which prove to Seller's satisfaction to be defective as a result of defective materials, or workmanship and within the period of time, in accordance with the Seller's stated product warranty (see Terms and Conditions above), provided, however, that written notice of claimed defects shall have been given to Exlar within thirty (30) days from the date of any such defect is first discovered. The product(s) claimed to be defective must be returned to Exlar, transportation prepaid by Buyer, with written specification of the claimed defect. Evidence acceptable to Exlar must be furnished that the claimed defects were not caused by misuse, abuse, or neglect by anyone other than Exlar.

Components such as seals, wipers, bearings, brakes, bushings, gears, splines, and roller screw parts are considered wear parts and must be inspected and serviced on a regular basis. Any damage caused by failure to properly lubricate Exlar products and/or to replace wear parts at appropriate times, is not covered by this warranty. Any damage due to excessive loading is not covered by this warranty.

The use of products or components under load such that they reach the end of their expected life is a normal characteristic of the application of mechanical products. Reaching the end of a product's expected life does not indicate any defect in material or workmanship and is not covered by this warranty.

Costs for shipment of units returned to the factory for warranty repairs are the responsibility of the owner of the product. Exlar will return ship all warranty repairs or replacements via UPS Ground at no cost to the customer.

For international customers, Exlar will return ship warranty repairs or replacements via UPS Expedited Service and cover the associated shipping costs. Any VAT or local country taxes are the responsibility of the owner of the product.

The foregoing warranty is in lieu of all other warranties (except as Title), whether expressed or implied, including without limitation, any warranty of merchantability, or of fitness for any particular purpose, other than as expressly set forth and to the extent specified herein, and is in lieu of all other obligations or liabilities on the part of Exlar.

Seller's maximum liability with respect to these terms and conditions and any resulting sale, arising from any cause whatsoever, including without limitation, breach of contract or negligence, shall not exceed the price specified herein of the product(s) giving rise to the claim, and in no event shall Exlar be liable under this warranty otherwise for special, incidental or consequential damages, whether similar or dissimilar, of any nature arising or resulting from the purchase, installation, removal, repair, operation, use or breakdown of the product(s) or any other cause whatsoever, including negligence.

The foregoing warranty shall also apply to products or parts which have been repaired or replaced pursuant to such warranty, and within the period of time, in accordance with Seller's stated warranty.

NO PERSON INCLUDING ANY AGENT OR REPRESENTATIVE OF EXLAR, IS AUTHORIZED TO MAKE ANY REPRESENTATION OR WARRANTY ON BEHALF OF EXLAR CONCERNING ANY PRODUCTS MANUFACTURED BY EXLAR, EXCEPT TO REFER PURCHASERS TO THIS WARRANTY.

1.2 Safety Considerations

As with any electro-mechanical device, safety should be considered during the installation and operation of your GS/X Series actuator. Throughout this manual you will see paragraphs marked with CAUTION and WARNING signs as shown below.

CAUTION



WARNING



Pay particular attention to these paragraphs. They are intended to provide you with helpful information to ensure safe and trouble-free installation.

2.0 SYSTEM CONFIGURATION

2.1 GS/X Series Actuator System Configuration

GS/X Series actuators incorporate an integral brushless servo motor. The design of this motor and selection of the proper feedback configuration allows GS/X Series actuators to be powered by nearly every brand of brushless motor amplifier on the market.

This flexibility allows GS/X Series actuators to be incorporated into the highest performance single and multi-axis motion control systems in use today. In applications varying from food and beverage packaging to multi-axis turning centers to aircraft assembly, the GS/X Series of actuators show incredible performance and durability.

The high torque to volume ratio available from a brushless motor, combined with the robust, high speed and high load capability of the planetary roller screw, make the Exlar line of linear actuators a true, all electric replacement for cumbersome high maintenance hydraulics. The use of electronic servo control provides simpler set up and more precise control than hydraulic systems as well. Shown below is a typical single axis system incorporating an Exlar GS/X Series actuator and a brushless motor amplifier.

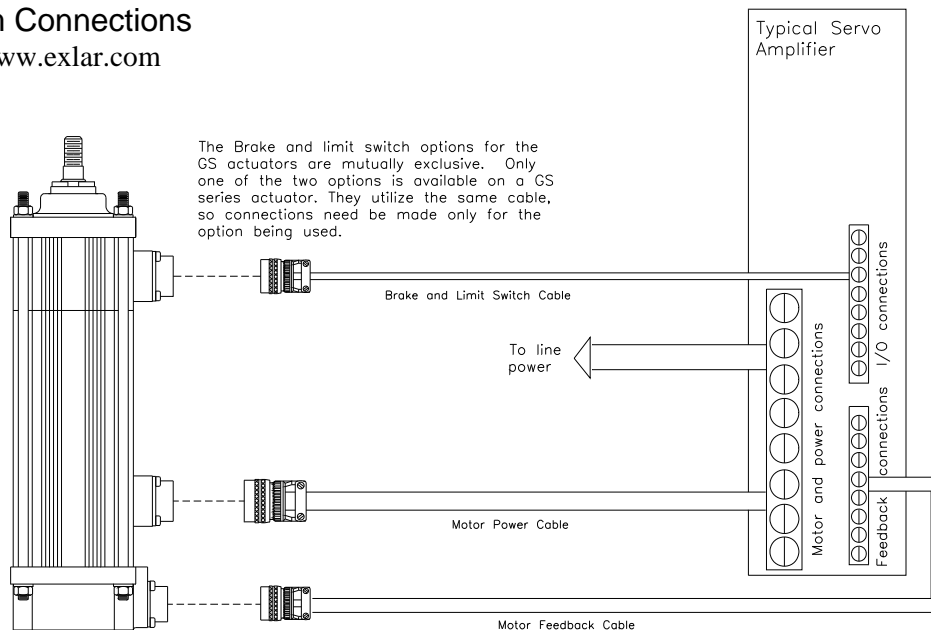
Each brand of brushless motor amplifiers may have unique wiring requirements, parameter settings and operational principles that affect how the actuator operates. The drawing on the following page shows general connection principles for typical resolver and encoder feedback amplifiers. Details on connections to specific brands of amplifiers can be obtained from www.exlar.com.



WARNING: Attempting to connect the power cable to the motor feedback connector may cause damage to the connector. Verify that pin patterns match before attempting to connect cables to actuator.

Never attempt to connect or disconnect the actuator with power applied. Dangerous voltages are present. Damage to equipment and injury to personnel can result. Many amplifiers have voltage present for a considerable time period after incoming power is removed. Take care to insure that the amplifier has discharged all power.

Typical System Connections (Please refer to www.exlar.com)



2.2 Standard Actuator Pin-outs and Connections

Please refer to www.exlar.com.

2.3 Feedback Information

Most GS/X Series actuators incorporate a 2 pole resolver or quadrature incremental encoder with commutation signals as the primary rotary feedback device. The selection of this feedback device is dictated by the amplifier used to operate the actuator. This amplifier is indicated in the model number of the GS/X Series actuator as a 3 digit code.

Each amplifier has specific requirements for the feedback on the motor. Not all resolver-based amplifiers can use the same resolver, resolver alignment, or relative direction of resolver rotation. Not all encoder-based amplifiers can use the same encoder, encoder alignment or relative direction of encoder rotation.

Many amplifiers offer software that allows the entering of parameters or the downloading of "motor data files" that dictate how the feedback must be set up on the motor. Exlar can provide many of these "motor files" or the proper parameters to enter. Entering motor parameter data to some amplifiers may require assistance from the amplifier manufacturer.

Feedback Alignment

When Exlar manufactures a GS/X Series actuator, the proper feedback is selected, mounted, aligned and test run on the amplifier that the customer plans to use, or one that is known to be equivalent for confirming proper feedback alignment and operation. In any case where it is determined that the feedback has become misaligned, or an amplifier change is made requiring the feedback to be aligned differently, it is recommended that Exlar be contacted and arrangements made to have that procedure performed.

Feedback Wiring

The wiring of the feedback device is critical to the operation of the actuator with the selected amplifier. Improperly wiring the feedback cable can cause unstable operation, incorrect operation or no operation at all. In some cases, improper current limits set in the amplifier, along with incorrect wiring of the feedback cable can lead to damage of the motor.

Resolvers

A resolver is a non-electronic device that works like a small transformer. When rotated, it generates two sine waves that are out of phase with one another. By decoding these two sine waves, the amplifier can monitor the direction, revolutions traveled, and speed of rotation of the motor. Each sine wave typically represents one revolution of the motor, so the amplifier can also use these signals to know where the motor is within that revolution. By knowing the motor's position, the amplifier can properly time the supply of current and voltage to the motor for it to rotate. This process is *commutation*. For the amplifier to properly commutate the motor, it must have a reference, or zero, point from which to track the motor's rotation. This reference point is critical, and is provided to the amplifier through the proper alignment of the resolver to the phases of the motor during the actuator assembly.

Encoders

An incremental encoder is an electronic rotary device that transmits a string of electrical pulses when rotated. Most brushless motors or servo systems that use incremental encoders use what is called a quadrature encoder. Typical brushless motor encoders use two data channels labeled A&B to provide direction, velocity and position information. The Channel labeled I or Z has one pulse per revolution and is called the index. The channels labeled as hall signals or commutation signals are typically labeled S1, S2 & S3; Hall 1, 2 & 3; or Hall A, B & C, depending on the manufacturer's conventions. These signals give the amplifier the commutation information that it needs to properly rotate the motor.

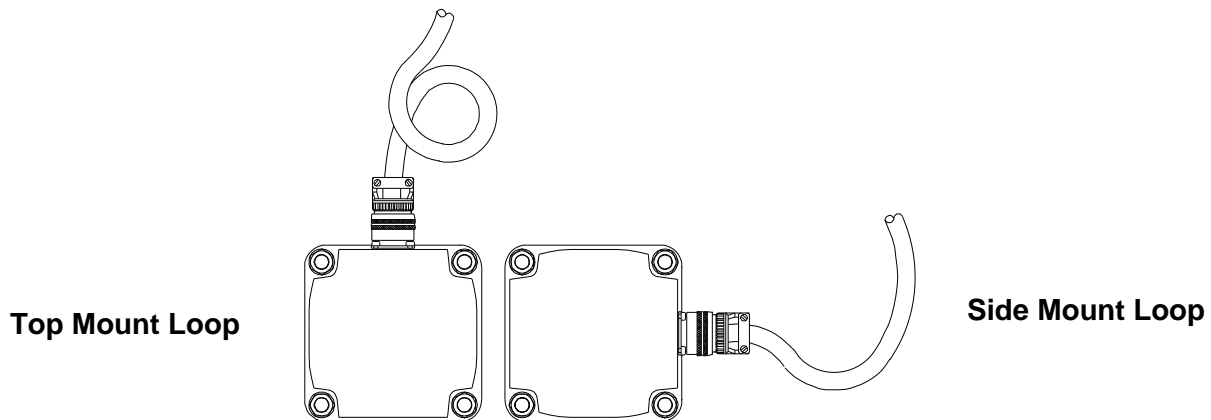
GS/X Series Feedback Devices

Standard GS/X Series actuators use either resolvers or encoders as their primary feedback device. Depending on the amplifier that will be used to operate the actuator, the hookup of the actuator can vary. Go to www.exlar.com, or contact Exlar for the correct wiring details.

2.4 Cable Routing

Over time, liquid contaminants such as oil and cleaning solutions will run down the cables and into the connectors if they are of an exposed type. To minimize the introduction of contaminants to the connector, route the cables so that there is a loop in the cable just prior to its attachment to the connector.

Two examples are shown below depending on the orientation of the connectors. Units mounted in such a way that the connectors are on the bottom surface of the actuator require no looping.



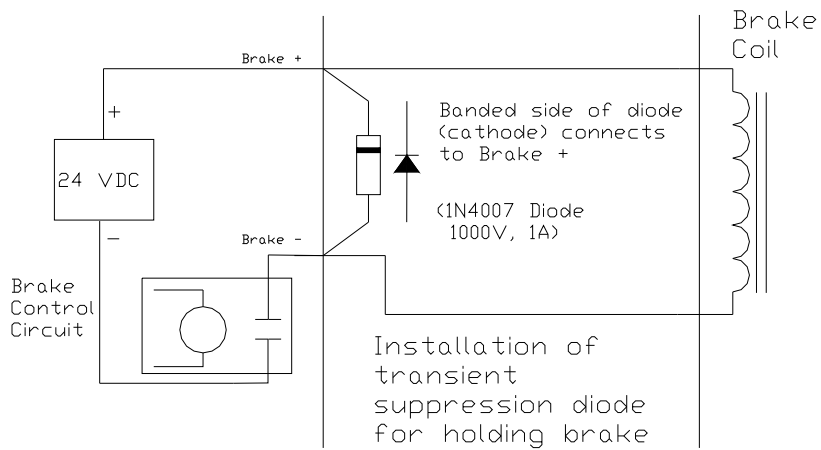
2.5 Internal Holding Brake

Many applications require the addition of the Exlar internal holding brake. The brake is held open by the supply of power to a magnetic/mechanical clutch. Whenever there is not power to the brake, the armature is held in place which prevents the inverted roller screw from turning and prevents the output rod from back driving, which in turn prevents the output rod from moving.

The RB holding brake is permanent magnet engaged, the EB is spring engaged and both are electrically released. The mechanical advantage of the roller screw allows the holding brake to prevent back driving of the load. The holding capacity of the brakes is sufficient to hold the rated force of the actuator when used in grease lubricated units. The use of oil as a lubricant reduces the holding capacity of the brake.

Historically, Exlar actuators and motors which had holding brakes are supplied with a transient suppression diode which can be wired to the actuator or motor brake connector. With the changes in servo amplifier and control technology, there are now instances where the diode is not required to be within the motor. An example of this is a control system using a dedicated brake control relay which contains transient suppression components.

Because of this change in technology, Exlar now provides the transient suppression diode separately from the actuator, for inclusion in the brake control circuitry as needed by the end user. A schematic, shown below, is provided with the shipped product showing the typical use of the transient suppression diode.



If the user is uncertain about their requirements for transient suppression, they should refer to their servo amplifier or controller technical documentation, or contact their servo amplifier or controller manufacturer for technical support.

For connection of your amplifier and actuator refer to www.exlar.com.

RB (Rear Brake) Specifications

BRAKE SPECIFICATIONS	GSX20	GSX30	GSX40	GSX50	GSX60
Holding torque (w/o oil)	19 lbf-in (2.2 Nm)	70 lbf-in (8 Nm)	97 lbf-in (11 Nm)	354 lbf-in (40 Nm)	708 lbf-in (80 Nm)
Current @ 24 VDC	0.75 Amps	0.75 Amps	0.88 Amps	1.0 Amps	1.3 Amps
Coil resistance (polarity sensitive)	113 Ohms	33 Ohms	27 Ohms	24 Ohms	21 Ohms

EB (Front Brake) Specifications

BRAKE SPECIFICATIONS	GS/X20	GS/X30	GSX40	GS45	GS/X60
Holding torque (w/o oil)	25 lbf-in (2.8 Nm)	40 lbf-in (4.5 Nm)	120 lbf-in (13.56 Nm)	80 lbf-in (9 Nm)	708 lbf-in (65 Nm)
Current @ 24 VDC	0.75 Amps	0.75 Amps	0.88 Amps	0.88 Amps	1.3 Amps



DO NOT attempt to operate the actuator with the brake applied. Allowing the actuator to operate with the brake applied may cause serious damage to the actuator and/or the brake. Do not use the brake to support heavy loads while an operator is under the load. Provide another means to lock the load in position. The brake is a spring applied friction mechanism and does not provide a positive lock.

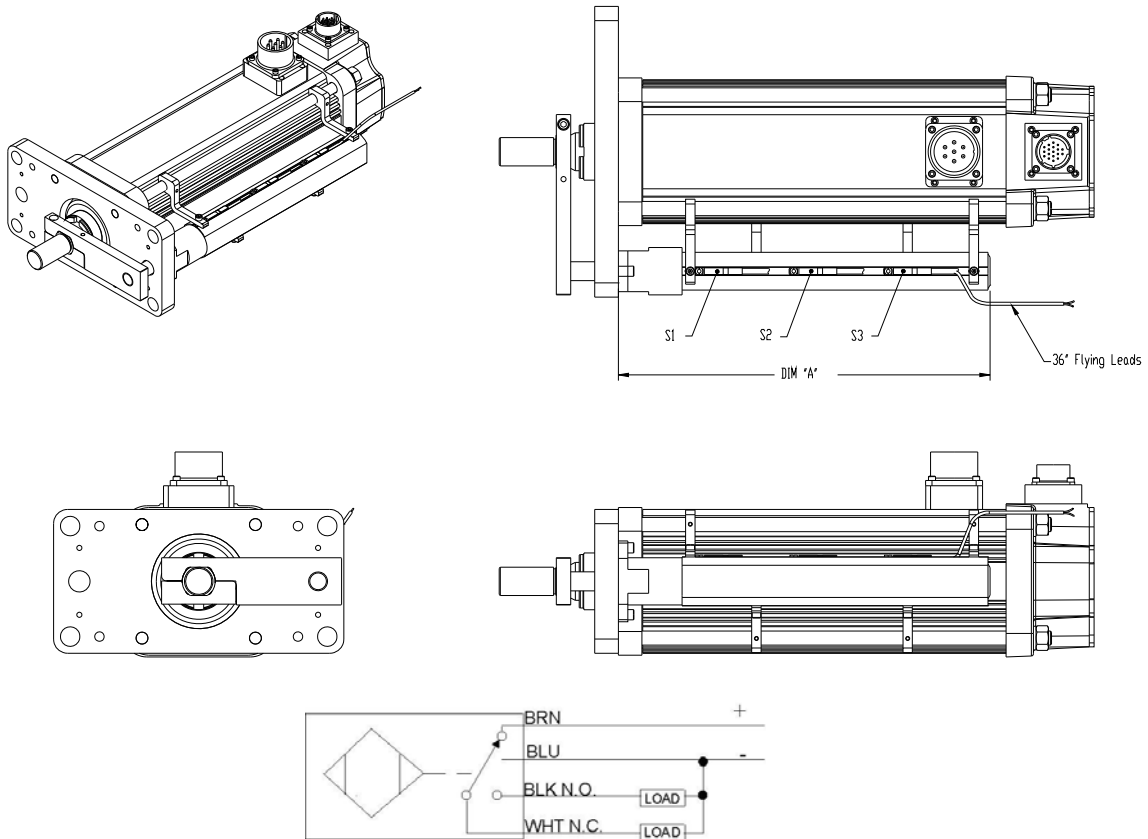
2.6 GS/X Linear Actuator External Limit Switch

With the anti-rotate option (Section 2.8) the GSX actuator can accommodate 1, 2 or 3 external limit switches for use as end of travel limit switches or home position sensors in a low profile extruded channel housing. A bracket with inductive proximity switches mounts to the tie rods and senses a traveling magnet inside the extrusion.

The number of switches desired is selected by ordering the L1, L2 or L3 option, in which 1, 2 or 3 switches will be provided, respectively.

The switches are 9-30 VDC powered, PNP output, with either normally open or normally closed logic operation depending on the switch configuration ordered. Below is a diagram indicating which logic operation will be provided for each switch, based on the option ordered.

External Limit Switch Locations



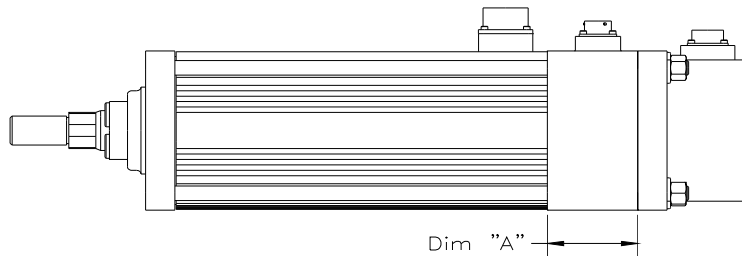
DIM "A"	3" Stroke	6" Stroke	8" Stroke	10" Stroke	12" Stroke	14" Stroke	18" Stroke
GSX20	5.515	8.515	n/a	12.500	14.515	n/a	n/a
GSX30	6.932	9.832	n/a	13.832	15.832	17.832	21.832
GSX40	n/a	9.832	11.83	13.832	15.832	n/a	21.832
GSX50	n/a	11.667	n/a	15.667	n/a	19.667	n/a
GSX60	n/a	10.461	n/a	14.461	n/a	n/a	n/a

CONFIGURATION OF LOGIC OF STANDARD SWITCH OPTION SELECTIONS			
Option	SW1	SW2	SW3
L1	Not Supplied	Normally Open	Not Supplied
L2	Normally Closed	Not Supplied	Normally Closed
L3	Normally Closed	Normally Open	Normally Closed

Switch Type	Exlar Part Number	Turck Part Number
Normally Closed Switch	43404	BIM-UNT-RP6X
Normally Open Switch	43403	BIM-UNT-AP6X

2.7 GS/X Linear Actuator Brake Extensions

The brake option may add a third connector to the actuator and require a case extension to accommodate the internal components. Option also slightly reduces the available stroke from the actuator. The case extension dimension and stroke reductions are shown below.



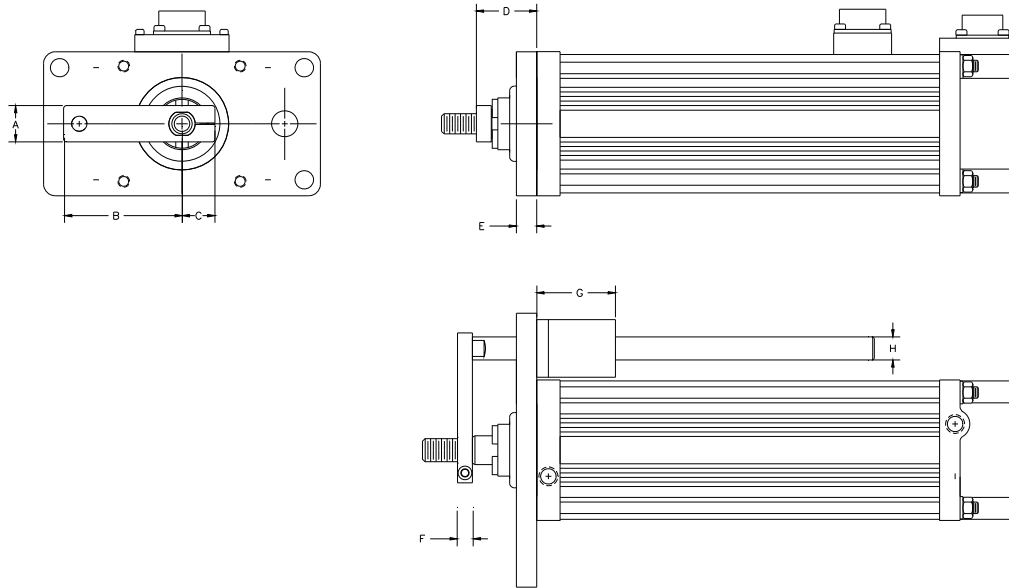
GSX Actuator	A – Brake Length Ext.	GS Actuator	A – Brake Length Ext.
GSX20	1.78 in (45.21 mm)	GS20	1.78 in (45.21 mm)
GSX30	1.61 in (40.9 mm)	GS30	1.77 in (44.96 mm)
GSX40	2.33 in (59.18 mm)	GS45	2.498 in (63.45 mm)
GSX50	2.5 in (63.45 mm)	GS50	3.544 in (90.02 mm)
GSX60	3.575 in (90.81 mm)		

2.8 GS/X Series Linear Actuator Anti-rotation Option

The unique design of the GS/X Series linear actuators allows the extending rod to rotate. This provides simple setup of the actuator by allowing the user to rotate the rod and thread it in and out of the actuator for mechanical attachment or system testing. This feature also requires that the rod be kept from rotating when used in its dedicated application to insure proper linear motion. In most applications, such as those where the load is coupled to linear bearings, or some other support device, the load cannot rotate, and thus provides anti-rotation for the extending rod of the actuator.

For applications in which the load is free to rotate, Exlar offers the anti-rotation systems shown below. The drawings next page show the rod and bushing on only one side of the actuator. For long stroke actuators, the rod and bushing are required on both sides of the actuator.

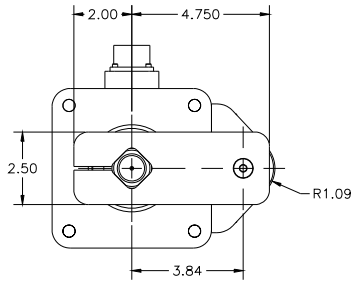
Anti-rotate Dimensions GS/X20, 30, 40, 45 and 60 (For GSX50 see next page)



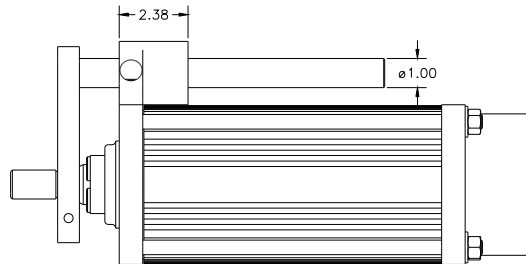
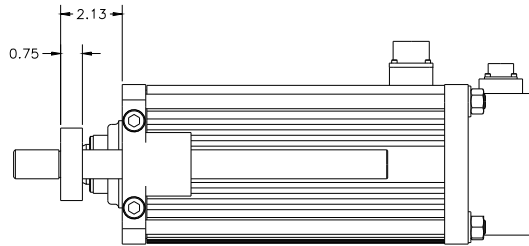
Dimensions in (mm)	GS/X20	GS/X30	GS/X40 and 45	GS/X60
A	0.60 (15.2)	0.79 (20.1)	1.25 (31.8)	1.75 (44.5)
B	1.81 (46.0)	2.54 (64.5)	3.78 (96.0)	5.79 (147)
C	0.54 (13.7)	0.71 (18.0)	0.98 (24.9)	1.55 (39.4)
D	1.00 (25.4)	1.30 (33.0)	1.64 (41.7)	1.94 (49.3)
E	0.44 (11.2)	0.44 (11.2)	0.63 (16.0)	0.75 (19.1)
F	0.28 (7.11)	0.32 (8.13)	0.38 (9.65)	0.50 (12.7)
G	0.31 (7.87)	1.69 (42.9)	1.69 (42.9)	2.81 (71.4)
H	0.37 (9.40)	0.50 (12.7)	0.50 (12.7)	1.00 (25.4)

For GSX50 anti-rotate dimensions, see page 12.

Anti-rotate Dimensions (GSX50)



2.8 GS/X Series



2.9 Ingress Protection Rating

The standard IP rating for GS/X Series actuators is IP65S. Ingress protection is divided into two categories; solids and liquids. For example, in IP65 the three digits following “IP” represent different forms of environmental influence:

- The first digit represents protection against ingress of solid objects.
- The second digit represents protection against ingress of liquids.
- The suffix digit represents conditions of motion during the operation.

Digit 1 - Ingress of Solid Objects

The IP rating system provides for 6 levels of protection against solids.

1	Protected against solid objects over 50mm e.g. hands, large tools.
2	Protected against solid objects over 12.5mm e.g. hands, large tools.
3	Protected against solid objects over 2.5mm e.g. wire, small tools.
4	Protected against solid objects over 1.0mm e.g. wires.
5	Limited protection against dust ingress. (no harmful deposit)
6	Totally protected against dust ingress.

Digit 2 - Ingress of Liquids

The IP rating system provides for 9 levels of protection against liquids.

1	Protected against vertically falling drops of water or condensation.
2	Protected against falling drops of water, if the case is disposed up to 15 degrees from vertical.
3	Protected against sprays of water from any direction, even if the case is disposed up to 60 degrees from vertical.
4	Protected against splash water from any direction.
5	Protected against low pressure water jets from any direction. Limited ingress permitted.
6	Protected against high pressure water jets from any direction. Limited ingress permitted.
7	Protected against short periods of immersion in water of 1m or less for 30 minutes or less.
8	Protected against long durations of immersion in water.
9	High-pressure, high-temperature wash-down applications.

Suffix

S	Device standing still during operation
M	Device moving during operation

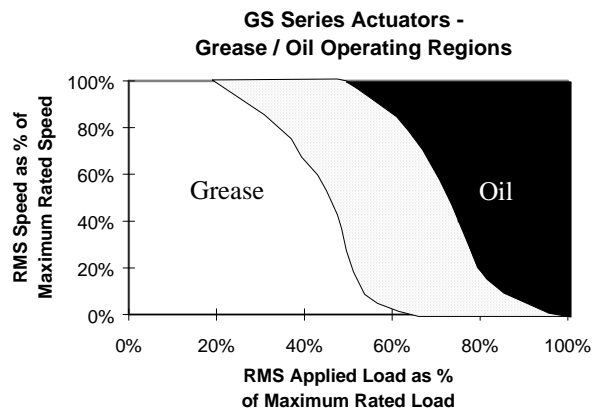
3.0 INSTALLATION AND OPERATION

3.1 Lubrication Requirements

GS/X Series actuators require either grease or oil lubrication. Actuators that operate in the lower range of their performance capabilities may use grease. Oil lubrication is required for actuators that will be running near the upper end of their performance limits. Recirculating oil provides lubrication and cools the actuator.

Determining if an application will require oil or grease lubrication should be done prior to ordering the actuator.

The following chart can be used to help determine oil vs. grease lubrication requirements:



3.2 Grease Lubrication

If your application uses grease lubrication, the actuator is shipped from the factory fully greased and ready for installation. Exlar recommends using Mobilith SHC 220, a high performance, extreme-pressure grease. The unique physical properties of the synthetic base oil provide outstanding protection against wear, rust, corrosion and high or low-temperature degradation. Mobilith SHC allows for very low starting and running torque values. Its operating range is -40 degrees C to 177 degrees C (-40 degrees F to 350 degrees F).

3.3 Oil Lubrication for High Power / Low Maintenance Operation

Consult Exlar to discuss your application if you plan to use oil cooling with your GSX actuator.

Exlar GSX actuators are delivered as standard with high performance lithium grease. This provides for capability to provide thousands of hours of service between re-lubrication periods in most applications.

Some applications into which GSX actuators are deployed involve high speed and high cycle rate with high acceleration, high force or a combination. To provide cooling of the motor within the GSX actuator for operation at the elevated current levels needed to perform these applications, GSX actuators can be configured to be used with recirculated oil lubrication. Using oil lubrication requires only low flow rates and low pressures to provide significant additional cooling.

There are several application and actuator configuration details that are involved in using a GSX with oil cooling, and any application that will use oil cooling must be discussed with Exlar Application engineering so that the correct actuator options can be selected, and the details of the application reviewed.

In linear actuator applications where high speed motion exists it is possible that the internal movement of the roller screw follower will act as a pump and create oil pressure higher than allowed. Take care that the oil pressure is monitored during cycling. If it appears that the pumping action of the actuator is causing spikes in the oil pressure it is recommended that the customer work directly with Exlar Engineering to determine if actuator configuration changes or application changes are required.

In all cases the reservoir in the lubrication system must be located below the level of the actuator to prevent the “filling up” of the actuator.

There is a high likelihood that over time as a result of seal wear and hardening, both external and internal leaks will develop. This will allow the movement of small amounts of oil to undesirable locations, specifically the encoder compartment and/or output rod. Exlar uses the finest quality linear rod seals available, rated for pressures beyond what should normally exist inside the actuator, however, over time you may find small amounts of oil on the output rod (linear) or shaft (rotary) which escaped through the output rod or shaft seal. In some cases this may accumulate to form an occasional drip.

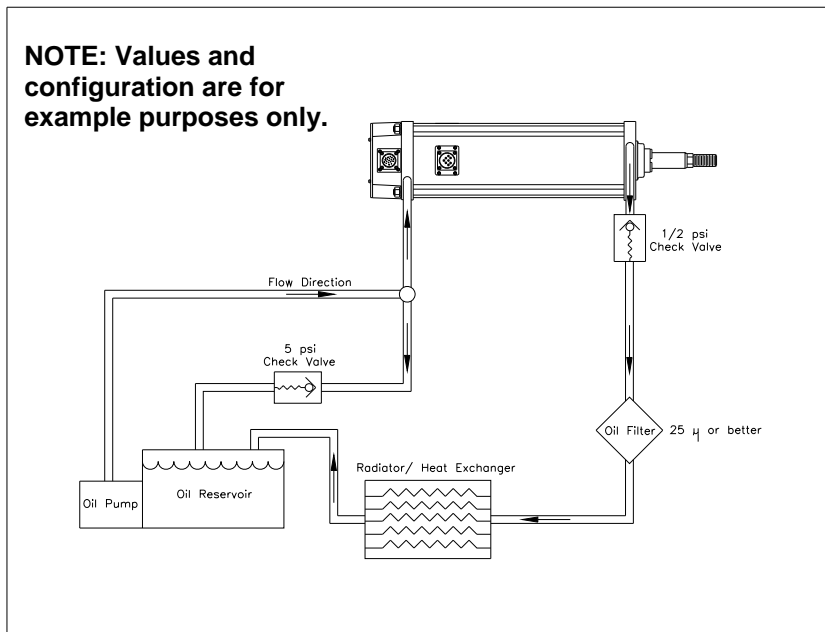
This becomes more critical when oil passes the feedback section seal and begins to accumulate in the feedback compartment of the actuator. Over time this oil may migrate to the encoder (if an encoder is used) potentially causing a failure of the feedback device. To avoid this intrusion situation and a possible untimely actuator failure, it is highly recommended that a drain port be provided in the feedback section of the actuator any time oil flow lubrication/cooling is employed. Since the oiling system reservoir is located below the actuator, the drive can be hooked directly to the reservoir with a plastic housing. It is recommended to work with Exlar Application Engineering to determine the best actuator configuration for your application.

A schematic of a possible example oil system is shown below. Exlar Application Engineering can assist you in the development of your own oil system, or suggest pre-packaged oil circulation systems.



The maximum allowable internal oil pressure for the GS/X Series actuators is 10 psi. Take care to insure that this pressure limit is maintained. Failure to do so may cause damage to the internal sealing components.

Example Oil System Schematic



As shown in the schematic to the left, a check valve or other method of pressure regulation should be used to maintain an internal actuator oil pressure of 5 psi.

Filtering of 25 microns or better should be used. Simple radiators or heat exchangers can be used to maintain oil temperature.

Exlar can recommend the appropriate oils for your specific application.

3.4 Mounting Configurations

The GS/X Series actuators come with a variety of mounting configurations. The standard configurations available are Side Mount, Extended Tie Rods, Rear Clevis and Front Flange. Side Mounted Trunnions are also available for some units. Certified drawings are available from Exlar. General drawings are shown in the Exlar catalog.

3.5 Mounting Considerations

Every effort should be made to minimize misalignment as much as is possible. Misalignment of the GS/X Series actuator with respect to whatever load the actuator is being used to move is of great concern. Any misalignment will decrease the life of the components within the actuator and also may create problems within the application associated with misalignment.



Excessive side load on the output rod of the actuator will dramatically reduce the life of the actuator and should be avoided completely. Side load can be caused from misalignment or loading that is not inline with the actuator output rod.

A GS/X Series actuator with the Side Mount option comes with threaded holes in the faceplate and endplate. Exlar recommends using hardened fasteners to mount a GS/X Series actuator to your machine frame. Exlar also recommends threading the mounting fastener into as much of the threaded hole in the actuator as possible, to prevent stripping out the threads in the actuator's mounting holes.



Note: Side Mount actuators may have reduced maximum load rating.

A GS/X Series actuator with the Extended Tie Rod mounting option comes with hex nuts on the faceplate that are tightened down enough to keep the actuator together during shipping. When mounting the actuator to your machine, these nuts should be removed and the tie rods should be placed through the machine frame and the nuts used on the back side of the machine's mounting flange. The tie rod nuts should then be tightened with a torque wrench to the following values:

GS/X20: 20 lbf-in (1.7 lbf-ft, 2.26 N-m)
GS/X30: 90 lbf-in (7.5 lbf-ft, 10.16 N-m)
GS/X40 and 45: 240 lbf-in (20 lbf-ft, 27.12 N-m)
GSX50: 600 lbf-in (50 lbf-ft, 67.79 N-m)
GS/X60: 600 lbf-in (50 lbf-ft, 67.79 N-m)



Failure to properly tighten the tie rods can cause damage to the actuator and possible premature failure. Over-tightening of the tie rods can cause damage to the actuator and affect normal operation.

3.6 General Operation

The GS/X Series linear actuators function in the same manner as a brushless servomotor. The servo amplifier is used to rotate the motor at controlled speed and torque, and for controlled numbers of revolutions and move times. This rotary motion is translated into linear motion by the internal planetary roller screw mechanism of the GS/X Series linear actuator.

See sections 2.6, 2.7 and 2.8 regarding the holding brake, external limit switches and anti-rotate mechanisms, that can affect the operation and motion of the actuator.

The relationship between the rotary motion of the motor and the linear motion of the actuator corresponds to the following relationships:

$$\text{Linear Distance Traveled (in)} = (\text{Motor Revolutions}) * (\text{Roller Screw Lead})$$

$$\text{Linear Speed (in/sec)} = ((\text{Motor RPM}) / 60) * (\text{Roller Screw Lead})$$

$$\text{Linear Force (lbf)} = ((\text{Motor Torque (in-lbf)}) * (2\pi) * (\text{efficiency})) / (\text{Roller Screw Lead (in)})$$

All of the above relationships require proper anti-rotation of the GS/X Series actuator rod.

For more information on sizing and selection of GS/X Series actuators and servo amplifiers to power them, consult the sizing and selection section of the Exlar catalog.



Motor RMS current must be maintained at a level below the continuous current rating of the GS/X Series actuator or damage to the motor stator will result.

The peak current setting must be maintained at a level below the peak current rating of the GS/X Series actuator or damage to the stator will result.



Care should be taken not to exceed the physical travel limits of GS/X Series Actuators. Doing so will cause the actuator to end-crash internally. End crashes can physically damage the roller screw and the internal components of the actuator. Care should be taken to avoid high speed impact with objects of high rigidity that immediately stop the travel of the actuator with no deceleration or energy absorption. An example would be a high speed impact of two solid steel parts. The resulting impact will create a very short effective deceleration time. Kinetic energy contained in the rotating inertia of the actuator and motor can possibly generate extremely high impact forces that exceed the mechanical capacities of the actuator and cause physical damage to the actuator. For applications requiring this type of impact, contact Exlar application engineering to insure that the actuator is properly sized or provisions made to absorb the induced energy.

3.7 Manual Drive Operating Instructions

Important:

If manually driving through a brake or high force is necessary, please consult Exlar engineering.

If a power tool is used to operate the manual drive the speed should be limited to 600 RPM

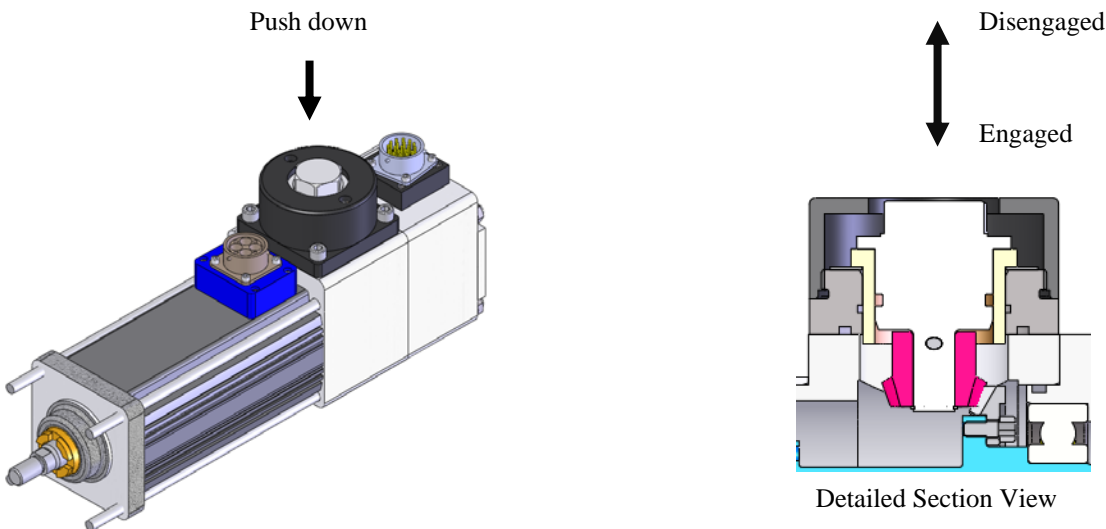
An impact driver should never be used to operate the manual drive.

Extreme caution should be taken when approaching end of stroke of the actuator or system.

- 1) Press down on the hex until you feel you have bottomed out the manual drive. Constant downward force is required to maintain engagement during operation.
- 2) Give the hex a slight turn while observing if you are moving the rod or not. It is possible that during engagement the gear teeth have not completely engaged; this will prevent the gears from meshing. If the rod is not moving continue to press down while turning the manual drive slowly until it pushes farther down. When this happens you have proper gear engagement.
- 3) After gear engagement is achieved, the manual drive can be operated. The maximum torque input for the manual drive should not exceed the values shown in Table 1.
- 4) When the manual drive movement is completed, cease the downward force and the manual drive will disengage.

Table 1. Maximum operating conditions

Model	Maximum Torque in-lbs / (Nm)
GSX 20	10 / (1.1)
GSX 30	30 / (3.4)
GSX 40	40 / (4.5)
GSX 50	80 / (9.0)
GSX60	105 / (11.8)



4.0 MAINTENANCE PROCEDURES

4.1 Disassembly



If your actuator has a preloaded roller screw, do not remove it from the cylinder. Preloaded screws require special tooling and procedures for proper disassembly and reassembly. Contact Exlar Corporation to arrange for maintenance of a preloaded screw actuator.

Refer to the exploded view on the following page.

- 1.) Remove the actuator assembly from the machine by disconnecting the cables, main rod coupling and actuator mounting bolts or fasteners.
- 2.) If your unit does not have an external anti rotate assembly, skip this step. Loosen the two machine screws that clamp the anti-rotate cross member to the actuator output rod. Slide the anti-rotate mechanism forward and off the actuator.
- 3.) Remove the rear tie rod nuts from the back of the actuator.



Extreme care should be taken when removing the tie rod nuts or tie rods so as not to twist or pull on the end cap of the actuator. The end cap houses the feedback device. Alignment of this feedback device to the phases of the motor is critical to the operation of the system. Some feedback devices are sensitive to movement of their mounting surface once installed and can be damaged if care is not taken.

- 4.) If your actuator does not have a front flange, skip this step. Slide the front flange forward and off the actuator. The tie rods will remain attached to the front flange.
- 5.) **If your actuator has an internal brake or internal limit switches, read the following three paragraphs before proceeding.** Remove the faceplate from the actuator by gently pulling it forward. It is sealed by an O-ring, and does require some force to remove. Take care not to damage the front seal on the threads of the actuator output rod when removing the faceplate.

Limit Switches

If your unit has internal limit switches, you will see that there is an extension of the actuator case that houses the limit switches and has the limit switch connector mounted to it. This case extension has a cylindrical assembly inside it with mounting surfaces for the limit switches. Carefully pull this entire assembly (case extension and face plate) forward to remove it from the actuator. The mounting assembly for the switches is not fastened to the case extension, so remove it slowly and ensure that all of the parts are moving together so that damage is not done to the switches or their wires.

Electric Brake

For units that have the EB option, there is also a case extension similar to the limit switch option. The brake housing is fastened to the back of the faceplate. The faceplate, case extension and brake housing can be removed together by gently pulling the case extension and faceplate forward. With the brake assembly

removed, you will see the brake spline attached to the roller screw cylinder. Remove the screws for the spline assembly and remove it from the roller screw cylinder.

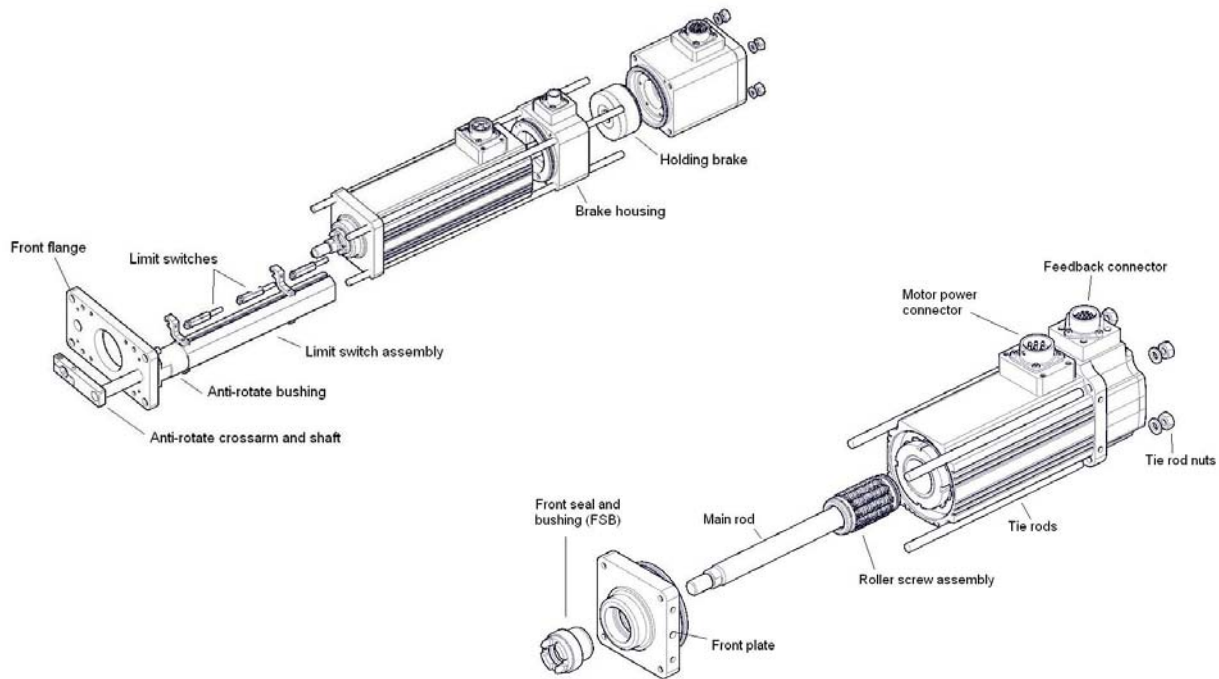
The RB option requires removal of the feedback device to access and Exlar should be consulted for assistance, or the unit returned to Exlar.



If your actuator has a preloaded roller screw, do not remove it from the cylinder. Preloaded screws require special tooling and procedures for proper disassembly and reassembly. Contact Exlar Corporation to arrange for maintenance of a preloaded screw actuator.

6.) When the face plate and limit switch or brake assembly (including spline) is removed, the thrust bearing and the open end of the roller screw internally threaded cylinder (ITC) are visible. The roller screw can be removed by turning it counter clockwise and threading it out of the cylinder. It may be necessary to hold the roller screw cylinder from turning to remove the screw.

Exploded View of GS Series Actuator



4.2 Lubrication Maintenance

Grease lubricated units will require periodic inspection and renewal of the bearing and roller screw grease. The table below shows the recommended grease renewal period.

RMS Rotational speed(RPM)	Recommended Grease Renewal Period hours)		
	CASE TEMP 65 degrees C (149 degrees F)	CASE TEMP 80 degrees C (176 degrees F)	CASE TEMP 95 degrees C (203 degrees F)
250	10,000	5,000	2,500
500	8,500	4,250	2,125
1000	6,000	3,000	1,500
1500+	3,500	1,750	875

Grease Renewal

The angular contact thrust bearings located in the front of the actuator, the roller screw cylinder, and the roller screw assembly are the components that require grease. They require a coating of grease. They do not need to be packed with grease. Excess grease only requires more torque from the motor when returned to operation, and does not improve the lubrication of the unit.

- 1.) Use a brush to work approximately 0.5 in³ of grease for every 3 inches of stroke length into the roller screw cylinder. Be sure to cover all of the threaded areas of the cylinder.
- 2.) Use a brush to work grease in to the roller screw assembly. Be sure to cover all the threaded surfaces of the screw assembly. This can be accomplished by applying grease to a few places on the roller screw assembly and rotating the components repeatedly in both directions to work the grease into the assembly.
- 3.) Force grease into the front of the thrust bearing assembly. Make a concerted effort to insure that the grease is well worked in. Grease must reach the bearing just behind the bearing that is visible as well. Use the following amounts of grease for each size roller screw and bearing:
GS/X20: 0.5 in³ **GS/X30:** 0.75 in³ **GS/X40/45:** 1.0 in³ **GSX50:** 1.5 in³ **GS/X60:** 2.0 in³

Oil Lubrication

It is recommended to regularly check the oil during operation to insure that it is flowing properly and maintaining case temperature. It is also recommended to check the lubrication regularly to insure that the lubricant being supplied to the actuator is clean. A filtering system is required, 25 microns or better filtering is recommended.

4.3 Reassembly

- 1.) Rethread the roller screw into the internally threaded cylinder (ITC). It is a multiple start screw, and this is not always easy. **DO NOT FORCE THE ROLLER SCREW INTO THE CYLINDER.** It is best to have the actuator vertical with the open end of the roller screw cylinder facing up. Position the roller screw above the cylinder so that it is aligned axially with the ITC. Slowly turn the roller screw 1/4 to 1/2 turn counterclockwise while in contact with the ITC. This will help to align the threads on the roller screw with the threads in the ITC. Rotate the roller screw clockwise and it should begin to thread into the cylinder. If it does not turn freely, remove it and begin again. When threading the screw into the cylinder, it will roll freely into the actuator. When it reaches the portion of the cylinder that contains the motor magnets, the roller screw will be more difficult to turn because of the magnetic field of the magnets. **THIS IS NORMAL.** Continue to thread the roller screw into the cylinder. When it reaches the bottom, it will become difficult to turn and the motor and bearings will begin to rotate with it. The roller screw is now fully inserted into the cylinder.
- 2.) Place a small amount of seal lubricant on the inside surface of the seal/bushing assembly.
- 3.) Replace faceplate and case extension:

Units Without Electric Brake or Limit Switch Options

Carefully slide the faceplate and bushing/seal assembly over the actuator rod end, while guiding the tie rods through the holes in the rear end cap of the actuator. The seal is a tight fit on the rod end. Take care not to damage the seal on the threads of the extending rod. Standard GS/X Series rods have a chamfer to provide a lead in for replacement of the seal and bushing. Be sure that the faceplate seats completely and squarely on the front of the actuator. The inner surface of the faceplate provides the pre-loading for the bearings, and it is important that it is properly seated.

Units With a Front Flange

Replace the faceplate. Remount front flange by sliding tie rods through the holes in the faceplate and through the holes in the rear end cap. Place the flange on the pilot diameter located on the front of the faceplate.

Units With Limit Switches

Carefully replace the faceplate and case extension taking care not to damage the seal on the threads of the rod end. Be sure to seat the mating portion of the case extension fully and squarely into the actuator housing. The inner surface of the case extension provides the pre-loading for the bearings, and it is important that it is properly seated. If the tie rods are attached to the faceplate, slide them through the holes in the end cap of the actuator.

Units With an Electric Brake

If power was removed from the brake when the actuator was disassembled, the mating spline should be centered and in position to be remounted to the brake spline.

Remount the spline assembly to the roller screw internally threaded cylinder (ITC). Re-install the screws using Loc-tite 22231, and tighten to secure spline assembly in place. It is important to insure that the brake spline is square and fully seated when remounted to the cylinder.

With the spline assembly remounted to the roller screw cylinder, slide the brake housing and case extension onto the actuator. Take care not to damage the seal on the threaded portion of the rod. The mating of the two spline halves is a very tight fit and can make reassembling a brake unit very difficult. Press the case extension and brake assembly onto the actuator housing so that the splines mate, and the case extension seats fully. If the case extension does not seat fully the spline halves are not mated and the brake will not work properly. When the contact between the brake halves is felt, gently rotating the actuator extending rod clockwise until it has traveled fully into the actuator can rotate the roller screw cylinder. To achieve proper alignment of the spline halves, slowly rotate the cylinder while pressing the brake extension onto the actuator. As the splines align, the brake extension will fully seat onto the main actuator housing.

4.) Replace the rear tie rod washers and nuts and tighten to the proper torque. Tighten the nuts simultaneously by partially tightening each in an opposing corner pattern until each is torqued to the rated value shown below.

GS/X20: 20 lbf-in (1.7 lbf-ft, 2.26 N-m)

GS/X30: 90 lbf-in (7.5 lbf-ft, 10.16 N-m)

GS/X40/45: 240 lbf-in (20 lbf-ft, 27.12 N-m)

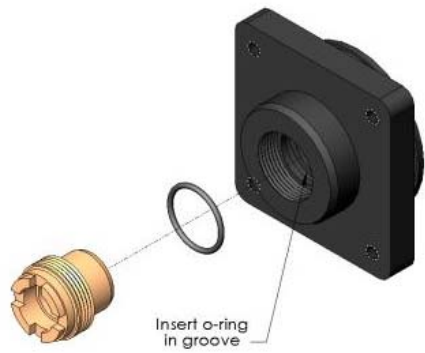
GSX50: 600 lbf-in (50 lbf-ft, 67.79 N-m)

GS/X60: 600 lbf-in (50 lbf-ft, 67.79 N-m)

5.) If your actuator has an external anti-rotate mechanism, slide the rod of the anti-rotate mechanism rod or rods through the front flange and into the guide bushing or bushings mounted to the rear of the flange. Position the extending rod so that the wrench flats are parallel to the long side of the flange. Slide the cross member assembly of the anti-rotate mechanism over the end of the rod and onto the wrench flats. Tighten the two screws that clamp the assembly to the actuator rod.

4.4 Seal Maintenance

It is recommended that at the suggested time of lubrication the main rod seal and bushing assembly be replaced. The main rod seal can be removed by threading it out of the face plate using a standard rod seal gland wrench or spanner wrench. A new main rod seal can be slid over the main rod, taking care not to touch the seal material to the threaded rod end. To have this service performed for you, contact Exlar Engineering or arrange with Exlar Returns Department to send your unit in for service.



Main Rod Gland Seal and Bushing

Seal Kits for Grease-Lubricated Actuators

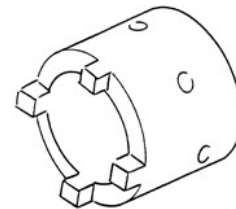
	Standard Main Rod Seal Gland Part Numbers	Install Torque
GSX20	18929	100 lb-in (11.29 N-m)
GSX30	19020	200 lb-in (22.58 N-m)
GSX40/GSX45	19021	360 lb-in (40.67 N-m)
GSX50	22706	660 lb-in (74.57 N-m)
GSX60	19022	900 lb-in (101.69 N-m)

Note: Some actuators are provided with special rod gland seals due to chemical exposure or other special requirements. Contact Exlar if there is a question about your particular actuator having a standard material seal.

Main Rod Seal Gland Installation/Replacement:

1. Using proper sized gland or spanner wrench, remove existing seal from actuator face plate, and slide off the actuator rod. This will require the removal of any rod attachments. One source for gland wrenches is Martin Fluid Power. http://www.mfpseals.com/seal_repair_kits/parker-2.shtml

Exlar Actuator Model	Martin Fluid Power Part No.	Size (in)	Description
GSX20-30	PH-0695900000	1/2, 5/8	Rod Gland Wrench
GSX40	PH-0695910000	1	Rod Gland Wrench
GSX50	PH-0695920000	1-3/8	Rod Gland Wrench
GSX60	PH-0695930000	1-3/4	Rod Gland Wrench



2. Remove the o-ring from the o-ring groove located inside the opening from which the seal was just removed.
3. Replace the o-ring with the o-ring supplied with the new rod seal gland.
4. Taking care not to touch the seal material to any sharp rod features such as threads, slide the seal on to the actuator rod and to the face plate.
5. Using the appropriate gland and spanner wrench, tighten the seal to the proper torque level indicated in the tables provided on this page.

Optional Seal Kits for Oil-Lubricated Actuators

Kits Including Seal, Wiper, Back-up Ring, O-ring			Kits Including Seal, Wiper, Back-up Ring, O-ring and FSB		
Model	Part Number	Install Torque	Model	Part Number	Install Torque
GSX20	PN 43527	100 lb-in (11.29)	GSX20	PN 43312	100 lb-in (11.29 N-m)
GSX30	PN 43528	200 lb-in (22.58)	GSX30	PN 40381	200 lb-in (22.58 N-m)
GSX40	PN 43529	360 lb-in (40.67)	GSX40	PN 40515	360 lb-in (40.67 N-m)
GSX50	PN 43530	660 lb-in (74.57)	GSX50	PN 40516	660 lb-in (74.57 N-m)
GSX60	PN 43531	900 lb-in (101.69)	GSX60	PN 43309	900 lb-in (101.69 N-m)

5.0 TROUBLESHOOTING PROCEDURES

This section provides you with guidelines and hints on troubleshooting various problems that may be encountered during installation and operation of your Exlar GS/X Series actuator.

Symptom / Trouble	Possible Cause / Troubleshooting Procedure
No response from actuator.	<ol style="list-style-type: none"> 1. Check amplifier for faults that may indicate problem. 2. Check to insure that amplifier is enabled. 3. Check for proper wiring.
Actuator seems to be enabled (receiving current) but is not operating or is operating erratically.	<ol style="list-style-type: none"> 1. Amplifier may be improperly tuned. Check all gain settings. If a motor file, or parameters specific to your amplifier/actuator combination have been supplied by Exlar, be sure that they are entered or downloaded properly. 2. Amplifier may be set up improperly for the particular motor being used. Check amplifier settings for number of poles, voltage, current, resistance, inductance, inertia, etc. 3. Feedback wiring may be incorrect. 4. Feedback conductors touching, or feedback cable may be damaged. 5. Motor phases are wired incorrectly or in incorrect order. (R,S,T). 6. Feedback (resolver or encoder) is improperly aligned. Contact Exlar.
Actuator cannot move load.	<ol style="list-style-type: none"> 1. Load is too large for the capacity of the actuator or too much friction is present. 2. Excessive side load. 3. Misalignment of output rod to load. 4. Amplifier has too low of current capacity or is limited to too low of current capacity.
Actuator housing moves or vibrates when shaft is in motion.	<ol style="list-style-type: none"> 1. Check actuator mounting. Insure that the actuator is securely mounted. 2. Amplifier is improperly tuned (wrong gain settings.) Tune amplifier.
Output rod rotates during motion and thus does not provide proper linear motion.	<ol style="list-style-type: none"> 1. Install Exlar anti-rotation assembly or incorporate anti-rotation into the application.
Limit switches not functioning.	<ol style="list-style-type: none"> 1. Limit switches wired improperly. Refer to manual. 2. The device being driven by the limit switches is not compatible with the electrical output of the limit switch. Check device requirements. 3. Switches have been damaged by improper wiring or improper voltage applied. Replace switches.
Brake does not hold load in place.	<ol style="list-style-type: none"> 1. Load is larger than the capacity of the brake. -check load level against actuator rating -oil lubricated units reduce holding capacity of the brake 2. Brake is not engaged. (Power is not removed, or only partially removed from brake). 3. Brake is being used as other than a power loss holding brake.
Actuator is overheating.	<ol style="list-style-type: none"> 1. Insufficient cooling for application requirements. See oil cooling section of this manual or Exlar catalog or contact Exlar engineering. 2. Actuator is being operated outside of continuous ratings. 3. Amplifier is poorly tuned causing excessive unnecessary current to be applied to motor. Check Gain settings.

5.1 Returning Product for Repair

STANDARD REPAIR LEADTIME:

- Two weeks for written evaluation from Exlar
- Two weeks from receipt of approval (by fax or email) for repair where parts are available.
- An evaluation charge per unit after evaluation applies if customer chooses not to repair; or if product is found not in need of repair.

EXPEDITED REPAIR LEADTIME:

- An expedite charge per unit can be quoted.
- This provides one week for written evaluation from Exlar
- This provides one week from receipt of approval (by fax or email) for repair where parts are available.

PROCEDURE:

- Please discuss the return with Exlar Technical Support prior to requesting an RGA number to see if it is possible to resolve the issue prior to return.
- If it is determined that an RGA number is required, please do so by contacting the Returned Goods Administrator. Phone 952-500-6200 or email returns@exlar.com.
 - International Repairs: Closely follow instructions provided by the Exlar Returned Goods Administrator. Failure to comply with issued instructions may result in delays for repair and return.
- Exlar requires a purchase order at the time of RGA; \$0 on warranty returns, or for the standard evaluation charge per unit on all non-warranty units for the evaluation fee.
- Following the evaluation, you will receive a quote from Exlar on the charges that will apply. If the actuator repair is approved, the evaluation fee will be waived and we will request an amended PO for the actual repair value.

6.0 GSX Force Measuring Option

6.1 Overview

This option features an internal strain gage type load cell. The load cell is factory preloaded to approximately 10,000 pounds. This preload can be measured by applying the 10V excitation and reading the mV output, and scaling the output by the calibration factor.

Example: If the calibration factor is 1.656 mV/V at full load, and the excitation supply is 10 volts, and the output signal is .894 mV, then without any external load on the actuator, the preload is:

$$Q = .894 \times 20000 / (1.656 \times 10) = 1079 \text{ pounds}$$

This preload will vary with time and temperature. Note that power supplies commonly used with load cells will also amplify the output signal to volts rather than millivolts.

6.2 Operation

Prior to applying load, sample the signal, either at rest or during move to load. Determine best method to minimize friction biasing.

At application of load, sample the signal and compare to unloaded value. The result is the load.

Example: Given the preload Q of 1079 pounds, and the signal after a load is applied is .338 mV, what is the load?

$$P = (.894 - .338) \times 20000 / (1.656 \times 10) = 671 \text{ pounds}$$

Note a positive value indicates the load is a compressive load on the actuator rod and a negative value indicates a tensile load on the rod actuator.

6.3 Specifications and Calibration Data

GSX40 Specifications

Excitation: 10VDC
Input Impedance: 352 Ohms
Output Impedance: 353 Ohms
Electrical Leakage: Infinite Meg Ohm

Capacities:

500 – 4000 lbs
200 Hz frequency response

For specifications on other frame sizes please contact Exlar Applications Engineering Dept.

6.4 Wiring Code

Wiring for the load cell connector depends on the type of connectors used on the actuator for power and feedback. If the connection option selects MS style connectors, an MS style load cell connector is used. If the connection option selects M23 or other style of connectors, an M12 eurofast style connector is used.

Mating cable for the MS style connector is CBL-ASSY1-SMA-xxx (length in ft).

Pin	Function	
A	(+)Excitation	10V
B	(-) Excitation	
C	(-) Output	
D	(+) Output	
E		
F	Shield	
G		
H		

Continued next page.

Mating cable for the M12 Euro style connector is CBL-ASSY1-SM1-xxx (length in ft.).

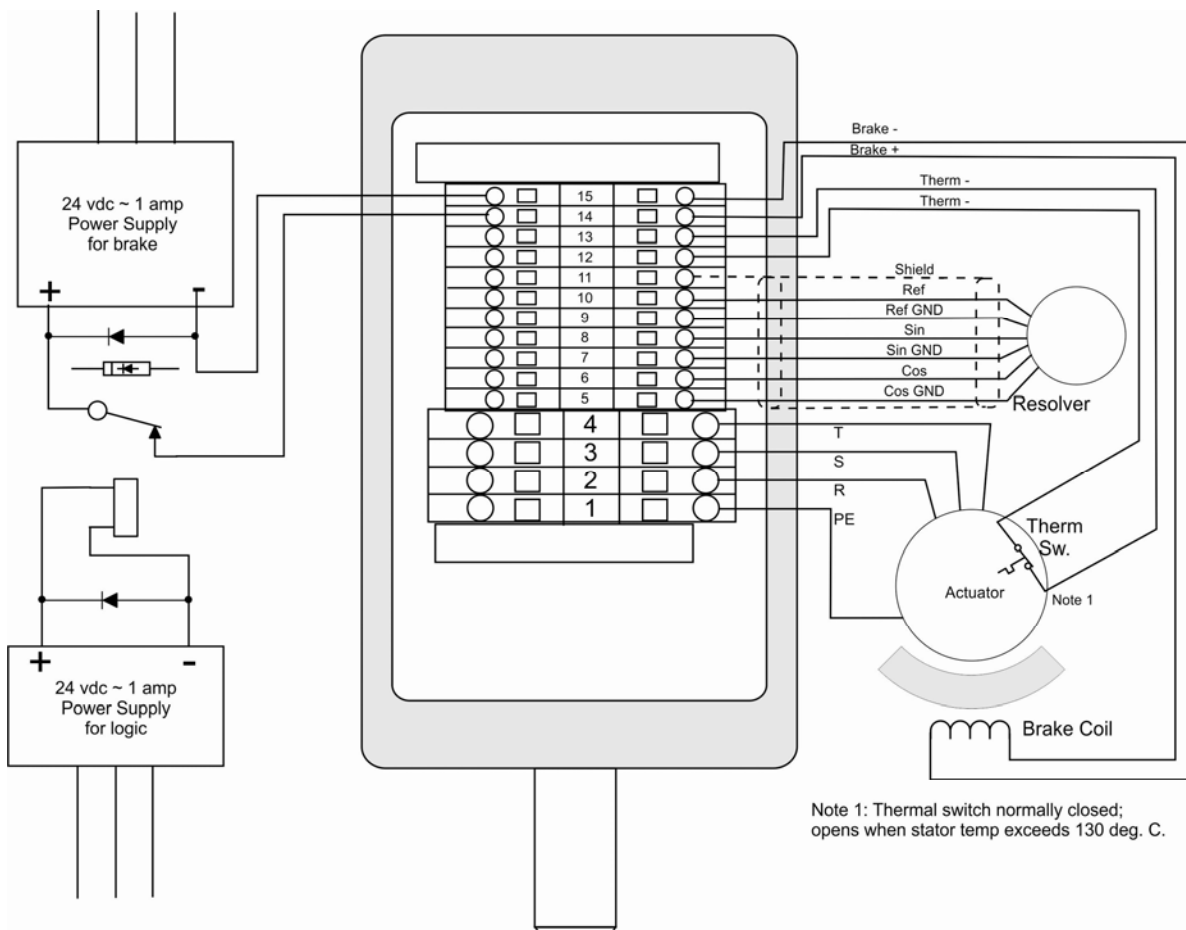
Pin	Function	
1	(+) Excitation	10V
2	(-) Excitation	
3	(-) Output	
4	(+) Output	
5	Shield	

7.0 GSX Class I Division 2 Option

Class I division 2 products are provided with an electrical box containing terminal strips for customer wiring access. The electrical box has two ½-NPT ports for customer conduit connection. It is the responsibility of the installer to insure that the interconnecting wire, cabling and conduit meet any local or regional required electrical codes and standards.

Low Volt Terminal Block – Rockwell 1492-L3		High Volt Terminal Block – Rockwell 1492-L6	
Voltage Rating	600 VAC/DC	Voltage Rating	600 VAC/DC
Current Rating	27 Amps	Current Rating	50 Amps
Wire Gauge Range	26-12 AWG	Wire Gauge Range	20-8 AWG

7.1 Terminal Box Wiring diagram



7.2 Class I Division 2 Terminal Box Terminations

Exlar uses spring clamp terminals for maximum vibration resistance and ease of connection

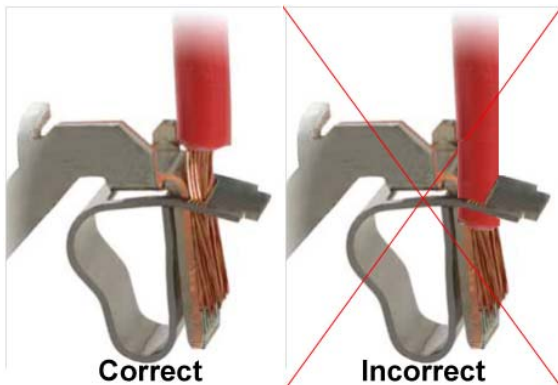
- Tin-plated terminals and stainless steel spring clamps for resistance to corrosion and vibration
- Spring clamp design to minimize stress relaxation and maintain contact force, even under vibration

To use spring clamp terminals:

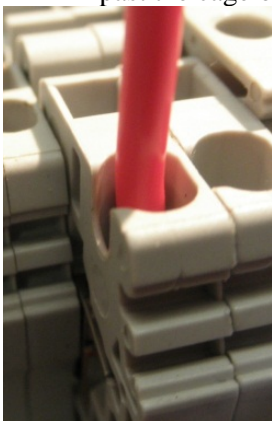
1. Strip the wire to .5”(12-13 mm). Longer is better than shorter since you can always trim to fit.
2. Open the terminal by inserting a flat blade screwdriver into the spring release and slide wire in until it stops.



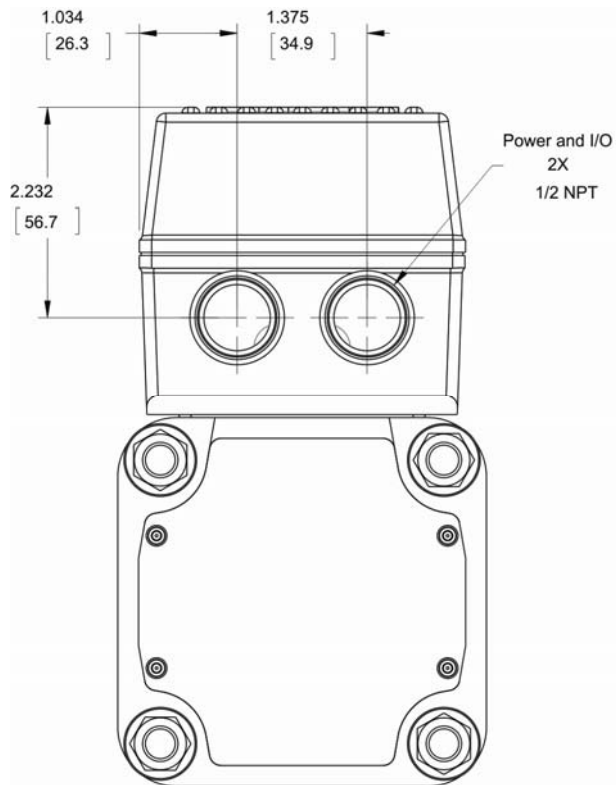
3. Make sure exposed wire is in the clamp, not insulated wire.



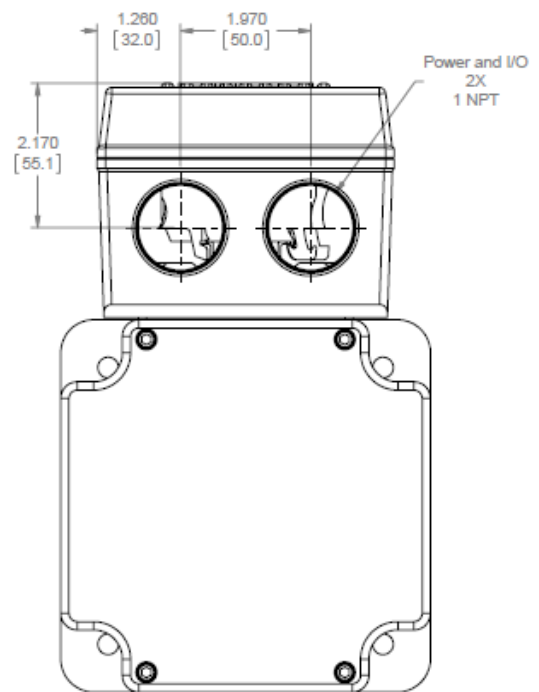
4. Remove the screwdriver. The clamp pressure will keep the wire in place. No exposed wire should protrude past the cage opening



7.3 Terminal Box Dimensions



GSX30; GSX40



GSX50; GSX60

8.0 Certifications

CERTIFICATE OF COMPLIANCE

Certificate Number 20130403-E225288
Report Reference E225288-20020531
Issue Date 2013-APRIL-03

Issued to: EXLAR CORP
18400 W 77TH ST
CHANHASSEN MN 55317

This is to certify that
representative samples of



COMPONENT - SERVO AND STEPPER MOTORS
See Addendum

Have been investigated by UL in accordance with the
Standard(s) indicated on this Certificate.

Standard(s) for Safety: UL 1004-1, Rotating Electrical Machines – General
Requirements
UL 1004-6, Servo and Stepper Motors
CSA C22.2 No. 100-04, Motors and Generators

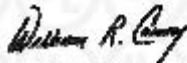
Additional Information: See the UL Online Certifications Directory at
www.ul.com/database for additional information

Only those products bearing the UL Recognized Component Marks for the U.S. and Canada should be considered as being covered by UL's Recognition and Follow-Up Service and meeting the appropriate U.S. and Canadian requirements.

The UL Recognized Component Mark for the U.S. generally consists of the manufacturer's identification and catalog number, model number or other product designation as specified under "Marking" for the particular Recognition as published in the appropriate UL Directory. As a supplementary means of identifying products that have been produced under UL's Component Recognition Program, UL's Recognized Component Mark:  may be used in conjunction with the required Recognized Marks. The Recognized Component Mark is required when specified in the UL Directory preceding the recognitions or under "Markings" for the individual recognitions. The UL Recognized Component Mark for Canada consists of the UL Recognized Mark for Canada:  and the manufacturer's identification and catalog number, model number or other product designation as specified under "Marking" for the particular Recognition as published in the appropriate UL Directory.

Recognized components are incomplete in certain constructional features or restricted in performance capabilities and are intended for use as components of complete equipment submitted for investigation rather than for direct separate installation in the field. The final acceptance of the component is dependent upon its installation and use in complete equipment submitted to UL LLC.

Look for the UL Recognized Component Mark on the product.



William R. Carney, Director, North American Certification Programs
UL LLC

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at www.ul.com/contact

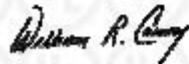


CERTIFICATE OF COMPLIANCE

Certificate Number 20130403-E225288
Report Reference E225288-20020531
Issue Date 2013-APRIL-03

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Permanent Magnet servo motors, GSX or SR Series, Model GSM or GSX or SR;
followed by 20, 21, 30, 31, 40, 41, 50, 60, 90 or 115;
followed by 01 through 24 or XX;
followed by 01 through 99 or XX;
followed by A, B, D, E, I, J, M, N, O, P, S, T or X;
followed by B, C, D, E, F, G, J, K, M, Q, R, S, T, Z or X;
followed by A, B, F, L, M, R, V, W or X;
followed by three letters or numbers;
followed by 1, 2, 3 or X;
followed by A, B, C, 1, 3, 5, 6 or X;
followed by 6 or 8;
may be followed by 01 through 99, AR, AS, AX, CF, EB, EN, ES, ET, FC, FF, FG, FM, FX, HB, HC,
HW, L1, L2, L3, LT, MW, NI, P5, PB, PF, RB, RD, SD, SR, SS, XH, XL, XM, N4, XT, XX;
may be followed by 00000 through 99999.



William R. Carney, Director, North American Certification Programs
UL LLC

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at www.ul.com/customer-service



Declaration of Conformity

*The undersigned, representing the
Manufacturer*

*and the authorized representative
established within the community.*

*Exlar Corporation
18400 West 77th Street
Chanhassen, MN 55317 USA*

*Exlar GmbH
Frankfurter Str. 107
65479 Raunheim, Germany*

declares, that the Exlar Brand products:

**GSX, GSM, SR, SLM, SLG Linear and Rotary Actuators
(Complete Model Listing Below)**

Model identification:

**GSX20, GSX30, GSX40, GSX50, GSX60,
GSX90, GSX115, SR21, SR31, SR41
SLM060, SLM075, SLM090, SLM115, SLM142, SLM180
SLG060, SLG075, SLG090, SLG115, GSM20, GSM30, GSM40**

*to which this declaration relates and are in conformity with the relevant EU
Directives listed below:*

**EU EMC Directive 2004/108/EC
EU Low Voltage Directive 2006/95/EC**

*using the relevant section of the following EU standards and other
normative documents:*

**EMC: EN 55014-1: 2006 + A1:2009
EN 55014-2: 1997 + A1: 2001 + A2: 2008**

Safety: IEC/EN 60034-1: 2010

Year of CE Marking: 2004

Manufacturer:

Signature: 
Name: Bill Zerull
Position: Chief Technology Officer
Date of Issue: 03-June-2013



Certificate of Compliance

Certificate: 2257566 **Master Contract:** 163694
Project: 2631418 **Date Issued:** June 19, 2013
Issued to: Exlar Corporation
18400 West 77th St
Chanhassen, MN 55317
USA
Attention: Gene Larson

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.



David Wood
Issued by: David Wood

PRODUCTS

CLASS 3228 02 - VALVES - Actuators - For Hazardous Locations
CLASS 3228 82 - VALVES - Actuators - For Hazardous Locations-Certified to U.S. Standard

Class I, Division 2, Group A, B, C and D:

• GSX & GSM Series Linear Actuators and SLM & SLG Series Rotary Actuators, input rated 24Vdc, 48Vdc, 120Vdc, 115Vrms, 230Vrms, 400Vrms, 460Vrms or a Special Voltage Rating (not exceeding 460 Vrms), 50A max. Temperature Code T4 (135°C), $-50^{\circ}\text{C} \leq T_a \leq +65^{\circ}\text{C}$ (see note 2).

Model Code Information:

GSX/GSMxx-xx xx-Txx-aaa-xbx-xx-(xx..c..NL..xx)

aaa – resolver feedback

b - Voltage Rating

A = 24Vdc

B = 48Vdc

C = 120Vdc

1 = 115Vrms



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3 = 230Vrms

5 = 400Vrms

6 = 460Vrms

X = Special Voltage Rating - Not to Exceed 460Vrms

c – Optional Mechanical and Speed Designations

HW = Hand-Wheel Switch

xx = denotes other options not affecting safety

x – denotes options not affecting safety

SLM/SLGxxx-xxx-xTxx-aaa-xbx-xx-(xx..c..NL.xx)

aaa – Resolver Feedback

b - Voltage Rating

A = 24Vdc

B = 48Vdc

C = 120Vdc

1 = 115Vrms

3 = 230Vrms

5 = 400Vrms

6 = 460Vrms

X = Special Voltage Rating - Not to Exceed 460Vrms

c – Optional Mechanical and Speed Designations

HW = Hand-Wheel Switch

xx = denotes other options not affecting safety

x – denotes options not affecting safety



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Conditions of Certification

1. This Certification covers the actuator only. The end use suitability of the combination of the associated electronic controller and the actuator is to be determined by the local inspection authority having jurisdiction.
2. The actuators may include a hand-wheel switch (denoted by HW in Model Code). In such cases, the hand-wheel switch conduit must be sealed within 18 inches. When the handwheel option is included the maximum ambient temperature rating is $-20^{\circ}\text{C} \leq T_a \leq +40^{\circ}\text{C}$.
3. The actuators may include a holding brake. The thermal effects of the brake pad have not been evaluated and are to be considered by the authority having jurisdiction.

APPLICABLE REQUIREMENTS

CAN/CSA Standard C22.2 No. 0-10 (*Tenth Edition – September 2010*) - General Requirements - Canadian Electrical Code, Part II

CSA Standard C22.2 No. 0.4-04 (*October 2008 including updates No. 1 & 2*) - Bonding of Electrical Equipment

CSA Standard C22.2 No. 139-10 (*Third Edition, June 2010*) - Electrically Operated Valves

CSA Standard C22.2 No. 213-M1987 (*Reaffirmed 2008*) - Non-incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations

UL Standard 429 (*Sixth Edition, Dated November 11, 2009*) - Electrically Operated Valves

ANSI/ISA-12.12.01-2007 - Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Division 1 and 2 Hazardous (Classified) Locations

MARKINGS

The markings are on a CSA Accepted Self-Adhesive Label material, e.g. CSA Accepted Brady B486 metallized polyester adhesive film label manufactured by Brady Worldwide Inc. Alternatively, permanent marking directly on the housing (ink, engraved, etched, etc).

- Manufacturer name: "Exlar, Corporation", "Exlar" or equivalent or the CSA Master Contract Number "163694" adjacent to the CSA Mark in lieu of the manufacturer name;
- Model number: as specified in the PRODUCTS section above;
- Manufacturing date in MMY format, or serial number, traceable to month of manufacture.
- Electrical ratings: as specified in the PRODUCTS section, above;
- Hazardous Location designation: as specified in the PRODUCTS section, above (may be abbreviated);
- Temperature code: as specified in the PRODUCTS section, above;
- Ambient temperature rating: as specified in the PRODUCTS section, above;



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- The CSA Mark with or without “C” and “US” indicators, as shown on the Certificate of Compliance;
 - The words: “Warning: Explosion Hazard - Do not disconnect equipment unless power has been switched off or the area is known to be non- hazardous” or equivalent;
 - The words: “For Supply Connections, Use Wires Suitable for at Least 90°C (194°F)”.

Note - Jurisdictions in Canada may require markings to be also in French. It is the responsibility of the Customer to provide bilingual marking, where applicable, in accordance with the requirements of the Provincial Regulatory Authorities. It is the responsibility of the Customer to determine this requirement and have bilingual wording added to the “Markings”.