Tolomatic™
EXCELLENCE *IN MOTION*

MANUAL

For Installation, Maintenance and Operation

GSWA Series Actuators

ServoWeld™

FOR RESISTANCE SPOT WELDING

Original instructions in English. Translations in community languages supplied as required.

Information furnished is believed to be accurate and reliable. However, Tolomatic assumes no responsibility for its use or for any errors that may appear in this document.

Tolomatic reserves the right to change the design or operation of the equipment described herein and any associated motion products without notice. Information in this document is subject to change without notice.

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1.0 Safety

1.1 Safety Symbols

General

Read completely through the applicable sections of the manual before the equipment/unit is unpacked, installed or operated. Pay careful attention to all of the dangers, warnings, cautions and notes stated in the manual.

Serious injury to persons or damage to the equipment may result if the information in the manual is not followed.

Safety Symbols

Items that are specifically marked DANGER, WARNING, CAUTION, PROHIBITIVE, MANDATORY ACTION, or NOTE! are arranged in a hierarchical system and have the following meaning:

DANGER!

Indicates a very hazardous situation which, if not avoided, could result in death or serious injury. This signal word is limited to the most extreme situations.

WARNING!

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION!

Indicates a potentially hazardous situation which, if not avoided, may result in property damage, minor or moderate injury.

PROHIBITED ACTION

Indicates Prohibited Action

MANDITORY ACTION

Indicates Manditory Action

NOTE!

Information that requires special attention is stated here.

WARNING FOR HOT SURFACES

WARNING! Normal operating temperature of weld actuator can range from 135 degrees F (57°C) to 175 degrees F (79°C).

1.2 Safety Considerations

Proper and Safe Use of Product

Fail Safe e-Stop Recommendations

A means for a fail-safe e-stop is highly recommended to ensure equipment and personal safety. The e-stop should provide a means to remove main power from the actuator to cease and prevent any unwanted motion.

Device Damage Prevention

To prevent permanent damage to the device, proper care should be taken not to exceed published voltage, current, temperature, and load/force ratings. In addition, proper mechanical assembly and proper wiring should be verified and safety measures checked before applying power to the complete equipment package.

Personal Safety

During normal operation the actuator can become hot, especially the motor housing. It is highly recommended to display proper safety notices and implement proper safety measures to prevent contact with hot surfaces. In addition, the case ground should be tied to an earth ground to prevent the presence of case voltage.

During normal operation, the actuator rod travels in and out creating a possible pinch point. Proper guarding and signage must be used prevent entry into possible pinch zones and contact with hot surfaces. It is highly recommended to display proper safety notices and implement proper safety measures to prevent contact with hot surfaces.

Handling and Unpacking

When unpacking and handling the actuator, care should be taken not to drop the actuator as this can damage the connectors, internal electronics, or cause misalignment of the actuator feedback device. Damage the internal mechanical components may cause poor performance or render the actuator non-functional. Since this is an electromechanical device, proper ESD measures should be taken to avoid static electricity from contacting the signal and power lines of the device. as this can damage the internal mechanical components rendering the actuator damaged or non-functional.

Packing and Transport

NOTE!

Package actuator to prevent damage during transport. It is recommended that the actuator be returned in its original packaging. If the original packaging is not available, the follow these recommendations.

1. Foam in place if possible.
2. Reinforce ends of box with multiple layers of cardboard or wood to prevent the actuator from breaking through the packaging during shipment.
3. Support the connectors or cables so that enough packaging or foam is in place to prevent shipping damage.
4. It is best to ship one unit per container because individual items that are not isolated with stable packaging (foam in place) from each other often get damaged during shipment.
5. When shipping more than one unit in a single container, it is recommended to foam in place to prevent damage during shipping to both the units and the packaging.
6. Add the RMA on the outside of the packaging. Failure to do so will delay processing.

Figure 1.1: Do not carry GSWA by connectors or cables.

CAUTION!

The GSWA ServoWeld actuator weight range is approximately 8.2 to 30.5 kg (18.1 to 67.2 lbs). Special care must be taken when lifting this device. Do not carry by the connectors. The connectors are not rated to support the weight of the actuator.

Modifications to the Equipment

WARNING!

The manufacturer takes no responsibility whatsoever if the equipment is modified or if the equipment is used in any way beyond performance specifications. Unauthorized modifications or changes to the equipment are strictly forbidden, and void all warranties.

Repair and Maintenance

WARNING!

All power and supply media must be shut OFF before any work is performed on any equipment that is associated with the GSWA. The only field maintenance that may be performed on the GSWA include lubrication and replacement of the wiper/scraper assembly. All other repair or maintenance for the GSWA must be performed at Tolomatic.

Requirement Regarding Personnel

NOTE!

All personnel must be completely informed regarding all safety regulations and the function of the equipment.

Risk Area and Personnel

When installed, pinch points are generated capable of high damaging forces. The risk area surrounding the ServoWeld actuator must either be enclosed or clearly marked, including display signage in accordance with all applicable national and international legal requirements. The risk area must be protected by a safety system that stops the equipment if anyone enters the risk area. Personnel who enter the risk area must be authorized, trained and qualified for the different tasks inside the risk area.

2.1 General Description

	
GSWA04	GSWA33 Guided

		
GSWA33	GSWA44	GSWA55

GSWA ServoWeld™ Actuators

The GSWA ServoWeld™ actuator (see figure 1.2) is a compact high-force, screw-drive servo actuator. The weld actuator provides linear motion of the moveable weld gun tip and develops the required thrust (squeeze) force for spot welding.

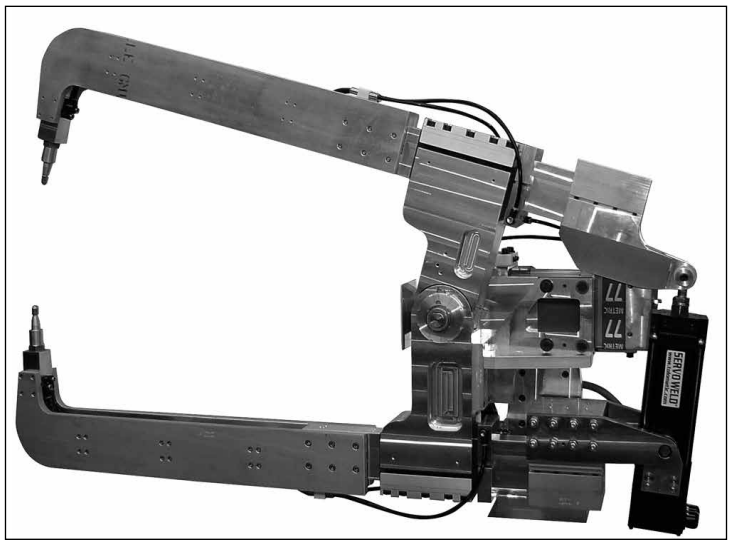

Figure 2.1: Example of ServoWeld™ welding actuator (GSWA04) installed on "X" Style weld gun unit.

2.2 Intended Use

Commonly used in robotic and other applications the GSWA ServoWeld™ weld actuator is a compact high force roller screw drive servo actuator. The weld actuator provides linear motion of the moveable weld gun tip and develops the required thrust (squeeze) force for spot welding.

⚠WARNING WARNING!

Before installation and commissioning of the equipment, this manual and all accompanying manufacturer documents and manuals MUST be completely read by the appropriate personnel. All warning texts must be given special attention.

2.3 Storage

Pay attention to the following when storing the actuator:

- Perform repairs, maintenance and inspections before storing equipment to ensure that the equipment is in good working order.
- Make sure the equipment is placed in a suitable storage position (horizontal) to prevent damage to the connectors and electronics.
- Protect the feedback device, which is located at the blind (non-rod end) of the ServoWeld actuator.
- Store in clean and dry environment.
- After six (6) months of storage it is recommended to cycle two complete strokes of the ServoWeld actuator to redistribute the internal lubricants.
- It is also recommended to cycle the ServoWeld actuator two complete strokes before placing in service.
- If stored for a period longer than 2 years without use it may be necessary to replace the lubricants. Return to Tolomatic for this maintenance.
- Storage temperature is -25°C to +60°C (-13°F to +140°F).

2.4 Identification Label

Figure 2.2: ServoWeld GSWA actuator identification label.

Figure 2.3: ServoWeld GSWA actuator identification label.

Do not remove the identification label. Do not render it unreadable.

2.5 Certification

CE 95

IP 65

c UL us LISTED

2.6 Manufacturer

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3 GSWA Product Configuration Overview

3.1 GSWA Series Configuration

GSWA Product Overview

- Four models: GSWA33, GSWA33 Guided, GSWA44, GSWA55 and GSWA04
- Roller Screw Options: 4, 5 and 10 mm lead
- Motor windings: 230 Vac & 460 Vac
- Feedback Choices (but not limited to):
  ABB Resolver, Comau Resolver, Emerson CT Hiperface, Fanuc a128
  Fanuc a64, Kuka Resolver, Motoman Absolute
  Nachi Absolute FD11 Series, Rockwell Automation Hiperface
  Rockwell Automation Hiperface DSL, Kawasaki Absolute E Series
- Motor configurated to be operated with (but not limited to):
  - ABB - Bosch Rexroth - Comau - Emerson
  - Fanuc - Kawasaki - Kuka - Motoman
  - Nachi - Parker - Tolomatic

NOTE!
For performance data and specifications please refer to the Tolomatic GSWA catalog #2750-4002.

3.2 Standard Configurations and options

NOTE!

NOTE Please see Tolomatic GSWA catalog #2750-4002 for complete information on ordering. Use 3D CAD files (available at www.tolomatic.com) for critical dimensions.

3.2.1 Screw Selection

GSWA: RN04, RN05, RN05XR, RN10: Roller nuts with 4mm, 5mm, 5mm extended or 10 mm lead. Contact Tolomatic for application review and assistance in selecting a screw technology.

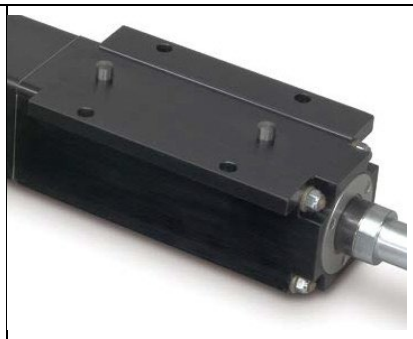
3.2.2 Motor Voltage

A2, B2, A3, B3: Available with 230 Vac or 460 Vac. With 2 and 3 stack windings.
Contact Tolomatic for application review and assistance in selecting voltage and windings.

3.2.3 Internal Holding Brake Option

1=No Brake, 2=24V Brake, 3=90V Brake, A spring held electronically released holding brake (parking brake) is available. The holding force of the brake is capable of holding the continuousforce of the actuator. The brake is spring set and releases when voltage is applied to the brake. A separate power source is required.

3.2.4 Mounting Options

		
Face Mount	Face and Side Mount	Base Mount
GSWA33, GSWA44, GSWA55	04 (optional hex rod also provides anti-rotate)	GSWA33 Guided Option (also provides anti-rotate and thrustrod side load capability)

Other mounting options can be accommodated: Side mounting holes, mounting plates, rear clevis, front flange, front trunnion and rear trunnion. Consult Tolomatic for other configurations.

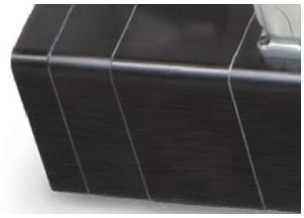
3.2.5 Standard Rod End Options

Standard rod end for the GSWA is internal threads.

Other rod end options include: External threads, clevis and spherical eye.

3.2.6 Special Options

Other GSWA options available are: 24V or 90V spring held / electronically released brake;
manual override;
anti rotate option

Brake	Manual Override	Anti-Rotate Hex
 24V or 90V Spring held / electronically released	 (Available ONLY on GSWA33 & GSWA04)	 (Available ONLY on GSWA04 and GSWA33 Guided Option)

NOTE!
The GSWA must be ordered with all desired options. Field installation of options generally cannot be done. Call Tolomatic for complete details.

NOTE!
Please see Tolomatic GSWA catalog #2750-4002 for complete information on ordering. Use 3D CAD files (available at www.tolomatic.com) for critical dimensions.

3.2.7 Feedback Device
Contact Tolomatic for application review and assistance in selecting feedback device.

3.2.8 Connector(s)
Connectors are matched to selected feedback device. Contact Tolomatic for application review and assistance in selecting feedback device.

3.2.9 Servo Drive
The GSWA ServoWeld actuators functions in the same way as a brushless servo motor. A servo drive is used to power and control the actuator. Please consult the servo drive manufacturer when sizing and selecting a servo drive for use with GSWA ServoWeld.

4.0 GSWA ServoWeld™ Mechanical Installation

⚠WARNING WARNING!

Before installation and commissioning of the equipment, this manual and all accompanying manufacturer documents and manuals MUST be completely read by the appropriate personnel. All warning texts must be given special attention.

4.1 ServoWeld™ Actuator System Configuration

ServoWeld™ series actuators incorporate an integral brushless servo motor. The design of the motor with the proper feedback device and electrical connectors allows the GSWA actuator to be powered by the robot 7th axis of most robot manufacturers used in the automotive body shops and many commercially available servo drive/controllers. This flexibility allows the ServoWeld™ actuator to be used in the highest performing single and multi-axis motion control systems. It is recommended that all servo amplifiers and drives be selected based on the following important parameters:

a) CE and UL approved system
b) Thermal switch input
c) Drive sizing key parameters for ServoWeld
   i) Peak current ii) Voltage
   iii) Peak RPM iv) Max current frequency

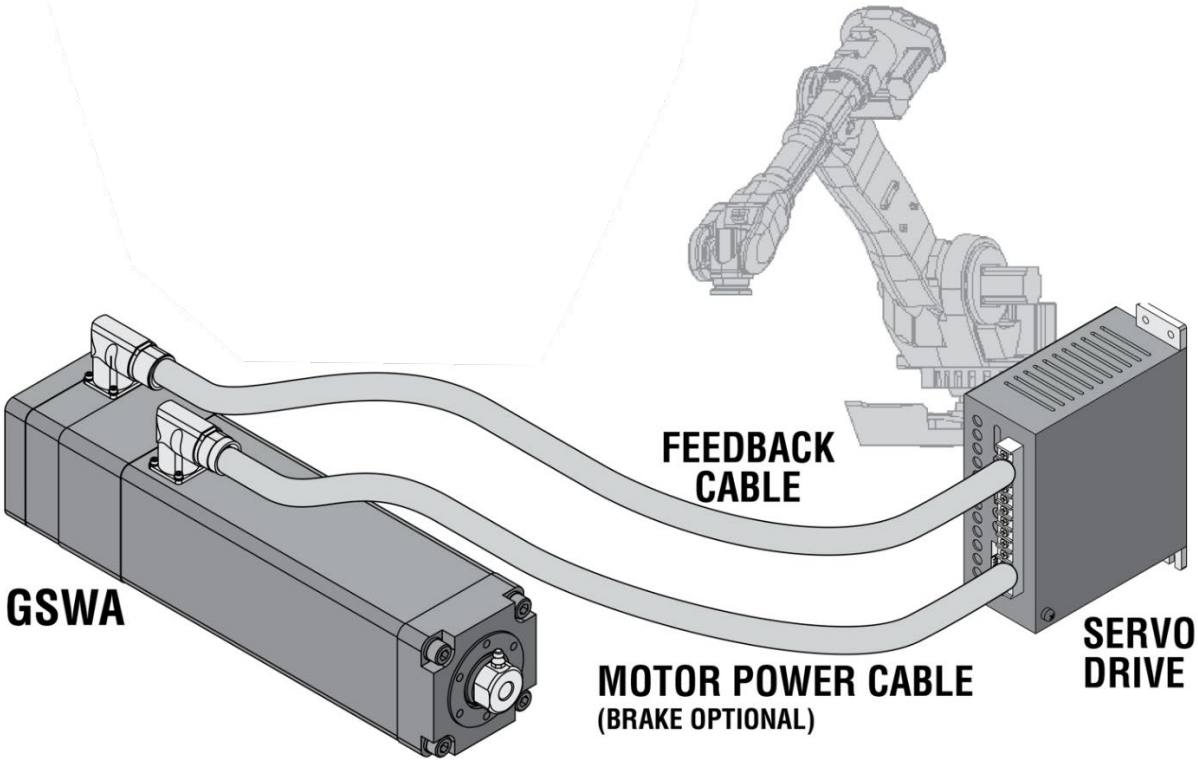


Figure 4.1: Typical connections for a single-axis system with an ServoWeld™ actuator with optional brake to a RSW servo system drive

4.2 Actuator Operation

General Operation

The ServoWeld™ actuator functions by converting the rotary motion of the integral brushless

servo motor into linear motion using a screw mechanism. The linear travel, speeds and forces are controlled in conjunction with a RSW servo system drive.

Each ServoWeld™ actuator is individually configured to work with the robot controller for the specific application.
The relationship between the rotary motion of the motor and the linear motion of the actuator corresponds to the following relationships:

Linear distance traveled = (motor revolutions) * (screw lead)

Linear Speed = ([motor RPM]/60) * (screw lead)

Linear Thrust (kN) = Motor torque (Nm) * 2 * π * pitch (rev/mm) * screw efficiency

or

Linear Thrust (lbf) = Motor torque (in•lb) * 2 * π * pitch (rev/in) * screw efficiency

⚠ CAUTION CAUTION!
Motor RMS current must be maintained at a level below the continuous current rating of the ServoWeld™ 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 ServoWeld™ actuator or damage to the motor stator will result.

⚠ CAUTION CAUTION!
Care should be taken to not exceed the physical travel limits of the ServoWeld actuator. Doing so will cause the actuator to reach mechanical end of stroke internally. Although protected by the end of stroke bumpers, repeatedly reaching internal end of stroke can physically damage the screw and the internal components of the actuator.

⚠ CAUTION CAUTION!
Power and Feedback cable lengths shall not exceed 10 meters. If the application requires cable lengths longer than 10 meters, please contact Tolomatic engineering for review.

Cold Temperature Startup Procedure
If startup ambient temperature is between 0-10 degrees Celsius, it is recommended to cycle the ServoWeld™ actuator (see recommended motion profile below) to bring the temperature up to operating temperature before proceeding with welding or calibrating the system. Initiating this startup procedure will lower the friction caused by cold temperatures and result in more accurate calibration of the system and better force repeatability performance during welding. If a motion profile other than recommended below will be used for the Cold Temperature Startup Procedure, contact Tolomatic for review of the motion profile before operating the actuator.

Recommended Motion Profile:

- Extend & retract full stroke of actuator at linear speed of 150 mm/sec for 5 or 4 mm lead screws and 300 mm/sec for 10 mm lead screws

- Dwell 1 second
- Repeat 75 times

Tip Dress Procedure
All forces are from thrust rod output of ServoWeld™ actuators ONLY and does not include the complete RSW weld gun system configurations. Each weld gun and robot servo controller/drive has different operational characteristics that influence low weld force tip capability (tip dress) of the complete servo RSW weld gun system. Other factors such as temperature and the percentage of maximum output force also affect the performance and force repeatability of tip dressing. If startup ambient temperature is in 0-10 degree Celsius range, please refer to Cold Temperature Startup Procedure.

- Minimum actuator output force: 1kN (225 lbf)
- Force repeatability at tip dress force [1.0 kN (225 lbf)]: ± 5% at steady state operating temperature

4.3 Planning Your Installation

To operate the actuator in compliance with the relevant safety regulations maximum performance limits must be observed.

⚠ CAUTION **CAUTION!**
When mounting your ServoWeld™ actuator in vertical or inclined positions be sure to include safety measures that control the working mass should the drive screw fail. Uncontrolled moving masses can cause injury or damage to property. If the screw drive fails, due to wear or excessive load, gravity may cause the working mass to drop.

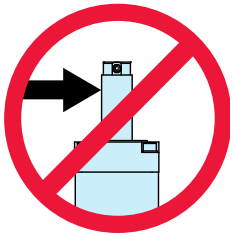
⚠ CAUTION **CAUTION!**
For bench or fixture setup and testing of round rod ServoWeld™ actuators, the actuator thrust rod must be anti-rotated by a fixture and the actuator securely retained to the bench or fixture. Never use a hand held wrench/device to provide the anti-rotate function while the motor is powered as contact with the internal end of stroke may send the wrench/device flying and may harm the operator or damage the actuator.

Installing the ServoWeld™ Weld Actuator
Please refer to the weld gun documentation supplied by the weld gun manufacturer for mechanical installation.

Inspection and Settings
Before commissioning the weld actuator, there are certain inspections and settings that must be completed. After all maintenance activities, the gun must be inspected before it is returned to service.

Side Load Considerations

⚠ CAUTION **CAUTION!**



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

The GSWA integrated motor actuator is not meant to be used in applications where side loading occurs. Loads must be guided and supported. Loads should be aligned with the line of motion of the thrust rod. Side loading will affect the life of the actuator.

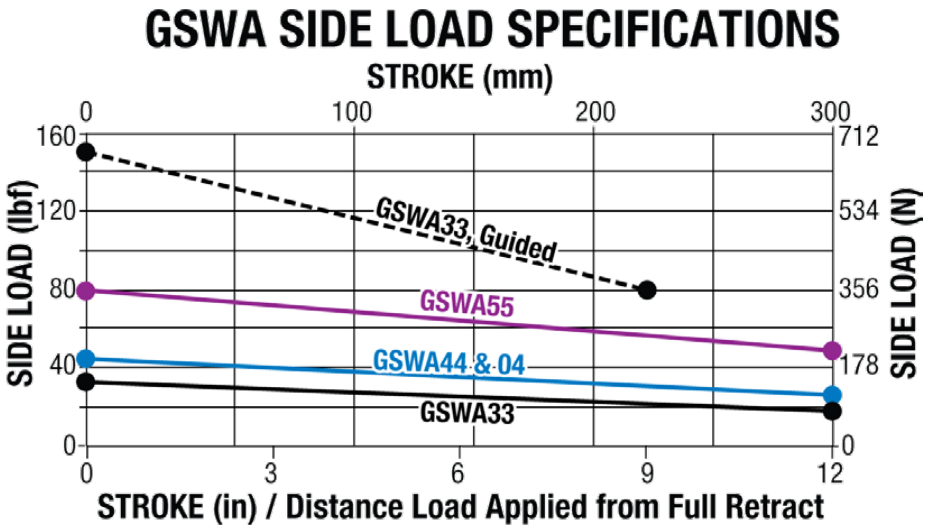


Figure 4.2: Side load must not exceed maximum values represented by the lines in the graph

The chart above has listed side load values for the GSWA actuators. The GSWA33, GUIDED actuator will accommodate side loading. For other GSWA configurations measures shall be established in gun design, especially in "C" style designs, to limit any side load values below specified line. For life optimization Tolomatic recommends side loads less than indicated in Figure 4.2.
GSWA04 hex nose bearing/thrust rod and GSWA Guided thrust rod configurations prevent thrust rod rotation. For maximum service life, external guiding is recommended to minimize side loading to the thrust rod and provide consistent weld gun movable tip / fixed tip alignment throughout service life.

Thrust Rod Wiper/Scraper
The thrust rod wiper / scraper assembly is field replaceable. For maximum service life measures should be taken to reduce / eliminate contamination, weld slag, and water in the thrust rod wiper / scraper interface area. Implementation of industrial thrust rod boot and/or deflective device can be effectively utilized in this area.

Cables

⚠ CAUTION **CAUTION!**

Shielded power and feedback cables are recommended to minimize electrical noise / grounding issues. Electrical noise or inadequate grounding can corrupt the feedback device signal.

⚠ CAUTION **CAUTION!**

Power and Feedback cable lengths shall not exceed 10 meters (32.8 ft.). If the application requires cable lengths longer than 10 meters, please contact Tolomatic engineering for review.

RSW Servo System Calibration

For optimal RSW servo system performance, high weld force from the production weld schedule, tip dress force and multiple weld forces in between should be included in the RSW servo system calibration process.
RSW servo system consists of robot 7th axis amplifier-feedback device-software, ServoWeld™ actuator, and RSW chassis.

Weld Tip / Part Contact Speed

Tolomatic testing confirms the highest actuator repeatability (Input Current verses Output Force) at a weld tip part contact speed of 25mm/second or less. Speeds greater than 25mm/second can create “impact contribution” to the weld force. This impact contribution to the weld force deteriorates prior to completion of the weld cycle.

Robot Carried Applications

Robot carried RSW gun applications by virtue of the continuous robot movement and various RSW gun positions have reduced exposure to water pooling / water ingression. In addition, in robot carried applications, positioning of the RSW gun can be programmed as part of the weld cap change program /routine to eliminate actuator exposure to water. (ServoWeld™ actuator above weld caps)

Tool Changer Applications

Weld gun storage fixture in cell should position weld gun so movable electrode is not loading SeroWeld thrust rod - back driving the ServoWeld. Weld gun tips should be positioned to weld gun closed at low force prior to disconnect from robot/tool changer. Consider ServoWeld configured with integral brake option.

Fixed/Pedestal Applications

One of the more challenging RSW applications is a pedestal RSW gun, ServoWeld™ actuator mounted vertical – thrust rod up. Measures should be taken to reduce and/or eliminate the actuator to water exposure, water pooling/spray in the access areas of the ServoWeld unit to maximize overall service life. Because water is a factor in the RSW gun environment as a result of regular weld cap changes there are a number of steps can be taken to reduce and/or eliminate the actuator's exposure to water.

- Pedestal RSW guns that can be mounted with the ServoWeld actuator vertical – thrust rod down should be considered.
- Pedestal RSW guns that must be mounted with the ServoWeld actuator vertical – thrust rod up should be mounted at an angle of a least 10 – 15% to minimize water pooling.
- Water channels are provided on the mounting face of the GSWA actuators. Care should be

taken when mounting to ensure the channels are not obstructed to minimize water pooling.

- Any RSW gun applications that are suspect for water exposure should utilize an external deflector (bib) or a thrust rod boot to keep the water away from the thrust rod wiper/scraper interface area.
- Any RSW gun application that is suspect for water exposure should consider utilizing a manual shut-off valve in the water saver circuit at the RSW gun. Shutting off the water prior to weld cap change can significantly reduce water exposure issues in the RSW gun environment.
- Pedestal RSW gun applications should have the mating electrical connectors (90 degree) on the cable dress package facing down with the cable dress cables looped to reduce water ingression via the electrical connectors (power/feedback).
- Allow adequate cable length so the cables are not in tension.
- Molded mating electrical connectors on the cable dress package for pedestal RSW gun applications.
- Confirming full engagement of the cable dress connector to the appropriate mating receptacle on ServoWeld™ actuators.
- Earth ground the thrust rod when possible.

4.4 Mounting

Thrust Rod Attachment - Round Thrust Rod

The design of the Round Rod ServoWeld actuator 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 an external mechanical guide, or some other support device, the load cannot rotate, and thus provides anti-rotation for the extending rod of the actuator.

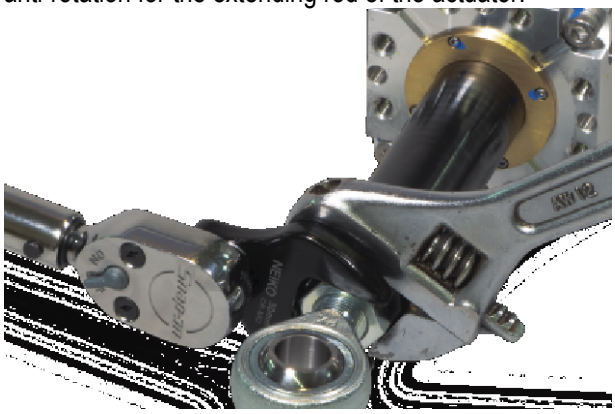


Figure 4.3: (CSWX pictured) For round rod, hold thrust rod stationary using a wrench on the flats at the end of the rod when attaching accessories, linkages or load to the actuator. Use a torque wrench to tighten the interfacing rod end to the actuator threaded connection point. Torque values provided in Table 4.2

Thrust Rod Attachment – Hex Rod and Guided Anti-Rotation Options

The design of the Hex Thrust Rod ServoWeld actuator restricts the thrust rod from rotating. To setup the actuator the unit can be powered and moved into position, or the mating components may be moved to the connection point on the actuator. This feature provides the anti-rotation needed to generate proper linear motion.

Figure 4.4: (SWA pictured) For hex rod, hold thrust rod stationary using a wrench on the flat of the rod when attaching accessories, linkages or load to the actuator. Use a torque wrench to tighten the interfacing rod end to the actuator threaded connection point. Torque values provided in Table 4.2.

⚠WARNING WARNING!
APPLYING TORQUE TO THE THRUST ROD MAY DAMAGE THE ACTUATOR. Avoid this by using a wrench to prevent the thrust rod from rotating while attaching the load, linkages or accessories to the rod end.

Thrust Rod Connection:
ROD END ATTACHMENT FOR ROUND ROD ACTUATOR: Hold flats on round rod stationary using a fixture, vise, or opposing wrench. Torque weld gun connection linkage or rod eye up to table value shown:

ROD END ATTACHMENT FOR HEX ROD AND GUIDED OPTION ACTUATOR: Hold flats on the thrust rod station- ary using a fixture, vise, or opposing wrench. Do not rely on the anti-rotate feature inside the actuator to oppose the installation torque. Torque weld gun connection linkage or rod eye up to table value shown:

M12	80 N-m		M16	200 N-m		M20	200 N-m		M27	250 N-m	
	59 ft-lb			147.5 ft-lb			147.5 ft-lb			185 ft-lb	

Table 4.1: Rod end torque recommendations

TAPPED HOLE MOUNTS RECOMMENDED TORQUE		
SIZE	**MAXIMUM TORQUE**	
M8	25 N-m	18 ft-lbf
Front Face or Side Tapped Holes for M8x1.25 SHCS		
M10	45 N-m	33 ft-lbf
Side Tapped Holes for M10 x1.5 Shoulder Bolt or SHCS		
M12	68 N-m	50 ft-lbf
Front Face or Side Tapped Holes for M12x1.75 SHCS		

Table 4.2: Tapped hole torque recommendations

Trunnion Mount
Trunnion Mount – Trunnion mounts supplied per customer request, male or female, sized to fit

the weld gun. Tolomatic supplies female Oilite Bushings when female trunnion mounting is requested. Mate trunnions with integral trunnion receptacles on the actuator. Ensure the actuator pivots on the trunnion pins without binding.

4.5 Anti Rotate

The design of the GSWA33, 44 & 55 actuator 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, Tolomatic offers anti-rotation in the GSWA04 and the GSWA33 Guided.

⚠WARNING WARNING!

Block the rod end from rotating while coupling the load to the thrust rod. Avoid applying torque through the thrust rod or to any of the anti-rotate components of the GSWA actuator while installing linkage
or loads to the GSWA thrust rod end. The anti-rotate is not designed to withstand the excess torque experienced with coupling a load to the actuator. **PERMANENT DAMAGE TO THE ACTUATOR MAY RESULT IF TORQUE IS APPLIED TO THE THRUST ROD**.

GSWA04 - Hex Rod

The GSWA04 with the hexagon shaped thrust rod does not allow the rod to rotate and so has an integral anti-rotate design. However, like the GSWA33 & GSWA44 side load must be avoided, this is an anti- rotate only. The hex rod does not provide any guide/support for a load.

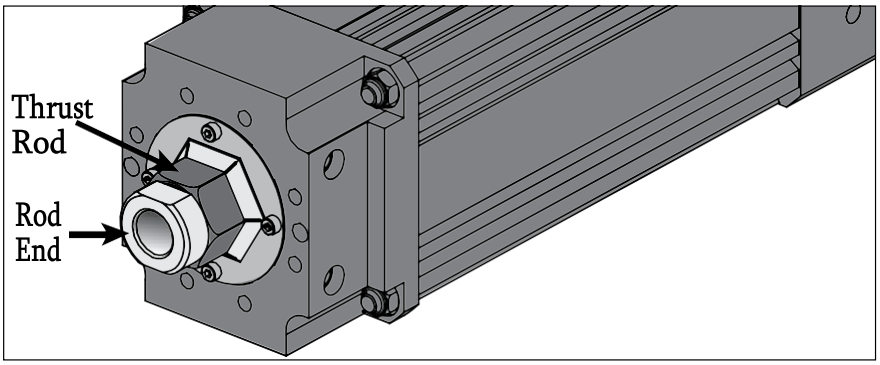


Figure 4.5: The hexagonal shape of the GSWA04 thrust rod does not allow the rod to rotate but does not provide guidance of the load.

GSWA33 Guided

The GSWA33 Guided features a robust internal anti-rotate assembly that includes integral mounting holes, dowel pins and large bushings that provide side loading support.

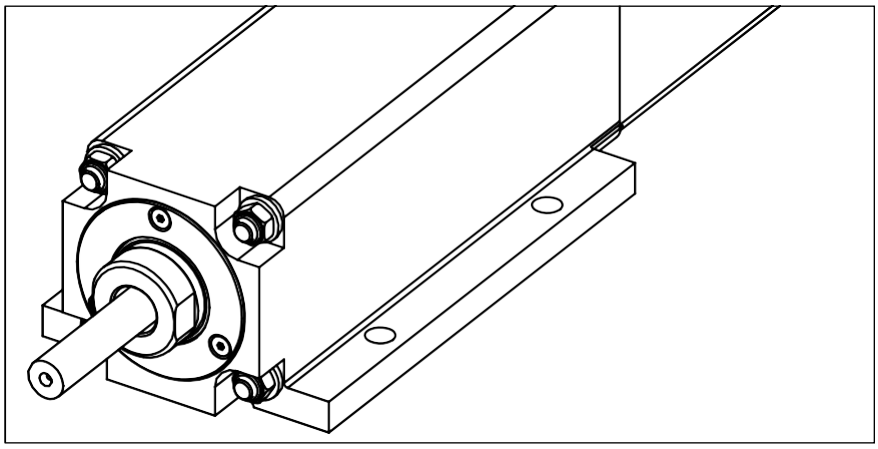


Figure 4.6: The design of the GSWA33 Guided includes this assembly that has these functions: anti- rotation device, mounting device, side load support.

5.0 GSWA ServoWeld™ Electrical Installation Guidelines

5.1 EMC Wiring Guidelines

⚠WARNING WARNING!

Thrust rod is not electrically connected to ground. The thrust rod should be earth grounded during installation for safety when possible.

Cable routing

It is recommended that the power and signal cables for ServoWeld™ actuators be routed as far apart as possible to minimize electrical noise in communication cables.
Over time, liquid contaminants such as oil and cleaning solutions may accumulate on the cables and into the connectors if they are 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.
Examples are shown 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.

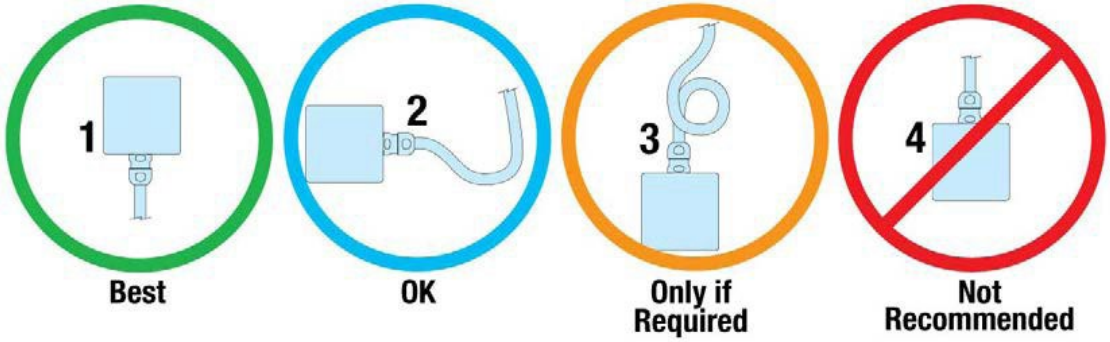


Figure 5.1: Recommended routing of ServoWeld cabling.

Shielding and grounding

Shielded cables are recommended. The standard cables provided by Tolomatic have an overall shield with drain wires and the case ground of the actuator is tied to a pin on the power connector. To minimize EMI and ensure system reliability, shield drain wires from all cables should be tied to a common earth ground.

⚠WARNING WARNING!

Thrust rod is not considered an adequate ground.

5.2 Connector Orientation

The standard Tolomatic connectors are shown in figure 5.2 below. Tolomatic can mount the connectors in the orientation desired by the customer, or be rotated during installation. The ServoWeld™ actuator is manufactured to fit many different connector configurations. Many drive/robot manufacturers have specific connectors/pinout/wiring for integrating the ServoWeld actuator into operation. Reference Appendix B for available configurations. Depending on the connector choice, some connectors may be rotated from -90° to 180°.

For the Tolomatic standard connectors it is not necessary to loosen the screws retaining the connectors. Just carefully rotate to the desired orientation.

NOTE!
Do not apply excessive force while rotating connectors.

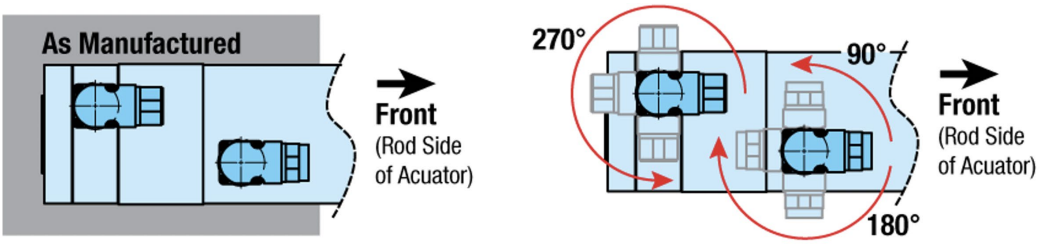


Figure 5.2: Connector rotation. Note that the Tolomatic standard connectors may be rotated from -90° to +180° allowing for cables to connect toward the front (rod end, as manufactured), to either side, both sides, or back of actuator.

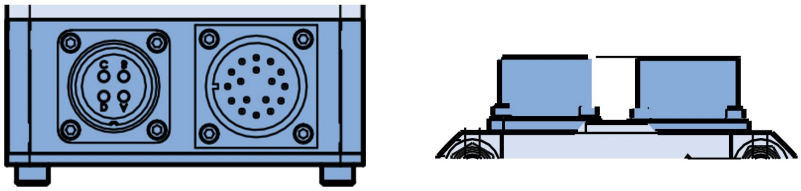


Figure 5.3: Drawing of box mount connectors used on some ServoWeld actuators.

See individual encoder/connector in section 5.5 for details.

5.3 Feedback Information

The selection of the feedback device is typically dictated by the RSW servo system drive or robot controller used to operate the actuator. Each RSW servo system drive or robot controller has specific requirements for the feedback on the motor. ServoWeld actuators may use an incremental, single-turn absolute, multi-turn absolute, or resolver type rotary feedback device. Not all resolver-based RSW servo system drives or robot controller can use the same resolver, resolver alignment, or relative direction of resolver rotation. Many RSW servo system drives or robot controllers offer software that allows the entering of parameters or the downloading of "motor data files" that dictate how the feedback must be integrated with the motor. Tolomatic can provide the proper parameters to enter to create these "data files". Entering motor parameter data to some RSW servo system drives may require assistance from the RSW servo system drive/robot manufacturer.

5.3.1 Feedback Commutation

When Tolomatic manufactures a ServoWeld actuator, the proper feedback is selected, mounted, aligned and test run on an RSW servo system drive that is known to be equivalent to the RSW servo system drive that the customer plans to use for confirming proper feedback alignment and operation.

⚠ CAUTION **CAUTION!**
In any case where it is determined that the feedback has become misaligned, or an RSW servo system drive change is made requiring the feedback to be aligned differently, it is recommended that Tolomatic be contacted and arrangements made to have that procedure performed.

5.3.2 Feedback Commutation Details

Terminology in the industry varies from motor supplier to motor supplier. One example is in the labeling of phases; some suppliers will reference phase R, S and T while others refer to U, V and W. With the differences in terminology visual explanations are used for clarification purposes.

Tolomatic ServoWeld Actuator motors are wired such that as the torque generating current vector progresses from phase U -> V -> W positive rotation is created. Positive rotation is defined as clockwise as viewed from the front face of the actuator. For reference, positive rotation will cause the thrust rod to extend.

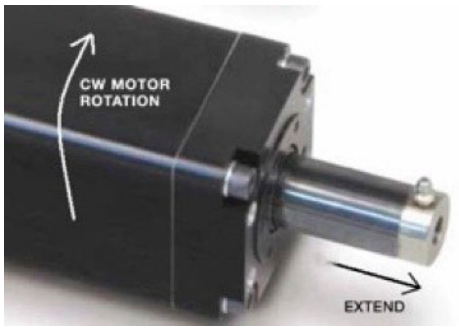


Figure 5.4: Thrust rod movement relative to motor rotation

Absolute Encoder Feedback

The commutation offset for absolute encoders in ServoWeld actuators are set to a specified offset angle supplied by the robot manufacturer. This can be accomplished by first locking the motor rotor with a current vector. The offset position can either be obtained with mechanical tooling or programming tool.

If the offset alignment value is needed, please consult the factory for this specification.

Resolver Feedback

The ServoWeld Actuator family is also offered with resolver feedback. A resolver must be excited with a sinusoidal Input and outputs two signals, commonly referred to as cos and sin. These signal's magnitude and the phase angle relative to the excitation voltage are used by the drive to determine the absolute position (single rotational) of the motor's armature. These actuators are aligned with a current vector from phase V (+) to phase W (-). At this location, the resolver body is rotated until the cos signal is null, and the sin signal is in phase with the excitation frequency.

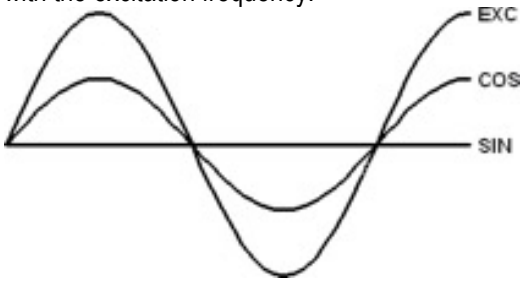


Figure 5.5: Motor rotational position at 0

Direction can be confirmed by rotating the shaft clockwise as viewed from the back, where, after 90 degrees of rotation the cos will now be in phase with the excitation frequency and the sin signal will be null.

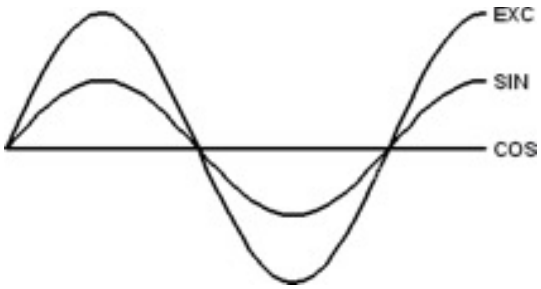


Figure 5.6: Motor rotational position at 90

Servomotor Information:

NOTE!
See servomotor specifications in Tolomatic GSWA catalog #2750-4002.

NOTE!
Do NOT exceed 650Vdc or 365 Vdc depending on motor selected, as it may cause damage to the actuator.
Supplying the motor more than 10% of the rated motor voltage may increase the rotational speed of the motor greater than its specified maximum speed, leading to premature failure of the actuator

⚠ CAUTION **CAUTION!**
In any case where it is determined that the feedback has become misaligned, or an RSW servo system drive change is made requiring the feedback to be aligned differently, it is recommended that Tolomatic be contacted and arrangements made to have that procedure performed.

5.4 Connector Pinouts

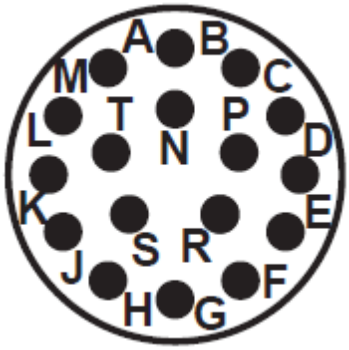
NOTE!

The correct robot motor file must be selected for each actuator, robot, and robot controller. Please contact Tolomatic on any questions related the correct motor file selection.

5.4.1 Feedback Code: Fanuc/A64

Feedback Type:	Absolute
Feedback Supply Voltage:	DC +5V ±5%
Positive Phase Sequence causes the thrust tube to:	Retract (see 2.3.2 for definition)

FEEDBACK CONNECTOR:



Style:	Box
Manufacturer:	Proprietary
Manufacturer P/N:	Proprietary
Insert Clocking:	Key between pins “K” & “L”

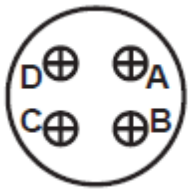
Feedback Connector Pinout:

Pin	Signal
A	SD
B	No Contact
C	No Contact
D	SD -
E	No Contact
F	REQ

Pin	Signal
G	REQ -
H	No Contact
J	+5 V
K	+5 V
L	SHIELD
M	No Contact

Pin	Signal
N	0 V
P	No Contact
R	+6 V A
S	0 V A
T	0 V

MOTOR POWER CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A18-10P
Clocking:	Key between pins “A” & “D”

Pin	Signal
A	Phase R (U)
B	Phase S (V)
C	Phase T (W)
D	GND

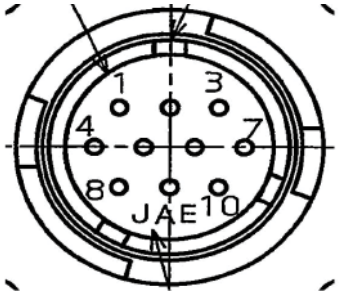
⚠WARNING **WARNING!**

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.2 Feedback Code: Fanuc/aiAR128

Feedback Type:	Absolute
Feedback Supply Voltage:	+5V ±5%
Positive Phase Sequence causes the thrust tube to:	Retract (see 2.3.2 for definition)

FEEDBACK CONNECTOR:

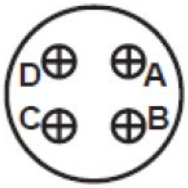


Style:	Box
Manufacturer:	Proprietary
Manufacturer P/N:	Proprietary
Insert Clocking:	As shown

Feedback Connector Pinout:

Pin	Signal	Pin	Signal
1	NC	6	RD
2	NC	7	0 V
3	NC	8	+5 V
4	+6 V A	9	+5 V
5	RD -	10	0 V

MOTOR POWER CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A18-10P
Clocking:	Key between pins "A" & "D"

Pin	Signal
A	Phase R (U)
B	Phase S (V)
C	Phase T (W)
D	GND

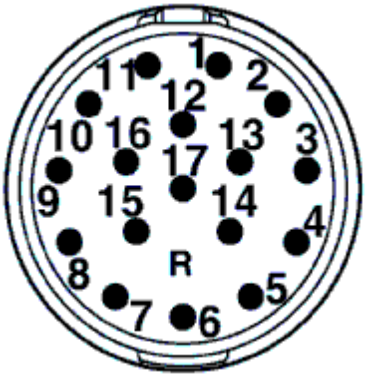
⚠WARNING WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.3 Feedback Code: FB1

Feedback Type:	Incremental
Feedback Supply Voltage:	DC +5V ±5%
Positive Phase Sequence causes the thrust tube to:	Extend (see 2.3.2 for definition)

FEEDBACK CONNECTOR:



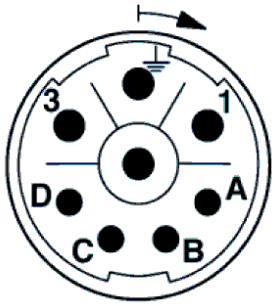
Style:	Swivel
Manufacturer:	RDE
Manufacturer P/N:	RC-17P1N8AAD00-12P
Insert Clocking:	Key between pins “1” & “11”

Feedback Connector Pinout:

Pin	Signal
1	A
2	A -
3	B
4	B -
5	I
6	I -
7	HALL A
8	HALL A –
9	HALL B

Pin	Signal
10	HALL B -
11	HALL C
12	HALL C -
13	Motor Thermal
14	Motor Thermal
15	+5 V
16	COM
17	No Contact

MOTOR POWER CONNECTOR:



Style:	Swivel
Manufacturer:	RDE
Manufacturer P/N:	SF-7EP1N8AAD00-6A7Q
Clocking:	As shown

Pin	Signal
1	Phase R (U)
PE	GND
3	Phase T (W)
4	Phase S (V)

Pin	Signal
A	No Contact
B	No Contact
C	No Contact

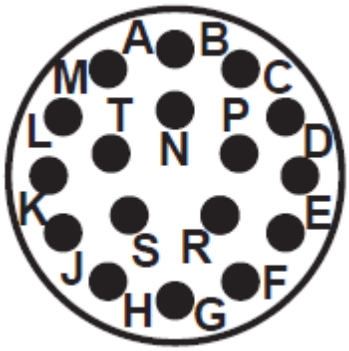
⚠WARNING **WARNING!**

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.4 Feedback Code: FB6 – Nachi/AX20

Feedback Type:	Serial – Smart ABS
Feedback Supply Voltage:	DC +5V ±5%
Positive Phase Sequence causes the thrust tube to:	Retract (see 2.3.2 for definition)

FEEDBACK CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-29P
Insert Clocking:	Key over pin “A”

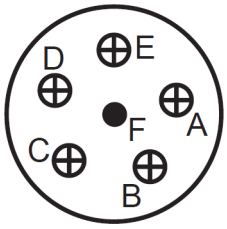
Feedback Connector Pinout:

Pin	Signal
A	A+
B	A-
C	B+
D	B-
E	SD+
F	SD-

Pin	Signal
G	GND
H	Vcc
J	GND (CASE)
K	Z+
L	Z-
M	Motor Thermal

Pin	Signal
N	Motor Thermal
P	No Contact
R	RESET
S	GND
T	Vb

MOTOR POWER CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-17P
Clocking:	Key over pin “E”

Pin	Signal
A	Phase T (W)
B	Phase S (V)
C	Phase R (U) (Nachi T)

Pin	Signal
D	No Contact
E	No Contact
F	GND

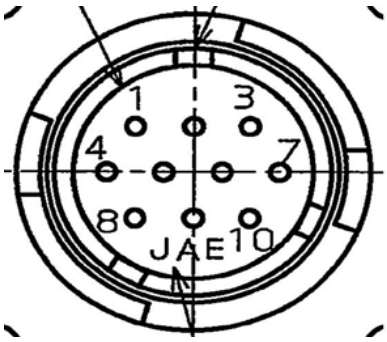
⚠WARNING! WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.5 Feedback Code: FB7 - Yaskawa / Motoman

Feedback Type:	Absolute
Feedback Supply Voltage:	DC +5V ±5%
Positive Phase Sequence causes the thrust tube to:	Retract (see 2.3.2 for definition)

FEEDBACK CONNECTOR:

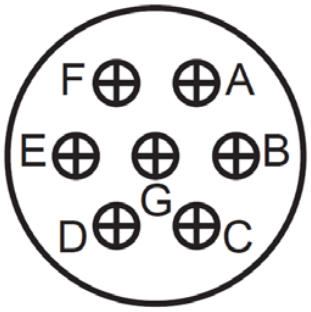


Style:	Box
Manufacturer:	JAE
Manufacturer P/N:	JN2AS10ML1
Insert Clocking:	As shown

Feedback Connector Pinout:

Pin	Signal	Pin	Signal
1	DATA +	6	BATTERY -
2	DATA -	7	FRAME GROUND
3	No Contact	8	No Contact
4	+5 VDC	9	0 V
5	BATTERY -	10	No Contact

MOTOR POWER CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-15P
Clocking:	Key between pins “A”& “F”

Pin	Signal
A	Phase T (W)
B	Phase S (V)
C	Phase R (U)
D	GND

Pin	Signal
E	Motor Thermal
F	Motor Thermal
G	No Contact

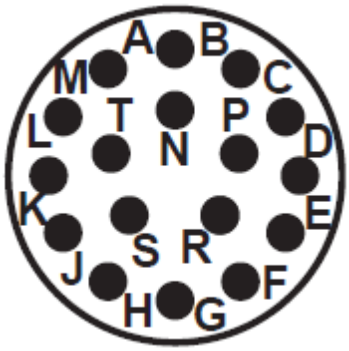
⚠WARNING! WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.6 Feedback Code: FB11 - ABB

Feedback Type:	Resolver
Feedback Supply Voltage:	Excitation 4 kHz
Positive Phase Sequence causes the thrust tube to:	Extend (see 2.3.2 for definition)

FEEDBACK CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-29P
Insert Clocking:	Key over pin "A"

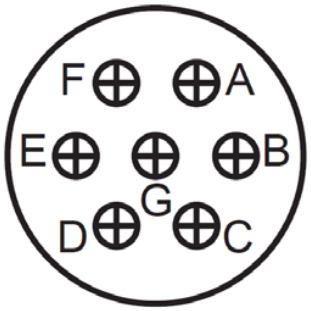
Feedback Connector Pinout:

Pin	Signal
A	COS (S1)
B	COS LO (S3)
C	SIN (S4)
D	SIN LO (S2)
E	EXC LO (R2)
F	EXC (R1)

Pin	Signal
G	No Contact
H	No Contact
J	No Contact
K	No Contact
L	No Contact
M	No Contact

Pin	Signal
N	No Contact
P	No Contact
R	No Contact
S	No Contact
T	No Contact

MOTOR POWER CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-15P
Clocking:	Key between pins "A"& "F"

Pin	Signal
A	Phase R (U)
B	Phase S (V)
C	Phase T (W)
D	GND

Pin	Signal
E	No Contact
F	Motor Thermal
G	No Contact

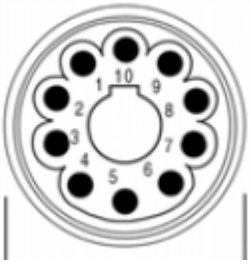
⚠WARNING! WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.7 Feedback Code: FB17 - Bosch

Feedback Type:	Absolute Endat 01
Feedback Supply Voltage:	DC 3.6 – 14 V
Positive Phase Sequence causes the thrust tube to:	Extend (see 2.3.2 for definition)

FEEDBACK CONNECTOR:

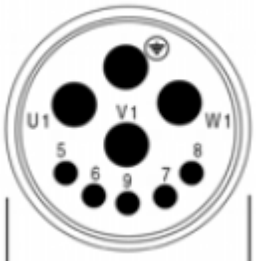


Style:	Swivel
Manufacturer:	Bosch Rexroth
Manufacturer P/N:	RGS1000/C01
Insert Clocking:	As shown

Feedback Connector Pinout:

Pin	Signal	Pin	Signal
1	Vcc	6	B -
2	GND	7	Enc DATA +
3	A +	8	Enc DATA -
4	A -	9	Enc CLK +
5	B +	10	Enc CLK -

MOTOR POWER CONNECTOR:



Style:	Swivel
Manufacturer:	Bosch Rexroth
Manufacturer P/N:	RLS1100/C02
Clocking:	As shown

Pin	Signal
U1	Phase R (U)
V1	Phase S (V)
W1	Phase T (W)
PE	GND
5	Motor Thermal

Pin	Signal
6	Motor Thermal
7	No Contact
8	No Contact
9	No Contact

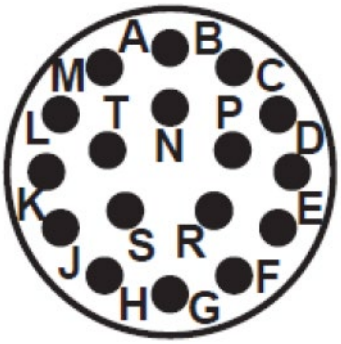
⚠WARNING WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.8 Feedback Code: FB18 – Kawasaki_D

Feedback Type:	Absolute
Feedback Supply Voltage:	DC +5V ±5%
Positive Phase Sequence causes the thrust tube to:	Retract (see 2.3.2 for definition)

FEEDBACK CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-29P
Insert Clocking:	Key between pins “K” & “L”

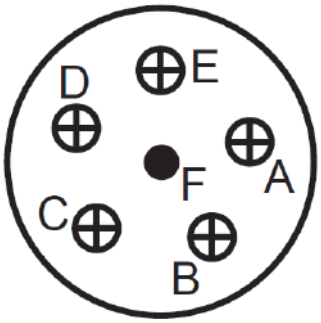
Feedback Connector Pinout:

Pin	Signal
A	SD
B	SD -
C	Vcc
D	0 V
E	GND
F	NC

Pin	Signal
G	NC
H	NC
J	NC
K	NC
L	NC
M	NC

Pin	Signal
N	NC
P	NC
R	NC
S	NC
T	NC

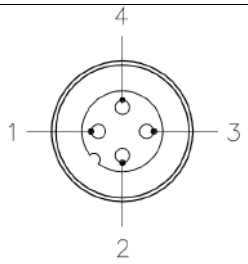
MOTOR POWER CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-17P
Clocking:	Key over pin "E"

Pin	Signal
A	Phase R (U)
B	Phase S (V)
C	Phase T (W)

Pin	Signal
D	NC (No Contact)
E	NC
F	GND



Style:	Box
Manufacturer:	Turck
Manufacturer P/N:	FS4.4/CS10604

Pin	Signal
1	Motor Thermal
2	NC
3	NC
4	Motor Thermal

⚠WARNING! WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.9 Feedback Code: FB20 – Kuka (Temp Switch)

Feedback Type:	Resolver
Feedback Supply Voltage:	Excitation 6 kHz
Positive Phase Sequence causes the thrust tube to:	Retract (see 2.3.2 for definition)

FEEDBACK CONNECTOR:

Style:	Swivel
Manufacturer:	Intercontec
Manufacturer P/N:	AEDC 052 MR04 00 0200 000
Insert Clocking:	Key over pin "8"

Feedback Connector Pinout:

Pin	Signal	Pin	Signal
1	SIN (S2)	7	EXC LO (R2)
2	SIN LO (S4)	8	Motor Thermal
3	No Contact	9	Motor Thermal
4	No Contact	10	EXC (R1)
5	No Contact	11	COS (S1)
6	GND	12	COS LO (S3)

MOTOR POWER CONNECTOR:

Style:	Swivel
Manufacturer:	Intercontec
Manufacturer P/N:	BEDC 106 MR14 00 0200 000
Clocking:	As Shown

Pin	Signal	Pin	Signal
1	Phase R (U)	4	BRK + (If Avail.)
2	Phase S (V)	5	BRK - (If Avail.)
3	GND	6	Phase T (W)

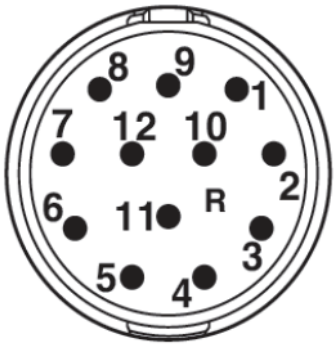
⚠WARNING WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.10 Feedback Code: FB21 - ABB

Feedback Type:	Resolver
Feedback Supply Voltage:	Excitation 4 kHz
Positive Phase Sequence causes the thrust tube to:	Extend (see 2.3.2 for definition)

FEEDBACK CONNECTOR:

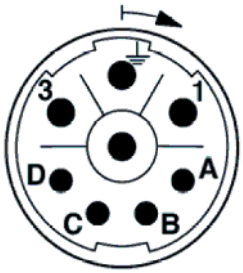


Style:	Swivel
Manufacturer:	Phoenix Contacts
Manufacturer P/N:	RF-12P1N8AAD00
Insert Clocking:	Key over pin "9"

Feedback Connector Pinout:

Pin	Signal	Pin	Signal
1	COS (S1)	7	No Contact
2	CPS LO (S3)	8	No Contact
3	SIN (S4)	9	No Contact
4	SIN LO (S2)	10	No Contact
5	EXC LO (R2)	11	No Contact
6	EXC (R1)	12	No Contact

MOTOR POWER CONNECTOR:



Style:	Swivel
Manufacturer:	Phoenix Contacts
Manufacturer P/N:	SF-7EP1N8AAD00
Clocking:	As Shown

Pin	Signal	Pin	Signal
1	Phase R (U)	A	Motor Thermal
PE	GND	B	Motor Thermal
3	Phase S (V)	C	No Contact
4	Phase T (W)	D	No Contact

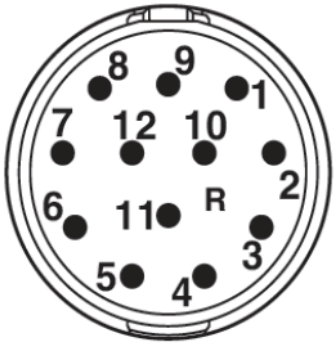
⚠WARNING! WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.11 Feedback Code: FB23 - Parker

Feedback Type:	Resolver
Feedback Supply Voltage:	Excitation 4 kHz
Positive Phase Sequence causes the thrust tube to:	Extend (see 2.3.2 for definition)

FEEDBACK CONNECTOR:

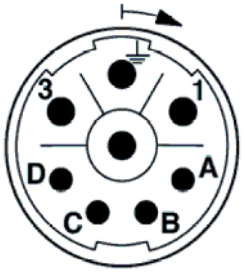


Style:	Swivel
Manufacturer:	Phoenix Contacts
Manufacturer P/N:	RF-12P1N8AAD00
Insert Clocking:	Key over pin "9"

Feedback Connector Pinout:

Pin	Signal	Pin	Signal
1	COS (S1)	7	Motor Thermal
2	CPS LO (S3)	8	Motor Thermal
3	SIN (S4)	9	No Contact
4	SIN LO (S2)	10	No Contact
5	EXC LO (R2)	11	No Contact
6	EXC (R1)	12	No Contact

MOTOR POWER CONNECTOR:



Style:	Swivel
Manufacturer:	Phoenix Contacts
Manufacturer P/N:	SF-7EP1N8AAD00
Clocking:	As Shown

Pin	Signal	Pin	Signal
1	Phase R (U)	A	No Contact
PE	GND	B	No Contact
3	Phase S (V)	C	No Contact
4	Phase T (W)	D	No Contact

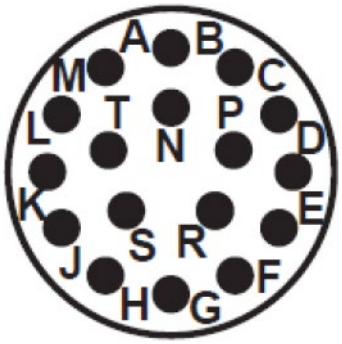
⚠WARNING WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.12 Feedback Code: FB25 – Nachi/FD11

Feedback Type:	Absolute
Feedback Supply Voltage:	DC +5V ±5%
Positive Phase Sequence causes the thrust tube to:	Retract (see 2.3.2 for definition)

FEEDBACK CONNECTOR:



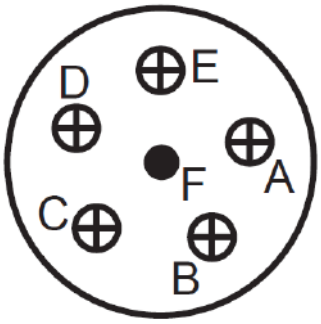
Style:	Box
Manufacturer:	Proprietary
Manufacturer P/N:	Proprietary
Insert Clocking:	Key over pin "A"

Feedback Connector Pinout:

Pin	Signal
A	No Contact
B	No Contact
C	No Contact
D	No Contact
E	SD +
F	SD -
G	GND
H	Vcc
J	GND

Pin	Signal
K	No Contact
L	No Contact
M	Motor Thermal
N	Motor Thermal
P	No Contact
R	No Contact
S	BAT -
T	BAT +

MOTOR POWER CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-17P
Clocking:	Key over pin "E"

Pin	Signal
A	Phase T (W)
B	Phase S (V)
C	Phase R (U)

Pin	Signal
D	No Contact
E	No Contact
F	GND

⚠WARNING WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.13 Feedback Code: FB26 - Comau

Feedback Type:	Resolver
Feedback Supply Voltage:	Excitation 4 kHz
Positive Phase Sequence causes the thrust tube to:	Extend (see 2.3.2 for definition)

FEEDBACK CONNECTOR:

Style:	Straight
Manufacturer:	Intercontec
Manufacturer P/N:	A EG A 052 MR 83 00 0201 000
Insert Clocking:	Key over pin "8"

Feedback Connector Pinout:

Pin	Signal	Pin	Signal
1	SIN LO (S2)	7	EXC LO (R2)
2	SIN (S4)	8	Motor Thermal
3	No Contact	9	Motor Thermal
4	No Contact	10	EXC (R1)
5	SHIELD	11	CPS (S1)
6	No Contact	12	COS LO (S3)

MOTOR POWER CONNECTOR:

Style:	Straight
Manufacturer:	Intercontec
Manufacturer P/N:	B EG A 116 MR 14 00 0200 000
Clocking:	As Shown

Pin	Signal	Pin	Signal
1	Phase T (W)	4	No Contact
2	Phase S (V)	5	No Contact
3	CHASSIS GND	6	Phase R (U)

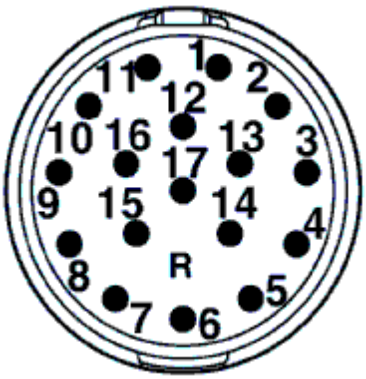
⚠WARNING WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.14 Feedback Code: FB27 - Emerson

Feedback Type:	Absolute
Feedback Supply Voltage:	DC 3.6 – 14 V
Positive Phase Sequence causes the thrust tube to:	Extend (see 2.3.2 for definition)

FEEDBACK CONNECTOR:



Style:	Swivel
Manufacturer:	Intercontec
Manufacturer P/N:	AEDC 113 MR83 00 0201 000
Insert Clocking:	Key between pins “1” & “11”

Feedback Connector Pinout:

Pin	Signal
1	Motor Thermal
2	Motor Thermal
3	No Contact
4	No Contact
5	No Contact
6	No Contact
7	No Contact
8	ENC CLK +
9	ENC CLK -

Pin	Signal
10	COS (B+)
11	ENC DATA +
12	ENC DATA –
13	COS LO (B-)
14	SIN LO (1-)
15	SIN (A+)
16	Vcc
17	COM

MOTOR POWER CONNECTOR:

Style:	Straight
Manufacturer:	Intercontec
Manufacturer P/N:	B EG A 116 MR 14 00 0200 000
Clocking:	As Shown

Pin	Signal
1	Phase R (U)
2	Phase S (V)
3	GND

Pin	Signal
4	Phase T (W)
5	BRK + (If Avail.)
6	BRK - (If Avail.)

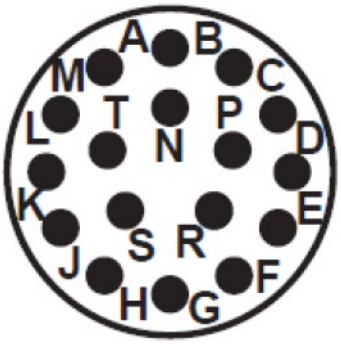
⚠WARNING WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

5.4.15 Feedback Code: FB29 – Kawasaki_ E

Feedback Type:	Absolute
Feedback Supply Voltage:	DC +5V ±5%
Positive Phase Sequence causes the thrust tube to:	Retract (see 2.3.2 for definition)

FEEDBACK CONNECTOR:

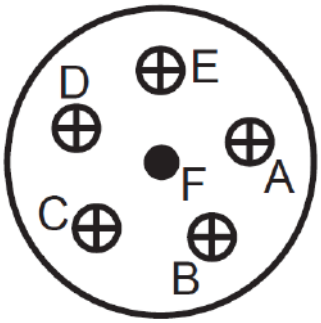


Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-29P-W
Insert Clocking:	Key between pins “K” & “L”

Feedback Connector Pinout:

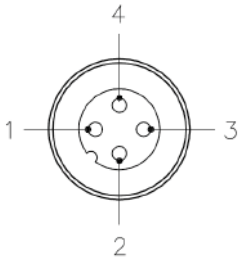
Pin	Signal	Pin	Signal	Pin	Signal
A	SD	G	NC	N	NC
B	SD -	H	NC	P	NC
C	Vcc	J	NC	R	NC
D	GND	K	NC	S	NC
E	CHASSIS GND	L	NC	T	NC
F	NC	M	NC		

MOTOR POWER CONNECTOR:



Style:	Box
Manufacturer:	Amphenol
Manufacturer P/N:	MS3102A20-17P
Clocking:	Key over pin "E"

Pin	Signal	Pin	Signal
A	Phase R (U)	D	NC (No Contact)
B	Phase S (V)	E	NC
C	Phase T (W)	F	CHASSIS GND



Style:	Box
Manufacturer:	Turck
Manufacturer P/N:	FS4.4/CS10604

Pin	Signal	Pin	Signal
1	Motor Thermal	3	No Contact
2	No Contact	4	Motor Thermal

⚠WARNING WARNING!

Feedback device, wiring and connector design are intended to operate with chosen robot controller or servo drive. Please verify robot controller/servo drive and mating cable are integrated for use with ServoWeld™ actuator before attempting to operate. Damage to the actuator or unintended operation could occur if not properly matched.

6.0 GSWA Operation and Start up Considerations

6.1 Attaching Cables & Homing / Mechanical Travel Limits

1. Carefully align each cable connector with the respective motor connector.
2. Fully seat the feedback and power connectors.
3. Verify continuity and functionality of the thermal switch signals, TS+ and TS-. These signals are transmitted through the cables that connects the motor to its motion control system.
4. When homing the ServoWeld™ actuator avoid excessive force. During homing do not exceed 20% of continuous thrust or speeds of 0.39 in/sec (10 mm/sec). **Exceeding these recommendations can cause permanent damage to the actuator.** Careful attention should always be taken to prevent exceeding the physical limits of the actuator.

⚠ CAUTION **CAUTION!**

The mechanical travel limits of the actuator must be verified to ensure the actuator will not reach an internal hard limit during normal operation. The end of stroke bumpers should NOT be engaged during normal programmed servo actuator operation.

6.2 Brake

Some applications benefit from the addition of the Tolomatic integral brake. Whenever the brake is not powered the screw is prevented from turning. (Back driving under the load)

⚠WARNING **WARNING!**

In all vertical application an un-powered ServoWeld GSWA actuator will require a brake to maintain position. Tolomatic recommends that the nominal back drive force specification (listed in Table 6.1) be used for reference only. Back drive force is subject to change throughout the life of the actuator, due to mechanical break in, ambient temperature, and duty cycle variation.

A brake can be used with the actuator to keep it from backdriving, typically in vertical applications. A brake may be used for safety reasons or for energy savings allowing the actuator to hold position when un-powered.

NOTE!

The optional Spring-Applied / Electronically-Released Brake typically requires 24 or 90 V power (depending on robot manufacturer).

The brake is spring engaged and electrically released. The holding capacity of the brakes exceeds the rated continuous force of the actuator.

⚠ CAUTION **CAUTION!**

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.

ServoWeld™ Brake Specifications

SERIES		GSWA33	GSWA44 & GSWA04	GSWA55
ROTOR INERTIA	oz-in^2	0.400	1.307	1.171
	gm-cm^2	73	239	214
CURRENT	Amp	0.43	0.67	0.67
HOLDING TORQUE	in-lb	35	89	145
	N-m	4.0	10.0	16.4
ENGAGE TIME	mSec	40	25	95
DISENGAGE TIME	mSec	50	50	26
VOLTAGE	Vdc	24 or 90 optional		

Table 6.1: GSWA brake specifications

Protecting the brake from voltage transients in applications where it will be engaged and disengaged frequently is advised. The use of a rectifying diode and zener diode will provide optimal protection against these transients.

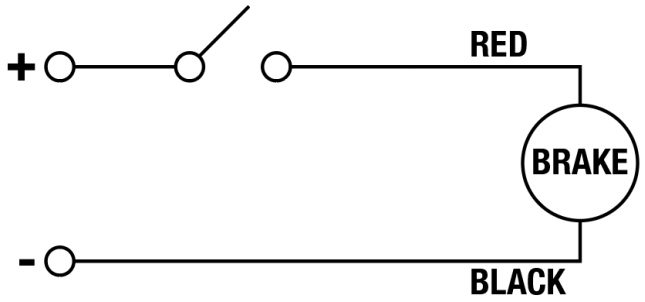


Figure 6.1: Fastest Engage / Disengage time, least protection

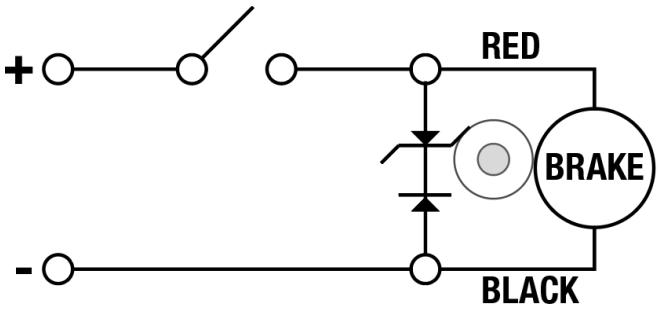


Figure 6.2: Increased Engage / Disengage time, best protection

7.0 GSWA Maintenance & Repair

7.1 Lubrication

NEW UNIT: All ServoWeld™ actuators have been lubricated at the factory and are ready for installation. If the actuator is placed in storage for more than 1 year after it is received, the actuator should be lubricated through the lubrication port on the thrust rod with (GSWA33: 3.0 grams; GSWA44/04: 5.0 grams; GSWA55: 7.0 grams) of Kluber Isoflex Topas NCA52 grease (Tolomatic, PN: 1150-1017) and cycled at least two full strokes prior to running in a loaded condition.

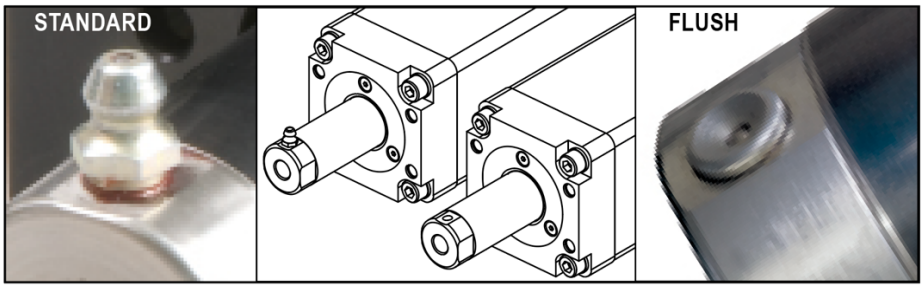


Figure 7.1: A standard or a flush style grease zerk allow periodic relubrication for the GSWA33, 04, 44 & 55 actuator. This can often be done without removing the actuator from its installation.

GSWA MODELS DO NOT REQUIRE ANY MAINTENANCE OR LUBRICATION FOR MOST APPLICATIONS.

NOTE!

If the GSWA ServoWeld actuator does include a lubrication port on the rod end as shown in Figure 7.1 lubrication can be performed in accordance with the following guidelines.

If operating GSWA44 & GSWA04 with RN04 roller screw above 3,300 lbf (14,679N) thrust rod output force lubrication is recommended. These models will have a factory installed lubrication port. Maintaining proper lubrication is required to achieve product life specifications of GSWA44 & GSWA04 with RN04 roller screw models.

Lubrication needs in a given application are dependent on multiple factors:

- Ambient temperature of the environment
- Weld Schedule:
  - Number of open/close (long moves) per minute
  - Number of welds per minute
  - Actuator thrust rod force required

7.2 Periodic Maintenance

PERIODIC MAINTENANCE: The forces in different applications impact the life of the grease in the actuator. Tolomatic recommends a simple, 5-minute maintenance procedure based on Table 7.1 for typical weld gun styles. For questions about your specific application, contact Tolomatic Customer Support.

Weld Gun Type	PM Schedule (weld cycles)
C gun	10,000,000
X gun / Pinch gun	5,000,000

Table 7.1: Periodic Maintenance (relubrication) Schedule

For optimal performance and maximum life, consider performing this simple

maintenance every 5,000,000 weld cycles.

NOTE!
Tolomatic also recommends validating the output force after 100,000 cycles and on an annual basis thereafter.
It is recommended that the actuator be visually inspected after initial startup and twice a year thereafter, specifically checking for uneven wear or discoloration of the thrust rod which may indicate side loading and lead to premature seal failure. Contact the nearest Tolomatic service center with any concerns or questions.

Procedure for lubrication

NOTE!
Before starting any maintenance activities, confirm ServoWeld actuator is in full retract position and supply power is shut off.

1. Ensure ServoWeld actuator is in full retract position
2. A standard grease fitting may be used on GSWA fitted with a standard grease zerk. For GSWA fitted with a flush type grease zerk, use a standard flush style nozzle fitting.
3. Apply the following amounts of grease into the grease Zerk on the rod end of the actuator:
   a. GSWA33: 3.0 grams
   b. GSWA44/04: 5.0 grams
   c. GSWA55: 7.0 grams

NOTE!
Note: Use Kluber Isoflex Topas NCA52 grease. Available from Tolomatic, PN: 1150-1017

4. Re-apply power to the ServoWeld actuator
5. Using the Robot teach pendant, complete five full extend / full retract moves of the ServoWeld actuator at low speed / low force to properly distribute the grease

⚠ CAUTION **CAUTION!**
Do not over-fill with grease
Overfilling will cause a reduction in performance, excessive heat build up and potential premature failure.

7.3 GSWA Field Maintenance and Repair

The only user serviceable component on most configurations of the GSWA actuator is the rod scraper/ wiper assembly.

Further disassembly of the GSWA is not recommended.

GSWA actuators should be returned to Tolomatic for evaluation and repair. Contact Tolomatic for instructions on how to return the GSWA actuator for evaluation.

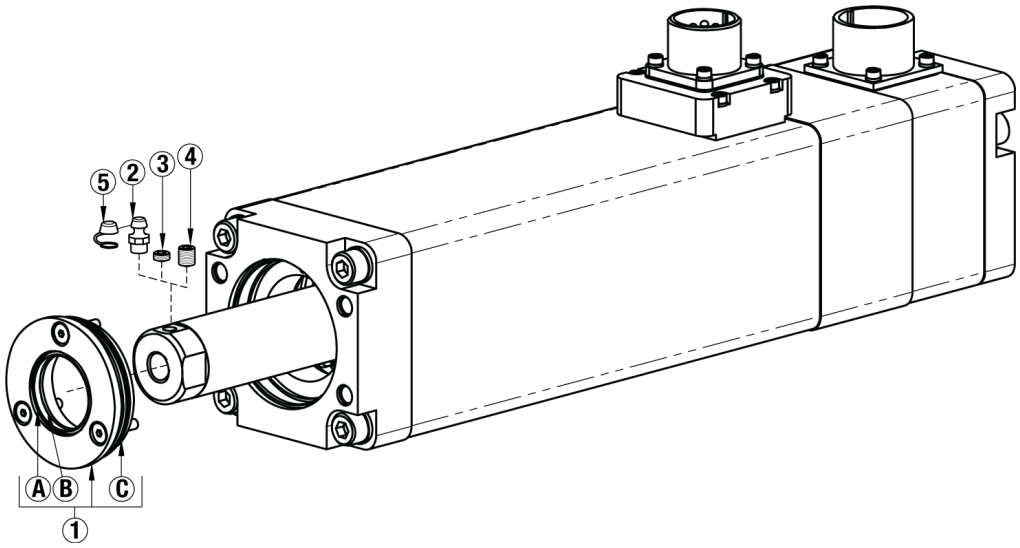


Figure 7.2: Exploded view of GSWA33

Parts Listing

ITEM	DESCRIPTION	GSWA33	GSWA33 GUIDED	GSWA44	GSWA04		GSWA55
					ROUND TUBE	HEX TUBE	
1.	WIPER/SCRAPER KIT	2733-9147	2733-9143	2744-9147	2750-9118	2750-9114	2755-9147
1A.	WIPER	2733-1432	2733-1309	2733-1309	2750-1432	2750-1425	2755-1432
1B.	SCRAPER	2733-1431	2733-1312	2733-1312	2750-1431	2750-1426	2755-1431
1C.	O-RING	1034-1000	2733-1317	2733-1317	2750-1434	N/A	0778-1008

ITEM	PART NO.	DESCRIPTION
2.*	0100-1601	Zerk, Fitting, 1/4-28
3.*	2309-1055	Set Screw, 1/4-28 (Flush zerk replacement)
4.*	2744-1214	Grease Fitting Plug, 1/4-28 (leak-proof)
5.*	2744-1213	Grease Zerk Cap (leak-resistant)

*If Applicable

Table 7.2: GSWA Parts Listing

Wiper Maintenance

In extreme environments it may be necessary to replace the rod scraper/wiper assembly.
The GSWA has a replaceable scraper/wiper assembly. This can be replaced by removing the zerk (if applicable) and the screws from the pilot ring.

⚠WARNING WARNING!

There is a possibility that base oil may leak from the Grease Zerk (#2). If applicable,in contamination sensitive applications replace Grease Zerk (#2) with a leak-proof Grease Fitting Plug (#4), or add a leak-resistant Grease Zerk Cap (#5) to cover Grease Zerk (#2).

7.4 ServoWeld™ Refurbishment & Remanufacturing Service

Tolomatic factory refurbishment or remanufacturing service is available for any ServoWeld™ actuator. This service will return the ServoWeld actuator to factory specs.

Refurbishment Service includes:

- Replace thrust rod
- Replace wiper/scraper components
- Visually inspect for additional worn or broken components
- Clean roller screw and nut
- Re-lubricate the roller screw and nut
- Re-assemble the actuator
- Functional test to assure unit is fully operational to original specifications

Remanufacturing Service includes:

- Replace thrust rod
- Replace wiper/scraper components
- Visually inspect for additional worn or broken components
- Replace roller screw/nut assembly
- Replace main bearing
- Re-assemble the actuator
- Functional test to assure unit is fully operational to original specifications
- 1 year warranty from date of shipment

Appendix A: Specifications

NOTE!
For performance data and specifications
please refer to the Tolomatic GSWA catalog #2750-4002

Actuator Specifications

Performance and Mechanical Specifications

		GSWA33, GSWA33-GUIDED			GSWA44, GSWA04						GSWA55	
		MV23/43			MV22/42		MV23/43					
SIZE	in	3.3			4.4						5.6	
	mm	*83.0*			*111*						*142*	
NUT/ SCREW		RN04	RN05	RN10	RN05	RN10	RN04	RN05	RN05 XR	RN10	RN05	RN10
SCREW LEAD	in	0.157	0.197	0.397	0.197	0.397	0.157	0.197	0.197	0.397	0.197	0.397
	mm	*4.0*	*5.0*	*10.0*	*5.0*	*10.0*	*4.0*	*5.0*	*5.0*	*10.0*	*5.0*	*10.0*
PEAK FORCE	lbf	2,500	2,500	1275	3,300	1,800	4,000	3,300	4,000	2,500	8,243	4,121
	kN	*11.1*	*11.1*	*5.7*	*14.7*	*8.0*	*17.8*	*14.7*	*17.8*	*11.1*	*36.7*	*18.3*
MAX. VELOCITY	in/sec	9.2	11.5	23.0	11.5	23.0	9.2	11.5	11.5	23.0	7.9	15.7
	mm/sec	*234*	*292*	*584*	*292*	*584*	*234*	*292*	*292*	*584*	*201*	*399*
SCREW DYNAMIC LOAD RATING	lbf	9240	12,050	10,611	16,479	17,175	15107	16,479	20.623	17,175	21,716	36,149
	kN	*41.10*	*53.60*	*47.20*	*73.30*	*76.40*	*67.2*	*73.30*	*91.74*	*76.40*	*96.60*	*160.80*
NOMINAL BACK DRIVE FORCE	lbf	98	78	39	91	46	114	91	91	46	152	76
	N	*436*	*347*	*173*	*405*	*205*	*507*	*405*	*405*	*205*	*676*	*338*
AMBIENT TEMP RANGE	°F	50 to 122										
	°C	*10 to 50*										
IP RATING	Standard IP65 (static)											
AGENCY LISTINGS	CE cULus IP65											

		GSWA33	GSWA33-GUIDED	GSWA04		GSWA44	GSWA55
		MV23,43	MV23,43	MV22,42	MV23,43	MV23,43	MV23,43
WEIGHT (with 6 in / 152 mm stroke)	lb	18.1	28.5	29.8	32.0	35.2	67.2
	kg	*8.2*	*12.9*	*13.5*	*14.5*	*16.0*	*30.5*
STROKE	in	6.0 to 18.0	6.0 to 9.0	6.0	6.0	6.0 to 18.0	
	mm	*152.4 to 451.2*	*152.4 to 228.6*	*152.4*	*152.4*	*152.4 to 451.2*	
WEIGHT PER UNIT OF STROKE	lb/in	0.6603	0.6603	1.1035	1.1035	1.1035	2.1115
	kg/mm	*0.0118*	*0.0118*	*0.0197*	*0.0197*	*0.0197*	*0.03771*
BASE INERTIA	lb/in	1.6723	1.6723	2.7716	3.3442	3.3442	3.3442
	kg-cm²	*4.8997*	*4.8997*	*8.1108*	*9.7864*	*9.7864*	*9.7864*
INERTIA PER UNIT OF STROKE	lb-in²/in	0.00358	0.00358	0.00984	0.00984	0.00984	0.00984
	kg-cm²/mm	*0.00041*	*0.00041*	*0.00113*	*0.00113*	*0.00113*	*0.00113*

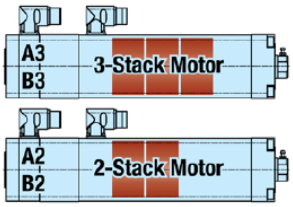
NOTE! For performance data and specifications please refer to the GSWA catalog #2750-4002.

Motor Specifications:

			GSWA33 GSWA33, GUIDED		GSWA04		GSWA44 GSWA04		GSWA55	
			MV23	MV43	MV22	MV42	MV23	MV43	MV23	MV43
BUS VOLTAGE		V_{RMS}	230	460	230	460	230	460	230	460
TORQUE CONSTANT (KT)		in-lb/A Peak	5.5	10.7	4.6	8.0	5.4	10.6	6.7	13.4
		N-m/A Peak	*0.62*	*1.21*	*0.52*	*0.90*	*0.61*	*1.2*	*0.76*	*1.51*
VOLTAGE CONSTANT (KE)		V/Krpm Peak	79.8	154	66.1	107.2	78.1	153.1	100	201
CONTINUOUS STALL TORQUE	No Water Cooling	in-lb	39	38	48.8	43.0	74	75	112	112
		N-m	*4.4*	*4.3*	*5.5*	*4.9*	*8.4*	*8.5*	*12.7*	*12.7*
	With Water Cooling	in-lb	78	76	97.6	86	148	150	NA	NA
		N-m	*8.8*	*8.6*	*11.0*	*9.7*	*16.7*	*17.0*	*NA*	*NA*
CONTINUOUS STALL CURRENT	No Water Cooling	A_{RMS}	5.0	2.5	7.5	3.8	9.7	5.0	11.8	5.9
	With Water Cooling	A_{RMS}	10.0	5.0	15.0	7.6	19.4	10.0	NA	NA
PEAK TORQUE		in-lb	117	114	146	129	222	225	335	335
		N-m	*13.2*	*12.9*	*16.5*	*14.6*	*25.1*	*25.4*	*37.8*	*37.8*
PEAK CURRENT		A_{RMS}	15	7.5	22.5	11.4	29.1	15.0	35.4	17.7
RESISTANCE		Ohms	2.07	8.3	0.9	4.2	0.58	2.32	0.57	2.93
INDUCTANCE		mH	3.8	15.0	3.65	15.7	2.75	11.5	1.4	5.8
SPEED @ RATED V		RPM	3,500						2,400	
NO. OF POLES			8							

MV23,43 = 3 Stack Motor

MV22,42 = 2 Stack Motor



RoHS COMPLIANT RoHs Compliant Components,

CE Approved

Standard thermal switch specifications

The motor windings have an integral normally closed thermal switch or resistance based temperature measurement device. These devices must be integrated with the robot controller. The switch opens at a temperature of 212° F (100°C), which is the windings maximum operating temperature. The thermal switch is meant to protect the windings, the actuators continuous operating region must still be obeyed. Operation that causes the windings temperature to approach 212° F (100°C) will reduce the expected life of the actuator.

NOTE!

For performance data and specifications
please refer to the Tolomatic GSWA catalog #2750-4002

Appendix B: Troubleshooting Procedure

SYMPTOM	POTENTIAL CAUSE	SOLUTION
No response from actuator	Controller / Drive not enabled	Enable Controller/Drive
	Controller / Drive faulted	Reset the Controller/Drive
	Improper / Failed wiring	Check the wiring
Drive is enabled but actuator is not operating or is operating erratically	Improper robot motor file selected	Confirm motor file selection with robot manufacturer
	Improper ServoWeld / gun system calibration in robot controller	Confirm ServoWeld / gun system has been calibrated per robot manufacturer calibration procedure
	Feedback wiring may be incorrect	Verify feedback wiring
	Feedback wiring may be incorrect	Verify feedback wiring
Actuator is operating but is not up to rated speeds/force	Improper robot motor file selected	Confirm motor file selection with robot manufacturer
	Improper ServoWeld / gun system calibration in robot controller	Confirm ServoWeld / gun system has been calibrated per robot manufacturer calibration procedure
	Motor phases are wired incorrectly or in incorrect order	Verify correct wiring of motor armature
	Drive may be improperly tuned	Check all gain settings
	Drive may be set up improperly for ServoWeld actuator used	Check drive settings for number of poles, voltage, current, resistance, inductance, inertia, etc.
	Feedback is improperly aligned	Contact Tolomatic
Actuator cannot move	Force is too large for the capacity of the actuator or too much friction is present	Verify force requirements
	Excessive side load	Verify correct operation
	Misalignment of output rod to application	Verify correct alignment
	Drive has too low of current capacity oris limited to tool low of current capacity	Verify correct drive and settings
	Actuator has crashed into hard stop	Disconnect from load and manually move away from hard stop. If problem persists, contact Tolomatic for service.
Actuator housing moves or vibrates when shaft is in motion	Loose mounting	Check actuator mounting
	Drive is improperly tuned – wrong gain settings	Tune drive

SYMPTOM	POTENTIAL CAUSE	SOLUTION
Actuator is overheating	Improper robot motor file selected	Confirm motor file selection with robot manufacturer
	Improper ServoWeld / gun system calibration in robot controller	Confirm ServoWeld / gun system has been calibrated per robot manufacturer calibration procedure
	Duty cycle is higher than actuator ratings	Verify duty cycle is within continuous ratings
	Drive is poorly tuned, causing excessive unnecessary current to be applied to motor	Check gain settings
	Actuator low or out of grease	Re-lubricate (if applicable)
Overheat fault - however actuator is not hot	Cable broken or connector disconnected	Replace faulty cable and/or insure proper connections

Appendix C: Warranty

C.1 Warranty

Warranty and Limitation of Liability

Tolomatic's complete terms and conditions can be found here https://www.tolomatic.com/info-center/resource-details/terms-and-conditions

Limited Warranty

Tolomatic warrants that at the time of delivery, Products shall be in good condition, free from defects in material and workmanship and that Products made to order shall conform to applicable drawings or specifications as referenced in the quotation or accepted purchase order ("Product Warranty"). The Product Warranty shall expire one year from date of shipment (the "Warranty Period"). Tolomatic warrants that Buyer shall acquire good title to the Products free from third party rights. These warranties are given only to Buyer and not to any third party.

The Product Warranty excludes any defects or non-conformance resulting (wholly or in part) from: (i) accidental damage, mishandling, incorrect installation, negligence or other circumstances arising after delivery; (ii) the repair or alteration of the Product by any party other than Tolomatic or its authorized representative; (iii) the failure by Buyer to provide a suitable storage, use, or operating environment for the Products; (iv) Buyer's use of the Products for a purpose or in a manner other than that for which they were designed; and (v) other abuse, misuse or neglect of the Products by Buyer or any third party.

The Product Warranty excludes any Products not manufactured by Tolomatic. Insofar as any Products are manufactured by third parties, Tolomatic shall, insofar as it can, pass to the Buyer the benefit of all warranties given by the supplier of such Products.

The Product Warranty shall be limited to defects of which Tolomatic is notified within twenty-one (21) days from the date of shipment to Buyer or, in the event of latent defects, within twenty-one (21) days of the defect being discovered and provided that such notice is received within the Warranty Period. As sole remedy for the breach of the warranty in paragraph (a) above, provided that (if required by Tolomatic) all non-conforming Products are returned to Tolomatic at Buyer's cost, and provided that Tolomatic confirms the defect or non-conformance, Tolomatic shall at its option (i) replace or repair the defective or non-conforming items, or correct any defective work or non-conformance, or (ii) refund to Buyer the original purchase price of the defective or non-conforming item and reimburse to Buyer any transportation and insurance charges incurred by Buyer.

Any claim by Buyer against Tolomatic alleging the breach of the Product Warranty must be commenced within twelve (12) months following the date of the alleged breach.

In the event the parties disagree whether or not a breach of the Product Warranty has occurred, Tolomatic may (but shall not be obliged to) undertake any repairs or replacement requested by Buyer pending final settlement of the matter. If it is determined that no such breach has occurred, Buyer shall pay Tolomatic upon demand the reasonable price of the repairs, corrections, or replacements made by Tolomatic including allowances for overheads and a reasonable profit margin.

THE WARRANTIES EXPRESSLY MADE UNDER THESE TERMS ARE EXCLUSIVE AND GIVEN IN LIEU OF ALL OTHER REPRESENTATIONS, WARRANTIES AND COVENANTS THAT MAY BE IMPLIED BY LAW, BY CUSTOM OF TRADE, BY THESE TERMS, BY THE PURCHASE ORDER OR OTHERWISE WITH RESPECT TO THE PRODUCTS. TO THE FULL EXTENT PERMITTED BY LAW, TOLOMATIC DISCLAIMS AND BUYER WAIVES ALL SUCH REPRESENTATIONS, WARRANTIES AND COVENANTS INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. BUYER'S SOLE REMEDY FOR BREACH OF WARRANTY IS STATED IN PARAGRAPH (d) ABOVE.

No Products shall be returned without Tolomatic's prior written consent. Products which Tolomatic consents to have returned shall be shipped by Buyer at Buyer's risk and expense, freight prepaid, to such location as Tolomatic designates.

Limitation of Liability

Tolomatic shall in no event be liable to Buyer or any third party, whether in contract, tort (including negligence), misrepresentation, strict liability or otherwise, for any incidental, punitive, consequential, indirect or special damages, including any loss of profits or savings or anticipated profits or savings, loss of data, loss of opportunity, loss of reputation, loss of goodwill or business or potential business, however caused, even if Tolomatic has been advised of the possibility of such damages in advance.

Under no circumstances shall Tolomatic's liability to Buyer in connection with any purchase order or Products supplied to Buyer exceed an amount equal to the amount paid by Buyer for such Products.

Buyer agrees and understands that it is solely Buyer's responsibility to ensure that Products are suitable for Buyer's requirements and for the environment, facilities or machinery for which they are intended by Buyer or by its end-customer to be fitted or used. Even if Tolomatic is advised of Buyer's intended use, Tolomatic makes no representation or warranty that the Product will be suitable for that purpose. Any technical advice furnished by Tolomatic relating to the intended use of the Products is given for information only and Tolomatic assumes no obligation or liability for the advice given or the results obtained. Except insofar as specifications or drawings form part of a purchase order and the Product Warranty, to the full extent permitted by law, Tolomatic disclaims and Buyer waives all representations, warranties and covenants that may be implied from the provision by Tolomatic of technical advice or information about Product. All such advice and information are accepted by Buyer at its risk.

Insofar as any liability or warranty of Tolomatic cannot be limited or excluded under applicable law, including any laws that do not permit limitations on liability relating to death or personal injury, the provisions of these terms and conditions shall be construed as being subject to such legal limitations, but only if those legal provisions have effect in relation to Tolomatic's liability notwithstanding the governing law provision in Section 18

Product Return Procedure

1. Before initiating the RMA process and obtaining an RMA number, please contact the Tolomatic Technical Support team to determine if it is possible to correct the issue in the field.

2. If an RMA is needed your Tolomtic Technical support team will initiate the RMA process and set up an RMA number. If possible, please contact your local distributor from which the actuator was originally purchased to begin the RMA process.

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Toll-Free: **1-800-328-2174**
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Appendix D: DoC

EU Declaration of Conformity

No: 36004707_03

We the manufacturer,

Tolomatic
3800 County Road 116
Hamel, MN 55340
USA

declare under our sole responsibility that the product(s),

GSWA Actuators

All Models

Fulfills the essential requirements of the following directives:

LVD Directive (2014/35/EU)

EN 60034-1:2010/AC:2010 Rotating electrical machines Part 1 Rating and performance

RoHS Directive (2011/65/EU, as amended by (EU) 2015/863)

REACH (Regulation (EC) No 1907/2006)

Assumption of conformity is based on the application of the harmonized or applicable technical standards and, when applicable or required, a European community notified body certification.

Brad Schulz
Director of Engineering & Technology

28.10.2022
Date (dd.mm.yyyy)