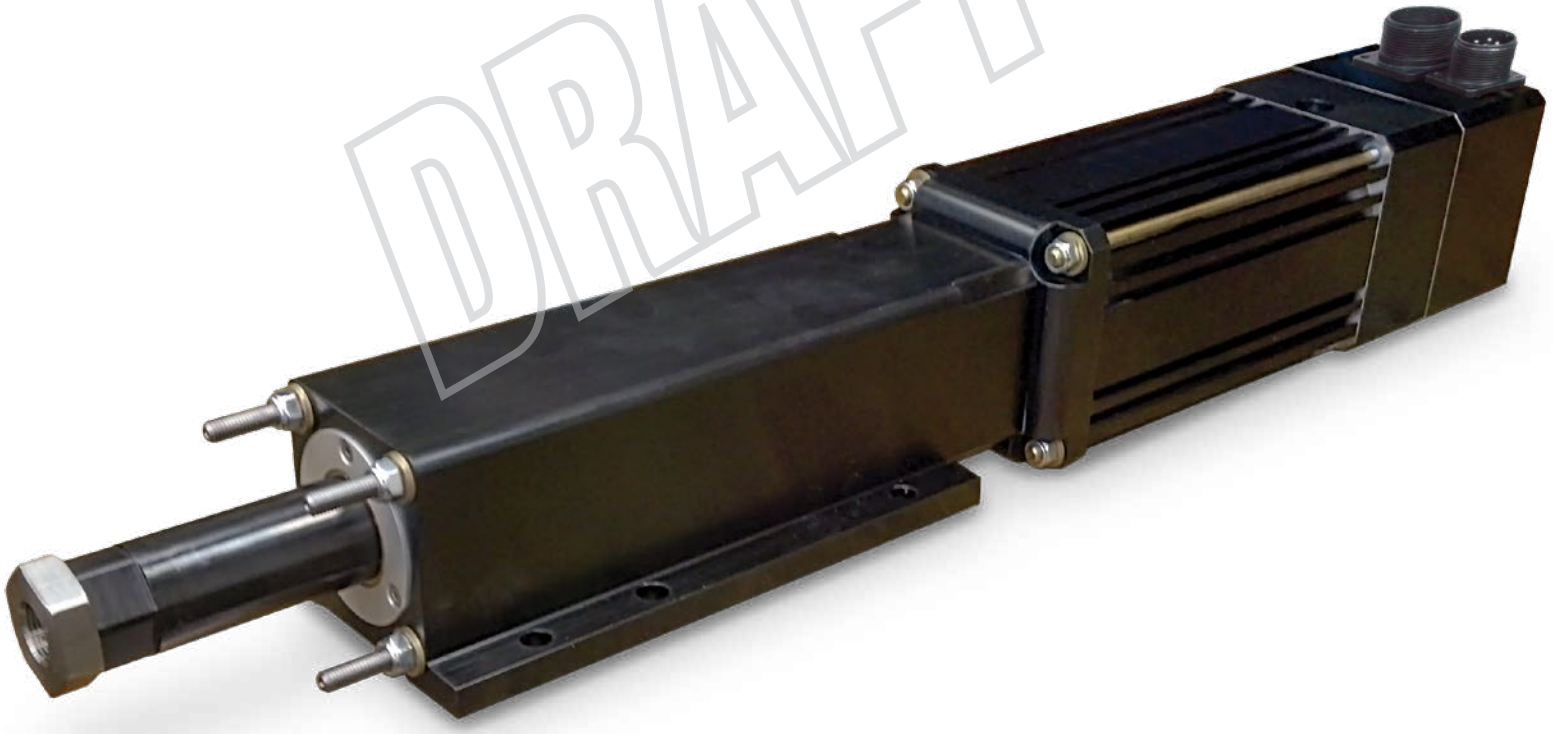
Tolomatic
EXCELLENCE IN MOTION®

SERVOWELD®

USER GUIDE

GSWA Actuator



LINEAR SOLUTIONS MADE EASY

201405271031

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Health and Safety Regulations

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!, 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, this situation may result in property damage or minor or moderate injury.

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).

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 ratings. In addition, proper wiring should be verified and safety measures checked before applying power.

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.

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 knock the actuator out of alignment. 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.

Packing and Transport

NOTE!

Anchor and secure actuator in such a way as to prevent damage during transport. Also make sure the actuator is clean and dry and protected from moisture.

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 GSWA 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.

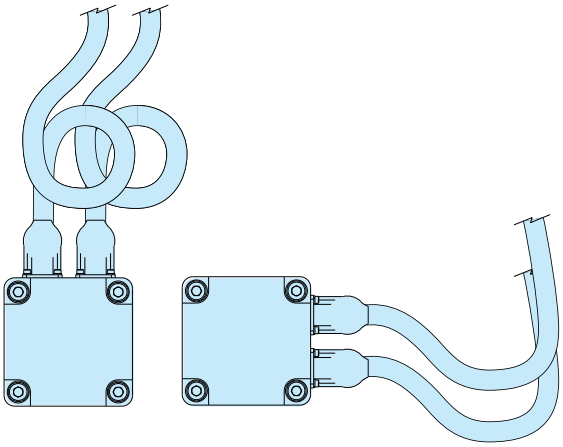
EMC Wiring Guidelines

Cable routing

It is recommended that the power and signal cables for GSWA 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.

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.



Shielding and grounding

When cabling the system, 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, all shield drain wires from all cables should be tied to a common earth ground.

WARNING!

Thrust rod is not considered an adequate ground.

Motion Control System Selection Recommendations

It is recommended that all servo amplifiers and PW (Projection Weld) servo system 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 GSWA

i) Peak current

ii) Voltage

iii) Peak RPM

iv) Max current frequency

1.1 General Description

The GSWA weld actuator (see figure 1.1) 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.

1.1.1 GSWA Product Overview

- Roller Screw Driven, 5 & 10 mm lead
- Weld Thrust up to:

	ROLLER NUT			
	05		10	
GSWA04	3,300 lbf	*14,669 N*	2,050 lbf	*9,113 N*

- Velocity up to:

	ROLLER NUT			
	05		10	
	in/sec	*mm/sec*	in/sec	*mm/sec*
GSWA04	11.5	*292*	23	*584*

- Motor windings: 230 Vac & 460 Vac
- IP65 standard

1.1.2 Standard Configuration and Options

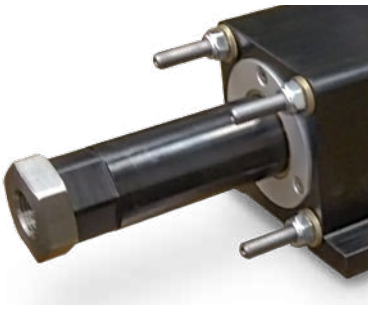
1.1.2.1 Standard Actuator Mount

Standard mounting for the GSWA is shown below.

	
Face Mount	Base Mount
Used for static GSWA mounted vertical –thrust rod applications only	

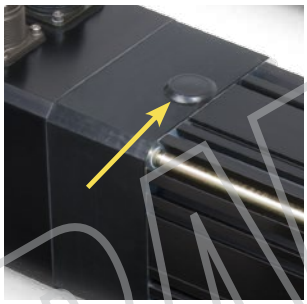
1.1.2.2 Standard Rod End Mount

Standard rod end for the GSWA is internal threads.



1.1.2.5 Manual Override

An access hole allows use of a screwdriver to manually extend or retract rod.



(Available on GSWA04)

1.2 Intended Use

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.

1.3 General Operation

The GSWA 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 PW servo system drive.

Each GSWA 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

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

CAUTION

Care should be taken not to exceed the physical travel limits of the GSWA 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.

1.4 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 GSWA actuator.
- Store in clean and dry environment.
- After six (6) months of storage it will be necessary to cycle two complete strokes of the GSWA to redistribute the internal lubricants.

It is also recommended to cycle the GSWA two complete strokes before placing in service.

- If stored for a period longer than 2 years without use it will be necessary to replace the lubricants. Please return to Tolomatic for this maintenance.

1.5 Identification Label

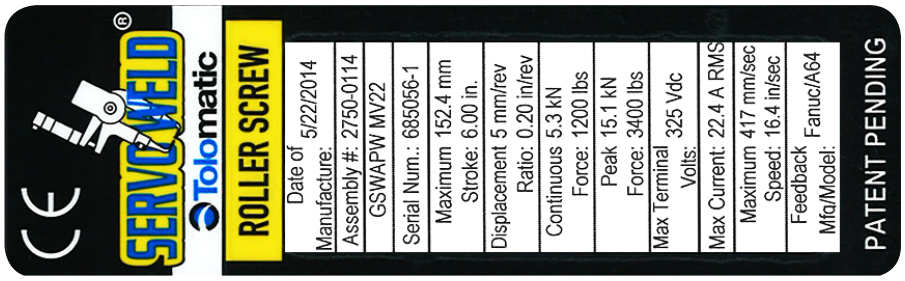


Figure 1.5-1: GSWA actuator identification labels

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

1.6 Certification

CE

IP 65

1.7 Manufacturer

Tolomatic
3800 County Road 116
Hamel, MN 55340, USA
763-478-8000
www.tolomatic.com
email: help@tolomatic.com

2.1 GSWA Actuator System Configuration

GSWA series actuators incorporate an integral brushless servo motor. The design of the motor with the proper feedback device and electrical connectors allows the GSWA 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 GSWA 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 GSWA

i) Peak current

ii) Voltage

iii) Peak RPM

iv) Max current frequency

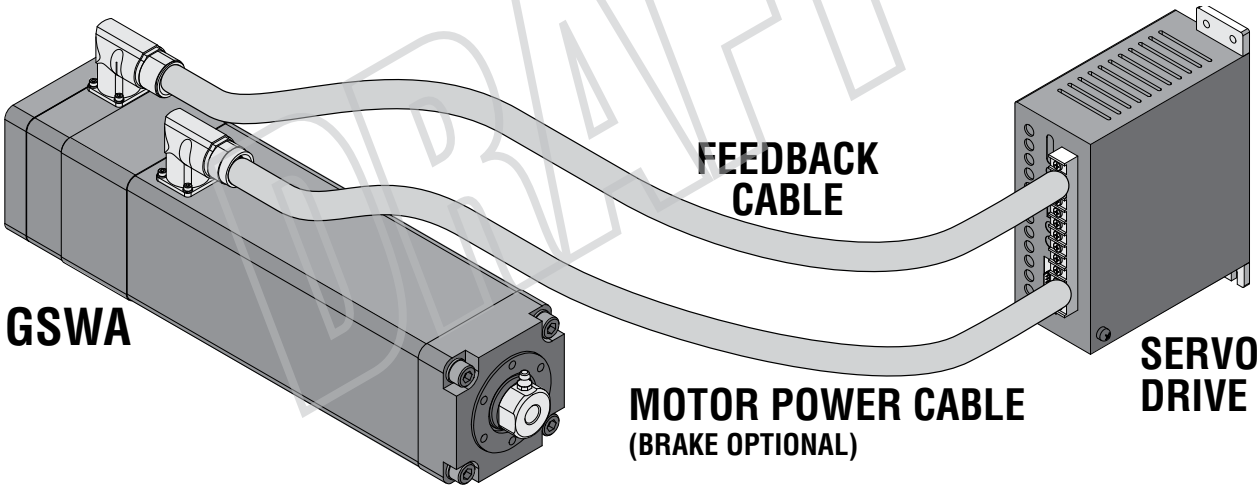


Figure 2.1-1: Typical connections for a single-axis system with an GSWA actuator with optional brake to a PW servo system drive

2.2 Planning Your Installation

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

When mounting your GSWA 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 will cause the working mass to drop.

2.2.1 Installing the GSWA Weld Actuator

Please refer to the weld gun documentation supplied by the weld gun manufacturer for mechanical installation.

2.2.2 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.

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.

2.2.3 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.

2.2.4 Cables

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

2.2.5 Weld Tip / Part Contact Speed

Tolomatic recommends that the part contact speed be held to less than 50 mm/sec. Speeds greater than 50 mm/sec can create shock loading scenarios on the actuator. This can have a negative effect on the overall life of the actuator.

2.2.6 Robot Carried Applications

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

2.2.7 Fixed Applications

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

- Pedestal PW guns that can be mounted with the GSWA vertical – thrust rod down should be considered.
- Pedestal PW guns that must be mounted with the GSWA vertical – thrust rod up should be mounted at an angle of a least 10 – 15% to minimize water pooling.
- Water channels on interfacing mounting components of the GSWA / PW Gun to minimize water pooling
- Any PW 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 PW gun application that is suspect for water exposure should consider utilizing a manual shut-off valve in the water saver circuit at the PW gun. Shutting off the water prior to weld cap change can significantly reduce water exposure issues in the PW gun environment.
- Pedestal PW 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 PW gun applications
- Confirming full engagement of the cable dress connector to the appropriate mating receptacle on GSWA.

2.3 Feedback Information

GSWA actuators use a Fanuc absolute encoder as the rotary feedback device.

2.3.1 Feedback Alignment

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

In any case where it is determined that the feedback has become misaligned, or an PW 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.

2.3.2 Feedback Alignment 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 GSWA motors are wired such that as the torque generating current vector progresses from phase R -> S -> T positive phase sequence is created. Depending on how the actuator is configured for a given PW servo system drive, this could cause the thrust rod to extend or retract as detailed in Appendix B.

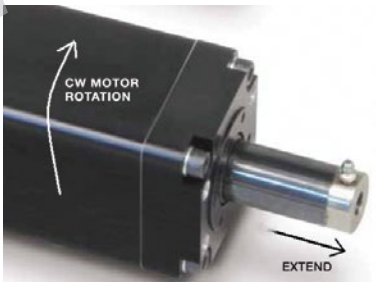


Figure 2.3-2: Thrust rod movement relative to motor rotation

2.4 Connectors

The standard Tolomatic connectors are shown in figure 2.4-1 below.

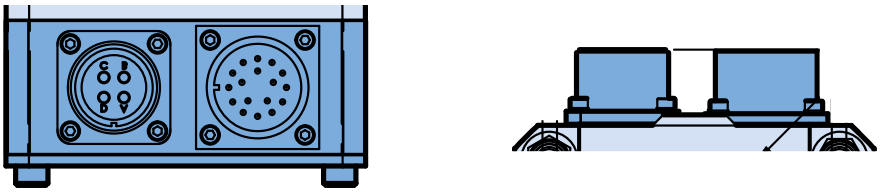


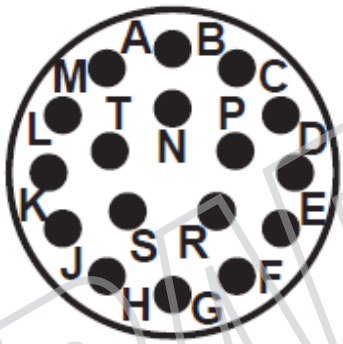
Figure 2.4-1: Drawing of box mount connectors used on GSWA actuators.

2.5 Connector Pinouts

Repeated in Appendix B

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:



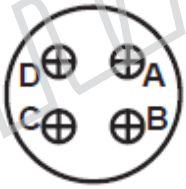
Style:	Box
Manufacturer:	Proprietary
Manufacturer P/N:	Proprietary
Insert Clocking:	Key between pins "K" & "L"

Feedback Connector Pinout:

Pin	Signal
A	SD
B	NC
C	NC
D	SD -
E	NC
F	REQ
G	REQ -
H	SHIELD
J	+5 V

Pin	Signal
K	+5 V
L	NC
M	NC
N	0 V
P	NC
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)

Pin	Signal
C	Phase T (W)
D	GND

2.6 Attaching Cables & Homing / Mechanical Travel Limits

⚠ 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.

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 GSWA avoid excessive force. During homing do not exceed 20% of continuous thrust or speeds of 0.39 in/sec *(10 mm/sec)*. The GSWA is designed with internal bumpers, however, **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.

2.7 Anti Rotate

For some rod-style actuator designs when unrestricted the rod will spin and not provide linear motion. The GSWA04 configured with TruForce is designed with internal mechanisms that insure consistent linear motion is guaranteed. However, the external rod can be rotated. In applications that require the load does not rotate, a means of anti-rotation for the load (which does not cause binding for the actuator's line of motion) needs to be added.

3.1 Duty Cycle at Maximum Force

Actuator	Motor	Roller Screw Lead	Duty Cycle	Hold Time	Weld Force	
		(mm/rev))	(welds/min)	(cycles)	(lbf)	(N)
GSWA04	MV22	5	20	15	2,750	12,224
		10	20	15	1,375	6,112
	MV23	5	20	15	3,300	14,669
		10	20	15	2,050	9,113

Table 3.1-1: GSWA04 duty cycle at maximum force

4.1 Lubrication

The GSWA design shares many of the design characteristics of Tolomatic's popular model IMA. ALL NEW GSWA ACTUATORS HAVE BEEN LUBRICATED AT THE FACTORY AND ARE READY FOR INSTALLATION. GSWA models do not require any maintenance or lubrication for most applications.

NOTE!

Before starting any maintenance activities, make sure that the supply power is shut OFF.

4.2 GSWA Maintenance and Repair

The only recommended user serviceable component on 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.

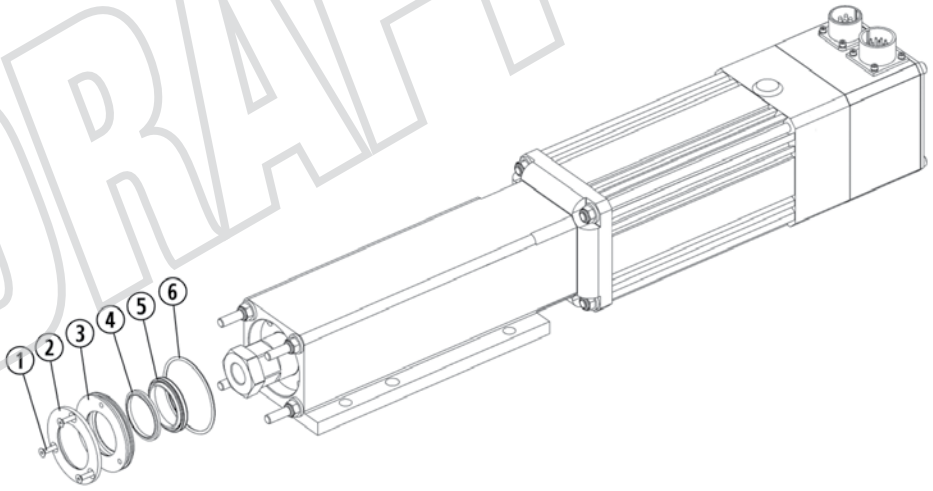


Figure 4.2-1 Exploded view of GSWA04

Parts Listing

ITEM	PART #	DESCRIPTION	QTY.
*1.	2733-1313	FLAT HEAD CAP SCREW	3
*2.	2733-1311	SCRAPER CAP-OUTER	1
*3.	2733-1310	SCRAPER CAP-INNER	1
4.	2733-1312	SCRAPER	1
5.	2733-1309	ROD WIPER	1
6.	2733-1317	O-RING	1

*These parts generally do not require replacement

4.2.1 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 rod end and the screws from the pilot ring.

4.3 Pulsecoder Replacement

GSWA models configured with Fanuc model A64 pulsecoder may be serviced in the field. The procedure is as follows.

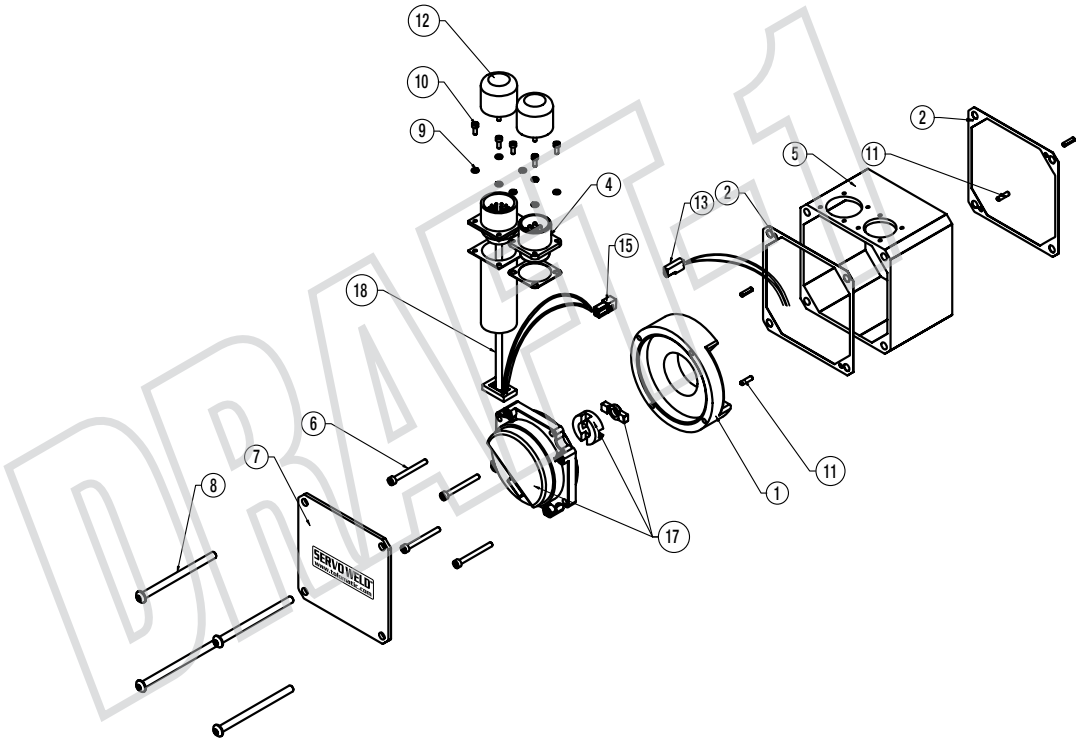


Figure 4.3-1 Exploded view of Fanuc Pulsecoder

WARNING!

Never rotate the actuator via the feedback device connection. Doing so may result in the loss of phasing between the feedback device and motor windings.

4.3.1 Disassembly

1. Remove the 4 cover plate cap screws (8).
2. Remove cover (7).
3. Remove the gasket (2).
4. Disconnect the pulsecoder harness (18) from the pulsecoder (17).

Disconnect both connectors from the housing.

5. Disconnect the motor temp sensor harness from motor leads (15, 13).

6. Remove the harness from the assembly.

7. Remove the 4 stainless steel socket head cap screws (6). The pulsecoder is now free to come off the assembly.

*Do not remove the black oxide fasteners, as they are holding the pulsecoder together.

4.3.2 Assembly

1. Install the connecting portion of the pulsecoder coupler onto the coupler half on the actuator. Orient the connector on the pulsecoder bottom left.

2. Position a connector gasket between the motor connector and encoder housing and with 4 socket head cap screws (10) and lock washers attach the motor connector to the pulsecoder housing.
Use no Loctite® on these fasteners.

3. Position the rubber boot over the pulsecoder harness and the inboard side of the connector.

4. Install the pulsecoder connector to the housing with 4 socket head cap screws, and lock washers (no Loctite). Be sure to locate the rubber boot/ gasket between the inboard side of connector and the outside of the housing. Connect harness to the pulsecoder and connect 2 pin motor temp leads to the harness connector. Install the pulsecoder and tighten the screws (6).

5. Locate a gasket (2) between the pulsecoder housing (5) and the pulsecoder cover plate (7) and with the 4 cap screws (8), attach the pulsecoder housing and cover to the main bearing plate. Coil the harness so that it will not create any interference.

A.1 Specifications

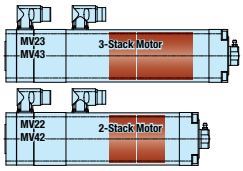
A.1.1 Performance and Mechanical Specifications

Performance & Mechanical Specifications:		GSWA04			
		MV22		MV23	
SIZE	in	4.4	4.4	4.4	4.4
	mm	*110.0*	*110.0*	*110.0*	*110.0*
NUT/ SCREW		**RN05**	**RN10**	**RN05**	**RN10**
SCREW LEAD	in	0.197	0.397	0.197	0.397
	mm	*5.0*	*10.0*	*5.0*	*10.0*
WELD THRUST	lbf	2,750	1,375	3,300	2,050
	N	*12,233*	*6,116*	*14,679*	*9,119*
MAX. VELOCITY	in/sec	11.5	23.0	11.5	23.0
	mm/sec	*279*	*584*	*279*	*584*
AMBIENT TEMP RANGE	°F	50 to 122			
	°C	*10 to 50*			
IP RATING	Standard IP65				
BACK DRIVE FORCE	lbf	91	46	91	46
	N	*405*	*205*	*405*	*205*
WEIGHT (W / 6" STROKE)	lb	44.8		45.0	
	kg	*20.3*		*20.4*	
STROKE	in	6.0			
	mm	*152.4*			

A.1.2 Motor Specifications:

Motor Specifications:		GSWA04	
		MV22	MV23
BUS VOLTAGE	Vrms	230	230
TORQUE CONSTANT (KT)	in-lb/A Peak	4.6	5.4
	N-m/A Peak	*0.52*	*0.61*
VOLTAGE CONSTANT (KE)	V/Krpm Peak	66.1	78.1
CONTINUOUS STALL TORQUE	in-lb	48.8	74
	N-m	*5.5*	*8.4*
CONTINUOUS STALL CURRENT	Arms	7.5	9.7
PEAK TORQUE	in-lb	146	227
	N-m	*16.5*	*25.1*
PEAK CURRENT	Arms	22.4	29.1
RESISTANCE	Ohms	0.9	0.58
INDUCTANCE	mH	3.65	2.75
SPEED @ RATED V	RPM	3,500	3,500
NO. OF POLES		8	8

MV22,42 = 2 Stack Motor
MV23,43 = 3 Stack Motor



CE Approved

A.1.3 Thermal sensor specifications

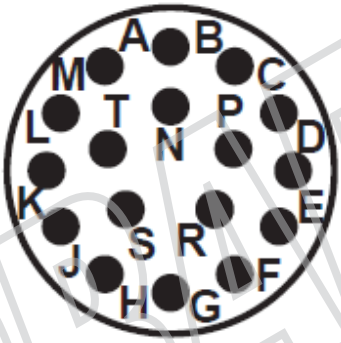
The motor windings have an integral normally closed thermal switch. The switch opens at a temperature of 212° F (100°C), which is the windings maximum operating temperature. The thermal switch is meant to protect the windings, the actuators continuous operating region must still be obeyed. Operation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

B.1 Wiring Diagrams

B.1.1 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:



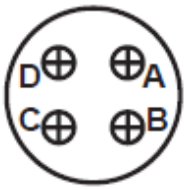
Style:	Box
Manufacturer:	Proprietary
Manufacturer P/N:	Proprietary
Insert Clocking:	Key between pins "K" & "L"

Feedback Connector Pinout:

Pin	Signal
A	SD
B	NC
C	NC
D	SD -
E	NC
F	REQ
G	REQ -
H	SHIELD
J	+5 V

Pin	Signal
K	+5 V
L	NC
M	NC
N	0 V
P	NC
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

C.1 Troubleshooting Procedure

SYMPTOM	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	Feedback cable may be damaged	Test the feedback cable
	Feedback wiring may be incorrect	Verify feedback wiring
Actuator is operating but is not up to rated speeds/force	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 GSWA 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 or is 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
Actuator is overheating	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

D.1 Warranty

Tolomatic, warrants product manufactured by it to be free from defects in material and workmanship for a period of one year from date of shipment by Tolomatic. If within such period any such product shall be proved to Tolomatic's satisfaction to be defective, such product shall either be repaired or replaced at Tolomatic's option.

This warranty shall not apply:

a. To product not manufactured by Tolomatic with respect to product not manufactured by Tolomatic the warranty obligations of Tolomatic shall in all respects conform and be limited to the warranty actually extended to Tolomatic by its supplier.

b. To product which shall have been repaired or altered by parties other than Tolomatic, so as, in Tolomatic's judgment, to affect the same adversely.

c. To product which shall have been subject to negligence, accident, or damage by circumstances beyond the control of Tolomatic or to improper operation maintenance or storage, or to other than normal use and service.

The foregoing warranties are exclusive and in lieu of all other expressed and implied warranties whatsoever, including but not limited to implied warranties of merchantability and fitness for a particular purpose. Tolomatic shall not be subject to any other obligations or liabilities whatsoever with respect to product manufactured or supplied by Tolomatic or service rendered by it.

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