

# ServoWeld® Actuators

## GSWA MODELS



**INTEGRAL MOTOR HIGH THRUST ACTUATOR**

# ServoWeld GSWA

Tolomatic is the world's leading manufacturer of integrated servo actuators for resistance spot welding used by the world's top weld gun OEM's and numerous global vehicle manufacturers.



## Superior Integrated Servo Motor Actuators

Tolomatic's ServoWeld family of integrated servo actuators are designed for best-in-class performance with the factors that are most important for resistance spot welding gun applications.

### NUMBER OF WELDS/ PRODUCT LIFE

Tolomatic's superior roller screw design has the **highest dynamic load rating for more welds** than any competitive technology (other roller screws, ball screw, pneumatic).

### FORCE REPEATABILITY

Skewed winding designed for welding minimizes motor cogging and **provides industry best actuator force repeatability:** •  $\pm 3\%$  Over the Lifetime of the Actuator

### EFFICIENCY

All elements of actuator (winding, screw, rod scraper, bearings) are designed to optimize the efficiency of the actuator system and provide the **most energy efficient solution on the market.**

### WELDS/ MINUTE

All elements of the actuator (winding, screw, rod scraper, bearings) are designed to last and run as cool as possible in welding applications, with the ability to add water cooling as an option. This means **more welds per minute than any competitive technology** (other roller screws, ball screw, pneumatic).

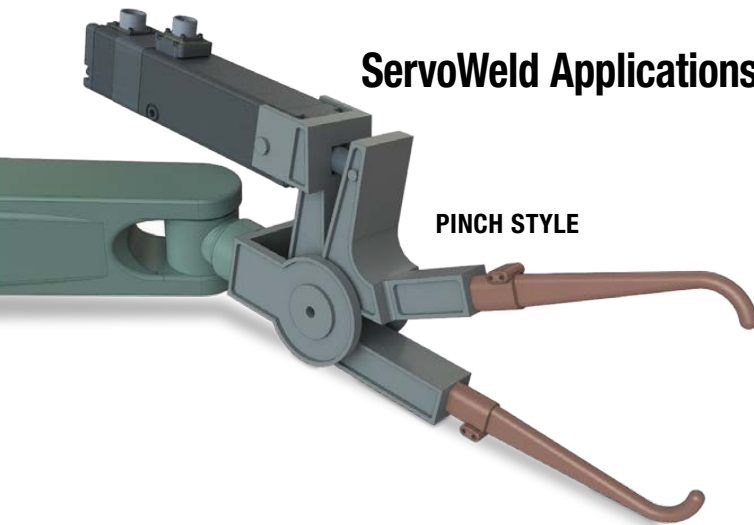
### WEIGHT

Tolomatic integrated servo actuators minimize weight when designed into the weldgun. Additionally, Tolomatic can customize actuators for a specific weldgun applications to provide **industry leading light weight designs.**

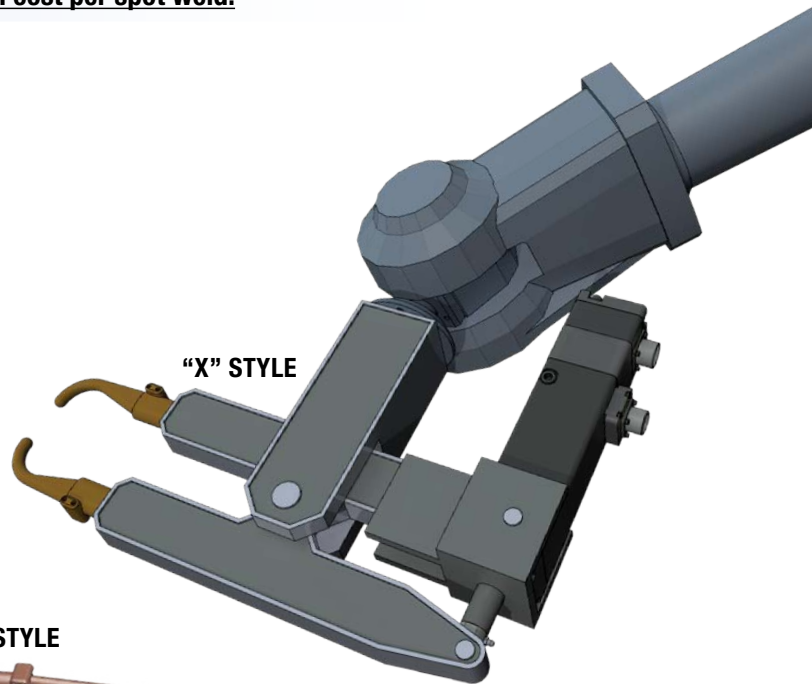
### LIFETIME COST

By building the longest lasting, most efficient and highest weld per minute actuators on the market, Tolomatic actuators provide the **lowest total cost per spot weld.**

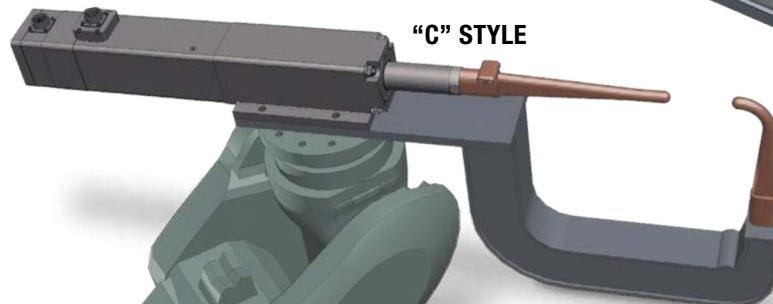
## ServoWeld Applications



PINCH STYLE

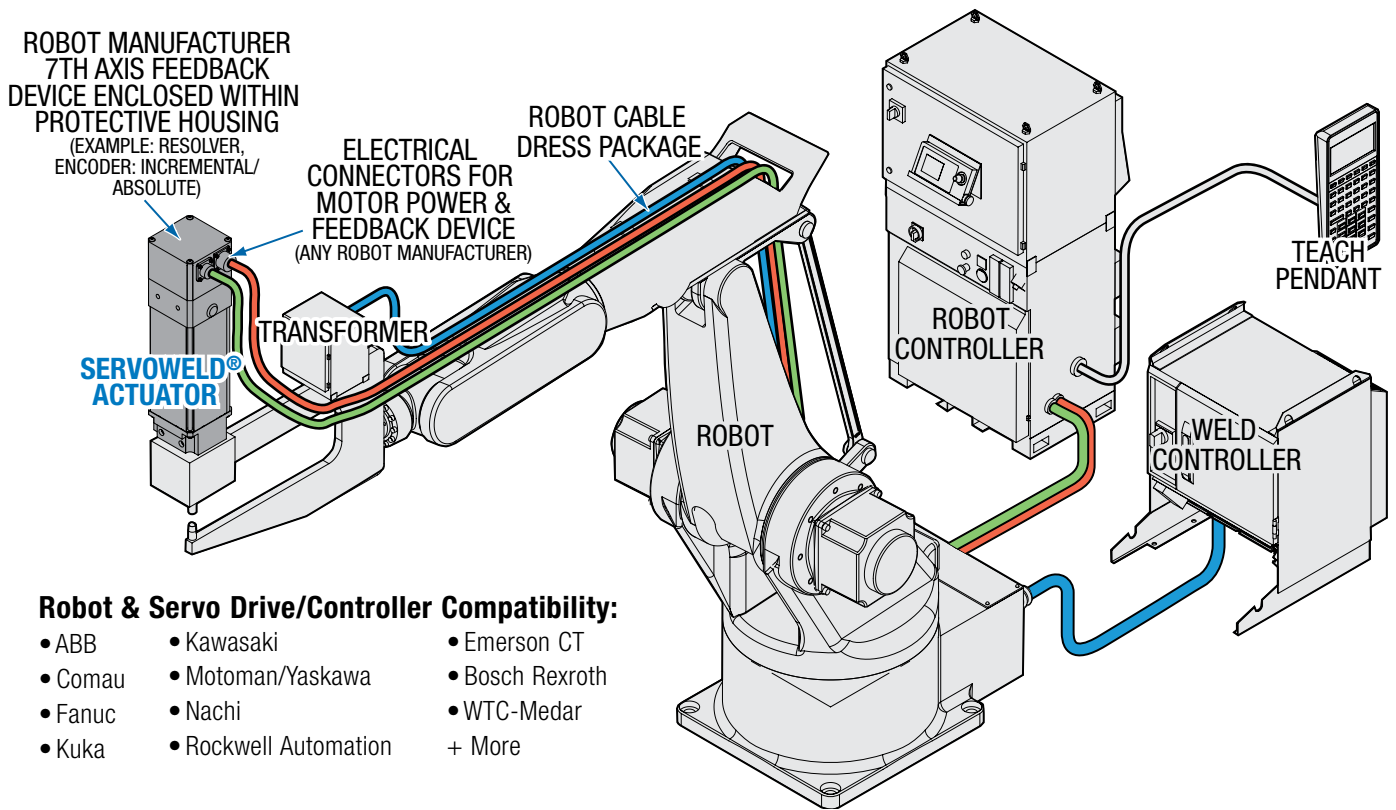


"X" STYLE



"C" STYLE

# Typical Robotic ServoWeld Installation



## Tolomatic Offers the Broadest, Most Capable Family of Integrated Servo Actuators for Resistance Spot Welding

Model:	GSWA	SWA	SWB
<b>Number of Welds<sup>1</sup> (millions):</b>	20+	20+	10+
<b>Re-lubrication without Disassembly:</b>	Yes <sup>4</sup>	Yes	Yes
<b>Peak Force:</b>	24.5 kN [5,500 lbf]	22.0 kN [4,950 lbf]	22.0 kN [4,950 lbf]
<b>Actuator Output Force<sup>2</sup> (Lifetime) Repeatability:</b>	±3%	±3%	±5%
<b>Weight (size 33, 3 / 44, 4)<sup>3</sup>:</b>	8.3 kg / 13.8 kg [18.3 lb / 30.4 lb]	7.2 kg / 12.6 kg [15.9 lb / 27.8 lb]	7.2 kg / 12.6 kg [15.9 lb / 27.8 lb]
<b>Water Cooling:</b>	Optional	Optional	Optional
<b>Manual Override:</b>	Optional	No	No
<b>Full Force Direction:</b>	Push and Pull	Push	Push

<sup>1</sup> Based on properly lubricated ServoWeld unit used as recommended in user manual. Weld schedule, tip force, environment and lubrication are factors in the total number of welds achievable with ServoWeld actuators.

<sup>2</sup> At weld force

<sup>3</sup> Weight varies with choice of feedback device and mounting options

<sup>4</sup> Some exceptions, see GSWA user manual

# GSWA33 INTEGRATED MOTOR ACTUATOR

## ENDURANCE TECHNOLOGY<sup>SM</sup>

Endurance Technology features are designed for maximum durability to provide extended service life.

### SKEWED MOTOR WINDINGS

- Skewed motor windings provide minimal torque ripple for force repeatability and smooth linear motion

### ADVANCED SCREW TECHNOLOGY

- Roller screws provide the highest thrust and life ratings available



### INTERNAL BUMPERS

- Bumpers protect the screw and nut assembly from damage at end of stroke

### ROD WIPER WITH SCRAPER

- Prevents contaminants from entering the actuator for extended life

### INTEGRAL MOUNTING

- Four threaded holes on front face are available for direct mounting or addition of customized options

### GREASE PORT

- Patented screw re-lubrication system provides extended screw service life
- Convenient lubrication without disassembly

### THREADED ROD END

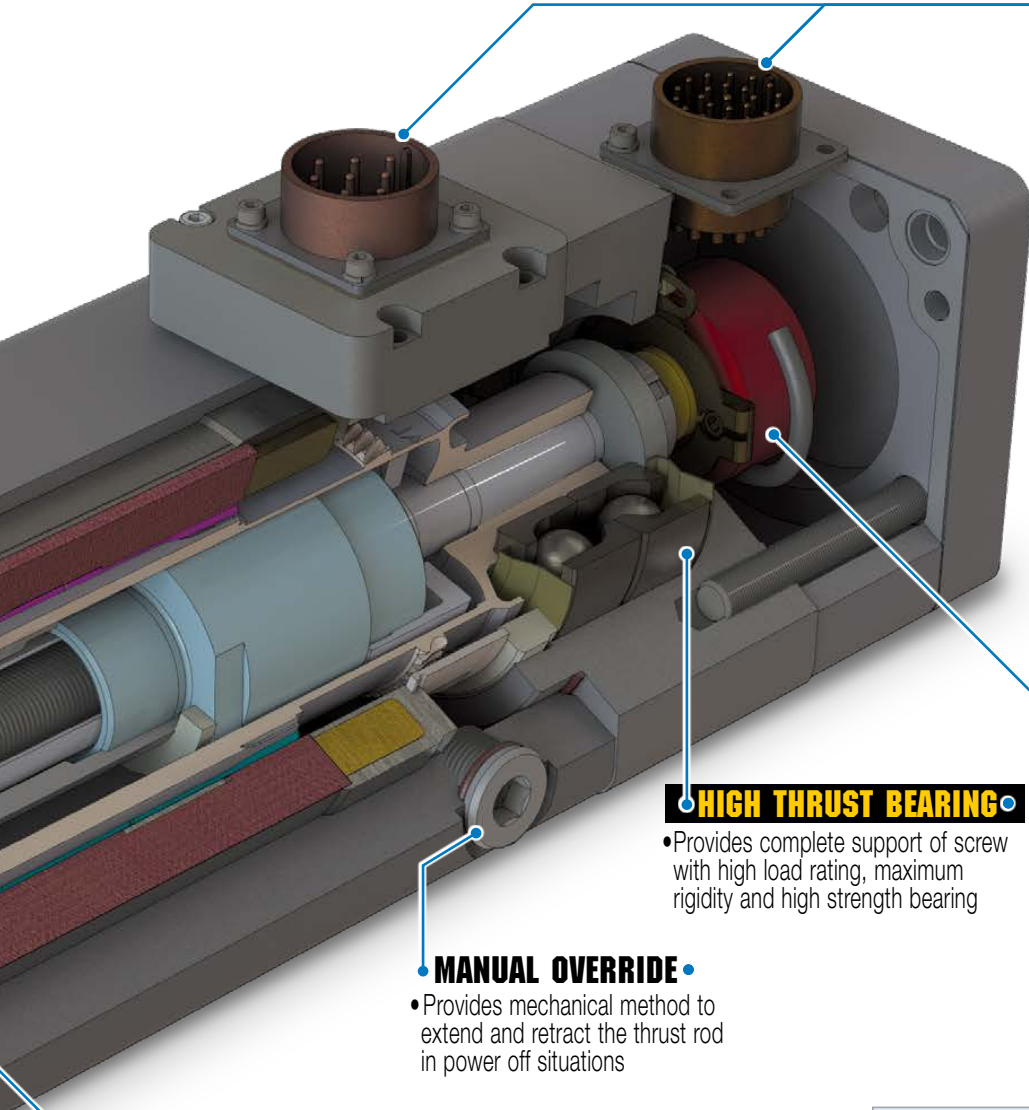
- Corrosion resistant zinc plated alloy steel construction
- Provides a common interface to multiple rod end options

### THRUST TUBE

- Steel thrust tube supports extremely high force capabilities
- Salt bath nitride treatment provides excellent corrosion resistance, surface hardness and is very resistant to adherence of weld slag, water and other potential contaminants

### LIGHTWEIGHT ALUMINUM DESIGN

- Black anodized extrusion design is optimized for rigidity and strength



**ROBOT & DRIVE/  
CONTROLLER  
COMPATIBILITY**

- Compatible feedback, connector(s) and wiring to match the following robot & drive/controller manufacturers' cable dress packages

**YOUR CHOICE:**

- + ABB
- + Comau
- + Fanuc
- + Kawasaki
- + Kuka
- + Motoman/Yaskawa
- + Nachi
- + Rockwell Automation
- + Bosch-Rexroth
- + Emerson CT
- + WTC-Medar
- & more

**FEEDBACK  
CHOICES**

- Customer specified to robot manufacturer
- Multi-turn absolute encoder
- Resolver
- Digital encoder

**HIGH THRUST BEARING**

- Provides complete support of screw with high load rating, maximum rigidity and high strength bearing

**MANUAL OVERRIDE**

- Provides mechanical method to extend and retract the thrust rod in power off situations

**MULTIPLE MOTOR WINDINGS**

**YOU CAN CHOOSE:**

- 230VAC or 460VAC rated windings potted directly into actuator housing
- Integral thermal switch for over temperature protection

**IP65**

- IP65 rating protects actuator from ingress of water, weld slag and other debris (static)

**OPTIONS**

- BRAKE** • Spring held / 24V electrically released
- WATER COOLING**
- MANUAL OVERRIDE**
- LIGHT WEIGHT**
- REAR TRUNNION MOUNTING**

# GSWA33, GUIDED INTEGRATED MOTOR ACTUATOR

## ENDURANCE TECHNOLOGY<sup>SM</sup>

Endurance Technology features are designed for maximum durability to provide extended service life.

### ROBUST BUSHINGS

- Large bushings provide additional side loading support for the thrust tube protecting the screw assembly
- Eliminates external guide on RSW chassis
- Protects guided mechanism in RSW environment

### ROD WIPER WITH SCRAPER

- Prevents contaminants from entering the actuator for extended life

### THRUST TUBE

- Steel thrust tube supports extremely high force capabilities
- Salt bath nitride treatment provides excellent corrosion resistance, surface hardness and is very resistant to adherence of weld slag, water and other potential contaminants
- Large diameter guided thrust tube

### ANTI-ROTATE ASSEMBLY

- Fully enclosed to protect components from harsh environments
- Provides additional side loading support

### ANTI-ROTATE MECHANISM

- Far more efficient than sliding designs
- Robust needle bearing resists wear

### THREADED ROD END

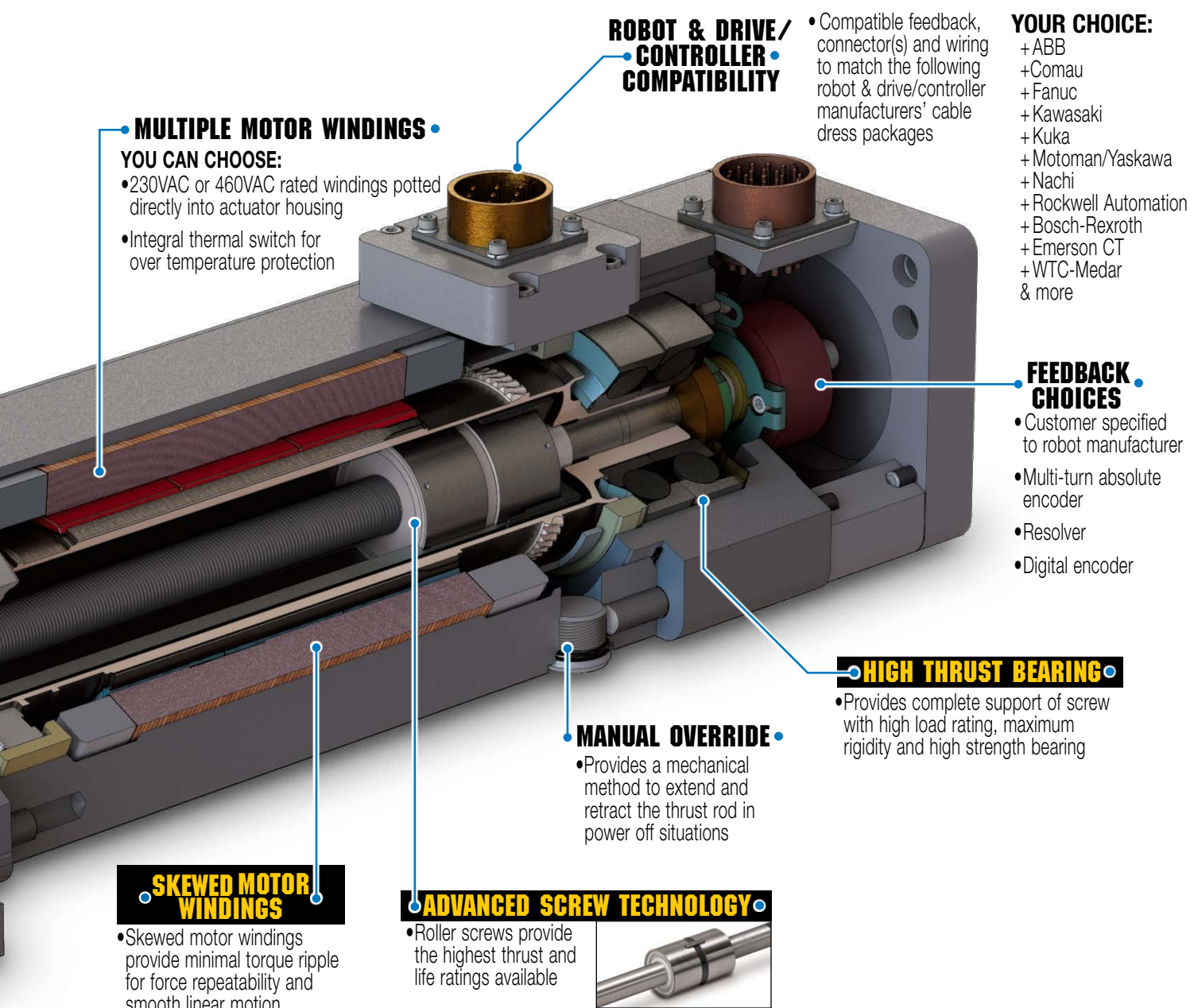
- Zinc plated alloy steel construction for corrosion resistance
- Provides a common interface to multiple rod end options

### INTERNAL BUMPERS

- Bumpers protect the screw and nut assembly from damage at end of stroke

### INTEGRAL MOUNTING

- Four holes on anti-rotate assembly are available for direct mounting or addition of customized options
- 2 dowel pins are located a bottom of anti-rotate unit for accurate positioning



**ROBOT & DRIVE/  
CONTROLLER  
COMPATIBILITY**

- Compatible feedback, connector(s) and wiring to match the following robot & drive/controller manufacturers' cable dress packages

**YOUR CHOICE:**

- + ABB
- + Comau
- + Fanuc
- + Kawasaki
- + Kuka
- + Motoman/Yaskawa
- + Nachi
- + Rockwell Automation
- + Bosch-Rexroth
- + Emerson CT
- + WTC-Medar & more

**FEEDBACK CHOICES**

- Customer specified to robot manufacturer
- Multi-turn absolute encoder
- Resolver
- Digital encoder

**MULTIPLE MOTOR WINDINGS**

**YOU CAN CHOOSE:**

- 230VAC or 460VAC rated windings potted directly into actuator housing
- Integral thermal switch for over temperature protection

**HIGH THRUST BEARING**

- Provides complete support of screw with high load rating, maximum rigidity and high strength bearing

**MANUAL OVERRIDE**

- Provides a mechanical method to extend and retract the thrust rod in power off situations

**SKEWED MOTOR WINDINGS**

- Skewed motor windings provide minimal torque ripple for force repeatability and smooth linear motion

**ADVANCED SCREW TECHNOLOGY**

- Roller screws provide the highest thrust and life ratings available



**IP65**

- IP65 rating protects actuator from ingress of water, weld slag and other debris (static)

**OPTIONS**

**BRAKE** • Spring held / 24V electrically released

**WATER COOLING**

**REAR TRUNNION MOUNTING**

# GSWA 04 & 44 INTEGRATED MOTOR ACTUATOR

## ENDURANCE TECHNOLOGY<sup>SM</sup>

Endurance Technology features are designed for maximum durability to provide extended service life.

Pictured below is the GSWA04. The GSWA44 has similar operating characteristics to the GSWA04, except the GSWA44 can be used on longer stroke applications and applications requiring weld force on retract. The GSWA44 does not have the manual override feature.

### SKewed MOTOR WINDINGS

- Skewed motor windings provide minimal torque ripple for force repeatability and smooth linear motion

### MULTIPLE MOTOR WINDINGS YOU CAN CHOOSE:

- 460VAC or 230VAC rated windings potted directly into actuator housing
- Integral thermal switch for over temperature protection

### ROBUST BUSHINGS

- Supports the thrust tube and nut assembly through entire stroke length

### THRUST TUBE

- Steel thrust tube supports extremely high force capabilities
- Salt bath nitride treatment provides excellent corrosion resistance, surface hardness and is very resistant to adherence of weld slag, water and other potential contaminants

### THREADED ROD END

- Solid stainless steel construction for corrosion resistance
- Provides a common interface to multiple rod end options

### INTEGRAL MOUNTING

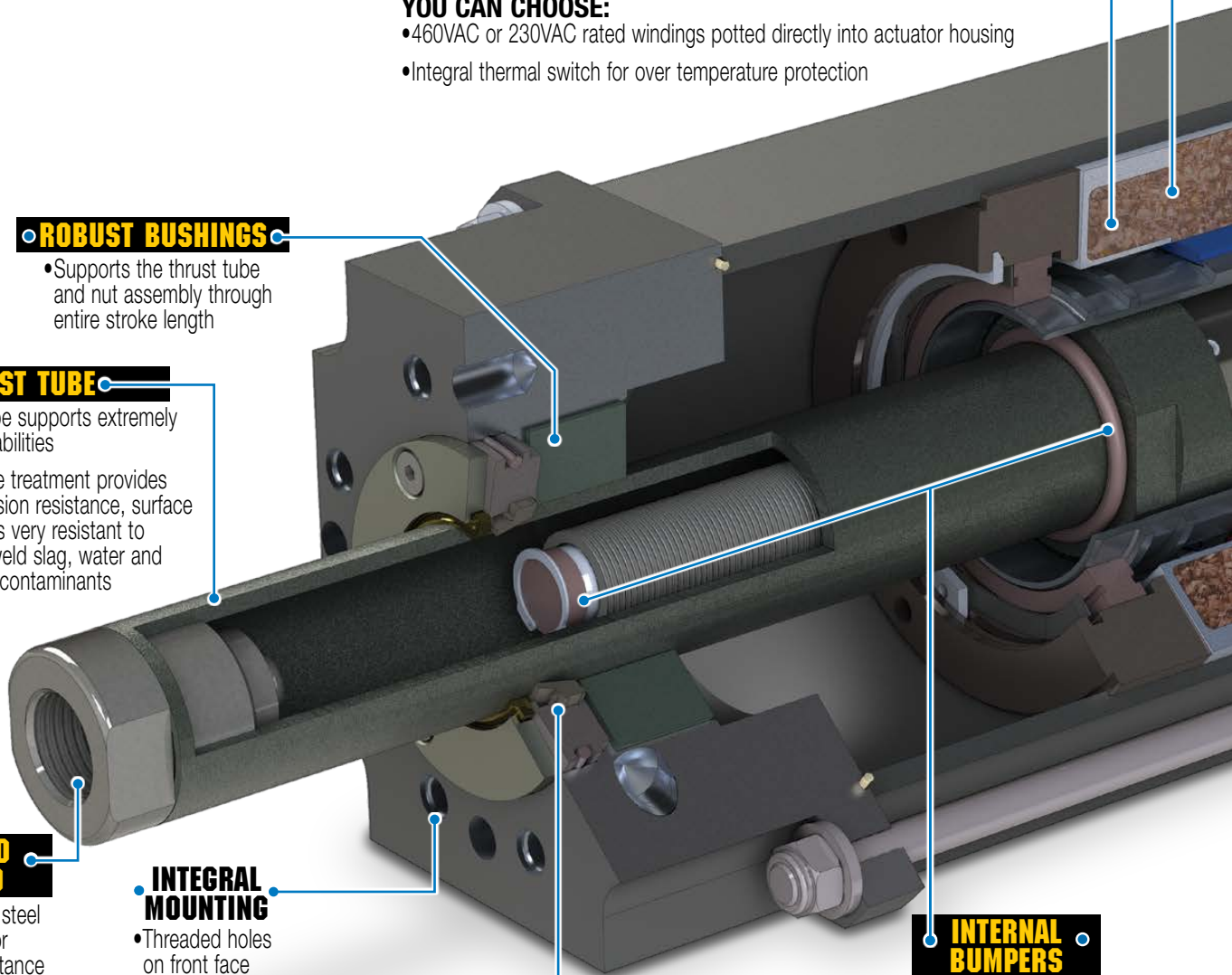
- Threaded holes on front face are available for direct mounting or addition of customized options

### ROD WIPER WITH SCRAPER

- Prevents contaminants from entering the actuator for extended life

### INTERNAL BUMPERS

- Bumpers protect the screw and nut assembly from damage at end of stroke





**MANUAL OVERRIDE**

- Provides a mechanical method to extend and retract the thrust rod in power off situations. (Two access ports 180° apart)  
Available on GSWA04 only.

**ROBOT & DRIVE/CONTROLLER COMPATIBILITY**

- Compatible feedback, connector(s) and wiring to match the following robot & drive/controller manufacturers' cable dress packages

**YOUR CHOICE:**

- + ABB
- + Comau
- + Fanuc
- + Kawasaki
- + Kuka
- + Motoman/Yaskawa
- + Nachi
- + Rockwell Automation
- + Bosch-Rexroth
- + Emerson CT
- + WTC-Medar & more

**FEEDBACK CHOICES**

- Customer specified to robot manufacturer
- Multi-turn absolute encoder
- Resolver
- Digital encoder

**HIGH THRUST BEARING**

- Provides complete support of screw with high load rating, maximum rigidity and high strength bearing

**LIGHTWEIGHT ALUMINUM DESIGN**

- Black anodized extrusion design is optimized for rigidity, strength and heat dissipation

**ADVANCED SCREW TECHNOLOGY**

- Roller screws provide the highest thrust and life ratings available



**IP65**

- IP65 rating protects actuator from ingress of water, weld slag and other debris (static)

**OPTIONS**

- WATER COOLING**
- REAR TRUNNION MOUNTING**

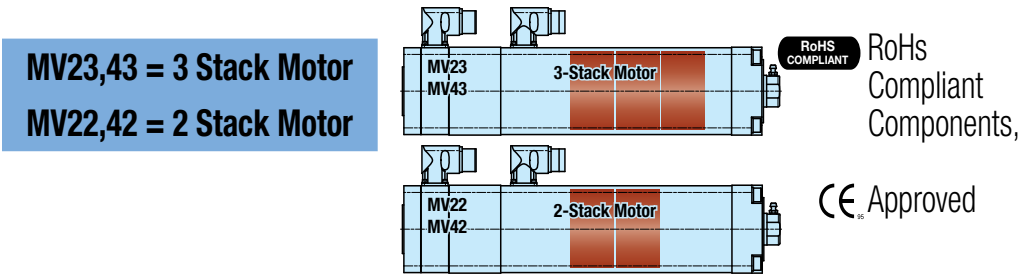
# ServoWeld - Integrated Motor Actuator

**Table 1: Performance & Mechanical Specifications:**

		GSA33, GSA33-GUIDED			GSA44, GSA40						GSA55	
		MV23/43			MV22/42		MV23/43					
SIZE	in	3.3			4.4						5.6	
	mm	83.0			110.0						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	4,950	2,500	6,875	3,438
	kN	11.1	11.1	5.7	14.7	8.0	17.8	14.7	22.0	11.1	30.6	15.3
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	22,488	36,149
	kN	41.42	54.01	47.56	73.87	76.99	67.72	73.87	91.74	76.99	100.80	162.03
AMBIENT TEMP RANGE	°F	50 to 122										
	°C	10 to 50										
IP RATING	Standard IP65 (static)											
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

**Table 2:**

		GSA33	GSA33-GUIDED	GSA40		GSA44	GSA55
		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	6.0	6.0	6.0 to 18.0	
	mm	152.4 to 451.2	152.4	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	3.3442	3.3442	3.3442	3.3442
	kg-cm <sup>2</sup>	4.8997	4.8997	9.7864	9.7864	9.7864	9.7864
INERTIA PER UNIT OF STROKE	lb-in <sup>2</sup> /in	0.00358	0.00358	0.00984	0.00984	0.00984	0.00984
	kg-cm <sup>2</sup> /mm	0.00041	0.00041	0.00113	0.00113	0.00113	0.00113



# ServoWeld - Integrated Motor Actuator

**Table 3:**  
Motor Specifications:

		GSA33		GSA04		GSA44		GSA55		
		GSA33, GUIDED				GSA04				
				MV23	MV43	MV22	MV42	MV23	MV43	MV23
<b>BUS VOLTAGE</b>		$V_{RMS}$	230	460	230	460	230	460	230	460
<b>TORQUE CONSTANT (KT)</b>		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
<b>VOLTAGE CONSTANT (KE)</b>		$V/Krpm$ Peak	79.8	154	66.1	107.2	78.1	153.1	100	201
<b>CONTINUOUS STALL TORQUE</b>	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	9.8	16.8	17.0	NA	NA
<b>CONTINUOUS STALL CURRENT</b>	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
<b>PEAK TORQUE</b>		in-lb	117	114	146	129	222	225	280	280
		N-m	13.2	12.9	16.5	14.6	25.1	25.4	31.6	31.6
<b>PEAK CURRENT</b>		$A_{RMS}$	15	7.5	22.4	11.9	29.1	15.0	29.5	14.8
<b>RESISTANCE</b>		Ohms	2.07	8.3	0.9	4.2	0.58	2.32	0.57	2.93
<b>INDUCTANCE</b>		mH	3.8	15.0	3.65	15.7	2.75	11.5	1.4	5.8
<b>SPEED @ RATED V</b>		RPM	3,500						2,400	
<b>NO. OF POLES</b>			8							

## BRAKE CONSIDERATIONS

An un-powered ServoWeld will require a brake to maintain its position if the force on the actuator exceeds Back Drive Force listed in Table 1.

A brake can be used with the actuator to keep it from back-driving, 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 requires 24V power.



Brake will increase actuator length and weight

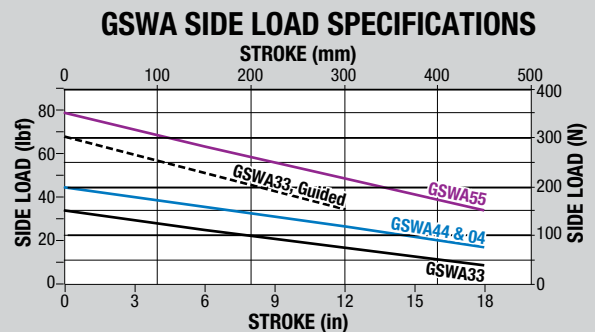
**Table 4:**  
Brake Specifications:

SERIES		33
<b>ROTOR INERTIA</b>	oz-in <sup>2</sup>	0.112
	gm-cm <sup>2</sup>	73
<b>CURRENT</b>	Amp	0.43
<b>HOLDING TORQUE</b>	in-lb	35
	N-m	4.0
<b>ENGAGE TIME</b>	mSec	40
<b>DISENGAGE TIME</b>	mSec	50
<b>VOLTAGE</b>	Vdc	24

## SIDE LOADING

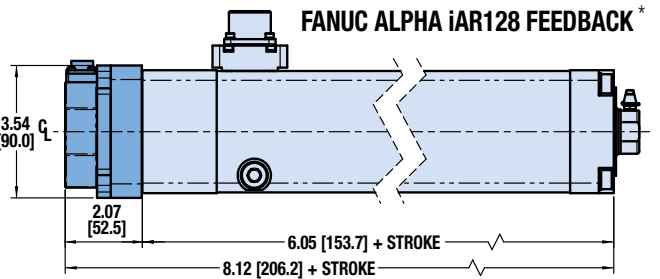
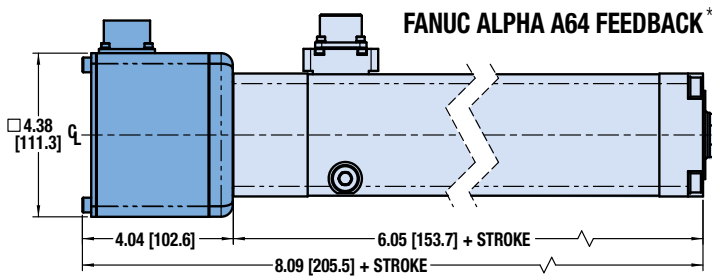
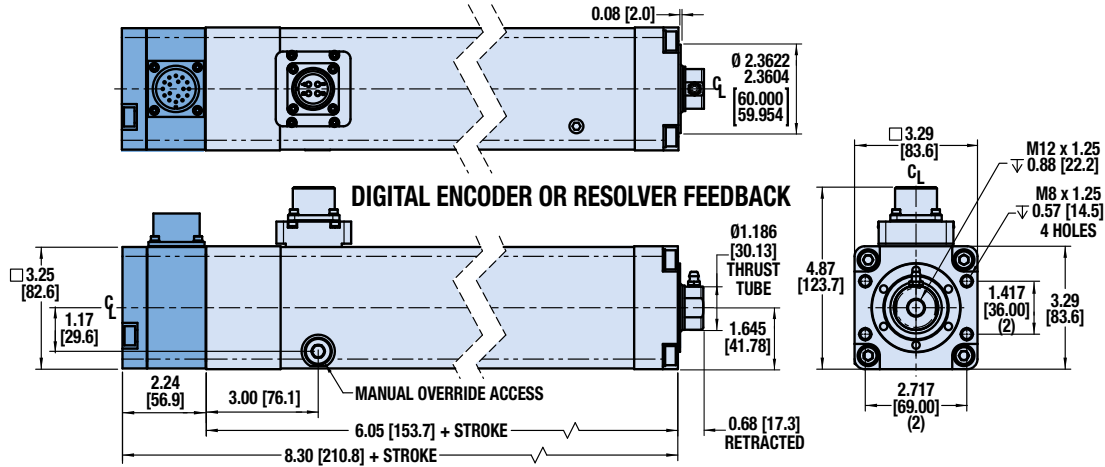
Some weld gun designs may subject the actuator to excessive side loading reducing overall service life. The GSA33, GUIDED actuator (page 8) will accommodate side loading. For other ServoWeld configurations measures are required, especially in "C" style designs, to limit side loading. For life optimization Tolomatic recommends side loads of less than 5% of axial load (thrust rod output force) for all roller screw configurations and less than 1% of axial load for all ball screw configurations.

## DISTANCE TRAVELED UNDER LOAD

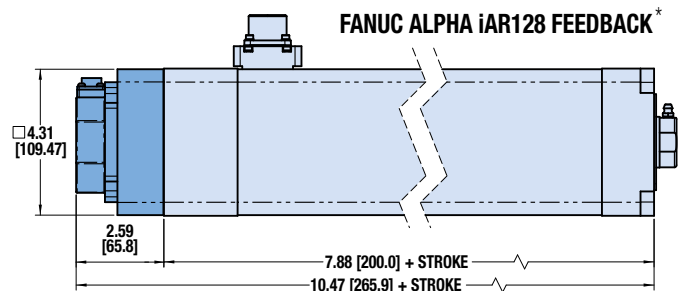
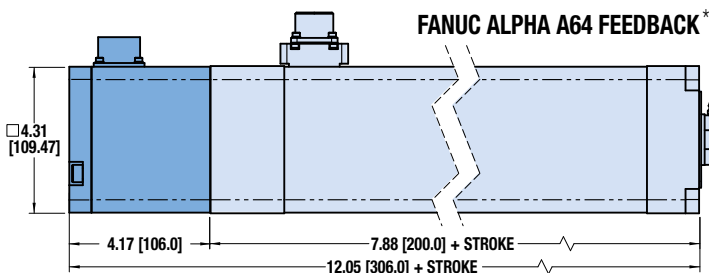
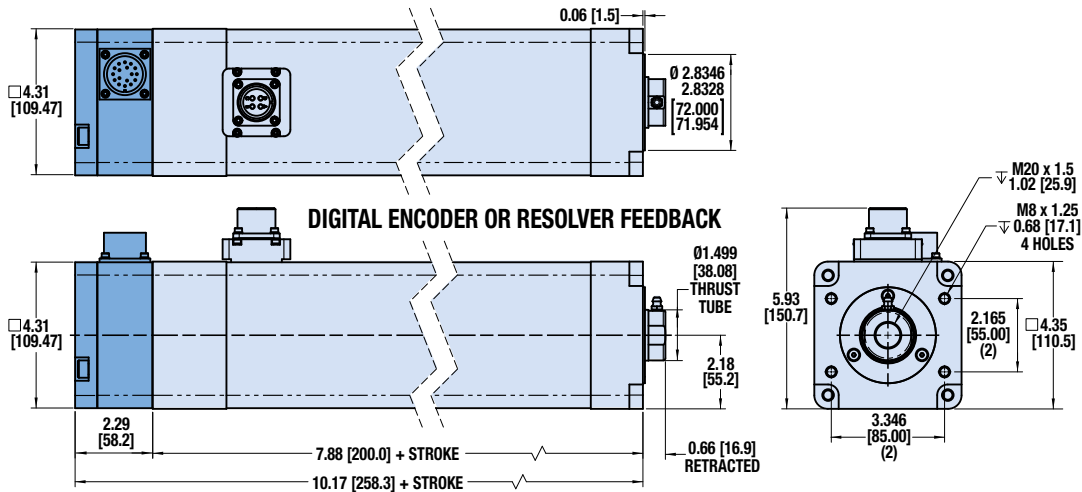


# GSWA Dimensions

## Dimensions: GSWA33



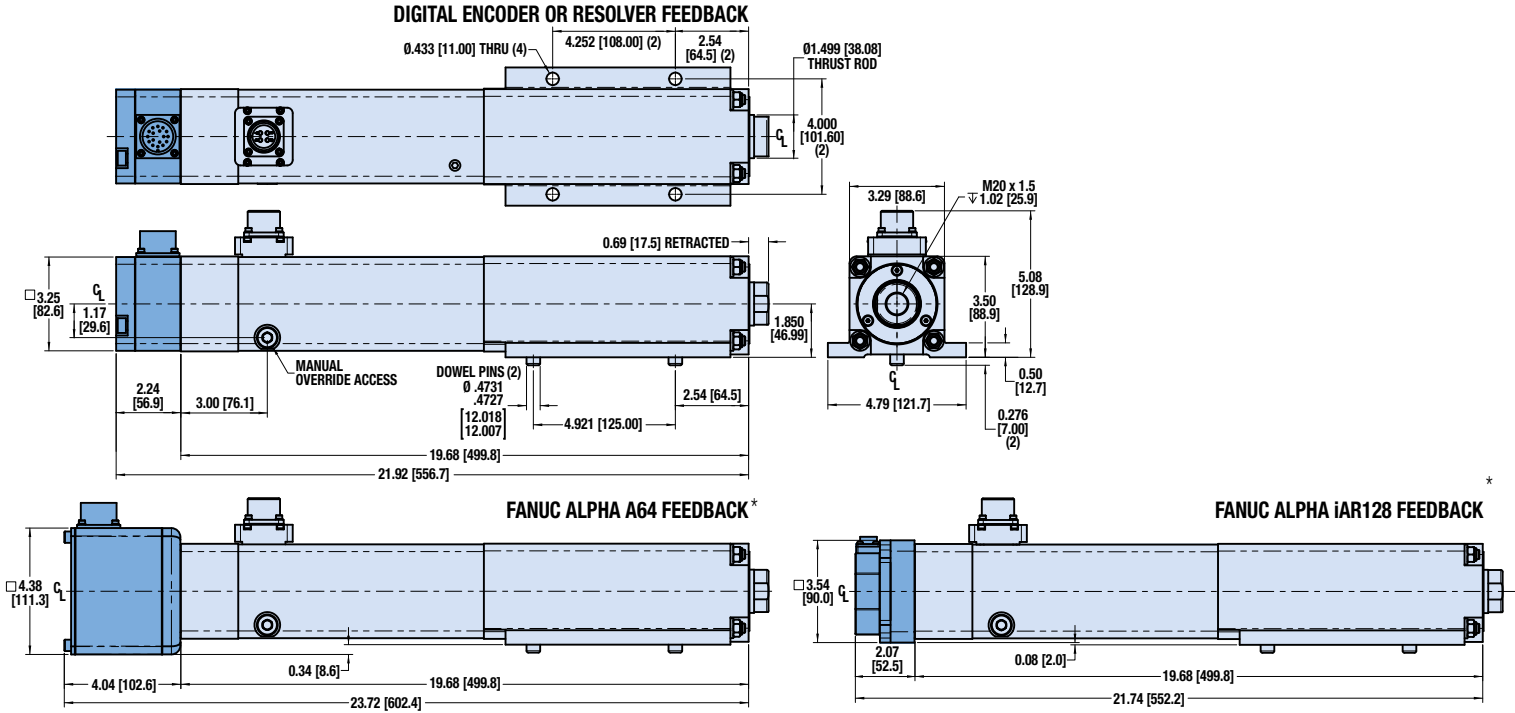
## Dimensions: GSWA44



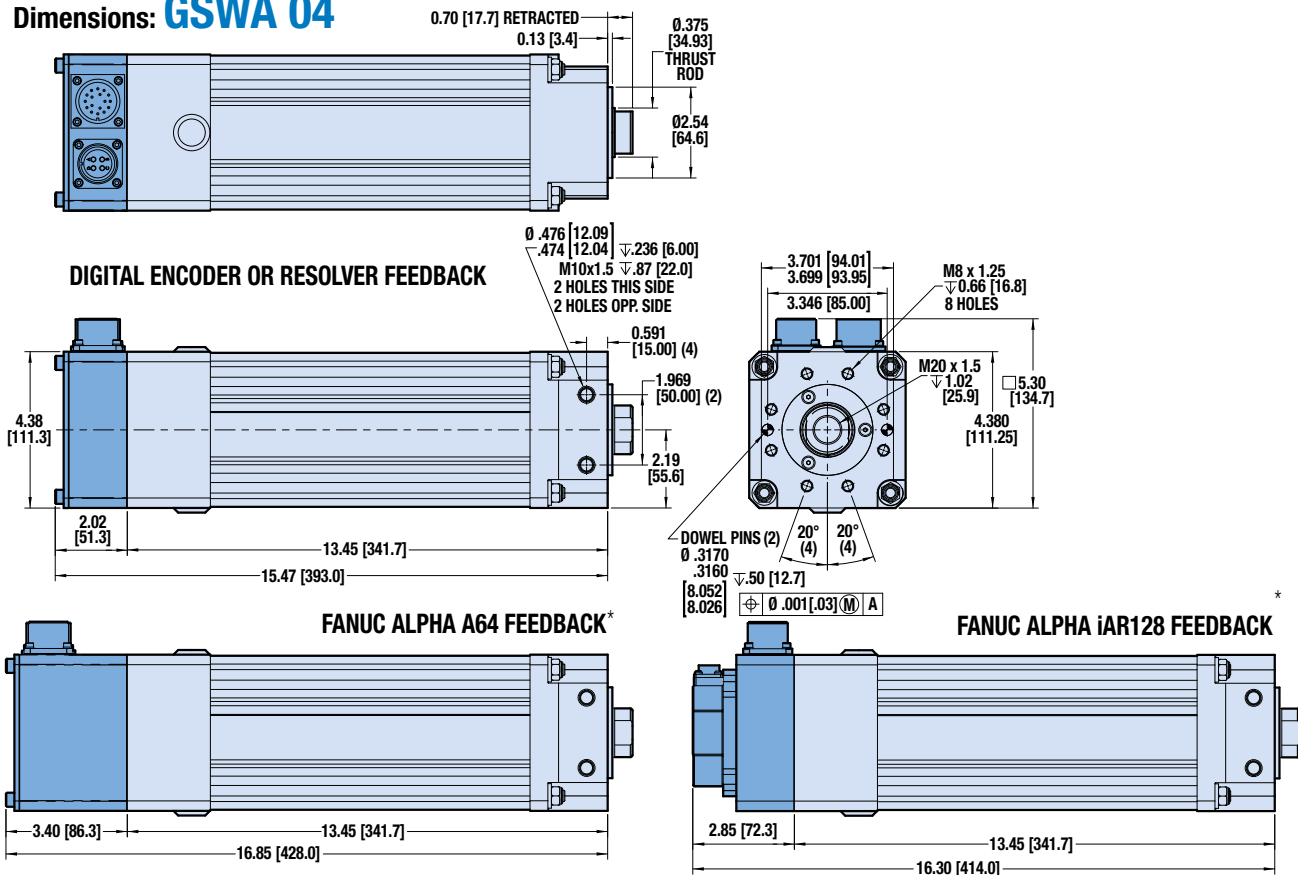
\*Shown fully assembled with customer supplied feedback

# GSWA - Dimensions

## Dimensions: GSWA33, Guided



## Dimensions: GSWA 04



\*Shown fully assembled with customer supplied feedback

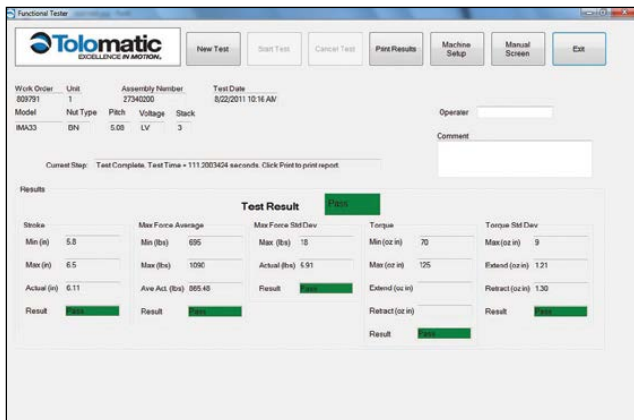
Contact Tolomatic for GSWA55 dimensions

# Complete Verification Testing is Performed on Every Actuator

Properly applied, every ServoWeld actuator shipped is guaranteed for millions of cycles of maintenance free or minimal maintenance performance.



Functional unit testing for hundreds of cycles quantifies stroke, length, torque under no load, input current vs force standard deviation.



Testing parameter results in progress for the Functional Test procedure.



Final system test ensures the feedback device is properly aligned with the ServoWeld motor poles.

We verify the performance of each individual unit before delivery to ensure they conform to Tolomatic's high standard of performance.

## 1. High POT (High Potential/High Voltage Test)

This standard electric motor test procedure is a 3-part test that checks the insulation system of the assembly to verify proper armature and thermal wire insulation.

## 2. Electronic phasing of ServoWeld® and feedback device (Encoder, Resolver, Feedback Device)

Using a fixed current and a specially designed fixture the feedback device is physically and electronically aligned relative to the phasing of the ServoWeld motor.

## 3. Functional Testing

Performed with Tolomatic motion control components and dedicated data acquisition equipment. Operated for hundred of cycles, this test quantifies these parameters - stroke length, torque under no load, input current vs force average, input current vs force standard deviation - using an electronic load cell in conjunction with data acquisition equipment.

## 4. Tolomatic System Test

Using a single-axis control unit the test ensures that the feedback device is properly aligned with the poles of the ServoWeld motor.

# ServoWeld Application Guidelines

**SIDE LOADING:** Some weld gun designs may subject the actuator to excessive side loading, reducing overall service life. The GSWA33, GUIDED actuator will accommodate side loading. For other ServoWeld configurations, measures are required, especially in “C” style designs, to limit side loading. For life optimization Tolomatic recommends side loads of less than 5% of axial load (thrust rod output force) for all roller screw configurations and less than 1% of axial load for all ball screw configurations.

For maximum service life, external guiding is recommended to minimize side loading to the thrust rod and provide consist weld gun movable tip/fixed tip alignment throughout service life.

**THRUST ROD WIPER/SCRAPER:** The thrust rod wiper/scrapper 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/scrapper interface area. Implementation of industrial thrust rod boot and/or deflective device can be effectively utilized in this area.

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

**RSW SERVO SYSTEM CALIBRATION:** RSW weld gun servo system consists of robot 7th axis amplifier, robot feedback device, robot RSW software, weld gun chassis, & ServoWeld.

For optimal RSW weld gun servo system performance the calibration process should include maximum weld tip force from the production weld schedule, tip dress force, and multiple weld tip forces in-between. Utilizing all the available robot manufacturer force table inputs will provide best RSW weld gun servo system performance. The same weld tip part contact speed should be used for both RSW weld gun servo system calibration and production weld schedule.

**WELD TIP/PART CONTACT SPEED:** Tolomatic testing confirms the highest ServoWeld 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 have reduced exposure to water pooling/water ingress by virtue of the continuous robot movement and various RSW gun positions. 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 ServoWeld exposure to water. (ServoWeld above weld caps)

**ROBOT MANUFACTURER SERVO FILE:** Robot manufacturer servo parameter files for operation of ServoWeld are available only from the robot manufacturer. Each robot manufacturer creates 3rd party motor servo parameter files, validates operation of ServoWeld via their 7th axis, and maintains servo motor parameter file for operation of ServoWeld.

**TOOL CHANGER APPLICATIONS:** Weld gun storage fixture in cell should position weld gun so movable electrode is not loading ServoWeld 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 mounted vertical – thrust rod up. Measures should be taken to reduce and/or eliminate the ServoWeld to water exposure, water pooling/spray in the access areas of the ServoWeld unit to maximize overall service life.

- Pedestal RSW guns that can be mounted with the ServoWeld vertical – thrust rod down should be considered.
- Pedestal RSW guns that must be mounted with the ServoWeld 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 ServoWeld/RSW Gun 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/scrapper 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 ingress 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.

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