MSM Series Brushless Servo Motor Manual

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Use of Motors

Servo motors are intended to drive machinery. As such, they must be part of a controlled system that includes a transistorized electronic amplifier. They are not intended for direct connection to the power supply or for use with thyristor drives. Instructions in the amplifier and control system manuals must be observed; this document does not replace those instructions.

Unless specified otherwise, servo motors are intended for use in a normal industrial environment without exposure to excessive or corrosive moisture or abnormal ambient temperatures. The exact operating conditions may be established by referring to the date for the motor. The mating of motors to machinery is a skilled operation; disassembly or repair must not be attempted. In the event that a motor fails to operate correctly, contact the place of purchase for return instructions.

Safety Notes

There are some possible hazards associated with the use of motors. The following precautions should be observed. Specific Warnings and Cautions are listed under the heading "Motor Installation."

Installation and Maintenance: Installation and maintenance or replacement must be carried out by suitably qualified service personnel, paying particular attention to possible electrical and mechanical hazards.

Weight: Large motors are generally heavy and the center of gravity may be offset. When handling, take appropriate precautions and use suitable lifting equipment. Beware of share edges; use protective gloves when handling such assemblies.

Flying leads: Ensure that flying or loose leads are suitably restrained to prevent snagging or entanglement before carrying motors with such leads.

Generation: If the motor is driven mechanically, it may generate hazardous voltages at its power input terminals. The power connector must be suitably guarded to prevent a possible shock hazard.

Loose motors: When running an unmounted motor, ensure that the rotating shaft is adequately guarded and the motor is physically restrained to prevent it from moving. Remove the key which otherwise could fly out when the motor is running.

Damaged cables: Damage to cables or connectors may cause an electrical hazard. Ensure there is no damage before energizing the system.

Supply: Servo motors must not be directly connected to a power supply; they require an electronic drive system. Consult the instructions for the drive system before energizing or using the motor.

Brakes: The brakes that are included on motors are holding brakes only and are not to be used as a mechanical restraining device for safety purposes.

Safety requirements: The safe incorporation of this product into a machine system is the responsibility of the machine designer, who should comply with the local safety requirements at the place where the machine is to be used. In Europe, this is likely to be the Machinery Directive.

Mechanical connection: Motors must be connected to the machine with a torsionally rigid coupler or a reinforced timing belt. Couplers which are not rigid will cause difficulty in achieving an acceptable response from the control system. Couplings and pulleys must be tight, as the high dynamic performance of a servo motor can easily cause couplings to slip and thereby damage the shaft and cause instability. Care must be taken in aligning couplings and tightening belts so that the motor is not subjected to significant bearing loads or premature bearing wear will occur. Once connected to a load, tuning will be affected. A system turned without a load will probably require retuning once a load is applied.

Connectors: Ensure power is removed before making or removing any connection Motor connectors should not be connected or disconnected while power is applied.

MSM Motor And Performance Data

460 Volt Motors

Motor Model	MSM100-6-604		MSM100-14-604		MSM115-34-404		MSM115-62-404		MSM115-89-404		MSM165-93-204		MSM165-146-304		MSM215-221-304		MSM215-319-304		MSM215-407-304		MSM215-505-304	
	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm
Continuous Torque	6	0.72	14	1.53	34	3.8	62	7	89	10	93	10.5	146	16.5	221	25	319	36	407	46	505	57
Peak Torque	34	3.8	71	8	106	12	195	22	283	32	301	34	478	54	620	70	885	100	1133	128	1416	160
Winding Data[1]																						
Speed (rpm)	6000		6000		4000		4000		4000		2000		3000		3000		3000		3000		3000	
Stall Current (amps peak)	2.0		3.4		4.5		7.8		10.9		6.2		13.6		20.5		28.7		36.6		45.5	
Maximum Current (amps peak)	9.3		17.7		15.6		26.9		38.2		24.0		52.3		65.1		93.3		117.4		147.1	
K_T (Nm/Amp)	.46		.52		.95		.99		1.03		1.86		1.34		1.36		1.36		1.4		1.39	
KE Voltage Constant[2] (V/KRPM)	55		62		115		120		123		225		161		164		164		170		168	
Poles	6		6		6		6		6		6		6		6		6		6		6	
Winding Resistance Ph to phase @ 25°C	24.4		9.0		8.4		3.4		2.0		5.7		1.56		0.76		0.40		0.28		0.24	
Winding Inductance Phase to phase (mH)	48		22.0		32.0		16.8		12.0		60.0		18.5		15.8		10.6		8.2		6.5	
Mechanical Data																						
Rotor Moment of Inertia	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$	$lb\text{-}in\text{-}s^2$	$kg\text{-}m^2$
	.0013	.00015	.0019	.00021	.0050	.00057	.0089	.0010	.0142	.0016	.0195	.0022	.0319	.0036	.0655	.0074	.0956	.0108	.1248	.0141	.0175	.1549
Rotor Moment of Inertia With Brake	.0023	.00026	.0028	.00032	.0082	.00093	.0122	.00138	.0171	.00193	.0266	.003	.0386	.0044	.0920	.0104	.1221	.0138	.1513	.0171	.1814	.0205
Motor Net Weight	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
	10.8	4.9	13.0	5.9	14.6	6.6	18.7	8.5	24.3	11.0	26.5	12.0	35.9	16.3	57.3	26.0	72.8	33.0	88.2	40.0	108	49
Motor Net Weight With Brake	12.4	5.6	14.6	6.6	17.0	7.7	21.1	9.6	26.7	12.1	30.6	13.9	40.1	18.2	63.9	29	79.4	36	94.8	43	114.7	52
Shaft Material	ST-60		ST-60		ST-60		ST-60		ST-60		ST-60		ST-60		ST-60		ST-60		ST-60		ST-60	

[1] Specifications at 25° C ambient   [2] 0 to peak value of volts, phase to phase

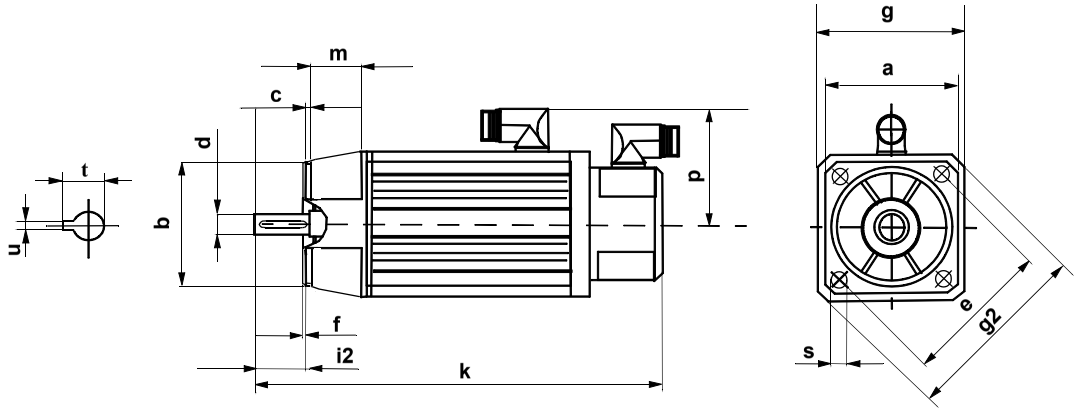
Storage and Operating Conditions:

Ambient Temperature: 0 to 40° C (32 to 104° F)

Storage Temperature: -30 to 70° C (-22 to 158° F)

Relative Humidity: 5 to 95% non-condensing

MSM Standard Motor Dimension



Shaft End Threaded Hole		
Motor	**Thread**	**Thread Depth**
MSM100-XXX	M5 x 0.8 mm	12.5
MSM115-XXX	M6 x 1.0 mm	16
MSM165-XXX	M8 x 1.25 mm	19
MSM215-XXX	M12 x 1.75 mm	28

Note: Motors manufactured to millimeter dimensions

	Dimensions															
	Flange							Shaft			Motor					
Model	**a** mm	**b** mm	**c** mm	**e** mm	**f** mm	**i2** mm	**s** mm	**d** mm	**u** mm	**u+d-t (key depth)** mm	**k[1]** mm	**k-i2[1] (length from face)** mm	**p** mm	**m** mm	**g** mm	**g2** mm
MSM100-6-604	90	80	8	100	3	30	7	14	5	3	224	194	81	27	99	120
MSM100-14-604	-	-	-	-	-	-	-	-	-	-	249	219	-			
MSM115-34-404	105	95	8	115	3	40	9	19	6	3.5	277	237	90	27	115	150
MSM115-62-404	-	-	-	-	-	-	-	-	-	-	317	277				
MSM115-89-404	-	-	-	-	-	-	-	-	-	-	357	317				
MSM165-93-204	142	130	12	165	3.5	50	12	24	8	5	316	266	126	32	142	186
MSM165-146-304	-	-	-	-	--	-	-	-	-	-	366	316				
MSM215-221-304	190	180	13	215	4	58	14	32	10	7	367	309	150	45	190	250
MSM215-319-304	-	-	-	-	-	-	-	-	-	-	415	357	-			
MSM215-407-304	-	-	-	-	-	-	-	-	-	-	463	405	-			
MSM215-505-304	-	-	-	-	-	-	-	-	-	-	511	453	-			

[1] Add 3mm for MSM100 motors with Sin/Cos feedback, 0 mm for MSM115 motors with Sin/Cos feedback, 21mm for MSM215 motors with Sin/Cos feedback, 22mm for MSM165 motors with Sin/Cos feedback.

Motors manufactured to millimeter dimensions shown. Inch dimensions can be obtained by dividing by 25.4. For further motor detail, engineering specification drawings are available.

Sin/Cos feedback is used with Single turn high reslolution (-S) and Multiturn high resolution (-M) feedback options.

Brake motors are the same length as non-brake motors.

MSM Motor Connector Ordering Information

Ordering options include the following:

- 24 VDC Brake (Consult factory for brake motor availability)
- Single turn high resolution
- Multi-turn high resolution

Consult the factory for information on any of these items.

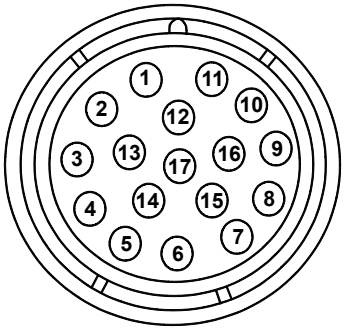
Note: Optional configurations or encoder line counts have extended lead times and additional charges.

Note: All options are not available.

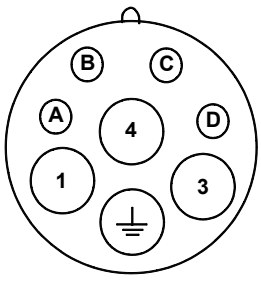
Connector	Part Number
Power Connectors	
Size 1, 16AWG	M.1302.0479
Size 1.5, 8-16AWG	M.1302.1998
Size 1.5, 6-10AWG	M.1302.1999
Encoder Feedback Connector	
17 Pin	M.1302.0510

MSM Motor Connector Tables

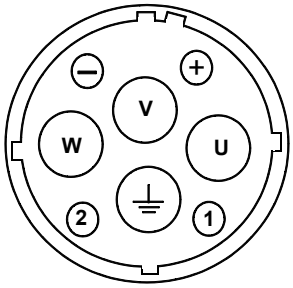
Feedback Connector			
Pin	**2000 Line Encoder**	**High Resolution Encoder (SRS 50)**	**Absolute Encoder (SRM 50)**
1	A+	Sine +	Sine +
2	A-	Sine -	Sine -
3	B+	Cos +	Cos +
4	B-	Cos -	Cos -
5	I+	485 +	485 +
6	I-	485 -	485 -
7	GND	GND	GND
8	Reserved	Reserved	Reserved
9	No connection	8-12 VDC	8-12 VDC
10	+5VDC	No Connection	No Connection
11	Common	Common	Common
12	Reserved	Reserved	Reserved
13	Temp +	Temp +	Temp +
14	Temp -	Temp -	Temp -
15	Hall A	No Connection	No Connection
16	Hall B	No Connection	No Connection
17	Hall C	No Connection	No Connection



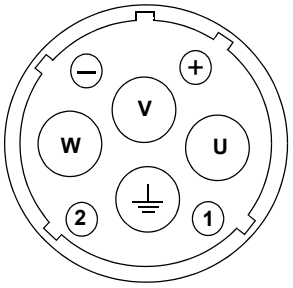
Motor Power Connector					
Size 1 Power Connector		**Size 2 Power**		**Size 3 Power**	
Pin	**Signal**	**Pin**	**Signal**	**Pin**	**Signal**
1	U	U	U	U	U
2	GND	GND	GND	GND	GND
3	V	W	V	V	V
4	W	V	W	W	W
A	Brake +	+	Brake +	+	Brake +
B	Brake -	-	Brake -	-	Brake -
C		1		1	
D		2		2	



Size 1; I < 13.5 Amps RMS



Size 1.5; I < 44 Amps RMS



Size 3; I < 97 Amps RMS

Standard Motor Radial Load Force Ratings For MSM Motors

Motors are capable of operating with the maximum radial or maximum axial shaft loads listed in the following tables. Radial loads are applied midway along the shaft extension. The table represents 20,000-hour L10 bearing fatigue life. This 20,000-hour life does not account for possible application-specific life reduction that may occur due to bearing grease contamination from external sources.

Motor	500 RPM		1000 RPM		2000 RPM		3000 RPM		4000 RPM		5000 RPM		6000 RPM	
	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
MSM100	84	185	65	143	50	112	44	98	38	85	36	80	34	76
MSM115	95	211	82	182	63	139	54	119	48	106	44	98	42	93
MSM165	122	269	89	197	67	148	56	123	48	107	45	101	42	93
MSM215	209	469	163	359	122	269	101	224	86	191	81	179	77	170
MSM307	51.4	113	40.9	90	32.3	71	28.2	62	25.5	56	53	24.1		

Note: The axial Load Force must always be zero.

Motor Installation

Unmounted motors, disconnected mechanical couplings and/or disconnected cables are dangerous if power is applied.

Disassembled equipment should be appropriately identified (tagged-out) and access to electrical power restricted (locked-out).

Failure to observe these safety procedures could result in personal injury and damage to equipment.

Observe the following installation guidelines and those under the heading “Safety Notes”:

1. Do not run motors that are not properly mounted. Attach all power and encoder cables after the motor is mounted.
2. Mount motors with connectors pointing downward and use a drip loop in the cable to keep liquids flowing away from the connectors.
3. The installer must comply with all local regulations and should use equipment and installation practices that promote electromagnetic compatibility and safety.

Outer surfaces of motor can reach high temperatures, 125°C (275°F) during motor operation.

Take precautions to prevent accidental contact with hot surfaces.

Failure to observe these safety procedures could result in personal injury.

Couplings and Pulleys

Mechanical connections to the motor shaft, such as couplings and pulleys, require a rigid coupling or a reinforced timing belt. The high dynamic performance of servo motors can cause couplings, pulleys or belts to loosen or slip over time. A loose or slipping connection will cause system instability and may damage the motor shaft and keyway. All connections between the system and the servo motor shaft must be rigid to achieve acceptable response from the system. Connections should be periodically inspected to verify the rigidity.

When mounting couplings or pulleys to the motor shaft, ensure that the connections are properly aligned and that axial and radial loads are within the specifications of the motor. The section “Load Force Ratings” provides guidelines to achieve 20,000 hours of bearing life. Additional information about load force ratings, including graphical depiction of varied load ratings and bearing life, is available for any motor from the Technical Support groups listed on the back cover.

Preventing Electrical Noise

ElectroMagnetic Interference (EMI), commonly called “noise”, may adversely impact motor performance by inducing stray signals. Effective techniques to counter EMI include filtering the AC power, shielding and separating signal carrying lines, and practicing good grounding techniques. Effective AC power filtering can be achieved through the use of isolated AC power transformers or properly installed AC line filters. Physically separate signal lines from motor cabling and power wiring; do *not* parallel signal wires with motor or power wires or route signal wires over the vent openings of servo drives. Ground all equipment using a single-point parallel ground system that employs ground bus bars or straps. If necessary, use electrical noise remediation techniques to mitigate EMI in “noisy” environments.

Knowledgeable cable routing and careful cable construction improves system electromagnetic compatibility (EMC). General cable build and installation guidelines include:

1. Keep wire lengths as short as physically possible.
2. Route signal cables (encoder, serial, analog) away from motor and power wiring.
3. Separate cables by 1 foot minimum for every 30 feet of parallel run.
4. Ground both ends of the encoder cable and twist the signal wire pairs.
5. Use shielded motor cables when necessary to prevent electromagnetic interference (EMI) with other equipment

High voltage can be present on the shield of a power cable, if the shield is not grounded

Ensure there is a connection to ground for any power cable shield.

Failure to observe these safety procedures could result in personal injury or damage to equipment.

Motor Model Name Identification

Model

Frame mm (bolt hole circle)

Torque in-l b

Speed 2 digits *100=RPM

Voltage 1 digit *100=Voltage

Feedback M, S, E [multiturn, SinCos, Incremental Encoder (linecount*1000)]

Brake Option 0, 2, (0 no brake, 24 volt)

Other Option AA (no other options) -- connectors, face plate, shaft modifications

K* - with keyway
*O – With Blower
*S - With Shaft Seal

See examples below:

Model Number	**Description**
MSM100-15-604-E2-0KA	100 frame 15 in-lb, 6000 RPM, 460 volt, line encoder with no brake, keyway, no other options
MSM165-92-204-S-2KA	165 frame 92 in-lb, 2000 RPM, 460 volt, Single turn high resolution, 24 volt brake, keyway, no options