

LSM 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 data 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 sharp 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.

LSM Motor And Performance Data

230 Volt Motors

Motor Model	LSM54-3-602		LSM63-6-602		LSM63-12-602		LSM75-21-602		LSM75-29-602	
	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm	In-lb	Nm
Continuous Torque	3	.33	6	.7	12	1.4	21	2.36	29	3.3
Peak Torque	12	1.32	25	2.8	50	5.6	78	8.8	117	13.2
Winding Data										
Speed (rpm)	6000		6000		6000		6000		6000	
Stall Current (amps peak)	1		2.1		4.1		5.5		8.3	
Maximum Current (amps peak)	3.8		8.1		15.8		21.6		33	
KT (Nm/Amp)	.35		.35		.36		.42		.40	
K _E Voltage Constant ³ (V/kRPM)	43		43		43		49		49	
Poles	8		8		8		8		8	
Winding Resistance Ph to phase @ 25°C	30.29		8.49		3.68		2.26		1.32	
Winding Inductance Phase to phase (mH)	57.5		26.2		13.0		17.9		12.4	
Mechanical Data										
Rotor Moment of Inertia	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²
	.00003	.0000029	.00011	.000013	.00017	.00002	.00029	.000033	.00039	.000044
Motor Net Weight	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
	1.5	.7	3.1	1.4	4.0	1.8	6.8	3.1	8.6	3.9
Shaft Material	Steel		Steel		Steel		Steel		Steel	

460 Volt Motors

Motor Model	LSM100-22-454		LSM100-35-454		LSM100-46-454		LSM130-78-454		LSM130-102-304		LSM165-119-454		LSM165-173-304		LSM165-221-454		LSM215-301-304		LSM215-451-204		LSM215-589-204	
	In-lb	Nim	In-lb	Nim	In-lb	Nim	In-lb	Nim	In-lb	Nim	In-lb	Nim	In-lb	Nim	In-lb	Nim	In-lb	Nim	In-lb	Nim	In-lb	Nim
Continuous Torque	22	2.5	35	4.0	46	5.2	78	8.8	102	11.5	119	13.5	173	19.5	221	25	301	34	451	51	589	66
Peak Torque	97	11	142	16	142	16	336	38	460	52	451	51	664	75	885	100	929	105	1398	158	1859	210
Winding Data¹																						
Speed (rpm)	4500		4500		4500		4500		3000		4500		3000		4500		3000		2000		2000	
Stall Current (amps peak)	3.3		5.0		6.4		10.7		9.6		16.4		16.5		30.3		30.4		29.7		38.9	
Maximum Current (amps peak)	16.3		22.6		21.2		50.9		48.1		70.7		72.1		134.4		107.5		106.1		144.2	
KT (Nm/Amp)	.82		.86		.88		.88		1.28		.87		1.29		.91		1.22		1.84		1.84	
KE Voltage Constant ² (V/krpm)	99		103		106		107		154		105		156		109		147		222		222	
Poles	8		8		8		8		8		8		8		8		8		8		8	
Winding Resistance Ph to phase @ 25°C	10.7		5.9		3.9		1.68		2.2		0.76		0.98		0.33		0.38		0.50		0.31	
Winding Inductance Phase to phase (mH)	25.8		16.8		12.44		8.46		12.4		6.68		9.6		3.6		6.94		10.0		7.4	
Mechanical Data																						
Rotor Moment of Inertia	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²	lb-in-s ²	kg-m ²
	.001	.00011	.0013	.000144	.0015	.00017	.0036	.00041	.0049	.00055	.0081	.00092	.0113	.00128	.0146	.00165	.0376	.00425	.0531	.0060	.0681	.0077
Rotor Moment of Inertia With Brake	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
	9.3	4.2	11.7	5.3	13.9	6.3	22	10.0	26	11.8	35.7	16.2	41.2	18.7	46.3	21.0	68.4	31.0	84.9	38.5	100.3	45.5
Motor Net Weight With Brake	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
	5	11	6.1	13.5	7.1	15.7	11.2	25	13	28.7	18.5	40.8	21	46.3	23.3	51.4	34.2	75.4	41.7	91.9	48.7	107.4
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

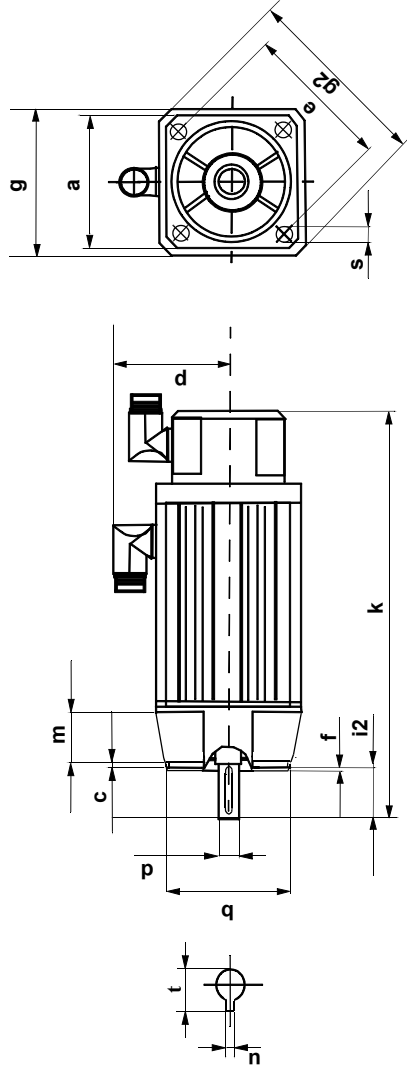
Storage and Operating Conditions:

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

LSM Standard Motor Dimensions



Shaft End Threaded Hole		
Motor	Thread	Thread Depth
LSM100-XXX	M5 x 0.8 mm	12.5
LSM130-XXX	M8 x 1.25 mm	19
LSM165-XXX	M10 x 1.5 mm	22
LSM215-XXX	M12 x 1.75 mm	28

Note: Motors manufactured to millimeter dimensions

Model	Dimensions															
	Flange						Shaft				Motor					
	a	b	c	e	f	i2	s	d	u	u+d-t	k ¹	k-i2 ¹ (length from face)	p	m	g	g2
LSM54-3-602	45	40	6	54	2.5	20	4.4	9	3	1.8	119	99	59.5	50	55	75.5
LSM63-6-602	55	40	6	63	2.5	20	5.4	9	3	1.8	124	104	60	56	55	75.5
LSM63-12-602											154	134				
LSM75-21-602	70	60	8	75	2.5	23	5.5	11	4	2.5	171	148	67	56	70	94
LSM75-29-602											201	178				
LSM100-22-454	90/94	80	8	100	3	30	7	14	5	3	235	205	77	NA ²	94	115
LSM100-35-454											265	235				
LSM100-46-454											295	265				
LSM130-78-454	120	110	9	130	3.5	50	9	24	8	5	320	270	90	28	115	150
LSM130-102-304											358	308				
LSM165-119-454	142	130	10	165	3.5	58	12	28	8	5	338	280	126	31.4	142	186
LSM165-173-304											388	330				
LSM165-221-454											428	370				
LSM215-301-304	190	180	12	215	4	80	14	38	10	7	400	320	150	37	190	250
LSM215-451-204											452	372				
LSM215-589-204											504	424				

¹Add 38mm for LSM54 motors with brake, 42mm for LSM63 motors with brake, 49mm for LSM75 motors with brake, 67mm for LSM100 motors with brake, 79mm for LSM130 motors with brake, 78mm for LSM165 motors with brake, 113mm for LSM215 motors with brake. Add 25mm for LSM75 motor with Sin/Cos feedback. LSM100-215 are the same length with Sin/Cos feedback.

²Not Applicable

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 resolution (-S) and Multiturn high resolution (-M) feedback options.

LSM Motor Connector Ordering Information

Ordering options include the following:

- 24 VDC Brake (Consult factory for brake motor availability)
- 1000 Line encoder is standard for LSM 55 and 63 motors
- Single turn high resolution
- Multi-turn high resolution

Consult the factory for information on any of these items.

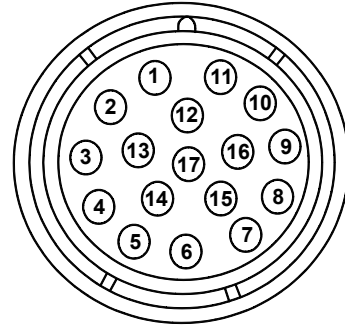
Note: Optional configurations or encoder line counts have extended lead times and additional charges.

Note: All options are not available.

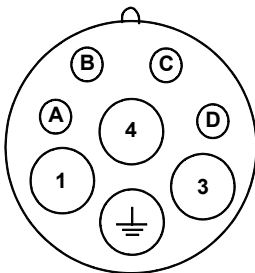
Connector	Part Number
Power Connectors	
Size 1, 16AWG	M.1302.0479
Size 1.5, 12-14 AWG	M.1302.1998
Size 1.5, 10 AWG	M.1302.2354
Size 1.5, 6-8 AWG	M.1302.1999
Encoder Feedback Connector	
17 Pin	M.1302.0510

LSM Motor Connector Data Tables

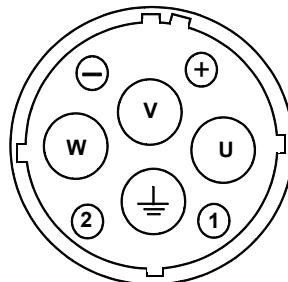
Feedback Connector			
Pin	2000 Line Encoder	High Resolution Encoder (SRS 50)	Absolute Encoder (SRM 50)
1	A+	Sine +	Sine +
2	A-	Sine -	Sine -
3	B+	Cos +	Cos +
4	B-	Cos -	Cos -
5	I+	485 +	485 +
6	I-	485 -	485 -
7	GND	GND	GND
8	Reserved	Reserved	Reserved
9	No connection	8-12 VDC	8-12 VDC
10	+5VDC	No Connection	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



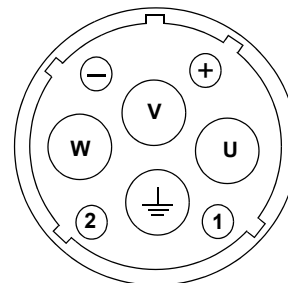
Motor Power Connector					
Size 1 Power Connector		Size 2 Power		Size 3 Power	
Pin	Signal	Pin	Signal	Pin	Signal
1	R	U	R	U	R
2	GND	GND	GND	GND	GND
3	T	W	T	W	T
4	S	V	S	V	S
A	Brake +	+	Brake +	+	Brake +
B	Brake -	-	Brake -	-	Brake -
C		1		1	
D		2		2	



Size 1; I < 13.5 Amps RMS



Size 1.5; I < 44 Amps RMS



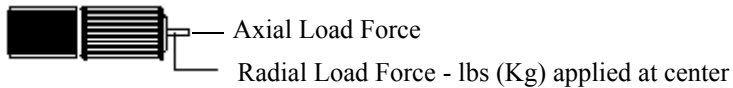
Size 3; I < 97 Amps RMS

Standard Motor Radial Load Force Ratings For LSM 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.

RADIAL LOAD FORCE RATINGS														
(Maximum Radial Load)														
	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)
LSM54	24	53	23	51	22	48	21	47	21	46	20	44	20	43
LSM63	28	61	27	60	26	58	25	55	24	53	24	52	23	50
LSM75	29	65	29	63	28	62	27	59	26	57	25	56	24	54
LSM100	56	123	56	123	48	106	42	94	36	80	34	76	33	73
LSM130	127	281	91	202	68	151	58	129	53	118	49	110	45	101
LSM165	147	325	107	236	76	168	63	140	56	123	46	103	43	95
LSM215	214	472	158	348	112	247	89	196	76	168	63	140	58	129

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
LSM100-14-502-E2-0AA	100 frame 14 in-lb, 5000 RPM, 230 volt, line encoder with no brake, no other options
LSM130-90-302-S-2AA	130 frame 90 in-lb, 3000 RPM, 230 volt, Single turn high resolution, 24 volt brake, no options