AEROTECH

Flat Linear Motor Hardware Manual

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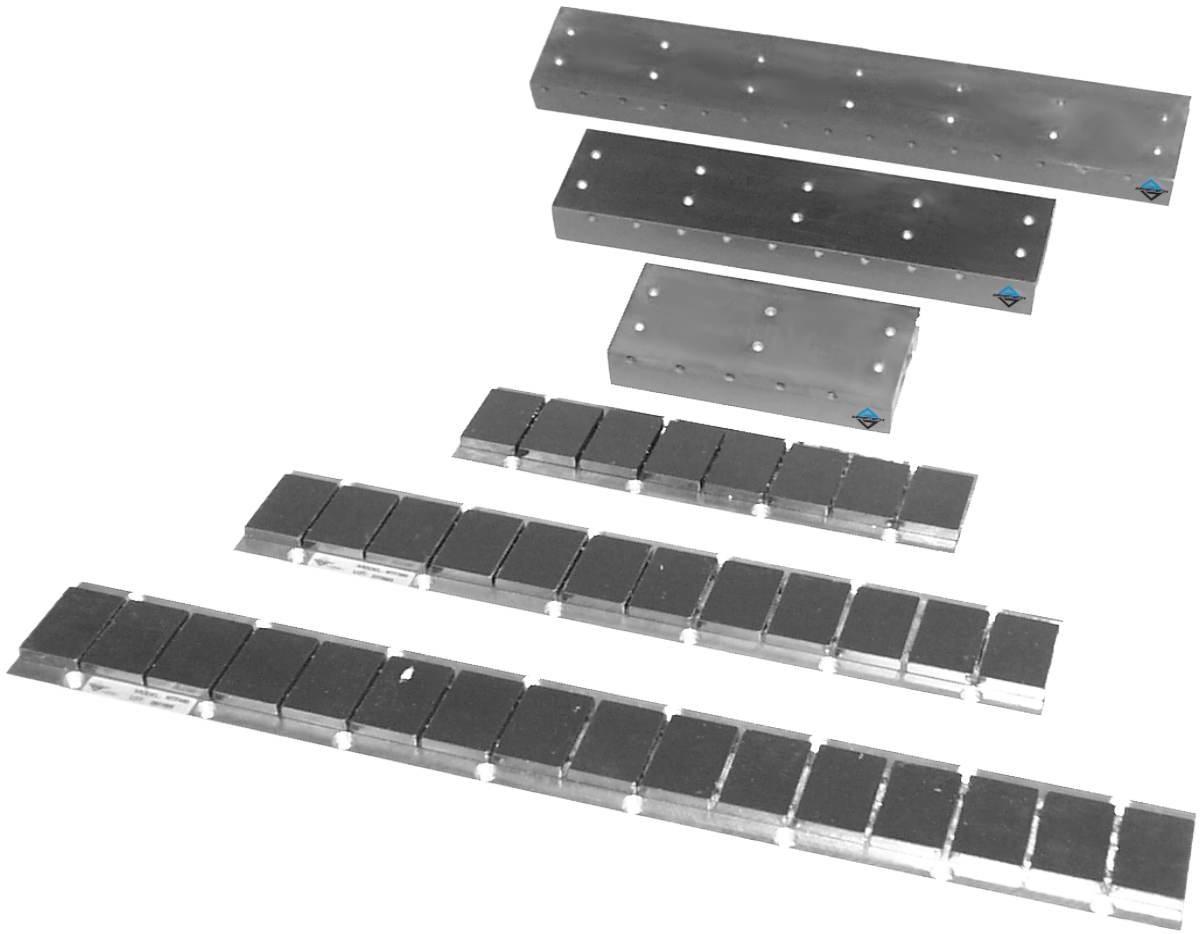

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Go to www.aerotech.com/global-technical-support for information and support about your Aerotech products. The website provides downloadable resources (such as up-to-date software, product manuals, and Help files), training schedules, and PC-to-PC remote technical support. You can also complete Product Return (RMA) forms and get information about repairs and spare or replacement parts. For immediate help, contact a service office or your sales representative. Have your customer order number available before you call or include it in your email.

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EU Declaration of Conformity

Manufacturer	Aerotech, Inc.
Address	101 Zeta Drive Pittsburgh, PA 15238-2811 USA
Product	BLMFI, BLMFS, and BLMFS5 Motors
Model/Types	All

This is to certify that the aforementioned product is in accordance with the applicable requirements of the following Directive(s):

2014/35/EU	Low Voltage Directive LVD
2011/65/EU	RoHS 2 Directive

and has been designed to be in conformity with the applicable requirements of the following documents when installed and used in accordance with the manufacturer's supplied installation instructions.

IEC 60034-1:2010	Rotating Electrical Machines
IEC 61010-1:2010	Safety requirements for Electrical Equipment for measurement, control, and laboratory use
NOTE:	Safe operation of the motor requires over speed and over current protection. This may be done by the connected controller / amplifier combination.

Name	/ Alex Weibel
Position	Engineer Verifying Compliance
Location	Pittsburgh, PA

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Safety Procedures and Warnings

Read this manual in its entirety before installing, operating, or servicing this product. If you do not understand the information contained herein, contact an Aerotech representative before proceeding. Strictly adhere to the statements given in this section and other handling, use, and operational information given throughout the manual to avoid injury to you and damage to the equipment.

The following statements apply wherever the Warning or Danger symbol appears within this manual. Failure to observe these precautions could result in serious injury to those individuals performing the procedures and/or damage to the equipment.

NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time. All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. Refer to www.aerotech.com for the most up-to-date information.

NOTE: This product is intended for light industrial manufacturing or laboratory use.

DANGER: This product contains potentially lethal voltages. To reduce the possibility of electrical shock, bodily injury, or death the following precautions must be followed.

1. The user must restrict user access to motor coil / wires while energized. This is accomplished by providing an enclosure around the operating components which, when opened, removes power to the drive. The motor may also be contained in a grounded mechanical system (positioning stage) which restricts direct access to the high voltage motor components.
2. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
3. Disconnect electrical power before servicing equipment.
4. All components must be properly grounded in accordance with local electrical safety requirements.
5. Motor frame is safety grounded with a conductor equal in size to the phase conductors.
6. The drive must contain a properly-sized fuse, matched to the motor cable wire size.
7. These motors are not rated for use in explosive atmospheres. They are not to be operated in the presence of potentially explosive mixtures of air-borne dust or combustible vapors.
8. Motors and their associated drive, cabling, etc. are sources of electromagnetic fields. Persons with implanted medical devices need to evaluate the risks associated with these devices before entering an area where they are in use.
9. Operator safeguarding requirements must be addressed during final integration of the product.

DANGER: The motor temperature can pose a burn hazard. Do not touch the motor until it has cooled sufficiently.

WARNING: To minimize the possibility of electrical shock, bodily injury or death the following precautions must be followed.

1. Aerotech's motors are meant to be part of a drive package consisting of an amplifier and a controller. The motor relies on the drive package for fault protection. Aerotech, Inc. does not approve of their motors being used in any other way.
2. To prevent electrical shock hazards, allow only qualified persons to install and service this equipment.
3. Equipment grounds must be in place and maintained to reduce the risk of serious or potentially fatal injury from electric shock.
4. Moving parts can cause crushing or shearing injuries. Access to all stage and motor parts must be restricted while connected to a power source.
5. Never install or operate equipment that appears to be damaged.
6. Disconnect electrical power to the motor before performing maintenance procedures. In addition, uncouple or otherwise prevent motor-coupled machinery from moving the motor during service.
7. Motors are capable of very high speeds and acceleration rates. Always avoid being in the direct path of moving machinery.
8. The motor over temperature sensor must be monitored by the drive and used to shut down the drive in the event of excessive motor temperatures.
9. Cables can pose a tripping hazard. Securely mount and position all system cables to avoid potential hazards.
10. Do not expose this product to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.
11. The BLMF motor must be mounted securely. Improper mounting can result in injury and damage to the equipment.
12. Use care when moving the BLMF motor. Lifting or transporting the BLMF motor improperly can result in injury or damage to the BLMF.
13. This product is intended for light industrial manufacturing or laboratory use. Use of this product for unintended applications can result in injury and damage to the equipment.
14. If the product is used in a manner not specified by the manufacturer, the protection provided by the product can be impaired and result in damage, shock, injury, or death.

Chapter 1: Overview

NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time. All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. Refer to www.aerotech.com for the most up-to-date information.

Table 1-1: BLMFx Options

Motor Series	
BLMFI-81	81 mm long flat linear motor forcer with thermistor; ironless design for zero cogging
BLMFI-142	142 mm long flat linear motor forcer with thermistor; ironless design for zero cogging
BLMFI-264	264 mm long flat linear motor forcer with thermistor; ironless design for zero cogging
BLMFI-386	386 mm long flat linear motor forcer with thermistor; ironless design for zero cogging
BLMFS-81	81 mm long flat linear motor forcer with thermistor; steel lamination design for higher force
BLMFS-142	142 mm long flat linear motor forcer with thermistor; steel lamination design for higher force
BLMFS-264	264 mm long flat linear motor forcer with thermistor; steel lamination design for higher force
BLMFS-325	325 mm long flat linear motor forcer with thermistor; steel lamination design for higher force
BLMFS-386	386 mm long flat linear motor forcer with thermistor; steel lamination design for higher force
BLMFS5-142	142 mm long flat linear motor forcer; steel lamination design; with HED and temperature switch
BLMFS5-262	262 mm long flat linear motor forcer; steel lamination design; with HED and temperature switch
BLMFS5-382	382 mm long flat linear motor forcer; steel lamination design; with HED and temperature switch
Winding Designation (Required)	
-A	76 cm (2.5 ft) flying leads (standard)
-B	Optional winding
Hall-Effect Sensors (Required)	
-NH	No Hall-effect sensors
-H	With Hall-effect sensors
Vacuum Preparation (Optional)	
-V	Vacuum preparation for 10^{-6} Torr
-UHV	Ultra-high vacuum preparation, contact the factory
Note: Vacuum preparation motors are ordered as an Engineering Special line item	
Flat Magnet Tracks (Optional)	
MTF240P	240 mm (9.4 in) long flat magnet track for use with a BLMFI or BLMFS forcer
MTF360P	360 mm (14.2 in) long flat magnet track for use with a BLMFI or BLMFS forcer
MTF480P	480 mm (18.9 in) long flat magnet track for use with a BLMFI or BLMFS forcer
MTF#P	Custom length flat magnet track
MTF5240P	240 mm (9.4 in) long flat magnet track for use with a BLMFS5 forcer
MTF5420P	420 mm (16.5 in) long flat magnet track for use with a BLMFS5 forcer
MTF5#P	Custom length flat magnet track
Note: Magnet tracks are ordered as a separate line item	

1.1. Basic Specifications

NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time. All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. Refer to www.aerotech.com for the most up-to-date information.

Table 1-2: BLMFI Forcer Models (BLMFI-81 and BLMFI-142)

		BLMFI-81		BLMFI-142	
Performance Specifications (1) (5)					
Continuous Force, No Forced Cooling (2)	N (lb)	22.7 (5.1)		39.3 (8.8)	
Peak Force (3)	N (lb)	90.6 (20.4)		157.3 (35.4)	
Attraction Force	N (lb)	0		0	
Electrical Specifications (5)					
Winding Designation	A / B	-A	-B	-A	-B
BEMF Constant (line-line, max)	V/(m/s) (V/(in/s))	8.68 (0.22)	4.34 (0.11)	16.75 (0.43)	8.37 (0.21)
Continuous Current, No Forced Cooling (2)	A_{pk} (A_{rms})	3.0 (2.12)	6.00 (4.24)	2.70 (1.91)	5.40 (3.82)
Peak Current, Stall (3)	A_{pk} (A_{rms})	12.00 (8.49)	24.00 (16.97)	10.80 (7.64)	21.60 (15.27)
Force Constant, Sine Drive (4) (8)	N/A_{pk} (lb/A_{pk})	7.55 (1.70)	3.78 (0.85)	14.57 (3.28)	7.28 (1.64)
	N/A_{rms} (lb/A_{rms})	10.68 (2.40)	5.34 (1.20)	20.60 (4.63)	10.30 (2.32)
Motor Constant (2) (4)	$N/\sqrt{W}$ ($lb/\sqrt{W}$)	3.14 (0.71)		4.31 (0.97)	
Resistance, 25°C (line-line)	Ω	5.5	1.4	10.9	2.7
Inductance (line-line)	mH	2.9	0.73	6.5	1.63
Thermal Resistance, No Cooling	°C/W	1.92		1.20	
Maximum Bus Voltage	V_{DC}	340		340	
Mechanical Specifications					
Coil Weight	kg (lb)	0.50 (1.10)		0.84 (1.85)	
Coil Length	mm (in)	81.0 (3.19)		142.2 (5.60)	
Heat Sink	mm (in)	100x100x13 (4x4x0.5)		150x150x13 (6x6x0.5)	
Magnet Track Weight	kg/m (lb/ft)	4.70 (3.15)		4.70 (3.15)	
Magnetic Pole Pitch	mm (in)	30.00 (1.18)		30.00 (1.18)	

1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature
2. Values shown @ 100°C rise above a 25°C ambient temperature, with motor mounted to the specified aluminum heat sink.
3. Peak force assumes correct rms current; consult Aerotech.
4. Force constant and motor constant specified at stall
5. All performance and electrical specifications ±10%
6. Maximum winding temperature is 125°C.
7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures
8. All Aerotech amplifiers are rated Apk; use force constant in N·m/Apk when sizing.

Table 1-3: BLMFI Forcer Models (BLMFI-264 and BLMFI-386)

		BLMFI-264		BLMFI-386	
Performance Specifications (1) (5)					
Continuous Force, No Forced Cooling (2)	N (lb)	78.6 (17.7)		136.0 (30.6)	
Peak Force (3)	N (lb)	314.2 (70.6)		543.9 (122.3)	
Attraction Force	N (lb)	0		0	
Electrical Specifications(5)					
Winding Designation	A / B	-A	-B	-A	-B
BEMF Constant (line-line, max)	V/(m/s) (V/(in/s))	17.37 (0.44)	34.73 (0.88)	27.91 (0.71)	55.82 (1.42)
Continuous Current, No Forced Cooling (2)	A_{pk} (A_{rms})	5.20 (3.68)	2.60 (1.84)	5.60 (3.96)	2.80 (1.98)
Peak Current, Stall (3)	A_{pk} (A_{rms})	20.80 (14.71)	10.40 (7.35)	22.40 (15.84)	11.20 (7.92)
Force Constant, Sine Drive (4) (8)	N/A_{pk} (lb/A_{pk})	15.11 (3.40)	30.21 (6.79)	24.28 (5.46)	48.56 (10.92)
	N/A_{rms} (lb/A_{rms})	21.36 (4.80)	42.73 (9.61)	34.34 (7.72)	68.67 (15.44)
Motor Constant (2) (4)	N/√W (lb/√W)	6.40 (1.44)		8.38 (1.88)	
Resistance, 25°C (line-line)	Ω	5.3	21.2	8.0	32.0
Inductance (line-line)	mH	3.50	14.00	5.20	21.20
Thermal Resistance, No Cooling	°C/W	0.66		0.38	
Maximum Bus Voltage	V_{DC}	340		340	
Mechanical Specifications					
Coil Weight	kg (lb)	1.10 (2.42)		1.70 (3.74)	
Coil Length	mm (in)	264.2 (10.40)		386.1 (15.20)	
Heat Sink	mm (in)	300x300x13 (12x12x0.5)		400x400x13 (16x16x0.5)	
Magnet Track Weight	kg/m (lb/ft)	4.70 (3.15)		4.70 (3.15)	
Magnetic Pole Pitch	mm (in)	30.00 (1.18)		30.00 (1.18)	

1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature
2. Values shown @ 100°C rise above a 25°C ambient temperature, with motor mounted to the specified aluminum heat sink.
3. Peak force assumes correct rms current; consult Aerotech.
4. Force constant and motor constant specified at stall
5. All performance and electrical specifications ±10%
6. Maximum winding temperature is 125°C.
7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures
8. All Aerotech amplifiers are rated Apk; use force constant in N·m/Apk when sizing.

Table 1-4: BLMFS Forcer Models (BLMFS-81, BLMFS-142, BLMFS-264)

		BLMFS-81		BLMFS-142		BLMFS-264	
Performance Specifications (1) (5)							
Continuous Force, No Forced Cooling (2)	N (lb)	34.0 (7.6)		58.3 (13.1)		117.8 (26.5)	
Peak Force (3)	N (lb)	136.0 (30.6)		233.1 (52.4)		471.3 (106.0)	
Attraction Force	N (lb)	197 (44)		341 (77)		628 (141)	
Electrical Specifications(5)							
Winding Designation	A / B	-A	-B	-A	-B	-A	-B
BEMF Constant (line-line, max)	V/(m/s) (V/(in/s))	13.02 (0.33)	6.51 (0.17)	24.81 (0.63)	12.40 (0.32)	26.05 (0.66)	52.10 (1.32)
Continuous Current, No Forced Cooling (2)	A_{pk} (A_{rms})	3.00 (2.12)	6.00 (4.24)	2.70 (1.91)	5.40 (3.82)	5.20 (3.68)	2.60 (1.84)
Peak Current, Stall (3)	A_{pk} (A_{rms})	12.00 (8.49)	24.00 (16.97)	10.80 (7.64)	21.60 (15.27)	20.80 (14.71)	10.40 (7.35)
Force Constant, Sine Drive (4) (8)	N/A_{pk} (lb/A_{pk})	11.35 (2.55)	5.67 (1.27)	21.58 (4.85)	10.79 (2.43)	22.66 (5.09)	45.32 (10.19)
	N/A_{rms} (lb/A_{rms})	16.02 (3.60)	8.01 (1.80)	30.52 (6.86)	15.26 (3.43)	32.05 (7.20)	64.09 (14.41)
Motor Constant (2) (4)	$N/\sqrt{W}$ ($lb/\sqrt{W}$)	4.71 (1.06)		6.38 (1.43)		9.61 (2.16)	
Resistance, 25°C (line-line)	Ω	5.5	1.4	10.9	2.7	5.3	21.2
Inductance (line-line)	mH	4.50	1.13	10.40	2.60	5.70	22.80
Thermal Resistance, No Cooling	°C/W	1.92		1.20		0.66	
Maximum Bus Voltage	V_{DC}	340		340		340	
Mechanical Specifications							
Coil Weight	kg (lb)	0.60 (1.32)		1.02 (2.24)		1.90 (4.18)	
Coil Length	mm (in)	81.0 (3.19)		142.2 (5.60)		264.2 (10.40)	
Heat Sink	mm (in)	100x100x13 (4x4x0.5)		150x150x13 (6x6x0.5)		300x300x13 (12x12x0.5)	
Magnet Track Weight	kg/m (lb/ft)	4.70 (3.15)		4.70 (3.15)		4.70 (3.15)	
Magnetic Pole Pitch	mm (in)	30.00 (1.18)		30.00 (1.18)		30.00 (1.18)	

1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature
2. Values shown @ 100°C rise above a 25°C ambient temperature, with motor mounted to the specified aluminum heat sink.
3. Peak force assumes correct rms current; consult Aerotech.
4. Force constant and motor constant specified at stall
5. All performance and electrical specifications ±10%
6. Maximum winding temperature is 125°C.
7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures
8. All Aerotech amplifiers are rated Apk; use force constant in N·m/Apk when sizing.

Table 1-5: BLMFS Forcer Models (BLMFS-325, BLMFS-386)

		BLMFS-325		BLMFS-386	
Performance Specifications (1) (5)					
Continuous Force, No Forced Cooling (2)	N (lb)	163.2 (36.7)		193.4 (43.5)	
Peak Force (3)	N (lb)	652.6 (146.7)		773.5 (173.9)	
Attraction Force	N (lb)	787 (177)		925 (208)	
Electrical Specifications(5)					
Winding Designation	A / B	-A	-B	-A	-B
BEMF Constant (line-line, max)	V/(m/s) (V/(in/s))	33.49 (0.85)	66.98 (1.70)	39.69 (1.01)	79.39 (2.02)
Continuous Current, No Forced Cooling (2)	A_{pk} (A_{rms})	5.60 (3.96)	2.80 (1.98)	5.60 (3.96)	2.80 (1.98)
Peak Current, Stall (3)	A_{pk} (A_{rms})	22.40 (15.84)	11.20 (7.92)	22.40 (15.84)	11.20 (7.92)
Force Constant, Sine Drive (4) (8)	N/A_{pk} (lb/A_{pk})	29.14 (6.55)	58.27 (13.10)	34.53 (7.76)	69.06 (15.53)
	N/A_{rms} (lb/A_{rms})	41.20 (9.26)	82.41 (18.53)	48.83 (10.98)	97.67 (21.96)
Motor Constant (2) (4)	$N/\sqrt{W}$ ($lb/\sqrt{W}$)	11.15 (2.51)	11.15 (2.51)	11.91 (2.68)	11.91 (2.68)
Resistance, 25°C (line-line)	Ω	6.5	26.0	8.0	32.0
Inductance (line-line)	mH	7.40	29.60	8.75	35.00
Thermal Resistance, No Cooling	°C/W	0.47	0.47	0.38	0.38
Maximum Bus Voltage	V_{DC}	340	340	340	340
Mechanical Specifications					
Coil Weight	kg (lb)	2.31 (5.08)		2.76 (6.07)	
Coil Length	mm (in)	325.1 (12.80)		386.1 (15.20)	
Heat Sink	mm (in)	350x350x13 (14x14x0.5)		400x400x13 (16x16x0.5)	
Magnet Track Weight	kg/m (lb/ft)	4.70 (3.15)		4.70 (3.15)	
Magnetic Pole Pitch	mm (in)	30.00 (1.18)		30.00 (1.18)	

1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature
2. Values shown @ 100°C rise above a 25°C ambient temperature, with motor mounted to the specified aluminum heat sink.
3. Peak force assumes correct rms current; consult Aerotech.
4. Force constant and motor constant specified at stall
5. All performance and electrical specifications ±10%
6. Maximum winding temperature is 125°C.
7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures
8. All Aerotech amplifiers are rated Apk; use force constant in N·m/Apk when sizing.

Table 1-6: BLMFS5 Forcer Models (BLMFS5-142, BLMFS5-262, BLMFS5-382)

		BLMFS5-142		BLMFS5-262		BLMFS5-382	
Performance Specifications (1) (5)							
Continuous Force, Water Cooling (2,6)	N (lb)	323.4 (72.7)		522.3 (117.4)		697.1 (156.7)	
Continuous Force, No Cooling (2)	N (lb)	174.8 (39.3)		282.3 (63.5)		376.8 (84.7)	
Peak Force (3)	N (lb)	699.3 (157.2)		1129.2 (253.9)		1507.2 (338.8)	
Cogging Force	N (lb)	57.8 (13.0)		62.3 (14.0)		67.2 (15.1)	
Attraction Force	N (lb)	2410 (542)		4446 (1000)		6482 (1457)	
Electrical Specifications(5)							
Winding Designation	A / B	-A	-B	-A	-B	-A	-B
BEMF Constant (line-line, max)	V/(m/s) (V/(in/s))	21.99 (0.56)	43.97 (1.12)	21.99 (0.56)	43.97 (1.12)	21.99 (0.56)	43.97 (1.12)
Continuous Current, Water Cooling (2,6)	A_{pk} (A_{rms})	16.91 (11.96)	8.45 (5.98)	27.31 (19.31)	13.65 (9.65)	36.45 (25.77)	18.22 (12.89)
Continuous Current, No Forced Cooling (2)	A_{pk} (A_{rms})	9.14 (6.46)	4.57 (3.23)	14.76 (10.44)	7.38 (5.22)	19.70 (13.93)	9.85 (6.97)
Peak Current, Stall (3)	A_{pk} (A_{rms})	36.56 (25.85)	18.28 (12.93)	59.04 (41.75)	29.52 (20.87)	78.80 (55.72)	39.40 (27.86)
Force Constant, Sine Drive (4,8)	N/A_{pk} (lb/A_{pk})	19.13 (4.30)	38.25 (8.60)	19.13 (4.30)	38.25 (8.60)	19.13 (4.30)	38.25 (8.60)
	N/A_{rms} (lb/A_{rms})	27.05 (6.08)	54.10 (12.16)	27.05 (6.08)	54.10 (12.16)	27.05 (6.08)	54.10 (12.16)
Motor Constant (2,4)	N/√W (lb/√W)	14.40 (3.24)	14.40 (3.24)	20.37 (4.58)	20.37 (4.58)	24.94 (5.61)	24.94 (5.61)
Resistance, 25°C (line-line)	Ω	1.7	6.7	0.8	3.4	0.6	2.2
Inductance (line-line)	mH	9.90	39.60	4.95	19.80	3.30	13.20
Thermal Resistance, Water Cooling	°C/W	0.20	0.20	0.15	0.15	0.13	0.13
Thermal Resistance, No Cooling(4)	°C/W	0.68	0.68	0.52	0.52	0.44	0.44
Maximum Bus Voltage	V_{DC}	340	340	340	340	340	340
Mechanical Specifications							
Coil Weight	kg (lb)	1.42 (3.12)		2.31 (5.08)		3.81 (8.38)	
Coil Length	mm (in)	142.0 (5.59)		262.0 (10.31)		382.0 (15.04)	
Heat Sink	mm (in)	380x380x13 (15x15x0.5)		380x380x13 (15x15x0.5)		380x380x13 (15x15x0.5)	
Magnet Track Weight	kg/m (lb/ft)	4.2 (2.82)		4.2 (2.82)		4.2 (2.82)	
Magnetic Pole Pitch	mm (in)	30.00 (1.18)		30.00 (1.18)		30.00 (1.18)	

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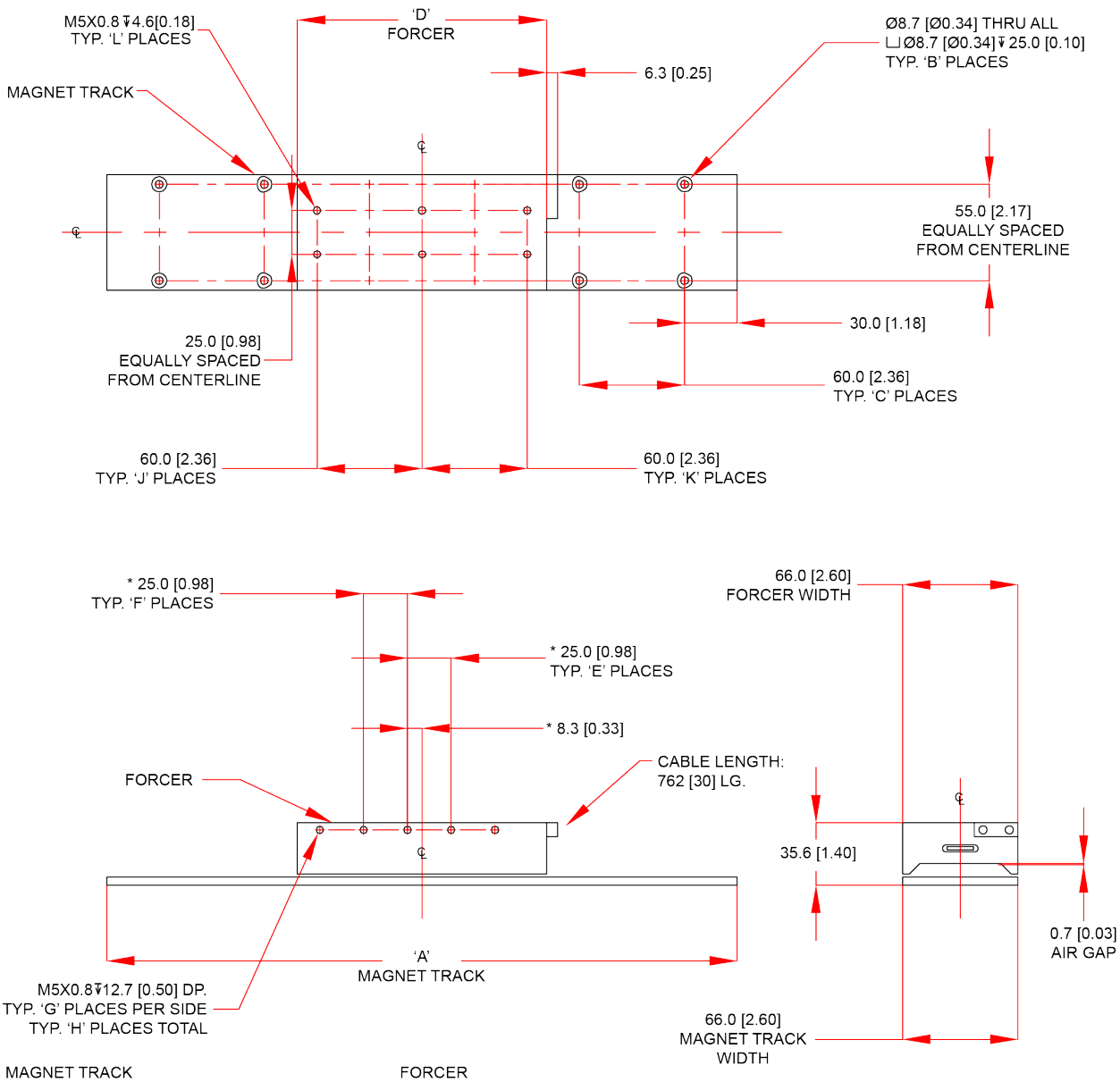
3. Peak force assumes correct rms current; consult Aerotech.
4. Force constant and motor constant specified at stall
5. All performance and electrical specifications ±10%
6. Maximum winding temperature is 125°C.
7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures
8. All Aerotech amplifiers are rated Apk; use force constant in N·m/Apk when sizing.

1.2. Dimensions

NOTE: All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. The most recent system drawings and schematics can be found on your software DVD or on www.aerotech.com.



MAGNET TRACK

MODEL NO.	A	B	C
MTF240P	240 [9.45]	8	3
MTF300P	300 [11.81]	10	4
MTF360P	360 [14.17]	12	5
MTF480P	480 [18.90]	16	7
MTF540P	540 [21.26]	18	8

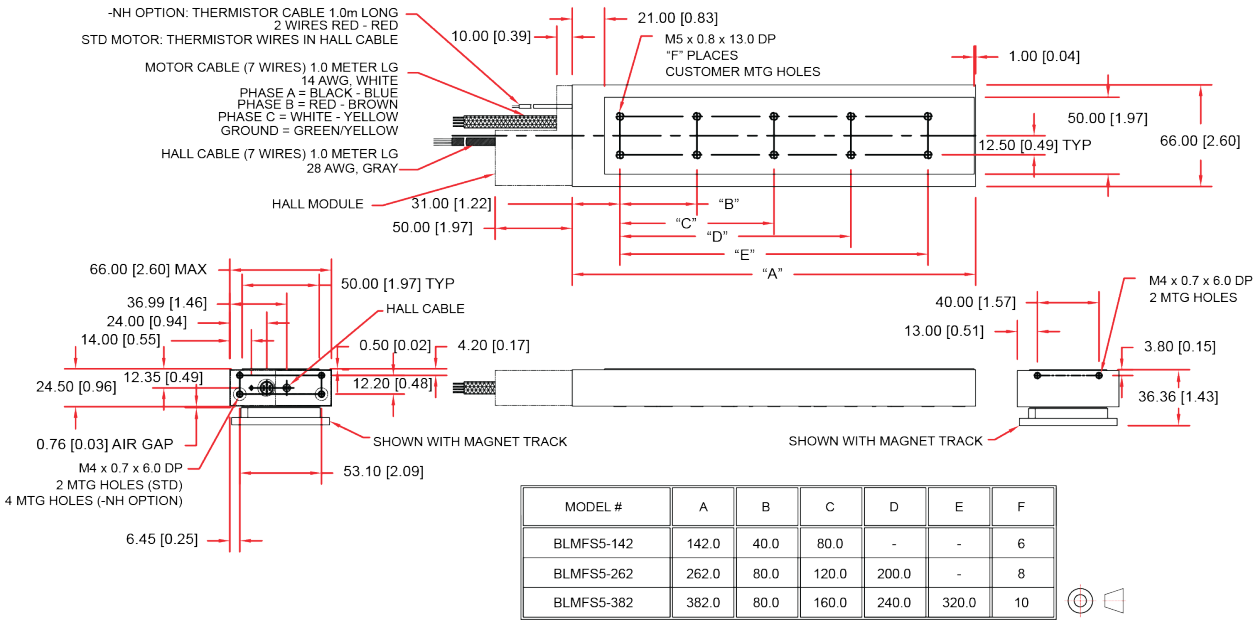
DIMENSIONS - MILLIMETERS [INCHES]

FORCER

MODEL NO.	D	E	F	G	H	J	K	L
BLMF-81	81 [3.19]	1	1	2	4	1	1	4
BLMF-142	142 [5.59]	2	2	5	10	1	1	6
BLMF-264	264 [10.39]	4	4	9	16	2	2	10
BLMF-325	325 [12.80]	5	5	11	22	2	2	10
BLMF-386	386 [15.20]	7	7	15	30	3	3	14

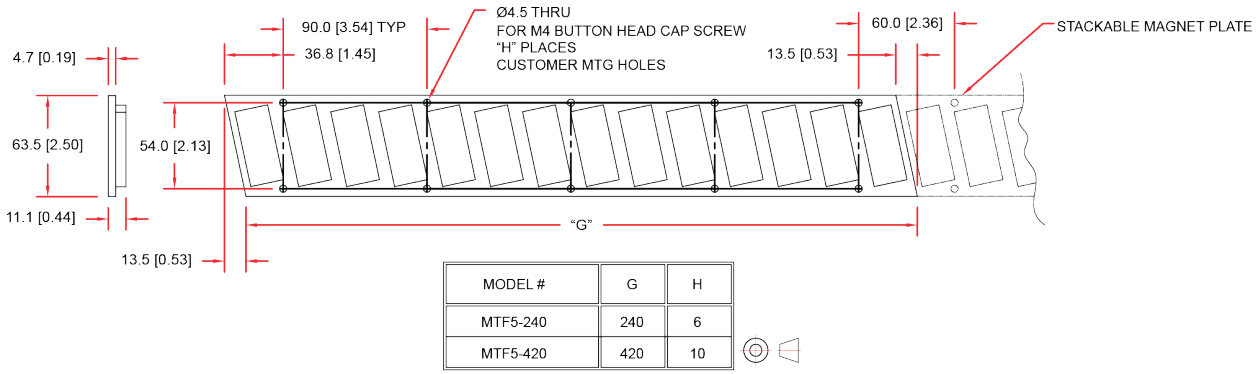
* DIMENSIONS DO NOT APPLY TO BLMF-81
CONSULT AEROTECH INC.

Figure 1-1: BLMFS/BLMFI Model Dimensions



MODEL #	A	B	C	D	E	F
BLMFS5-142	142.0	40.0	80.0	-	-	6
BLMFS5-262	262.0	80.0	120.0	200.0	-	8
BLMFS5-382	382.0	80.0	160.0	240.0	320.0	10

Figure 1-2: BLMFS5 Model Dimensions



MODEL #	G	H
MTF5-240	240	6
MTF5-420	420	10

Figure 1-3: BLMFS5 Mounting Track (MTF5) Dimensions

1.3. Environmental Specifications

The environmental specifications for the BLMF motors are listed in the following table.

Table 1-7: Environmental Specifications

Ambient Temperature	Operating: 0° to 25° C (32° to 77° F) Contact Aerotech for information regarding your specific application and environment.
	Storage: -10° to 85° C (14° to 185° F) in original shipping packaging
Humidity	Operating: 20% to 60% RH
	Storage: 10% to 70% RH, non-condensing in original packaging
	Ambient conditions need to be such that condensation on the motor does not occur. The motors are not to be used in wash-down environments.
Altitude	Operating: 0 m to 1,000 m (0 ft to 3280 ft) above sea level Contact Aerotech if your specific application involves use above 1000 m or below sea level.
Atmosphere	Not to be used in a hydrogen atmosphere.
Use	Indoor use only

WARNING: Do not expose this product to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.

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Chapter 2: Assembly and Installation

The linear motor can be configured in two different ways. The magnet track can be held stationary while the forcer moves or the forcer can be held stationary while the magnet track moves.

DANGER: Strong rare-earth magnets are present in the linear motor magnet track. Loose metal objects (tools, watches, keys, etc.) may cause personal injury and/or damage to the equipment.

DANGER: Use extreme caution when mounting the BLMFS or BLMFS5 forcer. The forcer will clamp to the track with extreme force if allowed to do so. Attach the forcer rigidly in its mounting position working away from the track not above it. The forcer and track have to be rigidly mounted before allowing the forcer to move into position over the track.

WARNING: Devices need to be in place so that intentional or unintentional disruption of electrical power doesn't result in unexpected motion. The motion could possibly result in bodily injury or damage to equipment. This is especially important in vertical applications where the use of a fail-safe brake needs to be incorporated in the event of a power disruption.

2.1. Bearing System

The flat linear motor arrangement and load must be supported by a linear bearing system. The bearing system must be capable of supporting the forcer, the load, and, in the case of using BLMFS and BLMFS5 forcers, a considerable magnetic attractive force between the forcer and the magnet track.

2.2. Straightness and Flatness Requirements

Straightness and flatness tolerances are deviations from a straight line in two dimensions. There are two separate alignment tolerances: straightness (side-to-side), and flatness (air gap) of the motor that need to be maintained over the length of travel. Mounting surface flatness has to be held to specific tolerances to maintain desirable motor performance.

Straightness

The forcer may deviate left or right ±0.030 in (±0.76 mm) from the magnet track center line during motion (refer to Figure 2-1). Generally, the BLMF motor operates regardless of straightness provided the forcer does not contact the magnet track during motion.

Flatness

The nominal air gap between the forcer and magnet track surfaces is 0.030 in (0.76 mm). The air gap has a tolerance specification of +0.010 in / -0.000 in (+0.25 mm / -0.00 mm). Larger gaps result in a decrease of output force from the motor. Smaller gaps result in a significantly increased magnetic attractive force of the forcer to the track.

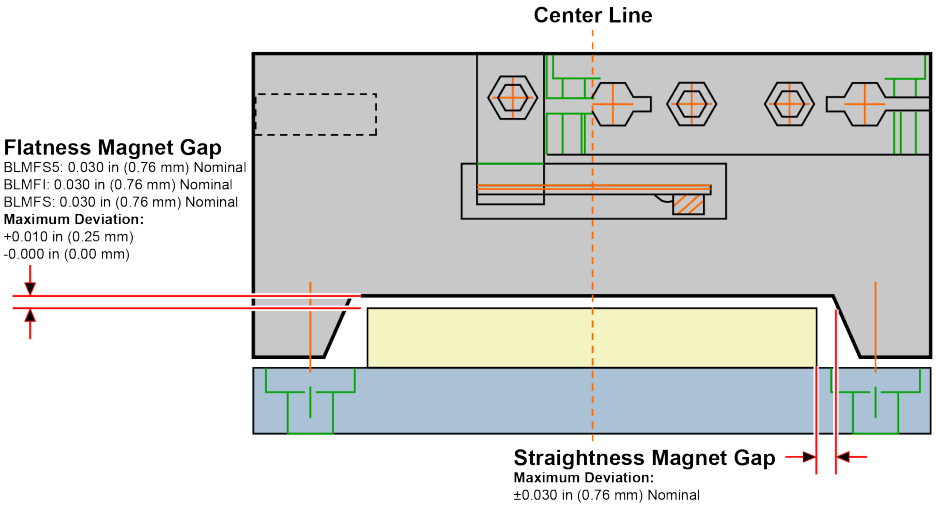


Figure 2-1: BLMF Straightness and Flatness Tolerances

2.3. Mechanical Arrangement of the Magnet Track

The track can be mounted in a horizontal or vertical orientation. In addition, the track can be the stationary or moving part of the machine. With the forcer stationary and the magnet track moving, the load generally increases but the cable management system is simplified. A stationary forcer usually allows for increased heat transfer from the forcer.

2.4. Track Stacking

To increase the linear motor travel distance, magnet tracks can be stacked end-to-end as shown in Figure 2-2.

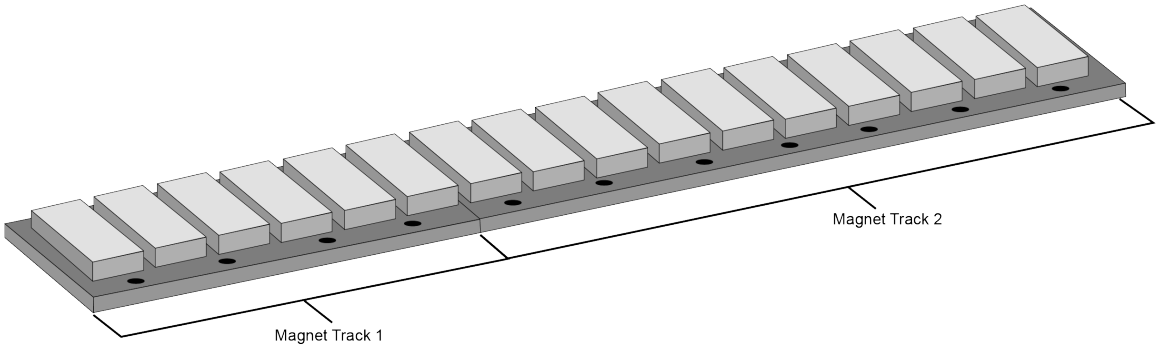


Figure 2-2: Stacking Tracks

2.5. Position Transducer Resolution

The motion controller requires the use of a position transducer for all forms of motion control. This is typically a linear encoder. The specific application determines the encoder resolution.

2.6. Cable Management

A high-flex cable management system must be used to connect the forcer and feedback signals to the stationary motion controller. The cable that exits the BLMF forcer is not a high-flex type, therefore it must terminate before entering the cable management system (refer to Figure 2-3). Termination of the forcer and encoder cable is in most cases through a D-shell connector. A mating D-shell connector serves as the termination point of the high-flex cable in the cable management track.

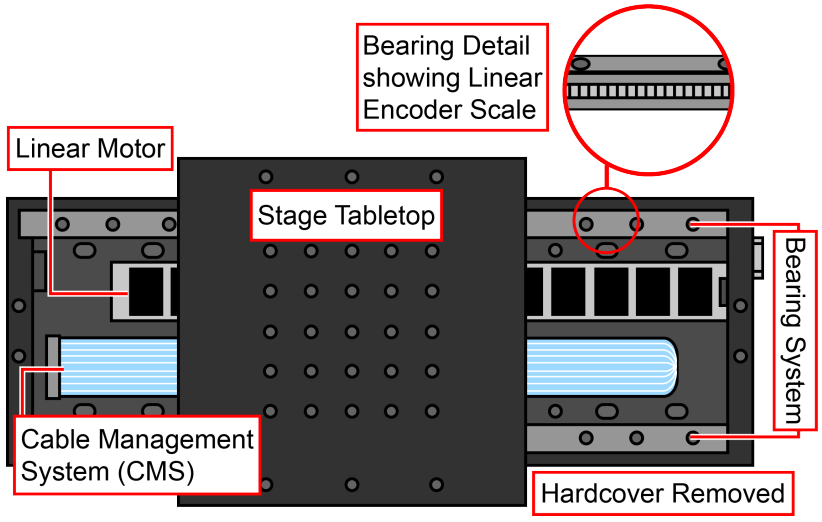


Figure 2-3: Linear Motor with Tape Scale Encoder and Cable Management

2.7. Motor Wiring

The forcer is supplied with flying leads for the motor winding, Hall effect devices, and thermal overload sensor. The customer supplies all external wiring to interface with these devices. This supplied wiring must meet certain requirements to provide for safe and reliable operation.

The wiring must be able to supply the rated current without overheating. The wire insulation must be rated for the voltage and temperature at which the motor is operating. And, efforts must also be made to reduce EMI emissions and to increase EMI immunity through proper cable selection and installation. In addition to supplying the external wiring, the customer is also responsible for providing over-current protection for the motor.

Guidelines are given in the following sections to help with the selection and installation of the wiring.

Table 2-1: Cable Diameter and Wire Gauge

Motor Series	Motor			Feedback		
	Cable Diameter mm [in]	Wire Gauge AWG [mm^2]	Cable P/N	Cable Diameter mm [in]	Wire Gauge AWG [mm^2]	Cable P/N
BLMFS	0.178	24	MCX01001	0.171	28	MCX00202
BLMFI	0.178	24	MCX01001	0.171	28	MCX00202
BLMFS5	0.340	14	ECX00155	0.171	28	MCX00202

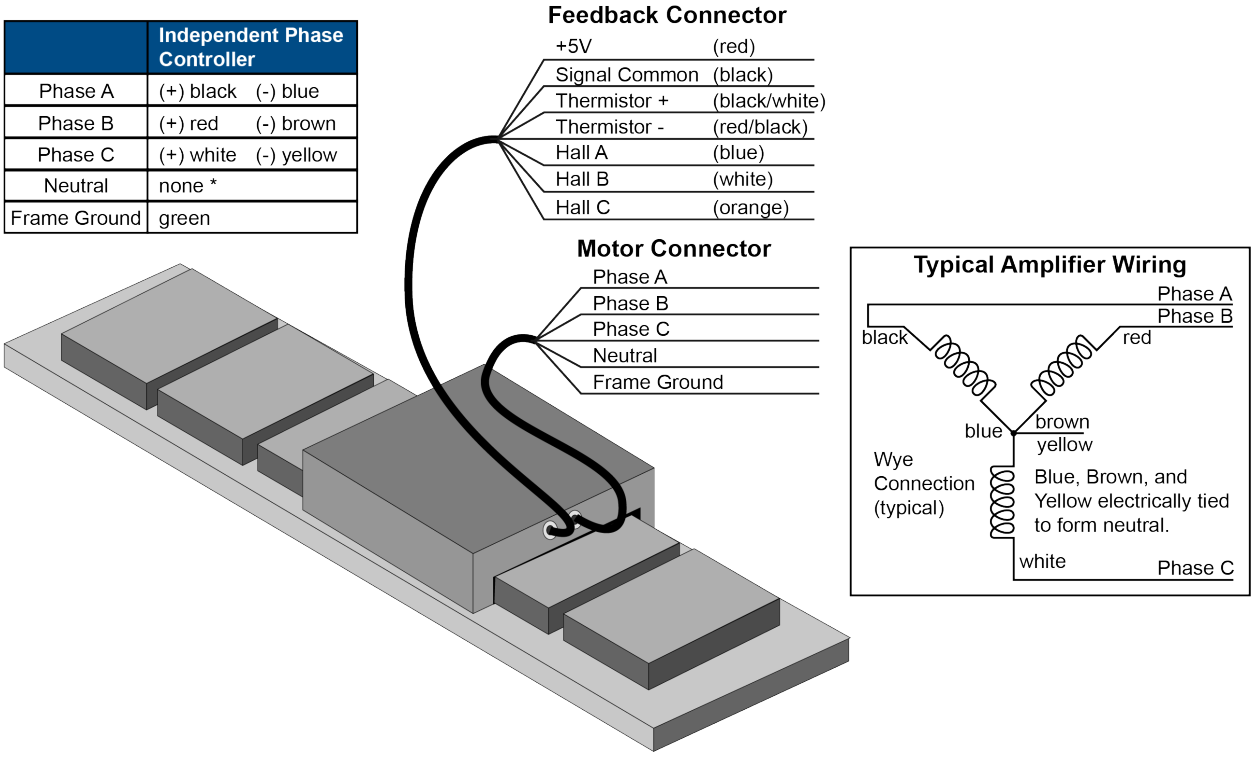


Figure 2-4: Wiring Overview

2.7.1. Motor Power Conductors

The motor power conductors must be sized to handle the electrical current requirements of the motor. The motor data sheets list the required values for the various motors. The wire insulation voltage rating is chosen based on the maximum voltage that will be applied to the motor.

2.7.2. Protective Ground

The protective ground is a safety conductor used to ground the motor case. The protective ground conductor must have a current carrying capacity at least equal to that of the motor wires. The insulation is standard Green/Yellow and must be rated for the maximum voltage applied to the motor winding. The protective ground wire is usually bundled along with the motor wires, but system requirements may be that a separate protective ground wire is needed.

2.7.3. Over-Current Protection

Motors need to be provided with over-current protection to prevent motor over-heating. Over-current protection can be accomplished using programmable current limits, traps, over current protection circuitry, or fusing. Fuse values should be selected according to the RMS current rating of the motor. For most applications slow-blow type fuses should be used.

When the motor is part of an Aerotech system using an Aerotech controller and drive, the "Amp_{pk}" continuous current rating of the motor must be used to set the motor over-current protection fault. If the motor is being installed in a system not configured by Aerotech the customer is responsible for providing the necessary over current protection.

2.7.4. Hall-Effect Device and Thermistor Wiring

The insulation of these wires should have a rating for at least the maximum voltage applied to the motor winding. The temperature rating of the wire insulation must also be sufficiently high to withstand the operating temperatures specific to the application.

2.7.5. Wiring Guidelines

The wiring guidelines given below can help to reduce EMI related problems which can result in poor overall system performance.

- Keep cable lengths as short as possible. Long cable runs are more susceptible to EMI pickup than short runs.
- Use grounded shielded cables for both the motor power and signal wiring
- The use of twisted pair shielded cabling can help reduce magnetically induced currents.
- Braided shield has a slightly better low frequency shielding capability than a foil shield. Foil is often used where RF shielding is necessary.
- Do not bundle signal, motor power cables, or ac power lines within the same protective shield or conduit. Rather use separate protective shields or conduits.
- Do not introduce multiple paths to ground from a grounding point. Multiple paths to ground can create ground loops within the system.
- The use of EMI suppression devices may be necessary where the EMI environment warrants their use.

2.7.6. Thermal Protective Device

BLMF motors incorporate a positive-temperature coefficient (PTC) thermistor as a thermal protection device. The nominal resistance of the thermistor is 100 ohms at 25°C. The thermistor exhibits a rapid increase in resistance to 1,000 ohms as the motor temperature approaches the thermistor's transition temperature of 100°C.

WARNING: The thermal protective device used in the motor must be incorporated in an external shutdown circuit to provide protection to the motor.

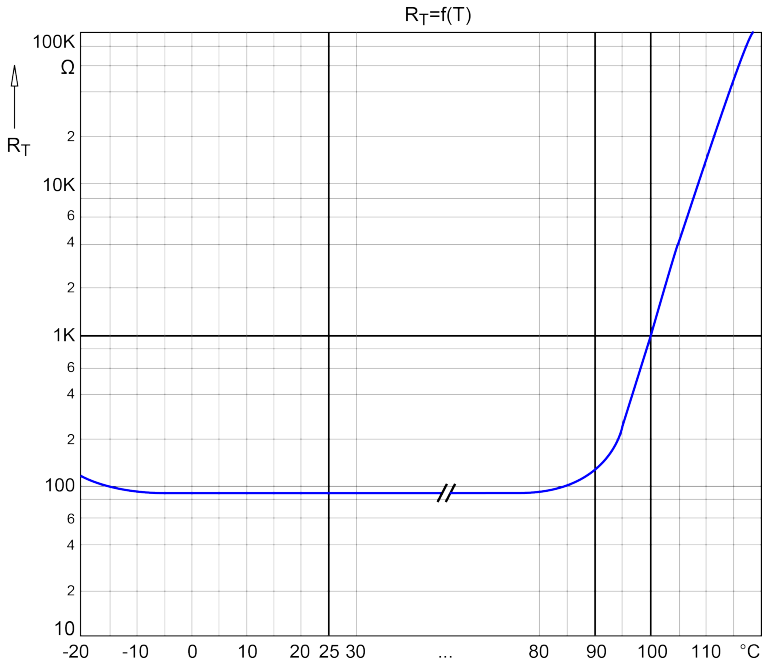


Figure 2-5: Thermal Sensor Resistance as a Function of Temperature

This thermistor can be used in a variety of different electronic interfaces. A precaution when using this type of device in an interface circuit is to avoid self-heating effects. An excessive amount of current through the thermistor will cause its temperature to rise and a false triggering will occur.

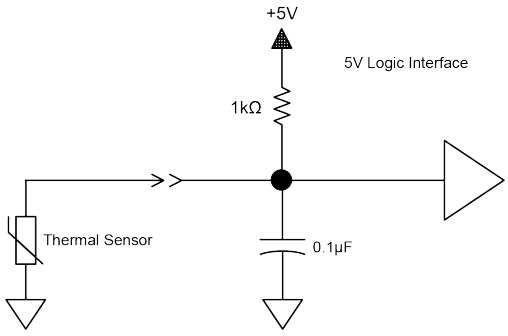
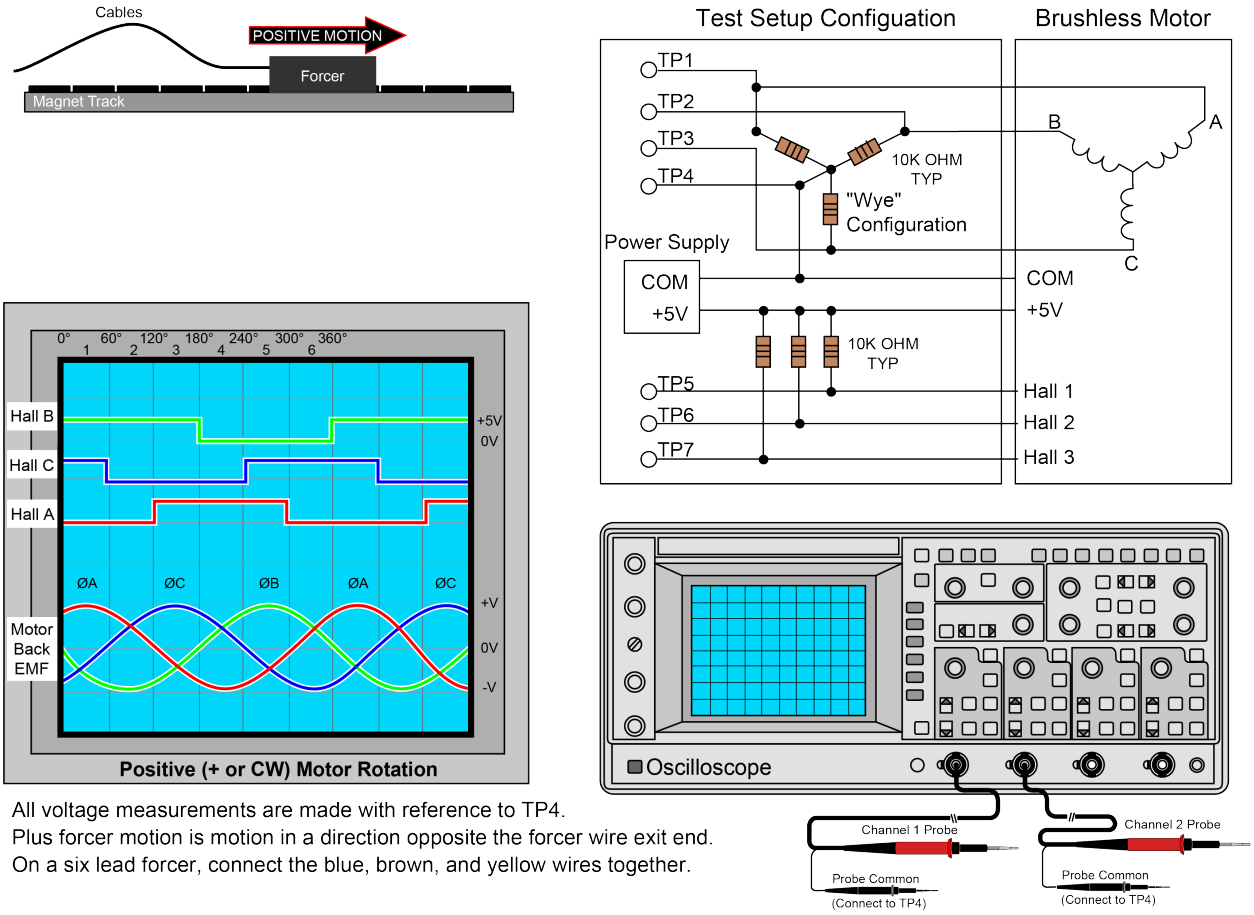


Figure 2-6: Typical Thermistor Interface Circuit

2.8. Hall-Effect Operation and Motor Phasing

In linear servomotors, one popular method of commutation is with Hall-effect sensors. They sense the presence of a magnetic field and provide an output as a function of the forcer position. Aerotech linear motor Hall sensors provide a unique set of Hall sensor outputs every sixty electrical degrees. Therefore the forcer position can be resolved to any of six segments over 360 electrical degrees. The Hall sensors used in the linear motors have an open collector output. Figure 2-7 shows the motor BEMF versus Hall signal relationship if observed.



All voltage measurements are made with reference to TP4.
Plus forcer motion is motion in a direction opposite the forcer wire exit end.
On a six lead forcer, connect the blue, brown, and yellow wires together.

Figure 2-7: Linear Motor Phasing

2.9. Motor Heating

The motor's temperature rise above ambient establishes a limit on the amount of force producing current allowed through the motor winding. The thermal characteristics of the motor, the effectiveness of the surrounding medium to transfer heat away from the motor, and any supplemental cooling determine the operating conditions.

The motor specification tables give the continuous motor current that will result in a predetermined temperature rise of the motor. This temperature rise is based on a single set of operating conditions as noted on the motor specifications. The use of supplemental cooling allows for increases in continuous motor current and therefore increased force.

The motor's thermal limit will not be exceeded so long as the minimum environmental and thermal conditions exist. Poor heat transfer away from the motor, excessive loading, elevated ambient temperatures, etc. are conditions that will cause excessive motor heating and failure. The importance of motor overload and thermal protection devices as described in previous sections becomes apparent.

2.10. Maintenance

Regular preventative maintenance should include but is not limited to the following: make frequent checks for excessive or abnormal motor heating, excessive motor vibrations, loose motor to machine couplers, obstructed air flow to the motor, burning smells, an accumulation of debris on the motor, etc.

Motors should be wiped with a clean dry cloth to remove any grease, dirt, or other material that has accumulated on the motor. Fluids and sprays are not recommended for chance of internal motor contamination. Cleaning the motor labels should be avoided to prevent their removal.

Non-ferrous tools should be used when working around the magnet track.

DANGER: Do not attempt to disassemble the magnet track for cleaning or any other reason since this can result in serious injury.

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Appendix A: Warranty and Field Service

Aerotech, Inc. warrants its products to be free from harmful defects caused by faulty materials or poor workmanship for a minimum period of one year from date of shipment from Aerotech. Aerotech's liability is limited to replacing, repairing or issuing credit, at its option, for any products that are returned by the original purchaser during the warranty period. Aerotech makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, whether or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability on any claim for loss or damage arising out of the sale, resale, or use of any of its products shall in no event exceed the selling price of the unit.

THE EXPRESS WARRANTY SET FORTH HEREIN IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE. IN NO EVENT SHALL AEROTECH BE LIABLE FOR CONSEQUENTIAL OR SPECIAL DAMAGES.

Return Products Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within thirty (30) days of shipment of incorrect material. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. A "Return Materials Authorization (RMA)" number must accompany any returned product(s). The RMA number may be obtained by calling an Aerotech service center or by submitting the appropriate request available on our website (www.aerotech.com). Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than thirty (30) days after the issuance of a return authorization number will be subject to review.

Visit https://www.aerotech.com/global-technical-support.aspx for the location of your nearest Aerotech Service center.

Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warranted defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an expedited method of return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

Fixed Fee Repairs - Products having fixed-fee pricing will require a valid purchase order or credit card particulars before any service work can begin.

All Other Repairs - After Aerotech's evaluation, the buyer shall be notified of the repair cost. At such time the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within thirty (30) days of notification will result in the product(s) being returned as is, at the buyer's expense.

Repair work is warranted for ninety (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

On-site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty-related, then the following policy applies:

Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special rates apply.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following “On-Site Non-Warranty Repair” section apply.

On-site Non-Warranty Repair

If any Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies:

Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.

Service Locations

http://www.aerotech.com/contact-sales.aspx?mapState=showMap

USA, CANADA, MEXICO	CHINA	GERMANY
Aerotech, Inc. Global Headquarters Phone: +1-412-967-6440 Fax: +1-412-967-6870	Aerotech China Full-Service Subsidiary Phone: +86 (21) 3319 7715	Aerotech Germany Full-Service Subsidiary Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720

JAPAN	TAIWAN	UNITED KINGDOM
Aerotech Japan Full-Service Subsidiary Phone: +81 (0)50 5830 6814 Fax: +81 (0)43 306 3773	Aerotech Taiwan Full-Service Subsidiary Phone: +886 (0)2 8751 6690	Aerotech United Kingdom Full-Service Subsidiary Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649

Have your customer order number ready before calling.

Appendix B: Revision History

Revision	Description
2.01.00	• Manual reorganization • Added Declaration of Incorporation: EU Declaration of Conformity • Updated Safety Procedures and Warnings • Updated Model Options: Table 1-1 • Updated Basic Specifications: Section 1.1. • Updated Dimensions: Section 1.2. • Updated Flatness specifications: Section 2.2. • Updated Motor Wiring specifications: Section 2.7. • Updated Thermal Protective Device section: Section 2.7.6.
2.00.00	• Complete manual revision • Motor Specifications updated • Motor dimension drawings updated • Ordering / Part Numbers updated
1.02	N/A
1.01	N/A
1.00	New Manual

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