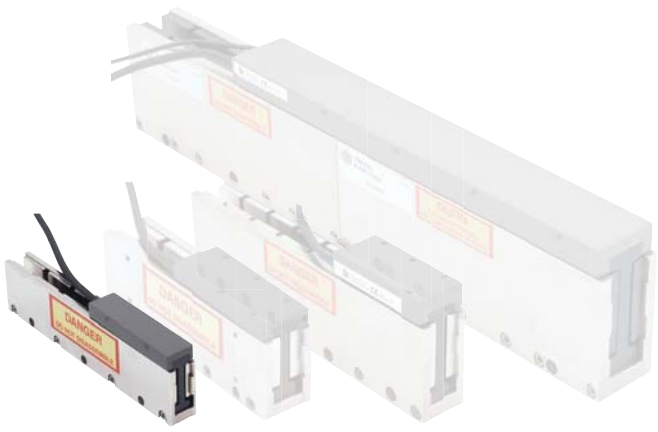


I-FORCE Ironless Linear Motors

Catalog USA

Parker

TRILOGY LINEAR MOTORS

TABLE OF CONTENTS

110 Ironless Linear Motor
- Specifications 1
- Dimensions 2, 3
- Wiring 4

210 Ironless Linear Motor
- Specifications 5
- Dimensions 6, 7
- Wiring 8

310 Ironless Linear Motor
- Specifications 9
- Dimensions 10, 11
- Wiring 12

410 Ironless Linear Motor
- Specifications 13
- Dimensions 14, 15
- Wiring 16

How to order 18

I-FORCE Ironless linear motors

Parker Trilogy's I-Force ironless linear motors offer high forces and rapid accelerations in a compact package. With forces ranging from 5.5 lbf (24.5 N) continuous up to 883 lbf (3928 N) peak, the I-Force family offers a superior combination of performance and size.

The I-Force patented I-beam shape with its overlapping windings allows for a higher power density in a smaller motor, improved heat removal, and added structural stiffness. In addition, the ironless (or air core) linear motor design has no attractive force toward the magnets. This allows for easy installation and zero cogging during motion.

Ultra high-flex cables come standard with I-Force motors. In addition, we offer modular magnet tracks for unrestricted travel length. Incredibly smooth motion, high precision and high force density make the I-Force linear motors an ideal solution for your demanding positioning requirements.

Overlapping Windings:
- Increased force density
- Improved heat dissipation
- Lower temperature rise
- Smaller, less expensive motor

No attractive force toward the magnets:
- Easier/Safer assembly and handling, smoother travel (no cogging)

Uses thermally conductive epoxy together with the windings (Patented RE34674):
- Better heat dissipation

Vacuum encapsulation process:
- Allows motors to be used in high-vacuum environments (Rated at 10^-6 torr, currently used in 10^-7 torr applications)

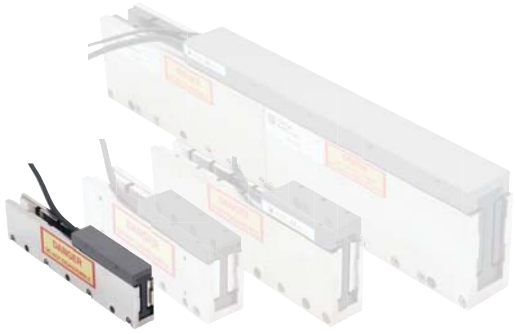
Modular magnet track:
- Unrestricted travel length

Embedded overtemp thermostat or optional thermistor:
- Protects windings against overheating

Ultra high-flex cables:
- Longer cable life, good for millions of cycles

I-Force Ironless Linear Motors

110 Specifications



I FORCE

- Ironless motor, patented, RE34674
- Cross-section: 2.05”H (50mm) x 0.82”W (21mm)
- Peak forces in two sizes to 45lbs (200N), continuous forces to 10lbs (44N)
- Precision ground 3-piece track (110 model) or lightweight formed and machined (115 model)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Single-piece magnet tracks to 36” length
- Prealigned imbedded digital Hall effect devices
- Internal thermal cutout switch protects coil

PERFORMANCE

MOTOR MODEL		110-1	110-2
Peak Force	N	108.5	202.5
	lb	24.4	45.5
Continuous Force	N	24.5	45.4
	lb	5.5	10.2
Peak Power	W	938	1641
Continuous Power	W	47	82

ELECTRICAL

MOTOR MODEL		110-1			110-2		
WIRING TYPE	UNITS	S-Series	P-Parallel	T-Triple	S-Series	P-Parallel	T-Triple
Peak Current	A	15.9	31.8	47.7	14.8	29.6	44.4
Continuous Current	A	3.6	7.2	10.8	3.3	6.6	9.9
Force Constant	N/A peak	6.8	3.4	2.3	13.7	6.8	4.6
	lb/A peak	1.5	0.8	0.5	3.1	1.5	1.0
Back EMF	V/m/s	7.9	3.9	2.6	15.7	7.9	5.2
	V/in/s	0.20	0.10	0.07	0.40	0.20	0.13
Resistance 25°C, phase to phase	ohms	3.8	1.0	0.4	7.6	1.9	1.0
Inductance, phase to phase	mH	1.0	0.3	0.1	2.0	0.5	0.2
Electrical Time Constant	ms	0.3	0.3	0.3	0.3	0.3	0.3
Motor Constant	N/-W	3.56	3.56	3.56	5.02	5.02	5.02
	lb/-W	0.80	0.80	0.80	1.13	1.13	1.13
Max Terminal Voltage	VDC	330	330	330	330	330	330

THERMAL

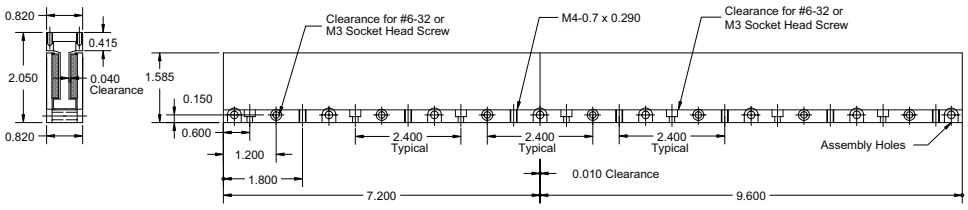
MOTOR MODEL		110-1	110-2
Thermal Dissipation Constant	W/°C	0.63	1.09
Thermal Time Constant	min	3.2	3.2
Maximum Winding Temperature	°C	100	100

MECHANICAL

MOTOR MODEL		110-1	110-2
Coil Weight	kg	0.12	0.22
	lb	0.27	0.48
Coil Length	mm	81.3	142.2
	in	3.20	5.60
Attractive Force	N	0	0
	lbf	0	0
Electrical Cycle Length	mm	60.96	60.96
	in	2.40	2.40

MODULAR 11007M 11009M

Best Value!



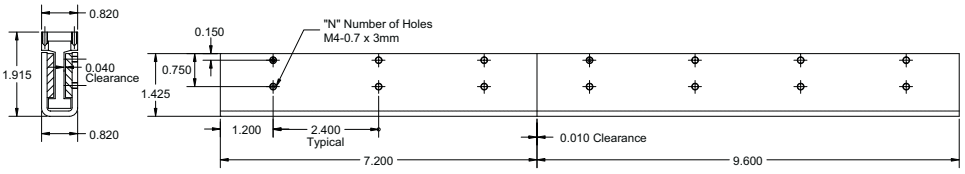
Incremental Length:
2.4in/60.96mm

Minimum Length:
2.4in/60.96mm

Maximum Length:
(For Single Piece)
36in/914.40mm

Weight/Foot:
2.66lbs/ft

MODULAR 11507M 11509M



Incremental Length:
2.4in/60.96mm

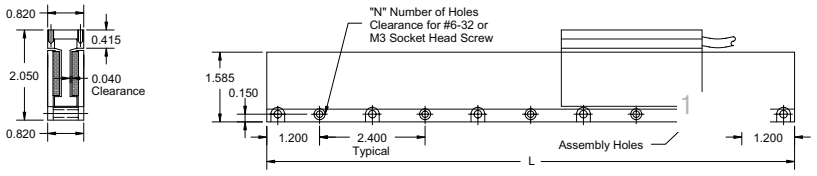
Minimum Length:
2.4in/60.96mm

Maximum Length:
(For Single Piece)
24in/609.6mm

Weight/Foot:
2.20lbs/ft

SINGLE PIECE 110xxM1

Best Value!



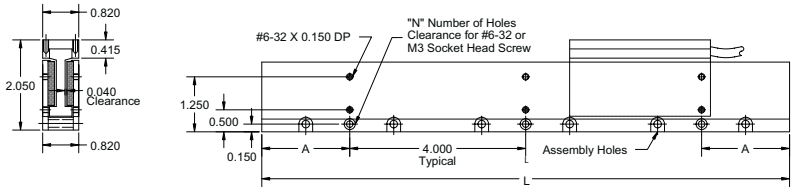
Incremental Length:
2.4in/60.96mm

Minimum Length:
2.4in/60.96mm

Maximum Length:
(For Single Piece)
36in/914.90mm

Weight/Foot:
2.66lbs/ft

SINGLE PIECE 110xxS



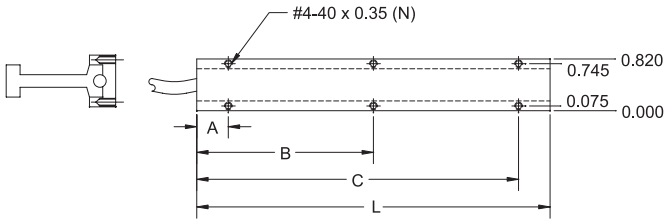
Incremental Length:
1.2in/30.48mm

Minimum Length:
8.4in/213.4mm

Maximum Length:
(For Single Piece)
36in/914.90mm

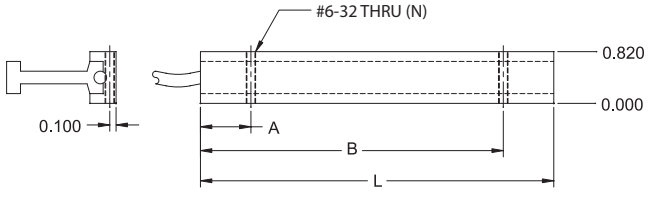
Weight/Foot:
2.66lbs/ft

(A) ENGLISH TOP MOUNTING



COIL SIZE (inches)	L	N	A	B	C
110-1A	3.20	4	0.50	2.70	---
110-2A	5.60	6	0.50	2.80	5.10

(B) ENGLISH SIDE MOUNTING



COIL SIZE (inches)	L	N	A	B
110-1B	3.20	2	0.80	2.40
110-2B	5.60	2	0.80	4.80

110 Dimensions

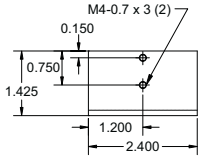
MODULAR TRACK

LENGTH In Inches	QUANTITY 11007M 11507M	QUANTITY 11009M 11509M
7.2	1	0
9.6	0	1
12.0	0	0
14.4	2	0
16.8	1	1
19.2	0	2
21.6	3	0
24.0	2	1
26.4	1	2
28.8	0	3
31.2	3	1
33.6	2	2
36.0	1	3
38.4	0	4
40.8	3	2
43.2	2	3
45.6	1	4
48.0	0	5
50.4	3	3
52.8	2	4
55.2	1	5
57.6	0	6
60.0	3	4
62.4	2	5
64.8	1	6
67.2	0	7
69.6	3	5
72.0	2	6

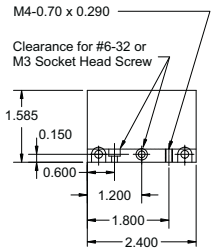
*Please note that 72.0 inches is NOT the maximum length for modular tracks.

110xxS

P/N 110xx S	L	A	N
11008 S	8.4	0.20	3
11009 S	9.6	0.80	3
11010 S	10.8	1.40	3
11012 S	12.0	2.00	3
11013 S	13.2	2.60	3
11014 S	14.4	3.20	3
11015 S	15.6	3.80	3
11016 S	16.8	0.40	5
11018 S	18.0	1.00	5
11019 S	19.2	1.60	5
11020 S	20.4	2.20	5
11021 S	21.6	2.80	5
11022 S	22.8	3.40	5
11024 S	24.0	4.00	5
11025 S	25.2	0.60	7
11026 S	26.4	1.20	7
11027 S	27.6	1.80	7
11028 S	28.8	2.40	7
11030 S	30.0	3.00	7
11031 S	31.2	3.60	7
11032 S	32.4	0.20	9
11033 S	33.6	0.80	9
11034 S	34.8	1.40	9
11036 S	36.0	2.00	9



P/N 11502 M



P/N 11002 M

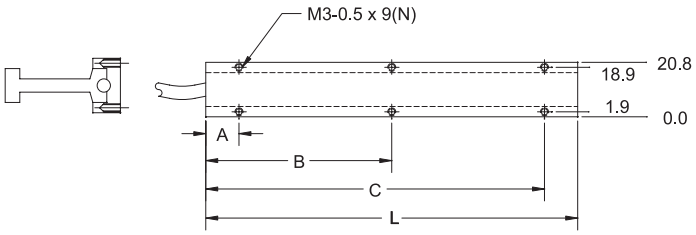
SINGLE PIECE 110xxM

P/N 110xx M	L	N
11002 M	2.4	1
11004 M	4.8	2
11007 M	7.2	3
11009 M	9.6	4
11012 M	12.0	5
11014 M	14.4	6
11016 M	16.8	7
11019 M	19.2	8
11021 M	21.6	9
11024 M	24.0	10
11026 M	26.4	11
11028 M	28.8	12
11031 M	31.2	13
11033 M	33.6	14
11036 M	36.0	15

SINGLE PIECE 115xxM

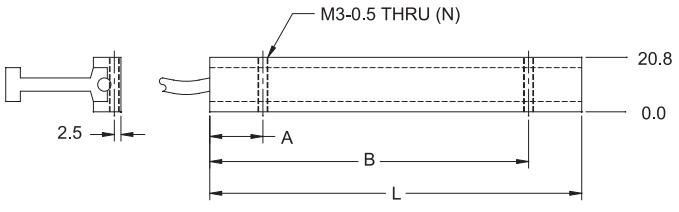
P/N 115xx M	L	N
11502 M	2.4	1
11504 M	4.8	2
11507 M	7.2	3
11509 M	9.6	4
11512 M	12.0	5
11514 M	14.4	6
11516 M	16.8	7
11519 M	19.2	8
11521 M	21.6	9
11524 M	24.0	10

(M) METRIC TOP MOUNTING



COIL SIZE (mm)	L	N	A	B	C
110-1M	81.3	4	12.7	68.6	---
110-2M	142.2	6	12.7	71.1	129.5

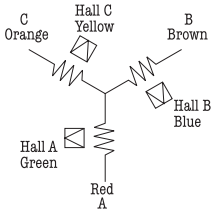
(N) METRIC SIDE MOUNTING



COIL SIZE (mm)	L	N	A	B
110-1N	81.3	2	20.3	60.9
110-2N	142.2	2	20.3	121.9

WD0

WYE wound with Thermostat
Digital Hall Effect Devices
Single Cable: THF10



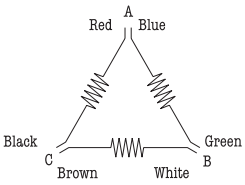
HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
I_{OUT} Continuous 15 mA

Thermostat(NC)
Opens at 90°C
Yellow(+)
Orange(-)

WD1

Delta wound with Thermistor
Single Cable: THF08



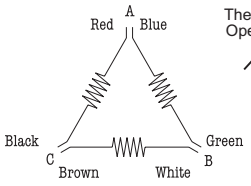
Orange
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Yellow

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Resistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

WD2

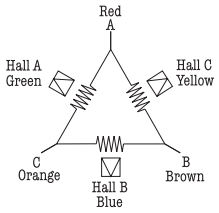
Delta wound with Thermostat
Single Cable: THF08



Thermostat(NC)
Opens at 90°C
Yellow(+)
Orange(-)

WD3

Delta wound with Thermostat
Digital Hall Effect Devices
Single Cable: THF10



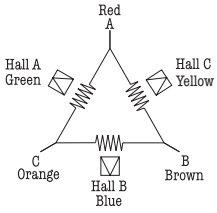
HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
I_{OUT} Continuous 15 mA

Thermostat(NC)
Opens at 90°C
Grey(+)
Violet(-)

WD4

Delta wound with Thermistor
Digital Hall Effect Devices
Single Cable: THF10



HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
I_{OUT} Continuous 15 mA

Grey
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Violet

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Reistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

NOTES

1. Peak force and current based on 5% duty cycle and one second duration.
2. Continuous force and current based on coil winding temperature maintained at 100°C.
3. Force constant is peak of resistive force produced by 1.0 amp thru one motor lead and 0.5 amps thru other two leads. Also, Back EMF (V/in/sec) * 7.665 = Force constant (lb/amp).
4. Motor resistance measured between any two motor leads with motor connected in Delta winding at 25°C. For temperature at 100°C, multiply resistance by 1.295 (75°C rise * 0.393%/°C)
5. Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.
6. Motor inductance measured using 1Kz with the motor in the magnetic field.
7. Electrical Time Constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.
8. Thermal Time Constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.
9. Thermal Dissipation Constant is amount of power in watts required to raise the winding temperature by 1°C. Reciprocal of Thermal resistance. Determined experimentally.
10. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
11. Electrical Cycle Length is distance coil must travel to complete 360° electrical cycle.
12. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.
13. Motors available with nickel plating or black epoxy coating on magnets. Track part number modified with -N or -B at end. Must be specified at time of order.

210 Specifications

- Ironless motor, patented, RE34674
- Cross-section: 2.25”H (57.1mm) x 1.25”W (31.7mm)
- Peak forces in four sizes to 110lbs (494), continuous forces to 24.8lbs (104.5N)
- Precision ground 3-piece track (210 model) or lightweight formed and machined (215 model)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Prealigned imbedded digital HEDs, also available in separate cable from motor leads
- Internal air cooling manifold standard
- Internal thermal cutout switch protects coil

PERFORMANCE

MOTOR MODEL		210-1	210-2	210-3	210-4
Peak Force	N	137.0	255.8	375.0	494.2
	lb	30.8	57.5	84.3	111.1
Continuous Force	N	30.7	57.4	84.1	110.3
	lb	6.9	12.9	18.9	24.8
Peak Power	W	905	1583	2261	2940
Continuous Power	W	45	79	113	147

ELECTRICAL

MOTOR MODEL		210-1			210-2			210-3			210-4		
WIRING TYPE	UNITS	S-Series	P-Parallel	T-Triple	S-Series	P-Parallel	T-Triple	S-Series	P-Parallel	T-Triple	S-Series	P-Parallel	T-Triple
Peak Current	A	12.6	25.2	37.8	11.8	23.6	35.4	11.5	23	34.5	11.3	22.6	33.9
Continuous Current	A	2.8	5.6	8.4	2.6	5.2	7.8	2.6	5.2	7.8	2.5	5.0	7.5
Force Constant	N/A peak	10.9	5.4	3.6	21.8	10.9	7.3	32.7	16.4	10.9	43.6	21.8	14.5
	lb/A peak	2.5	1.2	0.8	4.9	2.5	1.6	7.4	3.7	2.5	9.8	4.9	3.3
Back EMF	V/m/s	12.6	6.3	4.2	25.2	12.6	8.4	37.8	18.9	12.6	50.4	25.2	16.8
	V/in/s	0.32	0.16	0.11	0.64	0.32	0.21	0.96	0.48	0.32	1.28	0.64	0.43
Resistance 25°C, phase to phase	ohms	5.9	1.5	0.7	11.8	3.0	1.3	17.7	4.4	2.0	23.6	5.9	2.6
Inductance, phase to phase	mH	2.4	0.6	0.3	4.8	1.2	0.5	7.2	1.8	0.8	9.6	2.4	1.1
Electrical Time Constant	ms	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Motor Constant	N/-W	4.54	4.54	4.54	6.45	6.45	6.45	7.87	7.87	7.87	9.12	9.12	9.12
	lb/-W	1.02	1.02	1.02	1.45	1.45	1.45	1.77	1.77	1.77	2.05	2.05	2.05
Max Terminal Voltage	VDC	330	330	330	330	330	330	330	330	330	330	330	330

THERMAL

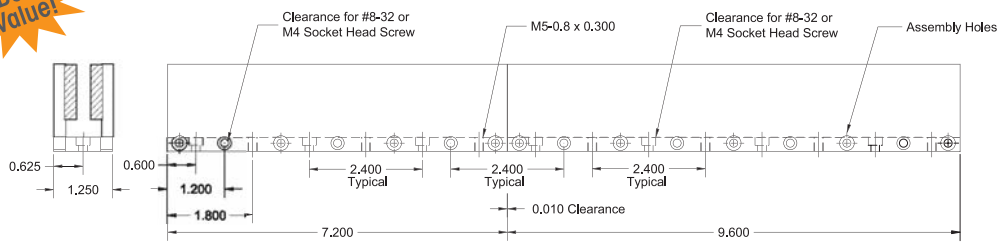
MOTOR MODEL		210-1	210-2	210-3	210-4
Thermal Dissipation Constant	W/°C	0.60	1.06	1.51	1.96
Thermal Time Constant	min	4.3	4.3	4.3	4.3
Maximum Winding Temperature	°C	100	100	100	100

MECHANICAL

MOTOR MODEL		210-1	210-2	210-3	210-4
Coil Weight	kg	0.16	0.27	0.39	0.51
	lb	0.35	0.60	0.86	1.12
Coil Length	mm	81.3	142.2	203.2	264.2
	in	3.2	5.6	8.0	10.4
Attractive Force	N	0	0	0	0
	lbf	0	0	0	0
Electrical Cycle Length	mm	60.96	60.96	60.96	60.96
	in	2.4	2.4	2.4	2.4

MODULAR 21007M 21009M

Best Value!



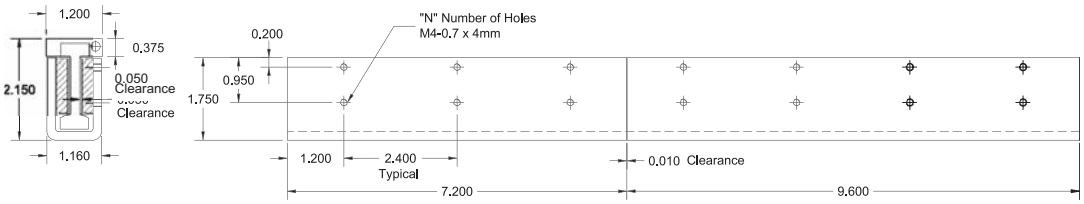
Incremental Length: 2.4in/60.96mm

Minimum Length: 2.4in/60.96mm

Maximum Length: (For Single Piece) 48in/1219.2mm

Weight/Foot: 5.50lbs/ft

MODULAR 21507M 21509M



Incremental Length: 2.4in/60.96mm

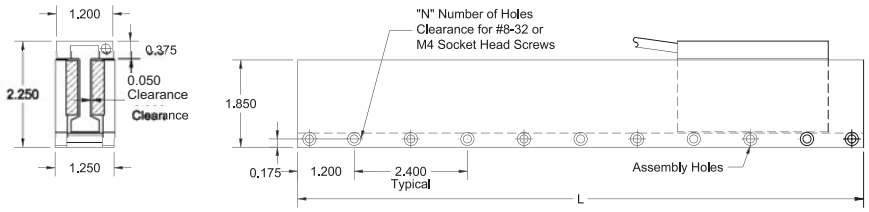
Minimum Length: 2.4in/60.96mm

Maximum Length: (For Single Piece) 24in/609.6mm

Weight/Foot: 3.95lbs/ft

SINGLE PIECE 210xxM1

Best Value!



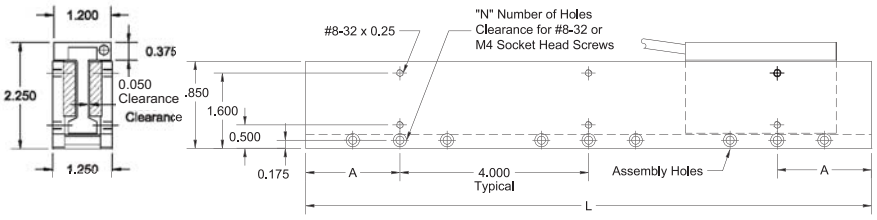
Incremental Length: 2.4in/60.96mm

Minimum Length: 2.4in/60.96mm

Maximum Length: 48in/1219.2mm

Weight/Foot: 5.50lbs/ft

SINGLE PIECE 210xxS



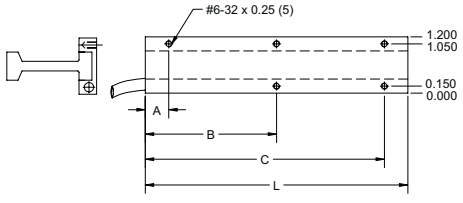
Incremental Length: 1.2in/30.48mm

Minimum Length: 8.4in/213.4mm

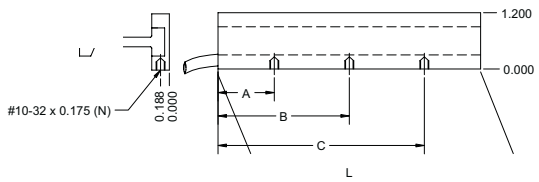
Maximum Length: 48in/1219.2mm

Weight/Foot: 5.50lbs/ft

(A) ENGLISH TOP MOUNTING



(B) ENGLISH SIDE MOUNTING



COIL SIZE (inches)	L	N	A	B	C
210-1A	3.20	5	0.50	1.60	2.70
210-2A	5.60	5	0.50	2.80	5.10
210-3A	8.00	5	0.50	4.00	7.50
210-4A	10.40	5	0.50	5.20	9.90

COIL SIZE (inches)	L	N	A	B	C
210-1B	3.20	2	1.950	2.950	---
210-2B	5.60	2	1.625	3.975	---
210-3B	8.00	3	2.438	4.000	5.562
210-4B	10.40	3	2.600	5.200	7.800

210 Dimensions

MODULAR TRACK

LENGTH In Inches	QUANTITY 21007M 21507M	QUANTITY 21009M 21509M
7.2	1	0
9.6	0	1
12.0	0	0
14.4	2	0
16.8	1	1
19.2	0	2
21.6	3	0
24.0	2	1
26.4	1	2
28.8	0	3
31.2	3	1
33.6	2	2
36.0	1	3
38.4	0	4
40.8	3	2
43.2	2	3
45.6	1	4
48.0	0	5
50.4	3	3
52.8	2	4
55.2	1	5
57.6	0	6
60.0	3	4
62.4	2	5
64.8	1	6
67.2	0	7
69.6	3	5
72.0	2	6

*Please note that 72.0 inches is NOT the maximum length for modular tracks.

210xxS

P/N 210xx S	L	A	N
21008 S	8.4	0.20	3
21009 S	9.6	0.80	3
21010 S	10.8	1.40	3
21012 S	12.0	2.00	3
21013 S	13.2	2.60	3
21014 S	14.4	3.20	3
21015 S	15.6	3.80	3
21016 S	16.8	0.40	5
21018 S	18.0	1.00	5
21019 S	19.2	1.60	5
21020 S	20.4	2.20	5
21021 S	21.6	2.80	5
21022 S	22.8	3.40	5
21024 S	24.0	4.00	5
21025 S	25.2	0.60	7
21026 S	26.4	1.20	7
21027 S	27.6	1.80	7
21028 S	28.8	2.40	7
21030 S	30.0	3.00	7
21031 S	31.2	3.60	7
21032 S	32.4	0.20	9
21033 S	33.6	0.80	9
21034 S	34.8	1.40	9
21036 S	36.0	2.00	9
21037 S	37.2	2.60	9
21038 S	38.4	3.20	9
21039 S	39.6	3.80	9
21040 S	40.8	0.40	11
21042 S	42.0	1.00	11
21043 S	43.2	1.60	11
21044 S	44.4	2.20	11
21045 S	45.6	2.80	11
21046 S	46.8	3.40	11
21048 S	48.0	4.00	11

210xxM1

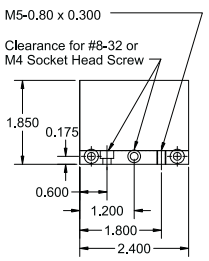
P/N 210xx M1	L	N
21002 M1	2.4	1
21004 M1	4.8	2
21007 M1	7.2	3
21009 M1	9.6	4
21012 M1	12.0	5
21014 M1	14.4	6
21016 M1	16.8	7
21019 M1	19.2	8
21021 M1	21.6	9
21024 M1	24.0	10
21026 M1	26.4	11
21028 M1	28.8	12
21031 M1	31.2	13
21033 M1	33.6	14
21036 M1	36.0	15
21038 M1	38.4	16
21040 M1	40.8	17
21043 M1	43.2	18
21045M1	45.6	19
21048 M1	48.0	20

SINGLE PIECE 215xxM

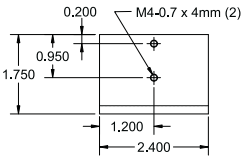
P/N 215xx M	L	N
21502 M	2.4	1
21504 M	4.8	2
21507 M	7.2	3
21509 M	9.6	4
21512 M	12.0	5
21514 M	14.4	6
21516 M	16.8	7
21519 M	19.2	8
21521 M	21.6	9
21524 M	24.0	10

SINGLE PIECE 210xxM

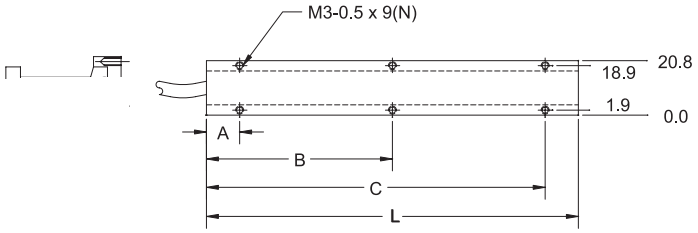
P/N 210xx M	L	N
21002 M	2.4	1
21004 M	4.8	2
21007 M	7.2	3
21009 M	9.6	4
21012 M	12.0	5
21014 M	14.4	6
21016 M	16.8	7
21019 M	19.2	8
21021 M	21.6	9
21024 M	24.0	10
21026 M	26.4	11
21028 M	28.8	12
21031 M	31.2	13
21033 M	33.6	14
21036 M	36.0	15
21038 M	38.4	16
21040 M	40.8	17
21043 M	43.2	18
21045 M	45.6	19
21048 M	48.0	20

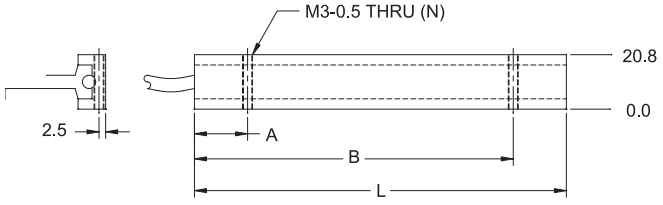


P/N 21002 M



P/N 21502 M



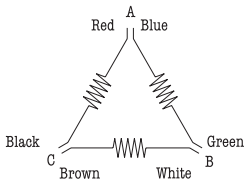


COIL SIZE (mm)	L	N	A	B	C
210-1M	81.3	5	12.7	40.6	68.6
210-2M	142.2	5	12.7	71.1	129.5
210-3M	203.2	5	12.7	101.6	190.5
210-4M	264.2	5	12.7	132.1	251.5

COIL SIZE (mm)	L	N	A	B	C
210-1N	81.3	2	49.5	74.9	---
210-2N	142.2	2	41.3	101.0	---
210-3N	203.2	3	61.9	101.6	141.3
210-4N	264.2	3	66.0	132.1	198.1

WD1

Delta wound with Thermistor
Single Cable: THF08



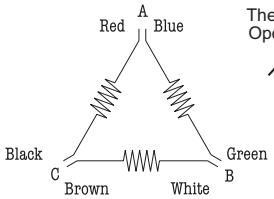
Orange
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Yellow

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Resistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

WD2

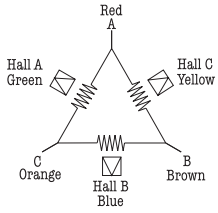
Delta wound with Thermostat
Single Cable: THF08



Thermostat(NC)
Opens at 90°C
Yellow(+)
Orange(-)

WD3

Delta wound with Thermostat
Digital Hall Effect Devices
Single Cable: THF10



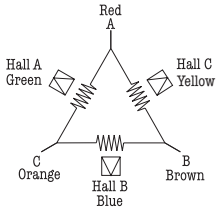
HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
I_{OUT} Continuous 15 mA

Thermostat(NC)
Opens at 90°C
Grey(+)
Violet(-)

WD4

Delta wound with Thermistor
Digital Hall Effect Devices
Single Cable: THF10



HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
I_{OUT} Continuous 15 mA

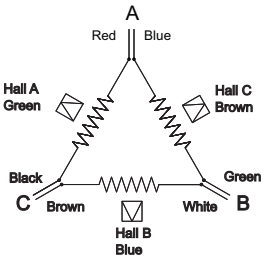
Grey
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Violet

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Reistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

WD7

Delta wound with Thermostat
Digital Hall Effect Devices
Dual Cables: THF06 and THF08



Thermostat
(Normally Closed)
Opens at 90C
Orange (+)
Yellow (-)

HED Power
Black (+)
White (Gnd)

HALL EFFECT DEVICES
Symmetrical Response
4.5 to 18 Vdc power
Open Collector Output
15ma continuous

NOTES

1. Peak force and current based on 5% duty cycle and one second duration.
2. Continuous force and current based on coil winding temperature maintained at 100°C.
3. Force constant is peak of resistive force produced by 1.0 amp thru one motor lead and 0.5 amps thru other two leads. Also, Back EMF (V/in/sec) * 7.665 = Force constant (lb/amp).
4. Motor resistance measured between any two motor leads with motor connected in Delta winding at 25°C. For temperature at 100°C, multiply resistance by 1.295 (75°C rise * 0.393%/°C).
5. Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.
6. Motor inductance measured using 1Kz with the motor in the magnetic field.
7. Electrical Time Constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.
8. Thermal Time Constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.
9. Thermal Dissipation Constant is amount of power in watts required to raise the winding temperature by 1°C. Reciprocal of Thermal resistance. Determined experimentally.
10. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
11. Electrical Cycle Length is distance coil must travel to complete 360° electrical cycle.
12. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.
13. Motors available with nickel plating or black epoxy coating on magnets. Track part number modified with -N or -B at end. Must be specified at time of order.

310 Specifications

I-FORCE

- Ironless motor, patented, RE34674
- Cross-section: 3.40”H (86.4mm) x 1.35”W (34.3mm)
- Peak forces in two sizes to 263lbs (1170N), continuous forces to 58lbs (262N)
- Precision ground 3-piece track (310 model) or lightweight formed and machined (315 model)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Single-piece magnet tracks to 66” length
- Prealigned embedded digital HEDs, also available in separate cable from motor leads
- Internal air or liquid cooling available
- Internal thermal cutout switch protects coil

PERFORMANCE

MOTOR MODEL		310-1	310-2	310-3	310-4	310-5	310-6
Peak Force	N	218.9	409.3	600.0	790.0	980.0	1170.0
	lb	49.2	92.0	135.1	177.2	220.3	263.2
Continuous Force	N	49.0	91.6	133.9	176.2	219.3	262.0
	lb	11.0	20.6	30.1	39.6	49.3	58.9
Peak Power	W	1077	1885	2693	3500	4308	5116
Continuous Power	W	54	94	135	179	215	256

ELECTRICAL

MOTOR MODEL		310-1			310-2			310-3			310-4			310-5			310-6		
WIRING TYPE	UNITS	S	P	T	S	P	T	S	P	T	S	P	T	S	P	T	S	P	T
Peak Current	A	16.1	32.2	48.3	15.0	30.0	45.0	14.7	29.4	44.1	14.5	29.0	43.5	14.4	28.8	43.2	14.3	28.6	42.9
Continuous Current	A	3.6	7.2	10.8	3.4	6.8	10.2	3.3	6.6	9.9	3.2	6.4	9.6	3.2	6.4	9.6	3.2	6.4	9.6
Force Constant	N/A peak	13.7	6.8	4.6	27.3	13.6	9.1	40.9	20.5	13.6	54.7	27.4	18.2	68.1	34.0	22.7	81.8	40.9	27.3
	lb/A peak	3.1	1.5	1.0	6.1	3.1	2.0	9.2	4.6	3.1	12.3	6.2	4.1	15.3	7.7	5.1	18.4	9.2	6.1
Back EMF	V/m/s	15.7	7.8	5.2	31.5	15.7	10.5	47.2	23.6	15.7	63.0	31.5	21.0	78.7	39.4	26.2	94.5	47.2	31.5
	V/in/s	0.40	0.20	0.13	0.80	0.40	0.27	1.20	0.60	0.40	1.60	0.80	0.53	2.00	1.00	0.67	2.40	1.20	0.80
Resistance 25°C, phase to phase	ohms	4.3	1.1	0.5	8.6	2.2	1.0	12.9	3.2	1.4	17.2	4.3	1.9	21.5	5.4	2.4	25.8	6.5	2.9
Inductance, phase to phase	mH	3.0	0.8	0.3	6.0	1.5	0.7	9.0	2.3	1.0	12.0	3.0	1.3	15.0	3.8	1.7	18.0	4.5	2.0
Electrical Time Constant	ms	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Motor Constant	N/-W	6.67	6.67	6.67	9.43	9.43	9.43	11.57	11.57	11.57	13.34	13.34	13.34	14.95	14.95	14.95	16.37	16.37	16.37
	lb/-W	1.50	1.50	1.50	2.12	2.12	2.12	2.60	2.60	2.60	3.00	3.00	3.00	3.36	3.36	3.36	3.68	3.68	3.68
Max Terminal Voltage	VDC	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330

NOTE: S-Series P-Parallel T-Triple

THERMAL

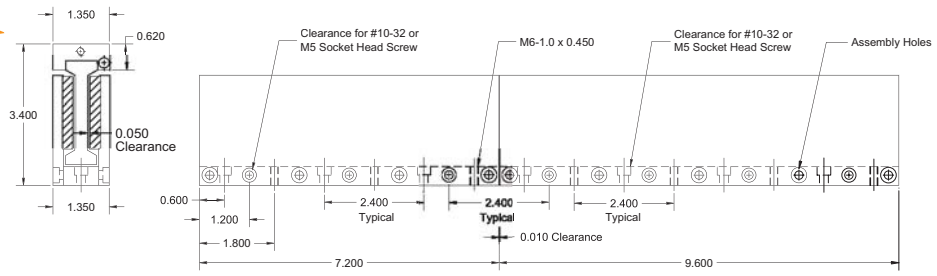
MOTOR MODEL		310-1	310-2	310-3	310-4	310-5	310-6
Thermal Dissipation Constant	W/°C	0.72	1.26	1.80	2.33	2.87	3.41
Thermal Time Constant	min	7.5	7.5	7.5	7.5	7.5	7.5
Maximum Winding Temperature	°C	100	100	100	100	100	100

MECHANICAL

MOTOR MODEL		310-1	310-2	310-3	310-4	310-5	310-6
Coil Weight	kg	0.31	0.55	0.80	1.03	1.27	1.53
	lb	0.69	1.22	1.75	2.27	2.80	3.36
Coil Length	mm	81.3	142.2	203.2	264.2	325.1	386.1
	in	3.2	5.6	8.0	10.4	12.8	15.2
Attractive Force	N	0	0	0	0	0	0
	lbf	0	0	0	0	0	0
Electrical Cycle Length	mm	60.96	60.96	60.96	60.96	60.96	60.96
	in	2.4	2.4	2.4	2.4	2.4	2.4

MODULAR 31007M 31009M

Best Value!



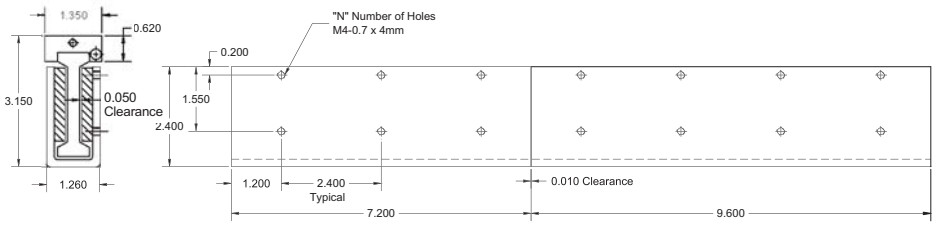
Incremental Length:
2.4in/60.96mm

Minimum Length:
2.4in/60.96mm

Maximum Length:
(For Single Piece)
64.8in/1645.9mm

Weight/Foot:
8.50lbs/ft

MODULAR 31507M 31509M



Incremental Length:
2.4in/60.96mm

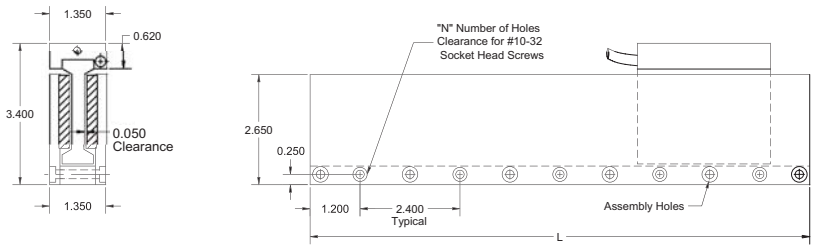
Minimum Length:
2.4in/60.96mm

Maximum Length:
(For Single Piece)
24in/609.6mm

Weight/Foot:
5.62lbs/ft

SINGLE PIECE 310xxM1

Best Value!



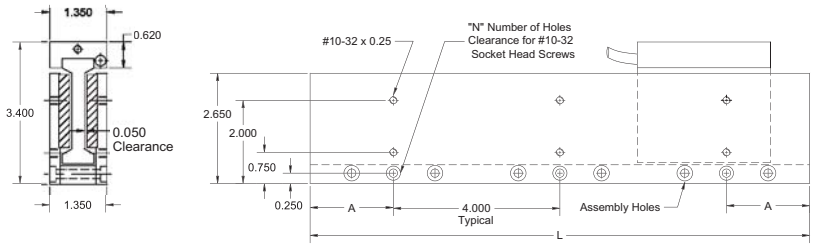
Incremental Length:
2.4in/60.96mm

Minimum Length:
2.4in/60.96mm

Maximum Length:
64.8in/1645.9mm

Weight/Foot:
8.50lbs/ft

SINGLE PIECE 310xxS



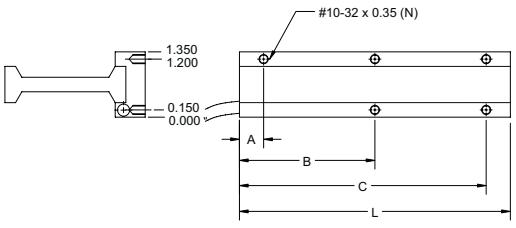
Incremental Length:
1.2in/30.48mm

Minimum Length:
8.4in/213.4mm

Maximum Length:
66in/1676.4mm

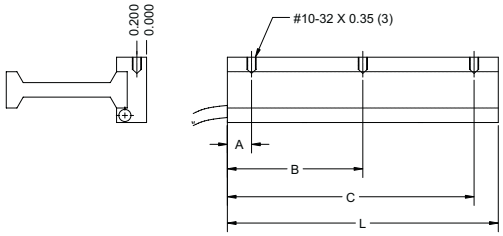
Weight/Foot:
8.50lbs/ft

(A) ENGLISH TOP MOUNTING



COIL SIZE (inches)	L	N	A	B	C
310-1A	3.20	5	0.50	1.60	2.70
310-2A	5.60	5	0.50	2.80	5.10
310-3A	8.00	5	0.50	4.00	7.50
310-4A	10.40	5	0.50	5.20	9.90
310-5A	12.80	5	0.50	6.40	12.30
310-6A	15.20	5	1.70	7.60	13.50

(B) ENGLISH SIDE MOUNTING



COIL SIZE (inches)	L	N	A	B	C
310-1B	3.20	3	0.50	1.60	2.70
310-2B	5.60	3	0.50	2.80	5.10
310-3B	8.00	3	0.50	4.00	7.50
310-4B	10.40	3	0.50	5.20	9.90
310-5B	12.80	3	0.50	6.40	12.30
310-6B	15.20	3	1.70	7.60	13.50

310 Dimensions

MODULAR TRACK

LENGTH In Inches	QUANTITY 31007M 31507M	QUANTITY 31009M 31509M
7.2	1	0
9.6	0	1
12.0	0	0
14.4	2	0
16.8	1	1
19.2	0	2
21.6	3	0
24.0	2	1
26.4	1	2
28.8	0	3
31.2	3	1
33.6	2	2
36.0	1	3
38.4	0	4
40.8	3	2
43.2	2	3
45.6	1	4
48.0	0	5
50.4	3	3
52.8	2	4
55.2	1	5
57.6	0	6
60.0	3	4
62.4	2	5
64.8	1	6
67.2	0	7
69.6	3	5
72.0	2	6

*Please note that 72.0 inches is NOT the maximum length for modular tracks.

SINGLE PIECE 315xxM

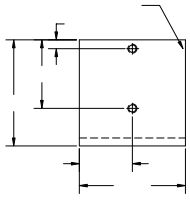
P/N	315xx	M	L	N
	31502	M	2.4	1
	31504	M	4.8	2
	31507	M	7.2	3
	31508	M	9.6	4
	31512	M	12.0	5
	31514	M	14.4	6
	31516	M	16.8	7
	31519	M	19.2	8
	31521	M	21.6	9
	31524	M	24.0	10

310xxS

P/N	310xx	S	L	A	N
	31008	S	8.4	0.20	3
	31009	S	9.6	0.80	3
	31010	S	10.8	1.40	3
	31012	S	12.0	2.00	3
	31013	S	13.2	2.60	3
	31014	S	14.4	3.20	3
	31015	S	15.6	3.80	3
	31016	S	16.8	0.40	5
	31018	S	18.0	1.00	5
	31019	S	19.2	1.60	5
	31020	S	20.4	2.20	5
	31021	S	21.6	2.80	5
	31022	S	22.8	3.40	5
	31024	S	24.0	4.00	5
	31025	S	25.2	0.60	7
	31026	S	26.4	1.20	7
	31027	S	27.6	1.80	7
	31028	S	28.8	2.40	7
	31030	S	30.0	3.00	7
	31031	S	31.2	3.60	7
	31032	S	32.4	0.20	9
	31033	S	33.6	0.80	9
	31034	S	34.8	1.40	9
	31036	S	36.0	2.00	9
	31037	S	37.2	2.60	9
	31038	S	38.4	3.20	9
	31039	S	39.6	3.80	9
	31040	S	40.8	0.40	11
	31042	S	42.0	1.00	11
	31043	S	43.2	1.60	11
	31044	S	44.4	2.20	11
	31045	S	45.6	2.80	11
	31046	S	46.8	3.40	11
	31048	S	48.0	4.00	11
	31049	S	49.2	0.60	13
	31050	S	50.4	1.20	13
	31051	S	51.6	1.80	13
	31052	S	52.8	2.40	13
	31054	S	54.0	3.00	13
	31055	S	55.2	3.60	13
	31056	S	56.4	0.20	15
	31057	S	57.6	0.80	15
	31058	S	58.8	1.40	15
	31060	S	60.0	2.00	15
	31061	S	61.2	2.60	15
	31062	S	62.4	3.20	15
	31063	S	63.6	3.80	15
	31064	S	64.8	0.40	17
	31066	S	66.0	1.00	17

310xxM1

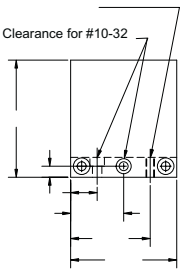
P/N	310xx	M1	L	N
	31002	M1	2.4	1
	31004	M1	4.8	2
	31007	M1	7.2	3
	31009	M1	9.6	4
	31012	M1	12.0	5
	31014	M1	14.4	6
	31016	M1	16.8	7
	31019	M1	19.2	8
	31021	M1	21.6	9
	31024	M1	24.0	10
	31026	M1	26.4	11
	31028	M1	28.8	12
	31031	M1	31.2	13
	31033	M1	33.6	14
	31036	M1	36.0	15
	31038	M1	38.1	16
	31040	M1	40.8	17
	31043	M1	43.2	18
	31045	M1	45.6	19
	31048	M1	48.0	20
	31050	M1	50.4	21
	31052	M1	52.8	22
	31055	M1	55.2	23
	31057	M1	57.6	24
	31060	M1	60.0	25
	31062	M1	62.4	26
	31064	M1	64.8	27



P/N 31502 M

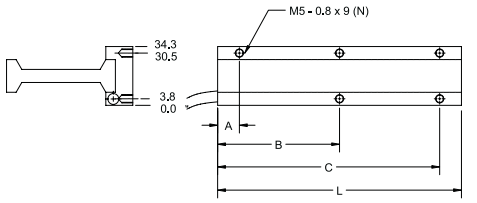
SINGLE PIECE 310xxM

P/N	310xx	M	L	N
	31002	M	2.4	1
	31004	M	4.8	2
	31007	M	7.2	3
	31009	M	9.6	4
	31012	M	12.0	5
	31014	M	14.4	6
	31016	M	16.8	7
	31019	M	19.2	8
	31021	M	21.6	9
	31024	M	24.0	10
	31026	M	26.4	11
	31028	M	28.8	12
	31031	M	31.2	13
	31033	M	33.6	14
	31036	M	36.0	15
	31038	M	38.1	16
	31040	M	40.8	17
	31043	M	43.2	18
	31045	M	45.6	19
	31048	M	48.0	20
	31050	M	50.4	21
	31052	M	52.8	22
	31055	M	55.2	23
	31057	M	57.6	24
	31060	M	60.0	25
	31062	M	62.4	26
	31064	M	64.8	27



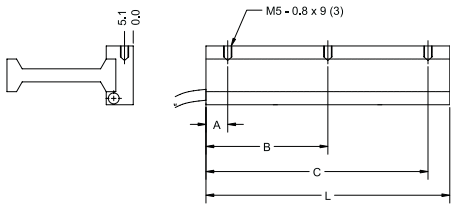
P/N 31002 M

(M) METRIC TOP MOUNTING



COIL SIZE (mm)	L	N	A	B	C
310-1M	81.3	5	12.7	40.6	68.6
310-2M	141.2	5	12.7	71.1	129.5
310-3M	203.2	5	12.7	101.6	190.5
310-4M	264.2	5	12.7	132.1	251.5
310-5M	325.1	5	12.7	162.6	312.4
310-6M	386.1	5	43.2	193.0	342.9

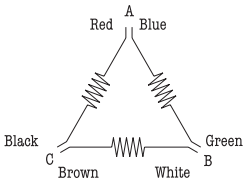
(N) METRIC SIDE MOUNTING



COIL SIZE (mm)	L	N	A	B	C
310-1N	81.3	3	12.7	40.6	68.6
310-2N	141.2	3	12.7	71.1	129.5
310-3N	203.2	3	12.7	101.6	190.5
310-4N	264.2	3	12.7	132.1	251.5
310-5N	325.1	3	12.7	162.6	312.4
310-6N	386.1	3	43.2	193.0	342.9

WD1

Delta wound with Thermistor
Single Cable: THF08



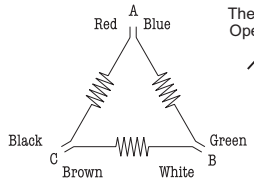
Orange
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Yellow

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Resistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

WD2

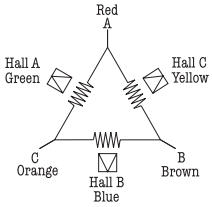
Delta wound with Thermostat
Single Cable: THF08



Thermostat(NC)
Opens at 90°C
Yellow(+)
Orange(-)

WD3

Delta wound with Thermostat
Digital Hall Effect Devices
Single Cable: THF10



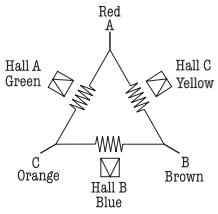
HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
I_{OUT} Continuous 15 mA

Thermostat(NC)
Opens at 90°C
Grey(+)
Violet(-)

WD4

Delta wound with Thermistor
Digital Hall Effect Devices
Single Cable: THF10



HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
I_{OUT} Continuous 15 mA

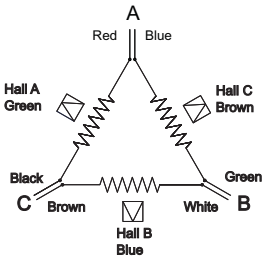
Grey
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Violet

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Reistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

WD7

Delta wound with Thermostat
Digital Hall Effect Devices
Dual Cables: THF06 and THF08



Thermostat
(Normally Closed)
Opens at 90C
Orange (+)
Yellow (-)

HED Power
Black (+)
White (Gnd)

HALL EFFECT DEVICES
Symmetrical Response
4.5 to 18 Vdc power
Open Collector Output
15ma continuous

NOTES

1. Peak force and current based on 5% duty cycle and one second duration.
2. Continuous force and current based on coil winding temperature maintained at 100°C.
3. Force constant is peak of resistive force produced by 1.0 amp thru one motor lead and 0.5 amps thru other two leads. Also, Back EMF (V/in/sec) * 7.665 = Force constant (lb/amp).
4. Motor resistance measured between any two motor leads with motor connected in Delta winding at 25°C. For temperature at 100°C, multiply resistance by 1.295 (75°C rise * 0.393%/°C)
5. Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.
6. Motor inductance measured using 1Kz with the motor in the magnetic field.
7. Electrical Time Constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.
8. Thermal Time Constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.
9. Thermal Dissipation Constant is amount of power in watts required to raise the winding temperature by 1°C. Reciprocal of Thermal resistance. Determined experimentally.
10. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
11. Electrical Cycle Length is distance coil must travel to complete 360° electrical cycle.
12. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.
13. Motors available with nickel plating or black epoxy coating on magnets. Track part number modified with -N or -B at end. Must be specified at time of order.

410 Specifications

- Ironless motor, patented, RE34674
- Cross-section: 4.50”H (114.3mm) x 2.00”W (50.8mm)
- Peak forces in two sizes to 883lbs (3928N), continuous forces to 197 lbs (878N)
- Precision ground 3-piece track (410 model)
- Two lengths of modular magnet tracks allow unlimited length of travel
- Single-piece magnet tracks to 72.24” length
- Prealigned embedded digital HEDs, also available in separate cable from motor leads
- Internal air cooling manifold or liquid cooling manifold
- Internal thermal cutout switch protects coil

PERFORMANCE

MOTOR MODEL		410-2	410-3	410-4	410-6	410-8
Peak Force	N	1041.4	1523.6	2006.3	2967.2	3928.1
	lb	234.1	342.5	451.0	667.0	883.0
Continuous Force	N	233.1	340.8	448.9	663.7	878.6
	lb	52.4	76.6	100.9	149.2	197.5
Peak Power	W	2835	4050	5265	7695	10125
Continuous Power	W	142	203	263	385	506

ELECTRICAL

MOTOR MODEL		410-2			410-3			410-4			410-6			410-8		
WIRING TYPE	UNITS	S	P	T	S	P	T	S	P	T	S	P	T	S	P	T
Peak Current	A	19.1	38.2	57.3	18.6	37.2	55.8	18.4	36.8	55.2	18.1	36.2	54.3	18.0	36.0	54.0
Continuous Current	A	4.3	8.6	12.9	4.2	8.4	12.6	4.1	8.2	12.3	4.1	8.2	12.3	4.0	8.0	12.0
Force Constant	N/A peak	54.5	27.3	18.2	81.8	40.9	27.3	109.0	54.5	36.3	163.7	81.8	54.6	218.4	109.2	72.8
	lb/A peak	12.3	6.1	4.1	18.4	9.2	6.1	24.5	12.3	8.2	36.8	18.4	12.3	49.1	24.6	16.4
Back EMF	V/m/s	63.0	31.5	21.0	94.5	47.2	31.5	126.0	63.0	42.0	189.0	94.5	63.0	252.0	126.0	84.0
V/in/s		1.60	0.80	0.53	2.40	1.20	0.80	3.20	1.60	1.07	4.80	2.40	1.60	6.40	3.20	2.13
Resistance 25°C, phase to phase	ohms	8.0	2.0	0.9	12.0	3.0	1.3	16.0	4.0	1.8	24.0	6.0	2.7	32.0	8.0	3.6
Inductance, phase to phase	mH	10.0	2.5	1.1	15.0	3.8	1.7	20.0	5.0	2.2	30.0	7.5	3.3	40.0	10.0	4.4
Electrical Time Constant	ms	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Motor Constant	N/-W	19.57	19.57	19.57	23.98	23.98	23.98	27.67	27.67	27.67	33.90	33.90	33.90	39.14	39.14	39.14
	lb/-W	4.40	4.40	4.40	5.39	5.39	5.39	6.22	6.22	6.22	7.62	7.62	7.62	8.80	8.80	8.80
Max Terminal Voltage	VDC	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330

NOTE: S-Series P-Parallel T-Triple

THERMAL

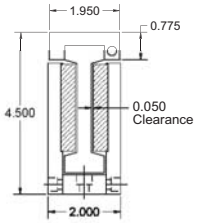
MOTOR MODEL		410-2	410-3	410-4	410-6	410-8
Thermal Dissipation Constant	W/°C	1.89	2.70	3.91	5.13	6.75
Thermal Time Constant	min	15.1	15.1	15.1	15.1	15.1
Maximum Winding Temperature	°C	100	100	100	100	100

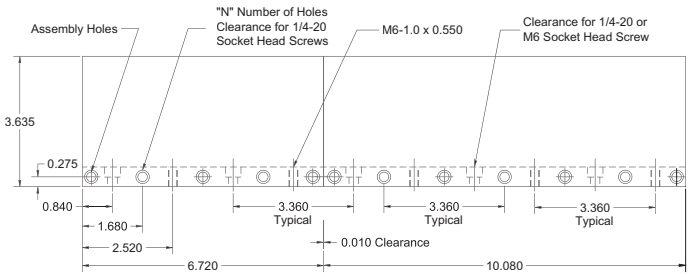
MECHANICAL

MOTOR MODEL		410-2	410-3	410-4	410-6	410-8
Coil Weight	kg	1.59	2.27	2.95	4.32	5.68
	lb	3.5	5.0	6.5	9.5	12.5
Coil Length	mm	199.1	284.5	369.8	540.5	711.2
	in	7.84	11.20	14.56	21.28	28.00
Attractive Force	N	0	0	0	0	0
	lbf	0	0	0	0	0
Electrical Cycle Length	mm	85.34	85.34	85.34	85.34	85.34
	in	3.36	3.36	3.36	3.36	3.36

MODULAR 41006M 41010M

Best Value!





Incremental Length:
3.36in/85.34mm

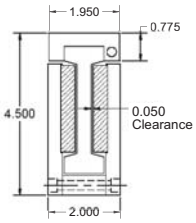
Minimum Length:
6.72in/170.7mm

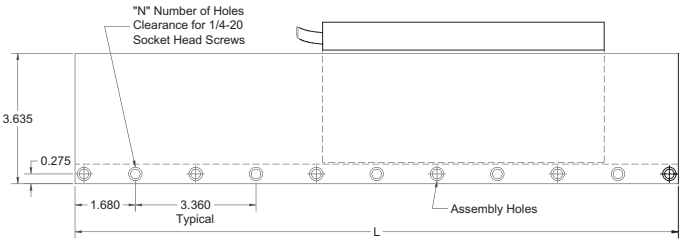
Maximum Length:
70.56in/1792.22mm

Weight/Foot:
20.0lbs/ft

SINGLE PIECE 410xxM1

Best Value!





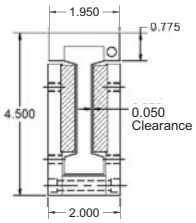
Incremental Length:
3.36in/85.34mm

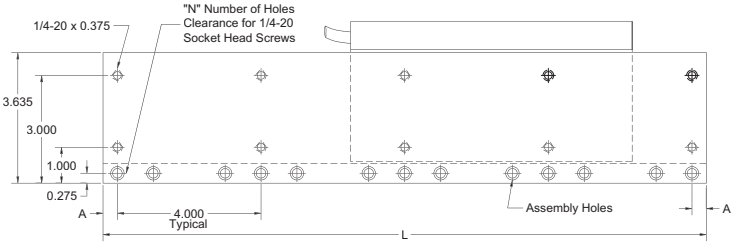
Minimum Length:
6.72in/170.7mm

Maximum Length:
70.56in/1792.22mm

Weight/Foot:
20.0lbs/ft

SINGLE PIECE 410xxS





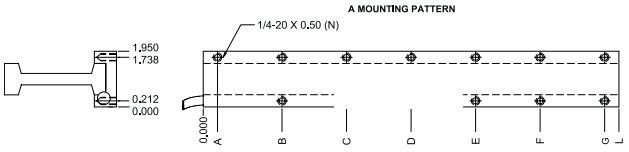
Incremental Length:
1.68in/42.67mm

Minimum Length:
16.80in/426.72mm

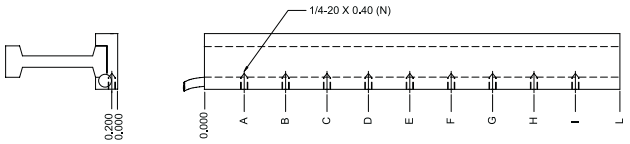
Maximum Length:
72.24in/1834.9mm

Weight/Foot:
20.0lbs/ft

(A) ENGLISH TOP MOUNTING



(B) ENGLISH SIDE MOUNTING



COIL SIZE (in)	L	N	A	B	C	D	E	F	G
410-2A	7.84	5	0.50	3.92	7.34	---	---	---	---
410-3A	11.20	8	0.50	1.60	5.60	9.60	10.70	---	---
410-4A	14.56	9	0.50	3.28	7.28	11.28	14.06	---	---
410-6A	21.28	13	0.50	2.64	6.64	10.64	14.64	18.64	20.78
410-8A	28.00	13	2.00	6.00	10.00	14.00	18.00	22.00	26.00

COIL SIZE (in)	L	N	A	B	C	D	E	F	G	H	I
410-2B	7.84	3	2.90	4.90	6.90	---	---	---	---	---	---
410-3B	11.20	3	4.10	7.10	10.10	---	---	---	---	---	---
410-4B	14.56	4	2.78	5.78	8.78	11.78	---	---	---	---	---
410-6B	21.28	6	3.14	6.14	9.14	12.14	15.14	18.14	---	---	---
410-8B	28.00	9	3.50	6.50	9.50	12.50	15.50	18.50	21.50	24.50	27.50

410 Dimensions

MODULAR TRACK

LENGTH Inches	QUANTITY 41006M	QUANTITY 41010M
6.72	1	0
10.08	0	1
13.44	0	0
16.80	1	1
20.16	0	2
23.52	2	1
26.88	1	2
30.24	0	3
33.60	2	2
36.96	1	3
40.32	0	4
43.68	2	3
47.04	1	4
50.40	0	5
53.76	2	4
57.12	1	5
60.48	0	6
63.84	2	5
67.20	1	6
70.56	0	7
73.92	2	6
77.28	1	7
80.64	0	8
84.00	2	7
87.36	1	8
90.72	0	9
94.08	2	8
97.44	1	9

410 xx M1

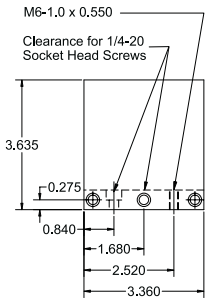
P/N 410xx M1	L	N
41006 M1	6.72	2
41010 M1	10.08	3
41013 M1	13.44	4
41016 M1	16.80	5
41020 M1	20.16	6
41023 M1	23.52	7
41026 M1	26.88	8
41030 M1	30.24	9
41033 M1	33.60	10
41036 M1	36.96	11
41040 M1	40.32	12
41043 M1	43.68	13
41047 M1	47.04	14
41050 M1	50.40	15
41053 M1	53.76	16
41057 M1	57.12	17
41060 M1	60.48	18
41063 M1	63.84	19
41067 M1	67.20	20
41070 M1	70.56	21

410 xx S

P/N 410xx S	L	A	N
41016 S	16.80	1.68	5
41018 S	18.48	2.52	5
41020 S	20.16	3.36	5
41021 S	21.84	0.84	7
41023 S	23.52	1.68	7
41025 S	25.20	2.52	7
41026 S	26.88	3.36	7
41028 S	28.56	0.84	9
41030 S	30.24	1.68	9
41031 S	31.92	2.52	9
41033 S	33.60	3.36	9
41035 S	35.28	0.84	11
41036 S	36.96	1.68	11
41038 S	38.64	2.53	11
41040 S	40.32	3.36	11
41042 S	42.00	0.84	13
41043 S	43.68	1.68	13
41045 S	45.36	2.52	13
41047 S	47.04	3.36	13
41048 S	48.72	0.84	15
41050 S	50.40	1.68	15
41052 S	52.08	2.52	15
41053 S	53.76	3.36	15
41055 S	55.44	0.84	17
41057 S	57.12	1.68	17
41058 S	58.80	2.52	17
41060 S	60.48	3.36	17
41062 S	62.16	0.84	19
41063 S	63.84	1.68	19
41065 S	65.52	2.52	19
41067 S	67.20	3.36	19
41068 S	68.88	0.84	21
41070 S	70.56	1.68	21
41072 S	72.24	2.52	21

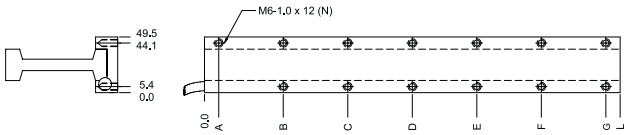
SINGLE PIECE 410xxM

P/N 410xx M	L	N
41003 M	3.36	1
41006 M	6.72	2
41010 M	10.08	3
41013 M	13.44	4
41016 M	16.80	5
41020 M	20.16	6
41023 M	23.52	7
41026 M	26.88	8
41030 M	30.24	9
41033 M	33.60	10
41036 M	36.96	11
41040 M	40.32	12
41043 M	43.68	13
41047 M	47.04	14
41050 M	50.40	15
41053 M	53.76	16
41057 M	57.12	17
41060 M	60.48	18
41063 M	63.84	19
41067 M	67.20	20
41070 M	70.56	21



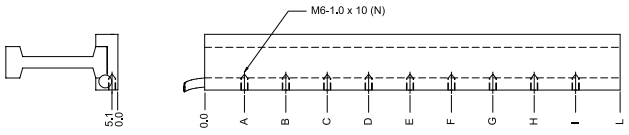
P/N 41003 M

(M) METRIC TOP MOUNTING



COIL SIZE(mm)	L	N	A	B	C	D	E	F	G
410-2M	199.1	5	12.7	99.6	186.4	---	---	---	---
410-3M	284.5	8	12.7	40.6	142.2	243.8	271.8	---	---
410-4M	369.8	9	12.7	83.3	184.9	286.5	357.1	---	---
410-6M	540.5	13	12.7	67.1	168.7	270.3	371.9	473.4	527.8
410-8M	711.2	13	50.8	152.4	254.0	355.6	457.2	558.8	660.4

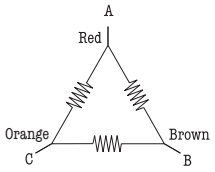
(N) METRIC SIDE MOUNTING



COIL SIZE (mm)	L	N	A	B	C	D	E	F	G	H	I
410-2N	199.1	3	73.7	124.5	175.3	---	---	---	---	---	---
410-3N	284.5	3	104.1	180.3	256.5	---	---	---	---	---	---
410-4N	369.8	4	70.6	146.8	223.0	299.2	---	---	---	---	---
410-6N	540.5	6	79.7	156.0	232.2	308.4	384.6	460.8	---	---	---
410-8N	711.2	9	88.9	165.1	241.3	317.5	393.7	469.9	546.1	622.3	698.5

WD1

Delta wound with Thermistor
Single Cable: THF05



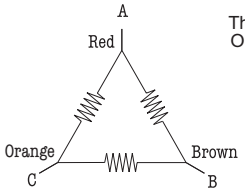
Orange
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Yellow

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Resistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

WD2

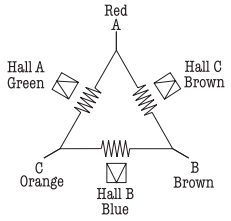
Delta wound with Thermostat
Single Cable: THF05



Thermostat(NC)
Opens at 90°C
Yellow(+)
Orange(-)

WD3

Delta wound with Thermostat
Digital Hall Effect Devices
Dual Cable: THF05 and THF06



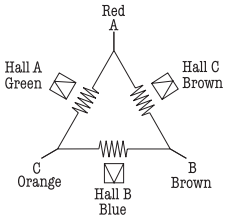
HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
I_{OUT} Continuous 15 mA

Thermostat(NC)
Opens at 90°C
Grey(+)
Violet(-)

WD4

Delta wound with Thermistor
Digital Hall Effect Devices
Dual Cable: THF05 and THF06



HED Power
Black(+)
White(gnd)

Hall Effect Devices
Symmetrical Response
4.5V to 18 V Operation
Open Collector Output
I_{OUT} Continuous 15 mA

Grey
Thermistor Omega 44004
2.2 kOhms Resistance @ 25°C
Violet

$\frac{1}{T} = A + B(LOG_eR) + C(LOG_eR)^3$

Where T = °Kelvin; R = Reistance; A, B, C = fitting constants
A=1.4626 E-3 B=2.4024 E-4 C=8.0353 $_E$-8

NOTES

1. Peak force and current based on 5% duty cycle and one second duration.
2. Continuous force and current based on coil winding temperature maintained at 100°C.
3. Force constant is peak of resistive force produced by 1.0 amp thru one motor lead and 0.5 amps thru other two leads. Also, Back EMF (V/in/sec) * 7.665 = Force constant (lb/amp).
4. Motor resistance measured between any two motor leads with motor connected in Delta winding at 25°C. For temperature at 100°C, multiply resistance by 1.295 (75°C rise * 0.393%/°C)
5. Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.
6. Motor inductance measured using 1Kz with the motor in the magnetic field.
7. Electrical Time Constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.
8. Thermal Time Constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.
9. Thermal Dissipation Constant is amount of power in watts required to raise the winding temperature by 1°C. Reciprocal of Thermal resistance. Determined experimentally.
10. Motor Constant is a measure of efficiency. Calculated by dividing the force constant by the square root of the motor resistance at maximum operating temperature.
11. Electrical Cycle Length is distance coil must travel to complete 360° electrical cycle.
12. Use TIPS sizing software for the most accurate estimate of coil temperature for a particular motion profile.
13. Motors available with nickel plating or black epoxy coating on magnets. Track part number modified with -N or -B at end. Must be specified at time of order.

Motor Coil

Order Example:

110 - 2 B - NC - WD2 P - 8

Series
110

Coil size
1 or 2

Mounting
A top, English
B side, English
M top, metric
N side, metric
C custom

Cooling
NC no cooling
AC not available
LC not available

Cable Length
in feet (8 ft. standard)

Winding
S Series
P Parallel
T Triple (not available for 1-pole motor)

Wiring
WD0*, WD1, WD2, WD3, WD4

Magnet Track:

11024M1 - N

110xxM:	11007M, 11009M	7.20”, 9.60	modular sections
11507M:	11507M, 11509M	7.20”, 9.60	modular sections
110xxM1:	11036M1, max	36.00” max	single piece, 2.4” incr.
110xxM:	11036M, max	36.00” max	single piece, 2.4” incr.
115xxM:	11524M, max	24.00” max	single piece, 2.4” incr.
110xxS:	11036M, max	36.00” max	single piece, 1.2” incr.

Magnet coating
N nickel (standard)
B black epoxy

Motor Coil

Order Example:

210 - 2 M - NC - WD2 P - 8

Series
210

Coil size
1, 2, 3 or 4

Mounting
A top, English
B side, English
M top, metric
N side, metric
C custom

Cooling
NC no cooling
AC air cooling
LC liquid cooling

Cable Length
in feet (8 ft. standard)

Winding
S Series
P Parallel
T Triple (not available for 1-pole motor)

Wiring
WD1, WD2,
WD3, WD4, WD7

Magnet Track:

21024M1 - N

210xxM:	21007M, 21009M	7.20”, 9.60” modular sections
21507M:	21507M, 21509M	7.20”, 9.60” modular sections
210xxM1:	21048M1 max	48.00” max single piece, 2.4” incr.
210xxM:	21048M max	48.00” max single piece, 2.4” incr.
215xxM:	21524M max	24.00” max single piece, 2.4” incr.
210xxS:	21048S max	48.00” max single piece, 1.2” incr.

Magnet coating
N nickel (standard)
B black epoxy

Motor Coil

Order Example:

310 - 2 A - NC - WD2 P - 8

Series
310

Coil size
1, 2, 3, 4, 5, or 6

Mounting
A top, English
B side, English
M top, metric
N side, metric
C custom

Cooling
NC no cooling
AC air cooling
LC liquid cooling

Cable Length
in feet (8 ft. standard)

Winding
S Series
P Parallel
T Triple (not available for 1-pole motor)

Wiring
WD1, WD2,
WD3, WD4, ED7

Magnet Track:

31024M1 - N

310xxM:	31007M, 31009M	7.20”, 9.60” modular sections
31507M:	31507M, 31509M	7.20”, 9.60” modular sections
310xxM1:	31064M1 max	64.8” max single piece, 2.4” incr.
310xxM:	31064M max	64.80” max single piece, 2.4” incr.
315xxM:	31524M max	24.00” max single piece, 2.4” incr.
310xxS:	31066S max	64.8” max single piece, 1.2” incr.

Magnet coating
N nickel (standard)
B black epoxy

Motor Coil

Order Example:

410 - 2 B - NC - WD2 P - 8

Series
410

Cable Length
in feet (8 ft. standard)

Coil size

1, 2, 3, 4, 5, or 6

Winding
S Series
P Parallel
T Triple (not available for 1-pole motor)

Mounting
A top, English
B side, English
M top, metric
N side, metric
C custom

Wiring
WD1, WD2,
WD3, WD4

Cooling
NC no cooling
AC air cooling
LC liquid cooling

Magnet Track:

41024M1 - N

410xxM:	41006M, 41010M	6.72", 10.08" modular sections
410xxM1:	41070M1max	70.56" max single piece, 3.36" incr.
410xxM:	41070M max	70.56" max single piece, 3.36" incr.
410xxS:	41072S max	70.56" max single piece, 1.68"

Magnet coating
N nickel (standard)
B black epoxy

Other Linear Motor Solutions from Parker

400LXR Linear Motor Tables

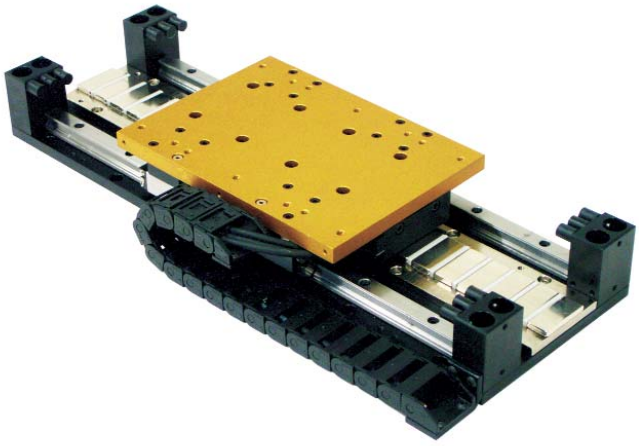
- Multiple family sizes
- Dowel Pin features and carriage designs for simple multi-axis connectivity
- Robust extruded actuators with a metal strip seal enclosure for more complete linear motor protection

LX80 Long Travel Miniature Linear Stages

- Small cross section
- Long travels
- Internal cable management

MX80 Miniature Precision Stages

- Submicron precision
- No moving cables
- 5 G accelerations and 2 m/s velocities in a 25mm x 80mm footprint



Linear Motor Actuators

- Pre-engineered, ready-to-run packages
- High performance at an economical cost
- Designed for multi-axis compatibility

Motion Control Technologies from Parker

Parker provides “perfect fit” electromechanical solutions for high-precision positioning and high-speed automation. These systems are offered at selectable levels of integration ranging from motor components ... to basic single axis mechanical tables ... to complete electromechanical systems and robots including motors, drives, controls, and machine interface.

EPX InteractX Powerstations

- InteractX Windows HMI with unlimited tags and 60+ drivers
- Hard drive or Compact Fash storage
- Ethernet, USB, RS232/422/485 communications
- Breakthrough graphic technology
- Panel tool library for easy screen development (no scripting)

ACR9000 Motion Controller

- Interpolation of up to 8 axes of servo or stepper control
- Advanced multitasking
- 10/100 Base T Ethernet and USB communications
- Absolute encoder support via SSI
- Linear motor “gantry lock” feature to provide accurate skew control for gantry roots

Aries servo amplifiers

- Fully digital, sinusoidally commutated brushless servo drive
- 7 power levels available up to 16 ARMS continuous current, or 3000 W
- Plug in and Spin - no set up required with Parker smart encoder
- Supports incremental, absolute and resolver feedback

Engineered Precision Motion Systems

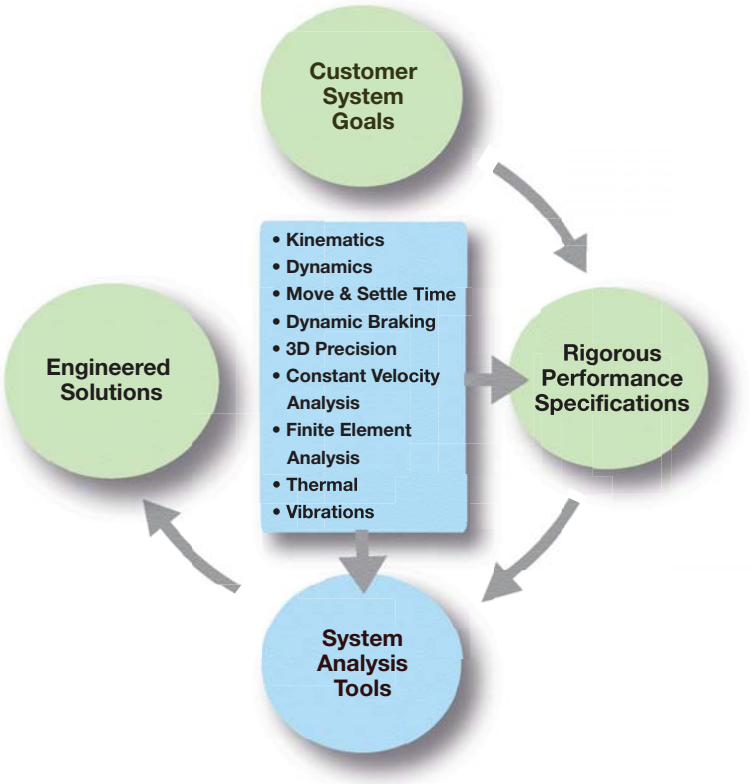
OEMs and manufacturers look to Parker because they know our extensive motion system design experience, systematic project management process, and global infrastructure ensure their needs are met.

Through years of motion system design and manufacturing, we have developed a collaborative development cycle and systematic six-step project management process that leads the motion industry.

Since our technology enables our customer's technology, we build strategic partnerships and strictly maintain confidentiality with our customers.

Parker's Engineered Solutions incorporate air-bearing, linear motor, and pneumatic technology with composite or conventional materials to create a total solution.

Collaborative Development Cycle



Custom Engineered systems for demanding industries

- Flat Panel
- Semiconductor
- Life Sciences and Biomedical
- Aerospace
- And other industries with rigorous performance specifications

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