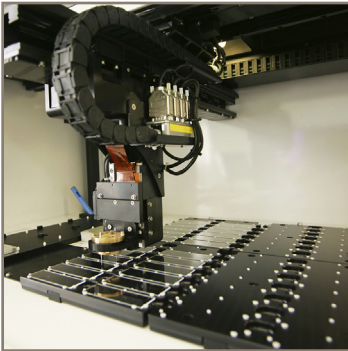
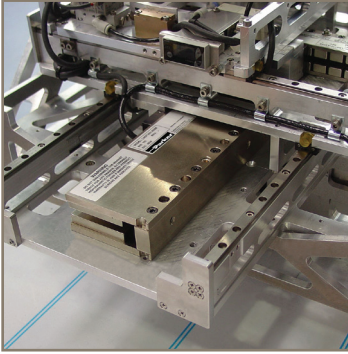
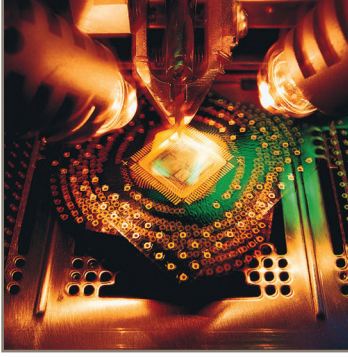
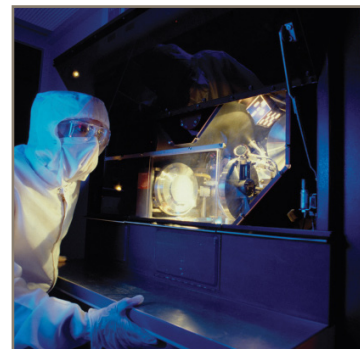




Linear Motors

I-Force Ironless and RIPPED Ironcore Series



ENGINEERING YOUR SUCCESS.

I-Force and Ironcore Linear Motors

Parker Hannifin has been providing innovative automation solutions for decades. This spirit of innovation continues within the exploding market of linear motor technology.

In 2003, Parker acquired Trilogy Corporation, one of the most recognized brands in linear motors. The powerful combination of Parker's and Trilogy's patented linear motor solutions gives automation and robotics customers distinct performance enhancements and cost of ownership benefits over competing technologies.

With a full complement of linear motor components and fully engineered positioning systems, Parker has the right solution to increase productivity and to enhance the accuracy and dynamic performance of your machine.

Parker has one of the broadest offerings in available linear motor technologies. From component or "kit" style motors, packaged positioning tables, to complete custom engineered systems, Parker can provide a solution for any linear motion requirement. This document focuses on Parker's two families of component-style motors. Typical applications for Parker linear motor products include:

- **Semiconductor and electronics**
- **Flat panels, solar panels**
- **Medical and life sciences**
- **Machine tools**
- **Optics and photonics**
- **Large format printing, scanning and digital fabrication**

Linear Motor Design Benefits

- **High speeds**
- **High accelerations**
- **Fast response – 100 times that of a mechanical system**
- **Stiffness – spring rate better than a mechanical system**
- **Zero backlash – direct drive technology**
- **Maintenance free operation – mechanical simplicity due to reduced component count**
- **Long travels without performance loss**
- **Suitable for vacuum and extreme environments**



Linear Motor Advantages

A linear motor operates in exactly the same way as a rotary motor that has been “unwrapped.” The same electromagnetic effects that produce torque in a rotary motor now produce a direct force in a linear motor.

For many applications, linear motors offer distinct advantages over conventional rotary drive systems. For example, there is no need to couple the motor to the load by means of intermediate mechanical components such as gears, ballscrews, or belt drives. The load is directly connected to the motor.

Therefore, there is no backlash or elasticity from the moving elements. Thus, the dynamic behavior of the servo control is improved and higher levels of accuracy are achieved.

The absence of a mechanical transmission component also results in a drive system with low inertia and noise. In addition, mechanical wear only occurs in the guidance system. Consequently, linear motors have better reliability and lower frictional losses than traditional rotary drive systems.

Design Engineering with Linear Motors

Component linear motors such as the I-Force and Ironcore consist of a motor coil and separate magnet track.

The coil assembly is known as the “forcer” or sometimes as the “primary” element. The forcer generally consists of the motor coil and an attachment plate or mounting bar which allows the coil to connect to the carriage. The motor cables typically exit from one side of the package.

The magnet track is sometimes referred to as the “secondary” element. Depending on the type of linear motor used, the magnet track can either be a single row of magnets or a double-sided configuration offering balanced attraction forces.

The ability to select linear motor components gives the user an economical solution and complete flexibility with respect to integration into the machine. However, this flexibility also requires an understanding of motor characteristics, linear feedback technology, cooling methods, and the performance of the servo amplifier and control system.

- **Let Parker’s extensive motion design experience, systematic project management process, and global infrastructure solve your most demanding motion problems**
- **Collaborative development cycle aligns customer goals and rigorous performance specifications with a complete engineered solution**

Please contact Parker application engineering if you need any assistance with your design.

I-Force Ironless Motors

Page 4 – 29

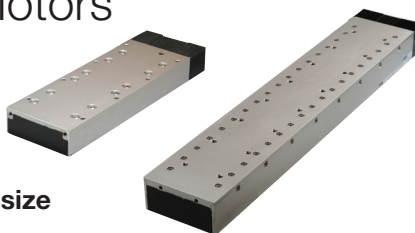
- **Four track sizes**
- **Forces to 3928 N (883 lbs)**
- **Unlimited lengths**
- **Ultra high performance**
- **Zero cogging**



RIPPED Ironcore Motors

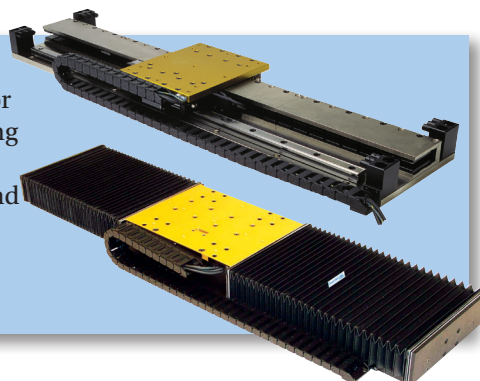
Page 30 – 38

- **3 track sizes**
- **Forces to 7433 N (1671 lbs)**
- **Unlimited lengths**
- **Highest power per package size**



For information on Parker’s extensive line of linear motor positioner products including industrial-grade, precision-grade, multi-axis systems and custom capabilities, please visit our website at

parker.com/emc



I-Force Ironless Linear Motors

Parker's I-Force Ironless Linear Motors offer high forces and rapid accelerations in a compact package. With forces ranging from 24.5 N (5.5 lbf) to 878.6 N (197.5 lbf) continuous up to 108.5 N (24.5 lbf) to 3928 N (883 lbf) 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.

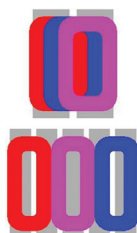
Ultra high-flex cables come standard with I-Force motors. In addition, Parker offers modular magnet tracks for unrestricted travel length. Incredibly smooth motion, high precision and high force density make the I-Force linear motors an ideal solution for your demanding positioning requirements.

No attractive force toward the magnets

- Easier/Safer assembly and handling, smoother travel (no cogging)

Overlapping windings

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



Overlapped windings

Non-overlapped windings

Uses thermally conductive epoxy together with the windings

- Patented ironless motors design (RE34674) provides 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

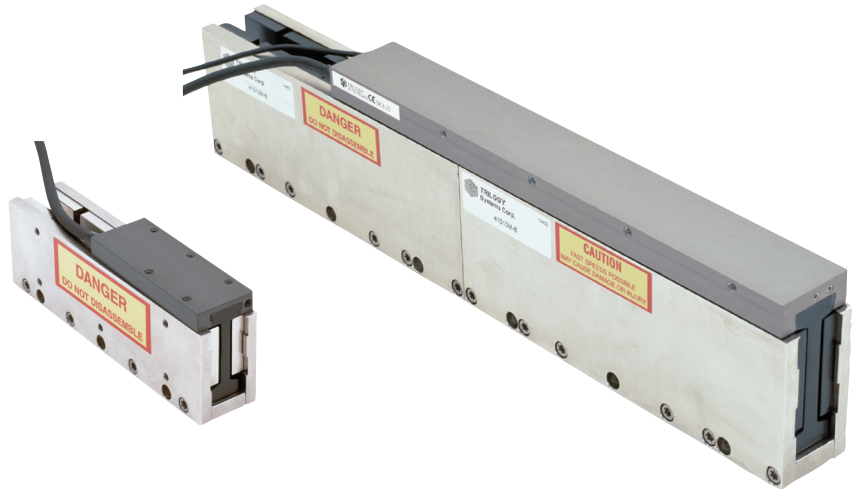
- Precision ground 3-piece track
- Unrestricted travel length
- Two lengths of modular magnet tracks allow unlimited length of travel

Embedded overtemp thermostat or optional thermistor

- Protects windings against overheating
- Prealigned imbedded digital Hall effect devices
- Internal thermal cutout switch protects coil

Ultra high-flex cables

- Longer cable life, good for millions of cycles



Ironless Advantages

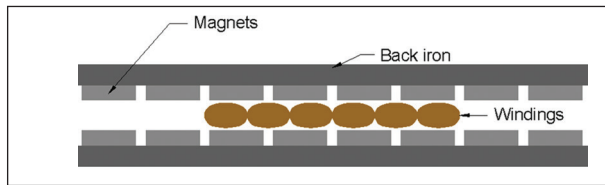
- No attractive force – balanced dual magnet track, safe and easy to handle, no force to deal with during assembly
- No cogging – ironless forcer for zero cogging and ultimate smoothness.
- Low weight forcer – no iron means higher acceleration and deceleration rates, higher mechanical bandwidth.
- Air gap forgiving – easy to align and install

Disadvantages Compared to Ironcore

- Heat dissipation – higher thermal resistance, patented Parker I-beam design helps mitigate this issue (see below)
- Lower RMS power when compared to ironcore designs.
- Uses twice as many magnets which increases unit cost

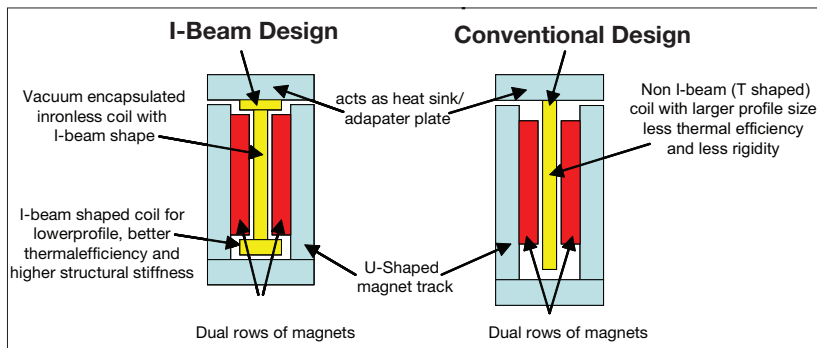
I-Force Patented I-Beam Design

Ironless motors consist of a forcer (windings), which rides between dual magnet rails.



The forcer does not have any iron laminations in the coil – hence the name ironless. Instead, the copper windings are encapsulated and located in the

air gap between the two rows of magnets. Because the motors are ironless, there are no attractive forces or cogging forces between the forcer and the magnet track.



Parker's patented I-beam shape provides very high forces in a compact package. In addition, the design is more thermally efficient than tradition ironless motor designs.

The ironless forcers have lower mass than their ironcore counterparts resulting in extremely high accelerations and overall dynamic performance. The ironless design has zero cogging and the lack of attractive force allows for extended bearing life and, in some applications, the ability to use smaller bearings.

While the high dynamic performance and zero cogging motion make the ironless motors a powerful design, they are not as thermally efficient as their ironcore counterparts. A small contacting surface area and a long thermal path from the winding base to the cooling plate makes the full-load power of these motors low. In addition, the dual row of magnets increases the overall cost of these motors in relation to the generated force and stroke length.

I-Force Ironless Motor Selection

				
Model	110	210	310	410
Page	6	12	18	24
Cross Section – H x W mm (in)	50 x 21 (2.05 x 0.82)	57.1 x 31.7 (2.25 x 1.25)	86.4 x 34.3 (3.40 x 1.35)	114.3 x 50.8 (4.50 x 2.00)
Continuous Force – N (lbs)	44 (10)	104.5 (24.8)	262 (58)	878 (197)
Peak Force – N (lbs)	200 (45)	494 (110)	1170 (263)	3928 (883)
Maximum Track Length – mm (in)	Unlimited	Unlimited	Unlimited	Unlimited
Modular Single Piece	914 (36)	1219 (48)	1676 (66)	1829 (72)
Cooling ¹	—	Internal air cooling manifold available	Internal air cooling manifold or liquid cooling available	Internal air cooling manifold or liquid cooling available
Digital Hall Effect Devices	None, Imbedded	None, Imbedded	None, Imbedded	None, Imbedded

¹ Consult factory for cooling performance

I-Force Ironless 110 Series

Performance

Model	Units	110-1	110-2
Peak Force ¹⁾	N (lb)	108.5 (24.4)	202.5 (45.5)
Continuous Force ²⁾	N (lb)	24.5 (5.5)	45.4 (10.2)
Peak Power	W	938	1641
Continuous Power	W	47	82

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.

Electrical

Model	Units	110-1		110-2		
Winding	Series/Parallel/Triple	S	P	S	P	T
Peak Current	A pk sine	15.9	31.8	14.8	29.6	44.4
	RMS	11.2	22.5	10.4	20.9	31.4
Continuous Current	A pk sine	3.6	7.2	3.3	6.6	9.9
	RMS	2.5	5.1	2.3	4.7	7.1
Force Constant ¹⁾	N/A peak	6.8	3.4	13.7	6.8	4.6
	lb/A peak	1.5	0.8	3.1	1.5	1.0
Back EMF ²⁾	V/m/s	7.9	3.9	15.7	7.9	5.2
	V/in/s	0.20	0.10	0.40	0.20	0.13
Resistance @ 25°C (phase-to-phase) ³⁾	ohms	3.8	0.95	7.6	1.9	0.84
Inductance (phase-to-phase) ⁴⁾	mH	1.0	0.3	2.0	0.5	0.2
Electrical Time Constant ⁵⁾	ms	0.3	0.3	0.3	0.3	0.3
Motor Constant ⁶⁾	N/W	3.56	3.56	5.02	5.02	5.02
	lb/W	0.80	0.80	1.13	1.13	1.13
Terminal Voltage (max.) ⁷⁾	VDC	330	330	330	330	330

1) 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).

2) Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.

3) 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).

4) Inductance measured using 1 Kz with the motor in the magnetic field.

5) Electrical time constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.

6) 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.

7) Consult factory for use with non-Parker amplifiers.

Thermal*

Model	Units	110-1	110-2
Thermal Resistance Wind-Amb	°C/W	1.59	0.92
Thermal Time Constant (min.) ¹⁾		3.2	3.2
Maximum Winding Temperature ²⁾	°C	100	100

* Use Parker's MotionSizer software for the most accurate estimate of coil temperature for a particular motion profile.

1) Thermal time constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.

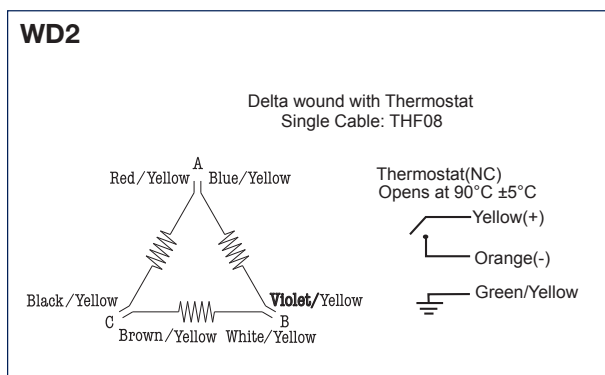
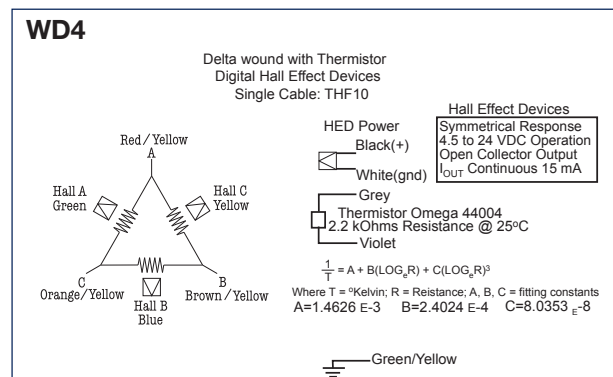
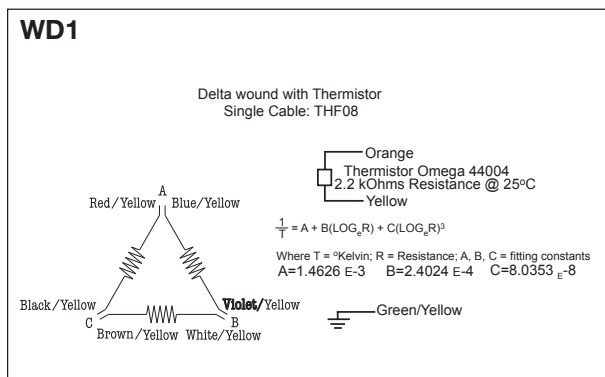
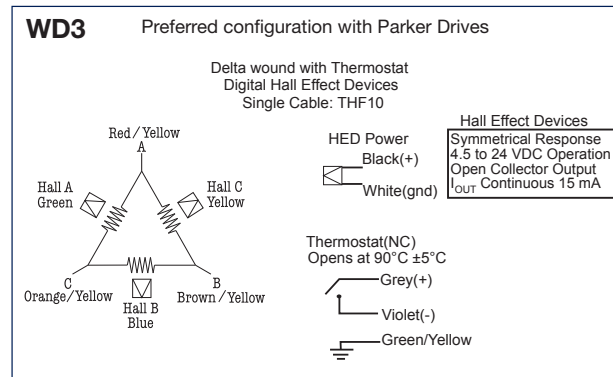
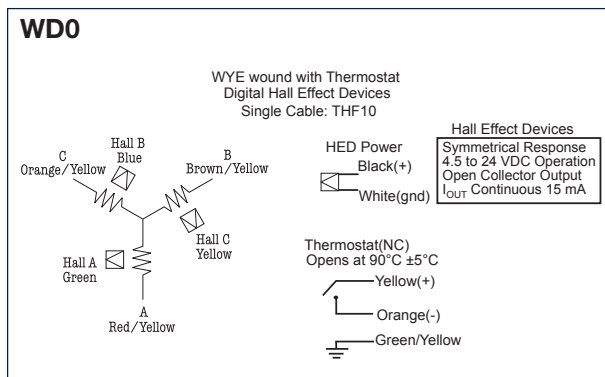
2) Thermal resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated determined experimentally.

Mechanical

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

1) Electrical cycle length is distance coil must travel to complete 360° electrical cycle.

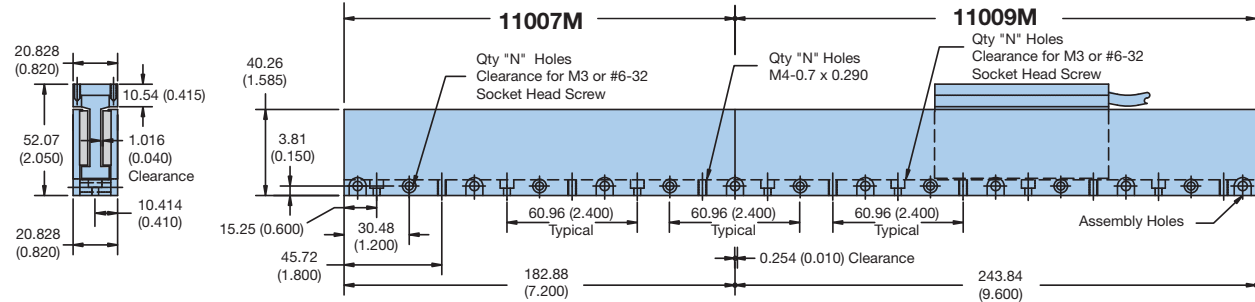
Wiring Options



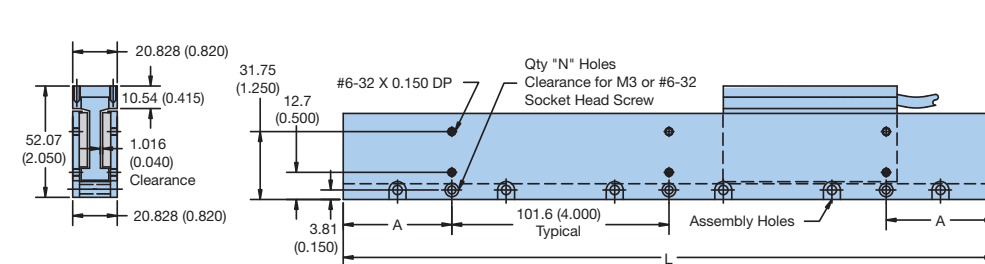
I-Force Ironless 110 Series

Magnet Track Specifications

110xxM Modular – mm (in)



110xxS Single Piece – mm (in)



	110xxM Modular	110xxS Single Piece
Incremental Length – mm (in)	60.96 (2.4)	30.48 (1.2)
Minimum Length – mm (in)	121.92 (4.8)	213.4 (8.4)
Maximum Length – mm (in) (for single piece)	914.40 (36)	914.40 (36)
Flatness - mm (in) per 12" of magnet track	0.1016 (0.004)	0.1016 (0.004)
Weight – kg/m (lbs/ft)	3.89 (2.66)	3.89 (2.66)

110xxM Modular

Part Number	L		N
	mm	in	
11004M	121.92	4.8	2
11007M	182.88	7.2	3
11009M	243.84	9.6	4
11012M	304.80	12.0	5
11014M	365.76	14.4	6
11016M	426.72	16.8	7
11019M	487.68	19.2	8
11021M	548.64	21.6	9
11024M	609.60	24.0	10
11026M	670.56	26.4	11
11028M	731.52	28.8	12
11031M	792.48	31.2	13
11033M	853.44	33.6	14
11036M	914.40	36.0	15

Modular Track Combinations With 11007M and 11009M Sections

Length (L)*		Quantity	
mm	in	11007M	11009M
182.9	7.2	1	0
243.8	9.6	0	1
365.8	14.4	2	0
426.7	16.8	1	1
487.7	19.2	0	2
548.6	21.6	3	0
609.6	24.0	2	1
670.6	26.4	1	2
731.5	28.8	0	3
792.5	31.2	3	1
853.4	33.6	2	2
914.4	36.0	1	3
975.4	38.4	0	4
1036.3	40.8	3	2
1097.3	43.2	2	3
1158.2	45.6	1	4
1219.2	48.0	0	5
1280.2	50.4	3	3
1341.1	52.8	2	4
1402.1	55.2	1	5
1463.0	57.6	0	6
1524.0	60.0	3	4

*Length is unlimited by combining modular track sections.

110xxS Single Piece

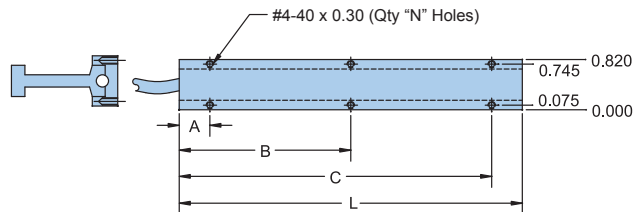
Part Number	L		A		N
	mm	in	mm	in	
11008S	213.36	8.4	5.08	0.20	3
11009S	243.84	9.6	20.32	0.80	3
11010S	274.32	10.8	35.56	1.40	3
11012S	304.80	12.0	50.80	2.00	3
11013S	335.28	13.2	66.04	2.60	3
11014S	365.76	14.4	81.28	3.20	3
11015S	396.24	15.6	96.52	3.80	3
11016S	426.72	16.8	10.16	0.40	5
11018S	457.20	18.0	25.40	1.00	5
11019S	487.68	19.2	40.64	1.60	5
11020S	518.16	20.4	55.88	2.20	5
11021S	548.64	21.6	71.12	2.80	5
11022S	579.12	22.8	86.36	3.40	5
11024S	609.60	24.0	101.60	4.00	5
11025S	640.08	25.2	15.24	0.60	7
11026S	670.56	26.4	30.48	1.20	7
11027S	701.04	27.6	45.72	1.80	7
11028S	731.52	28.8	60.96	2.40	7
11030S	762.00	30.0	76.20	3.00	7
11031S	792.48	31.2	91.44	3.60	7
11032S	822.96	32.4	5.08	0.20	9
11033S	853.44	33.6	20.32	0.80	9
11034S	883.92	34.8	35.56	1.40	9
11036S	914.40	36.0	50.80	2.00	9

I-Force 110 Series

Coil Specifications

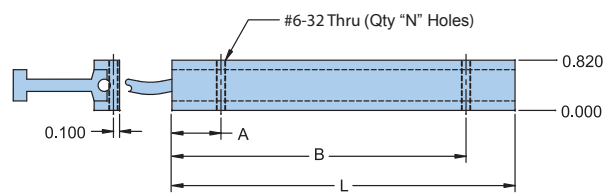
Imperial Mounting Options

Top Mounting (A)



Coil Size/Mounting Code	Dimensions (in)				
	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

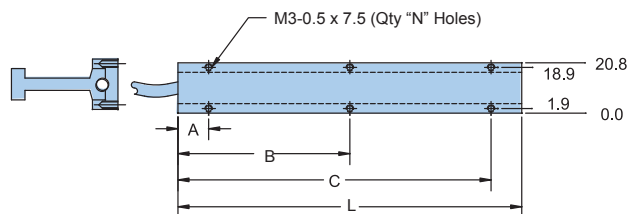
Side Mounting (B)



Coil Size/Mounting Code	Dimensions (in)			
	L	N	A	B
110-1B	3.20	2	0.80	2.40
110-2B	5.60	2	0.80	4.80

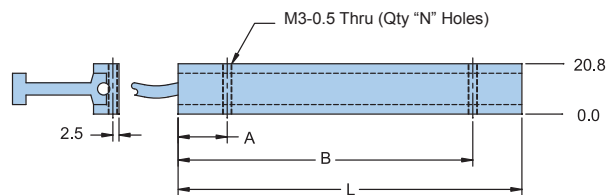
Metric Mounting Options

Top Mounting (M)



Coil Size/Mounting Code	Dimensions (mm)				
	L	N	A	B	C
110-1M	81.3	4	12.7	68.6	—
110-2M	142.2	6	0.50	71.1	129.5

Side Mounting (N)



Coil Size/Mounting Code	Dimensions (mm)			
	L	N	A	B
110-1N	81.3	2	20.3	60.9
110-2N	142.2	2	20.3	121.9

How to order

Fill in an order code from each of the numbered fields to create a complete Motor Coil and Magnet Track order number.

Motor Coil

Order Example:

①	②	③	④	⑤	⑥	⑦
110	-	2	B	-	NC	- WD2 P - 8

- ① **Series**
110
- ② **Coil Size**
1 One pole
2 Two poles
- ③ **Mounting**
A Imperial top mount
B Imperial side mount
M Metric top mount
N Metric side mount
- ④ **Cooling**
NC No cooling
- ⑤ **Wiring Options** (Refer to page 7)
WD0
WD1
WD2
WD3
WD4
- ⑥ **Winding**
S Series
P Parallel
T Triple (not available for 1-pole motor)
- ⑦ **Cable Length**
xx Specify in feet (8 ft standard)

Magnet Track

Order Example:

①	②
11024M	- N

- ① **Series**
11007M 7.20" modular sections (refer to Modular Track Combinations chart on page 9)
11009M 9.60" modular sections (refer to Modular Track Combinations length chart on page 9)
110xxM 4.8 to 36.0" single piece, 2.4" increments (refer to part number selection chart on page 9)
110xxS 8.4" to 36.0" single piece, 1.2" increments (refer to part number selection chart on page 9)
- ② **Magnet Coating**
N Nickel coating (standard)
B Black epoxy

I-Force Ironless 210 Series

Performance

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

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.

Electrical

Model	Units	210-1			210-2			210-3			210-4		
Winding	Series/Parallel/Triple	S	P	T	S	P	T	S	P	T	S	P	T
Peak Current	A pk sine	12.6	25.2	37.8	11.8	23.6	35.4	11.5	23.0	34.5	11.3	22.6	33.9
	RMS	8.9	17.8	26.7	8.3	16.7	25.0	8.1	16.3	24.4	8.0	16.0	23.9
Continuous Current	A pk sine	2.8	5.6	8.4	2.6	5.2	7.8	2.6	5.2	7.8	2.5	5.0	7.5
	RMS	1.9	3.9	5.9	1.8	3.7	5.5	1.8	3.7	5.5	1.8	3.5	5.3
Force Constant ¹⁾	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 ²⁾	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) ³⁾	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) ⁴⁾	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 ⁵⁾	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 ⁶⁾	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
Terminal Voltage (max.) ⁷⁾	VDC	330	330	330	330	330	330	330	330	330	330	330	330

1) 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).

2) Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.

3) 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).

4) Inductance measured using 1 Kz with the motor in the magnetic field.

5) Electrical time constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.

6) 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.

7) Consult factory for use with non-Parker amplifiers.

Thermal*

Model	Units	210-1	210-2	210-3	210-4
Thermal Resistance Wind-Amb	°C/W	1.67	0.94	0.66	0.51
Thermal Time Constant (min.) ¹⁾		4.3	4.3	4.3	4.3
Maximum Winding Temperature ²⁾	°C	100	100	100	100

* Use Parker's MotionSizer software for the most accurate estimate of coil temperature for a particular motion profile.

1) Thermal time constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.

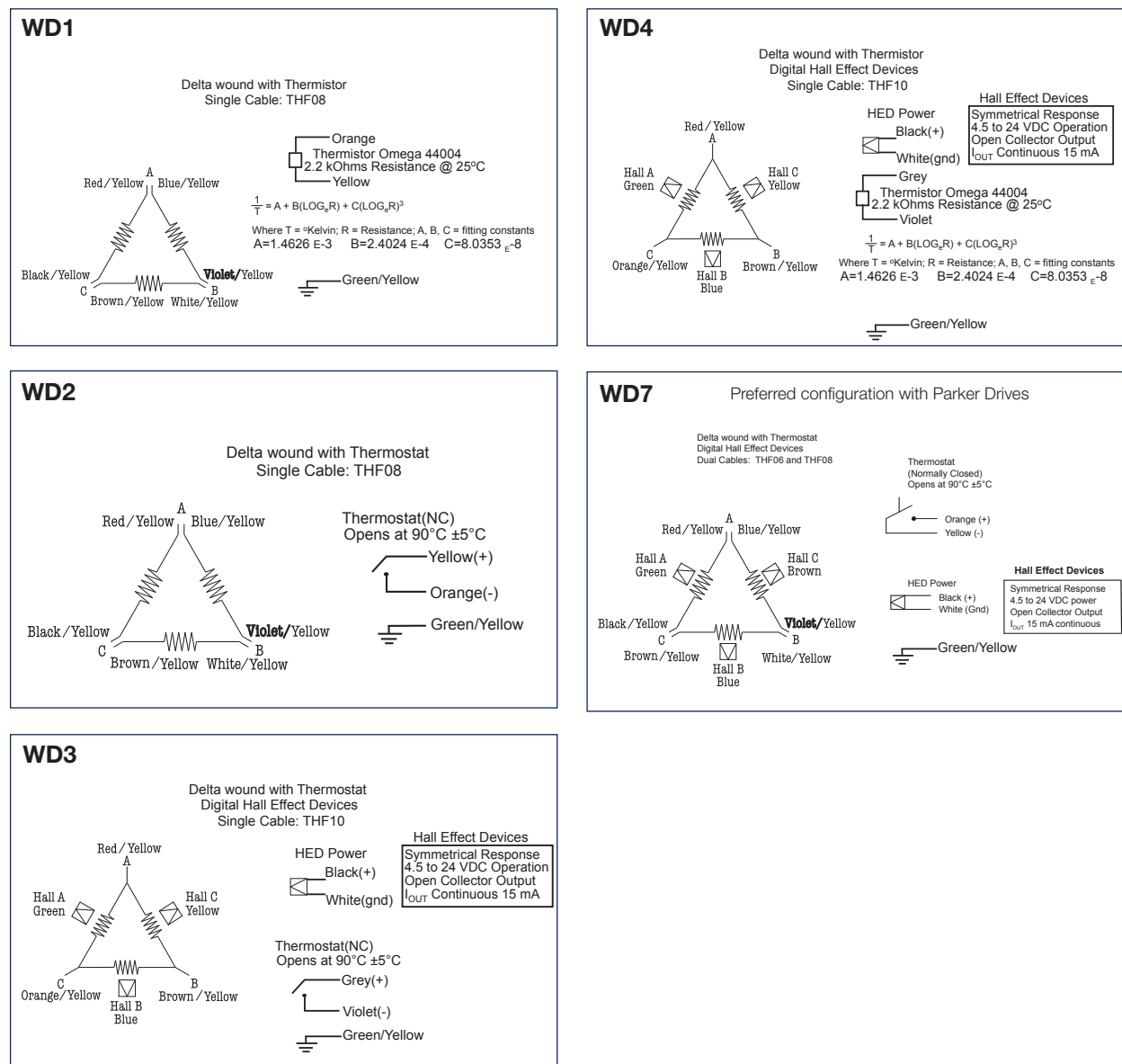
2) Thermal resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated determined experimentally.

Mechanical

Model	Units	210-1	210-2	210-3	210-4
Coil Weight	kg (lb)	0.16 (0.35)	0.27 (0.60)	0.39 (0.86)	0.51 (1.12)
Coil Length	mm (in)	81.3 (3.20)	142.2 (5.60)	203.2 (8.00)	264.2 (10.4)
Attractive Force	N (lbf)	0	0	0	0
Electrical Cycle Length ¹⁾	mm (in)	60.96 (2.40)	60.96 (2.40)	60.96 (2.40)	60.96 (2.40)

1) Electrical cycle length is distance coil must travel to complete 360° electrical cycle.

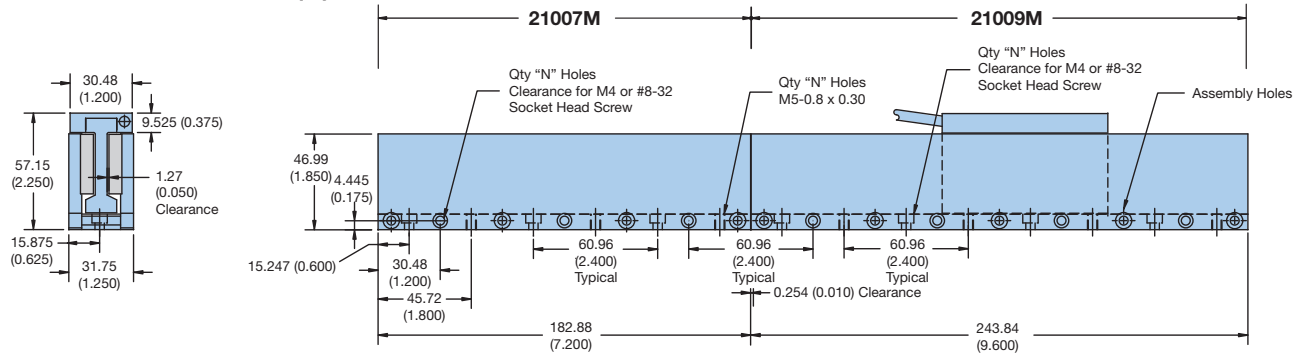
Wiring Options



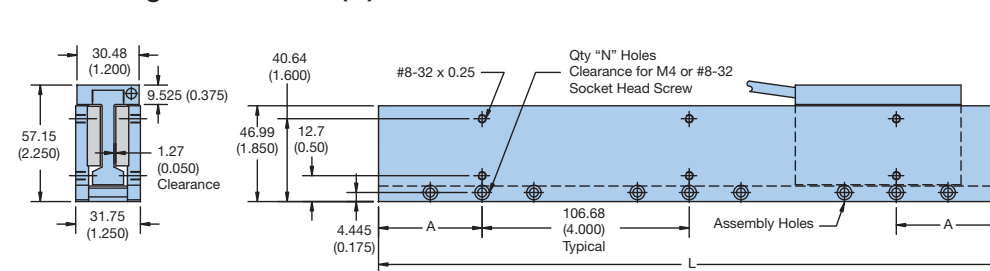
I-Force Ironless 210 Series

Magnet Track Specifications

210xxM Modular – mm (in)



210xxS Single Piece – mm (in)



	210xxM Modular	210xxS Single Piece
Incremental Length – mm (in)	60.96 (2.4)	30.48 (1.2)
Minimum Length – mm (in)	121.92 (4.8)	213.4 (8.4)
Maximum Length – mm (in) (for single piece)	1219.2 (48)	1219.2 (48)
Flatness - mm (in) per 12" of magnet track	0.1016 (0.004)	0.1016 (0.004)
Weight – kg/m (lbs/ft)	8.22 (5.50)	8.22 (5.50)

210xxM Modular

Part Number	L		N
	mm	in	
21004M	121.92	4.8	2
21007M	182.88	7.2	3
21009M	243.84	9.6	4
21012M	304.80	12.0	5
21014M	365.76	14.4	6
21016M	426.72	16.8	7
21019M	487.68	19.2	8
21021M	548.64	21.6	9
21024M	609.60	24.0	10
21026M	670.56	26.4	11
21028M	731.52	28.8	12
21031M	792.48	31.2	13
21033M	853.44	33.6	14
21036M	914.40	36.0	15
21038M	975.36	38.4	16
21040M	1036.32	40.8	17
21043M	1097.28	43.2	18
21045M	1158.24	45.6	19
21048M	1219.20	48.0	20

Modular Track Combinations With 21007M and 21009M Sections

Length (L)*		Quantity	
mm	in	21007M	21009M
182.9	7.2	1	0
243.8	9.6	0	1
365.8	14.4	2	0
426.7	16.8	1	1
487.7	19.2	0	2
548.6	21.6	3	0
609.6	24.0	2	1
670.6	26.4	1	2
731.5	28.8	0	3
792.5	31.2	3	1
853.4	33.6	2	2
914.4	36.0	1	3
975.4	38.4	0	4
1036.3	40.8	3	2
1097.3	43.2	2	3
1158.2	45.6	1	4
1219.2	48.0	0	5

*Length is unlimited by combining modular track sections.

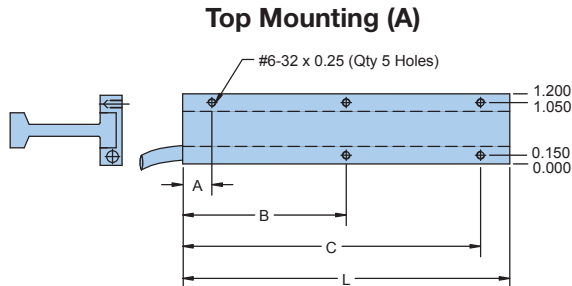
210xxS Single Piece

Part Number	L		A		N
	mm	in	mm	in	
21008S	213.36	8.4	5.08	0.20	3
21009S	243.84	9.6	20.32	0.80	3
21010S	274.32	10.8	35.56	1.40	3
21012S	304.80	12.0	50.80	2.00	3
21013S	335.28	13.2	66.04	2.60	3
21014S	365.76	14.4	81.28	3.20	3
21015S	396.24	15.6	96.52	3.80	3
21016S	426.72	16.8	10.16	0.40	5
21018S	457.20	18.0	25.40	1.00	5
21019S	487.68	19.2	40.64	1.60	5
21020S	518.16	20.4	55.88	2.20	5
21021S	548.64	21.6	71.12	2.80	5
21022S	579.12	22.8	86.36	3.40	5
21024S	609.60	24.0	101.60	4.00	5
21025S	640.08	25.2	15.24	0.60	7
21026S	670.56	26.4	30.48	1.20	7
21027S	701.04	27.6	45.72	1.80	7
21028S	731.52	28.8	60.96	2.40	7
21030S	762.00	30.0	76.20	3.00	7
21031S	792.48	31.2	91.44	3.60	7
21032S	822.96	32.4	5.08	0.20	9
21033S	853.44	33.6	20.32	0.80	9
21034S	883.92	34.8	35.56	1.40	9
21036S	914.40	36.0	50.80	2.00	9
21037S	944.88	37.2	66.04	2.60	9
21038S	975.36	38.4	81.28	3.20	9
21039S	1005.84	39.6	96.52	3.80	9
21040S	1036.32	40.8	10.16	0.40	11
21042S	1066.80	42.0	25.40	1.00	11
21043S	1097.28	43.2	40.64	1.60	11
21044S	1127.76	44.4	55.88	2.20	11
21045S	1158.24	45.6	71.12	2.80	11
21046S	1188.72	46.8	86.36	3.40	11
21048S	1219.20	48.0	101.60	4.00	11

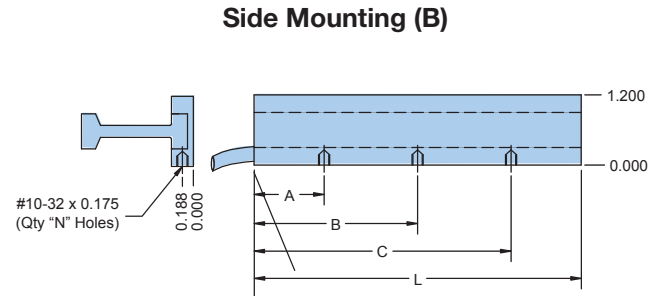
I-Force Ironless 210 Series

Coil Specifications

Imperial Mounting Options

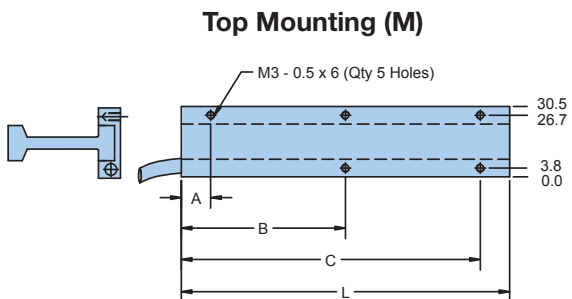


Coil Size/Mounting Code	Dimensions (in)			
	L	A	B	C
210-1A	3.20	0.50	1.60	2.70
210-2A	5.60	0.50	2.80	5.10
210-3A	8.00	0.50	4.00	7.50
210-4A	10.40	0.50	5.20	9.90

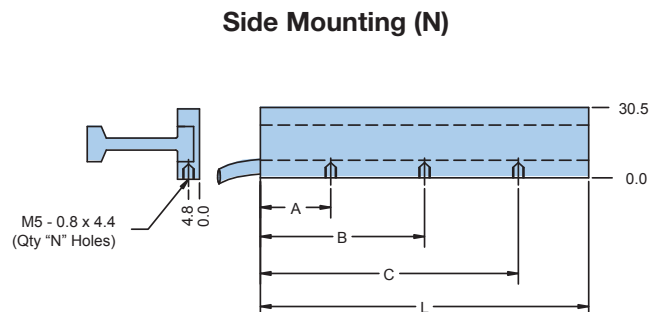


Coil Size/Mounting Code	Dimensions (in)				
	L	N	A	B	C
210-1B	3.20	2	1.950	2.950	—
210-2B	5.60	2	1.625	3.975	—
210-3B	8.00	3	2.438	4.000	5.562
210-4B	10.40	3	2.600	5.200	7.800

Metric Mounting Options



Coil Size/Mounting Code	Dimensions (mm)			
	L	A	B	C
210-1M	81.3	12.7	40.6	68.6
210-2M	142.2	12.7	71.1	129.5
210-3M	203.2	12.7	101.6	190.5
210-4M	264.2	12.7	132.1	251.5



Coil Size/Mounting Code	Dimensions (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

How to order

Fill in an order code from each of the numbered fields to create a complete Motor Coil and Magnet Track order number.

Motor Coil

Order Example:

①	②	③	④	⑤	⑥	⑦				
210	-	2	B	-	NC	-	WD2	P	-	8

- ① **Series**
210
- ② **Coil Size**
 - 1** One pole
 - 2** Two poles
 - 3** Three poles
 - 4** Four poles
- ③ **Mounting**
 - A** Imperial top mount
 - B** Imperial side mount
 - M** Metric top mount
 - N** Metric side mount
- ④ **Cooling**
 - NC** No cooling
 - AC** Air cooling
- ⑤ **Wiring Options** (Refer to page 13)
 - WD1**
 - WD2**
 - WD3**
 - WD4**
 - WD7**
- ⑥ **Winding**
 - S** Series
 - P** Parallel
 - T** Triple (not available for 1-pole motor)
- ⑦ **Cable Length**
 - xx** Specify in feet (8 ft standard)

Magnet Track

Order Example:

①	②
21024M	- N

- ① **Series**
 - 21007M** 7.20" modular sections (refer to Modular Track Combinations chart on page 15)
 - 21009M** 9.60" modular sections (refer to Modular Track Combinations length chart on page 15)
 - 210xxM** 4.8 to 48.0" single piece, 2.4" increments (refer to part number selection chart on page 15)
 - 210xxS** 8.4" to 48.0" single piece, 1.2" increments (refer to part number selection chart on page 15)
- ② **Magnet Coating**
 - N** Nickel coating (standard)
 - B** Black epoxy

I-Force Ironless 310 Series

Performance

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

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.

Electrical

Model	Units	310-1			310-2			310-3			310-4			310-5			310-6		
Winding	Series/Parallel/Triple	S	P	T	S	P	T	S	P	T	S	P	T	S	P	T	S	P	T
Peak Current	A pk sine	16.1	32.2	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	
	RMS	11.4	22.8	10.6	21.2	31.8	10.4	20.8	31.2	10.3	20.5	30.8	10.2	20.4	30.5	10.1	20.2	30.3	
Continuous Current	A pk sine	3.6	7.2	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	
	RMS	2.5	5.1	2.4	4.8	7.2	2.5	4.7	7.0	2.3	4.5	6.8	2.3	4.5	6.8	2.3	4.5	6.8	
Force Constant ¹⁾	N/A peak	13.7	6.8	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	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 ²⁾	V/m/s	15.7	7.8	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	0.80	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) ³⁾	ohms	4.0	1.0	8.1	2	0.87	12.1	3	1.3	16.1	3.87	1.74	20.2	4.84	2.17	24.2	5.8	2.6	
Inductance (phase-to-phase) ⁴⁾	mH	3.0	0.8	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 ⁵⁾	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	
Motor Constant ⁶⁾	N/W	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	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	
Terminal Voltage (max.) ⁷⁾	VDC	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330	

1) 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).

2) Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.

3) 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).

4) Inductance measured using 1 Kz with the motor in the magnetic field.

5) Electrical time constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.

6) 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.

7) Consult factory for use with non-Parker amplifiers.

Thermal*

Model	Units	310-1	310-2	310-3	310-4	310-5	310-6
Thermal Resistance Wind-Amb	°C/W	1.39	0.79	0.56	0.43	0.35	0.29
Thermal Time Constant (min.) ¹⁾		7.5	7.5	7.5	7.5	7.5	7.5
Maximum Winding Temperature ²⁾	°C	100	100	100	100	100	100

* Use Parker's MotionSizer software for the most accurate estimate of coil temperature for a particular motion profile.

1) Thermal time constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.

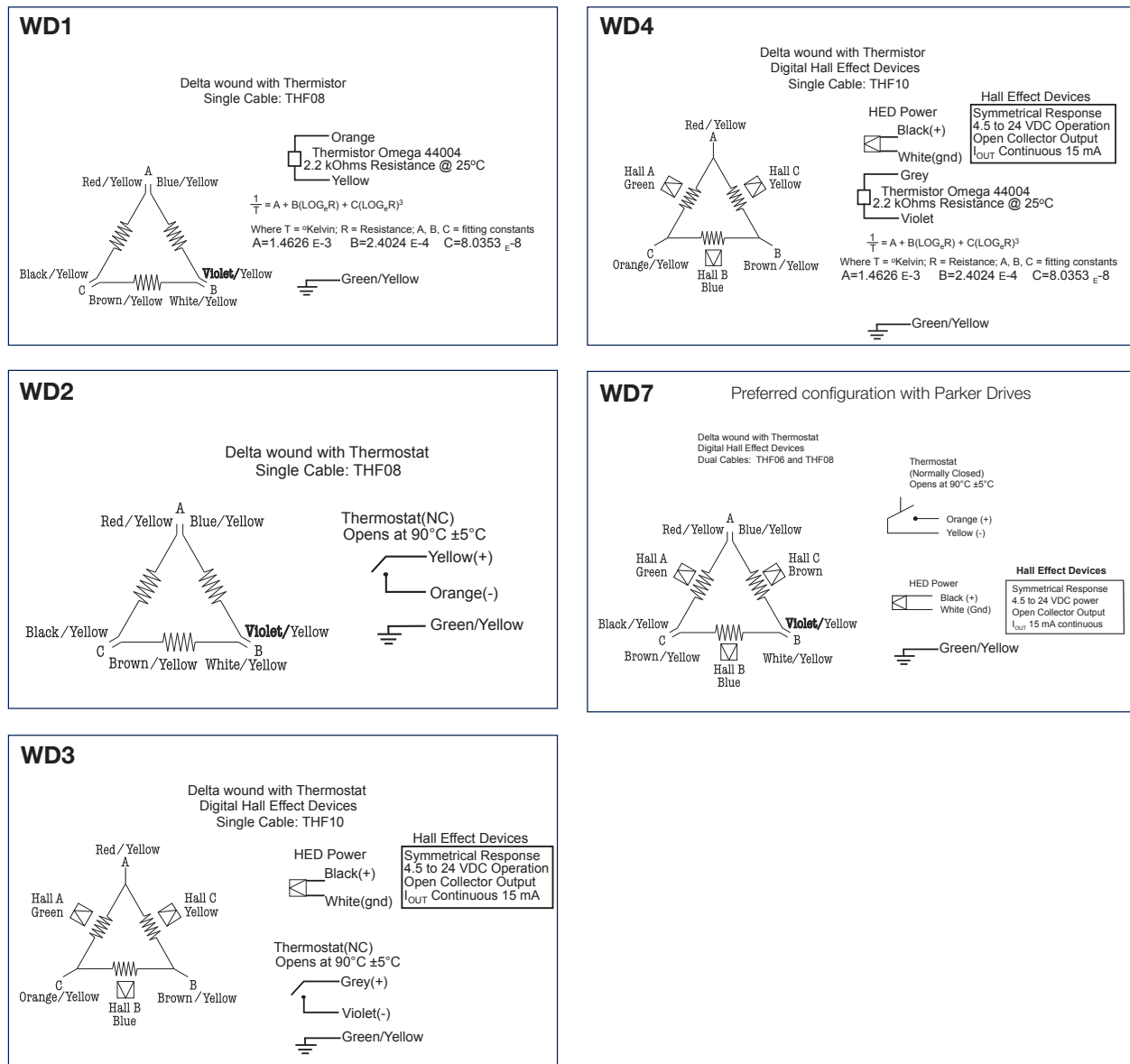
2) Thermal resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated determined experimentally.

Mechanical

Model	Units	310-1	310-2	310-3	310-4	310-5	310-6
Coil Weight	kg (lb)	0.31 (0.69)	0.55 (1.22)	0.80 (1.75)	1.03 (2.27)	1.27 (2.80)	1.53 (3.36)
Coil Length	mm (in)	81.3 (3.20)	142.2 (5.60)	203.2 (8.00)	264.2 (10.4)	325.1 (12.8)	386.1 (15.2)
Attractive Force	N (lbf)	0	0	0	0	0	0
Electrical Cycle Length ¹⁾	mm (in)	60.96 (2.40)	60.96 (2.40)	60.96 (2.40)	60.96 (2.40)	60.96 (2.40)	60.96 (2.40)

1) Electrical cycle length is distance coil must travel to complete 360° electrical cycle.

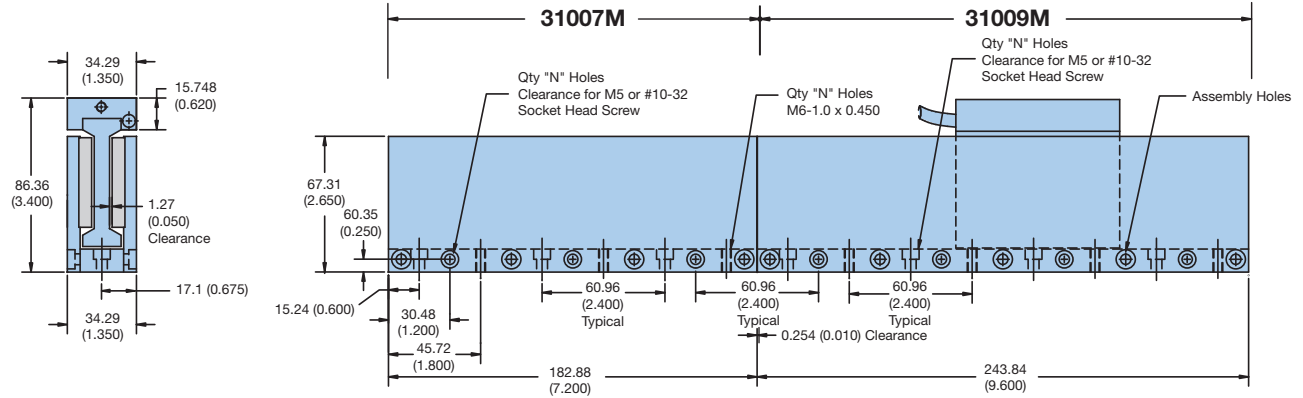
Wiring Options



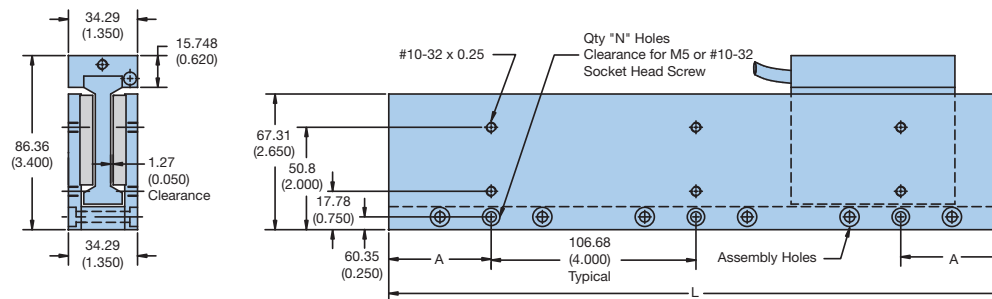
I-Force Ironless 310 Series

Magnet Track Specifications

310xxM Modular – mm (in)



310xxS Single Piece – mm (in)



	310xxM Modular	310xxS Single Piece
Incremental Length – mm (in)	60.96 (2.4)	30.48 (1.2)
Minimum Length – mm (in)	121.92 (4.8)	213.4 (8.4)
Maximum Length – mm (in) (for single piece)	1584.96 (62.4)	1615.4 (63.6)
Flatness - mm (in) per 12" of magnet track	0.1016 (0.004)	0.1016 (0.004)
Weight – kg/m (lbs/ft)	12.7 (8.50)	12.7 (8.50)

310xxM Modular

Part Number	L		N
	mm	in	
31004M	121.92	4.8	2
31007M	182.88	7.2	3
31009M	243.84	9.6	4
31012M	304.80	12.0	5
31014M	365.76	14.4	6
31016M	426.72	16.8	7
31019M	487.68	19.2	8
31021M	548.64	21.6	9
31024M	609.60	24.0	10
31026M	670.56	26.4	11
31028M	731.52	28.8	12
31031M	792.48	31.2	13
31033M	853.44	33.6	14
31036M	914.40	36.0	15
31038M	975.36	38.4	16
31040M	1036.32	40.8	17
31043M	1097.28	43.2	18
31045M	1158.24	45.6	19
31048M	1219.20	48.0	20
31050M	1280.16	50.4	21
31052M	1341.12	52.8	22
31055M	1402.08	55.2	23
31057M	1463.04	57.6	24
31060M	1524.00	60.0	25
31062M	1584.96	62.4	26

Modular Track Combinations With 31007M and 31009M Sections

Length (L)*		Quantity	
mm	in	31007M	31009M
182.9	7.2	1	0
243.8	9.6	0	1
365.8	14.4	2	0
426.7	16.8	1	1
487.7	19.2	0	2
548.6	21.6	3	0
609.6	24.0	2	1
670.6	26.4	1	2
731.5	28.8	0	3
792.5	31.2	3	1
853.4	33.6	2	2
914.4	36.0	1	3
975.4	38.4	0	4
1036.3	40.8	3	2
1097.3	43.2	2	3
1158.2	45.6	1	4
1219.2	48.0	0	5

*Length is unlimited by combining modular track sections.

310xxS Single Piece

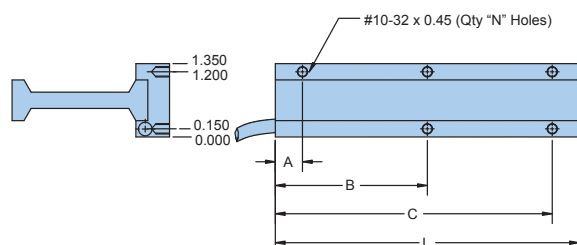
Part Number	L		A		N
	mm	in	mm	in	
31008S	213.36	8.4	5.08	0.20	3
31009S	243.84	9.6	20.32	0.80	3
31010S	274.32	10.8	35.56	1.40	3
31012S	304.80	12.0	50.80	2.00	3
31013S	335.28	13.2	66.04	2.60	3
31014S	365.76	14.4	81.28	3.20	3
31015S	396.24	15.6	96.52	3.80	3
31016S	426.72	16.8	10.16	0.40	5
31018S	457.20	18.0	25.40	1.00	5
31019S	487.68	19.2	40.64	1.60	5
31020S	518.16	20.4	55.88	2.20	5
31021S	548.64	21.6	71.12	2.80	5
31022S	579.12	22.8	86.36	3.40	5
31024S	609.60	24.0	101.60	4.00	5
31025S	640.08	25.2	15.24	0.60	7
31026S	670.56	26.4	30.48	1.20	7
31027S	701.04	27.6	45.72	1.80	7
31028S	731.52	28.8	60.96	2.40	7
31030S	762.00	30.0	76.20	3.00	7
31031S	792.48	31.2	91.44	3.60	7
31032S	822.96	32.4	5.08	0.20	9
31033S	853.44	33.6	20.32	0.80	9
31034S	883.92	34.8	35.56	1.40	9
31036S	914.40	36.0	50.80	2.00	9
31037S	944.88	37.2	66.04	2.60	9
31038S	975.36	38.4	81.28	3.20	9
31039S	1005.84	39.6	96.52	3.80	9
31040S	1036.32	40.8	10.16	0.40	11
31042S	1066.80	42.0	25.40	1.00	11
31043S	1097.28	43.2	40.64	1.60	11
31044S	1127.76	44.4	55.88	2.20	11
31045S	1158.24	45.6	71.12	2.80	11
31046S	1188.72	46.8	86.36	3.40	11
31048S	1219.20	48.0	101.60	4.00	11
31049S	1249.68	49.2	15.24	0.60	13
31050S	1280.16	50.4	30.48	1.20	13
31051S	1310.64	51.6	45.72	1.80	13
31052S	1341.12	52.8	60.96	2.40	13
31054S	1371.60	54.0	76.20	3.00	13
31055S	1402.08	55.2	91.44	3.60	13
31056S	1432.56	56.4	5.08	0.20	15
31057S	1463.04	57.6	20.32	0.80	15
31058S	1493.52	58.8	35.56	1.40	15
31060S	1524.00	60.0	50.80	2.00	15
31061S	1554.48	61.2	66.04	2.60	15
31062S	1584.96	62.4	81.28	3.20	15
31063S	1615.44	63.6	96.52	3.80	15

I-Force Ironless 310 Series

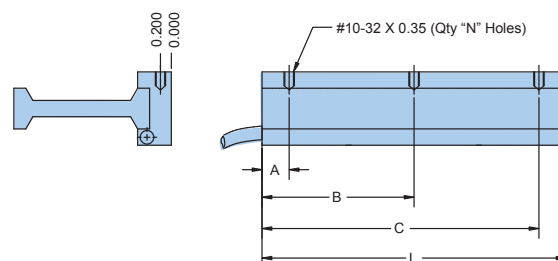
Coil Specifications

Imperial Mounting Options

Top Mounting (A)



Side Mounting (B)

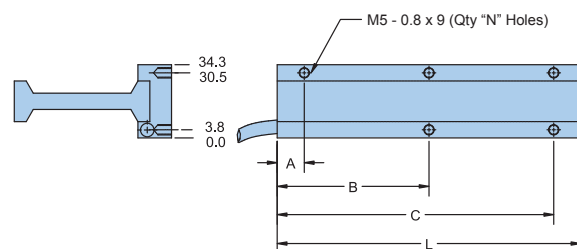


Coil Size/Mounting Code	Dimensions (in)				
	L	N	A	B	C
310-1A	3.20	4	0.50	1.60	2.70
310-2A	5.60	5	0.50	2.80	5.10
310-3A	8.00	5	0.50	4.00	7.50
310-4A	10.40	5	0.50	5.20	9.90
310-5A	12.80	5	0.50	6.40	12.30
310-6A	15.20	5	1.70	7.60	13.50

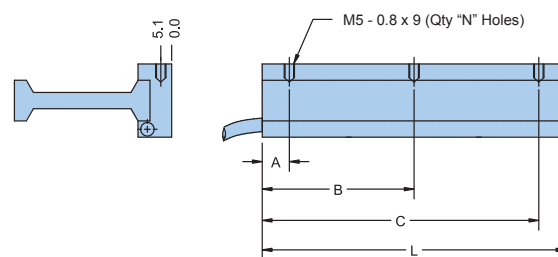
Coil Size/Mounting Code	Dimensions (in)				
	L	N	A	B	C
310-1B	3.20	2	0.50	1.60	2.70
310-2B	5.60	2	0.50	2.80	5.10
310-3B	8.00	3	0.50	4.00	7.50
310-4B	10.40	3	0.50	5.20	9.90
310-5B	12.80	3	0.50	6.40	12.30
310-6B	15.20	3	1.70	7.60	13.50

Metric Mounting Options

Top Mounting (M)



Side Mounting (N)



Coil Size/Mounting Code	Dimensions (mm)				
	L	N	A	B	C
310-1M	81.3	4	12.7	40.6	68.6
310-2M	142.2	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

Coil Size/Mounting Code	Dimensions (mm)				
	L	N	A	B	C
310-1N	81.3	2	12.7	40.6	68.6
310-2N	142.2	2	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

How to order

Fill in an order code from each of the numbered fields to create a complete Motor Coil and Magnet Track order number.

Motor Coil

Order Example:

①	②	③	④	⑤	⑥	⑦				
310	-	2	B	-	NC	-	WD2	P	-	8

- ① **Series**
310
- ② **Coil Size**
 - 1** One pole
 - 2** Two poles
 - 3** Three poles
 - 4** Four poles
 - 5** Five poles
 - 6** Six poles
- ③ **Mounting**
 - A** Imperial top mount
 - B** Imperial side mount
 - M** Metric top mount
 - N** Metric side mount
- ④ **Cooling**
 - NC** No cooling
 - AC** Air cooling
 - LC** Liquid cooling
- ⑤ **Wiring Options** (Refer to page 19)
 - WD1**
 - WD2**
 - WD3**
 - WD4**
 - WD7**
- ⑥ **Winding**
 - S** Series
 - P** Parallel
 - T** Triple (not available for 1-pole motor)
- ⑦ **Cable Length**
 - xx** Specify in feet (8 ft standard)

Magnet Track

Order Example:

①	②
31024M	- N

- ① **Series**
 - 31007M** 7.20" modular sections (refer to Modular Track Combinations chart on page 21)
 - 31009M** 9.60" modular sections (refer to Modular Track Combinations length chart on page 21)
 - 310xxM** 4.8 to 62.4" single piece, 2.4" increments (refer to part number selection chart on page 21)
 - 310xxS** 8.4" to 63.6" single piece, 1.2" increments (refer to part number selection chart on page 21)
- ② **Magnet Coating**
 - N** Nickel coating (standard)
 - B** Black epoxy

I-Force Ironless 410 Series

Performance

Model	Units	410-2	410-3	410-4	410-6	410-8
Peak Force ¹⁾	N (lb)	1041.4 (234.1)	1523.6 (342.5)	2006.3 (451.0)	2967.2 (667.0)	3928.1 (883.0)
Continuous Force ²⁾	N (lb)	233.1 (52.4)	340.8 (76.6)	448.9 (100.9)	663.7 (149.2)	878.6 (197.5)
Peak Power	W	2835	4050	5265	7695	10125
Continuous Power	W	142	203	263	385	506

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.

Electrical

Model	Units	410-2			410-3			410-4			410-6			410-8		
Winding	Series/Parallel/Triple	S	P	T	S	P	T	S	P	T	S	P	T	S	P	T
Peak Current	A pk sine	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
	RMS	13.5	27.0	40.5	13.2	23.6	39.5	13.0	26.0	39.0	12.8	25.6	38.4	12.7	25.5	38.2
Continuous Current	A pk sine	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
	RMS	3.0	6.1	9.1	3.0	5.9	8.9	2.9	5.8	8.7	2.9	5.8	8.7	2.8	5.7	8.5
Force Constant ¹⁾	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 ²⁾	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) ³⁾	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) ⁴⁾	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 ⁵⁾	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 ⁶⁾	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
Terminal Voltage (max.) ⁷⁾	VDC	330	330	330	330	330	330	330	330	330	330	330	330	330	330	330

1) 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).

2) Back EMF measured between any two motor leads while moving at constant velocity. Value is amplitude or 0-Peak of sine wave produced.

3) 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).

4) Inductance measured using 1 Kz with the motor in the magnetic field.

5) Electrical time constant is time it takes for motor value to reach 63% of its final current after a step change in voltage.

6) 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.

7) Consult factory for use with non-Parker amplifiers.

Thermal*

Model	Units	410-2	410-3	410-4	410-6	410-8
Thermal Resistance Wind-Amb	°C/W	0.53	0.37	0.26	0.19	0.15
Thermal Time Constant (min.) ¹⁾		15.1	15.1	15.1	15.1	15.1
Maximum Winding Temperature ²⁾	°C	100	100	100	100	100

* Use Parker's MotionSizer software for the most accurate estimate of coil temperature for a particular motion profile.

1) Thermal time constant is time it takes for motor temperature to reach 63% of its final value after a step change in power.

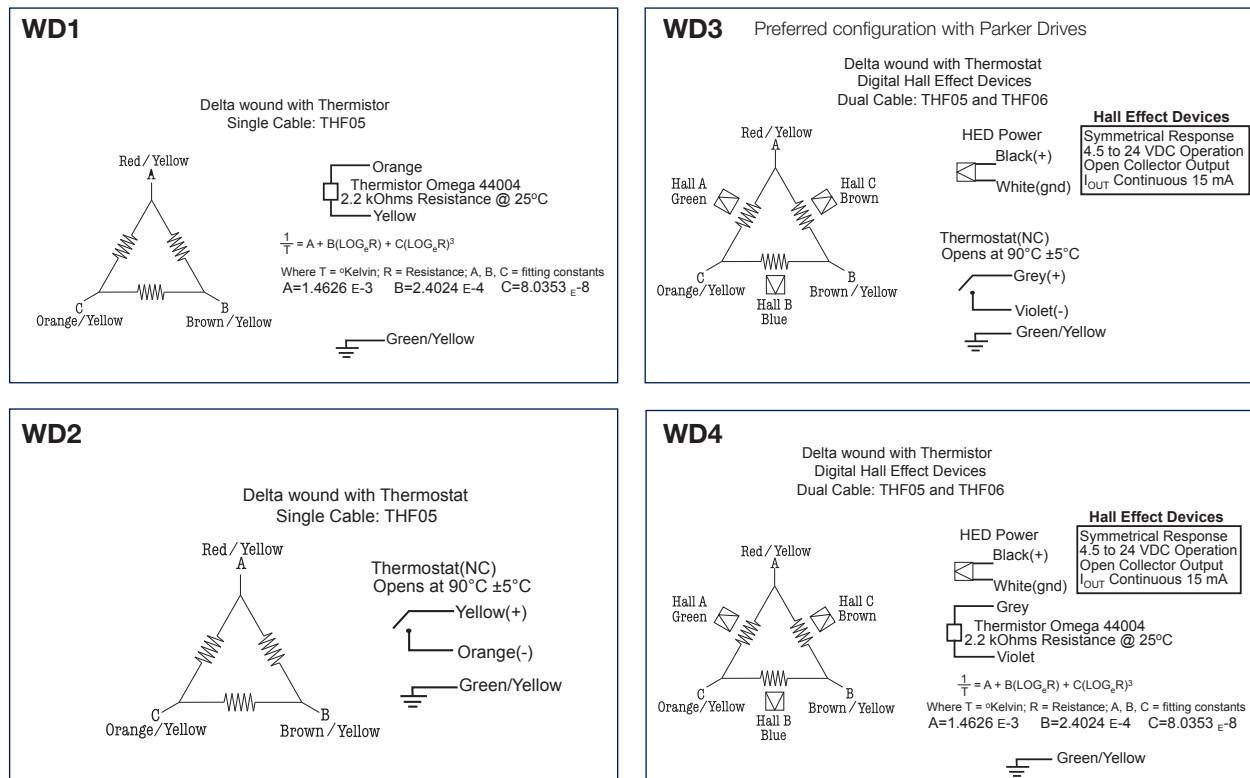
2) Thermal resistance is the number of degrees (Celsius) of temperature rise in the winding per watt of power dissipated determined experimentally.

Mechanical

Model	Units	410-2	410-3	410-4	410-6	410-8
Coil Weight	kg (lb)	1.59 (3.5)	2.27 (5.0)	2.95 (6.5)	4.32 (9.5)	5.68 (12.5)
Coil Length	mm (in)	199.1 (7.84)	284.5 (11.20)	369.8 (14.56)	540.5 (21.28)	711.2 (28.00)
Attractive Force	N (lbf)	0	0	0	0	0
Electrical Cycle Length ¹⁾	mm (in)	85.34 (3.36)	85.34 (3.36)	85.34 (3.36)	85.34 (3.36)	85.34 (3.36)

1) Electrical cycle length is distance coil must travel to complete 360° electrical cycle.

Wiring Options



410xxM Modular

Part Number	L		N
	mm	in	
41006M	170.69	6.72	2
41010M	256.03	10.08	3
41013M	341.38	13.44	4
41016M	426.72	16.80	5
41020M	512.06	20.16	6
41023M	597.41	23.52	7
41026M	682.75	26.88	8
41030M	768.10	30.24	9
41033M	853.44	33.60	10
41036M	938.78	36.96	11
41040M	1024.13	40.32	12
41043M	1109.47	43.68	13
41047M	1194.82	47.04	14
41050M	1280.16	50.40	15
41053M	1365.50	53.76	16
41057M	1450.85	57.12	17
41060M	1536.19	60.48	18
41063M	1621.54	63.84	19

Modular Track Combinations With 41006M and 41010M

Length (L)*		Quantity	
		41006M	41010M
170.69	6.72	1	0
256.03	10.08	0	1
341.38	13.44	2	0
426.72	16.80	1	1
512.06	20.16	0	2
597.41	23.52	2	1
682.75	26.88	1	2
768.10	30.24	0	3
853.44	33.60	2	2
938.78	36.96	1	3
1024.13	40.32	0	4
1109.47	43.68	2	3
1194.82	47.04	1	4
1280.16	50.40	0	5
1365.50	53.76	2	4
1450.85	57.12	1	5
1536.19	60.48	0	6
1621.54	63.84	2	5
1706.88	67.20	1	6
1792.22	70.56	0	7
1877.57	73.92	2	6
1962.91	77.28	1	7
2048.26	80.64	0	8
2133.60	84.00	2	7
2218.94	87.36	1	8
2304.29	90.72	0	9
2389.63	94.08	2	8

*Length is unlimited by combining modular track sections.

410xxS Single Piece

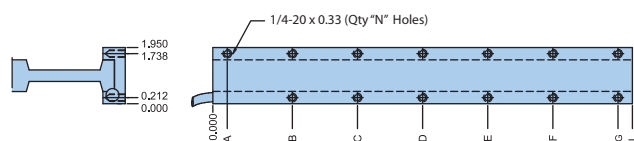
Part Number	L		A		N
	mm	in	mm	in	
41008S	213.4	8.40	5.08	0.200	3
41010S	256.0	10.08	26.42	1.040	3
41011S	298.7	11.76	47.75	1.880	3
41013S	341.4	13.44	69.09	2.720	3
41015S	384.0	15.12	90.42	3.560	3
41016S	426.7	16.80	10.16	0.400	5
41018S	469.4	18.48	31.50	1.240	5
41020S	512.1	20.16	52.83	2.080	5
41021S	554.7	21.84	74.17	2.920	5
41023S	597.4	23.52	95.50	3.760	5
41025S	640.1	25.20	15.24	0.600	7
41026S	682.8	26.88	36.58	1.440	7
41028S	725.4	28.56	57.91	2.280	7
41030S	768.1	30.24	79.25	3.120	7
41031S	810.8	31.92	100.58	3.960	7
41033S	853.4	33.60	20.32	0.800	9
41035S	896.1	35.28	41.66	1.640	9
41036S	938.8	36.96	62.99	2.480	9
41038S	981.5	38.64	84.33	3.320	9
41040S	1024.1	40.32	105.66	4.160	9
41042S	1066.8	42.00	25.40	1.000	11
41043S	1109.5	43.68	46.74	1.840	11
41045S	1152.1	45.36	68.07	2.680	11
41047S	1194.8	47.04	89.41	3.520	11
41048S	1237.5	48.72	9.14	0.360	13
41050S	1280.2	50.40	30.48	1.200	13
41052S	1322.8	52.08	51.82	2.040	13
41053S	1365.5	53.76	73.15	2.880	13
41055S	1408.2	55.44	94.49	3.720	13
41057S	1450.8	57.12	14.22	0.560	15
41058S	1493.5	58.80	35.56	1.400	15
41060S	1536.2	60.48	56.90	2.240	15
41062S	1578.9	62.16	78.23	3.080	15

I-Force Ironless 410 Series

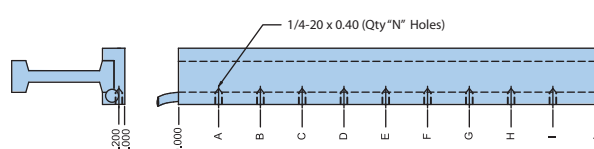
Coil Specifications

Imperial Mounting Options

Top Mounting (A)



Side Mounting (B)

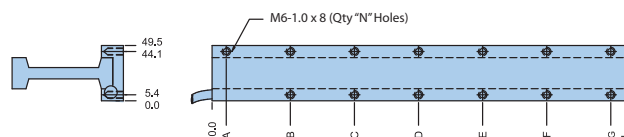


Coil Size/ Mounting Code	Dimensions (in)								
	L	N	A	B	C	D	E	F	G
410-2A	7.84	5	0.50	3.92	7.34	—	—	—	—
410-3A	11.20	8	0.50	1.60	5.60	9.60	10.70	—	—
410-4A	14.56	9	0.50	3.28	7.28	11.28	14.06	—	—
410-6A	21.28	13	0.50	2.64	6.64	10.64	14.64	18.64	20.78
410-8A	28.00	13	2.00	6.00	10.00	14.00	18.00	22.00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

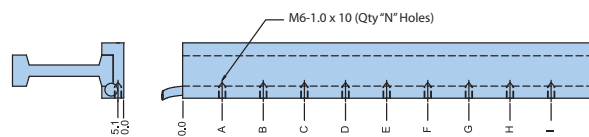
Coil Size/ Mounting Code	Dimensions (in)										
	L	N	A	B	C	D	E	F	G	H	I
410-2B	7.84	3	2.90	4.90	6.90	—	—	—	—	—	—
410-3B	11.20	3	4.10	7.10	10.10	—	—	—	—	—	—
410-4B	14.56	4	2.78	5.78	8.78	11.78	—	—	—	—	—
410-6B	21.28	6	3.14	6.14	9.14	12.14	15.14	18.14	—	—	—
410-8B	28.00	9	3.50	6.50	9.50	12.50	15.50	18.50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

Metric Mounting Options

Top Mounting (M)



Side Mounting (N)



Coil Size/ Mounting Code	Dimensions (in)								
	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

Coil Size/ Mounting Code	Dimensions (in)										
	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

How to order

Fill in an order code from each of the numbered fields to create a complete Motor Coil and Magnet Track order number.

Motor Coil

Order Example:

①	②	③	④	⑤	⑥	⑦				
410	-	2	B	-	NC	-	WD2	P	-	8

- ① **Series**
410
- ② **Coil Size**
 - 2** Two poles
 - 3** Three poles
 - 4** Four poles
 - 6** Six poles
 - 8** Eight poles
- ③ **Mounting**
 - A** Imperial top mount
 - B** Imperial side mount
 - M** Metric top mount
 - N** Metric side mount
- ④ **Cooling**
 - NC** No cooling
 - AC** Air cooling
 - LC** Liquid cooling
- ⑤ **Wiring Options** (Refer to page 25)
 - WD1**
 - WD2**
 - WD3**
 - WD4**
- ⑥ **Winding**
 - S** Series
 - P** Parallel
 - T** Triple
- ⑦ **Cable Length**
 - xx** Specify in feet (8 ft standard)

Magnet Track

Order Example:

①	②
41023M	- N

- ① **Series**
 - 41006M** 6.72" modular sections (refer to Modular Track Combinations chart on page 27)
 - 41010M** 10.08" modular sections (refer to Modular Track Combinations length chart on page 27)
 - 410xxM** 6.72 to 63.89" single piece, 3.36" increments (refer to part number selection chart on page 27)
 - 410xxS** 8.4" to 62.16" single piece, 1.68" increments (refer to part number selection chart on page 27)
- ② **Magnet Coating**
 - N** Nickel coating (standard)
 - B** Black epoxy