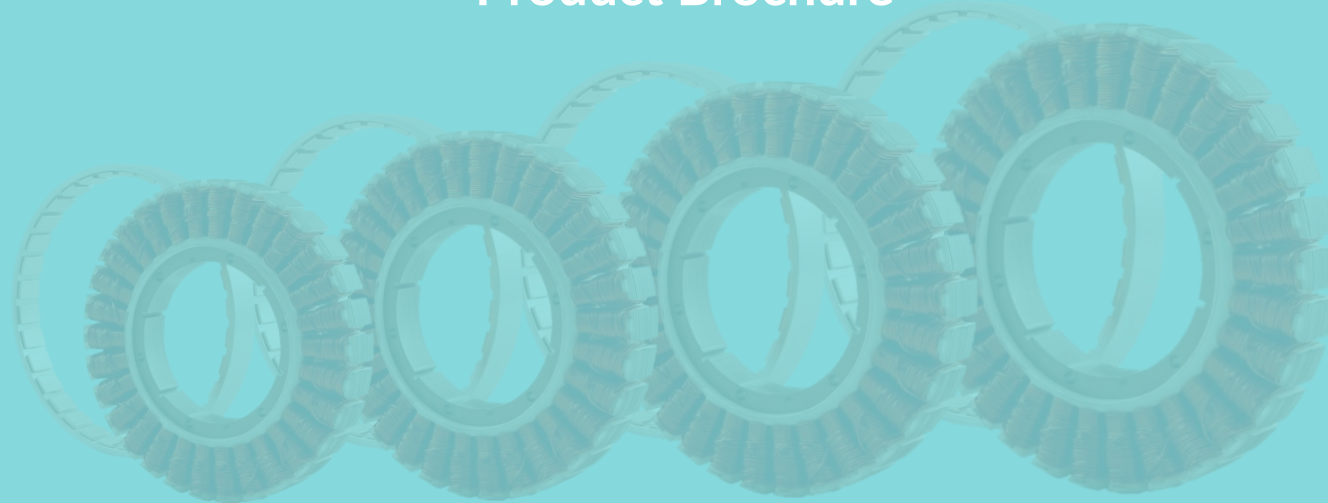


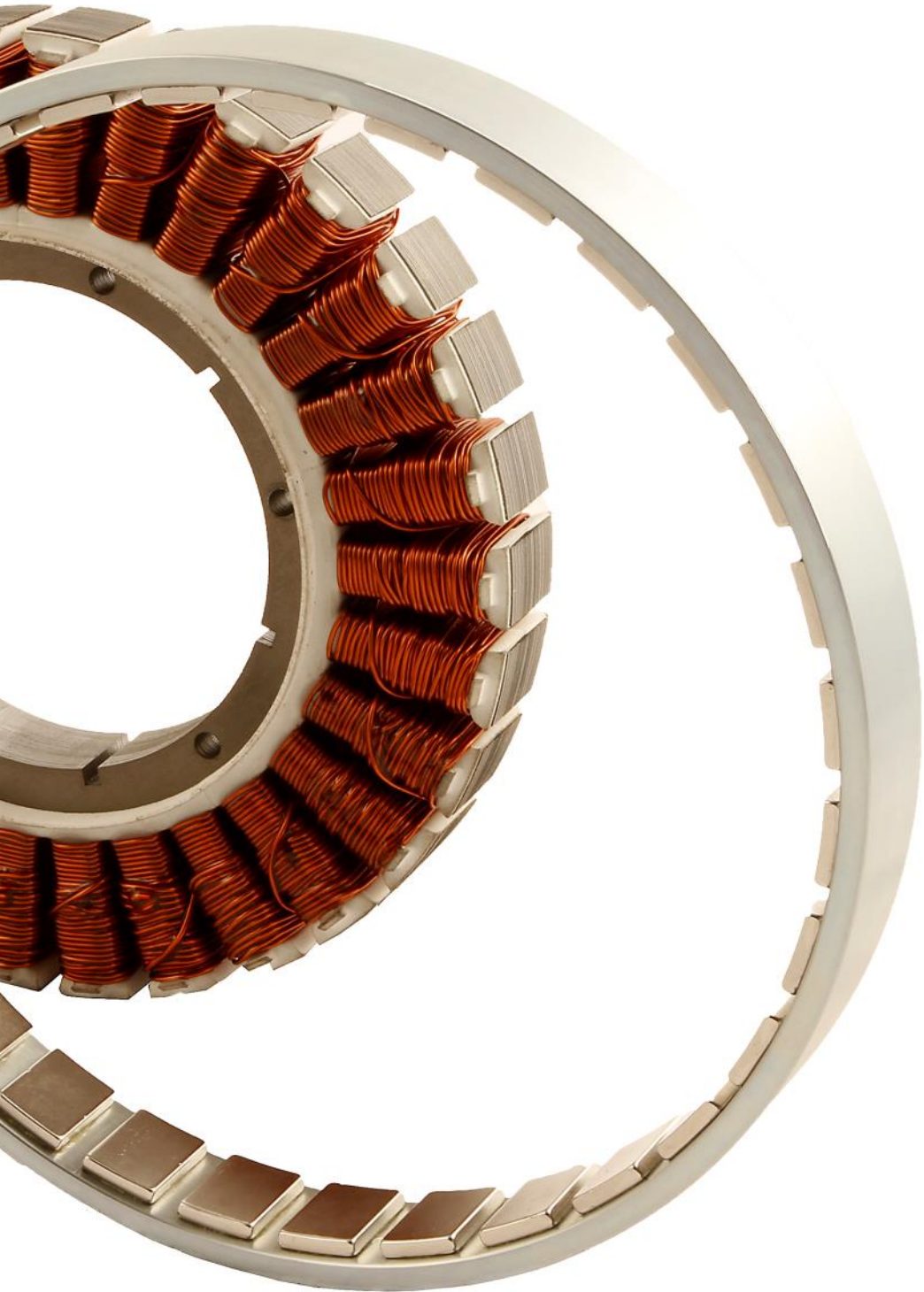


MAGNETIC INNOVATIONS

Frameless High Torque Motors

Product Brochure





Magnetic Innovations

high torque motors are the right motors for your systems

- High dynamics
- High torque density
- High efficiency
- Optimal speed control
- High reliability and lifetime
- Low maintenance
- Quiet operation

About us

Magnetic Innovations is a solid global partner for the development of direct drive torque motors. With years of experience in the development of high torque motors for demanding applications, we bring the most innovative motor designs to the market.

Besides our in-house production in the Netherlands, we have manufacturing facilities in the USA, Eastern Europe and China.

Magnetic Innovations creates tomorrow's technology today that will result in the best cost optimized solutions for your requirements.



Direct Drive Torque Motors

In direct drive torque motors, the motor directly drives the load which eliminates the use of a transmission or a gearbox. As a result, the amount of moving parts in the system is reduced tremendously increasing the efficiency and creating a quiet and high dynamic operation. Therefore, direct drive technology achieves a very high lifetime.

Furthermore, geared motors have a lower torque to inertia ratio. This means that a high torque is required to accelerate the motor. For direct drive torque motors inertia is low, which makes the motors very suitable for high speed, acceleration applications with fast starts and stops.

Our frameless motors are permanent-magnet synchronous motors (PMSM). "Frameless" refers to a motor without a frame, housing, bearing or feedback system. As a result, system suppliers are capable of optimizing the motor according to their application and reduce the cost of ownership.

Direct drive motors are ideal for applications where a high positioning accuracy is needed and small size, low weight, minimum power and optimal speed control is desired.



Our MI-F series consists of three outer diameters, 110, 250 and 485mm. Each standard motor has motor heights ranging from 25 to 75mm. Combined with various winding designs and cooling options, we offer you a wide range of direct drive frameless motor designs. Also for your special requirements, we offer customized designs.

Please contact us for your best motor!

CREATING
TOMORROW'S
TECHNOLOGY
TODAY!



Our Way of Working

After sales

Often forgot but very important. After a successful project, we keep a certain level of engagement with our clients to consult and understand the level of satisfaction. This leads to innovation of excellence.

Client Support

Understanding the requirements of our clients is key. In this first step, a joint understanding is created where needs and options are discussed.

Logistics

We know that just-in-time deliveries are essential. Our quick response and client feedback ensures efficient make-to-order manufacturing and logistics, while shipping from different locations around the world.

R&D

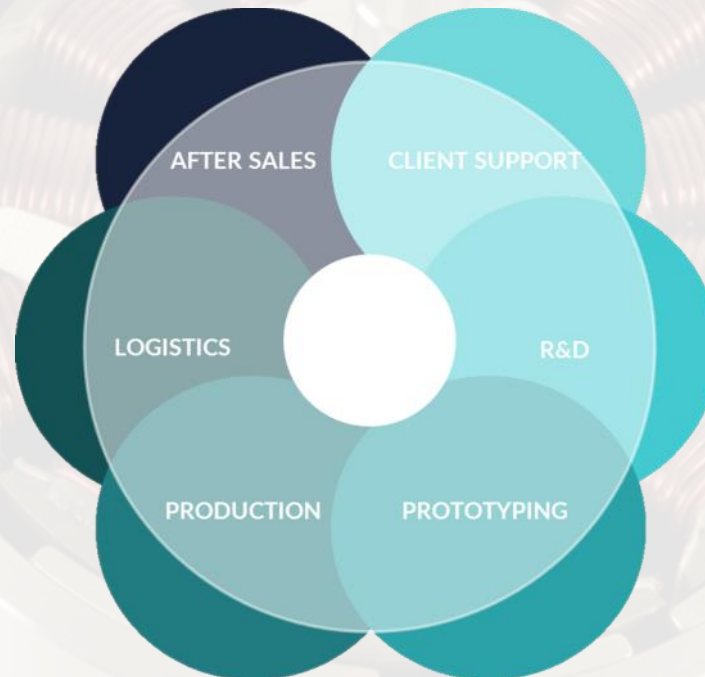
After having a clear understanding of the requirements, an in-depth approach is taken to research and develop the best solution for your application.

Production

Our ISO 9001 certified production facilities ensure the high quality standards needed in the manufacturing of frameless high torque motors. Reliability is guaranteed.

Prototyping

With our first-time-right design philosophy we are able to build a prototype for you that is as close as possible to the final series-production product, avoiding multiple iterations. This enables you to test and optimize the application in an early stage and shorten the time-to-market.



Why Direct Drive Torque Motors?

Cost Optimized Solutions

Compared to brushed motors, the absence of brushes in direct drive motors eliminates mechanical wear. The load is directly driven by the motor. No gearboxes, worm gear drives or other transmissions necessary. This reduces the moving parts in the system, resulting in high operational life and reliability, while reducing overall system costs. Therefore, direct drive torque motors enable cost optimized solutions for your applications.

High Positioning Accuracy

Due to backlash issues in geared systems, the positional accuracy is greatly decreased. The imperfect transmission component geometries result in belt stretching, gear chatter and eventually loss in accuracy.

Direct drive torque motors are able to produce excellent accuracy at a wide range of rpm's.

High Dynamic Performance

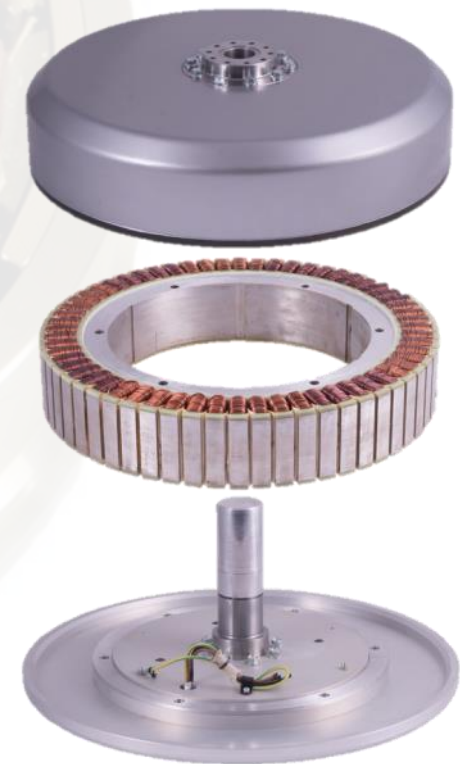
In non-direct drive systems the control loop bandwidth and non-direct coupling of the load result in limitations of the dynamic performance. The dynamic performance is enhanced by direct drive technology. Due to very high control loop bandwidth and direct coupling, limitations such as backlash, cogging and long-term drift are eliminated.

Ease of Use

The high torque frameless motors consist of two parts. The armature assembly (stator) with windings and the rotor assembly carrying the magnets that produce torque, both integrated into a customer specific application. A major advantage is the freedom in design and choice of bearings, shaft, housing and sensors that are required for the application. In addition, because of the high specific torque density these motors are very suitable for small building volumes.

High Torque to Power ratio

Direct drive torque motors contain a relative large number of poles. This combined with different winding types results in high force and power density of our motors. As a result, the power requirements and energy consumption are generally low.



Why MI-F Torque Motors?

Unmatched Performance

With the use of our magnetic and thermal simulation software, our frameless high torque outrunner motors are designed to deliver unmatched performance. Compared to inrunners, outrunner direct drive torque motors are capable of producing more torque and are more efficient. Moreover, the MI-F series are characterized by extremely low cogging and good thermal performance.

Wide Product Range

Magnetic Innovations offers more than 40 torque motors suitable for a wide range of applications. In our standard range we offer three outer diameters and motor heights combined with a variety of windings designs. Our motors are cooled by either convectional or water cooling. If needed, we offer customized torque motor designs.

Ease of use

The MI-F series are designed to be built in the integral part of a system. With its outrunner and frameless design, size and weight are decreased making the motors easy to integrate and use in various applications.

MI	Magnetic Innovations
F	Frameless
110/250/485	Outer diameter
25/50/75	Lamination stack
1/2	Design type
A/W	Air / water cooling

Customized designs offer various sizes, design and cooling types

Patented Technology

Based on years of experience and expertise in direct drive technology, Magnetic Innovations has been able to patent many direct drive technologies.



MI-F Features

Peak Torque ranging from 14.1-1410Nm

Customized laminations ranging from 10-75mm

Up to 600V DC bus voltage

Highly efficient

(optional) temperature sensor

Outer diameter ranging from 110-485mm

Quiet operation and compact design

Stator

(optional) Shaft

Continuous Torque ranging from 4-796Nm

High torque density

Very high lifetime

Rotor

Magnets

Rotor ring

Low cogging

MI-F Torque Motors

To maximize the torque of our direct drive motors, Magnetic Innovations uses innovative winding configurations combined with optimized permanent magnet technology. The range of continuous torque is covered between 4Nm and 796Nm and peak torque between 14Nm and 1143Nm. The motors are intended to be used in combination with a 3-phase sinusoidal current amplifier which guarantees smooth rotation with low torque ripple. The drive can either utilize sensed or sensorless control of the current. The low cogging design makes the motors also suitable for servo control applications.

The MI-F series are designed for a wide RPM range. Depending on your application, we are able to easily fit the motor for an amplifier by adjusting the winding type.

High performance applications require temperature control to safeguard motor integrity. For these applications, water cooling as well as forced air cooling and temperature control sensors can be integrated to effectively maintain high performance.

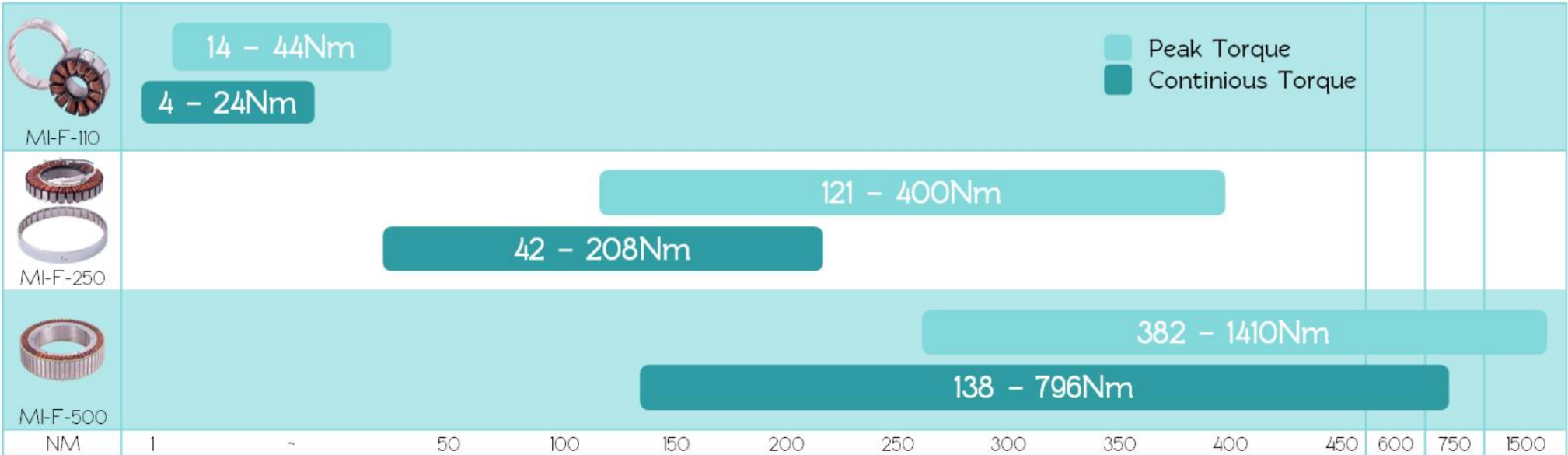


MAGNETIC
INNOVATIONS

With more than 40 standard torque motors in our product range most requirements can be met. Please contact us so we can help you with the best frameless high torque motor for your application!

info@magneticinnovations.com

+31 40 205 17 18



MI-F Applications

Automotive Industry

Compared to induction motors with the same volume/weight, the peak point energy efficiency of frameless high torque motors is much higher, making the MI-F series very suitable for vehicle/bicycle propulsion.

Industrial HVLS Fans

A quiet environment and high efficiency operation is essential in many fan applications. Driving the fan blades directly with an MI-F torque motor instead of an induction motor with a gear or belt, will assure high efficiency, quiet operation and longer operational life in addition to a reduced motor size by a factor of 2 to 3.

Energy Technology

The ongoing trend towards green energy applications leads many industries to permanent magnet synchronous motors. The MI-F series have been used in various green energy applications such as wind-and water turbine generators.



Machine Tool

A significant reduction of costs can be achieved by installing direct drive motors in various machines and systems. Low maintenance operations are guaranteed when applying the MI-F series.

Robotics & Semicon

The MI-F series are characterized by low cogging values and a high accuracy. This results in smooth operations where errors are minimized. Also suitable for the medical technology applications.

Conveyor Belts

In industries where space is limited, hygiene is important and maintenance cost is high, the direct drive MI-F series, MI smart belt motors and MI drum motors offer an opportunity. MI motors are distinguished from other belt drive solutions by the lack of gearboxes, no grease, no oil, No Problem!

MI-F-110 Specifications

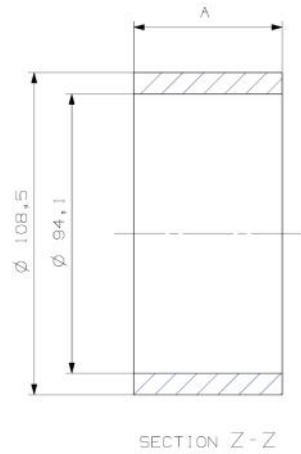
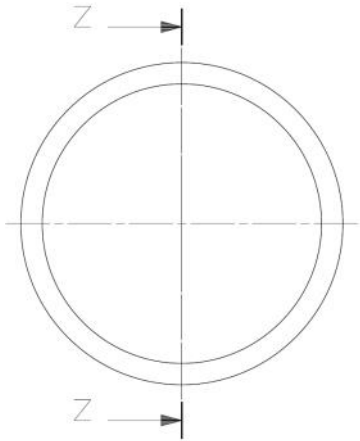
MI-F-110 series	Unit	MI-F110-25-1		MI-F110-25-2		MI-F110-25-3		MI-F110-50-1		MI-F110-50-2		MI-F110-75-1		MI-F110-75-2	
		Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
Motor type Max DC bus Voltage	VDC	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Stall torque	Nm	3,52	6,53	3,1	6,1	3,52	6,53	7,6	14,0	7,7	14,2	11,8	21,6	11,7	21,7
Continuous torque	Nm	4,0	7,4	3,6	8,8	4,0	7,4	8,7	15,7	8,7	16,0	13,4	24,2	13,4	24,4
Peak torque	Nm	14,1	14,1	14,7	14,7	14,1	14,1	27,9	27,9	29,4	29,4	41,6	41,6	44,3	44,3
Torque constant at 20°C	Nm/Arms	0,50	0,50	2,84	2,84	0,864	0,864	0,99	0,99	3,97	3,97	1,49	1,49	5,95	5,95
Motor constant at 20°C	(Nm)^2/W	0,62	0,62	0,53	0,53	0,62	0,62	1,45	1,45	1,31	1,31	2,42	2,42	2,18	2,18
Stall current	Arms	7,3	14,5	1,1	2,2	4,2	7,9	7,9	15,7	1,9	3,8	8,2	16,3	1,9	3,9
Continuous current	Arms	8,4	16,7	1,3	2,5	4,85	8,9	9,1	18,1	2,2	4,4	9,4	18,8	2,2	4,5
Peak current	Arms	48,8	48,8	7,9	7,9	28,2	28,2	48,8	48,8	11,3	11,3	48,8	48,8	11,3	11,3
Maximum no load rpm	rpm	3000	4750	1800	1800	3000	4750	3000	4750	1400	1400	3750	3750	850	850
Back EMF constant (*)	Vrms/rpm	0,031	0,031	0,193	0,193	0,0537	0,0537	0,062	0,062	0,269	0,269	0,093	0,093	0,403	0,403
Coil Resistance at 20°C (*)	Ohm	0,29	0,29	12	12	0,87	0,87	0,44	0,44	8	8	0,6	0,6	10,8	10,8
Coil Induction (*)	mHenry	2	2	80	80	5,4	5,4	4,0	4,0	78	78	5,9	5,9	117	117
Electric time constant	msec	6,9	6,9	6,7	6,7	6,2	6,2	9,0	9,0	9,7	9,7	9,9	9,9	10,8	10,8
Max. Continuous Power Dissipation	Watt	48	193	45	181	48	193	88	350	90	361	127	509	127	509
Thermal resistance	K/W	2,90	0,73	3,10	0,78	2,90	0,73	1,60	0,40	1,60	0,40	1,10	0,28	1,10	0,28
Rotor outer diameter	mm	108,5	108,5	108,5	108,5	108,5	108,5	108,5	108,5	108,5	108,5	108,5	108,5	108,5	108,5
Stator inner diameter	mm	32	32	32	32	32	32	32	32	32	32	32	32	32	32
Motor Height	mm	44,5	44,5	44,5	44,5	44,5	44,5	69,5	69,5	69,5	69,5	94,5	94,5	94,5	94,5
Lamination Stack Height	mm	25	25	25	25	25	25	50	50	50	50	75	75	75	75
Pole pairs	-	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Rotor Inertia	kg.m^2	0,0012	0,0012	0,0012	0,0012	0,0012	0,0012	0,0023	0,0023	0,0023	0,0023	0,0035	0,0035	0,0035	0,0035
Stator Mass (excl. watersleeve)	kg	1,11	1,11	1,11	1,11	1,11	1,11	2,22	2,22	2,22	2,22	3,33	3,33	3,33	3,33
Rotor Mass	kg	0,41	0,41	0,41	0,41	0,41	0,41	0,82	0,82	0,82	0,82	1,23	1,23	1,23	1,23
Total Mass	kg	1,52	1,52	1,52	1,52	1,52	1,52	3,04	3,04	3,04	3,04	4,56	4,56	4,56	4,56
Water flow (max dT_water= 5°C) (**)	ltr/min	N/A	0,6	N/A	0,6	N/A	0,6	N/A	1,0	N/A	1,0	N/A	1,5	N/A	1,5

(*) terminal to terminal (**)Inlet water temperature 20°C.
Ambient temperature = 20°C, Max. allowed coil temperature = 160°C

Disclaimer: The above data assumes that appropriate stiffness has been applied in the mechanical construction and bearing system between Stator and Rotor to prevent mechanical vibration and dynamic resonance.

MI-F-110

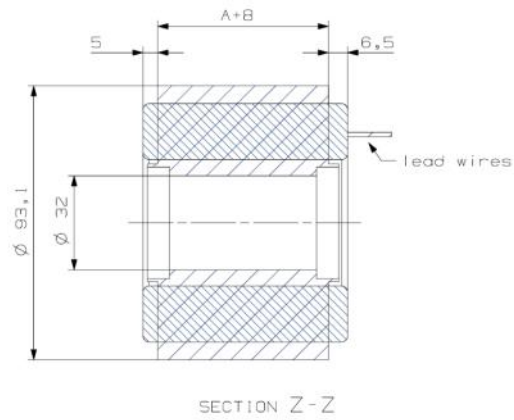
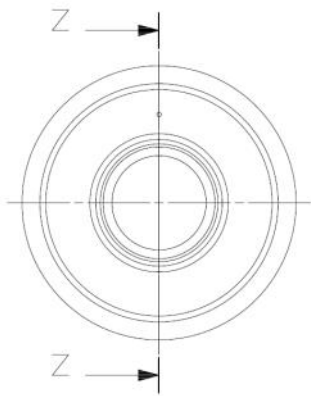
Rotor



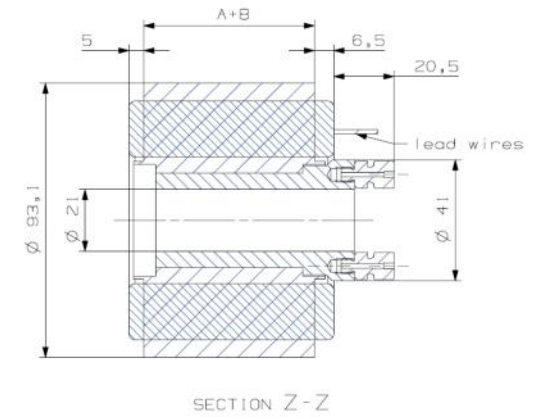
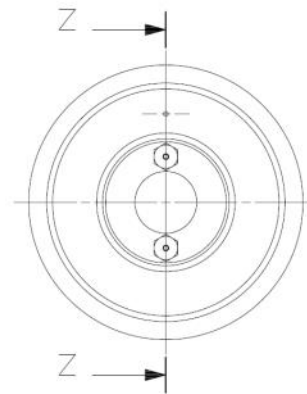
	MI-F-110-25	MI-F-110-50	MI-F-110-75
A	25mm	50mm	75mm



Assy



Assy water cooled



MI-F-250 Specifications

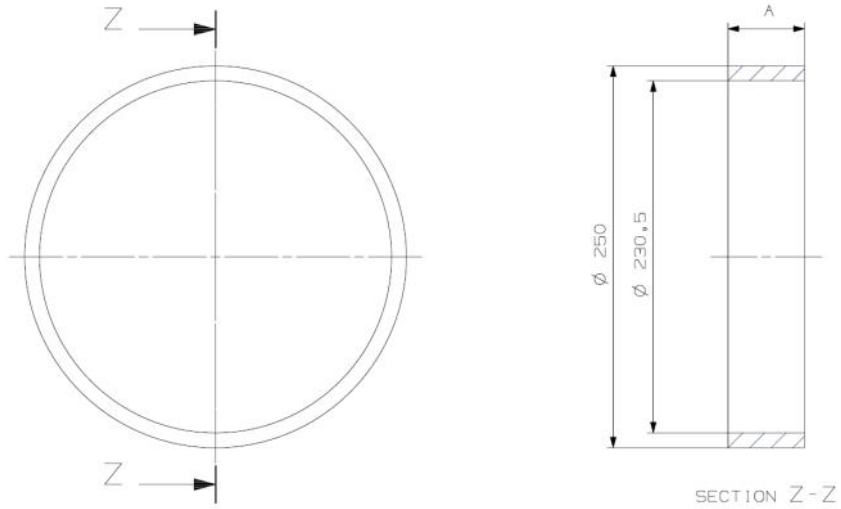
MI-F-250 series	Unit	MI_F-250-25-1		MI_F-250-25-2		MI_F-250-50-1		MI_F-250-50-2		MI_F-250-75-1		MI_F-250-75-2	
		Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
Motor type Max DC bus Voltage	VDC	600	600	600	600	600	600	600	600	600	600	600	600
Stall torque	Nm	35,1	64,5	36,8	69,5	65,6	121,8	68,0	129,0	95,5	185,5	98,0	195,3
Continuous torque	Nm	39,9	72,1	42,0	78,1	74,6	136,5	77,7	145,0	108,6	207,7	112,0	219,8
Peak torque	Nm	120,6	120,6	133,5	133,5	241,0	241,0	267,5	267,5	363,0	363,0	400,0	400,0
Torque constant at 20°C	Nm/Arms	1,95	1,95	6,91	6,91	3,91	3,91	13,82	13,82	5,86	5,86	20,73	20,73
Motor constant at 20°C	(Nm) ² /W	16,2	16,2	17,0	17,0	41,5	41,5	42,93	42,93	69,4	69,4	70,6	70,6
Stall current	Arms	19,2	38,6	5,5	11,4	17,8	36,0	5,0	10,4	17,1	36,6	4,9	10,5
Continuous current	Arms	22,1	44,5	6,4	13,1	20,5	41,4	5,9	12,0	19,8	42,1	5,6	12,1
Peak current	Arms	120,5	120,5	34,8	34,8	120,5	120,5	34,8	34,8	120,5	120,5	34,8	34,8
Maximum no load rpm	rpm	1750	1750	1000	1000	1500	1500	450	450	1000	1000	300	300
Back EMF constant (*)	Vrms/rpm	0,127	0,127	0,437	0,437	0,253	0,253	0,875	0,875	0,379	0,379	1,31	1,31
Coil Resistance at 20°C (*)	Ohm	0,156	0,156	1,87	1,87	0,247	0,247	2,96	2,96	0,338	0,338	4,1	4,1
Coil Induction (*)	mHenry	2	2	25	25	4	4	50	50	6	6	75	75
Electric time constant	msec	12,7	12,7	13,3	13,3	15,8	15,8	16,9	16,9	17,3	17,3	18,4	18,4
Max. Continuous Power Dissipation	Watt	177	736	177	756	237	1000	237	1000	298	1400	298	1400
Thermal resistance	K/W	0,76	0,19	0,79	0,19	0,59	0,14	0,59	0,14	0,47	0,10	0,47	0,10
Rotor outer diameter	mm	250	250	250	250	250	250	250	250	250	250	250	250
Stator inner diameter	mm	115	115	115	115	115	115	115	115	115	115	115	115
Motor Height	mm	44	44	44	44	69	69	69	69	94	94	94	94
Lamination Stack Height	mm	25	25	25	25	50	50	50	50	75	75	75	75
Pole pairs	-	16	16	16	16	16	16	16	16	16	16	16	16
Rotor Inertia	kg.m ²	0,0196	0,0196	0,0196	0,0196	0,0393	0,0393	0,0393	0,0393	0,0589	0,0589	0,0589	0,0589
Stator Mass (excl. watersleeve)	kg	5,76	5,76	5,76	5,76	11,52	11,52	11,52	11,52	17,28	17,28	17,28	17,28
Rotor Mass	kg	1,32	1,32	1,32	1,32	2,64	2,64	2,64	2,64	3,96	3,96	3,96	3,96
Total Mass	kg	7,08	7,08	7,08	7,08	14,16	14,16	14,16	14,16	21,24	21,24	21,24	21,24
Water flow (max dT _{water} = 5°C) (**)	ltr/min	N/A	2,1	N/A	2,2	N/A	2,9	N/A	2,9	N/A	4,0	N/A	4,0

(*) terminal to terminal (**)Inlet water temperature 20°C.
Ambient temperature = 20°C, Max. allowed coil temperature = 160°C

Disclaimer: The above data assumes that appropriate stiffness has been applied in the mechanical construction and bearing system between Stator and Rotor to prevent mechanical vibration and dynamic resonance.

MI-F-250

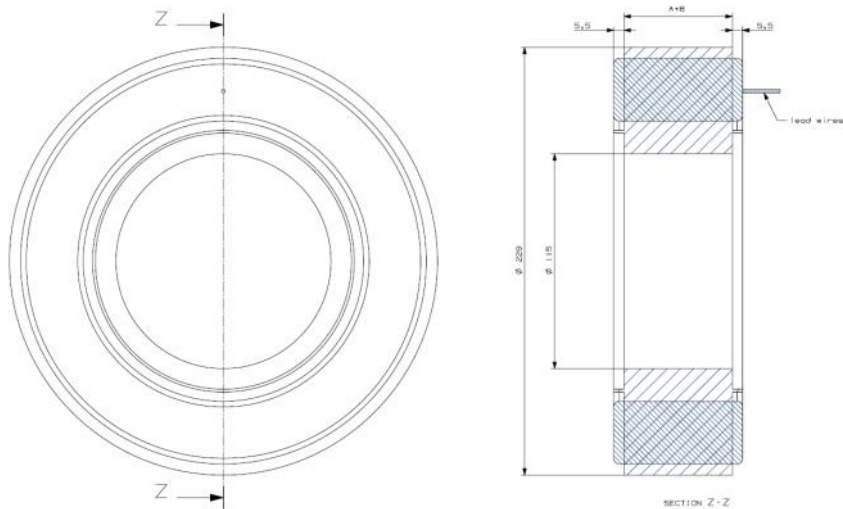
Rotor



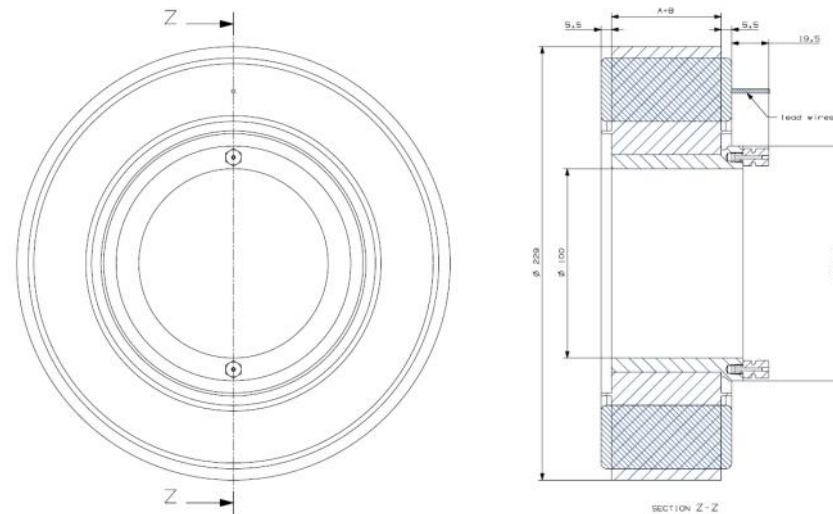
	MI-F-250-25	MI-F-250-50	MI-F-250-75
A	25mm	50mm	75mm



Assy



Assy water cooled



MI-F-485 Specifications

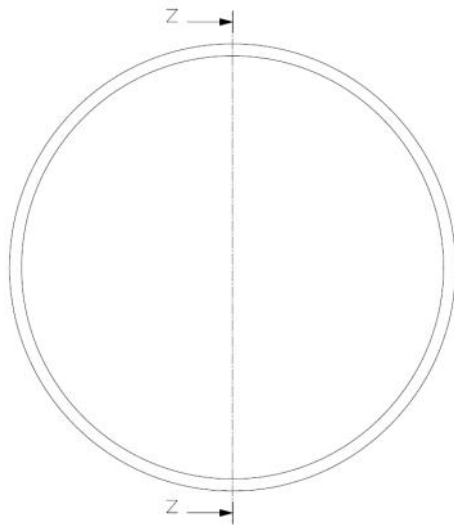
MI-F-485 series	Unity	MI-F-485-25-1		MI-F-485-25-2		MI-F-485-50-1		MI-F-485-50-2		MI-F-485-75-1		MI-F-485-75-2	
		Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
Motor type Max DC bus Voltage	VDC	600	600	600	600	600	600	600	600	600	600	600	600
Stall torque	Nm	126,5	226,6	121,5	226,6	242	436	218,6	409,3	403	716	366	679
Continuous torque	Nm	143,6	252,7	138,8	255,8	275	487	250	463	457	796	418	765
Peak torque	Nm	520	520	525	525	925	925	940	940	1310	1310	1420	1420
Torque constant at 20°C	Nm/Arms	6,2	6,2	41	41	12,4	12,4	82	82	18,6	18,6	123	123
Motor constant at 20°C	(Nm)^2/W	155	155	143	143	388	388	358	358	635	635	585	585
Stall current	Arms	21,9	43,2	3,2	6,3	20,8	41,2	3	6	23,4	46,1	3,4	6,7
Continuous current	Arms	25,2	49,8	3,6	7,3	24,0	47,4	3,5	6,9	26,9	53,1	3,9	7,8
Peak current	Arms	201,1	201,1	28,9	28,9	201,2	201,2	28,9	28,9	201,2	201,2	28,9	28,9
Maximum no load rpm	rpm	875	875	150	150	450	450	70	70	340	340	50	50
Back EMF constant (*)	Vrms/rpm	0,39	0,39	2,71	2,71	0,78	0,78	5,45	5,45	1,17	1,17	8,13	8,13
Coil Resistance at 20°C (*)	Ohm	0,163	0,163	7,80	7,80	0,261	0,261	12,53	12,53	0,359	0,359	17,23	17,23
Coil Induction (*)	mHenry	3,5	3,5	162	162	7,2	7,2	328	328	10,7	10,7	491	491
Electric time constant	msec	21,6	21,6	20,7	20,7	27,4	27,4	26,2	26,2	29,7	29,7	28,5	28,5
Max. Continuous Power Dissipation	Watt	244	974	244	974	350	1400	350	1400	609	2435	609	2435
Thermal resistance	K/W	0,58	0,14	0,58	0,14	0,40	0,10	0,40	0,10	0,23	0,06	0,23	0,06
Rotor outer diameter	mm	485	485	485	485	485	485	485	485	485	485	485	485
Stator inner diameter	mm	306	306	306	306	306	306	306	306	306	306	306	306
Motor Height	mm	50	50	50	50	75	75	75	75	100	100	100	100
Lamination Stack Height	mm	25	25	25	25	50	50	50	50	75	75	75	75
Pole pairs	-	32	32	32	32	32	32	32	32	32	32	32	32
Rotor Inertia	kg.m^2	0,163	0,163	0,163	0,163	0,327	0,327	0,327	0,327	0,491	0,491	0,491	0,491
Stator Mass (excl. watersleeve)	kg	14,55	14,55	14,55	14,55	29,10	29,10	29,10	29,10	43,70	43,70	43,70	43,70
Rotor Mass	kg	2,89	2,89	2,89	2,89	5,78	5,78	5,78	5,78	8,67	8,67	8,67	8,67
Total Mass	kg	17,44	17,44	17,44	17,44	34,88	34,88	34,88	34,88	52,37	52,37	52,37	52,37
Water flow (max dT _{water} = 5°C) (**)	ltr/min	N/A	2,8	N/A	2,8	N/A	4,0	N/A	4,0	N/A	7,0	N/A	7,0

(*) terminal to terminal (**)Inlet water temperature 20°C.
Ambient temperature = 20°C, Max. allowed coil temperature = 160°C

Disclaimer: The above data assumes that appropriate stiffness has been applied in the mechanical construction and bearing system between Stator and Rotor to prevent mechanical vibration and dynamic resonance.

MI-F-485

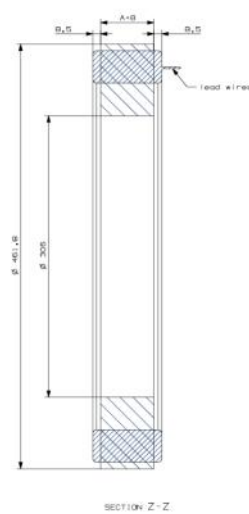
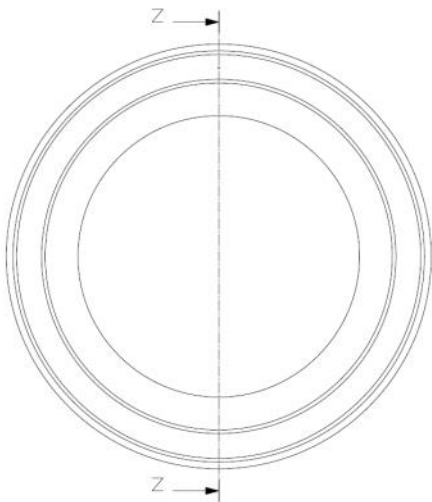
Rotor



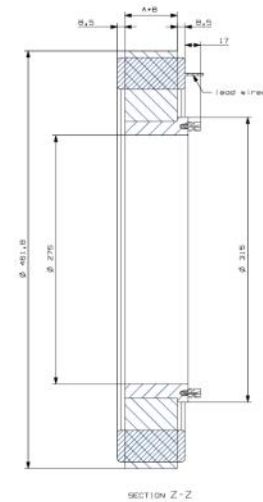
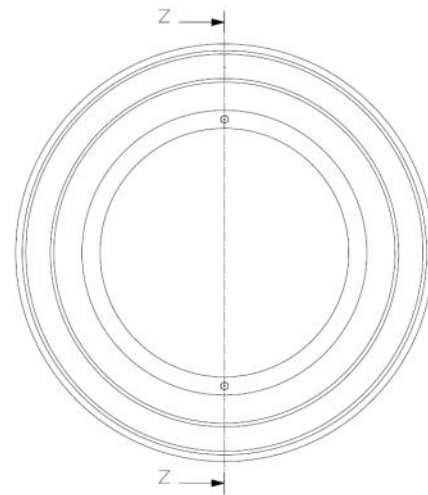
	MI-F-485-25	MI-F-485-50	MI-F-485-75
A	25mm	50mm	75mm



Assy



Assy water cooled



Meeting Your Requirements

Understanding the customer requirements and supporting in the decision making process for a torque motor is essential to ensure the right choice for excellent performance. From the Magnetic Innovations engineers you can expect the necessary assistance and guidance!

Motor size

To pick the correct motor size the necessary torque and velocity requirements need to be understood. This varies greatly between applications. Therefore Magnetic Innovations offers a wide range of torque motors to fit the best cost optimized motor design to the application.

To match the velocity requirements the current and voltage should be also known. These values, combined with the torque specifications, greatly influence the winding configuration.

Based on the duty cycle, the continuous torque can be determined and calculated. Furthermore, the stall torque needs to be defined to ensure a safe operation when a torque motor is in a stationary position.



Motor constant

The motor Constant is being chosen based upon the sweetspot requirement of the application involving maximum RPM, available DC bus-voltage and Peak Torque requirement.

Thermal parameters

Accuracy and repeatability levels are influenced by the thermal specifications of the torque motor. To enable high accuracy and repeatability levels it is key to ensure acceptable temperatures of the system. Magnetic Innovations has been continuously improving thermal control in the MI-F high torque motors to ensure high dynamic performance through the whole operation range. For demanding applications MI-F water cooling designs offer a great solution to reach high performance levels in small building volume.

Additional Products

Moving Magnet Actuators

The principle of the Moving Magnet Actuator (MMA) is that the moving part is a magnet. The coils are mounted on the static part, which enables an optimum thermal path and as such improved cooling ability. The high reliability and lifetime are determined by the lack of connecting wires on the moving part. These MMA's can be applied where high speed, high force density and a high reliability/lifetime are required.

Direct Drive Hub Motors

The torque motors of Magnetic Innovations are perfectly suited to function as a hub motor for vehicle propulsion purposes. In the HT series the magnetic design is optimized to reach the highest torque output available in the market today. Two versions with different torque capability are available. The outrunner motor concept enables a seamless integration of the motor into the hub of the wheel.

Smart Belt Motors

The SBM125-series is a new generation of single-side mounted Direct-Drive 3-phase PMSM's designed for high dynamic applications in the packaging equipment and semiconductor market. Most applications that use standard high speed, low torque servo motors, which require gear boxes to provide speed reduction, can be replaced with our gear free motor solutions. No oil, no maintenance, no problems.

Direct drive drum Motors

The MI direct drive drum motors are often used in hygienic environments, such as the food and packaging industry. The drum motors offer a clean and quiet operation without the use of oil and grease. With its unique gearless design and IP69K rated enclosure it offers a perfect solution to drive your conveyors.





MAGNETIC
INNOVATIONS

Creating Tomorrow's Technology Today!

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