

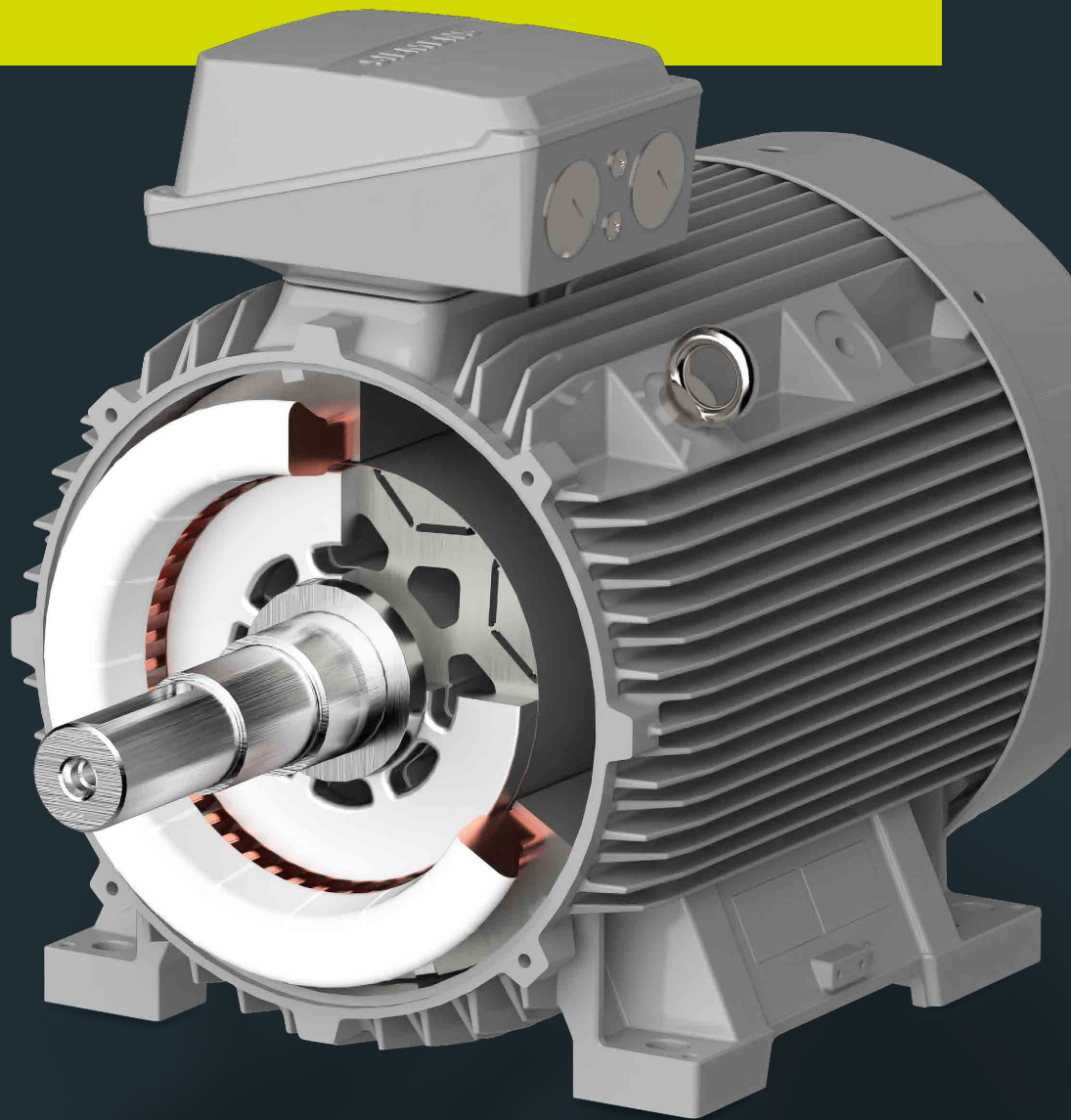
INNOMOTICS

A Siemens Business

The groundbreaking innovation

IE5 Permanent Magnet motors

PM motors with efficiency class IE5 – the pinnacle of internationally recognized efficiency levels and even more.



innomotics.com

Permanent Magnet motors

As global industries head towards sustainable and energy-efficient operations, **Innomotics' Permanent Magnet (PM) motors**, conforming to the **IE5 efficiency class**, stand out as foundational and contemporary motion applications.

This brochure offers an insight into **Innomotics' leading-edge technology of Permanent Magnet motors**, highlighting the multitude of advantages and the adaptability across various applications.

The Principle Behind Permanent Magnet Motors

At the core of PM motors are permanent magnets – predominantly made from rare-earth materials – that produce a consistent magnetic field. In contrast to traditional induction motors, which necessitate electrical current to generate a magnetic field in the rotor, PM motors inherently generate this magnetic field due to the integrated magnets. This elemental distinction leads to its superior efficiency.

The Utility of Permanent Magnets

Rare-earth magnets are the driving force behind the high-efficiency levels seen in Innomotics PM motors. The integration of these magnets into the motors empowers them with superior magnetic properties that are far beyond what traditional ferrite magnets can offer. The rare-earth magnets offer a higher power density, allowing for smaller, lighter, and more efficient motors than those using ferrite magnets.

IE5 Efficiency and Beyond

Innomotics, a pioneer in motor technology, exemplifies its commitment to groundbreaking innovation with its PM motors adhering to the IE5 efficiency class – the pinnacle of internationally recognized efficiency levels and even higher.



Key features of our PM motors include:

High torque and power density: Due to superior design which allows to deliver same torque in smaller frame size compared to induction motor technology, industries can downsize their motor requirements without compromising on performance, leading to a reduced motor footprint.

Unparalleled Efficiency:

With compliance to the IE5 efficiency class, these motors ensure top-tier energy efficiency, leading to reduced operational expenses and minimized carbon footprints.

High Efficiency in partial loads: With PM motor technology you are able to deliver significantly higher energy efficiency values at partial loads and lower speeds.

Reduced Weight:

Due to motor design and higher torque density, PM motors tend to weigh less than traditional counterparts of comparable power outputs. This reduced weight makes them ideal for applications where the overall weight is a critical factor.

Flexibility in Design:

The inherent properties of PM motors, such as their compactness and reduced weight, offer to machine builders more flexibility. This is especially advantageous in applications where space is a premium or where compact motor shapes are needed.

Wide Operating Range:

PM motors are renowned for their broad speed range without compromising efficiency, assuring flexibility in varied applications.

High Torque Density:

PM motors offer superior torque per unit volume compared to many conventional motor designs, enabling high performance within a compact structure.

Enhanced Dynamics:

Quick acceleration and deceleration are intrinsic to PM motors, making them optimal for tasks necessitating rapid changes in speed and direction.

Cooler Operation:

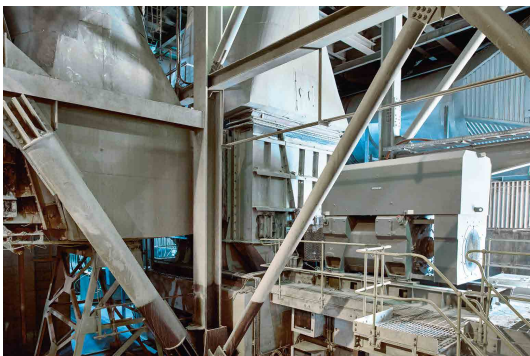
The absence of rotor current losses means PM motors frequently operate at cooler temperatures, prolonging component lifespan and mitigating thermal stresses.

Applications

From individual applications to large-scale industrial infrastructures, PM motors' unparalleled efficiency, compactness, and superior performance make them a preferred choice. Innomotics presents PM motors suitable for industries such as material handling, HVAC, water and waste water (W&WW), automotive, food processing, textile and beyond. PM motors are not limited to conventional applications, but excel in other demanding cases especially where constant torque is needed or high power density is a decisive factor.

The wide field of applications that can be addressed includes, for example, the following:

- Pumps
- Fans
- Blowers
- Compressors
- Cranes
- Conveyor belts
- Extruders
- Mixers

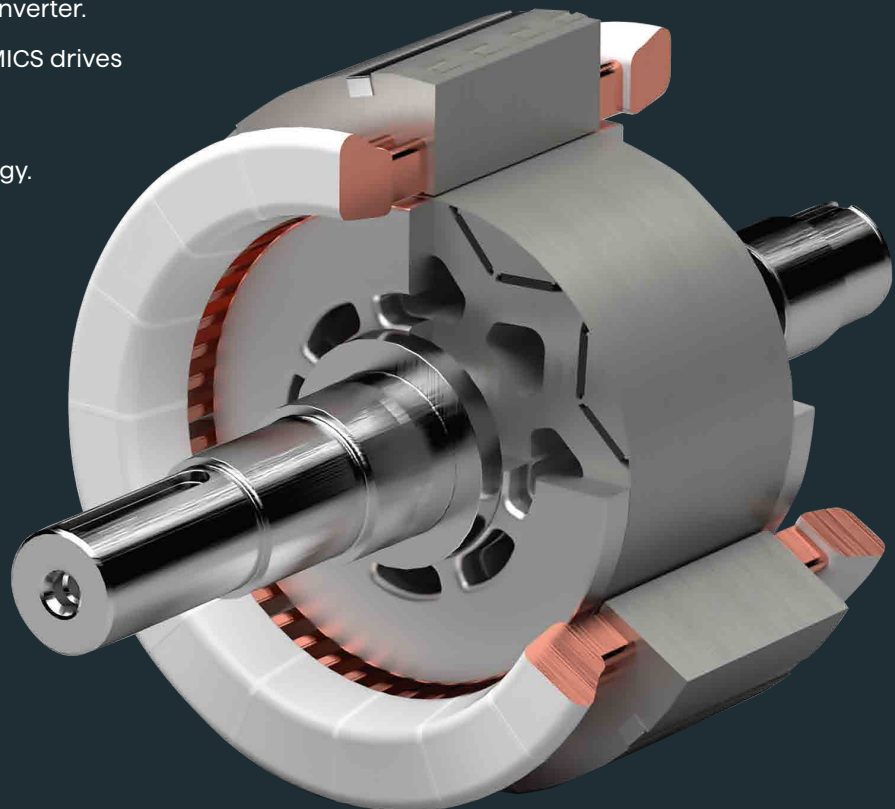


Design

Innomotics PM motors are built on the 1LE1 asynchronous motor platform, ensuring interchangeability due to the uniformity of mechanical components. One of the standout benefits of the 1LE1 platform is its extensive variety of options, facilitating tailored customizations.

Characteristics of Innomotics PM motors:

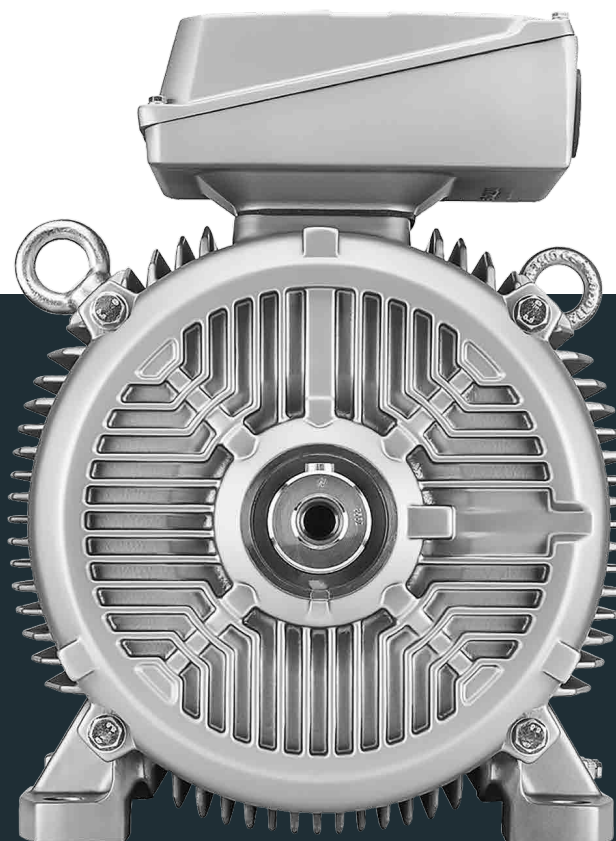
- Designed for variable speed applications, emphasizing highly efficient operation and robust torque characteristics.
- Prioritizes low operational costs.
- Experiences minimal system power losses due to the reluctance principle and the optimal coordination between the motor and the converter.
- Optimized with Siemens SINAMICS drives (G120, G220).
- Compatible with all converters supporting PM motor technology.



Technical specifications

Brief overview of the general technical specifications
for **Innomotics PM motors**

- Motor type: 1FZ1
- Operation: converter operation
- Power range: 90 - 250 kW
- Shaft height: 280
- Rated speed: 1500 and 3000 rpm
- Cooling method:
IC411 (self-ventilation), optionally
IC416 (forced ventilation)
- Degree of protection: IP55
- Connection type: star
- Vibration level: Grade A



SIEMENS									
Innomotics GmbH, DE-90441 Nürnberg									
3-MOT 1UV5285K 1FZ15052DK521AB4-Z UD 2022/2345678 001001									
IEC/EN 60034 280M IMB3 Th.Cl.155(F) -20°C ≤ Tamb ≤ 40°C									
765kg IP55									
IC411		30g	6317-C3	CONVERTER DUTY ONLY VPWM					
		30g	6317-C3	INPUT 380-480V					
		8000 h	UNIREX-N3			Ld 0.42mH			
		Nmax 2250 1/min		FREQ 20-150 Hz		Lq 0.96mH			
V	Hz	A	kW	cosφ	Nm	1/min	EFF/%	IE-CL	EMF/V
380 Y	100	270	160	0.93	1019	1500	97.2	IE5 S9	305
Made in Czech Rep.									

Rating plate

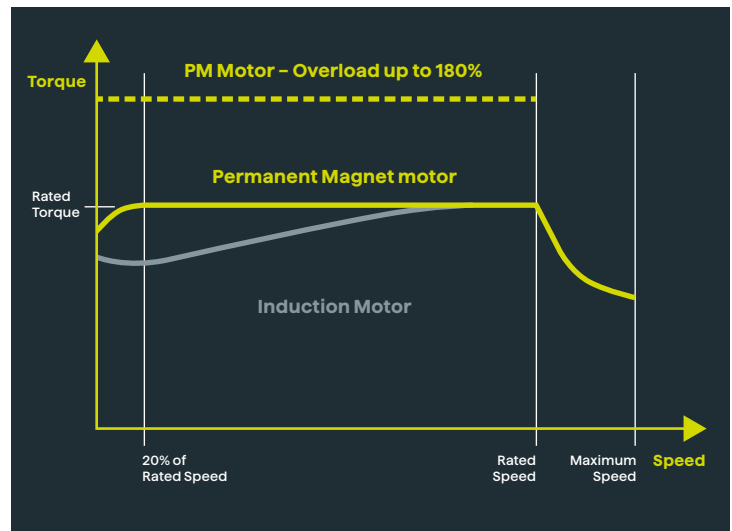
The rating plate for the PM motor contains all the necessary information for straight-forward and fast commissioning with converters. As is standard for Innomotics motors, the rating plate also provides all the crucial practical information to assist in identifying the motor.

Torque and efficiency characteristics

Torque characteristics

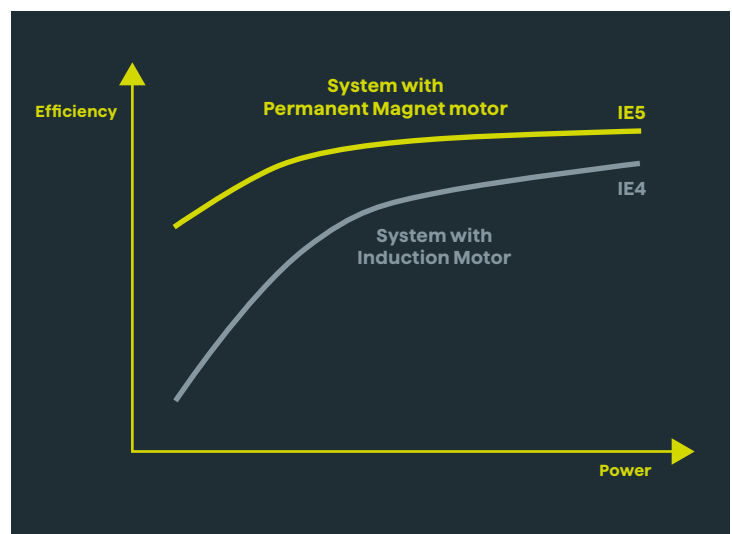
The permanent magnet motor from Innomotics offers a wide range of constant torque without the use of forced ventilation in speed range between 20% of nominal speed up to nominal speed, expanding its usability to more applications than previously possible for asynchronous motors.

Innomotics PM motor also offers up to 180% short overload capability. For encoderless operations, Innomotics can guarantee a limit within 20% of the nominal speed when using a SINAMICS converter.



Efficiency characteristics

The Innomotics PM motor meets the IE5 efficiency class standards. When compared to an equivalent asynchronous motor, the PM motor consistently delivers superior efficiency across the entire speed range.



Motor features

Insulation system

PM motors feature Advanced insulation system tailored for converter operation, ensuring the winding's longevity without any associated risks.

Admissible voltage peaks:

$$\hat{U}_{\text{phase-to-phase}} \leq 1600 \text{ V},$$

$$\hat{U}_{\text{phase-to-ground}} \leq 1400 \text{ V},$$

$$t_s > 0.1 \mu\text{s}$$

Thermal protection

As a standard thermal protection of Innomotics PM motors, customer has the possibility of choosing either 3 PTC or Pt1000 without price adder.

- 3 PTC – Article number position 15 (letter B)
- 1 Pt1000 – Article number position 15 (letter K)

Innomotics offers several other possibilities of thermal protection, safeguarding the motor winding against overheating due to phase loss, overload, or voltage fluctuations, including under-voltage and over-voltage scenarios.

Bearing current protection

All PM motors in the SH280 series from Innomotics come standard with insulated NDE bearings. This ensures a longer lifespan for the motor's bearing system while also allowing the use of standard bearings instead of hybrid ones. This design reduces maintenance costs over the motor's lifetime.

Control Methods

Introduction of Permanent Magnet (PM) motors, characterized by their higher efficiency and power density, has led to new possibilities in motor control. When paired with Variable Speed Drives (VSD), these motors offer unparalleled precision and versatility.

Vector Control (Field-Oriented Control):

Vector control, also known as Field-Oriented Control (FOC), provides more precise control over motor torque and speed. By decoupling the motor's torque-producing current from the magnetizing current, FOC enables independent control of torque and flux, thereby offering more nuanced control dynamics.

Smooth operation without an encoder is a matter of course.

Applications: Suited for applications requiring rapid torque changes and high precision.

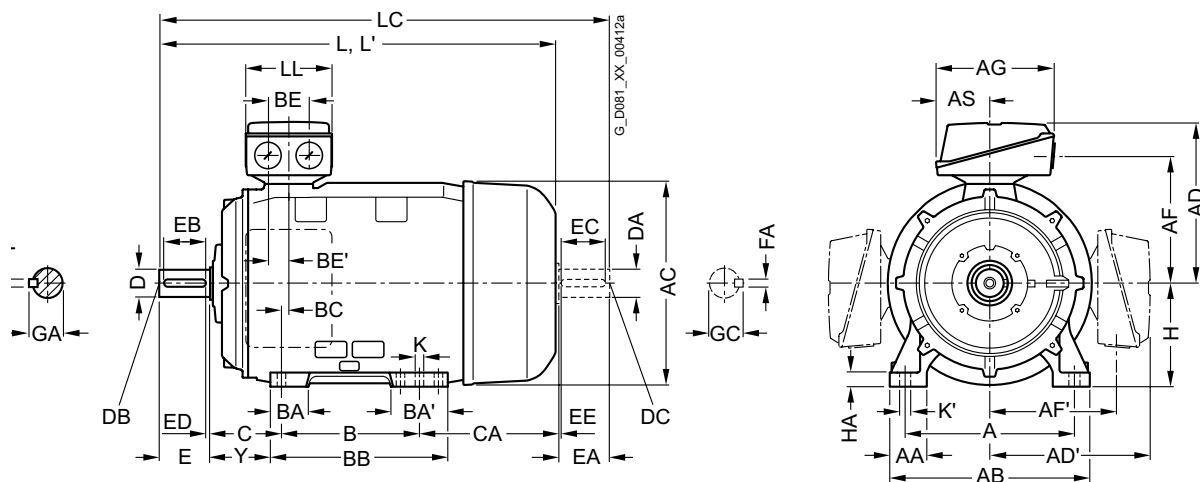
Description of motor design and electrical parameters

Values valid for motor nominal voltage 380V (voltage code 2-1)

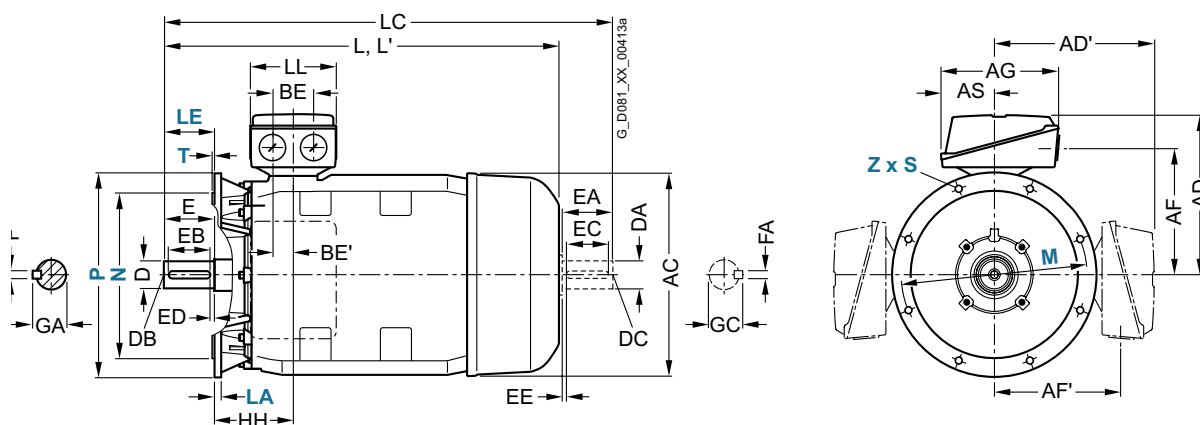
Article number	Rated Power [kW]	Rated Torque [Nm]	Rated Current [A]	Rated Power factor	Efficiency [%]	Maximum speed [rpm]	Maximum Torque/ Rated Torque	bEMF at rated speed (20°C) [V]	Moment of inertia [kg/m²]	Weight [kg]	Efficiency class
3000 rpm											
1FZ1505-2DL32-1...	110	350	174	0.99	96.8	3600	1,8	401	0.84	518	IE5
1FZ1505-2DL42-1...	132	420	210	0.98	96.9	3600	1,8	393	1.01	564	IE5
1FZ1505-2DL52-1...	160	509	255	0.99	97.0	3600	1,8	418	1.29	629	IE5
1FZ1505-2DL62-1...	200	637	315	0.99	97.2	3600	1,7	401	1.57	719	IE5
1FZ1505-2DL72-1...	250	796	410	0.95	97.2	3600	1,7	375	2.02	824	IE5
1500 rpm											
1FZ1505-2DK22-1...	90	573	155	0.91	96.9	2250	1,8	325	1.31	599	IE5
1FZ1505-2DK32-1...	110	700	189	0.91	97.0	2250	1,7	322	1.49	645	IE5
1FZ1505-2DK42-1...	132	840	225	0.92	97.1	2250	1,7	334	1.67	720	IE5
1FZ1505-2DK52-1...	160	1019	270	0.93	97.2	2250	1,6	306	1.85	765	IE5
1FZ1505-2DK62-1...	200	1273	340	0.92	97.4	2250	1,6	338	2.03	805	IE5

Dimensions

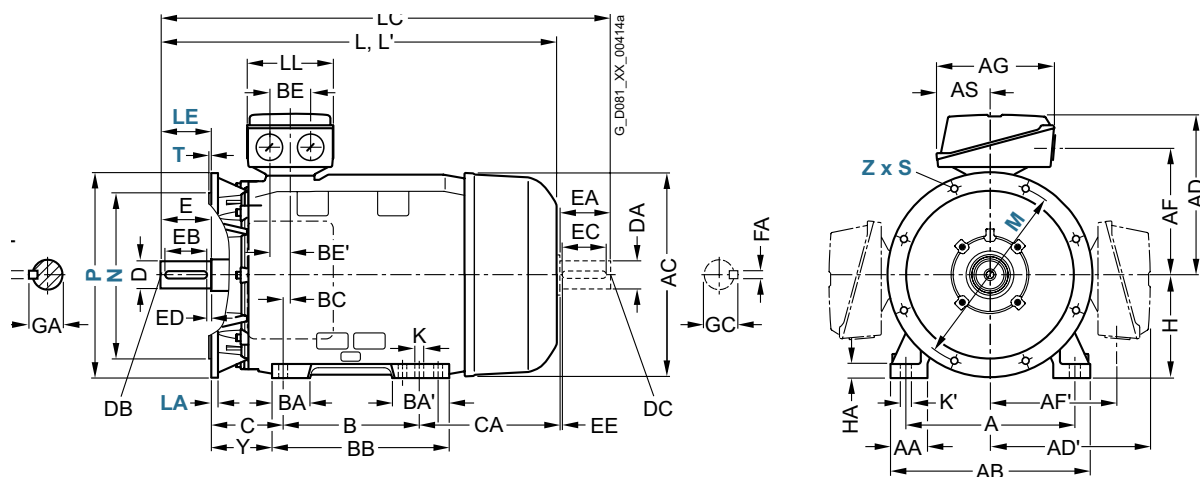
Type of construction IM B3



Type of construction IM B5 and IM V1



Type of construction IM B35



Dimension designation acc. to IEC

Rated Speed [kW]	Rated Power [kW]	Motor type	A	AA	AB	AC	AD	AD'	AF	AF'	AG	AS	B	BA	BA'	BB	BC	BE	BE'	C	CA	H	HA	Y	HH	K	K'
[mm]																											
3000	110	1FZ1505-2DL3	457	100	540	551	433	433	345	345	319	145	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30
3000	132	1FZ1505-2DL4	457	100	540	551	527	527	417	417	374	164	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30
3000	160	1FZ1505-2DL5	457	100	540	551	527	527	417	417	374	164	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30
3000	200	1FZ1505-2DL6	457	100	540	551	527	527	417	417	374	164	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30
3000	250	1FZ1505-2DL7	457	100	540	551	527	527	417	417	374	164	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30
1500	90	1FZ1505-2DK2	457	100	540	551	433	433	345	345	319	145	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30
1500	110	1FZ1505-2DK3	457	100	540	551	433	433	345	345	319	145	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30
1500	132	1FZ1505-2DK4	457	100	540	551	527	527	417	417	374	164	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30
1500	160	1FZ1505-2DK5	457	100	540	551	527	527	417	417	374	164	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30
1500	200	1FZ1505-2DK6	457	100	540	551	527	527	417	417	374	164	368	101	152	479	20	110	55	190	267	280	40	160	210	24	30

Rated Speed [kW]	Rated Power [kW]	Motor type	L	LA	LC	LE	LL	D	DB	E	EB	ED	F	GA	DA	DC	EA	EC	EE	FA	GC	M	N	P	S	T	Z
[mm]																											
3000	110	1FZ1505-2DL3	960	18	1105	140	233	65	M20	140	125	10	18	69	60	M20	140	125	10	18	64	500	450	550	15,8	5	8
3000	132	1FZ1505-2DL4	960	18	1105	140	299	65	M20	140	125	10	18	69	60	M20	140	125	10	18	64	500	450	550	15,8	5	8
3000	160	1FZ1505-2DL5	960	18	1105	140	299	65	M20	140	125	10	18	69	60	M20	140	125	10	18	64	500	450	550	15,8	5	8
3000	200	1FZ1505-2DL6	1070	18	1215	140	299	65	M20	140	125	10	18	69	60	M20	140	125	10	18	64	500	450	550	15,8	5	8
3000	250	1FZ1505-2DL7	1070	18	1215	140	299	65	M20	140	125	10	18	69	60	M20	140	125	10	18	64	500	450	550	15,8	5	8
1500	90	1FZ1505-2DK2	960	18	1105	140	233	75	M20	140	125	10	20	79,5	65	M20	140	125	10	18	69	500	450	550	15,8	5	8
1500	110	1FZ1505-2DK3	960	18	1105	140	233	75	M20	140	125	10	20	79,5	65	M20	140	125	10	18	69	500	450	550	15,8	5	8
1500	132	1FZ1505-2DK4	1070	18	1215	140	299	75	M20	140	125	10	20	79,5	65	M20	140	125	10	18	69	500	450	550	15,8	5	8
1500	160	1FZ1505-2DK5	1070	18	1215	140	299	75	M20	140	125	10	20	79,5	65	M20	140	125	10	18	69	500	450	550	15,8	5	8
1500	200	1FZ1505-2DK6	1070	18	1215	140	299	75	M20	140	125	10	20	79,5	65	M20	140	125	10	18	69	500	450	550	15,8	5	8

Reliable motion for a better tomorrow.

Looking for more information?
Check these web sites:

innomotics.com

portal.innomotics.com

siemens.com/spc

Publisher information:

Innomotics GmbH, Frauenauracher Str. 80, 91056 Erlangen,
Germany

Article-No.: IN-PMM01-November 2023
Printed in Germany

© Innomotics 2023

The following pages contain the Siemens logo and the Siemens legal information. Please note that since July 1st, 2023 the Siemens Businesses Large Drives Applications and Low Voltage Motors are part of Innomotics GmbH, Germany.

All rights to and product information on the following pages have been transferred from Siemens to Innomotics. The re-branding of the document will take place in due course.