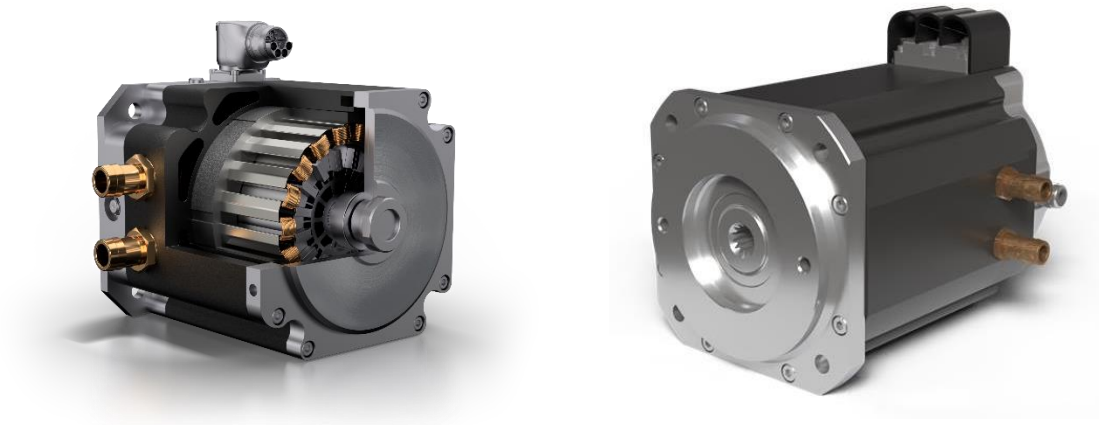
MMA eMotor

LOW & HIGH VOLTAGE ELECTRIC MOTORS
TRACTION, PROPULSION & WORK FUNCTION ELECTRIFICATION



PRODUCT CATALOG

POCLAIN

1. PRODUCT OVERVIEW

MMA electric motors are designed for mobile on-/off-highway applications. They balance power, size, weight, noise, efficiency, and costs. Compared to standard induction motors, MMA-Series motors are up to 6 times lighter, 75% shorter, and up to 3 sizes smaller. Advantages of the MMA range are:

- High power density and efficiency (92-94%)
- Liquid cooled as a standard (water/glycol or oil) –Best performances in every operating conditions
- Low noise and vibration
- IP 67 protection class
- Can be freely placed within the vehicle and requires no maintenance
- Customized shafts, flanges, and coolant connectors available
- Optional rotor-position-sensor (sin/cos-encoder)
- Suitable battery supply voltage (DC): 48 V – 850 V
- Available motor voltages (AC): 34 VRMS and 600 VRMS

MMA Motors are PMSM type, available in three frame sizes with various lengths offering different power and torque. Each variant can be tuned to your application for optimal efficiency through winding adjustments.

This technical catalog aims to provide comprehensive customer information for selecting the appropriate motor from the MMA electric motor series for each technical application. The acronym MMA represents:

2. TABLE OF CONTENT

3. MMA EMOTOR RANGE

MMA frame size matrix

The MMA motor series has 3 sizes, each of which is divided into the “Standard Speed” and “High Speed” type ranges. Both ranges are each structured in several lengths and nominal operating speeds so that a variety of available output powers can be derived.

		Standard speed				High speed			
		1500	2000	2500	3000	3000	4000	5000	6000
Frame size	Lenght	Continuous power P nom [kW]				Continuous power P nom [kW]			
MMA 80	L					1,2	1,6	2,0	
	M					2,9	3,9	4,9	6,0
	A	2,5	3,4	4,3	5,2	5,2	6,9	8,6	10,3
	B	4,0	5,3	6,6	7,9	7,9	10,7	13,3	16,0
	C	5,0	6,7	8,3	10,0				
MMA 100	D	9,4	12,5	15,7	18,7			31,4	37,7
	E	11,8	15,7	19,6	22,0/23,4			39,3	47,1
	F	17,0	21,3	23,5	24,8/28,2			47,1	56,5
	G	16,5	22,0	24,8	33,0			55,0	65/66
MMA 125	H	25,1	33,5	41,9	50,0	50,0	67,0	83,7	100,0
	I	28,3	37,7	47,1	56,5	56,5	75,4	94,0	113,0
	J	37,5	50,0	62,5	75,0	75,0	100,0	125,0	150,0
	K	50,0	66,8	83,5	100,0	100,0	133,0	167,0	200,0

Available voltage level range=		17 VAC / 24 VDC 400 VAC / 565 VDC
		34 VAC / 48 VDC 400 VAC / 565 VDC
		230 VAC / 330 VDC 600 VAC / 850 VDC

Cooling method	X =	Water jacket & natural convection
	X =	Water jacket

Figure 1: MMA frame size matrix

MMA80 range

The MMA80 motor series is distinguished by its exceptionally high power density. This attribute stems from the specific combination of stator and rotor design, resulting in a notably high winding factor exceeding 93%. The winding factor quantifies the extent to which the rotor magnets are utilized to generate torque. Additionally, the MMA80 motors feature a SPOKE rotor, where the magnets are arranged akin to spokes in a traditional wheel. This configuration maximizes the magnetic volume that can be effectively employed relative to the rotor volume, thereby attributing the substantial power density of the MMA80 motors to these two critical factors.

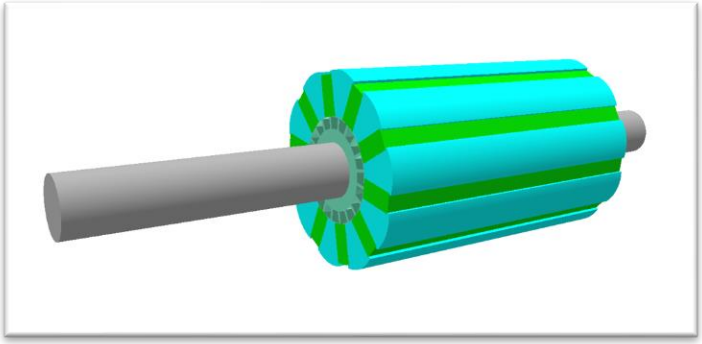


Figure 2: Principle SPOKE rotor design of MMA80

The MMA80 motor series is primarily designed for use as a mobile power unit motor. Any form of electro-hydraulic or pneumatic system can be driven. Applications such as fans and other actuator areas in vehicles are also conceivable.

Tab. 1 MMA 80 types and availabilities

MMA 80 "Standard Speed"	This type is currently available in the speed range of 1500-3000 rpm, in the voltage range of 230-400 volts (AC), with water jacket cooling and in 3 lengths. *For low voltage range from 24 V (DC) information's on request*
MMA 80 "High Speed"	This type will be available with the speed range of 3000-6000 rpm, in the voltage range of 24 V(DC)-400 V (AC), in 4 lengths, with water jacket cooling or natural convection. *For this type of range further information's on request*.

MMA100 range

The MMA 100 motor series is distinguished by its exceptionally high power density, achieved through a carefully chosen combination of stator and rotor design. This results in an outstanding winding factor exceeding 93%. The winding factor refers to the utilisation degree of the rotor magnets, indicating how much of the magnet volume contributes effectively to torque generation. Furthermore, the MMA 100 motors feature a SPOKE rotor, where the magnets are arranged similarly to spokes in a traditional wheel. This topology maximises the usable magnetic volume relative to the rotor volume, thereby enabling the remarkable power density of the MMA 100 motors derived from these two critical factors.

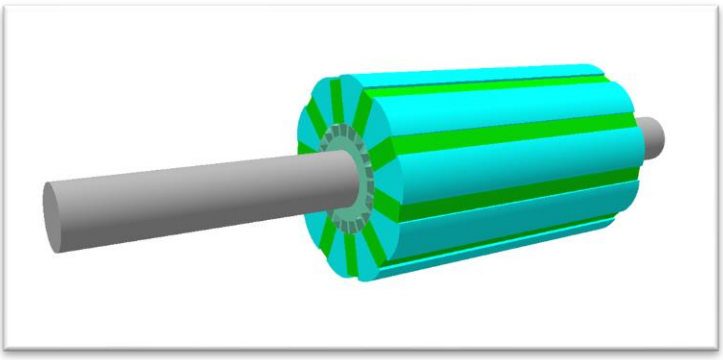


Figure 3: Principle SPOKE roto design of MMA100

The “Standard Speed” type range of the MMA 100 motor series has been developed as an aggregate motor in electro hydraulics, the so-called ePTOs. Their use can range from the electrification of vehicle superstructures to the electrohydraulic drive of small and medium-sized commercial vehicles.
The “Highspeed” type has been developed as a traction motor for use in so-called e-axles for small and medium-sized commercial vehicles. In this way, the MMA 100 also completes fully electric drive train solutions.

Tab. 2 MMA 100 types and availabilities

MMA 100 “Standard Speed”	This type is available in the speed range of 1500-3000 rpm, in the voltage range of 48 V(DC)-400 V (AC),), with water jacket cooling and in 3 lengths.
MMA 100 “High Speed”	This type is available in the speed range of 5000-6000 rpm, in the voltage range of 48 V(DC)-400 V (AC),), with water jacket cooling and in 4 lengths.

MMA125 range

The development of the MMA 125 prioritizes the creation of an authentic "dual-use" engine. This engine is designed to support larger ePTOs or electro-hydraulic applications, as well as traction motors within a power range of 25-200 kW. To fulfill these extensive requirements, the MMA 125 features a broad constant output power range, realized through the selected rotor topology. This rotor type is known as a V-shape IPM (Interior Permanent Magnet) rotor, characterized by its V-shaped magnet arrangement within the rotor body. From this motor size onwards, transitioning from the SPOKE to the IPM rotor topology is advantageous as it allows for significant savings in magnet material while maintaining nearly identical power density.

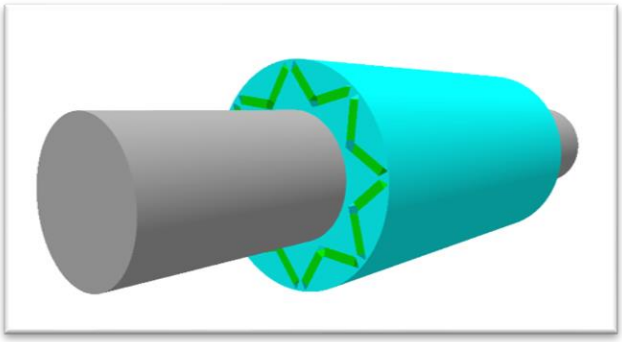


Figure 4: Principle V-shape IPM rotor design of MMA 125

Tab. 3 MMA 125 types and availabilities

MMA 125 “Standard Speed”	This type will be available with the speed range of 1500-3000 rpm, in the voltage range of 230 V(AC)-850 V (DC), in 4 lengths, with water jacket cooling. Further information’s on availability of MMA 125 on request.
MMA 125 “High Speed”	This type will be available with the speed range of 3000-6000 rpm, in the voltage range of 230 V(AC)-850 V (DC), in 4 lengths, with water jacket cooling. Further information’s on availability of MMA 125 on request.

Normative references

MMA motors are developed, tested and produced according to following standards:

- 2006/42/EG – Machinery Directive
- 2014/35/EG – Low Voltage Directive (LVD)
- 2011/65/EU - RoHS-Directive
- IEC 60349-4: Electric traction – Rotating electrical machines for rail and road vehicles
- DIN EN 60068-2-6_2008-10: Vibration (sinusoidal) test
- DIN EN 60068-2-27:2010-02: Shock test
- DIN EN IEC 60068-2-11:2021: Salt spray test – 240 hours

4. SELECTION CRITERIA

Terms and definitions

The rated operating modes (abbreviated S1 to S10) are defined in the international standard IEC 60034-1, which corresponds to the European standard EN 60034-1 and various national standards.
If no rated operating mode is specified on the rating plate of a machine, it is designed for continuous operation with a constant load. In addition to any other rated operating mode, additional information such as the switching cycles per hour and the duty cycle is required in order to assess the suitability of a machine for an application. If only the duty cycle is specified in addition to the rated operating mode, the cycle time is 10 minutes.

Tab. 4 Gerneral terms and definitions

Parameter	Abbr.	Unit	Definition
Duty cycle S1	S1		Operating mode S1 stands for continuous operation with constant load.
Duty cycle S2	S2		Operating mode S2 stands for short-time operation. For some MMA motors, there are 2 specifications for short-time operation of 10 and 60 seconds.
Feasible operation time	t_{on}		Operating time of the respective operating mode
Torque	T	[Nm]	Torque under nominal voltage, temperature and specified current in defined duty cycle
Power	P	[kW]	Shaft-output-power under nominal voltage, temperature and specified current in defined duty cycle
Speed	n	[rpm]	Speed under nominal voltage, temperature and specified current in defined duty cycle
Phase Current	I_{rms}	[A]	Motor phase current under displayed nominal load point
Phase Voltage	U_{rms}	[V]	Motor phase voltage under displayed nominal load point
Battery Current	I_{DC}	[A]	Inverter input current under displayed nominal load point
Battery Voltage	U_{DC}	[V]	Inverter supply voltage under displayed nominal load point
Electric frequency	f_{el}	[Hz]	Rotational electrical frequency to according speed under nominal voltage, temperature and specified current in defined duty cycle
Efficiency	η	[%]	Efficiency under displayed nominal load point
Power factor	cos(ϕ)	[V]	Power factor under displayed nominal load point

Operating conditions

Tab. 5 General operating conditions

Ambient temperature range	[°C]	-30 / 80 or -20 / 80 (depending on sealing material
Protection class		IP67
Thermal class		H
Thermal protection		PTC (Pt1000 on request)
Cooling type		Water cooled
min flow rate (motor coolant)	[l/min]	10
rated flow rate (motor coolant)	[l/min]	10
max flow rate (motor coolant)	[l/min]	30
Pressure drop @ rated flow rate	[bar]	0.02
Coolant		Water/Ethylenglycol 50/50
Max. cooling pressure (motor coolant)	[bar]	3
Coolant max temperature	[°C]	60
Rotational direction**		Clockwise

5. MOTOR CHARACTERISTICS BY FRAME SIZE

Motor performance designator

Beside the frame size, MMA motors are defined via a so-called performance designator. This designator consists out of 2 letters and one number. The first letter is the motor stack length described in the frame size matrix visible in **Erreur ! Source du renvoi introuvable.**.the second letter indicates the winding variant, which depend on the supply voltage and the output performance. The number indicates the rotor topology, where 1 stands for SPOKE-rotor and 2 stands for a V-shape IPM-rotor.

MMA 80 Variants

Tab. 6 of MMA 80 of the self variants

Frame size	Performance Designator	Stator length	Voltage [V_{AC}/V_{DC}]	Nominal speed	Torque S1 max [Nm]	Motor Power [kW]
MMA80	AA1	060	400/565	3000	16,5	5,2
MMA80	AC1	060	230/330	3000	16,5	5,2
MMA80	BA1	090	400/565	1500	25	4
MMA80	BC1	090	230/330	1500	25	4
MMA80	BC1	090	400/565	3000	25	7,9
MMA80	BD1	090	230/330	3000	25	7,9
MMA80	CA1	120	400/565	3000	32	10
MMA80	CB1	120	230/330	3000	32	10

MMA 100 Variants

MMA100 low voltage

The table below is not exhaustive. Refer to “Figure 1: MMA Frame Size Matrix” in this document for more details. Datasheets are available upon request and our application engineers can support you on finding the best compromise in our portfolio to suits your needs.

Tab. 7 of MMA 100 variants

Frame size	Performance Designator	Stator length	Voltage [V_{AC}/V_{DC}]	Nominal speed	Torque S1 max [Nm]	Motor Power [kW]
MMA100	DA1	100	34/48	3000	59	17,5
MMA100	EA1	125	34/48	3000	70,4	22
MMA100	FC1	150	34/48	3000	79	24,8
MMA100	FH1	150	68/96	3000	80	24,8
MMA100	GA1	175	34/48	2500	95	24,8
MMA100	FB1	150	34/48	2000	102	21.3
MMA100	FG1	150	68/96	2000	105	22
MMA100	FA1	150	34/48	1500	108,6	17

MMA100 high voltage

The table below is not exhaustive. Refer to “Figure 1: MMA Frame Size Matrix” in this document for more details. Datasheets are available upon request and our application engineers can support you on finding the best compromise in our portfolio to suits your needs.

Tab. 8 of MMA 100 variants

Frame size	Performance Designator	Stator length	Voltage [V_{AC}/V_{DC}]	Nominal speed	Torque S1 max [Nm]	Motor Power [kW]
MMA100	DC1	100	400/565	3000	61	18,8
MMA100	DB1	100	230/330	6000	61	37,7
MMA100	DD1	100	600/850	6000	61	37,7
MMA100	EB1	125	230/330	6000	72,5	47,1
MMA100	EC1	125	400/565	3000	74,7	23,4
MMA100	ED1	125	600/850	6000	78,4	47,1
MMA100	FE1	150	400/565	3000	89,7	24,8
MMA100	FD1	150	230/330	6000	91,2	56,5
MMA100	FF1	150	600/850	6000	93,5	56,5
MMA100	GC1	175	230/330	6000	103,5	65
MMA100	GE1	175	600/850	6000	103,5	66
MMA100	GD1	175	600/850	3000	105,4	33
MMA100	GF1	175	400/565	2500	105	65
MMA100	GB1	175	230/330	3000	105,6	33

MMA 125 Variants

The table below is not exhaustive. Refer to “Figure 1: MMA Frame Size Matrix” in this document for more details. Further information’s on the technical details and availability of MMA 125 on request.

Tab. 9 of MMA 125 variants

Frame size	Performance Designator	Stator length	Voltage [V_{AC}/V_{DC}]	Nominal speed	Motor Power [kW]
MMA125	HA2	160	230/330	6000	100
MMA125	HB2	160	600/850	6000	100
MMA125	IA2	180	230/330	6000	113
MMA125	IB2	180	600/850	6000	113
MMA125	JA2	240	230/330	6000	150
MMA125	JB2	240	600/850	6000	150
MMA125	KA2	320	230/330	6000	200
MMA125	KB2	320	600/850	6000	200

6. MECHANICAL INTERFACES

Drive side interfaces MMA 80

A-interface (claw coupling shaft Ø17; k6; 15 mm)

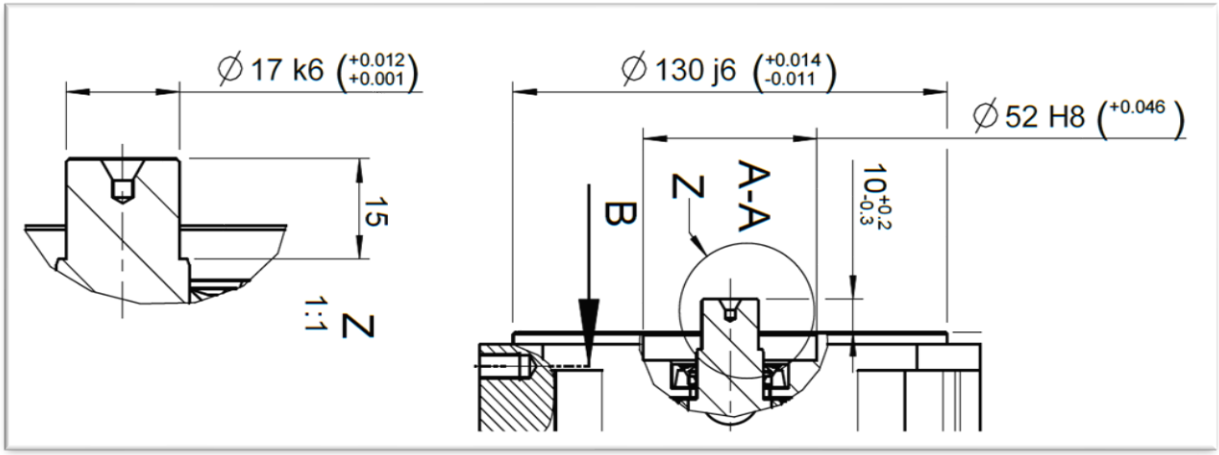


Fig. 1 MMA 80 A-interface

D-interface (Norm shaft Ø19mm; k6; 40mm)

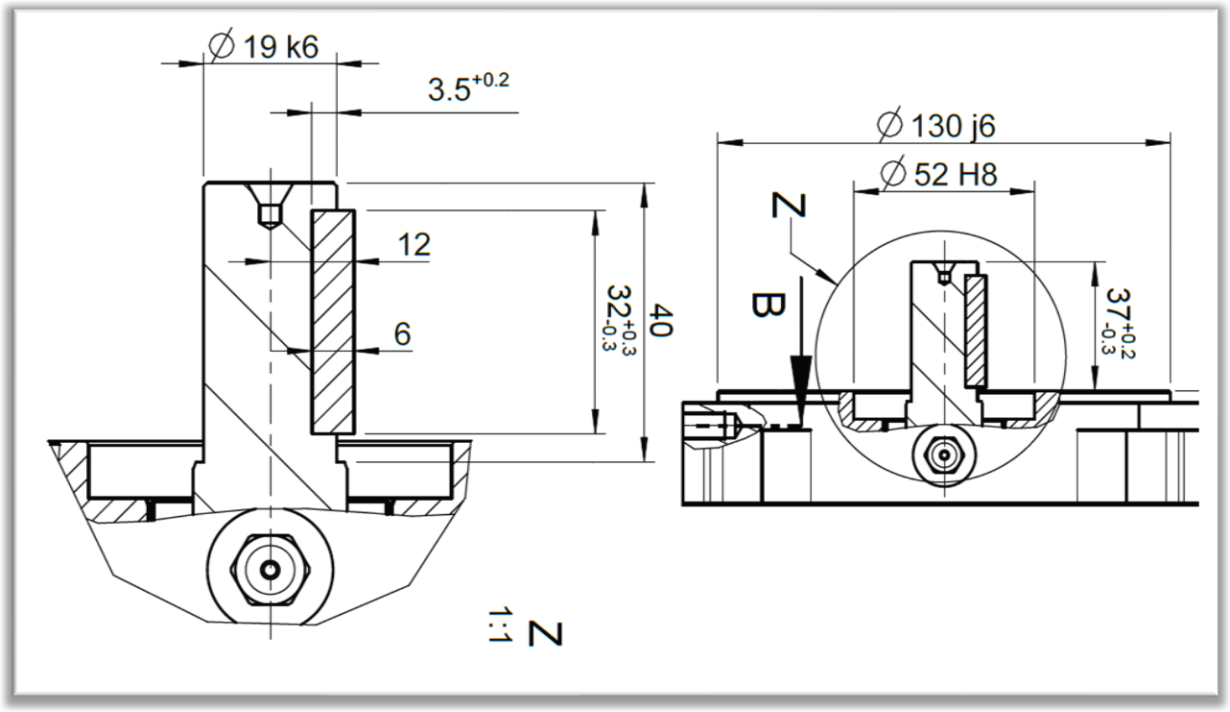


Fig. 2 MMA 80 D-interface

Drive side interfaces MMA 100

B5 interface

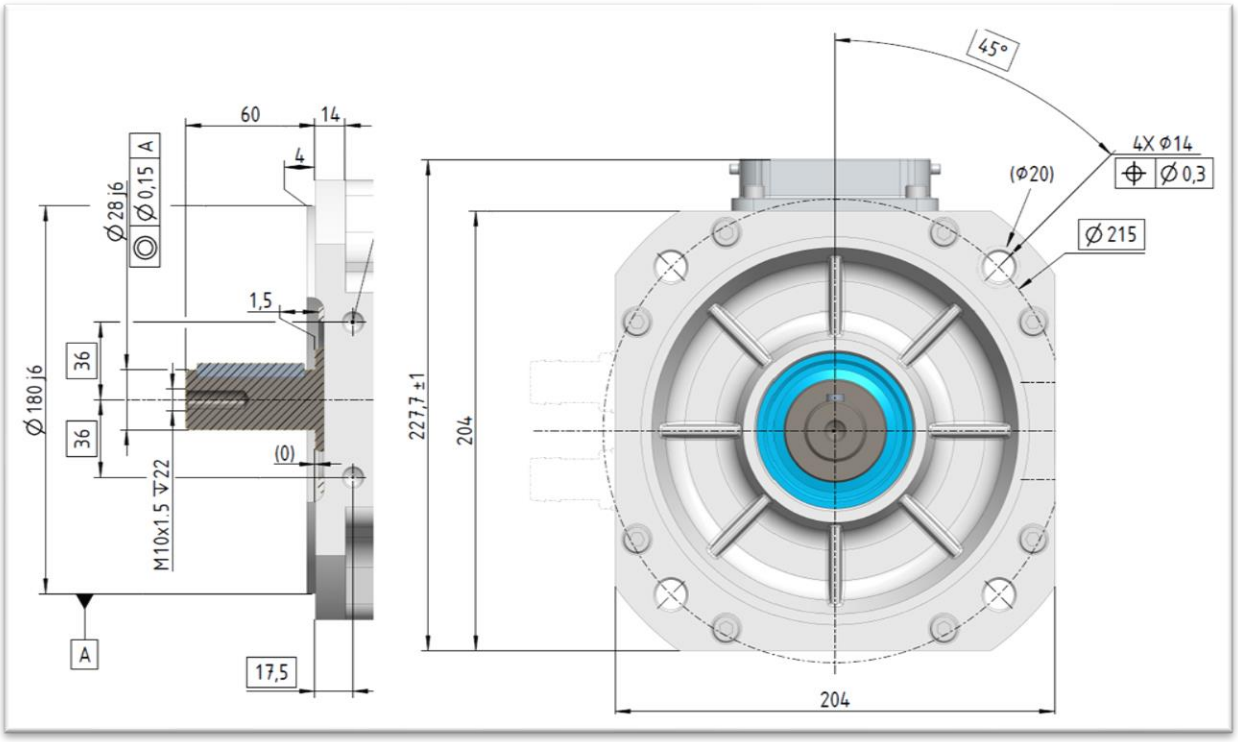


Fig. 3 MMA 100 B5 interface

SAE A interface

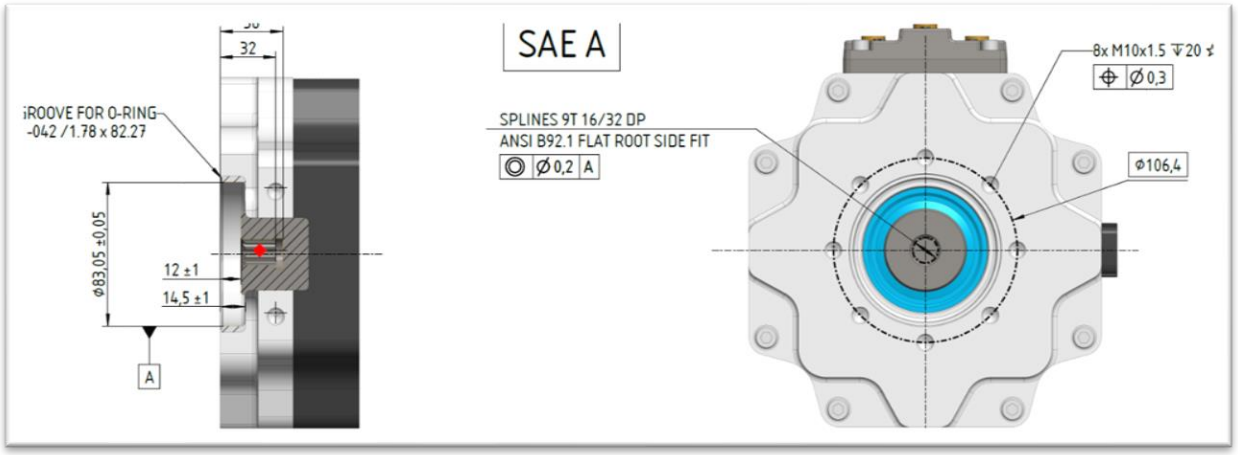


Fig. 4 MMA 100 SAE A interface

SAE B & BB interface

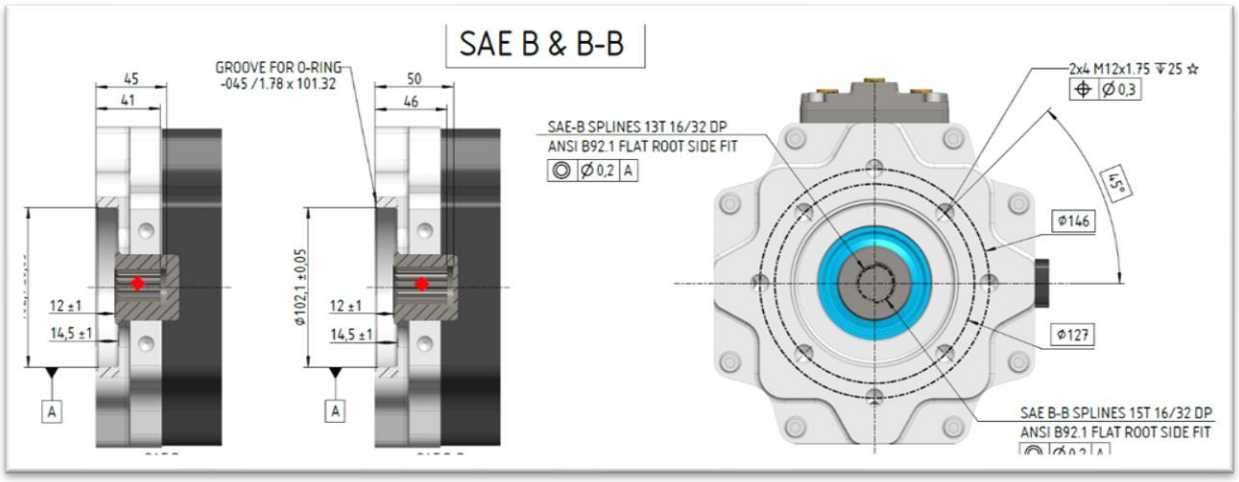


Fig. 5 MMA 100 SAE B & BB interface

SAE C – 4 bolts interface

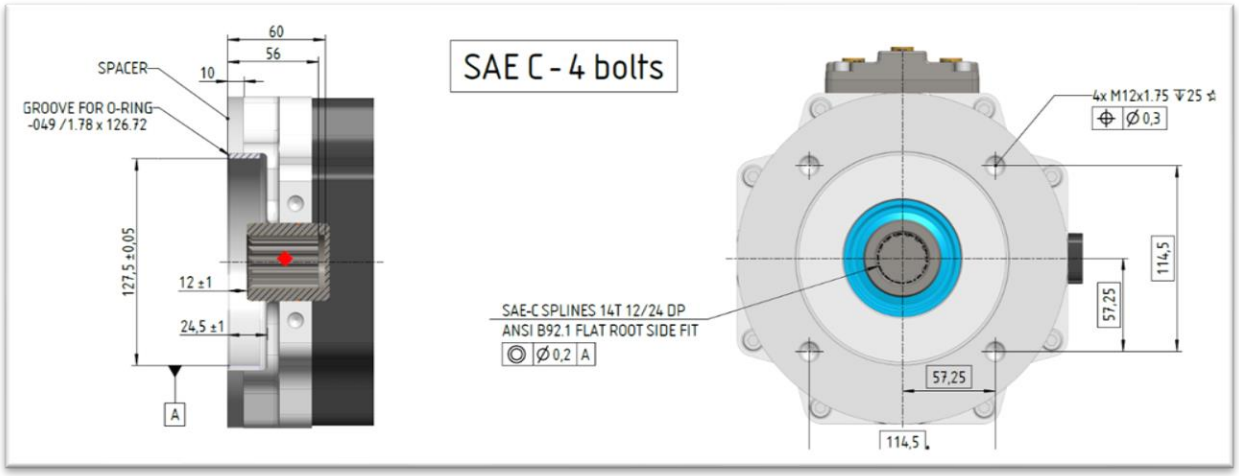


Fig. 6 MMA 100 SAE C - 4 bolts interface

Drive side interface MMA 125

Further information's on the technical details and availability of MMA 125 on request.

7. ELECTRICAL INTERFACES

Connections MMA80

Phoenix M23 Hybrid connector

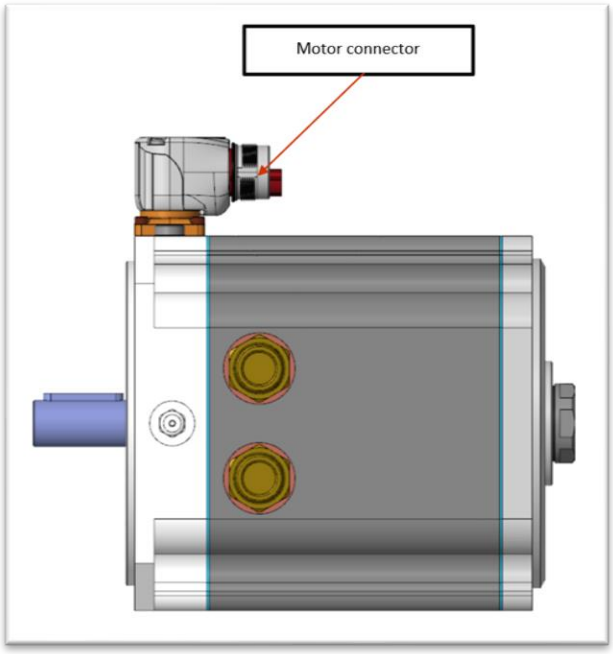
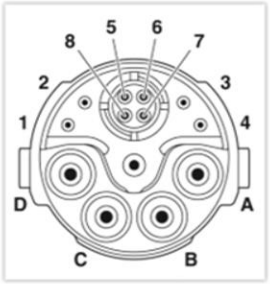


Fig. 7 MMA 80 with Phoenix connector

- Phoenix Contact M23 Hybrid connector SH-8EPC58AAC00S
- SPEEDCON interlock
- M23
- Diameter power contacts and PE = 2 mm
- Diameter signal contacts = 1 mm



The following motor cable connections (looking at the frontside of the motor connector) must be observed fo the correct rotational direction:

A ➔ not connected
B ➔ Motor phase "U"
C ➔ Motor phase "V"
D ➔ Motor phase "W"
Center pin ➔ PE

Signal pin 1 ➔ Temperature monitoring switch minus
Signal pin 2➔ not connected
Signal pin 2➔ not connected
Signal pin 4 ➔ Temperature monitoring switch plus

Fig. 8 Phoenix connector informations

Connections MMA100

Low voltage connector Moteg 70

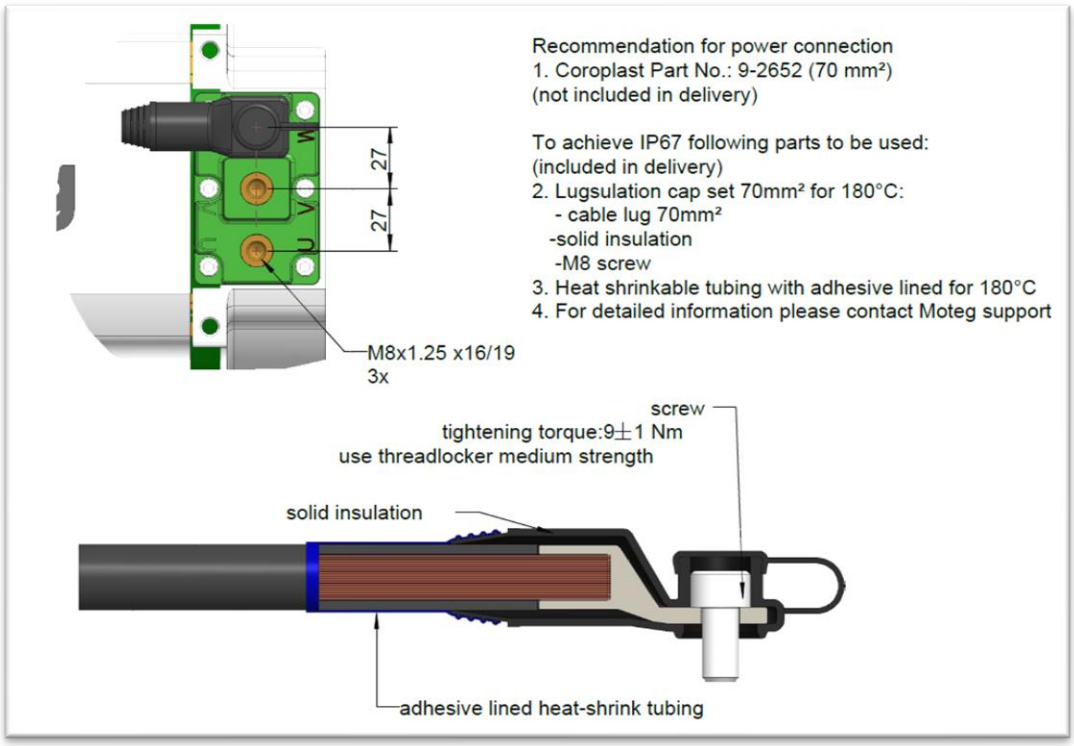


Fig. 9 Connector MOTEG 70

High voltage Amphenol Power LOK 300

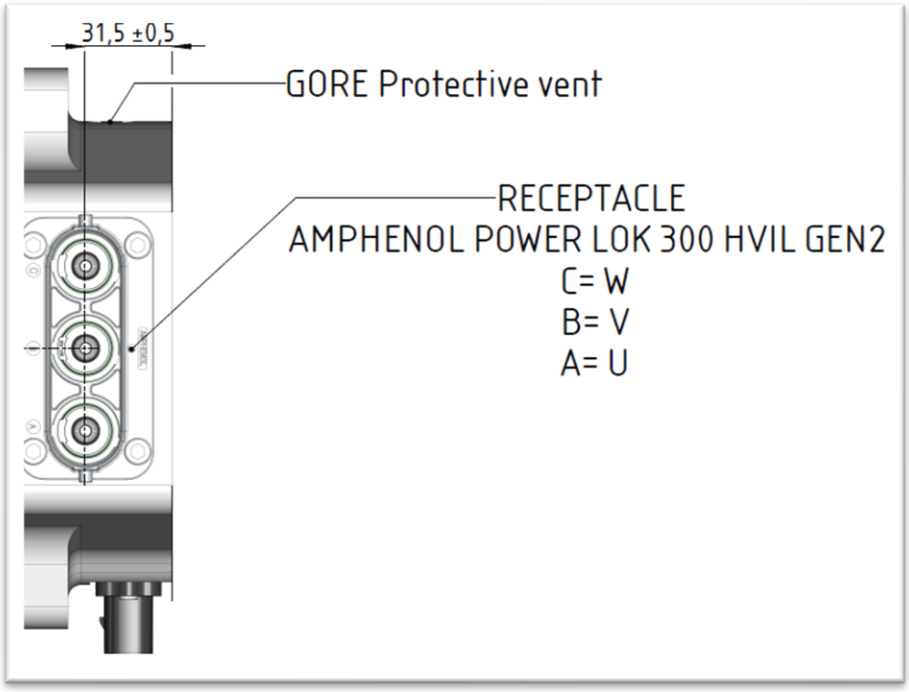
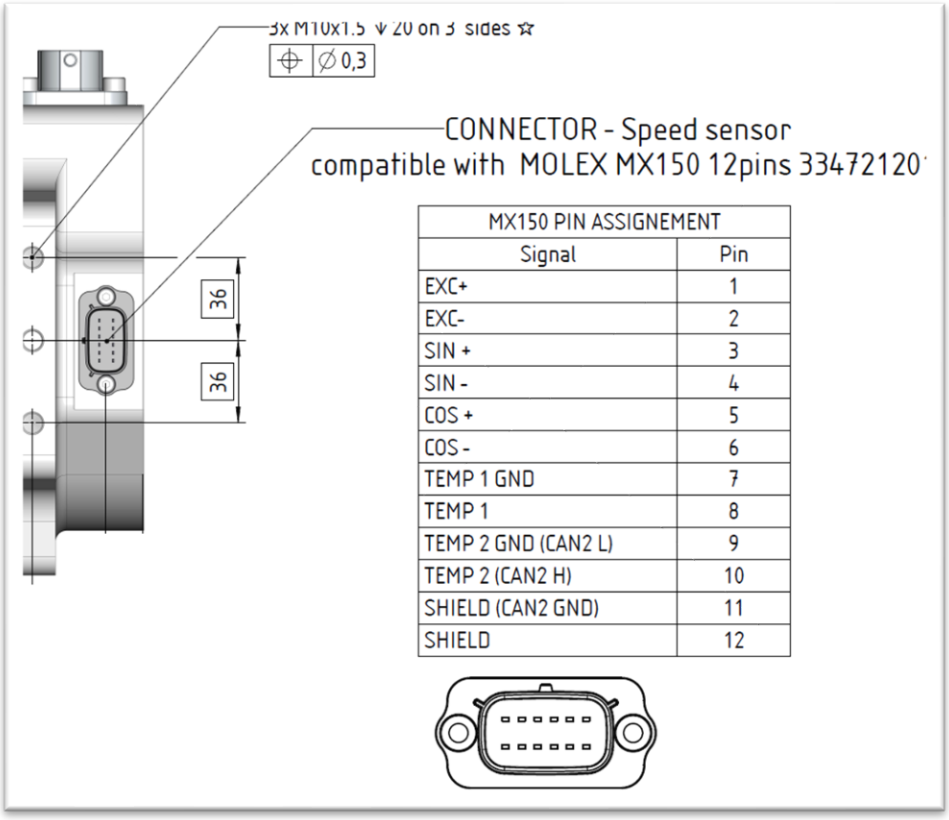


Fig. 10 Connector Amphenol Power LOK 300

Sensor connector Molex MX150



MX150 PIN ASSIGNEMENT	
Signal	Pin
EXC+	1
EXC-	2
SIN +	3
SIN -	4
COS +	5
COS -	6
TEMP 1 GND	7
TEMP 1	8
TEMP 2 GND (CAN2 L)	9
TEMP 2 (CAN2 H)	10
SHIELD (CAN2 GND)	11
SHIELD	12

Fig. 11 Connector MOLEX MX150 for rotor position and temperature

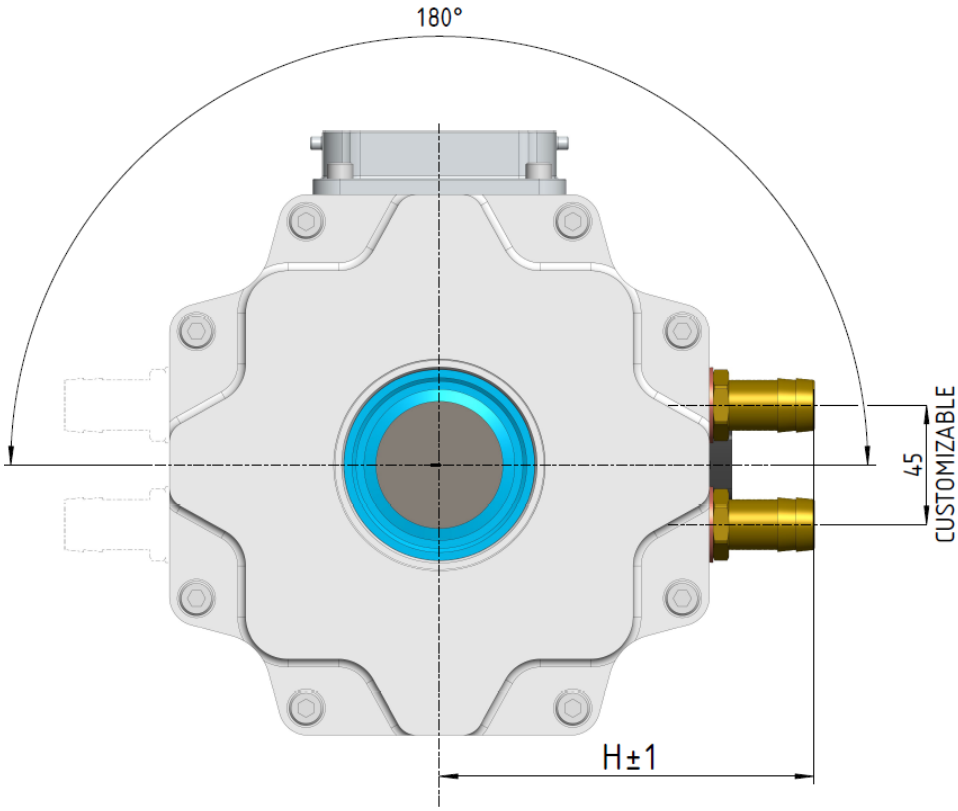
Connections MMA 125

Further information's on the technical details and availability of MMA 125 on request.

8. COOLING INTERFACES AND OPTIONS

Cooling options MMA 80 & MMA 100

For the MMA 80 and MMA 100 there is a variety of cooling connector available. Beside the standard right-side position of the cooling connectors a left-side variant (mirrored) is available on request. Further details are shown in Fig. 12.



COOLING CONNECTION
Angular location every 180° factory built

TYPE	H (mm)
NONE	PLUGGED
DN08	135.5
DN10	141.5
DN13	141.5
DN16	141.5
DN 19	141.5
NORMAQUICK PS3 NW12	140

Fig. 12 cooling options MMA 80 & 100

Cooling connectors MMA 125

Further information's on the technical details and availability of MMA 125 on request.

9. RECOMMENDED INVERTERS

MMA inverters are perfectly suited to Poclain's emDrive inverters. Inverter and eMotors can be delivered already paired.

Frame size	Length	Standard speed 1500	Standard speed 2000	Standard speed 2500	Standard speed 3000	High speed 3000	High speed 4000	High speed 5000	High speed 6000
		Recommended Inverter LV / HV				Recommended Inverter LV / HV			
MMA 80	L					H5	H5	H5	
	M					H5	H5	H5	H5
	A	H5	H5	H5	H5	H5	H5	H10 100	H10 100
	B	H5	H5	H5	H5	H5	H10 100	H10 100	H10 100
	C	H5	H5	H5	H5				
MMA 100	D	L30 450/ H20 200	L30 450/ H20 200	L30 450/ H20 200	L30 450/ H20 200			H20 200/ H20 130	H20 200/ H20 130
	E	L30 450/ H20 200	L30 450/ H20 200	L30 450/ H20 200	L30 450/ H20 200			H20 200/ H20 130	H20 200/ H20 130
	F	L30 450/ H20 200	L30 450/ H20 200	L30 450/ H20 200	L30 450/ H20 200			H20 200/ H20 130	H20 200/ H20 130
	G	L30 450/ H20 200	L30 450/ H20 200	L30 450/ H20 200	H20 200/ H20 130			H20 200/ H20 130	H20 200/ H20 130
MMA 125	H	H20 200/ H40 300	H20 200/ H40 300	H20 200/ H40 300	H20 200/ H40 300	H20 200/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300
	I	H20 200/ H40 300	H20 200/ H40 300	H20 200/ H40 300	H20 200/ H40 300	H20 200/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300
	J	H20 200/ H40 300	H20 200/ H40 300	H20 200/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300
	K	H20 200/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300	H40 450/ H40 300

Fig. 13 Matrix of recommended inverters

Tab. 10 of inverter details

H5"	**Poclain** High voltage mobile inverter. For technical details please contact customer support under https://poclain.com/electrification
H10 100	**Poclain** High voltage mobile inverter. For technical details please contact customer support under https://poclain.com/electrification
L30 450	**Poclain** Low voltage mobile inverter. For technical details please contact customer support under https://poclain.com/electrification
H20 200	**Poclain** High voltage mobile inverter. For technical details please contact customer support under https://poclain.com/electrification
H40 300	**Poclain** High voltage mobile inverter. For technical details please contact customer support under https://poclain.com/electrification
H40 450	**Poclain** High voltage mobile inverter. For technical details please contact customer support under https://poclain.com/electrification

10. ORDERING INFORMATION'S

Model code

In the following section the naming convention of the product key for the MMA motor series is described.

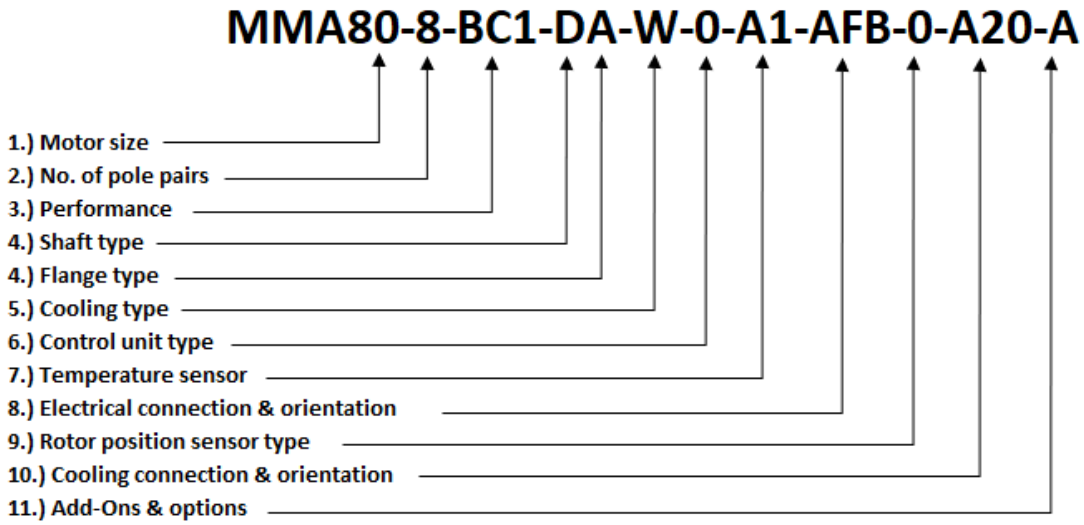


Fig. 14 naming convention of MMA product key

Motor size

Available MMA motor sizes can be seen in **Erreur ! Source du renvoi introuvable.**.

No. of pole pairs

The used Number of pole pairs in the currently available MMA 80 series is 8. The new version will use 5 pole pairs to be able to reach the performance of the high-speed motor range.
Within the MMA 100 series the number of pole pairs is 5.

Performance

Description of the performance designator is done in Tab. 1 & Tab. 2 & Tab. 3.

Shaft type

Within the MMA range there is a variety of different shaft types available. Details display in the following:
Shaft type:
A: Shaft for eAir Ø17(k6); 15 mm
D: Norm shaft Ø19mm (k6); 40mm
G: Hollow shaft 15 teeth ANSI B92.1 (SAE B-B)
H: Hollow shaft 13 teeth ANSI B92.1 (SAE B)
J: Hollow shaft 9 teeth ANSI B92.1 (SAE A)
K: Hollow shaft 14 teeth ANSI B92.1 (SAE C 4 bolts)
L: Shaft Ø 28mm (j6); B5-MMA100

Flange

Within the MMA range there is a variety of different flange types available. Details display in the following:
Flange types:
A: Standard MOTEG (eAir/eServo)
C: Standard MOTEG mirrored (coolant connectors on opposite side)
E: SAE A flange MMA100
F: SAE B & BB flange MMA100
G: SAE C-4 bolt flange MMA100
H: B5-100 flange (NDS connector)

Cooling type

Within the MMA range there are 2 cooling types available. Details display in the following:
Cooling type:
N: Natural convection (no active cooling)
W: Liquid cooled

Control unit type

Within the MMA range there are 2 control unit types available. Details display in the following:
Control unit type:
0: none
1: inverter (flanged or integrated)

Temperature sensor

Within the MMA range there is a variety of different temperature sensor types available. Details display in the following:
Temperature sensor:
A_: PTC
B_: PT1000
C_: PT100
D_: 2xPT1000
_1: included in power connector
_2: Molex MX150

Electrical connection & orientation

Within the MMA range there is a variety of different electrical connector types available. Details display in the following:
Electrical connection & orientation:
A__: Phoenix M23
C__: cable lugs connection M8
D__: DC inverter connection 2 pins
E__: Amphenol Power Lok 300 HVIL 3 POS

_F_: front
_B_: back

__A: straight
__B: 0° assembly angle (angle set between 0 - 135°)
__C: 180° assembly angle (angle set between 180 - 315°)

Rotor position sensor type

Within the MMA range there is a variety of different rotor position types available. Details display in the following:
Rotor position sensor:
0: none
1: Sin/Cos Encoder
2: Resolver XY

Cooling connection & Orientation

Within the MMA range there is a variety of different cooling connector types available. Details display in the following:
Cooling connection & orientaion:
Coolant hose connector:
A1: none
A2: DN19
A3: DN13
A4: DN08
A5: DN16
A6: DN10
A7: NORMAQUICK PS3 NW12
A8: DN19 angled (90°)
A9: DN10 angled (90°)

Add-Ons & options

Within the MMA range there is a variety of different Add-Ons and options available. Details display in the following:
Add-On & options:
A: none
B: Baseplate with standard MOTEG anti-vibration feet
C: Baseplate (customized)
D: Pump adapter (eServo)
E: B5 adapter
F: external hydraulic pump adapter

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Poclain reserves the right to make any modification it deems necessary to the product described in this document without prior notification. Illustrations are not binding. The information contained in this document must be confirmed by Poclain before any order is submitted.

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