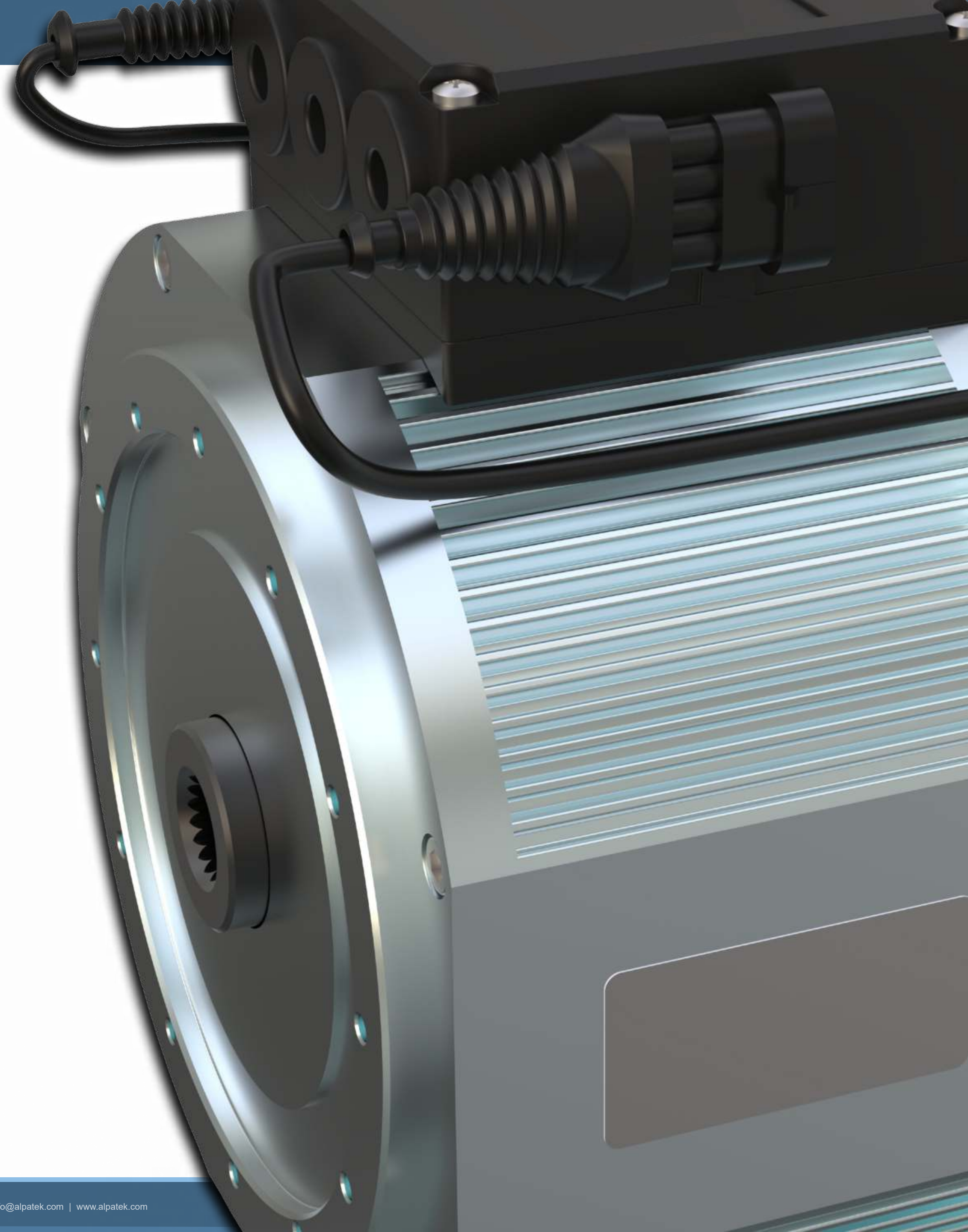


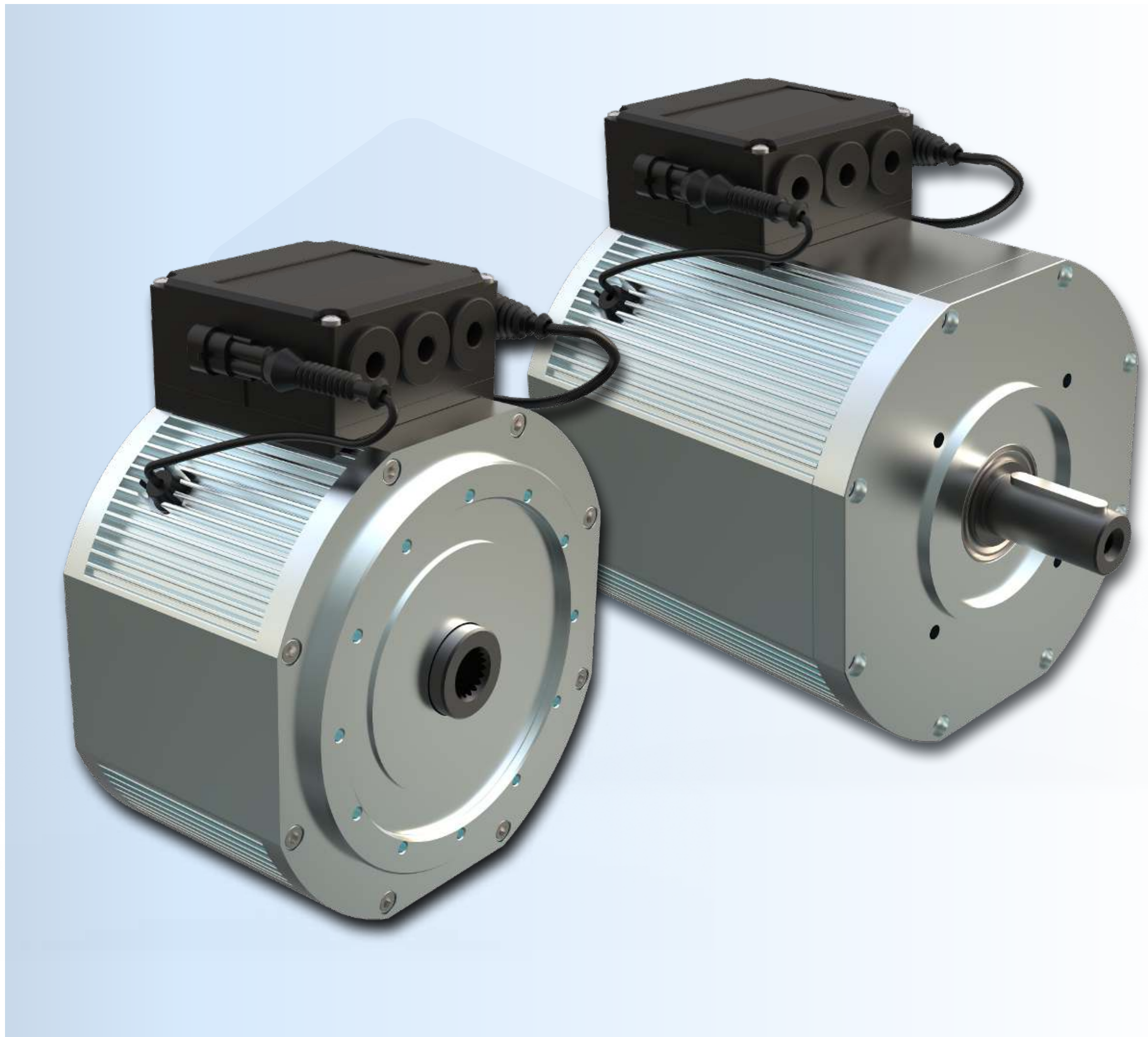
# ALPATEK

BATTERY DRIVE SYSTEMS AND MOTORS

## PMAC SERIE

PMAC ELECTRIC MOTORS





**CONTENTS**

INTRO	3
TECHNICAL CHARACTERISTICS	4
PERFORMANCES	5
MOTOR SIZING	6
MOTOR MODELS	7
PMAC 077 SERIE	8
PMAC 096 SERIE	10
PMAC 132 SERIE	12
PMAC 200 SERIE	15
CONFIGURATIONS	21
APPLICATIONS	22
OPTIONS	23
SENSORS	24
ORDER CODE	25

**WARNINGS**

Failure or improper selection of the products described here can cause death, personal injury and property damage. This document provide products and options for further investigation by users having technical expertise. Users must analyze all aspects of application, follow applicable industry standards & certifications, and follow the information concerning the product in the current product catalog.



**TECHNICAL CHARACTERISTICS**

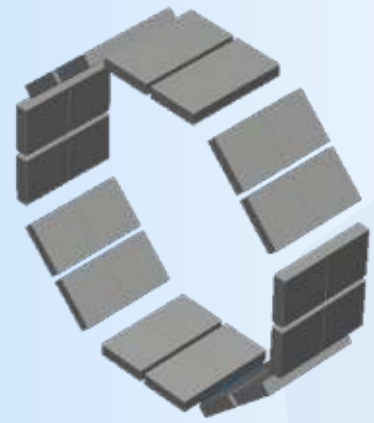
Motor Type	Permanent Magnet Synchronous Motor
Power Range	0,2 to 80kW (peak)
Voltage Range	24 to 600 Vdc
Torque Range	Up to 270Nm (peak)
Magnet Materials	NeFeBrare earth magnets
PolesNumbers	4 to 10 poles
Motor Feedback	SinCos(resolver option)
Protection	Up to IP6k9k
Thermal Class	F with potting
Thermal Protection	KTY84-130
Connections	Terminal box (flying cables option)
Cooling	Self Cooling (liquid cooling option)
Mounting Orientation	Arbitrary
General Regulations	Complying IEC 60034
Marking	CE, UL®

**OVERVIEW**

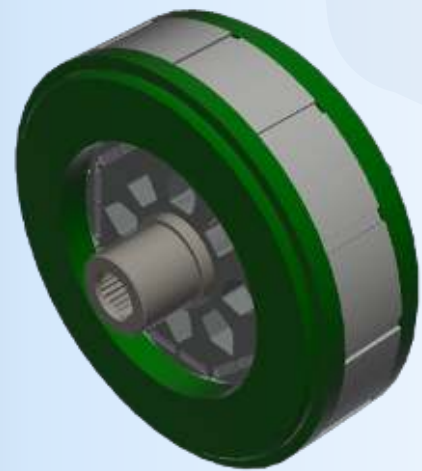
PMAC Serie offer Permanent Magnet Synchronous technology boasting up to 97% efficiency that enable the production of motors a third of the size and weight of typical induction ones.

Scalable design and high-speed performance thanks to field weakening equates to an unbeatable overall package, available for traction, hydraulics pumps and IEC/NEMA flanges.

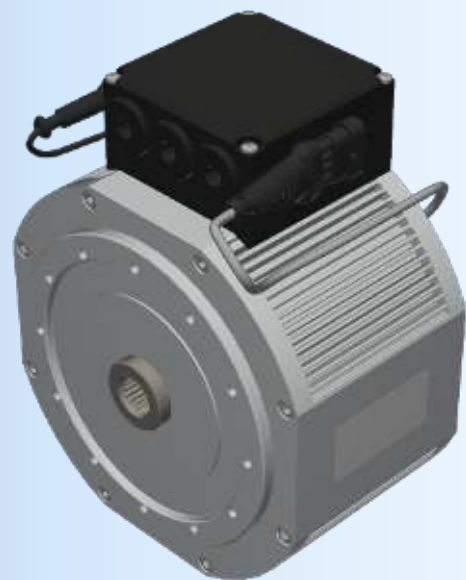
## TECHNICAL CHARACTERISTICS



**INTERIOR PERMANENT MAGNET**  
Rare-earth permanent magnet deeply positioned in the rotor generating a strong magnet torque.



**ENCAPSULATED STATOR**  
Fully encapsulated for an excellent electrical insulation, thermal dissipation and shock proof.



**HIGH POWER DENSITY**  
IPM technology allows production of motors a third of the size & weight of typical AC induction.

## FEATURES

### ✓ HIGHEST EFFICIENCY

High Efficiency thanks to optimal electric design characteristics (dedicated to each single application) combined to the best component technology, allowing minimize of losses during power generation.

### ✓ SMALLER DIMENSIONS

Alpatek innovative motors are the key technology to space-saving in electrification. The combination of two rotating forces of the ever potent neodymium magnet torque and original reluctance torque, elevated power can be generated at lower motor volumes.

### ✓ BREAKTHROUGH PERFORMANCE

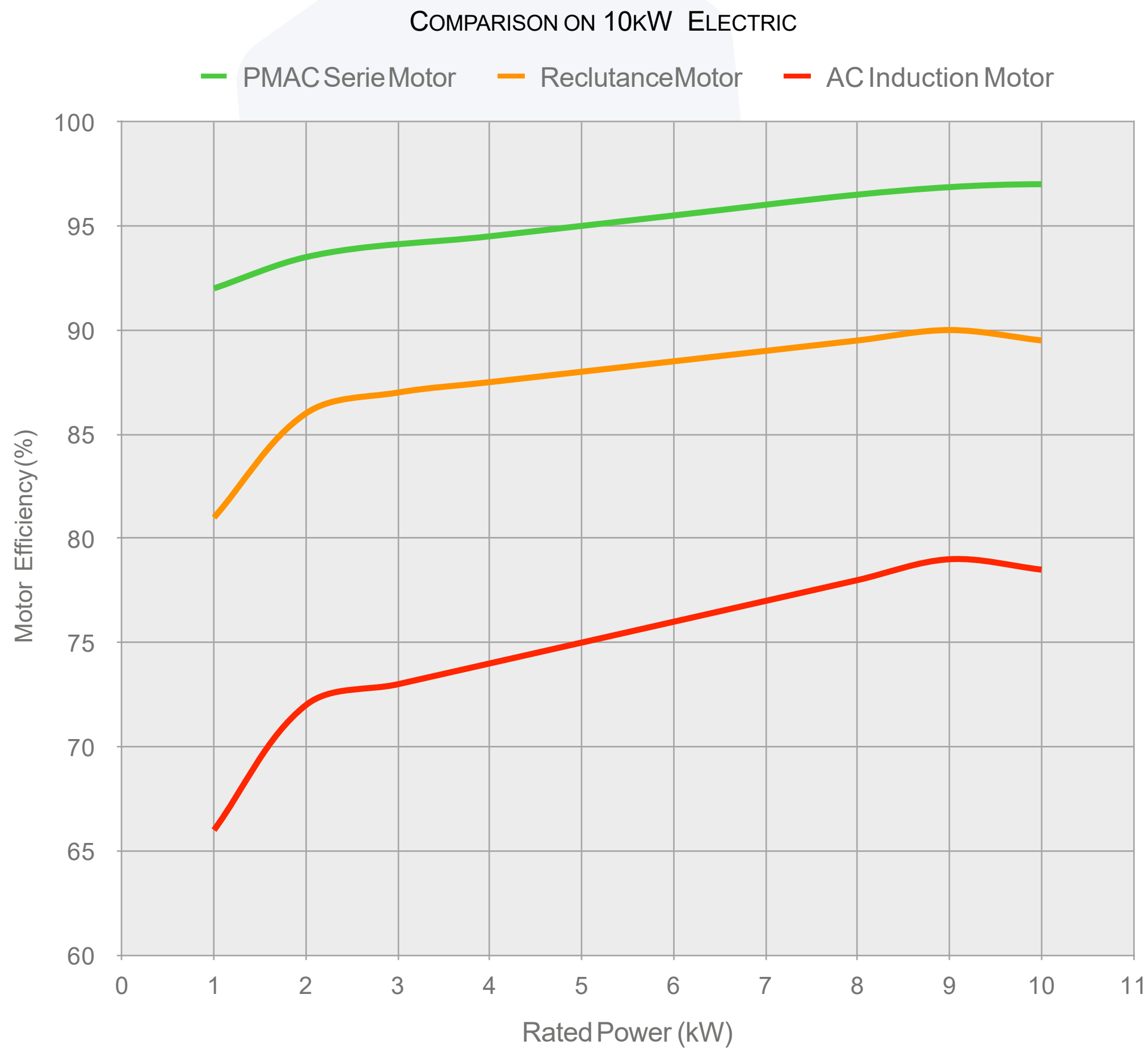
PMAC Serie utilizes highly engineered rotor design to achieve the highest efficiencies. Higher power density thanks to NeFeB rare earth magnet NiCuNi surface-coated to guarantee high performance and protect them against oxidation and corrosion.

### ✓ MODULAR

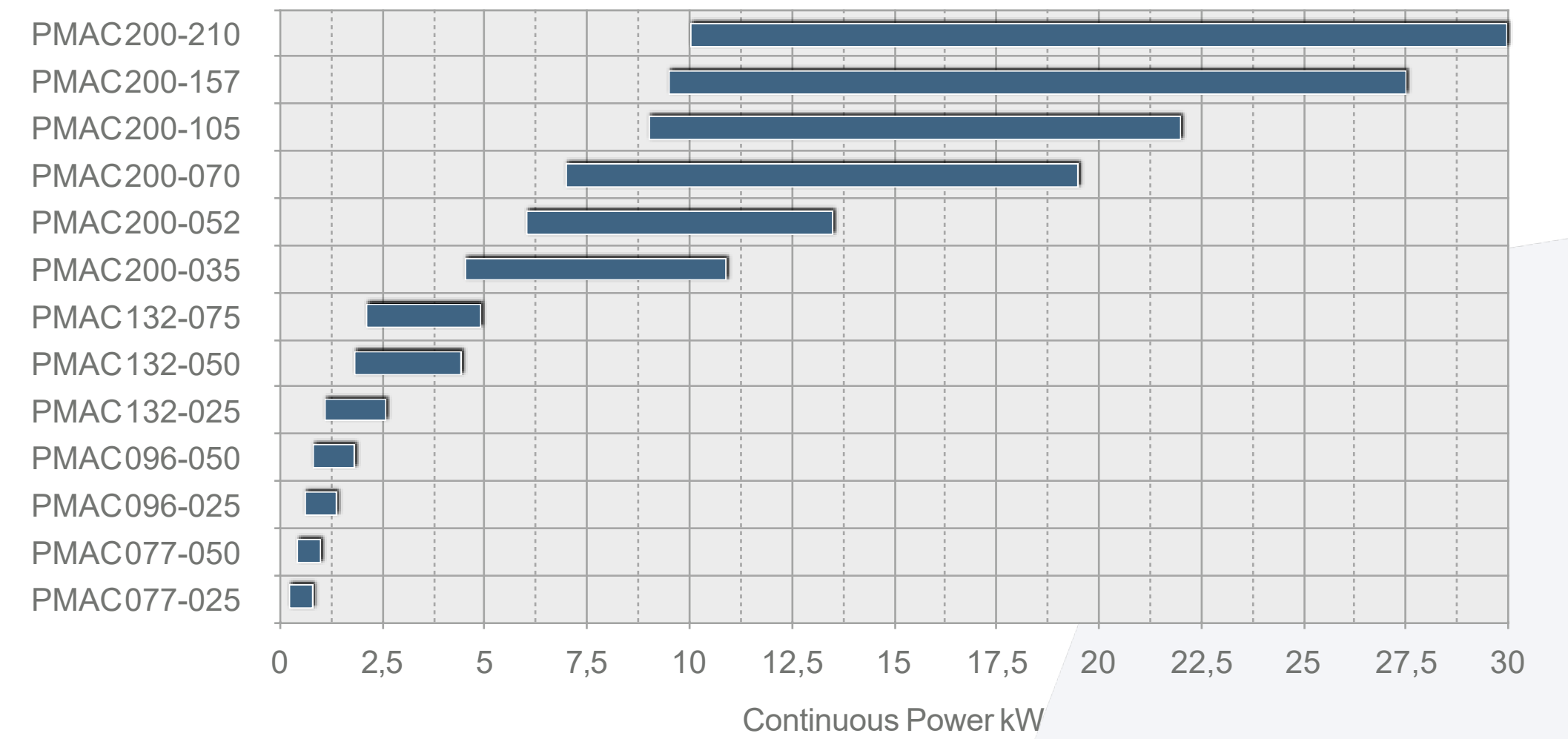
Thanks to high modularity of standard lamination stack length and great scalability in performances PMAC Serie motors fit within a wide-range of applications. Customization capability including specific mechanical design, we collaborate with every customer providing special solutions and interfaces

### BREAKTHROUGH PERFORMANCE

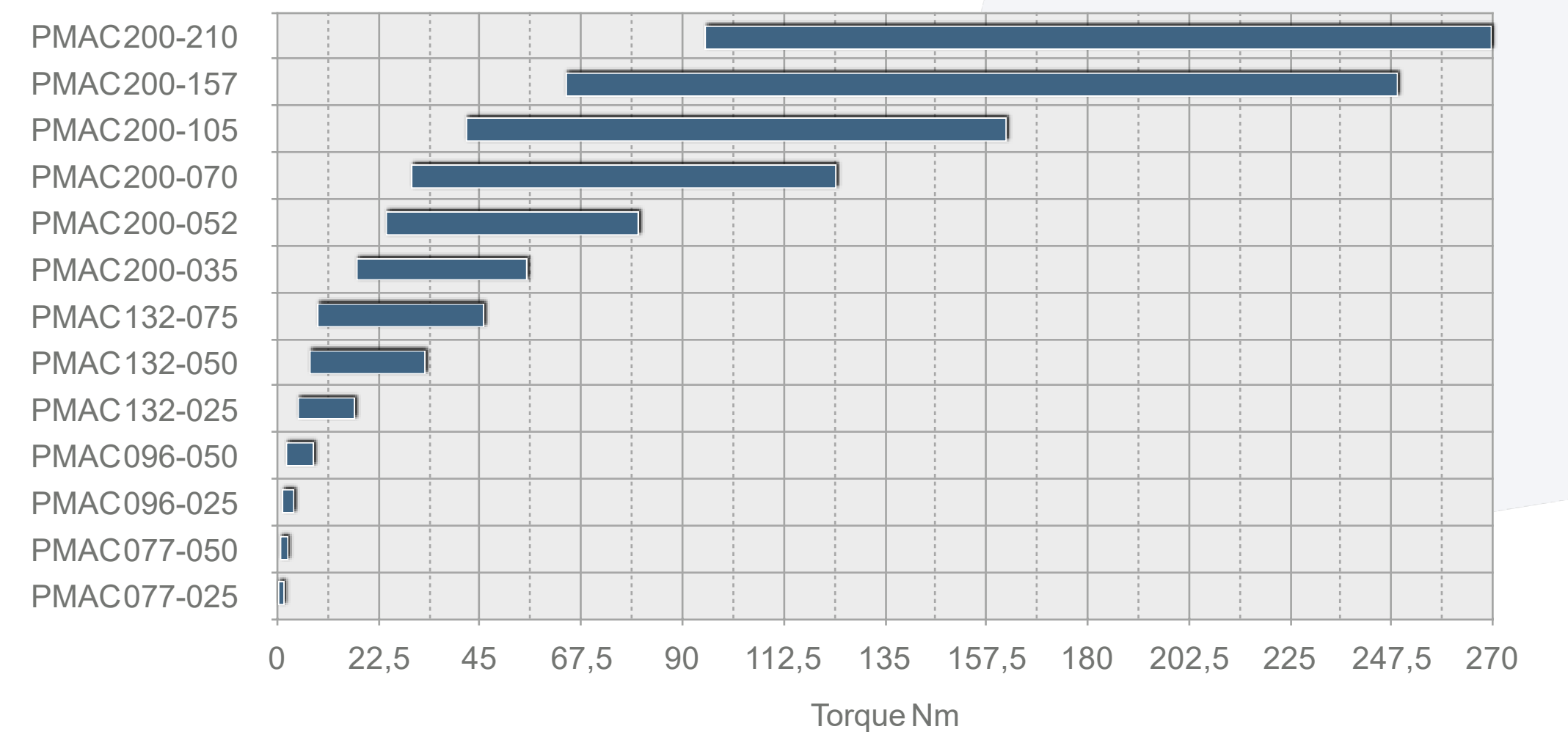
Thanks to interior permanent magnet technology, PMAC Serie efficiency is much higher than traditional AC Induction and Reluctancemotors.



### POWER RANGE



### TORQUE RANGE



### CHOOSING THE RIGHT MOTOR

Motor sizing is the key for the success of any electrification project

By selecting the appropriate voltage, rotor length and winding model, following parameters can be refined to match the vehicle's specific performance requirements:

#### 1. INSTANT AREA

Extreme working conditions, where electric motor can operate for limited periods only.

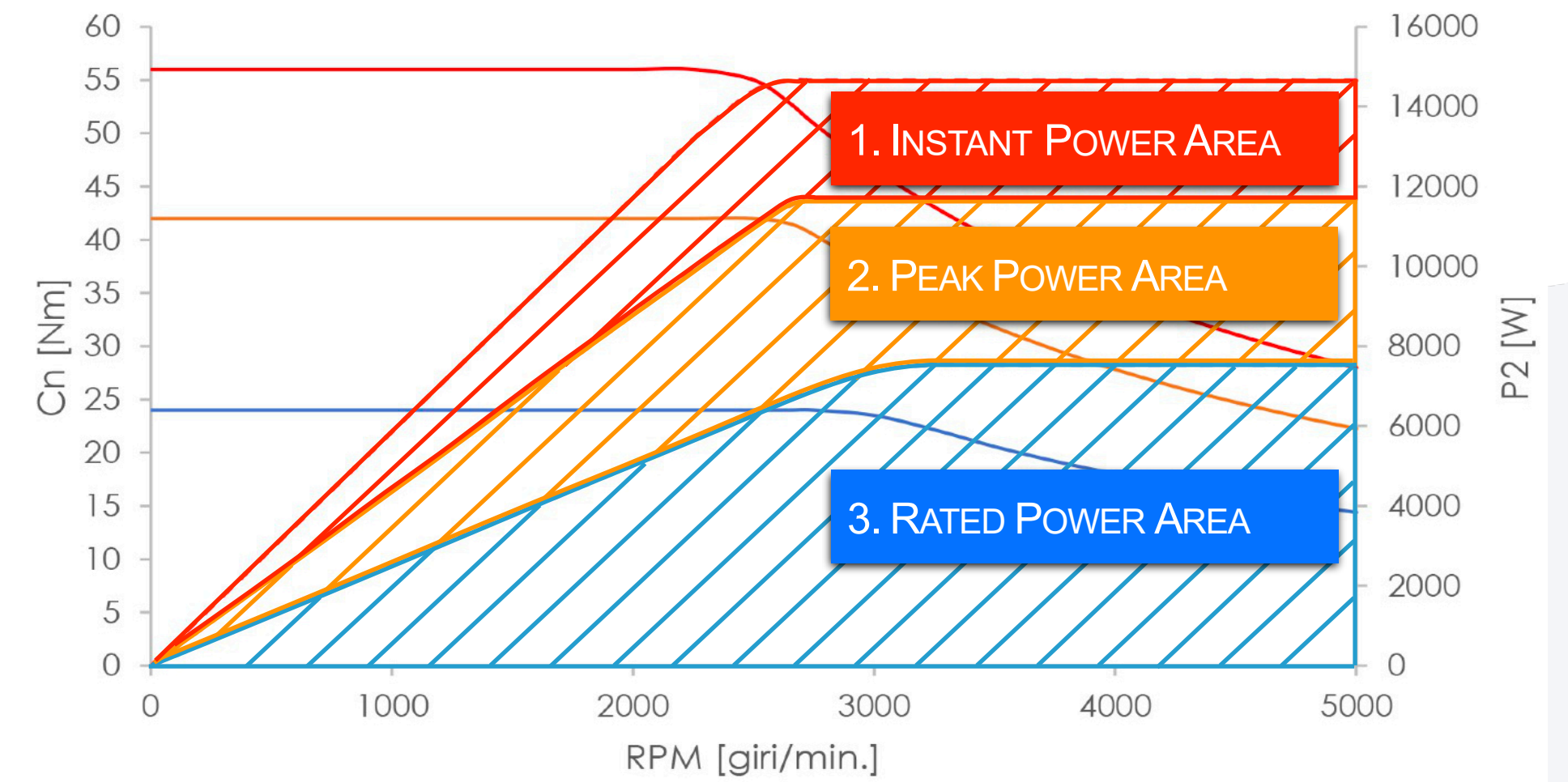
#### 2. PEAK AREA

Peak working conditions, where electric motor can operate intermittently in safe conditions.

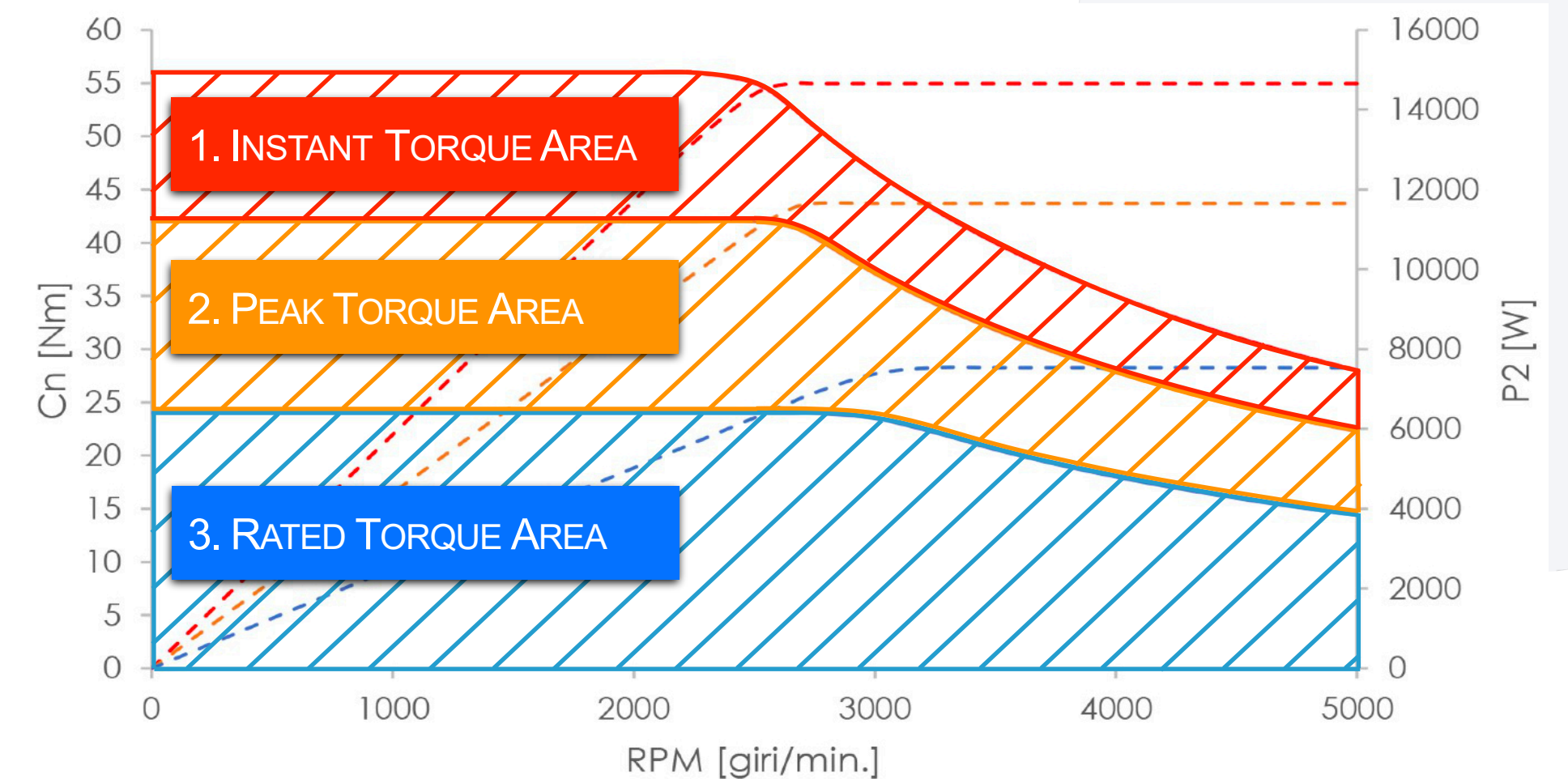
#### 3. RATED AREA

Nominal working conditions where the electric motor can operate continuously.

### POWER CURVES



### TORQUE CURVES



**PMAC SERIERANGE**

High power density and speed capabilities of PMAC Serie motors combined with a matched inverter provide the speed and torque required to achieve unparalleled performances in a wide variety of electric vehicle and machines.

Alpatek motors have been designed in 4 families, each family provide different motor models thanks to modularity of lamination stack length.

- ✓ PMAC 077 SERIE
- ✓ PMAC 096 SERIE
- ✓ PMAC 132 SERIE
- ✓ PMAC 200 SERIE

**PMAC 077 SERIE**



077-025



077-050

**PMAC 096 SERIE**



096-025



096-050

**PMAC 132 SERIE**



132-025



132-050



132-075

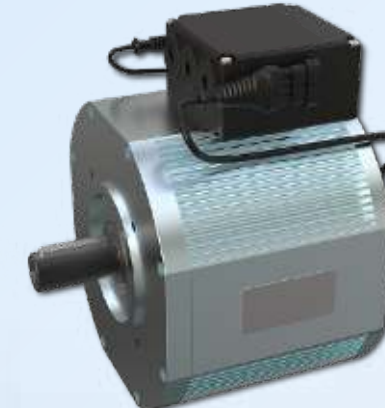
**PMAC 200 SERIE**



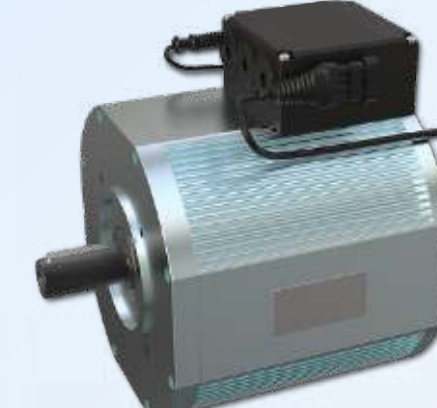
200-035



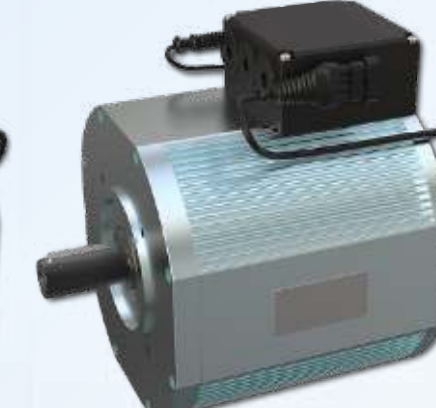
200-052



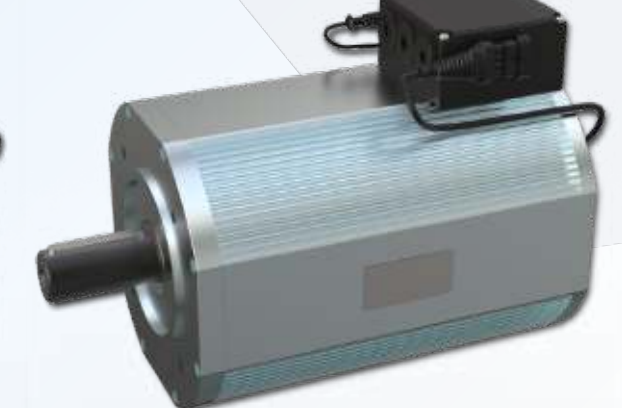
200-070



200-105

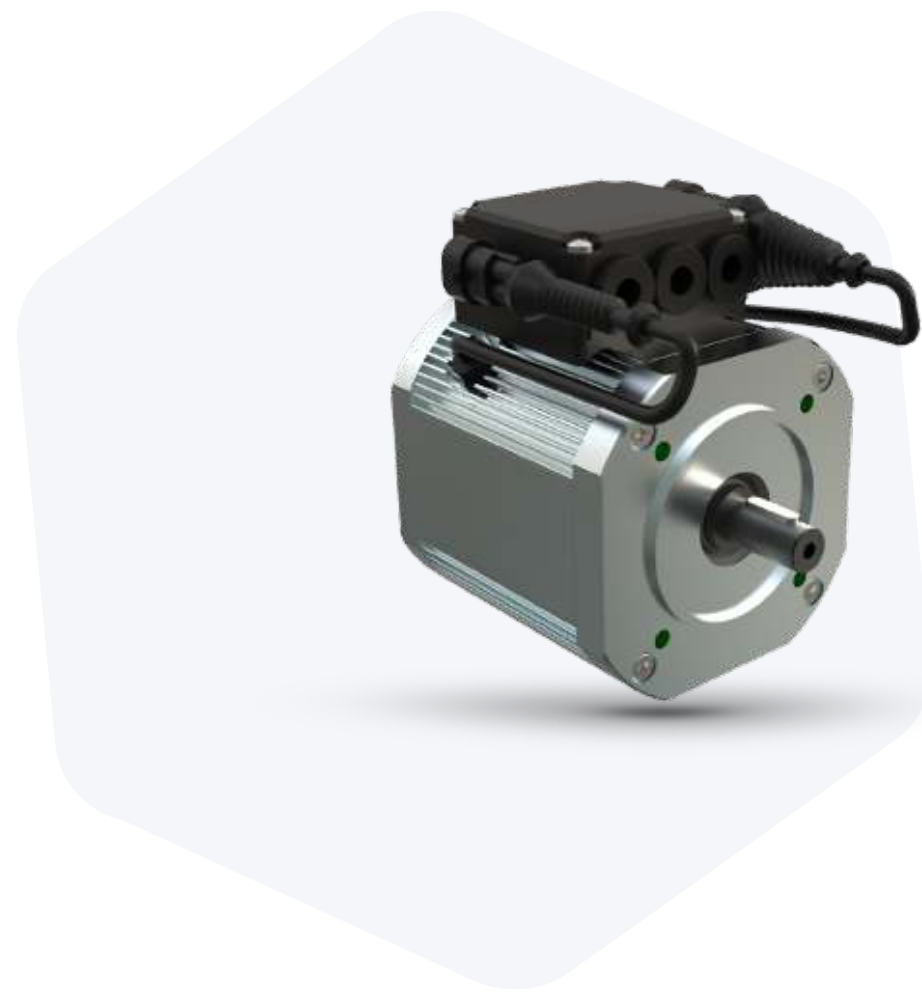


200-157

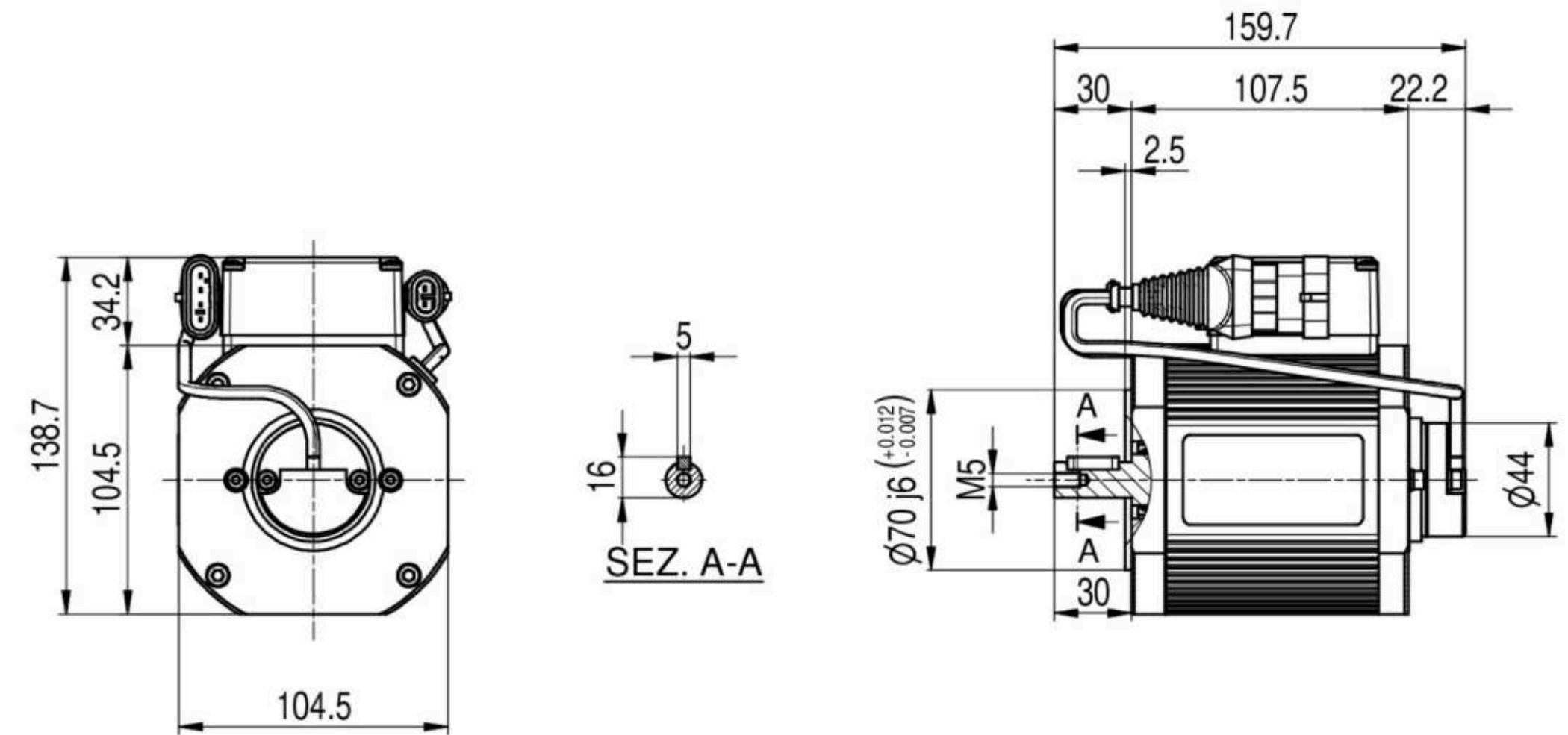


200-210

PMAC077-025



STANDARD LAYOUT



TECHNICAL DATA

Motor	Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1 PMAC077-025-10	24	0,37	0,6	1	2,6	16	48	3.700

PMAC077 SERIE

PMAC096 SERIE

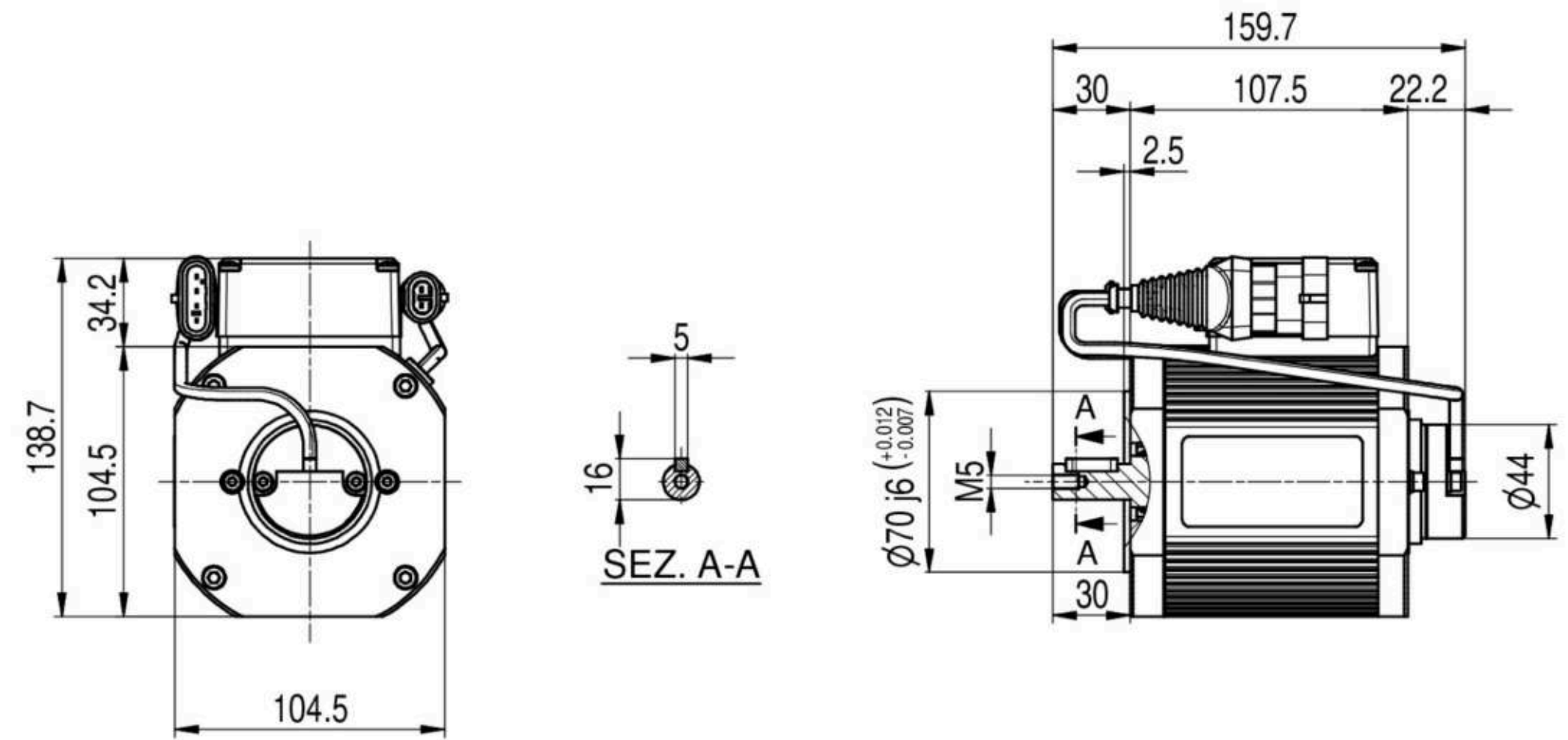
PMAC132 SERIE

PMAC200 SERIE

PMAC077-050



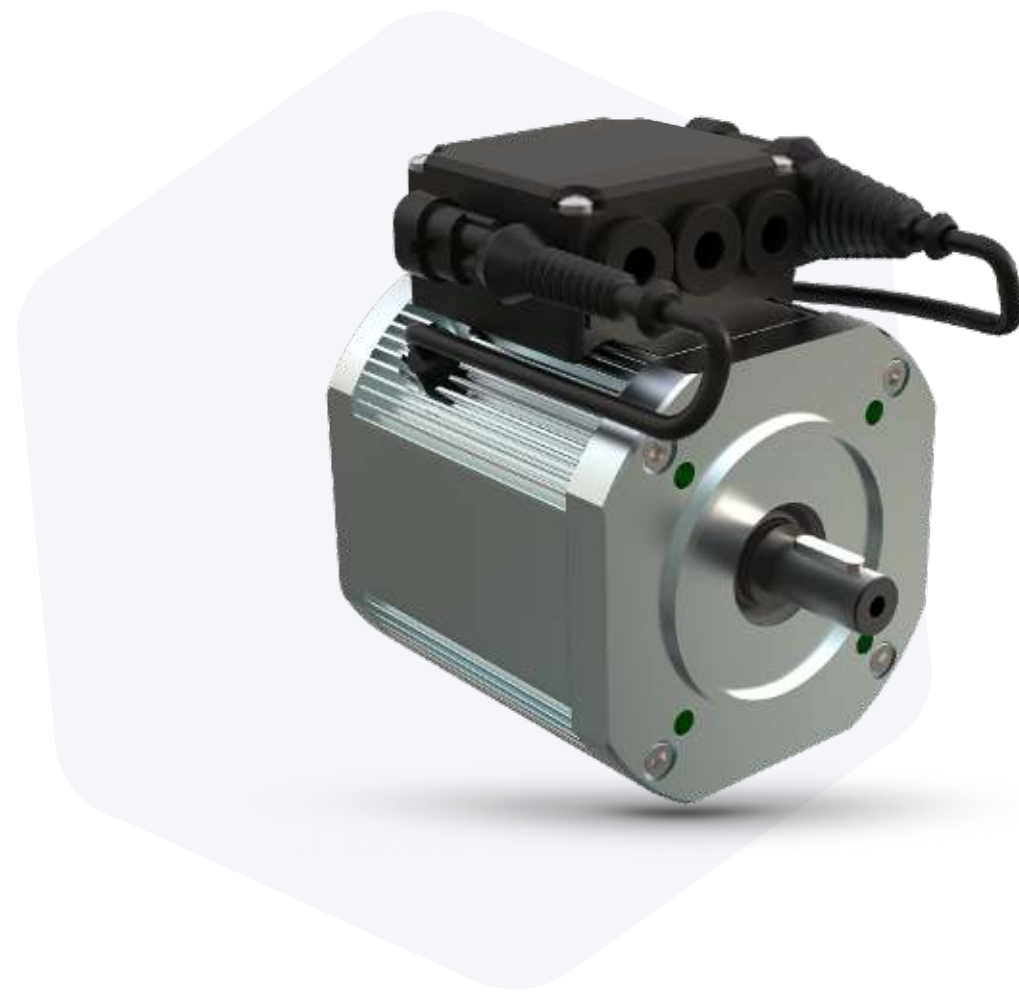
STANDARD LAYOUT



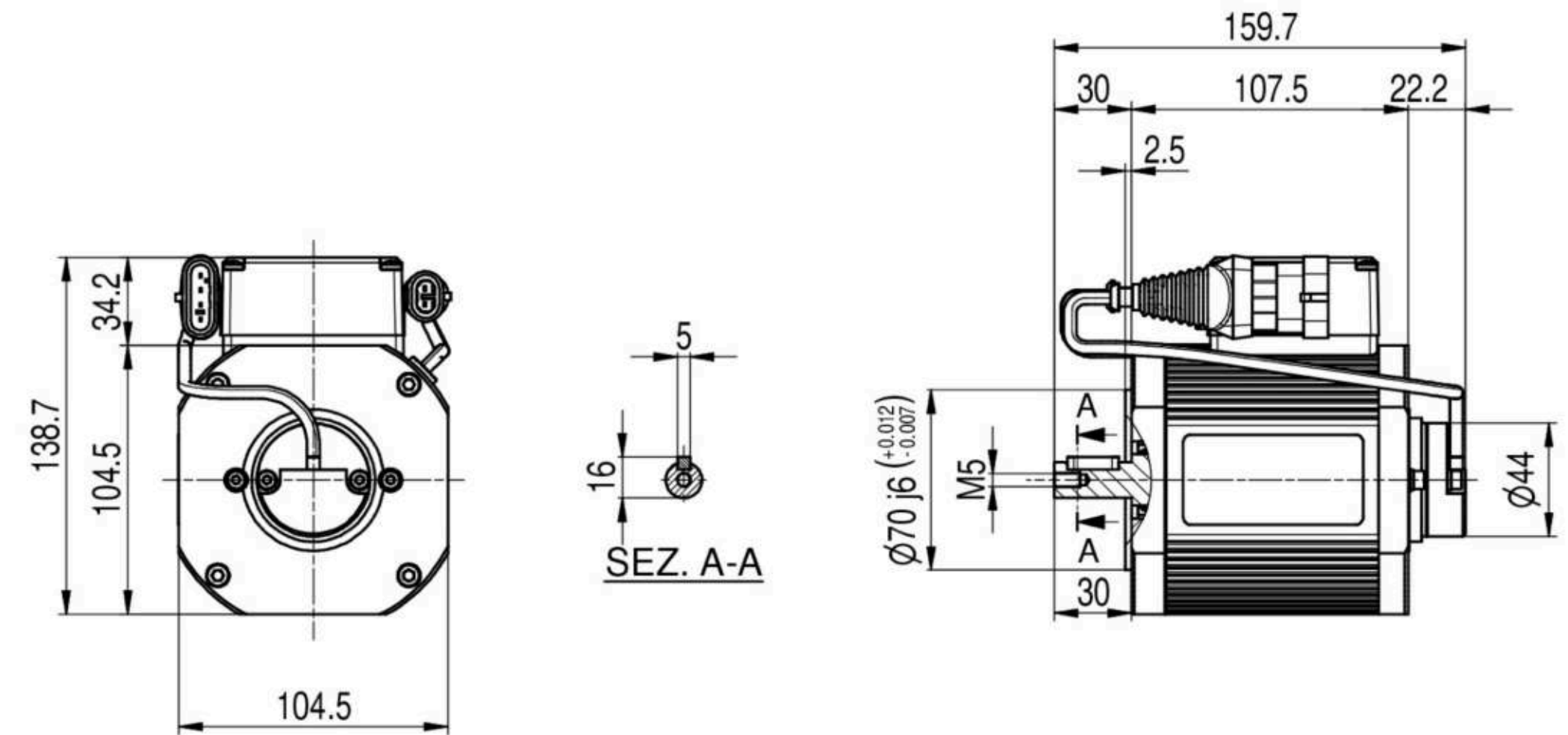
TECHNICAL DATA

Motor	Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
Coming Soon								

PMAC096-025



STANDARD LAYOUT



TECHNICAL DATA

Motor	Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1 PMAC096-025-036	24	0,5	1,4	1,0	2,8	20	60	5.000
2 PMAC096-025-070	48	0,5	1,5	1,0	2,8	10	31	5.000

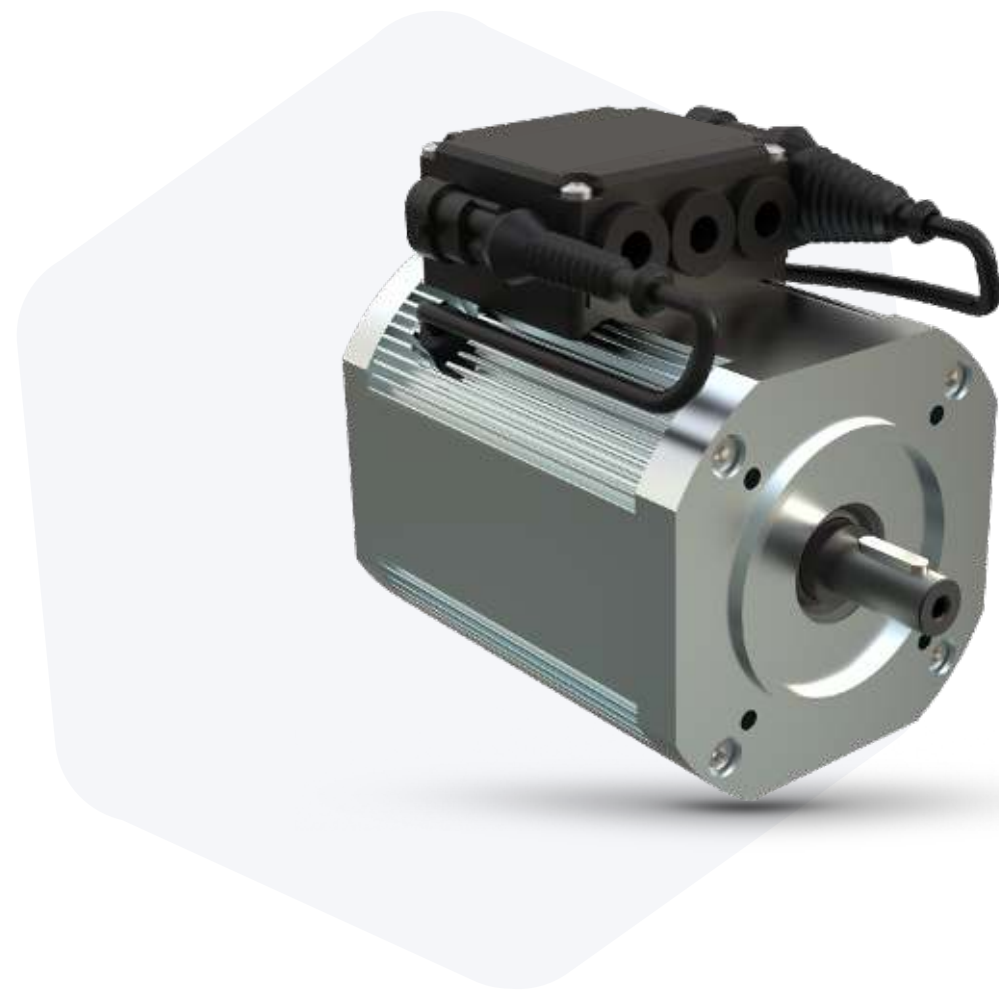
PMAC077 SERIE

PMAC096 SERIE

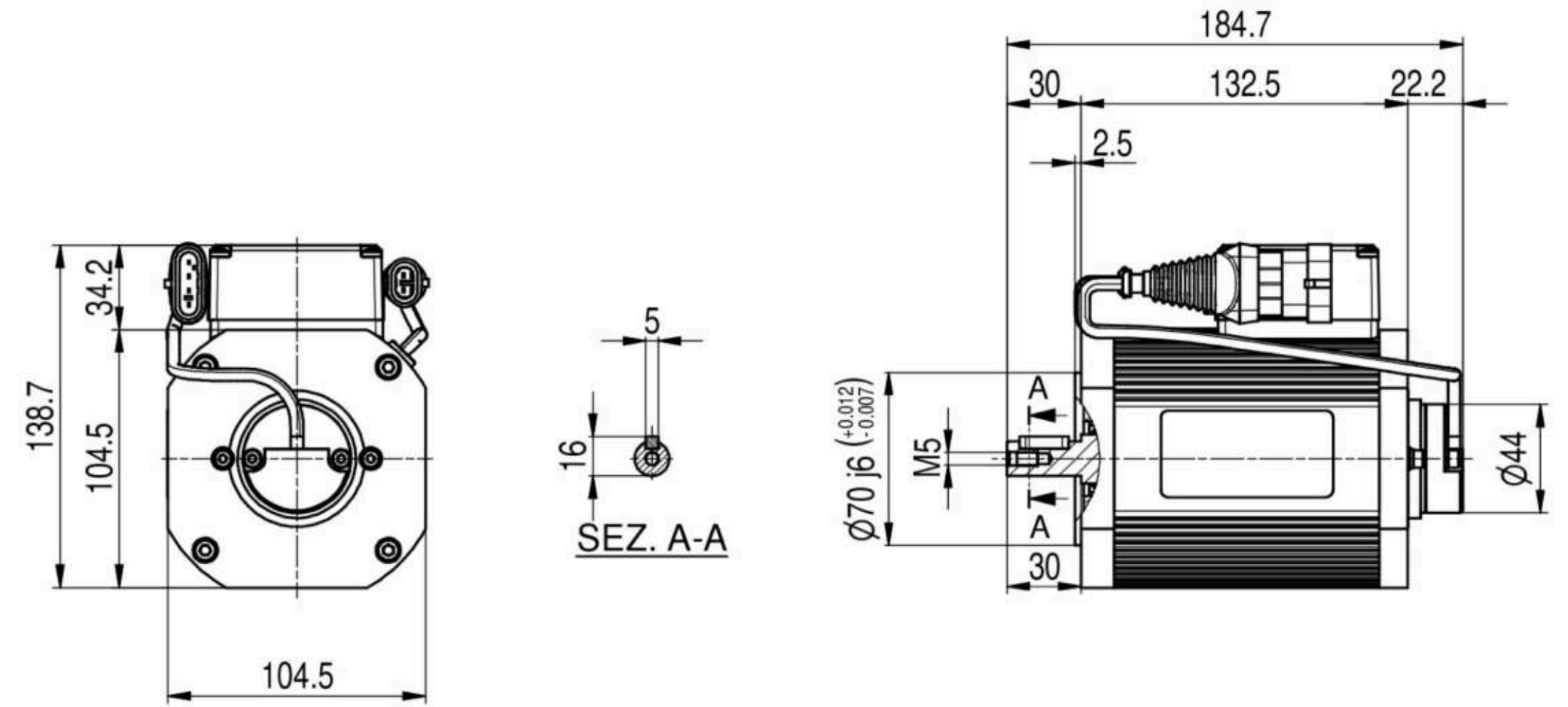
PMAC132 SERIE

PMAC200 SERIE

PMAC096-050



STANDARD LAYOUT



TECHNICAL DATA

Motor		Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1	PMAC 096-050-18	24	1,0	3,2	2,1	6,0	40	120	5.000
2	PMAC 096-050-38	48	1,0	3,0	2,1	6,0	20	60	5.000

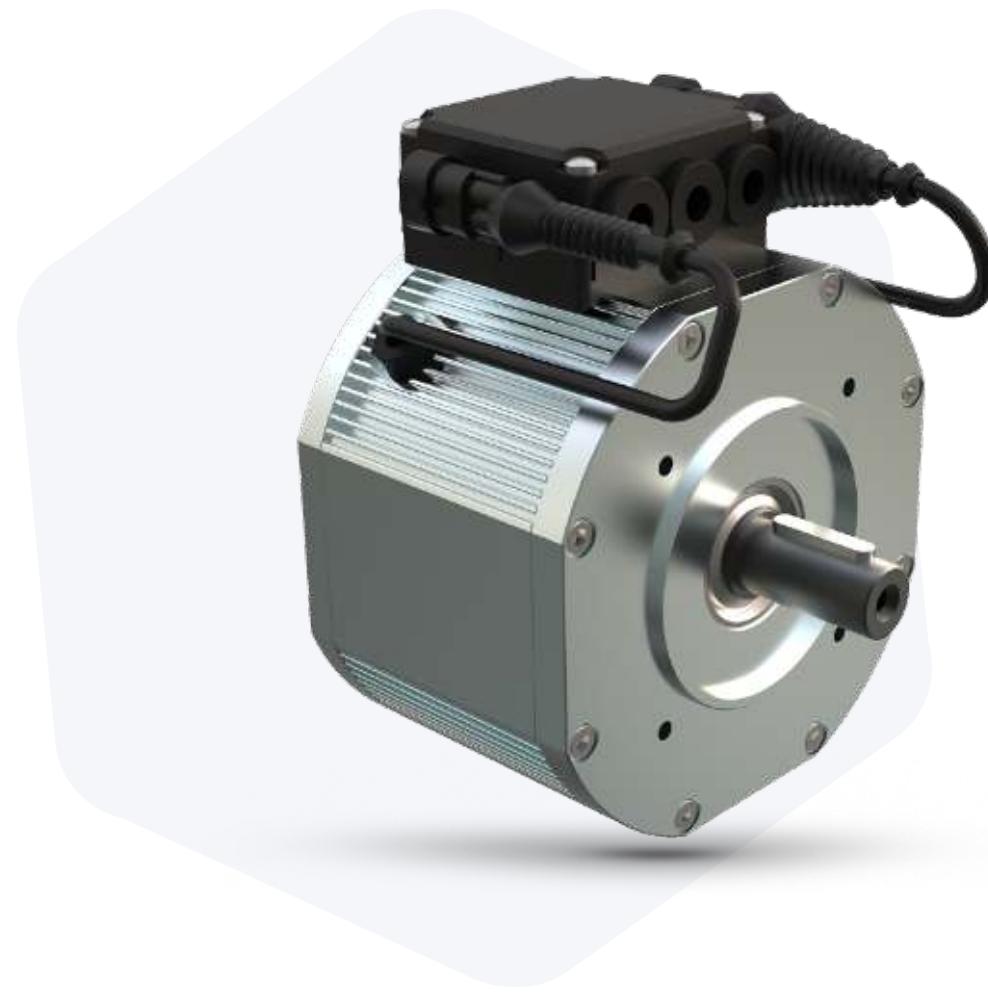
PMAC077 SERIE

PMAC096 SERIE

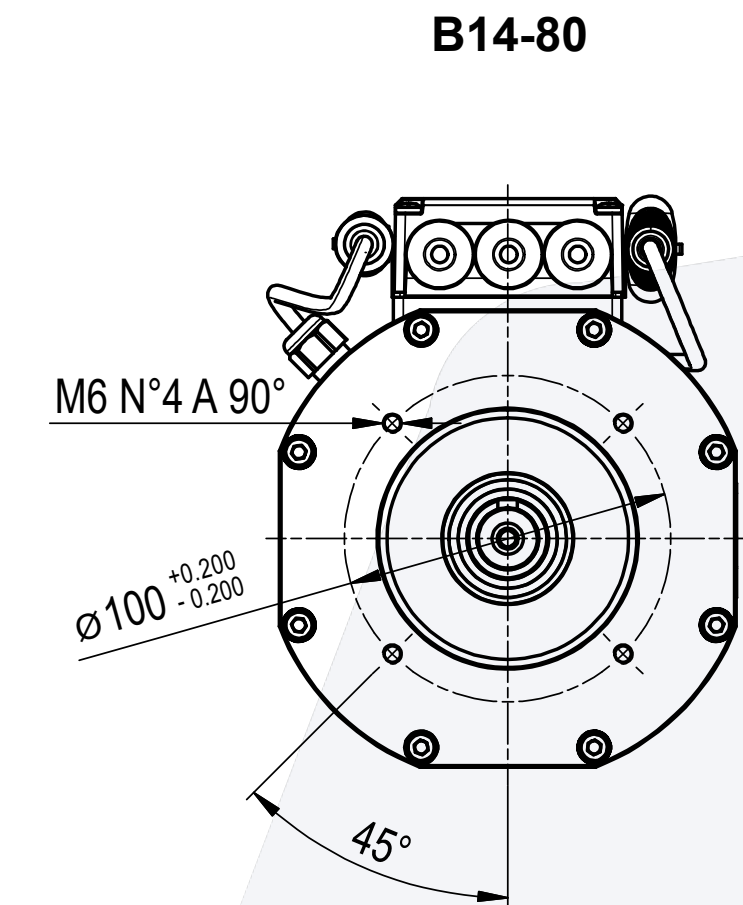
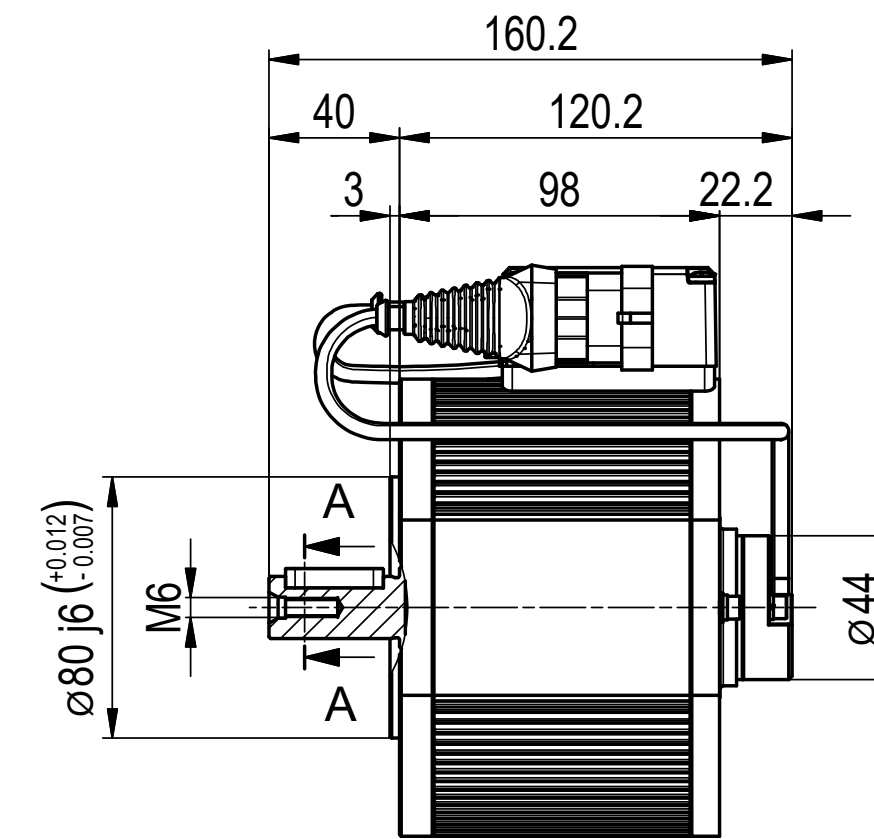
PMAC132 SERIE

PMAC200 SERIE

PMAC 132-025



STANDARD LAYOUT



TECHNICAL DATA

Motor	Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1 PMAC132-025-10	24	1,5	3,5	4,3	13,0	73	250	3.000
2 PMAC132-025-20	36	1,1	1,5	4,7	12,7	35	105	2.300
3 PMAC132-025-20	48	1,5	3,1	4,3	13,0	34	115	3.000
4 PMAC132-025-40	80	1,5	2,8	4,3	13,0	19	65	3.000
5 PMAC132-025-68	96	1,5	3,6	4,7	12,7	17	51	3.000

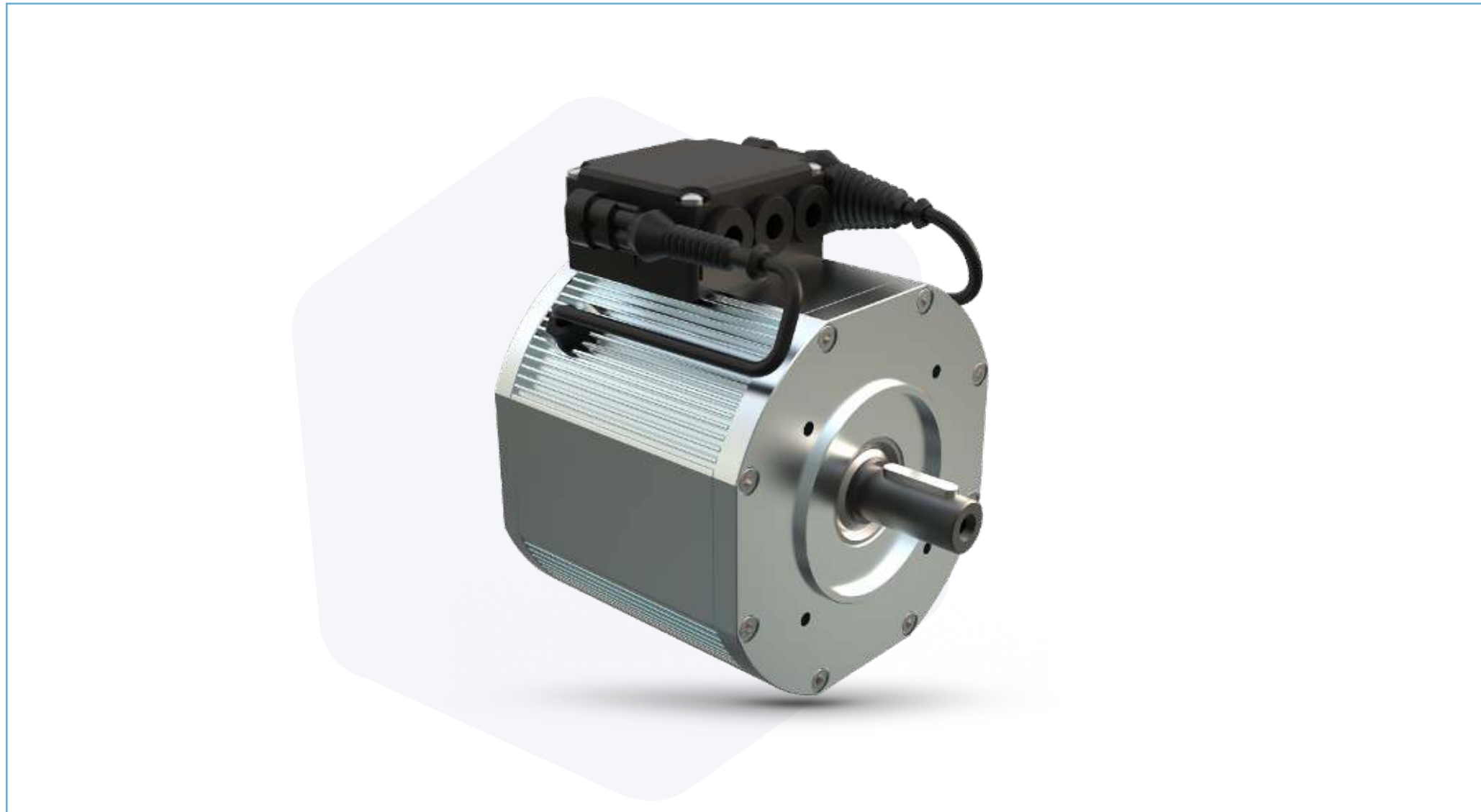
PMAC077 SERIE

PMAC096 SERIE

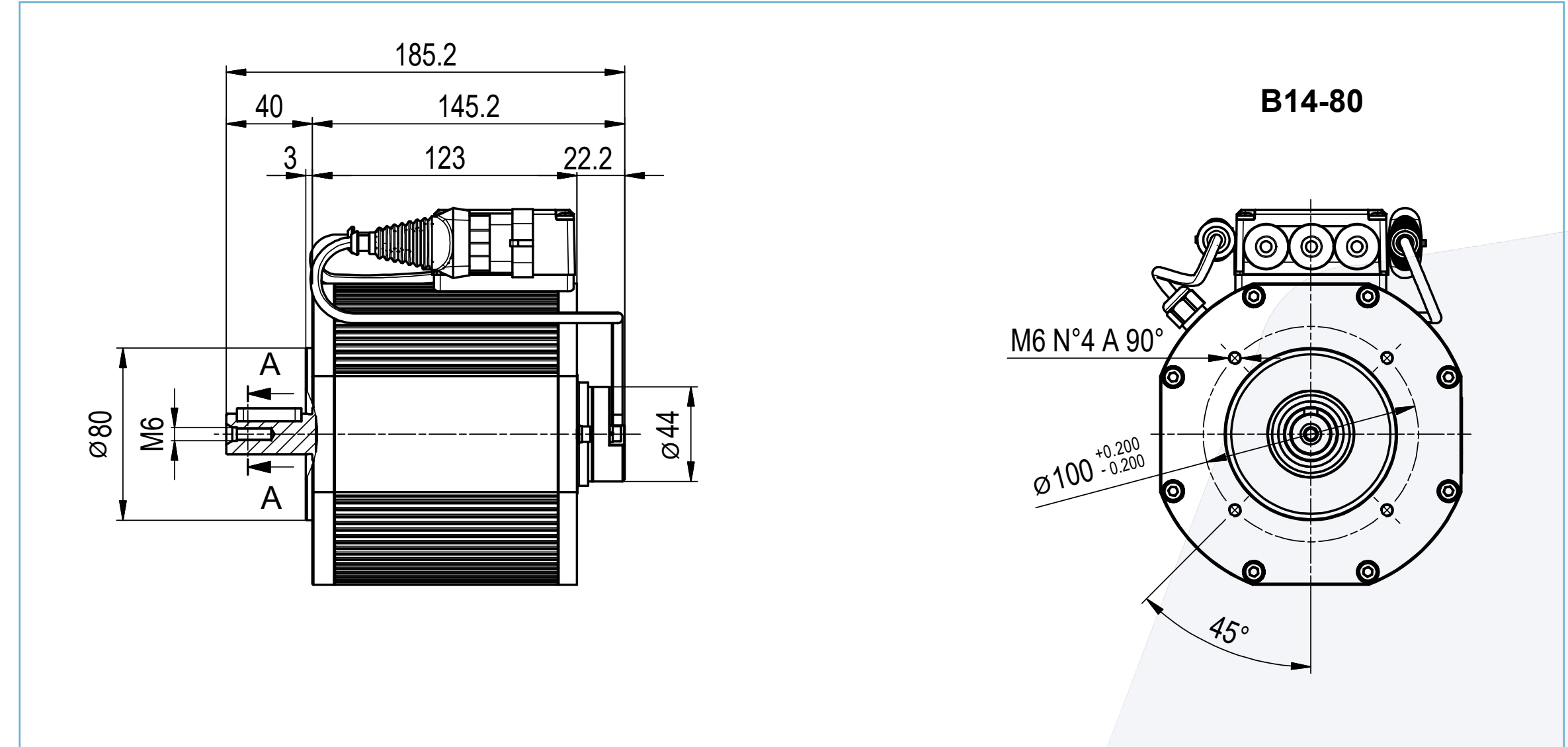
PMAC132 SERIE

PMAC200 SERIE

PMAC 132-050



STANDARD LAYOUT



TECHNICAL DATA

Motor			Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1	PMAC132-050-24		24	2,2	6,2	7,0	25,5	95	400	3.000
2	PMAC132-050-48		48	2,2	6,2	7,0	25,5	47	200	3.000
3	PMAC132-050-80		80	2,2	6,2	7,0	25,5	30	130	3.000

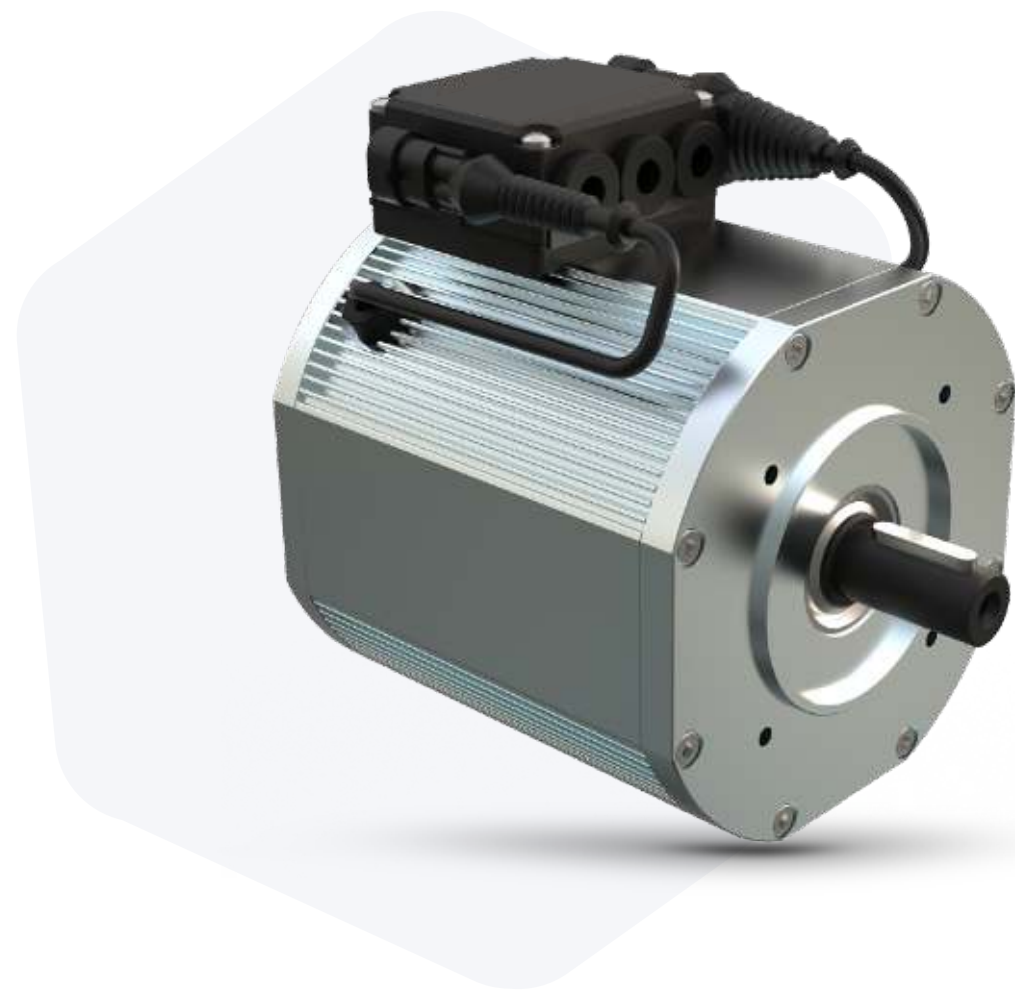
PMAC077 SERIE

PMAC096 SERIE

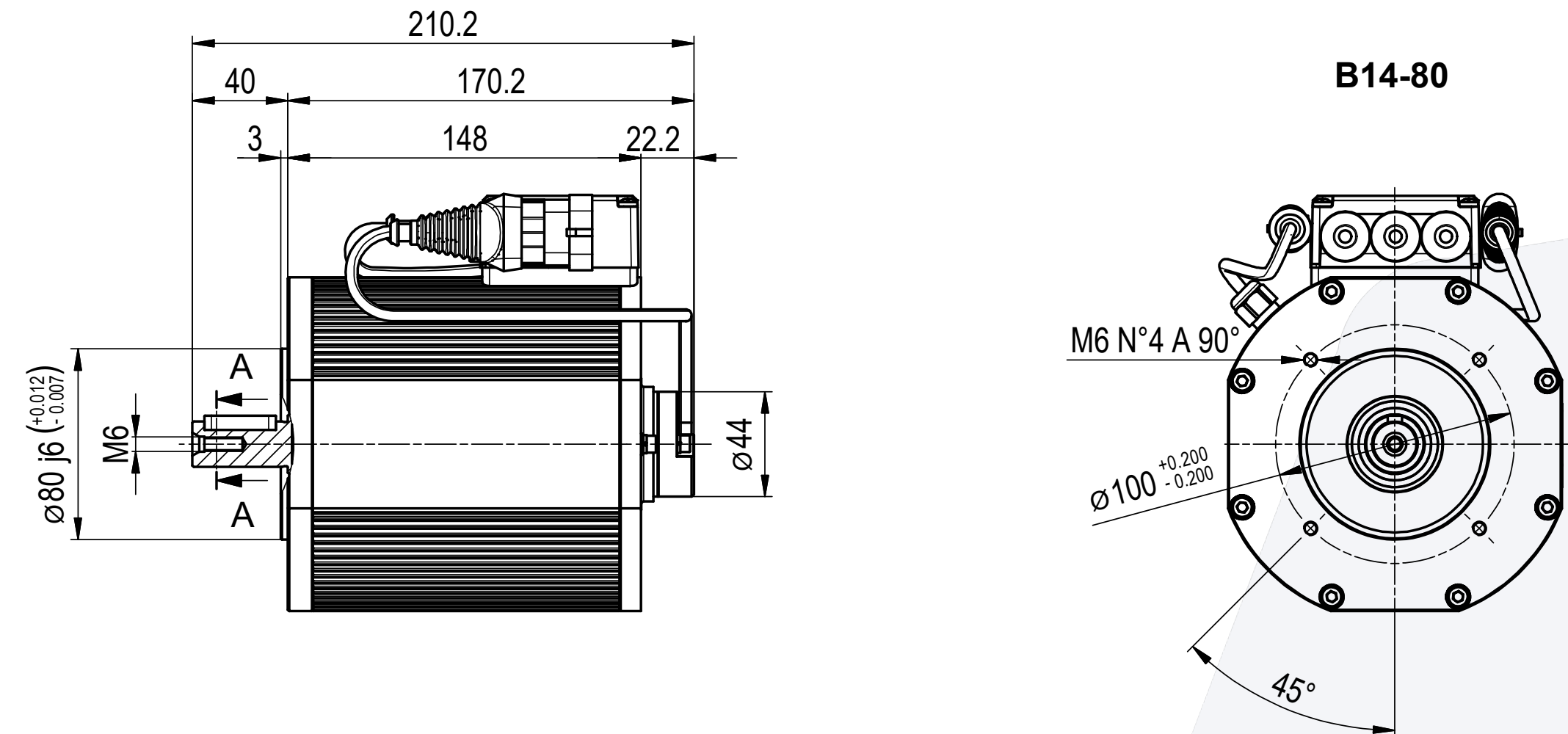
PMAC 132 SERIE

PMAC 200 SERIE

PMAC 132-075



STANDARD LAYOUT



TECHNICAL DATA

Motor	Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1 PMAC132-075-06	24	3,0	10,0	9,5	41,0	130	660	3.000
2 PMAC132-075-06	36	2,1	5,9	9,0	37,0	68	312	2.250
3 PMAC132-075-06	48	3,0	10,0	9,5	41,0	65	330	3.000
4 PMAC132-075-06	80	3,0	10,0	9,5	40,0	38	200	3.000
5 PMAC132-075-70	560	2,8	14,0	9,0	37,0	21	37	3.000

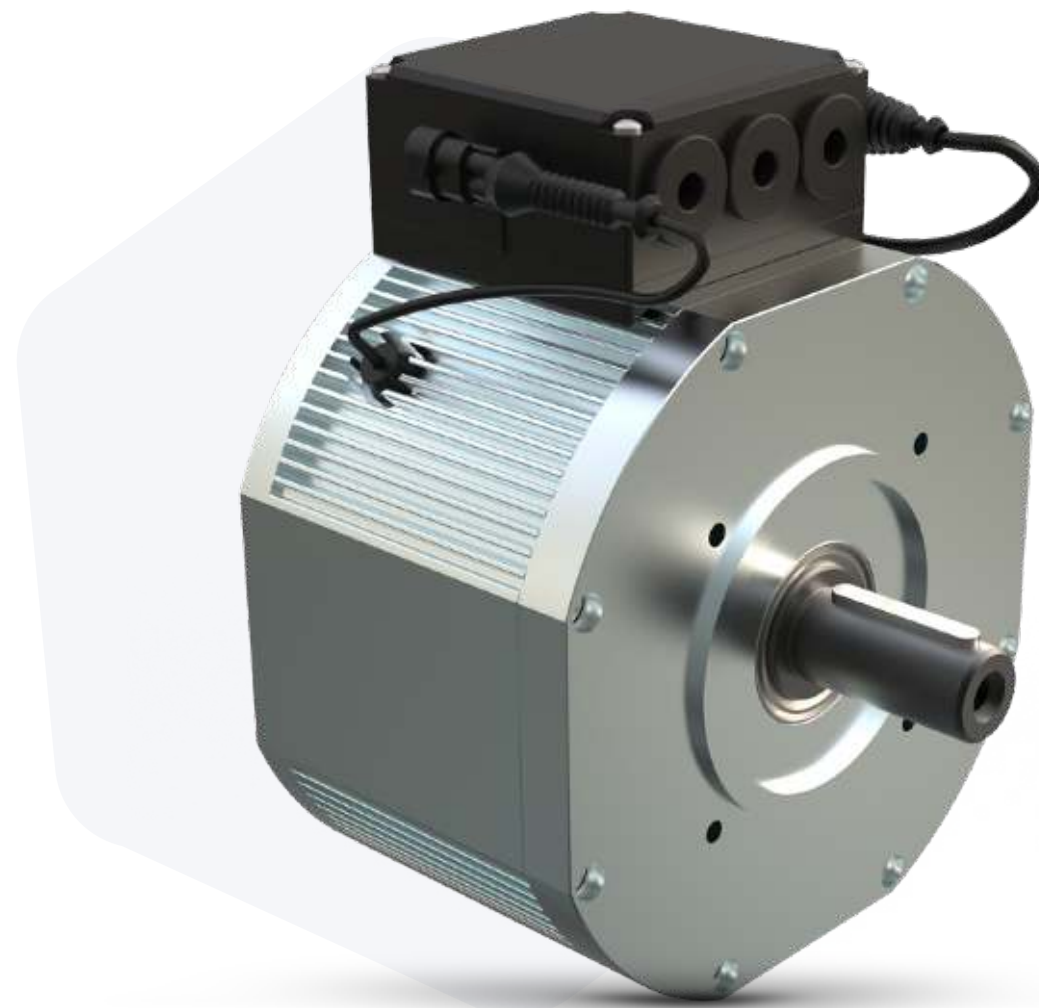
PMAC077 SERIE

PMAC096 SERIE

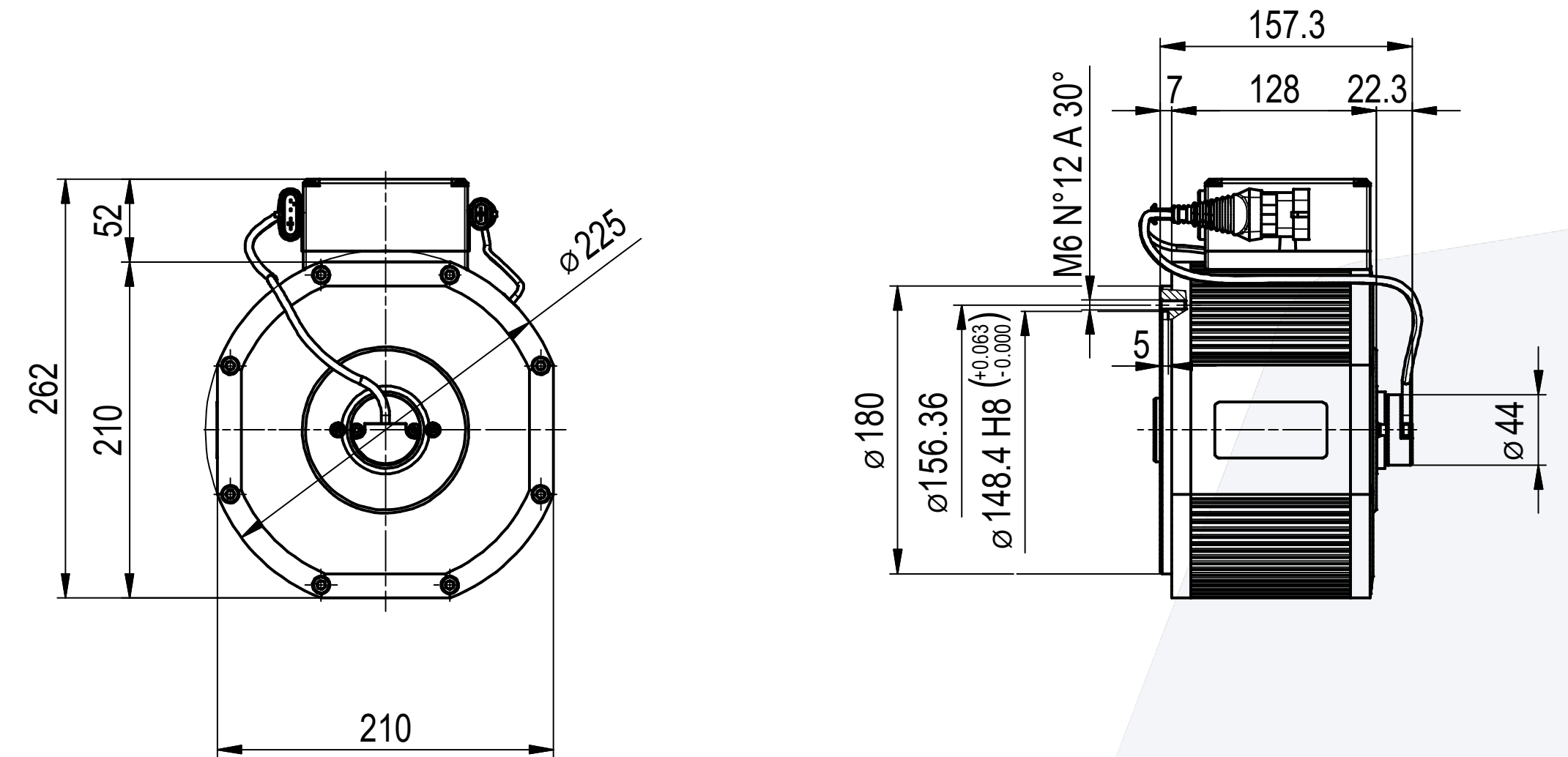
PMAC132 SERIE

PMAC200 SERIE

PMAC200-035



STANDARD LAYOUT



TECHNICAL DATA

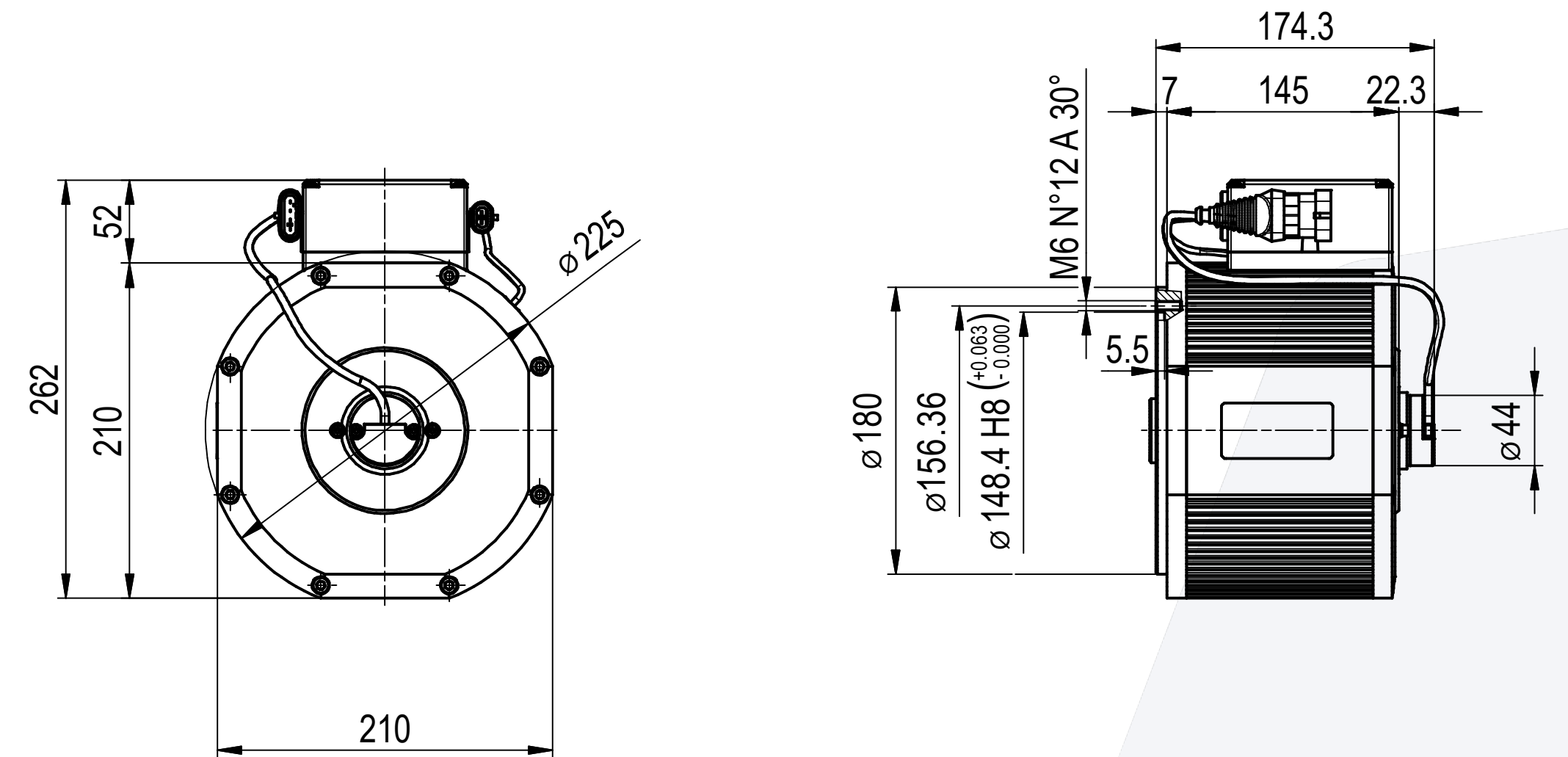
Motor	Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1 PMAC200-035-19	24	5,5	9,5	17,5	38,0	250	700	3.000
2 PMAC200-035-48	48	4,5	9,8	17,5	48,0	85	300	2.500
3 PMAC200-035-28	48	5,5	14,8	17,5	38,0	170	460	3.000
4 PMAC200-035-28	72	6,4	15,0	17,5	48,00	85	300	3.500
5 PMAC200-035-28	80	6,4	12,0	17,5	38,0	85	255	3.500
6 PMAC200-035-28	96	6,4	14,2	17,5	38,0	85	255	3.500
7 PMAC200-035-96	400	6,0	10,0	23,0	50,0	18,2	49	2.500

LC - LIQUID COOLED      2P - 2 PAIR CONNECTIONS

PMAC200-052



STANDARD LAYOUT

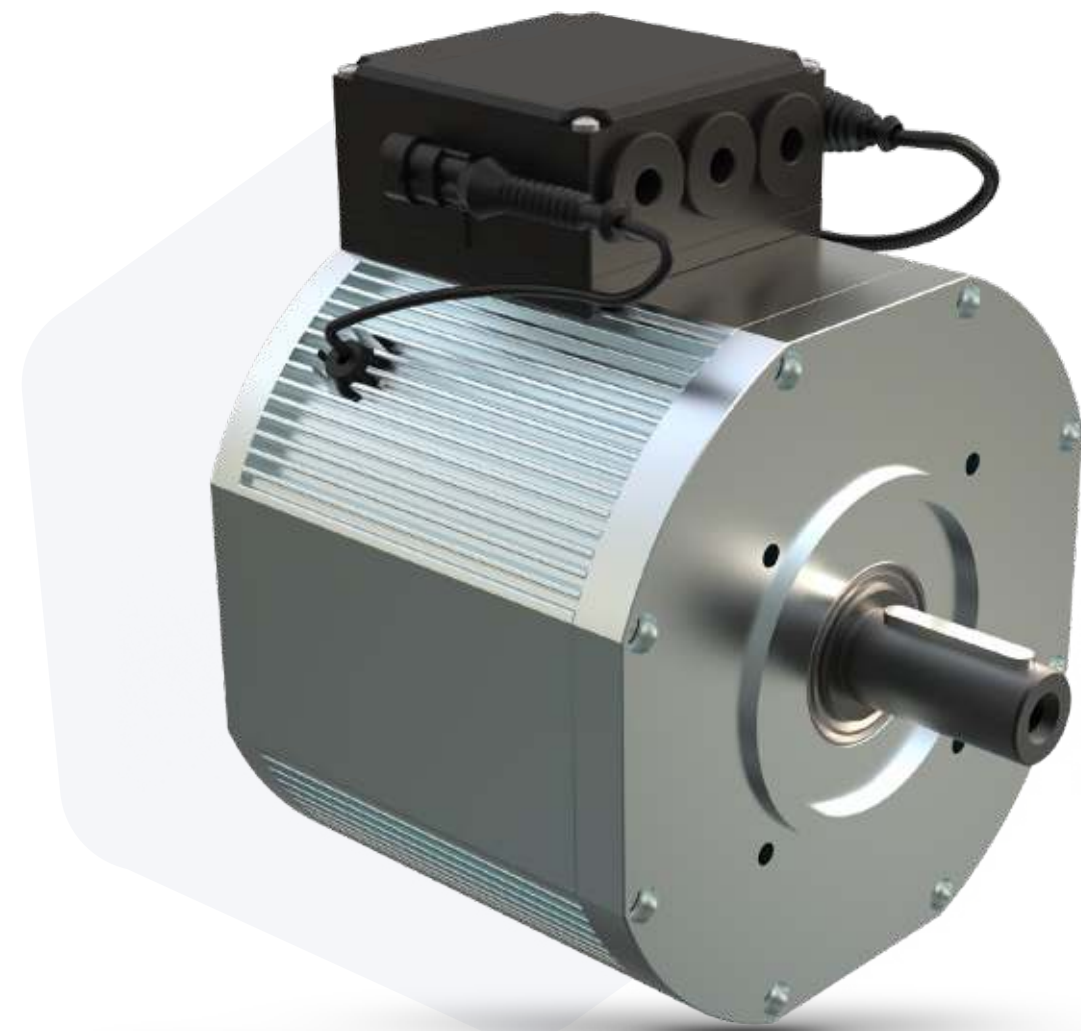


TECHNICAL DATA

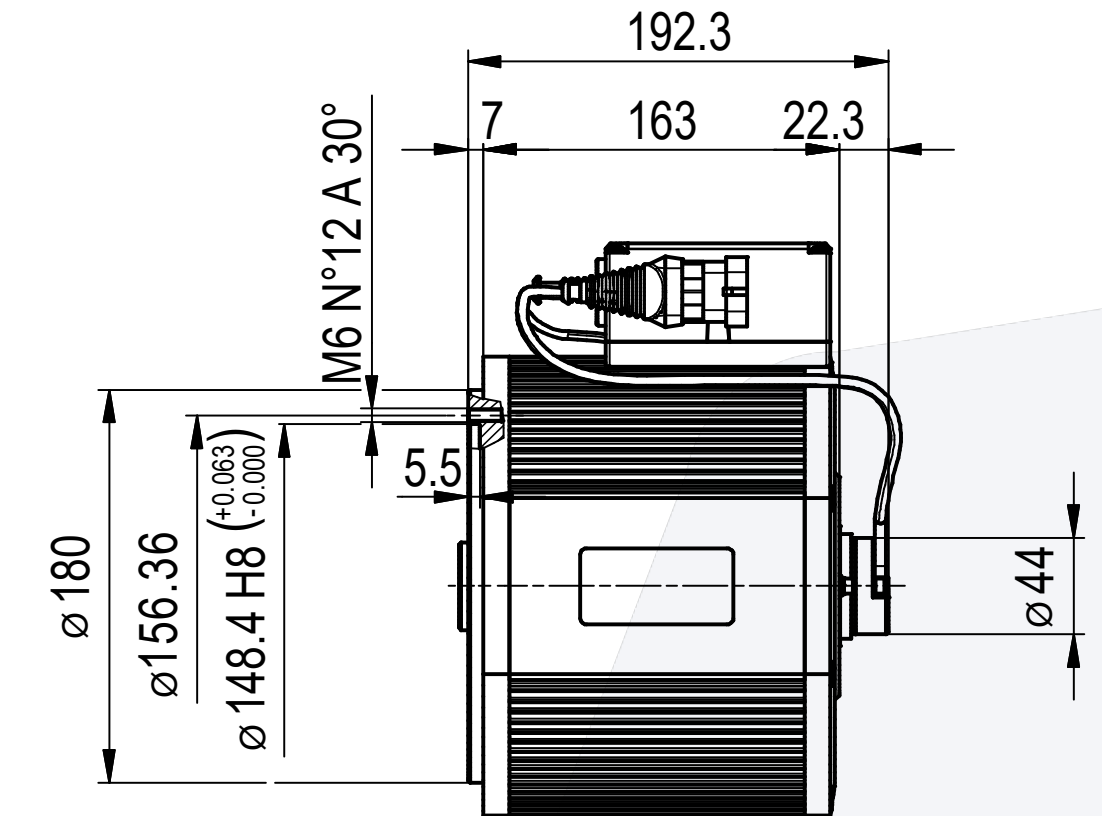
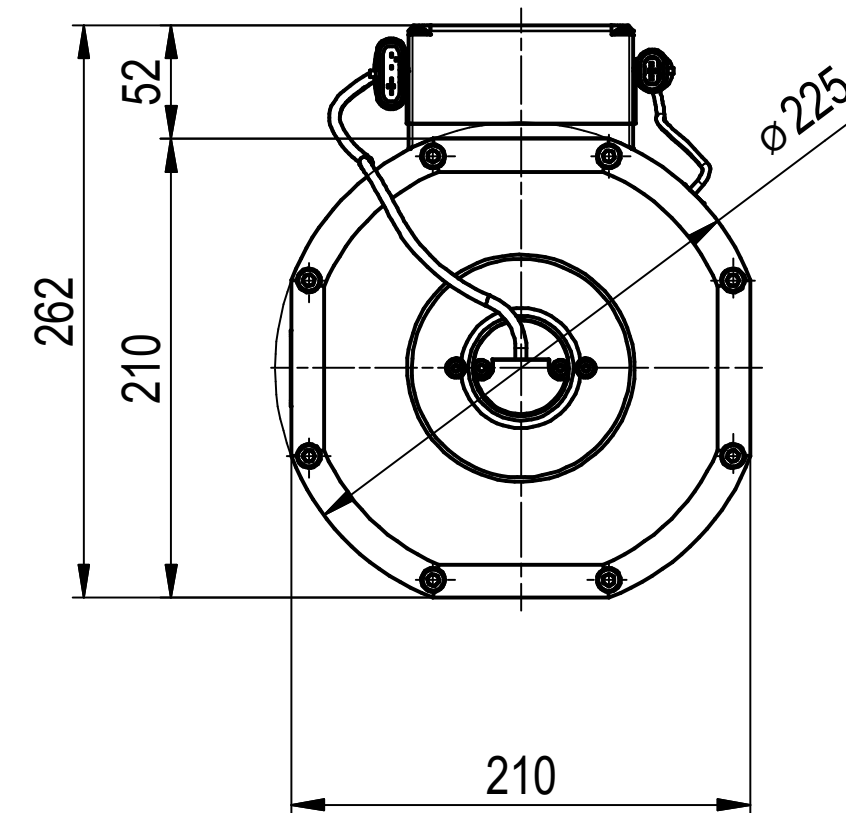
Motor			Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1	PMAC200-052-19		24	5,0	9,8	24,0	56,0	230	690	2.000
2	PMAC200-052-19	2P	48	5,0	10,0	24,0	67,0	110	380	2.000
3	PMAC200-052-28		48	7,5	14,8	24,0	56,0	160	490	3.000
4	PMAC200-052-28	LC	48	8,0	15,5	30,0	70,0	190	525	2.500
5	PMAC200-052-28	2P	80	6,3	11,8	24,0	56,0	80	240	2.500
7	PMAC200-052-28	2P	96	7,5	14,0	24,0	56,0	80	240	3.500
8	PMAC200-052-68	LC-2P	400	8,0	14,0	30,0	70,0	23	62	2.500

LC- LIQUID COOLED      2P- 2 PAIR CONNECTIONS

PMAC200-070



STANDARD LAYOUT

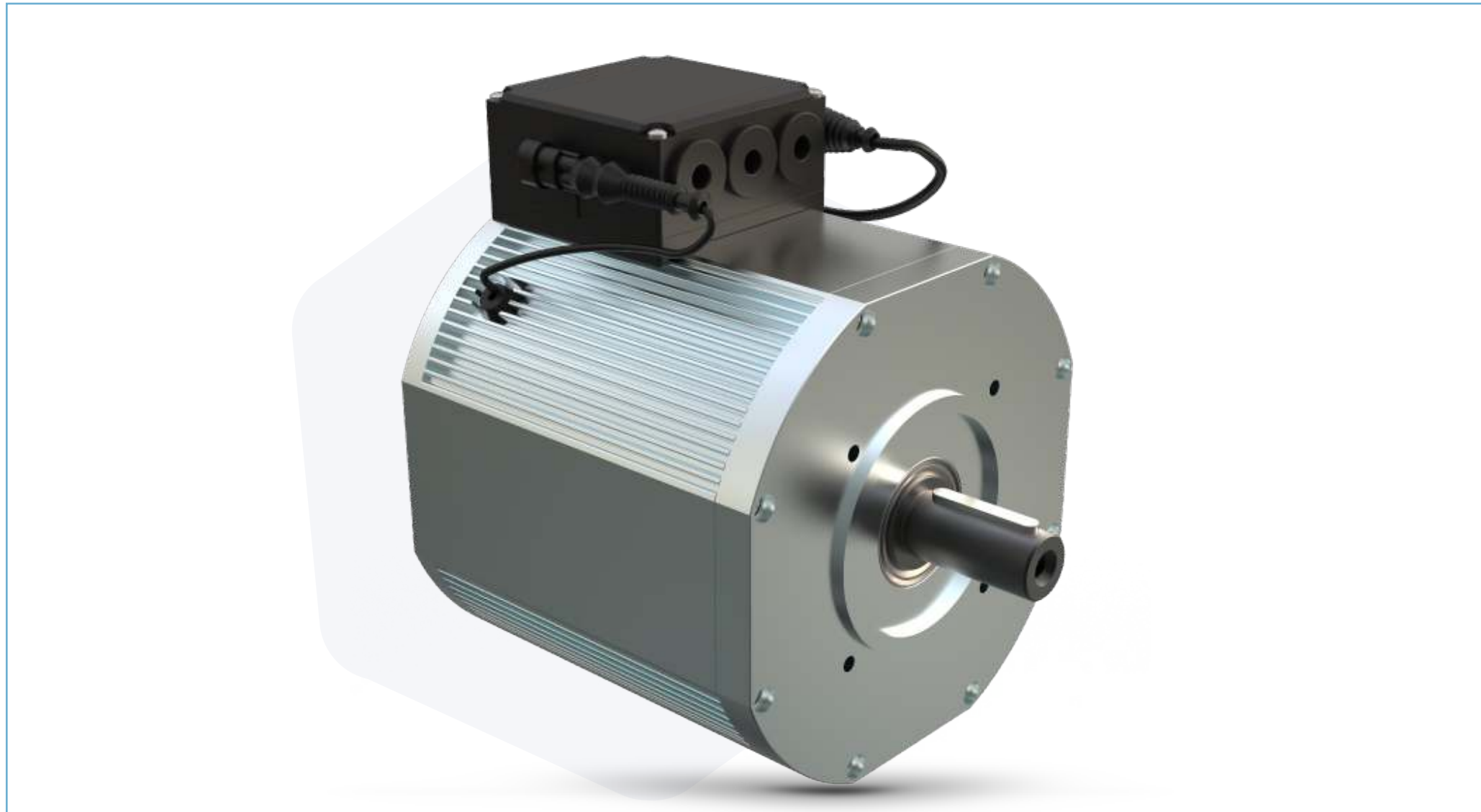


TECHNICAL DATA

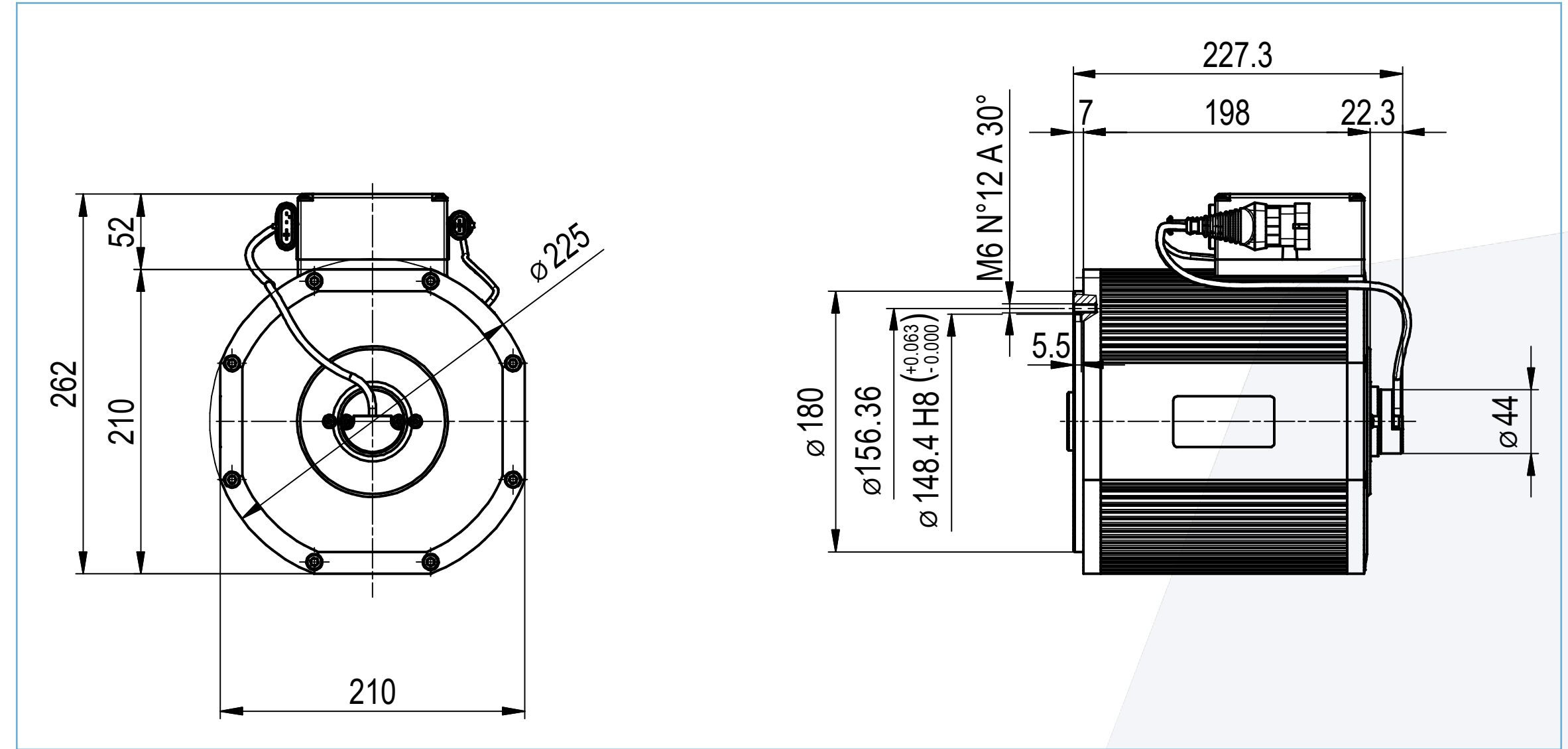
Motor			Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1	PMAC200-070-19	2P	48	5,0	15,0	32,0	92,0	115	400	1.500
2	PMAC200-070-28		48	8,0	20,8	32,0	94,0	155	540	2.500
3	PMAC200-070-28	LC	48	8,0	18,0	40,0	80,0	180	540	2.000
4	PMAC200-070-28		72	10,0	29,0	30,0	83,0	148	448	3.000
5	PMAC200-070-28		80	10,0	20,5	30,0	72,0	148	448	3.000
6	PMAC200-070-19	2P	96	10,0	22,5	30,0	86,0	100	350	3.000
7	PMAC200-070-28		96	12,5	26,0	30,0	72,0	148	448	4.000
8	PMAC200-070-36		400	10,0	15,0	30,0	72,0	24	72	3.000
9	PMAC200-070-48	LC-2P	400	10,0	21,0	38,0	90,0	30	84	2.500
10	PMAC200-070-30		600	10,0	15,0	30,0	72,0	30	51	3.000

LC- LIQUID COOLED      2P - 2 PAIR CONNECTIONS

PMAC200-105



STANDARD LAYOUT

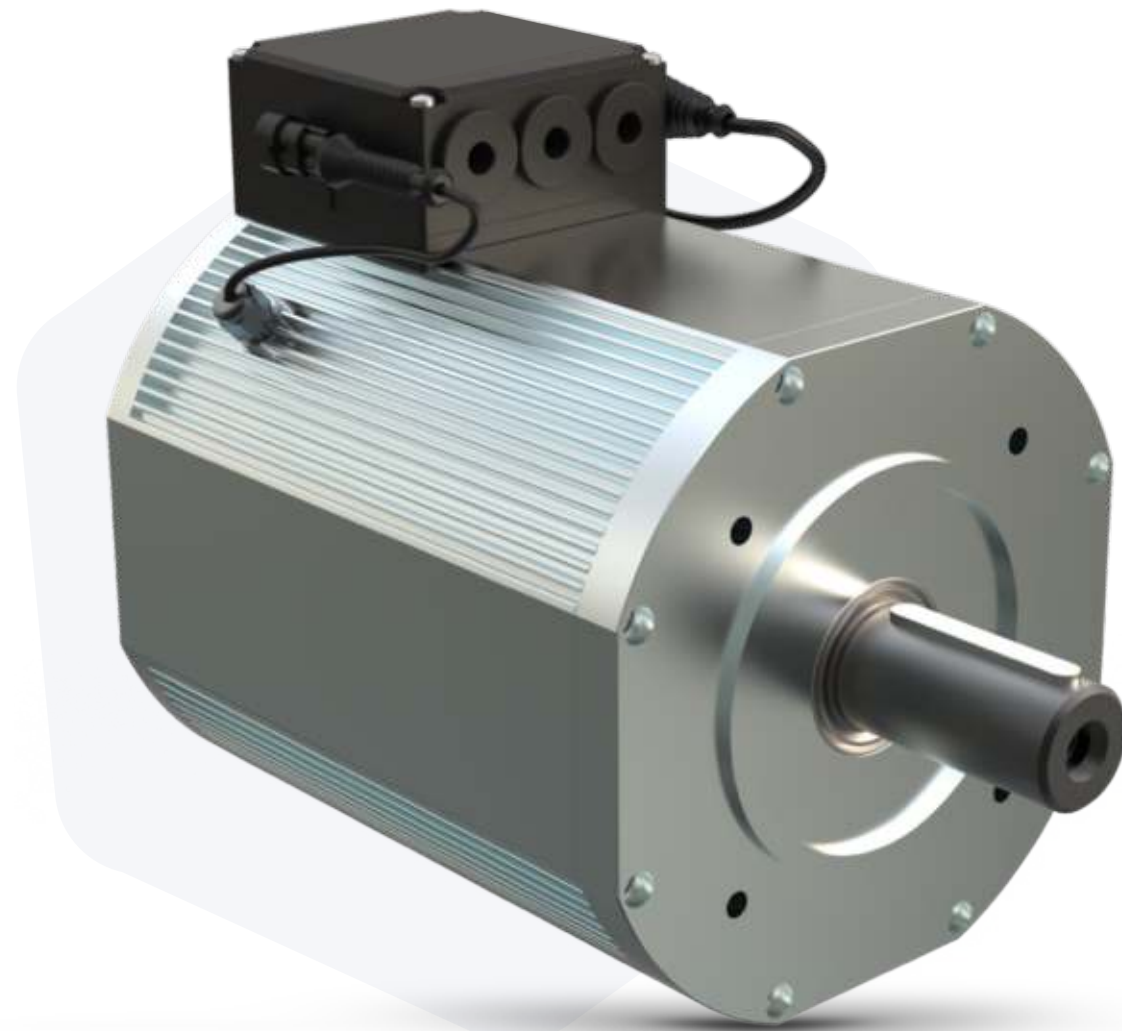


TECHNICAL DATA

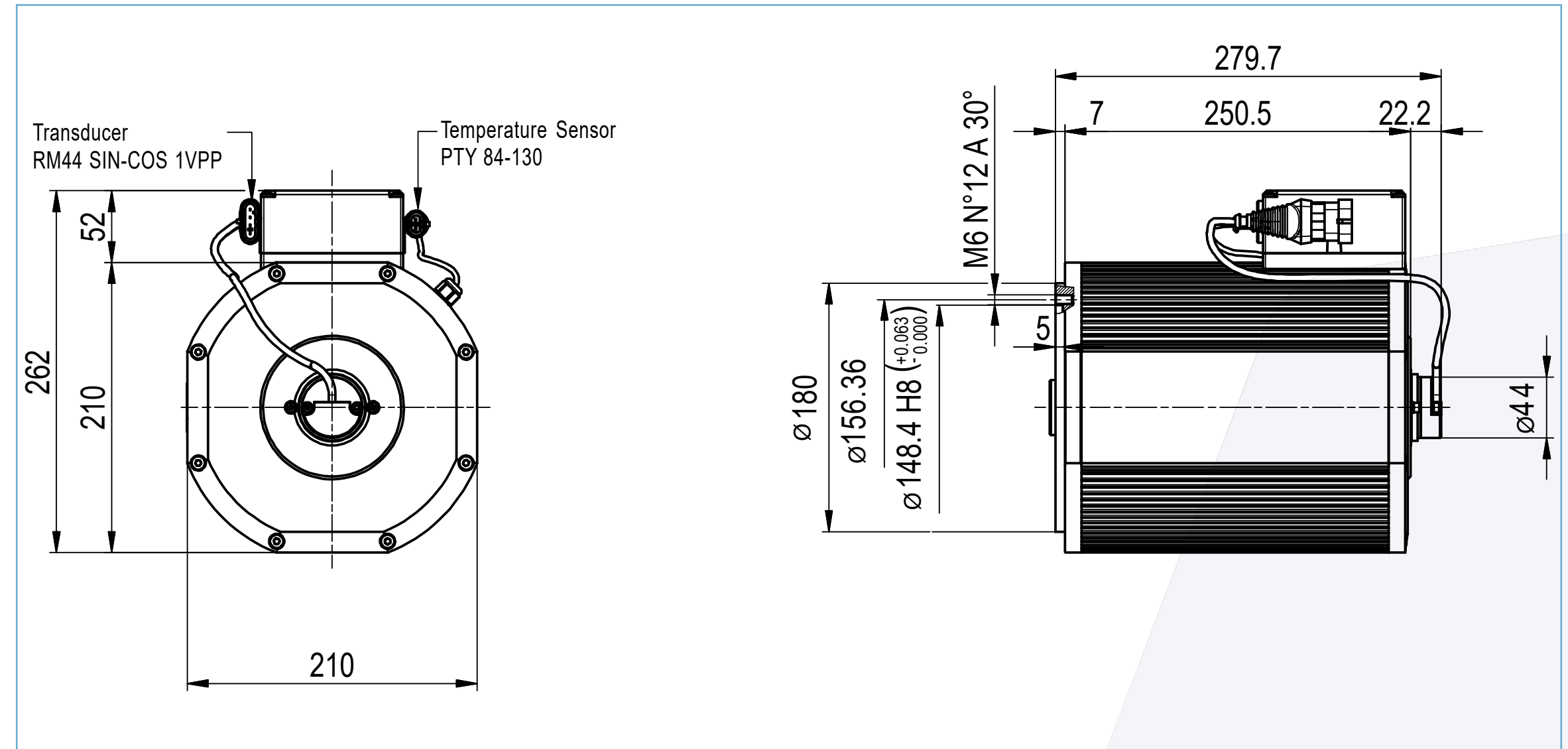
Motor			Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1	PMAC200-105-19		48	9,0	29,0	44,0	120,0	210	650	2.000
2	PMAC200-105-19	LC	48	12,0	25,5	56,0	116,0	250	730	2.000
3	PMAC200-105-19		80	13,0	35,0	42,0	109,0	210	650	3.000
4	PMAC200-105-28		96	13,0	29,0	42,0	109,0	140	420	3.000
5	PMAC200-105-68	LC	400	15,0	31,0	56,0	130,0	41	110	2.500

LC - LIQUID COOLED      2P - 2 PAIR CONNECTIONS

PMAC200-157



STANDARD LAYOUT

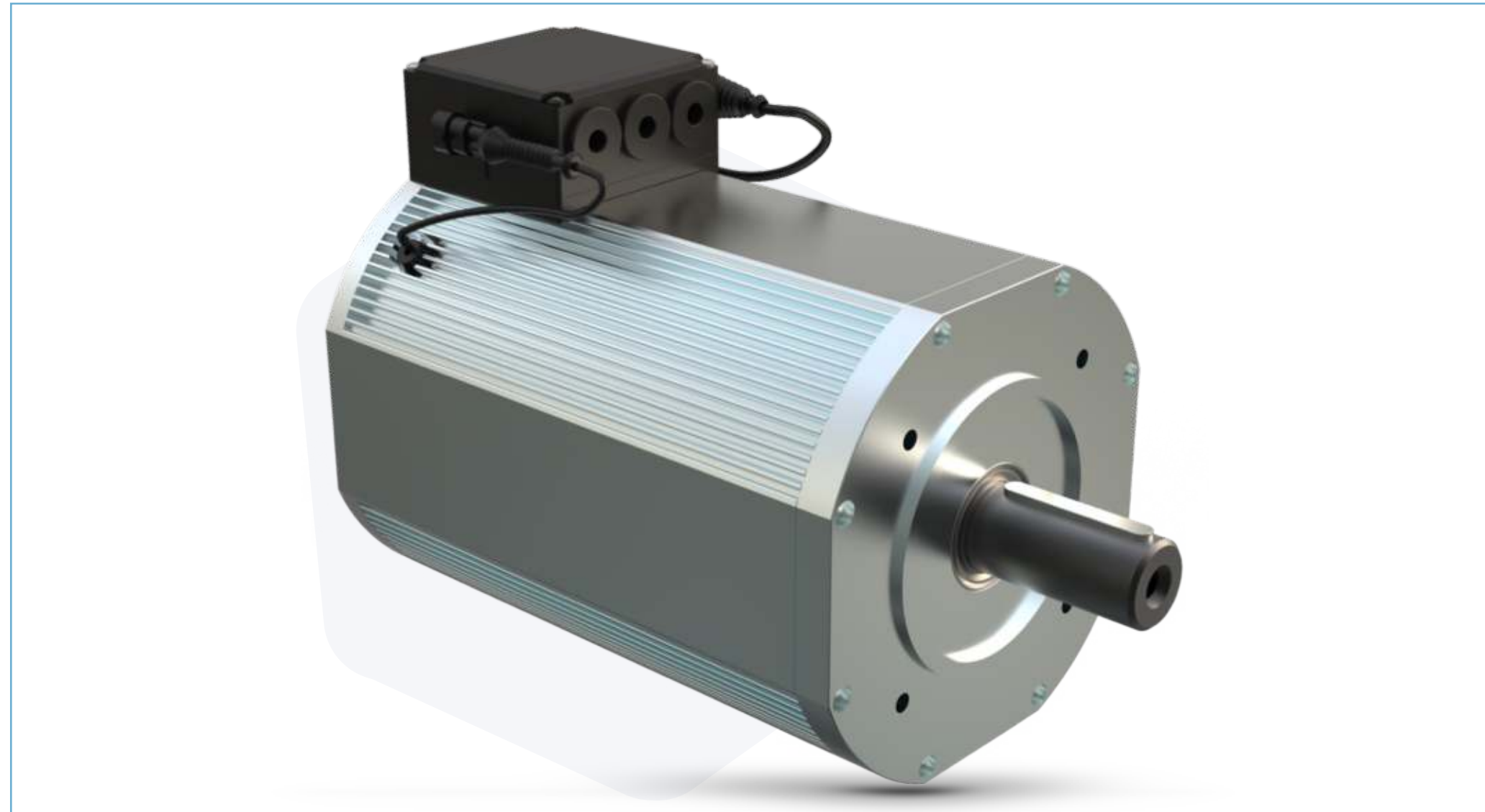


TECHNICAL DATA

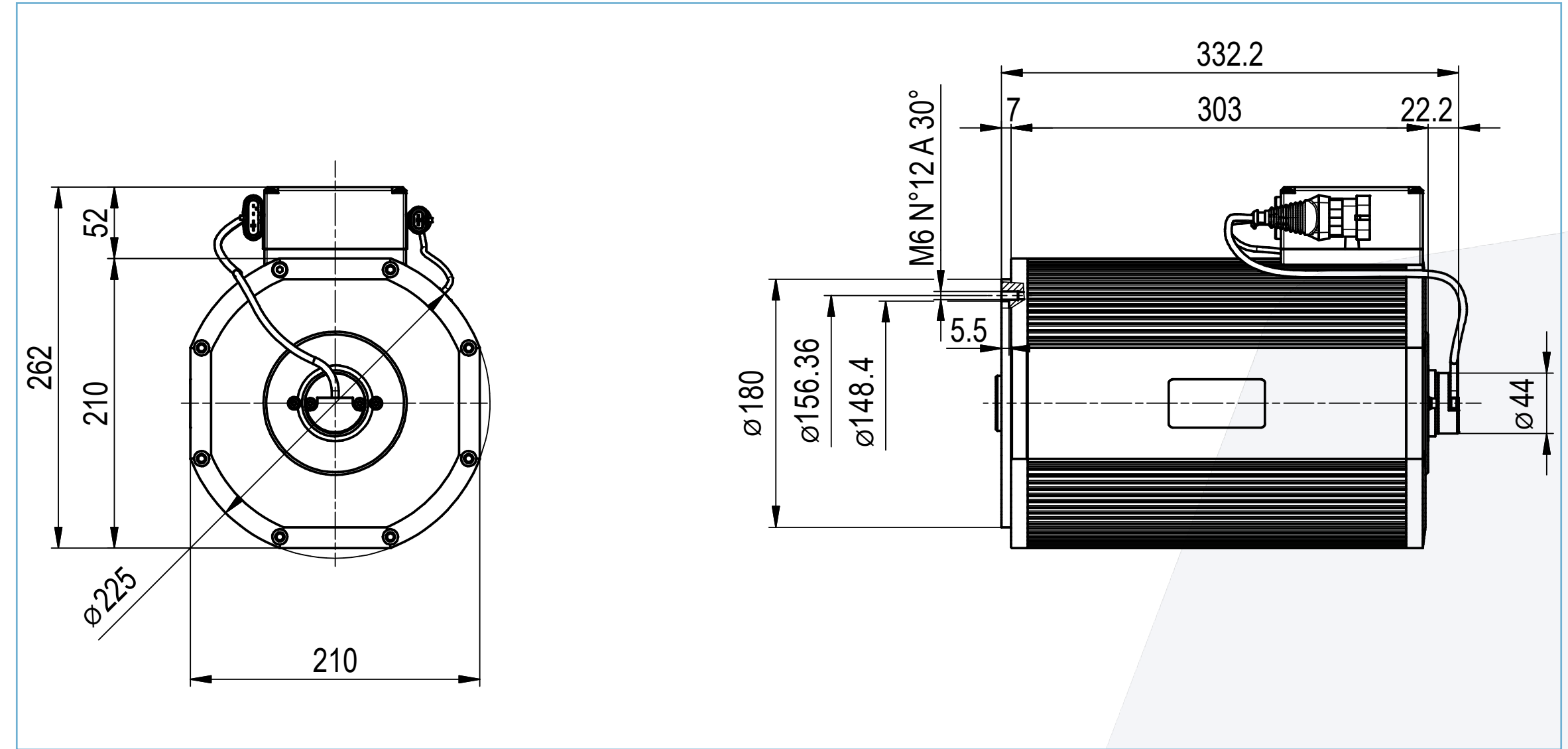
Motor			Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1	PMAC200-157-19		48	8,5	22,5	64,0	185,0	190	660	1.250
2	PMAC200-157-19		96	16,5	45,0	64,0	185,0	190	660	2.500
3	PMAC200-157-47	LC-2P	400	20,0	45,0	80,0	190,0	57	155	2.500

LC - LIQUID COOLED      2P - 2 PAIR CONNECTIONS

PMAC200-210



STANDARD LAYOUT

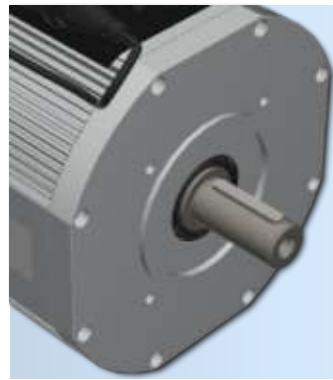


TECHNICAL DATA

Motor			Battery DC Voltage [V]	Rated Power [kW]	Instant Power [kW]	Rated Torque [Nm]	Instant Torque [Nm]	Rated Current [Arms]	Peak Current [Arms]	Rated Speed min <sup>-1</sup>
1	PMAC200-210-19		48	10,0	27,0	95,0	245,0	230	660	1.000
2	PMAC200-210-19	LC	48	15,0	27,0	143,0	245,0	350	660	1.000
3	PMAC200-210-19		80	20,0	47,0	95,0	245,0	230	660	2.000
4	PMAC200-210-19		96	20,0	40,0	95,0	225,0	230	660	2.000
5	PMAC200-210-19		120	20,0	60,0	95,0	265,0	210	730	2.000
6	PMAC200-210-28	2P	400	30,0	90,0	95,0	270,0	95	260	3.500
7	PMAC200-210-68	LC	650	30,0	70,0	100,0	285,0	65	230	3.000

LC - LIQUID COOLED      2P - 2 PAIR CONNECTIONS

CONFIGURATIONS



IEC B14 FLANGES



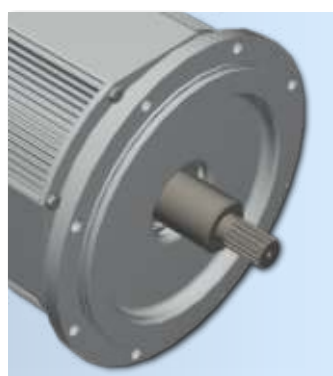
IEC B5 FLANGES



SAEA-B FLANGES



NEMA FLANGES



CUSTOM FLANGES

PERMISSIBLE FORCES

Radialforce Fr [N]

Size	Model	1.000 rpm	2.000 rpm	3.000 rpm	4.000 rpm	5.000 rpm
PMAC 077	025	n/a	n/a	n/a	n/a	n/a
	050	n/a	n/a	n/a	n/a	n/a

Size	Model	1.000 rpm	2.000 rpm	3.000 rpm	4.000 rpm	5.000 rpm
PMAC 096	025	n/a	n/a	n/a	n/a	n/a
	050	n/a	n/a	n/a	n/a	n/a

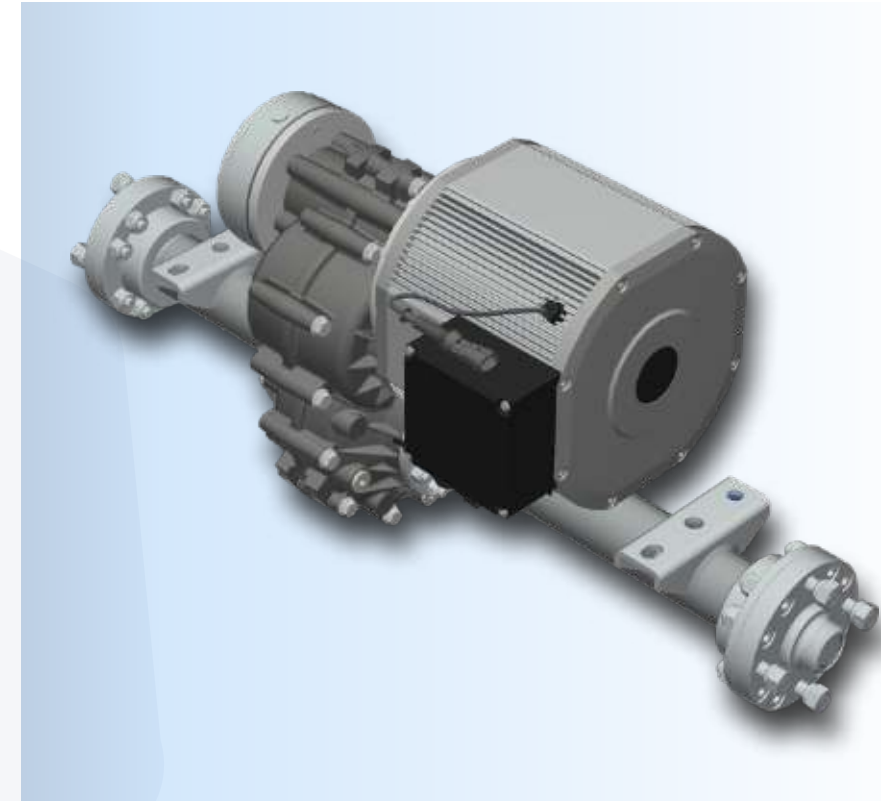
Size	Model	1.000 rpm	2.000 rpm	3.000 rpm	4.000 rpm	5.000 rpm
PMAC 125	025	1.070	850	740	670	620
	050	1.120	890	780	710	650
	075	1.160	920	800	730	680

Size	Model	1.000 rpm	2.000 rpm	3.000 rpm	4.000 rpm	5.000 rpm
PMAC 200	035	2.300	1.830	1.590	1.450	1.340
	052	2.360	1.870	1.630	1.480	1.380
	070	2.400	1.900	1.660	1.510	1.400
	105	2.460	1.950	1.710	1.550	1.440
	210	2.560	2.030	1.770	1.610	1.490

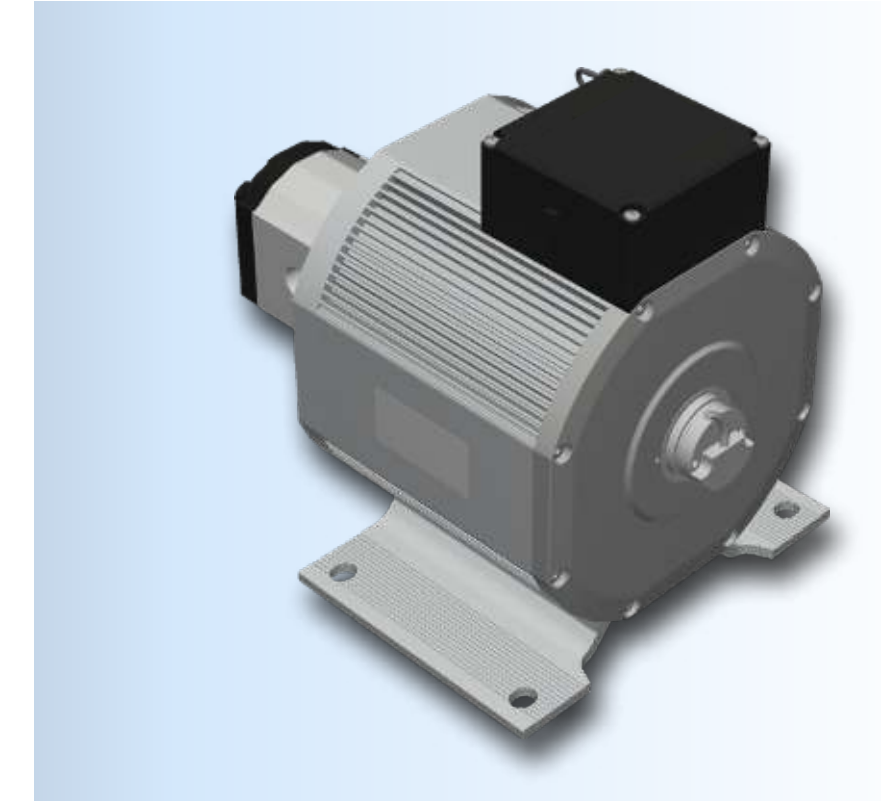
APPLICATIONS

Alpatek can provide complete system for electric vehicles as:

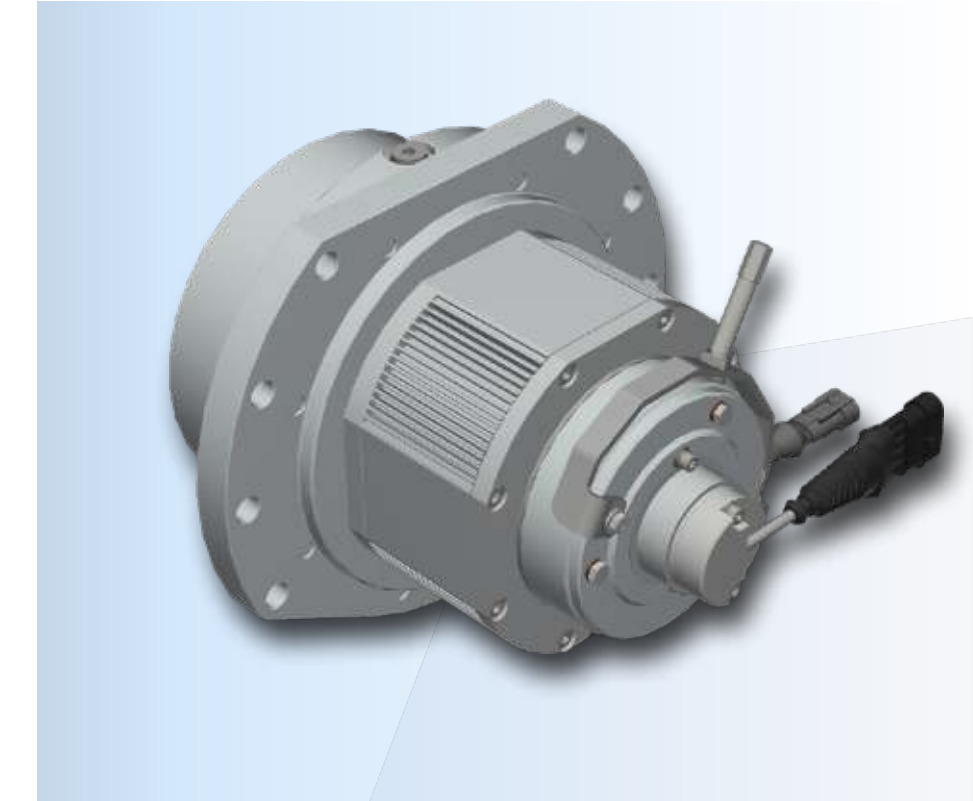
- ✓ ELECTRIC TRANSAXLES
- ✓ HYDRAULIC PUMPS
- ✓ WHEEL DRIVES
- ✓ HYBRID SYSTEM
- ✓ STEERING SYSTEM
- ✓ WATER PUMPS



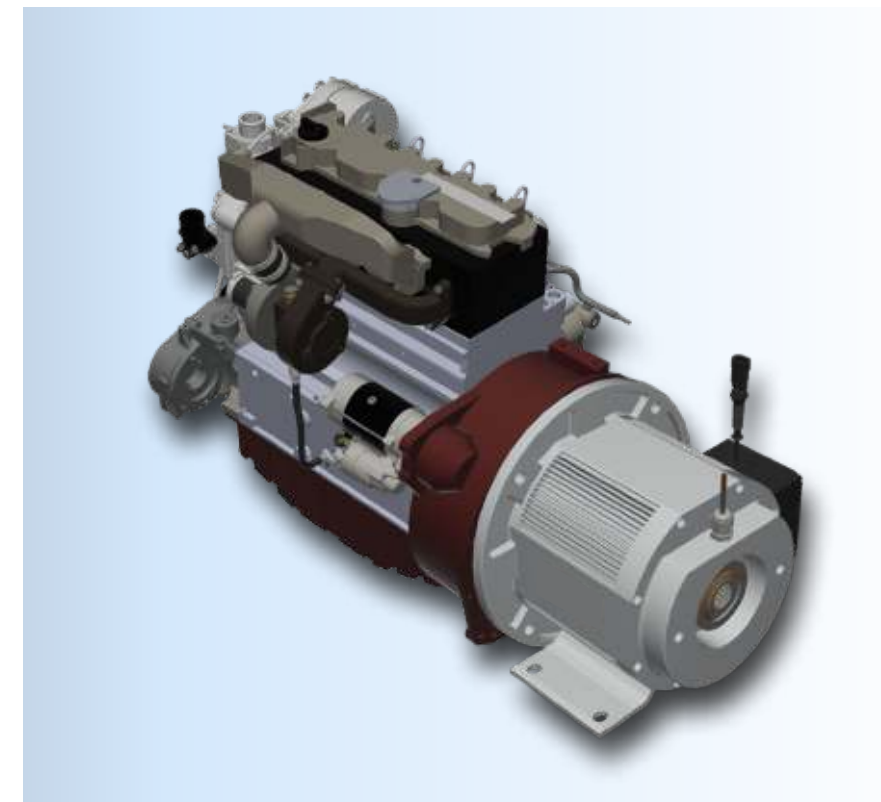
ELECTRIC TRANSAXLES



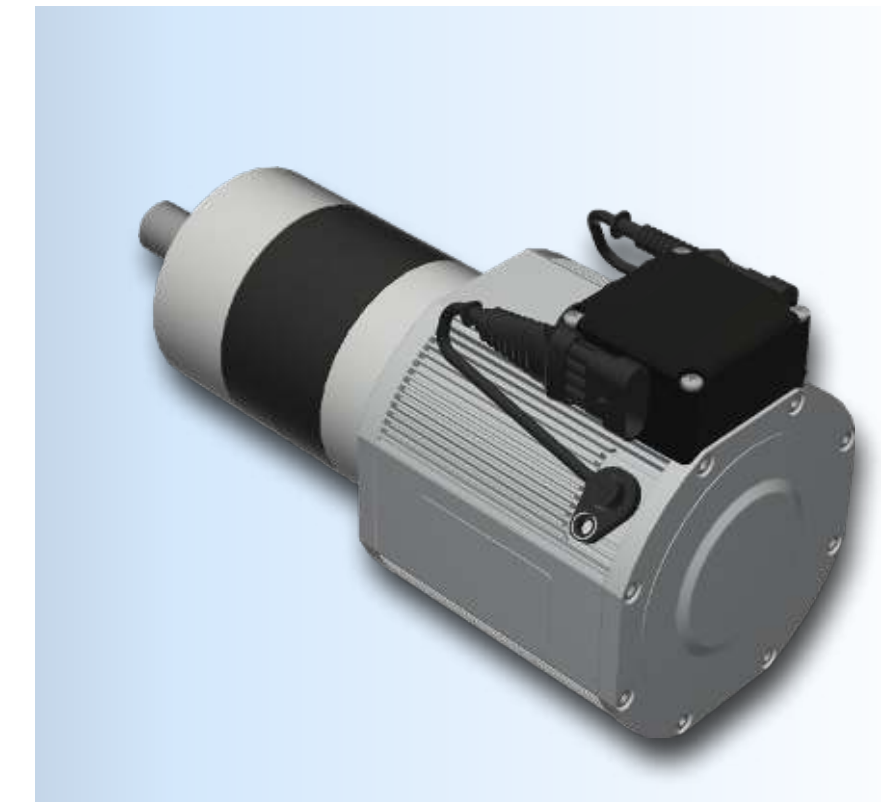
HYDRAULIC PUMPS



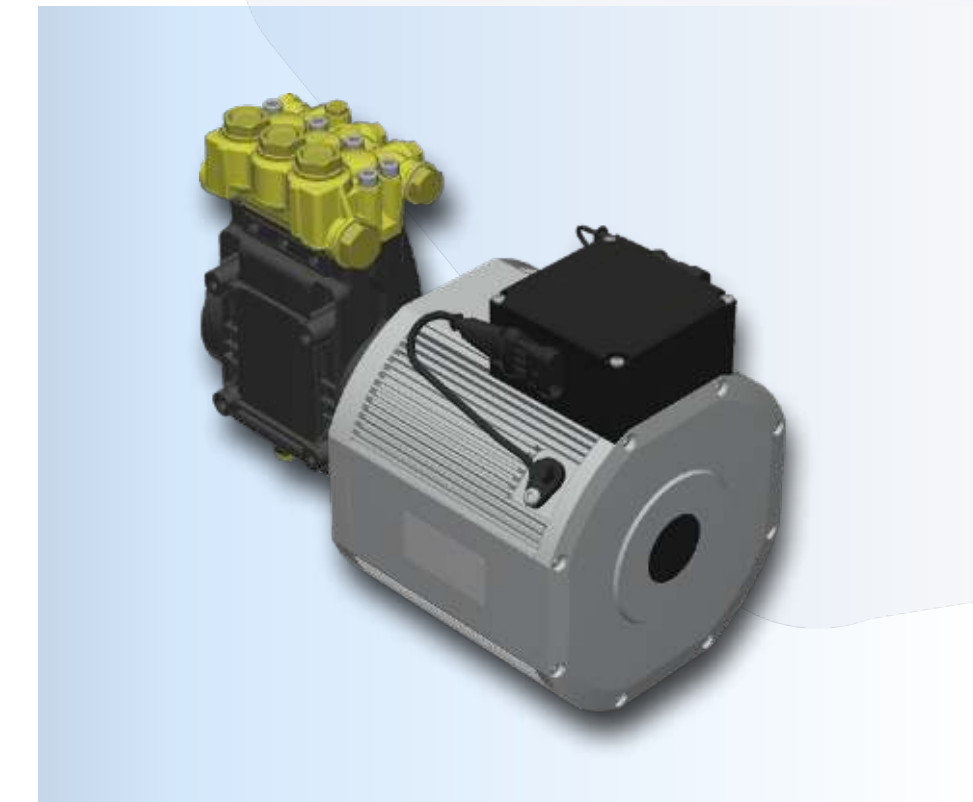
WHEEL DRIVES



HYBRID SOLUTIONS



STEERING SYSTEMS



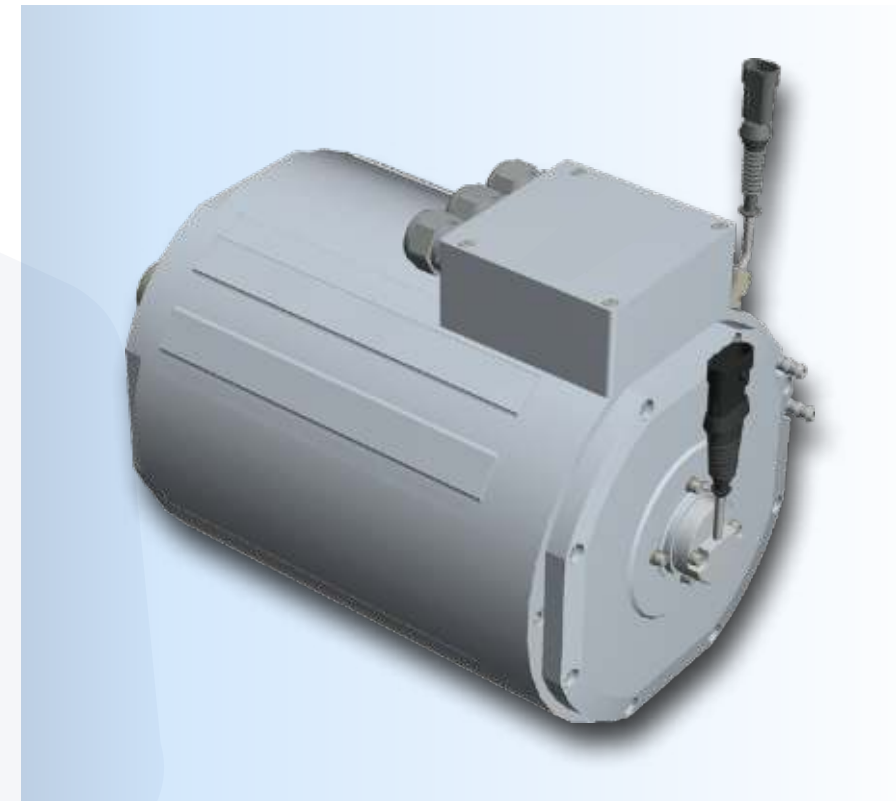
WATER PUMPS

OPTIONS

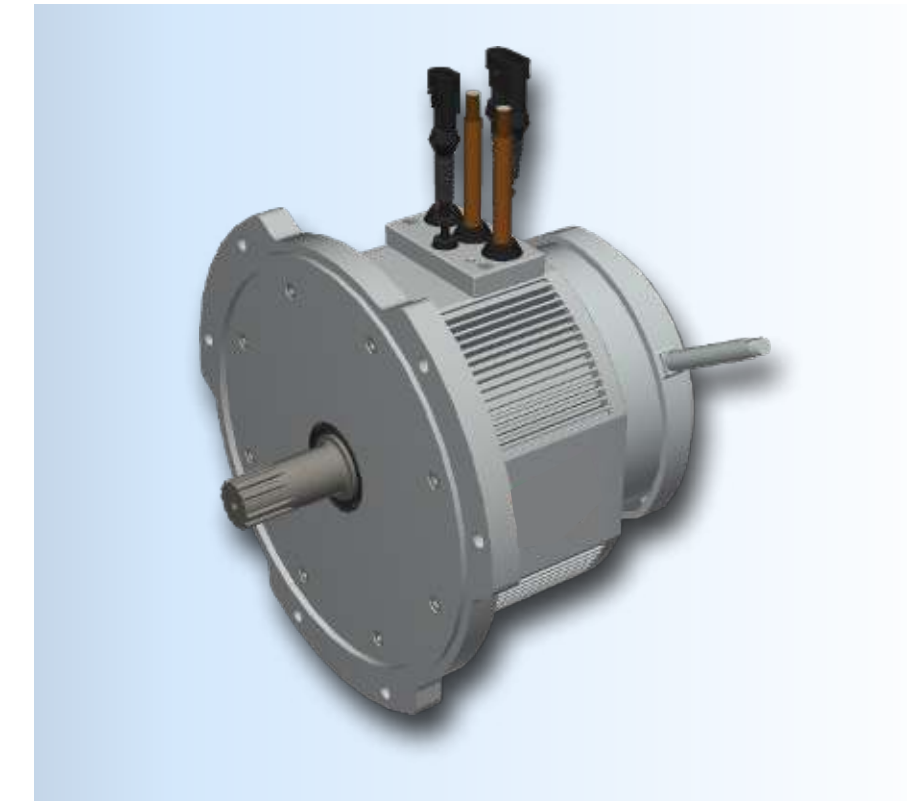
PMAC Serie is the most complete range of electric motors on the market.

There are different options you can choose to customize your electric motor, discover them all:

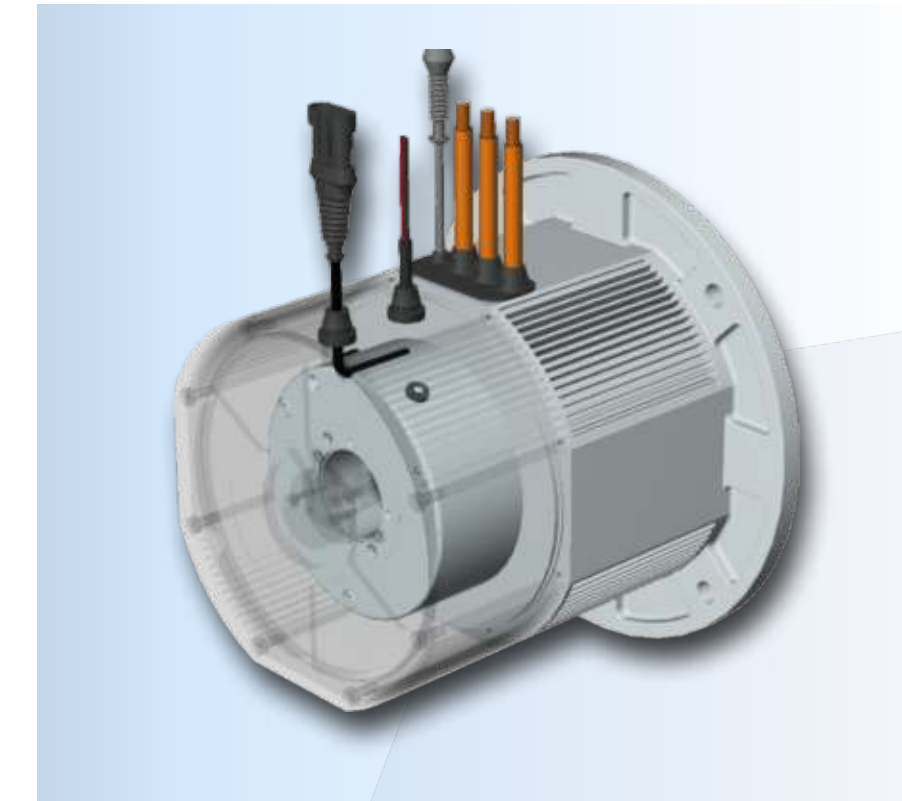
- ✓ LIQUID COOLED
- ✓ CUSTOM VERSIONS
- ✓ INTEGRATED EM BRAKES
- ✓ FLYING CABLES
- ✓ GORE VALVES
- ✓ MOTOR FEEDBACK



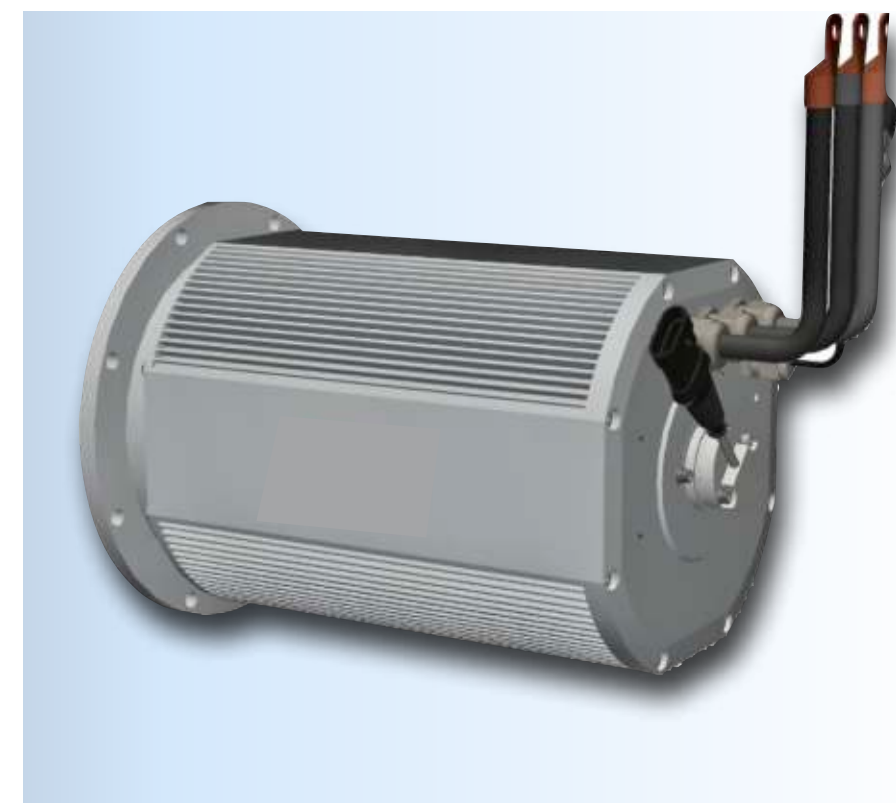
LIQUID COOLED



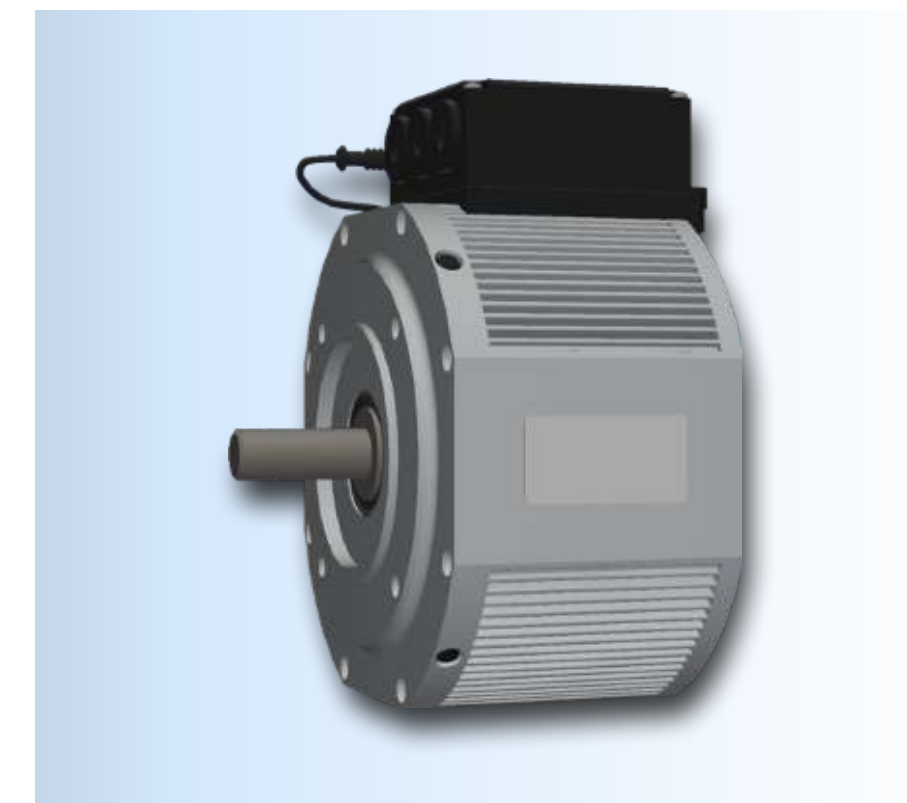
CUSTOM VERSION



INTEGRATED EM BRAKES



FLYING CABLES



GORE VALVES



MOTOR FEEDBACK

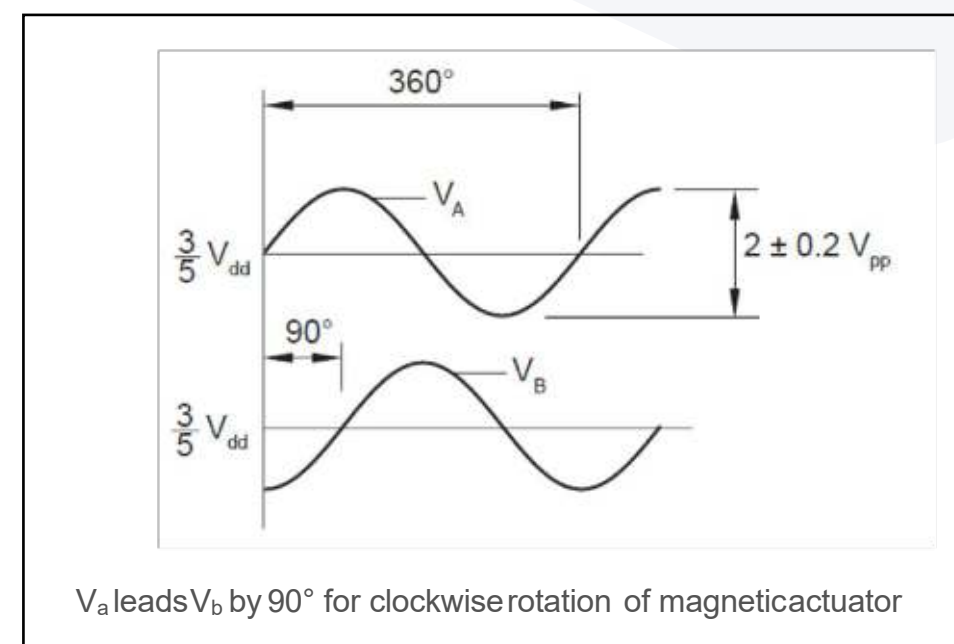
### MOTOR FEEDBACK TECHNICAL DATA

Output Specifications		
5V 2 channels VA VB sinusoids (90° phase shifted, single ended)		
Power Supply	Vdd = 5V ± 5%	
Power Consumption	13mA	
Outputs	Signal amplitude $2 \pm 0.2 V_{pp}$	Signal offset $3/5 V_{dd} \pm 5 mV$
Maximum output frequency	1kHz	
Maximum cable length	3m	
Operating temperature	40 °C to +125 °C IP64	40 °C to +85 °C IP68
Maximum speed	60.000rpm	
Internal serial impedance	720 Ω	

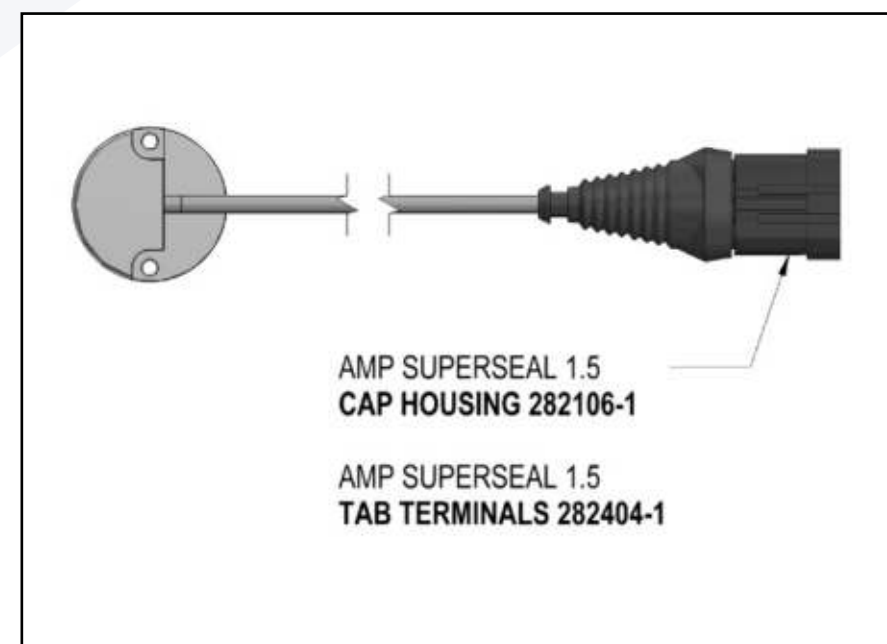
### TEMPERATURE SENSOR TECHNICAL DATA

Output Signal										
Test current 2mA										
°C	Ωmin	Ωmax		°C	Ωmin	Ωmax		°C	Ωmin	Ωmax
-40	340	379		30	599	652		110	1.029	1.096
-30	370	411		40	645	700		120	1.089	1-164
-20	403	446		50	694	750		130	1.152	1.235
-10	437	483		60	744	801		140	1.216	1.309
0	474	522		70	797	855		150	1.282	1.285
10	514	563		80	852	912		160	1.250	1.463
20	555	607		90	910	970		170	1.420	1.544
25	577	269		100	970	1.030				

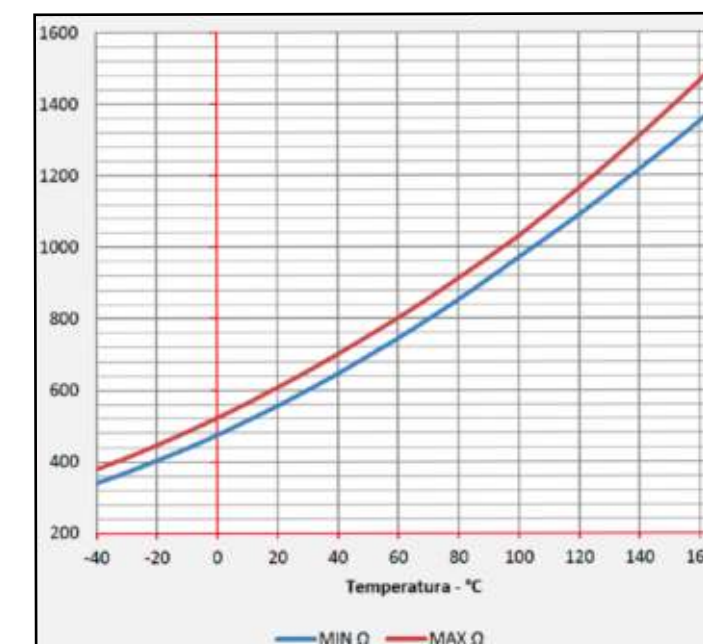
### TIMING DIAGRAM



### CONNECTORS



### RESISTANCE DIAGRAM



### CONNECTORS



### CONNECTIONS



PIN	Function
1	Positive VDC
2	Channel B
3	Channel A
4	Ground

### CONNECTIONS



PIN	Function
1	Resistance
2	Ground

**ORDER CODE**

1	2	3	4	5	6	7	8	9	10	11	12
51	X	000	000	00	X	0	0	0	X	0	00

1	Product Category
51	ElectricMotors

5	Winding Turns
	Turns Number

8	Interface
1	TX1/DD1 Serie(Key)
2	TX1/DD1 Serie(DIN5482)
3	TX2 Serie
4	IEC B14
5	IEC B5
6	IEC B14 + B3
7	IEC B5 + B3
8	SAEA
9	SAEA + B3
A	G1
B	G2
C	G3
D	G4
E	G1 + B3
F	G2 + B3
G	G3 + B3
H	G4 + B3
I	
J	DIN 5482
K	
L	SAE AA
M	SAEAA + B3
N	
O	NEMA C
P	NEMA D
Q	NEMA TC
R	NEMA TD
S	SPECIAL
T	SAE B
U	SAEB + B3
W	WD 220

9	Feedback
0	Sensorless
1	Hall effect
2	
3	
5	SinCos
6	Sick EKS36
7	Resolver

L	EM Brake03/056
M	EM Brake04/065
N	EM Brake05/075
O	EM Brake06/083
P	
Q	EM Brake08/102
R	EM Brake09/114
S	EM Brake10/127
T	EM Brake12/148
U	EM Brake14/165
V	EM Brake16/190
W	EM Brake18/220
X	EM Brake20/257

2	Motor Type
A	PMDC
C	SMDC SM
E	AMAC
G	PMAC SM IR
H	PMAC SM ER
J	PMACIM IR
K	PMACIM ER

6	Voltage
C	24
D	36
E	48
F	72
G	80
H	96
I	60
L	110
M	120
N	144
O	360
P	400
S	560
T	600
U	650
V	780

10	EM Brake
0	Without EM Brake
1	Preparedfor 01/037
2	Preparedfor /047
3	Preparedfor 03/056
4	Preparedfor 04/065
5	Preparedfor 05/075
6	Preparedfor 06/083
7	
8	Preparedfor 08/102
9	Preparedfor 09/114
A	Preparedfor 10/127
B	Preparedfor 12/148
C	Preparedfor 14/165
D	Preparedfor 16/190
E	Preparedfor 18/220
F	Preparedfor 20/257
G	
H	
I	
J	EM Brake01/037
K	EM Brake02/047

3	Stator Diameter
077	77 mm
096	96 mm
125	125 mm
132	132 mm
200	200 mm

7	IP Protection
0	IP 00
2	IP 20
4	IP 44
5	IP 54
6	IP 55
7	IP 65
8	IP 66
9	IP 67
10	
11	

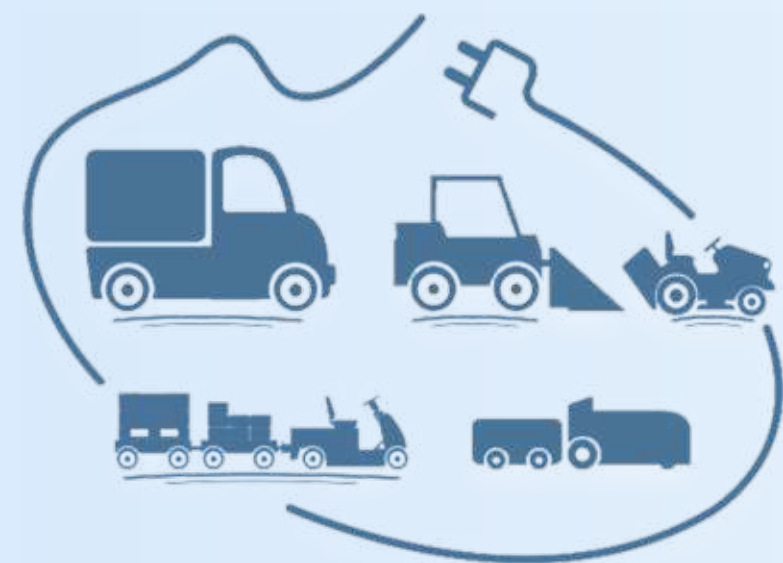
4	Stator Length
025	25 mm
035	35 mm
050	50 mm
052	52 mm
075	75 mm
090	90 mm
105	105 mm
125	125 mm
157	157 mm
165	165 mm
200	200 mm
210	210 mm

11	Cooling
0	Self Cooling
1	Internal Fan(front)
2	Internal Fan(rear)
3	Forced Cooling (lateral)
4	Forced Cooling (rear)
5	Liquid cooling

12	Version
00	Version 00
01	Version 01
...	Version ...

Alpatek B.V.  
Addenhoeve 7  
3911 TG Rhenen  
The Netherlands

[WWW.ALPA TEK.COM](http://WWW.ALPA TEK.COM)



**ALPA TEK**  
BATTERY DRIVE SYSTEMS AND MOTORS