



# MAGELEC

## PROPULSION



PMSM Axial Flux Motor Generators  
IGBT & SiC Inverters  
High Speed & Efficient Transmissions

Electric Powertrain Systems



## Welcome to MAGELEC Propulsion

We're a passionate team. We push the performance and value boundaries of MAGELEC products through innovative design and engineering of functional materials. We use our deep technical knowledge in the application of analytical sciences and materials characterization to create and advance a wide variety of products throughout the lifecycle; from conception through development, manufacturing and product performance support.

Innovation is a core competency at MAGELEC. Our development process includes mechanical, electromagnetic, and thermal analysis through rapid prototyping, light weighting and system characterization all with a single objective; production of high performance electric powertrain systems that meet the objectives of our Clients.

Industrialization of innovative processes, including composite component production, processing of high performance alloys, and copper coil winding. We chose to vertically integrate key processes to ensure control and quality.





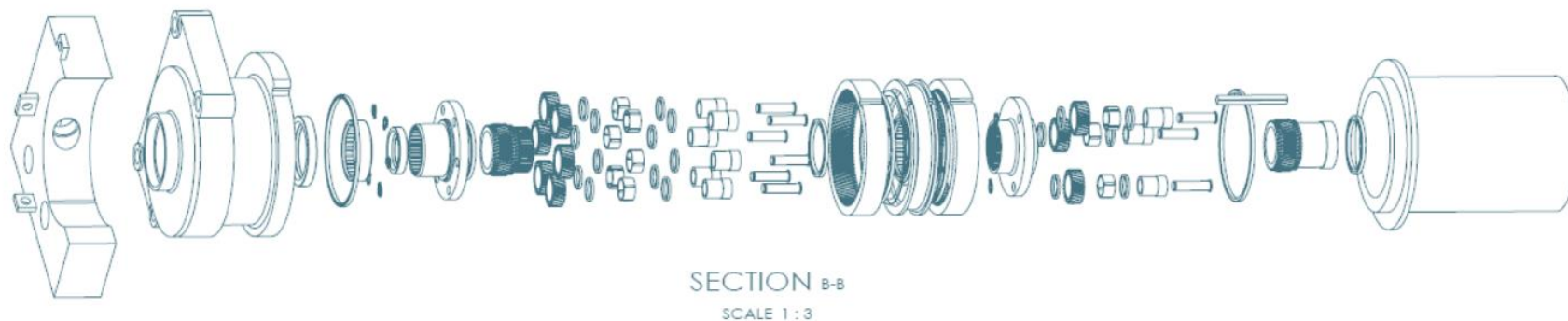
### The Leading Edge of Electric Propulsion Technology

MAGELEC Propulsion's engineering team create the most power dense, light weight axial flux powertrain solutions in the world. Chosen by Formula E, Electric Touring & GT Cars and Electric Race Motorcycle teams. The specific torque generated by our axial flux PMSM MGUs exceed radial flux, reluctance and induction motors. Developed for motorsport or daily commercial duty, our compact, light weight designs reduce powertrain mass, improving vehicle performance, increasing payload and range.

### A Global Team, Headquartered in Shanghai

MAGELEC Propulsion operates engineering R&D in;  
 Shanghai PRC                      Houston TX  
 Bologna ITA

Sales & Distribution in;  
 Shanghai PRC                      Houston TX  
 Bologna ITA





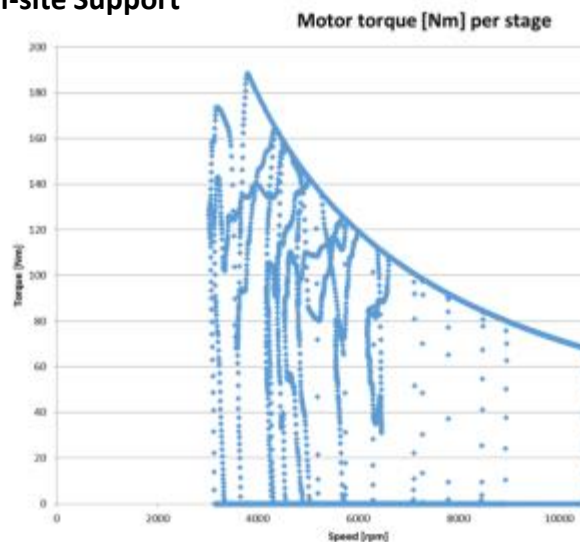


### Powertrain Solution for

- Motorcycles
- Passenger Car
- Pickup, MPV, SUV
- Light & Medium Duty
- Bus & Coach
- Supercar
- Motorsport
- Off High Way



## Powertrain System Sizing, Customer on-site Support



**MAGELEC**  
PROPULSION

### MAGELEC Powertrain- Vehicle # 1, Ram Promaster Based Van

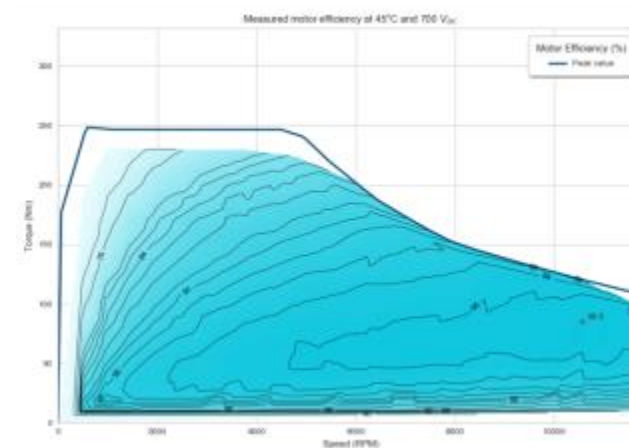
Information for customer vehicle

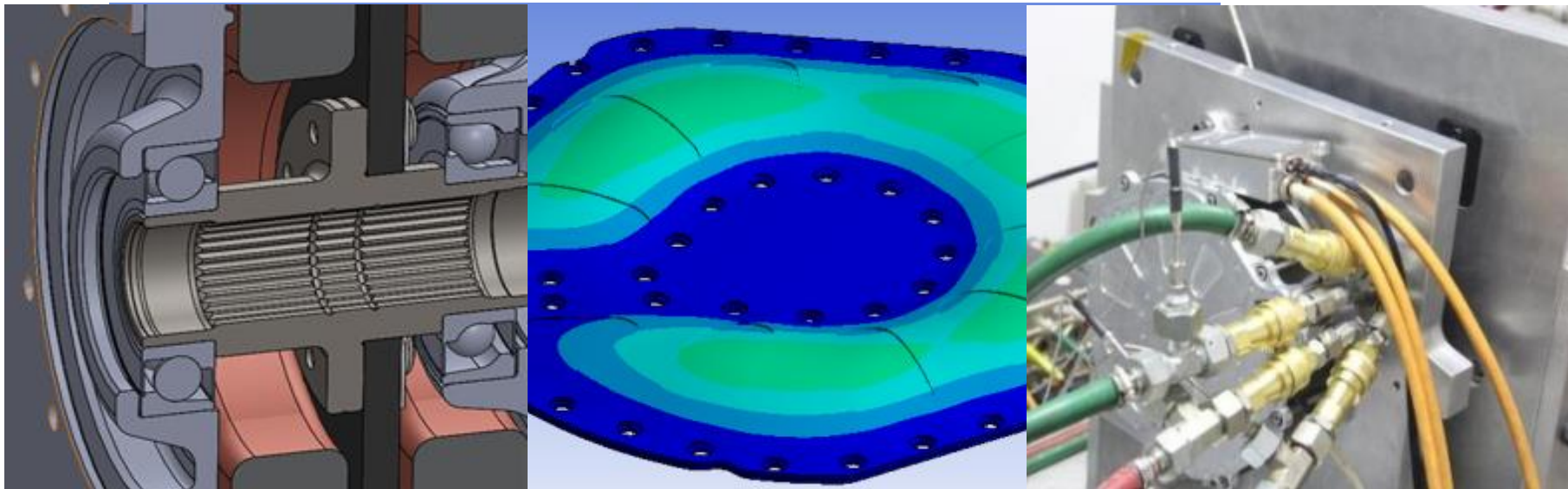


APPLICATION		
Customer / vehicle	Passenger Bus / Cargo Van (Based on RAM Promaster)	
Calculation Vehicle	Passenger Bus / Cargo Van (Based on RAM Promaster)	
VEHICLE		
	Customer Input	Calculate Input
Gross vehicle weight (GVW)	10000 lb	4535.7 kg
Drive Line Configuration	1WD	1WD
Vehicle Weight Distribution	7:3	7:3
Frontal area	2.34 m <sup>2</sup>	2.540 m <sup>2</sup>
Rolling radius	—	0.572 m
Drag coefficient	—	0.364
Rolling resistance coefficient	—	0.01300
Tyre coefficient of friction	—	1.000
Coefficient of Moment of Inertia	—	1.00
Speed Targets		
Intermittent	55 mph	304.6 kph
Continuous	55 mph	88.5 kph
ELECTRICAL SYSTEM		
	TARGET / INPUT	
Battery capacity	62.1 kWh	62.1 kWh
Max. Battery Voltage	VDC	
Battery Nominal voltage	840 VDC	
Max. Battery Voltage	VDC	
Calculate voltage	—	940 VDC
Battery Nominal Current	300 A	800.0 A
Battery Intermittent Current	250 A	250 A
Battery peak current	400 A, 15s	400 A
Battery Nominal power	—	108.5 kW
Battery Peak Power	—	108.5 kW
Battery Efficiency	—	100%



- Vehicle Performance Simulation
  - Acceleration
  - Gradeability
  - Max Speed
- Duty cycle Simulation
  - Temperature
  - Efficiency
  - Life time
- Customer On Site Support
  - System Setup and Commissioning
  - Issue Resolution
  - Tuning and Calibration





### Axial Flux PMSM MGUs

Axial Flux Permanent Magnet Synchronous Machine Technology.

- Mechanical Design Modelling
- Electromagnetic & Thermal Simulation, with ANSYS Maxwell
- Rapid Prototyping
- Performance Testing & Characterization
- Product Validation Testing
- Product Industrialization
- Power Density up to 7.8 kW/kg
- Motor Generator Units up to 600 kW & 1200Nm
- Flexible and Modular Design
- Air, Oil, WEG cooling
- Efficiency up to 96.3%

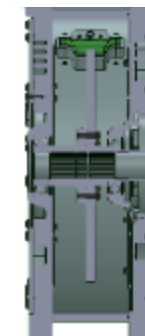
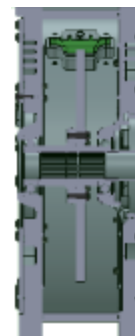




## MAGELEC Medium Voltage MGUs

	Medium Voltage							
	M19P5-S-19	M19P5-D-19	M21P4-S-19	M21P4-D-19	M24P4-S-19	M24P4-D-19	M27P4-S-19	M27P4-D-19
Battery Voltage [Vdc]	200 - 600	200 - 600	200 - 600	200 - 600	200 - 600	200 - 600	200 - 600	200 - 600
Peak Current [Arms]	326	326x2	437	437x2	554	554x2	641	641x2
Continue Torque [Nm]	46	92	85	170	152	304	215	430
Peak Torque (20s) [Nm]	131	262	206	412	352	704	580	1,160
Continuous Power (360V) [kW]	26	52	45	90	60	120	60	120
Peak Power (360V, 20s) [kW]	72	144	91	182	113	238	128	256
Rated Speed (360V) [rpm]	5,400		4,000		5,400		3,750	
Max Speed (360V) [rpm]	15,000		12,000		9,000		7,350	
Peak Efficiency [%]	≥95							
Environmental Protection Class	IP67							
Main Outer diameter [mm]	268	268	288	288	323	323	348	348
Length [mm]	119	238	119	238	129	258	143	286
Weight (dry) [kg]	19.5	39.4	23	46.4	32.5	65.4	43.5	87.4
Technology	Axial Flux PMSM							
Coolant	Water & Glycol							
Connecting Box	Flexible							

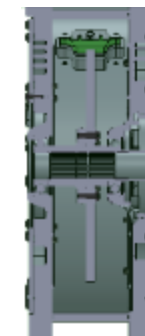
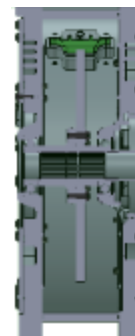
Stated performance is for 'MGU-only', Values may change when MGU is paired with MCU.



## MAGELEC High Voltage MGUs

	High Voltage							
	M19P5-S-19	M19P5-D-19	M21P4-S-19	M21P4-D-19	M24P4-S-19	M24P4-D-19	M27P4-S-19	M27P4-D-19
Battery Voltage [Vdc]	600 - 800	600 - 800	600 - 800	600 - 800	600 - 800	600 - 800	600 - 800	600 - 800
Peak Current [Arms]	326	326x2	437	437x2	554	554x2	641	641x2
Continue Torque [Nm]	46	92	85	170	152	304	215	430
Peak Torque (20s) [Nm]	131	262	206	412	352	704	580	1,160
Continuous Power (600V) [kW]	44	88	73	146	94	188	96	192
Peak Power (600V, 20s) [kW]	116	232	150	300	201	402	218	436
Rated Speed (600V) [rpm]	9,000		6,700		5,400		3,750	
Max Speed (600V) [rpm]	15,000		12,000		9,000		7,350	
Peak Efficiency [%]	≥95							
Environmental Protection Class	IP67							
Main Outer diameter [mm]	268	268	288	288	323	323	348	348
Length [mm]	119	238	119	238	129	258	143	286
Weight (dry) [kg]	19.5	39.4	23	46.4	32.5	65.4	43.5	87.4
Technology	Axial Flux PMSM							
Coolant	Water & Glycol							
Connecting Box	Flexible							

Stated performance is for 'MGU-only', Values may change when MGU is paired with MCU.

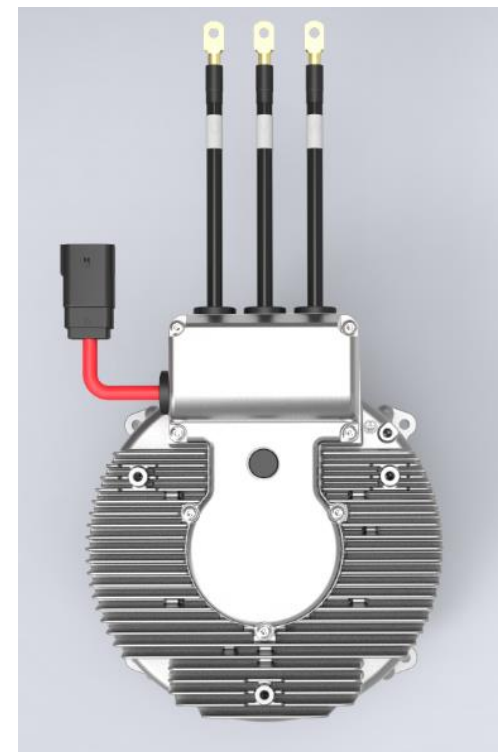




## MAGELEC Low Voltage MGUs

	Low Voltage		
	M13C9-S-20	M15C6-S-20	M17C3-S-20
Battery Voltage [Vdc]	30~160	30~160	30~160
Peak Current [Arms]	208	384	638
Continuous Torque [Nm]	12	18	30
Peak Torque (20s) [Nm]	35	58	80
Continuous Power (48V) [kW]	3.0	5.0	10.5
Peak Power (48V, 20s) [kW]	6.7	12.3	20.2
Rated Speed (48V) [rpm]	1,800	2,000	2,400
Max Speed (48V) [rpm]	4,500	4,500	6,000
Peak Efficiency [%]	≥94		
Environmental Protection Class	IP67		
Main Outer diameter [mm]	194	214	239
Length [mm]	120	130	143
Weight (dry) [kg]	9	12	14.5
Technology	Axial Flux PMSM		
Coolant	Air Cooling		
Connecting Box	Flexible		

Stated performance is for 'MGU-only', Values may change when MGU is paired with MCU  
Common performance can be achieved at other voltages by different winding configurations.



## Low Voltage Axial Flux Motor - Cartridge

Integrated Design for Traction Unit and Auxiliary

	Low Voltage-Cartridge		
	M13C9-C-21	M15C6-C-21	M17C3-C-21
Battery Voltage [Vdc]	24~160	24~160	24~160
Peak Current [Arms]	237	384	638
Continue Torque [Nm]	10.5	16.8	19.3
Peak Torque (20s) [Nm]	43.9	58.0	83.0
Contine Power (48V) [kW]	2.5	3.8	5.5
Peak Power (48V, 20s) [kW]	5.8	10.4	20.0
Rated Speed (48V) [rpm]	1,300	1,500	2,000
Max Speed (48V) [rpm]	4,500	4,500	6,000
Peak Efficiency [%]	≥94		
Environmental Protection Class	IP67		
Main Outer diamter [mm]	204	232	263
Length(power cable from top) [mm]	152	161	167
Weight (dry) [kg]	10.4	14.6	18
Technology	Axial Flux PMSM		
Coolant	Air Cooling		
Connecting Box	Flexible		

- Light and compact design
- Integrated Electric Emergency & Parking Brake
- Easy to assembly with OMNI Gear Planetary or other Parallel Shaft gearbox
- Suitable for 24V, 48V, 72V, 96V Battery Voltage
- IP67
- Temperature sensor 2xPT100 – other type on demand
- Resolver - Sin-Cos Encoder - other type on demand



## MAGELEC Range Extender & Genset & Low Power Applications



MAGELEC Axial Flux Motor technology's short length offers unique packaging opportunities for Range Extenders & Gensets & Low power applications

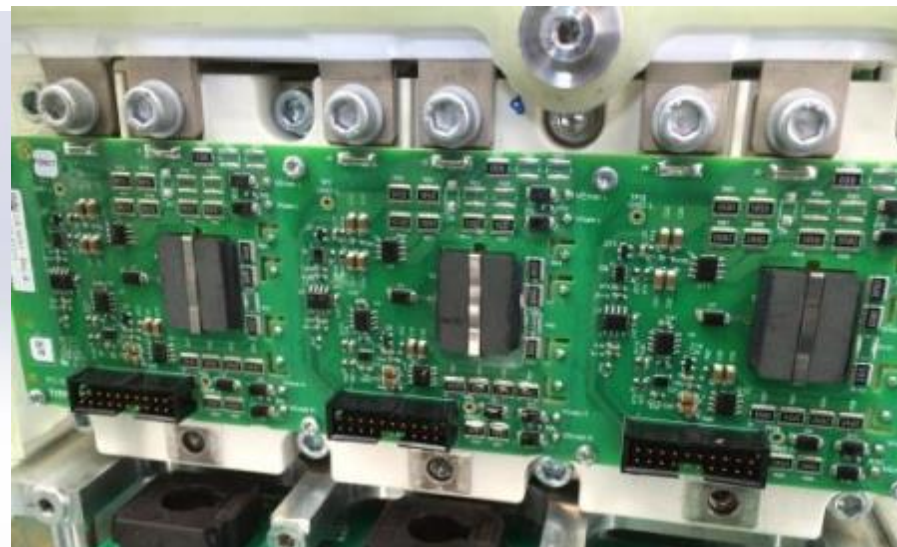
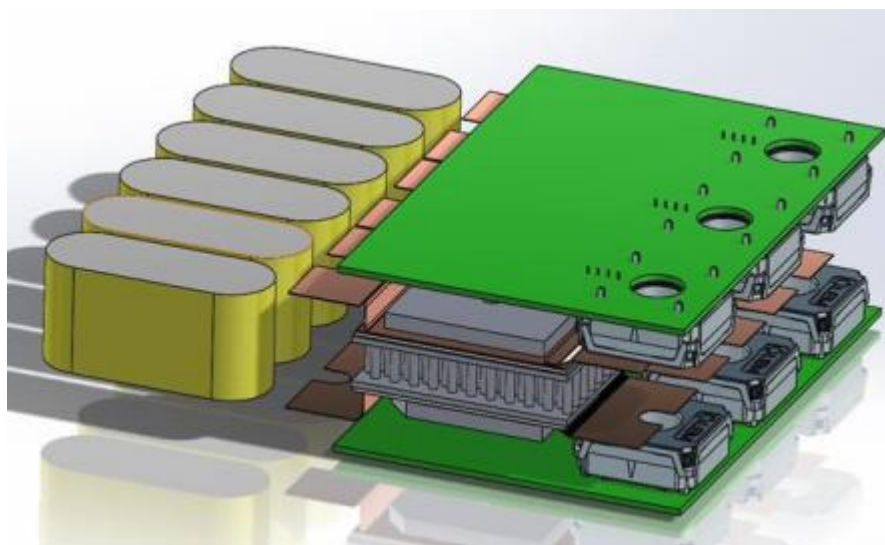
- Flat front and rear faces for easy integration
- Low-inertia rotor for fast acceleration and easy mounting/integration
- No losses in rotor structure due to non-metallic construction
- High power factor allows for down-sized power electronics
- Large cooling area available due to axial flux topology
- Air cooling option for low system cost and complexity

Physical integration of inverter hardware is possible to simplify vehicle integration

Modular approach makes it easy to multiply output power for high-performance applications

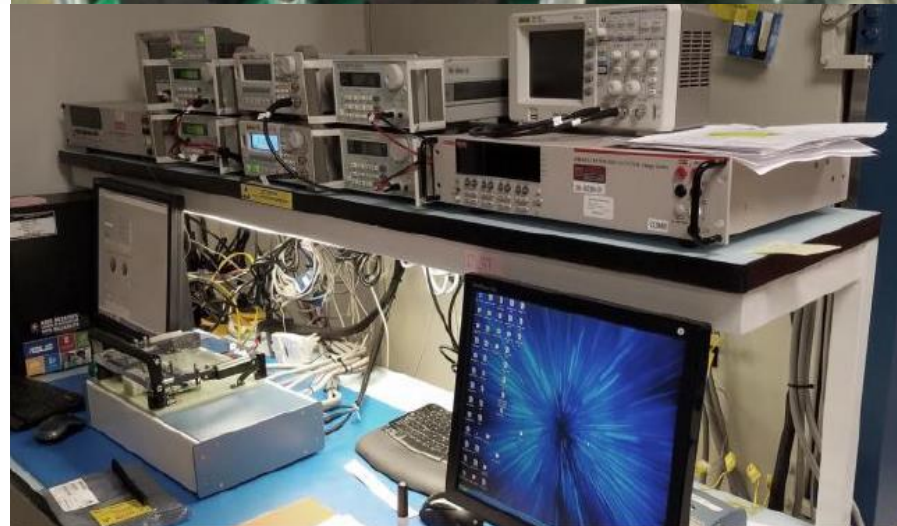


## IGBT &amp; SiC MOSFET MCUs



## IGBT &amp; Silicon Carbide MOSFET, Motor Control Units

- 48V through 800V capability
  - Power Stage Design and Development
  - Mechanical & Thermal Design
  - Passive Component Sizing
  - Design of Control Electronics and SW
  - Designed for Automated Assembly
  - Compatible with ISO26262
- 
- Power Electronics up to 480 kVA.
  - Power Density up to 43 kW/kg
  - Efficiency up to 99.3%





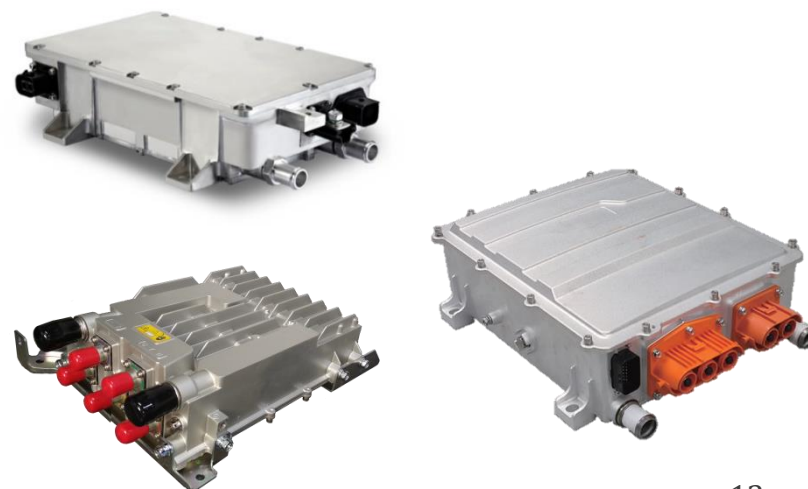
## High & Medium Voltage MCUs

	Medium-High Voltage				
Model	IFL100-36	GVD550-3L14-080	GVD550-3L14-115	GVD550-5L14-140	GVD550-5L14-200
DC Voltage operating [Vdc]	220-450	200 - 450	200-450	400-750	400-750
Motor Current Continuous [A]	160	200	280	200	280
Motor Current Peak [Arms]	450	400	560	400	560
Output Power Peak -elect- [kVA]	150	80	115	140	200
Auxiliary Power Supply [Vdc]	9-16	8-32			
Main Outer dimensions [mm]	297x398x104	391x320x122			
Weight (dry) [kg]	8.5	<13			
Peak Efficiency [%]	≥98%				
Environmental Protection Class	IP67				
Technology	IGBT				
Communication	CAN, Custom.dbc messaging, Standard J1939				
Coolant	Water & Glycol				
Power Connector type	Amphenol HVBI	AMPHENOL HVSL 1000			
HVIL	The controller detects the high voltage interlock signal and CAN state feedback.				

Multi-function inverters are available in product portfolio

## DC/DC Converter

Model		GVD510-2AL2R5LD	GVD510-2BL2R5LD
Input Voltage [Vdc]		200~430	400-750
Output	Adjustable Range [Vdc]	9~16	9~16
	Rated Power [kW]	2.5	2.5
	Rated Current [A]	180	180
	Temperature [°C]	-40~85	-40~85
Other	Coolant	Water & Glycol	Water & Glycol
	Protection Class	IP67	IP67
	Weight (dry) [kg]	4.5	4.5
	Main Dimensions [mm]	170x250x65	170x250x65



## MAGELEC Low Voltage MCUs

Model	Low Voltage			
	emDrive 150_250/60	emDrive 200_400/60	emDrive 150_300/120	emDrive 500_800/120
DC Voltage operating [Vdc]	20-60	20-60	20-120	30-120
DC Overvoltage Trip SW/HW [Vdc]	60/63	60/63	120/126	120/126
Max DC Voltage non operating [Vdc]	63	63	135	135
Motor Current Continuous [Arms]	150	200	150	500
Motor Current Peak (60s) [Arms]	250	400	300	800
Output Power Peak -elect- (60s) [kVA]*	17	27	43	110
DC Bus Capacitance [ $\mu$ F]	6240	13120	2400	14500
Peak Efficiency [%]	$\geq 97$	$\geq 97$	$\geq 97$	$\geq 97$
Environmental Protection Class	IP62	IP62	IP62	IP65
Main Outer dimensions [mm]	200 x 150 x 58	201 x 150 x 58	202 x 150 x 58	205 x 310 x 78
Volume [l]	1.3	1.3	1.3	3.7
Weight (dry) [kg]	1.7	1.7	1.7	4.9
Technology	MOSFET	MOSFET	MOSFET	MOSFET
Communication	CAN open	CAN open	CAN open	CAN open
Coolant	Air	Air	Air	Water & Glycol

\* Depend on load and cooling

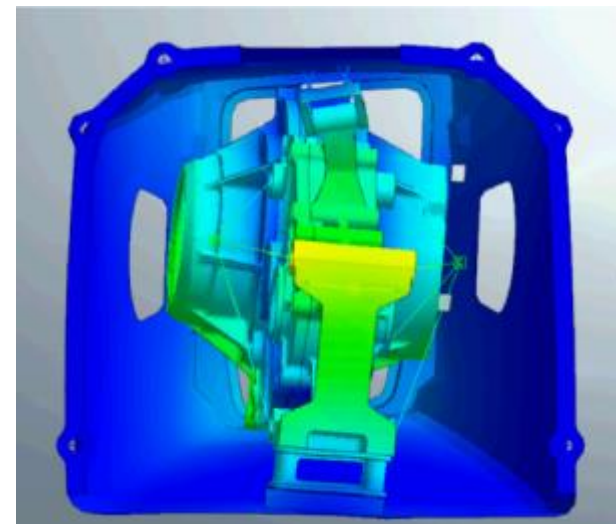


## Transmissions; Transaxle, Longitudinal, Vector



Rich History in Bespoke, Automotive, Commercial and Motorsport

- High Efficiency Gear Design
- FEM and NVH Simulation and Optimization, with ROMAX
- Rapid Prototyping, Aluminium, Magnesium, Composite, Ceramic
- 86xx & 93xx Alloys, Gears Grade up to ISO 5
- Light Transmission with Input Speed up to  $22,000\text{r}^{-1}$
- Spur & Helical Gear
- Open & Mechanical Locking Differentials, Customized Output Flanges
- Park Locks CAN Controlled
- Efficiency up to 99%



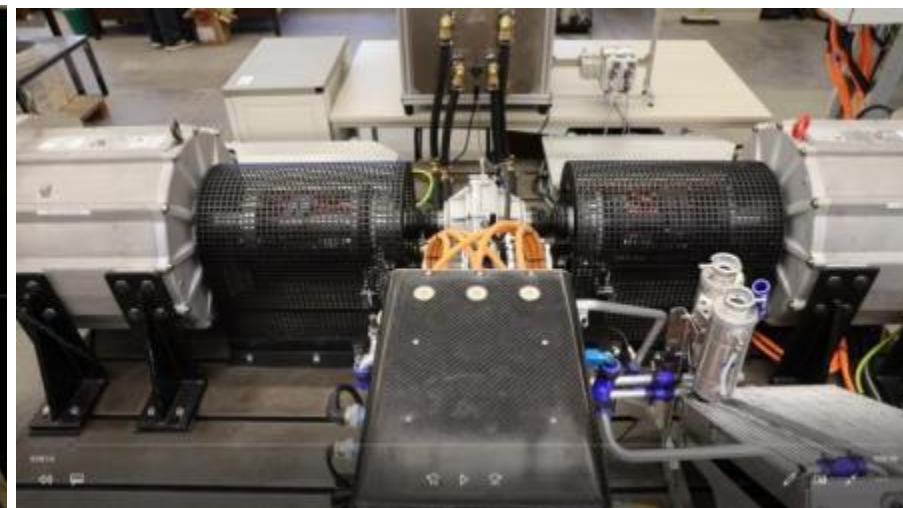
## MAGELEC Longitudinal &amp; Transversal GBXs

	Longitudinal & Transversal					
	F03L1-x-19	F03T1-x-19	F06L1-x-19	F06T1-x-19	F12L1-x-19	F12T1-x-19
<b>Max Input Torque [Nm]</b>	300	300	600	600	1200	1200
<b>Max Input Speed [rpm]</b>	15,000	15,000	12,000	12,000	7,500	12,000
<b>Center Distance [mm]</b>	120	265	120	265	165	265
<b>Reduction Ratio Range</b>	1.35 - 4.43	5.20 - 13.35	1.1 - 3.5	5.9 - 13.32	1.0 - 3.94	2.98 – 6.03
<b>Weight (dry) [kg]</b>	17.5	39.5	19.5	49.5	23.5	49.5
<b>Peak Efficiency [%]</b>	≥98%	≥97%	≥98%	≥97%	≥98%	≥97%
<b>Application</b>	Longitudinal	Transversal	Longitudinal	Transversal	Longitudinal	Transversal
<b>Fit with MAGELEC MGUs</b>	M19Px, M21Px	M19Px, M21Px	M21Px, M24Px, M27Px	M21Px, M24Px, M27Px	M24Px, M27Px, M34Px	M21Px, M24Px, M27Px
<b>Differential Type</b>	NA	Open	NA	Open	NA	LSD
<b>Max Output Torque [Nm]</b>	1,330	4,000	2,100	7,500	4,770	7,200
<b>Gear Type</b>	Helical	Helical	Helical	Helical	Helical	Helical
<b>Lubrication Type</b>	Splash	Splash	Splash	Splash	Splash	Splash
<b>Park Lock (Option)</b>	NO	YES	NO	YES	NO	NO
<b>Output Flange (Option)</b>	YES	YES	YES	YES	YES	YES





## Electric Powertrain Component and System Testing



- MGU & MCU Performance Testing
- MGU & MCU Characterization
- MGU & MCU Endurance Testing
  - Climatic
  - Vibration/Shock
  - NVH
- Transmission Performance Testing
- Transmission Lubrication Analysis
- Powertrain System Performance Testing
- Powertrain System Endurance Testing



## MAGELEC Motorsport &amp; Race Solutions-MGU

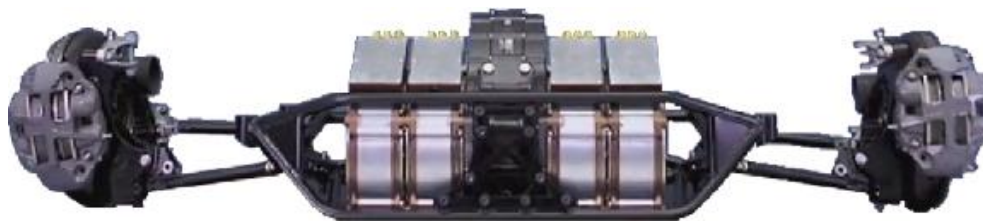
	High Voltage-Race							
	M21S5-S-20	M21S5-D-20	M21H5-S-20	M21H5-D-20	M21R5-S-20	M21R5-D-20	M21E5-S-21	M21E5-D-21
Battery Voltage [Vdc]	600 - 800	600 - 800	600 - 800	600 - 800	600 - 800	600 - 800	600 - 800	600 - 800
Peak Current [Arms]	350	350×2	350	350×2	350	350×2	394	394×2
Continue Torque [Nm]	112	224	110	220	120	240	121	242
Peak Torque (20s) [Nm]	222	444	230	460	285	570	291	582
Continuous Power (600V) [kW]	76	152	75	150	75	150	93	186
Peak Power (600V, 20s) [kW]	135	270	147	294	151	302	178	356
Rated Speed (600V) [rpm]	5,400		6,000		5,200		5,000	
Max Speed (600V) [rpm]	12,500		12,500		12,500		14,000	
Peak Efficiency [%]	≥96				≥97		≥96	
Environmental Protection Class	IP67							
Main Outer diameter [mm]	288	288	288	288	288	288	288	288
Length [mm]	111	222	112	224	112	224	119	238
Weight (dry) [kg]	23.5	47.4	23.6	47.6	23.6	47.6	25.0	50.2
Technology	Axial Flux PMSM							
Coolant	Water & Glycol							
Connecting Box	Flexible							



## MAGELEC Motorsport &amp; Race Solutions GBX&amp;MCU

## GBX

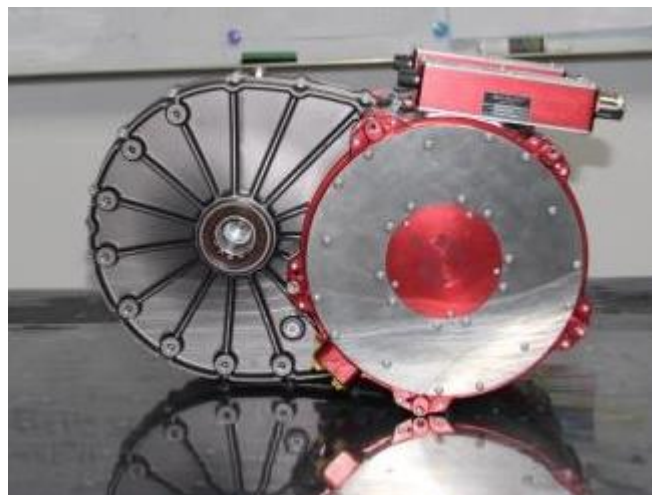
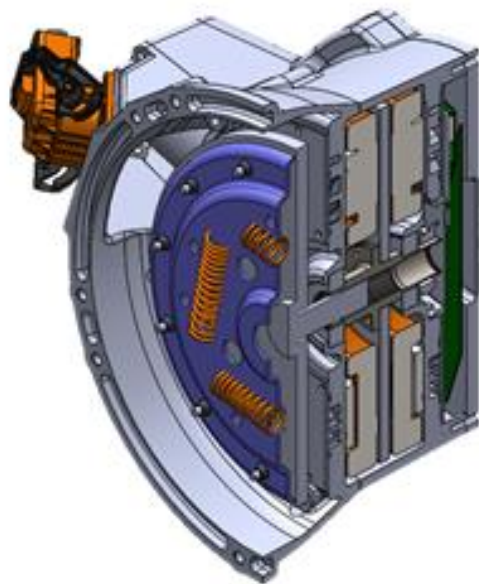
	Sport & Race	
	F06V1-Z-19-SX	F06V1-Z-20-HX
Max Input Torque [Nm]	600x2	600x2
Max Input Speed [rpm]	12,500	12,500
Center Distance [mm]	215	215
Reduction Ratio	5.67, 6.00	5.00, 5.33, 5.67, 6.00
Weight (dry) [kg]	22.5	37.6
Peak Efficiency [%]	≥98%	≥98%
Application	Vector Drive	Vector Drive
Fit with Magelec MGUs	M21x	M21x
Differential Type	NA	NA
Max Output Torque [Nm]	3,600x2	3,600x2
Gear Type	Spur	Helical
Lubrication Type	Splash (E-Pump Option)	Splash (E-Pump Option)
Park Lock (Option)	NO	NO
Output Flange (Option)	YES	YES



## MCU

Inverter Serial	N4056	
DC-Link Voltage_Nominal	VDC	750
DC-Link Voltage Range_Operating	VDC	100~900
DC-Link Voltage Limit_Non-operating	VDC	1000
Output Current_Peak_1min	Arms	400
Output Current_Continuous	Arms	250
Switching Frequency Range	kHz	15~35
Output Fundamental Frequency	Hz	0~2000
Peak Efficiency	%	>99
Dimension	mm	262x208x90
Weight	kg	5
Volume	L	4.2
Auxiliary Battery System	VDC	8-16V
CAN		CAN 2.0A/B, CAN FD
IP Rating		IP67, IP6K9K (ISO 20653)
Vibration	m/s <sup>2</sup>	27.8 (3g <sub>rms</sub> ), (ISO16750-3, 4.1.2.4, Test IV)
Mechanical Shock	m/s <sup>2</sup>	500 (50g), (ISO16750-3, Test 4.2.2)
Cooling Medium		50/50 Water Ethylene Glycol
Cooling Flow Rate	LPM	10-12
Coolant Pressure Drop	Bar	<0.3bar @12LPM, 20° C
Coolant Absolute Pressure	Bar	3
Coolant Inlet Temperature Range_Operating	° C	-40 to +75
Coolant Inlet Temperature Range_Non-operating	° C	> +75
Ambient temperature_Storage	° C	-40 to +85
Power Interface DC In	2x	Amphenol Powerlok 200 Series (+/-)
Power Interface AC Out	3x	Amphenol Powerlok 120 Series (U,V,W)
Motor/System Connector	1/1	Deutsch AS Series Connector AS010-35 and AS012-35
Water Cooling Connector	2x	Raymond QC Series 250895-0-00_1

## Powertrain System Integration



- Modular Design
  - Low - Medium Volume
  - Low Investment
  - Flexible
- Integrated Design
  - Medium - High Volume
  - Best Unit Price
  - Optimized Weight and Packaging

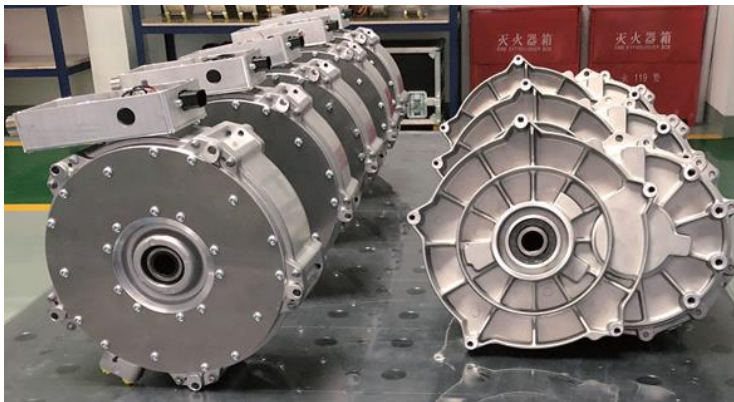




## Manufacturing

MAGELEC Propulsion Shanghai headquarters are located in Shanghai Jiading Malu, 30 minutes from Shanghai Centre

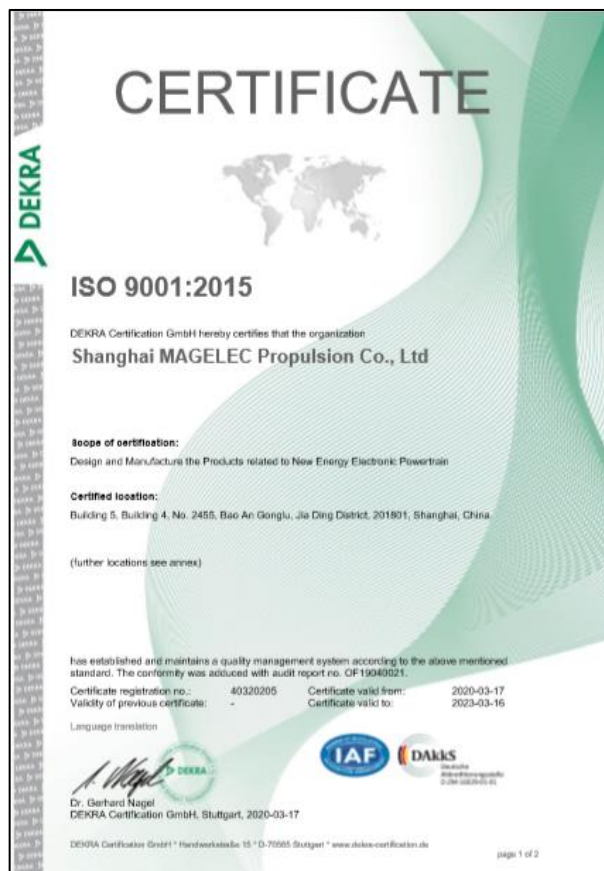
- 15,000m<sup>2</sup> Production facility on 14 acres
- Core Process Capabilities
  - Stator
    - Punching
    - Copper Forming, Insertion
    - Varnish, Curing
    - Potting
  - Rotor
    - Assembly
    - High Speed Balancing
    - Magnetizing
- MGUs Assembly Line
- MCUs Assembly Line
- Transmission Assembly Line



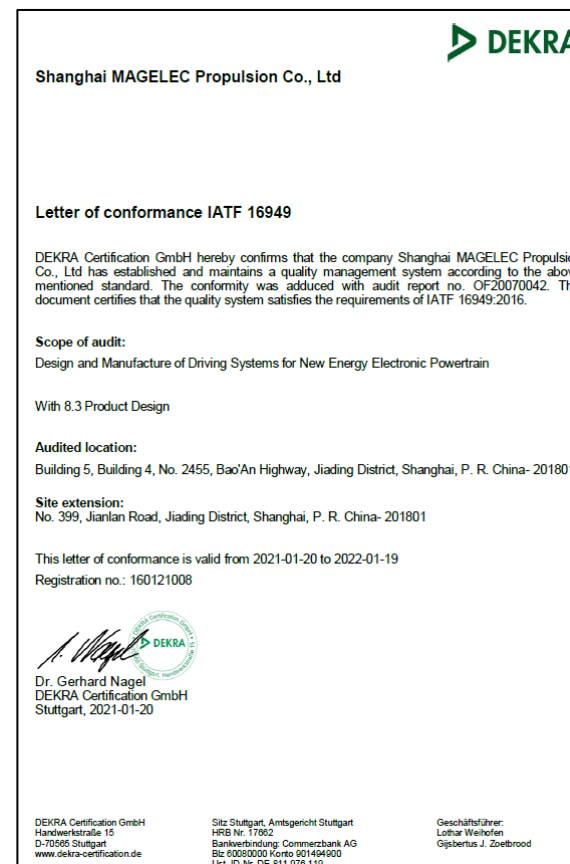
## Quality Management System

MAGELEC is dedicated to provide High Technology, Outstanding Quality and Fast Solution to exceed customer expectations in products and service for New Energy Electronic Powertrain

### ISO 9001:2015



### IATF 16949



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**MAGELEC**  
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