



aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding



Mobile Inverters and Motors

For Hydraulic Implements, Vehicle Traction, and Auxiliary Vehicle Applications



ENGINEERING YOUR SUCCESS.

Parker Hannifin

The global leader in motion and control technologies and systems

A Winning Combination

Parker has decades of experience in the development of products and systems for OEMs and users of mobile hydraulic equipment. Parker is now bringing its experience in electric motor and drive technology to the efficient control of mobile hydraulic systems.

With systems engineering and manufacturing teams in Europe, North America and Asia, Parker can provide the expertise to help its customers reduce fuel consumption, reduce noise generation and expand control functionality.

Industry-Leading Motor Design

Parker designs and manufactures permanent magnet AC motors in three global locations, not only for hydraulic system control, but also for vehicle traction and auxiliary vehicle systems, such as fans, pumps and compressors.

Designed for optimum performance at a variety of input voltages, Parker PMAC motors can be customized to maximize performance and minimize footprint.

Manufacturing to Meet Our Customers' Needs

Parker is committed to meeting the increasing service demands that our customers require to succeed in the global mobile market. Parker's manufacturing teams seek continuous improvement through the implementation of lean manufacturing methods throughout the process. We measure ourselves on meeting our customers' expectations of quality, not just our own. In order to meet these expectations, Parker continues to invest in our manufacturing facilities in Europe, the Americas and Asia.



About Parker Hannifin Corporation

With annual sales exceeding \$13 billion, Parker Hannifin is the world's leading diversified manufacturer of motion and control technologies and systems, providing precision-engineered solutions for a wide variety of mobile, industrial and aerospace markets. The company employs approximately 60,000 people in 48 countries

around the world. Parker has increased its annual dividends paid to shareholders for 56 consecutive years, among the top five longest-running dividend-increase records in the S&P 500 index. For more information, visit the company's web site at <http://www.parker.com>, or its investor information site at <http://www.phstock.com>

WARNING - USER RESPONSIBILITY

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This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

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The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance by the provisions stated in the detailed 'Offer of Sale' which is available upon request.



Mobile Applications

Electro-hydraulic actuation

Frequency-controlled ePump systems for hydraulic implement control

Parker mobile inverters and motors provide frequency control of mobile hydraulic pump systems, particularly in the control of on-vehicle hydraulic implements.

Typical vehicle systems include:

- **Construction machinery**
- **Aerial lift trucks**
- **Truck-mounted cranes**
- **Intermodal handling equipment**
- **Mining equipment**

Through the combination of electric motor-inverter systems with hydraulic pumps, in addition to an onboard battery system, the user is able to achieve significant fuels savings, the ability to operate equipment with the internal combustion engine off and the ability to use the kinematics of the hydraulic implements to recharge the battery system. For more detailed system information, refer to Page 5.



Electric and hybrid-electric vehicle traction

Permanent magnet motors and inverters for drivetrain applications

In vehicle systems, power density is a key design factor. The torque density and speed capabilities of Parker permanent magnet AC (PMAC) motors, combined with voltage-matched inverters, provide the speed and torque required to achieve breakthrough performance in a variety of vehicle platforms:

- **Class 8 trucks**
- **Motorcycles and scooters**
- **Small transport vehicles**
- **Watercraft**
- **Personal recreational vehicles**

With design teams on multiple continents, Parker has the expertise to provide the optimal motor for the power supplied.

Where overall size and weight are not significant design factors, Parker can also provide high efficiency AC induction motors in combination with our inverter systems.

For more detailed system information, refer to Page 4.



Vehicle auxiliary systems

Motors and inverters for onboard pumps, fans, compressors

In addition to vehicle propulsion, there are numerous systems that are traditionally reliant on the internal combustion engine for power, such as:

- **Power steering**
- **Compressors for climate control**
- **Air compressors for braking**
- **Cooling fans**

By decoupling these systems from the

engine, and implementing battery-fed electric motor systems, the vehicle operator can achieve efficiency improvements in the engine, or be able to reduce the size of the engine.

Parker can assist with the development of motor-inverter systems to operate auxiliary vehicle systems across of range of battery voltages and control systems.



System Examples

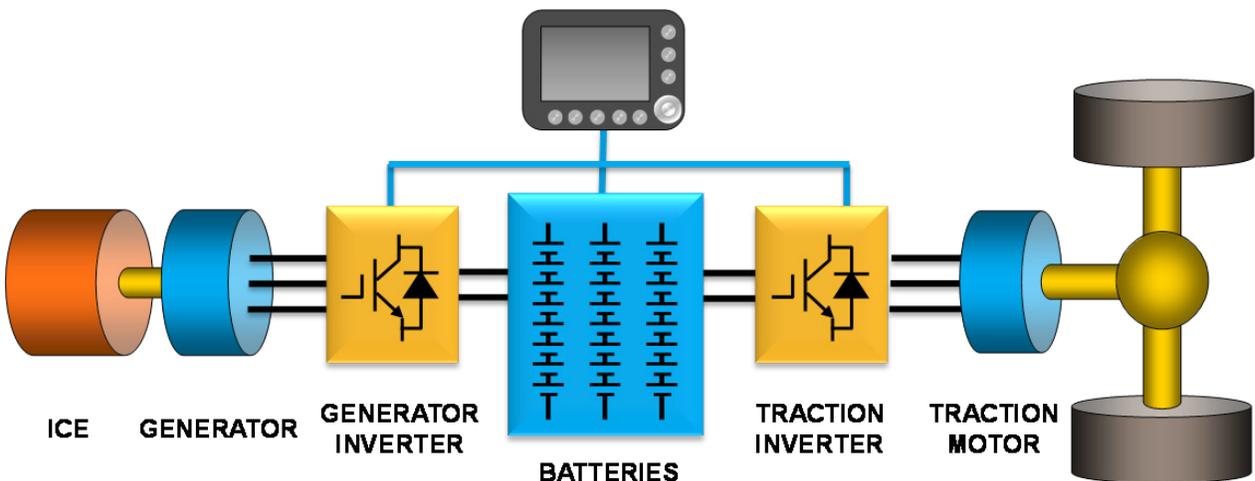
Drivetrain/Traction

Description

Parker offers complete solutions or sub-systems for a wide range of drivetrain and traction applications. High performance IGBT-based inverters provide maximum versatility, offering compatibility with PMAC or induction motor designs. Parker's inverter-motor combinations are pre-engineered for the highest efficiency and performance, minimizing losses both during motoring and power regeneration, and providing maximum vehicle range. Whether applied to series- or parallel-hybrid, or all-electric designs, you can rest assured that Parker has a reliable solution

Drivetrain/Traction Benefits:

- **Optimized system design with PMAC or AC induction motors**
- **Improved speed performance through flexible motor control: Resolver, encoder, sensorless**
- **Integration into vehicle control system via CAN communications**
- **Maximum performance and power density through flexible liquid and air cooling**



This illustration shows a typical series-hybrid traction system. The internal combustion engine (ICE), which may be a traditional gasoline or diesel design, or a gas turbine, drives the Parker PMAC generator, which produces alternating current. The generator output is then converted to DC, used to keep the batteries charged. The battery bank can allow operation with the ICE offline, and also absorbs regenerative energy during braking. A Parker battery management system coordinates charging and discharging while monitoring crucial battery parameters. The traction inverter produces variable frequency alternating current which is used to power the traction motor, which in turn drives the wheels of the vehicle. The system is coordinated by a central controller over Parker IQAN or other means of communication.

System Examples

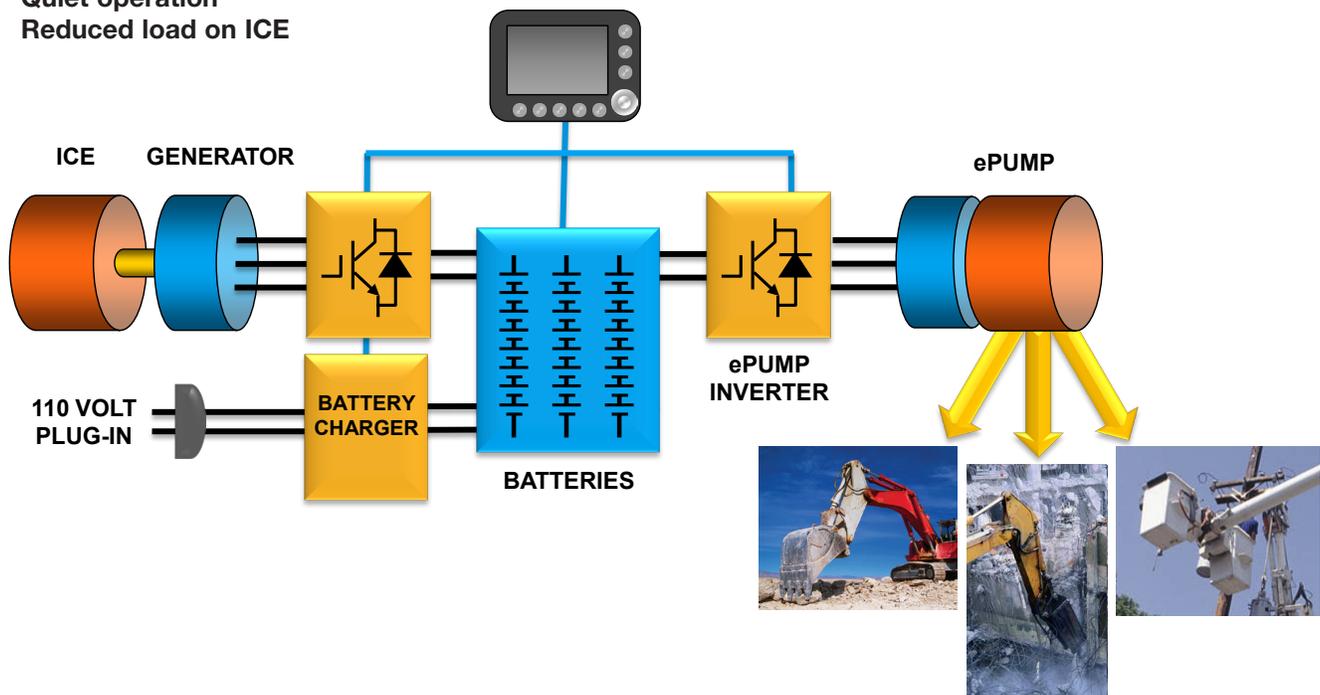
ePump/Electro-Hydraulic Actuator (EHA)

Description

The combination of Parker's experience and expertise in hydraulics with high efficiency electric motors and inverters results in a comprehensive offering of "ePump" systems: hydraulic pumps driven by speed-controlled electric motors. Especially suited to utility trucks and commercial vehicles, the ePump allows implements to be driven electrically, reducing load on the vehicle's main engine. In cases where the vehicle is stationary during operation, idling can be eliminated, resulting in reduced fuel consumption and emissions. Vehicles using implements while in motion can benefit from less load on the engine possibly allowing a smaller, more efficient engine to be used.

ePump Benefits:

- **Fuel savings from reduced idling**
- **Reduced emissions**
- **Quiet operation**
- **Reduced load on ICE**



This illustration shows a typical ePump system that is used to power a hydraulic implement. The AC motor driving the pump is powered by the battery bank through an efficient Parker mobile inverter. In this particular system, the batteries may be charged from line voltage while the truck is out of service, or by running a small combustion engine or turbine if plug-in access is not available. The advantages of the ePump based system include fuel savings and reduced emissions, as an oversized combustion engine does not need to run continuously while the hydraulics are in use. When used in new applications, since the combustion engine is not relied upon to power the hydraulics, a smaller and more fuel efficient engine can be used. For a retrofit application, periods of engine idling can be reduced or even eliminated, reducing fuel consumption.

MC Series

Low Voltage Mobile Inverters

Description

The Parker MC Series Mobile Inverter range provides high performance and functionality in a compact package for mobile motor control applications from 24 to 80 VDC. Compatible with multiple asynchronous motor manufacturers, the MC series settings can be optimized with supplied configuration software. Each inverter provides system control capabilities, such as analog and digital inputs and outputs, contactor coil drivers and proportional valve drivers.

Product Capabilities

- **Advanced field oriented vector control**
- **Auto-configuration of typical induction motors**
- **High efficiency cold plate heat sink design**
- **IP 65 protection class**
- **Motor temperature sensor input**
- **Encoder supply output (5V)**
- **AB encoder input**
- **Dual, configurable throttle inputs**
- **Configurable CAN communication**
- **Parker IQAN compatible**
- **Ability to control vehicle control tasks separate from motor control**
- **5 configurable coil drive outputs**
- **2 configurable digital outputs**
- **2 analog inputs**
- **6 digital inputs**
- **Powerful MC configuration utility for system design and diagnostics**

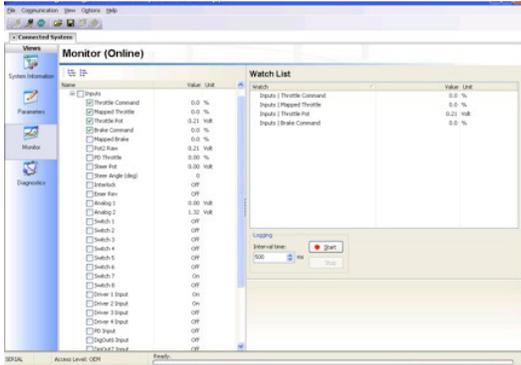


Model	MC-C	MC-D	MC-E	MC-F
Nominal Voltage	24 VDC	24/48 VDC	36/48/80 VDC	36/48/80 VDC
Max 2 minute Current	250 Arms	350 Arms	450/350 Arms	650/650 Arms
Max 2 minute Power	7.1 kVA	19.6 kVA	33.2 kVA	61.7 kVA
Switching Freq (Induction)	2.0 - 4.0 kHz			
Weight	3.8 lbs/1.7 kg	6.3 lbs/2.8 kg	9.1 lbs/4.1 kg	15 lbs/6.8 kg
Operating Temperature	-40°C to 50°C			
Storage Temperature	-40°C to 95°C			
Protection	IP65			
Control Type	Induction (consult factory for PMAC)			
Feedback	Quadrature encoder			
Communication Protocol	CANopen, serial			
Cooling Options	Air cooled			
Certifications	UL recognized component per UL583, EMC: designed to EN12895, Safety: designed to EN1175, CE marked to EN61800-5-1 (Safety, Low Voltage Directive) - MC-E and MC-F only.			

MC Series

Accessories and Dimensions

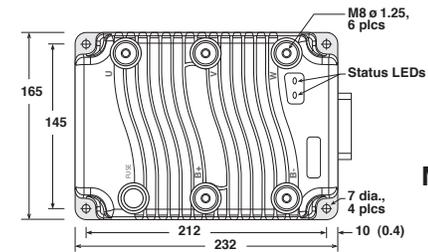
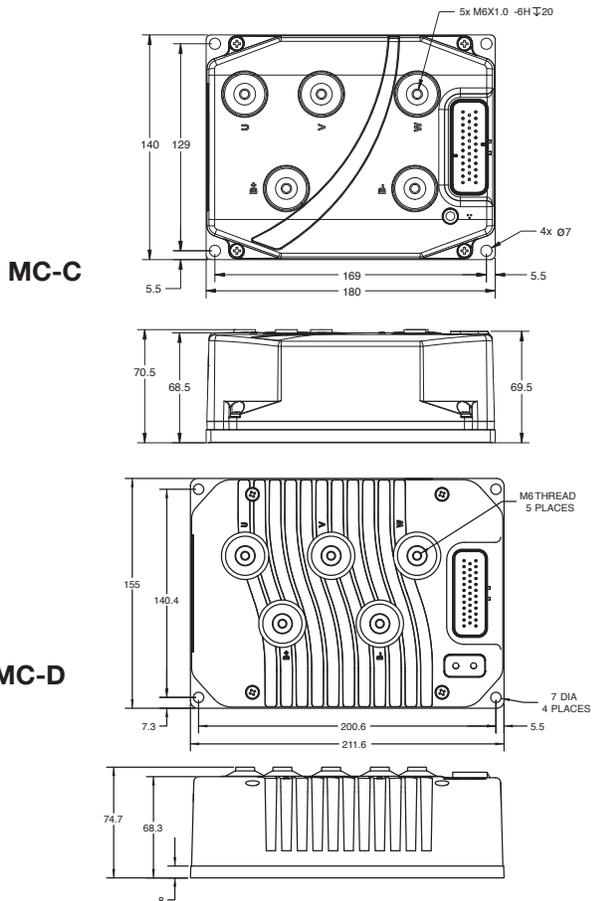
Please consult your Parker representative for information on additional accessories required for the integration of MC Series inverters into vehicle systems. Accessories include contactors, feedback devices and connection cables, and mounting hardware.



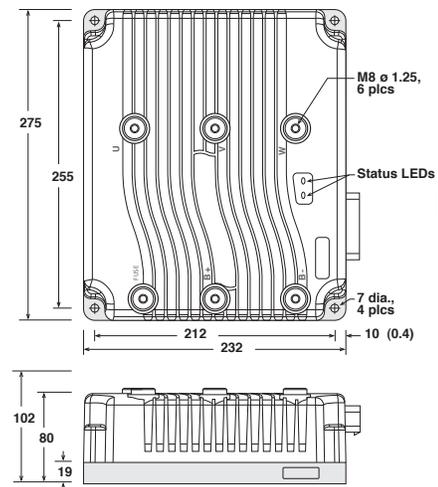
MC Configuration Manager

- PC-based programming
- System monitoring
- System diagnostics
- Adjust system variables and programmable parameters
- Online or offline use
- Windows XP™/Vista™/Windows 7™ compatible
- Includes USB adaptor

Dimensions (mm)



MC-E



MC-F

MA3 Series

High Voltage Mobile Inverters

Parker's MA3 Series inverter combines high performance motor control with intelligent control functionality. Suitable for either PMAC or AC induction motors, it also offers the flexibility of several feedback options. Speed and torque points can be adjusted instantaneously and performance algorithms optimized to the vehicle's needs. On-board digital communications with multiple protocols come standard, along with a USB programming port. The rugged cast aluminum housing integrates a proprietary cooling configuration and necessary environmental protection for the toughest mobile applications.

Product Features:

- **Environmentally sealed cast housing**
- **Regenerative braking**
- **Electronically controlled sinusoidal commutation**
- **Full programmability**
- **Compatible with choice of feedback devices**
- **4 analog and 6 digital inputs/outputs**
- **CAN communications**
- **Mini USB programming port**
- **Beaded hose barb coolant connections**



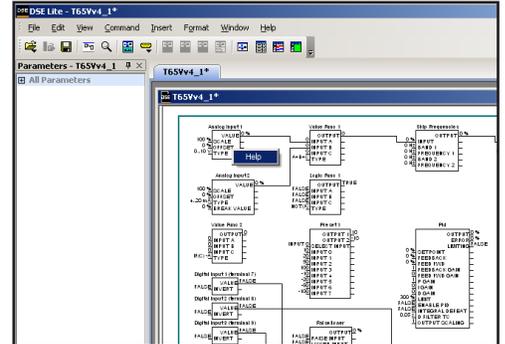
Description	MA3-40			MA3-60			MA3-80		
	225 Arms	325 Arms	400 Arms	225 Arms	325 Arms	400 Arms	225 Arms	325 Arms	400 Arms
Voltage Operating Range	205 - 400 VDC			310 - 600 VDC			410 - 800 VDC		
Nominal Voltage	320 VDC			480 VDC			640 VDC		
Peak Current Output	225 Arms	325 Arms	400 Arms	225 Arms	325 Arms	400 Arms	225 Arms	325 Arms	400 Arms
Continuous Current Output	130 Arms	185 Arms	225 Arms	130 Arms	185 Arms	225 Arms	130 Arms	185 Arms	225 Arms
Peak Power	93.5 kW	135 kW	160 kW	155 kW	225 kW	270 kW	187 kW	270 kW	325 kW
Continuous Power	54 kW	77 kW	93.5 kW	90 kW	128 kW	156 kW	108 kW	154 kW	187 kW
Switching Freq (PMAC)	4.0 kHz			4.0 kHz			4.0 kHz		
Switching Freq (Induction)	2.0 - 4.0 kHz			2.0 - 4.0 kHz			2.0 - 4.0 kHz		
Efficiency	97%			97%			97%		
Control Voltage Range	7 to 32 VDC			7 to 32 VDC			7 to 32 VDC		
Max Control Current @ 7 V	8 ADC			8 ADC			8 ADC		
Min Control Current @ 32 V	0.7 ADC			0.7 ADC			0.7 ADC		
Max Inrush Current	18.9 ADC			18.9 ADC			18.9 ADC		
Weight	35 lbs/15.9 kg			35 lbs/15.9 kg			35 lbs/15.9 kg		
Operating Temperature	-40°C to 55°C			-40°C to 55°C			-40°C to 55°C		
Storage Temperature	-40°C to 85°C			-40°C to 85°C			-40°C to 85°C		
Protection	IP65			IP65			IP65		
Control Type	Speed/Torque			Speed/Torque			Speed/Torque		
Feedback	Resolver			Resolver			Resolver		
Communication Protocol	CANopen			CANopen			CANopen		
Cooling Options	Water/Glycol or Hydraulic Oil (Alternate cooling configurations are available. Please contact us with special requirements.)								
Flow Rate max (min)	2 gpm/7.6 lpm (1 gpm/3.8 lpm)			2 gpm/7.6 lpm (1 gpm/3.8 lpm)			2 gpm/7.6 lpm (1 gpm/3.8 lpm)		
Max Pressure	30 psi/2.07 bar			30 psi/2.07 bar			30 psi/2.07 bar		
Max Inlet Temperature	55°C			55°C			55°C		
Certifications	CE and UL pending (Consult factory)								

MA3 Series

Accessories and Dimensions

DSE Lite Software

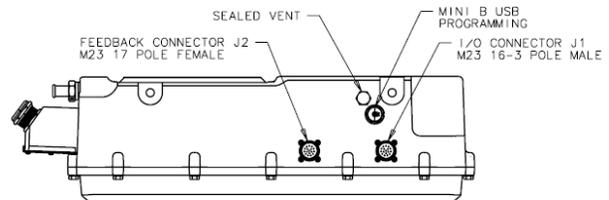
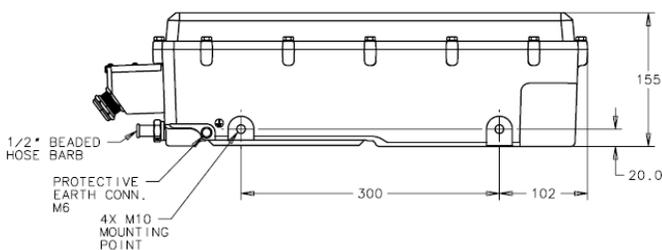
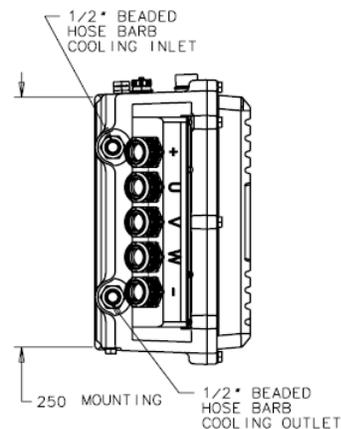
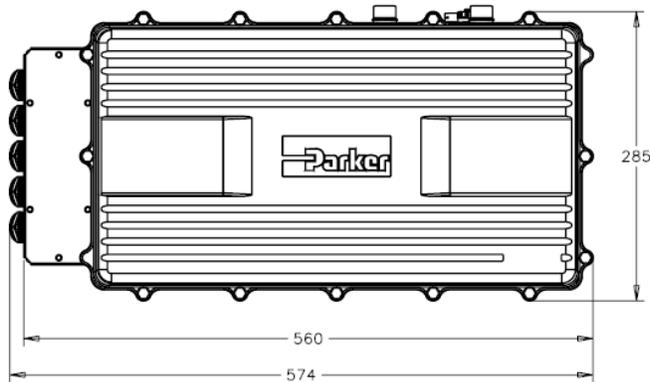
For inverter setup and tuning, DSE Lite is an easy-to-use software tool with straightforward function block programming and an intuitive user interface. In addition to supporting user-defined configurations, it offers real-time monitoring and performance charting. An online help function is available for the various drive function blocks. DSE Lite is compatible with Windows XP™ and Windows Vista™ operating systems. DSE Lite is available for download free of charge from www.parker.com/ssdusa



Cables - Resolver Feedback

Assembly P/N	Description
175-00726-03	0.92 m (3 ft) cable
175-00726-05	1.52 m (5 ft) cable
175-00726-10	3.05 m (10 ft) cable
175-00726-15	4.57 m (15 ft) cable
175-00726-25	7.62 m (25 ft) cable

Dimensions (mm)



Motors and Generators

Permanent Magnet (PMAC)

Exceptional Performance

Parker's range of PMAC motors and generators have been designed to meet the challenging requirements of vehicle duty performance. The design has focused on reducing magnetic material content, optimizing stator lamination design, and a cooling configuration that yields a compact motor with very high output power.

- Specific Power (peak) >14 kW/L
- Specific Power (cont) >10 kW/L
- Power Density (peak) >3.9 kW/kg
- Power Density (cont) >2.6 kW/kg

Parker's vehicle motors include patent-pending cooling, constant torque/constant power regions, low-cost electrical connections, and full environmental protection.

Specifications

Motor Dimensions	Units	Value
Length	mm	200/250/300/350/550
Diameter	mm	142/210/310/470
Shaft	mm	Spline
System Performance	Units	Value
Peak Power	kW	13 - 400
Rated Power	kW	9 - 250
Peak Torque	Nm	22 - 1400
Rated Torque	Nm	15 - 980
Peak Efficiency	%	96
Maximum Speed	RPM	8000
Base Speed	RPM	2000 - 4000
Input Voltage	VDC	24 - 750
Maximum Current	Amps, rms	up to 1250
Cooling	Units	Value
Type	N/A	Internal
Coolant	N/A	Water or Oil
Inlet Temperature	Degrees Celsius	50° - 70°
Pressure	mm Hg	51 - 510



Custom Solutions

Parker's family of PMAC motors and generators shares breakthrough magnetic and thermal designs, but can easily be customized to fit the mechanical constraints of our customers' vehicle programs. With no minimum volume requirement, Parker can assist in the development of both prototype and serial production motors and generators.

Customization Specialists

As a designer and manufacturer of PMAC motors and generators, Parker is well positioned to quickly and cost effectively design and produce custom solutions to our customers' specifications, including mechanical solutions, such as connectors, shafts, mounting and motor kits. Additionally, Parker can customize motor magnetic designs and cooling systems to produce desired performance under specific conditions, such as voltage, duty cycle, ambient temperature or operating environment.



Motors and Generators

Permanent Magnet (PMAC)

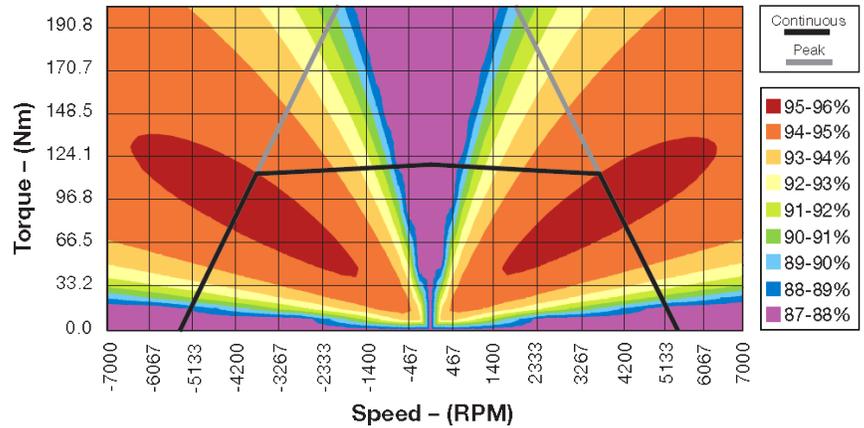
Highest Efficiency

The right selection and design of the best component technology with the optimal performance characteristics ensures that PMAC motors and generators will perform at very high efficiencies.

Parker's PMAC stators and rotors have been very carefully designed to minimize losses over a large operational region.

Not only does this utilize each battery charge more effectively, but it also increases reliability by limiting thermal buildup and cycling that can lead to material fatigue and failure. Together, this provides the lowest total cost of ownership.

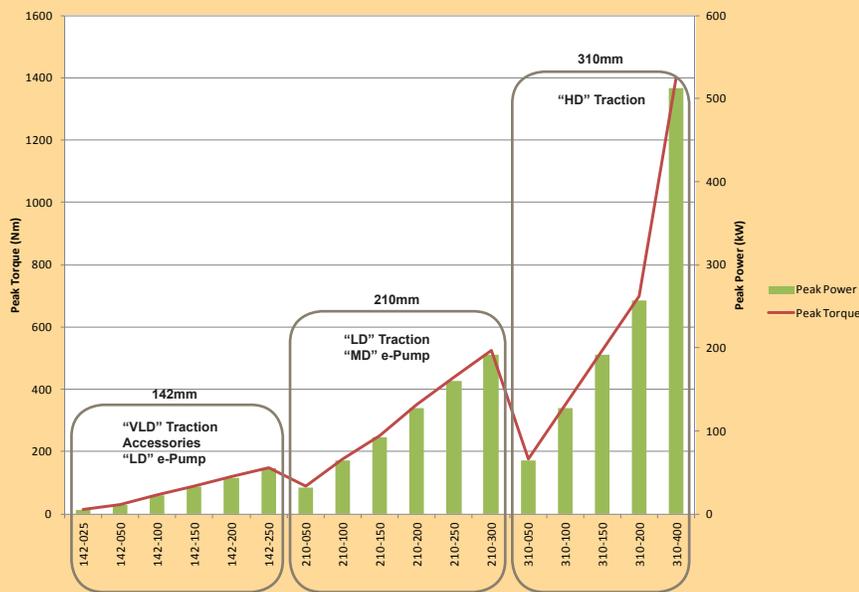
Sample Efficiency Map - 270mm Frame



Broad Scalability

From electric power steering motors the largest electric traction motors, the same cutting edge design ensures predictable performance and reliability

Peak Power and Peak Torque @ 3500 RPM



- Three diameters: 142mm, 210mm and 310mm
- Extrusion-based housing, internal rotor and stator construction, patent-pending cooling configuration create a motor package with unmatched flexibility to scale torque/power levels up or down as application requirements shift.
- 12 standard sizes. Custom lengths made with 95% production parts.
- Voltage from 24VDC to 750VDC
- Flexible base speed
- 8000 RPM max speed
- Peak power to 300kW+

Asynchronous Motors

Asynchronous induction motors designed for mobile application are available as part of a complete Parker mobile inverter system.

Asynchronous motors are available for inverter systems from 24 VDC to 650 VDC and are delivered with a pre-configured and tested Parker mobile inverter.

Please consult your Parker representative to discuss your specific application requirements.



Battery Management Systems

Hybrid vehicle systems require substantial energy storage facilities, and Parker can assist with battery system design, including:

- Local battery management modules
- Real-time battery status communications to supervisory system
- Charging and cell-to-cell balancing
- Loading and temperature management
- System packaging

We work with multiple battery chemistries, including traditional lead-acid and advanced lithium-ion technologies.



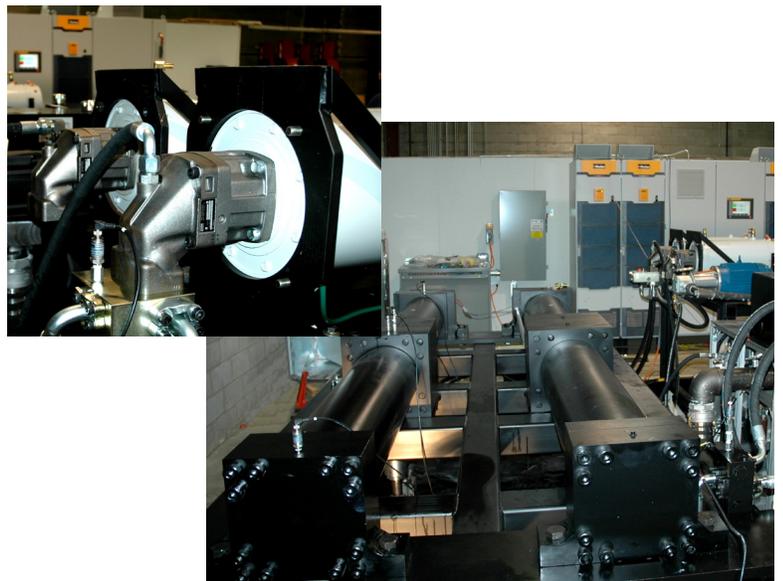
Testing Capabilities

In addition to comprehensive motor design and manufacturing capabilities, Parker can provide motor performance testing at our motor testing facilities in the U.S. and Europe. Parker motor testing facilities utilize programmable, Parker-designed and manufactured power conversion systems to simulate real-world motor conditions up to 350 kW continuous power. Additionally, Parker can couple motor-inverter combinations to hydraulic test rigs to simulate the response of different combinations of hydraulic components.

Typical testing outcomes include:

- Motor continuous and peak torque validation
- Drive cycle simulation and power usage
- Drive cycle efficiency data
- Quantification of time at peak torque

Please consult your Parker representative for more information.



EHP System ePump Kits

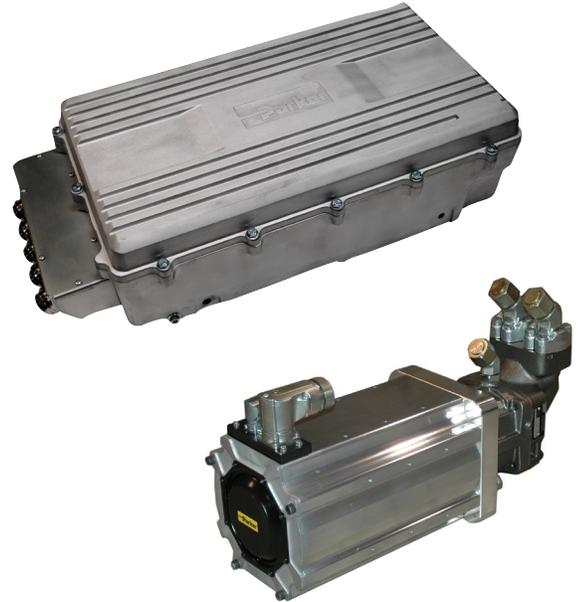
Mobile Inverters • PMAC Motors • Hydraulic Pump

Subsystem Capabilities

Mobile OEMs face tremendous demands to provide machines that cost less to operate and that will meet future regulatory standards. To reduce the time to meet these demands, Parker offers pre-engineered and customizable ePump kits to assist in the development of hybrid-electric vehicle platforms. An ePump kit includes:

- Low or high voltage inverter, depending on battery system and performance requirements
- Matched AC induction or Permanent Magnet AC motor
- Motor-pump mounting
- Mobile hydraulic pump: fixed displacement (vane or gear style) or variable displacement (bent-axis piston style)

To understand the performance capabilities of each unique kit, we have developed a complete ePump test facility that can measure the hydraulic output of an ePump with a given electrical input. In addition, we can customize our test stand variables (temperature, duty cycle, on-board power availability) to develop a unique ePump kit for your application.



Flexible Solutions

- **5 pre-engineered high voltage ePump kits are available to meet your application needs**
- **Induction and PMAC motor flexibility, along with multiple hydraulic pump options creates unique performance capabilities**
- **Direct coupled pumps for ease of implementation**
- **High and low voltage mobile inverter options across multiple power ranges**
- **Optional plug & play CAN interface available with Parker IQAN controllers**

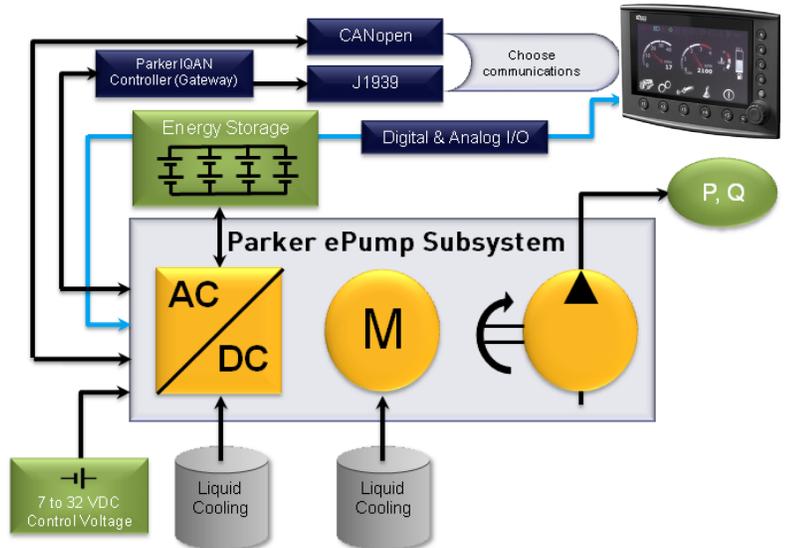
Description	Kit Options				
	1	2	3	4	5
Pump type	Vane	Bent Axis	Piston	Bent Axis	Bent Axis
Maximum flow	320 l/min	111 l/min	155 l/min	203 l/min	145 l/min
Continuous operation ¹					
RMS pressure	29 bar	80 bar	104 bar	141 bar	200 bar
RMS power	13 kW	15 kW	23 kW	48 kW	48 kW
RMS bus current	24 Amps DC	30 Amps DC	50 Amps DC	105 Amps DC	94 Amps DC
Peak operation ²					
Pressure	50 bar	190 bar	350 bar	275 bar	420 bar
Power	27 kW	35 kW	90 kW	93 kW	101 kW
Bus current	60 Amps DC	67 Amps DC	130 Amps DC	190 Amps DC	186 Amps DC
Rated performance fluid temperature range	10°C - 50°C	10°C - 50°C	10°C - 50°C	10°C - 50°C	10°C - 50°C
Operating fluid temperature range	-40°C - 80°C	-40°C - 70°C	0°C - 70°C	-40°C - 80°C	-40°C - 70°C
Filtration	ISO 18/14	ISO 20/18/13	ISO 16/13	ISO 20/18/13	ISO 20/18/13
NOTES					
(1) RMS pressure and power at 650 VDC and water/glycol cooling.					
(2) Operation for 60 seconds. RMS duty cycle not to exceed continuous operation.					

ePump Kits

Mobile Inverters • PMAC/Induction Motors • Hydraulic Pump

Control and Communication

- Control, operation performance and health monitoring of the ePump Kit subsystem is accomplished through analog, discrete, and CANopen digital formats
- SAE J1939 protocol compatibility is available by using a Parker IQAN controller as a gateway
- For variable speed fixed displacement pump configuration, optimized and responsive pressure/flow can be achieved by using motor current and motor speed feedback
- The inverter is capable of real-time speed torque commands enabling all traditional pump PQ control architectures



IQAN - ECD Controllers

The highly intelligent IQAN system is an electronic approach to controlling and monitoring hydraulic systems on mobile machines. Parker IQAN master communication modules can be used as a standalone controller, a single bus master, or with other IQAN master modules. The IQAN-MC3 model is designed in accordance with IEC 61508, and can be used to implement safety functions of up to SIL2. There are two CAN interfaces for bus Communication using IQAN CAN Protocol (ICP) and SAE J1939 or Generic CANopen.

- **Rugged Design**
- **32-Bit Technology**
- **TFT color display modules available**
- **User Friendly - No programming experience needed**
- **Software based development**
- **Functions can be easily modified in the field**
- **Safety functionality**
- **Global support**



Description	IQAN Master Modules					IQAN Expansion Modules					
	MDL2	MD3	MC2	TOC2	MC3	XA2	XS2	XT2	LC5-C01	LM	XC10
Can Interfaces	4	3	2	-	4	1	1	2	1	1	1
Proportional Outputs	2	-	8	2	4	6	-	5	-	-	4
Digital Outputs	6	1	(8)	-	5	(12)	12	(6)	1	(1)	(20)
Voltage/Digital Inputs	8/(12)	7/(7)	5/(5)	2/2	16/8	8/(12)	8/(20)	10/(10)	8/(13)	2/(6)	10/(26)
Frequency Inputs	(1)		(5)		8	(1)		(3)	-	-	4
USB Ports	1	1	1	-	-	-	-	-	-	-	-
RS-232 Ports	2	1	-	1	-	-	-	-	-	-	-



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