Rotrex™ E-charger

Technical Datasheet

Product:	EC-8/15/30/38
Version:	1.5
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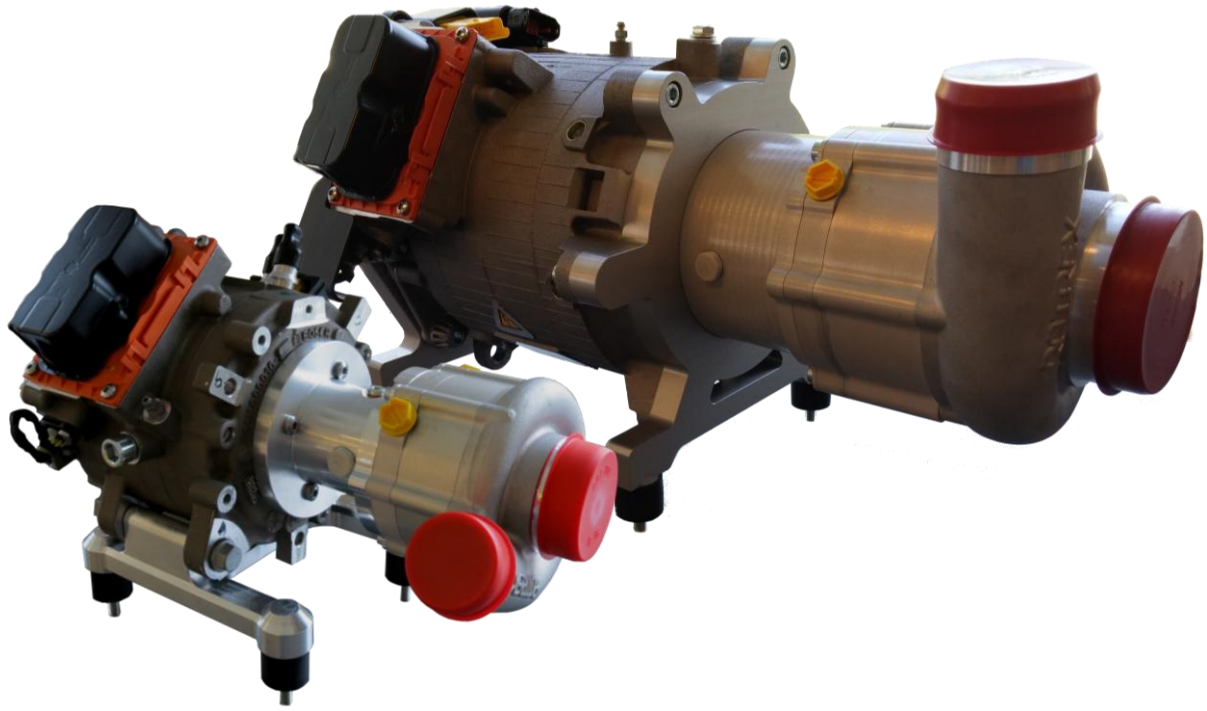


Prototype Status v1.5 (June 2015) updates and changes:

- **NEW** IP67/IP69 mobile inverter available in the 60A range (~40kW @ 560VDC), with bigger power ranges to be expected later. This new mobile inverter most importantly features native CAN communication (including SAE J1939) as well as the widest DC input voltage range on the market.

- **NEW** EC30-B180 and EC38-B180 series E-chargers launched! The EC-30/38-B180 series, that bring Rotrex' two biggest compressor ranges into the high-power operating regime, with electrical compressor power of up to 60kW.

General description of the E-charger compressor system

Due to recent successes with an electrification of the Rotrex Supercharger portfolio, Rotrex is now able to offer complete E-Charger compressor systems for various industrial, process engineering, educational, automotive, mobile and green energy applications. The E-Charger is equally well suited for permanently installed industrial applications, research and development on mobile solutions in laboratory environments, as well as mobile and automotive applications in the field.

Typical applications for the automotive/mobile system are: Air pumps for fuel cells (10kW - 1MW output), pre-boosters for downsized turbocharged engines, forced exhaust gas recirculation, particle filter regeneration systems etc.

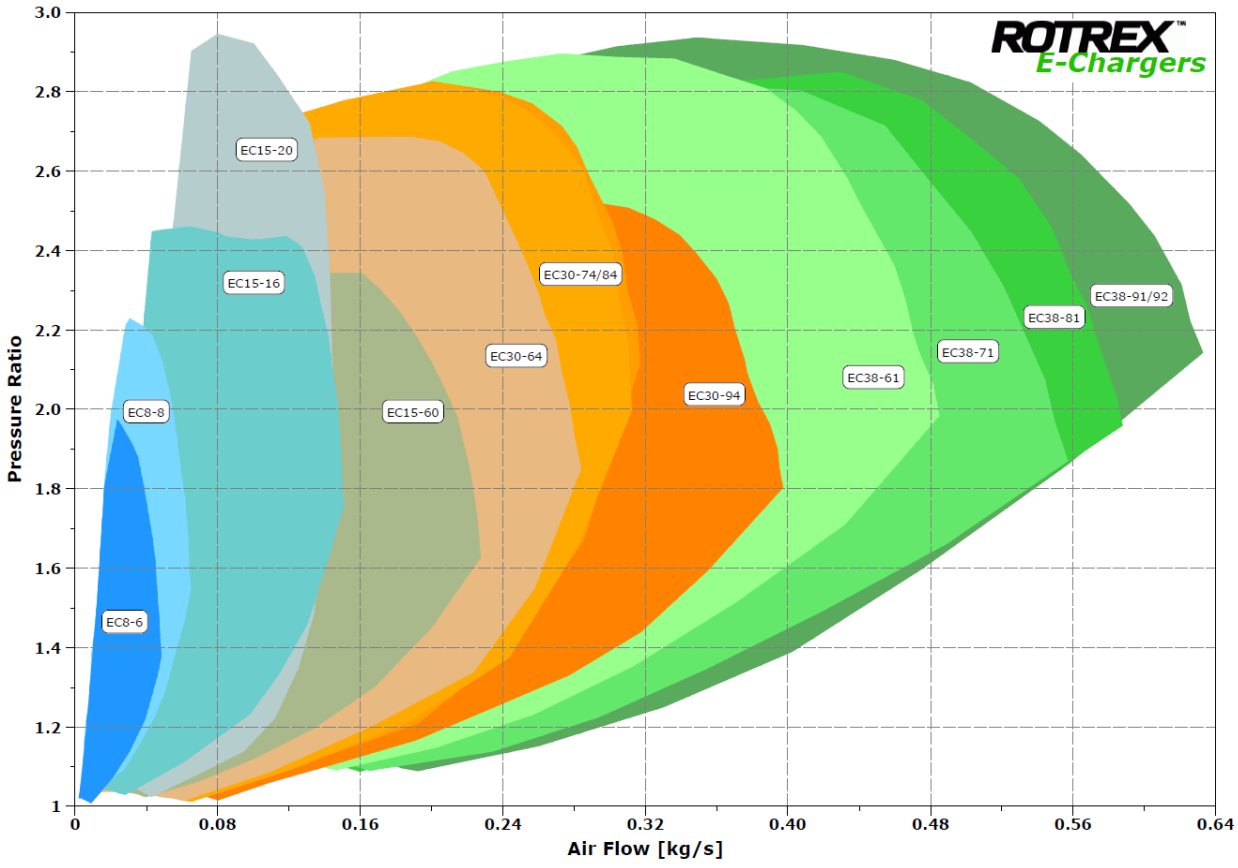
The E-charger prototype is available in two distinct physical packages, based on either the type "B-138" electric motor (approximately 20kW power output) and the type "B-180" electric motor (with approximately 60kW power output).

The Rotrex E-charger compressors are based on Rotrex traction drive technology, and comes in four different sizes . These are the C8, C15, C30 and C38. Each of these traction drive sizes are available with typically 2-4 different centrifugal compressor setups, known as sub-trims. With a total of four different traction drive sizes and no less than 12 different standard sub-trims, a sub-trim can be found to match nearly any aerodynamic operating point, resulting in the highest possible compressor efficiency for each application.

E-chargers based on the Type-B138 electric motor are available in the entire C8, C15, C30 and C38 range, while only the C30 and C38 variants are available with the Type-B180 electric motor. For applications requiring very high mass flow at low compression ratios, which cannot be obtained with the EC8 and EC15 E-chargers, a combination of Type B138 motors and oversized C30 and C38 compressors can be excellent solutions.

A compressor datasheet on each traction drive size, including compressor map for each sub-trim, is available for download at www.rotrex.com (under technology/technical data). Customized aerodynamic setups can also be developed.

The compressors themselves feature an integrated dual-action oil pump, that works as a dry sump scavenging pump in addition to being the oil supply pump. A small oil filter and oil canister is mounted externally by the system designer, along with an oil cooler. An oil radiator (cooled by fan air) or optionally a water cooled oil cooler (liquid-liquid heat-exchanger) is required for keeping the oil temperature within the allowable range. Please read the technical handbook for important installation details!



(The Rotrex E-charger range now covers an immense span of air flows with the introduction of the EC30 and EC38)

The Rotrex C-type compressor has been developed and extensively tested with the special Rotrex traction fluid. To maintain performance and durability it is very important that the unit is run exclusively with the special Rotrex traction fluid. Full attention must be paid to ensure that the oil inlet temperature to the compressor is never exceeded (maximum 80°C oil in temperature).

The high speed permanent magnet synchronous motors (PMSM) in the E-chargers are joined to the compressor head units through a high speed direct drive coupling system. The result is a small, fully enclosed, compact and rugged E-charger unit, with an IP67 ingress protection classification and no exposed snagging or rotating mechanical parts to look out for. Mechanical vibrations are nearly absent due to the direct-drive connection, the lack of toothed gears and the extreme speeds of the centrifugal compressors. The E-charger is supplied with rubber shock dampeners to protect the E-charger from external shocks and vibrations.

The NEW RPCS730 automotive rated mobile inverter

Rotrex also proudly presets a brand new RPCS 730, IP67/IP69 automotive rated mobile inverter from REFU-drive. Notable features of the RPCS 730 are the native CAN SAE J1939 communication along with the widest DC input voltage range on the market: 150 - 800 VDC (with the output power still governed by the maximum output current).

The RPCS 730 is water cooled, similarly to the Type-B138 and Type-B180 electric motors. Combined with the liquid-liquid heat-exchanger oil cooling option, the entire system is completely sealed from dirt and contamination, capable at operating in extreme engine compartment environments, with no preventive maintenance required. Specifications for the RPCS 730 can be found on the last pages.

This presently available RPCS 730 is in the range of ~60A output current (~40kW @ 560VDC), and more powerful versions are currently under development.

The RPCS 730 is a brand new state-of-the-art automotive rated mobile inverter (reproduced with permission)

The Parker AC30 inverter range for "industrial" applications

The compressor characteristics of the E-chargers make them quite applicable for a wide range of stationary applications in the industrial segment where 3-phase 400-480VAC is commonly available. As the E-chargers outperform all other compressor technologies in the low pressure segment, with respect to compressor efficiency and power density, the E-charger can be used in such diverse applications as green house spraying, granulate transport, cooling, drying, waste water treatment, fuel cell backup power, UPS systems etc.

The Parker AC30 inverter
(reproduced with permission)

System limitations and conditions

With E-Charger prototype systems being offered as research and development systems, a number of limitations and conditions are associated with the use of these systems.

The system developer is solely responsible for the proper electrical wiring of the components, including the fulfillment of all local and national electrical regulations and laws. Furthermore, both the motor and the inverter must be properly grounded to Protective Earth (PE) in stationary installations. Rotrex cannot take responsibility for the electrical characteristics of customer installations. All cables and cable accessories (between the E-charger and the inverter) are delivered along with the E-charger system, but some minor manual cable assembly work is required. Assembly guides are a part of the standard information and documentation package accompanying the E-charger.

The maximum power output of the E-charger is dependent on the combination of a number of factors such as compressor size, cooling water temperature, inverter input voltage, inverter current limit and motor winding temperature. Regardless of how the system developer runs the E-charger, the maximum motor winding temperature on both motor types is 130°C. Both inverter types are fitted with a trip system, that shuts down the E-charger in the event of excessive motor winding temperatures, preventing permanent system damage. A wide range of incidents can effectively be prevented with this safety system, as the common root cause is excessive winding temperatures.

The E-charger unit is fundamentally designed to keep all internal rotating parts contained in a worst case scenario mechanical failure, but proper measures must be taken by the system developer to ensure that no human injury can occur in the unlikely event of a complete mechanical failure.

Any E-Charger system must be allowed a full 10 minutes de-energizing period after complete removal of power, before any mechanical work on the E-charger system can commence.

Deviation from the standard Rotrex oil circuit components can damage the E-charger.

Rotrex offers the E-Charger systems as laboratory type development kits for highly skilled and experienced personnel, requiring that the system developer is obliged to treat it as such. The Rotrex E-charger system and all subsystems are sold as a subsystem for integration into other products and are therefore not to be considered a finished product in themselves.

Rotrex is currently only offering limited warranty on the E-charger systems. This is a consequence of the E-charger being in continuous development, where customers are offered early access to the technology, in exchange for contributing in field trials of the system. The growing internal Rotrex database on E-charger extended endurance testing indicates a very rugged and dependable system, however it has not yet been released for production durability. In general, durability and life time depends heavily on the duty cycle of the application. Please contact Rotrex for more information on duty cycle considerations.

E-charger head units

Characteristic	EC-8 range	EC-15 range	EC-30 range	EC-38 range
Total drive ratio	1 : 12.52	1 : 12.67	1: 9.49	1 : 7.5
Unit weight (*)	≈ 16 kg		≈ 38 kg	
E-charger unit physical dimensions	350 x 250 x 280 mm		545 x 260 x 270 mm	
Motor type	Type-B138 (PMSM, sensorless)		Type-B180 (PMSM, sensorless)	
Maximum motor shaft speed	17500 RPM		12650 RPM	
Maximum impeller speed	220000 RPM	201500 RPM	120000 RPM	90000 RPM
Maximum air mass flow	0.065 kg/s	0.22 kg/s	0.39 kg/s	0.63 kg/s
Maximum pressure ratio	2.23	2.94	2.82	2.94
Maximum motor winding temp	130°C			
Motor winding temperature sensor	NTC			
Maximum cooling water temp (*)	105°C (corresponding de-rating required)			
Recommended cooling water temp	< 35°C (for true continuous maximum power)			
Maximum mechanical power (*)	>19 kW continuous (with proper cooling & >700VDC)		> 59 kW continuous (with proper cooling & >700VDC)	
Practical mechanical power (*)	≈ 15 kW continuous @ 3-phase 400VAC 50 Hz		≈ 45 kW continuous @ 3-phase 400VAC 50Hz	
Maximum continuous motor current(*)	≈ 32 A		≈ 100 A	
Enclosure rating, per design	IP67 minimum			
PMSM motor cooling method	Water/glycol 50-50% mix			
Min coolant flow rate (motor) (*)	6 l/min		8 l/min	
Compressor cooling method	Oil radiator requiring fan air or oil-water heat exchanger			
Max inlet oil temperature	+80°C (176°F)			
Rotational direction	Clockwise rotation, as seen from impeller side			

(*) Asterisk marked parameters are interpolated and not guaranteed

AC30 industrial type inverter (motor controller)

Characteristic	AC30 for EC8/15	AC30 for EC30	AC30 for EC38
Unit weight incl. motor leads (*)	≈ 11 kg	≈ 44 kg	≈ 90 kg
Drive physical dimensions	350 x 250 x 150 mm	670 x 260 x 316 mm	800 x 330 x 374 mm
Estimated efficiency	0.97	0.98	0.98
Electrical supply (AC)	3-phase 400VAC to 480VAC (+/- 10%) 45-65Hz		
Electrical supply (DC)	470 - 800 VDC directly on DC bus (requires external pre-charge circuit and fusing)		
Overvoltage category	Category III		
Commutation method	Sensorless space vector control		
E-charger control method	Closed loop speed control		
Cooling method	Forced convection air cooling with internal fans		
Enclosure rating	IP20		
Maximum continuous output current (including de-rating for high speed*)	≈ 30 A	TBD	TBD
Practical continuous output power at 400VAC/560VDC(*)	≈ 15kW	TBD	TBD
Motor winding overheat shutdown	Integrated NTC thermistor based shutdown control as standard		
Default control method	Analog, LAN (build-in application webpage)		
Optional expansion control methods	PROFIBUS DP-V1, DeviceNet, CANopen, PROFINET I/O, Ethernet IP, RS485, Modbus RTU, BACnet MSTP, BACnet/IP, CC-Link, ControlNet, EtherCat, Ethernet, analog voltage or current		

(*) Asterisk marked parameters are interpolated and not guaranteed

Conversion Toolbox
$°C = \frac{5}{9} \times (°F - 32)$ OR $°F = \frac{9}{5} \times °C + 32$
$CFM = \frac{kg}{s} \times 1731.8$ $\frac{kg}{s} = \frac{CFM}{1731.8}$ @15°C and 0.1013MPa
$\frac{kg}{s} = 0.0075 \cdot lb/min$ $lb/min = \frac{kg/s}{0.0075}$

RPCS 730-60A mobile inverter (motor controller)

Characteristic	
Unit weight incl. motor leads	≈ 13 kg
Ambient operating temperature	-40°C - 85°C
Physical dimensions	≈ 380 x 316 x 107 mm
STEP and IGES 3D model	Available upon request
Electrical supply (control board)	18-30 VDC
Electrical supply (high power bus)	150-800 VDC
Commutation method	Sensorless space vector control
E-charger control method	Closed loop speed control
Cooling method	50/50 glycol/water mix at >8 liter/min
Enclosure rating	IP67 and IP69
Vibration tolerance	5 g
Shock tolerance	20 g
Maximum continuous output current	≈ 60 A
Motor winding overheat shutdown	Integrated NTC thermistor based shutdown control as standard
Control and communication	CAN-bus (J1939, CANopen, ISObus)

(*) Asterisk marked parameters are interpolated and not guaranteed

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