

GreenMotor



GreenMotor

Features

Mega-Guard GreenMotor is a highly efficient permanent magnet motor for ship's propulsion and generator applications. GreenMotor is able to directly drive the propeller shaft in full electric or serial hybrid projects. Mega-Guard GreenMotor can also be used in combined motor and generator applications where GreenMotor is connected to a hybrid gearbox of a combustion engine or directly inline with the propeller shaft. In this parallel hybrid application Mega-Guard GreenMotor can be used as a propulsion motor (discharging the batteries) with stopped combustion engine and it is used as a generator (charging the batteries) when the combustion engine is powering the propeller.

Electric propulsion is applied in case of requirements regarding zero emission, better manoeuvrability and/or less fuel consumption for vessels with large difference in sailing profile. Silent running is another application of electric propulsion in combination with Mega-Guard GreenBatteries electric energy storage.

GreenMotor is controlled by other Mega-Guard products: GreenInverter, Propulsion Control System, Energy Management System and/or GreenGenerator. Various sizes of GreenMotor are available to suit all projects for full electric, serial hybrid or parallel hybrid propulsion.

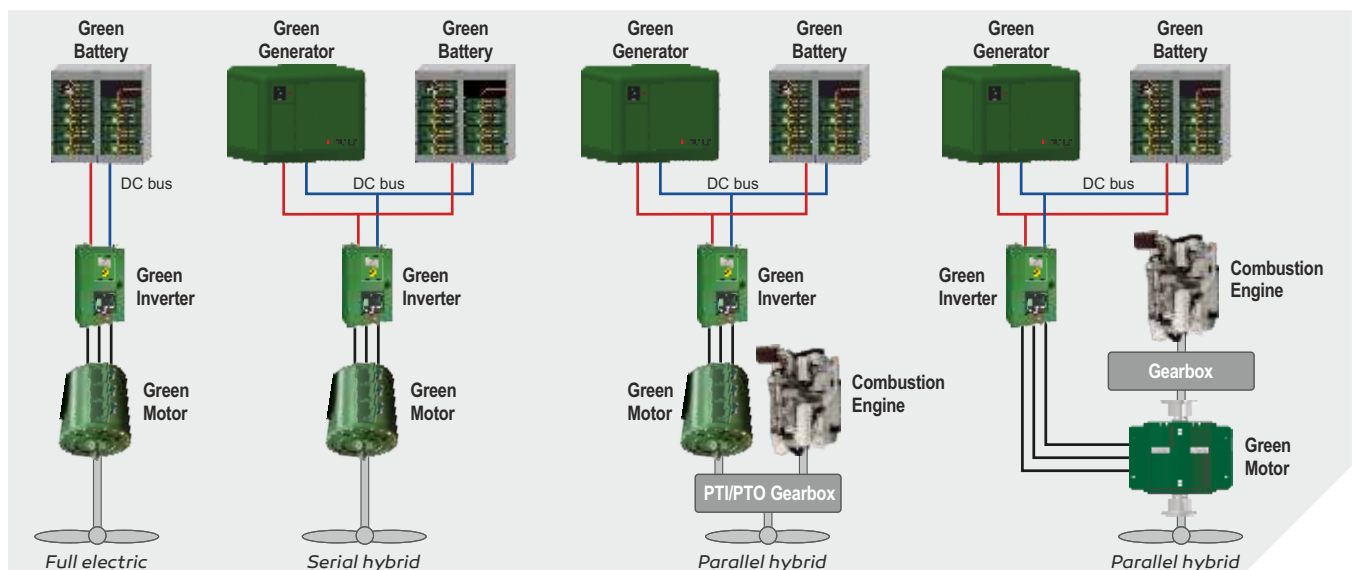


Sizes

Mega-Guard GreenMotor is available in 3 different diameters and with variable length in order to suit propulsion applications ranging from 160Nm to 25500Nm (20kW to 2890kW depending on nominal RPM).

Hollow shaft versions are available in order to support mounting of GreenMotor inline with propeller shaft.

In addition, Mega-Guard GreenMotor is available with a built-in planetary gearbox in order to suit applications with high power (up to 2400kW) and direct propeller drive at low RPM (250 - 600).



Specification

GreenMotor Specifications

Application	Marine propulsion and power generation: <ul style="list-style-type: none"> - Low speed direct propeller drive - Medium speed hybrid gearbox drive (motor and generator) - Medium speed generator - Low speed direct propeller drive with high speed motor with built-in planetary gear - Low speed hybrid direct propeller drive with hollow shaft and mounted inline between propeller and combustion engine
Type	Permanent magnet synchronous machine Torque motor/generator supporting sensor less control with nominal torque delivered in between 0 and maximum RPM
Construction	Lightweight due to efficient design and strong aluminium housing Aluminium alloy: 6082-T6 Finishing with green coating
Power ranges	Up to 1450Nm ; motor diameter 336mm and motor length up to 705mm Up to 5000Nm ; motor diameter 590mm and motor length up to 890mm Up to 25500Nm ; motor diameter 820mm and motor length up to 1411m Up to 65500Nm ; motor diameter 820mm with built-in planetary gearbox
Duty rating	Continuous
Cooling	Liquid cooled water/glycol. Maximum Inlet temperature: 40°C
Output shaft and bearings	Splined output shaft according DIN 5480 or flanged output shaft according ASTM-A 182 Drive side equipped with isolated bearing Non drive side equipped with non isolated bearing and shaft grounding Maintenance free bearings Optional: bearing temperature sensors
Mounting	Side mounting brackets with vibration dampers Front flange mounting according SAE sizing; SAE flange mounting is only available when the motor length is smaller then the motor diameter.
Connection	1 or 2 Connection Boxes mounted on rear side AC cabling: up to 240mm ² EMC cable glands IO cabling: EMC cable glands
Voltage Range	From 566VAC up to 700VAC supporting DC bus voltages from 800VDC to 1000VDC Designed for a string of 8 or 10 GreenBatteries
Windings	Single or double sets of triple windings Isolated windings: isolation test voltage > 2kV Thermal class H Each winding equipped with 2 temperature sensors Maximum winding temperature: 155°C
Heater	Optional heating element on drive side and non drive side
Testing	Maximum RPM = 110% of nominal RPM Maximum torque = 150% of nominal torque for 15 seconds Duration test at nominal power and nominal RPM on test bench
Protection	IP65
Ambient temperature	0 - 55°C
Environmental conditions	IEC60945
Class approval	LRS, DNV-GL, ABS, BV, CCS when required



GreenMotor stator assembly



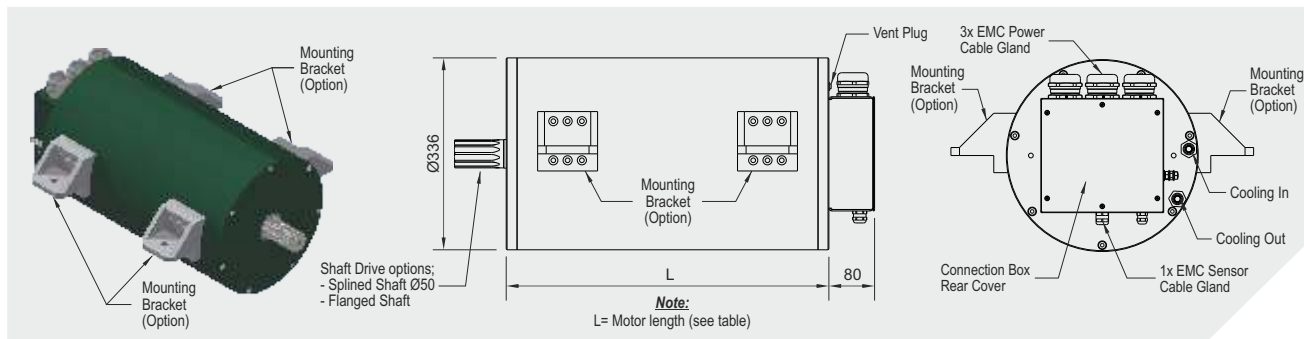
GreenMotor for generator application



GreenMotor 200kW

Electric Motor Generator

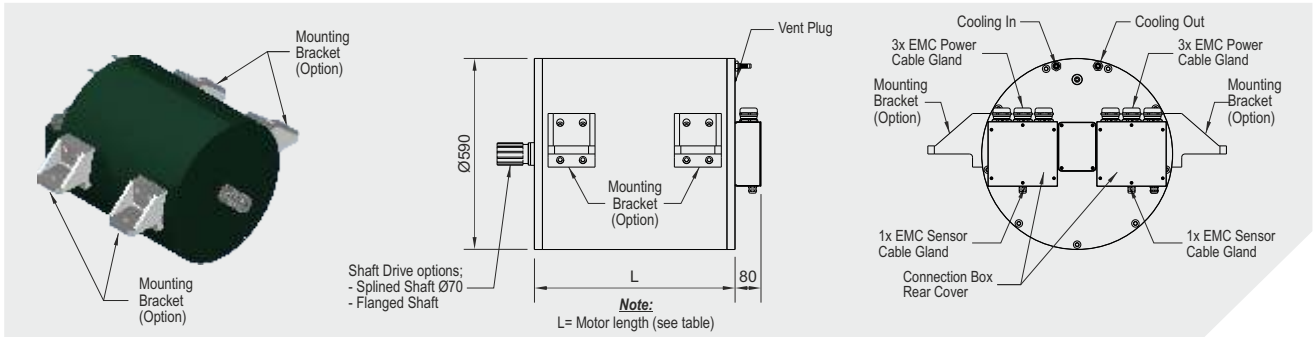
Features EMG-336d series: 160Nm to 1450Nm



Specification EMG-336d-215I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=215mm Weight: approx. 75kg Cooling liquid flow: 16l/min Cooling liquid Inlet temp.: max. 40°C	1200	20	161	492 694	26	2,5	94,0	HPI-225A-800VDC
	1800	36	192	524 739	43	4	95,5	HPI-225A-800VDC
	2700	53	188	517 729	64	10	96,7	HPI-225A-800VDC
	3600	66	173	454 640	88	16	97,1	HPI-225A-800VDC
Specification EMG-336d-285I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=285mm Weight: approx. 102kg Cooling liquid flow: 16l/min Cooling liquid Inlet temp.: max. 40°C	1200	54	437	467 658	75	16	94,7	HPI-225A-800VDC
	1800	77	407	458 646	105	25	96,0	HPI-225A-800VDC
	2700	105	374	473 667	138	35	96,8	HPI-225A-800VDC
	3600	142	378	493 695	178	50	97,3	HPI-225A-800VDC
Specification EMG-336d-355I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=355mm Weight: approx. 132kg Cooling liquid flow: 16l/min Cooling liquid Inlet temp.: max. 40°C	1200	85	680	473 669	114	25	95,4	HPI-225A-800VDC
	1800	115	610	478 676	148	35	96,5	HPI-225A-800VDC
	2700	170	601	511 723	205	70	97,3	HPI-225A-800VDC
	3600	213	565	469 663	278	120	97,5	HPI-450A-800VDC
Specification EMG-336d-425I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=425mm Weight: approx. 164kg Cooling liquid flow: 20l/min Cooling liquid Inlet temp.: max. 40°C	1200	99	787	494 697	125	25	95,5	HPI-225A-800VDC
	1800	144	765	497 701	180	50	96,7	HPI-225A-800VDC
	2700	204	720	469 661	267	120	97,4	HPI-450A-800VDC
	3600	260	692	531 749	300	120	97,5	HPI-450A-800VDC
Specification EMG-336d-495I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=495mm Weight: approx. 202kg Cooling liquid flow: 20l/min Cooling liquid Inlet temp.: max. 40°C	1200	106	884	444 626	146	35	96,3	HPI-225A-800VDC
	1800	159	843	495 698	195	50	97,2	HPI-225A-800VDC
	2700	238	842	492 694	293	120	97,6	HPI-450A-800VDC
	3600	310	823	436 615	429	2x 70	97,7	HPI-900A-800VDC
Specification EMG-336d-565I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=565mm Weight: approx. 230kg Cooling liquid flow: 30l/min Cooling liquid Inlet temp.: max. 40°C	1200	121	968	496 699	151	50	96,3	HPI-225A-800VDC
	1800	194	1027	470 663	251	120	97,1	HPI-450A-800VDC
	2700	290	1000	500 705	341	150	97,5	HPI-450A-800VDC
	3600	368	975	531 749	420	2x 70	97,5	HPI-900A-800VDC
Specification EMG-336d-635I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=635mm Weight: approx. 262kg Cooling liquid flow: 30l/min Cooling liquid Inlet temp.: max. 40°C	1200	148	1182	466 657	146	35	96,5	HPI-225A-800VDC
	1800	222	1181	516 728	219	70	97,2	HPI-450A-800VDC
	2700	311	1101	457 644	410	2x70	97,7	HPI-900A-800VDC
	3600	416	1103	456 643	548	2x 120	97,7	HPI-900A-800VDC
Specification EMG-336d-705I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=705mm Weight: approx. 296kg Cooling liquid flow: 30l/min Cooling liquid Inlet temp.: max. 40°C	1200	182	1452	483 682	235	95	96,0	HPI-450A-800VDC
	1800	272	1444	538 758	312	150	96,9	HPI-450A-800VDC
	2700	382	1354	531 750	440	2x95	97,3	HPI-900A-800VDC
	3600	477	1265	526 744	550	2x 120	97,3	HPI-900A-800VDC

Mentioned nominal voltages and current matches a nominal DC Bus voltage of 768VDC which corresponds to a string of 8 GreenBatteries. Nominal voltages and currents will be adapted in case of string of 6 or 10 GreenBatteries.

Features EMG-590d series: 1200Nm to 5000Nm

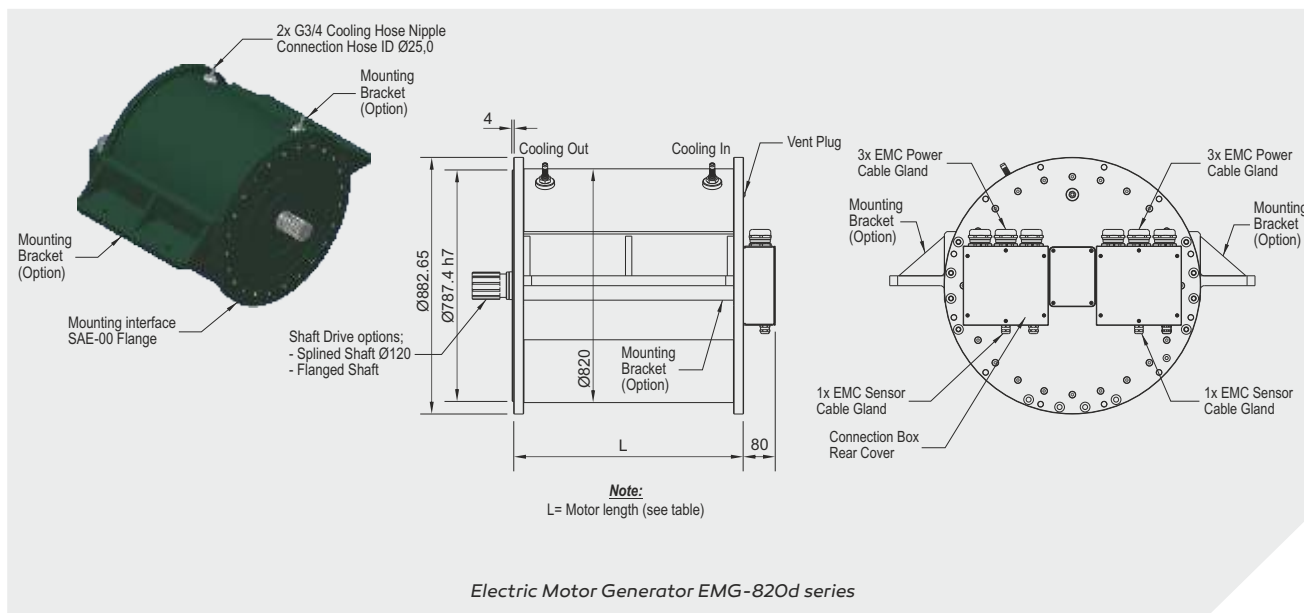


Specification EMG-590d-350I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=350mm Weight: approx. 343kg Cooling liquid flow: 16l/min Cooling liquid Inlet temp.: max. 40°C	600	82	1305	497 701	115	25	94,7	HPI-225A-800VDC
	900	122	1295	497 701	171	50	96,0	HPI-225A-800VDC
	1400	207	1417	454 640	246	95	97,0	HPI-450A-800VDC
	1800	225	1197	471 664	302	150	97,6	HPI-450A-800VDC
Specification EMG-590d-395I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=395mm Weight: approx. 403kg Cooling liquid flow: 23l/min Cooling liquid Inlet temp.: max. 40°C	600	108	1731	496 701	141	35	95,1	HPI-225A-800VDC
	900	168	1790	470 665	230	95	96,4	HPI-450A-800VDC
	1400	255	1740	463 655	348	150	97,3	HPI-450A-800VDC
	1800	316	1677	460 651	432	2x 70	97,5	HPI-900A-800VDC
Specification EMG-590d-440I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=440mm Weight: approx. 462kg Cooling liquid flow: 30l/min Cooling liquid Inlet temp.: max. 40°C	600	125	1990	497 701	176	50	95,7	HPI-225A-800VDC
	900	185	1960	497 701	260	120	96,7	HPI-450A-800VDC
	1400	301	2055	491 692	386	185	97,5	HPI-450A-800VDC
	1800	376	1995	470 663	501	2x 95	97,6	HPI-900A-800VDC
Specification EMG-590d-530I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=530mm Weight: approx. 583kg Cooling liquid flow: 20l/min Cooling liquid Inlet temp.: max. 40°C	1200	150	2391	501 706	186	50	95,5	HPI-225A-800VDC
	1800	237	2525	535 754	275	120	97,5	HPI-450A-800VDC
	2700	358	2445	492 694	445	2x 70	98,1	HPI-900A-800VDC
	3600	453	2407	525 740	529	2x 120	98,3	HPI-900A-800VDC
Specification EMG-590d-620I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=620mm Weight: approx. 708kg Cooling liquid flow: 20l/min Cooling liquid Inlet temp.: max. 40°C	1200	219	3470	498 702	275	120	96,8	HPI-450A-800VDC
	1800	296	3150	533 752	344	150	97,6	HPI-450A-800VDC
	2700	440	3002	512 722	525	2x120	98,2	HPI-900A-800VDC
	3600	584	3103	527 743	680	2x120	98,3	HPI-900A-800VDC
Specification EMG-590d-710I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=710mm Weight: approx. 828kg Cooling liquid flow: 45l/min Cooling liquid Inlet temp.: max. 40°C	600	224	3579	520 733	279	150	96,7	HPI-450A-800VDC
	900	364	3866	469 661	486	240	97,3	HPI-900A-800VDC
	1400	549	3744	481 678	707	2x 185	97,7	HPI-900A-800VDC
	1800	660	3500	458 646	884	2x 240	97,6	HPI-1400A-800VDC
Specification EMG-590d-800I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=710mm Weight: approx. 892kg Cooling liquid flow: 45l/min Cooling liquid Inlet temp.: max. 40°C	600	268	4279	499 704	334	150	97,1	HPI-450A-800VDC
	900	396	4210	555 783	438	240	97,8	HPI-450A-800VDC
	1400	611	4172	429 605	869	2x 240	98,3	HPI-1400A-800VDC
	1800	786	4172	551 707	869	2x 240	98,5	HPI-1400A-800VDC
Specification EMG-590d-890I	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms) (Vdc)	Nom. Current (Arms)	Cable Size Min (mm ²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=890mm Weight: approx. 1012kg Cooling liquid flow: 52l/min Cooling liquid Inlet temp.: max. 40°C	600	323	5146	460 649	442	2x 70	96,7	HPI-900A-800VDC
	900	484	5146	489 689	619	2x 150	97,4	HPI-900A-800VDC
	1400	698	4765	449 633	958	2x 240	97,5	HPI-1400A-800VDC
	1800	827	4390	404 570	1249	2x 300	97,6	HPI-1400A-800VDC

Mentioned nominal voltages and current matches a nominal DC Bus voltage of 768VDC which corresponds to a string of 8 GreenBatteries. Nominal voltages and currents will be adapted in case of string of 6 or 10 GreenBatteries.

Electric Motor Generator

Features EMG-820d series: 4500Nm to 25500Nm



Specification EMG-820d-475l	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms)	Nom. Voltage (Vdc)	Nom. Current (Arms)	Cable Size Min (mm²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=475mm	350	175	4800	634	895	162	50	97,3	HPI-225A-1000VDC
Weight: approx. 1046kg	550	267	4650	634	895	248	95	96,6	HPI-450A-1000VDC
Cooling liquid flow: 60l/min	900	452	4800	634	895	420	240	97,0	HPI-450A-1000VDC
Cooling liquid Inlet temp.: max. 40°C	1200	584	4650	634	895	543	2x 120	97,6	HPI-900A-1000VDC
Specification EMG-820d-563l	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms)	Nom. Voltage (Vdc)	Nom. Current (Arms)	Cable Size Min (mm²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=563mm	350	263	7200	634	895	244	95	96,8	HPI-450A-1000VDC
Weight: approx. 1251kg	550	403	7000	634	895	375	185	96,7	HPI-450A-1000VDC
Cooling liquid flow: 90l/min	900	678	7200	634	895	631	2x 150	97,2	HPI-900A-1000VDC
Cooling liquid Inlet temp.: max. 40°C	1200	879	7000	634	895	818	2x 240	97,1	HPI-900A-1000VDC
Specification EMG-820d-775l	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms)	Nom. Voltage (Vdc)	Nom. Current (Arms)	Cable Size Min (mm²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=775mm	350	439	12000	634	895	408	240	96,7	HPI-450A-1000VDC
Weight: approx. 1750kg	550	668	11600	634	895	621	2x 150	96,7	HPI-900A-1000VDC
Cooling liquid flow: 180l/min	900	1131	12000	634	895	1053	2x 240	97,7	HPI-1400A-1000VDC
Cooling liquid Inlet temp.: max. 40°C	1200	1457	11600	634	895	1356	4x 150	97,9	HPI-900A-1000VDC 2x
Specification EMG-820d-987l	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms)	Nom. Voltage (Vdc)	Nom. Current (Arms)	Cable Size Min (mm²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=987mm	350	604	16500	634	895	562	2x 120	97,0	HPI-900A-1000VDC
Weight: approx. 2259kg	550	835	14500	634	895	777	2x 185	96,8	HPI-900A-1000VDC
Cooling liquid flow: 210l/min	900	155	16500	634	895	1447	4x 185	97,6	HPI-900A-1000VDC 2x
Cooling liquid Inlet temp.: max. 40°C	1200	1822	14500	634	895	1696	4x 240	97,6	HPI-900A-1000VDC 2x
Specification EMG-820d-1199l	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms)	Nom. Voltage (Vdc)	Nom. Current (Arms)	Cable Size Min (mm²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=1199mm	350	769	21000	634	895	716	2x 240	96,3	HPI-900A-1000VDC
Weight: approx. 2768kg	550	1077	18700	634	895	1002	2x 300	97,3	HPI-1400A-1000VDC
Cooling liquid flow: 300l/min	900	1979	21000	634	895	1842	4x 240	97,6	HPI-1400A-1000VDC 2x
Cooling liquid Inlet temp.: max. 40°C	1200	2350	18700	634	895	2188	4x 300	97,8	HPI-1400A-1000VDC 2x
Specification EMG-820d-1411l	Speed (RPM)	Cont. Motor Power (kW)	Cont. Torque (Nm)	Nom. Voltage (Vrms)	Nom. Voltage (Vdc)	Nom. Current (Arms)	Cable Size Min (mm²)	Efficiency (%)	GreenInverter (Model)
Motor length: L=1411mm	350	934	25500	634	895	896	2x 240	96,5	HPI-1400A-1000VDC
Weight: approx. 3257kg	550	1344	23000	634	895	1251	4x 150	97,6	HPI-1400A-1000VDC 2x
Cooling liquid flow: 360l/min	900	2403	25500	634	895	2237	4x 300	97,8	HPI-1400A-1000VDC 2x
Cooling liquid Inlet temp.: max. 40°C	1200	2890	23000	404	895	2690	6x 240	97,8	HPI-1400A-1000VDC 3x

Mentioned nominal voltages and current matches a nominal DC Bus voltage of 960VDC which corresponds to a string of 10 GreenBatteries. Nominal voltages and currents will be adapted in case of string of 6 or 10 GreenBatteries.

GreenMotor with built-in planetary gear

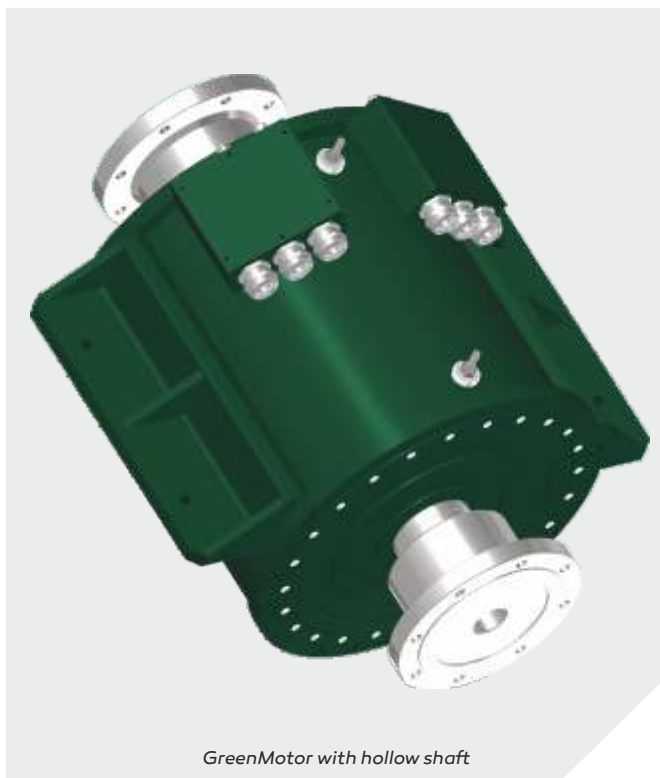
Electric propulsion motors for direct propeller drive have highest reliability due to their simple construction. The drawback however is the heavy weight and consequently they are much more expensive than equivalent powered high RPM electric motors. Basically there are two solutions when using a high RPM electric motor for ship's propulsion:

- ▶ In parallel hybrid application: connect the electric motor via a PTI/PTO connection to the hybrid gearbox of the combustion engine.
- ▶ In direct propeller drive application: apply an electric motor with a gearbox

GreenMotor is available with built-in planetary gear for direct propeller drive. The electric motor is designed for a nominal RPM of e.g. 3600 and via a reduction ratio of e.g. 6x the propeller shaft is driven with 600RPM. This combination is more light weight and less cost than a direct drive GreenMotor. The drawback is that more mechanical components are used and the total efficiency is about 2.5% lower. Please consult factory with your requirements and we will offer a suitable solution.



GreenMotor with built-in planetary gear

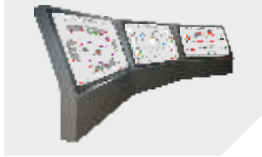


GreenMotor with hollow shaft

GreenMotor with hollow shaft

Many ships want to transfer to hybrid propulsion without modifying the propulsion train too much. The combustion engine with gearbox is frequently not suitable for parallel hybrid application as a suitable PTI/PTO connection is not present. A low RPM electric motor can be mounted in line with the propeller shaft. In this case the electric motor shaft must be suitable for carrying the load of the combustion engine as well. Electric motor shaft size should be at least equivalent to propeller shaft size. GreenMotor is available with a hollow shaft supporting a shaft of sufficient thickness. Example: EMG-590d series can be delivered with a flanged 150mm diameter shaft on both sides for low RPM direct propeller drive projects up to 323kW. Please consult factory with your requirements and we will offer a suitable solution.

Vessel Management System



Power Management System



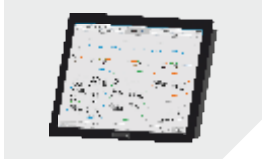
Fire Alarm System



CCTV Video Distribution



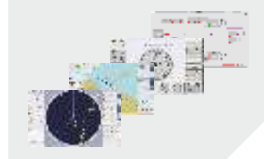
Ship Performance Monitor



Fleet Management System



Integrated Navigation System



Heading Control System



Propulsion Control System



Dynamic Positioning System



BNWAS Watch Alarm System



Navigation Light Control



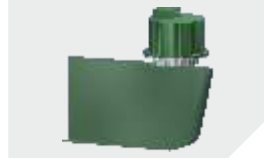
Wiper Control System



Energy Management System



Electric Fin Stabilizer



Electric Steerable POD



GreenInverter



GreenGenerator



GreenBattery



GreenMotor



*Ship automation,
navigation and
electric propulsion*