



MARINE SOLUTIONS

Innovative electrification solutions from Baumüller
Engineering | Hardware | Software

Practical solutions for a clean future: Baumüller offers complete drive systems for ships with the goal of reducing carbon emissions.



SUSTAINABILITY

Practical solutions for a clean future

Support for your emissions exit

Baumüller has continued to develop products and systems for the shipping industry over many years and is now one of the **leading suppliers of modern ship drive systems**. Baumüller not only supplies drive systems in combination with battery and methanol units but also the necessary charging and fast charging infrastructure. The systems are also prepared for the use of hydrogen units for emission-free operation.



Lowering ship drive costs, reducing emissions and meeting new guidelines are all possible with fully electric or hybrid solutions from Baumüller. We have been a specialist in electric drive and automation technology for decades and successfully use our systems in numerous areas of mobile drive technology. With our wide-ranging portfolio of products and services, from the motor to the converter and the control to charging systems, to the BAS-PCS power management system and the BAS-Link DC Grid energy distribution platform to the diagnostic software or the links to diverse battery management systems, we offer attractive and efficient alternatives to the classic ship's drive.

Baumüller as an original equipment manufacturer with extensive services

Baumüller not only offers excellent motors, converters and corresponding control systems, but also a comprehensive marine service portfolio. As a result, runtimes can be maximized, problems detected and rectified early, and overall smooth operation is enabled.

Our technology and experience for the following types of ship:

- | | | |
|---------------------------|-------------------------------|------------------------------|
| ✓ Inland waterway vessels | ✓ Offshore vessels | ✓ Tugs |
| ✓ Yachts | ✓ Crew transfer vessels (CTV) | ✓ Dredgers |
| ✓ Work boats | ✓ Passenger and pilot boats | ✓ Trawlers and fishing boats |
| ✓ Ferries | ✓ Rescue and patrol boats | |

More than 80 ships and boats successfully electrified

We are the experts for the complete drive system: From control to power management. To date, for example, we have implemented hybrid cargo ships for inland waterways and coastal deployment, hybrid work ships, and hybrid and electric ferries. Regardless of whether original equipment or engine replacement – our ship drives have a convincingly low environmental impact, improved maneuverability, and space-saving installation compared to classic diesel drives.



DRIVE TYPES

Fully electric and emission-free: E-ships with electric battery drive

Quiet and completely free from fine particulates, these are the main advantages of a fully-electric or battery-run e-drive for ships and boats. The motors are run completely with rechargeable lithium-ion batteries, without diesel any engines. Baumüller undertakes the complete engineering, from the drive dimensioning to the power management.

Successful combination – e-ships with hybrid drives

Generators with electric motors are a successful combination and the perfect way to achieve more environmental protection and fuel savings. Beside diesel generators and fuel cells, e-fuels and combinations of the different energy sources, so-called H2 dual fuel generators are used.

The principle of the hybrid drive system: Skillfully combined generators with electric motors produce maximum efficiency. Unlike traction drives, generators are not exposed to power peaks and are therefore always operated with optimal efficiency. The generators can therefore be smaller from the outset.

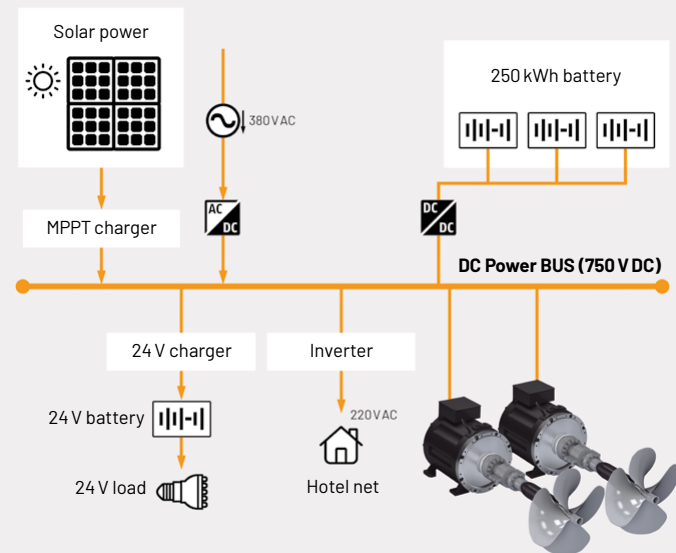
Optimal efficiency: In a parallel hybrid ship drive, electric motors and main engines are synchronously connected and achieve the full power together.

Drive with fuel cells for an emission-free future

The hybrid hydrogen ship drive offers a further solution for emission-free water transport. Another major advantage is continuous operation without charging pauses, as are necessary for pure electric drives.

Hydrogen is therefore a very promising energy source for shipping. Baumüller also offers its marine systems in combination with fuel cells.

Fully-electric ship drive: E-ships with battery-operated electric motors

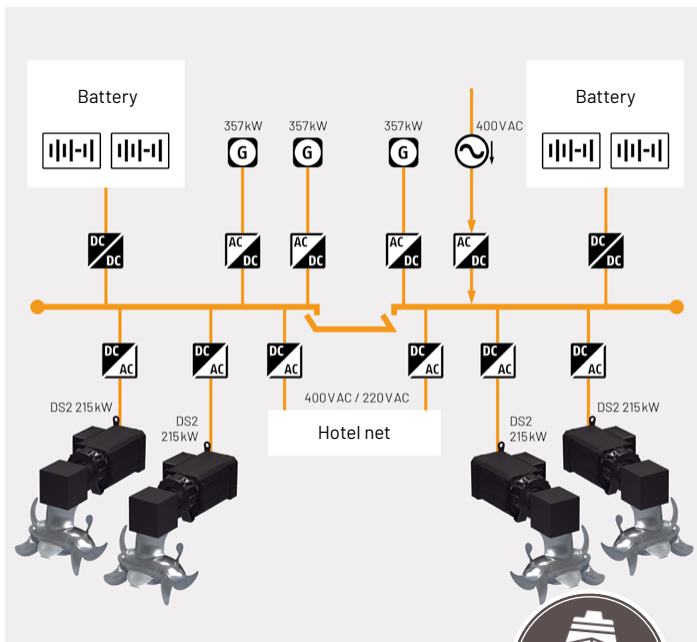


The advantages of a pure e-drive

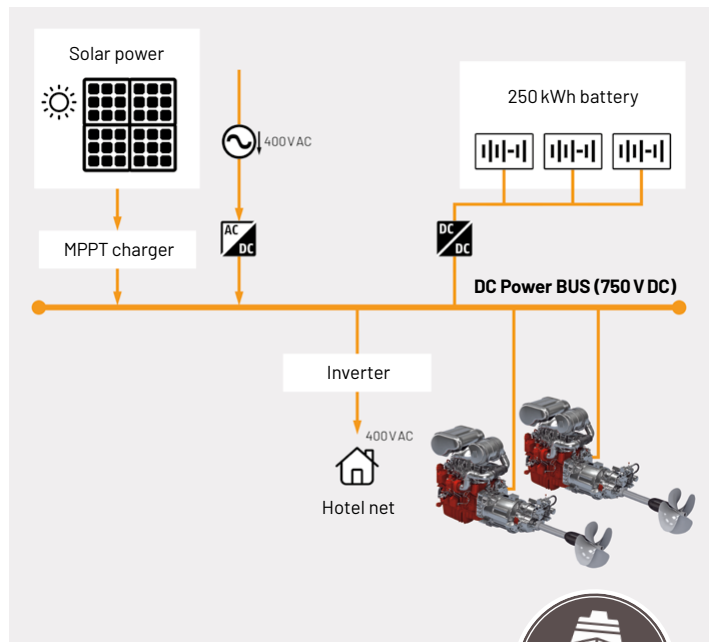
- ✓ **Highly energy-efficient** – lower consumption than with classic solutions
- ✓ **Fully practical** – due to quick charging concepts and state-of-the-art rechargeable battery technologies
- ✓ **Low noise** – minimum noise impact
- ✓ **Emission-free** – no CO₂ discharge
- ✓ **For the fun of driving** – from 0 to 100 in a few seconds

Fully electric, hybrid and parallel hybrid drive systems

Hybrid ship drive: E-fuel generators with electric motors



Parallel hybrid ship drive: Electric motors and main engines synchronously connected



The advantages of a hybrid drive

- ✓ **Optimized drive solution** – up to 30 percent fuel saving and noise reduction
- ✓ **Powerful** – enormous increase in efficiency
- ✓ **Automatic energy recovery** – battery charges itself automatically thanks to recuperation
- ✓ **Quickly charged** – not dependent on charging stations
- ✓ **For large distances** – thanks to the combustor, large ranges are possible

MODULAR

The flexible e-drive system as a modular solution

All system modules are available for CE boats or ships with class approval.

System engineering and commissioning of prototypes



Implementation of the individual drive concept based on the system module, from concept to realization

Control system with intelligent power management system



The intelligent BAS-PCS power management system is based on marine-approved components and is flexibly expandable

Drives for propulsion, thrusters, generators



- ✓ Electric motors with high performance & efficiency
- ✓ Air or water-cooled
- ✓ From the direct drive via PTI/PTO to the Z-drive

4-quadrant converter for marine use



- ✓ Air or water-cooled
- ✓ Nominal voltage 400/690 V AC; up to 1200 V DC
- ✓ Variable use as AFE, motor or M-grid converter

Batteries



- ✓ Use of different types of battery depending on the load profile requirements
- ✓ Interface with the battery management systems of established battery manufacturers

DC/DC converter



- ✓ Mobile converter for linking HV batteries to DC link
- ✓ Air or water-cooled

Energy distribution platform



Central or decentralized BAS-Link DC grid energy distribution is possible.

Charging systems



- ✓ Innovative fast charging infrastructure
- ✓ Shore-to-ship power

Worldwide service

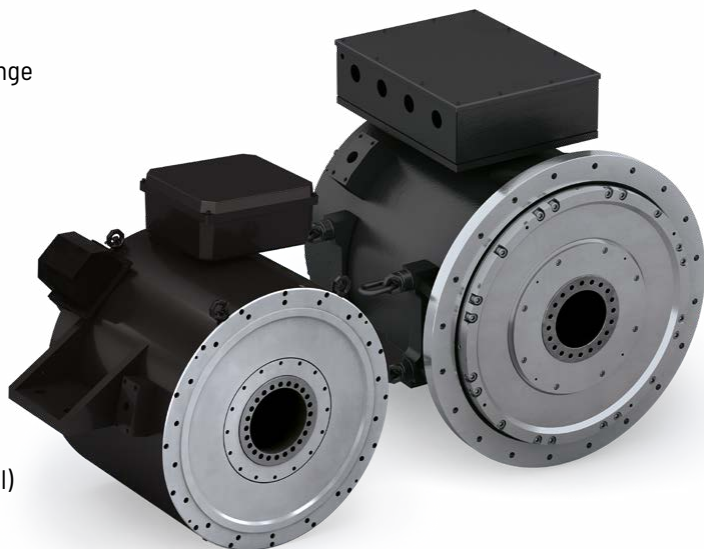
We ensure the reliability of your marine system over its entire life cycle with our wide range of maintenance, repair and retrofit services.



Products for Marine:

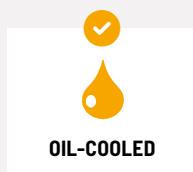
DST2 135-560 – The powerful high-torque motors

- ✓ Very good smooth running characteristics
- ✓ Energy-efficiency is maintained through wide speed/load range
- ✓ Suitable for sophisticated direct drive technology
- ✓ High torque at low velocities
- ✓ Low-noise
- ✓ Water cooling in a stainless steel design
- ✓ Compact and robust design
- ✓ Smooth housing surface – easy to keep clean
- ✓ Permanent field high-torque motors
- ✓ IP54 type of protection
- ✓ Encoders: Resolver, SinCos (option), digital encoder (optional)
- ✓ Other encoders on request



Other motors on request

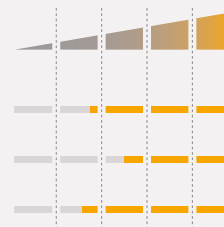
Cooling methods



The DST2 motors are available in water-cooled and oil-cooled versions.

Spectrum

Power
Torque
Acceleration



DST2 135-560 – Technical data

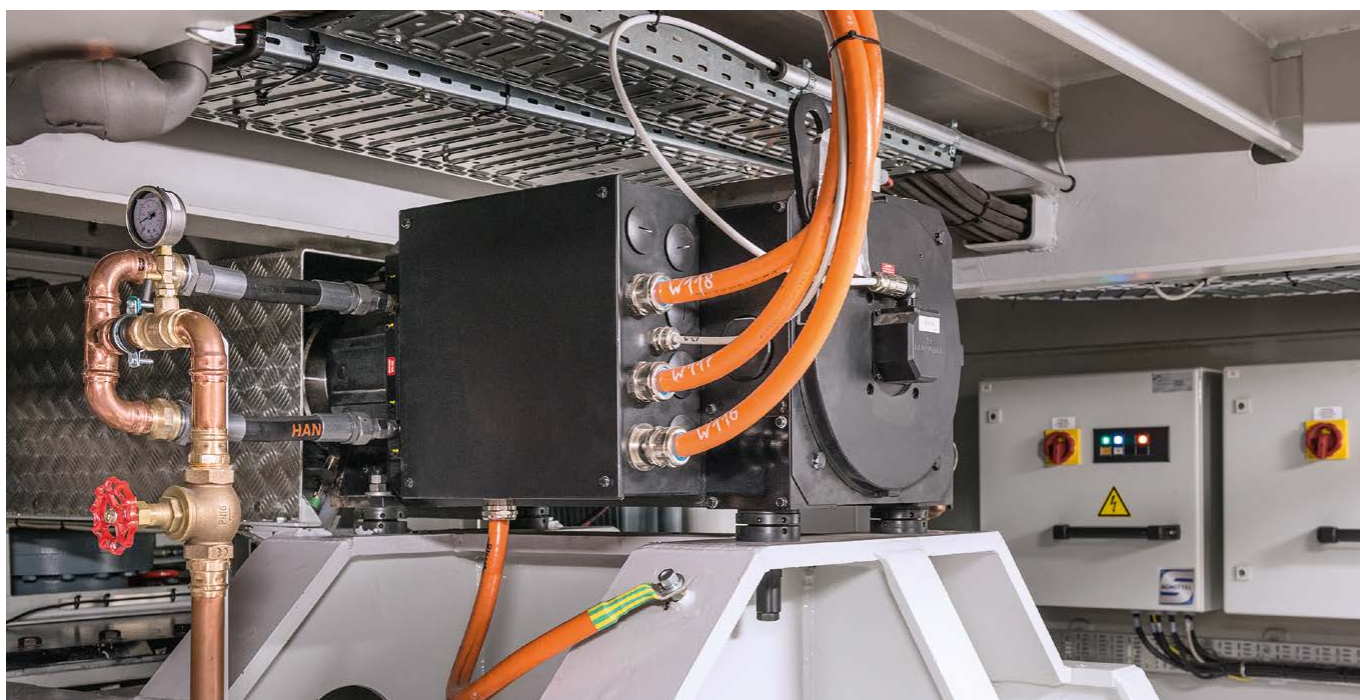
Type	P_N		n_N	M_N		$M_{0\text{ MAX}}$	
	[kW]	[hp]		[Nm]	[lbf ft]	[Nm]	[lbf ft]
DST2-135	2-60	2.7-80.4	175-1500	140-580	103-428	1325-1110	240-819
DST2-200	5-126	6.7-169	150-1000	310-2030	229-1497	790-4450	583-3282
DST2-260	20-225	27-302	150-750	1130-4760	833-3511	2410-9800	1777-7228
DST2-315	16-285	21-382	100-600	1200-8600	885-6343	3330-18400	2456-13570
DST2-400	92-530	123-710	100-300	8800-18600	6490-13718	14800-31600	10915-23305
DST2-560 *	153-875	205-1173	100-300	13900-29200	10251-21535	30200-60700	22273-44766

Subject to change.
The values specified are maximum values. For details, please refer to the technical documentation.

*) on request

FROM A SINGLE SOURCE

Manufacturer-independent drive systems from a single source

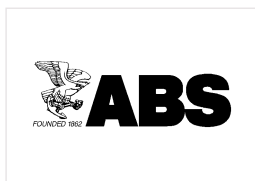


Certified ship drive products and services

Specially for shipbuilding Baumüller has adjusted its products accordingly and had them certified. Thus, for example, the **DST2 high-torque motors** are prepared for easy integration into the ship design. In addition, Lloyd's Register has confirmed that the high-torque motors meet the specific requirements of shipping. The DST2 motors are available with outputs from 2 to 875 kW and nominal speeds between 50 and 1500 min⁻¹.

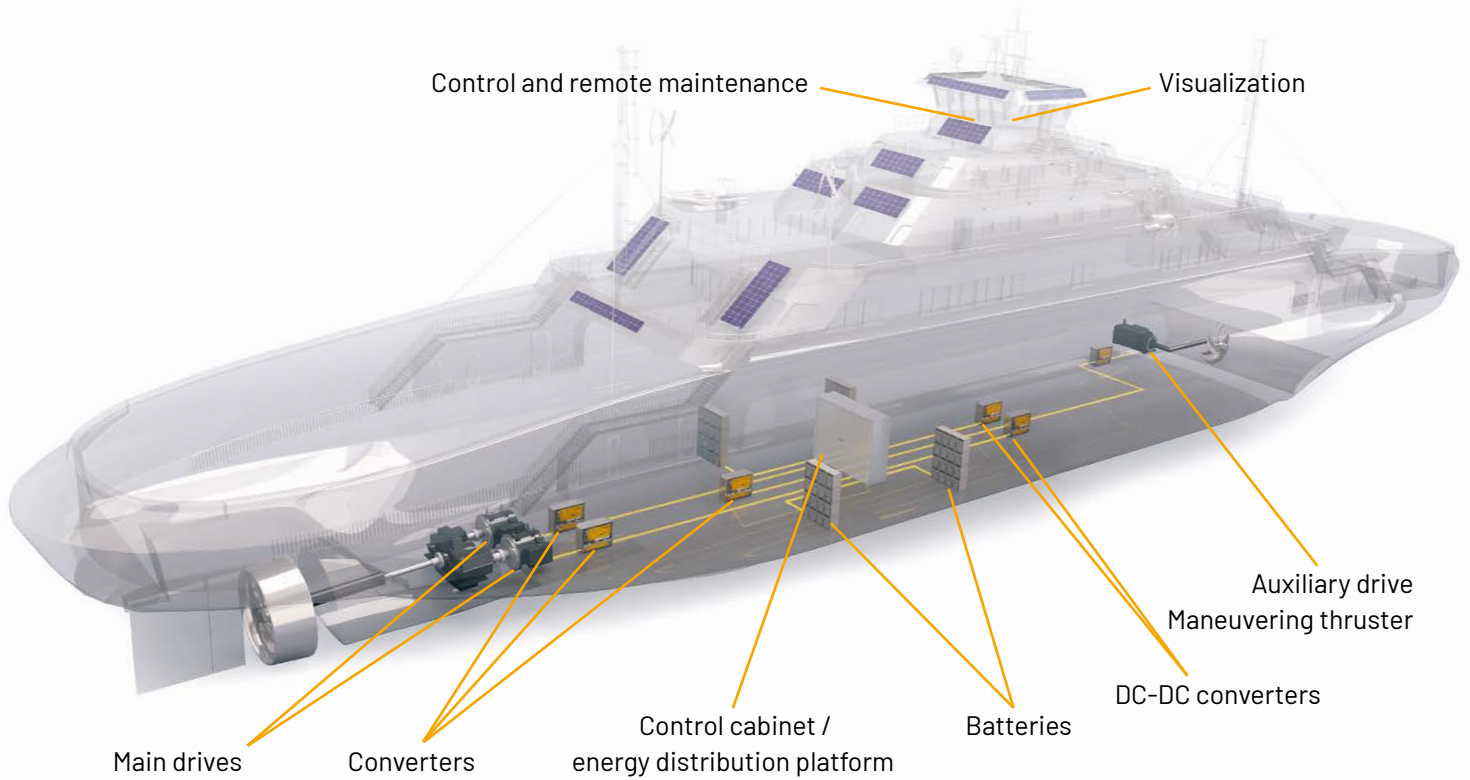
Furthermore, motors with an output of up to 6 MW can be offered for specific projects.

Among other things, the powerful and dynamic three-phase synchronous motors of the DS2 series, with an output of up to 300 kW, are used for the **drive of the rudder propellers**. Furthermore, components of recognized manufacturers such as Danfoss, Omron and Phönix are used in the projects.



Control and remote maintenance

Visualization



Main drives

Converters

Control cabinet /
energy distribution platform

Batteries

DC-DC converters

Auxiliary drive
Maneuvering thruster

Fuel cells



Battery and control room



Main drives



Control technology



Control cabinets



Converters



System engineering



Visualization and software



Remote servicing



BAS-PCS

Intelligent power management system

Demand-actuated power output of the units saves fuel

The intelligent BAS-PCS power management system controls, among other things, demand-actuated power output of the units in the drive system. The software is suitable for different technologies and fuels and manages the energy demand, not only for fossil fuels but also for e-fuels and combinations thereof.

The software, programmed by Baumüller, adjusts the speeds of the units so that the energy generated is equal to the ship's exact current requirement. This means that the vessel, for example, at moderate cruising speed, is driven by only one generator. If a faster speed is necessary or the vessel has to maneuver, the second generator is connected automatically within seconds. The software controls the connection of the second motor at a speed that does not require two motors running permanently, and thus a redundant system is not required. With the help of the BAS-PCS power management systems, ships that only have to have one unit running can be approved. This can save fuel. If the maximum power is necessary quickly in emergency situations, this is identified by the system and is made available.



If a faster speed is necessary, the second generator (on the right) is connected automatically within seconds. The software controls the connection of the second motor at a speed that does not require two motors running permanently and thus a redundant system is not required.

Synchronization with the shore system: Energy supply with shore power system

Furthermore, the BAS-PCS power management system synchronizes with the shore system when the ship is moored so that the ship is supplied with energy with the help of the shore power system and the diesel-operated power supply can be provided by the on-board system. It is designed so that other energy sources such as a battery or fuel cell can be added.

Dashboard with current operating status of all drives

Information about the current operating status of all drives is displayed clearly on a monitor at the control panel. The captain is therefore always informed and in addition, additional energy, and thus fuel is saved by the system's self-regulation.

BAS-Link DC-Grid

Energy distribution platform for efficient energy supply

The BAS-Link DC Grid energy distribution for the drive system is based on a joint link. To achieve high energy efficiency, the energy for the drive system and the on-board power loads is tapped from the direct current link. Single fault tolerance execution in accordance with the DNV requirement is standard.



Central or decentralized BAS-Link DC Grid energy distribution is possible



The link is set up in two distribution systems. In normal operation, these are interconnected. If a fault occurs in one part of the link supply, it is disconnected. The non-defective part of the link supply can continue to be operated. The links are monitored by two insulation monitors. Link is set up to be selective according to the DNV and the Estrin 2025 regulations.

There is a charging circuit for charging the link. If the link is discharged, base charging is necessary. The base charging takes place either via the charging connection or via the batteries.

CHARGING SYSTEMS

for hybrid and fully-electrical ships



Baumüller is a partner of shipyards, system integrators and ship owners and is itself a supplier of complete systems.

Innovative quick-charging infrastructure and onshore power supply

The hybridization and electrification of ships is also accompanied by a demand for high-performance charging infrastructure. Baumüller closes the gap between the drive system and the charging station and offers the complete charging technology, not only for fast charging systems but also for the shore power. Baumüller flexibility is reflected in the different charging solutions for hybrid and fully-electric ships as well as for shore power solutions for ports.

Ports with shore-to-ship power benefit twice. With the sale of energy, they open up a new business model and reduce additional CO₂ emissions and noise at the mooring place. The ship operators can in turn save fuel.

Baumüller customers benefit from:

- ✓ **Our own broad range of products and services**
from the converter through to the energy management and battery management system
- ✓ **Know-how:** High-quality and reliable products for charging stations
- ✓ **Continuous engineering**
- ✓ **Fast and customer-focused decision-making routes:** The experience and advantages of a worldwide operating, successful and innovative family business with tradition
- ✓ **Worldwide service**

Charging points: Precise-fitting system architecture for quick charging

We offer the charging infrastructure you want for nighttime charging and periodic charging: **Innovative charging solutions for hybrid and fully-electric ships.** We support you with precisely what you need for your order and undertake projects, not only for the charging technology alone but also for charging and drive technology, and work with you to close the gap in your existing technology.

Charging stations at ferry berths

Are you looking for an innovative charging system?
In a DC quick-charging system, the mains inverter from AC to DC is located at the ferry berth. Additional battery storage can reduce the mains connected loads and thus enable cost-optimized supply. The necessary infrastructure on the ship is therefore small and the battery capacities on the ship can be reduced due to the availability of higher charging capacities. This saves weight and optimises the usable space on the ship. With this concept, the charging stations make emission-free shipping even more appealing.

Our know-how extends from manual charging stations for nighttime charging with plugs and a maximum charging capacity of 22 kW, to manual charging stations with CCS2 standard and a charging capacity of up to 425 kW per plug through to automatic charging stations, either via a tappet with plug or a crane solution with up to 4 MW of power. The charging period depends on the number of plugs. We offer CCS 2.0 sockets up to max. 500 A, depending on the drive dimensioning and charging time. In future, this will be extended to up to 3000 A per plug by the MCS standard.



Charging solutions

- ✓ Autonomous telescopic charging via loader crane
- ✓ Tappet charging system
- ✓ Manual charging stations

Onshore power supply: Emission-free and cost-effective during laytimes



Until now, diesel generators had to secure the power supply so that the onboard system functions even during the laytime spent in port. Shore power is an environmentally aware alternative for the energy supply. Shore power technologies use the on-shore electricity system and thus enable emission-free power supply for the on-board services. Shore power supplies are positioned directly at the berth in a port or on a pier, and are more cost-effective to run than units operated with ship diesel.

The different voltages and frequencies on-board and on-shore are converted to the on-board system voltage on-shore with the help of a transformer. Baumüller takes care of the measures required to implement the shore power systems.

REFERENCES

Benefit from our know-how
for your ship propulsion

Interested in our system?



Scan the QR code and contact us now.
www.baumueller.com/en/contact/bas

Fully electric: eD-TEC speed boat



Year of manufacture 2022
Length 9 m | Width 2.50 m | Maximum speed 40 kn
Drives: 2x 200 kW, controllers: b maXX mobil
Battery capacity: 98 kWh

Fully electric: Ceresio



Year of manufacture 2021
Length 31.35 m | Width 6.28 m
Drives: 2x DST2-260 electric motor 180 kW
Battery capacity: 840 kWh, charging station: 1.6 MW charger

Hybrid: AERØxpresen



Year of manufacture 2019
Length 49.36 m | Width 12.50 m | Draft 1.92 m
Drives: 2x Scania DI16 8-cylinder diesel motors,
2x drive units 450 kW

Diesel-electric: Trischen



Year of manufacture 2019
Length 22 m | Width 7.5 m
Work ship with diesel-electric drive system,
2x drive units DST2 225 kW

Diesel-electric: MS Emmerich



Year of manufacture 2020
Length 38 m | Width 8.0 m
WSA work ship with diesel-electric drive system
2x diesel Scania, 2x drive units DST2 225 kW

Diesel-electric: Opal



Year of manufacture 2015
Motors: 2x DST2-315Y0, 144 kW
Battery capacity: 460.8 kWh
2 generators 1x 150 kW, 1x 130 kW

Diesel-electric: MS Aquadelta



Year of manufacture 2022
Length 48 m | Width 12 m
Water injection dredger with diesel-electric drive system
5x diesel generators, 2x rudder propellers 450 kW

Fully electric: Bridge Inspection Vessel BPS18



Year of manufacture 2028
Length: 19 m | Width: 4.9 m
2x 80 kW rudder propellers, 1x 80 kW pumpjet
Battery capacity: 1300 kWh

Hybrid: Ferry Farge



Image: Irene Neumann

Year of manufacture 2017
Length 59 m | Width 14 m | Maximum speed 14 km/h
Capacity: 32-34 passenger cars, 6 semis, up to 249 people
Drives: 4x DS2 main motors 200 kW each

Fully electric: Qi-Fu No.1



Year of manufacture 2017
Length 25 m | Width 6.5 m
Capacity: up to 150 persons; 46 bicycles
Drives: 2x 2 powerMELA® systems, each with 150 kW

COMPLETE SYSTEM

Precise-fitting and customized:
From the electric motor to the
complete drive system



ENGINEERING



- ✓ Dimensioning
- ✓ Simulation
- ✓ Commissioning

HARDWARE



- ✓ High-torque motors
- ✓ Inverters
- ✓ Batteries and fuel cells
- ✓ Control technology
- ✓ Cabinets

SOFTWARE



- ✓ Visualization
- ✓ Power management system
- ✓ Remote service

Baumüller is a partner to shipyards, system integrators and ship owners and is itself also a supplier of complete systems.

Baumüller offers exactly the service you need - from individual motors and components to the complete drive system with self-regulating energy and battery management. We support you with tailored solutions that you need for your project.



FLEXIBLE PROJECTS

from the motor to the total system



TURNKEY PARTNERSHIP

for complete propulsion systems



TECHNOLOGY CONCEPTS

from hybrid to fully electric



LIFECYCLE MANAGEMENT

for system optimization

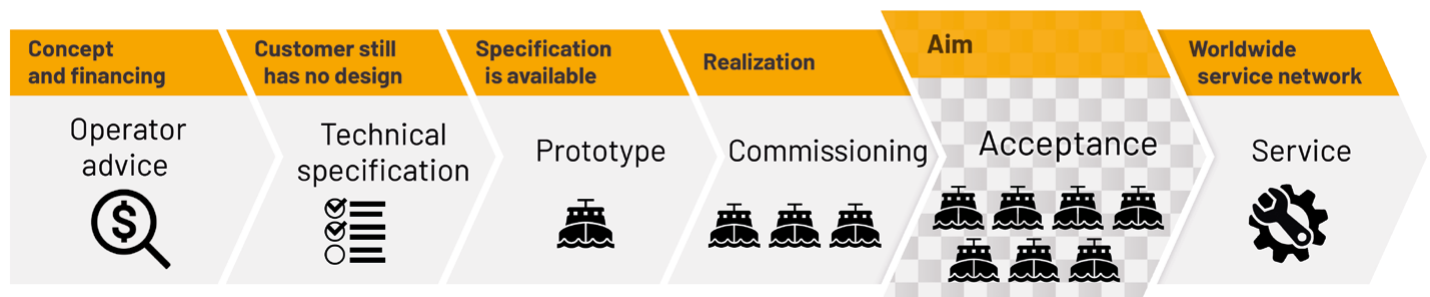
Operator advice for the concept development, tender specification and grants

We enter into discussions with you and your partners with no prior technology bias and guide you reliably through the complex decision-making process. Alongside the suitable drive technology and fuel type, we also provide advice and support during the budget planning and financing and find the suitable grant program for you. Together, we develop tender packages for the submission and implement the awarded project reliably.

Your advantages

- ✓ Production-compatible design and development from the prototype to the pilot series – all from a single source
- ✓ Reduction of your time-to-market through our expertise
- ✓ High energy efficiency and power density of the electric motors with low noise emissions
- ✓ Increase in competitiveness through a combination of new motor concepts with innovative production technology

Close coordination with customers



We work with you as a partner from the requirements specification to the prototype to series production

Baumüller is the worldwide leader when it comes to the development of electric drive systems. Through our diverse product program in the field of motors we have extensive production expertise. We are thus your partner for production-ready design and optimization of your motor for lot sizes between 10 and over 1000 motors per year. As a non-group-affiliated, mid-sized company, we are able to respond to your customers' wishes quickly and efficiently with innovative drive solutions. This makes us the perfect partner for challenging projects and future technologies.

We complement our know-how acquired in industrial motor building with our experience of mobile drives and their particular requirements. Thus, the impacts of temperature, dust and moisture are taken into account by special cooling options and suitable sealing measures.

We accompany you en route to your electric future.

MARINE SERVICE

Safe e-mobility on the high seas



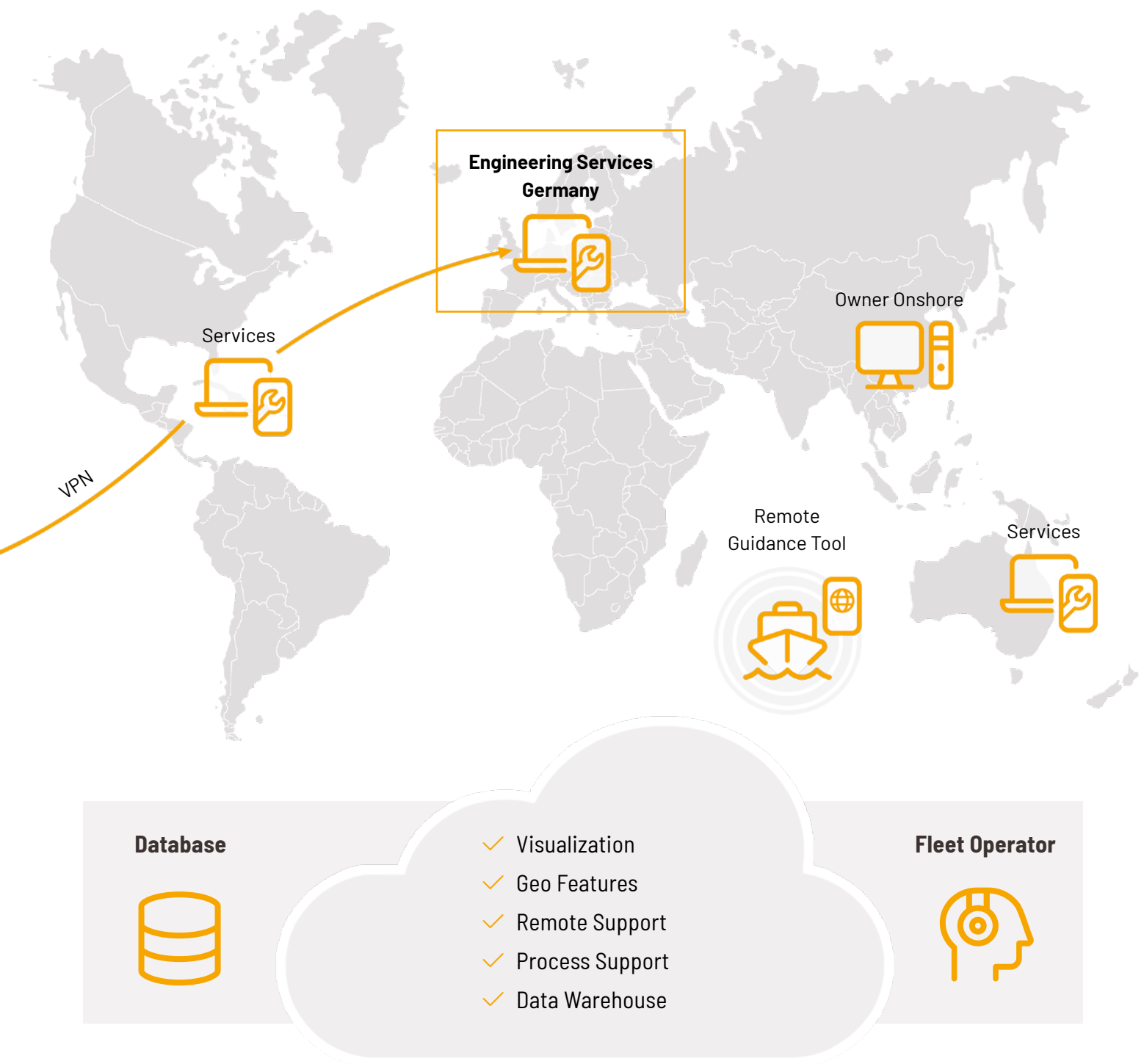
Shipping does not have fixed business hours. If you need maintenance or repair support, you can therefore dependably reach us around the clock. Our technicians then come to help you as quickly as possible. The times can vary depending on your berth location, however, we are able to keep them very short thanks to our worldwide network and our 24/7 availability. This reduces potential downtimes as well as costs.

Service on site – Baumüller worldwide

For our worldwide marine service network we not only use our Baumüller locations but also selected marine specialists. You receive mechanical support for structural steelwork and all electrical maintenance services. In addition, components can be replaced or other service topics such as defective cables, fusing, insulation problems, and much more can be dealt with on site. With our marine service, such visits can be planned early and carried out with minimum laytime and thus maximal reduced breakdowns.

Maximal service availability

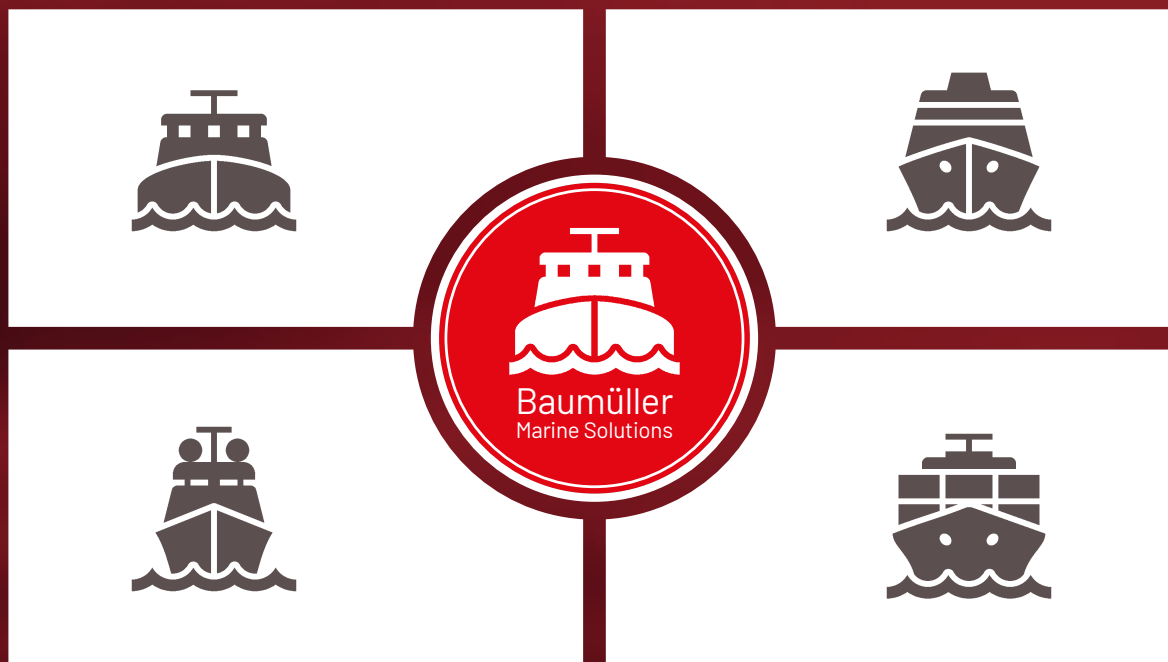
To minimize the actual maintenance time, Baumüller also uses its own online service. Already trained personnel can therefore use a remote guidance tool to obtain instructions and advice from Baumüller technicians from afar. Mutual, simultaneous exchange enables many problems to be solved directly on site by personnel who are professionally instructed, thereby saving time. On the one hand, this creates certainty and saves time and money.



Your advantages

- ✓ **Troubleshooting & short response times** - fast and mobile service team, service via online connection
- ✓ **Repair, installation & commissioning** - from the component to the overall system
- ✓ **Diagnostics** - modern diagnostic techniques for fast fault detection
- ✓ **Inspections & maintenance** - avoid downtimes for your ships
- ✓ **Transportation logistics** - collection and on-schedule delivery of your replacement parts
- ✓ **OEM service** on behalf of the customer - hotline with OEM number switching

MARINE SOLUTIONS



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