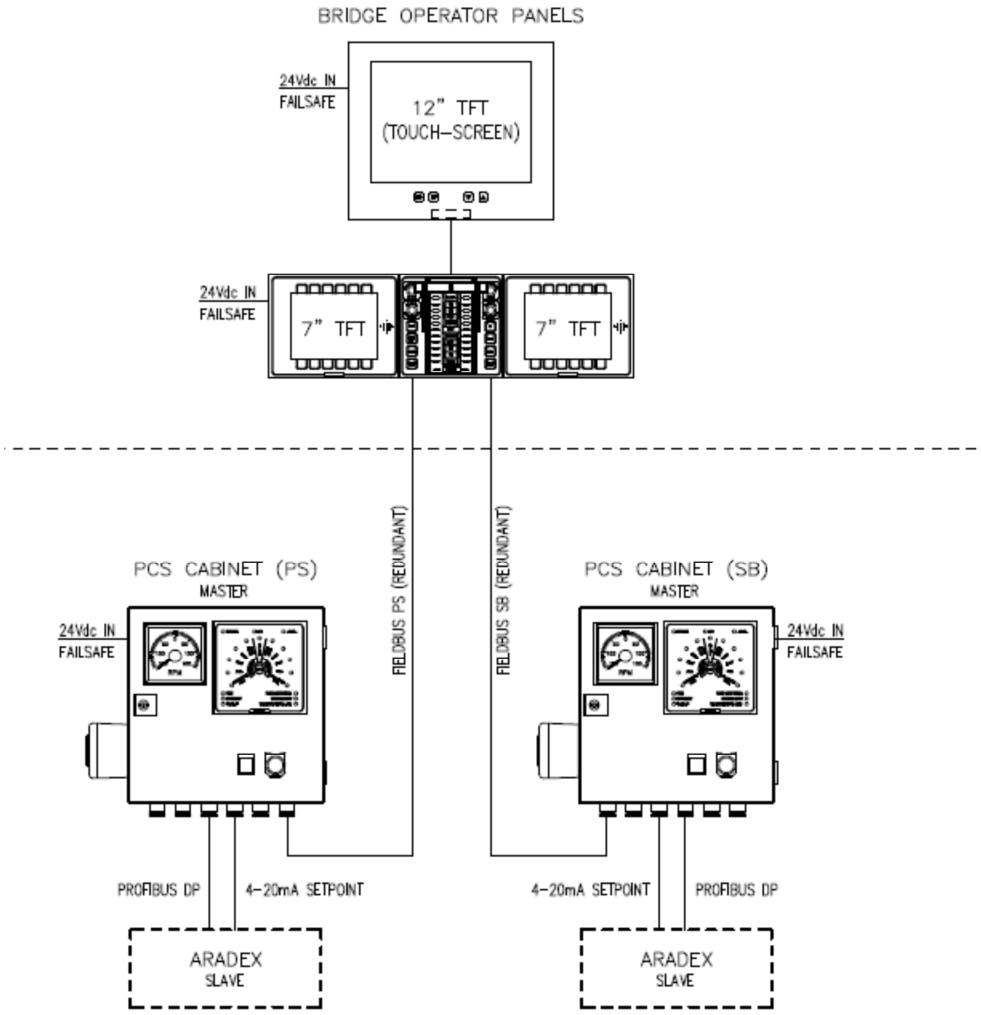
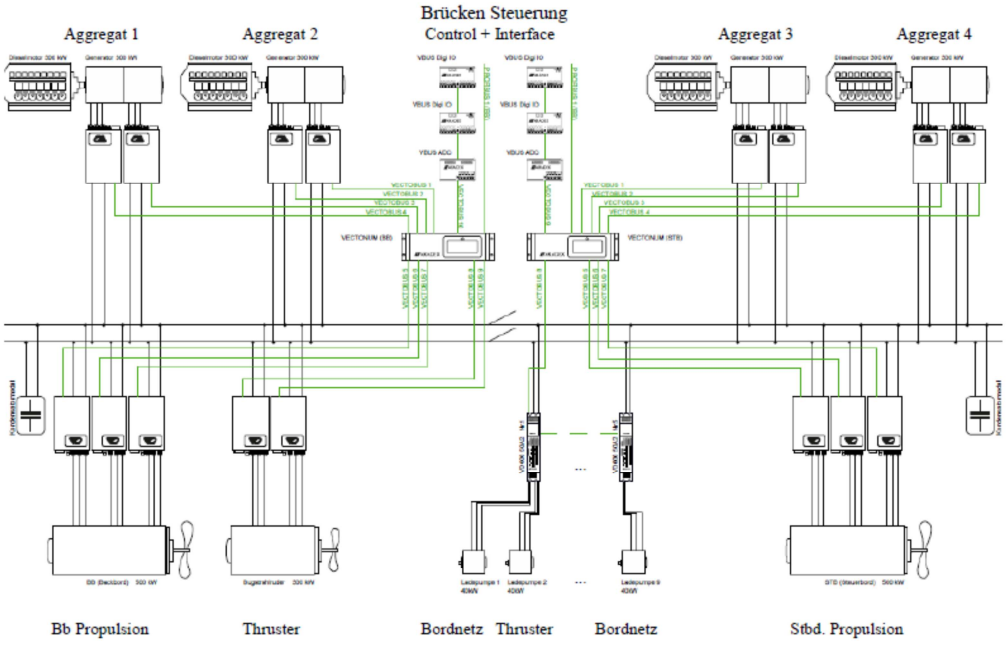

BRIDGE OPERATOR PANELS
24Vdc IN
FAILSAFE
12" TFT
(TOUCH-SCREEN)
24Vdc IN
FAILSAFE
7" TFT
7" TFT
FIELDBUS PS (REDUNDANT)
FIELDBUS SB (REDUNDANT)
PCS CABINET (PS)
MASTER
24Vdc IN
FAILSAFE
PCS CABINET (SB)
MASTER
24Vdc IN
FAILSAFE
PROFIBUS DP
4-20mA SETPOINT
4-20mA SETPOINT
PROFIBUS DP
ARADEX
SLAVE
ARADEX
SLAVE


Brücken Steuerung
Control + Interface
Aggregat 1
Aggregat 2
Aggregat 3
Aggregat 4
Bb Propulsion
Thruster
Bordnetz
Thruster
Bordnetz
Stbd. Propulsion

DC-intermediate circuit power distribution under increasing attention of the marine market

Based on consumption optimized energy generation, economically consumer and hence torquey propulsion units has the in Hamburg located Torque Marine IPS GmbH & Co. KG in 2010 with its High Torque Power Drive (HTP)™ ® an innovative diesel electrically propulsion system for the inland waterway, coastal and towing shipping developed, which is clearly superior to conventional propulsions with combustion engine and reverse gear.
With dimensions of 84 m in length, a width of 9.5 m and a max draft of 2.86 m the bulker ENOK can load up to 1.500 to. Since mid of 2010 the vessel is in regular service on the European inland waterways.
ENOK is worldwide the very first and only bulker which is fitted with a permanent magnetic motor (PM drive) as a gearless electrically direct drive.
Based on five European Patents the company Torque Marine IPS, together with its partners, have converted the ENOK from a conventional diesel mechanically into a diesel electrically propulsion system with DC-intermediate circuit.
The change from traditional AC network with conventional converter towards the today's DC-intermediate technology enables significantly improved energy efficiency and most importantly safety because of redundancy.
The Torque Marine System® combines traditional constant speed running generators with modern speed controlled generators as well as renewable energy sources and energy storage and transfers the power via a 650V-bus (direct- current intermediate circuit)
The propulsion system and the wiring system are combined by the DC-bus with the consumer via intelligent inverter.
With this the need for main AC-switchboards, electric cabinets and propulsions for converter transformers are dropped.
The Torque Marine System® offers fuel savings up to 25% and reduces the electrically equipment, space requirement and weight of more than 50%.
In the shaping of the DC-bus Torque Marine follows three important requirements:

1. The safe operation by redundant system technology with common DC-bus by separation into single 210 / 230 KWe power segments.
2. Simple integration by modular assemblies
3. Complete system supply with clear interfaces

With this, very short commissioning periods, fast availabilities and matching toward new energy sources e.g. batteries, fuel cells, natural gas prime mover, etc can be provided.
Conventional diesel- / gas electrically propulsion systems made of standard industrial components with inverter require spacy converter cabinets and feature, in standard application (generator / converter / motor), a remarkable worse efficiency. Furthermore, with a direct drive a gear is required to reduce the high speed of the electric motor into the necessary rated speed for the propulsion system.
Torque is a very important issue for propulsion. This offers large potential savings. The company has integrated, with its Torque Marine System®, the latest and newest developments of the liquid cooled inverter technology, combined with highly efficient PM-generators and motors as well the most modern technology in energy storage and battery design.
The combination of robust power blocks and new logic offers naval architects unmatched freedom degree by choosing energy sources during engineering and planning with the new Torque Marine System®.

Safety and Control

AC- and DC-bus electrically drive systems are based so far on fast acting Power-Management-Systems (PMS) to ensure safety and control. Fuses and switches are selected very carefully to ensure selectivity in case of danger.
With the Torque Marine DC-bus power and stability is not any longer controlled by a PMS. Now they are controlled additionally via a communication system in each converter separately. Each converter decides itself which amount of power can be absorbed out of the DC-bus or can be delivered to the DC-bus. The network stays fully operational, also if the PMS is online – without a possible overloading risk of the DC-bus converter. The PMS-system automatically can make more power available to adjust the power demand if requested.
Connecting and disconnecting is enabled manually on request by the operator or automatically within a preprogrammed order. The performances at the generator –inverter – DC-bus – inverter – motor are softly connected by defined 100% power take off.

By this it's not possible to get an impact load on the genset (natural gas prime mover, battery, fuel cell, etc).
The power producer can be manually started or stopped by the ship's crew.
Even the possible breakdown of a single aggregate, motor, generator or inverter does not have any effect on the supply reliability and ships operation.
The distributed Power Control enables the system best for DP-system of vessels, because the stability is always ensured and a system overload can be avoided. For a fully redundant operation, e.g. in DP-mode, the DC-bus can be easily split into two or more independent DC-networks.

Well-known problems in conventional DC intermediate circuits respectively electrical drive systems.

* Extremely fast fuses are used to protect the industrial inverter in DC-networks.
* Each (standard) inverter contains a large DC capacitor, an internal circuit may break not only the next backups but in the worst case, all the major fuses can blow on the DC bus, as all the inverter internal DC capacitors are a source for short-circuit current .

This can result in a DC-bus blackout.

Torque Marine offers with its DC-bus and their VECTOPOWER inverter the ultimate solution to this problem. By removing the large internal capacitors on the DC-bus, an inverter short circuit cannot create anymore the potential to blow all other important fuses.
* In case of error, only the faulty fuses in the inverter will be blown.
* The inverter-based distributed load balancing and power control guarantees an immediate response to powertrain changes, by maintaining the functional system integrity.
* Since the DC power needs no fixed frequency generators anymore, the generator speed can be optimized for the most efficient load point.
* With this aggregates with different speed and output can be connected on a common DC-link.
* While conventional systems usually work with standard AC generators, the DC-bus allows easy integration.

TORQUE Marine Innovative Propulsion Systems (IPS) are:

* Liquid-cooled PM-generators for variable speeds.
* High efficient systems over a wide range of speed.
* A robust design and direct liquid cooled. Torque Marine VECTOPOWER inverter become, in combination with gensets with variable speeds, DC-aggregates and can be used throughout a wide range of speed and load.

TORQUE Marine offers single and multiple solutions:

* It is possible, to combine one or more DC-bus systems with one Torque Marine generator.
* The water-cooled generators in robust design, with high degree of protection (IP65) and wide temperature range limit, are suitable for almost every engine room. The Torque Marine

inverter offer excellent liquid cooling with cooling water inlet temperature at the box coolers / heat exchangers of up to 35 °C. The inverters feat ure a high protection class (IP67) as well as high shock and vibration resistance.
By this design, Torque Marine VECTOPOWER inverter can be mounted directly to the generator or prime mover.
* Therefore inverter cabinets can be avoided which saves valuable engine room space.
* With its PLC-based programming and flexible motor control, the Torque Marine VECTOPOWER inverter can be adjusted to operate as a generator to the inverter DC-link or to work as an inverter from the DC intermediate circuit.
* In contrast to standard industrial inverters, which are sensitive to moisture, shock, saline mist and high air temperature, the Torque Marine VECTOPOWER converter is suitable, by its rugged design with IP67-housing, liquid cooling and the ability to withstand shocks up to 50g and 105 °C. , for each engine room situation.
* The example of an inland waterway vessel equipped with two 230 KWe diesel engines in the foreship and a 460 KWe unit in the rear engine room shows how dramatically the space saving can be.
* Standard liquid-cooled generator rectifier requires a cabinet of 400 x 2000 x 600 mm.
* Compact Torque Marine IPS VECTOPOWER converter do not require a cabinet or additional space. In addition, the unit can be shortened by smaller volume and weight of the PM generator
* It is possible to mount the VECTOPOWER inverter as active inverter directly on the unit.
* The units can run at variable speed. Within this range an automatically control at 650 V DC-link is set.

Flexible components

The modular, redundant TM © DC bus design gives naval architects large freedom by choosing the right energy sources and installation position on the vessel.
The TM©® DC-bus-design does not require a fixed frequency. Any traditional or modern power source and stored energy can simple be connected to the DC power source. Fixed or variable speed generators, high-speed turbines, wind, solar and fuel cells all benefit from a common DC bus. All electrical energy storage solutions can be easily mounted. For low C-rates, which are often used in yachts and ferries, the lithium-ion batteries (LiFeMnPo4) are supplied in standard air-cooled version. In case of higher requirements water-cooled lithium-ion batteries can be used.
The integrated battery ensures optimal BMS performance and long life, and with its direct connection to the Torque Marine VECTOPOWER DC-DC converter, the battery bank can be freely configured in voltage and capacity and can be easily connected to the DC bus. The LiFeMnPo4 battery systems offered by Torque Marine produce no gases and are classified as safe by U.S. authorities, according to UN standards and the American International Assurance.
Cells can be crushed, punctured, soaked in salt water, short circuited, fully discharged and recharged without catching fire. If an external fire sets the cells under fire, standard methods of firefighting are used to delete the fire. The flames from the batteries do not produce free oxygen or combustible gases.
In addition to batteries with low C-rate cycles, Torque Marine capacitive energy storage modules with a fully integrated capacitor management system can be used.
* This provides an excellent solution for high cyclic and high load fluctuations. All components are designed for the same harsh environment and provide IP67 housing. They are designed for direct liquid cooling, high shock as well as vibration resistance. Components can be placed directly on or nearby of its application. Only one or more DC distributions need to be installed at a suitable location.

Installation space, which normally for AC distribution at standard industrial applications, is reserved for inverter becomes available and can be used for more useful applications.
The unique combination of high-performance components in combination with the ultimate loadability and safety in the design of distributed DC-link solution provides substantial advantages for a large number of ships.
* The shipbuilding industry benefits from space-saving, by separated redundant system engineering and hence failure-safe system. The galvanic separation of the propulsion systems from the general on-board electrical network, causes not the well-known general net disturbances.
* Ferries and tugs turn, can benefit from the support grid and battery supported shore power charging which results in minimum emissions. Ships with dynamic positioning systems and inland waterway vessels benefit from a flexible engine room layout and fuel efficiency. Remarkable fuel savings were realized with ships under dynamic load conditions.
* Vessel in DP mode save up to 30% fuel, if the combination of distributed DC power with an energy-storage solution is used.
* If the gensets are operating under low load conditions, energy storage devices such as Lithium ion batteries feature an economical solution.
* Surplus energy of the units are collected in energy storage.
* Propulsion or on-board network system peaks are powered by the energy storage.
* The generators can operate at a stable optimal load. The power control and load balancing ensures a constant load on the generator and the battery support in case of load demand. The modular, redundant Torque Marine System® supports with its user-friendly logically structured system engineering all functions required for the safe operation of the ship. At highly variable load conditions (ports, stand-by with tugs, ferries over short distances, etc) is the use of energy storage economically.
* Excess generator power is saved.
* Short-term load requirements are delivered from the energy storage device.
* This allows a significant reduction of operating times in terms of the aggregates and thus a significant reduction in operating costs.

About Torque Marine IPS GmbH

„Torque Marine IPS Innovative Propulsion Systeme GmbH & Co. KG“, based in Hamburg, has been established in June 2008 with the aim to develop a diesel-electrically ship propulsion system
Company partners are Claus-D. Christophel (Hamburg) and Hans Helmut Schramm (Brundsbüttel). Both are very activ since many years in the maritime market: Claus-D. Christophel has been managing partner in his 1974 established CDC Mess- und Regeltechnik GmbH. In 2008 he sold this enterprise to the Finnish Wärtsilä Group. Since 12 years Hans Helmut Schramm is the owner and CEO of the Hans Schramm & Sohn GmbH & Co. KG.

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1.00 Redundanter Antrieb EP2218637

EP 2 218 637 B1 EUROPÄISCHE PATENTSCHRIFT Datum 18.04.2012
EP2218637 - Drive system for a ship / Antriebssystem für ein Schiff
interner Titel: Redundanter Elektroantrieb für Schiffe
https://register.epo.org/espacenet/regviewer?AP=09002100&CY=EP&LG=en&DB=REG

2.00 Modularer Systemaufbau EP2218638

EP 2 218 638 B1 EUROPÄISCHE PATENTSCHRIFT Datum 18.04.2012
EP2218638 - Drive system for a ship / Antriebssystem für ein Schiff
interner Titel: Modularer Aufbau von Elektromotoren für Schiffe
https://register.epo.org/espacenet/regviewer?AP=09002108&CY=EP&LG=en&DB=REG

3.00 Steuerung und Überwachung EP2226245

EP 2 226 245 B1 EUROPÄISCHE PATENTSCHRIFT Datum 02.05.2012
EP2226245 - Drive system for a ship / Antriebssystem für ein Schiff
interner Titel: Elektronische Steuerung für ein Schiff
https://register.epo.org/espacenet/regviewer?AP=09003167&CY=EP&LG=en&DB=REG

4.00 Hybrid System EP2243699

EP 2 243 699 B1 EUROPÄISCHE PATENTSCHRIFT Datum 18.04.2012
EP2243699 - Drive system for a ship / Antriebssystem für ein Schiff
interner Titel: Modularer Antrieb mit Batteriepuffer für Schiffe
https://register.epo.org/espacenet/regviewer?AP=09005615&CY=EP&LG=de&DB=REG

5.00 Diagnose von Schiffsantrieben EP 2 202 145

EP 2 202 145 B1 EUROPÄISCHE PATENTSCHRIFT Datum 15.08.2012
EP2202145 - Diagnose von Schiffsantrieben
https://register.epo.org/espacenet/regviewer?AP=09014924&CY=EP&LG=de&DB=REG

6.00 Markenschutz

Trade mark name: TORQUE Marine
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Trade mark basis: CTM
OHIM © Registration date: 26/04/2010
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The Trade Marks and Designs Registration Office of the European Union