THE SWITCH
A BEMAC GROUP COMPANY

THE SWITCH DC-HUB FOR MULTI-MEGAWATT POWER SYSTEMS

BEMAC

GAME-CHANGING TECHNOLOGY

The Switch DC-Hub is the world's smartest technology for a multi-megawatt DC power system. It ensures stable and secure operation for chosen consumers and enables a vessel to be future-flexible for new fuel sources.

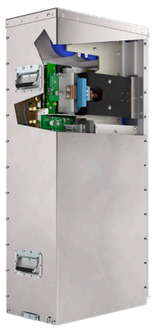
PROTECTION DEVICES FOR SAFE DC POWER DISTRIBUTION

The Switch offers a full suite of protection devices that guarantees safe DC distribution under all sailing conditions, making DC increasingly attractive for future-flexibility.

The 4 ultrafast devices protect inside The Switch DC-Hubs, between DC-Hubs, and to and from batteries.

The Switch DC-Hub for multiple applications optimizes multi-megawatt DC distribution systems for all marine vessels.

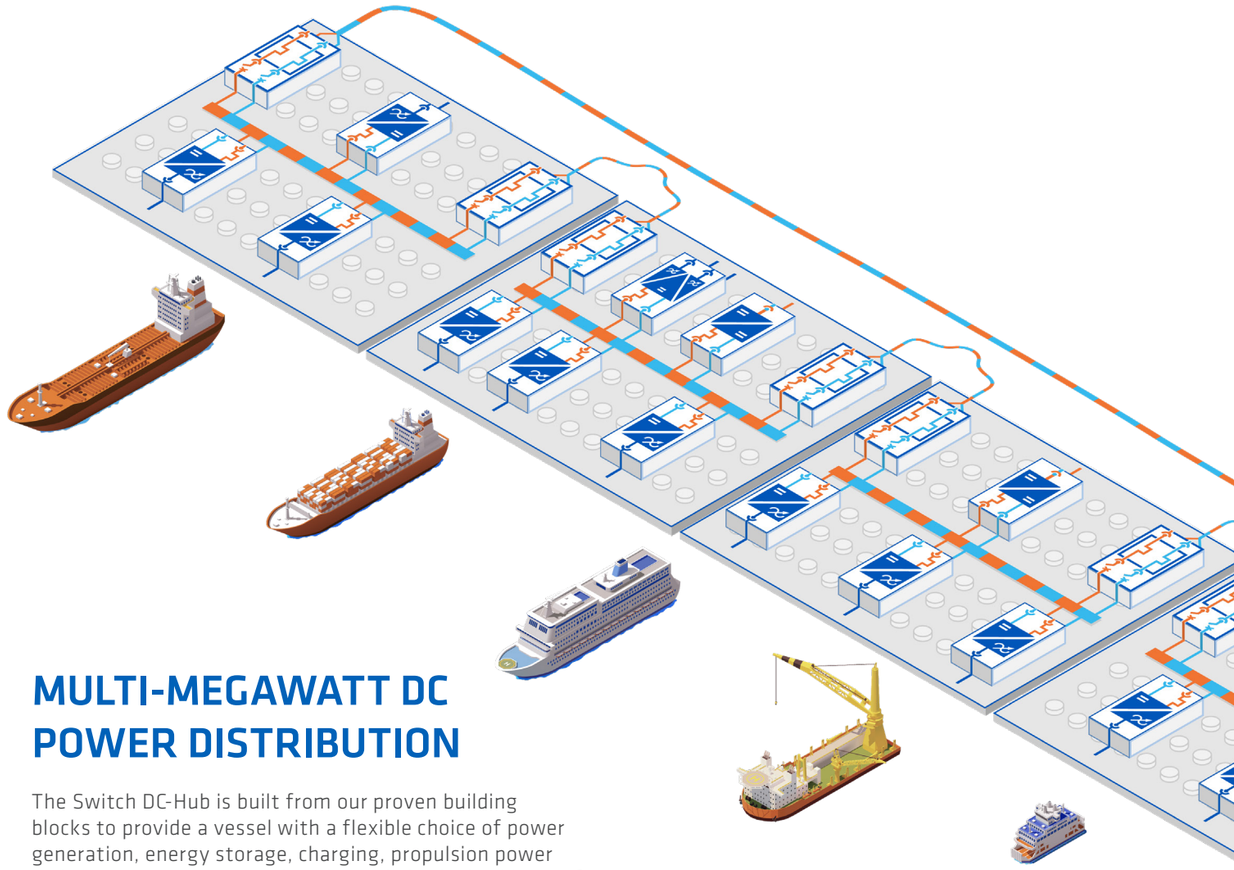
The Switch Electronic Bus Link (EBL) connects the vessel's DC-Hubs and protects against faults between DC-Hubs. The up to DP3-rated and DNV-approved EBL provides protection outside the DC-Hub by splitting onboard grids in microseconds to isolate any faulty DC-Hub.



The Switch Electronic DC Breaker (EDCB) protects against short-circuit faults inside a DC-Hub and ensures ride-through. This semiconductor-based device disconnects any failing drive module within 10 microseconds from the common DC link.

The Switch Battery Short-Circuit Limiter (BSCL) restricts any short-term current from batteries, immediately blocking the short-circuit system. This allows more batteries to be connected to the electrical system and fewer DC-Hubs, making the entire system more compact.

The Switch Electronic Current Limiter (ECL) connects the battery directly to the DC link to protect it from external failure and ensure ride-through. It functions similar to EBL.



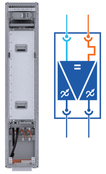
MULTI-MEGAWATT DC POWER DISTRIBUTION

The Switch DC-Hub is built from our proven building blocks to provide a vessel with a flexible choice of power generation, energy storage, charging, propulsion power and clean power connected to the DC link, the backbone of the DC-Hub.

The Switch DC-Hub can work independently alone or together with other The Switch DC-Hubs.

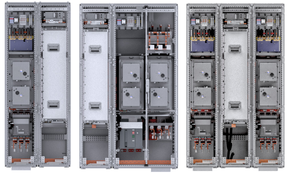
SWITCH TRACKS TO DC DISTRIBUTION

BUILDING BLOCKS



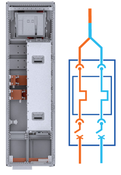
Motor/generator inverter (MI/GI)

- Motor and variable-speed generator applications
- Shaft generator support (PTO, PTI, PTH)
- PM, IPM and EESM supported
- Torque, speed, power, DC voltage and scalar control modes
- Typically, no need for du/dt filter with VSD compatible machines: du/dt average is <2.5 kV/µs at inverter terminal



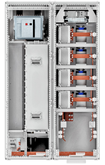
Active front end (AFE)

- Grid compliance, THDu <5% (typically <3%)
- Grid or DC voltage control
- Island mode support with blackout start
- Active harmonics damping
- Possible to connect several AFEs to the system
- Possible to parallel units with LCL or dedicated winding



Electronic Bus Link (EBL)

- Connects The Switch DC-Hubs together
- Critical faults are detected and disconnected in approximately 10 microseconds
- Allows a ring network
- Improves redundancy while enabling fuel savings
- DP3 tested and approved by DNV
- Several units can be connected to the system



DC/DC chopper for batteries

- Links battery, fuel cells and other DC-source connections to the DC-Hub with maximum efficiency
- Enables numerous applications: reserve power, peak shaving, backup power and more
- Ensures constant DC voltage
- Allows DC voltage, current or power control modes
- Configurable output
- Several units can be connected to the system

HOW TO BUILD?

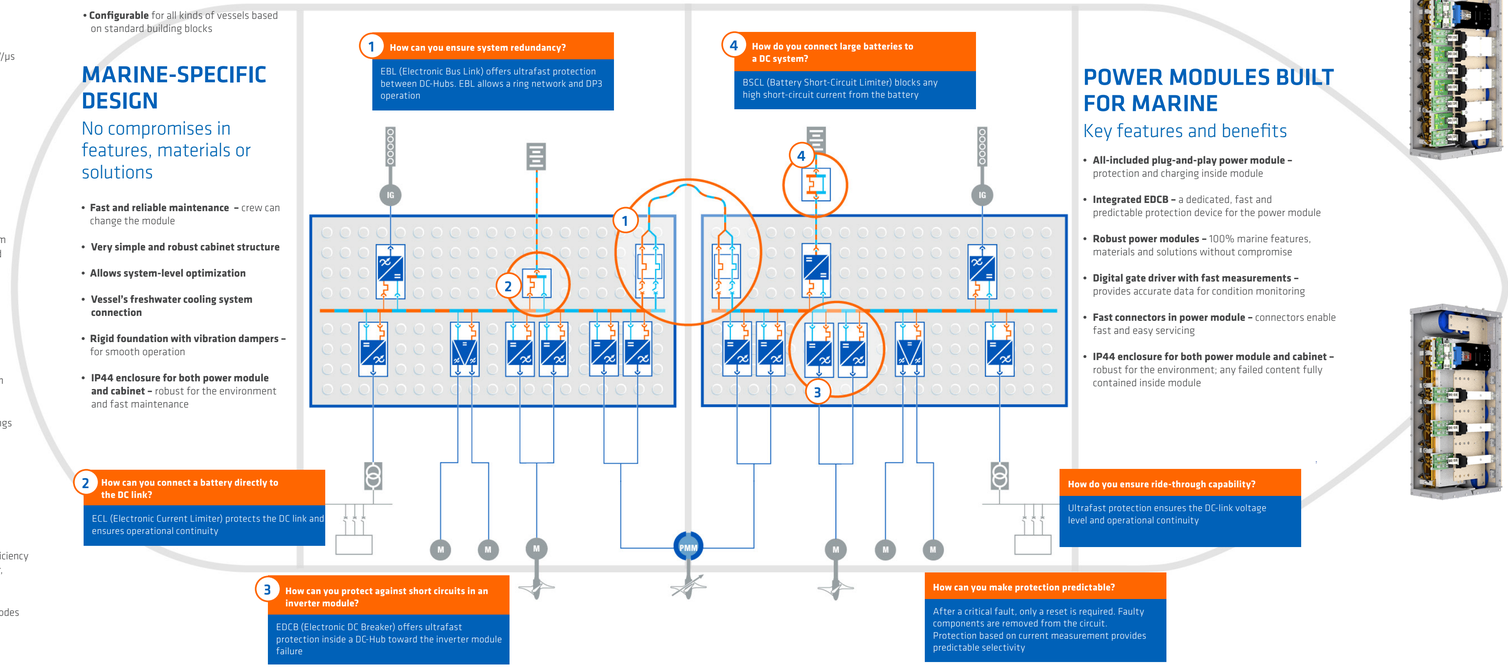
Configure your own

- **Configurable** for all kinds of vessels based on standard building blocks

MARINE-SPECIFIC DESIGN

No compromises in features, materials or solutions

- **Fast and reliable maintenance –** crew can change the module
- **Very simple and robust cabinet structure**
- **Allows system-level optimization**
- **Vessel's freshwater cooling system connection**
- **Rigid foundation with vibration dampers –** for smooth operation
- **IP44 enclosure for both power module and cabinet –** robust for the environment and fast maintenance



HOW TO PROTECT?

POWER MODULES BUILT FOR MARINE

Key features and benefits

- **All-included plug-and-play power module –** protection and charging inside module
- **Integrated EDCB –** a dedicated, fast and predictable protection device for the power module
- **Robust power modules –** 100% marine features, materials and solutions without compromise
- **Digital gate driver with fast measurements –** provides accurate data for condition monitoring
- **Fast connectors in power module –** connectors enable fast and easy servicing
- **IP44 enclosure for both power module and cabinet –** robust for the environment; any failed content fully contained inside module

POWER MODULES

High-power module with EDCB

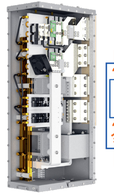
High-power density module for high-power applications. Several units can be connected in parallel to reach higher power. Continuous current of 1,200–1,600 A per module. Parallel connection of up to 4 units.

Flexible module with EDCB

The flexible module allows several applications to be combined within one module. The flexible design provides space savings while combining applications in one module.

Half module with EDCB

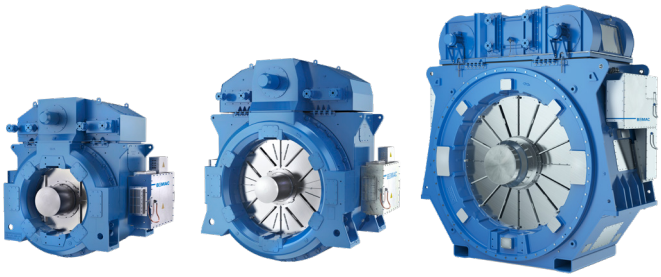
Solution for lower power applications within the same frame.



Electronic Bus Link (EBL)

Connects The Switch DC-Hubs together and disconnects them in approximately 10 microseconds. EBL allows a ring network and improves redundancy while operating with all DC-Hubs connected together.

WIDEST RANGE OF PERMANENT MAGNET (PM) MACHINES AVAILABLE



PMM1000M
Up to 250 rpm / 230 kNm
Typically used in 1–2 MW direct-drive systems

PMM1500M
Up to 220 rpm / 630 kNm
Typically used in 2–4 MW direct-drive systems

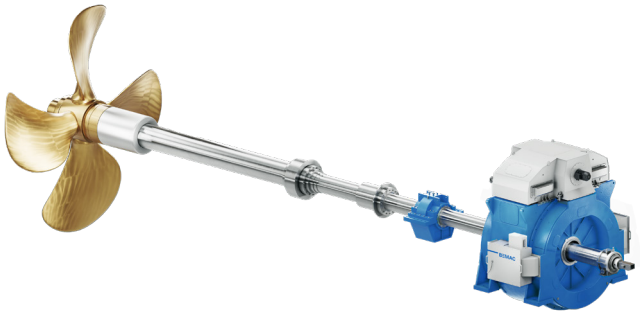
PMM2000M
Up to 130 rpm / 2,100 kNm
Typically used in 4–12 MW direct-drive systems

Our wide range of PM machines improves overall efficiency for propulsion and onboard electricity generation, helping reduce CO_2 emissions and operating expenses.

Advantages of PM technology

- Higher efficiency, lowering fuel consumption and emissions
- Simple construction
- Higher reliability
- Less maintenance
- Reduced space requirements
- Enhanced shaft line dynamics

DIRECT-DRIVE PROPULSION: BEARINGLESS CONCEPT



The Switch PMM can be used as a direct-drive propulsion motor, either conventionally with its own bearings and shaft or as a novel concept, utilizing the common bearings between the propulsion shaft and motor. A tandem configuration is also possible on request.

FULL-POWER TESTING UP TO 18 MW

Complete full-power testing with machines and drives up to 18 MW is available at our Large Drive Test Center in Lappeenranta, Finland.

All tests fulfill international standards and class requirements.

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The Switch is now part of the BEMAC Group whose products are unified under the BEMAC brand.

www.theswitch.com

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