

SUBSEA POWER CONVERSION

Unlocking new opportunities through HV DC Subsea Power Systems

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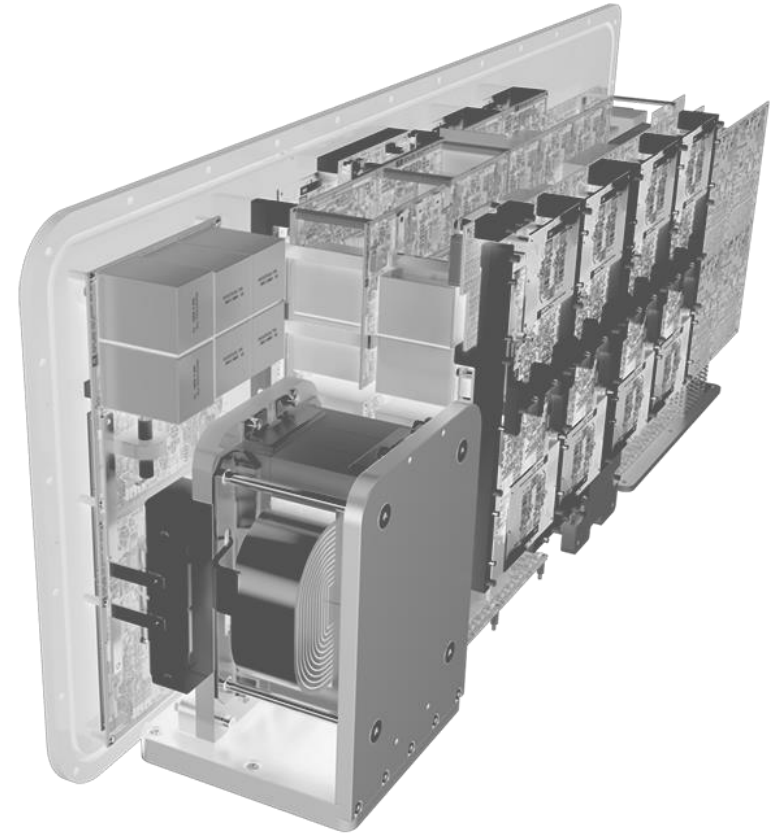
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AGENDA

- Introduction to CSS & CSS Isotek
- Conventional Subsea AC Power & Transformers
- Transition to Subsea DC Power Systems
- CSS Isotek Power Converter Technology
- Modular DC-DC Power Converter Project
- MPC Future Developments & Applications



WHO WE ARE

- Offices in Norway, UK, Croatia, Bosnia, Brazil
- 4,000sqm UK facilities & 2,000sqm Norway facility
- 120+ dedicated employees
- Global client base & agent network
- MORGRIP Mechanical Pipeline Connectors since 1987
- Remote Subsea Pipeline Welding since 1978
- Complete Deepwater Tie-In and Pipeline Repair Solutions since 2000
- Subsea Distribution systems since 2011

OUR EXPERIENCE

Connector Subsea Solutions (CSS) is a technology leading engineering business with a large a portfolio of products and equipment to provide solutions primarily to the Offshore Oil & Gas industry.

CSS develops and supplies novel, reliable and cost-effective technologies and solutions for subsea and deepwater projects and has a proven track record from some of the world's most demanding subsea environments.



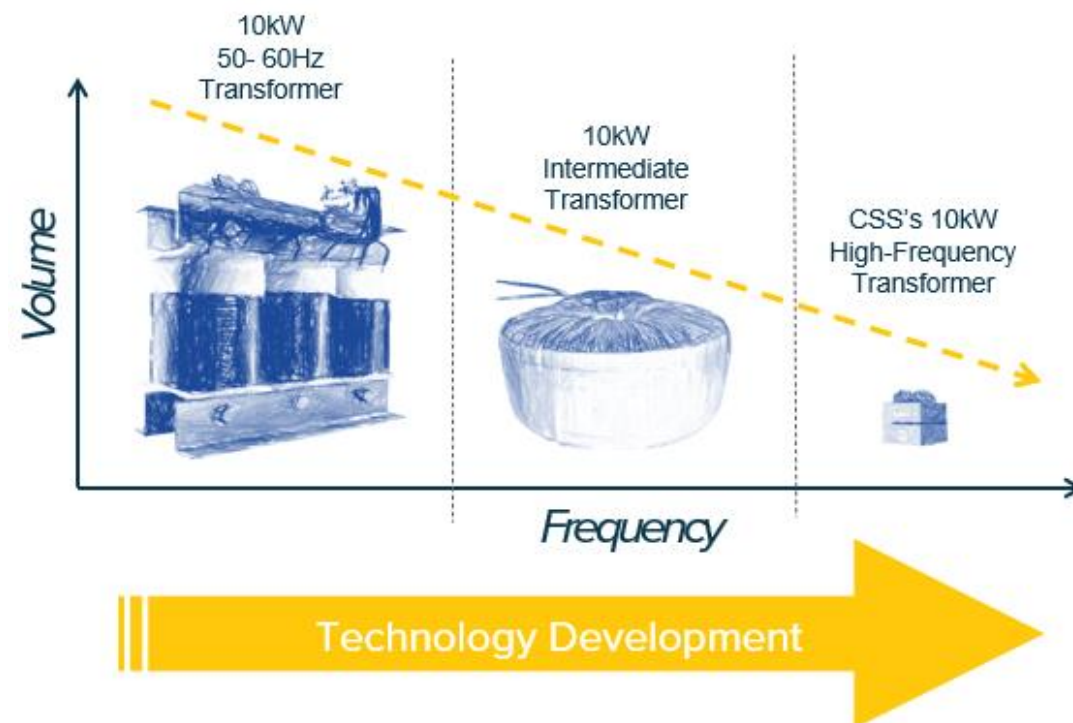
INTRODUCTION TO CSS ISOTEK

- **Acquired by Connector Subsea Solutions AS in 2020**
- **Evolved from Isotek Electronics established in 1978**
- **Created to design and manufacture computer-based control systems**
- **A dedicated team of 20+ multidisciplined engineers & technicians**
- **Over 30 years' experience of designing & delivering complete welding solutions and associated subsea power and control systems including:**
 - Diver assisted (TIG) welding & control systems
 - Remote Orbital and Hot –Tap (MIG) welding & control systems
 - Key Partners with Equinor in their PRSi systems for power, control & software systems
- **Supply of a variety of bespoke control & power system developments**



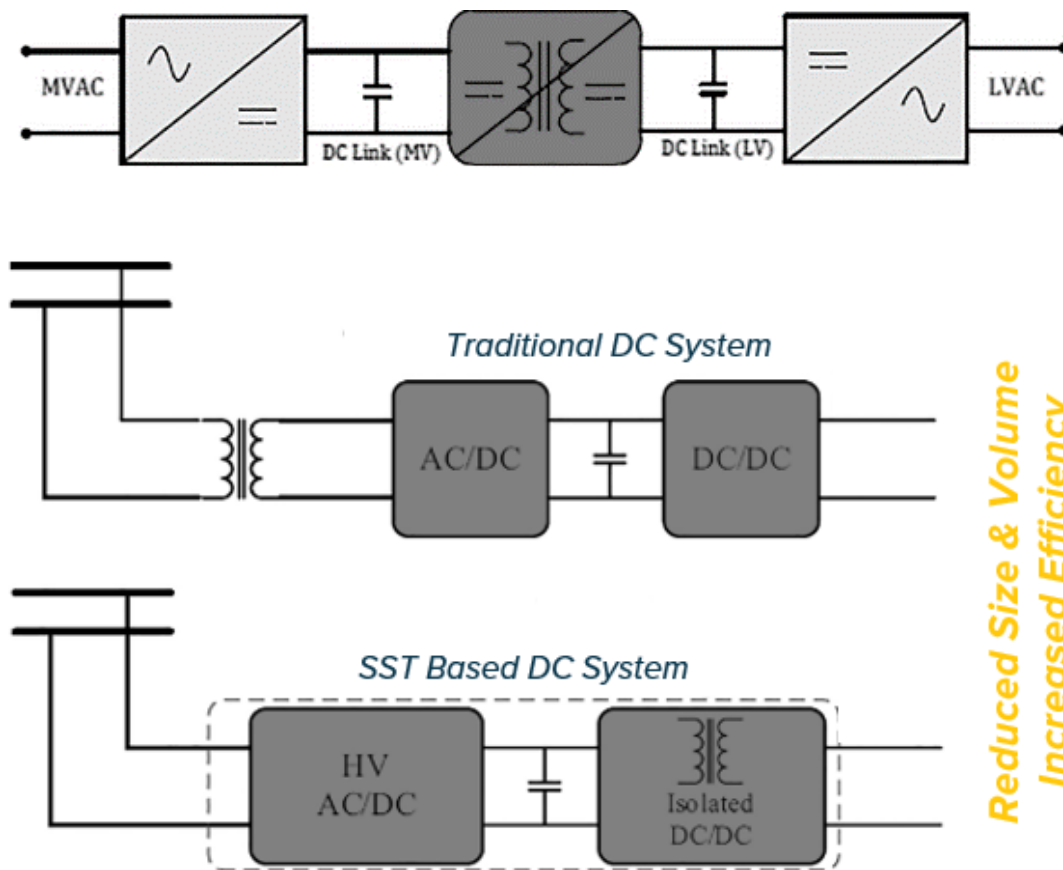
CONVENTIONAL AC POWER SYSTEMS & TRANSFORMERS

- High Voltage (HV) AC
- Large transformers
- Large filtering components
- Resistive & reactive power losses
- NO dynamic control
- Supplementary circuits required



TRANSITION TO SUBSEA DC POWER SYSTEMS

- High-frequency DC-AC conversion
- DC-DC Power Supply technology
- Wide Bandgap Semiconductors (SiC, GaN)
- High blocking voltages & switching speeds
- Development of DC Thrusters in subsea
- An attractive commercial alternative



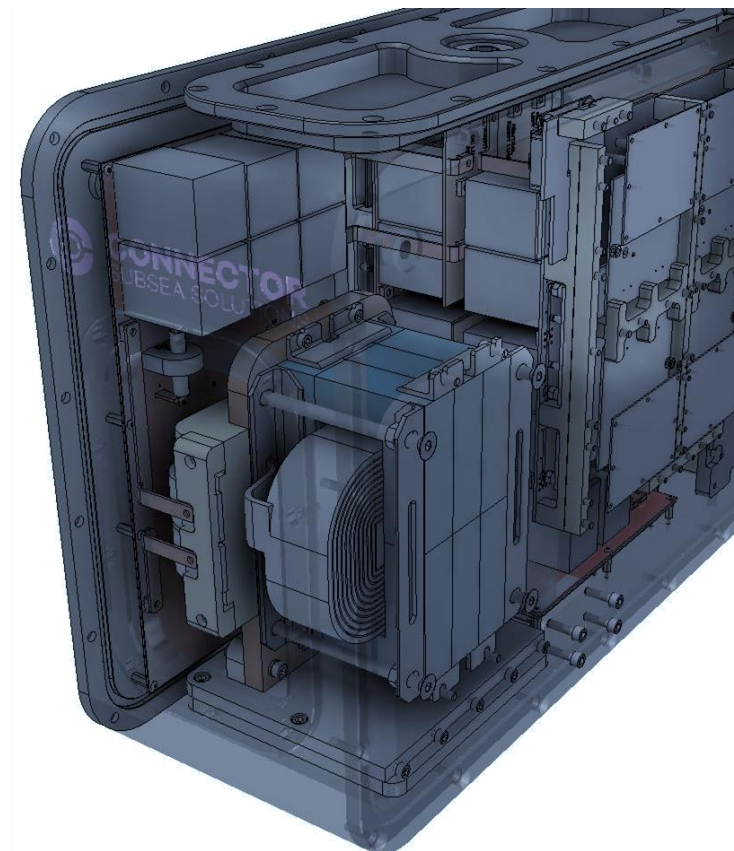
CSS ISOTEK POWER CONVERTER TECHNOLOGY

CSS Isotek offers various Power Converter solutions to step-down HV/MV DC in a compact, low weight & efficient manner

- Utilise power electronics - wide bandgap SiC devices
- Operate at higher switching frequencies
- Reduce magnetics physical size & weight
- Operate at higher voltages & power levels
- Pressure tolerant components and design (6000m W/D)

Technology is capable of being reconfigured & repackaged to suit individual applications with respect to voltages & power

Note: CSS Isotek have developed this technology as part of an internal product development & own all related rights & IP

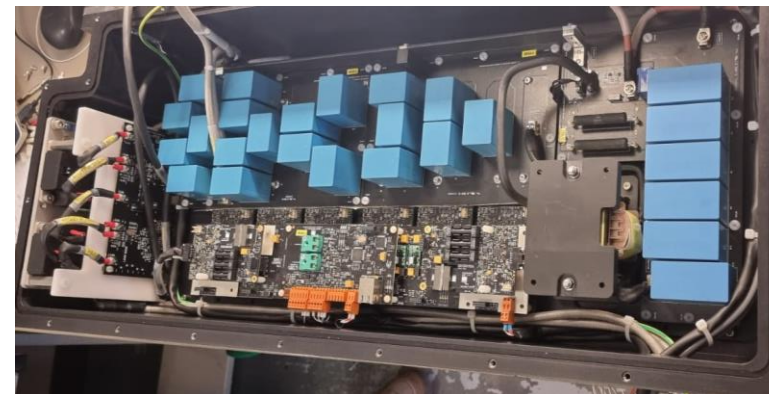


MODULAR DC-DC POWER CONVERTER PROJECT

The Modular DC–DC Power Converter (MPC) Project began in 2013

To date, multiple 10kW PC units have been delivered. Several 25 & 50kW MPC units have been tested. A complete 100kW MPC system is currently undergoing pre-production testing with a key client.

- Improved power efficiency & controllability of thrusters
- Weight reduction in voltage level conversion
- Reduced oil volume subsea and reduced leak possibilities
- High Voltage DC transmission (lower losses than AC system)
- 2 cores are required for DC instead of 3 (for AC)



50kW Prototype MPC ↑
10kW System ↓

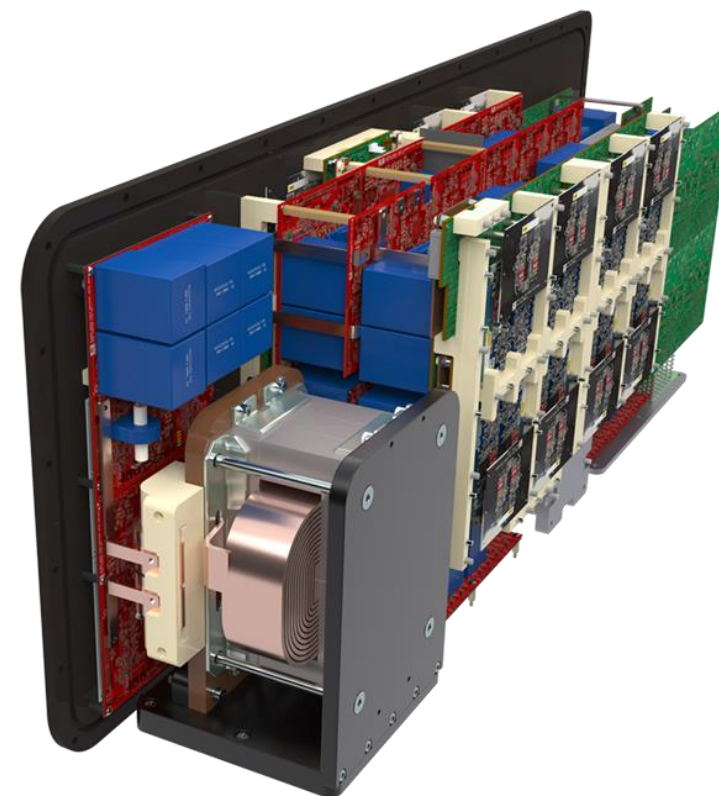
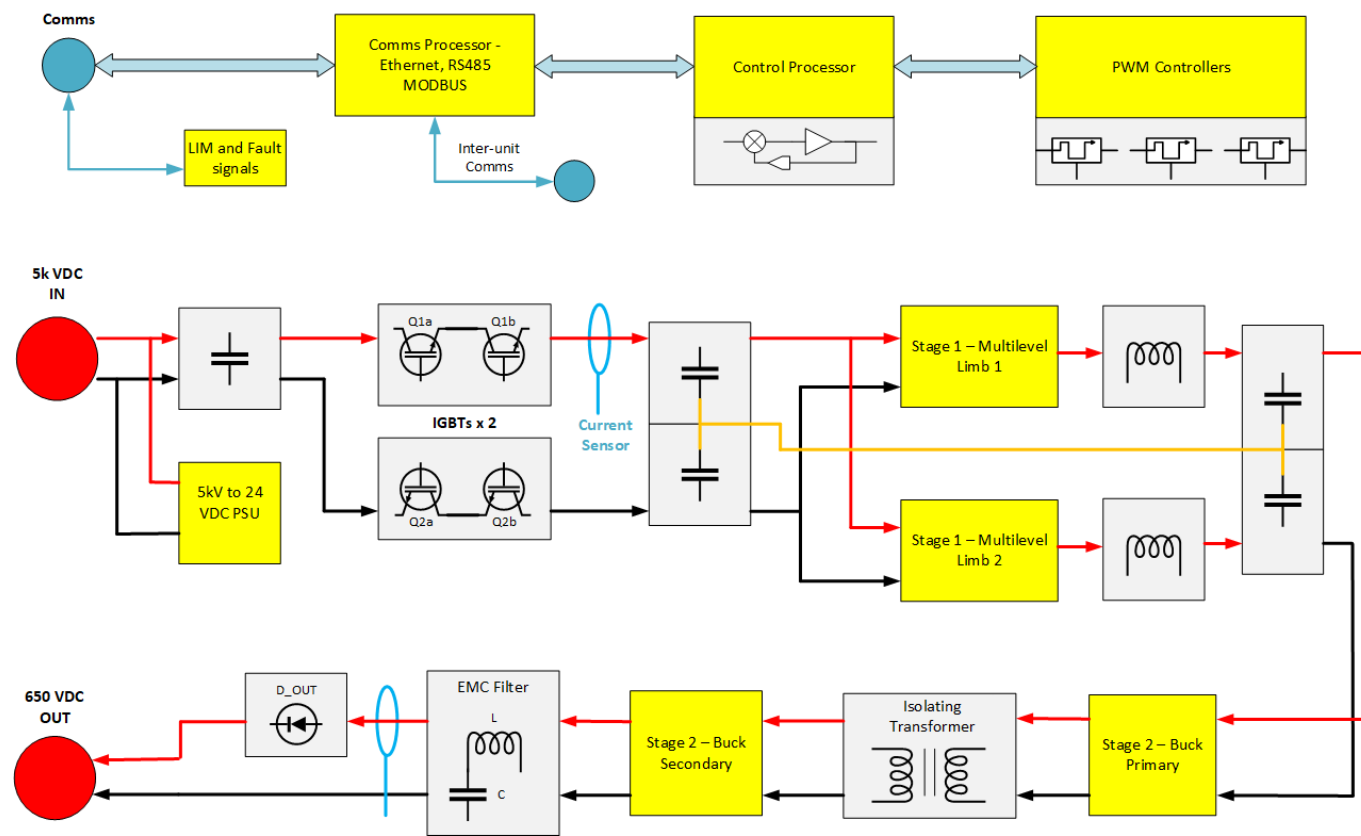


10kW = 4kg

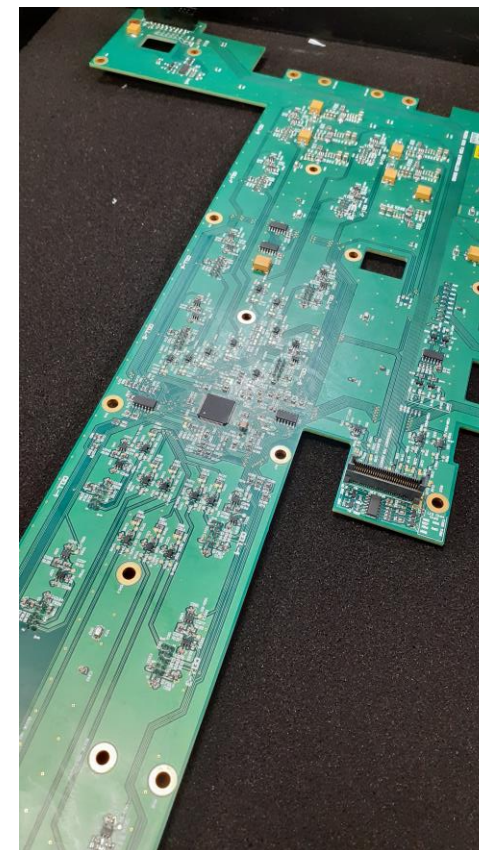
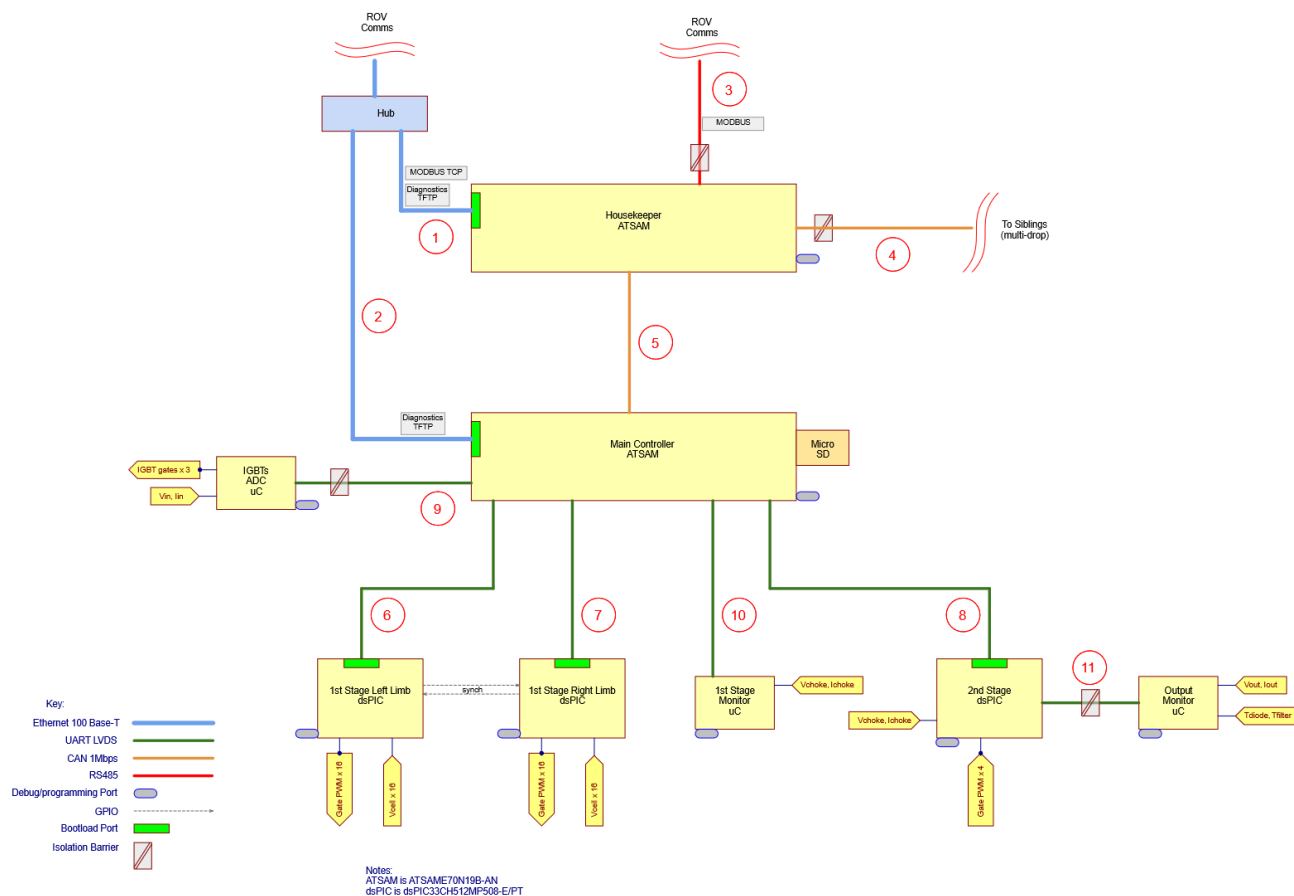
10kVA
= 85kg



OVERVIEW OF SYSTEM DESIGN

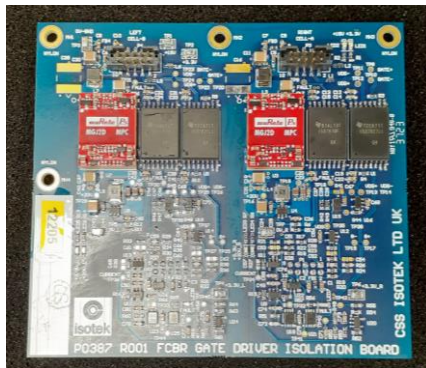
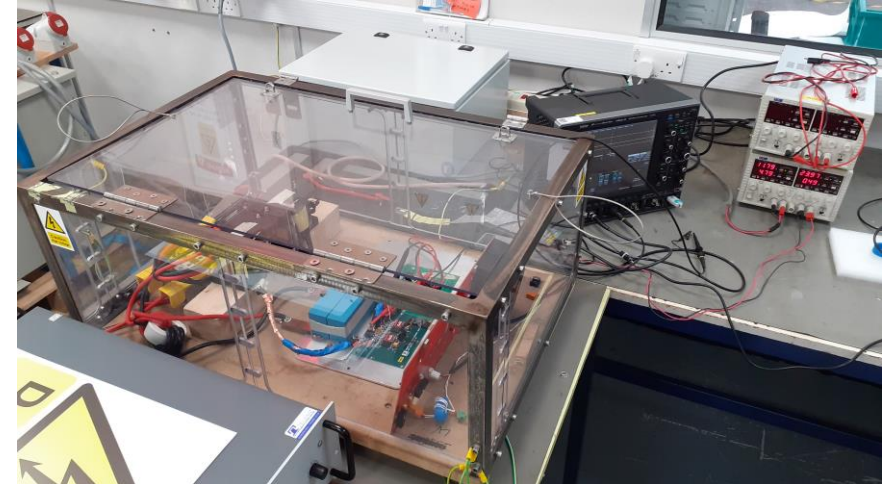


HIGH LEVEL CONTROL PHILOSOPHY



CURRENT PROJECT ACTIVITIES

- Tank thruster testing up to 50kW
- Complete 50kW + 50kW unit wet testing
- eROV integration of 100kW system
- Complete eROV system tank testing
- Production refinements & tuning



MPC FUTURE DEVELOPMENTS & APPLICATIONS

- Scalability of voltage and power
- Repackaging to application requirements
- Full solid state transformer (SST) solution
- MPC technology is transferable to other critical applications including:
 - Observation to Work Class ROVs + Resident ROVs & AUVs
 - Subsea inspection tooling & monitoring systems
 - Auxiliary power systems within Offshore Renewables
 - Fully electric vessels, deep-sea equipment & machinery
 - Subsea production equipment power & control
 - Infield power generation, battery systems & storage



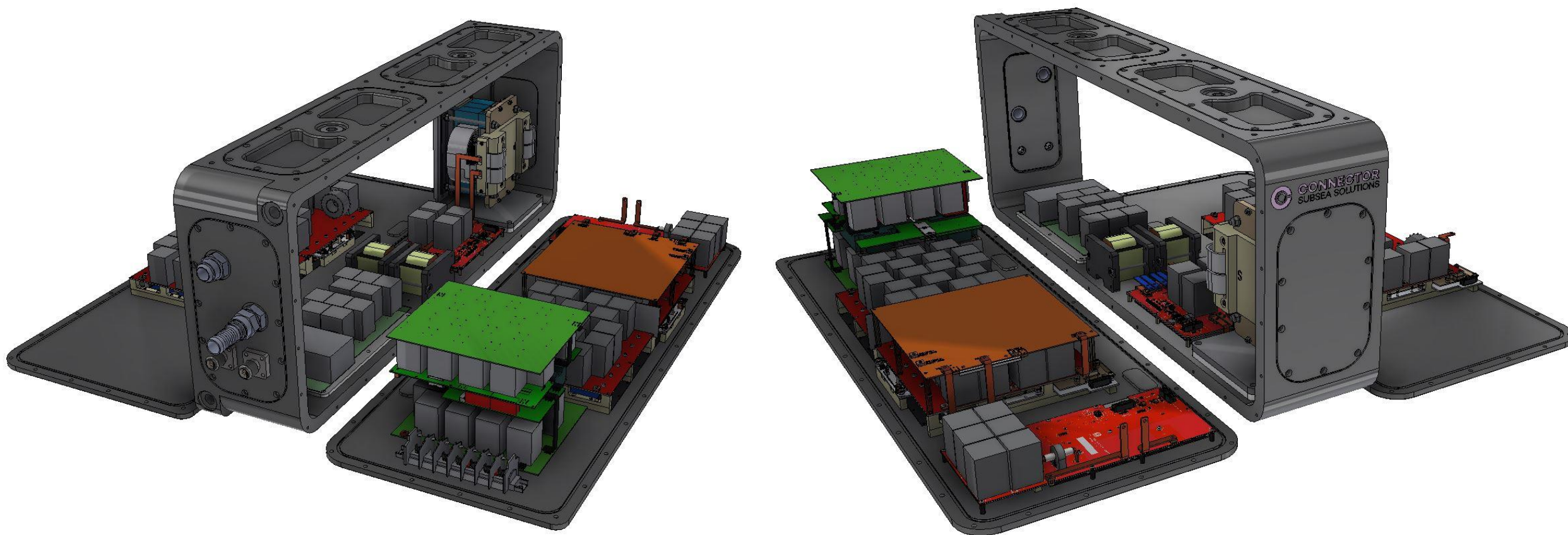
THANK YOU FOR YOUR TIME ...

For further information please visit us at Stand 58

Contact Connector Subsea Solutions www.connectorsubsea.com

Email sales.isotek@connectorsubsea.com

ARRANGEMENT OF COMPLETE 50KW PC ASSEMBLY



CSS ISOTEK

Summary of Products, Services & Capabilities

Welding, Power & Control System Specialists

CSS Isotek has a highly experienced and dedicated team of multidiscipline engineers able to deliver complex welding, power and control solutions in bespoke applications.

With a strong track record of delivering proven systems and technologies, CSS Isotek continues to develop and supply market leading, innovative solutions into the offshore OEM market.

CSS Isotek is focused on our core capabilities:

- Focus on high reliability in extreme environments
 - Complete remote welding & tooling systems
 - High-end power & electronics integration
 - Bespoke controllers & software solutions
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