



# Power Assemblies Products & Capabilities



FIRSTLY  
**INTRODUCTION**  
 TO DYNEX SEMICONDUCTOR

Dynex Semiconductor Ltd has a rich history in the design, development and production of High Power Semiconductor modules and Power Assemblies. Throughout the years, Dynex products have been applied in projects that vary from transportation, power grid, renewables, industrial, equipment and specialist applications.

The Power Semiconductor and Power Assemblies operation is located in Lincoln, England, manufacturing a range of high power IGBT modules, Bipolar capsule devices and power assemblies.

**WHY CHOOSE DYNEX**  
 FOR YOUR PROJECT?

- ✓ Over 60 years' experience in the design and build of power assemblies
- ✓ Design and manufacture products with high quality materials, following internal and external processes and standards
- ✓ Engineering experts who encompass a wealth of power electronic experience and industry knowledge
- ✓ Bespoke assemblies designed and manufactured in-house to meet specific customer requirements
- ✓ Customer support from all business areas
- ✓ In-house design capability
- ✓ ISO14001, ISO9001 and ISO50001 certified

# CONTENTS

INTRODUCTION TO DYNEX POWER ASSEMBLIES	4
.....	
<b>POWER ASSEMBLY PRODUCTS</b>	
STANDARD POWER ASSEMBLIES	5-6
.....	
MODULAR POWER STACK	7
.....	
PULSED POWER ASSEMBLIES	8
.....	
PULSED POWER ENERGY DELIVERY EQUIPMENT	8
.....	
POWER FACTOR CORRECTION	9
.....	
TRACTION CONVERTER, UPGRADE AND OVERHAUL	10
.....	
CONTRACT ASSEMBLY AND CAPABILITIES	11
.....	
<b>IN-HOUSE MANUFACTURING SUPPORT CAPABILITIES</b>	
POWER ASSEMBLY DESIGN	13
.....	
ON-SITE TESTING FACILITIES	14
.....	
POWER ELECTRONICS LABORATORY	14
.....	
MACHINE SHOP	14
.....	
IMPORTANT INFORMATION	15
.....	



# INTRODUCTION TO POWER ASSEMBLIES

Dynex provide power assemblies products for those customers that require more than the basic semiconductor components.

## OUR PRODUCTS

Specialising in the design and manufacture of assemblies such as rectifiers and converters, Dynex has an established supply chain for all components of power assemblies, resistors and capacitors for snubber networks and control circuits.

Our highly skilled power electronics, mechanical and electrical engineering experts have direct access to the company's wider application, test and product design groups.



### Key Features

The design and manufacture of power semiconductors and assemblies are supported by:

- ✓ In-house CNC machine shop
- ✓ In-house test facilities
- ✓ In-house power electronics laboratory

## STANDARD POWER ASSEMBLIES

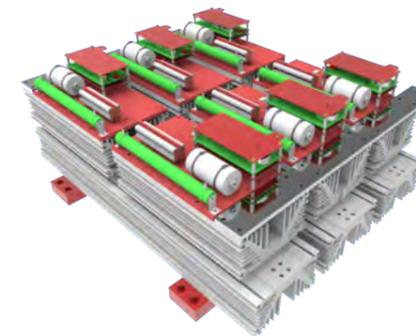
Rectifiers, Stack Assemblies, Inverters/Converters

Dynex offer a varied range of industry standard power assemblies configured to suit your application and specific performance requirements.

In order to maximise the semiconductor performance in an assembly, the type of heatsink, transient conditions, overloads, ambient temperature, surface finish (e.g. black anodised) and the method of cooling (air, liquid or phase change) needs to be considered.

Our designers encompass a wealth of experience using 3D CAD and simulation software, with an increasing range of bipolar and IGBT power semiconductor devices and components available to ensure that standard power assemblies are optimised for customer applications.

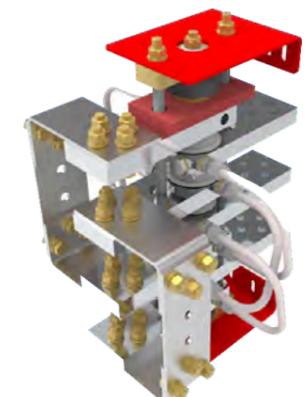
### RECTIFIERS



### STACK ASSEMBLIES



### INVERTERS/CONVERTERS



## Assemblies by Application



### TRANSPORT

Standard Assemblies, Modular Power Stack, Pulsed Power Assemblies & Delivery Equipment, Power Factor Correction, Traction Upgrade and Overhaul, Contract Assembly



### INDUSTRIAL

Standard Assemblies, Modular Power Stack, Pulsed Power Assemblies & Delivery Equipment, Power Factor Correction, Traction Upgrade and Overhaul, Contract Assembly



### RENEWABLES

Standard Assemblies, Modular Power Stack, Pulsed Power Assemblies & Delivery Equipment, Power Factor Correction, Contract Assembly



### POWER GRID

Standard Assemblies, Modular Power Stack, Pulsed Power Assemblies & Delivery Equipment, Power Factor Correction, Contract Assembly



### CUSTOM EQUIPMENT

Contract Assembly



### SPECIALIST

Contract Assembly

Single phase controlled and uncontrolled rectifier assemblies

3-phase and dual 3-phase rectifier assemblies

3-phase (6 pulse) and dual 3-phase (12 pulse) controlled rectifier assemblies

Stick stacks for high voltage/high current applications

MV soft starts

Thyristor/GTO assemblies with anti-parallel diode combinations

Air cooled and water cooled stack assemblies

3-phase thyristor inverter power units

IGBT chopper H-Bridge inverter modules

IGBT full 3-phase inverters for motor control

Frequency converters



## STANDARD POWER ASSEMBLIES

Bipolar Assemblies, Pulse Power, IGCT, Soft Start, Locomotive Rectifier

Dynex are driven by the manufacturing of highly efficient power assemblies that deliver on performance and reliability for customer applications.

Dynex offer a variation of standard power assemblies in order to meet customer requirements.



### Air Cooled Bipolar Assemblies

VDRM:  $\leq 15\text{kV}$  Irms:  $\leq 1500\text{A}$

#### Application:

- ✓ Locomotive
- ✓ Industry
- ✓ Converter

**Features:** Thyristor/ diode available, extruded aluminium heat pipe heat sinks

### Water Cooled Bipolar Assemblies

VDRM:  $\leq 20\text{kV}$  Irms:  $\leq 3000\text{A}$

#### Application:

- ✓ Industrial
- ✓ Converter
- ✓ Heat pipe power supply

**Features:** Thyristor/ diodes, IGCT available; gate drive and protection

### Pulse Power Bipolar Assemblies

VDRM:  $\leq 40\text{kV}$  Irms:  $\leq 4000\text{A}@500\mu\text{s}$

#### Application:

- ✓ Pulse power supply
- ✓ High power microwave

**Features:** Pulsed power device based for single switch application, gate drive and protection

### Locomotive Rectifier

#### Vibration resistance

#### Application:

- ✓ Traction converter for locomotive

**Features:** Alloyed diodes based air-cooling structure, vibration resistance and high reliability

### Soft Start Module

#### Thyristor/ Diode based

#### Application:

- ✓ LV Soft-starter

**Features:** Thyristor/ diode based, air-cooling structure, compact and light weight, stable and reliable performance

### IGCT Assemblies

Up to 14MVA  
High surge current: single unit  $>35\text{kA}@10\text{ms}$

#### Application:

- ✓ Rolling mill drive
- ✓ Off-shore wind power

**Features:** IGCT/ FRD based water cooling compact structure, up to 14MVA



## MODULAR POWER STACK

Suitable for Soft Starter and bypass switches

### Key Features

- ✓ Standardised power semiconductor solution for soft-start application
- ✓ Serialised parts with more than 10 power ratings to meet various application requirements
- ✓ Standardised design dedicated to reducing the complexity and work-load of soft-starter design
- ✓ Compact structure, power stack and bypass, enables the switch to be integrated into typical soft-starter cabinet
- ✓ Easy to mount and maintain without auxiliary thermal grease
- ✓ Centre distributed gate control
- ✓ Sealed housing structure with inert gas protection enable improved PC capability and reliability
- ✓ Thermal design to enforce thermal resistance performance
- ✓ Automatic production platform, suitable for mass production.

### SOFT START MODULE



#### Compact and lightweight

Heat dissipation performance  
ITAV@Tc 85°C (A) = 410A~660A

### THYRISTOR MODULE



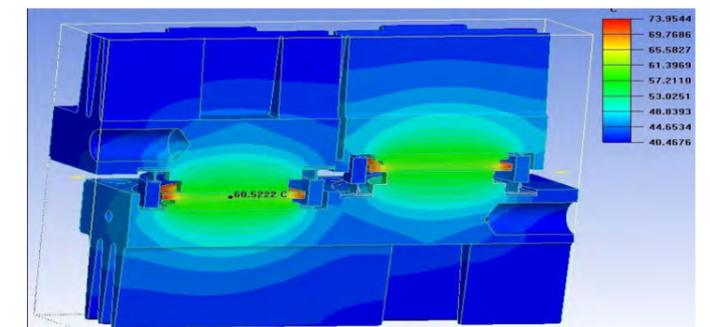
#### Standard series product

Heat dissipation performance  
ITAV@Tc 85°C (A) = 15A~320A

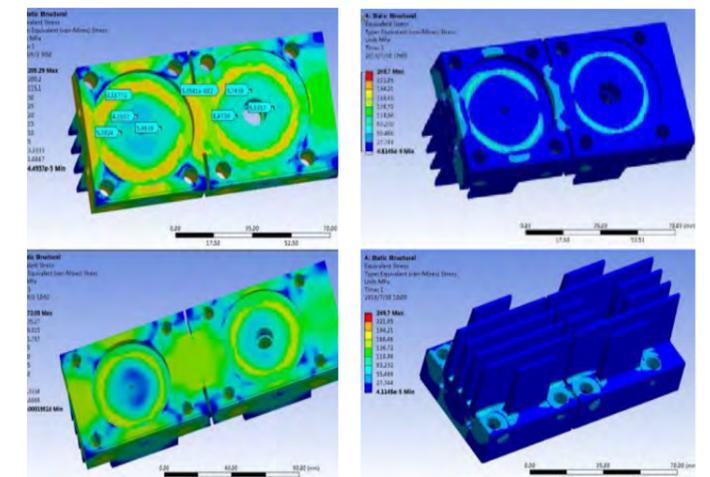
COMING SOON!

### MECHANICAL SIMULATION

ANSYS Software



Optimised heatsink structure and module design to enhance thermal performance and soft-start



Stress simulation is adopted to optimise the module assembling structure and integral design



## PULSED POWER ASSEMBLIES

Connection of energy, protecting a load, thyatron & ignitron replacement

For many pulse power applications, semiconductor switches can offer advantages over alternative switch technologies. These advantages include; an increased number of operations and general reliability, improved waveform shaping and pulse control, increased repetition rate and higher current pulses.

The choice of the semiconductor device is critical for reliable operation.

Dynex offer a wide range of thyristor types, including those that have been specifically developed for high di/dt pulsed power applications. In addition to this, Dynex have many years experience in providing assemblies for custom pulsed power requirements.

Our pulsed power equipments are typically used for:

- ✓ Connection of energy storage to low inductance loads
- ✓ Crowbars for by-passing / protecting a load
- ✓ General thyatron and ignitron replacement.



## PULSED POWER ENERGY DELIVERY EQUIPMENT

Power supply converters to control the delivery of energy



Dynex have developed a number of complete power supply converter equipments which enable customers to control the delivery of energy using Thyristor, GTO and IGBT technology to provide the best solutions.

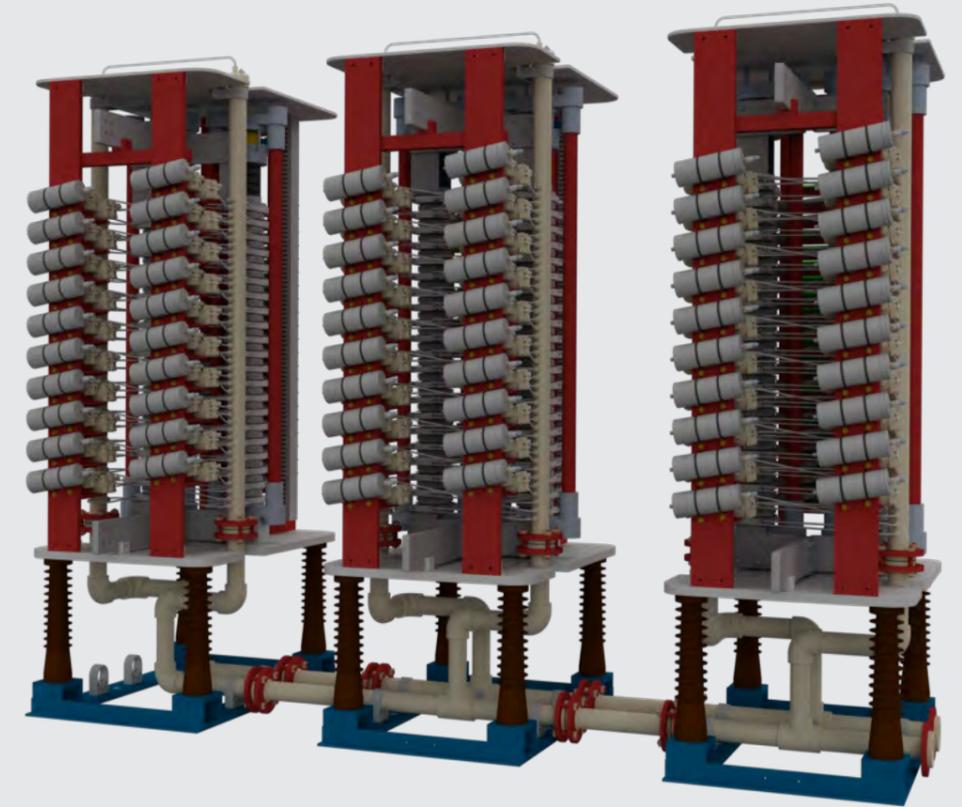
The power supplies utilise the latest energy storage techniques with batteries, ultracapacitors or conventional capacitors. The output of our supplies deliver controlled DC or AC pulses using H bridge topology with IGBT modules.

The range of power supplies offer voltages up to 30kV and currents up to 40,000A DC suitable for applications in high power protection circuit testing, lightning simulation, magnet control, UPS and sag protection.

## POWER FACTOR CORRECTION

SVC TCR Valve power assemblies and STATCOM

- + Operation at 35kV
- + Range extends up to 300MVar



Thyristor Controlled Reactors (TCRs) are primarily used in combination with Fixed or Mechanically Switched Capacitors (FC or MSC) to provide Static VAR Compensation (SVC). This enables improved quality of the mains voltage supply by compensating for large loads with poor power factors. Typical example applications include; flicker reductions and power factor compensation of electric arc furnaces in steel mills.

Dynex provide a complete range of water-cooled SVC valve assemblies, which utilise the latest  $i^2$  thyristor technology for optimum efficiency and can be used in both single phase and three phase applications. These are primarily designed for operation at 35kV, with

the range extending up to 300MVar. We have a growing number of reference projects currently in operation for the entire range.

The Dynex range of TCRs have been designed with optimum performance. All thyristor modules used in the TCR valves are matched to improve static and dynamic sharing whilst N+1 redundancy is included as standard to ensure consistent availability of supply, even in the harshest of operating conditions.

These switches are directly connected to the high voltage grid with Dynex designs completing tracking and flashing requirements. All valve assemblies are tested and verified at the Dynex facility.



## TRACTION CONVERTER UPGRADE AND OVERHAUL

Mid-life upgrades for traction power and control electronic equipment

With a typical lifespan of 40 years, the rolling stock industry are facing an increasing demand for mid-life upgrades for dated traction power and control electronic equipment.

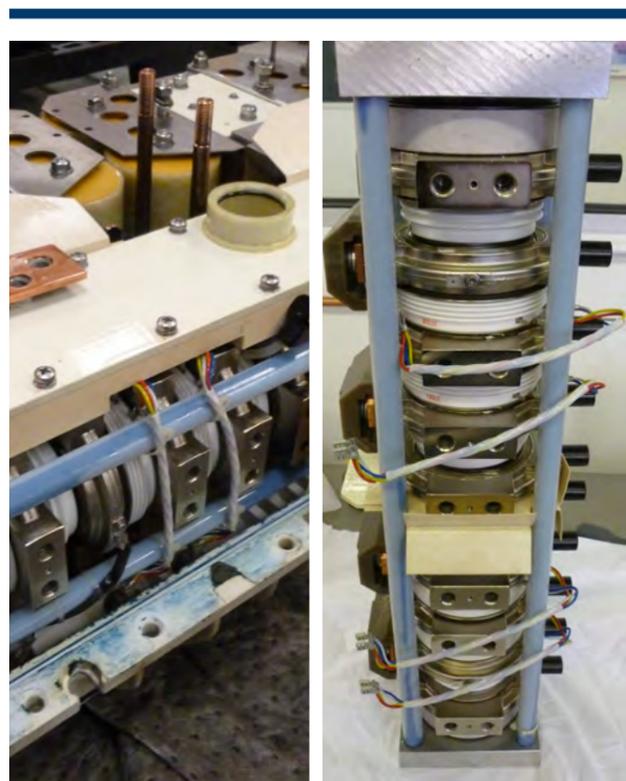
Dynex has a 40 year history of providing power electronics to the traction industry, many of which are still operational today. Using our proprietary knowledge of the wear out mechanisms associated with the power semiconductors and clamp assemblies provided, Dynex can offer an assessment of the likely health of semiconductors in application, as well as providing a feasibility report on the current availability of equivalent parts for replacement or spare stock.

Dynex offer the following capabilities to support this:

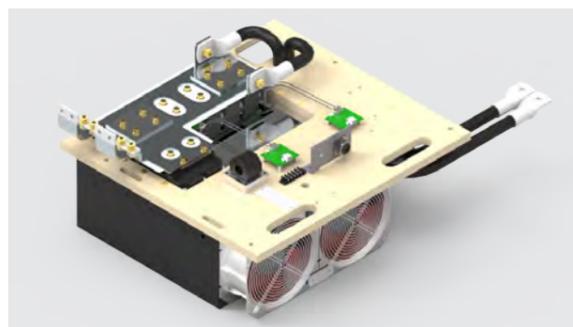
- ✓ Re-traction of propulsion systems (e.g. GTO to IGBT)
- ✓ Converter mid-life upgrade/overhaul
- ✓ Reliability improvements
- ✓ Replacement Semiconductor devices

Mid-life upgrades offer a number of benefits including:

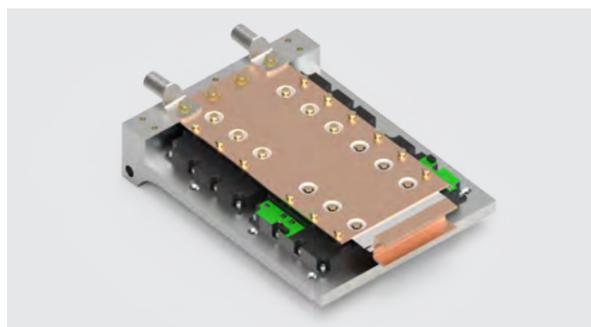
- ✓ Improved reliability and maintainability resulting in reduced life cycle cost
- ✓ Availability through lower downtime and higher reliability
- ✓ Obsolescence management - full collaborative agreement with Dynex insures long-term UK support for spares and maintenance.



Disassembly and repairing of a GTO based assembly in an oil cooled converter system, these assemblies are also load tested at Lincoln



Dynex designed converter for Class 73 re-traction project



Concept converter design for GTO to IGBT conversion



## CONTRACT ASSEMBLY & CAPABILITIES

Full process traceability with barcode scanning



Dynex cater for both higher volume less complex assemblies and lower volume more complex assemblies.

Process control software has been developed for key projects, the platform provides;

- ✓ Rich process instructions to operators
- ✓ Manipulation of external tooling such as electronic assembly tools
- ✓ Enforcement of full process traceability with barcode scanning of sub-components with data verification
- ✓ ESD clean room assembly facility and environment
- ✓ Mounting procedures followed to the torque requirements and assembly sequence.

### CASE STUDY

#### Project Type

High voltage application, large assembly size (4m x 3m), liquid cooled with weight requiring mechanical handling over a 12 month period.

#### Prototype Evaluation

Provided full inspection and testing of the first customer build and able to fix all identified build defects and passed all testing at both room and elevated temperature / stress conditions.

#### Mechanical handling for manufacture and test

Completed the design and manufacture of mechanical handling requirements including the trolleys, which could be used for assembly and testing phases, supporting easy movement between different cells in the production cycles and transfer to packaging.

#### Build control & quality

Adhered to internal processes which enabled the customer to identify, qualify and manage sub-contract parts to the required standards. Full build control and test results storage with

tractability of component serial numbers.

#### Manufacturing

Configured a dedicated cell based assembly area with required mechanical handling, fed from other cells preparing sub-assemblies, enabled quick transfer to the dedicated test area with controlled access.

#### BOM & Planning

Completed BOM sourcing with material & logistics handling for material in-flow and shipment of finished product.

#### Packaging for shipment

Prepared using nitrogen purging, packed for direct shipment to project site or storage facility.

#### Testing

Tests were completed by the engineers and technicians

- ✓ HV voltage testing
- ✓ Pressure testing
- ✓ Heat run testing

## DESIGN

## 3D Modelling, thermal, mechanical and electrical simulation

The power technologies design team have vast experience of working alongside customers to create bespoke power assemblies to meet their exact requirements.

Dynex are able to provide a "fast prototype" service for most power conversion applications for the purpose of approving production by Dynex.

During the enquiry phase, the applications support team interact with customers to understand their specification and requirements.

Following a comprehensive simulation analysis to ensure feasibility of the project, a proposal

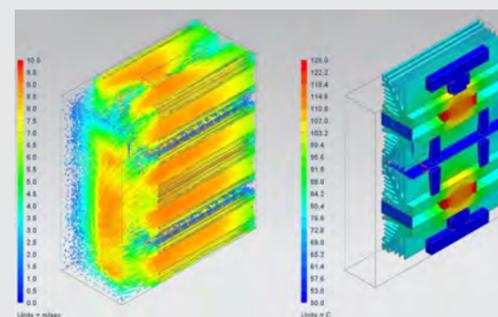
is prepared to include estimated costings and semiconductor device selection.

In collaboration with the customer, the team produce a full engineering design with 3D modelling and if required, thermal, mechanical and electrical simulations to validate the design prior to manufacturing by Dynex.

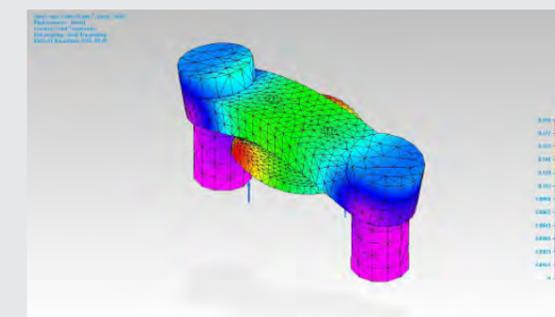
During each stage of the design, customer feedback is encouraged to ensure the design and testing meets their requirements.

The design team use the following software to generate custom and standard power assemblies:

# In-house Manufacturing Support Capabilities



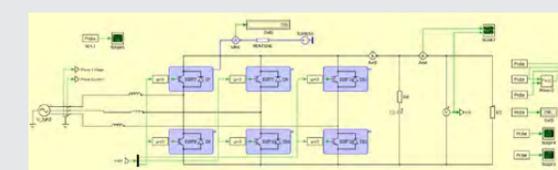
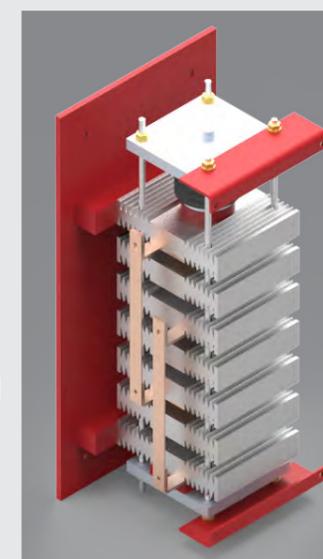
COMPUTATIONAL FLUID DYNAMICS - SIMULATION OF FLUID FLOW AND HEAT TRANSFER



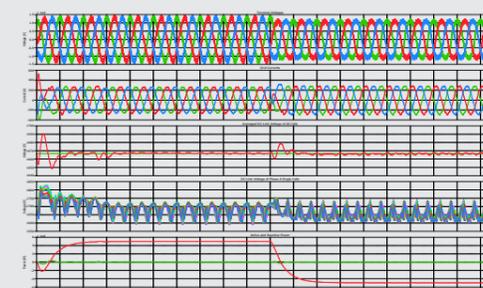
FINITE ELEMENT ANALYSIS - SIMULATION OF STRESS AND DISPLACEMENT



SOLID EDGE RENDERING - 3D SOLID MODELLING



PLECS SCHEMATIC - MODELLING AND SIMULATION OF COMPLETE POWER ELECTRONIC SYSTEM



PLECS WAVEFORM

## ON-SITE POWER TESTING FACILITY

- +  
Testing up to 100kV
- +  
Testing up to 4kA
- +  
Liquid flow rates up to 120 L/min
- +  
Assemblies up to 2 tonnes in weight

Dynex provide on-site power testing for the power assemblies it manufactures. Assembled products can be verified for standard end of line testing for example, isolation tests, partial discharge measurements and switching. The team provide specialised tests on custom assemblies, such as high energy crowbars and controlled 3 phase rectifiers, testing up to 100kV and 4kA.

As part of the test facility we are able to perform pressure and thermal heat run tests using our localised liquid cooling plant for assemblies that use liquid flow rates up to 120 L/min.



## POWER ELECTRONICS LABORATORY



The experienced multi disciplinary team based in the power electronics laboratory provide lab validation and qualification capabilities for the semiconductor and power assembly business.

During the initial design stages, the power assemblies team validate the electrical circuits for expected behaviour. Component suitability

investigation is undertaken to compare the life span of ultra capacitors from different manufacturers for use in Dynex power assemblies.

Our in-house laboratory is a high value asset for the engineering team and our customers, providing a unique environment to create specialised test conditions, in relation to power assemblies manufactured by Dynex.

## MACHINE SHOP CAPABILITIES

We use conventional and CNC machines to cater to customer requirements and are able to work with a wide range of materials.

Dynex is an ISO 9001 certified company, and we ensure the quality of all product remains at the forefront of what we do.



## IMPORTANT INFORMATION

The products and information in this publication are intended for use by appropriately trained technical personnel. Due to the diversity of product applications, the information contained herein is provided as a general guide only and does not constitute any guarantee of suitability for use in a specific application. The user must evaluate the suitability of the product and the completeness of the product data for the application. The user is responsible for product selection and ensuring all safety and any warning requirements are met. Although we have endeavoured to carefully compile the information in this publication it may contain inaccuracies or typographical errors. The information is provided without any warranty or guarantee of any kind.

This publication is an uncontrolled document and is subject to change without notice. When referring to it please ensure that it is the most up to date version and has not been superseded. The products are not intended for use in medical or other applications where a failure or malfunction may cause loss of life, injury or damage to property. The user must ensure that appropriate safety precautions are taken to prevent or mitigate the consequences of a product failure or malfunction.

All products and materials are sold and services provided subject to Dynex's conditions of sale, which are available on request. Any brand names and product names used in this publication are trademarks, registered trademarks or trade names of their respective owners.

### Warning Counterfeit Products:

There are counterfeit products on the semiconductor marketplace. Unfortunately, many of these products will have markings and labels that closely resemble those from Dynex's genuine products, making it

difficult to realise the difference. Dynex has extensive, proven controls to ensure its products are properly manufactured, tested, handled, and stored to prevent failures. Counterfeit products will not have been subjected to these processes. Therefore, Dynex does not warrant any parts purchased through unauthorised channels nor do we accept any liability for failure of counterfeit products.

Dynex's Advice to customer is as follows:-

Only purchase from Dynex directly or from one of Dynex's authorised distributors. Our Customer Services team can advise you whether a distributor is authorised via the details below.

Dynex products should not be purchased if the outer appearance differs from Dynex products you normally receive unless Dynex or a Dynex authorised distributor has provided you with a product change notification or can be seen on datasheets from the Dynex Website. We strongly advise against purchasing extraordinarily low priced Dynex products from unauthorised distributors. Dynex does not support the sale of Dynex products via online auction houses. We will be pleased to confirm the authenticity of the products. To do so please contact Dynex's Customer Services (see reverse for contact information) with the following information:

- ✓ Part number, quantity purchased, unit cost
- ✓ Name and contact name of the supplier with address, phone, and web/ e-mail addresses
- ✓ Digital photos of inner & outer label, inner & outer packaging, and front & back of product
- ✓ Copy of purchase order and invoice

This is intended to provide you with additional information on counterfeiting and steps that can be taken to better recognize counterfeit products.



Dynex Semiconductor Ltd  
Doddington Road  
Lincoln LN6 3LF  
United Kingdom

Email: [powersolutions@dynexsemi.com](mailto:powersolutions@dynexsemi.com)  
Main switchboard: +44 (0)1522 500 500  
Website: [www.dynexsemi.com](http://www.dynexsemi.com)

 @Dynexpower  Dynex Semiconductor Ltd

Feb 2020 - DNX-PA201-001

Copyright © 2020 Dynex Semiconductor Ltd.