



**Richardson
Electronics**

POWER & MICROWAVE
TECHNOLOGIES

DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS

RF & Microwave / Power Energy / Industrial

rellpower.com

BRINGING DISRUPTIVE TECHNOLOGY TO GLOBAL MARKETS

Founded
in 1947

Global network: 60 sales offices / 4 distribution hubs

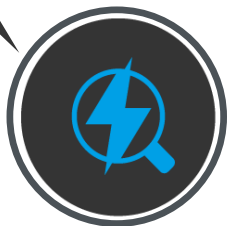
ISO 9001:2008 Certified

>400 employees: >50% in sales, engineering, product management

Rich, unique history of engineering, manufacturing and distributing

BRINGING DISRUPTIVE TECHNOLOGY TO GLOBAL MARKETS

DEMAND CREATION BUSINESS MODEL



IDENTIFY & SELL DISRUPTIVE
TECHNOLOGIES

INTRODUCE NEW PRODUCTS
TO THE MARKET

DEVELOP SOLUTIONS FOR
OUR CUSTOMERS

PROVIDE EXCEPTIONAL
GLOBAL SUPPORT

Our Line Card



Richardson Electronics
POWER & MICROWAVE TECHNOLOGIES

**Power & Microwave Technologies
Global Partners**

RF & MICROWAVE AND POWER ELECTRONICS COMPONENTS

RELLPOWER.COM

RF & MICROWAVE



POWER SEMICONDUCTORS



PASSIVES



ELECTRON TUBES AND COMPONENTS



RICHARDSON ELECTRONICS, LTD. | 800.348.5580 | 630.206.2200 | RELPOWER.COM

	Semiconductor Diodes	Semiconductors	Semiconductor Modules	RF Connectors / Cables	RF Test & Measurement	Electrolytic Capacitors	Film / High Voltage / Oil-Filled Capacitors	Power & Microwave Ceramic Capacitors	Ultracapacitors & Solutions	Vacuum Capacitors & Relays	Electromechanical	Frequency Control	Passive Devices	Value-Added & System Solutions	RF & Microwave Connector/Assembly	Thermal Management
3Rwave					*								*	*		
Amotech													*	*		
Anaren			*											*	*	
Anokiwave	*															
Applied Power Systems		*									*				*	
Bonitron									*					*		
CeramTec								*								
Cooling Source																*
Cornell Dubilier						*	*									
CSR Times Electric	*	*									*		*	*		
Dynawave			*										*	*		
Exxelia						*	*	*					*			
FTCAP						*	*									
Global Power	*	*														
High Energy Corp.							*	*						*	*	
Infinii Microwave		*			*											
IOXUS									*							
Jennings										*						
Junkosha			*													
LiConn			*	*												
LS Mtron									*					*		
MACOM		*	*					*				*	*	*	*	
National Electronics	*	*	*			*	*	*		*		*	*	*	*	
OHMTE										*		*	*	*	*	
QORVO	*	*	*					*				*	*	*	*	
SHX					*							*	*	*	*	
Starpower	*	*														
Tecate								*					*	*		
Tuyue				*									*	*		
USCI	*	*	*											*	*	
Vishay							*	*								
WanT Com		*			*											

DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS



POWER & MICROWAVE
TECHNOLOGIES



- Leading technology in High Powered IGBT (Modules 650-3300V & Discrete), MOSFETs, Bipolar & SiC Modules
- Research & Development in Nuremberg Germany with manufacturing located in Jiaxing China. 3 operational fabs and New facility opened in Shanghai for focus on the EV market.
- Heavy investments in R&D and development of new technologies—including “Sintering” and new die bonding.
- Becoming 100% independent supplier. Star Power has control of own IGBT Chip Technology
- Reliability, cost and lead time surpasses the competition with new chip technology.
- <http://www.starpowereurope.com/en>

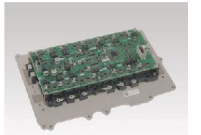
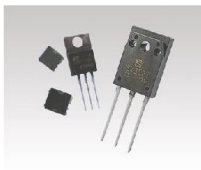
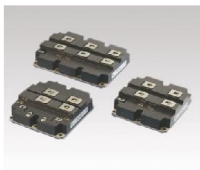


DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS



Fuji Electric

Innovating Energy Technology



Fuji Electric is a global manufacturer of Power Semiconductor products offering Industrial IGBT Power modules, High Power IGBT modules, Intelligent Power Modules, SiC devices (Hybrid & Full SiC), Discrete Rectifier Diodes, Discrete MOSFET & IGBT devices.

- IGBT Modules- 10A-3600A 600V-3300V several topologies and packages
 - Gen 6 and Gen 7 X series now available
 - GEN 7 Reduces power dissipation, Achieves equipment size reduction, Contributes to improving equipment reliability
 - IPM's 600-1200V, 25A-400A
- SiC Modules- Hybrid (SiC SBD) 600-1700V, 35A-1200A
All SiC (SiC MOSFET & SiC Schottky Diode) 1200V, 25A-400A
- Discrete IGBT's-600-1200V, 15A-75A
- Super Junction MOSFET- 600-650V, 25-380mohm
- Schottky Barrier Diodes- 650-1200V, 10A-50A
- https://americas.fujielectric.com/fecoa_products/igbt/

DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS



- Specializes in the development of high efficiency Silicon Carbide (SiC) devices & foundry services
- Standard SiC products: 650V – 1200V Schottky Diodes, JFETS and Cascodes
- **Schottky Diodes**- 4-100A 650-1200V Best in class, **Cascodes**- 20-100mOhm 650-1200V Use of existing gate driver, Best in performance (Low Vf, Qrr & switching energy), Reliability (No SiC Gate oxide, No SiC body diode, 5V Threshold voltage) and Cost (lowest RDS, on in industry)
- Disruptive SiC device & process IP. 14 issued patents including foundational IP relating to particular devices made with SiC
- Fabless, with 2 external fabs running 4" & 6" wafer lines
- Gen 3 (6 inch wafer) now available for sampling
- Best in class performance at a competitive cost from stock!
- Affordable increased power efficiency in key markets that will drive the new and greener economy
- www.unitedsic.com

DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS



**Richardson
Electronics**

POWER & MICROWAVE
TECHNOLOGIES

MSpower

MS POWER GmbH



- MS Power GmbH, headquartered in Eschborn, Germany, is a leading manufacturer of Bipolar semiconductor products. The current portfolio of products mainly covers the range of Bi-Polar semiconductor chips and discrete in forms of Stud Screw Fit Diodes/Thyristors (SCR), Capsule Devices and Modules.
- Diodes- 6A-6400A up to 7kV; Thyristors- 16A-5000A up to 6.5kV; Diode Modules-25A-1000A up to 6kV; SCR & SCR/Diode Modules- 25A-800A up to 4400V
- Capabilities include; Wafer fab in-house chip production, Packaging fab with world class soldering technology (vacuum soldering) and best in class high power testing center
- Full line of Distributed Gate Thyristors for Induction Heating applications.
- Modules offered in both soldered and compression bonded technologies
- Cost competitive and available from stock
- www.mspowergroup.com

DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS



POWER & MICROWAVE
TECHNOLOGIES



- 35 years of experience in manufacturing high quality Screw terminal and snap type aluminum electrolytic capacitors & DC Link Film capacitors for low and medium/high frequencies.
- Long life 85° & 105° Celsius Snap and Screw terminal electrolytic capacitors
 - 20,000 hours at rated condition
 - **600V** screw terminal electrolytic available 1500-6800uF!
 - Fully vertically integrated
 - Custom designs
 - Kendeil have developed software models to provide fast accurate life predictions for any given operating condition
- Short delivery time (3-5 weeks) vs the competition of 12+ weeks
- Satma, an etching facility, is solely owned by Kendeil. Having the etching capability for anode foil gives Kendeil the ability to control the complete process of manufacturing these capacitors. In return, the customer receives **a cost effective, long life and exceptionally reliable product.**
- www.kendeil.com



DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS



POWER & MICROWAVE
TECHNOLOGIES



As the largest power capacitor company in North America, we offer one of the world's largest selection of aluminum electrolytic capacitors, mica capacitors, AC film capacitors, and DC film capacitors.



- Aluminum Electrolytic Capacitors-
 - Screw & snap in, Flat pack, Plug in radial, Axial, Radial, SMT
 - For DC link, Pulse, DC output filtering
- DC Film Capacitors-
 - DC Link, Bus & Board Mount
 - Snubber & Pulse Discharge
 - Custom Sizes and Terminations
 - For DC Link, Filter and RC Network applications
- AC Film Capacitors
 - Oil Filled Metal Case
 - Axial Wrap & Fill
 - Radial Box & Dipped
 - For Single & Three Phase PFC, AC Output, Harmonic Filter, Motor Run
- Low cost manufacturing in Mexicali Mexico
- Leading technical support for all the above products
- No other company is willing to do as many custom applications
- Superior Technology, Exceptional Service, Outstanding Value
- www.cde.com

DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS



- New-generation Ultra-Capacitor storage devices feature high power, high energy, reliability and long life, which enables use in a variety of applications such as back-up power, auxiliary power, instantaneous power and peak power compensation. Full line of cells and standard modules.

- Rated voltage: now, up to **3.0 V** cells
- Increased Energy Density
- Lower ESR
- Superior power & reliability versus competitive technologies
- Environmentally friendly
- Cost competitive, cells and modules from stock
- www.ultracapacitor.co.kr:8001

DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS



- The Tecate Group ultracapacitor offering is composed of industry-recognized cells and modules across a wide range of capacitance values and voltages (2.3V-3.0V).
- Our components are manufactured to withstand elevated humidity and temperature applications.
- Custom configurations in both cells and modules are available on request.
- Tecate offers design and layout services with quick turnaround including CAD renderings and Solid Works 3-D modeling.
- Testing support, RoHS compliance, documentation control and support, product serial number application and custom packaging
- www.tecategroup.com

DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS



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 **CELEM**
Power Capacitors



Celem is the world's leading manufacturer of heavy duty **power capacitors** for low (3-10 kHz), medium (10-70 kHz), high (70-2000 kHz), and ultra high (above 2MHz) frequencies. Capacitors can be either conduction cooled or water cooled, as per customers' needs.

All capacitors provide low losses, high reactive power density and easy mounting.

Celem also provides its own designed **matching transformers** and **assembly systems**.

Main applications are induction heating, plasma RF generators, wireless energy inductive transfer, and solar energy power inverters.

The company has been established in 1963 and serves customers worldwide.

WWW.CELEM.COM

DISRUPTIVE TECHNOLOGIES TO GLOBAL MARKETS

Cooling Source[®]

Quality Thermal Design Solutions



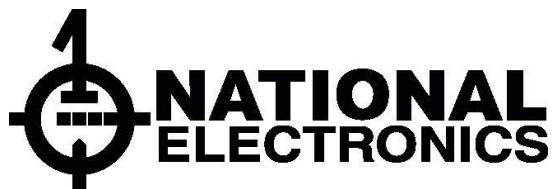
Whether you need a pre-manufactured heatsink with its own specific offerings, or whether you need a fully customized heatsink manufactured from a material and finish of your choice, Cooling Source, Inc. & Richardson Electronics will work with you to determine and deliver your needs. Our thermal analysis will help you optimize your heatsink, saving you time, effort and money.

- Products include; extrusion, bonded fin, skived fin, folded fin, cold plates, heat pipe, board level, fans & blowers, interface material
- Thermal analysis using CFD modeling & rapid prototyping available
- Manufacturing in Asia and USA to serve the global industry
- All Cooling Source facilities are ISO 9001:2015 registered
- High quality and competitive global market pricing
- www.coolingsources.com

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Richardson Electronics' National brand leverages our expertise and experience to provide customers with exactly what they need when it comes to industrial components, including SCR and rectifier discrete and modules, as well as passive components. We are committed to delivering high-quality, cost-effective component solutions that meet our customers' power conversion requirements.



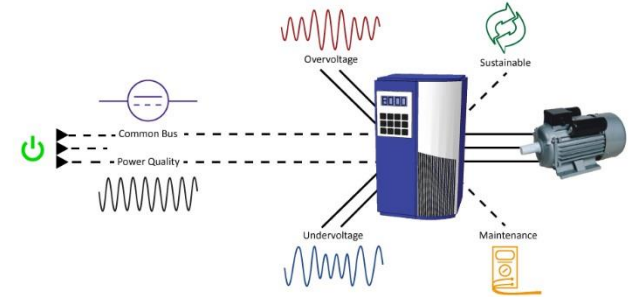
Products include;

- Phase & Distributed Gate SCR's
- Standard & Fast Recovery Rectifiers
- Clamp Compression Systems
- Firing Cards
- Electrolytic, Film & Ultra-Capacitors



Superior Reliability, Competitive Cost and Available from Stock

INTRODUCTION TO BONITRON



Line Regeneration, Braking Transistors & Resistors, Single & 3 Phase DC power Supplies, Sag & Full Outage Backup for VFDs



Diode Modules, Capacitor Maintenance Products

Bonitron designs and manufactures industrial power electronic modules. We specialize in power electronic assemblies for manufacturers of Variable Frequency Drives and system integrators that support critical applications within many industries worldwide. Bonitron Variable Frequency Drive (VFD) Option Modules include Line Regeneration Modules, Dynamic Braking Transistors and Resistors, Power Loss Ride Thru Modules. These products allow variable frequency drive systems to operate effectively and avert faults and production system shut downs that are due to poor power quality or system dynamics. Bonitron equipment is sold and supported by the distribution and integration channels of major drives manufacturers.

