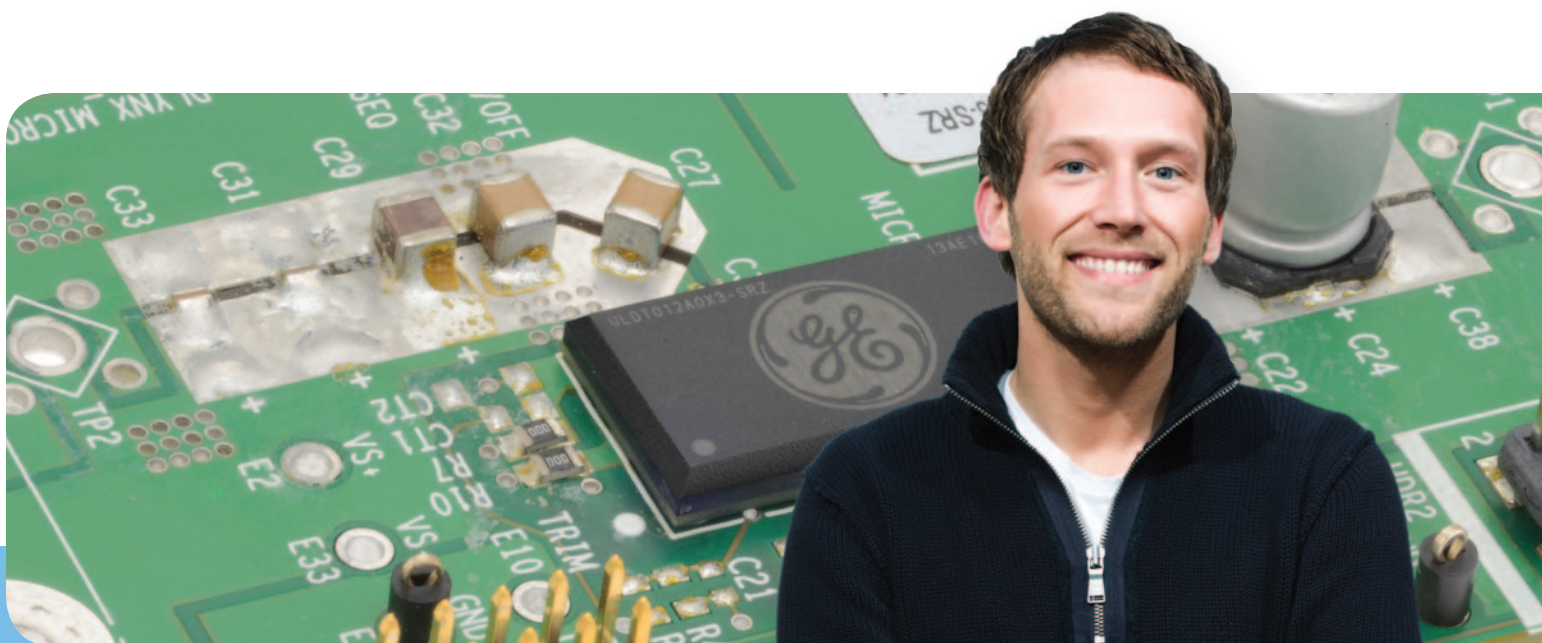


GE  
Critical Power

# End-to-End Embedded Power

## Product Selection Guide



# Critical Power

## Who We Are

GE's Critical Power business provides mission-critical facilities with end-to-end solutions to ensure that equipment and processes are protected from power system anomalies. The business offers a single source for power solutions from design to installation to after-market services. GE's Critical Power business delivers reliable, uninterrupted power.

Customers such as data centers, healthcare facilities and telecommunication networks utilize our end-to-end product and service solutions to ensure quality power and to maintain uptime for crucial equipment even during power disturbances.

## What We Do

### Embedded Power

- Products for AC-DC OEM embedded power for datacom, telecom, medical and industrial applications.
- Products for DC-DC OEM conversion for board mounted power applications in communications, computing, storage, industrial, medical and military markets.
- Full custom capabilities in both AC-DC and DC-DC product lines.

### Power Switching

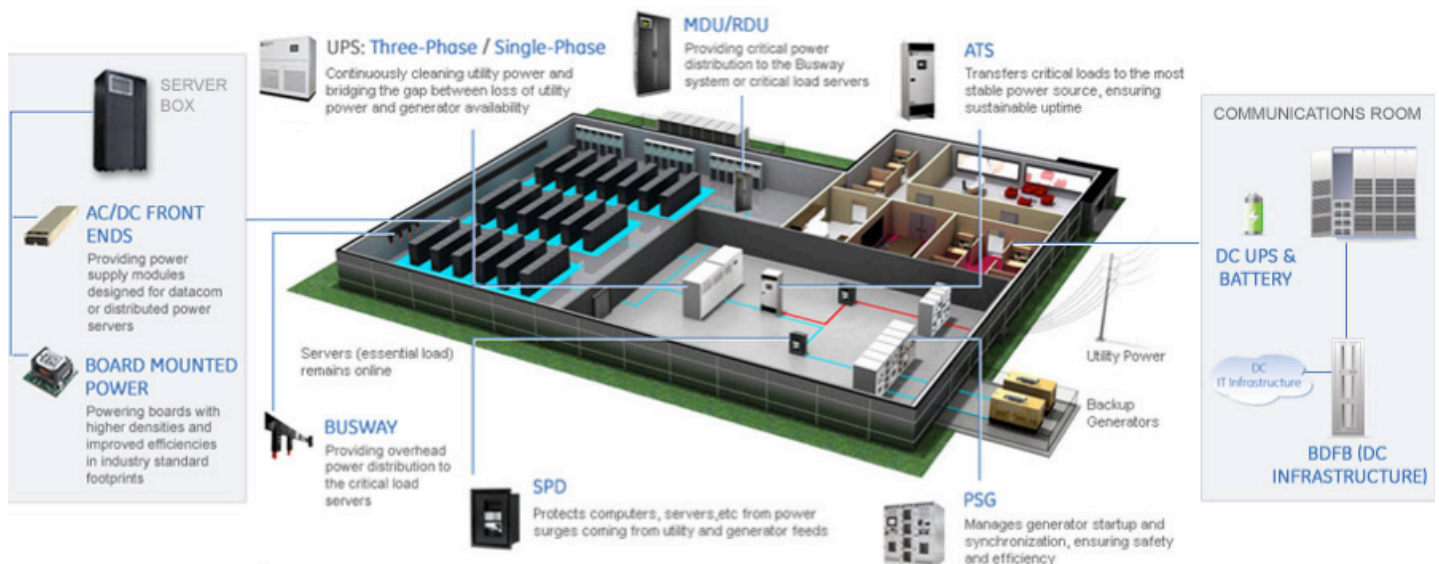
- Products for emergency standby, back-up power supply management and spike or surge protection plus installation and maintenance services for markets including datacenters, hospitals, telecommunications, financial institutions, transportation and industrial applications.

### Uninterruptible Power Supplies (UPS)

- Products and services to provide a continuous supply of power and conditioning for mission-critical applications plus global installation and maintenance services in markets including datacenters, hospitals, financial institutions, telecommunications networks, wind energy, transportation and industrial.

### DC Energy Systems

- Solutions for telecommunications, wireless and cable broadband service providers that leverage our extensive experience in turnkey project management, engineering, installation and maintenance services.



GE's Critical Power business brings end-to-end power solutions for a variety of markets including data centers, as in the example above.



## Total Cost of Ownership:

Critical Power business offers a majority of our products with above average efficiency levels. Many of our AC-DC products are certified 80+ Platinum for their efficiency numbers.

Large cloud computing companies, data centers and large industrial customers realize that the slightest edge they have over their competitors saves them considerable money in energy savings. For every sliver of efficiency gained, companies

can save in the millions in energy costs. More efficient power products result in less heat dissipation, which leads to less cooling and thereby reduced costs across the board.

With GE's Critical Power Business product line up, Total Efficiency\* power products are developed, which deliver increased efficiencies that lead to large cost savings over time.



## Key/Index

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# Embedded Power

GE's Critical Power business provides end-to-end power solutions that offer size, efficiency and cost advantages while reducing risk with standards-based power components.

## Hybrid Architecture:

85% overall efficiency

### Strengths:

- Large installed base
- Supports SELV systems
- Battery back-up systems
- Flexibility
- Increased value at lower power
- Optimized for battery operated systems

### Weaknesses:

- di/dt of isolated bricks less than POLs
- Increased costs for multiple isolation points
- Multiple conversion steps

## Intermediate Bus Architecture:

88% overall efficiency

### Strengths:

- Flexibility (bus voltage options)
- Multiple high di/dt loads
- Provides ground isolation
- Competitive cost
- Increased efficiencies
- Increased power densities

### Weaknesses:

- Multiple conversion steps

## AC to 12V Bus Architecture:

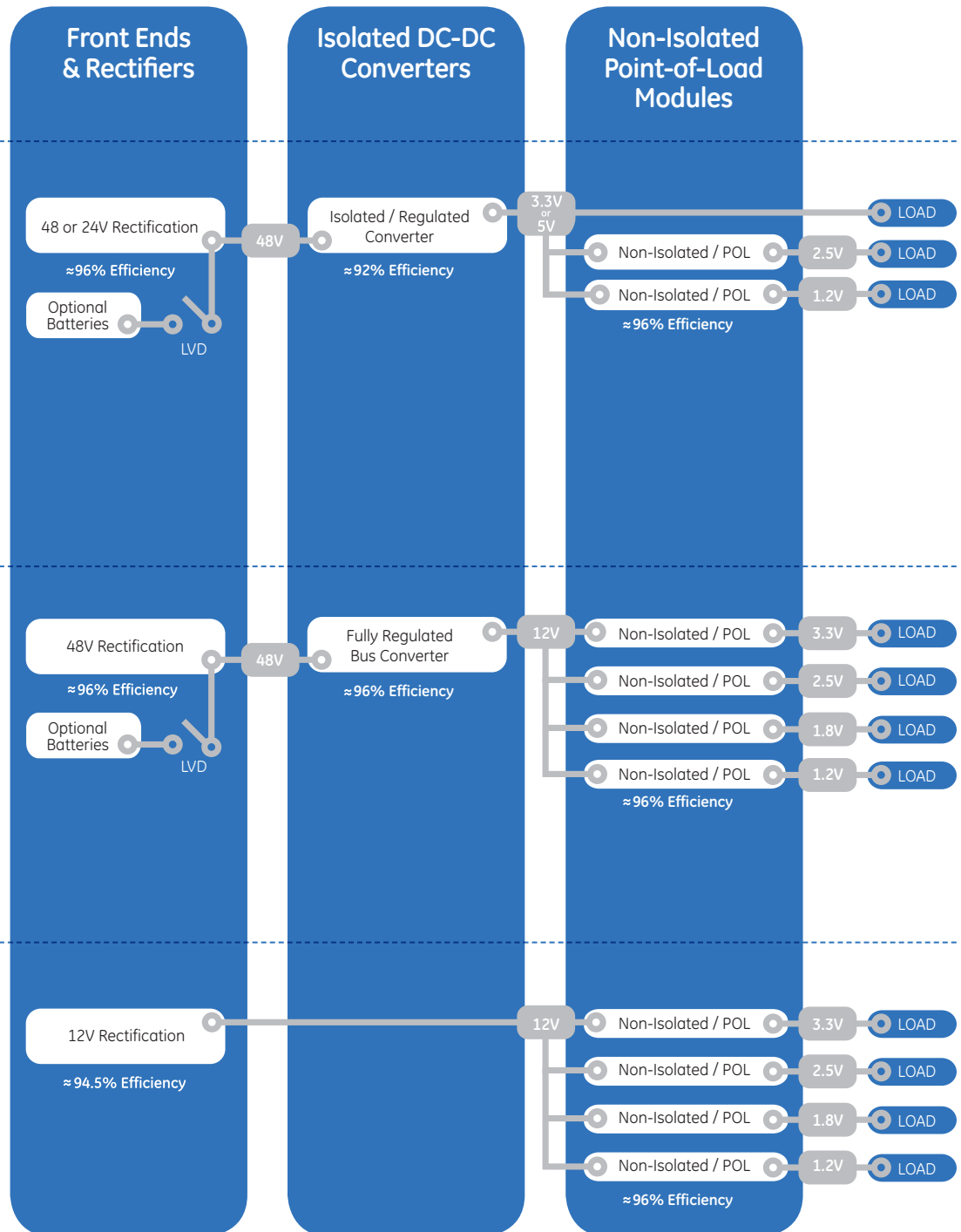
91% overall efficiency

### Strengths:

- Highest efficiency
- Best power density
- Improved EMI performance
- Lowest cost

### Weaknesses:

- Circulating current issues
- Higher I<sup>2</sup>R losses
- Few battery back-up options
- No secondary grounds



# Vertical Industry Solutions

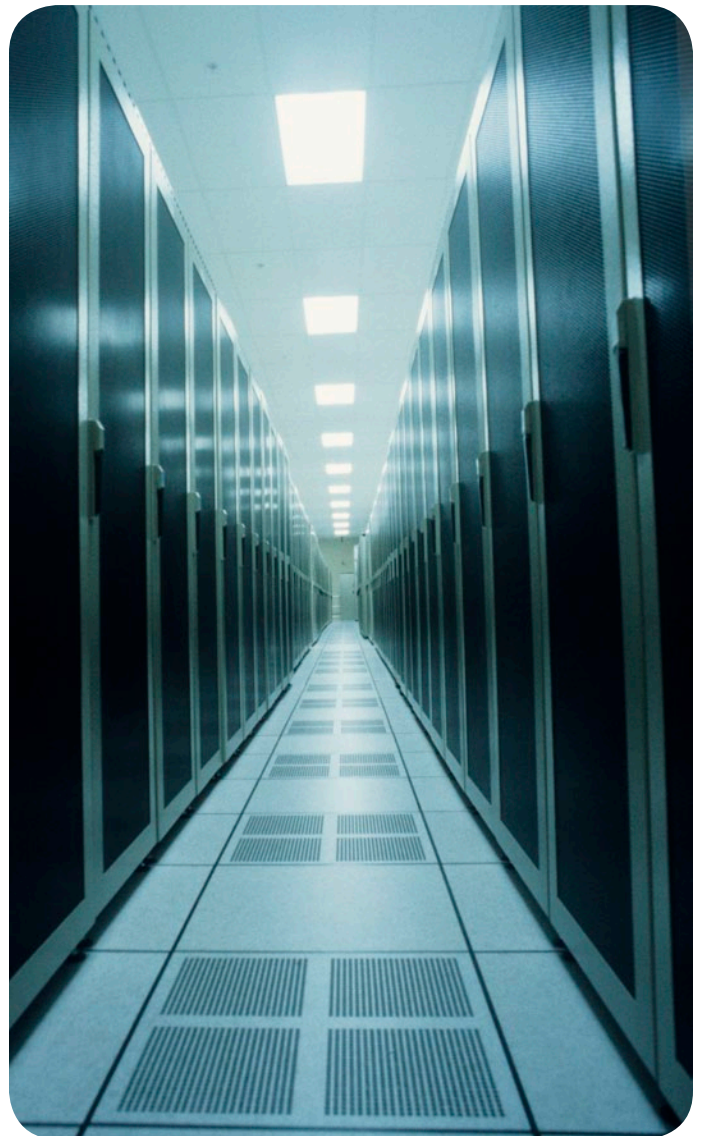
GE's Critical Power business DC-DC isolated and point-of-load (POL) power solutions are used in thousands of applications across a broad array of global industries where discrete power solutions have traditionally been deployed:

- Data Centers
- Broadcasting
- Smart Buildings
- Aerospace and Aviation
- Displays, Lighting and Signage
- Industrial Automation and Process Control
- Instrumentation, Test and Measurement
- Medical Devices
- Robotics

## Data Centers

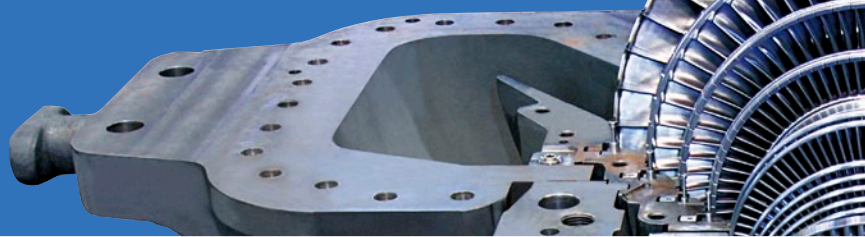
With close to half the total cost of power for a data center being utilized for cooling, the importance of utilizing embedded power products that are highly efficient takes on ever more critical role.

The GE Total Efficiency\* (TE) architecture reduces energy loss and lowers cooling costs as well as addresses issues end-to-end based on our proven experience and expertise in batteries, power distribution, DC energy systems, AC-DC power supplies, and DC-DC board mounted power to deliver a solution that is more safe, reliable and energy efficient than alternatives from our competitors.





# Vertical Industry Solutions



## Broadcasting

More video has been uploaded to YouTube in the last 60 days than if ABC, CBS and NBC had been airing new content 24-hours a day continuously for the past 65 years. Powering the electronics that allow CATV, video and broadcasting equipment to reliably function has never been more important.

Deployed globally in products used by cable, fiber-to-the-home (FTTH), broadband/ADSL, satellite and terrestrial operators, GE Critical Power solutions deliver advanced feature sets and digital control functions in our power modules. These modules provide flexibility and high density combined with reliability for superior OEM products.



## Smart Buildings

In many of today's smart buildings, power is being shifted from the devices that once required separate AC power, to devices that can both communicate and be powered over a single Power over Ethernet (PoE) cable. Enterprise devices such as badge scanners, 802.11n wireless access points, laptops, RFID device, pan-tilt-zoom security cameras, video phones and point-of-sale terminals take advantage of GE's PoE rectifiers, the CP2000AC54TEP and CP2725AC54TEP. These rectifiers provide 40 Amps and 50 Amps of 48 volt power required to run smart building systems.

The new solutions have a highly reliable, hot-pluggable and hot-swappable footprint and are easily integrated into switch architectures that support multiple redundant rectifiers on a common DC bus, in various redundancy schemes including N+1 or N+N arrangements. In addition, flexible communication interfaces allow the switch designer to choose the most effective way to communicate with the power supplies. Enterprise customers benefit from a solution specifically created for highly redundant environments, thereby reducing operating and service costs.



## Aerospace and Aviation

Electronics in the aviation industry are rapidly requiring increased capability and complexity while demanding a more compact design. Ranging from cockpit avionics and lighting systems to elaborate multimedia entertainment systems for commercial jets, the need for small, efficient, and reliable power electronics modules is critical. These new systems need a mixture of voltages and control frequencies. As design engineers continue to integrate more functionality into their innovative designs, the ability to support a complex mixture of output voltages will become even more important.

Using standard, commercially available power supplies yields space savings, simpler designs, and less cabling when the DC output is fed directly into the backplane as opposed to using an external power supply. GE's Critical Power business power modules deliver the latest developments in power design in an efficient compact form factor.

- Cockpit Avionics
- Navigation Systems
- Aircraft Control Panels
- Lighting Systems
- In-Flight Entertainment (IFE)



## Displays, Lighting and Signage

With the ever increasing demand for more efficient lighting solutions, LED lighting requires both constant-voltage and constant-current for its products. GE's Critical Power business power modules for lighting applications feature shielding from power disturbances, ruggedized designs, high efficiencies and high reliability in a small form factor.

- Outdoor Multimedia Displays
- Stadium Lighting
- Indoor and Outdoor Lighting
- Solar Lighting



## Industrial Automation and Process Control

Industrial automation uses information technology and control systems to manage machinery and processes reducing the need for human intervention and possible costly errors. Power supplies for industrial automation and control applications require a wide operating temperature range and extended shock and vibration testing. GE's Critical Power business modules offer sequencing, reliability, and remote on/off facilities to ensure continuous efficient operation in the power design.

Our ruggedized power supplies meet MIL STD 810F for extended shock and vibration testing, up to 50Grms, offer excellent thermal management up to 105°C, and maintain low ripple/noise operation.

- Conveyor Systems
- Motor Control Applications
- Factory Automation (PLCs)
- Switching Systems
- Transportation / Railway
- Remote Monitoring Equipment
- Security Systems



## Instrumentation, Test and Measurement

Test and measurement systems are ubiquitous in electronic devices and maximize the productivity of engineers and technicians responsible for packaged-part characterization in applications ranging from early device research through development, quality verification, and failure analysis. Automated test equipment systems are routinely used in electronics manufacturing operations, the semiconductor industry, and factory environments. GE's Critical Power business power modules provide key features important to this market segment such as output voltage accuracy, low output noise, and ingress protection. In factory environments, improved cooling, extended temperature ranges, and ruggedization also prove to be important in considering power solutions.

- Semiconductor Test Equipment
- Automated Test Equipment
- Oscilloscopes
- Microscopes



## Medical Devices

Sophisticated power solutions for ultrasound, dialysis, and diagnostic equipment require stringent parameters such as low output ripple and EMI noise, which, if left unconditioned, can disrupt the performance and accuracy of the end equipment. These highly sensitive systems require more sophisticated power solutions – a key strength for GE's Critical Power business. Given the sometimes long FDA approval cycles in the healthcare industry, our expertise in powering medical products provides solutions to complex system requirements which enable designers to improve product cycle times while reducing their time-to-market.

- Laboratory and Analytical
- Eye Care Equipment
- Medical Imaging
- Dental Equipment



## Robotics

The global robotics industry is estimated to reach \$21.4 billion US dollars by 2014 driven in part by demand from the auto and electronics markets. Power modules for robotics require a small form factor but a robust module to power their silicon processors and a variety of other electronics.

Power supplies for robotics applications require high levels of shock and vibration resistance and a wide operating temperature range.

- Manufacturing Systems
- Gantry Robots
- Industrial Robots



# AC-DC



## Product Matrix

Open Frame Power Supplies	MODEL	NOMINAL OUTPUT	DIGITAL COMM.	PROFILE	NOMINAL INPUT	MAX OUTPUT POWER	200W	500W	1000W	1500W	2000W	2500W	3000W	3500W	4000W
	CLP0212	12V		Open Frame	1Φ (110/220 VAC)	200W	<div></div>								
AC-DC & DC-DC Front Ends	MODEL	NOMINAL OUTPUT	DIGITAL COMM.	PROFILE	NOMINAL INPUT	MAX OUTPUT POWER	200W	500W	1000W	1500W	2000W	2500W	3000W	3500W	4000W
	CAR0812FP	12V	I2C/PMBus	1U	1Φ (110/220 VAC)	850W	<div></div>								
	CAR0812DC	12V	I2C/PMBus	1U	48Vdc	850W	<div></div>								
	CAR1212FP	12V	I2C/PMBus	1U	1Φ (110/220 VAC)	1200W	<div></div>								
	CAR1212DC	12V	I2C/PMBus	1U	48Vdc	1200W	<div></div>								
	CAR1612FP	12V	I2C/PMBus	1U	1Φ (110/220 VAC)	1600W	<div></div>								
	CAR1812FP	12V	I2C/PMBus	1U	1Φ (110/220 VAC)	1800W	<div></div>								
	CAR2512TE	12V	I2C/PMBus	1U	1Φ (110/220 VAC)	2500W	<div></div>								
	CAR2512FP	12V	I2C/PMBus	1U	1Φ (110/220 VAC)	2500W	<div></div>								
	CAR2512DC	12V	I2C/PMBus	1U	48Vdc	2500W	<div></div>								
AC-DC & DC-DC Front Ends	MODEL	NOMINAL OUTPUT (POSITIVE)	DIGITAL COMM.	PROFILE	NOMINAL INPUT	MAX OUTPUT POWER	200W	500W	1000W	1500W	2000W	2500W	3000W	3500W	4000W
	CAR1248FP	48V	I2C/PMBus	1U	1Φ (110/220 VAC)	1200W	<div></div>								
	CAR2024FP	24V	I2C/PMBus	1U	1Φ (110/220 VAC)	2000W	<div></div>								
	CAR2548FP	48V	I2C/PMBus	1U	1Φ (110/220 VAC)	2500W	<div></div>								
	CAR2548DC	48V	I2C/PMBus	1U	48Vdc	2500W	<div></div>								
AC-DC Front Ends & Rectifiers DC-DC Converters	MODEL	NOMINAL OUTPUT (NEGATIVE)	DIGITAL COMM.	PROFILE	NOMINAL INPUT	MAX OUTPUT POWER	200W	500W	1000W	1500W	2000W	2500W	3000W	3500W	4000W
	EP0300TE	48-54V	RS485	1U	1Φ (110/220 VAC)	300W	<div></div>								
	EP1000TE	48-54V	RS485	1U	1Φ (110/220 VAC)	1000W	<div></div>								
	EP1600TE	48-54V	RS485	1U	1Φ (110/220 VAC)	1600W	<div></div>								
	CAR1248TN	48-54V	I2C/PMBus	1U	1Φ (110/220 VAC)	1200W	<div></div>								
	CP2000TE	48-54V	I2C/PMBus/ RS485	1U	1Φ (110/220 VAC)	2000W	<div></div>								
	CP2000DC	48-54V	I2C/PMBus/ RS485	1U	48/60Vdc	2000W	<div></div>								
	CP2500TE	48-54V	I2C/PMBus/ RS485	1U	1Φ (110/220 VAC)	2500W	<div></div>								
	CP2500DC	48-54V	I2C/PMBus/ RS485	1U	48/60Vdc	2500W	<div></div>								
	CAR2548TN	48-54V	I2C/PMBus	1U	1Φ (110/220 VAC)	2500W	<div></div>								
	CP2725TE	48-54V	I2C/PMBus/ RS485	1U	1Φ (110/220 VAC)	2725W	<div></div>								
	CP2725TE-FBs	24-48V	I2C/PMBus/ RS485	1U	1Φ (110/220 VAC)	2725W	<div></div>								



## EP0300TE

- 300 watts / 48V out
- High efficiency operation - up to 91%
- $9 \times 2 \times 1.61$  /  $228.2 \times 50.4 \times 40.9\text{mm}$
- RS485 communication interface



## EP1000TE / EP1600TE

- 1,000 or 1,600 watts / 54V out
- High efficiency operation - up to 95%
- Power density up to  $27\text{W/in}^3$
- Universal AC input range with active PFC
- $8.19 \times 4.58 \times 1.58$  /  $208.0 \times 116.5 \times 40.2\text{mm}$
- RS485 communication interface
- Mates with SPS shelf family
- RoHS6



## CAR1248TN

- 1,200 watts / -48V out
- High efficiency operation - up to 91%
- Power density of  $19\text{W/in}^3$
- Universal AC input range with active PFC
- $11.20 \times 3.44 \times 1.65$  /  $284.5 \times 87.4 \times 41.9\text{mm}$
- I<sup>2</sup>C / PMBus digital interface
- Mates with ACE125 shelf



## CP2000DC / CP2500DC

- 2,000 or 2,500 watts / 54V out
- 40-60Vdc input range
- High efficiency operation - up to 92%
- Power density up to  $27.6\text{W/in}^3$
- $13.85 \times 4.00 \times 1.63$  /  $352.0 \times 101.6 \times 41.4\text{mm}$
- I<sup>2</sup>C and RS485 digital interface
- Mates with CPL PEM shelf



## CP2000TE / CP2500TE / CP2725TE

- 2,000, 2,500 or 2,725 watts / 54V out
- High efficiency operation - approaching 97%
- Power density of up to  $30\text{W/in}^3$
- $13.85 \times 4.00 \times 1.63$  /  $356.0 \times 101.6 \times 41.4\text{mm}$
- I<sup>2</sup>C and RS485 communication interface
- Mates with CPL shelf family



# AC-DC & DC-DC Front Ends



## CAR2548TN

- 2,500 watts / -48Vout
- High efficiency operation - up to 91%
- Power density of 27W/in<sup>3</sup>
- Universal AC input range with active PFC
- 14.25 x 4.00 x 1.61" / 362.0 x 102.0 x 40.9mm
- I<sup>2</sup>C / PMBus digital interface
- Mates with ACE254 shelf

## CAR0812FP

- 850 watts / 12Vout
- Efficiency of 92%
- Power density of 18W/in<sup>3</sup>
- Universal AC input range with active PFC
- 8.73 x 3.38 x 1.65" / 221.7 x 85.9 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface

## CAR0812DC

- 850 watts / 12Vout
- Efficiency of 92%
- Power density of 18W/in<sup>3</sup>
- 36 – 75Vdc input range
- 8.73 x 3.38 x 1.65" / 221.7 x 85.9 x 41.9mm
- I<sup>2</sup>C/PMBus digital interface

## CAR1212FP

- 1,200 watts / 12Vout
- High efficiency operation - up to 89%
- Power density of 16W/in<sup>3</sup>
- Universal AC input range with active PFC
- 11.20 x 4.00 x 1.65" / 284.5 x 101.6 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface

## CAR1212DC

- 1,200 watts / 12Vout
- High efficiency operation - up to 90%
- Power density of 16W/in<sup>3</sup>
- 36 – 75Vdc input range
- 11.20 x 4.00 x 1.65" / 284.5 x 101.6 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface

## CAR1612FP

- 1,600 watts / 12Vout
- Efficiency of 94.5%
- Power density of 20W/in<sup>3</sup>
- Universal AC input range with active PFC
- 12.45 x 4.00 x 1.65" / 316.23 x 101.6 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface
- Mates with ACE164 shelf

## CAR1812FP

- 1,800 watts / 12Vout
- Efficiency of 94%
- Power density of 22W/in<sup>3</sup>
- Universal AC input range with active PFC
- 12.45 x 4.00 x 1.65" / 316.23 x 101.6 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface
- Mates with ACE184RUW shelf



## CAR2512DC

- 2,500 watts / 12Vout
- High efficiency operation - up to 92%
- Power density of 25W/in<sup>3</sup>
- 36-75Vdc input range
- 15.38 x 4.00 x 1.65" / 390.5 x 101.6 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface

## CAR2512TE

- 2,500 watts / 12Vout
- Efficiency up to 94%
- Power density of 25W/in<sup>3</sup>
- Universal AC input range with active PFC
- 15.38 x 4.00 x 1.65" / 378.0 x 102.0 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface

## CAR2512FP

- 2,500 watts / 12Vout
- Efficiency up to 92.1% peak
- Power density of 25W/in<sup>3</sup>
- Universal AC input range with active PFC
- 15.38 x 4.00 x 1.65" / 378.0 x 102.0 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface

## CAR2024FP

- 2,000 watts / 24Vout
- High efficiency operation - up to 90.5%
- Power density of 21W/in<sup>3</sup>
- Universal AC input range with active PFC
- 14.25 x 4.00 x 1.65" / 316.2 x 101.6 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface
- Mates with ACE204 shelf



## CAR1248FP

- 1,200 watts / 48Vout
- High efficiency operation - up to 91%
- Power density of 19W/in<sup>3</sup>
- Universal AC input range with active PFC
- 11.20 x 3.44 x 1.65" / 284.5 x 87.4 x 41.9mm
- I<sup>2</sup>C / PMBus digital interface
- Mates with ACE125 shelf

## CAR2548FP

- 2,500 watts / 48Vout
- High efficiency operation - up to 91%
- Power density of 27W/in<sup>3</sup>
- Universal AC input range with active PFC
- 14.25 x 4.00 x 1.65" / 362.0 x 102.0 x 40.9mm
- I<sup>2</sup>C / PMBus digital interface
- Mates with ACE254 shelf

## CAR2548DC

- 2,500 watts / 48Vout
- High efficiency operation - up to 91%
- Power density of 27W/in<sup>3</sup>
- 36-75Vdc input range
- 14.25 x 4.00 x 1.61" / 362.0 x 102.0 x 40.9mm
- I<sup>2</sup>C / PMBus digital interface
- Mates with ACE254 shelf

Dozens of standard configurations are available including options for batteries, enclosures, sensors and cables. Please contact our technical support team to discuss your specific installation requirements.



# Energy Systems

## SPS Platform

- 48V Embedded or available rectifier shelf
- Mates with EP1000/1600 rectifier modules
- 1U High 19" / 483.0mm rack mount
- Maximum 10.37" / 264.0mm depth
- Adjustable mounting ears (flush or mid-mount)
- Rear / front panel DC distribution options
- Breaker and fuse panel options
- Optional pulsar edge controller



## Pulsar Edge Controller

- Available for both CPL & SPS platforms
- Compact design installs in shelf
- Preserves rectifier slots
- Advanced rectifier and battery management
- Web based GUI or front panel control
- Extensive alarm capability & data logging
- RJ45 craft and Ethernet ports
- Up to 5 Form C Relay Contacts



## CPL Platform

- 48V rectifier shelf
- I<sup>2</sup>C or RS485 control options
- Mates with CP2000TE / CP2500TE / CP2725TE rectifier modules
- 1U High 19" / 483.0mm rack mount
- Maximum 17.21" / 487.0mm depth
- Adjustable mounting ears (flush or mid-mount)
- Rear / front panel DC distribution options
- Breaker and fuse panel options
- Optional Pulsar Edge Controller



The CP2000TE and CP2725TE are both 80 PLUS Platinum certified in a compact 1U footprint with up to 30W/in<sup>3</sup>. The CPL is a highly flexible solution, which has with two communications protocols on board every power supply increasing its flexibility for use in embedded OEM applications or in external rack-mounted applications. The I<sup>2</sup>C protocol used in OEM embedded applications helps fully integrate the power supply into a platform and the RS485 communications using Galaxy Protocol allows standalone systems full alarm and communication capability, as well as battery management.

The CPL provides AC to 48V power conversion downstream of an AC UPS system or as the primary power conversion step in DC UPS systems with direct connected battery backup. Versions are also available with PoE isolation.

# Fan-Less .5U High Front Ends

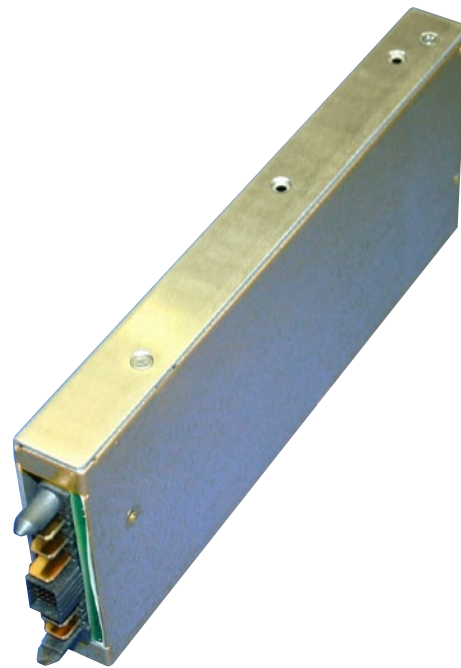
The industry's first half U height fan-less AC-DC rectifier offers an alternative means for thermal management that lends itself to conduction, convection, forced air or even liquid cooling applications. This shift towards alternative cooling capability allows system engineers to innovate and explore new thermal-mechanical options opening up considerable new opportunities. Eliminating fans reduces unwanted audible noise while synonymously increasing system MTBF (mean time between failure) and extending system reliability. In a sleek form factor, the CCR0512 reduces the real estate needed for use in hard-to-reach applications and minimizes the height affording low profile capabilities.

The CCR0512FP power supply is a paradigm shift for thermal management of AC-DC solutions. By taking advantage of accessibility to the unit's cold plate, the end user can choose how they prefer to cool the power supply lending itself to many different end applications.

With a universal AC input, this 12Vdc, 500W output fan-less solution supports N+N redundant capability and current sharing allowing end system scalability or fault tolerant operation. The CCR0512 is the perfect low-to-mid power platform geared for 12V applications with low profile constraints such as networking, test equipment and thin client server applications.

## CCR0512

- Conduction cooling for fan-less operation
- Compact 0.5U Profile
- Overall Dimensions: 0.877" x 3.35" x 8.790" / 22.3 x 85.1 x 22.3mm
- 12Vdc, 500W Output
- 10.8 to 13.2Vdc Output Voltage Programmability
- Universal AC input with Active PFC
- Hot Plugability
- Redundant Parallel Operation
- Active Load Sharing (Single Wire)
- Analog, I<sup>2</sup>C or PMBus means of control and monitoring
- Remote On/Off
- Remote Sense (up to 0.25V of total compensation)
- No Minimum Load Requirements
- Three visual LED Indicators; Input, Output and Fault status
- 3.3 or 5.0Vdc 2A Standby Output
- UL certified to UL60950-1, CAN/CSA† C22.2
- No.60950-1, and EN60950-1(VDE‡ 0805-1) Licensed
- CE mark meets 2006/95/EC directives
- ISO 9001 and ISO 14001 certified manufacturing facility
- Compliant to RoHS EU Directive 2002/95/EC

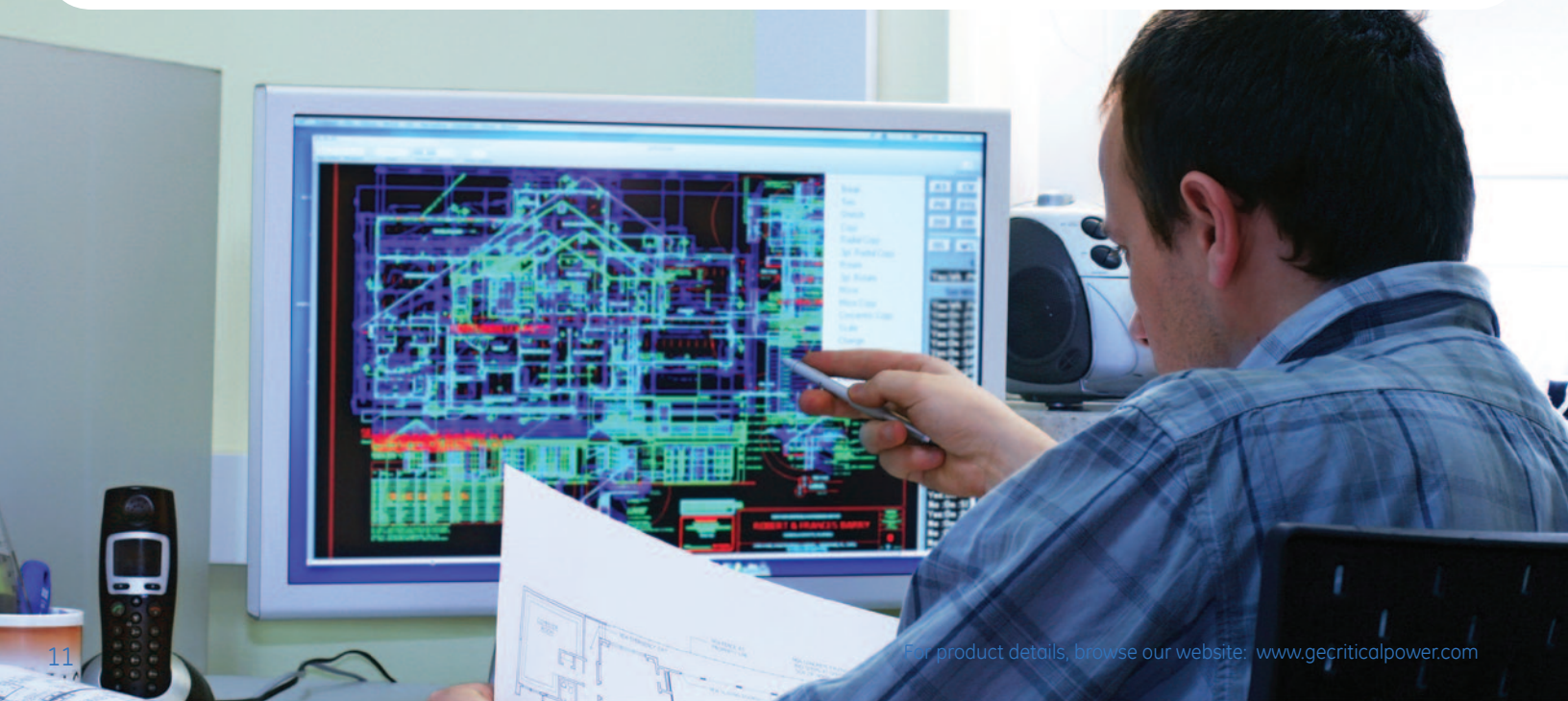
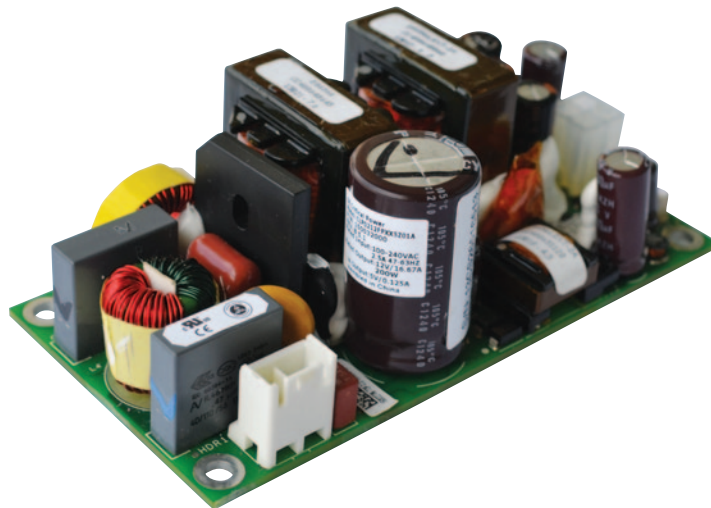


# Open Frame Power Supply

## CLP0212 Open Frame Power Supply

In a 2 x 4 inch footprint smaller than an iPhone®, the 12Vdc single-output CLP0212 open frame power supply delivers 80 PLUS® Gold energy efficiency. Half the size of other power supplies in this segment, the CLP series is specifically designed to handle power challenges associated with tight space and low airflow. Offering a leading 18W/in<sup>3</sup> power density in a 1U high, fanless form factor, the CLP series addresses a broad range of applications in new products from communications, computing and data storage original equipment manufacturers.

- Compact size 50.8 x 101.6 x 36.1 mm (2 x 4 x 1.4") with density of 18W/in<sup>3</sup>
- Universal AC Input Range (90 – 264 VAC)
- Output voltage of 12V (adjustable  $\pm 5\%$ )
- Maximum output current of 16.7A@ 12Vout (200W)
- Standby output of 5V or 3.3V @ 0.25A
- Efficiency - 80 PLUS® Gold
- Full load capability at 50°C and 1m/s (200LFM) airflow with derating at higher temperatures or lower airflows
- Remote ON/OFF
- Output overcurrent protection (non-latching)
- Overtemperature protection
- Output overvoltage protection
- Up to 12ms of holdup time
- Parallelable with current sharing
- Active power factor corrected input
- Conducted EMI - meets CISPR22 (EN55022) and FCC Class A requirements
- Compliant to RoHS EU Directive 2002/95/EC
- UL and cUL approved to UL/CSA60950-1, TUV (EN60950-1), CE Mark (for LVD) and CB Report available
- ISO 9001 and ISO 14001 certified manufacturing facilities





# Power Shelves



## ACE125

- 48V front end or rectifier shelf
- Mates with CAR1248 modules
- 5 bay power shelf
- 5 x 1,200W power modules
- 4,800W N+1 redundant
- 6,000W total power
- 1U High 19" / 483.0mm rack mount
- 14.98" / 380.5mm depth
- Class B emissions with fully-populated shelf

## ACE164

- 12V front end or rectifier shelf
- Mates with CAR1612 modules
- 4 bay power shelf
- 4 x 1,600W power modules
- 4,800W N+1 redundant
- 6,400W total power
- 1U High 19" / 483.0mm rack mount
- 16.4" / 416.6mm depth
- Class A emissions with fully-populated shelf

## ACE254

- 48V front end or rectifier shelf
- Mates with CAR2548
- 4 Bay power shelf
- 4 x 2,500W power modules
- 7,500W N+1 redundant
- 10,000W total power
- 1U High 19" / 483.0mm rack mount
- 18.07" / 459.0mm depth
- Class B emissions with fully-populated shelf

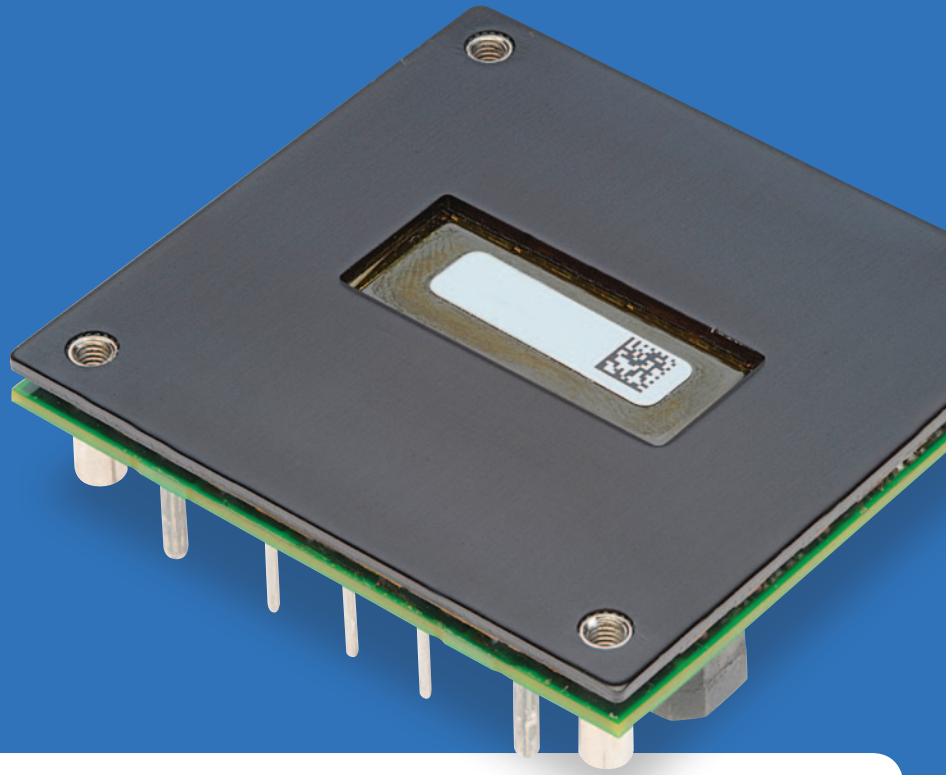
## ACE184

- 12V front end or rectifier shelf
- Mates with CAR1812 modules
- 4 bay power shelf
- 4 x 1,800W power modules
- 5,400W N+1 redundant
- 7,200W total power
- 1U High 19" / 483.0mm rack mount
- 16.4" / 416.6mm depth
- Class A emissions with fully-populated shelf

## ACE204

- 24V front end or rectifier shelf
- Mates with CAR2024FP modules
- 4 bay power shelf
- 4 x 2000W power modules
- 6000W N+1 redundant
- 8,000W total power
- 1U High 19" / 483.0mm rack mount
- 18.07" / 459.0mm depth
- Class B emissions with fully-populated shelf

# Isolated DC-DC Converters



## Product Matrix

Isolated and Regulated DC-DC Converters	MODEL	INPUT VOLTAGE	ISOLATION	FOOTPRINT	OUTPUT VOLTAGE	MAX CURRENT/ POWER	0W	50W	75W	100W	200W	300W	400W	500W	600W
	SHHD	18 - 75V	2250Vdc	1 × 1	3.3 - 12V	5A / 15W	<div></div>								
	SSTW	36 - 75V	2250Vdc	1 × 1	3.3 - 12V	5A / 15W	<div></div>								
	HC/HW	24 - 48 V	1500Vdc	1 × 1	1.8 - 5V	12A / 33W	<div></div>								
	KHHD	18 - 75V	2250Vdc	1/16 brick	3.3 - 12V	10A / 30W	<div></div>								
	KSTW	36 - 75V	2250Vdc	1/16 brick	3.3 - 12V	10A / 30W	<div></div>								
	KHHD	18 - 75V	2250Vdc	1/16 brick	3.3 - 12V	15A / 50W	<div></div>								
	KSTW	36 - 75V	2250Vdc	1/16 brick	3.3 - 12V	15A / 50W	<div></div>								
	KNW	36 - 75V	2250Vdc	1/16 brick	3.3 - 5V	20A / 66W	<div></div>								
	EHHD	18 - 75V	2250Vdc	1/8 brick	3.3 - 12V	20A / 75W	<div></div>								
	ESTW	36 - 75V	2250Vdc	1/8 brick	3.3 - 15V	25A / 82W	<div></div>								
	EVW	36 - 75V	2250Vdc	1/8 brick	5 - 12V	10A / 120W	<div></div>								
JRW	36 - 75V	1500Vdc	1/2 brick	1.2 - 12V	70A / 204W	<div></div>									
Fully Regulated Bus Converters	MODEL	INPUT VOLTAGE	ISOLATION	FOOTPRINT	OUTPUT VOLTAGE	MAX CURRENT/ POWER	0W	50W	75W	100W	200W	300W	400W	500W	600W
	QBDW (digital)	36 - 75V	2250Vdc	1/4 brick	8.1 - 12V	33A / 400W	<div></div>								
	QBWW	36 - 75V	2250Vdc	1/4 brick	8.1 - 12V	33A / 400W	<div></div>								
	QBVE	45 - 56V	500Vdc	1/4 Brick	10.4V	60A / 624W	<div></div>								
	QBVS	52 - 60V	500Vdc	1/4 Brick	12V	50A / 600W	<div></div>								
	EBDW (digital)	36 - 75V	2250Vdc	1/8 brick	6 - 12V	25A / 300W	<div></div>								
	EBWW	36 - 75V	2250Vdc	1/8 brick	6 - 12V	25A / 300W	<div></div>								

# Hammerhead

The Hammerhead\* series power modules are isolated dc-dc converters that operate over an ultra-wide input voltage range of 18 -75Vdc and provide a single precisely regulated output voltage. This series is a low cost, smaller size alternative to the existing LW/LAW/LC/SC/SW with enhanced performance parameters. The output is fully isolated from the input, allowing versatile polarity configurations and grounding connections. The modules exhibit high efficiency and built-in filtering for both input and output, which minimizes the need for external filtering. The module is fully self-protected with output overcurrent and overvoltage, overtemperature and input under voltage shutdown control.

- Ultra-wide Input Voltage Range, 18 to 75Vdc
- No minimum load
- High efficiency
- Constant switching frequency
- Low output ripple and noise
- Small Size and low profile, follows industry standard footprints
- Surface mount (SMT) or Through hole (TH)
- Reflow process compliant, both SMT and TH versions
- Positive Remote On/Off logic
- Output overcurrent/voltage protection (hiccup)
- Overtemperature protection
- Output Voltage adjust: 90% to 110% of  $V_o$ , nom
- Wide operating temperature range (-40°C to 85°C)
- Meets the voltage and current requirements for ETSI 300-132-2 and complies with and licensed for Basic insulation rating per EN60950-1
- 2250Vdc Isolation tested in compliance with IEEE 802.3 PoE standards
- ISO 9001 and ISO 14001 certified manufacturing facilities



## SHHD Hammerhead\* Series NEW

### 15W / 5A Max Power

- 1.10 x 0.96 x 0.34" / 27.94 x 24.38 x 8.5mm
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
SHHD001A3B	18 - 75V	12V	1.3A	88%
SHHD003A0A	18 - 75V	5V	3A	87%
SHHD005A0F	18 - 75V	3.3V	5A	88%

2250Vdc Isolation for PoE Applications

## KHHD Hammerhead\* Series NEW

### 50W / 15A Max Power

- 1.30 x 0.90 x 0.37" / 33.0 x 22.9 x 9.3mm
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
KHHD002A5B	18 - 75V	12V	2.5A	90%
KHHD006A0A	18 - 75V	5V	6A	91%
KHHD010A0F	18 - 75V	3.3V	10A	91%
KHHD004A2B	18 - 75V	12V	4.2A	90%
KHHD010A0A	18 - 75V	5V	10A	91%
KHHD015A0F	18 - 75V	3.3V	15A	91%

2250Vdc Isolation for PoE Applications

## EHHD Hammerhead\* Series

### 75W / 20A Max Power

- 2.28 x 0.90 x 0.30" / 57.9 x 22.8 x 7.6mm
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
EHHD006A0B	18 - 75V	12V	6A	93%
EHHD015A0A	18 - 75V	5V	15A	91%
EHHD020A0F	18 - 75V	3.3V	20A	91%

2250Vdc Isolation for PoE Applications



# Low Power Barracuda

Offering optimum efficiency, the low power modules are targeted at a broad range of communications equipment. These modules can be used in powering distributed power and intermediate bus architectures, as well as the latest integrated circuits or microprocessors. These isolated DC-DC converters can deliver up to 120W output power and provide a precisely regulated output voltage over a wide range of input voltages ( $V_{in} = 36-75Vdc$ ). Convenient packaging options, combined with open-frame construction, enable designers to develop cost- and space-efficient solutions. Additional features include remote On/Off, remote sense, output voltage adjustment, overcurrent/voltage protections and overtemperature protection.

## APPLICATIONS

- Distributed power architectures
- Wireless networks
- Access and optical network equipment
- Microprocessor powered applications
- Enterprise networks
- Latest generation IC's (DSP, FPGA, ASIC)



## SSTW Barracuda Low Power Series

### 15W / 5A Max Power

- $1.10 \times 0.96 \times 0.34'' / 27.94 \times 24.38 \times 8.5mm$
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
SSTW001A3B	48V (36 - 75V)	12V	1.3A	88%
SSTW003A0A	48V (36 - 75V)	5V	3A	87%
SSTW005A0F	48V (36 - 75V)	3.3V	5A	88%

2250Vdc Isolation for PoE Applications

## KSTW Barracuda Low Power Series

### 50W / 15A Max Power

- $1.30 \times 0.90 \times 0.37'' / 33.0 \times 22.9 \times 9.3mm$
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
KSTW002A5B	48V (36-75V)	12V	2.5A	90%
KSTW006A0A	48V (36-75V)	5V	6A	90%
KSTW010A0F	48V (36-75V)	3.3V	10A	90%
KSTW004A2B	48V (36-75V)	12V	4.2A	90%
KSTW010A0A	48V (36-75V)	5V	10A	91%
KSTW015A0F	48V (36-75V)	3.3V	15A	91%

2250Vdc Isolation for PoE Applications

## ESTW Barracuda Low Power Series

### 82W / 25 Max Power

- $2.3 \times .90 \times 0.34'' / 58.4 \times 22.8 \times 11.3 mm$
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
ESTW004A2C	48V (36-75V)	15V	4.2A	90%
ESTW006A0B	48V (36-75V)	12V	6A	90%
ESTW010A0A	48V (36-75V)	5V	10A	91%
ESTW015A0A	48V (36-75V)	5V	15A	91%
ESTW015A0F	48V (36-75V)	3.3V	15A	91%
ESTW025A0F	48V (36-75V)	3.3V	25A	92%

2250Vdc Isolation for PoE Applications

## KBVW Barracuda Low Power Series

### 70W / 6A Max Power

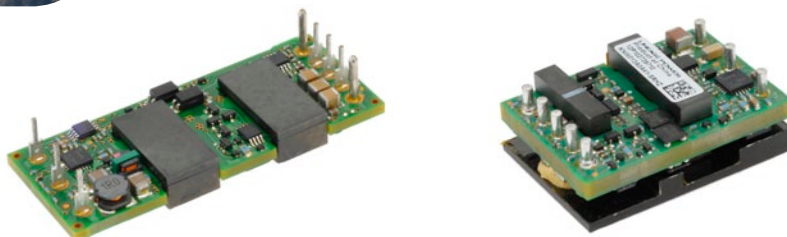
- $1.30 \times 0.90 \times 0.37'' / 33.0 \times 22.9 \times 9.3mm$
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
KBVW006A0B	48V (36-75V)	12V	6A	91%

2250Vdc Isolation for PoE Applications



## Low Power Series



### KNW Low Power Series

#### 66W / 20A Max Power

- 1.30 x 0.90 x 0.40" / 33.0 x 22.9 x 10.2mm
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
KNW013A0A	48V (36-75V)	5V	13A	91%
KNW015A0F	48V (36-75V)	3.3V	15A	92%
KNW020A0F	48V (36-75V)	3.3V	20A	91%

2250Vdc Isolation for PoE Applications

### HC / HW Low Power Series

#### 33W / 12A Max Power

- 1.86 x 1.16 x 0.34" / 47.2 x 29.5 x 8.5
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
HC005A0A	24V (18-36V)	3.3V	5A	86%
HC004A0A	24V (18-36V)	5V	4A	88%
HW005A0F	48V (36-75V)	3.3V	5A	87%
HW004A0A	48V (36-75V)	5V	4A	89%

2250Vdc Isolation for PoE Applications

### EVW Low power Series

#### 120W / 20A Max Power

- 2.3 x 0.90 x 0.32" / 58.4 x 22.8 x 8.1 mm
- Surface mount or through-hole

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
EVW020A0A	48V (36-75V)	5V	20A	92%
EVW020A0S6R0	48V (36-75V)	6V	20A	92%
EVW010A0B	48V (36-75V)	12V	10A	93%

2250Vdc Isolation for PoE Applications

# High Power Barracuda

The high power Barracuda series of DC-DC converters is a new generation of DC-DC power modules designed to support 10.4 -12Vdc intermediate bus applications where multiple low voltages are subsequently generated using point of load (POL) converters, as well as other application requiring a tightly regulated output voltage. The converter incorporates digital control, synchronous rectification technology, and innovative packaging techniques to achieve higher efficiencies. This leads to lower power dissipations such that for many applications a heat sink is not required. Standard features include on/off control, output overcurrent and overvoltage protection, overtemperature protection, input under and overvoltage lockout.

The output is fully isolated from the input, allowing versatile polarity configurations and grounding connections. Built-in filtering for both input and output minimizes the need for external filtering.

## Barracuda\* Series

- High efficiency operation up to 96%
- Remote sense and output voltage trim
- DOSA-standard quarter and eighth brick
- Negative remote on/off logic
- Output overcurrent/overvoltage protection
- Overtemperature protection
- Wide operating temperature range (-40°C to °85C)
- 1/8 Brick - 2.30 x 0.90 x 0.44" / 58.4 x 22.8 x 11.3mm
- 1/4 Brick - 2.30 x 1.45 x 0.46" / 58.4 x 36.8 x 11.7mm
- Optional baseplate

## Barracuda\* Digital Series

- Conforms to new DOSA standard for Second Generation Single Output Pin DC-DC Converters with Digital Connections
- Fully backwards compatible with other Barracuda series
- Digital interface with PMBus
- Two user configurable pins

### 1/8 Brick

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
EBVW020A0B	48V (36-75V)	12V	20A	95%
EBVW025A0B	48V (36-75V)	12V	25A	95%

### 1/4 Brick

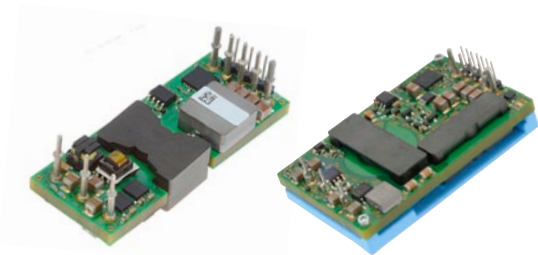
MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
QBVW025A0B	48V (36-75V)	12V	25A	96%
QBVW033A0B	48V (36-75V)	12V	33A	96%
QBVE060A0S10R4	48V (46-56V)	10.4V	60A	96%
QBV5050A0B	48V (52-60V)	12V	55A	96%

### 1/8 Brick

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
EBDW020A0B	48V (36V-75V)	12V	20A	95%
EBDW025A0B	48V (36V-75V)	12V	25A	95%

### 1/4 Brick

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
QBDW025A0B	48V (36V-75V)	12V	25A	96%
QBDW033A0B	48V (36V-75V)	12V	33A	96%





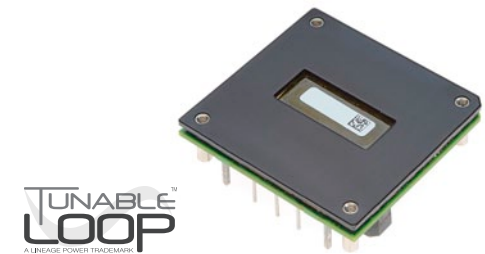
# Power Amplifiers

A new generation of power modules designed for maximum cost effectiveness and power density, the industry standard half-brick series DC-DC converter is an ideal choice for high voltage and power amplifier applications.

## Orca\* Series JRCW/JNCW Modules

- 450 watts maximum power
- 36-75Vdc input/28 - 48Vdc output model
- Output voltage adjustment trim, 16.0 to 35.2Vdc or 28.8 - 57.6Vdc
- High efficiency operation up to 94%
- Integral metal baseplate with optional threaded inserts
- Optional Tunable Loop\* for optimized output capacitance
- Operates at full power to case temperatures of 100°C
- 2.27 x 2.39 x 0.5" / 57.7 x 60.7 x 12.7mm

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
JRCW016A0R	48V (36-75V)	28V	16A	94%
JNCW016A0R	48V (36-75V)	28V	16A	94%
JRCW450R	48V (36-75V)	32V	14A	94%
JNCW450R	48V (36-75V)	32V	14A	94%
JRCW450U	48V (36-75V)	48V	9.4A	94%



## JNC/JNW Modules

- 350 watts maximum power
- 18-36 / 36-75Vdc input/28Vdc output model
- Output voltage adjustment trim, 16.8 to 32.0Vdc
- High efficiency operation up to 92%
- Integral metal baseplate with optional threaded inserts
- Optional Tunable Loop\* for minimized output capacitance
- Operates at full power to case temperatures of 85°C
- 2.27 x 2.39 x 0.5" / 57.7 x 60.7 x 12.7mm

MODEL	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY
JNC350R	24V (18-36V)	28V	12.5A	91%
JNW350R	48V (36-75V)	28V	12.5A	92%



# Filter & PIM Modules

## Filter Modules

The internal operation of DC-DC converters utilizes pulsed voltages and currents, which can generate broad-spectrum noise that results in electromagnetic emissions. To ease the task of meeting International Standards that limit emissions, GE offers a range of input filter modules with current ratings of 5A, 7A, 10A, 12A, and 20A. One properly sized filter module can be used with one or multiple DC-DC converter modules. Our filter modules reduce the levels of conducted common-mode and differential-mode noise, providing high insertion loss throughout the frequency range regulated by such bodies as the International Special Committee on Radio Interference (CISPR) and the U.S. Federal Communications Commission (FCC).

All of our filter modules are rated for differential input voltages up to 75Vdc and common-mode input voltages up to 1500Vdc. For further details on managing EMC, refer to individual DC-DC module and filter datasheets.



FLT007A0Z  
25.4 x 25.4 x 12.2 mm



FLT012A0Z  
48.3 x 25.4 x 11.7 mm



FLTR75V05Z  
25.4 x 25.4 x 10.2 mm



FLTR100V10Z  
51 x 28 x 12 mm



FLTR100V20Z  
50.8 x 40.6 x 12.7 mm

MODEL	RATED VOLTAGE	RATED CURRENT	COMMON-MODE INSERTION LOSS	DIFFERENTIAL-MODE INSERTION LOSS	RESISTANCE PER LEG (MOHMS)
FLT007A0Z	0-75V	7A max	60dB	66dB	25
FLT012A0Z	0-75V	12A max	56dB	57dB	20
FLTR75V05Z	0-75V	5A max	28dB	25dB	20
FLTR100V10Z	0-75V	10A max	36dB	44dB	14
FLTR100V20Z	0-75V	20A max	32dB	36dB	6.6



## ATCA Power Input Modules (PIM)

The PIM400 series of Power Input Modules is designed to greatly simplify the task of implementing dual redundant, hot swappable -48Vdc power distribution with EMI filtering on an ATCA or other telecom boards. The PIM400 with optional digital interface (I<sup>2</sup>C) capability, when used with a variety of GE's series of Bus converters (e.g. Barracuda\* Series) and POLs (e.g. DLynx\* Series), provides for a simple, elegant power architecture solution for a wide variety of intelligent power architectures.

Model	Input Voltage	Current Rating	Auxiliary Output 1	Auxiliary Output 2	Options
PIM400Z	-36 to -75 V	10A	3.3V/3.6A	5.0V/0.15A	-
PIM400KZ	-36 to -75 V	10A	3.3V/3.6A	5.0V/0.15A	I <sup>2</sup> C Digital Interface

### Features:

- Digital interface options with I<sup>2</sup>C
- Delivers up to 400W of rated power
- -48V/10A Dual redundant input power distribution
- High efficiency : 98% typical
- Integral EMI filter designed for minimal external filtering
- OR'ing FETs for A&B feeds
- A&B Feed Loss or open fuse alarm
- Hot swap capability
- Inrush current protection
- Industry Standard Quarter brick size



### Specifications

- Input voltage range -36 to -75V
- Management power 3.3V/3.6A & 5.0V/150mA
- Independent holdup capacitor charging voltage trimmable from 50 to 95V
- Operating temperature range : -40°C to 85°C

### Protection features

- Reverse polarity protection
- Input undervoltage lockout
- Input transient overvoltage protection
- Overcurrent and temperature protection



[illegible][illegible]



# Next-Generation Non-Isolated / POL



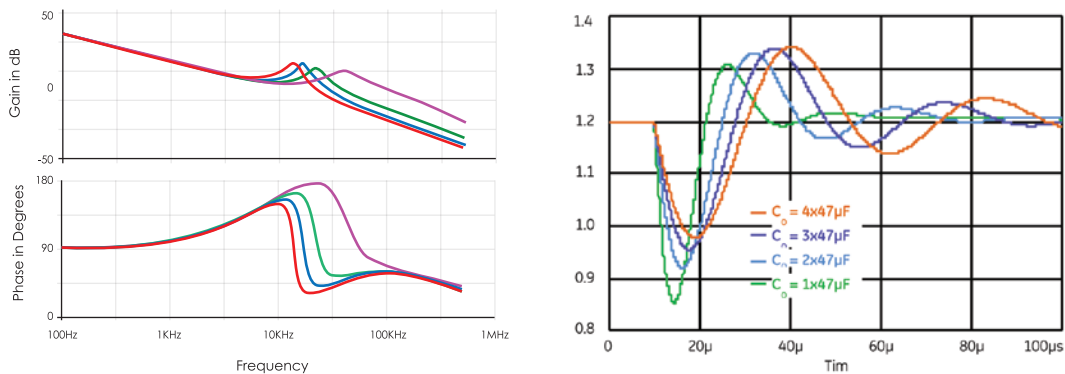
## Tunable Loop\* Technology

### Improved footprints, transient response, and costs

The power of Tunable Loop\* is a simple implementation of a resistor and capacitor in series across the point-of-load (POL) Trim and Output pins to optimize POL modules for multiple applications of varying demands. These very small passive devices never exceed a few k $\Omega$  resistance or a few hundred nF capacitance.

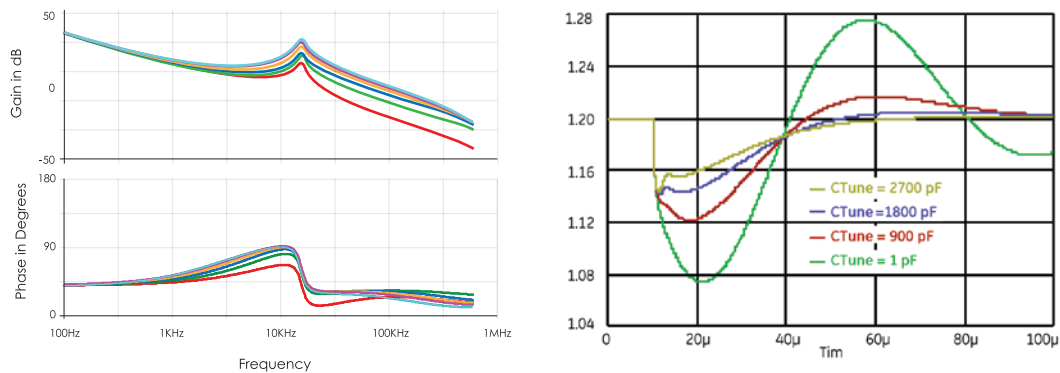
The figure below illustrates the transient response of a 12A PicoDLynx\* module to a 50% load step with varying external capacitance. The maximum voltage deviation improves from 347 mV (1x47uF) to 222mV (4x47uF) but the control loop bandwidth drops from 51kHz to 24kHz, increasing the duration of the voltage excursion. This is consistent with the reduction in control bandwidth and poorer phase margin caused by increased capacitance.

**Without Tunable Loop\*:** High deviation and reduced control bandwidth with increased output capacitance.

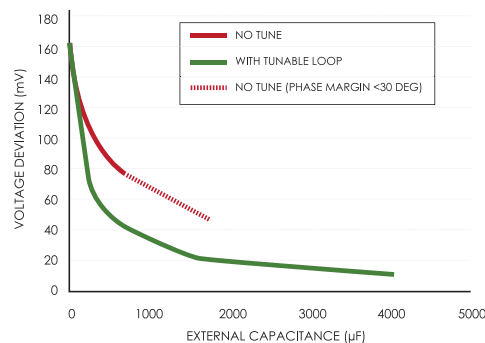


The goal of Tunable Loop\* is to regain the bandwidth lost with increased capacitance. If we fix the value of  $R_{Tune}$  to 330ohms and vary  $C_{Tune}$  from 1pF to 2700pF, we regain control bandwidth back to 82KHz and achieve a **4.8x reduction in voltage deviation**.

**With Tunable Loop\*:** Substantially reduced deviation through improved control bandwidth and reduced output capacitance.



Tunable Loop\* achieves lower voltage deviation with significantly reduced capacitance. As an example, the 12A PicoDLynx\* model (5Vin / 1.2Vout @ 8A), with a step load of 4A and deviation <4% (48mV) would require 3 ceramic caps + 4 electrolytic caps versus 1 ceramic cap + 1 electrolytic cap with Tunable Loop\*. This results in a \$1.45 reduction in external capacitor cost and a footprint reduction of 190mm<sup>2</sup> achieving **4X the effective current density**.



73% Cost Reduction  
74% Footprint Reduction

# Tunable Loop\* POL Converter Modules



## DLynx\* Series

The GE DLynx\* offers digital control and communication in ultra-compact industry standard footprints. Multiple devices can use industry standard PMBus communication to monitor and optimize power conversion, even during operation, making Adaptive Voltage Scaling (AVS) a reality. A minimum of three external components are needed to implement these modules, which leads to shortened design time. The GE DLynx\* family provides some of the most compact Point of Load DC-DC converters available with outstanding performance, control, and reliability at a cost competitive rate.

- 3 to 40A output current
- 3 to 14.4Vdc input models
- 0.45 to 5.5Vdc output models
- Dual offering – both digital & analog versions
- Standards-based DOSA footprint
- Tunable Loop\*
- Digital communication (PMBus)
- Total Efficiency\* architecture
- Superior thermal performance
- EZ-Sequence\*
- Cost efficient open frame design

	MODEL NUMBER	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	COMMUNICATIONS	EFFICIENCY	DIMENSIONS	
PicoDLynx*	PNVX002	3.0-14.0V	0.6-5.5V	2A	Analog	96%	12.2 x 12.2 x 4.5 mm	
	PDT003	3.0-14.4V	0.45-5.5V	3A	Digital	94%	12.2 x 12.2 x 6.25 mm	
	PVX003	3.0-14.4V	0.6-5.5V	3A	Analog	92%	12.2 x 12.2 x 6.25 mm	
	PDT006	3.0-14.4V	0.45-5.5V	6A	Digital	94%	12.2 x 12.2 x 6.25 mm	
	PVX006	3.0-14.4V	0.6-5.5V	6A	Analog	94%	12.2 x 12.2 x 6.25 mm	
	PDT012	3.0-14.4V	0.45-5.5V	12A	Digital	96%	12.2 x 12.2 x 6.25 mm	
	PVX012	3.0-14.4V	0.6-5.5V	12A	Analog	95%	12.2 x 12.2 x 6.25 mm	
MicroDLynx*	UDT020	3.0-14.4V	0.45-5.5V	20A	Digital	96%	20.32 x 11.43 x 8.6 mm	
	UVT020	3.0-14.4V	0.6-5.5V	20A	Analog	96%	20.32 x 11.43 x 8.6 mm	
MegaDLynx*	MDT040	4.5-14.4V	0.45-2.0V	40A	Digital	91.5%	33.02 x 13.46 x 10.9 mm	
	MVT040	4.5-14.4V	0.6-2.0V	40A	Analog	91.5%	33.02 x 13.46 x 10.9 mm	

## SlimLynx\* Low Profile Series

The new encapsulated SlimLynx\* series is a mere 3mm high allowing engineers to utilize this power module in very tight spaces, such as underneath the boards, in mezzanine structures, and in very small profile applications. A digital POL in an industry standard DOSA footprint, the SlimLynx\* delivers exceptionally high efficiency peaking at over 95%, which reduces energy consumption and heat dissipation.


- Ultra low height design for very dense power applications.
- High technology encapsulation for improved thermal performance, electrical insulation, and easy manufacturing.
- Bottom side placement
- Digital interface through the PMBus protocol
- Small footprint: 20.32 x 11.43 x 3mm (Max) (0.8 in x 0.45 in x 0.118 in)
- Output voltage programmable from 0.6 to 5.5Vdc via external resistor. Digitally adjustable down to 0.45Vdc
- Wide Input voltage range (3-14.4Vdc)
- Wide operating temperature range [-40°C to 85°C]
- DOSA approved footprint
- Tunable Loop\* to optimize dynamic output voltage

	MODEL NUMBER	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	COMMUNICATIONS	EFFICIENCY	DIMENSIONS	
SlimLynx*	ULDT012	3.0-14.4V	0.45-5.5V	12A	Digital	95.5%	20.32 x 11.43 x 3 mm	
	ULVT012	3.0-14.4V	0.6-5.5V	12A	Analog	95.5%	20.32 x 11.43 x 3 mm	

## ProLynx\* Wide Input Series




The ProLynx series offers a wide input voltage range of 9 to 36V and an extended output range of 3 to 18V. It can also generate negative output voltages using an alternate connection scheme. These power modules simplify board design and accelerate new product development schedules by minimizing the designer's steps over choosing a discrete power solution. The ProLynx can be used in a broad range of applications including automotive, industrial, medical, military, and wireless industries.

- Extra Wide Input voltage range (9 to 36Vdc)
- Output voltage programmable from 3 to 18Vdc via external resistor
- Can deliver up to 5A of output current
- Tunable Loop\* to optimize dynamic output voltage response
- Patent Pending AutoLimit automatic scaling of current limit with output voltage
- Output overcurrent protection (non-latching)
- Small size: 20.32 x 11.43 x 8.5 mm (0.8 in x 0.45 in x 0.335 in)
- Wide operating temperature range [-40°C to 105°C (Ruggedized: -D), 85°C (Regular)]

	MODEL NUMBER	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	COMMUNICATIONS	EFFICIENCY	DIMENSIONS	
ProLynx*	APXW003	9.0-36.0V 9.0-24V	3.0-18.0V -3.3 to -12V	3A	Analog	97%	20.32 x 11.43 x 8.5 mm	
	APXW005	9.0-36.0V 9.0-24V	3.0-18.0V -3.3 to -18V	5A	Analog	96%	20.32 x 11.43 x 8.5 mm	


## TLynx\* Surface Mount Models

The GE TLynx\* transformed the industry with the patented Tunable Loop\* technology that dramatically reduced the total board space requirement while continuing to improve transient performance. TLynx provides small size, proven reliability, great thermal performance, and cost effectiveness. Only three external components are needed to complete a design thereby reducing design time and increasing reliability. GE TLynx\* family provides a high performance Point of Load solution with a minimum of risk, time and cost.

	MODEL NUMBER	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY	DIMENSIONS	
PicoTLynx*	APXS002	3.0-14V	0.6-5.5V	2A	96%	12.2 x 12.2 x 6.25 mm	
	APXK004	8.0-16V	0.6-8.0V	4A	96%	12.2 x 12.2 x 6.25 mm	
MegaTLynx*	APTS030	6.0-14.0V	0.80-3.63V	30A	96%	33 x 13.46 x 10 mm	
GigaTLynx*	APTS050	4.5-14.0V	0.70-2.0 V	50A	95%	33 x 22.9 x 10 mm	

## Naos Raptor\* Single In Line Package (SIP)

The GE Naos Raptor\* family offers the high performance features of Tunable Loop\*, excellent thermal performance, and proven GE reliability in a SIP package, which requires a minimum of board space.

	MODEL NUMBER	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT	EFFICIENCY	DIMENSIONS	
Naos Raptor*	NQR002	3.0-14.0V	0.6-5.5V	2A	93%	10.4 x 16.5 x 8.1 mm	
	NSR003	4.5-14.0V	0.59-6.0V	3A	93%	10.4 x 16.5 x 7.84 mm	
	NSR006	4.5-14V	0.59-6.0V	6A	92%	10.4 x 16.5 x 7.84 mm	
	NQR010	4.5-14.0V	0.59-6.0V	10A	97%	10.4 x 16.5 x 8.4 mm	
	NSR020	4.5-13.8 V	0.59-6.0V	20A	97%	36.8 x 15.5 x 9.2 mm	
	NSR040	5.0-13.8V	0.60-5.0V	40A	95%	36.8 x 27.9 x 10.7 mm	
	NSR050	5.0-14.0V	0.60-2.0V	50A	93%	36.8 x 27.9 x 20.1 mm	
	NSR060	5.0-13.8V	0.60-5.0V	60A	95%	65.5 x 31.8 x 11.6 mm	

# Digital Power Solutions

## Digital Converters

GE's Critical Power business digitally controlled DC-DC power converters provide power engineers with a broad suite of information and tools to innovate their designs. Digital models offer more flexibility, often require less real estate, and deliver higher performance at an attractive price. The true power of digital communication becomes apparent when measurements and adjustments can be made instantaneously.

Digital modules provide the ability to diagnose and refine designs prior to final production, monitor and adjust running product and deliver exceptional thermal de-rating. Digital solutions combine voltage range accuracy while consuming less board space at competitive costs.

The non-isolated DLynx\* family and the isolated Barracuda\* family offer both an industry-standard DOSA footprint to ensure hardware compatibility and a standard PMBus interface to ensure software compatibility to minimize risk for future designs.

## DLynx\*

The DLynx\* portfolio is available in 3A, 6A, 12A, and 20A digital and analog versions in addition to a 40A module. The DC-DC POL converters efficiently power circuit board electronics such as processors, memory, application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs) and other silicon devices. The standards-based DOSA footprints and analog/digital compatibility with existing circuit board designs shrinks the size, lowers the cost and improves the performance of DC-DC converter modules.

An industry-standard PMBus interface and space-saving Tunable Loop\* technology deliver leading current density. With proven tools to simplify design, DLynx\* modules can be implemented with only three external components. Adaptive voltage scaling (AVS) leverages silicon performance to reduce power consumption through tight digital control ( $\pm 0.4$  percent) of the output voltage and a  $\pm 1$  percent controller set point reference.

## Barracuda\*

The cost-effective, high-efficiency Barracuda\* series delivers digital power communication and control in a quarter-brick and eighth-brick DOSA standard footprint. Power design engineers can deploy the new Barracuda\* modules in existing power designs as DOSA-compliant, drop-in upgrades for unregulated and semi-regulated bus converters. As part of the Total Efficiency\* architecture, the new Barracuda\* modules deliver peak efficiency of up to 96 percent.

A new digital PMBus interface supports a wide range of commands to both control and monitor the Barracuda\* modules with a full range of protections and warnings, digital on/off, trim, margin, power good, rise time adjustment, and input under voltage lockout.

## SlimLynx\*

The SlimLynx\* 12A is the first offering within a new series of encapsulated, digital and analog, non-isolated, DC-DC converters from GE's Critical Power business. The ultra-slim 3mm module provides industry-leading power density to reduce heat dissipation inside industrial, networking and telecommunication devices, while also delivering exceptionally high energy efficiency, peaking at over 95 percent. See [www.slimlynx.com](http://www.slimlynx.com) for more information.





## Digital Evaluation Kits

### Digital Power Insight Kit

### SlimLynx Evaluation Kit

The GE's Critical Power business Digital Power Insight\* (DPI) kit and SlimLynx\* Evaluation kit provide an easy to use digital evaluation set and GUI that give power engineers a user interface that delivers control flexibility over their digital power converters. The software features continuous monitoring (polling) of input voltage, output voltage and current, as well as module status. Status changes are automatically time stamped and logged by the software and are easily exported. A Command Line Interface (CLI) is available for a more in-depth analysis of the transmitted data across the I<sup>2</sup>C bus. The CLI is a useful tool for creating and executing user-defined routines and scripts, in addition to logging of data for future review or plotting. The software enables engineers to create custom configuration files and to fine-tune and optimize a variety of parameters to ensure the highest levels of performance and efficiency.

Design is simplified with GE's Critical Power business design tools like the ProGUI, a graphical user interface package. During development, measurement of different power related parameter's configurations allows the developer to optimize the design with a level of granularity and ease previously unavailable. See [www.digitalpowerinsight.com](http://www.digitalpowerinsight.com) for more information.

## Digital DC-DC Efficiency Impact

Digital communication allows system architects to adjust critical system parameters to optimize overall efficiency and minimize power dissipation. The data collected may also be employed to improve reliability and total cost of ownership (TCO).

$$n = \frac{P_{out}}{P_{in}} = \frac{P_{in} - P_{diss}}{P_{in}}$$

### Definition of System Efficiency

$$n = \frac{\text{Performance}}{P_{in}}$$

Module efficiency alone is not the most significant variable. System efficiency is the real target for optimization. Performance may be TPC benchmarks, GFLOPs, etc.



# Custom Capabilities



## GE Global Research (GRC)

GE Global Research is one of the world's most diversified industrial research labs, providing innovative technology for all of GE's businesses. Global Research has been the cornerstone of GE technology for more than 100 years, developing breakthrough innovations in areas such as medical imaging, energy generation technology, jet engines and lighting. GE Global Research is headquartered in Niskayuna, New York and has three other multidisciplinary facilities in Bangalore, India, Shanghai, China and Munich, Germany.

We employ 2,800 researchers all searching to uncover the next technological breakthroughs that will change the landscape for the GE businesses. Our diverse set of technology expertise ranges from electronics to chemistry, biosciences to computing, metallurgy to fluid mechanics, materials to imaging– and everything in between.

## Our Customer Focus

GE's Critical Power business maintains a broad range of standard technologies that are the ideal building blocks to solve your application's power requirements. Many of our customers want us to re-package our technologies to develop an optimal solution that maximizes performance while reducing their total cost of ownership. We quickly and cost effectively employ our leading-edge technologies to deliver custom products that best fit our customer's unique power requirements—reducing their risk and time to market by utilizing proven technologies.

## Talent

GE's Critical Power business retains independent Research & Development and Custom Product Development teams to ensure both continued development of next generation technology road maps as well as custom / modified designs. We are self-certified to support major safety agencies, further reducing product development schedules.

Our regional Field Application Engineers (FAEs) work closely with our customers to rapidly produce clean engineering prototypes, and, along with our design teams, provide ongoing sales and technical support throughout the life of each application. Our closed-loop engineering processes ensure continued process improvements and new technology trends are implemented into our future designs.

## Research & Design

GE's Critical Power business maintains strategic alliances with key suppliers and global industry leaders to help define future technology direction and objectives. Our alliances allow us greater utilization of next generation technologies and topologies that we deploy into our custom power designs to drive leading power densities and efficiencies for our customers.





## Product Development

Once a solution is proven at the prototype level, our product development teams execute a full development process finalizing the design and implementing improvements to the fabricated parts (such as PCBs, sheet metal, and magnetics), confirming the bill of materials, defining the quality assurance metrics, performing design verification tests, performing reliability tests (HALT / STRIFE), and testing for certification and EMI / safety qualification.

## Manufacturing & Quality Control

Our global operations and standardized processes enable us to build product at any of our global facilities utilizing consistent processes, equipment, training, and quality standards ensuring our customers receive exceptional product regardless of the country of design or manufacture. Our consistent approach ensures product quality, faster prototypes, and a reliable disaster recovery program.

## Facilities

Our manufacturing strategy is to use the best of both internal and third party manufacturing, allowing us the flexibility to best fit each application's requirements. Our manufacturing processes, quality systems, data collection, and documentation are standardized across all facilities ensuring a smooth transition among locations to accommodate optimal

capacity utilization and/or proximity of supply close to our end customer's manufacturing location. Employing a global procurement strategy further underscores our commitment to our customers. Managing a common AVL across all divisions allows us to leverage our cost structure with our supplier base, which contributes to competitive products with cost savings for our customers.

## Quality / Reliability

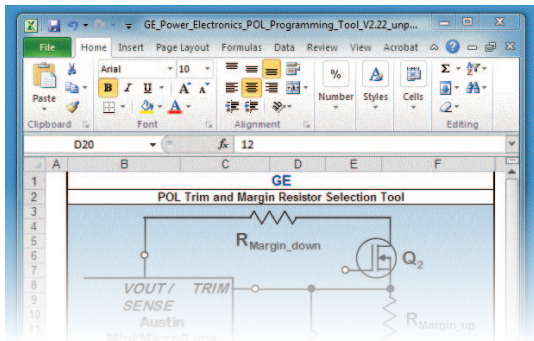
Our Global Total Quality Management System ensures consistent measurement and collection of SPC data and deployment of controls of operation. Starting with the design and development phase, we apply stringent derating criteria of components and expose our designs to STRIFE and HALT testing. Our focus on reliability continues into production by using HASS screening and elevated temperature testing. Finally, we monitor the process using CPK and statistical analysis tools, forming a closed-loop process. All of our facilities are ISO 9001:2000 and ISO14001 Certified with many of our Quality Managers holding Green and Black Belt Six Sigma ratings.

As a leading power provider, we offer our customers low-risk, leading-edge technology and consistent, high-quality product produced around the world and backed up by responsive local support.

# Engineering Resources & Tools

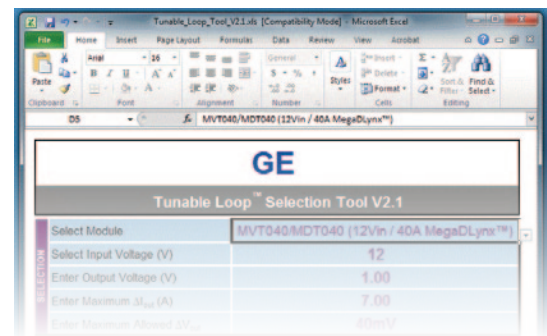
## POL Voltage Setting & Tolerance Tool

Helps designers set the output voltage of POL modules including trim resistor values; worst case static variation in the output voltage for a trim resistor; calculating the values of margining resistors; and selecting the external series resistor to program the output voltage to desired nominal, low and high values. Supports all Austin Lynx\*, Lynx II\*, TLynx\*, DLynx\* and NSR/NQR series of POL modules.



## Tunable Loop\* Selection Tool

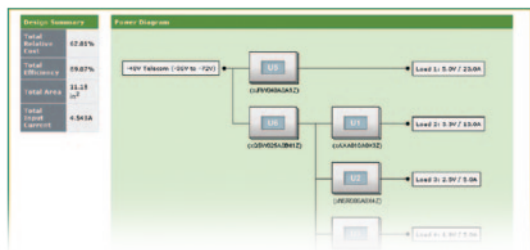
The Tunable Loop\* helps designers select output capacitors, and values of  $C_{TUNE}$  and  $R_{TUNE}$  for Tunable Loop\* POLs for optimized performance and reduced output capacitance. Supports the TLynx\*, DLynx\* and NSR/NQR series of POL modules.





## On-Line Power Module Selector

Helps select the best modules to meet your board-level powering requirements. Simply enter your input voltage range, output voltage and current needs and board constraints (maximum allowed temperature, minimum airflow and height). With this basic information, the selector provides a list of possible solutions with side-by-side comparisons and the ability to sort by size, efficiency and cost.



## Power Module Wizard

For applications where multiple rails on a board need to be powered, the Power Module Wizard can evaluate different on-board powering architectures and provide a comparison of different approaches. By providing the relative efficiency, cost and board size needed by combinations of modules, including isolated and non-isolated, the user can quickly make the choice that best matches their needs.

Design Number	Relative Cost	Board Area	Efficiency	Part Number	Quantity	Package	Input Voltage	Output Voltage	Max. Input Current	Max. Output Current	Board Size
0.001	0.04%	0.16 uF	97.97%	QBDW00000000	1	1 x 2	100V	5.0V	2.0A	2.0A	11.15
0.002	0.07%	0.16 uF	99.87%	QBDW00000000	1	1 x 2	100V	5.0V	2.0A	2.0A	11.15
0.003	12.97%	1.12 uF	99.87%	QBDW00000000	1	1 x 2	100V	5.0V	2.0A	2.0A	11.15

## Evaluation Boards

Evaluation boards enable designers to evaluate the performance of our converters, either stand-alone or with our POL modules and optional input filters. Features such as on/off control, output voltage trim, and remote sense can be tested as well as external filtering components on both the input and output side.

## Digital Power Insight\* Tools

Digital Power Insight\* software tools provide power engineers the flexibility to configure and reconfigure voltages, thresholds, warnings and settings for digital power modules using standards-based PMBus over I<sup>2</sup>C communications.

## ProGUI

The new ProGUI enhances the capability of the Digital Power Insight\* software suite with a powerful tool capable of communicating with up to 64 modules on the PMBus. Features include configuring modules, logging and plotting data obtained from the modules, and saving data for further analysis and documentation. The ProGUI, along with the previously available GUI and Command Line Interface (CLI) software tools, provide the user with a wide range of capabilities to communicate with digital modules during the design phase as well as with production boards. Products supported by these tools include the DLYNX\* POL modules (PDT 3A/6A/12A, UDT 20A and MDT 40A) as well as the Barracuda\* DC-DC isolated converters (QBDW and EBDW series) and the SlimLynx\* series.

For more information on our tools, go to [www.gecriticalpower.com](http://www.gecriticalpower.com)



# POL/Non-Isolated

I <sub>OUT</sub> \ V <sub>OUT</sub>	18V	8V	6V	5.5V	5V	3V	2V	0.7V	0.6V	0.45V
60A					NSR060					
50A							APTS050			
							NSR050			
40A							MDT040 <sup>†</sup>			
							MVT040			
					NSR040					
20A				UDT020 <sup>†</sup>						
				UVT020						
				ULDT012 <sup>†</sup>						
12A				ULVT012						
				PDT012 <sup>†</sup>						
				PVX012						
10A			NQR010							
6A				PDT006 <sup>†</sup>						
				PVX006						
5A	APXW005									
4A		APXK004								
	APXW003									
3A				PDT003 <sup>†</sup>						
				PVX003						
2A				APXS002						
				PNVX002						
				NQR002						

INCREASING POWER

First Letter	Package
AP	varies
P	Pico (12x12mm)
P	Micro (20x11mm)
P	Mega (33x13mm)
P	SIP, varies

ProLynx (9-36V <sub>in</sub> )
DLynx (3-14.4V <sub>in</sub> )
SlimLynx (3-14.4V <sub>in</sub> )
TLynx (V <sub>in</sub> varies)
Naos Raptor (SIP, V <sub>in</sub> varies)

<sup>†</sup> PMBus Digital

$I_{OUT} \setminus V_{OUT}$	48V	32V	28V	15V	12V	10.4V	5V	3.3V
78A								
68A								
60A						QBVE060A0S10R4		
55A								
50A					QBVS050A0B			
36A								
33A					QBDW033A0B			
25A			FNW700R		QBDW025A0B			
					EBDW025A0B			ESTW025A0F
24A								
20A					EBDW020A0B			EHHD020A0F
19A								
17A		JRCK017A0S32R						
16A		JRCW450R	JRCW016A0R					
15A							EHHD015A0A	KHHD015A0F
							ESTW015A0A	KSTW015A0F
								ESTW015A0F
10A							KHHD010A0A	KHHD010A0F
							KSTW010A0A	KSTW010A0F
							ESTW010A0A	
9.4A	JRCW450U							
6.0A					EHHD006A0B		KHHD006A0A	
					ESTW006A0B		KSTW006A0A	
					KBVW006A0B			
5.0A								SHHD005A0F
								SSTW005A0F
4.7A								
4.2A					KHHD004A2B			
				ESTW004A2C	KSTW004A2B			
3.0A							SHHD003A0A	
							SSTW003A0A	
2.5A					KHHD002A5B			
					KSTW002A5B			
1.3A					SHHD001A3B			
					SSTW001A3B			
0.3A								

HAMMERHEAD (18-75V<sub>in</sub>)BARRACUDA LOW (36-75V<sub>in</sub>)BARRACUDA HIGH (V<sub>in</sub> varies)ORCA (36-75V<sub>in</sub>)

# Standard AC-DC

$I_{OUT} \backslash V_{OUT}$	54V	52V	48V	32V	28V	24V	12V
208A							CAR2512TE
							CAR2512FP
							CAR2512DC
166A							CAR2012TE
150A							CAR1812FP
133A							CAR1612FP
100A							CAR1212FP
							CAR1212DC
83.3A						CAR2024FP	
70.8A							CAR0812FP
							CAR0812DC
60A			EP3000AC48				
52A			CAR2548TN				
50A	CP2725AC54TEZ/P						
	CP2725AC48TEZ-FB						
45A	CP2500AC54TEZ						
	CP2500DC54PEZ						
41.6A							CCR0512FP
40A	CP2000AC54TEZ/P						
	CP2000DC54PEZ						
30A		EP1600UTEZ					
25A			CAR1248FP				
			CAR1248TN				
20A		EP1000UTEZ				EP0500V	
16A							CLP0212 5V Aux
							CLP0212 3V Aux
10A		EP0500U					
6.0A			EP0300AC48				

EP Rectifier (AC in)

CP Rectifier (AC in)

CAR Rectifier (AC in)

CLP0212 (2x4 AC in)

CP Converter (DC in)

CAR Converter (DC in)

CCR (1/2 U)





## Notes:



Notes:

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imagination at work

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