Avnet Breda
High Power Density Modular Power Supplies

Steve Underwood – 22nd November 2010

Power-One General

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Power-One in Numbers

- 2010 Revenue of $820m, with $195m cash in bank and $40m of debt. We are profitable and growing
- Number 2 in the Renewable Energy Inverter market with an 11% market share, or 1.7GW shipped in 2010, about $500m
- Power Supply design in; Carlsbad California (PCB mount DCDC), Uster Switzerland (High Efficiency ACDC), Dubnica Slovakia (ACDC and Power Systems), Gongming China (ACDC)
- Power Supply manufacture in; Dubnica Slovakia (Industrial, Power Systems), Gongming China (ACDC and DCDC)
- 2010 Power Supply revenue = $121m Network Telecom Equipment (Power Systems, DCDC Bricks and POLs)
- 2010 Power Supply revenue = $91m Computer and Office Equipment (Server, Storage, and Network Front-Ends)
- 2010 Power Supply revenue = $90m Industrial
- Visit us at www.power-one.com for more details

Power-One, Inc.

A world leader in power conversion and management

As one of the world's ten largest providers of power conversion and management solutions, Power-One is one of only a few companies with the product breadth to support every step of the refinement of utility grade AC into the various DC voltages needed to power high-availability infrastructure systems – at the site, system and semiconductor levels.

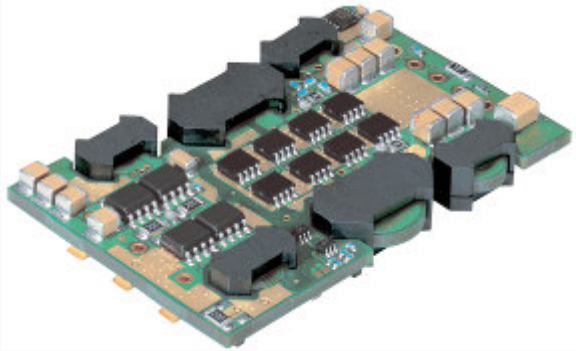


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Power-One – Power Products

- We have a range of DC Power Systems from 600W to 200kW, of ACDC power supplies from 30W to 7000W, of DCDC from 4W to 500W and POLs from 3A to 80A











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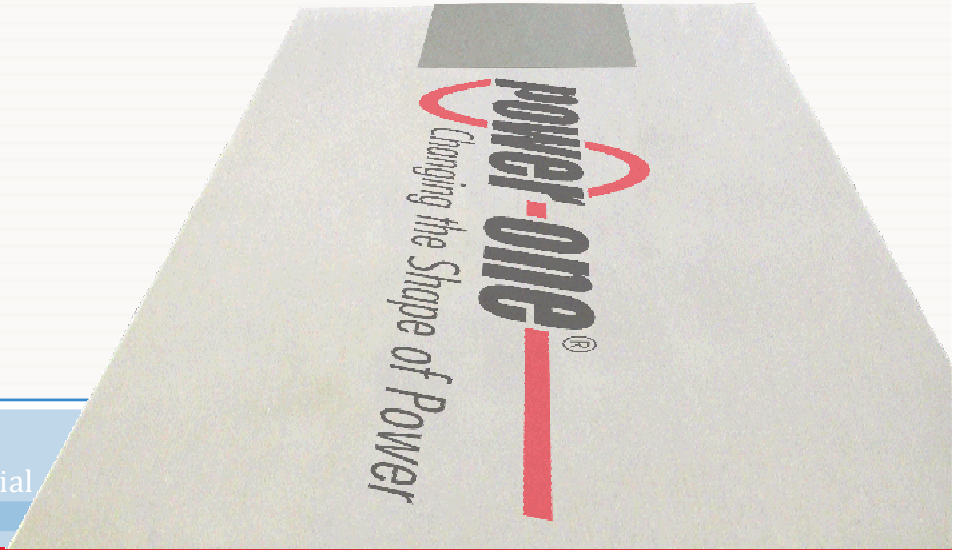
Power-One
Low Profile Modular Power Supply Family
LPM615

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Modular LPM: An Introduction



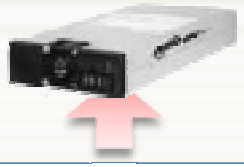
- Premium ACDC Modular Family
- 1500W 6-slot or 900W 4-slot Chassis
- 4 Single Output Modules Rated at 250W each
- Output Voltages 2V to 51V, Over 4 Ranges
- Low Profile
- High Power Density
- Designed and Built by Power-One
- Samples Available NOW



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LPM Modular Power: At a Glance

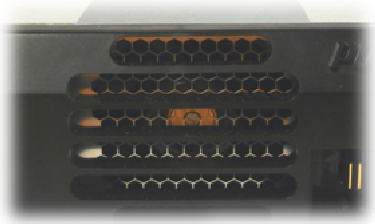




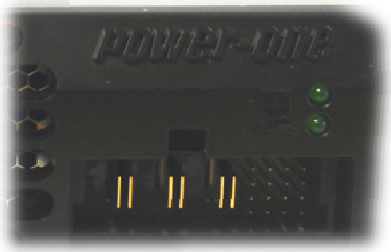


Front

Fan Inlet

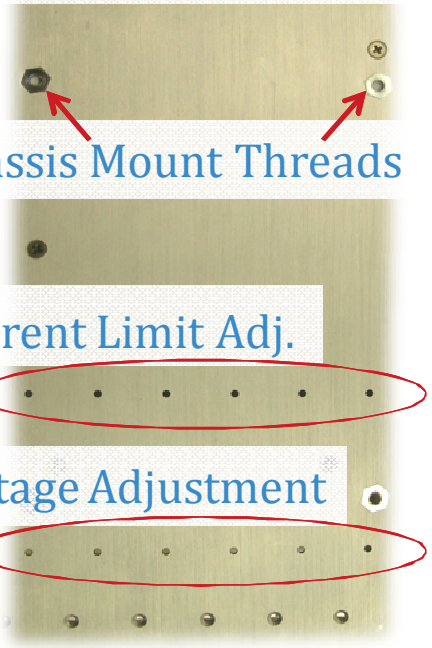


Input Connector



Underside

(Front)



Back

Output Connections

Negative Terminal

Positive Terminal



Output Signal Connector

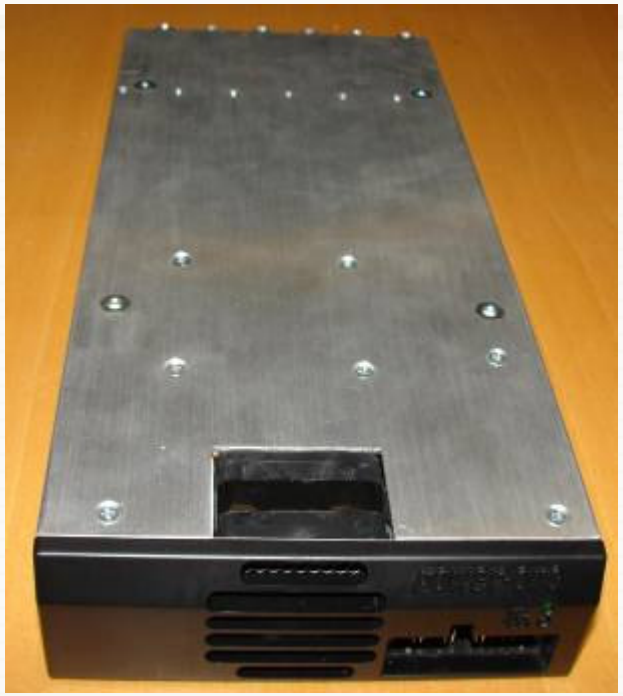
Who should use Modular ACDC?

- Semi Manufacture Plant
  - Automatic Test Equipment (ATE)
  - Diffusion
  - Metrology (Inspection)
  - Handlers
  - Lithography
  - Wire Bonders
  - Semiconductor Mask Making Equipment
- Other
  - High performance stage lighting.
  - Burn-in equipment.
  - Pick & Place .
  - Robotics.
  - Automated toll gates.
  - Lasers.

- Medical
  - Ultrasound .
  - Blood Analysis & Blood Scrubber.
  - Body Fluids Analysis.
  - CAT Scan.
  - Image Analysis Equipment.
  - Automated Drug Testing Equipment.
  - Cosmetic Lasers.
- Other (continued)
  - IC emulation.
  - Digital printing press equipment.
  - Flight simulators.
  - Airport landing systems.
  - Cheque sorters.
  - Electronic signs.

Example Applications and Customers

- Markets:-
  - Automation
  - Broadcast
  - Industrial/Military Computing
  - Medical
  - Security
  - Semi-conductor capital equipment
  - Test & Measurement including Laboratory Equipment and Instrumentation
- Typical Customers will include:-
  - ABB
  - Agilent
  - Applied Materials
  - Barco
  - Honeywell
  - Kontron
  - Raytheon
  - Siemens
  - And many others





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Why use the Power-One LPM Modular units?

- Highest Power Density in the Market Today
- Low 1.6” (1U) Height
- Small 5” x 10.6” Footprint
- Wide AC *and* DC Input Ranges in the Same Package
- Configuration Codes Permits Perfect Product Traceability
- Power-One Design, Manufacture and Support

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Leading High Power Density

- **Power Density**

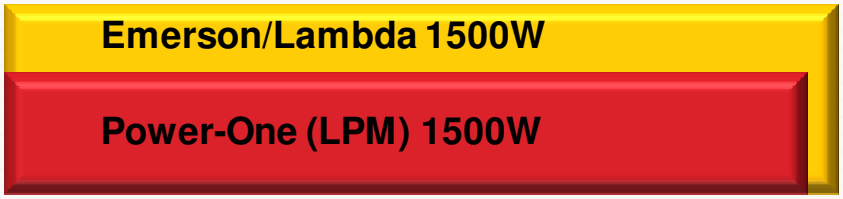
  64% **more** power per inch^3 than Lambda

  62% **more** power per inch^3 than Emerson

  20% **more** power per inch^3 than Excelsys

  That's 300W more power in the same package!

- **Profile comparison**



Side View



Top Down View (Footprint)

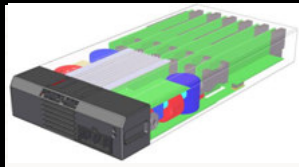
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Power Density and Dimensions – in detail

Manufacturer	Model	Power	Height	Width	Depth	Power Density
Power-One	LPMX	1500	1.6	5	10.6	17.68867925
Excelsys	Xcite	1200	1.6	5	10.7	14.01869159
Unipower	QuiQplus	1000	1.6	5	11.5	10.86956522
XP		1100	2.5	6	10	7.333333333
Lambda	Alpha	1000	2.6	5	11.2	6.868131868
Astec	iMP8	1200	2.5	7	10	6.857142857
Astec	iMP1	1500	2.5	8	11	6.818181818
Lambda	Alpha	1500	2.6	8	11.2	6.438873626
XP		1800	5	6.2	10	5.806451613
Sunpower		1000	2.5	7.2	11.2	4.96031746
Power-One	ESP	1000	2.6	7.4	10.7	4.857481493
XP		1400	5	6	10	4.666666667

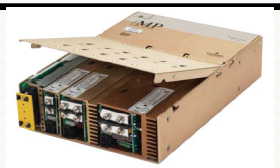
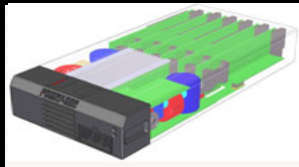
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Benchmark – Size + Power Density

Model		Comments	Verdict
Lambda Alpha		11.2" x 8" x 2", 8.4W/cuin	Av
Emerson iMP8		11" x 8" x 2.5", 6.8W/cuin	Av
XP Flexpower		10" x 5.2" x 5", 7W/cuin	Av
Excelsys Xcite		10.2" x 5" x 1.6", 14.7W/cuin	Very Good
Power-One LPM615		11" x 5" x 1.6", 17W/cuin	The Best

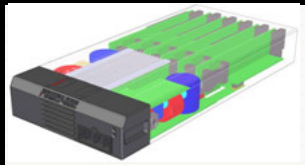
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Benchmark – Environmental Performance

Model		Comments	Verdict
Lambda Alpha		50C 100%, 70C 50%, -20C start, 10g shock, 3000m op	Weak Shock
Emerson iMP8		50C 100%, 70C 50%, -40C, no shock or altitude claims	Holes in data
XP Flexpower		50C 100%, 70C 50%, -20C, 30g shock, 3000m op	Good
Excelsys Xcite		40C 100%, 70C 50%, -20C, 1.5G shock,	Weak Shock
Power-One LPM615		50C 100%, 70C 50%, -20C, 50g shock, 3000ft op	Best

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Benchmark – Output Coverage

Model		Comments	Verdict
Lambda Alpha		Up to 16, 1.8V to 48V, 5A to 60A	
Emerson iMP8		Up to 21, 2V to 60V, 2A to 35A per slot	
XP Flexpower		Up to 14, 3.3V to 60V, 4.2A to 60A	
Excelsys Xcite		Up to 12, 1.5V to 58V, 3A to 50A	
Power-One LPM615		Up to 6 (12 later), 2V to 54V, 9A to 50A	covers 99% of market

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International High Power – Gone, but why?

- Old product line – Gone Now
- Complicated to build and support
- Not sensible or viable to introduce to new manufacturing plant
- Some market drift towards smaller products

- Over 10 million possible configurations from eight chassis and over 87 output modules.
- Up to 21 isolated outputs, 1000 to 4000 Watts.
- Optional .99 PFC to meet EN61000-3-2.
- Parallel/series outputs, more...
- Input circuitry highly ruggedized.

HPF5A4H6N6G1



LPM615 - Part Numbers Explained

LPM 6 15 – X X X X X X – D123

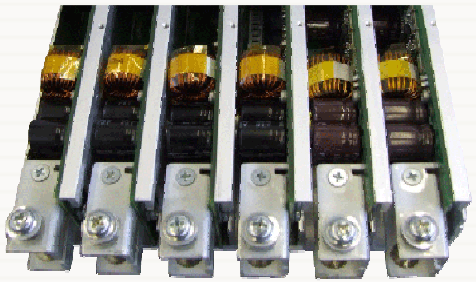
Chassis Type
LPM = Standard AC Input
LMM = Medical version of LPM

Number of Slots
6 = 6 Slots
4 = 4 Slots

Max Power
15 = 1500W
09 = 900W

Hardware Code
A, **B**, **C**, **D** or blanking plate **0**

Slot Numbering:



1 2 3 4 5 6

Configuration Code
Letter indicates Configuration Centre
Unique **3 digits** are the Build ID

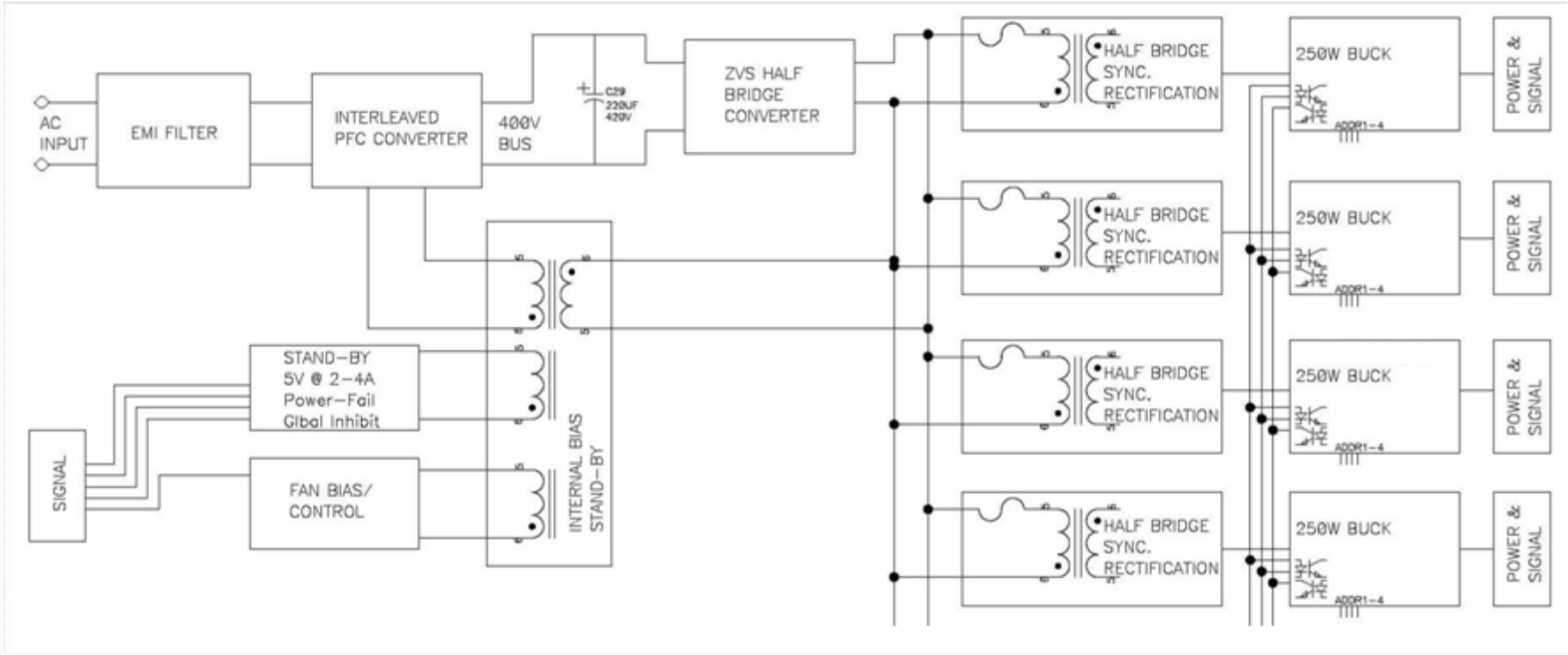
Configuration Centres will be issued with a unique letter for easy identification.

Build ID will reference a set-up file to show what the output voltage is set to.

An optimized **hardware part number** can be obtained using our Online LPM Configurator (See www.power-one.com for more information)

LPM615
Product Information

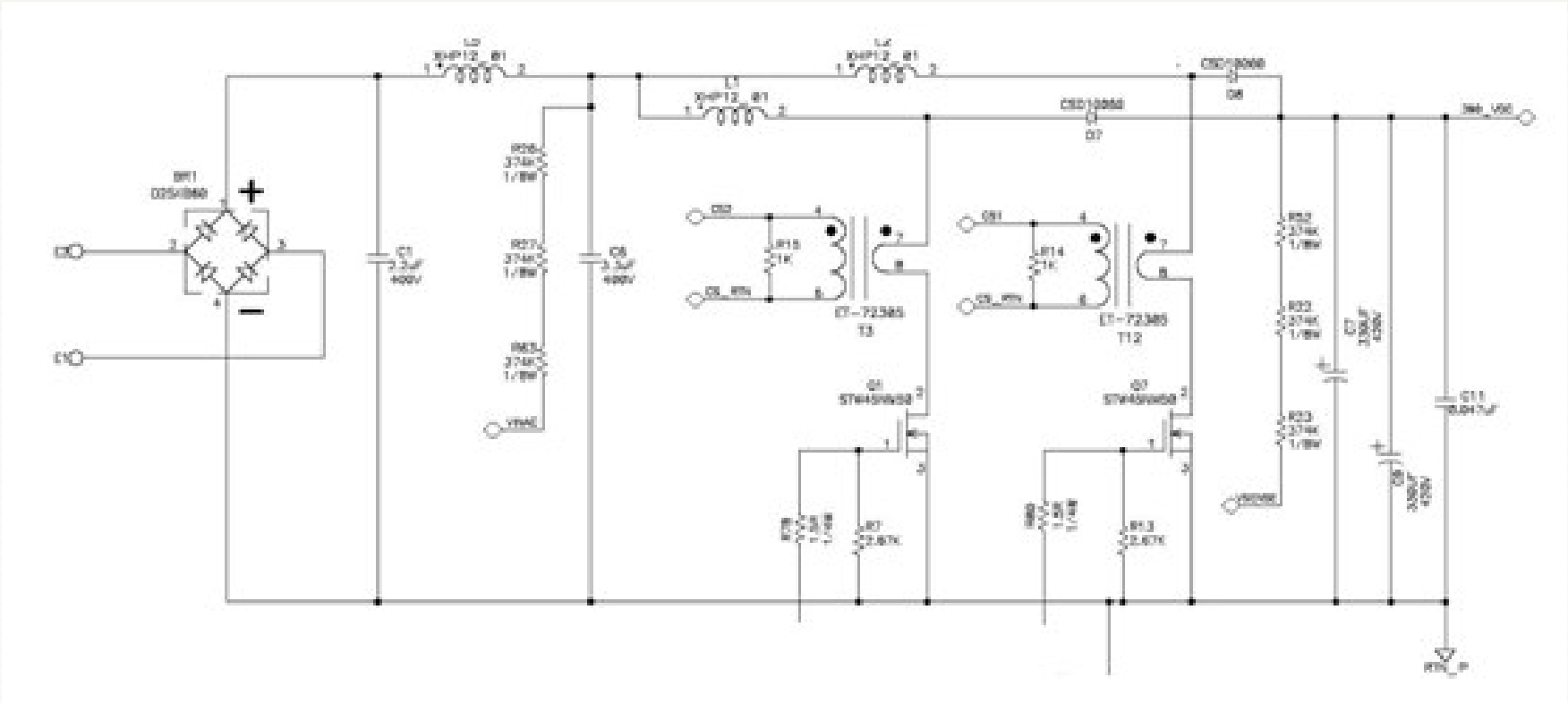
Inside the LPM – The Overall Topology



- Interleaved PFC generates a 400VDC bus
- Half-Bridge transistors on the motherboard generate a 400V square-wave
- Planar transformers on the modules reduce the voltage and isolate it
- Buck converter on the modules provides control, adjustment, and protection

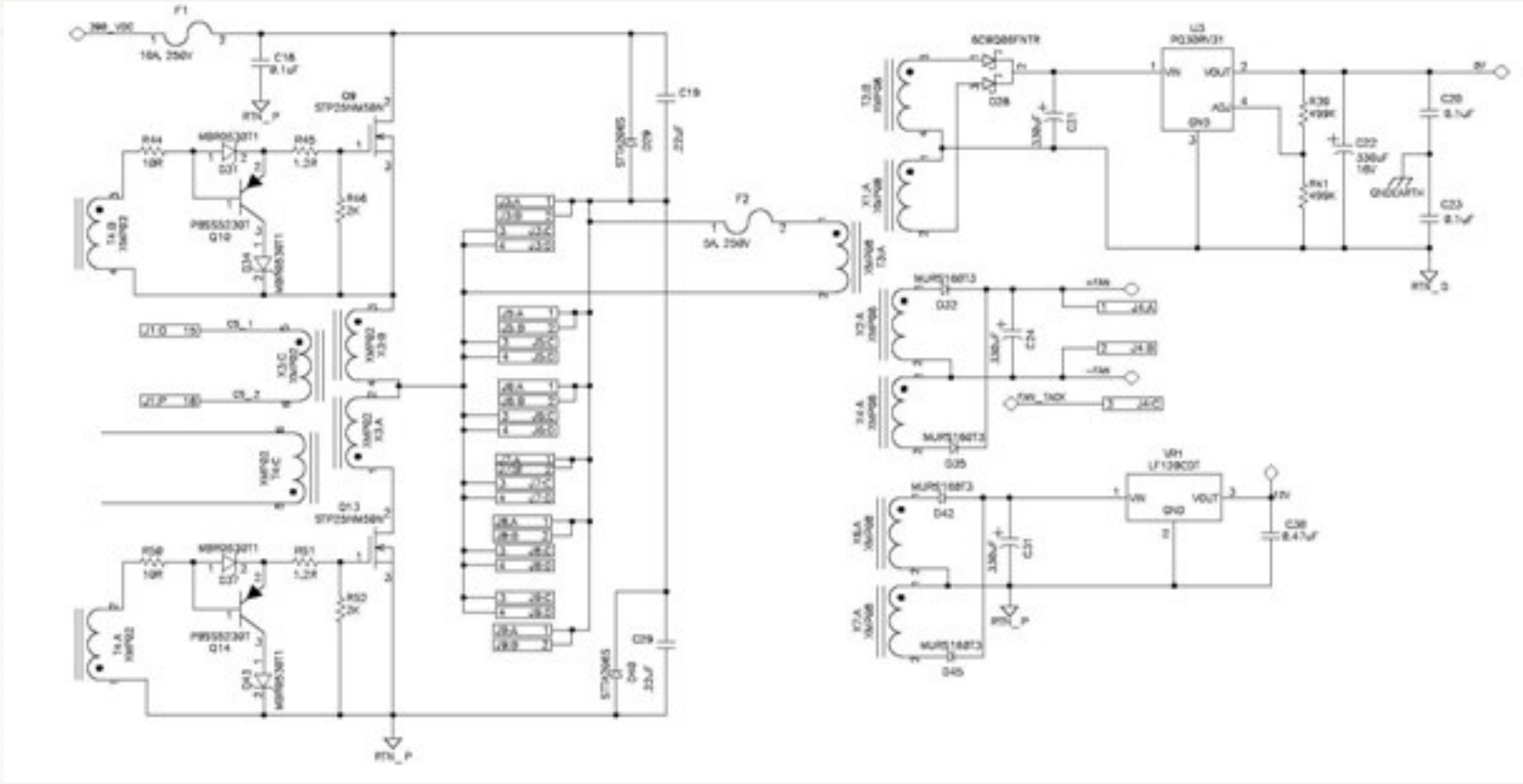
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Inside the LPM – The PFC stage



- Interleaved PFC means lower inductor height and volume
- Also provides lower ripple current for longer life and less interference
- Note the input pi filter
- Also note the multiple resistors used on high voltage sense points

Inside the LPM – The Half-Bridge



- Both transistors driven by transformer for symmetry
- 6 output module primary windings not shown here
- Right hand half is house-keeping supplies and secondary side monitoring

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Mechanical Highlights

- **Airflow Direction:**
  Front to Rear (Input to Output)



- **Dimensions:**
  Height: 1.6” (40.6mm)
  Width: 5” (127mm)
  Depth: 10.6” (269.2mm)



LPM Features: Rapid Assembly

- Modular Design
- Plug in Modules
- Easily Configured

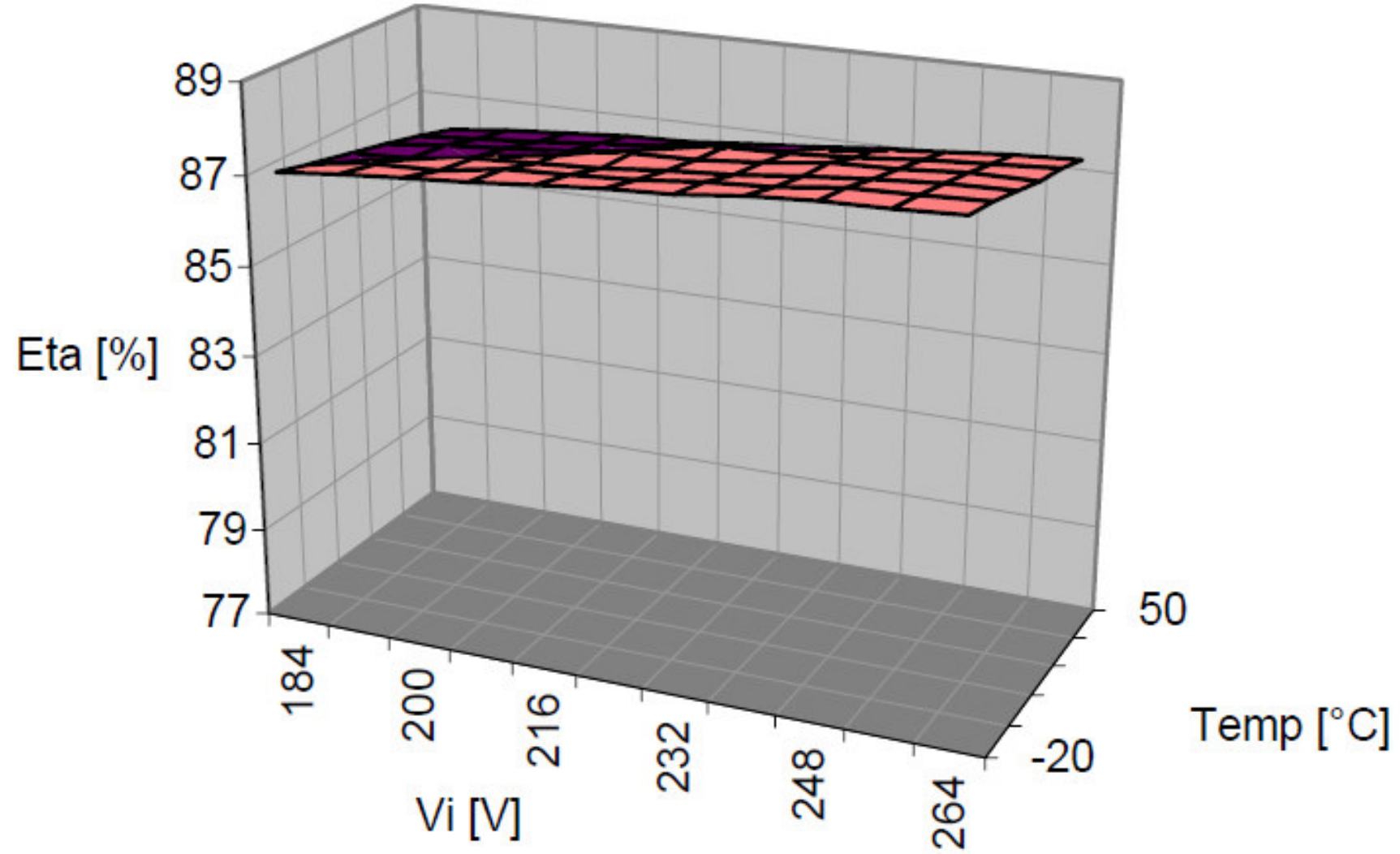


Assembly

- Simple Assembly
- Plug in Modules
- Easily Configured



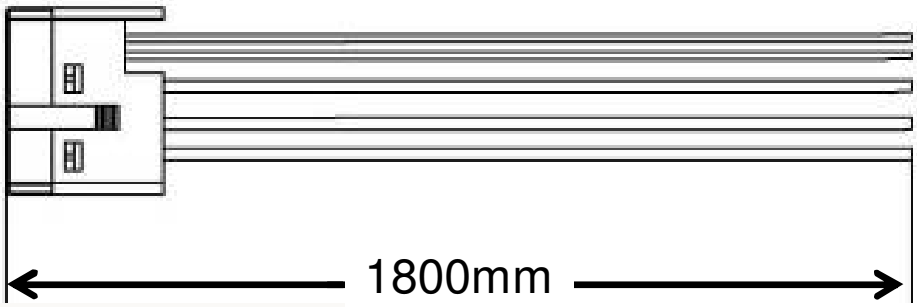
LPM615 Efficiency



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Input Connections

- FCI Connector offers fast and fault-free connection
- Supports power and control
- Part Number LPM000-LEAD-01



LPM - Front



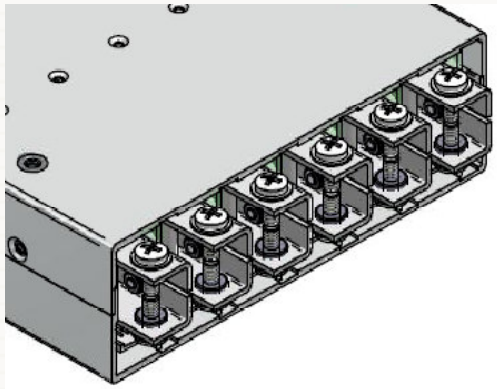




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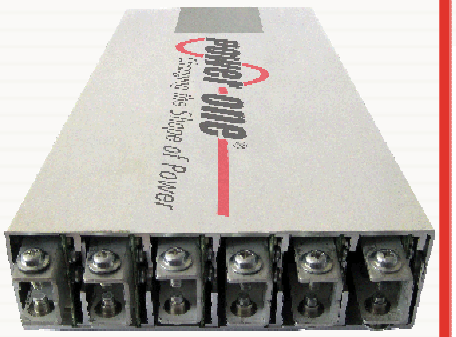
Output Connections

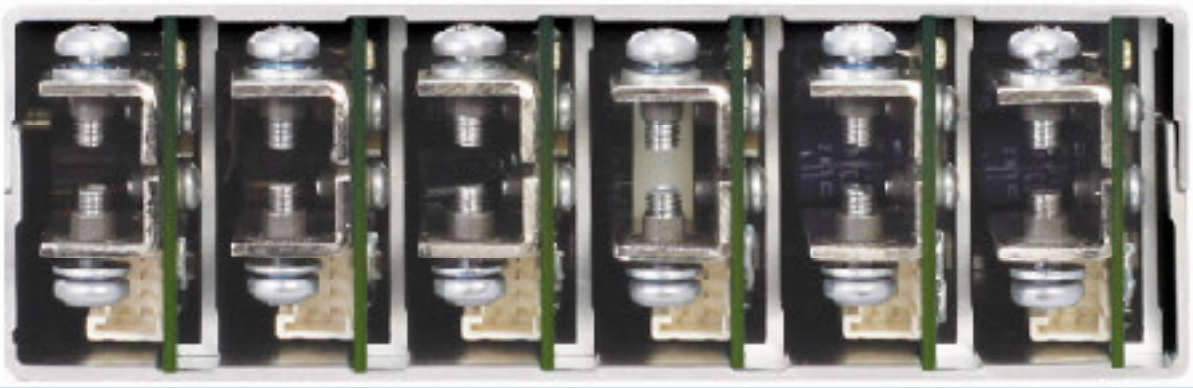
- Outputs via industry standard screw terminals
- Series connection for higher voltages
- Parallel connection for increased output power



M4 Screw Terminals

LPM - Rear

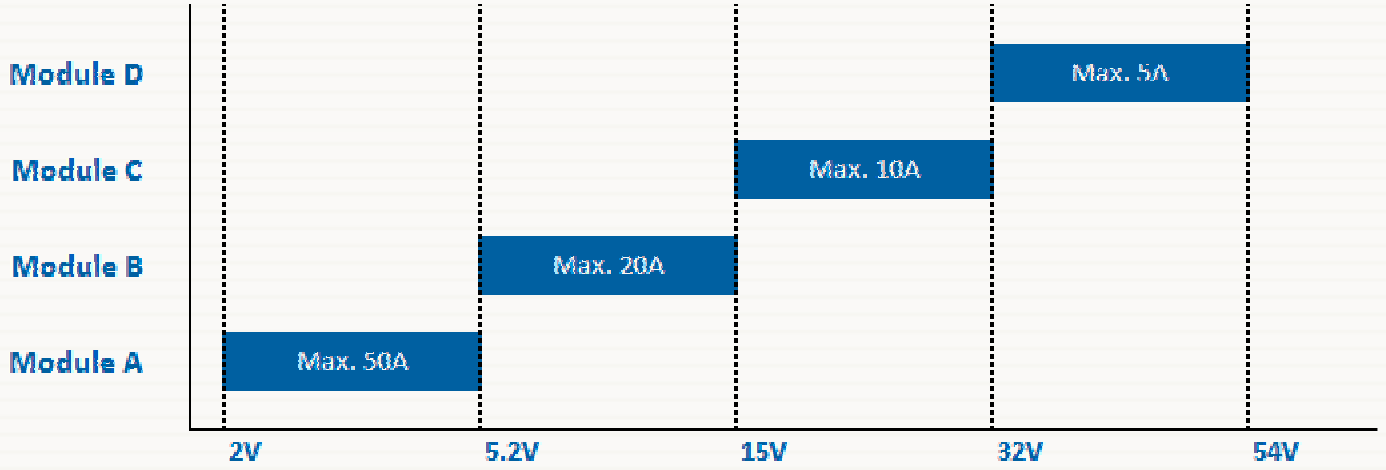


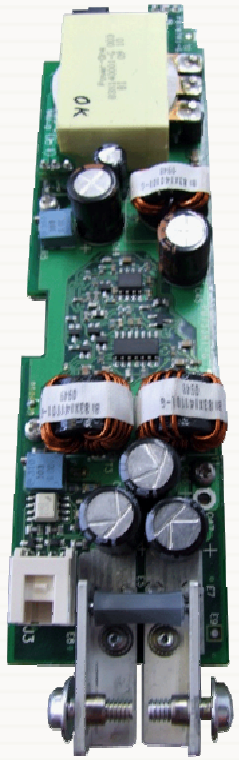




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Output Modules

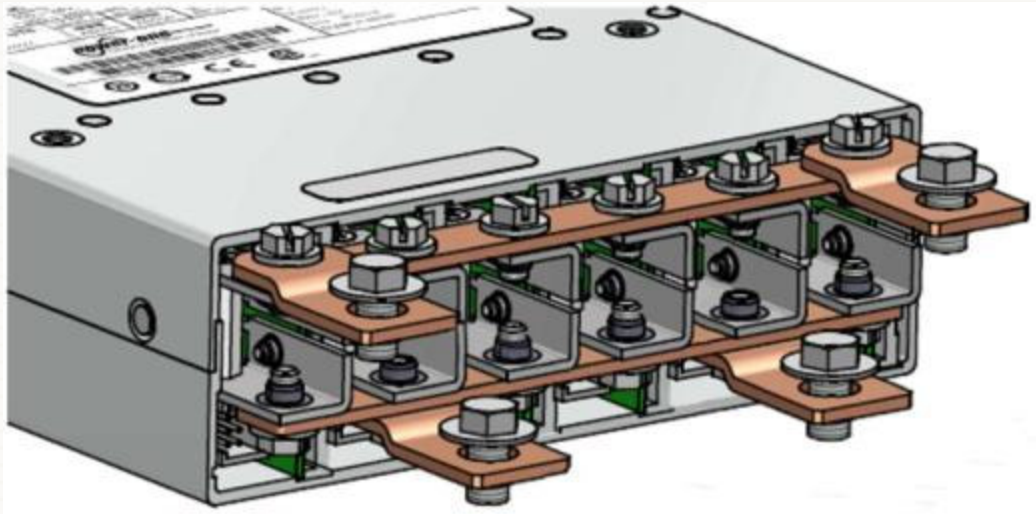


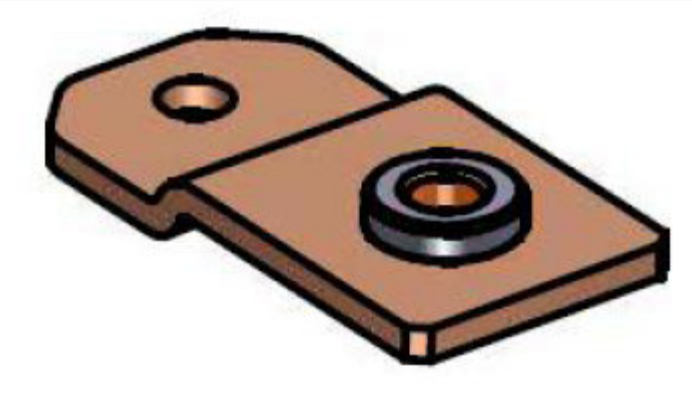


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LPM615 – how to Connect Modules

- Connecting modules on LPM615 will be just like connecting modules on International High Power.
- Control pins are isolated from power pins – so series connection is simple
- Modules have active current share, set the voltage identical, connect the power pins, connect the current share and control ground pins





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LPM In Development

- 1500W Chassis: 1U profile, 6-Slot

Launching December 2010

- 4 Wide-Trim Single Output Modules

Launching December 2010

- 900W Chassis: 1U Profile, 4-Slot

Launching May 2011

- Medical 6-Slot Chassis

Launching May 2011

- Medical 4-Slot Chassis

Launching July 2011

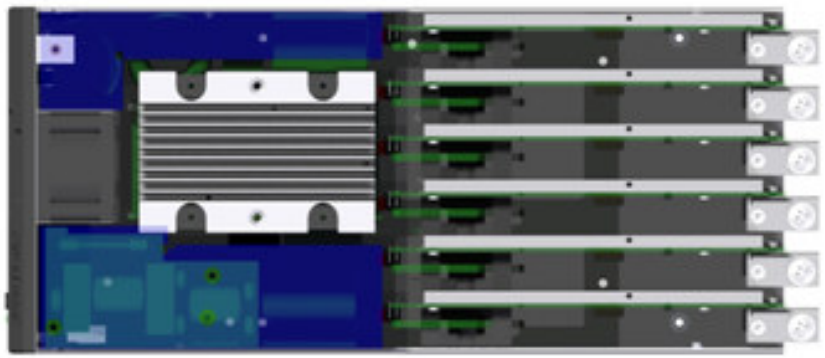


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LPM615
Product Configuration

LPM615 – how to Configure the product

- We want to maximize mtbf and life by putting the most highly dissipative modules in the best airflow

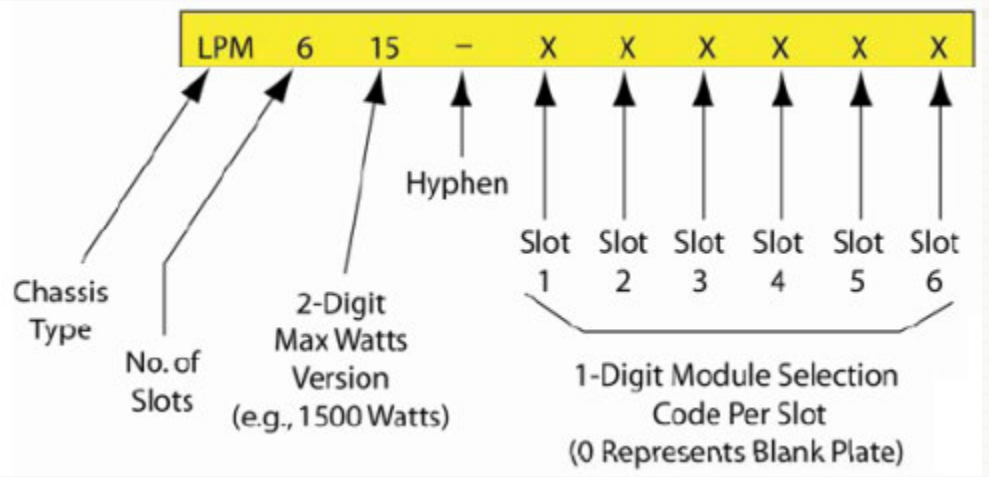


Requested:						Result:
O/P 1	O/P 2	O/P 3	O/P 4	O/P 5	O/P 6	LPM615
5V 25A	-	-	-	-	-	-00A000
10V 15A	24V 10A	-	-	-	-	-00BC00
5V 25A	48V 3A	3.3V 18A	-	-	-	-00AAD0
3V 40A	8V 18A	24V 6A	6V 15A	-	-	-0BABC0
2V 45A	17V 9A	7V 13A	19V 8A	52V 2A	-	-0CABCD
47V 5A	3.3V 49A	5.1V 32A	25V 10A	12V 15A	9V 19A	-CBAABD
90V 5A	-	-	-	-	-	-00DD00 (S)
98V 3A	5V 50A	-	-	-	-	-00ADD0 (S)
3V 45A	7V 18A	100V 5A	-	-	-	-00ABDD (S)
147V 7A	2V 40A	20V 10A	-	-	-	-0CADDD (S)
102V 4A	4V 32A	26V 9A	22V 10A	8V 18A	-	-CCABDD (S)
5V 60A	-	-	-	-	-	-00AA00 (P)
3.3V 70A	48V 5A	-	-	-	-	-00AAD0 (P)
8V 40A	30V 8A	25V 9A	-	-	-	-0CBBC0 (P)
4V 120A	10V 15A	20V 7A	-	-	-	-0BAAAC (P)
12V 40A	3.3V 50A	24V 20A	48V 5A	-	-	-CCABBD (P)(P)

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LPM615 – how to Configure the product

- This part of the number allows us to calculate cost and availability, and to assemble and test the basic product

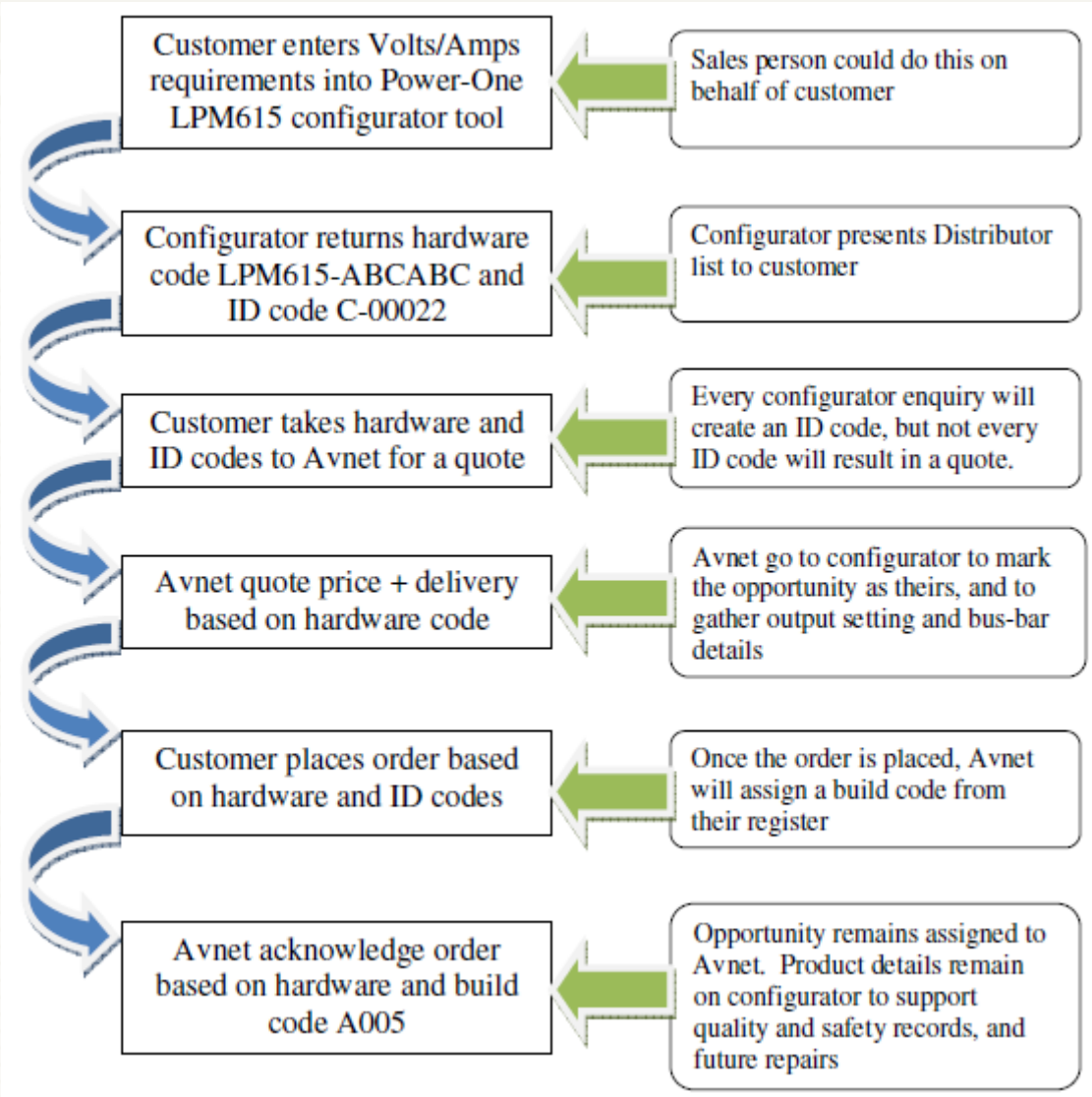


- This part of the number points to a web-based file which tells us about output settings and bus-bar arrangements



LPM615 – how to Configure the product

- Left hand column shows visible process
- Right hand column shows comments and back ground activities



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LPM615 – how to Configure the product

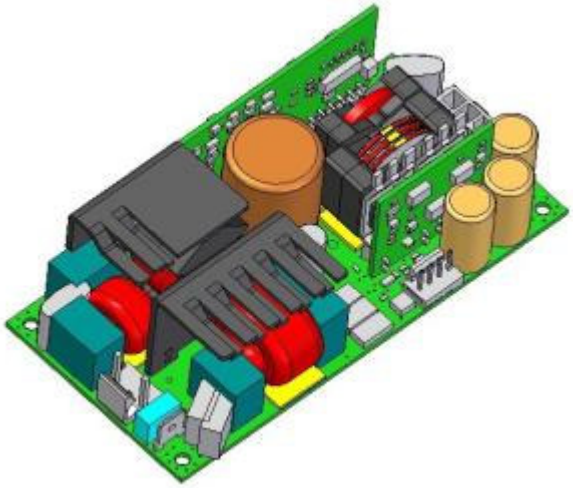
- Chassis, modules, bus-bars, and leads will be shipped to, and stocked by, configuring distributors in multi-packs
- Assembly requires removal of covers, therefore configuring distributor has to be safety approved
- Safety testing, functional testing, set-up, labelling and record-keeping will all be part of the assembly process
- Power-One will configure for non-configuring distributors but this is not a preferred route

Other New Power-One Power Supplies

AC-Embedded – Open Frame ACDC

- Goals for 2011 = Complete the design of a 400W family on a 3x5 footprint (ABC400), and a 200W family on a 2x4 footprint (ABC200)
- Goals for 2011 = Complete the design of a 250W medical family on a 3x5 footprint (MBC250), and a 120W medical family on a 2x4 footprint (MBC120)
- Engineering work has started in China on ABC400, ABC200, and MBC250.

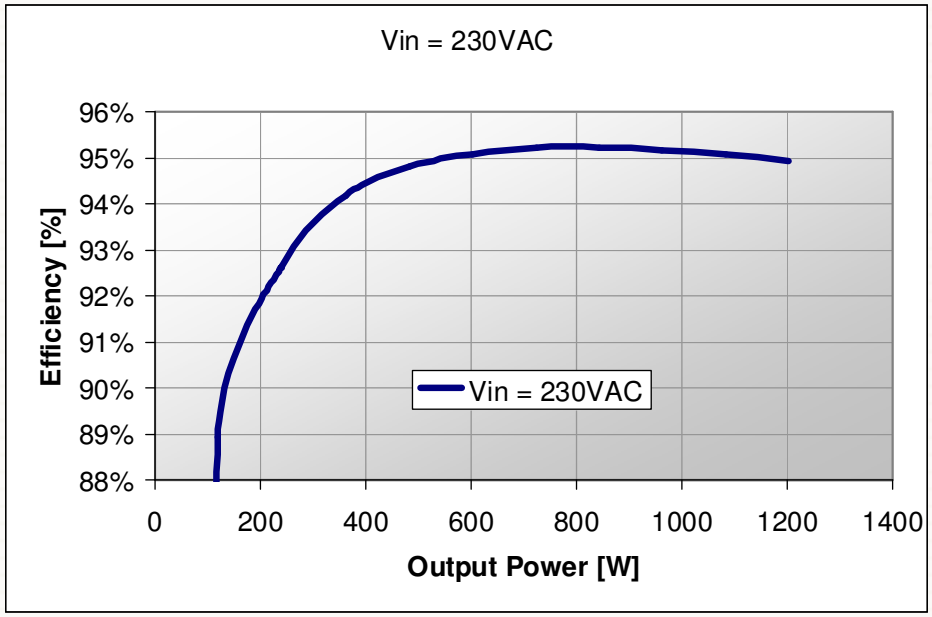




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XPGe12.48G

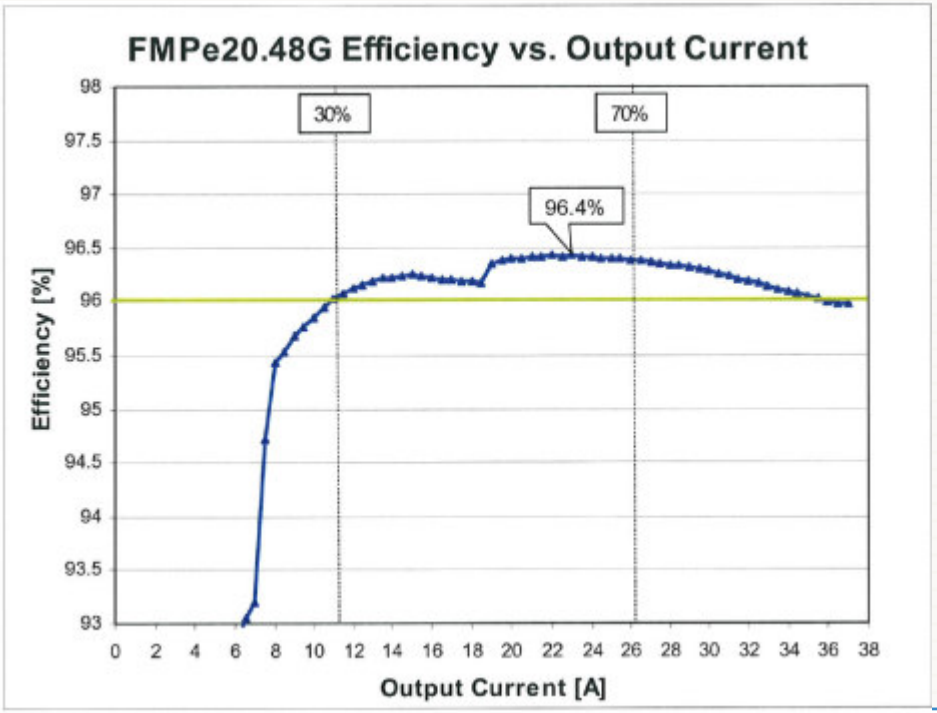




- XPGe12.48
  - 101.6 mm x 40.6 mm x 230 mm
  - 1.2kW (@ high line)
  - Vo = 46 … 57V
  - Efficiency >95%
  - Isolated RS-485 interface for control and monitoring
  - T_A = -40 … +55 ℃

FMPe20.48G

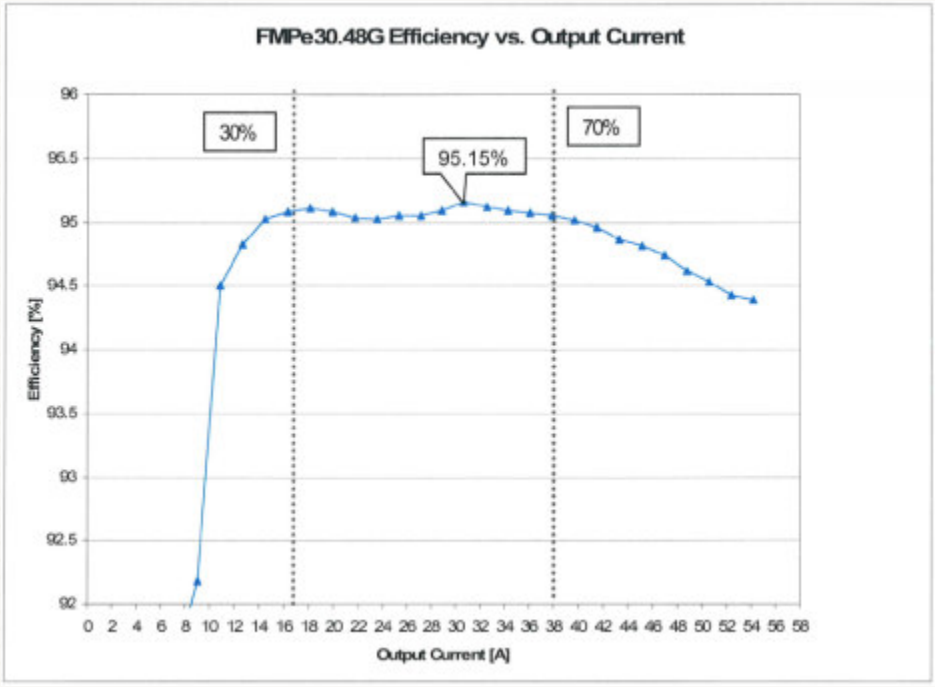




- FMPe20.48
  - 107 x 40 x 337mm
    - 4 units in 17 inch rack
    - 5 units in 23 inch rack
  - 2kW (@ high line)
  - Vo = 46 … 57V
  - Efficiency >96%
  - Isolated RS-485 interface for control and monitoring
  - T_A = -40 … +55 ℃

FMPe30.48G





- FMPe30.48
  - 107 x 40 x 337mm
    - 4 units in 17 inch rack
    - 5 units in 23 inch rack
  - 2.9kW (@ high line)
  - Vo = 46 … 57V
  - Efficiency >95%
  - Isolated RS-485 interface for control and monitoring
  - T_A = -40 … +55 ℃

Thank You

This presentation includes forward-looking statements within the meaning of the Safe Harbor provisions of the Private Securities Litigation Reform Act of 1995 that can be identified by the use of forward-looking words such as “will” or “estimate” or comparable words. These statements are subject to risks and uncertainties that could cause actual results to differ materially from those projected. We refer you to the Company’s most recent registration statement filed with the SEC for a detailed discussion of these risks and uncertainties. In addition, this presentation contains projections made by unaffiliated third parties. While we have no reason to doubt the accuracy of these projections, we have not made any independent investigation and do not make any representation regarding their accuracy. Moreover, future events may cause actual results to be substantially different than those projected.