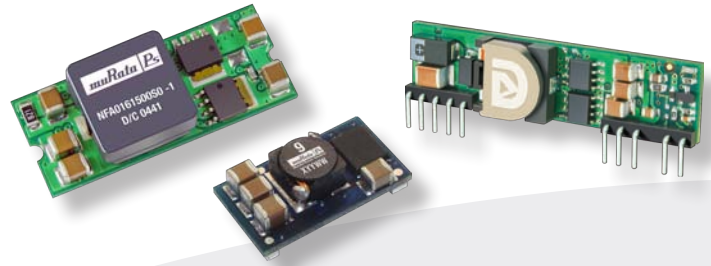


FPGA Power Guide

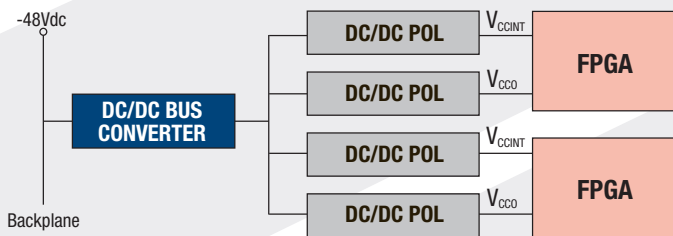


Powering innovation...

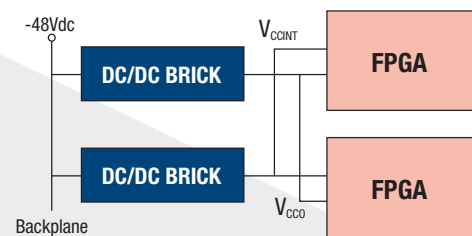


Murata Power Solutions' broad selection of DC/DC converters is well suited to powering modern FPGA products. A combination of distributed power and intermediate bus architecture products can effectively be deployed to meet the power requirements of leading FPGA products. These products include standard "brick" isolated converters as well as intermediate bus converters and non-isolated point-of-load (POL) converters. Examples of distributed and intermediate bus power architectures for powering FPGAs are provided here.

Intermediate Bus Power Solution for FPGA



Distributed Power Solution for FPGA



Steady State Power Requirements for FPGA Families in Typical Applications

| Altera | Stratix II | Stratix | Cyclone II | Cyclone |
|---------------------------------|---|---|---|---|
| V_{CCINT} (Core) | 1.2V ± 5% @ 1A to 6A | 1.5V ± 5% @ 1A to 10A | 1.2V ± 5% @ 500mA to 5A | 1.5V ± 5% @ 500mA to 5A |
| V_{CCO} (Vo) | 3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 500mA to 6A | 3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 500mA to 6A | 3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 500mA to 6A | 3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 500mA to 6A |
| V_{CCPD} (Aux) | 3.3V ± 5% @ 300mA | - | - | - |

| Xilinx | Virtex-5 | Virtex-4FX, SX, LX | Virtex-II Pro | Virtex-II | Virtex-E | Virtex | Spartan-3, -3E, -3L | Spartan-IIE | Spartan-II |
|---------------------------------|--|--|--|--|---|--|--|---|---|
| V_{CCINT} (Core) | 1V ± 5% @ 200mA to 5A | 1.2V ± 5% @ 200mA to 5A | 1.5V ± 5% @ 200mA to 12A | 1.5V ± 5% @ 200mA to 12A | 1.8V ± 5% @ 200mA to 7A | 2.5V ± 5% @ 200mA to 7A | 1.2V ± 5% @ 200mA to 5A | 1.8V ± 5% @ 200mA to 3A | 2.5V ± 5% @ 200mA to 2A |
| V_{CCO} (Vo) | 3.3V, 2.5V, 1.8V, 1.5V and/or 1.2V ± 5% @ 50mA to 4A | 3.3V, 2.5V, 1.8V, 1.5V and/or 1.2V ± 5% @ 50mA to 4A | 3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 50mA to 5A | 3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 50mA to 5A | 3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 500mA to 5A | 3.3V, 2.5V and/or 1.5V ± 5% @ 50mA to 5A | 3.3V, 3.0V, 2.5V, 1.8V, 1.5V and/or 1.2V ± 5% @ 50mA to 4A | 3.3V, 2.5V, 1.8V and/or 1.5V ± 5% @ 50mA to 750mA | 3.3V, 2.5V and/or 1.5V ± 5% @ 50mA to 500mA |
| V_{CCAUX} (Aux) | 2.5V ± 5% @ 300mA | 2.5V ± 5% @ 300mA | 2.5V ± 5% @ 300mA | 3.3V ± 5% @ 300mA | - | - | 2.5V ± 5% @ 300mA | - | - |

Some models have reduced output currents for the higher output voltage.

For more precise power requirements for specific FPGA applications please refer to the Xilinx and Altera Power Estimators available at www.xilinx.com/power and www.altera.com/power, respectively.

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- 1 Safety Critical Component means any component whose failure to perform could cause the failure of, or affect the operation of a Life Support Device.
- 2 Life Support Device means any device, system or ancillary equipment intended for implant into the body or used in relation to supporting or sustaining life.

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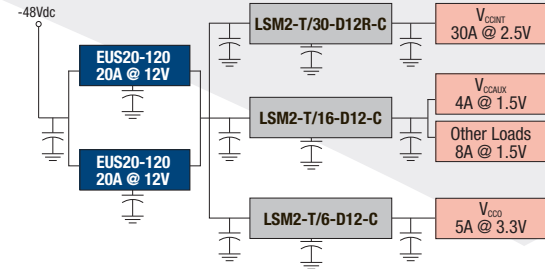
Modular vs Discrete Power Solutions for FPGAs

Many vendors currently offer power solutions for FPGAs using discrete based power solutions. While these solutions may seem attractive initially from a pure cost assessment, modular solutions offer many key advantages: **minimal design resources; reduced parts count and board real estate; multiple sourcing.**

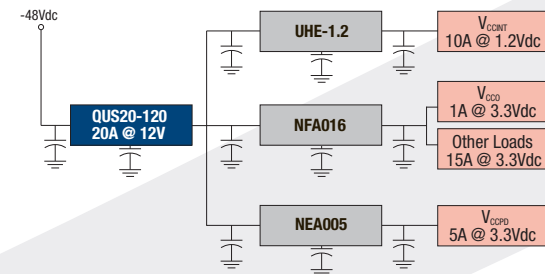
Intermediate Bus Power Solutions

- Modular DC/DC converter solution requires minimal design resources and is suitable for powering one or more FPGAs
- Highly efficient solution with POL conversion efficiencies approaching 93%
- Space efficient SMT packages designed for use in low-cost automated manufacturing environments
- Reliable power conversion solution with typical converter MTTF in excess of 1 million hours per Telcordia standards

Xilinx Spartan-3 Application Example, 10A Core Voltage (V_{CCINT})



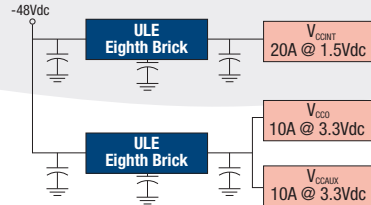
Altera Stratix II Application Example, 10A Core Voltage (V_{CCINT})



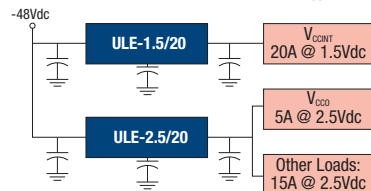
Distributed Power Solutions

- Modular DC/DC converter solution suitable for powering one or more FPGAs from standard telecomm -48Vdc bus
- Low profile, industry standard open frame converters with conversion efficiencies approaching 90%
- Space efficient, high power density power conversion solution available in both through hole and SMT packaging
- Reliable power conversion solution with typical converter MTTF in excess of 1 million hours per Telcordia standards

Xilinx Virtex-II Application Example, 40A Core Voltage (V_{CCINT})



Altera Cyclone Application Example, 20A Core Voltage (V_{CCINT})



Murata Power Solutions DC/DC Converter Modules Reduce System Parts Count and Simplify Solution Design...

| Product | Description | Power (W) | Input Voltage (Vdc) | Output Voltage(s) (Vdc) | Output Current (A) |
|--------------------------------------|---|-----------|-----------------------------|--|--------------------|
| Isolated Converters | | | | | |
| ULQ | Single Output, Quarter Brick, Through Hole/Surface Mount | 66 | 18-36 & 36-75 | 1.2-12 | 25 |
| ULE | Single Output, Eighth Brick, Through Hole/Surface Mount | 60 | 9-18, 18-36, & 36-75 | 1.2-24 | 30 |
| UHP | Single Output, Half Brick, Through Hole | 148 | 36-75 | 1.5, 1.8, 2.5, 3.3 | 60 |
| A Series 7-15W | Single Output, 1" x 2", Through Hole | 15 | 10-18, 18-36 & 36-75 | 1.2, 1.5, 1.8, 2.5, 3.3, 5.0, 12, 15 | 10 |
| UHE 12-30W | Single Output, 1.6" x 2", Through Hole | 10 | 9-18, 9-36, & 36-75 | 1.2, 1.5, 1.8, 2.5, 3.3, 5.0, 12, 15 | 10 |
| Q-Class | Single Output, Quarter Brick Single Board, PTH | 144 | 36-75 | 1.2, 1.5, 1.8, 2.5, 3.3, 12 | 55 |
| UWR 7-15W | 1" x 2", Through Hole | 15 | 10-8, 18-36, & 36-75 | 1.2-15 | 6 |
| HPH | 70A Half Brick | 350 | 36-75 | 1-5 | 70 |
| UVQ | Low-Profile Quarter Brick | 125 | 18-36 & 36-75 | 1.2-48 | 40 |
| UOQ | Wide Input Quarter Brick | 105 | 9-36 & 18-75 | 3.3-15 | 25 |
| UCQ | Low-Cost Quarter Brick | 115 | 18-36 & 36-75 | 3.3 & 5 | 35 |
| Bus Converters | | | | | |
| EUS15-120 | Single Output Eighth Brick, Pth | 180 | 36V - 55V | 12 | 15 |
| EUS20-120 | Single Output Eighth Brick, Pth | 240 | 36V - 55V | 12 | 20 |
| QUS20-120 | Single Output Quarter Brick, Pth | 240 | 36V - 55V | 12 | 20 |
| Non-Isolated (POL) Converters | | | | | |
| NGA | Single Adjustable and Fixed Output, SIP/DIP | 10 | 4.75-28 | 1.8, 2.5, 3.3, 5.0 | 2 |
| LSM/LSN-10A | Single Fixed Output, SMT/SIP | 50 | 3.0-3.6, 4.5-5.0, 10.8-13.2 | 1.0, 1.2, 1.5, 1.8, 2.5, 3.3, 5.0 | 10 |
| LSM/LSN-16A | Single Adjustable and Fixed Output, SMT/SIP | 50 | 3.0-5.5 & 10-14 | 0.75-5.0 | 16 |
| LSM/LSN2 | Adjustable Output SMT/SIP | 52 | 2.4-5.5 8.3-14 | 0.75-5 | 6, 10, 16 |
| LSN2-T/22 | Adjustable Output SMT/SIP 22A | 112 | 8.3-14 | 0.8-5 | 22 |
| LSN2-T30 | Adjustable Output SMT/SIP 30A | 150 | 6-14 | 0.8-5 | 30 |
| LEN | Single Output, Eighth Brick, Through Hole/SMT | 125 | 10.2-13.8 | 0.8, 1.0, 1.2, 1.5, 1.8, 2.5, 3.3, 5.0 | 28 |
| HEN | Single Output, Eighth Brick, Through Hole/SMT, High di/dt | 125 | 10.2-13.8 | 0.8, 1.0, 1.2, 1.5, 1.8, 2.5, 3.3, 5.0 | 25 |
| LQN | Single Output, Quarter Brick, Through Hole/SMT | 225 | 10.2-13.8 | 0.8, 1.0, 1.2, 1.5, 1.8, 2.5, 3.3, 5.0 | 50 |
| VCN60 | Single Adjustable Output, Through Hole, Vertical Mount | 120 | 10.2-13.2 | 0.6-3.5 | 60 |
| VCN70 | Single Adjustable Output, Through Hole, Vertical Mount | 140 | 10.2-13.2 | 0.6-3.5 | 70 |
| NCA005 | Single Adjustable Output, SMT/SIP | 16.5 | 3.0V-5.5V | 0.75-3.3 | 5 |
| NCA015 | | 49.5 | 3.0V-5.5V | 0.75-3.3 | 15 |
| NEA005 | | 25 | 8.3V-14V | 0.75-5.0 | 5 |
| NEF010 | Single Fixed Output, SMT/SIP | 50 | 8.3V-14V | 1.0, 1.2, 1.5, 1.8, 2.0, 2.5, 3.3, 5.0 | 10 |
| NEA010 | Single Adjustable Output, SMT/SIP | 50 | 8.3V-14V | 0.75-5.0 | 10 |
| NEA016 | | 80 | 8.3V-14V | 0.75-5.0 | 16 |
| NFA010 | | 50 | 6.0V-14V | 0.75-5.0 | 10 |
| NFA016 | | 80 | 6.0V-14V | 0.75-5.0 | 16 |
| NFA020 | | 100 | 6.0V-14V | 0.75-5.0 | 20 |

Design Considerations

- Core and I/O power consumption are design and application dependent. For more precise power requirements for specific FPGA applications please refer to the Xilinx and Altera Power Estimators available at www.xilinx.com/power and www.altera.com/power, respectively.
- Bulk and/or bypass capacitors will be required between the input supply and DC/DC converters depending on the placement of the input supply relative to the converters. Consult FPGA manufacturers datasheets to ensure adequate bulk and bypass capacitors are used.
- Start-up profile requirements vary by FPGA families and manufacturers; review FPGA device specifications for design considerations such as ramp-up and inrush current.

Filtering

Our extensive range of inductors has been specifically designed to operate at the high current levels required by FPGA applications. For technical details and full product datasheets, or to request a copy of our Magnetics data book, visit us at www.murata-ps.com/magnetics.

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