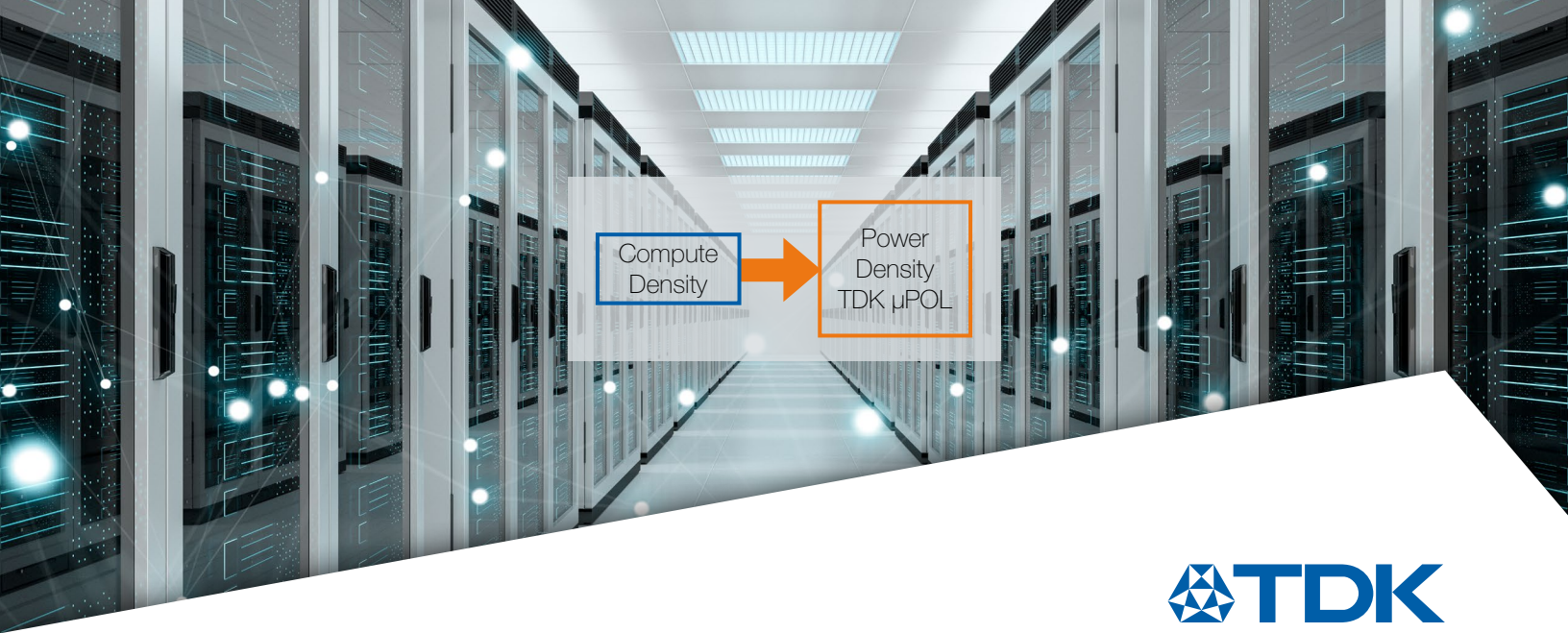




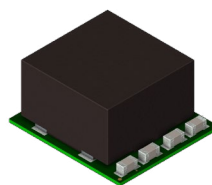
μPOL DC-DC Power Modules

Power Solutions Cookbook

Various FPGAs / SoCs, multi-ARM SoCs

Starter Designs and Power Maps for various FPGAs, SoCs, multi-ARM SoCs, and Ethernet chipsets are now available.

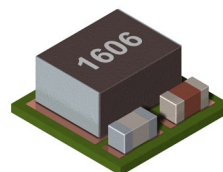
The starter designs provide a design guideline for TDK power modules and include the power map along with starter schematics on ORCAD (.dsn) files and are downloadable for preview upon registration. Additional starter PCB layout files are also available for fast design on various popular tools, including: Cadence, Altium, and Mentor.



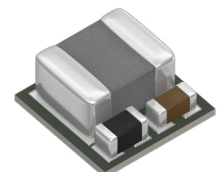
FS1525



FS1412



FS1606, FS1604,
FS1603



FS1406, FS1404,
FS1403, FS1703



More information

www.us.tdk.com/POL

or contact your local sales office

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TDK's μ POL Chip Embedded DC-DC Power Modules

Starter Designs for various FPGAs, SoCs, multi-ARM SoCs, Ethernet chipsets. Power maps are presented below. The starter designs provide a design guideline for TDK power modules includes the power map, starter schematics on ORCAD (.dsn) files that are downloadable for preview on registration. Additional starter PCB layout files are also available for fast design on various popular tools: Cadence, Altium and Mentor.

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www.us.tdk.com/POL

Download tools for quick design start.

Datasheets, power maps, reference designs, symbols, 3D models, and BOMs >>

Introduction of TDK μ POL™ DC-DC Power Modules

Chip Embedded DC-DC Power Modules

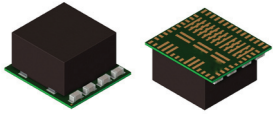
TDK's μ POL Technology provides endless opportunities to save space, design time without compromising in performance. These power modules contain matching MOSFET, Driver, Inductor and package make it possible to provide the most optimum solution without comprising performance, while reducing the number of external components to reduce the overall system cost.

Highlights

- μ POL Technology Includes Inductor, Controller, Power MOSFET, Driver & Digital Engine
- Analog DC-DC or Digital DC-DC Design (I2C / PMBus Serial Bus)
- Voltage, Current, & Temperature Telemetry Options
- Adjustable Vout ± 5 mV
- Output Voltage, $\pm 0.5\%$ Initial accuracy
- -40°C to 125°C Operating Temperature

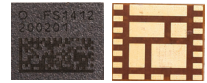
Chip Embedded Power Modules

45 Watts



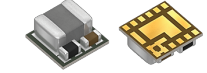
- FS1525**
- 25A sharable n=8 phase to 200A
 - 6.8 mm x 7.6 mm x 3.8 mm height
 - Analog, I2C/PMBus plus Telemetry

21 Watts



- FS1412**
- 12A in 4.9 mm x 5.8 mm x 1.6 mm height
 - Analog, I2C/PMBus plus Telemetry

15 Watts



- FS1406, FS1404, FS1403, FS1703**
- *FS1606, FS1604, FS1603 (same pinout as FS140x with Telemetry)
 - *FS1006 (30W), FS1003
 - 6A to 3A in 3.3 mm x 3.3 mm x 1.5 mm height (*1.35mm height)

10 Watts

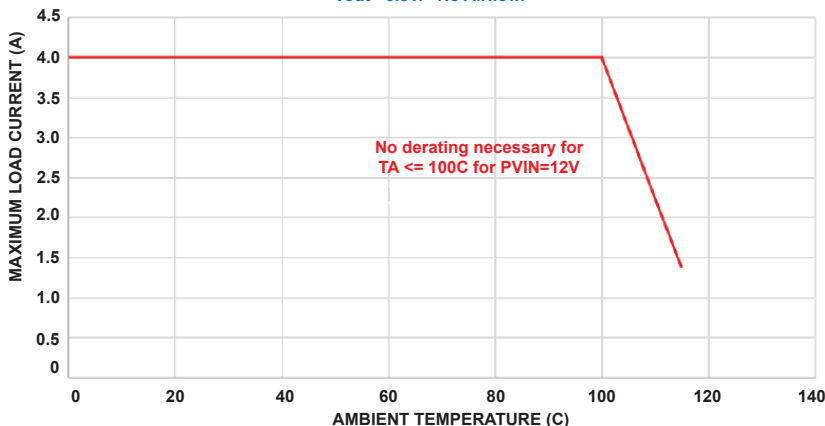


- FS3303 Coming Soon**
- 3A in 2.5 mm x 2.5 mm x 1.2 mm height
 - Low voltage input: 2.7V to 6V

Technology & Performance Advantages

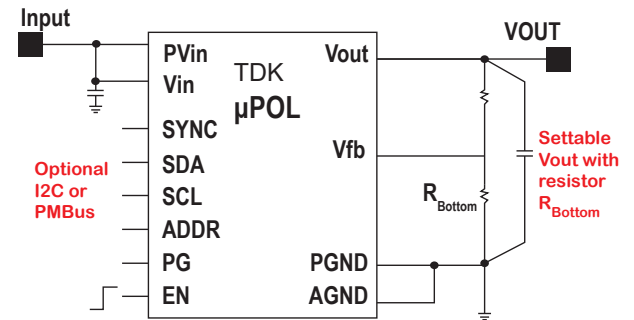
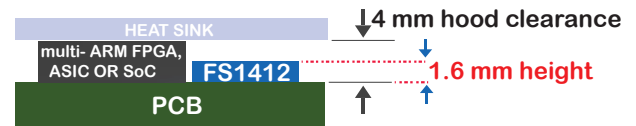
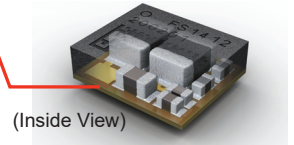
- Chip Embedded Power IC in Thermal Enhanced Packaging, Excellent thermal deratings over temperature
- Ultra Thin height, Small PCB footprint power design:
Total solution: 25% to 50% smaller than competitors

THERMAL DERATING FOR FS1604
Vout - 3.3V. No Airflow.



3D Chip Embedded Power Modules

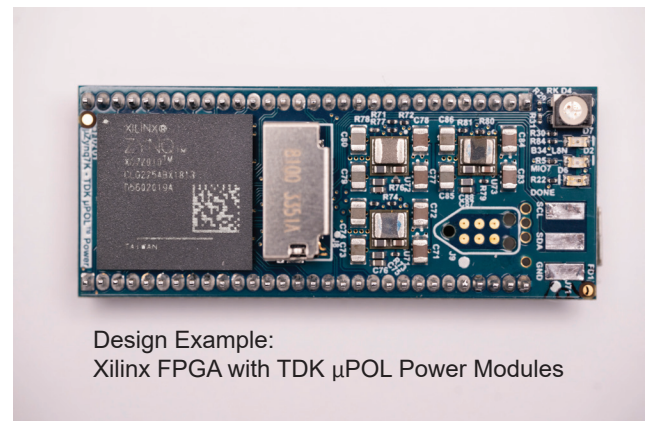
Ultrathin
1.6 millimeter height



www.us.tdk.com/POL

Download tools for quick design start.

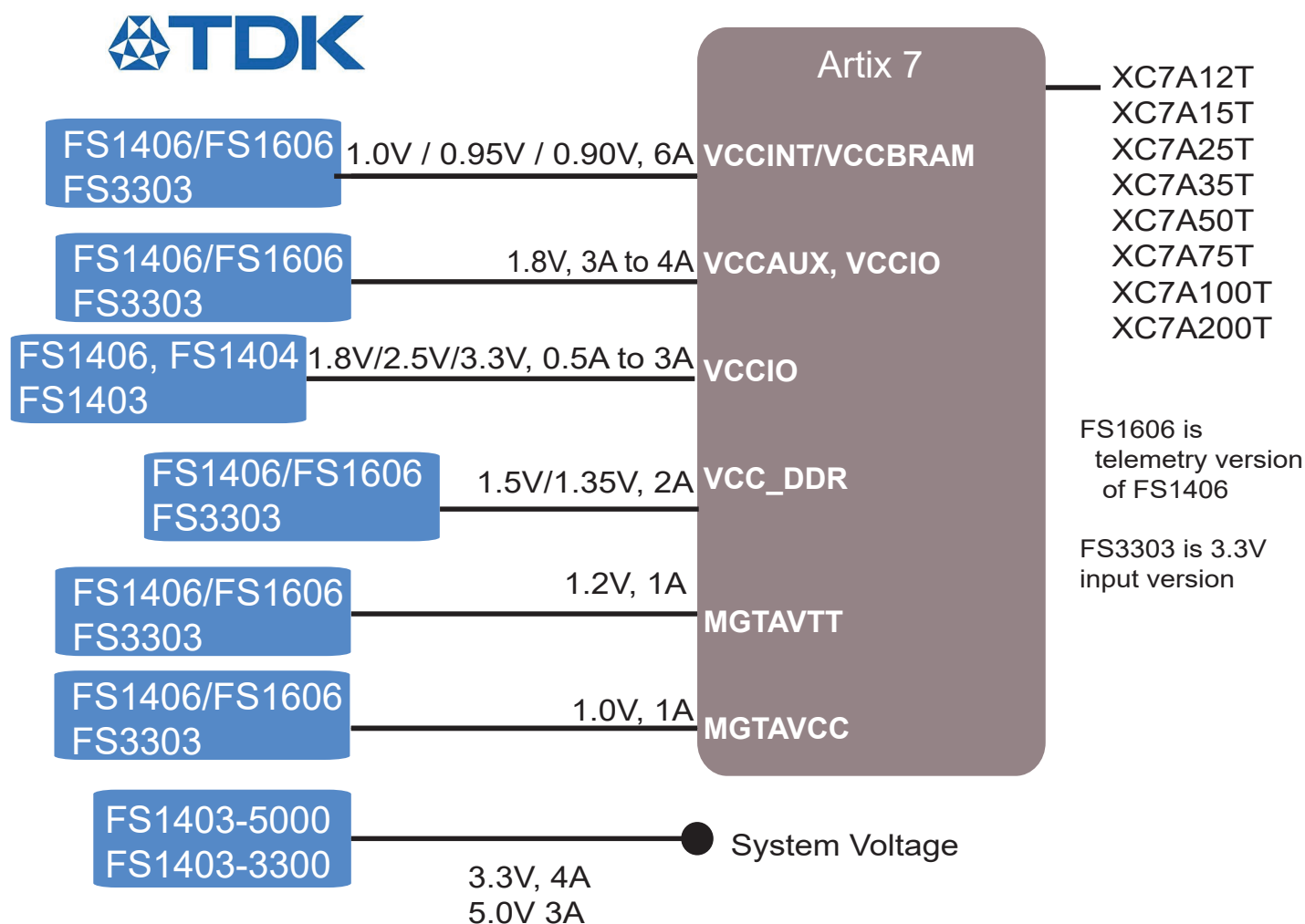
Datasheets, power maps, reference designs, symbols, 3D models, and BOMs >>



Design Example:
Xilinx FPGA with TDK μ POL Power Modules

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Artix 7

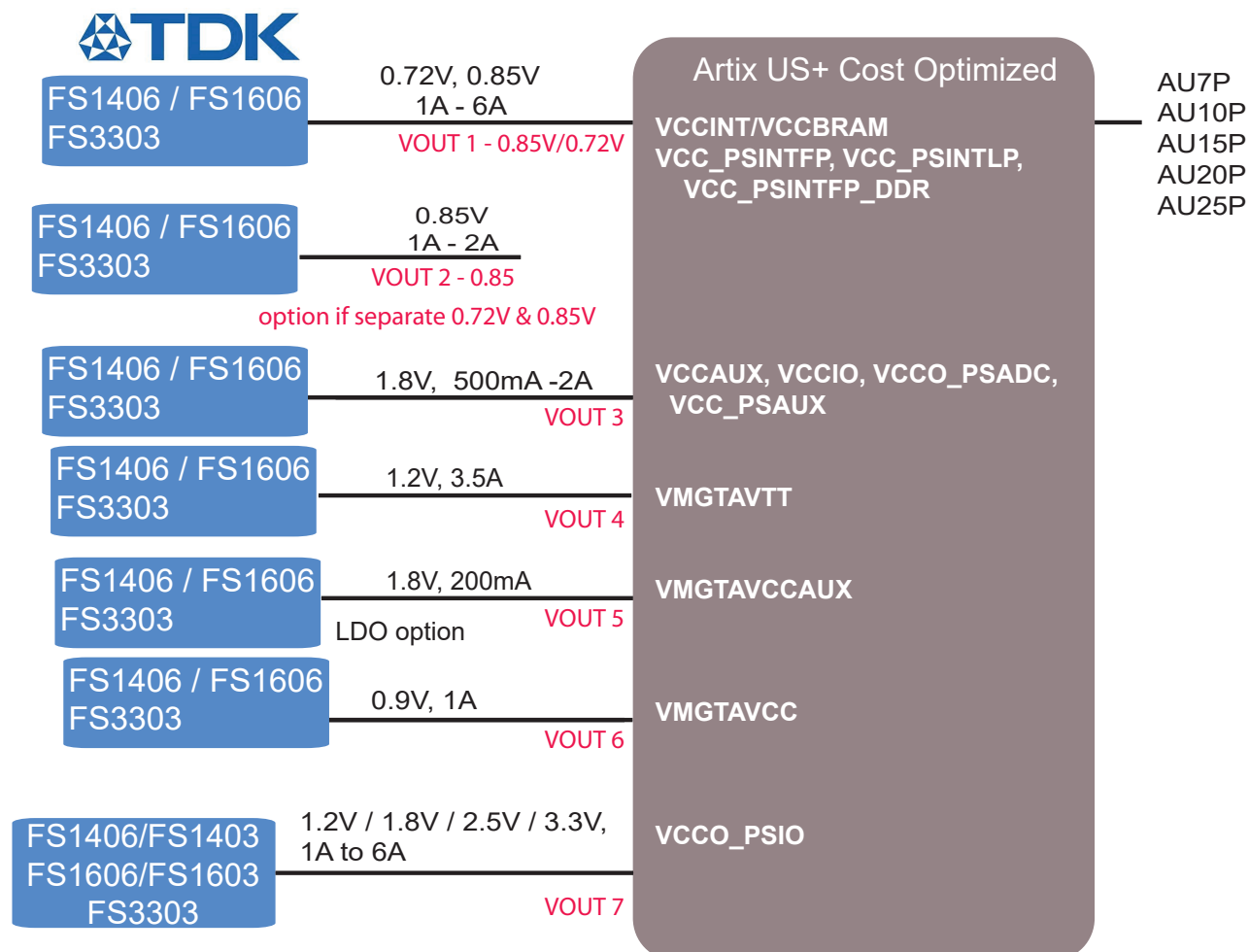


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1406-0600 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Artix UltraScale+ Cost Optimize



Design Notes:

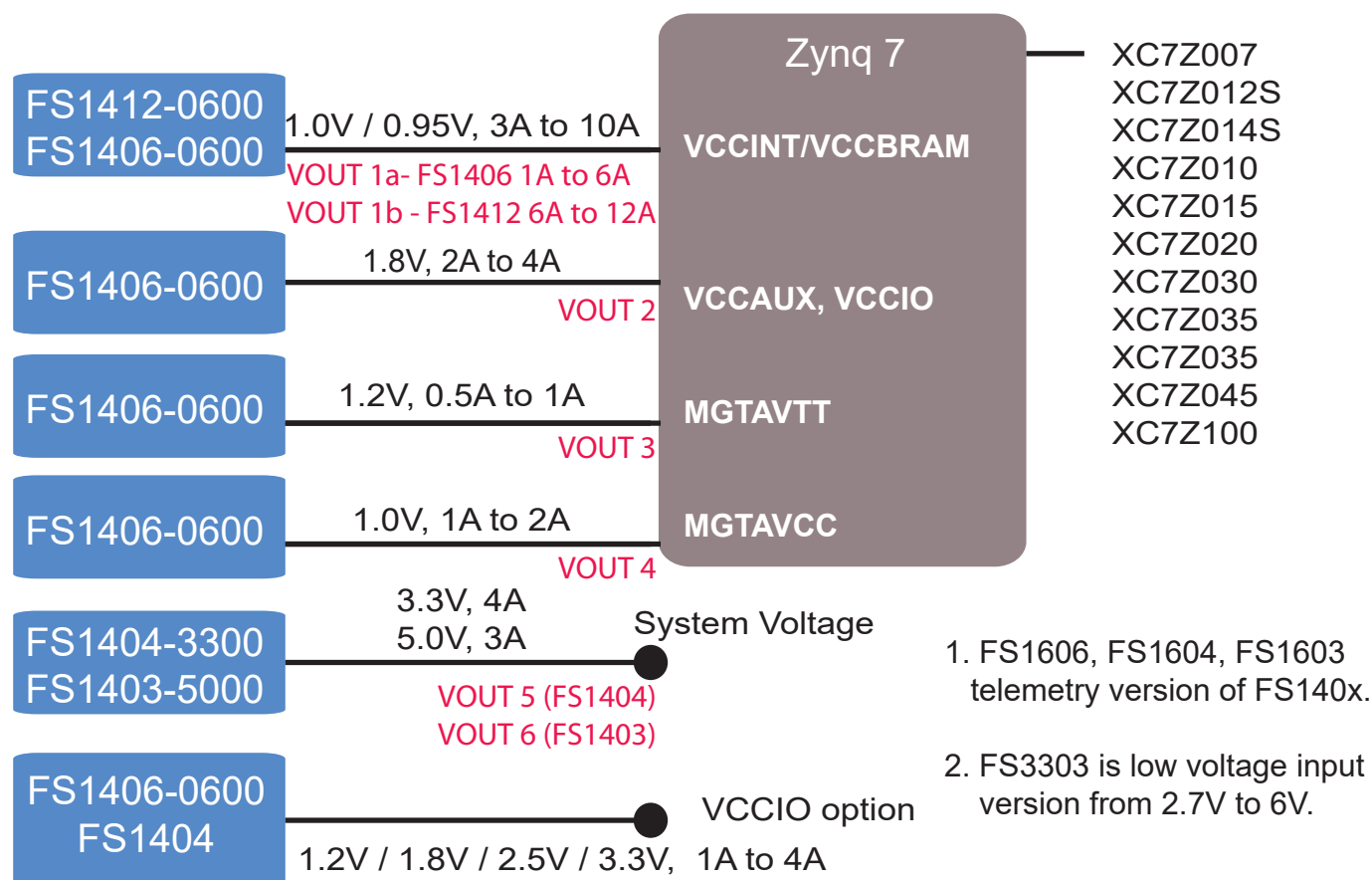
- 1) FS140x and FS160x same pinout
- 2) FS160x has added Telemetry option
- 3) FS3303 is 3V/5Vinput device (3A)

Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1406-0600 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Zynq 7

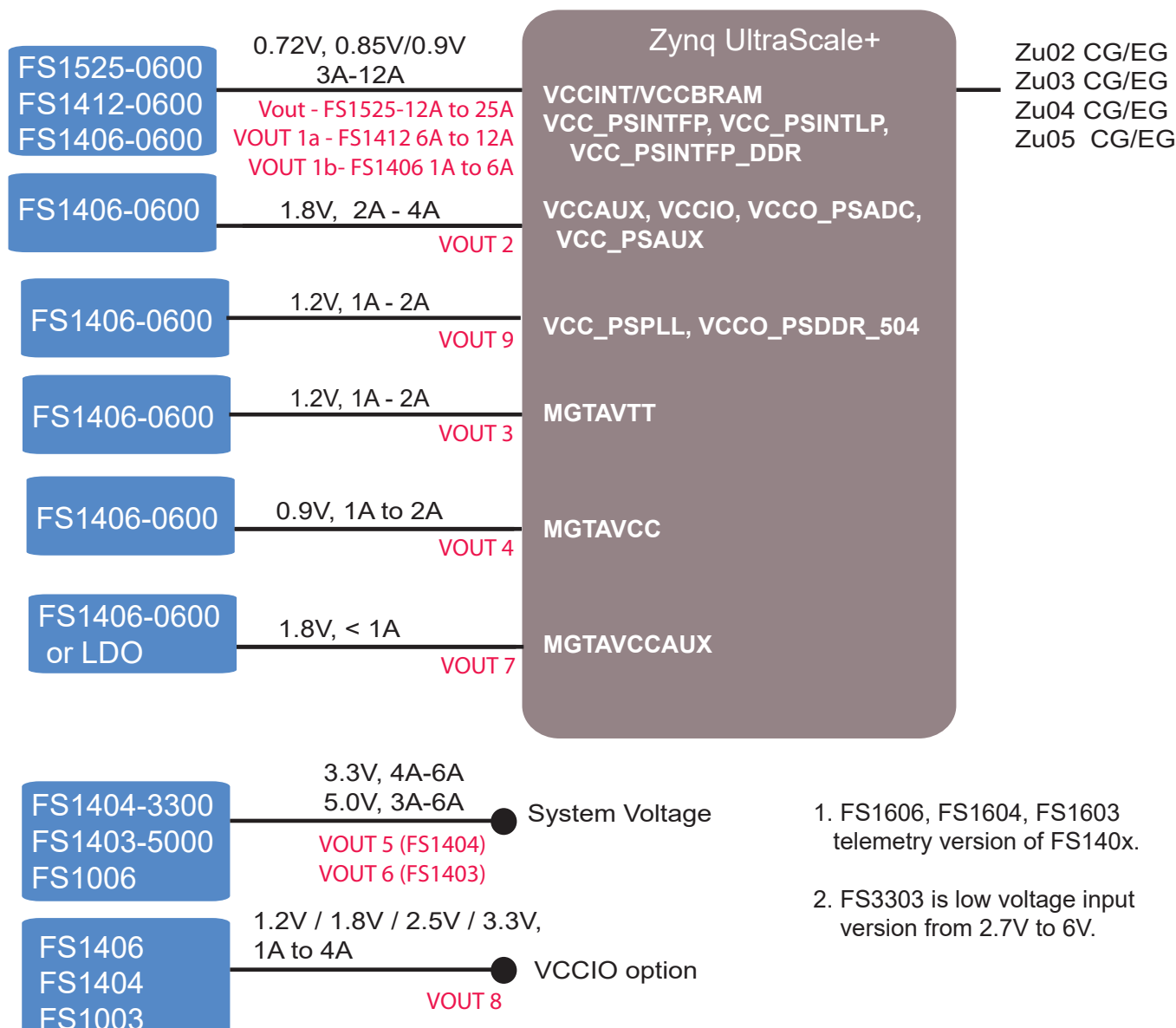


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1406-0600 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Zynq UltraScale+ MPSoC (Zu02 to Zu04)

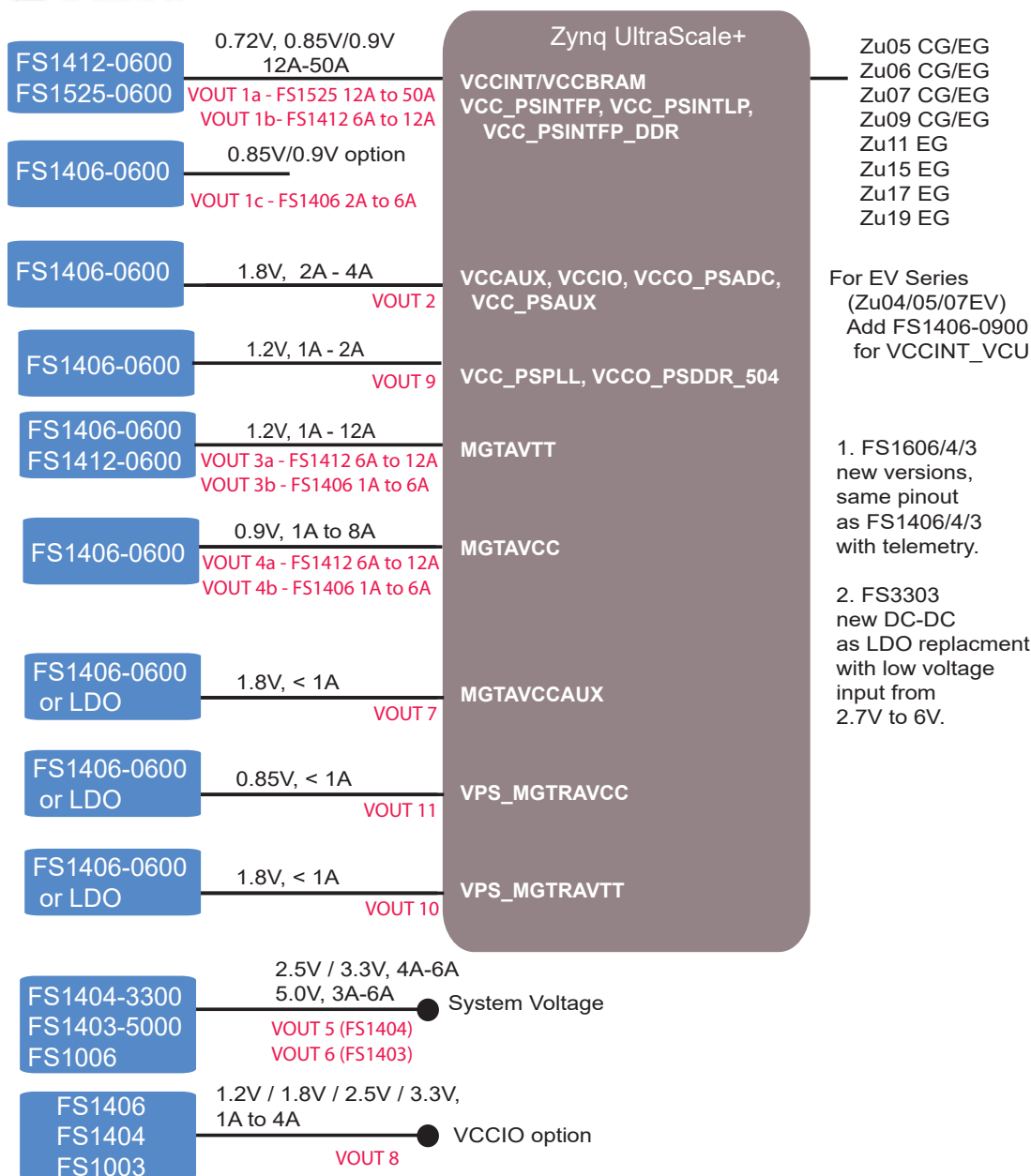


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Zynq UltraScale+ MPSoC (Zu05 to Zu19 CG/EG)

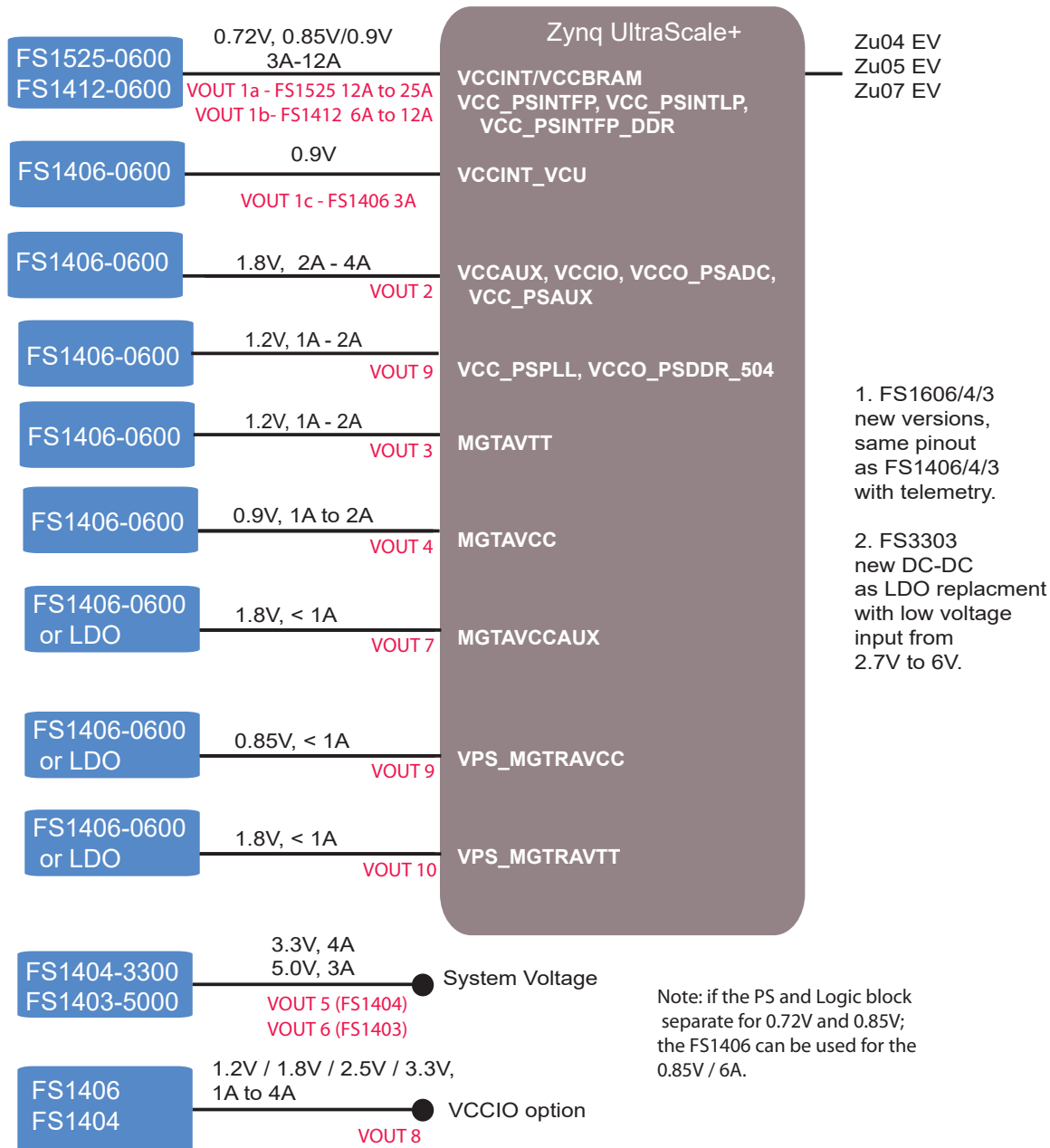


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2.
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Zynq UltraScale+ MPSoC (Zu04EV to Zu07EV)

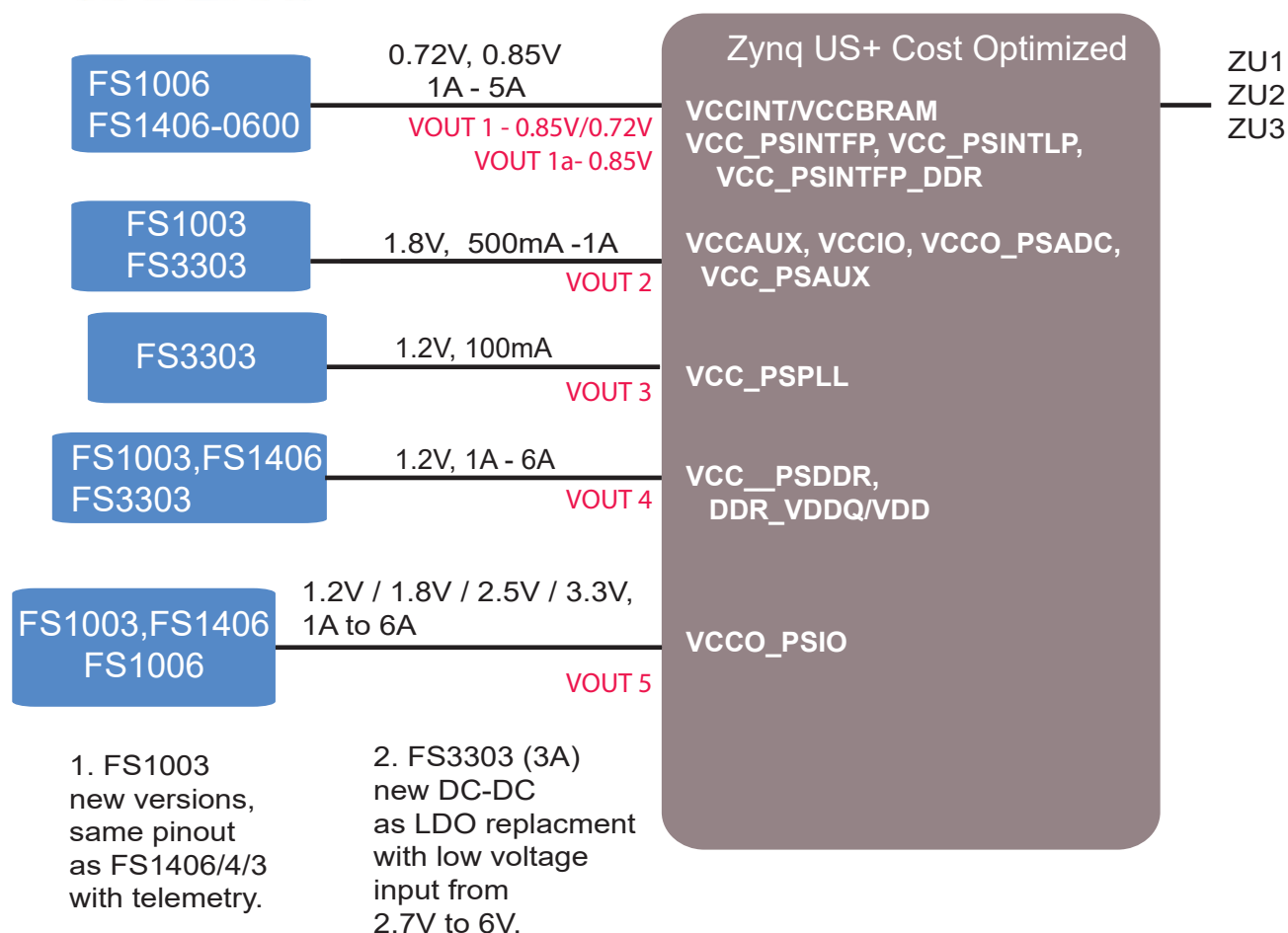


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2.
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS1003 provides an alternative for 0.6V to 5V outputs up to 3A
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Zynq UltraScale+ Cost Optimized

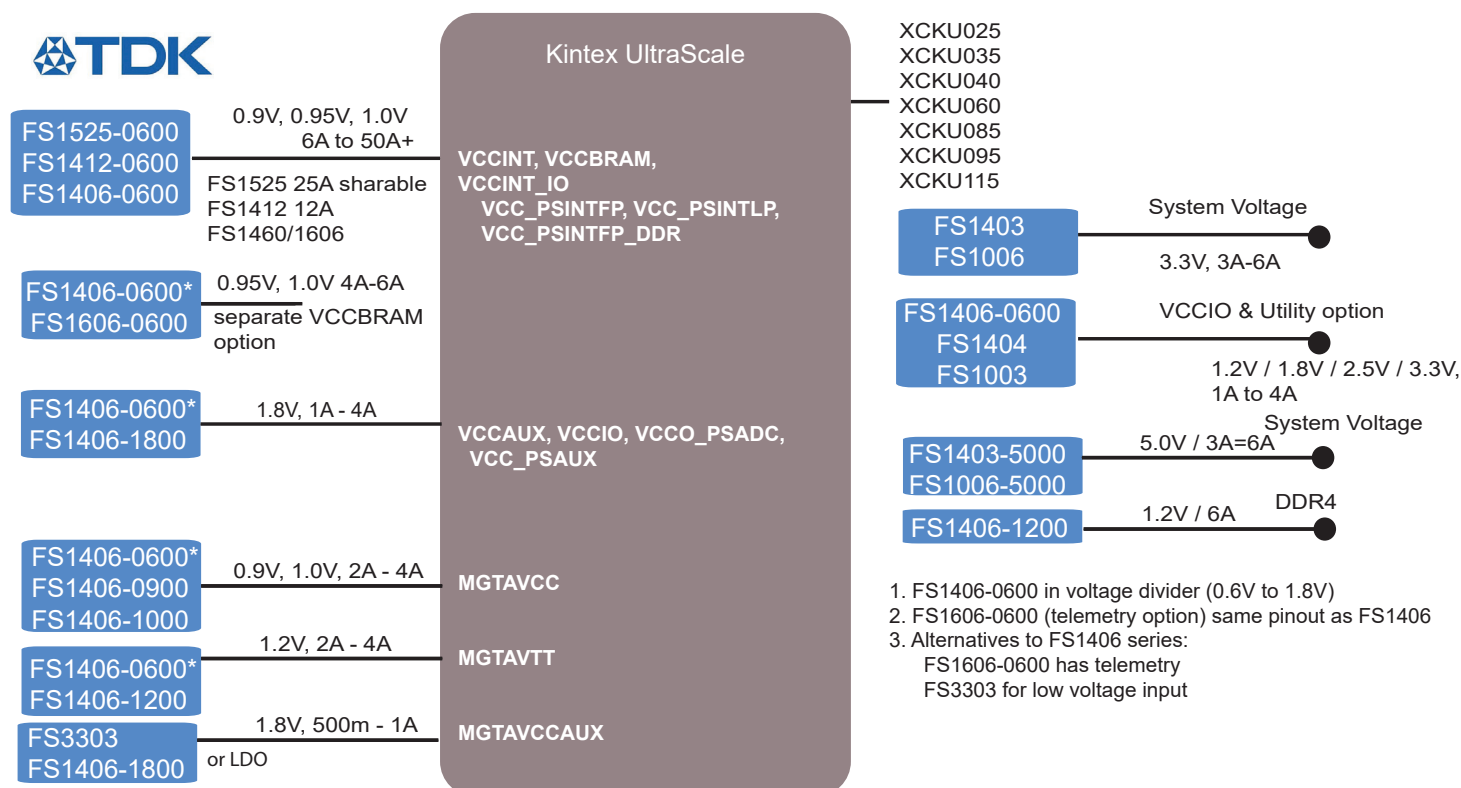


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1412 & FS1406 / FS1606 / FS1003 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Kintex UltraScale

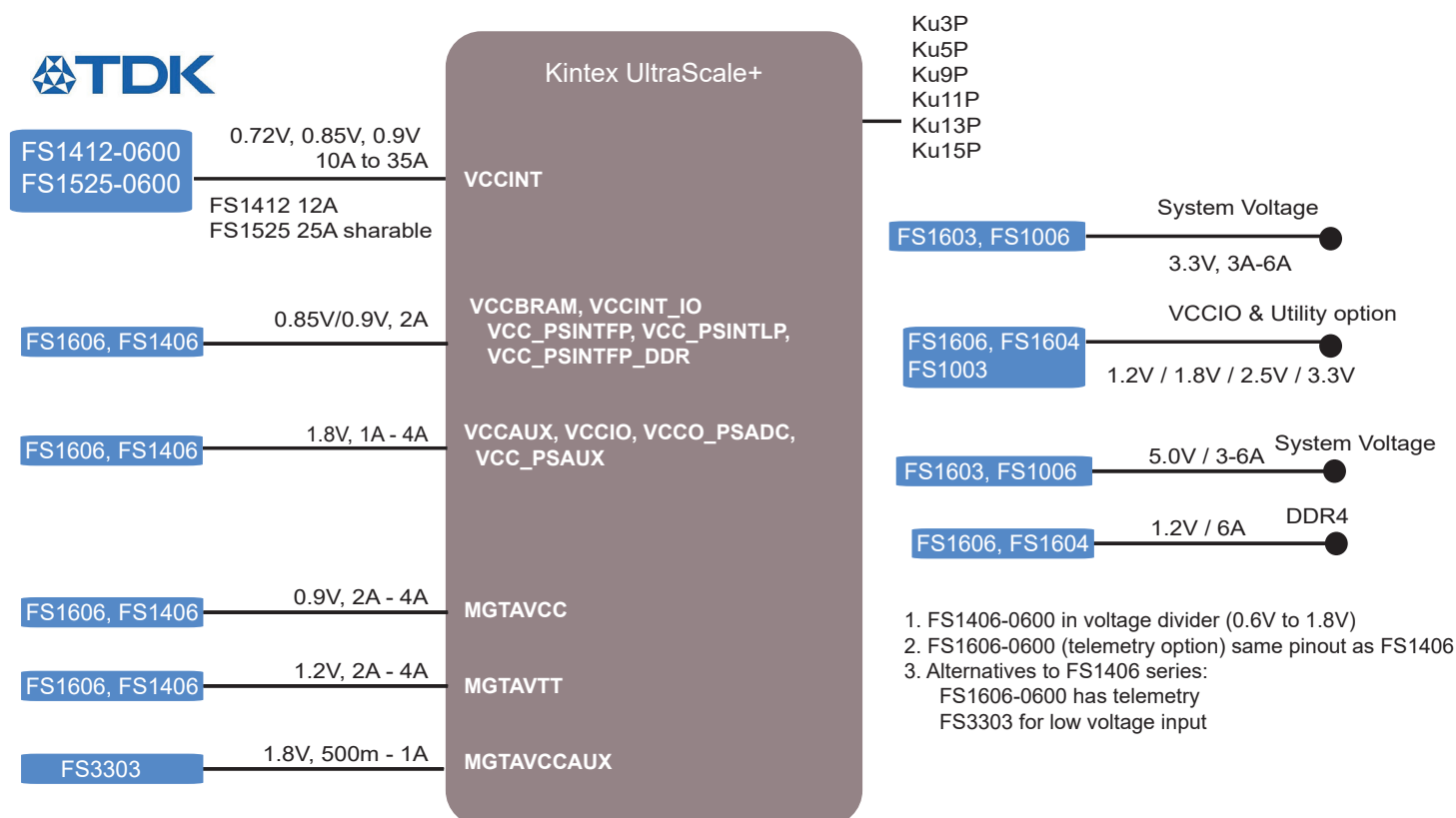


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. 25A to 200A current sharable
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Kintex UltraScale+

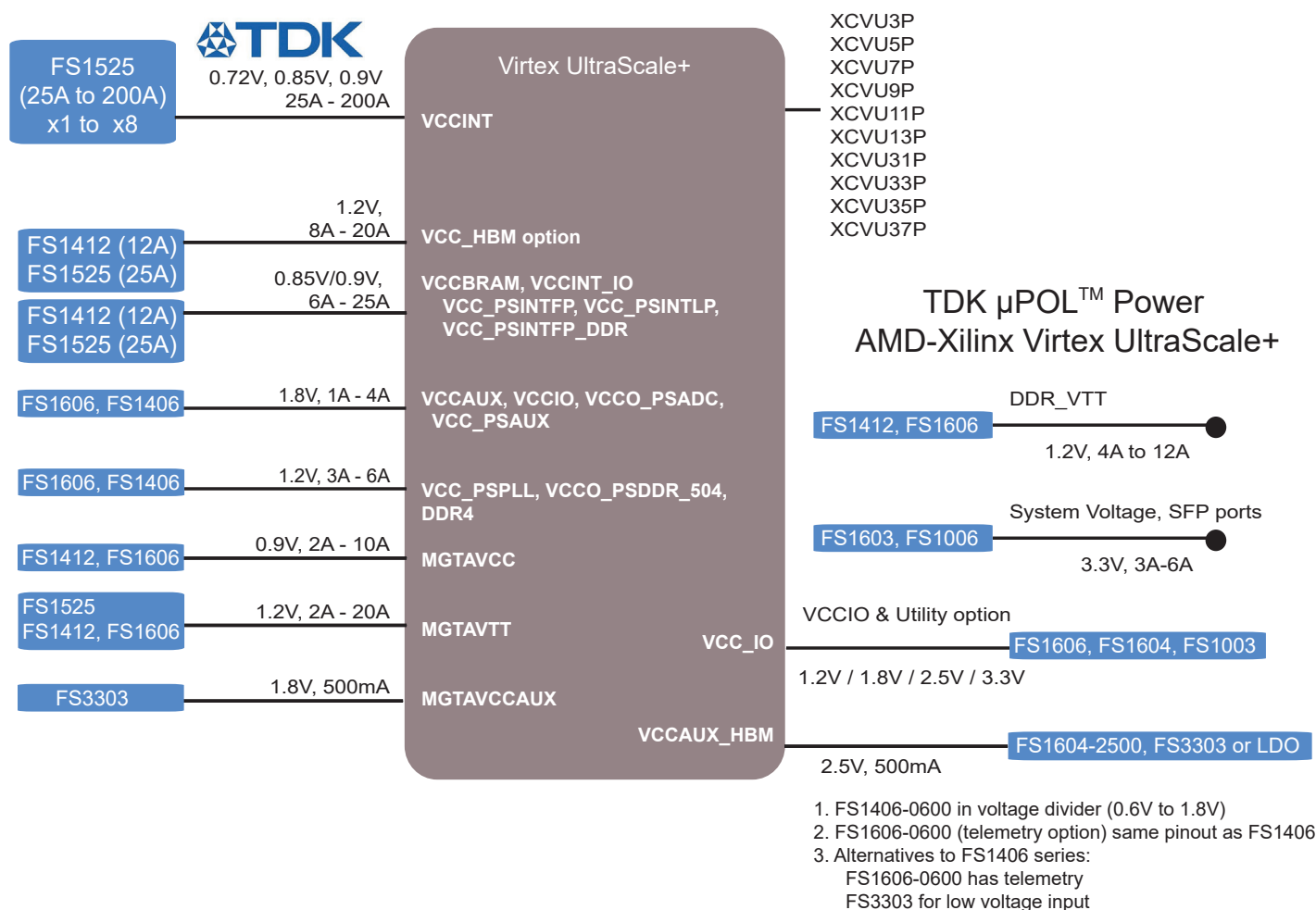


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. 25A to 200A current sharable
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Virtex UltraScale+

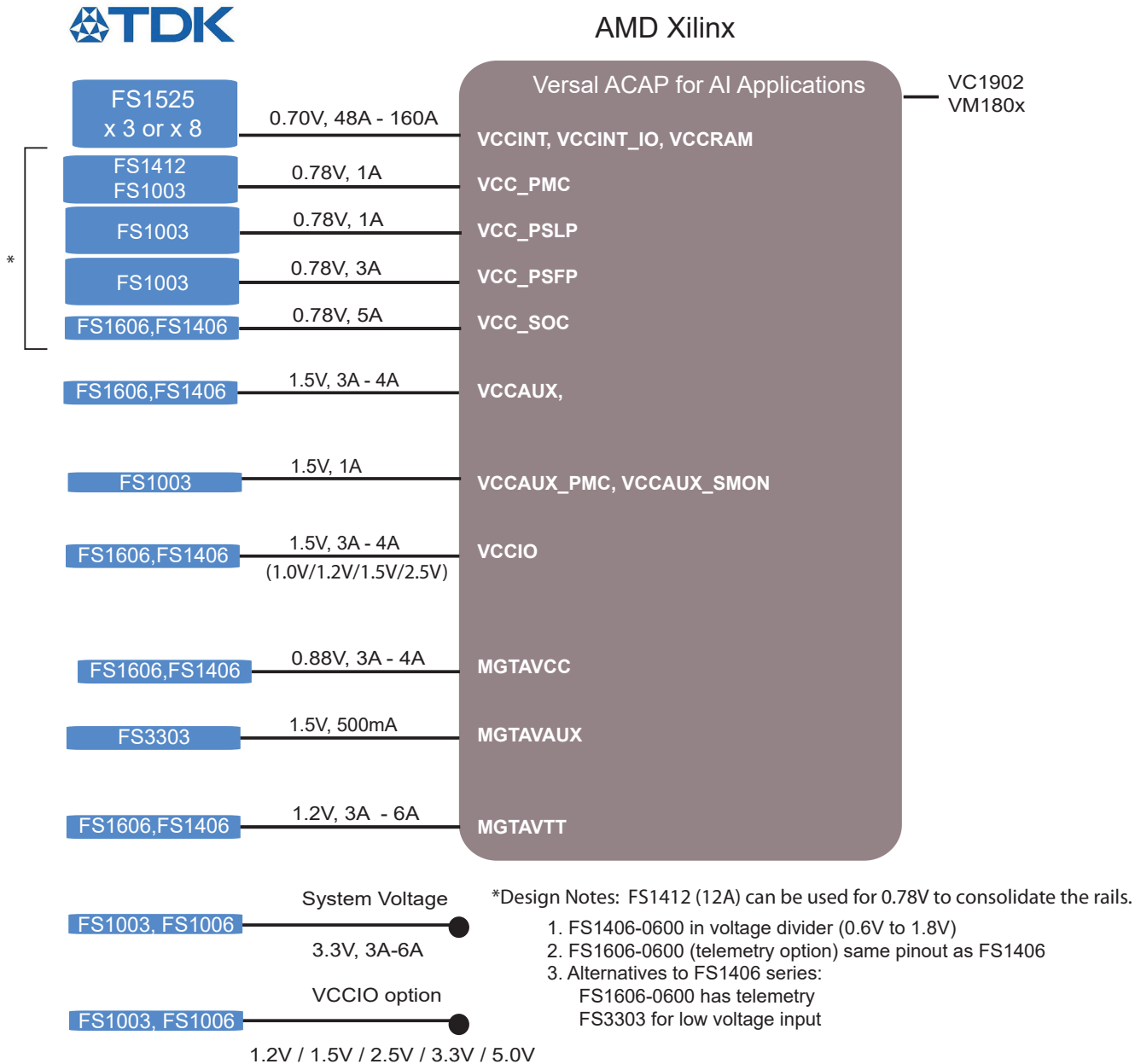


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. 25A to 200A current sharable
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Versal ACAP Series

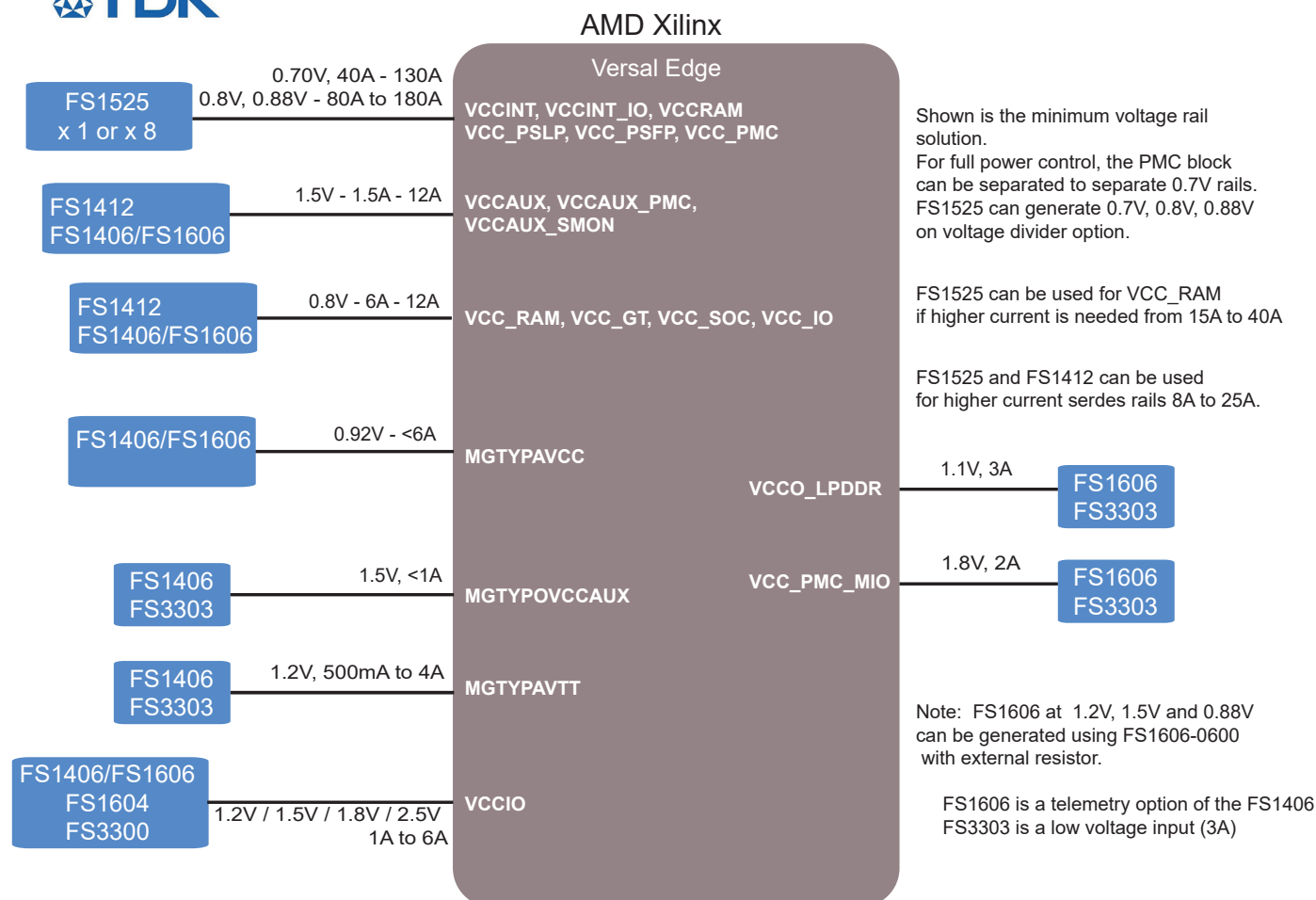


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. 25A to 200A current sharable. Telemetry and Vout start up and setting options.
- FS1412 & FS1406 / FS1606 / FS1003 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Versal Premium and Edge Series

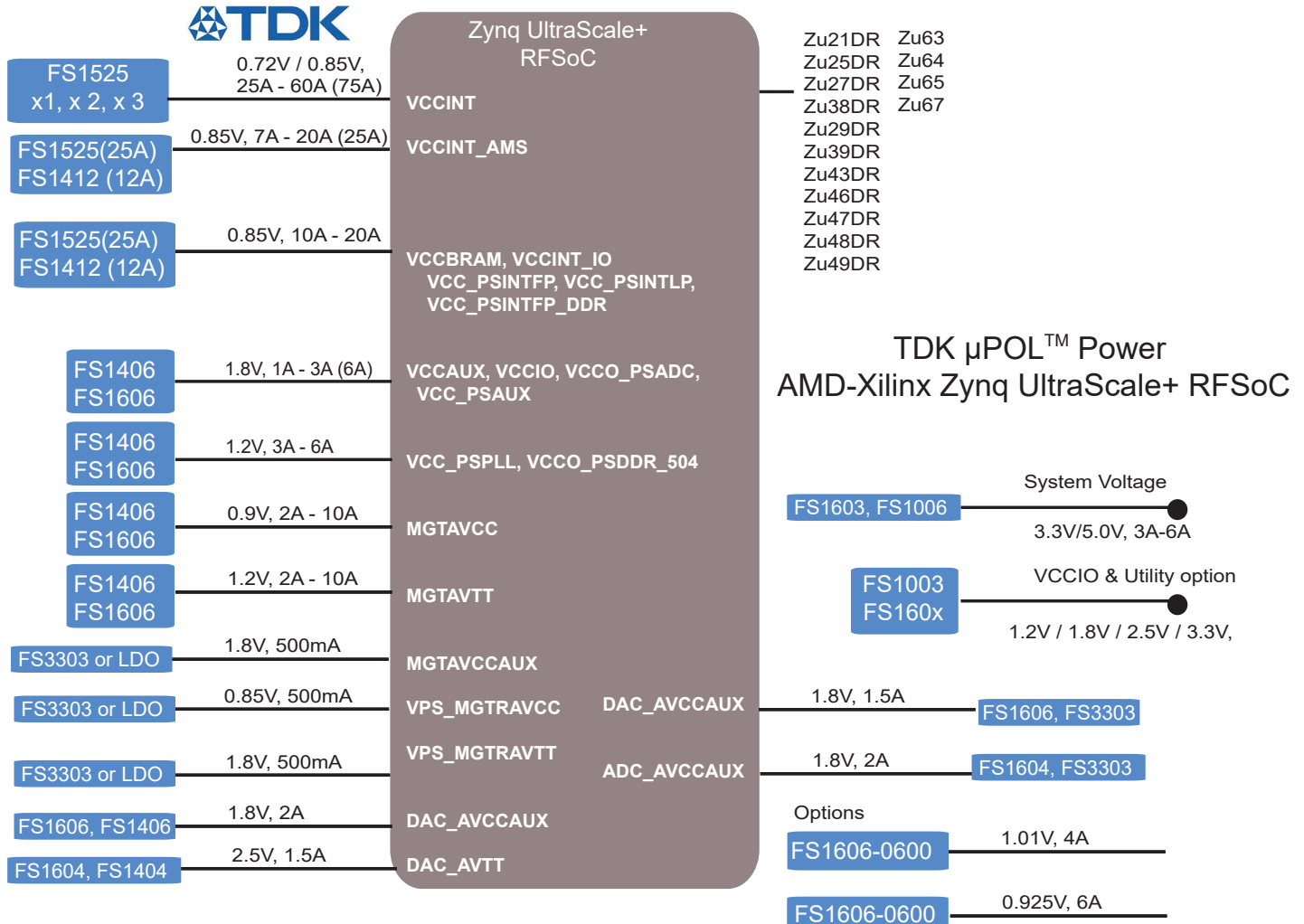


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. 25A to 200A current sharable. Telemetry and Vout start up and setting options.
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Zynq UltraScale+ RFSoc

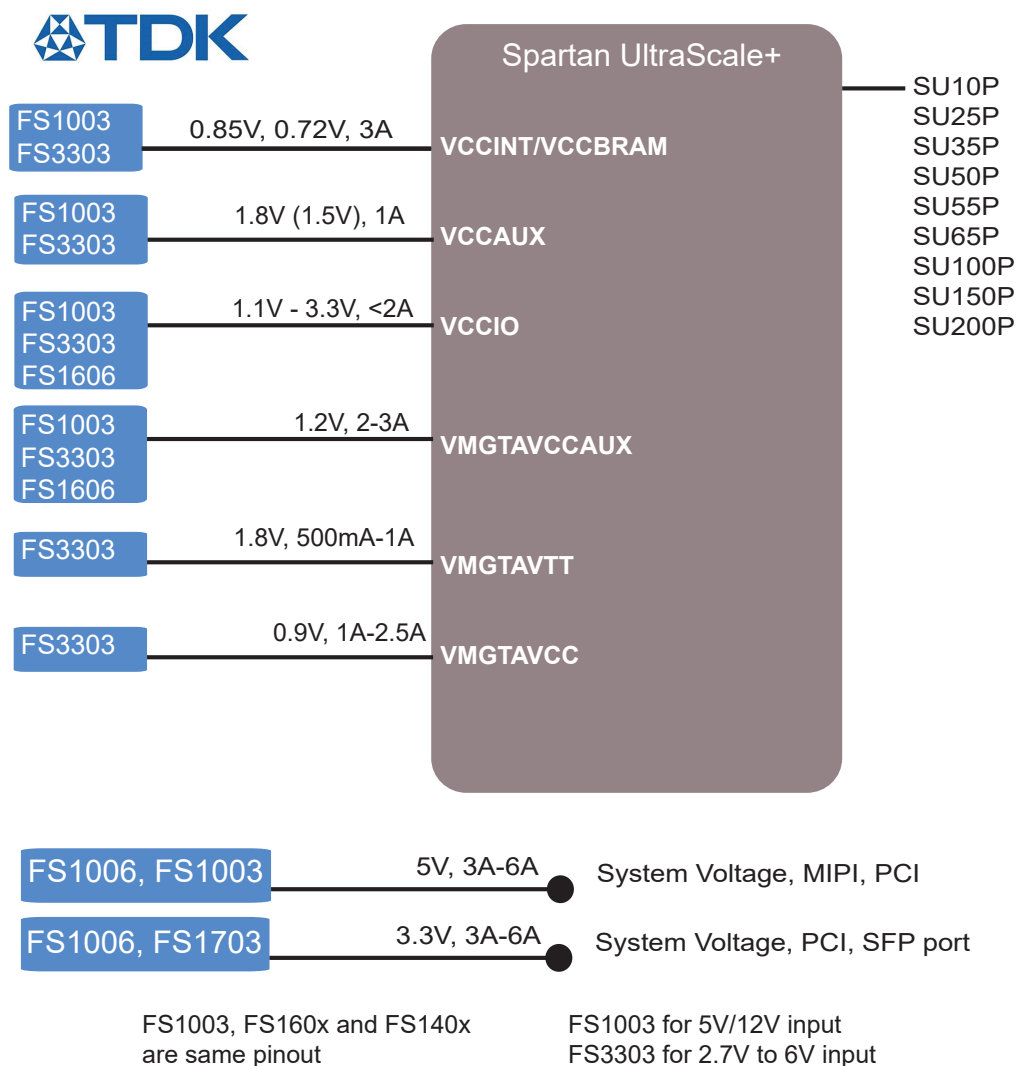


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. 25A to 200A current sharable. Telemetry and Vout start up and setting options.
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for AMD Xilinx Spartan UltraScale+ (early estimated power)

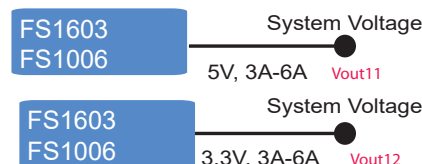
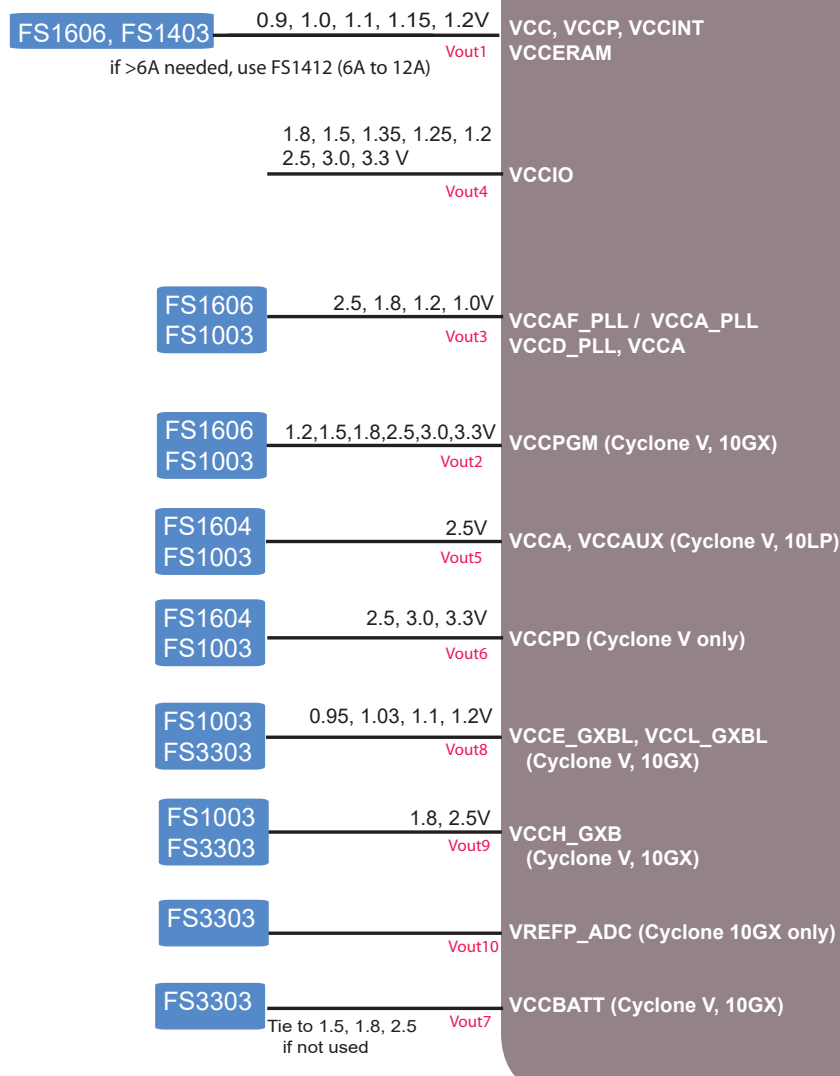


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1003 provides a quick analog DC-DC solution for Vout from 0.6V to 5.0V
- FS1003 and FS1606 same pinout options
- FS3303 provides a quick analog DC-DC solution for Vout from 0.4V to 3.3V low voltage input for 2.7V to 6V.
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Altera Cyclone



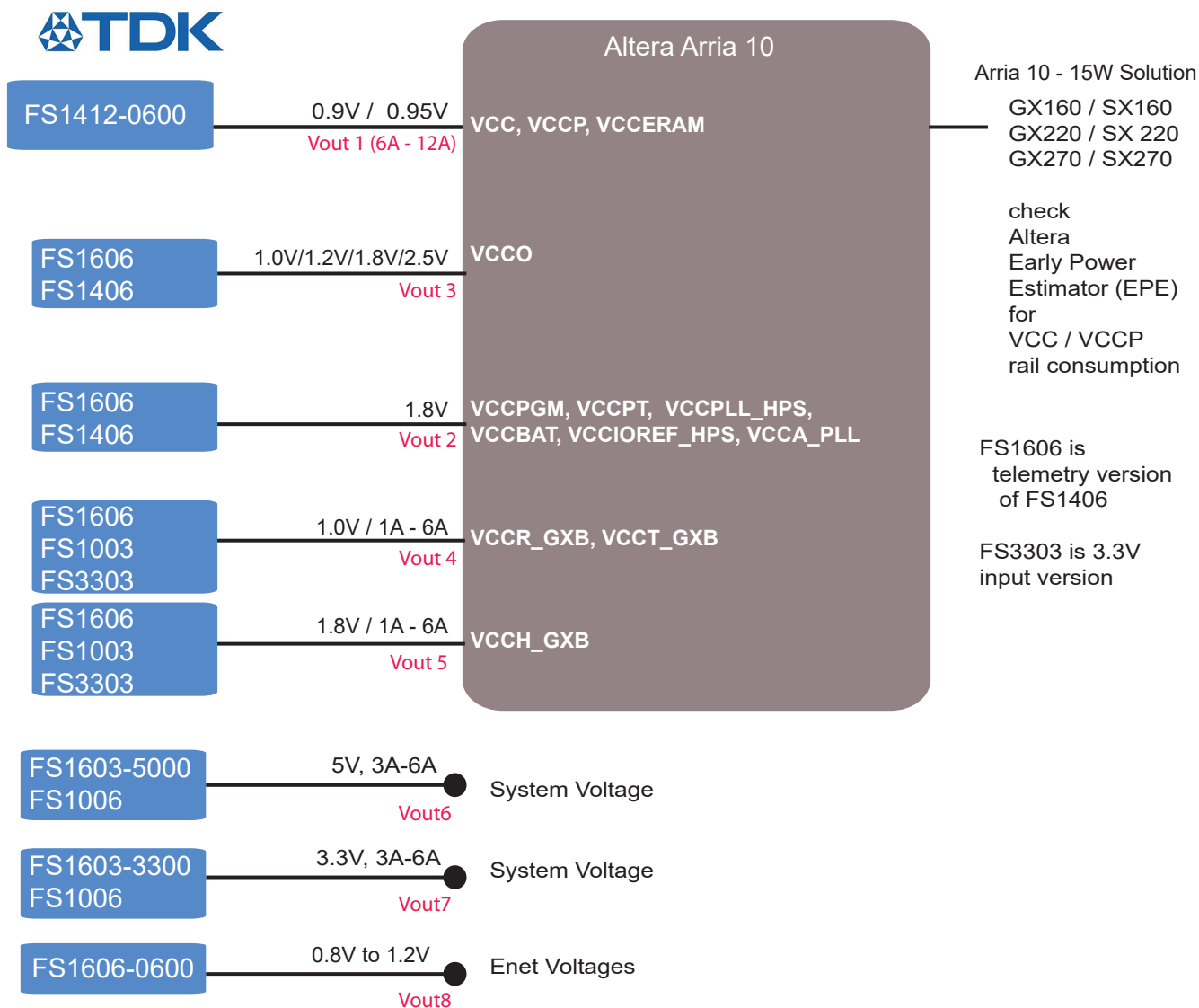
1. FS1406-0600 in voltage divider (0.6V to 1.8V)
2. FS1606-0600 (telemetry option) same pinout as FS1406
3. FS1006, FS1003, FS160x, FS140x are same pinout
4. Alternatives to FS1406 series:
FS1606-0600 has telemetry
FS3303 for low voltage input

Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS160x, FS140x, FS1006, FS1003 are same pinout (check Vout range and options for each)
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Altera Arria 10 - 10W to 15W

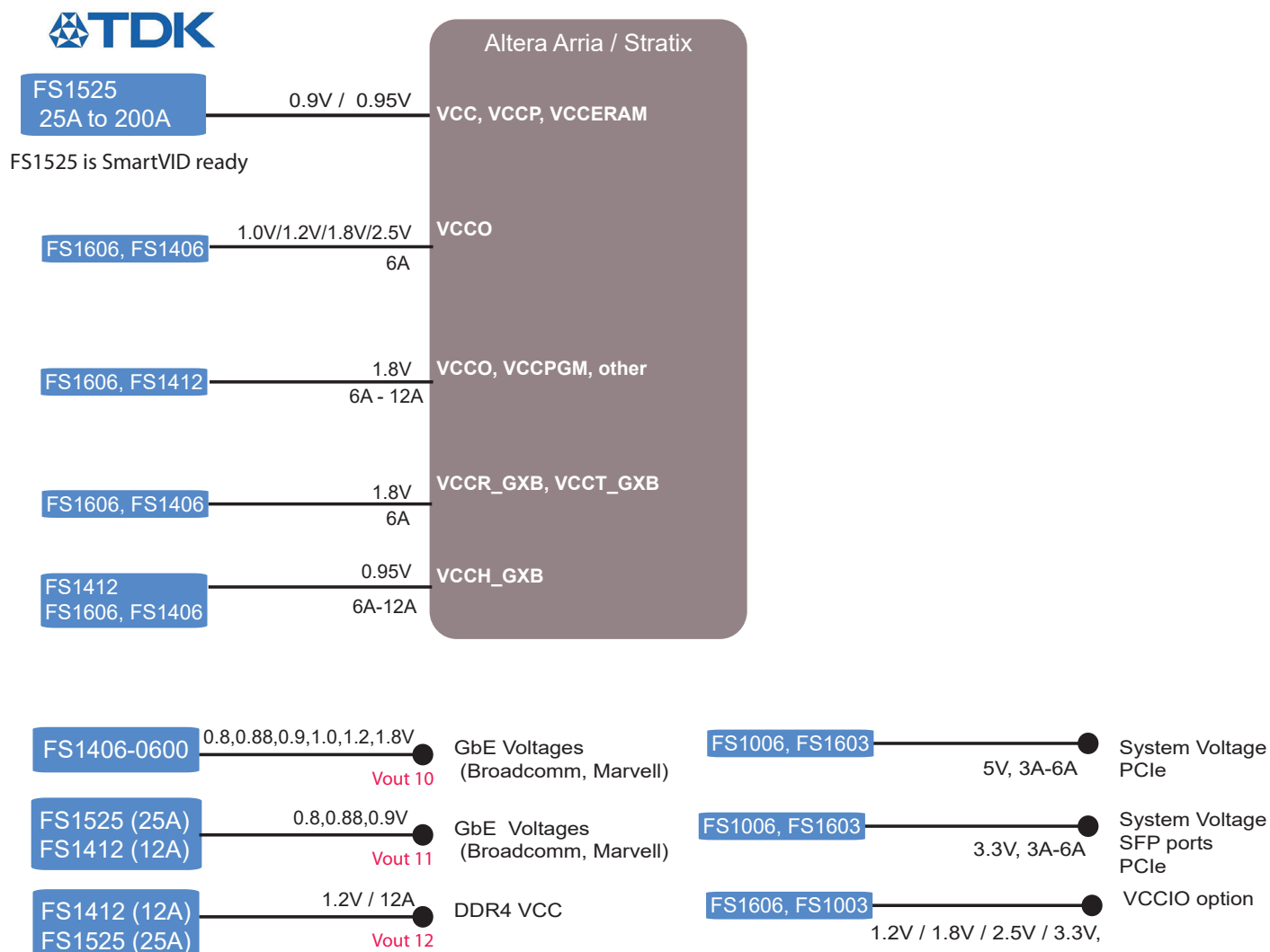


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS160x, FS140x, FS1006, FS1003 are same pinout (check Vout range and options for each)
- FS3303 provides low voltage input option for 2.7V to 6V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Altera Arria 10 & Stratix 10 - 50W to 100W+

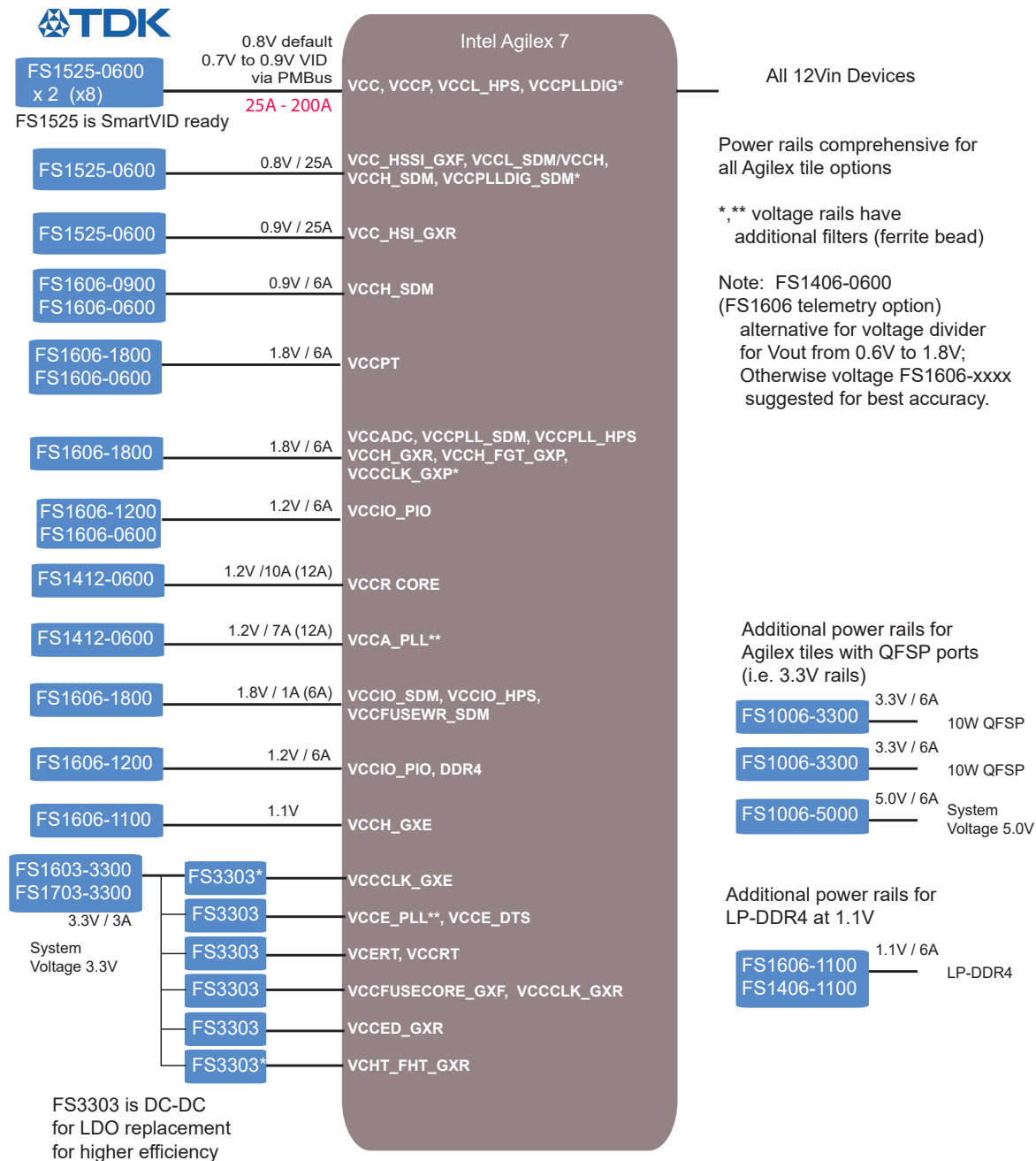


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. SmartVID support possible for Stratix and Agilex VID to +/-10mV step size.
- FS1412 & FS1406/1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS160x, FS140x, FS1006, FS1003 are same pinout (check Vout range and options for each)
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Altera Agilex 7

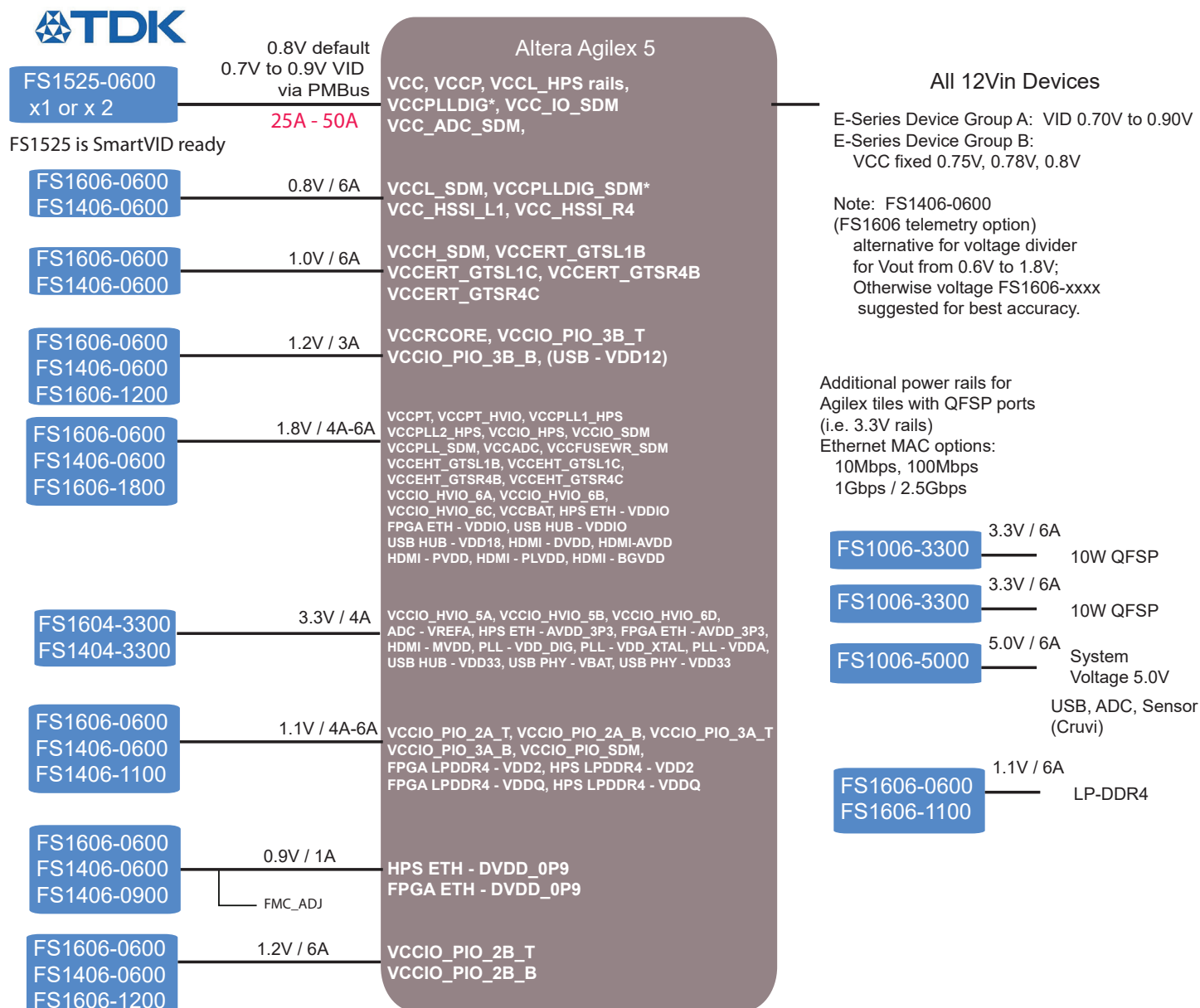


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. SmartVID support possible for Stratix and Agilex VID to +/-10mV step size.
- FS1412 & FS1406/1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS160x, FS140x, FS1006, FS1003 are same pinout (check Vout range and options for each)
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Altera Agilex 5

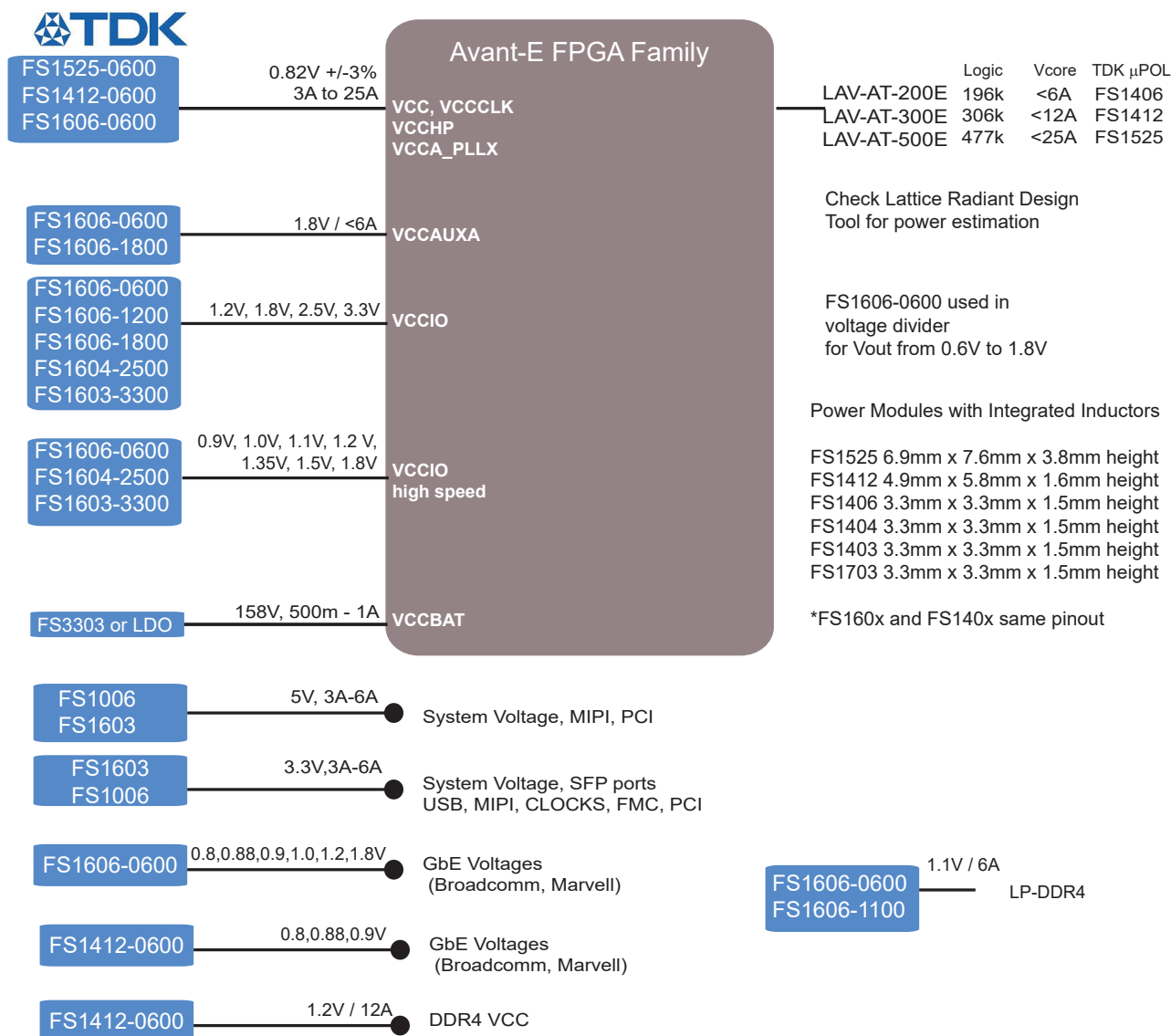


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. SmartVID support possible for Stratix and Agilex VID to +/-10mV step size.
- FS1412 & FS1406/1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS160x, FS140x, FS1006, FS1003 are same pinout (check Vout range and options for each)
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Lattice Avant-E

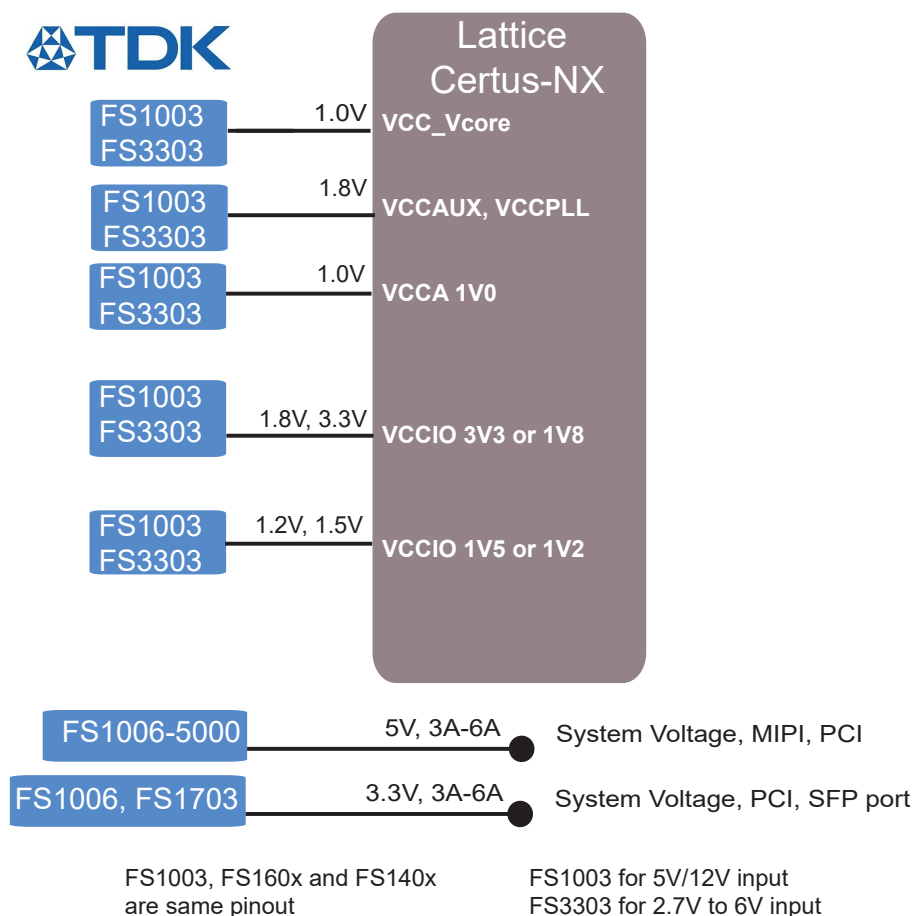


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. 25A, 0.6V to 1.8V
- FS1412 & FS1406/1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS160x, FS140x, FS1006, FS1003 are same pinout (check Vout range and options for each)
- FS3303 is DC-DC used for LDO replacement for higher efficiency. Low voltage input 2.7V to 6V.
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Lattice Certus-NX

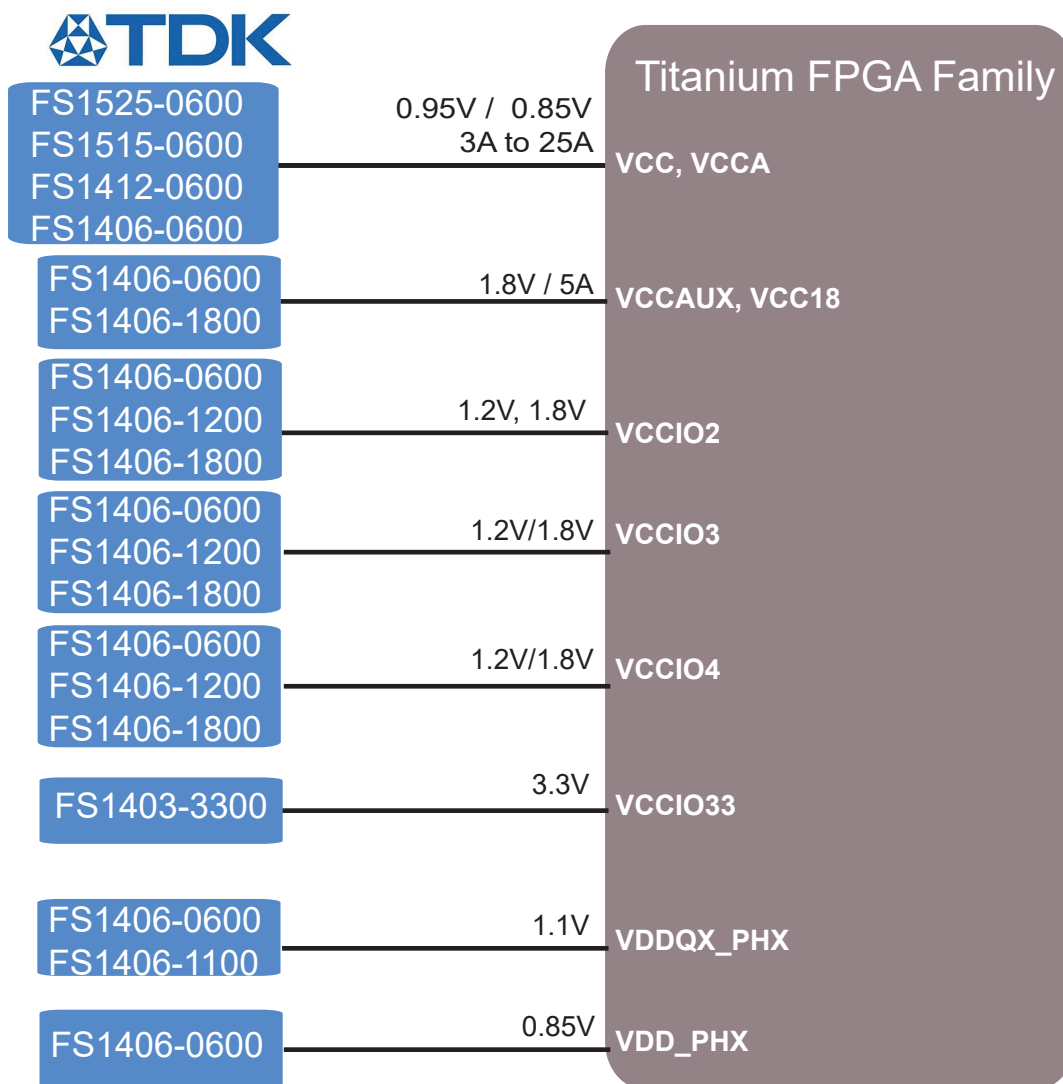


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1003 provides a quick analog DC-DC solution for Vout from 0.6V to 5.0V
- FS3303 provides a quick analog DC-DC solution for Vout from 0.4V to 3.3V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Efinix Titanium

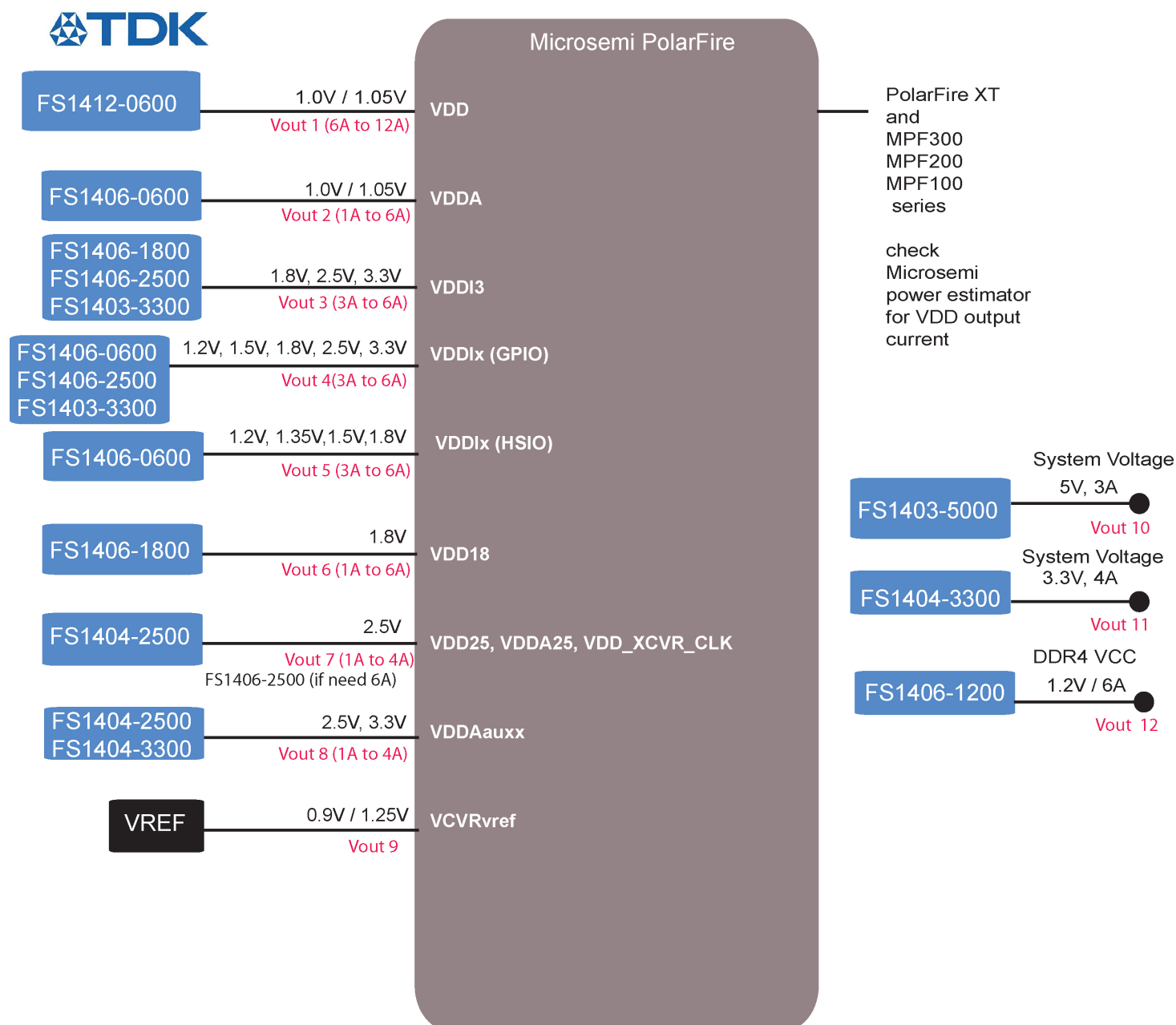


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. Telemetry and Vout start up and setting options.
- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Microsemi PolarFire

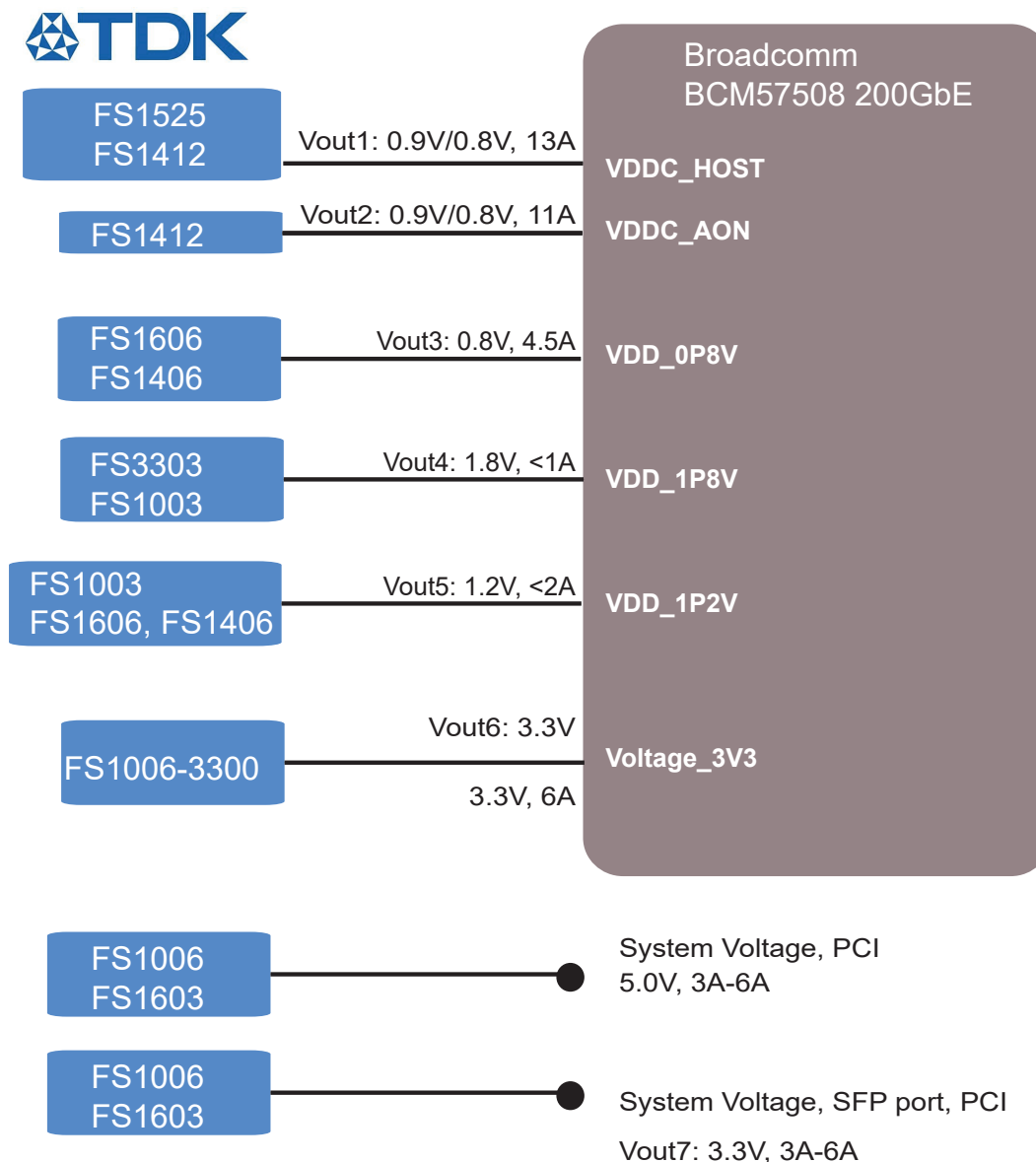


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TDK μ POL™ DC-DC Power Modules Solution

Power Map for Broadcom - 100G - 200G Ethernet

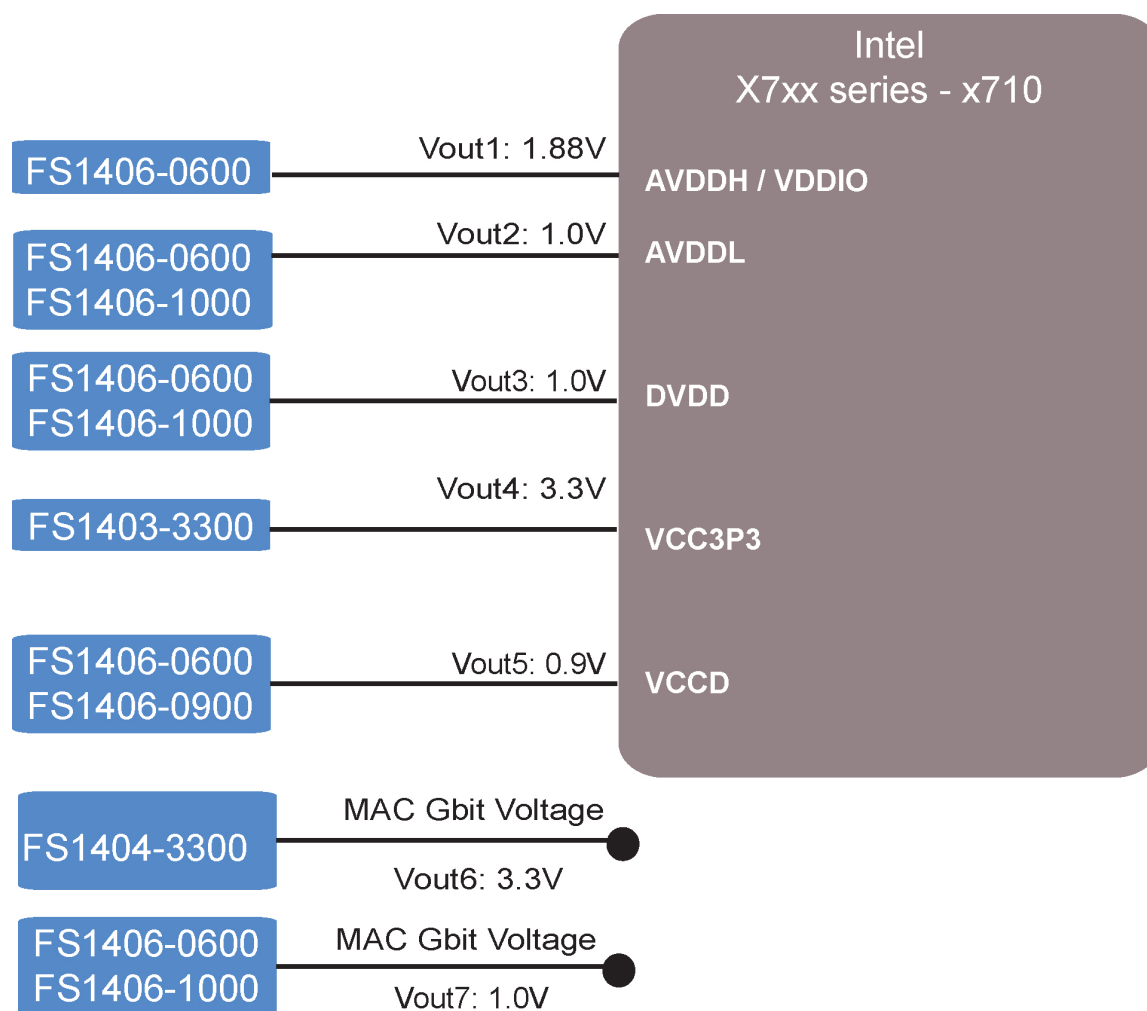


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. Telemetry and Vout start up and setting options.
- FS1412 & FS1406 / FS1606 (same pinouts) provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS1003 provides a quick analog DC-DC solution for Vout from 0.6V to 5.0V
- FS3303 provides a quick analog DC-DC solution for Vout from 0.4V to 3.3V
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Intel Ethernet - GbE Ethernet

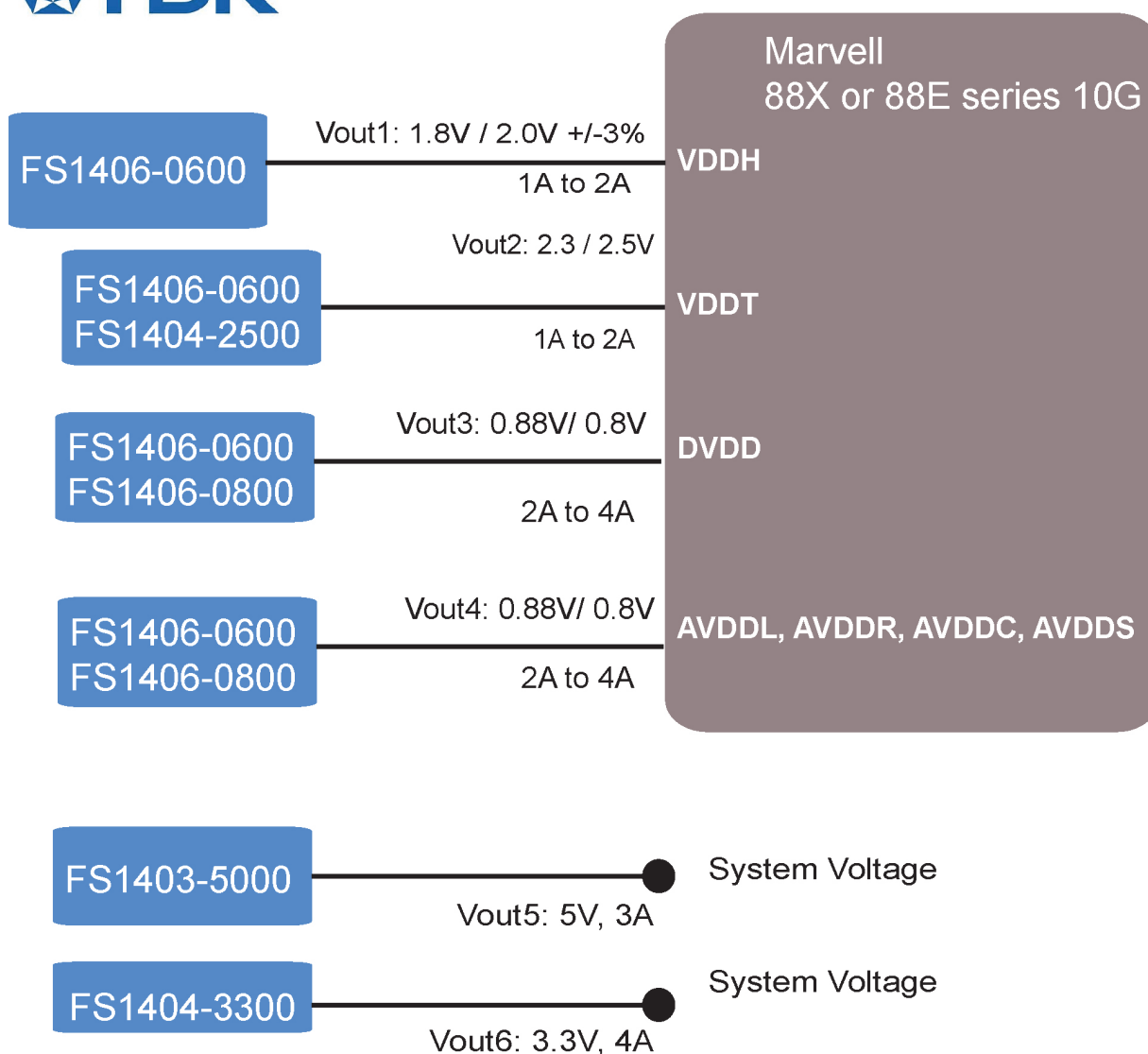


Highlights

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- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
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TDK μ POL™ DC-DC Power Modules Solution

Power Map for Marvell - GbE Ethernet

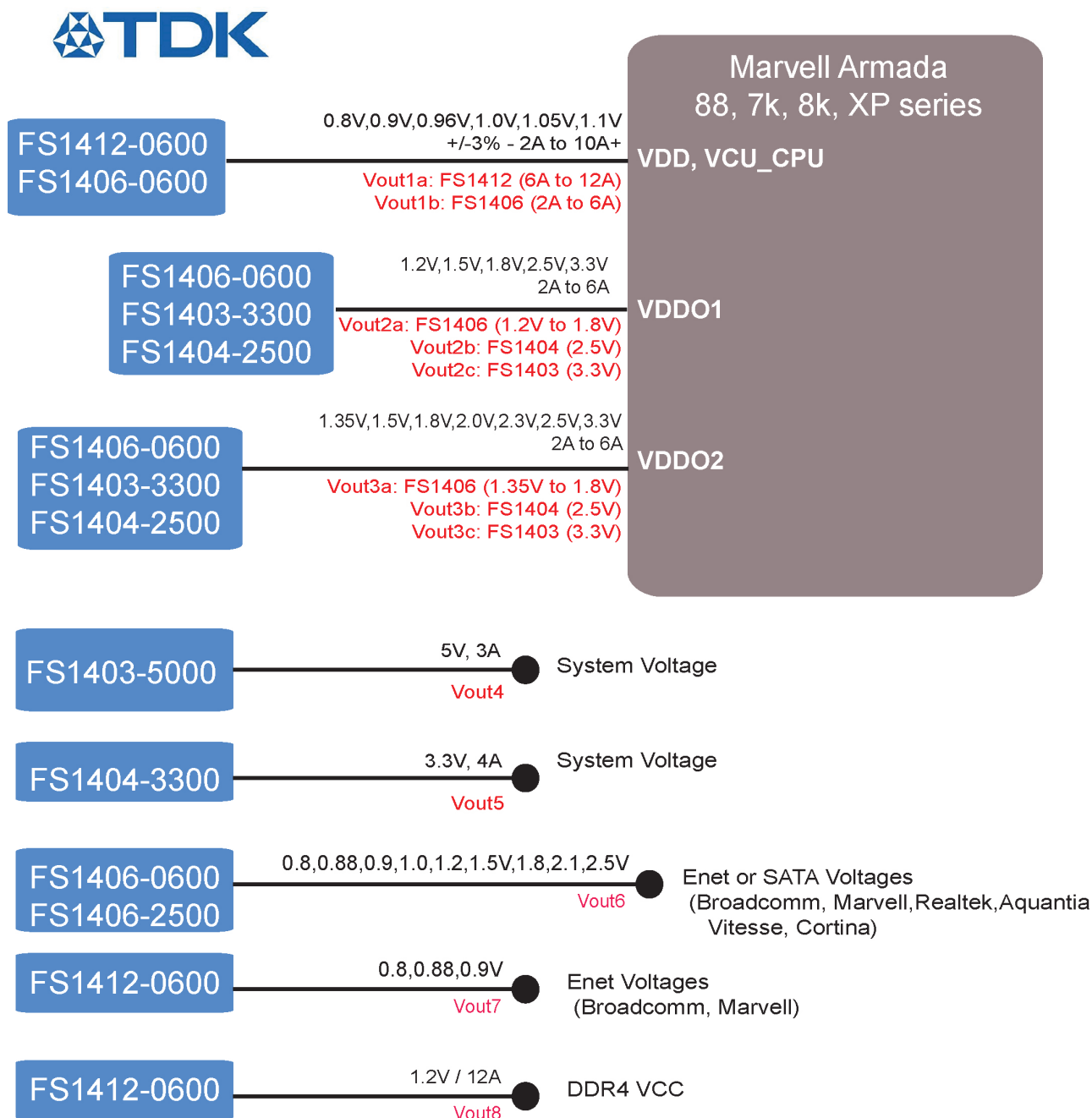


Highlights

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- FS1412 & FS1406 / FS1606 provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
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- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Marvell - Armada - multi-core ARM SoCs

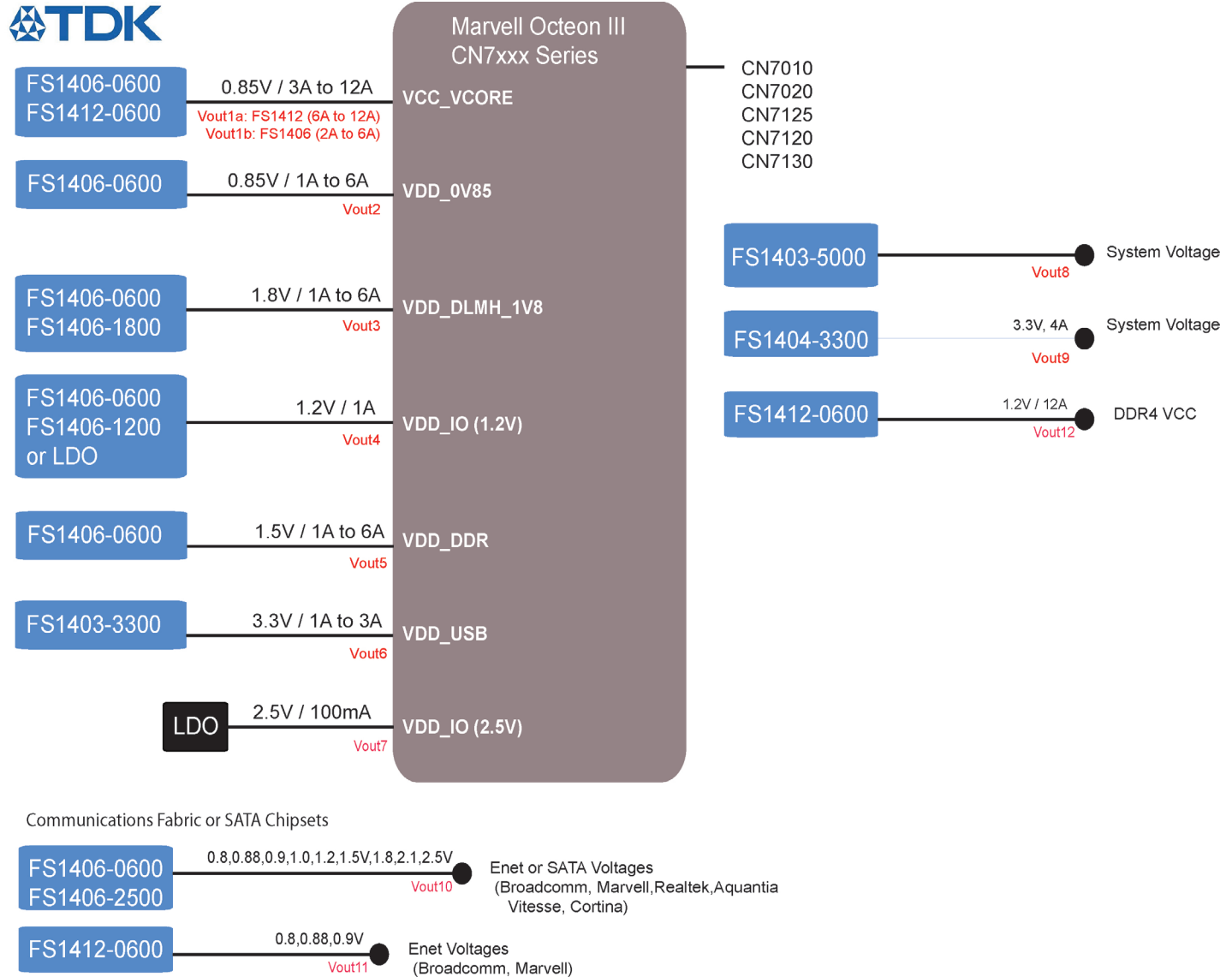


Highlights

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TDK μ POL™ DC-DC Power Modules Solution

Power Map for Marvell - Cavium Octeon - ARM Processor SoC

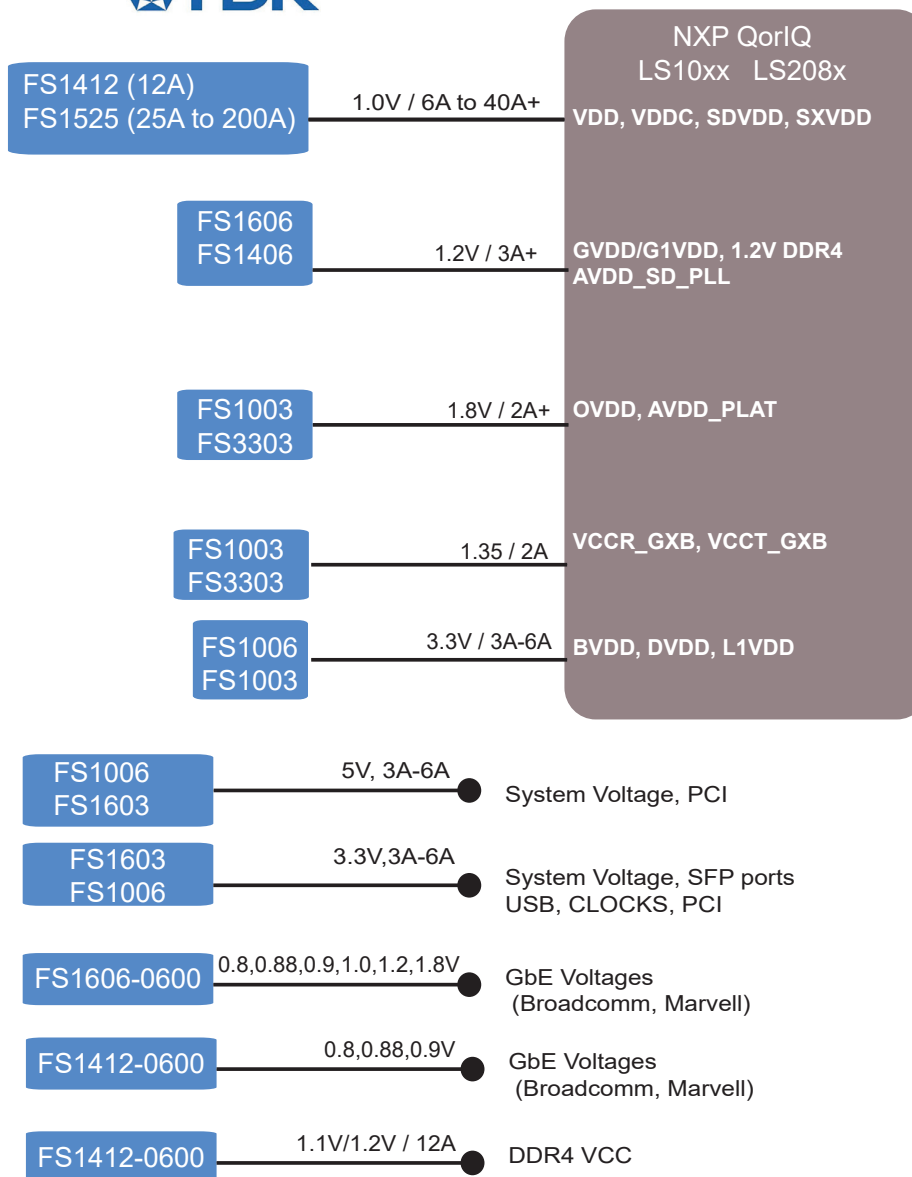


Highlights

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TDK μ POL™ DC-DC Power Modules Solution

Power Map for NXP - QorIQ - LayerScale Processors

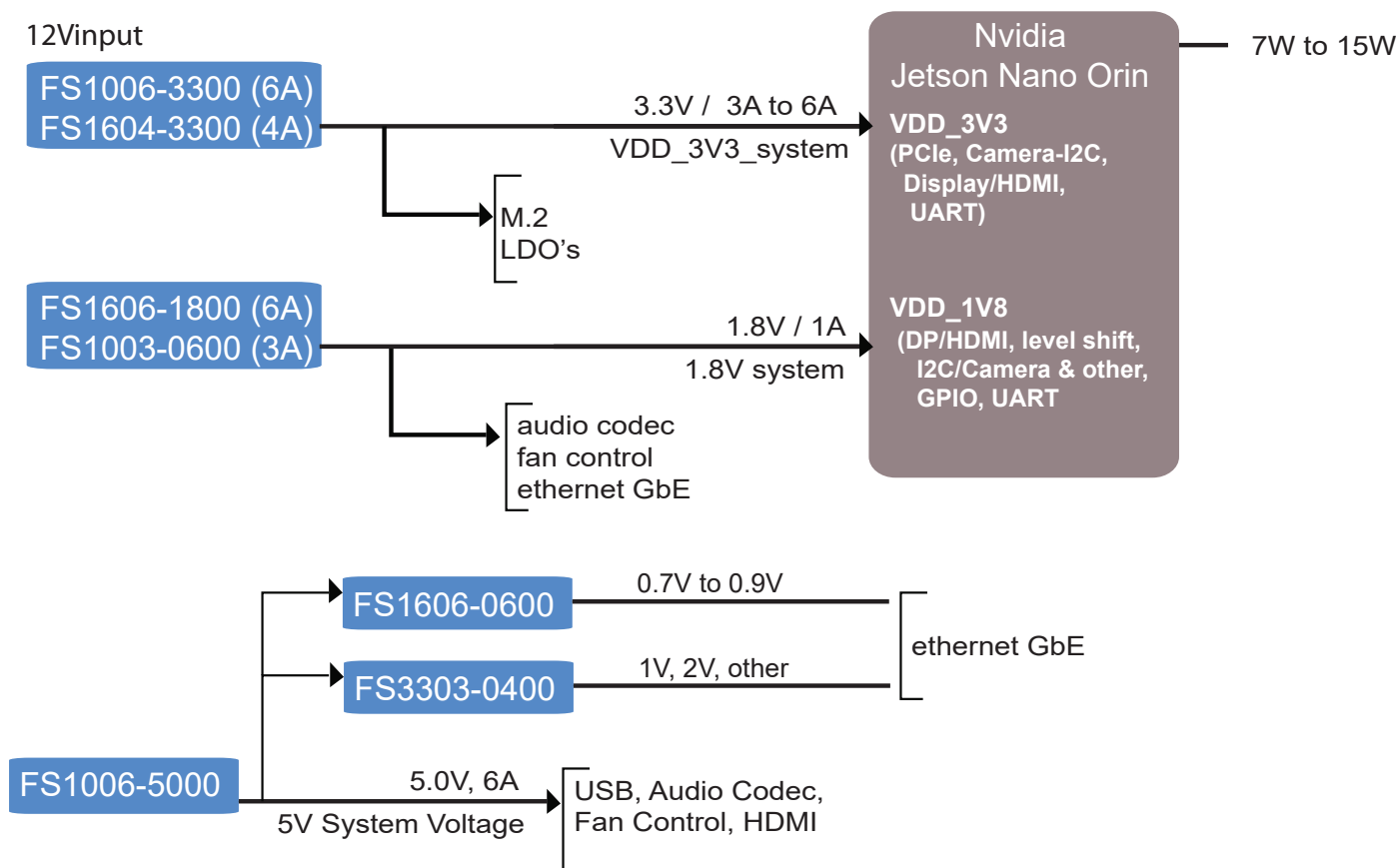


Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1525 PMBus 1.2. Telemetry and Vout start up and setting options.
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- FS1003 provides a quick analog DC-DC solution for Vout from 0.6V to 5.0V
- FS3303 provides a quick analog DC-DC solution for Vout from 0.4V to 3.3V
- Low height profile DC-DC power modules
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- -40°C to 125°C Operating Temperature

TDK μ POL™ DC-DC Power Modules Solution

Power Map for Nvidia - Jetson Nano Orin - 7W to 15W



Highlights

- μ POL™ Technology Includes Inductor in a Thermally Enhanced Package
- FS1606 and FS1003 (same pinouts) provides a quick analog DC-DC solution for Vout from 0.6V to 1.8V
- FS1003 provides a quick analog DC-DC solution for Vout from 0.6V to 5.0V
- FS1006 provides 3.3V (~20W) and 5V (30W) --- best in class in size for power density performance
- FS3303 provides a quick analog DC-DC solution for Vout from 0.4V to 3.3V for low voltage input (2.7V to 6V)
- Low height profile DC-DC power modules
- Excellent thermal derating performance
- -40°C to 125°C Operating Temperature