

How to Select the Right Power Solution for Your FPGA or PMIC



George Lakkas

Given their high performance and integration capabilities, several data center and industrial applications use Xilinx® Ultrascale™ and Ultrascale+ field-programmable gate arrays (FPGAs), including enterprise switches, server FPGA accelerator cards, test and measurement, and space and defense.

Knowing the Xilinx FPGA power specifications for a particular Ultrascale+ FPGA family – Zynq multiprocessor system-on-chip (MPSoC), Virtex, Kintex – requires downloading and using the [Xilinx Power Estimator \(XPE\)](#), as shown in [Figure 1](#).



Figure 1. XPE Tool Header

Once on the XPE site, you'll select the settings that correspond to your device family (Zynq Ultrascale+, for example), device part number (such as the XCZU9EG), speed grade, temperature grade and environment (including board size and layers). You'll then complete the power profile by selecting the clock, logic, input/output (I/O), RAM, digital signal processor (DSP) and transceiver options.

TI has done the pre-work and created a spreadsheet with all Xilinx Ultrascale+ Family variants, their corresponding part numbers, rail names, loading options (choices of clock/logic/I/O, RAM, DSP and transceiver) and voltage and current specifications, as shown in [Figure 2](#).

XCVU9P		XCVU11P		XCVU13P	
V _{CCINT}	low (14.779A)	V _{CCINT}	low (16.447A)	V _{CCINT}	low (22.728A)
Output Voltage: 0.720	med (28.801A)	Output Voltage: 0.720	med (32.320A)	Output Voltage: 0.720	med (46.871A)
Max Load: 49.389A	high (49.389A)	Max Load: 56.643A	high (56.643A)	Max Load: 91.441A	high (91.441A)
V _{CCINT_IO}	low (0.419A)	V _{CCINT_IO}	low (0.245A)	V _{CCINT_IO}	low (0.296A)
Output Voltage: 0.850	med (0.460A)	Output Voltage: 0.850	med (0.266A)	Output Voltage: 0.850	med (0.358A)
Max Load: 0.569A	high (0.569A)	Max Load: 0.328A	high (0.328A)	Max Load: 0.562A	high (0.562A)
V _{CCBRAM}	low (0.082A)	V _{CCBRAM}	low (0.079A)	V _{CCBRAM}	low (0.118A)
Output Voltage: 0.850	med (0.155A)	Output Voltage: 0.850	med (0.153A)	Output Voltage: 0.850	med (0.248A)
Max Load: 0.281A	high (0.281A)	Max Load: 0.289A	high (0.289A)	Max Load: 0.544A	high (0.544A)
V _{CCAUX}	low (0.714A)	V _{CCAUX}	low (0.725A)	V _{CCAUX}	low (0.932A)
Output Voltage: 1.800	med (0.727A)	Output Voltage: 1.800	med (0.754A)	Output Voltage: 1.800	med (1.187A)
Max Load: 0.924A	high (0.924A)	Max Load: 1.099A	high (1.099A)	Max Load: 2.557A	high (2.557A)
V _{CCAUX_IO}	low (0.279A)	V _{CCAUX_IO}	low (0.172A)	V _{CCAUX_IO}	low (0.198A)
Output Voltage: 1.800	med (0.279A)	Output Voltage: 1.800	med (0.172A)	Output Voltage: 1.800	med (0.199A)
Max Load: 0.280A	high (0.280A)	Max Load: 0.173A	high (0.173A)	Max Load: 0.200A	high (0.200A)
V _{CCO 1.5V}	low (0.335A)	V _{CCO 1.5V}	low (0.335A)	V _{CCO 1.5V}	low (0.335A)
Output Voltage: 1.500	med (0.335A)	Output Voltage: 1.500	med (0.335A)	Output Voltage: 1.500	med (0.335A)
Max Load: 0.335A	high (0.335A)	Max Load: 0.335A	high (0.335A)	Max Load: 0.335A	high (0.335A)
V _{CCADC}	low (0.024A)	V _{CCADC}	low (0.024A)	V _{CCADC}	low (0.032A)
Output Voltage: 1.800	med (0.024A)	Output Voltage: 1.800	med (0.024A)	Output Voltage: 1.800	med (0.032A)
Max Load: 0.024A	high (0.024A)	Max Load: 0.024A	high (0.024A)	Max Load: 0.032A	high (0.032A)

Figure 2. Xilinx Ultrascale+ Device Number Power Specs

These detailed power specifications for every Xilinx Ultrascale+ FPGA family, device number and loading type (low/medium/high) will soon be represented in TI's [Xilinx FPGA power selection portal](#) , as shown in [Figure 3](#). Xilinx Ultrascale FPGAs and TI's power solutions are already represented in this portal.

Find the right TI devices for your Xilinx solution

Family	Part Number	Nominal Input Voltage	
<input type="text" value="Virtex UltraScale"/>	<input type="text" value="XCVU065"/>	<input type="text" value="12.0V"/>	<input type="checkbox"/> Automotive only <input type="checkbox"/> Prefer PMBus <input type="checkbox"/> Prefer Freq. Synchronizable

TI Designs Reference Designs

- [PMP10520 - Xilinx Virtex UltraScale FPGA Multi-Gigabit Transceiver \(MGT\) Power Solution](#)
- [PMP10555 - Xilinx Ultrascale 16nm FPGA/SoC Power Solution for Mobile Radio Basestation](#)
- [PMP10896 - Complete PMBus Power System for Enterprise Ethernet Switches Reference Design](#)
- [PMP9407 - Xilinx Virtex Ultrascale FPGA Multi-Gigabit Transceiver \(MGT\) Power Reference Design with PMBus](#)
- [PMP9408 - Xilinx Virtex Ultrascale FPGA Multi-Gigabit Transceiver \(MGT\) Power Reference Design with PMBus](#)
- [PMP9475 - Xilinx Virtex UltraScale FPGA Power Solution Reference Design](#)

Pick a device for each Point-of-Load (POL) power requirement:

Hover on a part number to see more information

See Multiple Options

Power Requirements	Sequence #*	Loads**	Solution Options by Regulator Type				
			LDO†	Module	DC/DC Converter	Controller	PMIC
Power Supply: #1 Output Voltage: 0.95V Load Current: <input type="text" value="180A (High)"/>		VCCINT				TPS53667	
Power Supply: #2 Output Voltage: 1V Load Current: <input type="text" value="0.71A (High)"/>	5	VCCIO#5 VCCIO#6 VCCIO#7 VCCIO#1 VCCIO#2 VCCIO#3 VCCIO#4		TPS82150	TPS562200		
Power Supply: #3 Output Voltage: 0.95V Load Current: <input type="text" value="0.47A (High)"/>	1	VCCINT_IO		TPS82150	TPS561208		TPS650864

Figure 3. TI's Xilinx FPGA Power Solution Selection Portal

As you can see in [Figure 3](#), depending on the loading (low, medium, high), the power solution may vary to optimize the performance/efficiency/density/cost of the specific design. Based on TI's summary of the XPE power requirements of Ultrascale+ FPGA families and the solution recommendation on TI's Xilinx power solution selection portal, you may be able to get a head start on your board design with a corresponding reference design in the TI Designs reference designs library. For example, for the Virtex Ultrascale XCVU065 medium-loading VCCINT rail 120A requirement, TI's FPGA power solution selection portal recommends the [TPS53647](#) DCAP+™ control mode buck controller with PMBus. [Figure 4](#) shows a 1V/120A four-phase buck from the [High Efficiency, Power Density 1V/120A/30A/30A \(4+1+1\) with PMBus Reference Design](#) that you can use for this requirement.

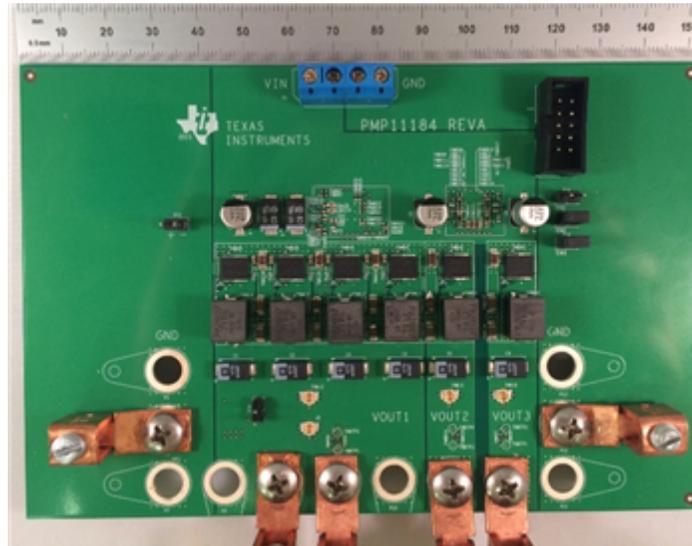


Figure 4. High Efficiency, Power Density 1V/120A/30A/30A (4+1+1) with PMBus Reference Design A noteworthy feature of TI's FPGA power solution selection portal is that hovering over the TI device number also gives you a quick overview of the specific WEBENCH® Designer results for that Xilinx FPGA (as shown in Figure 5), making it easy for you to make a first-level decision.

<p> TPS53647, 120A TPS53667, 180A </p>
<p> Design Information Efficiency: 89% BOM Cost: \$27.86 BOM Count: 122 Footprint: 1892mm² </p>

Figure 5. Quick Look at the Xilinx Virtex Ultrascale XCVU065 12V Input, VCCINT Rail, High-loading (200A) WEBENCH Designer Results

You can find and download the various Xilinx FPGA designs on the [TI reference designs selection page](#) . Type Ultrascale or Ultrascale+ in the Keyword box, get the results, and then filter for your particular FPGA or type of solution (power-management integrated circuit [PMIC], discrete buck converter/controller, multiphase buck or module), as shown in Figure 6.

Search TI reference designs

Find reference designs leveraging the best in TI technology to solve your system-level challenges

Search TI Designs Search power designs by parameters

Reset all 9 Results Results per Page 10

Ultrascale+

Figure 6. Finding Xilinx Ultrascale/Ultrascale+ FPGA Reference Designs on the TI Reference Designs Selection Page

You can also click the Search power designs by parameters tab and check the FPGA box. This will give you all of the available FPGA reference designs in tabular form, as shown in Figure 7, which you can filter for the Xilinx Ultrascale/Ultrascale+ reference design that you need.

Search TI Designs Search power designs by parameters

Reset filters Export results to spreadsheet 20 Results

Keywords

Input voltage range
Min (V) Max (V)

Output voltage range
Min (V) Max (V)

Output current
(A)

Isolated / Non-isolated
 Isolated
 Non-isolated

Input type
 AC
 DC

Designed for
 Processor
 ASIC
 FPGA

Title	Application	TI Devices	V _{in} (V) (min)	V _{in} (V) (max)	V _{out} (V)	I _{out} (A)	Output Power (W)	Isolated / Non-isolated	Input Type	Topology	Last Updated
Xilinx® Zynq® 7000 series (XC7Z015) Power Solution, BW - Reference Design	Avionics Space, Avionics & Defense Industrial	LM3880 LMZ31503 LMZ31506 LP2998 More	10.8	13.2	1	6	6	Non-isolated	DC	Buck-Integrated Switch	22 MAR 2017
Xilinx® Zynq® 7000 series (XC7Z015) Power Solution, BW - Reference Design	Avionics Space, Avionics & Defense Industrial	LM3880 LMZ31503 LMZ31506 LP2998 More	10.8	13.2	1.8	2	3.6	Non-isolated	DC	Buck-Integrated Switch	22 MAR 2017
Small, Efficient Power Supply Reference Design for Altera™ MAX10 FPGA for up to 125°C	DC Drives Factory Automation & Control Electronic Point of Sale Test & Measurement PLC, DCS & PAC Industrial Robots Instrumentation Motor Drives Industrial Logistics	TPS22925 TPS62097 TPS62480	2.7	5.5	2.5	2	5	Non-isolated	DC	Buck-Synchronous	12 DEC 2016
Small, Efficient Power Supply Reference Design for Altera™ MAX10	DC Drives Factory	TPS22925 TPS62097	2.7	5.5	1.5	2	3	Non-isolated	DC	Buck-Synchronous	12 DEC 2016

Figure 7. Finding Xilinx Ultrascale/Ultrascale+ FPGA Reference Designs on the TI Reference Designs Selection Page by Using the FPGA Filter

If you are designing with Xilinx Ultrascale/Ultrascale+ FPGAs and don't know where to start, TI has made it easy to select the power solution, find the optimal reference design from the [TI Designs reference design library](#) , and get ahead of the competition with our easy-to-use power selection and design tools.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2023, Texas Instruments Incorporated