

Scalable Power Solutions for Xilinx Ultra Scale FPGAs Kintex & Virtex 20nm/16nm



Solution Selector Guide

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International
IR Rectifier

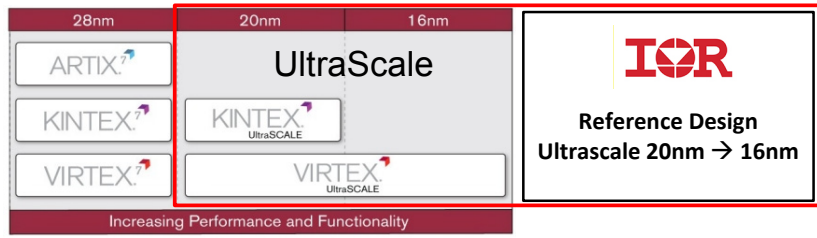
THE POWER MANAGEMENT LEADER

Introduction

The following document is a preliminary design for power solutions for Xilinx Ultra Scale 20nm (16nm) Kintex and Virtex FPGAs by International Rectifier. The devices can also be scaled for Artix FPGA and Zynq SoC. International Rectifier's power solution shown is targeted for Xilinx Ultra Scale FPGAs used in the following applications and FPGA families with,

Applications:

- 100G/s to 1T/s wired networking (JESD204B)
- Wireless infrastructure,
- Image processing
- DSP-intensive applications



FPGA Families ranging from 400k to 4.4M logic cells

- Kintex: XCKU040/60/75/100/114
- Virtex: KCVU65/80/95/125/160/190/440

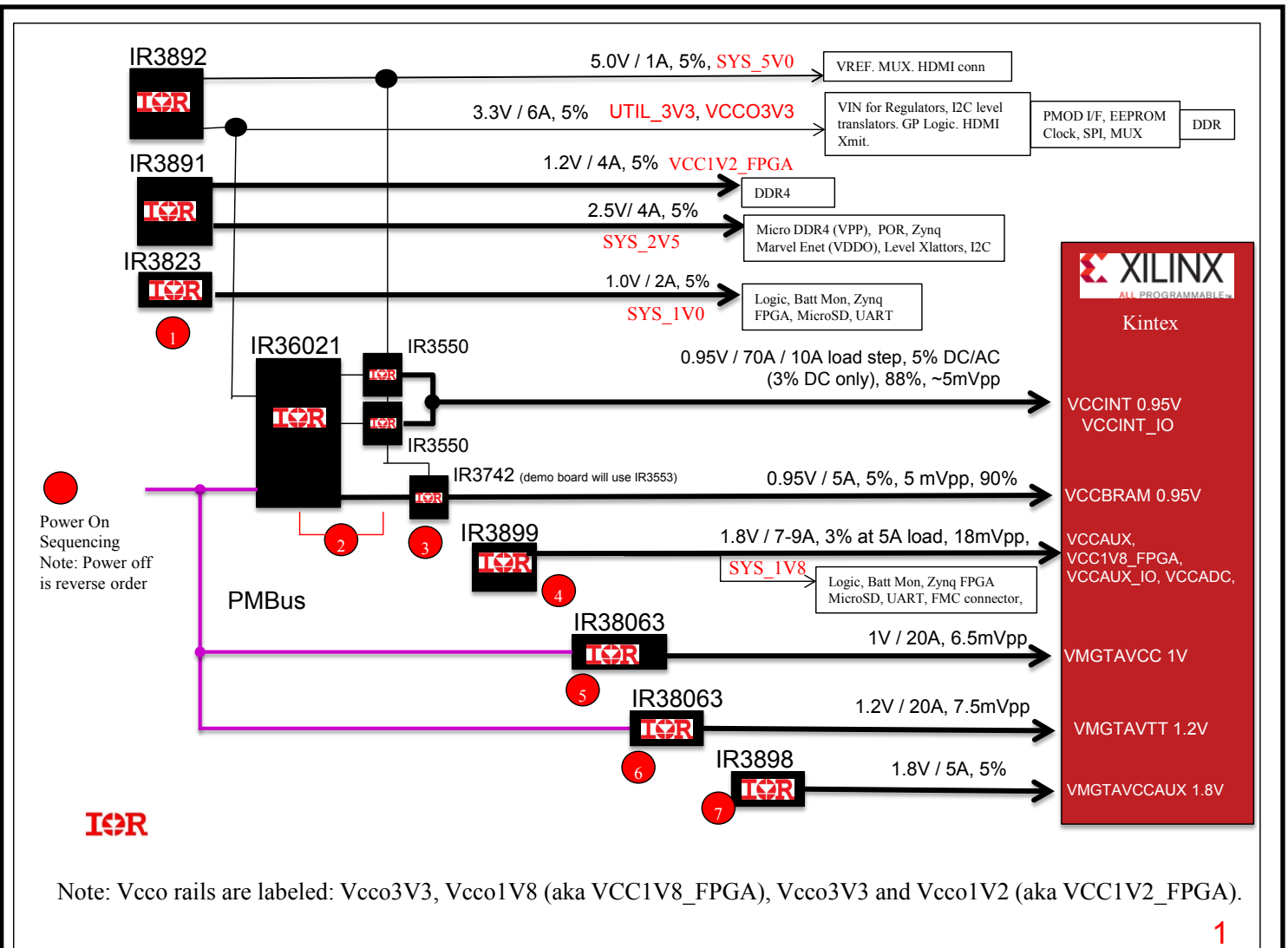


Figure 1: Ultra Scale Kintex - Power Diagram

IR Power Solution: Xilinx Ultra Scale Kintex & Virtex FPGAs

Figure 1 shows the Power Diagram Map for the IR solution for Kintex Ultra Scale devices while Figure 2 shows the Virtex Ultra Scale solution. Both of these solutions are equivalent to power rails for the Xilinx KCU105 reference design.

The only difference between the Kintex vs. Virtex Ultra Scale FPGAs is that the Virtex FPGA requires two additional rails for the ultrafast SERDES interface (see bottom rails of Figure 2), called the VMGTY voltage supply rails.

Both of the solutions use IR's Multi-phase Digital Controllers & PowIRStage devices for the FPGA core voltages: VCCINT, VCCBRAM. The other voltages of the FPGA include the VCCO, VCCAUX and VCCADC rails which are supplied by IR's POL Regulators.

Of the POL regulators the most critical rails that require low noise design are the SERDES rails which require DC & AC errors less than $\pm 2\%$ and ripple less than 10mV. Table 1 highlights the critical rail specs for the FPGA and summary of IR solutions selected.

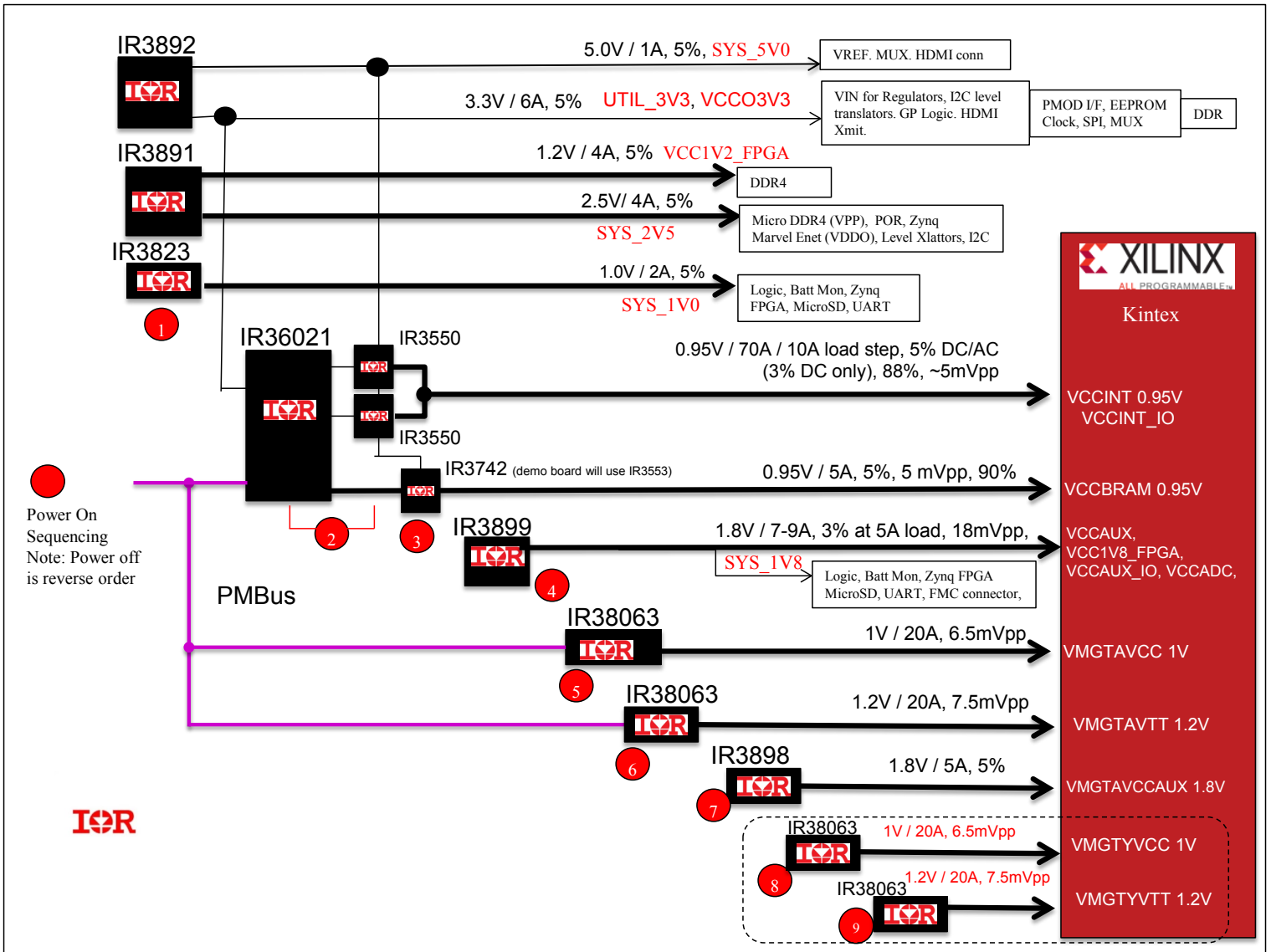


Figure 2: Ultra Scale Virtex - Power Diagram

IR Power Solution: Xilinx Ultra Scale Kintex & Virtex FPGAs

Xilinx Power Supply Requirements

The **5 Critical Rails for Xilinx Ultra Scale** devices are shown in Table 1. The key specs for each rail is shown and best fit solution provided by IR with highlighted benefits.

Criteria for IR devices selected:

- 1) Compact Design – Use of multi-output device for core and memory rails, less externals
- 2) Low Noise - Low ripple achieved with low jitter modulator (patented)
- 3) Scalability / Flexibility – Use separate power stages for core voltages to best partition vs. cost

Design options: For the Ultra Scale Kintex and Virtex solutions the current load on VCCINT can vary from ~30A to 60A as the FPGA ranges from 400k to 4.4M logic cells! The appropriate IR Pow-IRStage (IR3550 to IR3742) for the VCCINT can be chosen to match. All other rails can vary similarly see Table 3 for IR options.

Click [DESIGN OPTIONS](#).

IR Power Solution - Highlights

Performance. Table 2 highlights the performance results of the IR devices selected to meet the Xilinx requirements. **IR devices meet and exceed the requirements by Xilinx.**

Additional testing validated the potential cost and board space savings by removing external capacitors compared to the current KCU105 reference design.

IR Advanced Power with Xilinx Ultra Scale

Xilinx now offers on-chip and off-chip monitoring via the System Monitor (SYSMON) feature to support intelligent system and power management. The SYSMON interfaces to IR's digital devices (IR36021, IR3806x) via PMBus (Figure 3):

- Voltage control (VID) in 5mV steps (+/- 0.5%)
- Thermal & Over-Current protection

This allows advanced power management techniques on these recommended rails: VCCINT, VCCBRAM, VMGTxVCC, VMGTxVTT.

Supply	Rail Spec	IRF Solution	IRF Highlighted Benefits
Vccint	0.95V @ 70A DC & AC errors < ± 3%, load step 5A	Comanche IR36021 • 2x IR3550 60A PS • 1x IR3553 40A PS or 1x IR3742 20A PS	<ul style="list-style-type: none"> • VID tuning to optimize core voltage for FPGA • Ease of Design: Scalable vs. Use Case • Efficiency & space
Vccbram	0.95V @ 5A		
Vmgtavcc	1.0V @ 20A DC & AC errors < ± 2%, Ripple, 5mV to 10mV	Manhattan IR38063	<ul style="list-style-type: none"> • Low jitter/ripple, High Accuracy • Digital Telemetry with I2C/PMBus • Scalable from 6A to 35A
Vmgtavtt	1.2V @ 20A	Manhattan IR38063	
Vmgtaccaux	1.8V @ 5A DC & AC errors < ± 3%, load step 5A,	SupIRBuck IR3898	<ul style="list-style-type: none"> • Low jitter/ripple, High Accuracy

Table 1: Xilinx Critical Rails Requirements and IR Power

Supply	Voltage & Current	Efficiency	Ripple	Capacitor Count
Vccint	0.95V @ 70A 10A load step	~88%	~ 5mVpp	4 @ 100uF + 12 @ 22uF
Vccbram	0.95V @ 5A	90%	~5 mVpp	2 @ 100uF + 8 @ 22uF
Vmgtavcc	1V @ 20A	86%	6.4mVpp	6 @ 100uF
Vmgtavtt	1.2V @ 20A	86%	7.5mVpp	6 @ 100uF

Table 2: Performance Summary of IR Power Solution

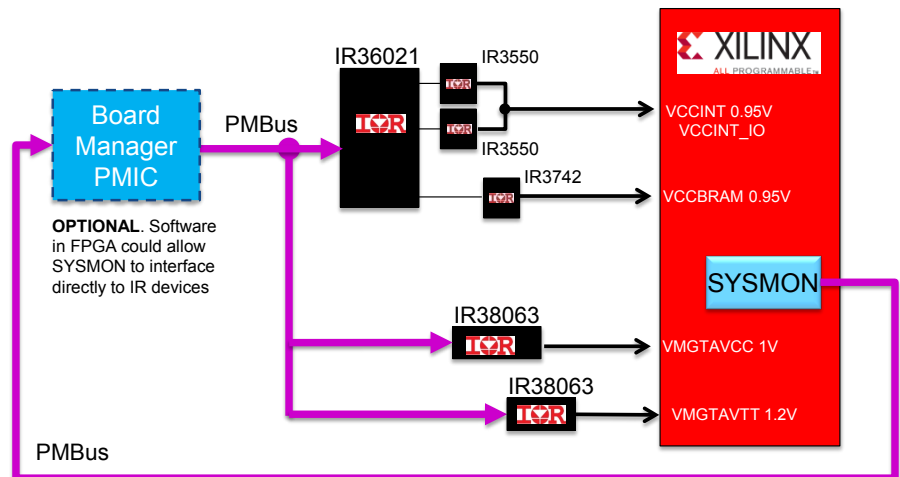


Figure 3: Advanced Power Options with SYSMON

IR Power Solution: Xilinx Ultra Scale Kintex & Virtex FPGAs

DESIGN OPTIONS

Finding the Right IR device for the Xilinx FPGA

Table 3 shows Design Options for IR Power devices by power rail. The devices are selected for Ultra Scale Kintex to Virtex FPGAs (20nm) by using Xilinx' XPE calculator.

Supply	1-5A	5-10A	10-25A	25-45A	45-80A
Vccint 0.85V – 0.97V	IR38060*	IR38062*	IR38063*	IR36021* Dual Controller + IR3553 x2 Vccint IR3742 x1 Vccbram	IR36021* Dual Controller + IR3550 x2 Vccint IR3742 x1 Vccbram
Vccbram 0.85V – 0.97V	IR38060*	IR38062*	IR38063*		
Vccaux 1.8V	IR3898	IR3899	N/A	N/A	
Vcco 1.8V	IR3898	IR3899			
Vmgtavcc 1.00V	IR38060*	IR38062*	IR38063*		
Vmgtvccaux 1.8V	IR3898	IR3899	IR3847		
Vmgtavtt 1.2V	IR38060*	IR38062*	IR38063*		

* PMBus enabled

Table 3: Operating Power Ranges for Xilinx Product Portfolio and Associated IR Solutions

MORE INFORMATION: mypower.irf.com/xilinx

Tony Ochoa tochoa1@irf.com