

PR449
Virtex™-4 Design 5

TPS51020 Dual DC/DC Controller-based Power Management Solution from $V_{IN} = 12\text{ V}$

FEATURES:

- Powers one or more FPGAs
- Can be modified to provide currents up to 20 A per rail
- High efficiency minimizes heat
- Flexible dual controller (TPS51020) design allows optimization for input voltage (4.5V to 28V), output power, size, power dissipation and/or cost
- The controller can be configured to provide DDR termination

IMPORTANT WEB LINKS:

- Link to the TI home page for Xilinx FPGA power management solutions at <http://www.ti.com/xilinuxfpga> for more information and other reference designs.
- Link to the datasheets at <http://focus.ti.com/lit/ds/symlink/TPS51020.pdf>
- Link to 40K design software tool at <http://focus.ti.com/docs/toolsw/folders/print/tps40k-sw.html> to assist further optimization/customization of design.

IMPLEMENTATION NOTES:

- **Sequencing:** Per Xilinx DS302 v1.3, Virtex-4 power rails can be turned on in any sequence, though V_{CCAUX} must power on before or with V_{CCO} for the minimum power-on current specifications shown in the Xilinx datasheet to apply. For this reason and to reduce the risk that large currents for charging bulk capacitance forces the point of load converter into current limit and/or pulls down the input supply at power up, the following recommended design techniques were used:
 - o Integrated soft-start configured with a capacitor to provide up to 5 ms monotonic rise time for V_{CCINT} , V_{CCAUX} and V_{CCO}
 - o Sequencing V_{CCINT} , V_{CCAUX} then V_{CCO} using the TPS3808 SVS and the PWRGD and ENABLE of the TPS51020
- **Additional Capacitance:** The TPS51020 controllers used for the V_{CCINT} , V_{CCAUX} and V_{CCO} rails have been compensated and soft-started to allow for a certain amount of additional bulk capacitance on the output rail, as specified below.

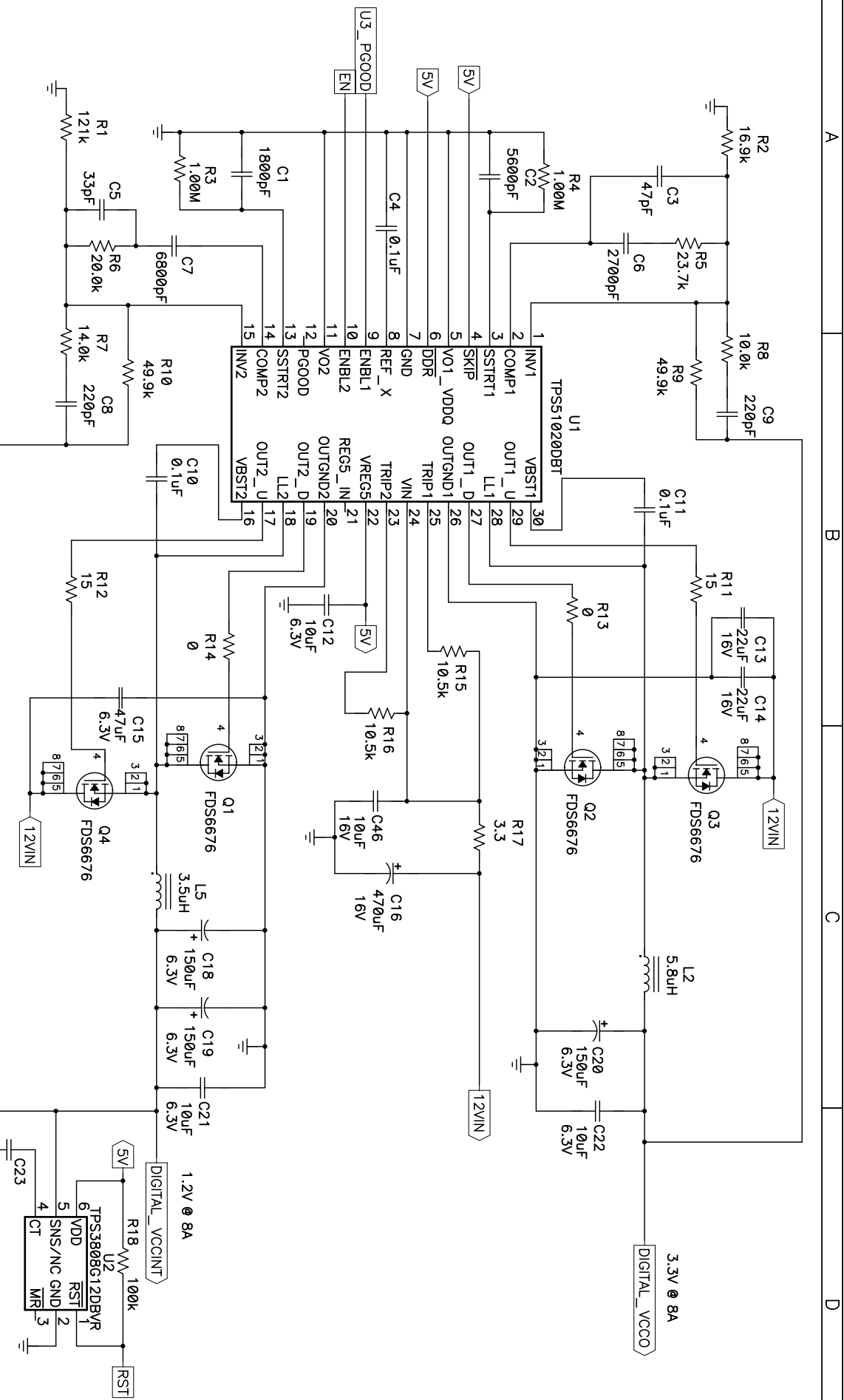
Capacitor (uF)	V_{CCO} QTY	V_{CCAUX} QTY	V_{CCINT} QTY
0.047	51	14	38
0.22	39	7	19
0.68	15	4	10
2.2	15	3	7
330 (0.15 Ω ESR)	15	1	3

If the amount of bulk capacitance increases, the TPS51020 control loop may need to be re-compensated and/or the soft-start timing may need to change. The 40K design software can help with these design changes.

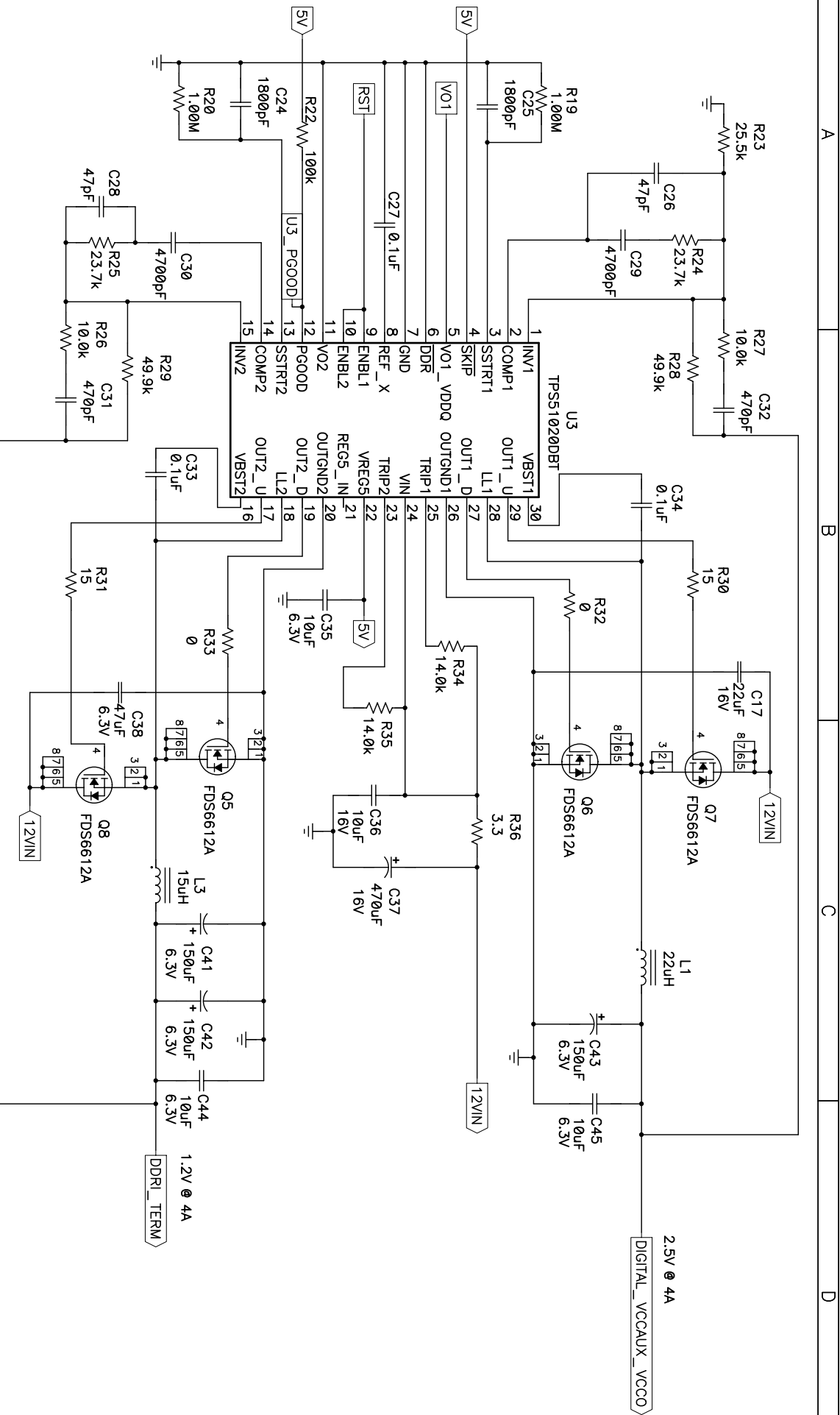
- **V_{CCAUX}** : V_{CCAUX} powers time-critical resources in the FPGA, including the Digital Clock Managers (DCMs). Therefore, this supply voltage is especially susceptible to power supply noise. V_{CCAUX} can share a power plane with V_{CCO}, but only if V_{CCO} does not have excessive noise. Changes in V_{CCAUX} voltage should take place no faster than 10 mV/ms
- **Modifications:** For input voltages other than 12V or higher output currents, use the 40K design software to make design modifications. For 5V input, see Virtex-4 Design 4 (PR448).

QUESTIONS?

- Send an email to <mailto:fpgasupport@list.ti.com>



Title		VrteX-4 51020 based for Vin=12V	
Size	Number		Rev
B	PR449		
Date	02/21/05	Drawn by	
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A

B

C

D

1

1

2

2

3

3

4

4

A

B

C

D

Additional Caps

VALUE	DIGITAL_VCC0 QTY	DIGITAL_VCCAU0 QTY	DIGITAL_VCCINT QTY
0.047 uF	51	14	38
0.22 uF	39	7	19
0.68 uF	15	4	10
2.2 uF	15	3	7
330 uF	15	1	3

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Filename: PR449_bom.xls					
Date: 02/22/2005					
PR449 BOM					
COUNT	RefDes	Description	Size	Part Number	MFR
3	C1, C24, C25	Capacitor, Ceramic, 1800pF, 25V, X5R	0805	Std	Std
6	C12, C21, C22, C35, C44, C45	Capacitor, Ceramic, 10uF, 6.3V, X5R, 10%	0805	C2012X5R0J106K	TDK
3	C13, C14, C17	Capacitor, Ceramic, 22uF, 16V, X5R, 10%	1210	C3225X5R1C226K	TDK
2	C15, C38	Capacitor, Ceramic, 47uF, 6.3V, X5R, 10%	1210	C3225X5R0J476K	TDK
2	C16, C37	Capacitor, Aluminum, SM, 470uF, 16V	8x10.2mm	EEVFK1C471P	Panasonic
6	C18, C19, C20, C41, C42, C43	Capacitor, Aluminum, 150uF, 6.3V, 12 milliohms, 20%	7343	EEF-UE0J151R	Panasonic
1	C2	Capacitor, Ceramic, 1800pF, 25V, X5R	0805	Std	Std
1	C23	Capacitor, Ceramic, 100pF, 25V, X5R	0805	Std	Std
2	C29, C30	Capacitor, Ceramic, 4700pF, 25V, X5R	0805	Std	Std
3	C3, C26, C28	Capacitor, Ceramic, 47pF, 50V, C0G	0805	Std	Std
1	C31	Capacitor, Ceramic, 470pF, 25V, X5R	0805	Std	Std
1	C32	Capacitor, Ceramic, 470pF, 25V, C0G	0805	Std	Std
2	C36, C46	Capacitor, Ceramic, 10uF, 16V, X5R, 10%	1206	C3216X5R1C106K	TDK
6	C4, C10, C11, C27, C33, C34	Capacitor, Ceramic, 0.1uF, 16V, X5R	0805	Std	Std
1	C5	Capacitor, Ceramic, 33pF, 50V, C0G	0805	Std	Std
1	C6	Capacitor, Ceramic, 2700pF, 25V, X5R	0805	Std	Std
1	C7	Capacitor, Ceramic, 6800pF, 25V, X5R	0805	Std	Std
1	C8	Capacitor, Ceramic, 220pF, 25V, X5R	0805	Std	Std
1	C9	Capacitor, Ceramic, 220pF, 25V, C0G	0805	Std	Std
1	L1	Inductor, SMT, 22uH, 2.8A, 32milliohms	12.9x12.9mm	CDRH125-220	Sumida
1	L2	Inductor, SMT, 5.8uH, 8.6A, 16.2milliohms	12.9x12.9mm	CDRH127LD-5R8	Sumida
1	L3	Inductor, SMT, 15uH, 3.3A, 30milliohms	12.9x12.9mm	CDRH125-150	Sumida
1	L5	Inductor, SMT, 3.5uH, 9.5A, 12milliohms	12.9x12.9mm	CDRH127/LD-3R5	Sumida
4	Q1 - Q4	Transistor, MOSFET, N-Chan, 30V, 8.4A, Rds 22 milliOhm	SO8	FDS6676	Fairchild
4	Q5 - Q8	Transistor, MOSFET, N-Chan, 30V, 8.4A, Rds 22 milliOhm	SO8	FDS6612A	Fairchild
1	R1	Resistor, Chip, 121k Ohms, 1/10W, 1%	0805	Std	Std
4	R11, R12, R30, R31	Resistor, Chip, 15 Ohms, 1/10W, 1%	0805	Std	Std
4	R13, R14, R32, R33	Resistor, Chip, 0 Ohms, 1/10W, 1%	0805	Std	Std
2	R15, R16	Resistor, Chip, 10.5k Ohms, 1/10W, 1%	0805	Std	Std
2	R17, R36	Resistor, Chip, 3.3 Ohms, 1/10W, 1%	0805	Std	Std
2	R18, R22	Resistor, Chip, 100k Ohms, 1/10W, 1%	0805	Std	Std
1	R2	Resistor, Chip, 16.9k Ohms, 1/10W, 1%	0805	Std	Std
1	R23	Resistor, Chip, 25.5k Ohms, 1/10W, 1%	0805	Std	Std
4	R3, R4, R19, R20	Resistor, Chip, 1.00M Ohms, 1/10W, 1%	0805	Std	Std
3	R5, R24, R25	Resistor, Chip, 23.7k Ohms, 1/10W, 1%	0805	Std	Std
1	R6	Resistor, Chip, 20.0k Ohms, 1/10W, 1%	0805	Std	Std
3	R7, R34, R35	Resistor, Chip, 14.0k Ohms, 1/10W, 1%	0805	Std	Std
3	R8, R26, R27	Resistor, Chip, 10.0k Ohms, 1/10W, 1%	0805	Std	Std
4	R9, R10, R28, R29	Resistor, Chip, 49.9k Ohms, 1/10W, 1%	0805	Std	Std
2	U1, U3	IC, Dual Sync Step-Down Controller	TSSOP30	TPS51020DBT	TI
1	U2	IC, Low Quiescent Current Programmable, 1.2-V, Delay Time 1ms to10s	SOT23-6	TPS3808G12DBVR	TI

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