PR433
Virtex™-4 Design 3
SWIFT™ (TPS54350 series) DC/DC Converter-based Power Management Solution
Providing up to 3A for V_{IN} = 12V

FEATURES:

- High efficiency converters minimize heat
- Modifiable for input voltages between 4.5V and 20V
- Use of the TPS54350 adjustable devices allow
  - use of smallest inductor and/or specific type of output capacitor
  - flexibility to re-compensate as needed, depending on the bypass/decoupling capacitors used with the FPGA
- Additional V_{CCO} rails easily added and sequenced (if desired) using the TPS54350 PWRGD and ENABLE.

IMPORTANT WEB LINKS:

- Link to the TI home page for Xilinx FPGA power management solutions at http://www.ti.com/xilinxfpga for more information and other reference designs.
- Link to datasheets at http://focus.ti.com/lit/ds/symlink/TPS54350.pdf
- Link to SWIFT™ design software tool at http://focus.ti.com/docs/toolsw/folders/print/swift-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:
  - Integrated soft-start configured with a capacitor to provide up to 5 ms monotonic rise time for V_{CCINT}, V_{CCAUX} and V_{CCO}
  - Sequencing V_{CCINT}, V_{CCAUX} then V_{CCO} using PWRGD and ENABLE
- **Bulk Capacitance:** The TPS54350 converters 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.

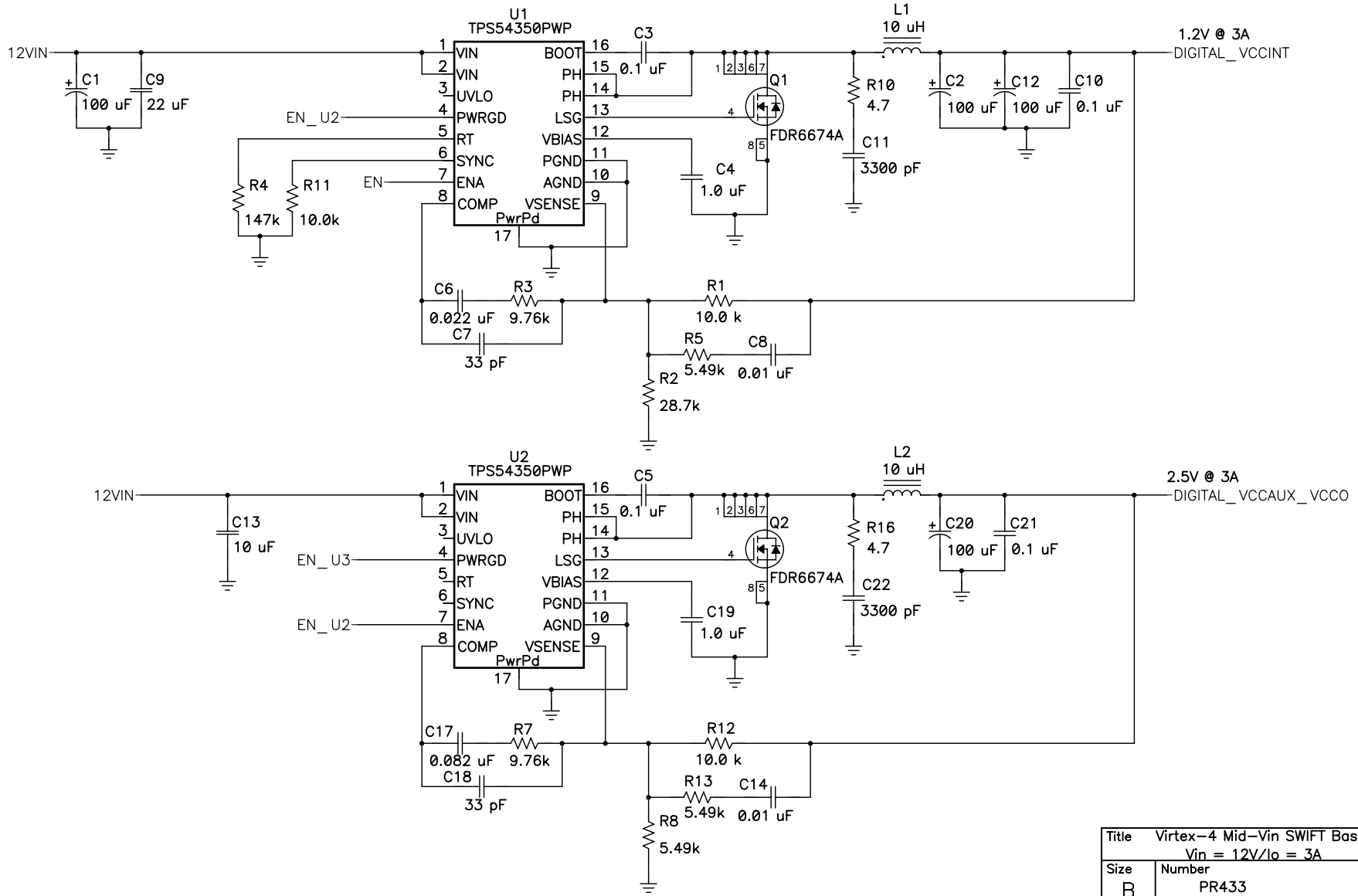
Capacitor (uF)	V_{CCO} QTY	V_{CCAUX} QTY	V_{CCINT} QTY
0.047	51	14	38
0.22	39	7	19
0.68	15	4	10
2.2	15	3	7
330 (0.15 Ω ESR)	15	1	3

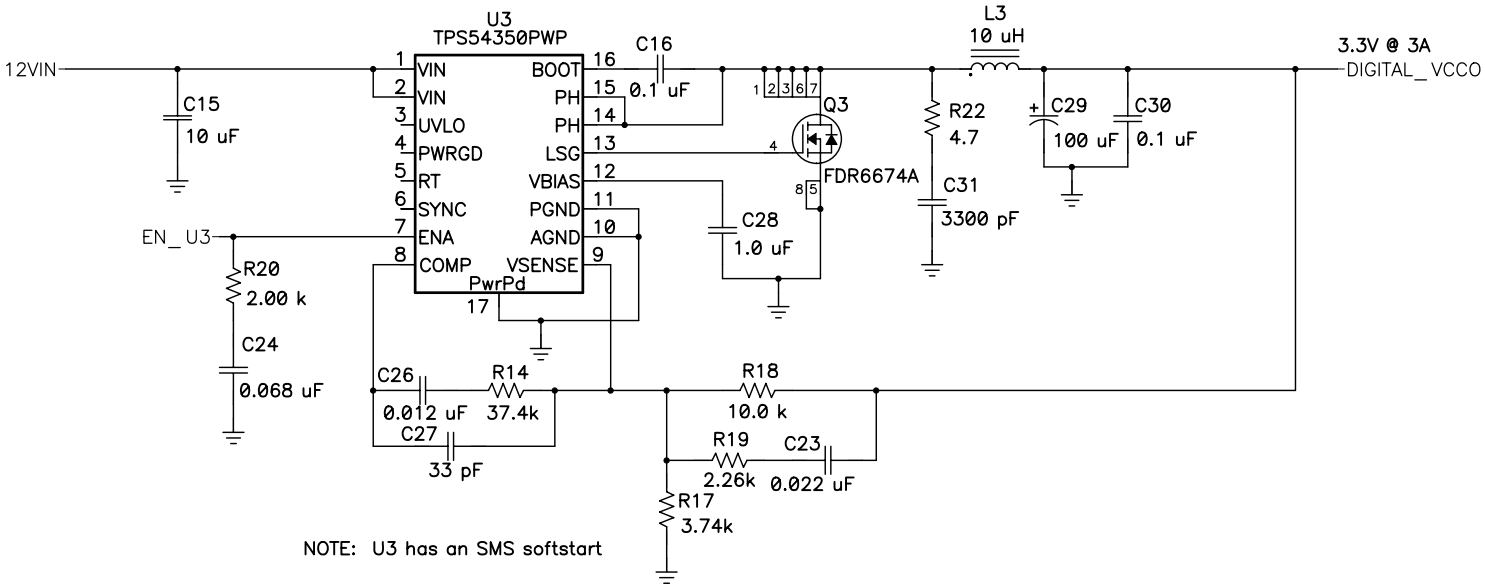
If the amount of bulk capacitance increases, the TPS54350 control loop may need to be re-compensated and/or the soft-start timing may need to change. The SWIFT design software can help with these design changes.

- **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, use the SWIFT design software to make design modifications.

QUESTIONS?

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


U1
TPS54350PWP
12VIN
C1
100 uF
C9
22 uF
C3
0.1 uF
L1
10 uH
1.2V @ 3A
DIGITAL_VCCINT
Q1
FDR6674A
R10
4.7
C11
3300 pF
C2
100 uF
C12
100 uF
C10
0.1 uF
EN_U2
EN
R4
147k
R11
10.0k
C4
1.0 uF
C6
0.022 uF
R3
9.76k
C7
33 pF
R1
10.0 k
R5
5.49k
C8
0.01 uF
R2
28.7k
VIN
BOOT
PH
UVLO
PWRGD
LSG
RT
VBIAS
SYNC
PGND
ENA
AGND
COMP
VSENSE
PwrPd
U2
TPS54350PWP
12VIN
C13
10 uF
C5
0.1 uF
L2
10 uH
2.5V @ 3A
DIGITAL_VCCAUX_VCCO
Q2
FDR6674A
R16
4.7
C22
3300 pF
C20
100 uF
C21
0.1 uF
EN_U3
EN_U2
C19
1.0 uF
C17
0.082 uF
R7
9.76k
C18
33 pF
R12
10.0 k
R13
5.49k
C14
0.01 uF
R8
5.49k
Title
Virtex-4 Mid-Vin SWIFT Based
Vin = 12V/Io = 3A
Size
B
Number
PR433
Rev
Date
2/21/05
Drawn by
Filename
pr433.sch
Sheet 1 of 2



Additional Caps

VALUE	DIGITAL_VCCO QTY	DIGITAL_VCCAUX 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

Title	Virtex-4 Mid-Vin SWIFT Based Vin = 12V/Io = 3A	
Size: B	Number: PR433e-2	Rev:
Date: 6/26/05		Drawn by:
Filename: pr433e-2.sch		Sheet 2 of 2

Filename: PR433e-2_bom.xls

Date: 06/26/2005

PR433e-2 BOM

COUNT	RefDes	Description	Size	Part Number	MFR
2	C1, C12	Capacitor, POSCAP, 100-uF, 6.3-V, 45-milliohm, 20%	7343(D)	6TPC100M	Sanyo
3	C10, C21, C30	Capacitor, Ceramic, 0.1 uF, 16-V, X7R, 10%	0603	C1608X7R1C104K	Std
3	C11, C22, C31	Capacitor, Ceramic, 3300-pF, 50-V, X7R, 10%	0603	C1608X7R1H332K	TDK
2	C13, C15	Capacitor, Ceramic, 10-uF, 25-V, X7R, 10%	1210	C3225X7R1E106K	TDK
1	C17	Capacitor, Ceramic, 0.022-uF, 50-V, X7R, 10%	0603	GRM188R71H223KA01	muRata
3	C2, C20, C29	Capacitor, POSCAP, 100-uF, 6.3-V, 45-milliohm, 20%	7343 (D)	6TPC100M	Sanyo
1	C23	Capacitor, Ceramic, 0.022-uF, 25-V, X7R, 10%	0603	GRM188R71E223KA01	muRata
1	C24	Capacitor, Ceramic, 0.068-uF, 50-V, X7R, 10%	0603	C1608X7R1H682K	TDK
1	C26	Capacitor, Ceramic, 0.012-uF, 50-V, X7R, 10%	0603	GRM188R71H123KA01	muRata
3	C3, C5, C16	Capacitor, Ceramic, 0.1-uF, 16-V, X7R, 10%	0603	C1608X7R1C104K	TDK
3	C4, C19, C28	Capacitor, Ceramic, 1.0-uF, 16-V, X7R, 10%	1206	C3216X7R1C105K	TDK
1	C6	Capacitor, Ceramic, 0.022-uF, 50-V, X7R, 10%	0603	GRM188R71H223KA01	muRata
3	C7, C18, C27	Capacitor, Ceramic, 33-pF, 50-V, C0G, 5%	0603	GRM1885C1H330JZ01	muRata
2	C8, C14	Capacitor, Ceramic, 0.01-uF, 50-V, X7R, 10%	0603	GRM188R71H103KA01	muRata
1	C9	Capacitor, Ceramic, 22-uF, 16-V, X5R, 10%	1210	C3225X5R1C226K	TDK
3	L1, L2, L3	Inductor, SMT, 10-uH, 8-A, 20-milliohm	0.51 x 0.51	IHLP-5050CZ	Vishay
3	Q1, Q2, Q3	Transistor, MOSFET, Nch, 11.5A, 30V 9.5 millohm	0.160 x 0.130	FDR6674A	Fairchild
3	R1, R12, R18	Resistor, Chip, 10.0k-Ohms, 1/16-W, 1%	0603	Std	Std
3	R10, R16, R22	Resistor, Chip, 4.7-Ohms, ½ W, 5%	2010	Std	Std
1	R11	Resistor, Chip, 10.0k-Ohms, 1/16-W, 1%	0603	Std	Std
1	R14	Resistor, Chip, 37.4k-Ohms, 1/16-W, 1%	0603	Std	Std
1	R17	Resistor, Chip, 3.74k-Ohms, 1/16-W, 1%	0603	Std	Std
1	R19	Resistor, Chip, 2.26k-Ohms, 1/16-W, 1%	0603	Std	Std
1	R2	Resistor, Chip, 28.7k-Ohms, 1/16-W, 1%	0603	Std	Std
1	R20	Resistor, Chip, 2.00k-Ohms, 1/16-W, 1%	0603	Std	Std
2	R3, R7	Resistor, Chip, 9.76k Ohms, 1/16-W, 1%	0603	Std	Std
1	R4	Resistor, Chip, 147k-Ohms, 1/16-W, 1%	0603	Std	Std
3	R5, R8, R13	Resistor, Chip, 5.49k-Ohms, 1/16-W, 1%	0603	Std	Std
3	U1, U2, U3	IC, 3-A Output Synchronous PWM Switcher	PWP16	TPS54350PWP	TI

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