PR220
Virtex-II Pro™ Design 2
SWIFT^{TM} (TPS54xxx series) DC/DC Converter-based Power Management Solution
Providing I_{CCINT}=6A from V_{IN}=5V

FEATURES:

- High efficiency minimizes heat
- Interchange SWIFT^{TM} device to support 1.5 A to 9 A load currents
    o 1.5A and 3A synchronous SWIFT devices are pin-pin compatible
    o 6A, 8A, and 9A synchronous SWIFT devices are pin-pin compatible
- Use of the TPS54x10 adjustable devices allow
    o use of smallest inductor and/or specific type of output capacitor
    o flexibility to re-compensate as needed, depending on the bypass/decoupling capacitors used with the FPGA
- In-rush current (for charging decoupling caps and FPGA start-up) that places a demand on the input power supply is minimized by the use of optional
    o Integrated soft-start configured with an capacitor to provide 10 ms rise time for V_{CCINT} and V_{CCO}
    o Sequencing of V_{CCINT}, V_{CCAUX}, then V_{CCO} using PWRGD and ENABLE
- High UVLO trip point and integrated soft-start of the SWIFT^{TM} devices eliminates the need for an external Supply Voltage Supervisor (SVS) to monitor the input rail.
- RocketIO™ powered by ultra-low noise, high PSRR (for rejecting noise at the input, preventing it from translating to the output) low dropout linear regulators (LDOs), TPS79xxx and TPS786xx. This series has been qualified by Xilinx to replace LT1963.
- Additional V_{CCO} rails easily added and sequenced (if desired) using the TPS54xxx PWRGD and ENABLE.
- The design meets Xilinx's V_{CCINT} and V_{CCO} start-up profile requirements, where applicable, including monotonic voltage ramp, in-rush current and power voltage ramp time requirements.
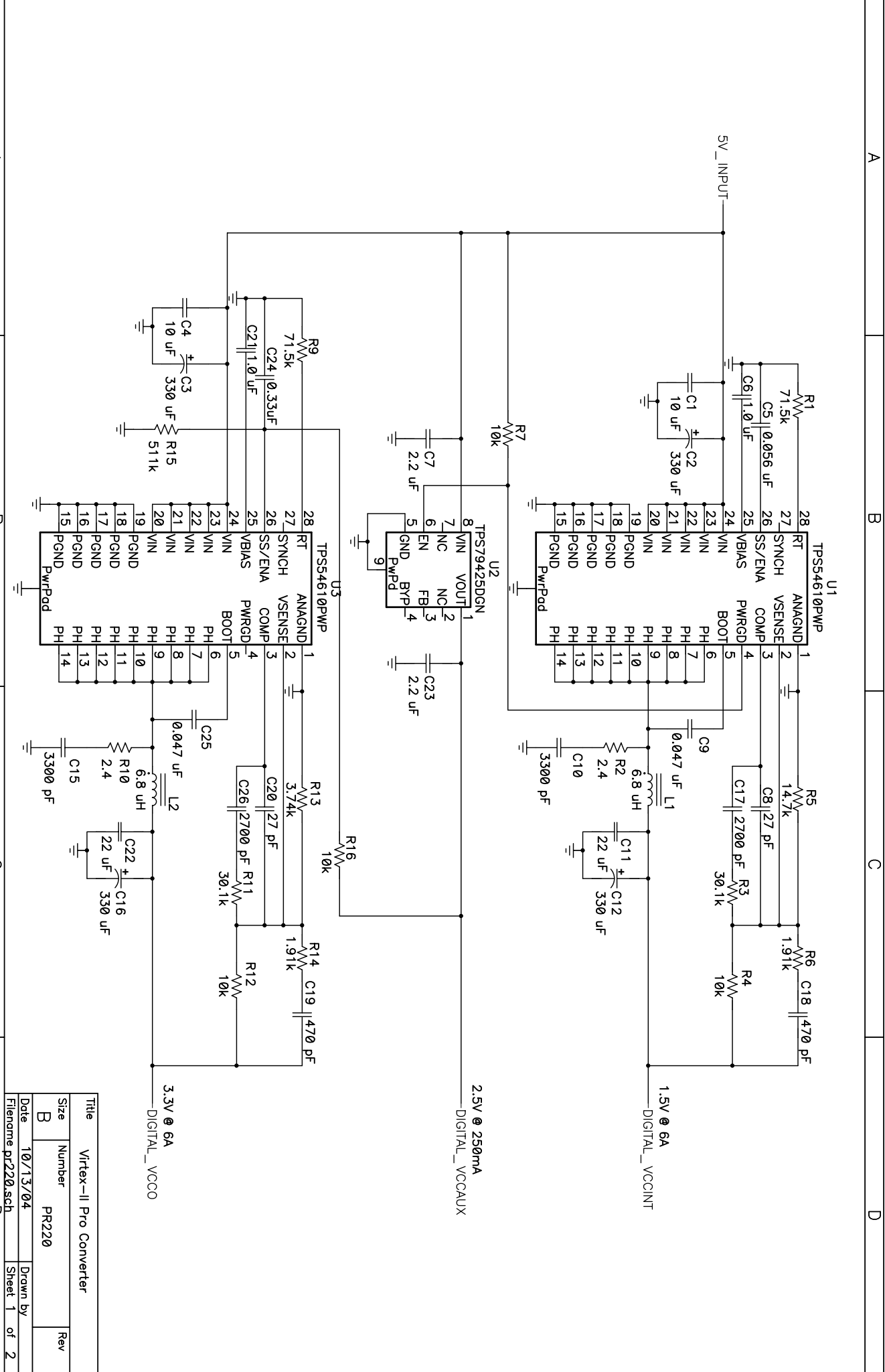
IMPORTANT WEB LINKS:

- 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/TPS54610.pdf and http://focus.ti.com/lit/ds/symlink/tps79425.pdf.
- Link to SWIFT^{TM} design software tool at http://focus.ti.com/docs/toolsw/folders/print/swift-sw.html to assist further optimization/customization of design.
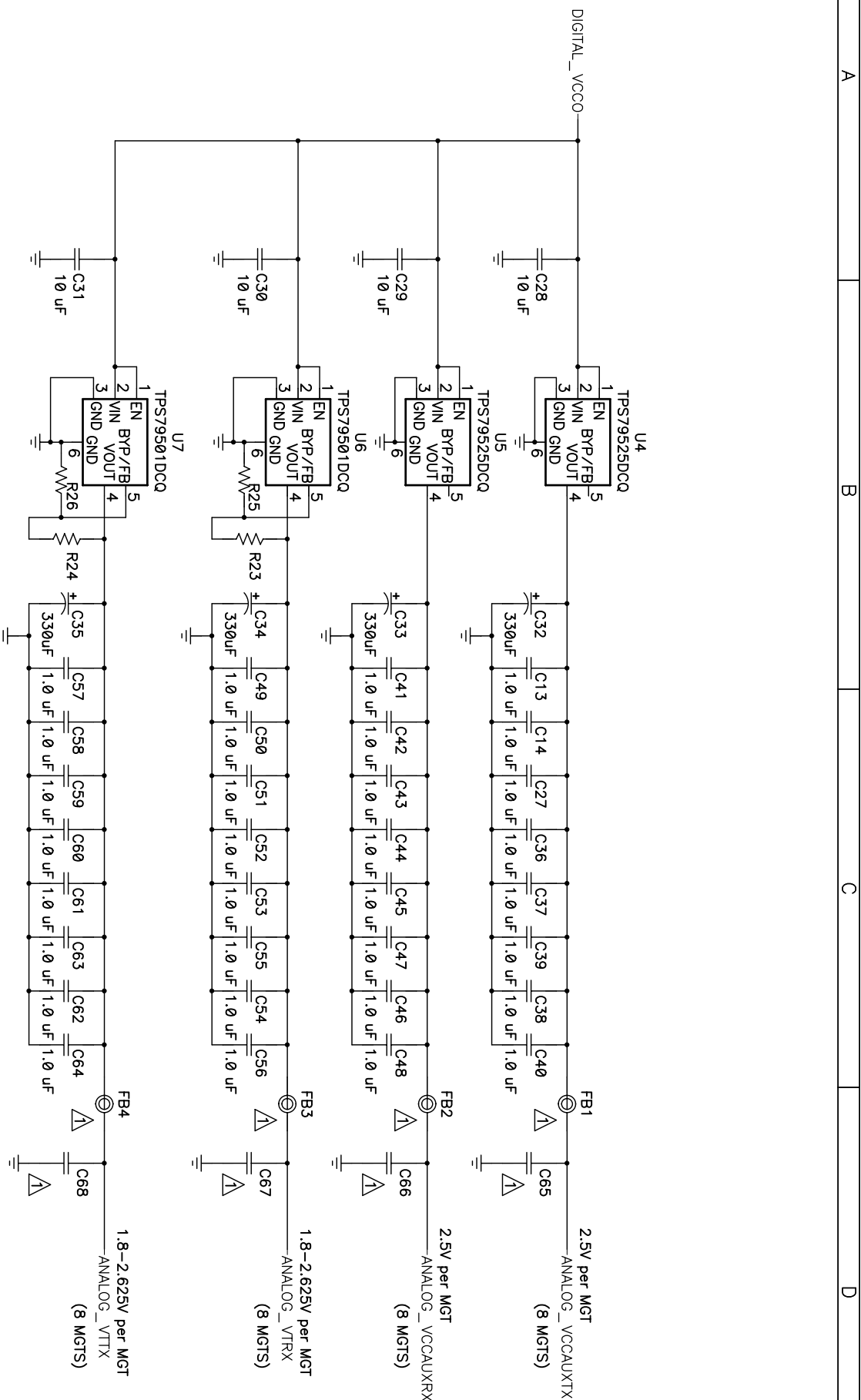
IMPLEMENTATION NOTES:

- **Sequencing:** Although Xilinx FPGAs **do NOT require it**, this reference design employs sequencing. This practice is consistent with good power supply design and prevents the input power supply from being pulled down due to supporting in-rush currents for charging large capacitive loads.
- **Additional Capacitance:**
  - The TPS54610's have been compensated to allow for up to the following additional capacitance on each rail:
    - 12 uF in ceramics in parallel with
    - two 330 uF capacitors, each with ESR between 0.1 and 2 ohms.
    If more bypass capacitance or bulk capacitors with ESR outside the range above is used, each TPS54x10 control loop may need to be re-compensated using the SWIFT design software.
- 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 beyond 200 mV peak-to-peak should take place no faster than 10 mV per milli-second.
- **RocketIO:** When powering the RocketIO:
  - $A_{VCCAUXTX}$, $V_{CCAUXRX}$, A_{VTRX}, and A_{VTTX} may each be powered by their own linear regulator or by the same regulator if their voltages are the same. Keep power dissipation capability of the linear regulator package in mind.
  - Select the appropriate TPS79xxx or TPS786xx based on the load current requirement, and the power dissipation capability of the package. In general, the lower the current rating, the lower the price of the linear regulator. Power dissipation of linear regulators is explained in TI Application Note SLVA118.
  - For the TPS79x01 adjustable devices, size the feedback resistors according to the datasheet. These resistors are not populated on the schematic.
  - All unused RocketIO transceivers must be connected to power (2.5V) and ground.
- **Modifications:**
  - Adapt for $V_{IN} = 3.3$ V by omitting U3.

QUESTIONS?

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

5V_INPUT

U1 TPS54610PWP
U2 TPS79425DGN
U3 TPS54610PWP

U1 TPS54610PWP pins:
28 RT
27 SYNCH
26 SS/ENA
25 VBIAS
24 VIN
23 VIN
22 VIN
21 VIN
20 VIN
19 VIN
18 PGND
17 PGND
16 PGND
15 PGND
PwrPad
1 ANAGND
2 VSENSE
3 COMP
4 PWRGD
5 BOOT
6 PH
7 PH
8 PH
9 PH
10 PH
11 PH
12 PH
13 PH
14 PH

U2 TPS79425DGN pins:
8 VIN
7 NC
6 EN
5 GND
PwrPd
9
1 VOUT
2 NC
3 FB
4 BYP

U3 TPS54610PWP pins:
28 RT
27 SYNCH
26 SS/ENA
25 VBIAS
24 VIN
23 VIN
22 VIN
21 VIN
20 VIN
19 VIN
18 PGND
17 PGND
16 PGND
15 PGND
PwrPad
1 ANAGND
2 VSENSE
3 COMP
4 PWRGD
5 BOOT
6 PH
7 PH
8 PH
9 PH
10 PH
11 PH
12 PH
13 PH
14 PH

Components:
C4 10 uF
C21 1.0 uF
R9 71.5k
C24 0.33uF
C3 330 uF
R15 511k
C1 10 uF
C6 1.0 uF
C5 0.056 uF
R1 71.5k
C2 330 uF
C7 2.2 uF
R7 10k
C23 2.2 uF
C25 0.047 uF
R10 2.4
L2 6.8 uH
C15 3300 pF
C22 22 uF
C16 330 uF
C26 2700 pF
C20 27 pF
R13 3.74k
R11 30.1k
R16 10k
R14 1.91k
R12 10k
C19 470 pF
C9 0.047 uF
R2 2.4
L1 6.8 uH
C10 3300 pF
C11 22 uF
C12 330 uF
C17 2700 pF
C8 27 pF
R5 14.7k
R3 30.1k
R6 1.91k
R4 10k
C18 470 pF

Output rails:
3.3V @ 6A — DIGITAL_VCCO
2.5V @ 250mA — DIGITAL_VCCAUX
1.5V @ 6A — DIGITAL_VCCINT

DIGITAL_VCCO

U4 TPS79525DCQ
1 EN BYP/FB 5
2 VIN VOUT 4
3 GND GND 6

U5 TPS79525DCQ
1 EN BYP/FB 5
2 VIN VOUT 4
3 GND GND 6

U6 TPS79501DCQ
1 EN BYP/FB 5
2 VIN VOUT 4
3 GND GND 6

U7 TPS79501DCQ
1 EN BYP/FB 5
2 VIN VOUT 4
3 GND GND 6

C28 10 uF
C29 10 uF
C30 10 uF
C31 10 uF

R25
R26
R23
R24

C32 + 330uF
C33 + 330uF
C34 + 330uF
C35 + 330uF

C13 1.0 uF
C14 1.0 uF
C27 1.0 uF
C36 1.0 uF
C37 1.0 uF
C39 1.0 uF
C38 1.0 uF
C40 1.0 uF

C41 1.0 uF
C42 1.0 uF
C43 1.0 uF
C44 1.0 uF
C45 1.0 uF
C47 1.0 uF
C46 1.0 uF
C48 1.0 uF

C49 1.0 uF
C50 1.0 uF
C51 1.0 uF
C52 1.0 uF
C53 1.0 uF
C55 1.0 uF
C54 1.0 uF
C56 1.0 uF

C57 1.0 uF
C58 1.0 uF
C59 1.0 uF
C60 1.0 uF
C61 1.0 uF
C63 1.0 uF
C62 1.0 uF
C64 1.0 uF

FB1
2.5V per MGT
ANALOG_VCCAUXTX
(8 MGTS)
C65

FB2
2.5V per MGT
ANALOG_VCCAUXRX
(8 MGTS)
C66

FB3
1.8-2.625V per MGT
ANALOG_VTRX
(8 MGTS)
C67

FB4
1.8-2.625V per MGT
ANALOG_VTTX
(8 MGTS)
C68

Refer to Xilinx's Rocket IO Tranceiver User Guide
(UG024) for component values

Title   Virtex-II Pro Converter
Size B   Number PR220   Rev
Date 10/13/04   Drawn by
Filename pr220.sch   Sheet 2 of 2

Filename: PR220_bom.xls

Date: 04/22/2004

PR220 BOM

COUNT	RefDes	DESCRIPTION	SIZE	MFR	PART NUMBER
2	C1, C4	Capacitor, Ceramic, 10-uF, 6.3-V, X5R, 10%	805	muRata	GRM21BR60J106KE01
2	C10, C15	Capacitor, Ceramic, 3300-pF, 50-V, X7R, 10%	603	muRata	GRM188R71H332KA01
2	C11, C22	Capacitor, Ceramic, 22-uF, 10-V, X5R, 10%	1210	muRata	GRM32ER61A226KA65
2	C17, C26	Capacitor, Ceramic, 2700-pF, 50-V, X7R, 10%	603	muRata	GRM188R71H272KA01D
2	C18, C19	Capacitor, Ceramic, 470-pF, 50-V, X7R, 10%	603	muRata	GRM188R71H471KA01
4	C2, C3, C12, C16	Capacitor, Tantalum, 330-uF, 6.3-V, 600-milliohm, 20%	7343(D)	Vishay	293D337X96R3D2
1	C24	Capacitor, Ceramic, 0.33-uF, 10-V, X5R, 10%	603	muRata	GRM188R61A334KA61
1	C5	Capacitor, Ceramic, 0.056-uF, 16-V, X7R, 10%	603	muRata	GRM188R71C563KC01
2	C6, C21	Capacitor, Ceramic, 1.0-uF, 6.3-V, X5R, 10%	603	muRata	GRM188R60J105KA01
10	C7, C23, C28, C29, C30, C31, C32, C33, C34, C35	Capacitor, Ceramic, 2.2-uF, 6.3-V, X5R, 10%	805	muRata	GRM21BR60J225KC01
2	C8, C20	Capacitor, Ceramic, 27-pF, 50-V, C0G, 5%	603	muRata	GRM1885C1H270JA01D
2	C9, C25	Capacitor, Ceramic, 0.047-uF, 25-V, X7R, 10%	603	muRata	GRM188R71E473KA01
2	L1, L2	Inductor, SMT, 6.8-uH, 18-A, 22-milliohm	0.51 x 0.51	Vishay	IHLP-5050CERZ6R8M01
3	R1, R9, R16	Resistor, Chip, 71.5k-Ohms, 1/16-W, 1%	603	Std	Std
1	R13	Resistor, Chip, 3.74k-Ohms, 1/16-W, 1%	603	Std	Std
1	R15	Resistor, Chip, 511k-Ohms, 1/16-W, 1%	603	Std	Std
2	R2, R10	Resistor, Chip, 2.4-Ohms, 1/8-W, 1%	1206	Std	Std
0	R23, R24, R25, R26	Resistor, Chip, xx-Ohms, 1/16-W, yy%	603	Std	Std
2	R3, R11	Resistor, Chip, 30.1k-Ohms, 1/16-W, 1%	603	Std	Std
3	R4, R7, R12	Resistor, Chip, 10k-Ohms, 1/16-W, 1%	603	Std	Std
1	R5	Resistor, Chip, 14.7k-Ohms, 1/16-W, 1%	603	Std	Std
2	R6, R14	Resistor, Chip, 1.91k-Ohms, 1/16-W, 1%	603	Std	Std
2	U1, U3	IC, IFET Power controller, Adj-V, 6-A	PWP28	TI	TPS54610PWP
1	U2	IC, Utralow-Noise, High PSRR, Fast RF 250 mA, LDO Linear Regulators, 2.5V	MSOP 8	TI	TPS79425DGN
2	U4, U5	IC, LDO Linear Regulator Ultralow-Noise High PSRR Fast RF, 500mA, 2.5V	SOT223-6	TI	TPS79525DCQ
2	U6, U7	IC, Utralow-Noise, High PSRR, Fast RF 250 mA, LDO Linear Regulators, Adj V	SOT223-6	TI	TPS79401DCQ

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