Cyclone™ III FPGA Starter Kit Power Reference Design
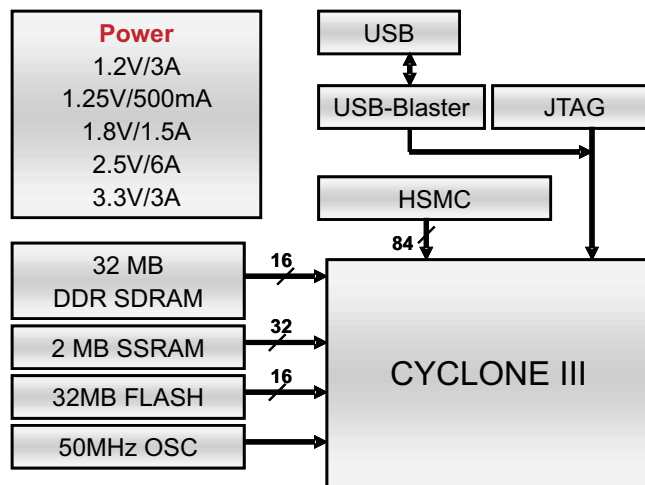
Matthew Borne   *PMP - DC/DC Converters*
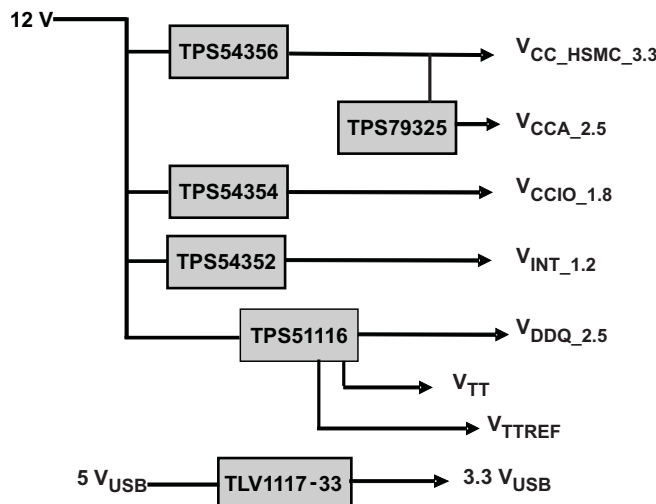
ABSTRACT

This power supply was designed to power the 3C25F324 starter kit. This reference design has many benefits over the existing power supply found on the starter kit demonstration board.

Altera™ Starter Kit Block Diagram
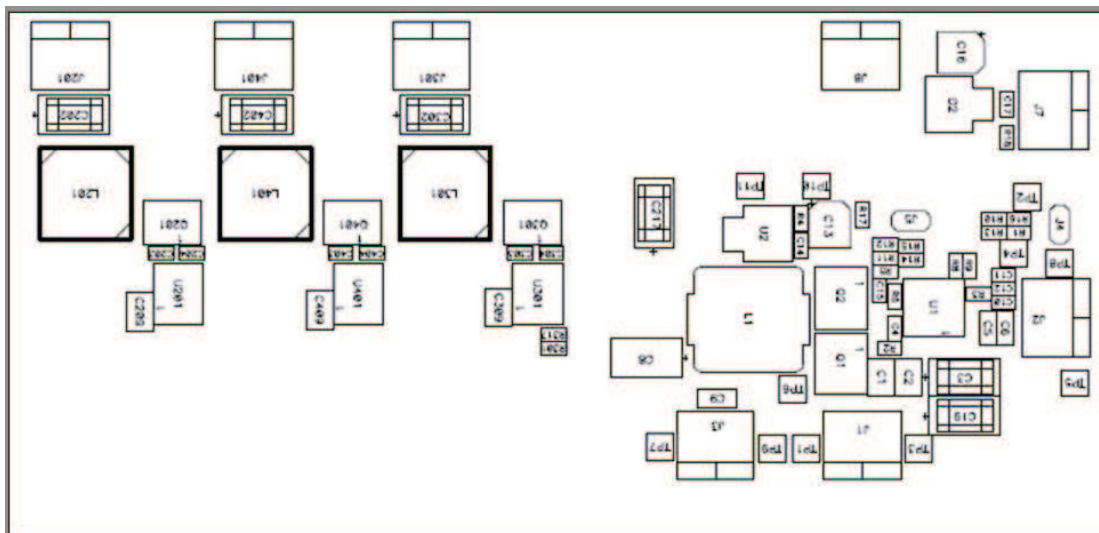

Power Reference Design Details

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POWER RAILS	VOLTAGE	LOAD
Vcc5.0	5 V	DDR bias, USB
Vcc3.3	3.3 V	HSMC, GPIO, Clock, LED, SRAM
Vcc2.5	2.5 V	DDR SRAM, SRAM, FLASH, VCCIO_ALL, VCCA_ALL
Vcc1.8	1.8 V	FLASH
Vcc1.2	1.2 V	VINT ,VCCD_ALL
Vcc1.25	1.25 V	DDR ref

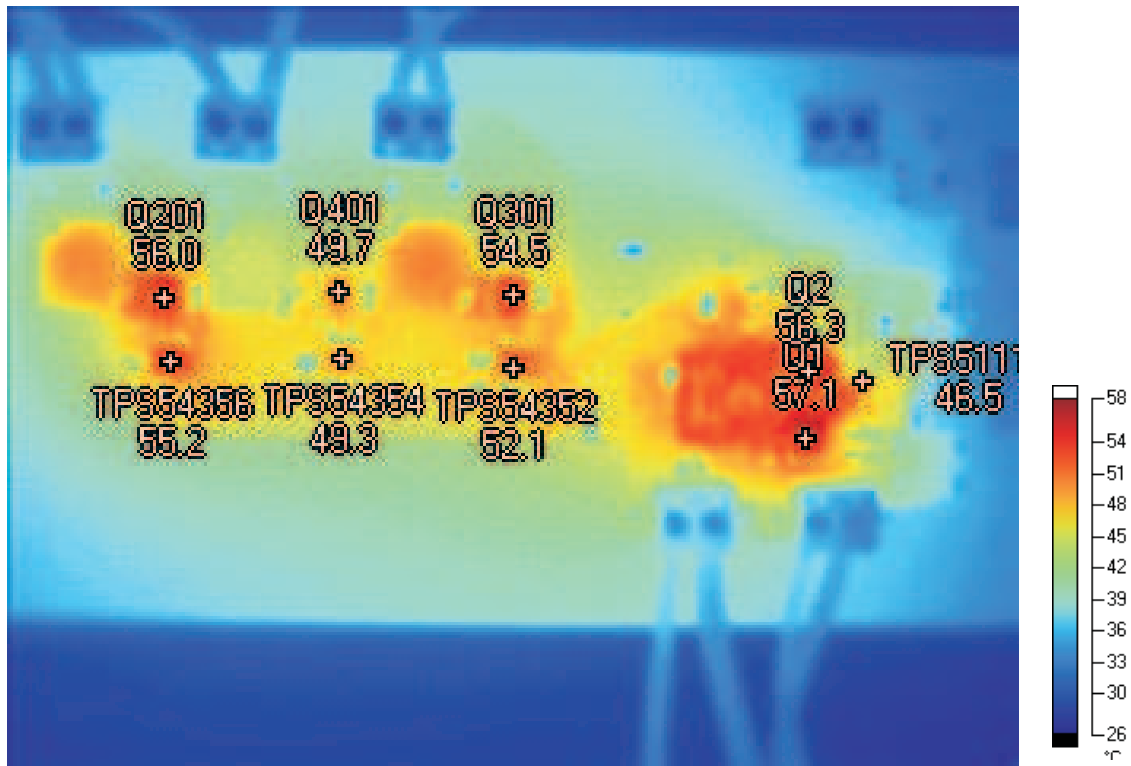## Power Reference Board Top Assembly View

Full load at all buck converters

- U1,   TPS51116,   2.5 V at 6 A
- U201,   TPS54356,   3.3 V at 3 A
- U301,   TPS54352,   1.2 V at 3 A
- U401,   TPS54354,   1.8 V at 1.5 A

Cyclone™ III Thermal Board Image

Markers

LABEL	TEMPERATURE	EMISSIVITY	BACKGROUND	
Q1	57.1°C	0.95	24°C	
Q2	56.3°C	0.95	24°C	
TPS51116	46.5°C	0.95	24°C	2V5
Q301	54.5°C	0.95	24°C	
TPS54352	52.1°C	0.95	24°C	1V2
Q401	49.7°C	0.95	24°C	
TPS54354	49.3°C	0.95	24°C	1V8
Q201	56°C	0.95	24°C	
TPS54356	55.2°C	0.95	24°C	3V3

$\rightarrow$ Hot Spot Q1 w/ 57.1°C, so max. dT = +33.1

TI Design Benefits

- DDR supply with one single controller; TI saves one complete DC/DC converter
- Existing starter kit catch diodes are overloaded
- TI does not use power modules
- TI offers higher efficiency
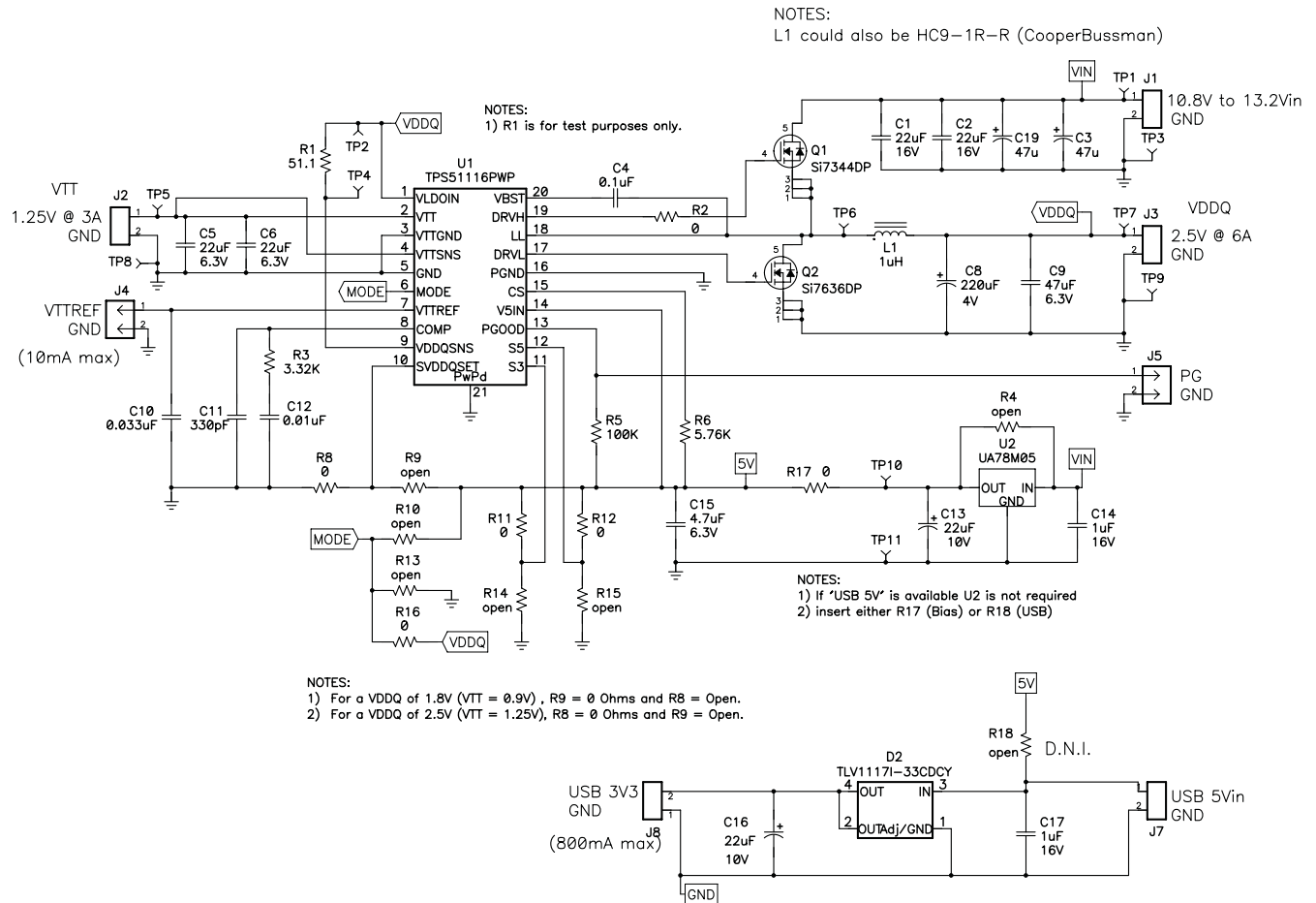- TI offers a low-cost complete discrete solution

Available Material From TI

- Schematic for DDR supply (could be either DDR1 or DDR2)
- Schematic for I/O – core – FPGA voltages
- Bill of Materials – low parts count for total PSU
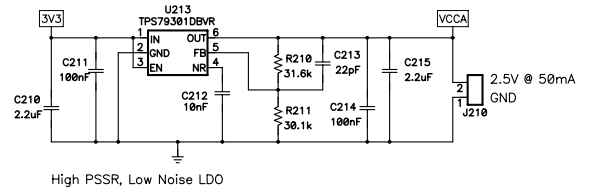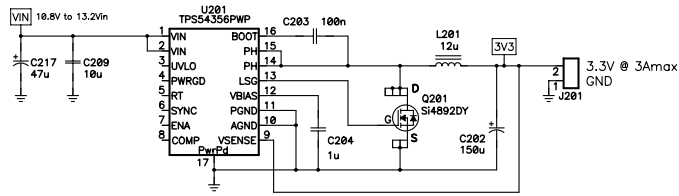- Gerber files
- Test Results

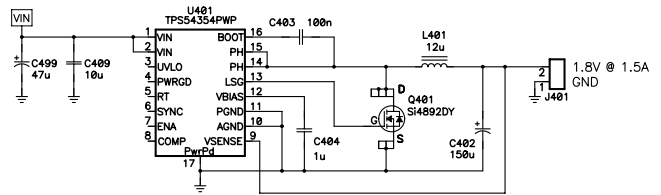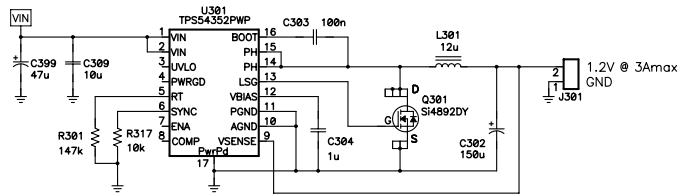## Request Additional Power Support

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Circuit Diagram DDR1, 2V5 and 1V25 (USB 3V3)

Circuit Diagram PoL, 3V3, 2V5, 1V8, 1V2

maximium effcy. w/ TPS54550 at 3Amps out;
use fsw 250kHz at 1V2 and 500kHz at 3V3.

Reference Design Bill of Materials

Count	Part Number	Description	Value	MFR
7	5000	Test Point, Red, Thru Hole Color Keyed	5000	Keystone
4	5001	Test Point, Black, Thru Hole Color Keyed	5001	Keystone
5	Std	POSCAP 16TQC47M	47µ	Sanyo
1	Std	Capacitor, Ceramic, 0.01 µF, 25V, X7R, 10%, 0603	0.01 µF	Std
1	Std	Capacitor, Ceramic, 0.10 µF, 25V, X7R, 10%, 0603	10 nF	Std
1	Std	Capacitor, Ceramic, 22 pF, 25V, X7R, 10%, 0603	22 pF	Std
1	Std	Capacitor, Ceramic, 0.033 µF, 16V, X7R, 10%, 0603	0.033 µF	Std
1	Std	Capacitor, Ceramic, 0.1 µF, 50V, X7R, 10%, 0603	0.1 µF	Std
2	Std	Capacitor, Ceramic, 100 nF, 50V, X7R, 10%, 0603	100 nF	Std
2	Std	Capacitor, Ceramic, 2.2 µF, 50V, X7R, 10%, 0603	2.2 µF	Std
3	Std	Capacitor, Ceramic, 1 µF, 16V	1 µ	Std
1	Std	Capacitor, Ceramic, 330 pF, 50V, NPO, 10%, 0603	330 pF	Std
3	Std	Capacitor, Ceramic, vvV, [temp], [tol]	100 n	Std
1	Std	Resistor, Chip, 147 kΩ, 1/16W, 1%	147 k	Std
6	Std	Resistor, Chip	0	Std
1	Std	Resistor, Chip	30.1 k	Std
1	Std	Resistor, Chip	31.6 k	Std
1	Std	Resistor, Chip	open	Std
1	Std	Resistor, Chip, 100 kΩ, 1%, 0603	100 K	Std
1	Std	Resistor, Chip, 10k, 0603, 1/16W, 1%	10 k	Std
1	Std	Resistor, Chip, 3.32 kΩ, 1%, 0603	3.32 K	Std
1	Std	Resistor, Chip, 5.76 kΩ, 1%, 0603	5.76 K	Std
1	Std	Resistor, Chip, 51.1 Ω, 1%, 0603	51.1	Std
3	4TPE150MI	POSCAP, TPE, 150 µF, 4V, 18 mΩ	150 µ	Sanyo
1	C1608X5R0J475KT	Capacitor, Ceramic, 4.7 µF, 6.3V, X5R, 10%, 0603	4.7 µF	TDK
2	C1608X5R1C105KT	Capacitor, Ceramic, 1 µF, 16V, X5R, 10%, 0603	1 µF	TDK
2	C2012X5R0J226MT	Capacitor, Ceramic, 22 µF, 6.3V, X5R, 20%, 0805	22 µF	TDK
1	C3216X5R0J476MT	Capacitor, Ceramic, 47 µF, 6.3V, X5R, 20%, 1206	47 µF	TDK
3	C3225X5R1C106M	Capacitor, Ceramic, 10 µF,16V, X5R, 20%	10 µ	TDK
2	C3225X7R1C226MT	Capacitor, Ceramic, 22 µF, 16V, X5R, 20%, 1210	22 µF	TDK
4	D120/2DS	Terminal Block, 2-pin, 15-A, 5,1 mm	(blank)	OST
2	ECE-Vxxxvvvz	Capacitor, Aluminum, xxV, 20%	22 µF	Panasonic
5	ED1609	Terminal Block, 2-pin, 15-A, 5,1 mm	ED1609-ND	OST
1	EEFCX0G221R	Capacitor, Aluminum, 220 µF, 4V, 5 mΩ	220 µF	Panasonic
3	ELLCTV120M	SMD Choke Coil, 12 µH, 26 mΩ, 3.7A	12 µ	Panasonic
1	IHLP5050EZRZ1R0M01	Inductor, SMT, 1 µH, 29A, 0.0025 Ω	1 µH	Vishay Dale
2	PTC36SAAN	Header, 2-pin, 100mil spacing, (36-pin strip)	PTC36SAAN	Sullins
3	Si4892DY	Trans, N-ch, 30V, 7A, 20 mΩ, Qg=10.5nC	Si4892DY	Vishay
1	Si7344DP	MOSFET, N-Ch, 20V, 14A, 0.012 Ω	Si7344DP	Vishay
1	Si7636DP	MOSFET, N-Ch, 30V, 25A, 0.0048 Ω	Si7636DP	Vishay
1	TLV1117I-xxCDCY	IC, vvV, 800 mA LDO Voltage Regulators	TLV1117I-33CDCY	Texas Instruments
1	TPS51116PWP	IC, Synchronous VDDQ Controller w/ VTT LDO	TPS51116PWP	Texas Instruments
1	TPS54352PWP	IC, 4.5-V to 20-V Input, 3-A Synchronous Converter	TPS54352PWP	Texas Instruments
1	TPS54354PWP	IC, 4.5-V to 20-V Input, 3-A Synchronous Converter	TPS54354PWP	Texas Instruments
1	TPS54356PWP	IC, 4.5-V to 20-V Input, 3-A Synchronous Converter	TPS54356PWP	Texas Instruments
1	TPS79301DBVR	IC, UltraLow-Noise, High PSRR, 200 mA, LDO	TPS79301DBVR	Texas Instruments
1	UA78M05IDCY	IC, Voltage Regulator, 5V, 500 mA	UA78M05	Texas Instruments

IMPORTANT NOTICE