

# Sine On™

An Analog Product Catalog

2Q 2007

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# Power Management Solutions for Xilinx® and Altera® FPGAs

## Single-Chip Solution for Spartan® and Cyclone®

### TPS75003



Get samples, datasheets, app reports, evaluation modules and software tools at:

[www.ti.com/sc/device/TPS75003](http://www.ti.com/sc/device/TPS75003)

#### Key Features

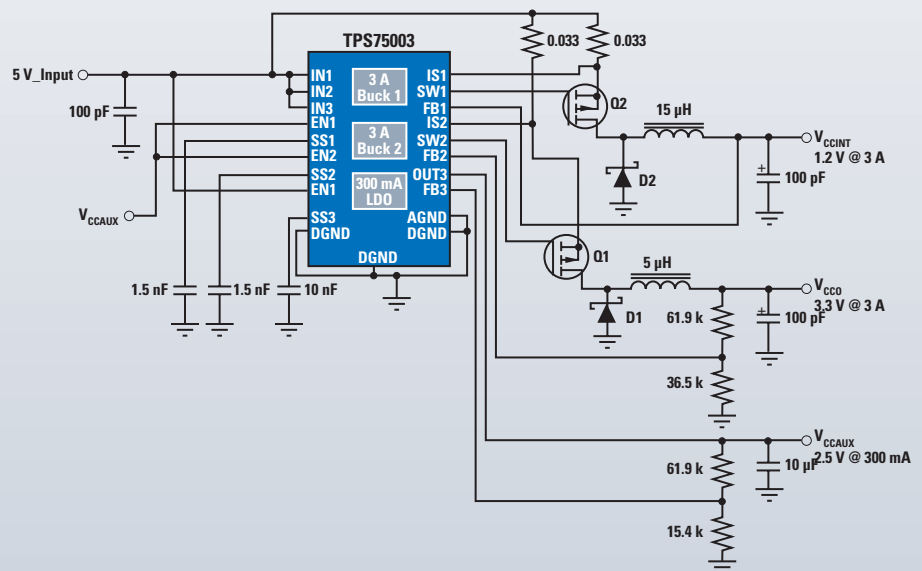
- Two 95% efficient 3-A buck controllers and one 300-mA LDO
- Adjustable output voltages to 1.2 V for buck and 1.0 V for LDO
- Input voltage range: 2.2 V to 6.5 V
- Independent enable for each supply
- Packaging: Low profile 4.5 mm x 3.5 mm QFN

#### Benefits

- Small single-chip solution
- Flexible sequencing

#### FPGA Applications

- Altera Cyclone II family
- Xilinx Spartan-3 family



## Power Management Solutions for Your FPGA and CPLD Designs

### Altera

Max <sup>®</sup> Max II	Cyclone <sup>®</sup> Cyclone II	Stratix <sup>®</sup> , GX Stratix II, GX Stratix III
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### Xilinx

CoolRunner <sup>®</sup> , XPLA3 CoolRunner-II	Spartan Family • IIE, /XL • 3, 3A, 3E	Virtex <sup>®</sup> , E, EM Virtex-II, Pro Virtex-4 Virtex-5
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- Broad portfolio including LDOs, Controllers, Integrated FET Converters and Modules
- FPGA reference designs, power design services, design software
- Seminars, webcasts and application notes
- Rapid delivery samples, evaluation modules
- Local application support
- Distributor partners

Texas Instruments' broad portfolio of high-performance power management products, local technical support and easy-to-use design tools can help you differentiate your FPGA-based design and speed your time to market.

This issue highlights several innovative devices optimized to work with FPGA and CPLD devices, such as those from leading manufacturers Xilinx and Altera. TI's new power management ICs and reference designs increase power efficiency and simplify design.

**Power Management Home Page:**  
[power.ti.com](http://power.ti.com)

**Power Management Solutions for Altera FPGAs:**  
[www.ti.com/alterafpga](http://www.ti.com/alterafpga)

**Power Solutions for Xilinx FPGAs:**  
[www.ti.com/xilinfpga](http://www.ti.com/xilinfpga)

**e-Store for Power Management Evaluation Modules**  
[www.ti.com/home\\_b\\_estore](http://www.ti.com/home_b_estore)

**Power Management FPGA Support Email**  
[fpgasupport@list.ti.com](mailto:fpgasupport@list.ti.com)

## High-Performance RF LDOs

### TPS791/792/793/794/795/796/786xx



Get samples, datasheets, app reports and evaluation modules at:

[www.ti.com/sc/device/PARTnumber](http://www.ti.com/sc/device/PARTnumber)

(Replace **PARTnumber** with **TPS79101**, **TPS79201**, **TPS79301**, **TPS79401**, **TPS79501**, **TPS79601**, or **TPS78601**)

#### Key Features

- Input voltage range: 2.7 V to 5.5 V
- Fixed output voltages: 1.8 V to 4.75 V and adjustable 1.2 V to 5.0 V
- Rated output current: 100 mA to 1.5 A
- Stable with ceramic output capacitor
- $32_{-}V_{RMS}$  output noise, 100 Hz to 100 kHz
- Fast startup time (50  $\mu$ s)
- Accuracy: 2% over load/line/temp
- Very high PSRR: 70 dB @ 1 kHz and 70 dB @ 10 kHz

#### Benefits

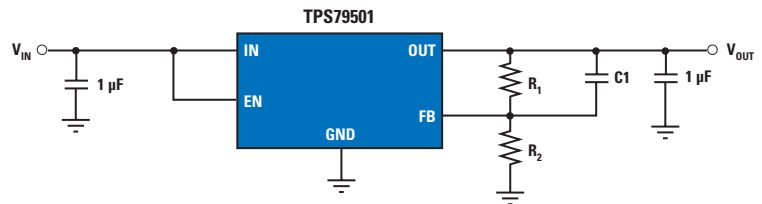
- Produces low-noise power for sensitive analog functions
- Uses smaller, less expensive ceramic capacitors

#### Applications

- Altera Stratix II GX, MAX II
- Xilinx Virtex-5, CoolRunner II
- Low-noise RF applications
- PLL and VCO power supplies

#### Typical Device Specifications

Device	$I_{OUT}$	$V_{DO}$ (mV)	EN	Packages
TPS79101	100 mA	38	/EN	SOT23
TPS79201	100 mA	38	✓	SOT23
TPS79301	200 mA	77	✓	SOT 23, WCSP
TPS79401	250 mA	145	✓	MSOP8, SOT223
TPS79501	500 mA	105	✓	SOT223
TPS79601	1.0 A	220	✓	SOT 223, DDPACK, SON (2.8 V)
TPS78601	1.5 A	340	✓	SOT223, DDPACK



## Ultra-Low Dropout Linear Regulators with Soft-Start and Tracking

### TPS744xx



Get samples, datasheets, app reports and evaluation modules at:

[www.ti.com/sc/device/TPS74401](http://www.ti.com/sc/device/TPS74401)

#### Key Features

- Programmable soft-start/tracking capabilities
- Input voltage range: 0.9 V to 5.5 V
- Bias voltage range: 2.375 V to 5.25 V
- Ultra-low  $V_{IN}$   $V_{DO}$ : 195 mV max @ 3 A
- Ultra-low  $V_{BIAS}$   $V_{DO}$ : 1.62 V max @ 3 A
- Output voltages: 0.8 V to 3.3 V
- 1% accuracy over load/line/temp
- Stable with any/no output capacitor
- Guaranteed min/max current limit

#### Benefits

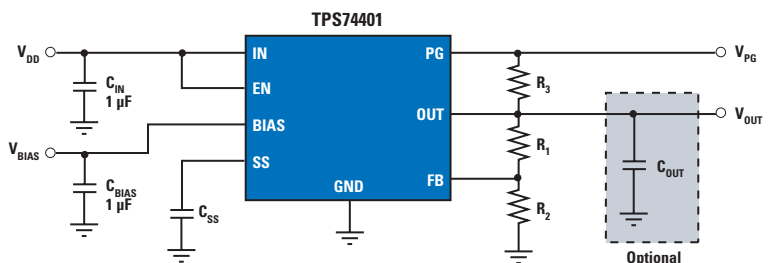
- Low-noise high-current linear solution
- Less board space than switching solution
- Fewer components than switching solution

#### Applications

- Altera Cyclone II, Stratix II, Stratix II GX, Stratix III
- Xilinx Spartan-3 family, Virtex-5
- Core and IO power supplies
- PLL and VCO power supplies

#### Typical Device Specifications

Device	$I_{OUT}$ (A)	$V_{DO}$ (mV)	Startup
TPS74201	1.5	55	Soft-Start
TPS74301	1.5	55	Track
TPS74401	3.0	110	Soft-Start



## 4.5-V to 15-V Input, Synchronous Buck DC/DC Controller

### TPS40190



Get samples, datasheets, app reports, evaluation modules and software tools at:

[www.ti.com/sc/device/TPS40190](http://www.ti.com/sc/device/TPS40190)

#### Key Features

- Input operating voltage range: 4.5 V to 15 V
- Output voltage down to 0.591 V with +1% reference accuracy
- Synchronous rectification for high efficiency
- Three selectable short-circuit thresholds
- Hiccup recovery from short-circuit condition
- Integrated bootstrap drivers for N-Channel MOSFET
- Internal soft-start

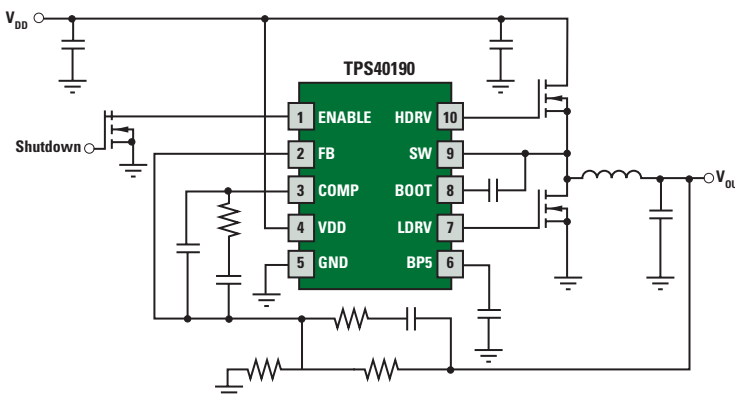
#### Benefits

- High-performance, low-cost solution
- Allows for a single-input power solution, no separate power supply needed to power the controller
- Provides power supply flexibility without adding circuit complexity

- Fewer external components, simplifies design
- Minimized switching losses improves efficiency
- Up to 25-A power supply possible with the TPS40190
- Minimizes power dissipation in fault condition, automatically restarts when fault is removed

#### Applications

- Altera Cyclone II, Stratix II, Stratix II GX, Stratix III
- Xilinx Spartan-3 family, Virtex-5
- Core and IO power supplies



## 4.5-V to 52-V Input, Low-Pin Count Buck Controller

### TPS40200



Get samples, datasheets, app reports and evaluation modules at:

[www.ti.com/sc/device/TPS40200](http://www.ti.com/sc/device/TPS40200)

#### Key Features

- 4.5-V to 52-V operation
- Voltage mode control with feed-forward compensation
- 700-mV voltage reference: 1% accuracy
- Internal under-voltage lockout
- Programmable frequency: 35 kHz to 500 kHz
- Programmable overcurrent protection
- Frequency synchronization
- Closed loop soft-start
- Integrated driver

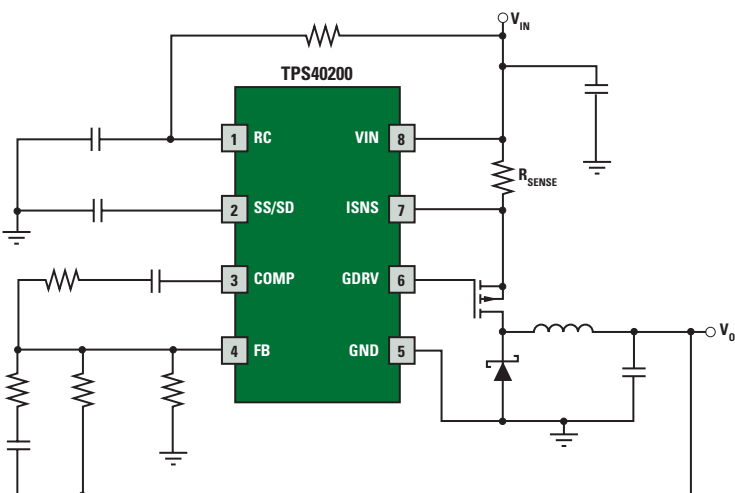
#### Benefits

- Wide-input range for use in many applications
- Voltage feed forward – great line regulation, fast transient response
- Programmable features allows flexible design; frequency, overcurrent protection, under-voltage lockout

- Soft-start provides smooth, well controlled power up
- Simple configuration — minimal external components

#### Applications

- Altera Cyclone II, Stratix II, Stratix II GX, Stratix III
- Xilinx Spartan-3 family, Virtex-5
- Core and IO power supplies



## 1.6-MHz, 3-V to 6-V Input, 3-A DC/DC Synchronous Buck Converter

### TPS54317



Get samples, datasheets, app reports, evaluation modules and software tools at:

[www.ti.com/sc/device/TPS54317](http://www.ti.com/sc/device/TPS54317)

#### Key Features

- Input voltage range: 3.0 V to 6.0 V
- Two 3-A (4.5-A peak) integrated MOSFETs provide synchronous rectification
- Adjustable/synchronizable switching frequency to 1.6 MHz
- Output voltage adjustable down to 0.9 V
- Power good, enable, adjustable slow-start, current limit, thermal shutdown and 1% accuracy
- Supported by free SwitcherPro™ design software

#### Benefits

- High frequency allows use of a smaller inductor and capacitor to save board space
- High efficiency greater than 90%
- Large current source from a small board space

## 4.5-V to 20-V Input, 3-A and 6-A Converters

### TPS54350, TPS54550



Get samples, datasheets, app reports, evaluation modules and software tools at:

[www.ti.com/sc/device/TPS54350](http://www.ti.com/sc/device/TPS54350) or [TPS54550](http://www.ti.com/sc/device/TPS54550)

#### Key Features

- Input voltage range: 4.5 V to 20 V
- Synchronous-buck for high efficiency
- Adjustable output voltage down to 0.9 V
- Power good, enable, adjustable slow-start, current limit, thermal shutdown
- 180° out-of-phase switching
- TPS54350 and TPS54550 are footprint compatible
- Fixed 250 kHz, 500 kHz, or adjustable switching frequency

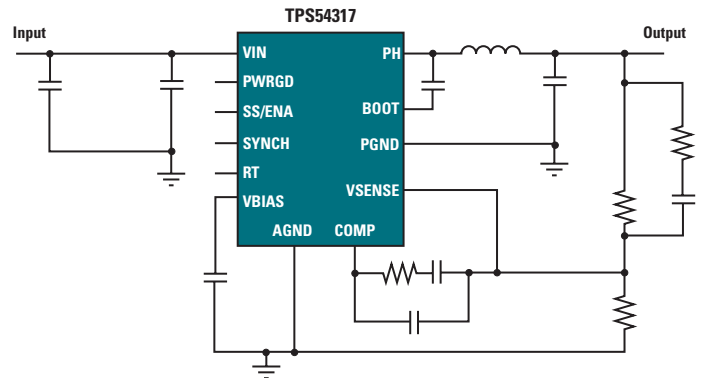
#### Benefits

- Accommodates high inrush currents
- Greater than 90% efficiency
- 1% regulation accuracy over temperature
- Reduces input bulk capacitance size
- Operates at up to 700 kHz for smaller passive components

#### Other Low-Voltage SWIFT™ Devices\*

Part Number	V <sub>IN</sub> Range (V)	I <sub>OUT</sub> (A)	Frequency	Package
TPS54310	3 to 6	3	Up to 700 kHz	20HTSSOP
TPS54610	3 to 6	6	Up to 700 kHz	28HTSSOP
TPS54910	3 to 4	9	Up to 700 kHz	28HTSSOP
TPS54010	3 to 4	14	Up to 700 kHz	28HTSSOP

\* Same feature set as TPS54317



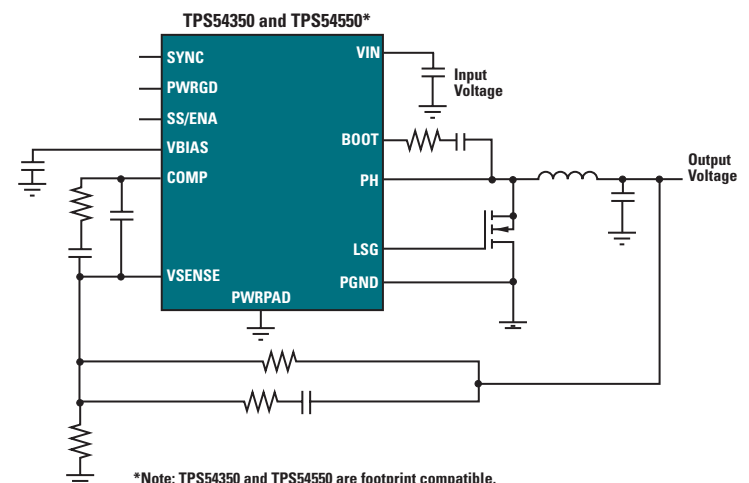
#### Applications

- Altera Cyclone II, Stratix II, Stratix II GX, Stratix III
- Xilinx Spartan-3 family, Virtex-5
- Core and IO power supplies
- Many integrated protection and performance features to protect the system

#### Mid-Voltage SWIFT™ Devices

Part Number	V <sub>IN</sub> Range (V)	I <sub>OUT</sub> (A)	Compensation	Package
TPS54350	4.5 to 20	3	External	16HTSSOP
TPS5435x	4.5 to 20	3	Internal*	16HTSSOP
TPS54550	4.5 to 20	6	External	16HTSSOP

\* Fixed output versions available (1.2, 1.5, 1.8, 2.5 and 3.3 V)



\*Note: TPS54350 and TPS54550 are footprint compatible.

#### Applications

- Altera Cyclone II, Stratix II, Stratix II GX, Stratix III
- Xilinx Spartan-3 family, Virtex-5
- Core and IO power supplies

## 1.2-A Step-Down Converter in MSOP-10

### TPS6204x



Get samples, datasheets, app reports, evaluation modules and software tools at:

[www.ti.com/sc/device/TPS62040](http://www.ti.com/sc/device/TPS62040)

#### Key Features

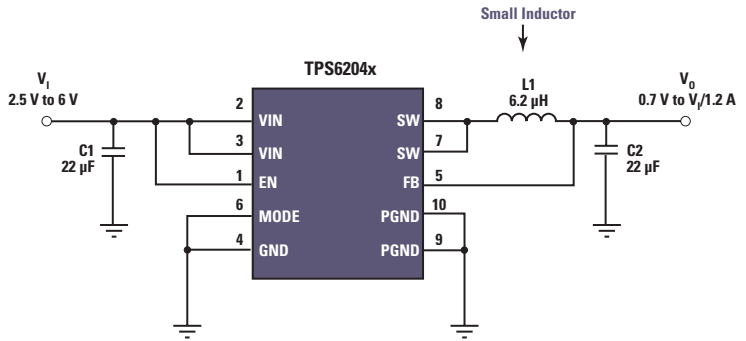
- Input voltage range: 2.5 V to 6.0 V
- Output current: up to 1.2 A with up to 95% efficiency
- 18- $\mu$ A (typ) quiescent current, 0.1- $\mu$ A shutdown
- PFM power-save mode for light loads
- 1.25-MHz fixed frequency PWM operation possible
- Adjustable output voltage range: 0.7 V to  $V_{IN}$
- 100% duty cycle mode
- Soft-start limits in-rush current
- Packaging: 10-pin MSOP

#### Benefits

- Suitable for 3-to 4-cell alkaline or 1-cell Li-Ion
- Conserve battery capacity
- High efficiency over entire load range
- Small inductors
- Ideal for low-noise applications

#### Applications

- Altera Max II, Cyclone II
- Xilinx CoolRunner-II, Spartan-3 family



## Dual-Channel Step-Down Converter with 1-Pin EasyScale™ Interface

### TPS62400



Get samples, datasheets, app reports, evaluation modules and software tools at:

[www.ti.com/sc/device/TPS62400](http://www.ti.com/sc/device/TPS62400)

#### Key Features

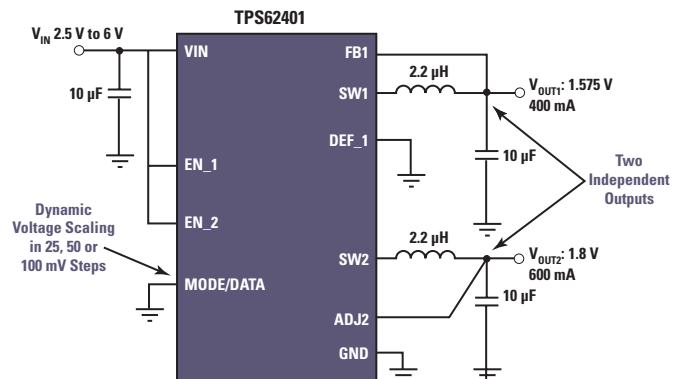
- Input voltage: 2.5 V to 6 V
- Output voltage: 0.7 V to 6.0 V (adj.)
- Output currents: 400 mA and 600 mA (TPS62400)
- Efficiency: 95% (max)
- EasyScale: simple one wire interface to adjust output voltage (dynamic voltage scaling)
- Fixed frequency operation: 2.25 MHz
- 180° out-of-phase operation
- Power-save mode (PFM/PWM) or forced PWM, 100% duty cycle
- Soft-start
- Packaging: 3 mm x 3 mm 10-pin QFN

#### Benefits

- Small solution size
- EasyScale™ digital programming allows simple DVS
- Reduced input capacitance
- No external compensation required

#### Applications

- Altera Max II, Cyclone II
- Xilinx CoolRunner-II, Spartan-3 family



## 2nd Generation PTH Point-of-Load Modules

### PTH04T2xx, PTH08T2xx



Get samples, datasheets, app reports, evaluation modules and software tools at:

[www.ti.com/T2](http://www.ti.com/T2)

### Key Features

- TurboTrans™ technology
- 1.5% output regulation
- Up to 50% smaller footprint
- SmartSync synchronization
- Wide input voltage (4.5 V to 14 V)
- Auto-Track™ sequencing
- Pb-free/RoHS compliant

### Benefits

T2's reduce development costs and save PCB space:

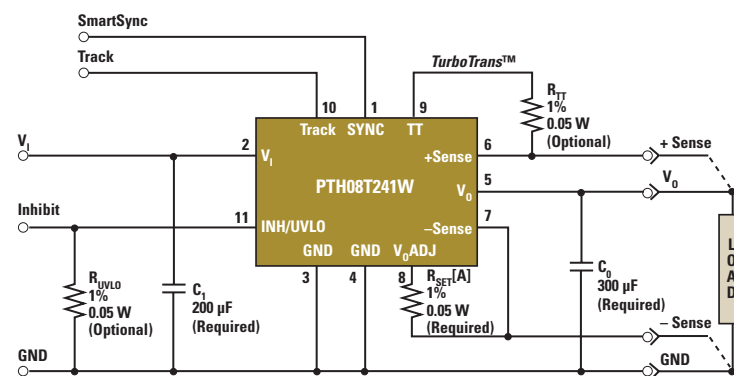
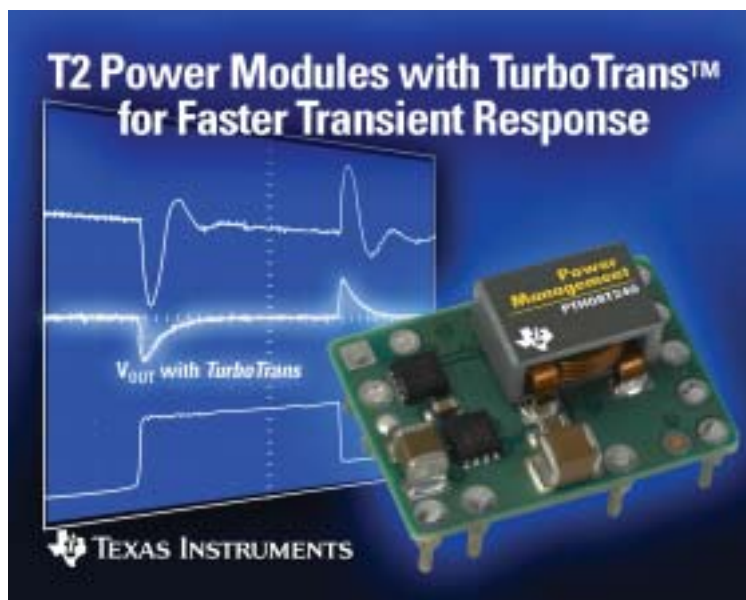
- Sequencing easily solved with Auto-Track technology
- SmartSync synchronization for input cap reduction/easier filtering
- TurboTrans technology for high transient load applications
  - Up to 8x reduction in output capacitors
  - Faster transient response
  - Stable with ultra-low ESR caps
- 1.5% tolerance meets specs of FPGA core

### Applications

- Altera Stratix II, Stratix II GX, Stratix III
- Xilinx Virtex-5
- Wireless infrastructure
- Telecom
- Networking
- Servers
- Mass storage

### Typical Device Specifications

Model	Input Voltage (V)	Output Voltage (V)	Output Current (A)
PTH04T260W	2.2 to 5.5	0.7 to 3.6	3
PTH08T260/261W	4.5 to 14	0.7 to 5.5	3
PTH04T230W	2.2 to 5.5	0.7 to 3.6	6
PTH08T230/231W	4.5 to 14	0.7 to 5.5	6
PTH04T240/241W	2.2 to 5.5	0.7 to 3.6	10
PTH08T240F	4.5 to 14	0.7 to 2.0	10
PTH08T240/241W	4.5 to 14	0.7 to 5.5	10
PTH04T220W	2.2 to 5.5	0.7 to 3.6	16
PTH08T220/221W	4.5 to 14	0.7 to 5.5	16
PTH05T210W	4.5 to 5.5	0.7 to 3.6	30
PTH08T210W	5.5 to 14	0.7 to 3.6	30
PTH08T250W	4.5 to 14	0.7 to 3.6	50
PTV08T250W	8 to 14	0.8 to 3.6	50



## 8-Channel Power Supply Sequencer and Monitor

### UCD9080



Get samples, datasheets, app reports, evaluation modules and software tools at:

[www.ti.com/sc/device/UCD9080](http://www.ti.com/sc/device/UCD9080)

### Key Features

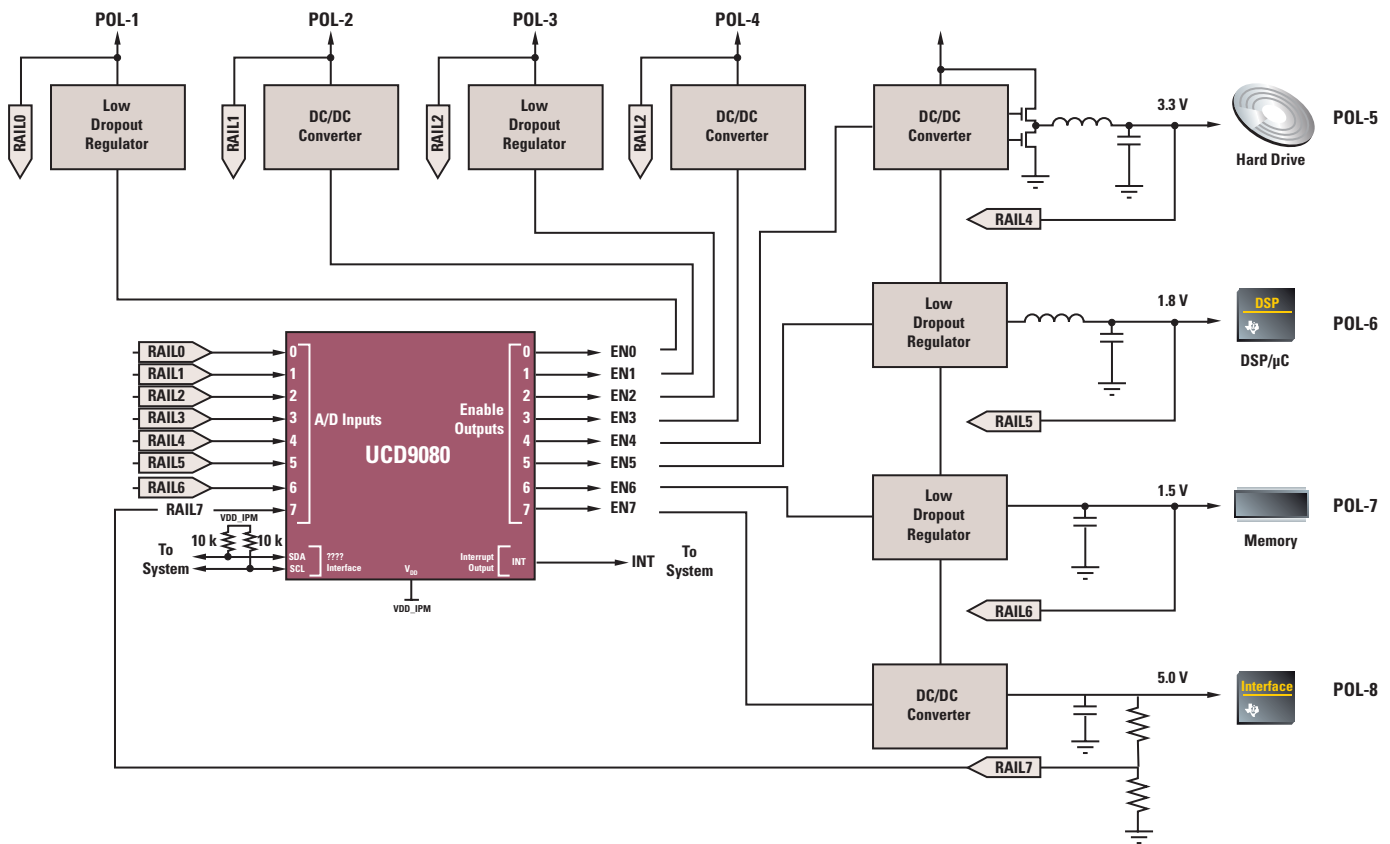
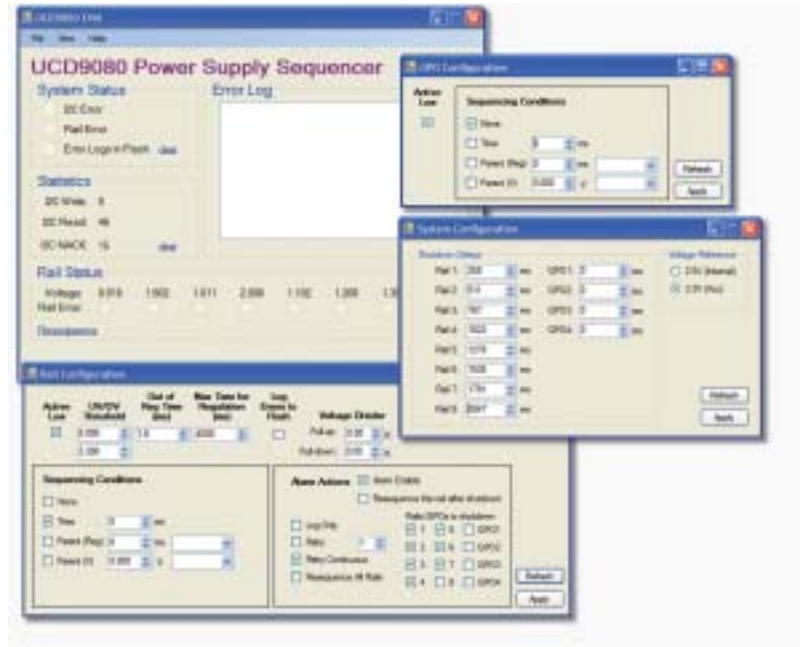
- Sequencing and monitoring of up to 8 voltage rails
- All rails monitored and updated every 50- $\mu$ s 3.5-mV resolution
- Sequencing of up to three digital outputs for power-on-reset and other functions
- Under- and over-voltage threshold per rail
- I<sup>2</sup>C interface for configuration and monitoring
- Microsoft® Windows® GUI for configuration and monitoring
- Flexible rail shutdown
- Supply voltage: 3.3 V
- Low power consumption: 300  $\mu$ A, 3.0 V

### Benefits

- Intuitive Windows-based GUI for easy sequencing
- Allows setting of dependent and independent rails
- Saves fault information if power is suddenly disrupted

### Applications

- Telecommunications switches servers
- Networking equipment
- Test equipment
- Any system requiring sequencing of multiple voltage rails



## Reference Design for Cyclone II and Spartan-3 Family

### 5 V<sub>IN</sub> Low Power, Small Size, Simple Design

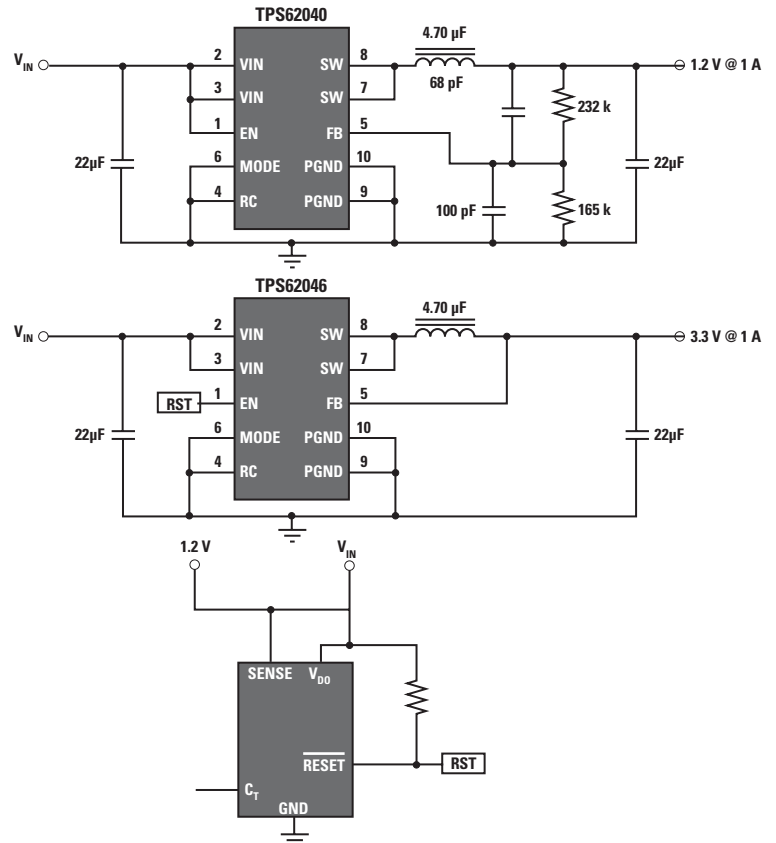
#### Dual TPS6204x

#### Key Features

- Integrated high and lowside FETs to achieve up to 95% conversion efficiency
- Typical quiescent current: 18  $\mu$ A
- Load current: 1.2 A
- Operating input voltage range: 2.5 V to 6.0 V
- Efficient generation of lower power I/O voltages
- Switching frequency: 1.25 MHz reduces inductor size and output voltage ripple
- Adjustable and fixed output voltages
- Power save mode operation at light load currents
- 100% duty cycle for lowest dropout
- Internal soft-start

#### Benefits

- Power rail sequencing
- High efficiency over wide-load range
- Small solution size



## Reference Design for Cyclone II and Spartan-3 Family

### 12 V<sub>IN</sub> Low Power, Cost Optimized

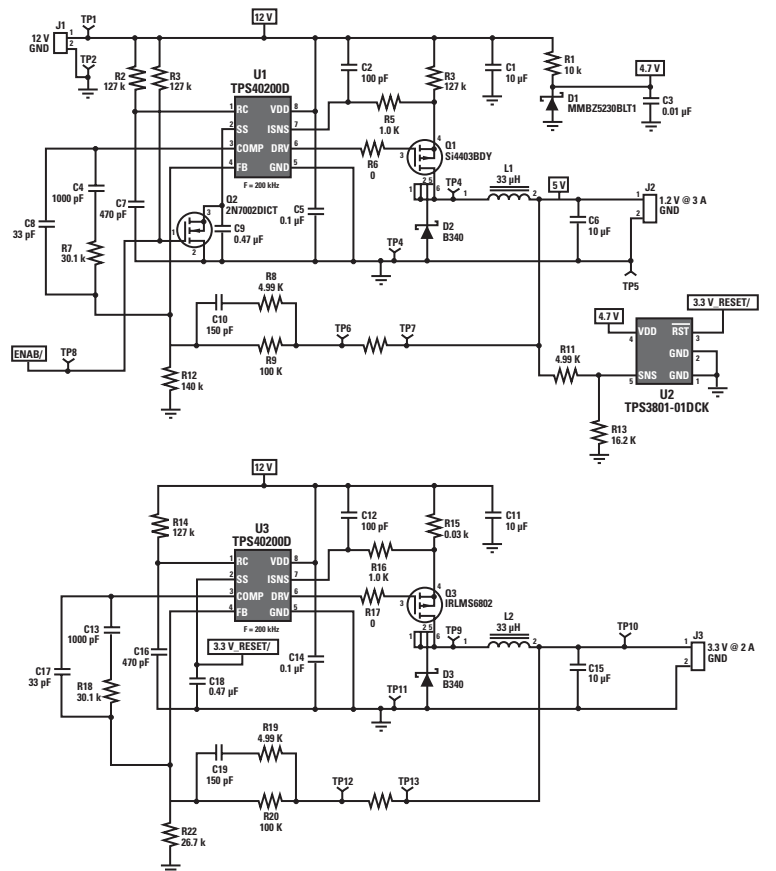
#### TPS40200

Download reference design schematic and BOM at:

[www-s.ti.com/sc/techlit/SBVR002](http://www-s.ti.com/sc/techlit/SBVR002)

#### Key Features

- Simple 8-pin wide V<sub>IN</sub> controller for voltage rails needing less than 3 A
- Voltage feed-forward for improved response to line transients



## Reference Design for Stratix II, Stratix II GX, Cyclone II, Virtex-4, Spartan-3 Family

### 12 V<sub>IN</sub>, Mid Power, Simple Design

#### TPS54350

Download reference design schematic and BOM at:

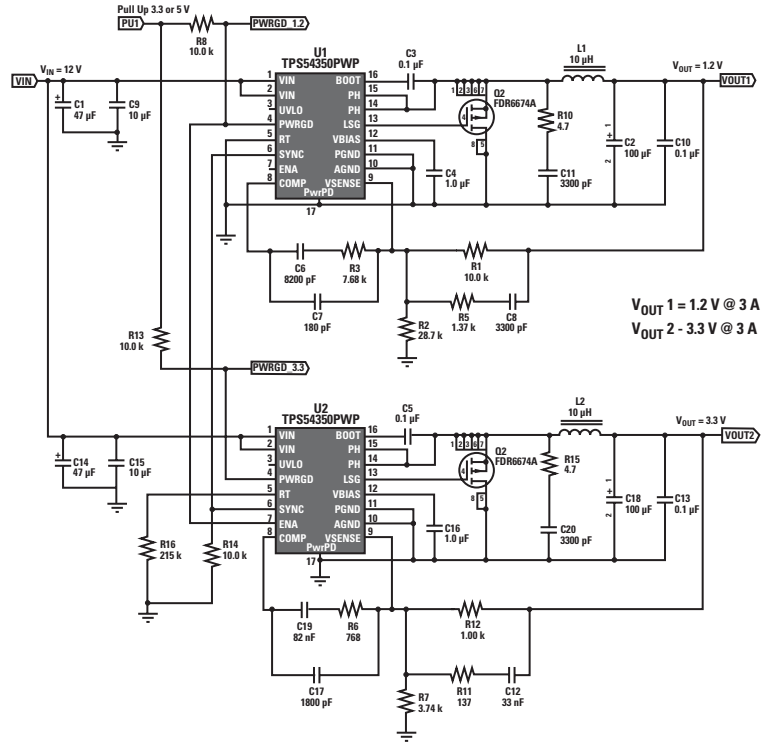
[www-s.ti.com/sc/techlit/SBVR001](http://www-s.ti.com/sc/techlit/SBVR001)

#### Key Features

- 180° out-of-phase operation minimizes input capacitance
- 1.2-V SWIFT™ power good pin sequences 3.3-V rail
- 100-mΩ MOSFET switch integrated for high efficiency at 3 A
- Uses external lowside MOSFET for synchronous operation
- Output voltage: adjustable down to 0.891 V with 1% accuracy
- SwitcherPro™ design software

#### Benefits

- Can be upgraded to 6 A with the TPS54550 pin-compatible device
- Integrated FET minimizes board space



## Reference Design for Stratix II, Stratix II GX, Cyclone II, Virtex-4, Spartan-3 Family

### 12 V<sub>IN</sub>, High Power, High Efficiency

#### TPS40190

Download reference design schematic and BOM at:

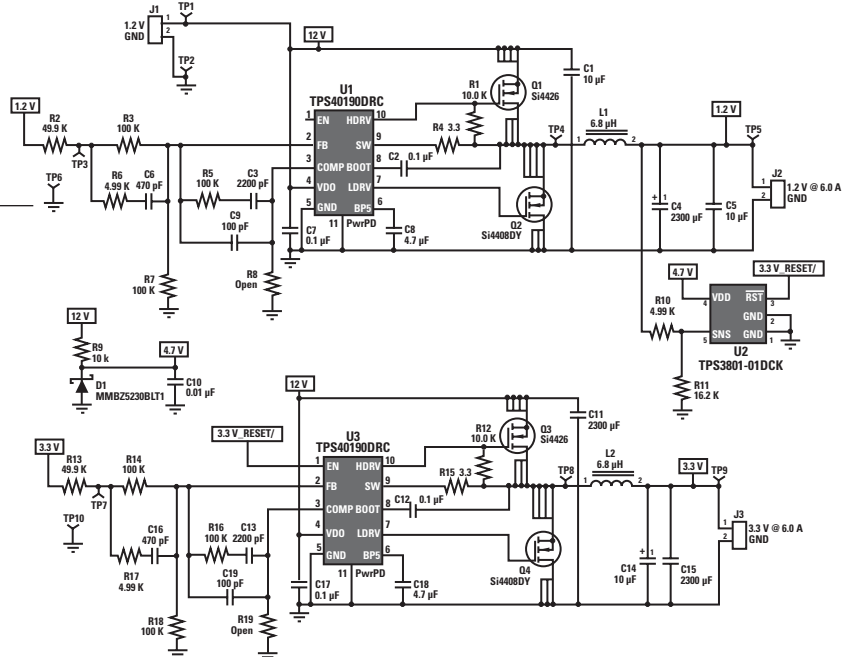
[www-s.ti.com/sc/techlit/SBVR003](http://www-s.ti.com/sc/techlit/SBVR003)

#### Key Features

- Input operating voltage range: 4.5 V to 15 V
- Reference 0.591 V ±1%
- Voltage mode control
- Selectable short-circuit protection thresholds
- Pre-bias output safe
- Fixed switching frequency of 300 kHz
- Internal soft-start
- Bootstrapped drivers for N-Channel MOSFET
- Adaptive anti-cross conduction
- Internal bootstrap diode

#### Benefits

- Scalable up to 20 A per rail
- Easy power sequencing with EN pin
- Highly efficient conversion to voltage rails



## Reference Design for Virtex-5 5-V Multiple FPGA Design for Complex Systems

### PTH08T230W

Download reference design schematic and BOM at:

[www-s.ti.com/sc/techlit/SLVR306](http://www-s.ti.com/sc/techlit/SLVR306)

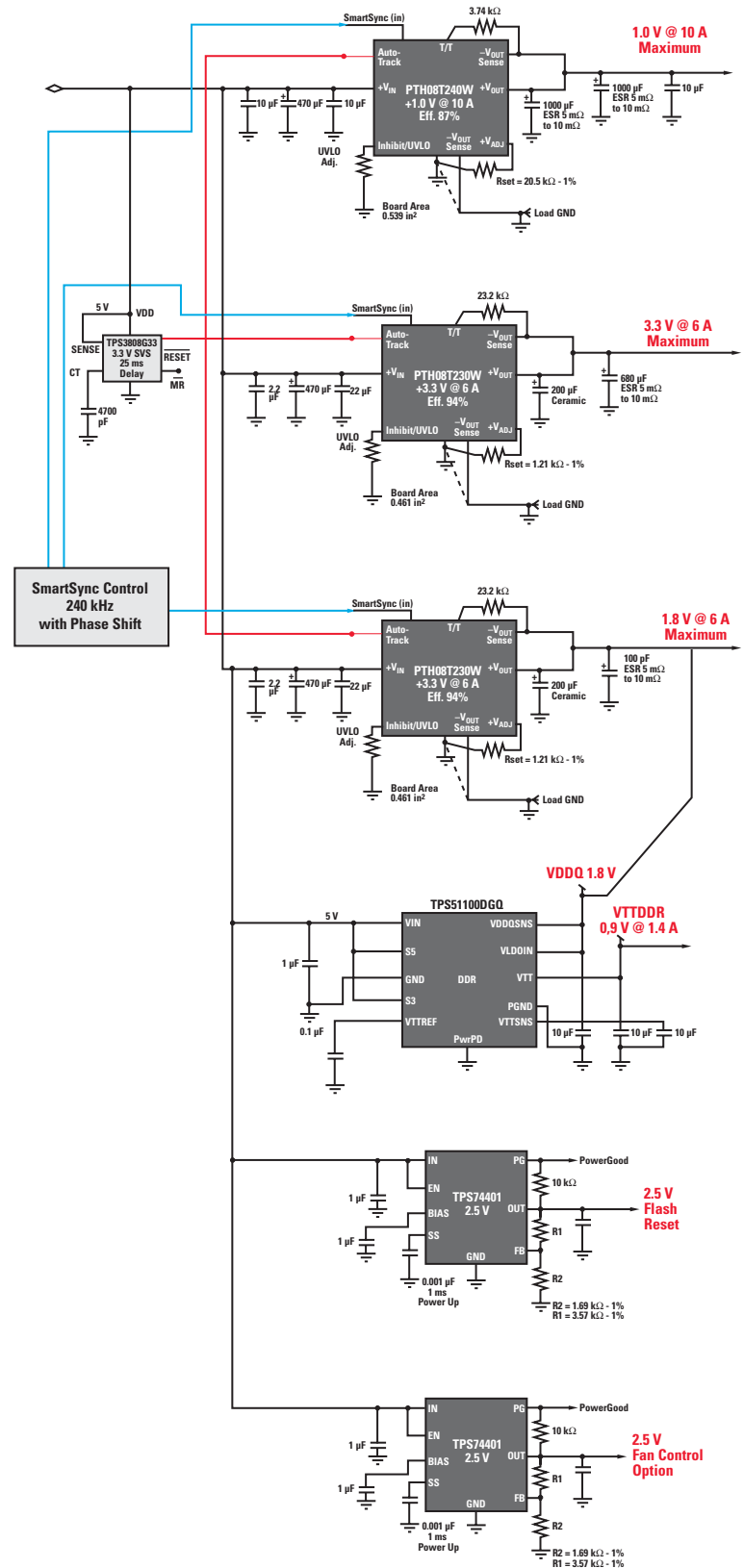
### Key Features

- T2 power modules for:
  - Higher current (up to 50 A)
  - Simplified sequencing with Auto-Track sequencing
  - Fast transient response with *TurboTrans* technology
  - Frequency synchronization with SmartSynch
- TPS51100 for DDR termination power
- Power supply for external flash memory
- Power supply for fan control
- Design used in Xilinx evaluation platform ML501

### Benefits

T2's reduce development costs and save PCB space:

- Sequencing easily implemented with Auto-Track technology
- SmartSynch synchronization for input cap reduction/easier filtering
- *TurboTrans* technology for high transient load applications
  - Up to 8x reduction in output capacitors
  - Faster transient response
  - Stable with ultra-low ESR caps
- 1.5% tolerance meets specs of FPGA core



## TI Worldwide Technical Support

### Internet

**TI Semiconductor Product Information Center Home Page**

support.ti.com

**TI Semiconductor KnowledgeBase Home Page**

support.ti.com/sc/knowledgebase

### Product Information Centers

#### Americas

Phone +1(972) 644-5580  
 Fax +1(972)927-6377  
 Internet support.ti.com/sc/pic/americas.htm

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