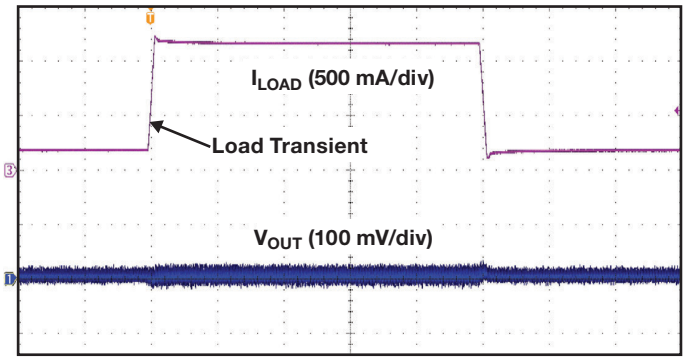
TI Power Solutions

DC/DC Converters with DCS-Control™ Topology

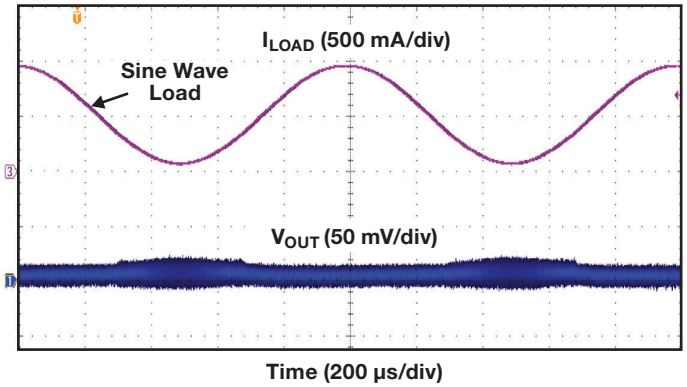
TEXAS INSTRUMENTS

TI's DCS-Control™ topology (**D**irect **C**ontrol with **S**eamless Transition into Power Save Mode) is an advanced architecture that combines the advantages of hysteretic and voltage mode control. The DCS-Control provides:

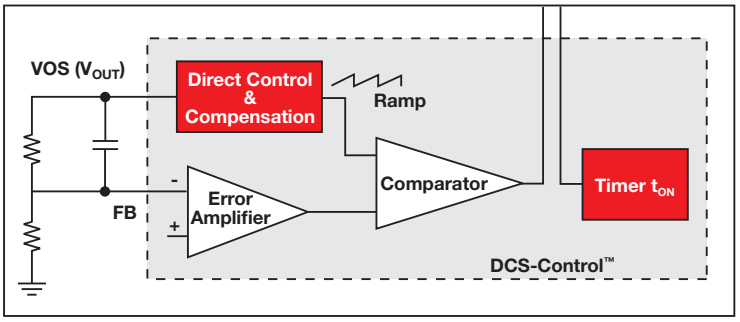
- High output-voltage accuracy throughout a seamless transition between PWM to Power Save Mode provided by a single building block
- Minimized interference with RF or other noise-sensitive circuits achieved by excellent DC-voltage and load-transient regulation, combined with low output voltage ripple
- Works with small (footprint and BOM count) and cost-competitive external components like low-ESR capacitors
- A robust design that tolerates large effective output capacitance
- Highest accuracy and smallest solution size combined with lowest quiescent current in versions with fixed output voltage



DCS-Control™ topology provides fast AC-line and load-transient regulation, ensuring high DC accuracy with a single building block.



The DCS-Control™ topology provides a seamless transition between PWM and power-save modes with very low output-voltage ripple.



Functional block diagram of the DCS-Control™ topology.

Other features supported on DCS-Control™ topology devices are:

- Adjustable soft start or tracking/sequencing
- Pin-selectable output voltage (margining)
- Pin-selectable switching frequency
- Power Good indicator
- Integrated bypass or load switch
- I^2C interface for dynamic voltage scaling
- Differential Remote Sense
- Extended UVLO hysteresis
- Adjustable ENABLE threshold and hysteresis
- Start-up into prebiased load
- HICCUP overcurrent protection
- Output-capacitor discharge
- 100% duty cycle

DC/DC Converters with DCS-Control™ Topology

Step-Down LED Driver with Dimming

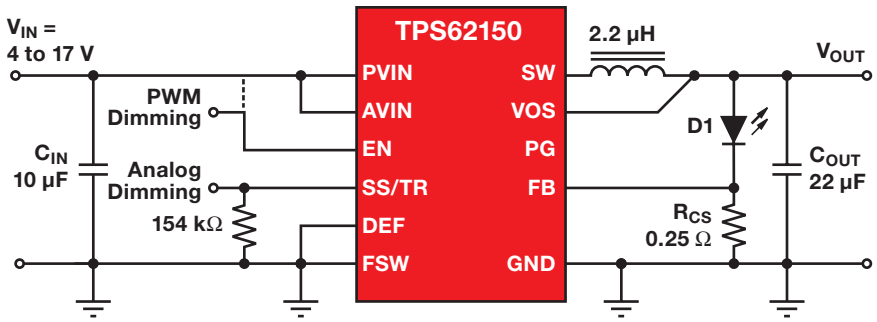
17-V Input Step-Down Converters with Adjustable Soft Start

TPS62150

TPS62150 demonstrates a small, simple, and easy way to implement a high-brightness constant current LED driver. The desired current must be maintained with an output voltage that varies with changes in the LED forward voltage due to analog dimming or varying temperatures. To achieve current regulation, the voltage across a known resistance (R_{CS}) is regulated. R_{CS} is connected from the feedback pin (FB) to GND. Due to the relatively high FB voltage, the power dissipated by R_{CS} can lower efficiency and reduce battery life. By putting a resistor from the SS/TR pin to GND, the FB voltage can be reduced. The LEDs are connected from the output of the inductor to the FB pin. Dimming can be realized in this application by either analog or PWM methods.

TIDesigns

- Efficient, High-Power LED Driver with Strobe and Synchronization for Fire Alarms **www.ti.com/tool/PMP9762**
- Isolated Flyback, Bucks (5 V @ 1.5 A) **www.ti.com/tool/PMP5539.3**
- Hercules Safety MCU Industrial Power Solution **www.ti.com/tool/PMP10189.5**



Get more information: **www.ti.com/lit/SLVA451**
www.ti.com/product/TPS62150

This topology can be applied to TPS62130, TPS62140 and TPS62150.

Sequencing and Tracking for Multiple Voltage Rails

Synchronous Step-Down (Buck) Converters

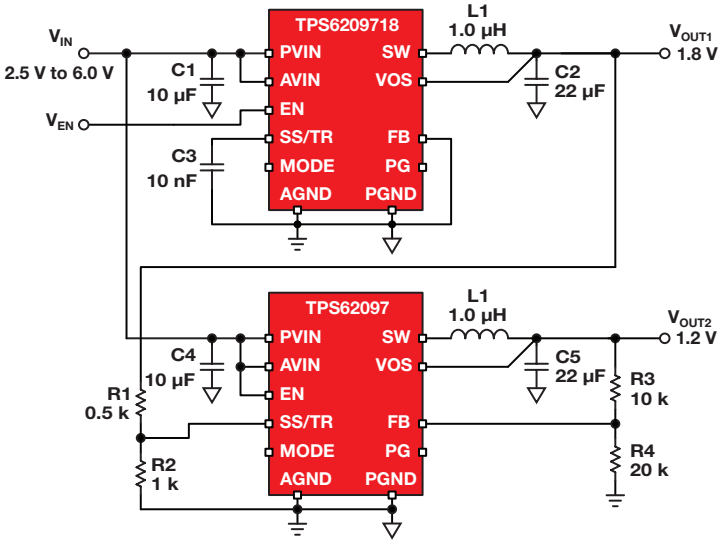
TPS62097

The TPS62097 synchronous buck DC/DC is ideal for use in systems that contain multiple output-voltage rails. The devices have:

- A built-in Power Good function to indicate the status of the device
- An adjustable soft-start circuit to control the output-voltage slope during start-up
- An Enable function for controlling the turn-on of the device

Each of these functions is useful for tracking and sequencing.

TI's Application Report SLVA470 describes how to use the ENABLE, Power Good and Soft-Start/Tracking functions in systems with multiple voltage rails.



Ratiometric and simultaneous start-up sequences are supported.

Get more information: **www.ti.com/lit/SLVA470**
www.ti.com/product/TPS62097

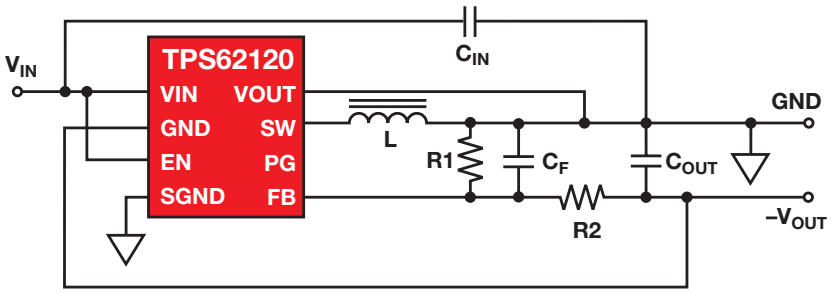
DC/DC Converters with DCS-Control™ Topology

Inverting Buck-Boost Topology

Step-Down Converter with Extended UVLO Hysteresis

TPS62120

The TPS62120 is a synchronous buck DC/DC converter designed for low-power applications such as ultra-low-power microprocessors, energy harvesting and low-power RF applications. The extended undervoltage lockout enables energy-harvesting applications to run longer from the supporting buffer capacitor. Moreover, the TPS62120 can be configured in an inverting buck-boost topology where the output voltage is inverted or negative with respect to ground. TI's Application Report SLVA478 describes the TPS62120 in an inverting buck-boost topology for use in low-current negative rails for operational-amplifier biasing and other low-power applications.



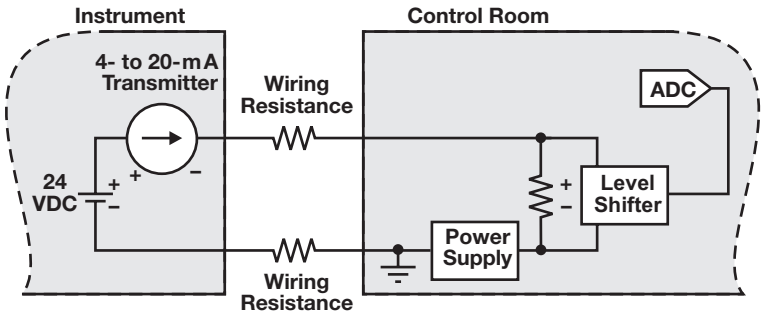
Get more information: **www.ti.com/lit/SLVA478**
www.ti.com/product/TPS62120

Harnessing Wasted Energy in 4- to 20-mA Current-Loop Systems

Step-Down Converter with Adjustable Enable Threshold and Hysteresis

TPS62125

A 4- to 20-mA current-loop signal is frequently used in industrial environments to transmit measurements across long distances, such as the temperature of a process or the pressure in a tank. This type of signaling is preferred because of its simplicity, noise immunity, safety and ability to traverse great lengths without data corruption. These current loops are also low-power systems, since relatively low currents transmit the data. Previously, whatever power was not used or lost in the signal transmission was merely dissipated in the transmitter; but now, with modern integrated circuits, even this small amount of power can be harnessed to support necessary functions in these systems.



Get more information: **www.ti.com/lit/SLYT488**
www.ti.com/product/TPS62125

DC/DC Converters with DCS-Control™ Topology

Powering Low-Power MCUs

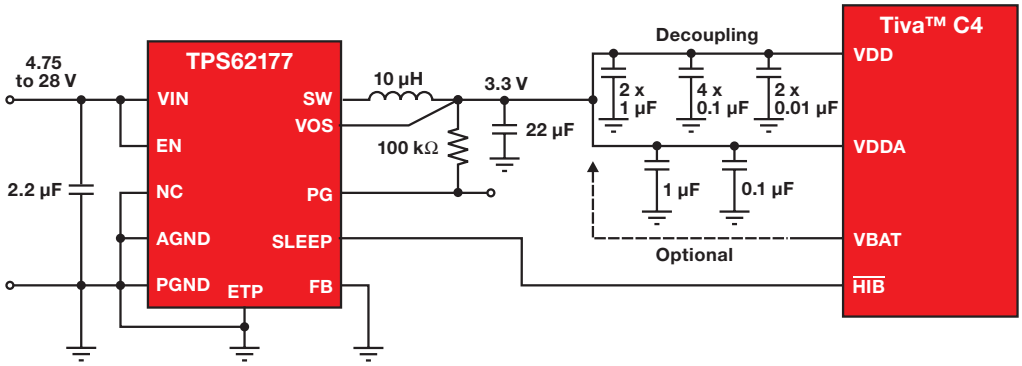
28-V Input Step-Down Converter with Sleep Mode

TPS62177

To optimize the balance between power and performance, low-power microcontrollers can be configured to operate in different modes ranging from deep-sleep mode to run mode. The current consumed by microcontrollers in an embedded system can vary from a few microamperes (1.3 µA in hibernation mode) to tens of milliamperes (30 mA at 80 MHz), depending on several factors in the end application. These factors can include mode of operation, system clock frequency, number of peripherals being clocked at a given time, drive strength of GPIOs and number of GPIOs being used to drive loads. The TPS62177 interfaces perfectly with the MCU's sleep modes, meeting the power requirements of embedded systems powered from two- to six-cell lithium batteries, USB ports or higher-voltage AC adapters.

TIDesigns

- 1-W Isolated Power Supply with Planar Transformer: **www.ti.com/tool/tida-00688**
- Ultra-Small 1-W, 12- to 36-V Iso Power Supply for Analog Prog Logic Controller Modules: **www.ti.com/tool/tida-00237**



Get more information: **www.ti.com/lit/SPMA066**
www.ti.com/product/TPS62177

Saving Battery Energy, Extending Application Run Time

Step-Down Converter with 400-nA Quiescent Current

TPS62745

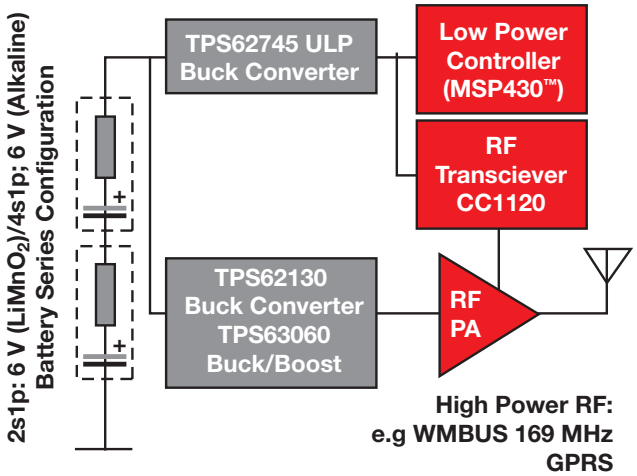
ADC input of MCUs require an external resistor divider to scale down battery voltage to match with ADC input range. The TPS62745 supports this functionality through the integrated V_{IN} switch and neglects the need for an extra load switch with integrated level shifter.

TPS62745 consumes only 400-nA quiescent current. The output voltage is set with four VSEL pins, supporting Dynamic Voltage Scaling (DVS). Once the battery voltage comes close to the output voltage the device enters a no ripple 100% mode to prevent RF interference.

See TPS62730 and TPS62740 for additional low-power RF solutions like BLE and ZigBee®.

TIDesigns

- Battery-Powered Data Collector for wM-Bus T-/C-Mode & DSSS-Coded Data Packets @ 868.95 MHz **www.ti.com/tool/tidc-dsss868wmbus-dc**



Get more information: **www.ti.com/lit/SLYT531**
www.ti.com/product/TPS62745, **TPS62740** and **TPS62730**

DC/DC Converters with DCS-Control™ Topology

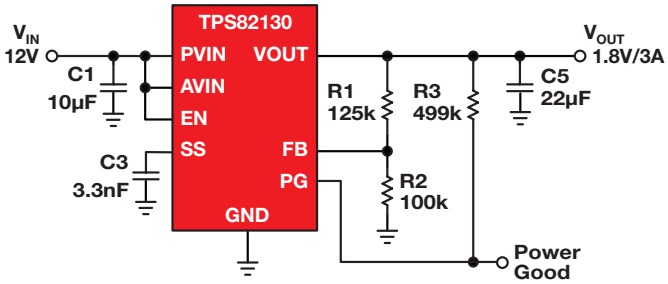
High Design Flexibility on Smallest Solution Size

17-V Input 3-A Step-Down Converter Module with Integrated Inductor

TPS82130

The TPS82130 is a MicroSiP™ power module optimized for small solution size and high efficiency. The module integrates a synchronous step-down converter and an inductor to simplify design, reduce external components and save PCB area. The low profile and compact solution is suitable for automated assembly by standard surface mount equipment.

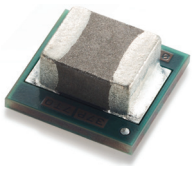
To maximize efficiency, the converter operates in PWM mode with a nominal switching frequency of 2.0 MHz and automatically enters Power Save Mode operation at light load currents. In Power Save Mode, the device operates with typically 20-µA quiescent current. Using the DCS-Control™ topology, the device achieves excellent load transient performance and accurate output voltage regulation.

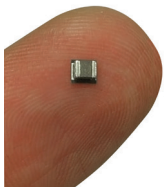


TIDesigns

- 16-Bit 1-GSPS Digitizer Reference Design with AC- and DC-Coupled Variable Gain Amplifier: **www.ti.com/tool/tida-00822**

Saves 40 mm2 PCB space (>40%) versus discrete TPS62130.





Get more information: **www.ti.com/product/TPS82130**

HotRod™ Leadframe Allows <65-mm^2 Solution Size

3-A Step-Down Converter with Hiccup Short-Circuit Protection in 2 x 2 QFN

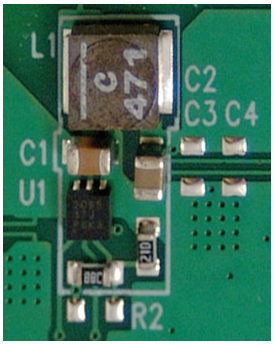
TPS62085

The TPS62085 is a high-frequency, synchronous step-down converter optimized for small solution size and high efficiency over a wide output-current range. The converter operates in PWM mode at medium to heavy loads and automatically enters power-save mode at light loads to maintain high efficiency. The switch current limit prevents the device from drawing high inductor current or excessive current from the battery or input-voltage rail. A demand for excessive current might occur with a shorted/saturated inductor, a heavy load or a shorted output circuit. Once the internal current limit is triggered 32 times, the device stops switching, resets the soft start, enables the output discharge and then automatically starts up again after a typical delay of 66 µs. This is called hiccup short-circuit protection. The device repeats this mode until the high current disappears.

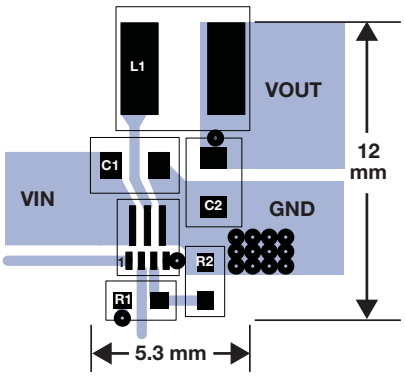
See TPS82085 for the same function and smaller footprint.

TIDesigns

- Altera Arria V GX FPGA Power Solution: **www.ti.com/tool/pmp9449**
- SSD Power Delivery Reference Design: **www.ti.com/tool/tida-00399**



Evaluation module layout.



PCB layout recommendation.

Get more information: **www.ti.com/product/TPS62085** and **TPS82085**

DC/DC Converters with DCS-Control™ Topology

Device	Input-Voltage Range (V)	Maximum Output Current	Output-Voltage Range (V)	Features	Consumer/ Wireless	Industrial/ Telecom	Q100 Available	Package	Price*
General-Purpose, Small, Efficient,									
TPS62230	2.0 to 6.0	0.5 A	Fixed Option	12-mm^2 solution footprint, 0.6-mm height	✔	✔	✔	1x1.5 SON	0.48
TPS62080	2.3 to 6.0	1.2 A	0.5 to 4.0	6.5-µA supply current (snooze mode), Power Good		✔	✔	2x2 SON	0.69
TPS62097	2.5 to 6.0	2.0 A	0.8 to V_{IN}	Power Good, adjustable soft start / tracking, frequency select		✔		2x2 QFN	0.81
TPS62085	2.5 to 6.0	3.0 A	0.8 to V_{IN}	HotRod™ package; output discharge, Power Good		✔	✔	2x2 QFN	0.87
TPS62090	2.5 to 6.0	3.0 A	0.8 to V_{IN}	Soft start, tracking, pin-to-pin to TPS62095		✔	✔	3x3 QFN	0.87
TPS62095	2.5 to 5.5	4.0 A	0.8 to V_{IN}	Soft start, tracking, pin-to-pin to TPS62090		✔		3x3 QFN	1.05
Extended Input-Voltage Range									
TPS62177	4.7 to 28	0.5 A	1.0 to 6.0	Sleep mode uses less than 5-µA supply current		✔		WSON	0.60
TPS62170	3.0 to 17	0.5 A	0.9 to 6.0	Power Good output		✔	✔	2x2 SON	0.53
TPS62160	3.0 to 17	1.0 A	0.9 to 6.0	Power Good output		✔	✔	2x2 SON, VSSOP	0.75
TPS62150	3.0 to 17	1.0 A	0.9 to 6.0	Frequency select, soft start/tracking, Power Good		✔	✔	3x3 QFN	0.79
TPS62140	3.0 to 17	2.0 A	0.9 to 6.0	Frequency select, soft start/tracking, Power Good		✔		3x3 QFN	0.88
TPS62130	3.0 to 17	3.0 A	0.9 to 6.0	Frequency select, soft start/tracking, Power Good		✔	✔	3x3 QFN	0.96
Long Battery Life, Lowest Power Consumption									
TPS62120	2.0 to 15	75mA	1.2 to 5.5	96% efficiency; extended ULVO hysteresis		✔		SOT, SON	0.50
TPS62125	3.0 to 17	0.3A	1.2 to 10	Adjustable EN threshold and hysteresis		✔		SON	0.55
TPS62730	1.9 to 3.9	0.1A	Fixed Option	Bypass for ultra-low-power RF applications	✔	✔		QFN	0.52
TPS62740	2.2 to 5.5	0.3A	1.8 to 3.3	360-nA I_q, 4-pin voltage select, load switch	✔	✔		SON/WCSP	0.94
TPS62770	2.5 to 5.5	0.3A	1.0 to 3.0	Buck + Boost + load switch, 3-pin VSEL	✔	✔		WCSP	1.50
TPS62745	3.3 to 10	0.3A	1.3 to 3.3	400-nA I_q, 4-pin voltage select, input switch		✔		2x3 SON	1.04
Modules, Integrated Inductor									
TPS82740	2.2 to 5.5	0.2A	1.8 to 3.3	360-nA I_q, 3-pin voltage select, load switch	✔	✔		MicroSiP™	1.36
TPS82084	2.5 to 6.0	2.0A	0.8 to V_{IN}	HICCUP mode, Power Good, output discharge		✔		MicroSiP	1.65
TPS82085	2.5 to 6.0	3.0A	0.8 to V_{IN}	HICCUP mode, Power Good, output discharge		✔		MicroSiP	2.15
TPS82130	3.0 to 17	3.0A	0.9 to 5.0	Power Good, extended soft start with Tracking		✔		MicroSiP	2.35

**Suggested resale price in U.S. dollars in quantities of 1,000.*

*Preview devices are listed in **bold teal.** New devices are listed in **bold red**.*

Additional Resources

Application Notes

- ±5% Voltage Margining (**www.ti.com/lit/SLVA489**)
- Easy Solar-Panel Maximum-Power-Point Tracking for Pulsed-Load Applications (**www.ti.com/lit/SLVA478**)
- Using the Wireless SimpleLink™ CC26xx in External Regulator Mode with the TPS62740 (**www.ti.com/lit/SLVA498**)
- How to Measure the Control Loop of DCS-Control™ Devices (**www.ti.com/lit/SLVA465**)
- Choosing an Appropriate Pull-Up/Pull-Down Resistor for Open Drain Outputs (**www.ti.com/lit/SLVA485**)
- Current Savings in CC254x Applications Using the TPS62730 (**www.ti.com/lit/SWRA365**)
- Using a DC/DC Converter to Reduce Power (Current) Consumption in CC430 Systems (**www.ti.com/lit/SLAA500**)
- Powering a Low-Power MCU from a High-Voltage Input (**www.ti.com/lit/SLVA335**)
- Using the TPS6215x in an Inverting Buck-Boost Topology (**www.ti.com/lit/SLVA469**)

TIDesigns

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- Ultra-Small 1-W, 12- to 36-V Iso Power Supply for Analog Prog Logic Controller Modules: **www.ti.com/tool/tida-00237**
- Altera Arria V GX FPGA Power Solution: **www.ti.com/tool/pmp9449**
- SSD Power Delivery Reference Design: **www.ti.com/tool/tida-00399**
- Power Solution for Battery Operated Meters With 30-dBm wM-Bus at 169 MHz: **www.ti.com/tool/tida-00676**
- Energy Buffering for Long-Life Battery Applications: **www.ti.com/tool/pmp9753**
- Data Collector for wM-Bus T-/C-Mode & DSSS-Coded Data Packets: **www.ti.com/tool/tidc-dsss868wmbus-dc**

Get more information: **www.ti.com/dcs-control**

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