

Welcome!

Texas Instruments New Product Update

- This webinar will be recorded and available at www.ti.com/npu
- Phone lines will be muted
- Please post questions in the chat or contact your sales person or field applications engineer

New Product Update: LED Illumination Drivers

Kenneth Du

2021.01.07

Agenda

- LED functions quick overview
- TI LED illumination drivers roadmap update
- Latest LED illumination driver TPS92200 introduction
 - Ultra-high efficiency
 - Flexible dimming method
 - Full protections
 - Applications

Agenda

- LED functions quick overview
- TI LED illumination drivers roadmap update
- Latest LED illumination driver TPS92200 introduction
 - Ultra-high efficiency
 - Flexible dimming method
 - Full protections
 - Applications

LED functions quick overview



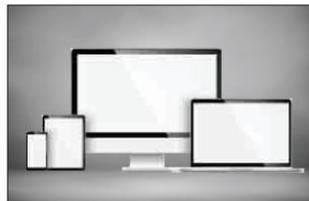
LED indication



LED animation



LED illumination



LED backlight



Common LED Functions and LED Driver Design Considerations

Visit www.ti.com/LED



RGB LED drivers

Add animation or indication functionality to your polychromatic LED arrays with our RGB LED drivers. Our versatile, multi-channel solutions are compatible for a variety of common interfaces.

[Learn more](#)



LED display drivers

Control individual LED strings with high integration and low-power consumption. Find a multi-channel LED driver for large or narrow pixel pitches, or a matrix solution for mini and micro-LED digital display signage applications.

[Learn more](#)



Backlight LED drivers

View our large portfolio of step-up (boost) LED drivers that utilize precise dimming control for LCD panel backlighting. Light a wide range of screen sizes with maximum VIN options from 1.8 V to 45 V.

[Learn more](#)



Illumination LED drivers

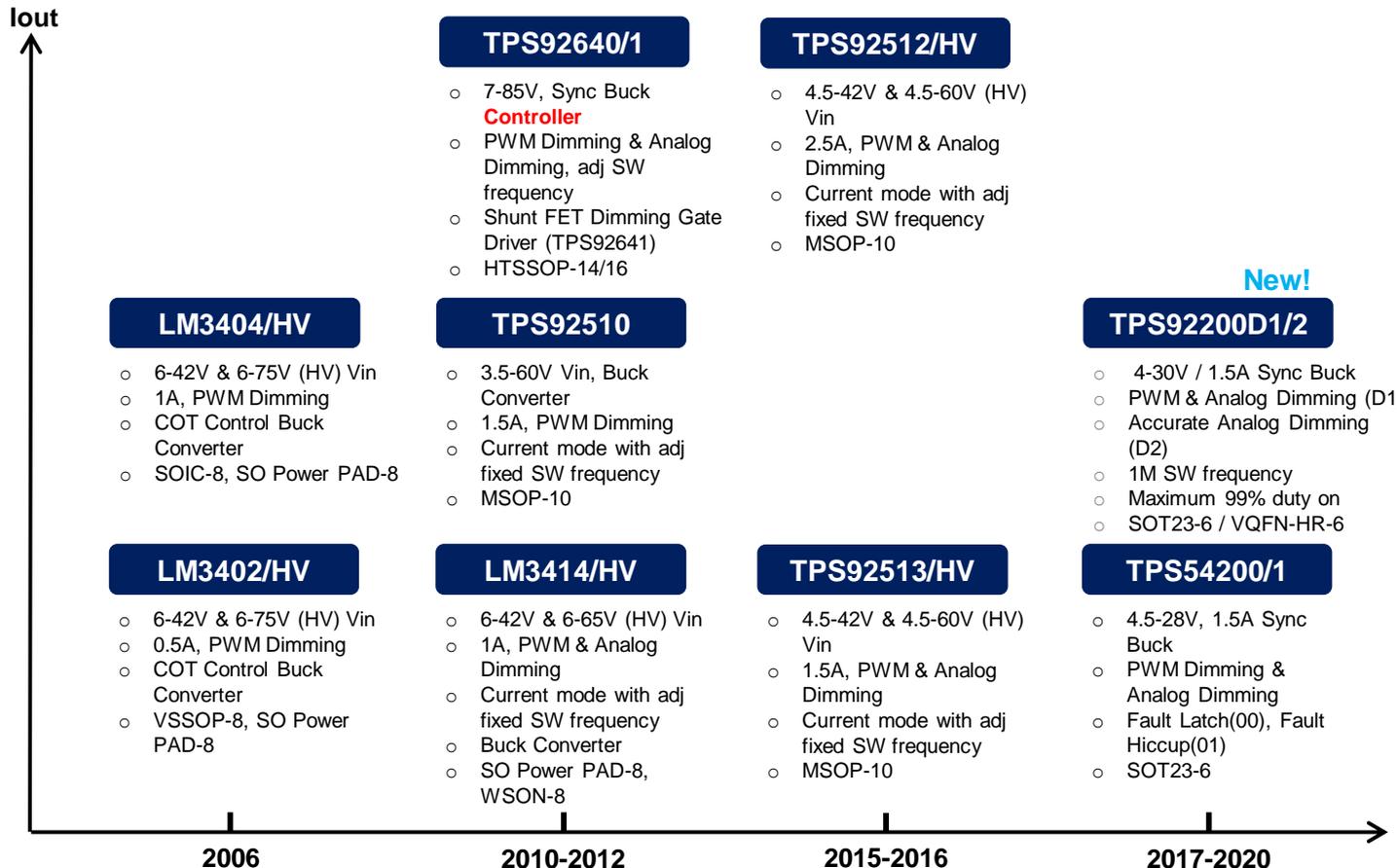
Enable illumination with infrared, multi-color or UV lights in your industrial or personal electronics designs with our step-down (buck) or multi-topology constant-current regulators.

[Learn more](#)

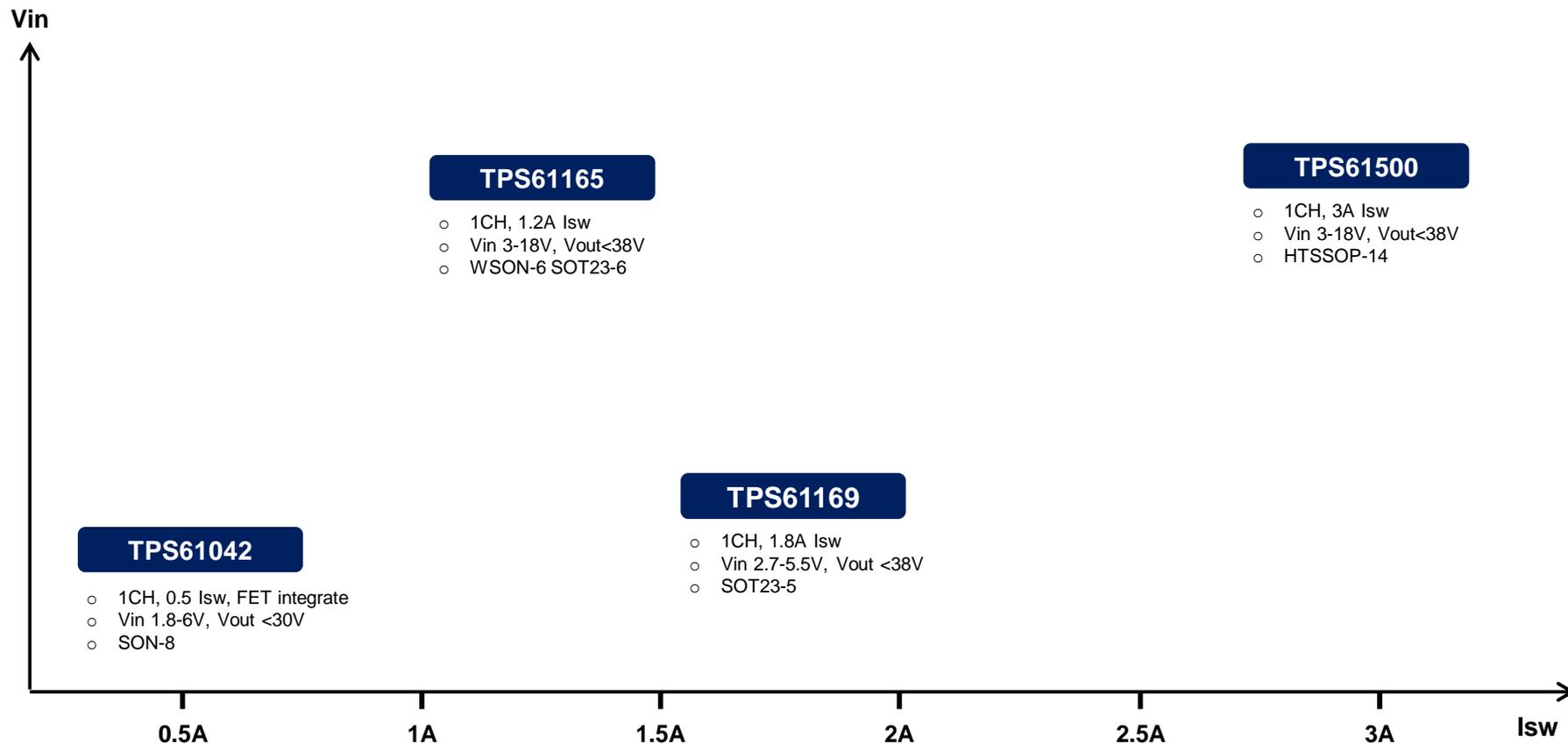
Agenda

- LED functions quick overview
- TI LED illumination drivers roadmap update
- Latest LED illumination driver TPS92200 introduction
 - Ultra-high efficiency
 - Flexible dimming method
 - Full protections
 - Applications

Buck/SEPIC LED illumination driver roadmap



Boost LED illumination driver roadmap



Agenda

- LED functions quick overview
- TI LED illumination drivers roadmap update
- Latest LED illumination driver TPS92200 introduction
 - Ultra-high efficiency
 - Flexible dimming method
 - Full protections
 - Applications

TPS92200

4-30V/1.5-A Synchronous buck LED driver with flexible dimming options

Features

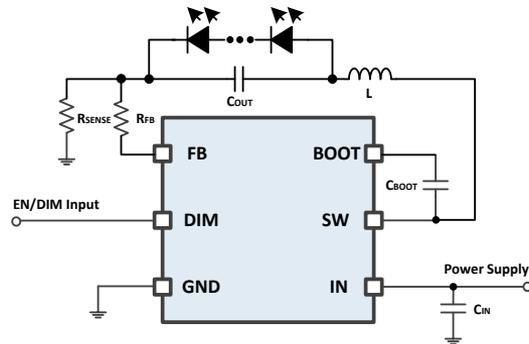
- 4V to 30V Wide Input Range
- Integrated 150mΩ/90mΩ MOSFETs for 1.5A Continuous Output Current
- 1MHz Switching Frequency
- Ultra-Low Shutdown Current: 1-μA
- Ultra-Low Output Discharge Current from Load: 1-μA (Charger application)
- Maximum Duty Cycle up to 99%
- **High efficiency up to 97% ($V_{in} = 12V$, 6 IR LEDs in series at 1.5A)**
- **Flexible Dimming Options for different applications:**
 - TPS92200D1: PWM Dimming with Digital Input and Analog Dimming with Analog Input
 - TPS92200D2: Analog Dimming with Digital Input
- Ultra-low and Accurate FB Voltage: 99mV/+/-3mV
- Peak Current mode with Internal Compensation
- **Full Protections:**
 - LED Open
 - LED+ Short to GND
 - LED+ / LED- Short Circuitry
 - Sense Resistor Open / Short Protection
 - Thermal Shutdown
- SOT23-6 (2.8 x 2.9 mm), VQFN-HR-6 (1.5 x 2 mm)

Applications

- **Video Surveillance** IR LED Driver
- **Facial Recognition** IR LED Driver
- **Stage Lighting** LED Driver
- **General Industrial and Commercial Illumination**
- **AA or Li-ion Battery Charger**

Benefits

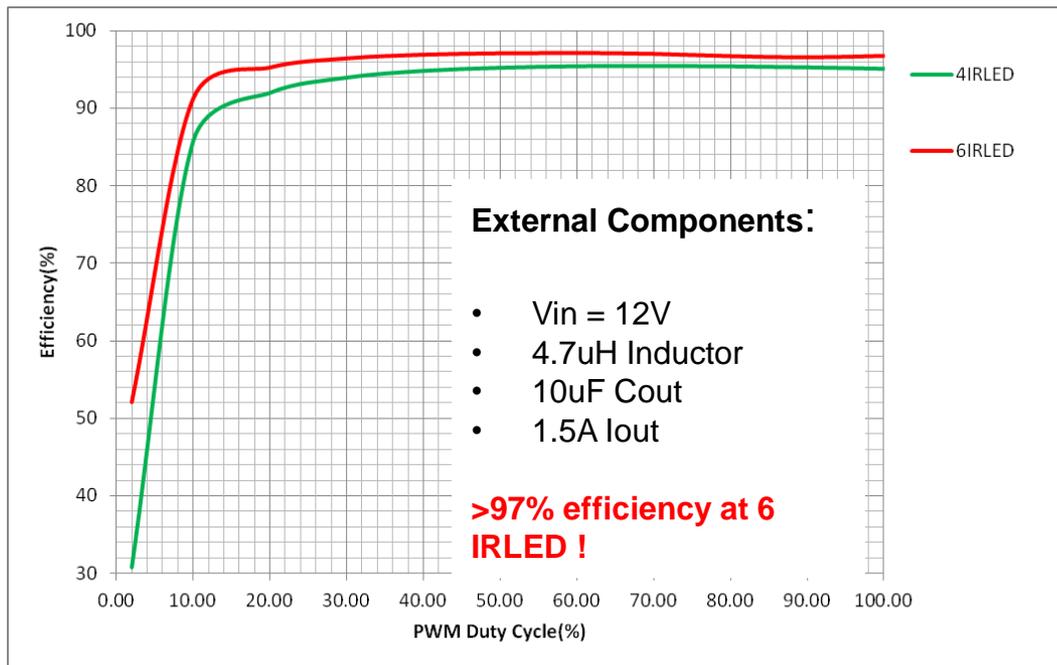
- **Ultra-low FB voltage for higher Efficiency**
- Ultra-low Shutdown Current (<1μA)
- **Flexible Dimming Options for Various Applications**
- Ultra-low Output Discharge Current help to Save An Output Diode for Charger Application
- Small and Few external component count to optimize board space and cost



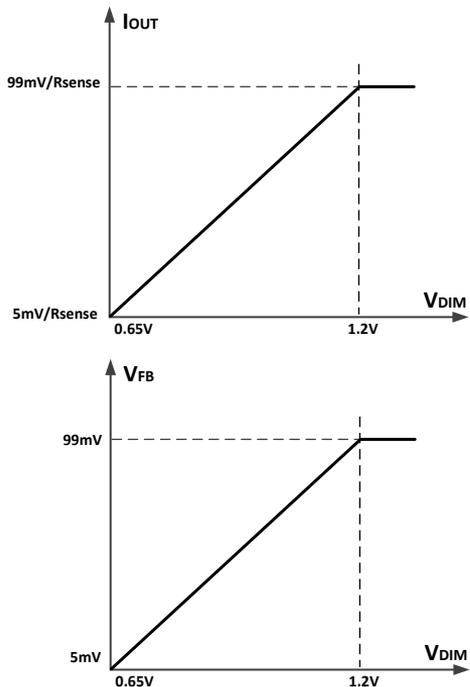
Device	Dimming Type	Dimming Input Type
TPS92200D1	PWM Dimming	Digital Signal (frequency: 100Hz – 2kHz)
	Analog Dimming	Analog Voltage (amplitude: 0.65-1.2V)
TPS92200D2	Analog Dimming	Digital Signal (frequency: 20kHz – 200kHz)

Ultra-high efficiency

- Synchronous topology
- Low R_{dson}
- 99mV FB voltage



Flexible dimming method - TPS92200D1



TPS92200D1 Analog Dimming

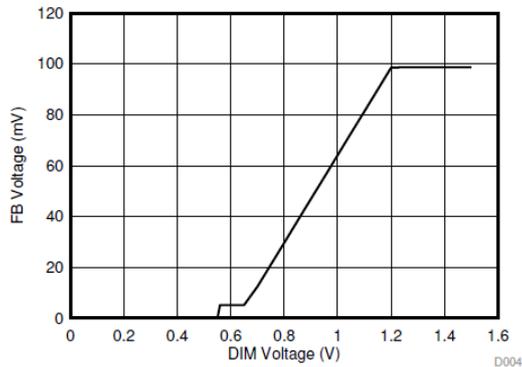
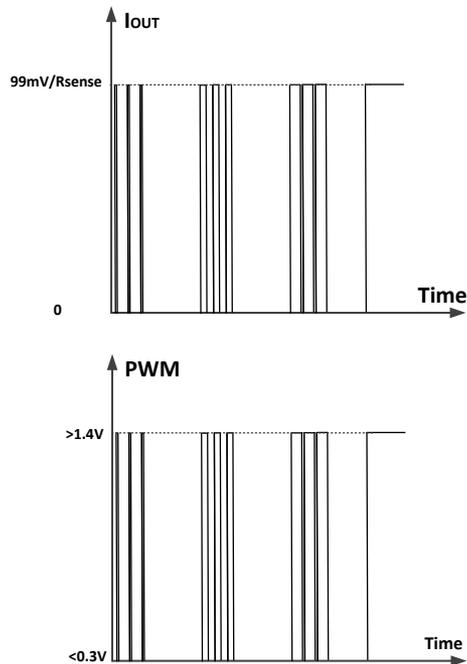


Figure 4. DIM Voltage vs. FB Voltage in Analog Dimming (For TPS92200D1)

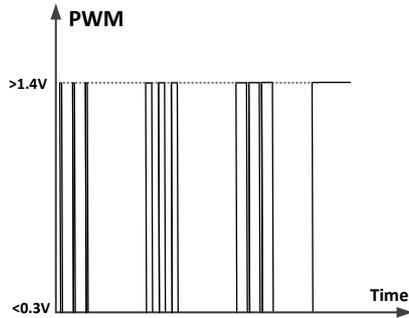
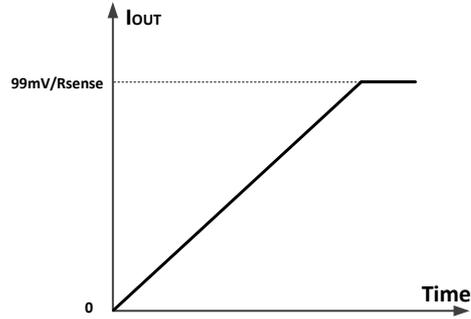


TPS92200D1 PWM Dimming

Analog dimming with voltage input

PWM dimming – Main FET

Flexible dimming method - TPS92200D2



TPS92200D2 Analog Dimming

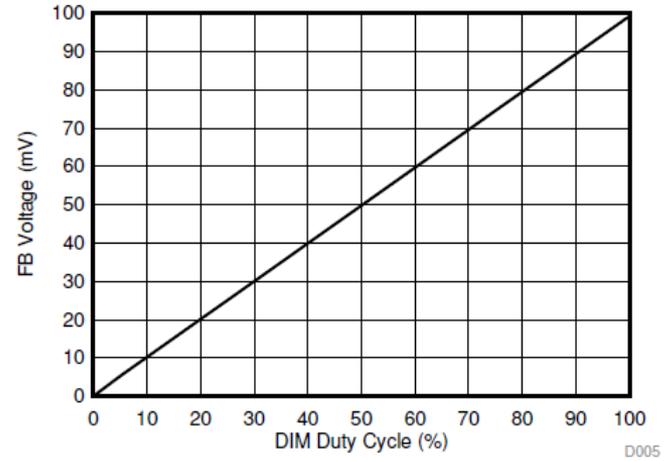


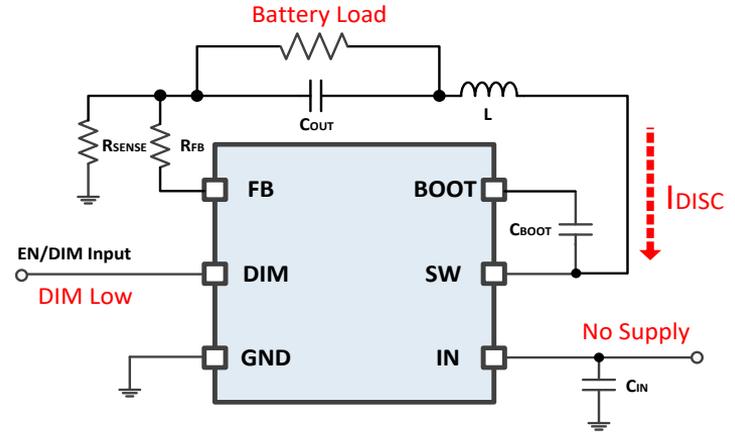
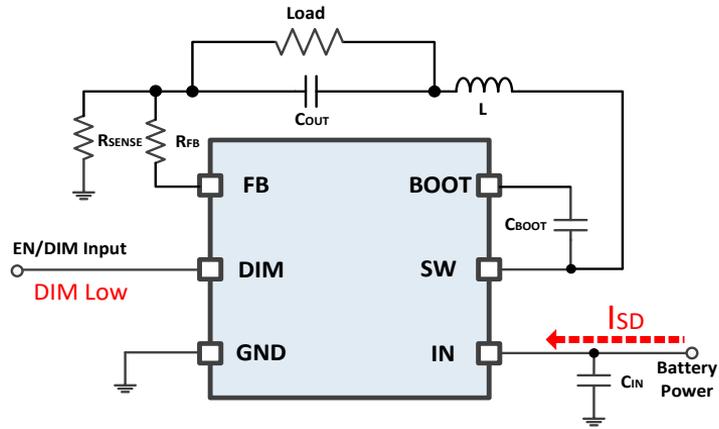
Figure 5. DIM Duty Cycle vs. FB Voltage in Analog Dimming (For TPS92200D2)

Analog dimming with PWM input

Full protections

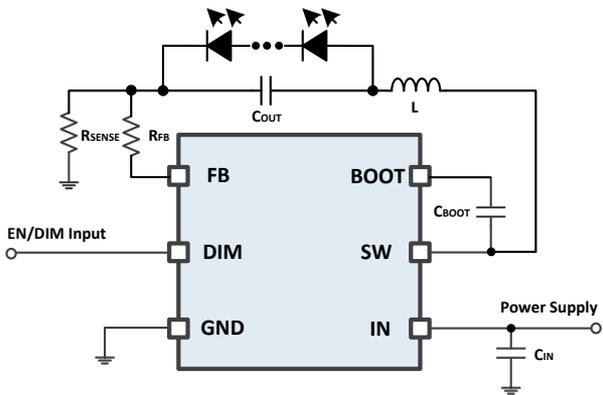
Fault Type	Criterion	Behavior
LED Open Load	VFB close to 0mV	The device keeps maximum turn-on duty cycle
LED+ and LED- Short Circuit	VFB > VFB_OVP	When VFB > VFB_OVP, the device keeps operating at minimum on time, and starts the auto-retry timer
LED+ Short to GND	High-side or low-side NMOS current limit triggered	When the high-side or low-side NMOS current limit is triggered, the device starts the auto-retry timer
Sense Resistor Open Load	VFB > VFB_OVP	When VFB > VFB_OVP, the device keeps operating at minimum on time, and starts the auto-retry timer
Sense Resistor Short Circuit to GND	High-side or low-side NMOS current limit triggered	When the high-side or low-side NMOS current limit is triggered, the device starts the auto-retry timer
Thermal Shutdown	TJ > TTSD	The device is disabled when TJ > TTSD, the device is re-activate when TJ falls below the hysteresis level

Ultra-low shutdown and discharge current



Parameter	Description	Value	Benefit
ISD	When DIM = Low, the current flow into IN pin	1uA	Reduce system power consumption
IDISC	When DIM or IN = Low, the current flow into SW & BOOT pin	1uA	When used as a charger and load is battery, increase battery endurance time

Application I: as IR LED/White driver



Video surveillance IR/White LED driver



Facial recognition IR LED driver

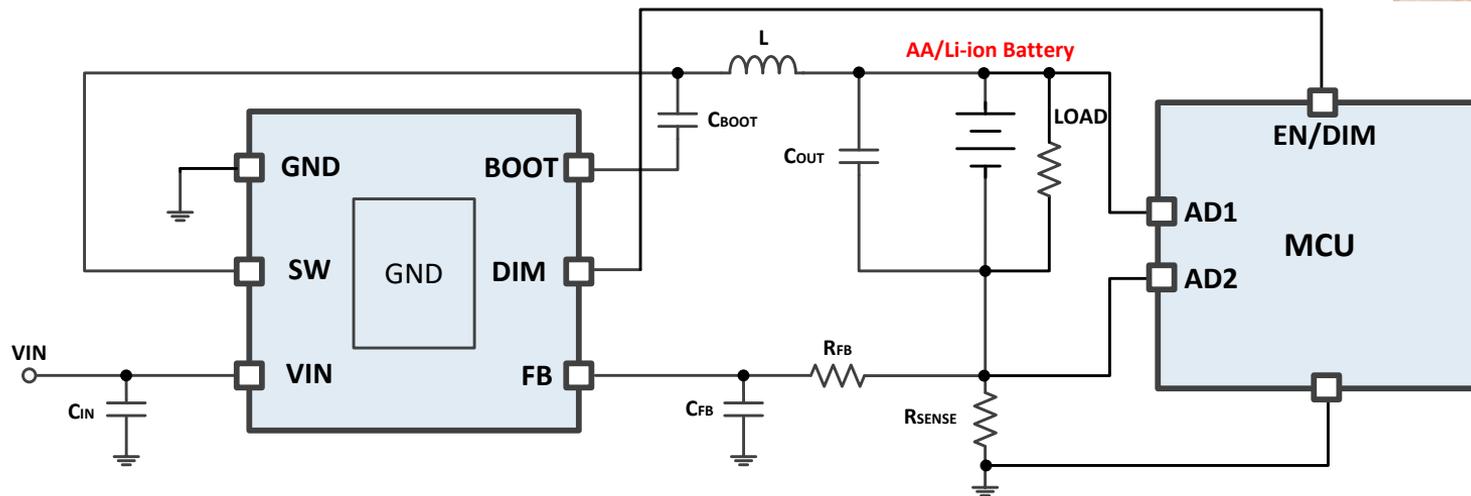


Stage lighting LED driver



General industrial and commercial illumination

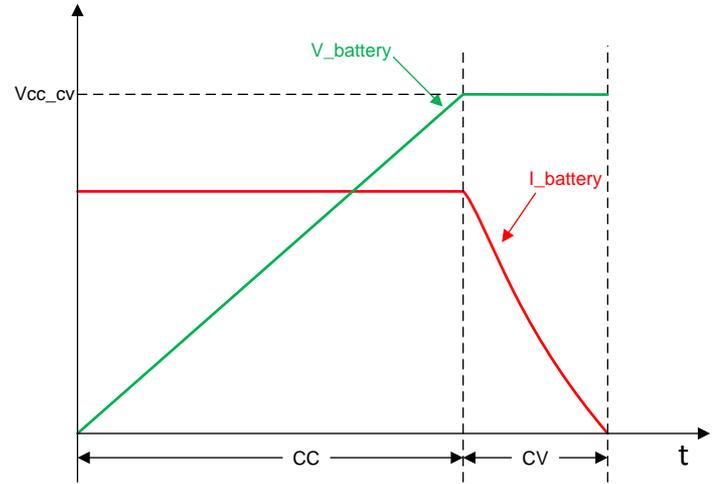
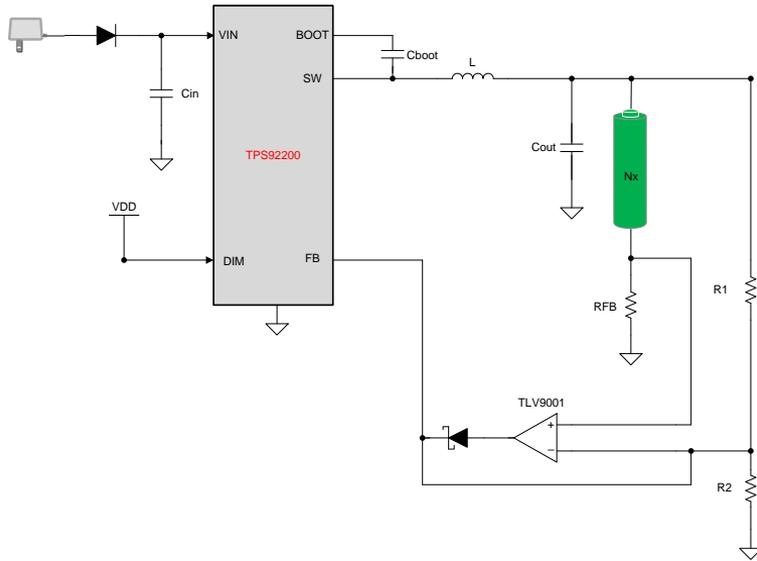
Application II: as battery charger



	Pre-charge	Full-charge	Constant voltage
Li-ion	YES with TPS92200 CC loop	YES with TPS92200 CC loop	YES with MCU CV loop
Ni-MH (2 cells)	Optional	YES with TPS92200 CC loop	No

System block diagrams

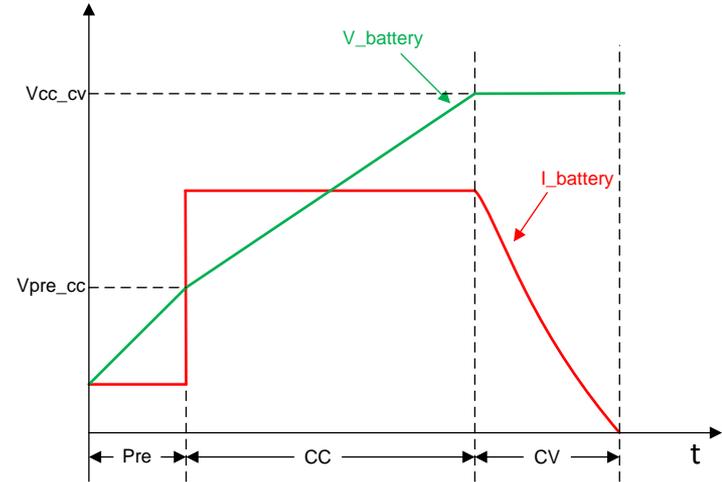
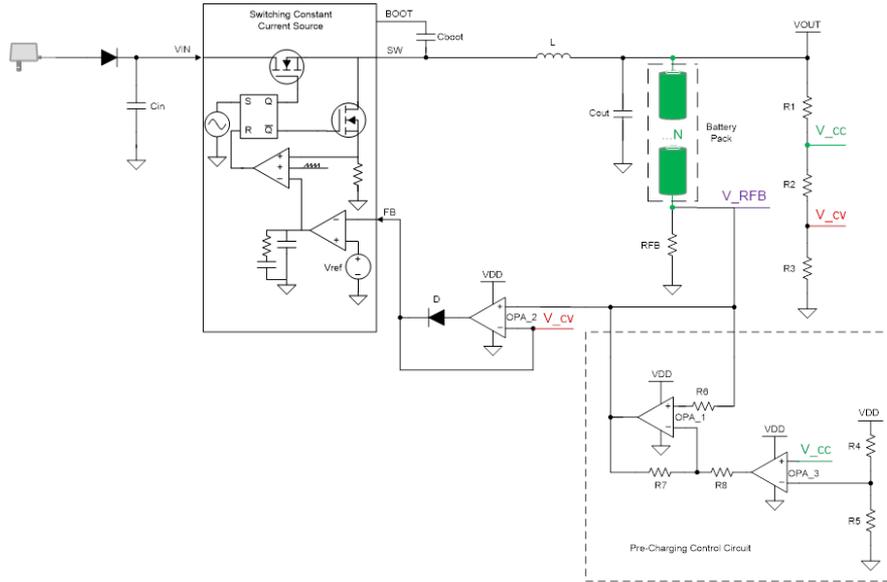
—CC/CV Battery charger solution



Advantage: Pure hardware CC/CV loop, low cost;
Disadvantage: No Pre-charge mode

System block diagrams

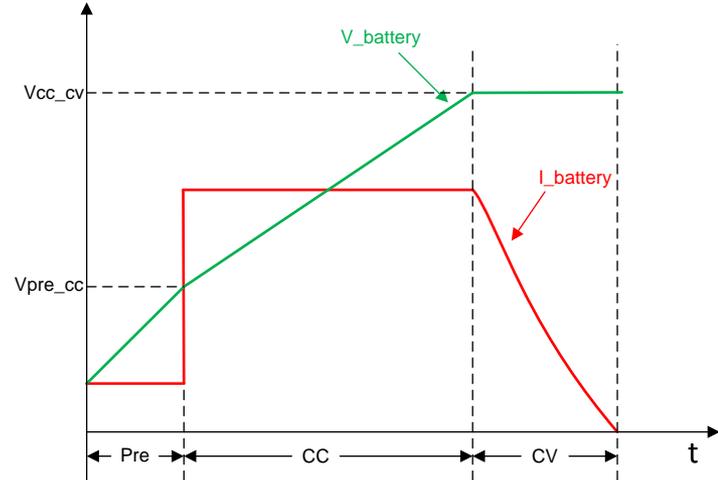
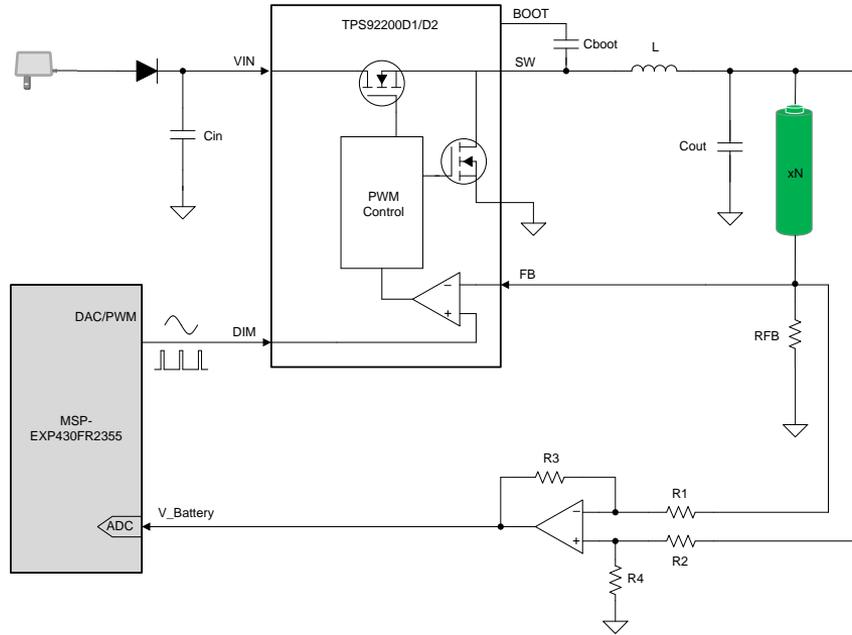
—PC/CC/CV Battery charger solution



Advantage: Pure hardware PC/CC/CV loop, customized pre-charge current;
Disadvantage: Need two channel amplifier + one channel comparator;

System block diagrams

—PC/CC/CV Battery charger solution3



Advantage: high precision and customized parameters;
Disadvantage: Need one channel amplifier + MCU(ADC)

TIDA-050042

1-6s, up to 1.5A Li-ion Battery Charger Solution with Switching Constant Current Source

Features

- Support from 4-V to 30-V input voltage range(1 - 6s Li-ion Battery)
- Up to 1.5A maximum charging current
- Pure hardware configurable 3-stage charging with TPS92200
 - Pre-Charge, CC & CV
 - CC & CV
- Small solution Size: 25mm x 30mm

Target Applications

- Vacuum Robot
- Cordless vacuum cleaner
- Electric shaver
- Small appliances
- Power Tools

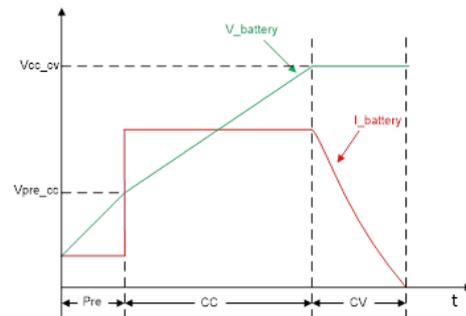
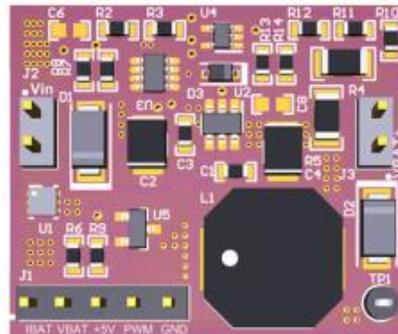
Tools & Resources

- [Design Guide](#)
- [Design Files](#)
- [Simulation Files](#)

- **Device Datasheets:**
 - [TPS92200](#)
 - [TLV9002](#)
 - [TLV7021](#)

Benefits

- **Size and Cost Optimized**
 - Small PCB size, higher power density with 2-Layer layout
 - 1MHz switching frequency enables lower value and smaller size of inductor and capacitors
 - TPS92200(\$0.18@1Ku) TLV9002(\$0.16@1Ku) TLV7021(\$0.16@1Ku)
- **Pure analog control topology**
 - Implement pre-charge with simple analog circuit
 - Enables smooth and stable CC -> CV transition with internal compensation and simple control logic
- **High Charge Accuracy($\pm 3\%$)** enables maximum usable battery capacity
- **High Charge Current 1.5-A** enables fast charge



Visit www.ti.com/npu

For more information on the New Product Update series, calendar and archived recordings



©2020 Texas Instruments Incorporated. All rights reserved.

The material is provided strictly "as-is" for informational purposes only and without any warranty.
Use of this material is subject to TI's **Terms of Use**, viewable at [TI.com](https://www.ti.com)

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (<https://www.ti.com/legal/termsofsale.html>) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2021, Texas Instruments Incorporated