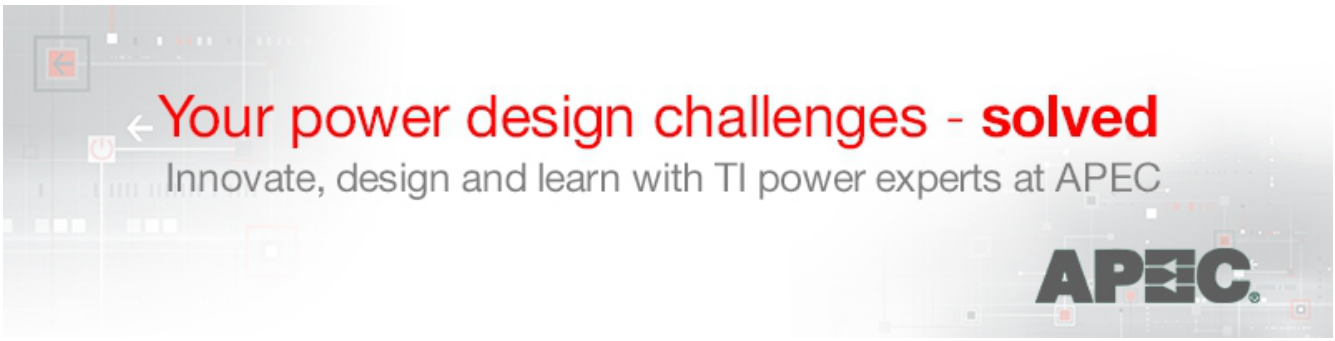
Technical Article

Searching for the Newest Innovations in Power? Find Them at APEC

Pradeep Shenoy



The Applied Power Electronics Conference (APEC) is a power engineer's dream – everyone in the industry attended and the blend of new technologies, new research and new connections created an electric energy. Last year, APEC had over 5,000 attendees making it one of the largest power conferences in the world. TI is proud to be a part of it – we hosted five industry sessions, four poster sessions and three technical lectures; we're excited to recap the experience with you!

Here is all you need to know about TI's involvement in the 2019 APEC conference, even if you couldn't make it to APEC this year, relive it with us below!

Check Out the Technical Presentations (PDF) We Hosted This Year!

Smart AC/DC linear regulator that saves you space Made in partnership with Kilby Labs, the TPS7A78's architecture solves common design challenges in Internet of Things and automation applications by reducing standby power to just a few tens of milliwatts in one-fourth the space. Using the switched-capacitor topology, this smart linear regulator eliminates external inductors/transformers for a tamper-resistant design while helping linear regulators evolve into AC/DC power designs. This is a simple approach to improving efficiency for non-magnetic AC/DC conversion.	±10-A isolated driver with fast protection and integrated sensor Watch live switching of an 800-V/200-A insulated gate bipolar transistor (IGBT) power module with overcurrent detection and safe module shutdown displayed on a scope. The IGBT module is driven by our latest ±10-A isolated gate driver, the UCC21750, which features integrated, fast short-circuit protection; safe shutdown capability; and an integrated, isolated sensor to measure the IGBT die temperature live and in action. A static printed circuit board will demonstrate how overall system and board size can be reduced to drive high-power solutions.
Automotive mild hybrid 48-V/12-V power supply reference design The development of AEC-Q100 switching power supplies with wider input voltage ranges and battery-friendly features is being catalyzed by the increasing prevalence of hybrid electric vehicles. TI's design eliminates intermediate power rail risks with co-existing 12-V and 48-V battery power systems, showcasing the wide input voltage capabilities of the LM5164-Q1 100-V, 1-A synchronous buck converter and the LM5180-Q1 65-V primary-side-regulated flyback converter.	High CMTI, opto-emulated isolated gate driver Upgrade your device with this drop-in replacement to optocoupler gate drivers. This video showcases a three-phase inverter reference design for 200-480 VAC drives with the new UCC23513 opto-emulated gate driver. Also see a live demo of a low-voltage half-bridge driver using the UCC23513 to drive insulated gate bipolar transistors, including key waveforms and features. The demonstration highlights the benefits of capacitive isolation when using this opto-emulated isolated gate driver over traditional optocoupler gate drivers.

Demos Highlights:

- **Isolating power safely**
  - **±10-A isolated driver with fast protection and integrated sensor:** We showcased live switching of an 800-V/200-A insulated gate bipolar transistor (IGBT) power module with overcurrent detection and safe

module shutdown displayed on a scope. The IGBT module is driven by our latest ±10-A isolated gate driver, the UCC21750, which features integrated, fast short-circuit protection; safe shutdown capability; and an integrated, isolated sensor to measure the IGBT die temperature. A static printed circuit board demonstrated how designers can reduce system and board size to drive high-power solutions by using this device.

  - **High CMTI, opto-emulated isolated gate driver:** Upgrade your device with this drop-in replacement to optocoupler gate drivers. This demo showcased a three-phase inverter reference design for 200-480 VAC drives with the new UCC23513 opto-emulated gate driver. There was also a demo of a low-voltage half-bridge driver using the UCC23513 to drive insulated gate bipolar transistors, including key waveforms and features. The demonstration highlighted the advanced benefits of capacitive isolation when using this opto-emulated isolated gate driver over traditional optocoupler gate drivers.

- **More power, less space**
  - **Smart AC/DC linear regulator that saves you space**: Made in partnership with Kilby Labs, the TPS7A78's architecture solves common design challenges in Internet of Things and automation applications by reducing standby power to just a few tens of milliwatts in one-fourth the space. Using the switched-capacitor topology, this smart linear regulator eliminates external inductors/transformers for a tamper-resistant design while helping linear regulators evolve into AC/DC power designs. This is a simple approach to improving efficiency for nonmagnetic AC/DC conversion.
  - **Lose the fan with GaN: a 99% efficient 1.5-kW robotics motor drive with GaN:** This demo featured a complete three-phase design for a compact, integrated motor drive showcasing the LMG3411R150 gallium nitride (GaN) power stage and Delfino™ TMS320F28379D microcontroller. TI GaN reduces total power loss in the drive by as much as 70%, enabling designers to integrate the drive electronics within the motor assembly, eliminating the need for cooling fans and bulky heat sinks. As a result, stand-alone cabinets and long power and communication cables are eliminated from the factory floor, while improving equipment life and performance.
  - **Faster charging with USB Type-C™ technology:** USB Type-C™ technology allows faster charging for both AC/DC and automotive applications using gallium nitride and silicon. Our award-winning UCC28780 active clamp flyback controller enables industry-leading power density for AC/DC adapters.
  - **Digitally controlled adaptive peak current mode-controlled phase-shifted full bridge for onboard charging**: This demo showcased a new reference design that leverages the differentiated on-chip control and protection features on the C2000™ F280049 microcontroller to enable adaptive peak current mode control of a phase-shifted full-bridge converter without the need for external hardware support circuitry.
  - **330-W, high efficiency at low line input, gaming notebook adapter:** Improve the power density of your AC/DC 330-W gaming notebook adapter with this reference design. The design's efficiency is higher than 95% at full load, while the power density is higher than 18 W/in^3, with natural cooling and power consumption lower than 0.5 W at no load. In order to reach this level of efficiency, the design uses advanced bridgeless power factor correction and a soft-switching inductor-inductor-capacitor topology.
  - **Digitally controlled high-voltage, power, efficiency and density bidirectional chargers with SiC FETs**: A new 6.6-kW bidirectional CLLLC DAB isolated DC/DC reference design with 300- to 700-kHz switching features the C2000™ F280049 microcontroller and UCC21530-Q1 silicon carbide gate drivers. This design highlights advanced digital control techniques and wide band-gap technology to enable higher efficiency and higher density chargers. Pairing with the totem-pole PFC reference design provides a complete solution for high-voltage battery-charging applications for onboard chargers (conventional and vehicle-to-grid) and grid storage.
- **Lowering EMI**
  - **Four-phase, low EMI surround-view ADAS camera power supply:** Camera-based automotive safety systems continue to require more processing power in less printed circuit board area, increasing the importance of higher power density and efficiency. The LM5143-Q1 demonstration was a four-phase wide V_{IN} surround-view driver assistance system power supply capable of producing up to 30 A, with the ultra-low-dropout, low EMI LM5143-Q1 buck controller as the centerpiece. Improved loop compensation, transient response, load and line regulation and current are shared across four paralleled phases for higher output current and optimized thermal performance.
- **Extending battery life**
  - **Automotive mild hybrid 48-V/12-V power supply reference design:** The development of AEC-Q100 switching power supplies with wider input voltage ranges and battery-friendly features is being catalyzed by the increasing prevalence of hybrid electric vehicles. TI's featured design eliminates intermediate

power rail risks with co-existing 12-V and 48-V battery power systems, showcasing the wide input voltage capabilities of the LM5164-Q1 100-V, 1-A synchronous buck converter and the LM5180-Q1 65-V primary-side-regulated flyback converter.

- **Three functions in a single-chip solution:** This demo features the BQ40Z80 battery pack manager as we demonstrate how it monitors and protects a battery pack cell by cell while using our patented Impedance Track™ technology for accurate gauging. Designed with ease of use in mind, this device enables eight multifunction pins for configurability in a single chip.
- **Accurate gauging and 50-µA standby current, 13S, 48-V Li-ion battery pack reference design:** Optimize your e-bike 13S battery pack system design with extended run time and idle time and low current consumption with our accurate gauging reference design. This design features state-of-charge gauging based on the BQ34z100-G1 and this demo shows the two ways to improve energy utilization efficiency by increasing state-of-charge accuracy and reducing current consumption.

Weren't Able to Attend This Year? Recap the Event below!

This was a record breaking year for APEC, it was largest one in history with over **6,000 people** in attendance! There was a palpable excitement and desire to engage, and it seemed like every session overflowed with people. One session I attended was a popular seminar on hybrid and resonant power converters by Prof. Robert Pilawa from UC Berkeley. Attendees were so dedicated that some had to stand in the back for the entire 3.5 hour long session. Another standout was a technical session by Dr. Gab-Su Seo; he demonstrated solar inverters that use dispatchable virtual oscillator control to form an AC grid in a decentralized manner. The learnings from this session could really help as more solar panels are connected to the power grid. This whole experience reminded me how exciting the future of power electronics is.

At TI, we focus our efforts on solving the industry's toughest power design challenges. These could be maintaining power density, or could be reaching 99% efficiency levels, or maybe it's simply keeping a short BOM - no matter what you're facing, we will work with you to solve it. But this all starts with identifying what's important to *you*. That's why we decided to ask APEC attendees a simple question: "What are your biggest design challenges?". The responses we got were varied, difficult problems, but we're confident that we can work towards a solution. After all, we can only reach innovation through adversity and these challenges might just lead to next big thing in APEC 2020!

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265