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NSREC Notes: Advanced PWM Controllers, Power MOSFETs, Buck Converters And QML Parts Are Among The Latest Power Products For Space

by David G. Morrison, Editor, How2Power.com

At this year's IEEE Nuclear & Space Radiation Effects Conference (NSREC 2025), held July 14-18 in Nashville, semiconductor and power converter companies showcased a variety of new rad-hard and rad-tolerant power ICs, reference designs, and power converter modules for space along with news of power MOSFET developments from a growing list of suppliers. Semiconductor manufacturers also highlighted their progress in achieving QML certification for many of their power components.

PWM controllers figured prominently among the power chips being shown in the expo. One innovative device from Renesas was a rad-tolerant double-ended PWM controller that supports multiple power supply topologies. Another from the same company was a rad-hard single-/dual-phase current-mode PWM controller that is PM bus-enabled. Meanwhile, EPC Space discussed its first PWM controller, a rad-hard IC specifically designed to drive a GaN-based power stage. This part has radiation hardness specs well beyond those normally designed for space as it was developed for powering sensors in CERN's Large Hadron Collider (LHC).

There were also several new buck converter ICs such as a new family of rad-hard 14-V input buck converters which generate outputs down to 0.6 V and a 3-V to 7-V input, quad-channel 3-A/channel buck converter with built-in sequencing from Texas Instruments. Another exhibitor, STMicroelectronics highlighted a rad-hard 5-A buck regulator with 3-V to 12-V input.

These buck converter chips were complemented by new point-of-load regulator modules such as a functionally complete 3-A rad-hard switching regulator module housed in a 12-pin flat-pack. This part from TTM Technologies generates an output as low as 0.6 V while operating from an input of 3 V to 16 V. This company is also developing a rad-hard GaN half bridge with integrated drivers, which will feature a Vin of 4.75 V to 18 V and output current up to 60 A for point-of-load converter applications and motor drives.

Other interesting power ICs included a rad-hard, QMLV, 3-V to 14-V, four-channel supervisor with watchdog timer and a 200-V rad-tolerant power stage combining silicon gate drivers and GaN FETs from Texas Instruments.

Semiconductor companies also continue to expand their power management reference designs for FPGAs. While last year, reference designs for AMD's Versal IC were prominent, this year there were designs for lower-power devices such as Microchip's PolarFire (Renesas) and AMD's Versal Edge FPGA (TI).

Other interesting reference designs included a 300-W ZVS full-bridge (TI) and a three-phase motor drive reference design employing half-bridge GaN power stages (EPC Space). But aside from these individual power management reference designs, it was particularly interesting to see one company's collection of reference designs to power a satellite's full electrical power system (EPS) (TI).

The semiconductor companies also showed or discussed multiple discrete power devices that they have developed. Reports of rad-hard silicon MOSFET developments from several vendors highlighted how the industry is responding to demands to move beyond a single source for these critical components. For example, Microchip now has a full family of rad-hard MOSFETs that are DLA qualified, and new products are coming. Meanwhile new GaN power transistors continue to enter the space market such as a rad-hard 300-V GaN FET from EPC Space.

Perhaps the most intriguing power transistor development came from a semiconductor startup that was not exhibiting but which had representatives in attendance. Semi Zabala reported that they have developed and are qualifying 600-V rad-hard GaN HEMTs for space applications. These are expected to challenge SiC MOSFETs, which require severe derating in rad-hard applications. Test results for these new GaN devices were featured in a poster by NASA in NSREC's Data Workshop.

In addition to the ICs, reference designs and discrete power semiconductors highlighted in the NSREC expo, there were a number of new dc-dc power modules. These included 6-,15-, 30- and 100-W rad-tolerant dc-dc converters from VPT. The company also discussed plans for a GaN-based family of 100-W hybrid-style, rad-hard dc-dc converters.

This article presents further details on the above and other power products presented in the NSREC 2025 exhibition. In addition, those interested in these developments may also appreciate the power-related papers presented in NSREC 2025's Radiation Effects Data Workshop and other paper and poster sessions. A list of these papers is included at the end of this article.

Power ICs And Reference Designs

Renesas showcased a number of its power ICs for space in its latest reference designs. A key example was its ISLRTPFDEMO1Z power management reference design for Microchip's RT PolarFire FPGA. In contrast with AMD's Versal, for which Renesas showed a power management reference design last year at NSREC, PolarFire is a less-power-hungry device.

The ISLRTPFDEMO1Z reference design includes regulators for all RT PolarFire rails and for DDR4 memory (Fig. 1). The eval board on display featured rad-tolerant versions of these devices, but as Abigail Eberts, strategic and technical product marketing, Intersil High Reliability & Space Products Analog & Connectivity, noted, the company also has rad-hard versions in plastic and hermetic packages.

Although the company has shown a power management reference design for PolarFire previously, this version shows more realistic layouts for the individual power blocks in order to showcase their true solution size, said Eberts. These layouts are outlined on the eval board as shown in Fig. 1. Another reason for highlighting the individual power blocks, said Eberts is that the flexibility of the FPGA and DDR is such that the user may not need all the power rails.

This reference design features a new power device, the ISL75055, which is a DDR terminator and general-purpose LDO. It includes an on-chip buffer and both inputs at the error amp are pinned. It features 600-µV deadband from source to sink and excellent transient performance. There are separate overcurrent limits for source and sink. Additionally, you can configure discharge behavior. This device was scheduled to be released in October.

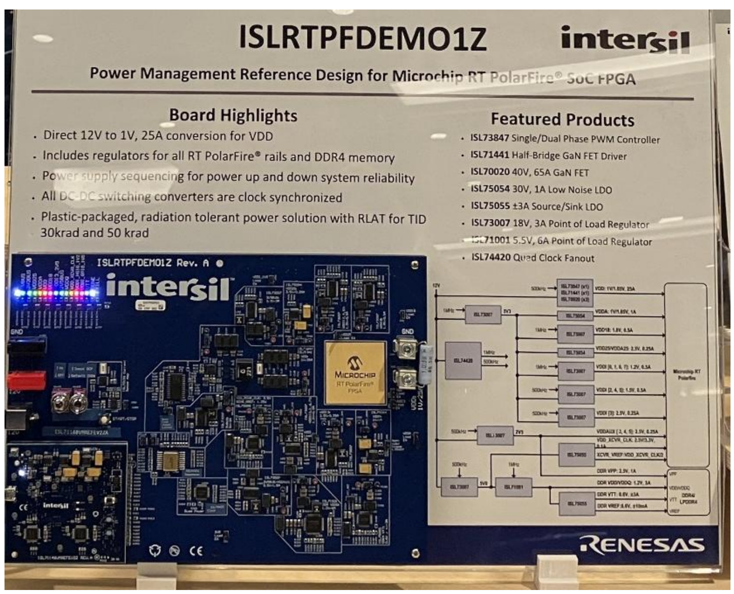

Fig. 1. The ISLRTPFDEMO1Z reference design includes regulators for all RT PolarFire rails and for DDR4 memory.

Another new device highlighted at the Renesas booth was the ISL73846, a double-ended PWM controller, which was released a couple weeks before NSREC (Fig. 2). This is a highly configurable device that supports multiple power supply topologies. To this end, the company is developing eval boards using this controller for push-pull, forward, boost, active clamp forward, flyback, half-bridge and full-bridge designs. This controller also features synchronous rectification and directly drives MOSFETs and GaN FETs. In addition, it includes an internal error amp but also allows use of an external one.

The initial version of the ISL73846 is rad-tolerant, but a rad-hard version was also planned. This device was subsequently reported in the August issue of Renesas' Rad Hard newsletter.

Three reference designs have been released online for this controller. These include a 28-V to 12-V, 144-W push-pull converter (ISL73846MEV1Z); a 28-V to 5-V, 50-W forward converter (ISL73846MEV2Z); and a 12-V to 28-V, 112-W two-phase boost converter (ISL73846MEV3Z).

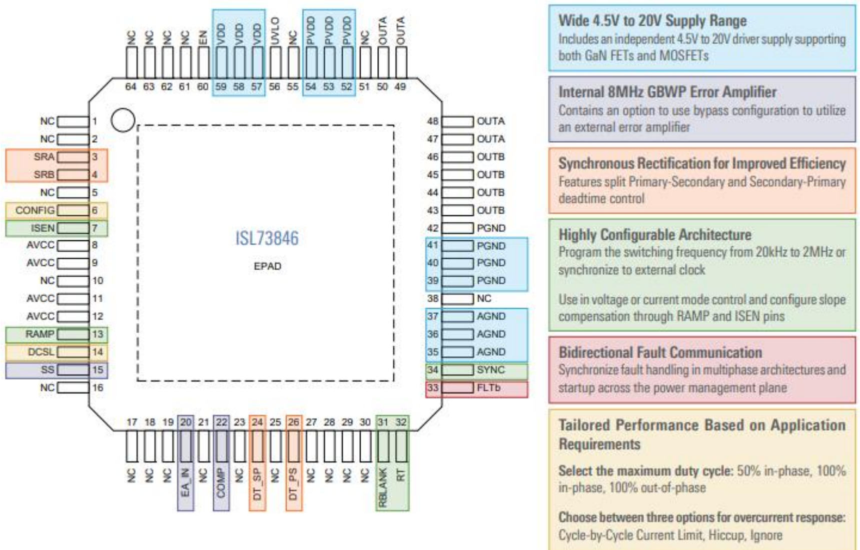

Fig. 2. The ISL73846 is a high-performance, highly configurable, double-ended PWM controller. It is capable of supporting a wide range of power supply topologies.

Another demo at the booth featured the ISL74420, a radiation-tolerant quad adjustable clock fanout for power management ICs. This chip can output four synchronization clocks. With each clock set to a different frequency division and phase delay, multiple devices can be configured to produce a multiphase converter with up to 24 phases as shown in the diagram in Fig. 3.

Beyond managing switching for the controllers on the ISLRTPFDEMO1Z reference design discussed above, the chip was also showcased in a more playful demo at NSREC where it controlled the lights on an interactive prize wheel, as shown in Fig. 3. Although the ISL74420 was shown at last year's conference, it was not released until the end of the year (2024).

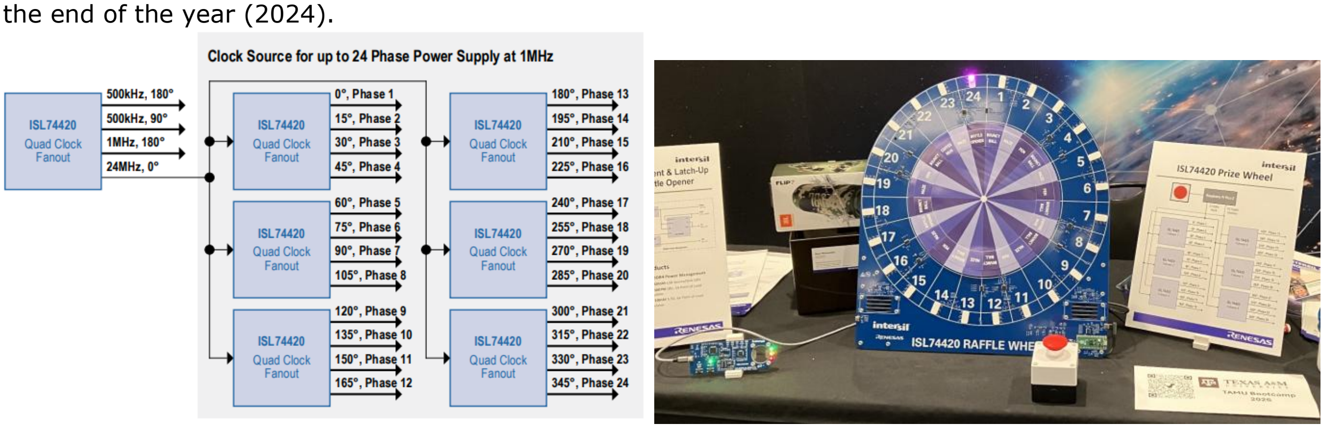

Fig. 3. The ISL74420 radiation-tolerant quad clock fanout IC can be used to control the synchronization of outputs in a multiphase converter (left) or in a more whimsical application to control the lights on a prize wheel (right).

Another power IC shown at last year's NSREC (and releasing this December) was the ISL73849, a radiation-hardened single-/dual-phase current-mode PWM controller. This is a PM bus-enabled controller, which provides telemetry and reconfigurable fault protection. The ISL73849 can change Vout on the fly, do cold sparing, and provide monitoring and diagnosis in real time.

Renesas also showed the ISL75054 1-A ultralow noise LDO. This regulator is intended to power RF or ADC circuitry up to 30 V and down to 0.5 V at 1 A in a small form factor. Voltage output is set using single resistor. A demo at the Renesas booth showed this LDO powering an RF gain block (Fig. 4).

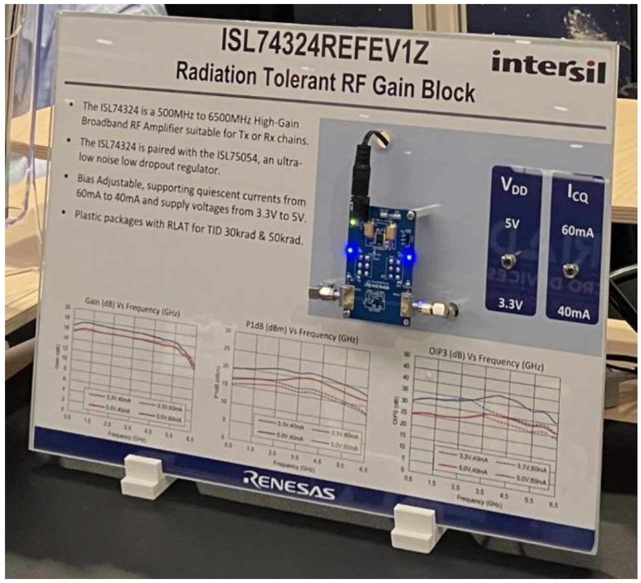

Fig. 4. Powering an RF gain block with the ISL75054 1-A ultralow noise LDO.

For more information, see Renesas' Hi-Rel Power Management page.

At the **Texas Instruments** booth, Kenny Matthews, space power marketing engineer, discussed the rapid pace with which their company has been releasing power management ICs for space, the capabilities of the newer components and the company's ability to address power management requirements across the whole satellite electrical power system (EPS). An interesting display showed the company's assortment of power management reference designs for the different parts of the satellite EPS.

As Matthews said, "We have released 17 products in the last 12 months with 12 parts in the last two months for space power." As it develops new parts, the power management group is making one die, and using it in three flows—Space Enhanced Product (-SEP, rad-tolerant plastic) aimed at LEO and MEO applications, MIL-STD QMLP (rad-hard plastic) and QMLV (rad hard hermetic). (As of the publication of this article, the 12 parts for space power management have grown to 17.)

Most of the releases this year are rad-tolerant plastic and most have QML-P pin-to-pin equivalents, which are coming, said Matthews. There are also hermetic parts, some already released.

Among the newest power management devices for space, the company is releasing a new family of rad-hard 14-V input buck converters which generate outputs down to 0.6 V. This family includes three versions in different output current ratings; 3 A (TPS7H4013-SEP), 6 A (TPS7H4012-SEP) and 12 A (TPS7H4011). This switching regulator family is noted for its use of integrated differential voltage sensing and for having one of tightest reference accuracies. The full family in -SEP versions will be released in December, while the QMLP versions will be released in Q1 of 2026.

Another new device is the TPS7H4104, which the company describes as the industry's first space-grade quad-channel buck converter. Rated for 3-V to 7-V input, this monolithic device delivers 3 A per channel. It also has built-in fixed sequencing for power up and power down of the outputs (Fig. 5). This part had prototypes available for early evaluation on the TI website a few weeks prior to NSREC and will be released by the end of the year.

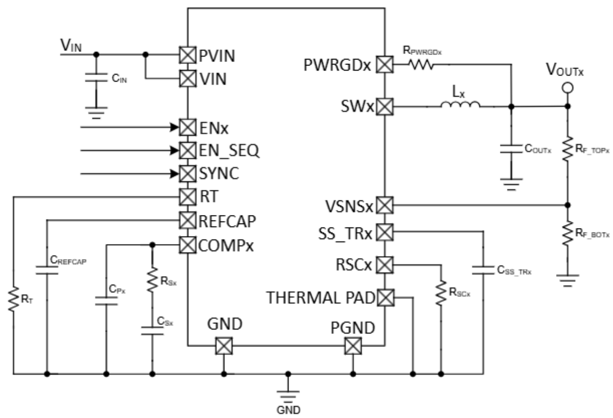

Fig. 5. Application circuit for the TPS7H4104 quad-channel buck converter.

The TPS7H3024-SP power supply supervisor is also new. This is a rad-hard, QMLV, 3-V to 14-V, four-channel supervisor with watchdog timer. The device can monitor up to four voltage rails with high accuracy, providing power supply resets as needed. The device is rad hard up to a TID of 100 krad (Si). It is also immune to single event latchip (SEL), single event burnout (SEB) and single event gate rupture (SEGR) up to a LET of 75 MeV-cm^2/mg. Moreover, no single event transients (SETs) or single event functional interrupts (SEFIs) were observed up to that same LET level. Ceramic versions of the TPS7H3024-SP were released in August.

Another new device is the TPS7H6101-SEP, which Matthews described as the industry's first 200-V rad-tolerant power stage. This device incorporates a silicon half-bridge gate driver and GaN FETs in same package, increasing power density and reducing source-loop inductance versus discrete implementations. The 200-V rating is needed in buck converter designs for satellites because of nominal 100-V inputs with voltage spikes at the solar panel.

Some of the above power management parts were featured in reference designs TI displayed for the satellite EPS (see Fig. 6). These reference designs included Alpha Data's overall reference design for AMD's Versal Core FPGA, which requires 140 A for the core power rail.

They also included a new reference design from Alpha Data for the lower-power Versal Edge FPGA, which only draws up to ~40 A. This eases thermal management requirements as heat generated on satellite boards must be conducted to the edge of the satellite and then dispersed with an infrared radiator.

With devices such as Versal increasing power consumption at the point of load, the power requirements upstream are also rising. This is leading to greater use of GaN FETs, for which TI is developing gate drivers including the previously mentioned 200-V driver and also 60-V and 22-V drivers. While ceramic models of these gate drivers were released last year, versions in plastic (rad-tolerant SEP and rad-hard QMLP), which offer greater power density, are new. Part numbers are TPS7H6005-SP/SEP, TPS7H6015-SP/SEP, and TPS7H6025-SP/SEP.

It has also led to TI's development of a 300-W ZVS full-bridge reference design for space (PMP23391). The board appears in the lower left corner of Fig. 6. According to Matthews, the use of this topology is new for space. TI's reference design converts 28 V to 12 V with 92% efficiency using the company's TPS7H5005 PWM controller, secondary-side referenced, driving two TPS7H6005 200-V half-bridge GaN gate drivers driving GaN FETs on the primary side to achieve ZVS operation at higher loads and one TPS7H6005 driving GaN FETs on the secondary side.

There was another reference design, the PMP23546, which included the TPS7H5020 single-output controller with an integrated gate driver to drive either GaN or Si FETs. This reference design generates the 12-V bias supplies for the gate drivers and PWM controller on both the primary and secondary side of the 300-W ZVS full bridge reference design described above. The board for the PMP23546 appears in Fig. 6 just above the one for the PMP23391.

Parts shown in both the PMP23391 and PMP23546 reference designs were rad tolerant, but there are also rad-hard equivalents. For more information, see TI's Space products page.

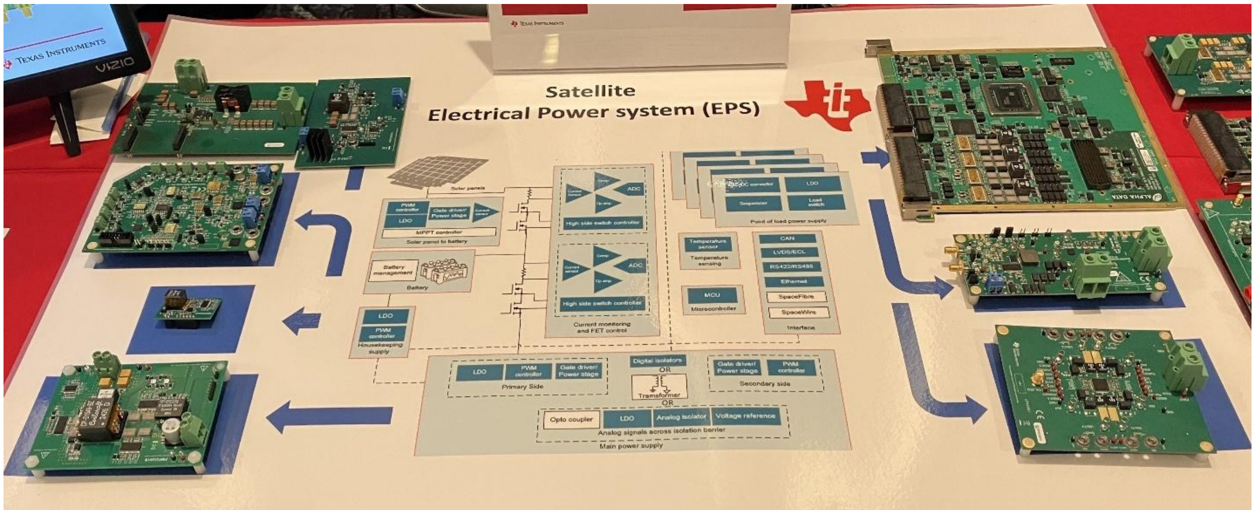

Fig. 6. One of the more interesting displays at NSREC 2025 was TI's block diagram of a satellite electrical power system (EPS) which highlighted the various parts and reference designs that TI offers for generating and managing the various supplies required in the EPS.

Bel Lazar, CEO of exhibitor **EPC Space**, discussed recent product developments and plans for the near future. For example, the company had just announced a three-phase motor drive reference design, the EPC7C021. The associated demo board, which measures 6.45 in. x 5.22 in., uses the company's EPC7011L7 for the half-bridge GaN power stages (Fig. 7).

The EPC7C021 can operate with customer-supplied external PWM signals as control inputs for each phase, or connected to the EPC9147A microcontroller interface board, which accepts a Microchip plug-in-module for the dsPIC33EP256MC506, a digital signal controller for precision motor control.

Users can program this plug-in-module using the Microchip motorBench Development Suite to drive the motor using sensorless FOC with space vector pulse width modulation. When using the customer-supplied PWM signals, the board has deadtime circuitry included for each phase and various analog signal (voltage and current) monitoring circuitry for each phase and the VDD supply current.

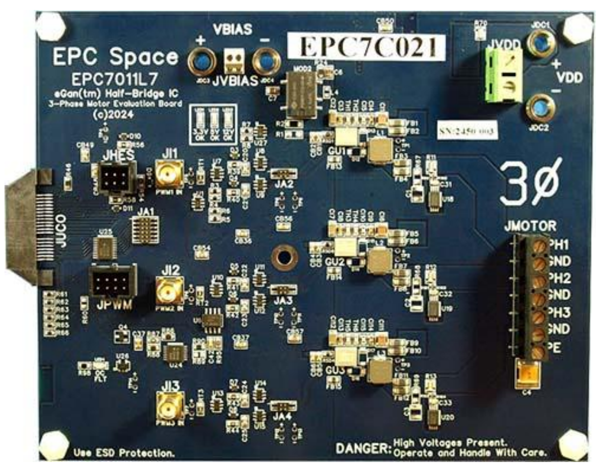

Fig. 7. EPC7C021 three-phase motor drive demo board.

Lazar also noted EPC Space's recent introduction of the EPC7030MSH, a rad-hard 300-V GaN FET suited for use in dc-dc converters. According to the company, this part has the lowest $R_{DS(ON)}$ and gate charge in its class, and delivers the highest current rating among all 300-V rad-hard GaN FETs currently on the market.

In addition, Lazar discussed the company's introduction of the EPCS4001 rad-hard PWM controller, which the company introduced in April. This device represented the first PWM controller introduced by EPC Space.

This CMOS ASIC was co-developed with CERN and specifically designed to drive EPC's GaN-based rad-hard power stage, the EPC7011, to implement buck converters for powering sensors in CERN's Large Hadron Collider

(LHC) (Fig. 8). As Lazar observed, the radiation environment in the LHC is much more demanding than in GEO orbits and also includes strong magnet fields. The TID specs for the controller reflect these requirements.

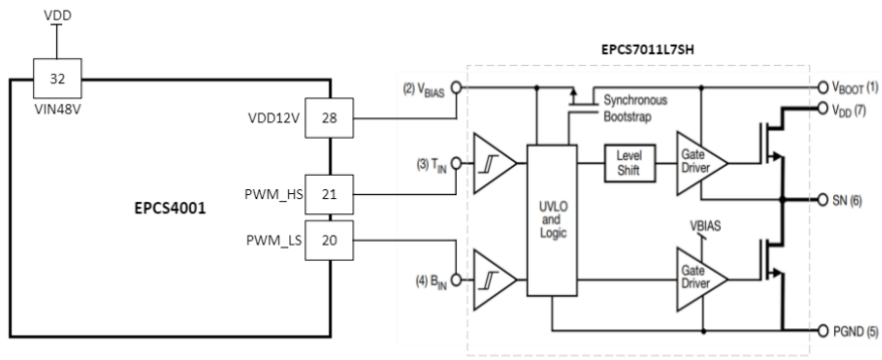

Fig. 8. Simplified application diagram for the EPCS4001 PWM controller. Per the datasheet, "the controller [is] capable of continuous operation up to very high radiation limit (50 Mrad and 4 x 10^{14} n/cm^2 and 2.23 x 10^{14} p/cm^2 (30 MeV proton beam). The controller has been designed for operation in a strong magnetic field in excess of 40,000 Gauss and has been optimized for cored and coreless inductors of 200 to 500 nH. To be compatible with these small inductance values, its switching operation is in the 0.5 to 3-MHz range."

Regarding the EPC7011 power stage (driver + FETs), Lazar noted that the company is "selling a lot of them." Meanwhile, he adds that the company is qualifying its EPC7009 single-output GaN gate driver for MIL-PRF-38535 certification, giving designers a choice of using discrete FETs and drivers or half-bridge power stages with built-in drivers (such as the EPCS7011). "The goal is to offer IC and power FET in any configuration the customer may want," said Lazar.

In addition to these developments, the company has been busy pursuing QPL certifications for its products. As of NSREC 2025, four of EPC Space's parts were qualified, and 14 more were expected to be qualified by the end of 2025 (or shortly after in Q1 2026), according to Lazar. He added that the company has also been shrinking lead times for its products and can deliver full space orders in 12 weeks.

Looking ahead to next year, Lazar said EPC Space will follow EPC's lead in introducing low-voltage GaN FETs, but in rad-hard-by-design versions. Specifically, it plans to release 20-V GaN FETs for point-of-load converters. But in general, EPC Space will be concentrating more on development of ICs for the next year as well as a couple of new Standard Military Drawings, per MIL-PRF-38535.

Lazar also noted a trend in the marketplace wherein some customers are using GaN FETs to build linear regulators. While there are older rad-hard linear regulators which have been on the market for years, these are typically bipolar, silicon devices. Using GaN FETs easily provides low-dropout-voltage in linear regulator designs.

EPC Space plans to introduce linear regulator demo boards to help customers with this application. In support of this, the EPC7C023 (using the EPC7019G as the pass element) and the EPC7C024 (using the EPC7014UB pass element) will be available in the Q1 2026 timeframe. For more information, see the EPC Space website.

Power MOSFETs

At its booth, **Microchip Technology** was showing non-power parts such as MCUs and Ethernet PHYs. However, Oscar Mansilla, Sr. manager, marketing and applications, offered an update on the company's rad-hard MOSFETs, saying the full family was DLA qualified to MIL-PRF-19500/746 in April.

This family includes rad-hard n-channel MOSFETs with a V_{DS} of 100, 150, 200, or 250 V in the SMD0.5 package. The devices are rated 100 krad and 300-krad versions are in the process of being qualified for the 150-, 200-, and 250-V V_{DS} devices. The 100-V transistor is available in both radiation levels (see the table).

These devices are fabricated using Microchip's M6 technology onshore in the Colorado Springs FAB5 and assembled/tested in the company's Lawrence, Mass. facility. M6 is a radiation-hardened-by-process vertical MOSFET technology with a standard planar gate.

Table. Key electrical specs for Microchip's n-channel family of DLA-qualified MOSFETs.

PN	V_{DS} (V)	I_D (A)	$R_{DS(ON)}$ (mΩ)	Q_G (nC)	V_{GS} (±V)	TID (krad)	Package
JANSR2N7593U3	250	12	210	50	20	100	SMD-0.5
JANSR2N7591U3	200	19	130	50	20	100	SMD-0.5
JANSR2N7589U3	150	16	88	50	20	100	SMD-0.5
JANSR2N7587U3	100	22	42	50	20	100	SMD-0.5

Mansilla also noted that newer products in plastic and larger die sizes would be coming in September. As of this writing, for new space applications, Microchip has released 150-V rad-hard MOSFETs in TO-220 plastic packages with screening to Microchip's New Space (MNS) flow for discrete products. For more information, see the Discrete Components for New Space page.

Microchip will also offer 100-V rad-hard MOSFETs and will expand its plastic package portfolio to offer both the 100-V and the 150-V MOSFETs in D2PAKs in addition to the TO-220s.

At the **STMicroelectronics** booth, Allan Soriano, applications staff engineer/FAE—power electronics & analog signal path, noted that the company introduced a rad-hard 5-A nom. (7-A max.) buck regulator with 3-V to 12-V input, the LEOPOL1, in June. Key radiation specs include hardness parameters such as a 50 krad(Si) TID, a 3 x 10^{11} proton/cm^2 TNID and a SEE performance characterized up to 62 MeV.cm^2/mg. (See the post in ST's Developer News.)

Soriano also said that the company will be introducing new space versions of select diodes such as the 1N5822, 1N5819, and 1N5811 in plastic packages. These are produced following the AEC-Q100 specification up until completion of PAT/GPAT, after which the parts are tested for TID and SEE as per MIL-STD-883.

In addition to the companies exhibiting at NSREC, representatives of a new GaN semiconductor startup, **Semi Zabala** were in attendance. According to founders Simon Wainwright and Jim Larrauri, the company has developed and is qualifying 600-V rad-hard GaN HEMTs for space applications in propulsion, lunar surface uses and fission.

While 600-V GaN is the most common variant among commercial GaN power devices and there are numerous rad-hard GaN transistors at 300 V and below from EPC Space and Infineon, the Semi Zabala devices are said to be the first 600-V rad-hard GaN power devices. They are being positioned as alternatives to SiC MOSFETs which must be highly derated for space use. For example, a 1200-V SiC MOSFET might be derated to 300 V for use in space's radiation environment (For more on this subject, see Paul Schimel's article, "The Path To Radiation Hardened SiC MOSFETs And Schottkies For Space Flight".)

Semi Zabala looks to double that 300-V rating with their GaN transistors, while also offering a more efficient alternative to 600-V rad-hard silicon MOSFETs. Data on sample devices was presented by NASA in a poster in the Data Workshop. For more information, see the company's website.

Power Converters

At the **VPT** booth, Leonard Leslie, VP of engineering, offered some updates on the company's dc-dc converter developments. For starters, he noted that the company has released 6-,15-, 30- and 100-W versions of its VSC series rad-tolerant converters, which have TID ratings of 30 krad(Si) and SEE ratings of 42 MeV/mg/cm^2.

Although not for space, the company was also planning to extend its VXR series by introducing quarter and half-brick style dc-dc converters with 270-V input. These would share the same construction as existing members of the series, which have a 28-V nominal input. A 125-W quarter brick would be first (and was released in October as the VXR125-27000S) followed by a 250-W half brick. These would offer the traditional output voltage options—3.3 V, 5 V, 12 V, 15 V or 28 V, said Leslie. The existing members of the VXR series and the new 270-V input models would share the same construction.

Further out, the company is planning to leverage its design of the 400-W GaN-based SGRB family of dc-dc converters to offer a 100-W family of GaN-based hybrid dc-dc converters. Although the SGRB converters are rad-hard, they employ pc-board style construction, with multiple hermetic devices on board. By using hybrid construction for the whole assembly, the new converters not only achieve hermeticity, but also enable greater power density and a wider operating temperature range. Efficiency of the new converters will be in the low 90s percentages. Leslie says these hybrid converters will be coming in mid to late 2026.

Finally, another division of the company, VPT Components, is releasing rad-hard silicon power MOSFETs with 100-V, 250-V and 600-V devices in development now. Produced in the LA Semiconductor fab in Idaho, these will offer the industry another source for MOSFETs. During NSREC, VPT Components announced a rad-hard MOSFET and die selector guide that lists their offerings.

At the **TTM Technologies** booth, Anup Singh, senior director, business development, microelectronics solutions for the space, defense & aerospace markets, highlighted the company's recent release of the MSK5065RH. Housed in a 0.795- x 0.670- x 0.175-in. 12-pin flat-pack, this is a functionally complete, 3-A rad hard switching regulator module based on Renesas' ISL73007SEH regulator IC. This regulator generates an output as low as 0.6 V while operating from an input of 3 V to 16 V. It achieves an efficiency of ≥85% at 3 A. Rad-hard specs include a 100-krad TID and SEL, SEB and SEGR immunity to a LET of 86 MeV-cm^2/mg.

Singh also noted another 3-A buck regulator module that the company was planning to introduce soon—the MSK5066RH. Offered in the larger, 0.915- x 0.75- x 0.240-in, 20-pin flat pack, this regulator features a precision-trimmed fixed output voltage. Based on a Texas Instruments controller, this regulator generates an output as low as 0.8 V while operating from an input of 3 V to 7.5 V.

While the MSK5065RH uses a constant 500-kHz switching frequency with peak current mode control, the MSK 5066RH offers a user-programmable or synchronized fixed frequency with peak current mode control. The MSK5066RH also features cycle-by-cycle current limiting. Rad-hard specs include a 100-krad TID and SEL, SEB and SEGR immunity to a LET of 75 MeV-cm^2/mg.

In addition, TTM Technologies is developing a GaN half bridge with integrated drivers, the TTM4306RH. Singh shared that the company aims to introduce this part by the end of the year. Featuring a Vin of 4.75 V to 18 V and output current up to 60 A, this power stage will target point-of-load converter applications and motor drives. This device will specify a TID level of up to 100 kRAD (Si) and SEE immunity of 86 MeV-cm^2/mg.

*Selected Power-Related Papers And Posters from NSREC 2025:**

Radiation Effects Data Workshop

DW-4 "Radiation Evaluation of the TPS7H6101-SEP Radiation-Tolerant 200-V, 12-A GaN Half Bridge Power Stage" by T. Lew, A. Marinelarena, and M. Trevino, Texas Instruments.

DW-10 "Radiation Evaluation of the TPS7H502X-SP Radiation-Hardness-Assured (RHA) Single-Ended PWM Controller with Integrated Silicon (Si) and Gallium Nitride (GaN) Field Effect Transistor (FET) Gate Driver" by T. Lew, A. Marinelarena, and E. Johnson, Texas Instruments.

DW-17 "Total Dose and SEE Testing of the ISL74420M Radiation Tolerant Quad Clock Fanout IC" by N. van Vonno, W. Newman, L. Pearce, E. Thomson, and M. Campanella, Renesas Electronics America. "This part provides four synchronized clocks and is particularly useful in multiphase power converters."

DW-19 "Total Dose and Single-Event Effects Testing of the ISL75054 Ultra-Low Noise LDO" by M. Campanella, W. Newman, N. van Vonno, D. Wackley, P. Larry, E. Thomson, and C. Thomson, Renesas Electronics America.

DW-22 "Radiation Evaluation of the TPS7H4104-SP Radiation-Hardness-Assured (RHA) 3-V to 7-V Input, 3A/Channel Quad-Channel Synchronous Step-Down Converter" by A. Marinelarena, T. Lew, and J. Cruz-Colon, Texas Instruments.

DW-26 "Total Ionizing Dose Characterization of Microchip Retriggerable Latching Current Limiting Power Switch" by S. Russell, D. Johnson, and E. Colmet-Daage, Microchip Technology.

DW-38 "Multi-Angle Single Event Effects Characterization of 100-V GaN-on-Silicon Power Transistor" by J. Brandt, EPC Space and R. Strittmatter, EPC.

DW-51L "SEE and TID test results of Microchip's M6 Power MOSFET Technology" by Oscar Mansilla, Microchip.

DW-53L "SEE Results of a Custom Power Management Integrated Circuit (PMIC) Using Global Foundries 130 nm Technology" by M. Byers, A. Omprakash, R. Young, B. Liu, R. Ng, A. Lara, A. Huynh, J. Steffan, A. Soto, M. Herrera, D. Kachuche, E. Normandy, B. Do, R. De Jesus, and R. Lyons, Raytheon.

DW-54L "Heavy Ion-Induced Single-Event Effects in GaN HEMTs" by A. Billa,1 P. Maloney,[1] G. Mayberry,[2] T. Liu,[2] B. Bolton,[1] H. Parra,[1] F. Ahmed,[1] J. Debnath,[1] D. Fleetwood,[2] and E. Zhang,[1] 1. University of Central Florida and 2. Vanderbilt University.

Technical Program Friday, Poster Papers

PH-2 "Total Dose Hardening Using a Sensitive Circuit Identification Methodology in a DC-DC Converter" by M. Murillo,[1] R. Milner,[2] B. Dean,[1] J. Diamico,[1] T. Tengberg,[2] A. Witulsi,[1] M. Alles,[1] S. Kosier,[1] J. Trippe,[1] T. Holman,[1] D. Ball,[1] M. Hu,[1] A. Fayed,[2] and L. Massengill,[1] 1. Vanderbilt University and 2. Ohio State University.

Session I Power Devices And Wide-Bandgap Semiconductors

I-1 "Temperature Effect of Single Event Burnout and Leakage Current in SiC Power MOSFETs" by K. Niskanen,[1] A. Javanainen,[1] C. Martinella,[2] A. Witulski,[3] and H. Kettunen,[1] 1. University of Jyväskylä, Finland 2. APS Laboratory - ETH Zurich, Switzerland 3. Vanderbilt University.

I-2 "Physical Model for Epitaxial Doping Dependence of Single-Event Leakage Current in SiC Power Devices" by A. Sengupta,[1] S. Kosier,[1] D. Ball,[1] S. Islam,[1] A. Sternberg,[1] J. Hutson,[2] J. Osheroff,[3] R. Schrimpf,[1] K. Galloway,[1] and A. Witulski,[1] 1. Vanderbilt University 2. Lipscomb University and 3. NASA Goddard Space Flight Center.

I-3 "Laser-Induced Single-Event Burnout in GaN Devices" by A. Khachatrian,[1] A. Koehler,[1] S. Buchner,[2] J. Hales,[2] and D. McMorrow,[1] 1. U.S. Naval Research Laboratory and 2. Jacobs.

I-4 "Investigations on TID Effects-Induced Parasitic Transistors in GaN Cascode Power Transistors" by H. Couillaud,[1] M. Gaillardin,[1] L. Artola,[2] and G. Hubert,[2], 1. CEA, DAM, CEA-Gramat, France and 2. ONERA/DPHY, France.

I-5 "Failure Mechanism Analysis, Modeling, and Simulation with TCAD for Wide Area SEB in 4H-SiC Power Device caused by Proton and Neutron Irradiation" by H. Lee, QRT, Republic of Korea.

Poster Papers

PI-1 "Single Ion-Induced Damage in Gallium Nitride High Electronic Mobility Transistors" by J. Gray,[1] A. Sternberg,[1] J. Kauppila,[2] D. Ball,[1] J. Trippe,[1] S. Kosier,[1] A. Witulski,[1] M. Alles,[1] J. Davidson,[1] R. Schrimpf,[1] and L. Massengill,[1] 1. Vanderbilt University and 2. Reliable MicroSystems.

PI-2 "Estimating SELC and SEB Thresholds in SiC Power Devices Using Standard Benchtop Switching Energy Measurements" by D. Ball,[1] S. Kosier,[1] K. Galloway,[1] A. Witulski,[1] A. Sternberg,[1] S. Islam,[1] A. Sengupta,[1] M. Alles,[1] J. Hutson,[2] R. Reed,[1] J. Osheroff,[3] and R. Schrimpf,[1], 1. Vanderbilt University 2. Lipscomb University and 3. NASA Goddard Space Flight Center.

PI-3 "Impact of Proton Energy on Displacement Damage and Total Ionizing Dose in SiC Vertical Power MOSFETs" by C. Martinella,[1] S. Bonaldo,[2] M. Belanche,[1] R. Kupper,[1] G. Andreetta,[2] M. Bagatin,[2] S. Gerardin,[3] A. Paccagnella,[2] and U. Grossner,[4] 1. APS Laboratory - ETH Zurich, Switzerland 2. University of Padova, Italy 3. DEI - Padova University, Italy and 4. APS - ETH Zurich, Switzerland.

PI-4 "Neutron SEE Test Considering Actual EV Operating and Environment for Commercial 1200-V SiC MOSFET" by M. Jo, QRT.

PI-5L "Influence of Ion LET and Epitaxial Thickness on Single-Event Effects in Homojunction GaN Vertical Diodes" by A. Senarath,[1] S. Islam,[1] A. Sengupta,[1] O. Meilander,[1] J. Osheroff,[2] T. Anderson,[3] A. Jacob,[4] R. Kaplar,[5] S. Kosier,[1] M. Ebrish,[1] D. Fleetwood,[1] J. Caldwell,[1] and R. Schrimpf,[1] 1. Vanderbilt University 2. NASA Goddard Space Flight Center 3. University of Florida and 4. U.S. Naval Research Laboratory and 5. Sandia National Laboratories.

**From the conference brochure*

For Further Reading About Power Product News From Past NSREC Conferences:

1. "NSREC Notes: Rad-Tolerant Power Devices, Reference Designs, And GaN-based Products Continue To Increase As Vendors Expand Space Portfolios," How2Power Today, August 2024.
2. "From the Editor's Desk" includes some highlights from NSREC 2023, How2Power Today, September 2023.
3. "NSREC Notes: Exhibitors Showcase Latest Reference Designs Along With Progress In Rad-Tolerant And Rad-Hard Power Components," How2Power Today, September 2022.
4. "NSREC Notes: Vendor Talks Highlight Advances In Power Devices, Packaging And Reference Designs For Space Applications," How2Power Today, October 2021
5. "NSREC Notes: Space Power Components Answer Calls For Higher Performance, Lower Cost," How2Power Today, March 2021.
6. "NSREC 2019: Rad Hard Power IC Portfolios Add New Functions And Higher Performance Options," How2Power Today, September 2019
7. "Vendors Fired Up Latest Rad Hard Power Solutions At NSREC 2018," How2Power Today, August 2018.
8. "More Power News From NSREC 2017," How2Power Today, August 2017.
9. "NSREC [2017] Highlights Latest Rad Hard Power Components For Space," How2Power Today, July 2017.
10. "Rad-Hard Power Converters Ride Intermediate Bus Into Space," How2Power Today, August 2012.