

NPIs, DESIGN  
AND TECHNOLOGY NEWS

# 23-i Power & Power Management



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Delighting our customers worldwide

# Accurate LDO voltage regulator ideal for battery-powered products

The STMicroelectronics LD56020 is a high-accuracy voltage regulator which is suitable for use in low-power and battery-powered applications thanks to its ultra-low dropout voltage and low quiescent current.



life.augmented

## FEATURES

- 120 mV dropout voltage at 200 mA load
- 18  $\mu$ A ground current at no load
- 8.8  $\mu$ Vrms output noise at 10 Hz to 100 kHz
- Logic-controlled electronic shutdown
- Output active discharge function
- Junction-temperature range: -40°C to 125°C

## APPLICATIONS

- Image sensors
- Voltage-controlled oscillator modules
- RF communications modules

LD56020 from STMicroelectronics provides low-noise output of up to 0.2 A.

Operating from an input voltage ranging between a very low 1.1 V and 5.5 V, the LD56020 regulates the output voltage with very high accuracy. The device supplies a fixed output voltage in a range between 0.6 V and 4.0 V, selectable in 50 mV steps. Output voltage tolerance is  $\pm 2\%$  over the entire operating-temperature range, and just  $\pm 1\%$  at 25°C.

The LD56020, which is stabilized with a small ceramic capacitor on the input and output, supplies an output current of up to 0.2 A. An enable logic control function puts the LD56020 in shutdown mode, in which it draws less than 0.1  $\mu$ A. The device features thermal shutdown protection and a short-circuit current fold-back function.

The LD56020 LDO is supplied in a choice of two packages:

- Four-lead flip-chip package with a footprint of 0.65 mm x 0.65 mm
- Five-lead SOT23

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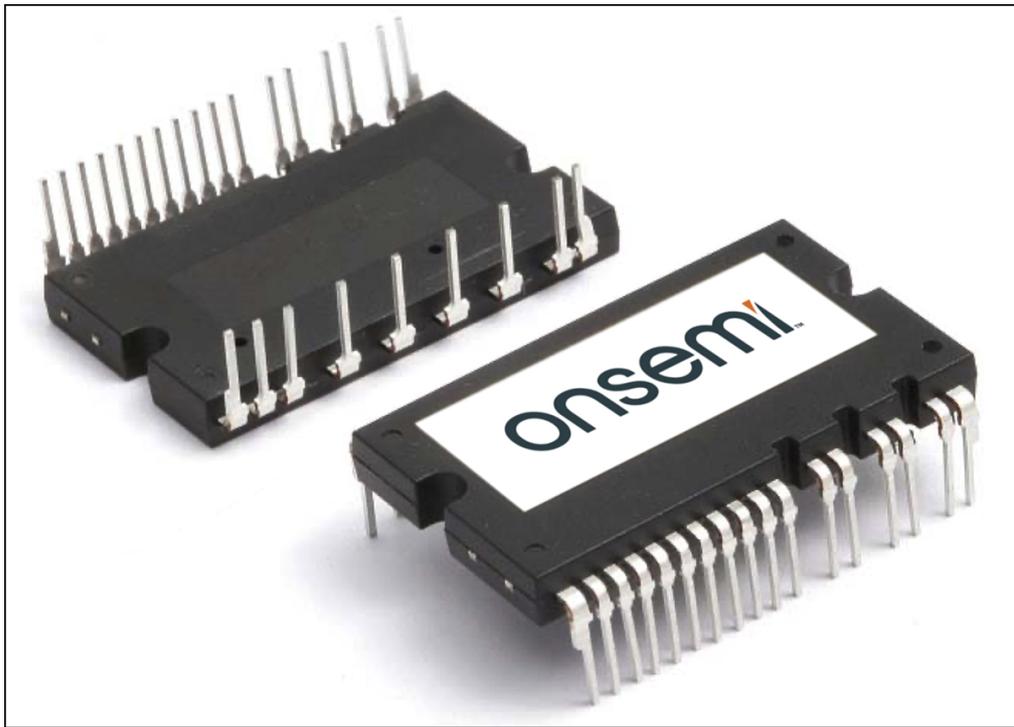
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 **SAMPLES**



# 600 V IPM provides complete inverter power stage for electric motors

The NFA42060R42 from onsemi is a Motion SPM 45 intelligent power module (IPM) which provides a complete inverter output power stage suitable for various types of electric motor.



NFA42060R42 from onsemi provides multiple system protection functions.

The 600 V/20 A NFA42060R42 combines a three-phase IGBT-based inverter circuit with an integrated high-voltage gate drive circuit and multiple system protection features. The 600 V NFA41560R42 IPM mirrors the features of the NFA42060R42, but has a maximum 15 A current rating.

The gate drivers of the modules are tuned to match the characteristics of the IGBTs, minimizing EMI and power losses. The multiple on-module protection features include under-voltage lockout, over-current shutdown, thermal monitoring and fault reporting.

The IPM's high-speed driver IC requires only a single supply voltage. It translates incoming logic-level gate inputs to the high-voltage, high-current signals required to properly drive the internal IGBTs. Separate negative IGBT terminals are available for each phase so that the module can support the widest variety of control algorithms.

The onsemi IPMs are mounted on a ceramic substrate which is notable for its low thermal resistance, enhancing the dissipation of heat generated by the IGBTs. Built-in bootstrap diodes and dedicated supply-voltage pins simplify the application PCB layout.

**onsemi**

## FEATURES

- NTC thermistor for temperature monitoring
- Separate Open Emitter pins for three-phase current sensing
- 2 kVrms/minute isolation rating
- Operating-temperature range: -40°C to 150°C

## APPLICATIONS

- Motor inverters
  - Ac induction motors
  - Brushless dc motors
  - Permanent magnet synchronous motors

## FREE DEV BOARD

The demo board supports the evaluation of the NCD83591 three-phase gate driver.

**Orderable Part Number**  
**NCD83591AS-GEVB**

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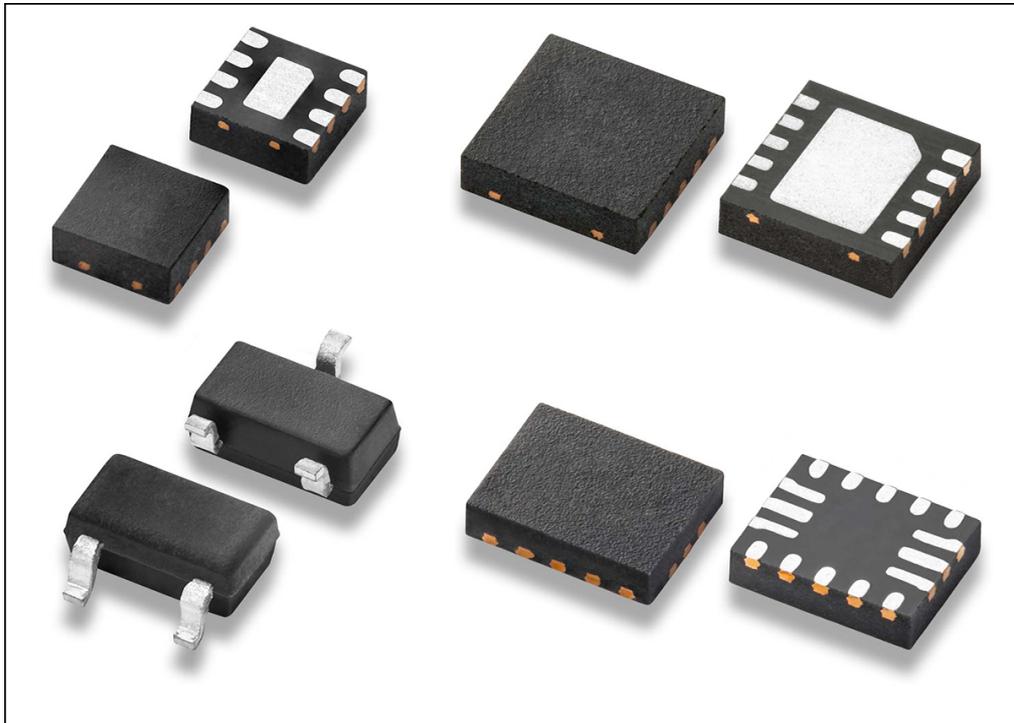
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# New eFuse protection devices operate over wide voltage range

Littelfuse has announced four versatile new eFuse ICs which provide a comprehensive set of protection functions for electronics circuits. Highly integrated, the eFuse ICs enable developers to reduce design time and save board space and bill-of-materials cost when compared to typical discrete solutions such as a combination of a hot-swap controller and MOSFET.



Littelfuse eFuse ICs ideal for consumer electronics, data communications and industrial applications.

The eFuse products, which operate over a wide voltage range of 3.3 V up to 28 V, offer the over-voltage protection of a standard fuse. But in addition, the fuses protect against over-current, short-circuit, inrush current, reverse current, and over-temperature events while supplying real-time diagnostic data.

The eFuse ICs are ideal for use in the protection of consumer electronics and data communications interfaces.

Part Number	Voltage Rating	Current Rating	Protection Functions	Package
LS0504EVT233	5 V	4 A	Over-voltage, over-current	SOT23-3
LS0505EVD22	5 V	5 A	Over-voltage, over-current	DFN
LS1205ExD33	18 V	5 A	Programmable current limit, output voltage clamp	DFN
LS2406ERQ23	28 V	6 A	True reverse blocking, fast role swap	QFN



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## FEATURES

- Low power consumption
- Accurate current limiting
- Fast response
- Adjustable thresholds for:
  - Over-voltage
  - Current limiting
  - Inrush current
- True reverse-current blocking

## APPLICATIONS

- Bluetooth headsets
- Wearable devices
- Tablet computers
- Charging cables
- Battery-powered devices
- Adapter-powered devices
- Networking equipment
- PCs and notebooks
- Data communications power supplies
- Fans
- Storage devices
- Industrial power supplies

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# Energy-saving motion sensor enables intelligent dimming of street lights

TE Connectivity (TE) has introduced the LUMAWISE Motion Sensor to give an easy and effective way to dim or turn off street lights when no pedestrian is in range. The sensor enables municipalities and lighting operators to save energy when lighting is not needed, but quickly return a luminaire to full brightness to maintain the safety, security and convenience of nearby users.



## FEATURES

- Compact design
- Easy, one-handed installation
  - Connector mounted underneath the luminaire

## APPLICATIONS

- Streetlights
- Park, recreational and walkway lighting
- Station lighting
- High-bay lights

LUMAWISE Motion Sensor affords easy integration thanks to Zhaga-D4i compliance.

The TE LUMAWISE Motion Sensor is compatible with the Zhaga-D4i ecosystem, the standard for smart city lighting. The sensor can work as a stand-alone control device, or in combination with a Zhaga-D4i ambient light sensing photocell or communication node to give more ways to control street lighting.

The sensor is a pluggable device with a standard Zhaga book 18 interface.

*LUMAWISE, TE Connectivity, TE and TE connectivity (logo) are trademarks.*



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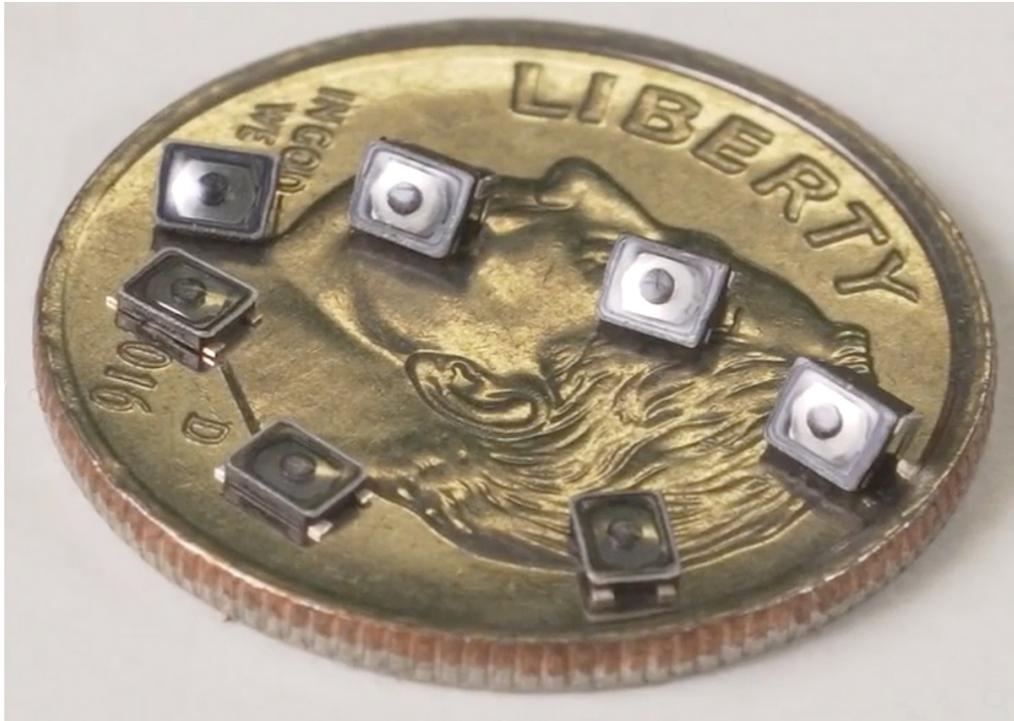
CONSUMER



TELECOMS

# Ultra-compact tact switch saves board space in wearable applications

The NanoT series from C&K, now part of Littelfuse, features the world's smallest side- and top-actuated tactile switches. The NanoT products are now available in both surface-mount and pin-in-paste versions in an edge-mount configuration, to give higher resistance to shear forces.



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## FEATURES

- Integrated actuator
- Up to 300,000 switching cycles
- IP67 for sealed switch compatibility with PCB coatings
- Less than 500 mΩ contact resistance

## APPLICATIONS

- Hearing aids
- Health monitoring devices
- Smart watches
- IoT devices
- Headsets

NanoT series from C&K has low profile of as little as 0.55 mm.

The small dimensions of the NanoT switches make them ideal for use in space-constrained applications such as smart glasses and other wearable devices, personal health monitoring devices, and battery-powered IoT devices. The side-actuated NanoT is in a 2.2 mm x 1.7 mm x 1.65 mm package. The top-actuated NanoT is even smaller, at 2.1 mm x 1.65 mm x 0.55 mm.

The availability of such a compact tact switch gives product designers new scope to save board space and to benefit from flexibility in the design of the board.

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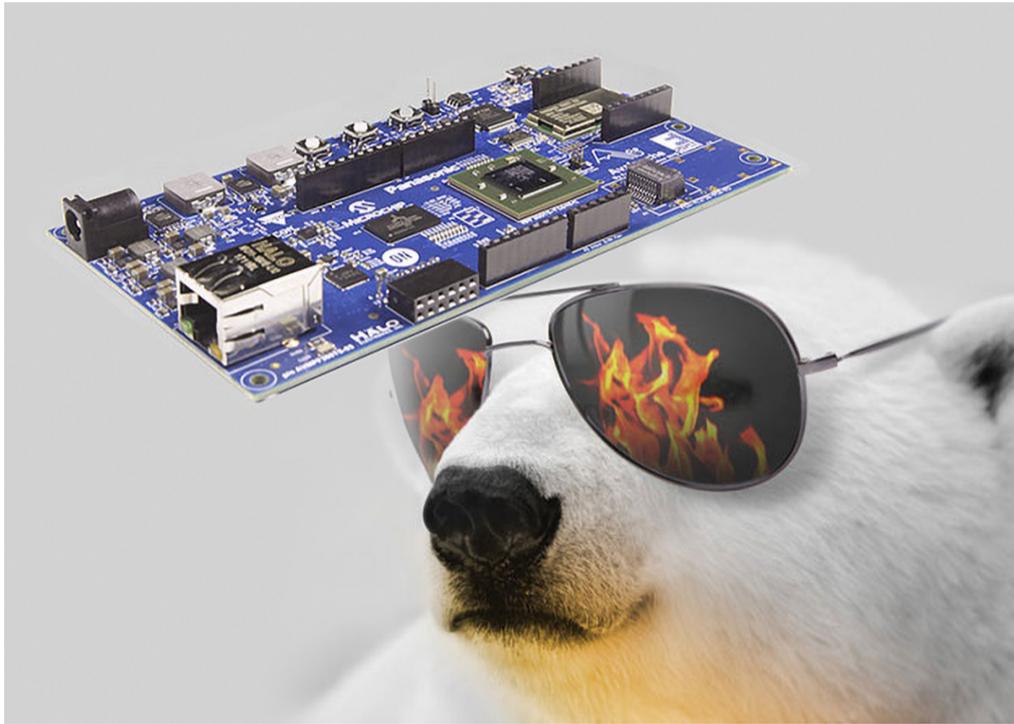
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# Specialized dev kits support video and imaging functions on PolarFire FPGA

Microchip supplies a range of evaluation boards, development kits, add-on daughter cards and programming and debug hardware which provide smart solutions for accelerating designs based on the PolarFire® and PolarFire SoC FPGAs.



Microchip and Future Electronics kits provide rich set of software and peripherals to support rapid development.

Microchip also provides easily accessible demonstration guides, application notes and sample designs.

The **PolarFire SoC Icicle Kit** low-cost development platform is an excellent solution for evaluating the device's five-core RISC-V microprocessor sub-system. The kit allows designers to experiment with the PolarFire SoC FPGA's support for the Linux® operating system, and its real-time execution and low-power capabilities, along with its rich set of peripherals.

With the **PolarFire Video and Imaging Kit**, designers can evaluate the PolarFire FPGA when performing 4K image processing and rendering using dual camera sensors, numerous display interfaces and popular imaging and video protocols including MIPI® CSI-2 TX, MIPI CSI-2 RX, HDMI® 1.4 TX, HDMI 2.0, DSI and HD/3G SDI.

The **PolarFire SoC Video Kit** is a full-featured, embedded vision development platform based on the PolarFire RISC-V SoC FPGA. The kit is suitable for use in the development of vision applications operating at the network edge, in which it offers security, reliability and power efficiency. The kit includes Microchip's VectorBlox™ Accelerator software development kit and IP for neural networks.

Complementing these Microchip kits, Future Electronics supplies the **Avalanche development kit**, which enables developers to quickly create a prototype based on the PolarFire FPGA. At the heart of the kit is a PolarFire FPGA with 300,000 logic elements.

The Avalanche kit is equipped with peripheral components including:

- Panasonic PAN9420 Wi-Fi® module
- 64 Mbits of serial Flash from Microchip
- Alliance Memory 4 Gbits DDR3 synchronous DRAM
- Microchip VSC8531 Gigabit Ethernet transceiver

The kit supports three industry-leading interface standards for connecting companion boards: Sullins headers are compatible with the Arduino™ interface, and provide a mikroBUS™ socket, and a Pmod connector/Interface.



## FEATURES

- PolarFire MPF300TS-FCG484 FPGA
- Microchip MIC23350 step-down converter
- Microchip MIC24051 switching regulator
- Microchip MCP121 voltage supervisor
- Microchip MCP3913 ADC
- Abracon timing solutions
- CUI universal power supply
- Diodes NX7031E0125.000000 oscillator

## APPLICATIONS

- Embedded vision
- Machine vision
- Displays
- Artificial intelligence

## FREE DEV BOARD

The Avalanche development kit from Future Electronics provides a full-featured system environment for the development of applications based on the mid-range PolarFire FPGA from Microchip, a device which is notable for its low-power operation, security capabilities, and immunity to single-event upsets.

**Orderable Part Number**  
**Avalanche**

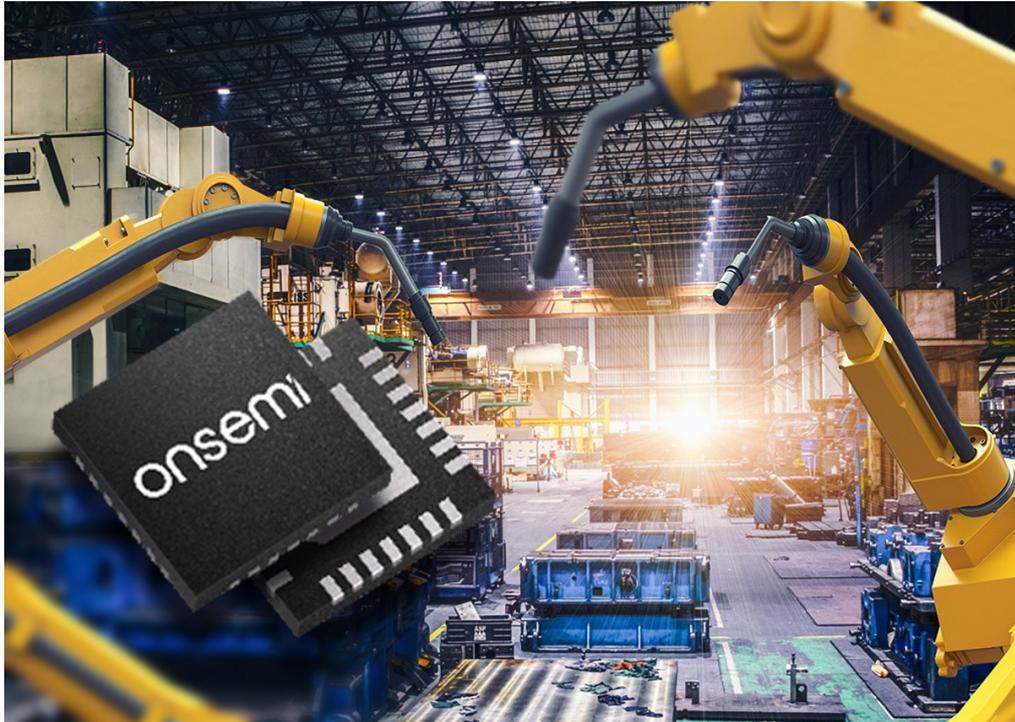
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# Integrated three-phase gate driver saves board space

The onsemi NCD83591 provides an easy way to implement a 60 V three-phase gate drive circuit for trapezoidal motor control applications.



NCD83591 from onsemi provides single-chip gate-driver solution for motor systems.

The NCD83591 is an integrated device: alongside the three-phase gate driver, it also features a high gain-bandwidth current-sense amplifier, and an embedded charge pump for the high-side gate driver which allows for dc static drive, and is tolerant to -12 V dc.

The gate driver solution is housed in a 4 mm x 4 mm 28-lead QFN package. The small board footprint and high level of integration make it ideal for applications which are space- or cost-constrained.

**onsemi**<sup>™</sup>

## FEATURES

- Externally configurable constant-current drive current range: 5 mA to 250 mA
- Under-voltage lockout
- Handles up to 30 kHz PWM control signals
- 4 kV ESD protection on human body model

## APPLICATIONS

- Power tools
- Outdoor power equipment
- Factory automation
- Building management
- E-bikes and e-scooters
- Hoverboards
- Cobots
- Automated guided vehicles
- Autonomous mobile robots
- Unmanned aerial vehicles

## FREE DEV BOARD

The demo board supports the evaluation of the NCD83591 three-phase gate driver.

**Orderable Part Number**

**NCD83591AS-GEVB**

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# Automotive precision op amp combines wide dynamic range with low-noise operation

Diodes Incorporated has introduced the AS2376Q, a precision operational amplifier for automotive systems. The device is ideal for the signal conditioning circuit in applications that operate at high frequency, such as on-board chargers and dc-dc converters.



**DIODES**  
INCORPORATED

## FEATURES

- AEC-Q100 Grade 1 qualified
- 760  $\mu$ A quiescent current
- Rail-to-rail input and output
- Single supply-voltage range: 2.2 V to 5.5 V
- Operating-temperature range: -40°C to 125°C

## APPLICATIONS

- Pumps
- Position sensors
- Vehicle occupant detection sensors
- Airbags
- Onboard chargers
- Dc-dc converters
- Battery management systems
- Wireless chargers
- Braking systems

The DIODES™ AS2376Q maintains high signal accuracy in high-frequency applications.

Featuring a gain-bandwidth product of 5.5 MHz, the AS2376Q op amp can handle signals at frequencies as high as 50 kHz without significant loss of accuracy. At the same time, low input-noise density of 9.5 nV/ $\sqrt{\text{Hz}}$  and 0.8  $\mu$ Vp-p low-frequency noise mean that the AS2376Q maintains good signal integrity.

The offset voltage is a low 5  $\mu$ V, a value which allows the AS2376Q to provide a wide dynamic range.

The AS2376Q is manufactured in IATF 16949-certified facilities, and supports PPAP documentation.

*DIODES is a trademark of Diodes Incorporated in the United States and other countries*

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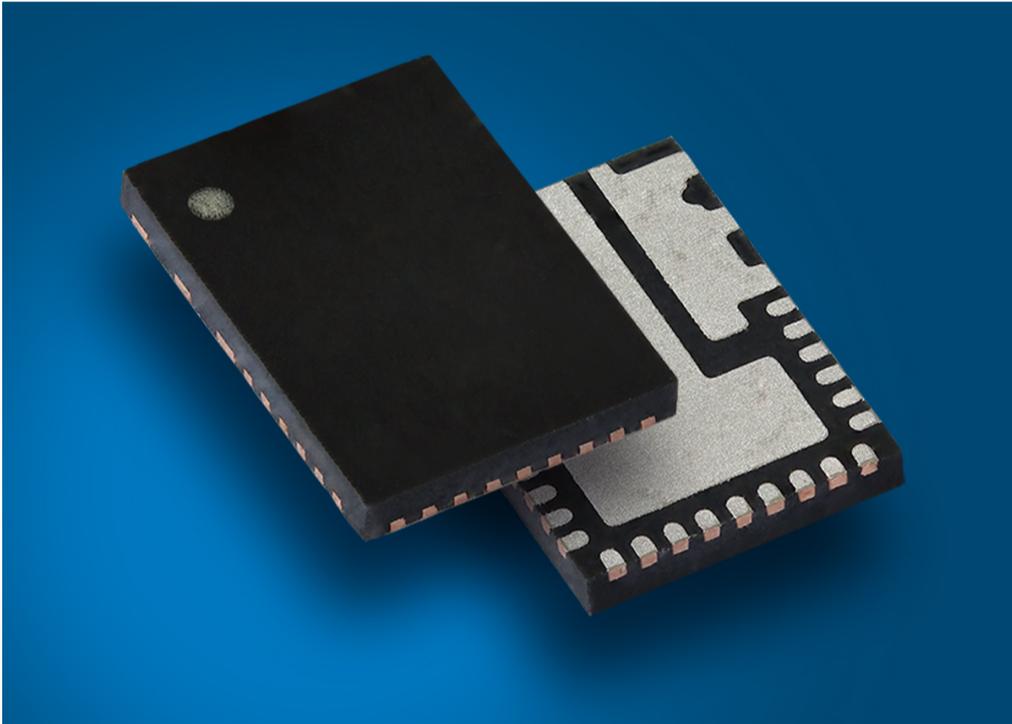
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# Compact voltage regulators offer higher power density and faster transient response

The Vishay portfolio of microBUCK<sup>®</sup> synchronous buck regulators includes a family of 15 A, 25 A, and 40 A devices in a thermally enhanced 5 mm x 7 mm PowerPAK<sup>®</sup> package. The SiC45x devices operate from an input voltage range of 4.5 V to 20 V, and supply an output voltage in the range 0.3 V to 12 V.



## FEATURES

- Programmable switching frequency: 30 kHz to 1,500 kHz
- Peak efficiency up to 98%
- Protection functions:
  - Over-voltage
  - Under-voltage
  - Over-current
  - Over-temperature
- Differential output remote sensing

## APPLICATIONS

- Cloud computing
- Enterprise servers
- Industrial computers
- Networking equipment
- Telecoms equipment
- Storage systems
- FPGA and SoC power supplies

Vishay SiC45x buck regulators supply a stable output current of up to 40 A.

With a compact footprint, the 15 A SiC453, 25 A SiC451, and 40 A SiC450 provide higher power density than the previous generation of devices. The regulators' high power density is the result of co-packaging high-performance N-channel trench MOSFETs with a PWM controller in a single device. Simplifying the design of high-performance point of load converters, the integrated devices require few external components for configuration and loop compensation.

The constant on-time architecture of the SiC45x also provides a very fast response to transient voltages, with minimum output capacitance and tight ripple regulation over a broad range of loads. The regulators maintain good loop stability regardless of the type of output capacitor used.

These Vishay buck regulators include a PMBus 1.3-compliant interface, supporting the implementation of power system telemetry in complex installations such as data centers and telecoms central offices.

The regulators automatically choose the correct internal compensation values based on the operating condition during the start-up sequence. At light loads, when the inductor current crosses zero, the control scheme turns off the low-side MOSFET to deploy a diode emulation mode with frequency foldback.

In ultrasonic mode, the frequency does not go below 25 kHz, keeping the switching frequency above the audible range, which is a benefit for noise-sensitive applications.

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# Multi-zone ToF ranging sensor detects multiple objects at up to 4 m

The VL53L5CX from STMicroelectronics is a multi-zone infrared direct time-of-flight (ToF) sensor which enables many ranging and object detection functions over a range up to 4 m.



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## FEATURES

- 60 Hz frame rate
- 940 nm VCSEL emitter with integrated analog driver
- Package size: 6.4 mm x 3.0 mm x 1.5 mm
- Compatible with wide range of cover glass materials

## APPLICATIONS

- Gesture recognition
- Liquid level control
- Smart buildings
- Smart lighting
- Automatic door openers
- Robotics
- IoT systems
- Camera auto-focus
- Video equipment

VL53L5CX detects separate objects in up to 64 zones in a wide field of view.

Part of the ST FlightSense™ product family, the VL53L5CX combines an infrared vertical-cavity surface-emitting laser (VCSEL) emitter and a single-photon avalanche diode (SPAD) array of photodetectors. Diffractive optical elements above the emitter enable the sensor to perform ranging in various ambient lighting conditions, and through a range of cover glass materials.

The sensor can be configured to divide the square 45° or diagonal 63° field of view into an array of 4 x 4 or 8 x 8 zones. This allows for the detection of multiple objects. The VL53L5CX can also detect the direction of movement of nearby objects, enabling functions including gesture detection, implemented with ST's STSW-IMG035 turnkey solution, and presence detection.

Unlike conventional IR sensors, the VL53L5CX uses direct ToF technology which enables absolute distance measurement whatever the target color and reflectance, and can operate at a fast 60 Hz.

The VL53L5CX is supplied with patented ST algorithms which enable it to detect various objects, and which also provide immunity to cover glass crosstalk at a range of more than 60 cm.

## FREE DEV BOARD

The P-NUCLEO-53L5A1 is a complete evaluation kit allowing designers to develop applications using the VL53L5CX multi-zone ranging sensor. The kit includes: X-NUCLEO-53L5A1 expansion board for the VL53L5CX STM32F401RE Nucleo microcontroller board 0.25 mm, 0.5 mm, and 1 mm height spacers to simulate air gaps Cover window to protect the sensor from dust

**Orderable Part Number**  
**X-NUCLEO-53L5A1**

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# Low-profile MicroSD memory card connector features push-push ejector

The MEM2080 from Global Connector Technology is the slimmest MicroSD memory card connector in the market that has a push-push ejector mechanism.



# GCT

## FEATURES

- 5,000 mating cycles
- Operating temperature range: -25°C to 60°C
- 12 V voltage rating
- 0.5 A current rating
- 100 mΩ maximum contact resistance

## APPLICATIONS

- Portable electronics
- Alarm systems
- Security systems
- Consumer electronics
- Smart metering

MEM2080 from GCT is ideal for space-constrained applications.

The surface-mount connector's low profile of 1.28 mm makes it suitable for use in product designs which are subject to height limitations. Strengthening the MEM2080's appeal to designers of space-constrained applications, the connector occupies a board area of just 184mm<sup>2</sup>.

Other features include a card detection switch which is in a normally open configuration.

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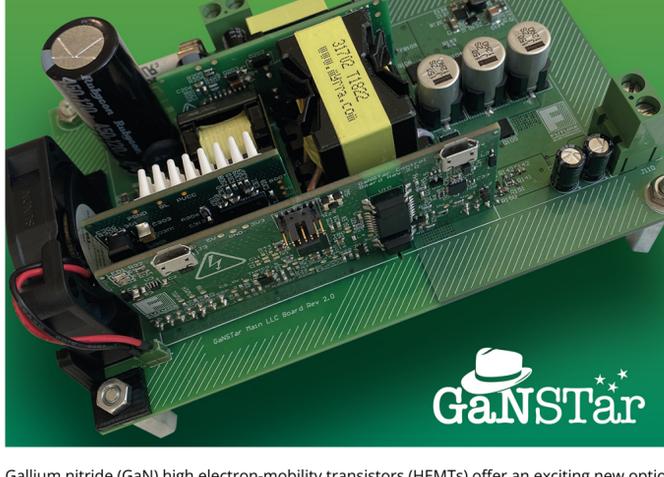
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TELECOMS

# An easier way to design GaN-based power systems: comparing the market's integrated driver offerings

By Vito Prezioso, Power Specialist Field Applications Engineer, Future Electronics (Northern Europe)



**FREE DEV BOARD**

Orderable Part Number  
**GaNStar**

**APPLY HERE NOW**

**FREE DEV BOARD**

Orderable Part Number  
**TobogGaN**

**APPLY HERE NOW**

Gallium nitride (GaN) high electron-mobility transistors (HEMTs) offer an exciting new option for power-system designers. Compared to silicon MOSFETs, GaN HEMTs allow them to dramatically reduce switching losses and increase power efficiency, as well as to support higher switching frequencies and so reduce system size and weight.

But the superior performance does not come without a penalty: a GaN HEMT is more difficult to drive than a silicon MOSFET. Whereas a silicon MOSFET needs a simple +10 V drive voltage and can handle transients up to 20 V without the risk of damage, GaN HEMTs can usually accept a maximum gate-drive voltage of just +6 V, and specify an optimal gate-drive voltage of +5 V. Turn-off conditions also have to be carefully managed, some HEMTs require a negative drive voltage to guarantee that the device will not turn on unintentionally. So a GaN HEMT calls for much tighter control of the gate driver's operation than a silicon MOSFET requires.

This makes an integrated system-in-package (SiP) combining a HEMT and gate driver highly appealing: the HEMT manufacturer can take care of selecting the optimal driver for the HEMT. In the integrated SiP the manufacturer will also implement an optimized gate-drive circuit. The prime benefit of such an optimized circuit is that performance and reliability are not affected by the parasitic inductance to which circuits built with discrete components are prone.

Figure 1 shows where parasitic inductance occurs:

- LS1 is the parasitic inductance due to the gate trace, which connects the Drive pin of the gate driver to the gate of the transistor through a resistor
- LS3 is the inductance generated by the return trace, which connects the Source pin of the transistor to the COM pin of the gate driver
- LS2 is the stray inductance attributable to the source leg, which also affects the power loop

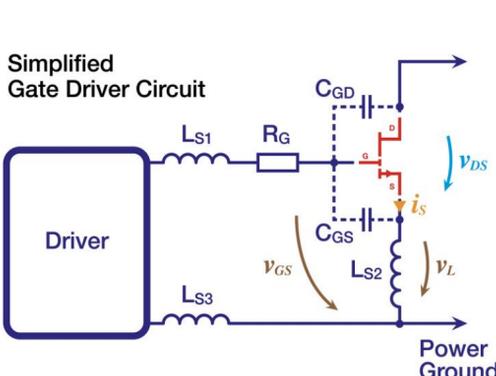


Fig. 1: Simplified gate-driver circuit showing the sources of parasitic inductance

The parasitic inductances, combined with Miller capacitance at a fast-switching transition, can introduce ringing and overshoot or undershoot voltage spikes at the gate. In the best case, this only generates EMI and impairs efficiency; in the worst case, it can actually damage the transistor.

In general, the wider the traces and the shorter the gate drive loop the better. With the driver and transistor combined in a single package, the gate-source loop is kept very short, resulting in substantially lower parasitic inductance than in a circuit with discrete HEMT and driver devices.

The best integrated devices in fact have extremely low stray inductance in the gate-drive loop. This almost eliminates gate-source voltage ringing, with the effect of:

- Lowering stress on the gate structure, and therefore improving the reliability of the HEMT
- Reducing the damping resistance on the driver output. This allows for faster switching and thus lower switching losses.

Integrated devices also offer lower stray inductance in the power loop, greatly reducing drain-source voltage spikes. This results in:

- Lower switching losses
- Lower EMI
- Lower drain-source voltage stress, improving reliability

On top of this, an integrated device offers a reduced component count and board footprint. Some single 650 V, 150 mΩ HEMTs which designers can find on the market today have a footprint of 8 mm x 8 mm. In an application, they require a discrete gate driver and gate-drive resistors. Compare this to the IGI60F1414A1L from Infineon: this CoolGaN™ Integrated Power Stage (IPS) device combines a half-bridge power stage consisting of two 600 V/140 mΩ enhancement-mode GaN switches with dedicated gate drivers in a thermally enhanced 8 mm x 8 mm QFN-28 package.

## Different products for different design requirements

These advantages, of easier design implementation, lower parasitic inductance, and smaller board footprint, have led all the main manufacturers of GaN HEMTs to build portfolios of integrated devices alongside their catalogs of discrete HEMTs and GaN drivers.

But certain trade-offs are associated with the use of integrated devices. First is that the customer's production is more tightly bound to the manufacturer and device: unlike a discrete HEMT and discrete driver, which might in many cases have an industry-standard footprint, an integrated driver device might offer fewer pin- or footprint-compatible alternative sources.

Beyond this, integration also hands to the device manufacturer the decision about how to manage trade-offs and meet the requirements of different types of applications. This means that there are important differences between the integrated GaN products on the market today.

The most striking ways in which the market's offerings vary are:

- Whether optimized for a specific topology or not
- Whether the device provides a means to adjust operation so as to minimize electro-magnetic emissions at the expense of efficiency
- The additional functions integrated into the device, in addition to the driver and HEMT

## Topology-specific integrated GaN products

With the launch of the MasterGaN family, STMicroelectronics took a unique space in the market for integrated GaN products. This is because these GaN SiPs were the first to feature an integrated half-bridge in either a symmetrical or asymmetrical configuration, paired with an optimized 600 V half-bridge driver.

ST created a family of five series of MasterGaN products to address the range of topologies which most customers use, and the range of power ratings which their applications require. So as Figure 2 shows, the MasterGaN2 and MasterGaN3 products are only for use in an active clamp flyback topology, since this topology calls for a lower on-resistance on the low side than on the high side. A new reference design from ST, the EVLONE65W, shows how much space can be saved when combining MasterGaN2 with the ST-ONE all-in-one digital power controller. EVLONE65W is a 65 W USB Power Delivery 3.1 charger board based on an active clamp flyback topology. Measuring 5.8 cm x 3.2 cm x 2.0 cm, the EVLONE65W achieves high power density of 30 W/in<sup>3</sup>.

For LLC resonant topologies, a symmetrical configuration is provided by the MasterGaN1, MasterGaN4 and MasterGaN5 series, supporting power ratings, according to ST, up to 400 W.

MasterGaN3	MasterGaN2	MasterGaN5	MasterGaN4	MasterGaN1
Up to 45 W	Up to 65 W	Up to 100 W	Up to 200 W	Up to 400W
200 mΩ + 500 mΩ Asymmetrical HB	150 mΩ + 200 mΩ Asymmetrical HB	500 mΩ + 500 mΩ Symmetrical HB	200 mΩ + 200 mΩ Symmetrical HB	150 mΩ + 150 mΩ Symmetrical HB
Active Clamp Flyback mainly			LLC Resonant mainly	

Fig. 2: With the MasterGaN family, ST introduced the industry's first integrated GaN half-bridge products

In fact, Future Electronics has developed a feature-rich development platform, called GaNStar, which can supply a maximum load of 500 W using the MasterGaN1. GaNStar implements a 96%-efficient LLC resonant dc-dc converter. It benefits from a precise digital control scheme running on the board's STM32G4 microcontroller and exemplary thermal design.

The MasterGaN products are, then, optimized for one of two soft-switching topologies. By contrast, integrated GaN devices from other important suppliers of GaN switches, with onsemi set to release 650 V integrated driver GaN products before the end of 2022, and Infineon with its IGI60F1414A1L CoolGaN IPS device, handle hard switching and are suitable for use in any topology. For instance, evaluation boards in development by onsemi implement converter designs including a 500 W totem-pole power factor correction converter, a 65 W flyback converter, and a 300 W LLC converter.

## Managing the EMI vs efficiency trade-off

In another respect, however, the Infineon CoolGaN IPS family is distinct from all the other integrated GaN devices on the market. These Infineon parts allow the power-system designer to access the gate of the transistors, and configure the gate-drive resistors/capacitor to adjust the ratio of  $dV/dt$ , as shown in Figure 3. This unique capability enables the designer to manage the balance of switching loss, electromagnetic emissions and overshoot, which can be valuable in applications which have a high sensitivity to EMI. There is a trade-off, however: the addition of the selectable external resistor lengthens the gate-source loop, which, as described above, increases parasitic inductance.

Like onsemi, Infineon has a pipeline of reference board designs based on the CoolGaN IPS family, including a 65 W quasi-resonant flyback converter for a high-density power adapter, and a 65 W active clamp flyback converter.

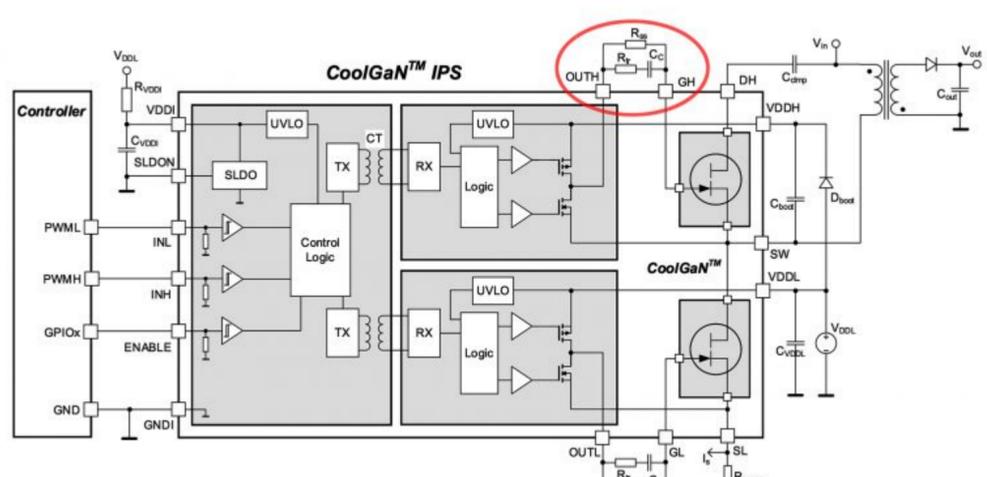


Fig. 3: An external resistor controls the  $dV/dt$  rate in CoolGaN IPS devices

## Deeper integration to reduce component count and board footprint

Integration of an optimized driver with its GaN HEMT provides value in part because it reduces development time and effort. This benefit can be extended beyond integration of the driver, however, as Power Integrations demonstrates. True to its name, Power Integrations specializes in the provision of multi-function products. The InnoSwitch™3 and InnoSwitch4 low-power ac-dc converters, for instance, are flyback controllers which integrate PowiGaN™ GaN transistors, a synchronous rectifier controller, and a FluxLink isolated feedback link. These parts minimize the length of the gate-source loop, and enable the designer to realize a very compact and highly efficient design at power levels up to 110 W.

Power Integrations also supplies the HiperPFS-5, a power factor correction controller with integrated 750 V PowiGaN GaN switches.

A useful way to evaluate the Power Integrations approach is with the TobogGaN power-supply board from Future Electronics, shown in Figure 4. This is a 60 W ac-dc converter based on the InnoSwitch3-Pro integrated flyback controller module, which includes a PowiGaN GaN switch on the primary side. Operating from a UnivnoSwitch3-Pro, the TobogGaN system achieves up to 92% efficiency at full load, supplying an output which is programmable between 5 V and 20 V.

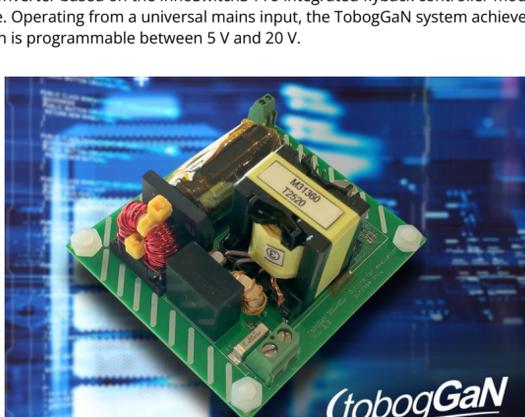


Fig. 4: The TobogGaN board from Future Electronics is a flyback converter rated for up to 60 W

Power Integrations does not have this section of the market to itself: it is also worth noting the VIPerGaN products from ST. The VIPerGaN50 is a quasi-resonant flyback controller paired with a GaN power switch. Operating from a mains input, it supports loads up to 50 W. ST also supplies the 65 W-rated VIPerGaN65 and the 100 W VIPerGaN100.

## Market responding to stimulus of demand

The diversity in the provision of integrated GaN drivers reflects the manufacturers' attempts to feel the pulse of the market: with demand for GaN products growing fast from a low base, it is yet to become clear whether, for instance, customers will prioritize efficiency and minimization of parasitic inductance over the freedom to control the  $dV/dt$  rate.

What is certain is that the market will continue to grow fast, and that GaN device manufacturers are investing heavily in development and production to meet this demand. Happily, then, customers can look forward to the prospect of a growing choice of products with which to optimize their efficient, high-density GaN-based power-system designs.

# Offline power converters offer very high efficiency and power density

Power Integrations has extended its InnoSwitch™3 portfolio of offline switcher ICs, adding new, highly efficient converters for small consumer devices, automotive devices with a 1,700 V rating, and optimized products for fast-charging power adapters.



InnoSwitch3 portfolio from Power Integrations includes products optimized for chargers, small and smart consumer devices, and high-voltage automotive systems.

InnoSwitch3 offline power converters can be used to supply loads up to 100 W in an enclosed power adapter without requiring a heat-sink. The converters offer increased efficiency of up to 95% across the full load range after Power Integrations replaced silicon transistors with high-voltage gallium nitride (GaN) transistors based on PowiGaN™ technology on the primary side of the IC, reducing conduction and switching losses.

The very high efficiency of the InnoSwitch3 products enables manufacturers of fast-charging USB Power Delivery (PD) power adapters to reduce the size of their products and achieve very high power density. The **InnoSwitch3-PD** simplifies the development and manufacturing of USB-PD power supplies by integrating the primary switch and controller, isolated feedback, secondary control and USB-PD controller into a single package. The InnoSwitch3-PD family is backed by various reference designs for USB PD chargers, together with the PI Expert™ automated design tool and technical support documentation.

The Power Integrations InnoSwitch3 family also includes the **InnoSwitch3-TN family**, which increases the efficiency of auxiliary power supplies used in appliances, consumer products and industrial applications. Ideal for both isolated and non-isolated designs, this advanced flyback controller can achieve up to 90% full load efficiency, flat efficiency across the load range, and very low no-load consumption. The InnoSwitch3-TN may be used as an accurate 5 V single-output power supply with two positive rails, or with both positive and negative rails.

For high-voltage automotive applications, the **InnoSwitch3-AQ family** of converters features a 1,700 V-rated silicon carbide (SiC) power switch. The InnoSwitch3-AQ simplifies the design and production of flyback power converters, particularly those requiring high efficiency and/or small size. The InnoSwitch3-AQ family combines primary and secondary controllers and safety-rated feedback into a single IC, allowing accurate output-voltage regulation over a wide input-voltage range of 30 V to 1,000 V dc.

The InnoSwitch3 architecture incorporates a novel inductive coupling feedback scheme, FluxLink™, which enables accurate drive information to be delivered across an isolation barrier without the use of an optocoupler. FluxLink provides fast communication, giving an almost instantaneous response to load transients.

This proprietary technology meets all global noise immunity standards. For safety, it complies with UL and TUV global isolation standards as well as the CQC 5,000 meter Chinese safety standard.

## Video links

Product Name	Description	Maximum Breakdown Voltage	Power Level
<b>InnoSwitch3-AQ</b>	For automotive applications	750 V, 900 V, 1,700 V	70 W
<b>InnoSwitch3-CE</b>	Offline systems consuming up to 65 W	650 V	65 W
<b>InnoSwitch3-CP</b>	Offline systems requiring constant-power profile	650 V, 725 V, 750 V	100 W
<b>InnoSwitch3-EP</b>	Offline systems consuming up to 100 W	725 V, 750 V, 900 V	100 W
<b>InnoSwitch3-MX</b>	Offline power supplies with multiple outputs for LED displays	650 V, 725 V, 750 V	85 W
<b>InnoSwitch3-PD</b>	For USB Type-C PD systems	750 V, 650 V	100 W
<b>InnoSwitch3-TN</b>	Offline flyback switcher IC	725 V	21 W
<b>InnoSwitch3-PRO</b>	Digitally controllable offline programmable power supply	650 V, 725 V, 750 V	100 W



## FEATURES

### InnoSwitch3-TN

- Less than 5 mW no-load power consumption at 230 V ac
- Enables designs which easily meet global energy efficiency regulations
- Achieves up to 90% full load efficiency
- Output over-voltage protection
- Open-gate detection for the synchronous rectification FET
- Hysteretic thermal shut-down
- Accurate internal constant-current limit

## APPLICATIONS

- Power adapters and chargers
- USB Type-C PD and programmable power supply (PPS) devices
- Industrial power supplies
- Metering
- Displays
- Appliances
- Networking equipment
- Games consoles
- Automotive systems

## FREE DEV BOARD

RDR-838 is a reference design report for a 60 W USB PD 3.0 power supply with a 3.3 V to 21 V output.

**Orderable Part Number**  
**RDR-838**

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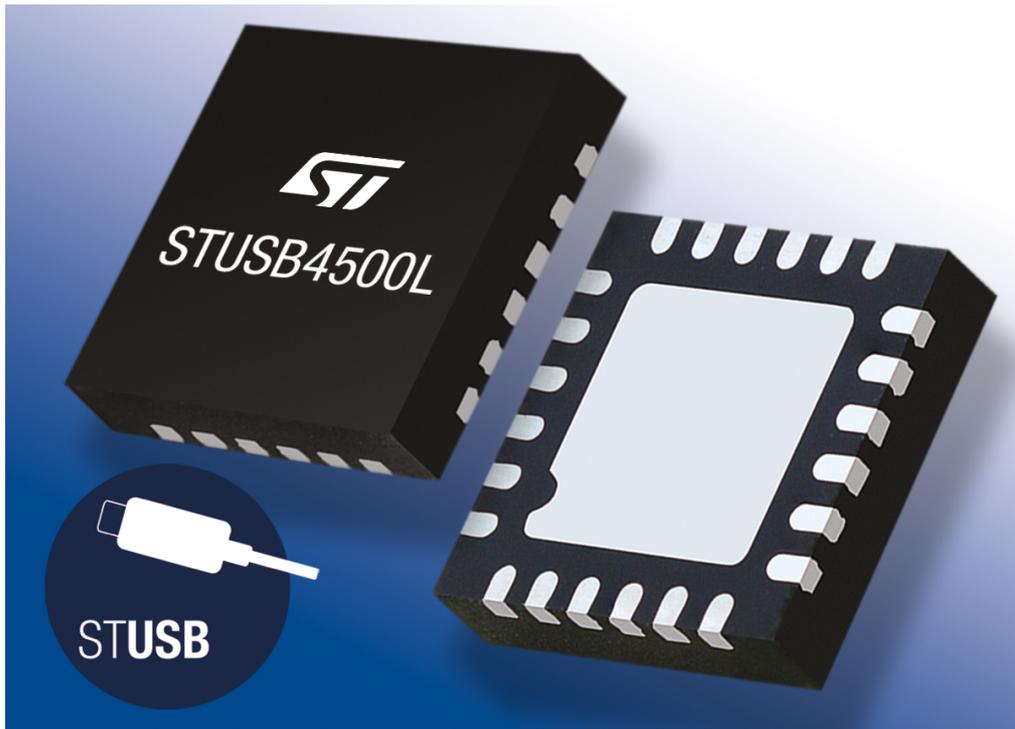
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TELECOMS

# 100 W USB PD sink power controller provides flexible management and protection features

The STUSB4500 from STMicroelectronics is a USB Power Delivery (PD) controller which provides robust and flexible management of devices sinking up to 100 W at 20 V/5 A.



STUSB4500 from STMicroelectronics can operate in stand-alone mode with no need for a microcontroller.

The STUSB4500 gives designers the flexibility to use a USB channel as a power source without the need for a microcontroller. The device implements a proprietary algorithm which allows the negotiation of a power delivery contract with a source in auto-run mode, without an MCU. The STUSB4500 stores up to three customizable power data object (PDO) profile configurations in an integrated non-volatile memory. The power profile can also optionally be customized by the application's microcontroller – an open source library of code for this is available.

The controller is compliant with the USB PD 2.0 specifications, and with the USB Type-C™ rev 1.2 standard. The device supports the USB PD standard dead battery mode, which means that sink devices may be powered from a dead battery state with a high-power charging profile.

Robust operation is assured by the controller's comprehensive set of protection features. These include short-circuit protection up to 22 V, and high-voltage capability up to 28 V on the bus voltage pins that are directly connected to its power path.



life.augmented

## FEATURES

- Zero power consumption when unplugged
- Fault management
  - Automatic restart after fault is cleared
- Dual high-power charging path support
- Integrated bus voltage monitoring
- Internal and/or external bus voltage discharge paths
- Debug accessory mode support
- Operating-temperature range: -40°C to 105°C
- Interoperable with USB PD rev 3.0 devices

## APPLICATIONS

- Printers
- Video and still cameras
- IoT devices
- Drones
- LED lighting
- Toys
- Gaming equipment
- Point-of-sale equipment
- Scanners
- Healthcare equipment

## FREE DEV BOARD

The STEVAL-ISC005V1 evaluation board is a ready-to-use USB PD sink based on the STUSB4500. It handles the USB PD negotiation with a source to enable one or more charging paths. LEDs report power availability on each of the four available outputs. The USB PD sink port is pre-configured with three different power data objects (PDOs) to address a broad range of applications at 5 V, 15 V or 20 V. PDOs can easily be customized with a graphical user interface tool.

**Orderable Part Number**  
**STEVAL-ISC005V1**

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# Power entry module gives protection from high transient loads

SCHURTER supplies the DC12 power entry module for use in industrial and medical applications that are exposed to high transient loads.



**SCHURTER**  
ELECTRONIC COMPONENTS

## FEATURES

- Rated current options: 1 A, 2 A, 4 A, 6 A, 10 A
- Leakage current:
  - Standard module less than 0.5 mA
  - Medical module less than 5  $\mu$ A
- Quick-connect terminals
- V-lock cord retention
- Available in white or black
- Operating-temperature range: -25°C to 85°C

## APPLICATIONS

- Industrial systems
- Medical equipment

DC12 from SCHURTER integrates inlet protection, line switching and filtering in a single module.

The shielded DC12 provides three functions:

- Appliance inlet protection to Class I or II
- One- or two-pole line switch which may be illuminated
- Line filter in a standard or medical version

The module offers two panel-mount options: a screw-on version mounted from the front or rear side, and a snap-in version for front mounting.

The DC12 is suitable for use in medical equipment specified according to the IEC/UL 60601-1 standard for 1 MOOP or 1 MOPP.

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TELECOMS

# 16 MHz to 96 MHz crystal offers tight stability over time and temperature

The ECX-1637B, from ECS Inc., is a very compact, surface-mount crystal which is ideal for wireless and IoT applications.



## FEATURES

- Maximum 3 pF shunt capacitance
- Load capacitance options:
  - 8 pF or 10 pF
- 100  $\mu$ W drive power
- Minimum  $\pm 7$  ppm frequency tolerance option
- Available in 1,000- and 3,000-piece reels

## APPLICATIONS

- IoT devices
- Wireless communications
- Wi-Fi networking
- Bluetooth networking

Compact ECX-1637B from ECS Inc. fits in small wireless applications.

Housed in a 2.0 mm x 1.6 mm x 0.45 mm ceramic package, the ECX-1637B supports frequencies in a range from 16 MHz to 96 MHz with a standard frequency tolerance of  $\pm 10$  ppm. Multiple frequency stability options over the operating-temperature range of  $-30^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  include devices with stability as tight as  $\pm 10$  ppm. Aging in the first year is just  $\pm 1$  ppm at  $25^{\circ}\text{C}$ .

ECS also supplies versions with an extended temperature range operating at a maximum of  $125^{\circ}\text{C}$ .



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TELECOMS

# DDR5 DIMM sockets compatible with the latest high-performance computing architectures

TE Connectivity (TE) has introduced DDR5 DIMM sockets to support the next generation of memory hardware for high-performance computing and server platforms.



## FEATURES

- Data rate up to 6.4 Gbits/s
- 1 A current rating per pin
- 106.8 N maximum insertion force
- Minimum 25 mating cycles
- Withstands high shock and vibration

## APPLICATIONS

- Data centers
- Servers
- High-performance computing (HPC) equipment
- Work stations

High-quality construction and space-saving design make the sockets ideal for use in data centers.

The TE DDR5 DIMM sockets enable high-speed operation at a rate of up to 6.4 gigatransfers per second.

When partnered with TE Connectivity processor sockets and PCIe Gen 5 connectors, the new DDR5 DIMM sockets provide a complete high data-rate connector framework for the latest computing architectures.

The TE sockets offer long life and robust operation. Thermal protection minimizes asset downtime and increases system reliability. In addition, the sockets' robust construction and design features allow for easy installation and system upgrades.

Narrow latch types and space-saving features provide for good airflow between components. Custom features are selectable by configuring the part number at the time of ordering.

*TE Connectivity, TE and TE connectivity (logo) are trademarks.*

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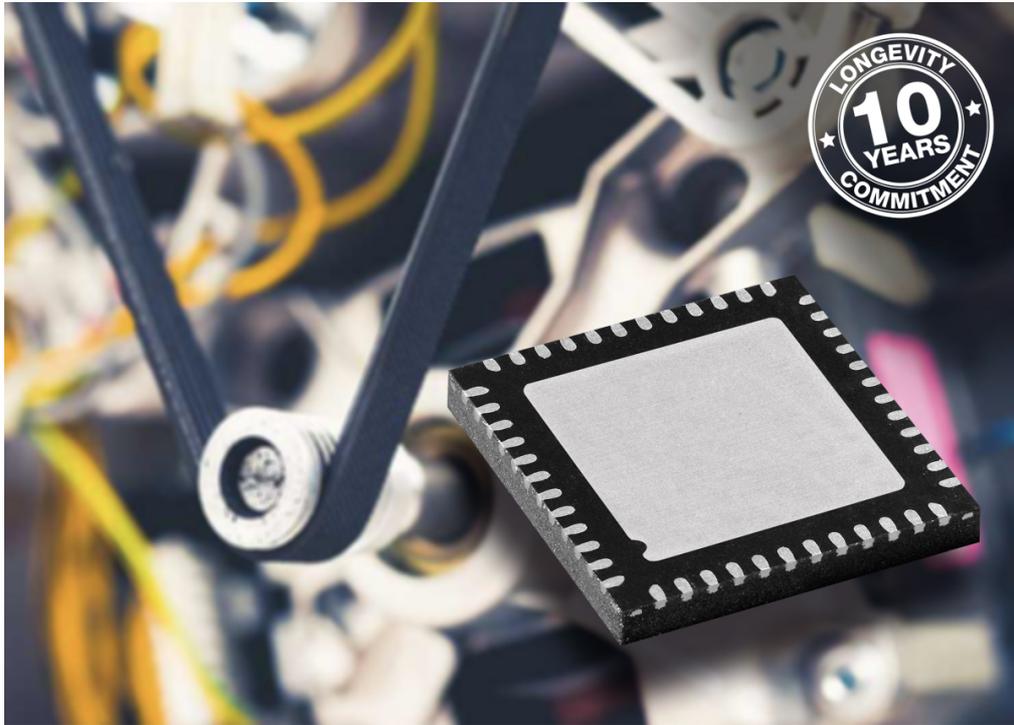
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# Dual full-bridge driver gives robust operation in stepper or dc motors

The STMicroelectronics L6206Q is a dual full-bridge driver which supplies a peak current output of 5.6 A to a dc or stepper motor.



## FEATURES

- Supply-voltage range: 8 V to 52 V
- 0.3  $\Omega$  on-resistance at a junction temperature of 25°C
- Operating frequency up to 100 kHz
- Paralleled operation
- Cross-conduction protection
- Under-voltage lockout
- Integrated fast freewheeling diodes

## APPLICATIONS

- Bipolar stepper motors
- Dual or quad dc motors

The STMicroelectronics L6206Q includes built-in over-current and thermal protection features.

The device benefits from ST's BCD multipower technology, which combines isolated DMOS power transistors with CMOS and bipolar circuits on the same chip. Supplied in a 7 mm x 7 mm VFQFPN package, the L6206Q driver ensures reliable and safe operation of electric motors: it features thermal shutdown protection, and performs non-dissipative over-current detection on the high-side power MOSFETs. A diagnostic output can easily be used to implement over-current protection.

The L6206Q is a member of the L62 series, which includes various motor drivers for a wide range of applications in small and medium-sized motors. The products include the L6208 and L6228, which feature an embedded stepping sequence generator for driving stepper motors.

The L6205/06/07 and L6225/26/27 are general-purpose brushed dc motor drivers, and feature programmable over-current protection.

The L6229, L6230, L6234 and L6235 are ideal for both sensed and sensorless driving of three-phase brushless dc motors. They include embedded PWM current control and decoding logic for Hall-effect position sensors.

## FREE DEV BOARD

The EVL62XX-MAIN expansion board hosts small EVL62XX-PLUG plug-in boards, enabling the quick and easy evaluation of members of the L62 family of drivers for brushed dc and stepper motors. The EVL62XX-MAIN is compatible with the Arduino UNO R3 connector.

**Orderable Part Number**  
**EVL62XX-MAIN**

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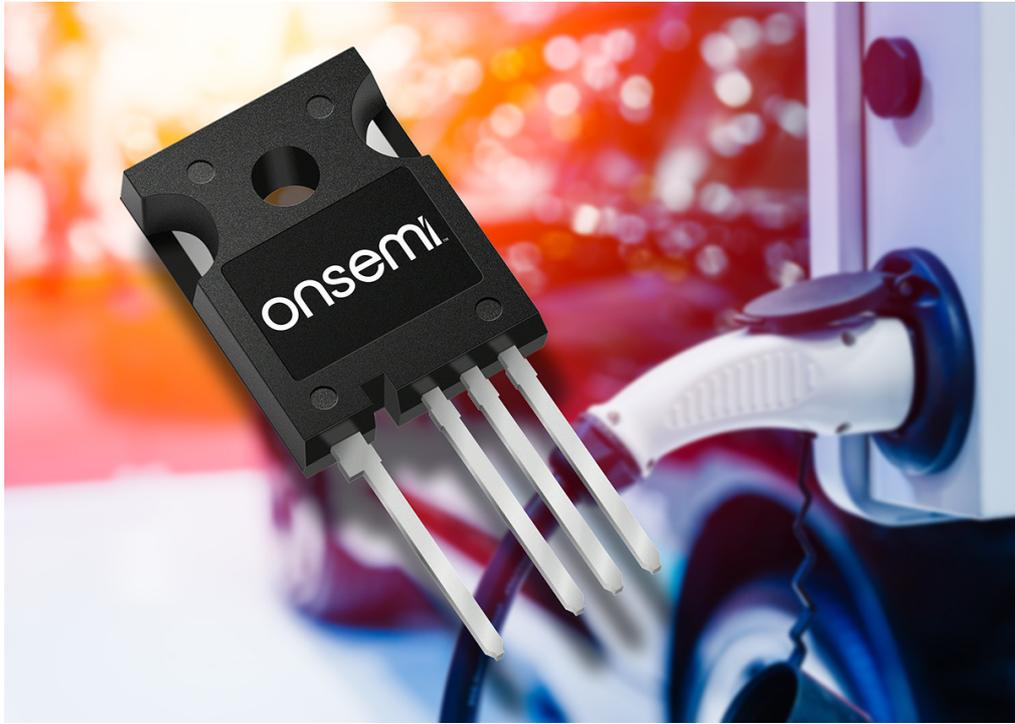
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# Expansion of SiC MOSFET family gives designers choice of package styles

onsemi supplies a growing range of silicon carbide (SiC) MOSFETs which give power-system designers a wide choice of package, footprint and voltage-rating options.



**onsemi**

## FEATURES

### NTH4L028N170M1

- Low common-source inductance
- Gate-drive voltage range: 18 V to 20 V
- Low switching losses
- 100% avalanche tested

## APPLICATIONS

- Solar inverters
- Uninterruptible power supplies
- Solid-state transformers
- Medium-voltage grid equipment
- Energy storage systems
- Hydrogen electrolyzers
- Fuel cells

onsemi SiC MOSFETs offer low on-resistance and low switching losses.

The expansion of the onsemi family comes in response to demand for devices based on SiC technology, which offers a combination of lower switching losses and faster switching speeds than traditional silicon power switches. These attributes have made SiC MOSFETs popular in applications which require high power-conversion efficiency, high power density or both.

onsemi, which recently announced the expansion of its SiC production facilities in Czechia and in New Hampshire, US, is supplying the industrial market with SiC MOSFETs that feature voltage ratings up to 1,700 V.

Part Number	Voltage Rating	On-resistance	Package Style
NTH4L014N120M3P	1,200 V	14 mΩ	TO247-4L
NTH4L020N090SC1	900 V	20 mΩ	TO247-4L
NVH4L060N065SC1	650 V	44 mΩ	TO247-4L
NTH4L028N170M1	1,700 V	28 mΩ	TO247-4L
NTMT045N065SC1	650 V	33 mΩ	Power88
NVBG025N065SC1	650 V	19 mΩ	D2PAK-7L

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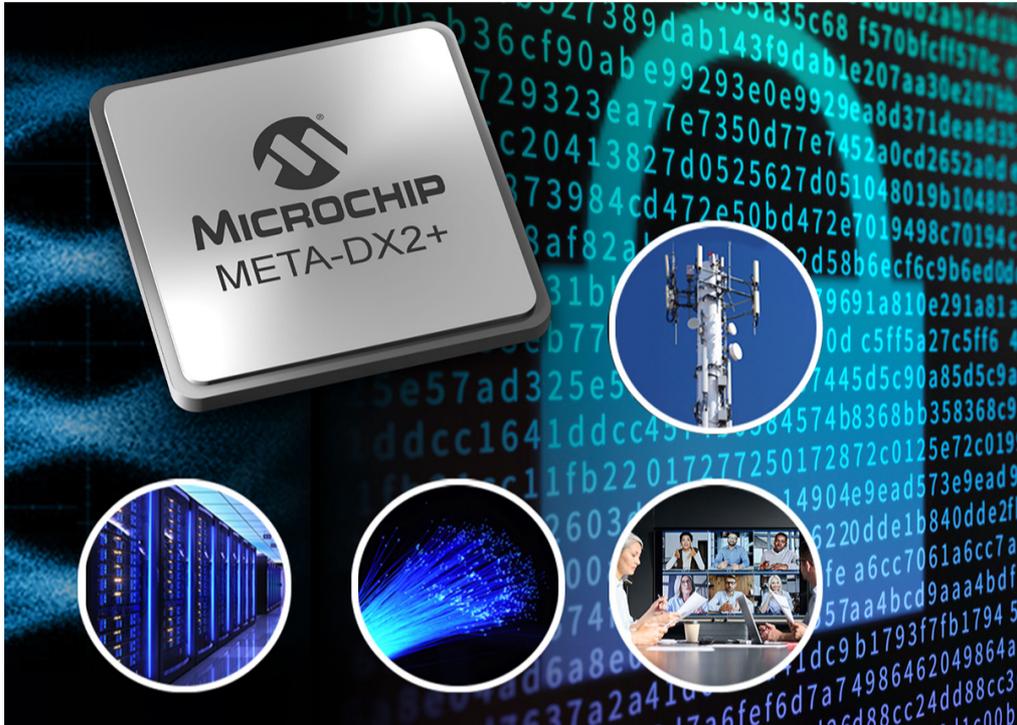
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TELECOMS

# Launch of industry's first terabit-scale secure Ethernet transceiver with port aggregation

Microchip has introduced a new family of META-DX2+ physical layer (PHY) devices in response to growing demand for 112G PAM4 network connectivity for enterprise Ethernet switching platforms, as well as cloud data center and telecom service provider switches and routers.



## FEATURES

- MAC/PHY configuration options:
  - Dual 800 GbE
  - Quad 400 GbE
  - 16x 100/50/25/10/1 GbE
- Integrated 1.6 Tbits/s MACsec/IPsec engines
- Flexible connectivity between external switches, processors, and optics
- 48 or 32 Long Reach (LR)-capable 112G PAM4 SerDes
- Support for Ethernet, OTN, Fibre Channel and proprietary data rates

## APPLICATIONS

- Telecoms and networking equipment
- Servers
- Enterprise computing systems:
  - Switches
  - Security appliances
  - Routers
  - Optical transport systems

META-DX2+ from Microchip enables OEMs to double router and switch system capacity with 112G PAM4 connectivity for 800G ports.

The META-DX2+ Ethernet transceivers are the industry's first to integrate 1.6 Tbits/s of line-rate end-to-end encryption and port aggregation. This enables networking equipment OEMs to maintain a compact footprint in the transition to 112G PAM4 connectivity in enterprise Ethernet networking equipment. The move to 112G PAM4 is also backed by a Microchip META-DX retimer and PHY portfolio and the META-DX2L retimer.

The configurable 1.6 Tbits/s datapath architecture of the META-DX2+ offers twice the performance of the next best competing devices in total gearbox capacity and hitless 2:1 protection switch mux modes, enabled by its unique ShiftIO capability. Flexible XpandIO port-aggregation capabilities optimize router/switch port utilization when supporting low-rate traffic.

The new META-DX2+ devices also include IEEE 1588 Class C/D Precision Time Protocol support for the nanosecond-accurate timestamping required for 5G and enterprise business-critical services.

By offering a portfolio of footprint-compatible retimers and advanced PHYs with encryption options, Microchip enables developers to expand their designs to add MACsec and IPsec functionality based on a common board design and software development kit.

Like the META-DX2L retimer, the new series of META-DX2+ PHYs can be used with Microchip's PolarFire® FPGAs, the ZL30632 high-performance phase-locked loop, oscillators, voltage regulators, and other components which have been pre-validated as a system to help speed designs into production.

<https://www.microchip.com/content/dam/mchp/mrt-dam/videos/meta-dx2-ethernet->



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TELECOMS

# High-current wire-to-board connector provides for secure locking

Hirose supplies the DF63 series of small, high-powered wire-to-board connectors for use in industrial equipment that must achieve high levels of reliability.



**HRS** HIROSE  
ELECTRIC  
EUROPE B.V.

## FEATURES

- 1 to 6 contact positions
- 3.96 mm or 7.92 mm pitch
- 630 V ac/dc voltage rating
- Rated for 30 or 50 mating cycles
- Cable sizes: AWG 16 to AWG 22

## APPLICATIONS

- Robots
- Medical devices
- Industrial machinery
- Smart meters
- Gaming equipment
- Home appliances

DF63 from Hirose saves space and allows for close mounting of multiple connectors.

The main connector range consists of cable-mount female crimp sockets and board-mount vertical and right-angle male headers. The connectors can handle a maximum current of 15 A. Hirose also supplies in-line versions of the connector, and a waterproof DF63W series.

The connectors' form factor enables the designer to achieve space savings. The three-position header only occupies board space of 88mm<sup>2</sup> due to its small pitch.

Secure locking is assured by a robust lock which gives a clear tactile click when mated. This confirms the connector is fully engaged. The lock is on the center of the housing, eliminating the risks of uneven locking and cable entanglement, which are common with side locks. This also enables multiple connectors to be mounted close together when side-by-side.

The header features square male pin contacts which have a wide conductive surface area of 1.14mm<sup>2</sup> on each side to carry high currents. Each contact is protected by housing walls to avoid the risk of short circuits and to prevent it from being touched.

The cable-mount female socket housing uses crimp contacts which have an internal multi-point contact structure to ensure good contact wipe and high contact reliability. The design of the housing base is tapered to allow resin sealing up to 5 mm high. The resin stopper, which is a step underneath the lock, stops the resin rising too far.

The DF63 series is part of the EnerBee™ product family. The EnerBee family features wire-to-board and wire-to-wire power connectors which provide technically advanced connectivity solutions for industrial power sources.

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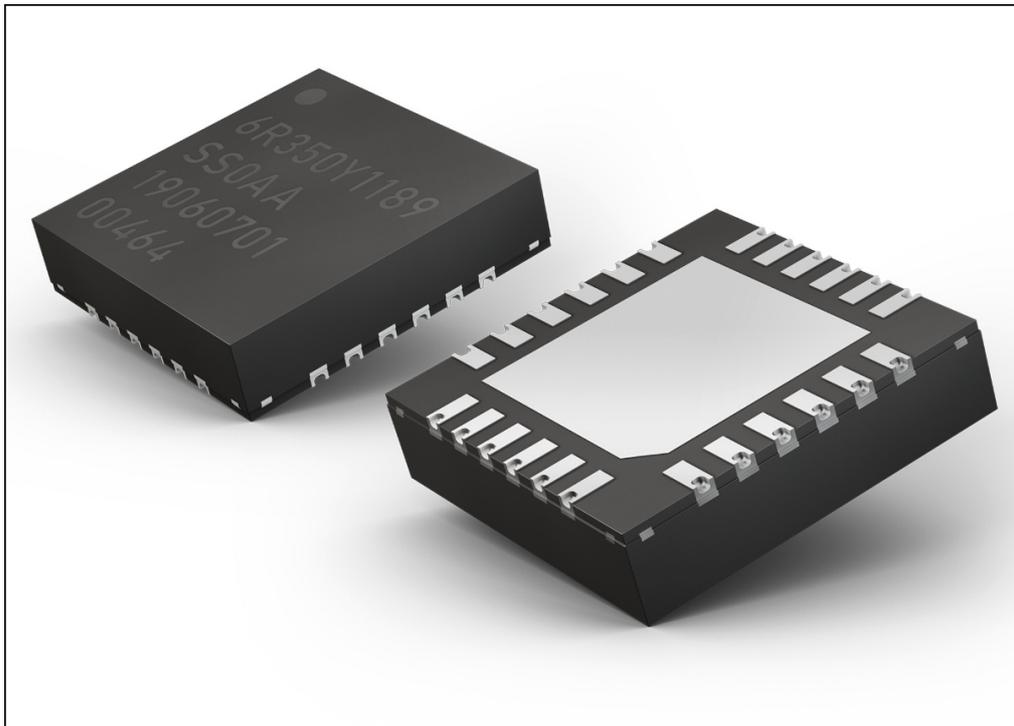
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TELECOMS

# Robust package design makes six-axis motion sensor ideal for harsh automotive applications

**EWTS5G sensor is automotive-qualified and supports the requirements of the ISO 26262 standard. Panasonic Industry Europe has developed a six-axis inertial motion sensor which provides the robust and accurate performance required in automotive applications.**



EWTS5G sensor is automotive-qualified and supports the requirements of the ISO 26262 standard.

The new AEC-Q100 qualified EWTS5G MEMS sensor combines a three-axis gyroscope and three-axis accelerometer in a compact QFN package with wettable flanks. Factory calibrated, it offers excellent performance over a wide dynamic range: total sensitivity error is less than  $\pm 3\%$ , and the sensor provides measurement bandwidth of more than 20 kHz.

The EWTS5G is housed in a special stepped package which offers high reliability in the harsh automotive environment. During board assembly, the solder creates a reliable connection in the throat of the step. This allows for correct soldering and error-free assembly, which is essential for safety-critical automotive applications such as ABS brakes or traction control.

This robust, shock- and vibration-resistant device also supports compliance with the specifications of the ISO 26262 functional safety standard, and is compatible with ASIL-D applications.

## Panasonic INDUSTRY

### FEATURES

- Package dimensions: 4.5 mm x 4.5 mm x 1.1 mm
- High sensitivity
- Low offset
- Low noise
- Operating-temperature range: -40°C to 125°C

### APPLICATIONS

- Automotive systems:
  - Traction control systems
  - Electronic stability control
  - Roll stability control
  - Pitch stability control
  - Rollover airbag systems
  - ABS brakes
  - Adaptive cruise control
  - Adaptive front-lighting systems
  - Chassis stability monitoring
  - Motorcycles
- Agricultural machinery
- Construction machinery
- Automated ground vehicles
- Forklift trucks
- Drones
- Industrial robots
- E-bikes



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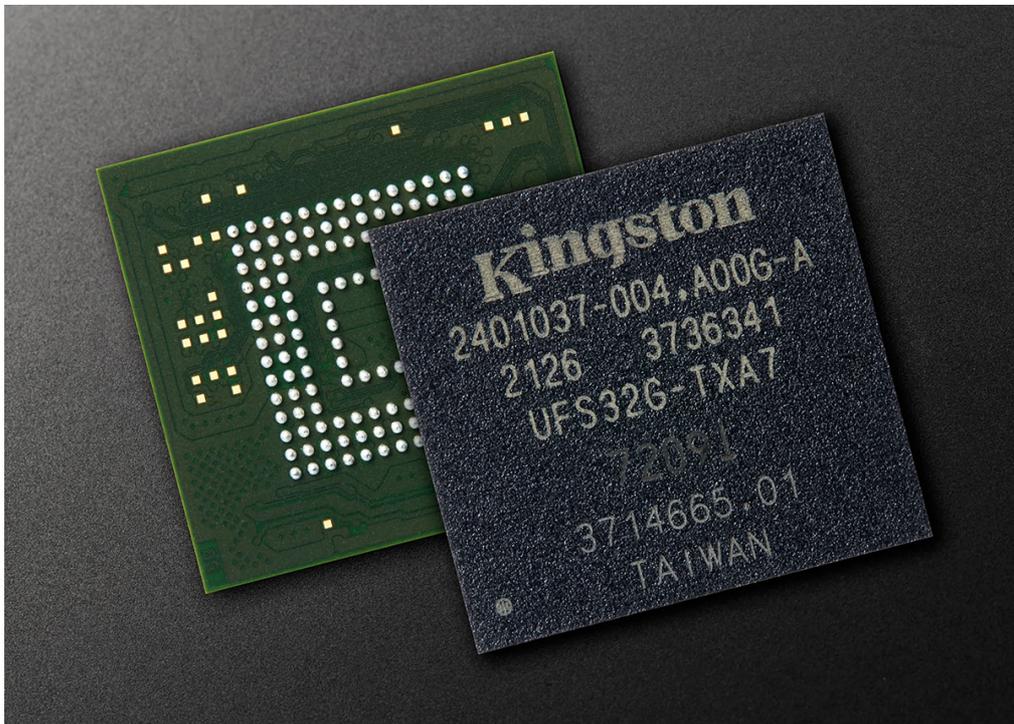
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# High-capacity UFS memory ICs provide low-power storage for embedded computing devices

Kingston's Universal Flash Storage (UFS) is an ideal storage solution for applications that require high performance and low power in a single integrated package. The small form factor and low power consumption of Kingston UFS devices make them ideal for embedded and mobile applications.



**Kingston**  
TECHNOLOGY

## FEATURES

- Operating-temperature range: -25°C to 85°C

## APPLICATIONS

- Smartphones
- Tablet computers
- PCs
- Chromebooks
- Virtual reality/augmented reality devices
- High-definition video, surveillance and conferencing systems

Kingston UFS memory products have a small board footprint and low profile.

UFS is an open standard developed by the Joint Electronic Device Engineering Council (JEDEC). Compliance with this standard ensures compatibility with many host processors.

The Kingston UFS products integrate non-volatile NAND Flash memory with a UFS controller. The advanced UFS controller provides all the algorithms necessary to reliably manage the NAND Flash memory while fully implementing UFS functionality and features.

Part Number	Memory Capacity	Interface Version	Package Size (mm)
UFS64G-TX17	64 Gbytes	UFS 3.1	11.5 x 13 x 0.8
UFS128-TX17	128 Gbytes	UFS 3.1	11.5 x 13 x 1.0
UFS256-TX17	256 Gbytes	UFS 3.1	11.5 x 13 x 1.1
UFS32G-TXA7	32 Gbytes	UFS 2.1	11.5 x 13 x 0.85
UFS64G-TXA7	64 Gbytes	UFS 2.1	11.5 x 13 x 0.85

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# Efficient ac-dc power modules supply 5 W in a 1" x 1" package

The RAC05-K series of ultra-compact ac-dc power supply modules from RECOM offers excellent efficiency over the entire load range. These power supplies are suitable for use in IoT equipment and industrial applications.



## RECOM

### FEATURES

- Suitable for Class II installations
- Efficiency up to 84%
- 75 mW no-load power consumption
- Internal fuse
- Protection functions:
  - Short-circuit
  - Over-voltage

### APPLICATIONS

- IoT devices
- Industrial equipment
- Control systems

Compact RAC05-K series from RECOM enables power-system designers to achieve high power density.

The modules operate from a universal mains voltage range of 85 V to 264 V ac and have a maximum 5 W power rating. Designers can choose from parts supplying an output voltage of 3.3 V, 5 V, 12 V, 15 V or 24 V. Output accuracy is  $\pm 1\%$ .

Housed in a lightweight, fully-encapsulated plastic casing which has a 1" x 1" footprint, the RAC05-K series modules have safety approvals for the IEC 60950-1 and UL 62368-1 standards. The products also meet the requirements of the EN 55032-B specifications for EMI emissions without any external components.



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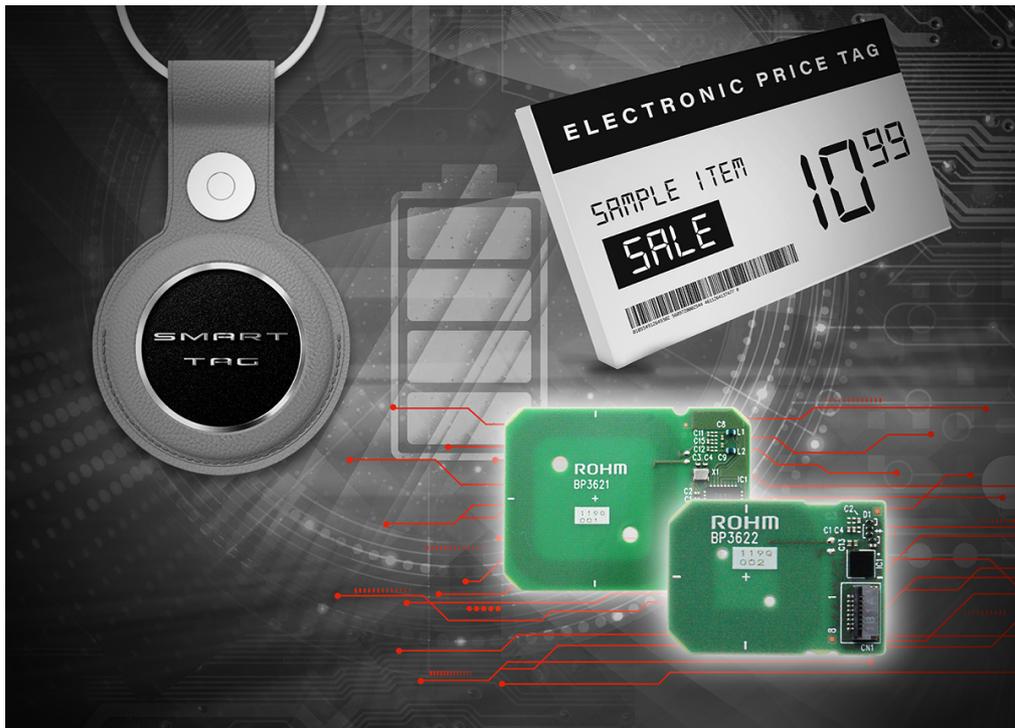
CONSUMER



TELECOMS

# Power modules provide ready-made solution for NFC wireless charging

The BP3621 and BP3622 from ROHM Semiconductor are small, integrated power modules which provide a ready-made solution for implementing wireless charging at a frequency of 13.56 MHz. The BP3621 is the wireless power transmitter and the BP3622 is the receiver.



## FEATURES

- 200 mW maximum output power
- 212 kbits/s maximum data rate
- Operating-temperature range: -10°C to 50°C

## APPLICATIONS

- Smart tags
- Smart cards
- ID cards
- PC peripherals
- Personal healthcare devices
- Wearable devices

BP3621 and BP3622 from ROHM Semiconductor form a complete transmitter/receiver system with an ultra-compact footprint.

The operation of the modules at the NFC frequency of 13.56 MHz means that they achieve good coupling with a small antenna at a range of up to 10 mm. The BP3621 has a footprint of 35 mm x 26 mm, while the BP3622 measures 24 mm x 17 mm.

The built-in antenna can support bi-directional data communication and the functionality of an NFC Forum Type 3 tag, enabling the implementation of communications functions which are useful in the application, such as relaying the state of charge of the battery.

The BP3621 and BP3622 can easily be used in very small devices with limited space on the back side. ROHM Semiconductor supplies the modules with software for performing wireless charging and NFC tag communication.

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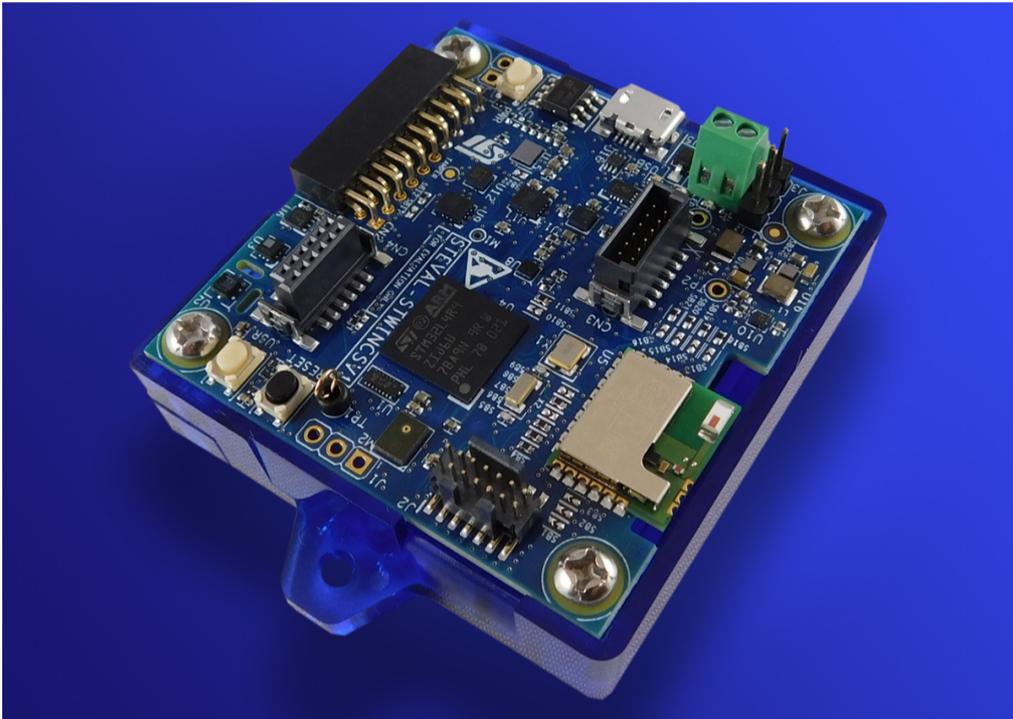
 **DATASHEET #2**

 **SAMPLES**



# Development kit provides reference design for wireless sensor nodes in industrial IoT applications

The STWINKT1B SensorTile kit from STMicroelectronics is a reference design platform for a wireless sensor node. It can be used in the prototyping and testing of designs for industrial IoT applications such as condition-based monitoring and predictive maintenance.



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## FEATURES

- Micro-SD card slot for stand-alone data logging
- Option to implement authentication and brand protection with STSAFE-A110
- 480 mAh lithium battery
- STLINK-V3MINI debugger

## APPLICATIONS

- Predictive maintenance
- Condition monitoring
- Asset tracking
- Smart logistics
- Wearable devices
- Consumer electronics

STWINKT1B SensorTile kit from STMicroelectronics incorporates motion, environmental and acoustic sensors to give a realistic application environment for rapid development.

The STWINKT1B SensorTile kit features a core system board with a range of embedded industrial-grade sensors and an STM32L4R9 microcontroller, which is based on an Arm® Cortex®-M4 processor. The MCU performs vibration analysis on the data provided by the kit's IIS3DWB three-axis digital vibration sensor and by an ISM330DHCX sensor, an inertial measurement unit consisting of a three-axis accelerometer and three-axis gyroscope, backed by a machine learning core.

The other sensors included on the system board are:

IIS2DH low-power, high-performance MEMS motion sensor

IIS2MDC low-power three-axis magnetometer

LPS22HH digital absolute pressure sensor

HTS221 relative humidity and temperature sensor

STTS751 low-voltage digital local temperature sensor

IMP34DT05 industrial-grade digital MEMS microphone

IMP23ABSU analog MEMS microphone with frequency response up to 80 kHz

The development kit is complemented by a rich set of software packages and optimized firmware libraries, as well as a dashboard application running in the cloud. An on-board module provides Bluetooth® Low Energy connectivity. An STEVAL-STWINWFV1 expansion board enables connection to Wi-Fi® networks. Wired connectivity is also supported via an on-board RS-485 transceiver and USB On-The-Go interface.

The core system board includes an STMod+ connector for compatible daughterboards associated with the STM32 family, such as the LTE Cell pack.

## FREE DEV BOARD

The STWINKT1B is a development kit and reference design which simplifies the prototyping and testing of industrial IoT applications such as condition monitoring and predictive maintenance.

The board enables the designer to evaluate the performance of a range of STMicroelectronics motion and environmental sensors and microphones, and is backed by a rich set of software packages and optimized firmware libraries, as well as a cloud dashboard application.

**Orderable Part Number**  
**STEVAL-STWINKT1B**

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# UVC LEDs offer long lifetime and high disinfection efficacy

Vishay has introduced two UVC LEDs which produce 12x higher radiant power at a lower cost than previous devices, while offering higher disinfection efficacy and a longer service life.



High radiant power and 274 nm output make Vishay UVC LEDs ideal for direct disinfection of surfaces, air and water.

The VLMU35CR40-275-120 and VLMU35CR41-275-120 produce an output with a typical wavelength of 274 nm, making them ideal for sterilization applications in medical, industrial and consumer products. Many UVC LEDs available today have a 280 nm peak wavelength: the 274 nm output of the VLMU35CR40-275-120 and VLMU35CR41-275-120 produces 20% better sterilization efficacy. The LEDs are ideal for use in equipment for the direct disinfection of surfaces, air, and static water.

The VLMU35CR41-275-120 provides a minimum radiant power of 30 mW at 250 mA, which is the same power as the closest competing device operating at 350 mA. The minimum radiant power of the VLMU35CR40-275-120 is 27.5 mW.

These Vishay LEDs are supplied in a compact, surface-mount package with a ceramic substrate and a quartz window. The dimensions are 3.45 mm x 3.45 mm x 1.7 mm. The robust package enables Vishay to guarantee a long service life of 27,000 hours at 250 mA and 25°C.

These Vishay LEDs can be used to replace low-pressure UVC mercury tubes, especially in compact designs in which small components are required.



## FEATURES

- Wavelength range: 265 nm to 280 nm
- 300 mA maximum dc forward current
- 5.2 V minimum forward voltage
- $\pm 60^\circ$  angle of emission

## APPLICATIONS

- Sterilization devices for:
  - Ear buds
  - Toothbrushes
  - Water bottles
  - Refrigerators
  - Air purifiers
  - Door handles
  - Medical instruments
  - Coffee machines
  - ATMs
  - Toilet seats
  - Vacuum cleaners

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# Rugged circular fiber connectors make termination easy

The 5000 series of expanded beam circular fiber connectors from Bulgin combines high performance with a simple process for termination.



Bulgin 5000 series connectors are suitable for use in harsh conditions including in military tactical equipment.

Compatible with the specifications of the MIL-DTL-83526D standard, the connectors are suitable for use in harsh environments, including military tactical communications devices, as well as mining, broadcast and marine equipment. They may be used with any other MIL-DTL-83526D connector.

Bulgin has also implemented a patented arrangement for ferrule-lens alignment. Fiber ferrules are terminated using standard termination tools, and may be easily placed in position. This means that the two- and four-channel 5000 series connectors allow for rapid in-field termination and repair when inserts and termination kits are available.

Bulgin also supports the 5000 series connectors with a new management system which prevents twisting of fibers and cable, a common cause of performance impairment.

The 5000 series is available with plug, jam nut and flange-mount connector body options, and with plug-to-plug, plug-to-LC and plug-to-SC cable assembly options.



## FEATURES

- 2 dB maximum insertion loss
- Less than 1.5 dB average insertion loss
- IP68 rating
- Available with OM1 and OM3 fiber types
- Cable length up to 450 m
- Secure, proven locking system
- Operating-temperature range: -50°C to 80°C with outdoor tactical cable

## APPLICATIONS

- Fiber connections in harsh environments:
  - Military equipment
  - Mining equipment
  - Broadcast equipment
  - Marine equipment

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# Innovations in component technology address latest requirements of 5G mobile equipment designs

Read this to find out about:

- Why new types of 5G equipment require components which are more robust and smaller, and offer higher signal integrity
- New resistor designs for 5G applications which are resistant to solder joint cracking under temperature stress
- The latest miniature relays for densely populated power distribution units

**Panasonic**

INDUSTRY

The steady advance of mobile networking technology has delivered many benefits to consumers. In the 21st century, the move from 2G through 3G to 4G came in tandem with the transformation of the mobile phone from a simple device for voice calling to a high-specification mobile computer providing broadband internet access.

Now the next stage in mobile evolution, 5G, is rolling out worldwide, bringing a new set of capabilities: in particular, 5G is the first mobile networking technology to truly meet the needs of the mobile Internet of Things (IoT). In addition, 5G technology provides for much denser concentrations of networked devices in a cell, and supports much lower-latency and high-bandwidth communication. This means that new types of mobile network infrastructure have emerged:

- New 'small cell' micro-base stations allow for lower-cost installations in city centers to support the connection of huge numbers of IoT devices
- 5G customer premises equipment (CPE) installed in homes and offices provides a wireless broadband internet access point, an alternative to traditional wired copper or optical internet connections to the end user
- Ever larger data centers supporting the mobile network provide higher capacity to handle the greatly increased volumes of data traffic that the 5G air interface can support

The changing nature of mobile network infrastructure is placing new demands on equipment manufacturers, and this in turn driving the development of new and improved electronics components for 5G equipment. The most important of these demands are:

- Increased robustness to cope with higher-power electrical connections and harsh exterior conditions, including high temperatures, and airborne contaminants such as atmospheric sulfur
- Miniaturization, where tight space constraints strongly affect the component choices made by the designers of small cells intended for installation in the city center, of CPE gateways mounted on the outside wall of a consumer's home, and of data centers
- Higher signal integrity, which is required to maintain high data quality and minimize bit errors in 5G networks which operate at higher frequency and higher data rates than previous mobile network technologies

These new requirements are determining the component selection decisions made by manufacturers of 5G network modules and systems, and in response Panasonic has developed new products and technologies in important component categories such as resistors, capacitors, connectors, and relays. This article describes how these new components are rising to the challenge of 5G.

## Robust components handle harsh operating conditions

Whether mounted on a traditional tall mast or affixed to the wall of a city center building, a 5G antenna, remote radio head (RRH) or baseband unit (BBU) is exposed to extremes of temperature and to atmospheric sulfur. These are conditions in which standard commercial components, intended for use indoors, are at risk of premature failure.

The specifications for the precision resistors used in 5G equipment require particularly careful attention. The temperature coefficient of resistance (TCR) shows the drift in resistance as the operating temperature changes, while the maximum operating temperature and temperature derating threshold indicate the upper limits of the resistor's temperature capabilities.

These capabilities are being stretched because miniaturization means that heat-dissipating components are packed more closely together with less space for cooling airflows. In response, Panasonic has created the new ERJ-H family of thick-film precision resistors which offer superior temperature characteristics. The ERJ-H resistors meet the need in two ways:

- The maximum operating temperature has been lifted in the ERJ-H from 155°C to 175°C compared to the existing ERJ resistors, and the temperature derating threshold from 70°C to 105°C, shown in Figure 1
- The resistors have been miniaturized, for instance the ERJHP6 offers an equivalent resistance value and power rating in the 0805 case size to the ERJP14 in a 1210 case, a two-step reduction in case size. The smaller the case size, the less mechanical stress is applied to solder joints by thermal shrinkage and expansion. This means that the ERJ-H series resistors pose a smaller risk of solder joint cracking than the ERJ resistors when operating in 5G equipment

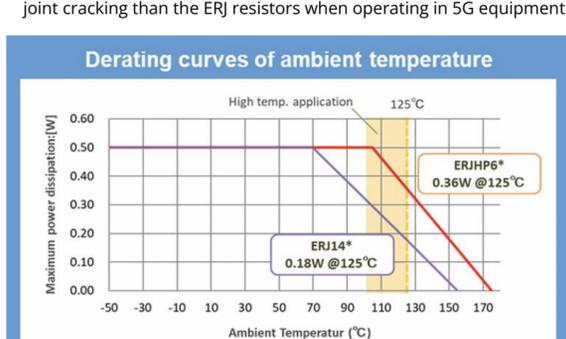


Fig. 1: Derating curves of the ERJ-H high-temperature family compared to the ERJ resistors

Mobile network operators' business model for 5G systems requires reliable operation and minimal unplanned downtime. Both thermal stress and sulfur contamination can cause component failure. Panasonic addresses the need for high sulfur resistance while providing designers with a choice of features and benefits.

The **ERJ-S thick-film resistors** have gold inner electrodes, and gold is inherently immune to sulfur corrosion.

The **ERJ-U thick-film resistors** have silver-palladium alloy inner electrodes which are highly resistant to sulfur corrosion, and which also survive 12,000 hours of immersion in an oil bath

The **ERA-V series of thin-film resistors** has a new structure which helps to protect the inner electrode, enhancing sulfur resistance, and which absorbs stress to reduce the risk of solder joint cracking, as shown in Figure 2. The ERA-V series resistors also feature a new, smoother substrate which reduces localized current density. As a result, the ERA-V resistors now offer a much higher ESD rating than the earlier ERA-A series, up to 2 kV, with only small changes in resistance when exposed to even higher ESD strikes up to 4 kV.

## Achieve excellent anti solder-joint crack by back side resin layer

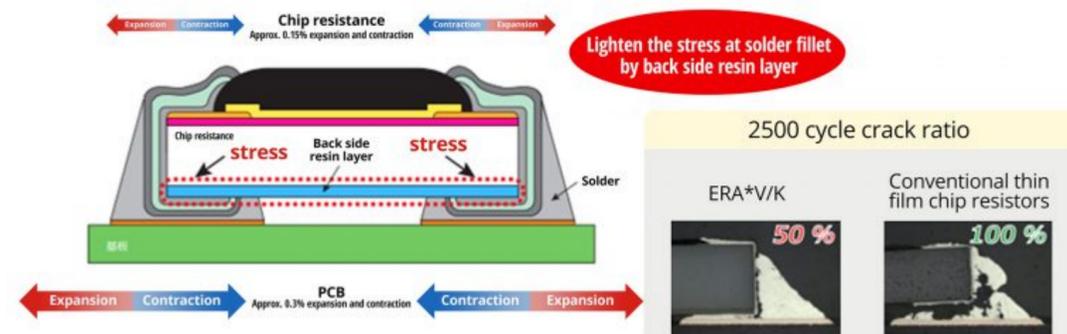


Fig. 2: The new structure of the ERA-V resistor features a stress absorbing layer

Panasonic's efforts to offer more robust components to designers of 5G equipment extend beyond its families of resistors to include its portfolio of electromechanical relays. In data centers, automatic transfer switch applications support hot-swappable redundant power supplies. In the event of a power failure, a relay is required to perform high-current switching in the transition from the main power supply to the redundant power supply. To meet this requirement, Panasonic supplies the HE-S relay family, which carries two channels of 35 A, and which provides an auxiliary contact to detect contact welding. Very low coil holding power helps to reduce system power consumption.

Design options are widened further by the HE-PV family of relays, which offer 48 A and 90 A current ratings.

## Space-saving components support system miniaturization

New relay technology is also coming to the support of 5G equipment manufacturers' miniaturization efforts, as well as providing more robust component options. Space-saving relays are of particular interest to manufacturers of the power distribution units (PDUs) which supply arrays of servers in 5G network data centers. These rack-mounted PDUs have very tight space constraints, and can feature as many as 48 relays on a single unit.

The DW family of PCB single-pole single-throw (SPST) relays with latching capability is ideal for this application because of the very small board footprint, giving the PDU designer greater flexibility in board layout, and promoting improved airflow and thermal dissipation from high-power components, shown in Figure 3. The latching feature also ensures the switch timing is consistent, making it easier to implement a more effective zero-cross circuit to prolong the life of the relay. The high inrush type DW series has a current switching rating of 16 A at 277 V ac, but has an option to switch up to 20 A to accommodate the higher-power PDU designs required by market segments such as cryptocurrency mining.

The DW relays are also offered with a double-pin option in the same SPST configuration. The extra pins allow for better heat dissipation from the contacts, which generate most of the heat inside a relay. This double-pin option also increases the relay's short-circuit rating, a crucial characteristic in PDUs. A PDU is a high-cost item. One of the most obvious failure modes of a PDU is a short-circuit generated when the PDU is inserted wrongly into a system through human error. The DW relays' high short-circuit withstanding capability protects the board against the risk of damage, helping to save the operator from potentially large equipment replacement costs.



Fig. 3: The DW relay has a small board footprint and a high current capability

In a different product category, the miniaturization trend in 5G equipment is equally at work. Panasonic supplies a broad choice of POSCAP™ tantalum-polymer and SP-CAP™ polymer aluminium capacitors. These low-profile capacitors are notable for high temperature capability and long lifetime as well as small size.

Providing confidence in the performance and quality of the space-saving Panasonic capacitors, both POSCAP and SP-CAP family devices are specified in 5G networking equipment reference design boards developed by many of the world's leading suppliers of microprocessors and FPGAs.

## High signal integrity supports reliable mobile broadband connectivity

The third of the three trends driving component selection for 5G mobile network equipment is signal integrity, to maintain reliable communications at the very high frequencies and data-transfer rates at which 5G base stations and terminals operate.

This is why Panasonic has developed a family of RF connectors which are optimized for the 5G millimeter-wave frequencies. At these frequencies, signals are highly sensitive to electro-magnetic interference (EMI) generated by components close to the connector on densely populated circuit boards. This means that RF connectors require highly effective shielding to screen out the interfering frequencies.

The Panasonic 5G RF connectors benefit from a unique construction which provides for class-leading signal integrity and robustness, and in addition, offer a footprint some 16% smaller than that of directly competing devices, to aid miniaturization.

The unique features of the Panasonic 5G connectors include:

- Insulated molding with metal shield. This construction, which requires advanced production equipment and techniques to be manufactured in volume, isolates the pins which carry high-frequency signals, insulating them from EMI and dramatically improving signal integrity.
- Tough Contact pins. In competing connectors, pins are typically manufactured with a stamping process. In the Panasonic 5G RF connectors, the pins are bent and rolled, a process implemented with special tooling, which makes the pins stronger and more flexible, so that the connector is better able to withstand shock and vibration. This contributes to signal integrity by maintaining a secure physical connection under all operating conditions.

## Continuous improvement of products for next-generation communications

This article has highlighted the product developments which enable 5G network manufacturers to compete successfully in a market which demands more robustness, continued miniaturization and high signal integrity.

Innovation at Panasonic never stops, however. In the world of broadband connectivity and mobile infrastructure, the most eye-catching of the product developments on the horizon is a family of DC switching relays, for use in new all-dc power architectures for data centers, which will avoid the losses incurred when converting mains ac to a dc supply to servers.

The design of a DC switching relay is extremely challenging: whereas an ac relay can switch at 0 V to avoid arcing, a DC switching relay always switches under load, which creates substantially more arcing than in an AC relay.

Panasonic is now developing a new family of DC switching relays which will use novel methods to manage safely the dissipation of arcing energy, and to enhance the design of the relay's contacts to counteract the pitting and material deposition caused by switching under load.

This, and many other innovations in resistor, capacitor and connector design, will ensure that Panasonic components continue to meet the new and emerging demands of manufacturers serving the 5G equipment market.

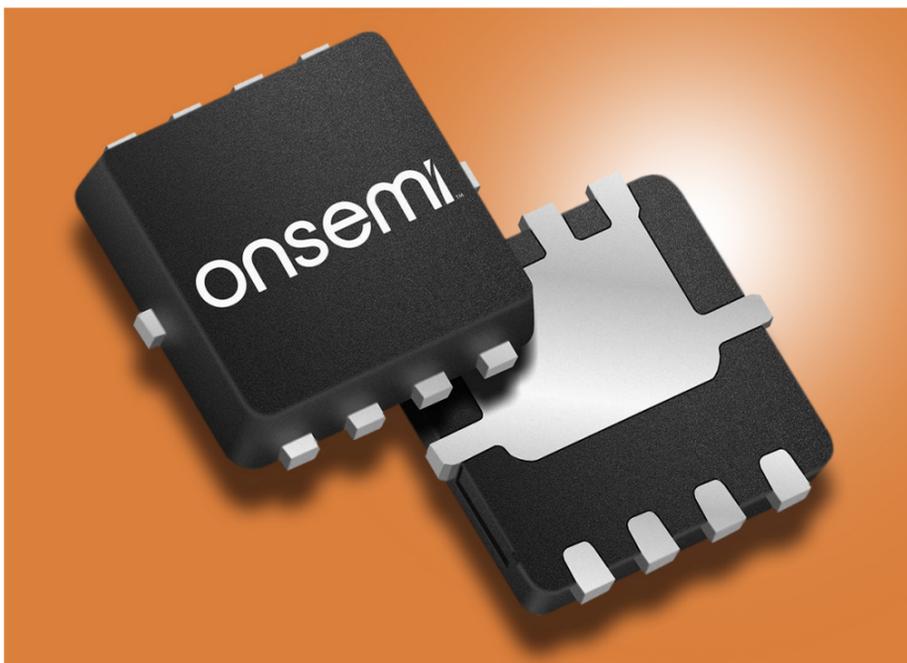
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# Broad range of silicon MOSFETs for high-efficiency conversion

onsemi supplies a wide range of silicon N-channel MOSFETs which are fabricated with its T8 technology. The devices offer attractive on-resistance and gate charge values, making them suitable for use in power-system designs which require high conversion efficiency.



**onsemi**

## FEATURES

- Low on-resistance
- Low capacitance
- Low gate charge
- Thermally efficient packages

## APPLICATIONS

- Dc-dc converters
- Ac-dc converters
- Motor drives
- Battery management systems
- ORing and power load switches

onsemi T8 technology MOSFETs available in multiple package styles.

Product	Package	Dimensions (mm)	Voltage Rating (V)	Maximum Drain Current (A)	Maximum On-resistance at 10 V (mΩ)	Typical Gate Charge at 10 V (nC)
NTTF55D1N06HL	WDFN-8/u8FL	3x3	60	78	5.2	22.5
NTMF55H600NL	SO-8FL/DFN-5	5x6	60	250	1.3	89
NTMF55H615NL	SO-8FL/DFN-5	5x6	60	200	1.8	62
NTMF55H630NL	SO-8FL/DFN-5	5x6	60	120	3.1	35
NTTF53D7N06HL	PQFN-8	5x6	60	103	3.9	32.7
NTMF55H663NL	SO-8FL/DFN-5	5x6	60	61	7.2	17
NTMF55H610NL	SO-8FL/DFN-5	5x6	60	47	10	13
NTTF55D9N08H	WDFN-8/u8FL	3x3	80	84	5.9	31
NTTF58D1N08H	WDFN-8/u8FL	3x3	80	61	8.3	23
NTTF56H850NL	WDFN-8/u8FL	3x3	80	64	8.6	26
NTTF56H850N	WDFN-8/u8FL	3x3	80	68	9.5	19
NTTF56H854NL	WDFN-8/u8FL	3x3	80	41	13.4	17
NTTF56H860NL	WDFN-8/u8FL	3x3	80	30	20	12
NTMF56H800NL	SO-8FL/DFN-5	5x6	80	224	1.8	112
NTMF56H801NL	SO-8FL/DFN-5	5x6	80	160	2.7	90
NTMF56H818N	SO-8FL/DFN-5	5x6	80	123	3.7	46
NTMF56H824N	SO-8FL/DFN-5	5x6	80	103	4.5	38
NTMF56D1N08H	SO-8FL/DFN-5	5x6	80	89	5.5	32
NTMF56H836NL	SO-8FL/DFN-5	5x6	80	77	6.2	34
NTMF56H848NL	SO-8FL/DFN-5	5x6	80	59	8.8	25
NTMF56H852NL	SO-8FL/DFN-5	5x6	80	42	13.1	17
NTMF56H858NL	SO-8FL/DFN-5	5x6	80	30	19.5	12
NTMF56H864NL	SO-8FL/DFN-5	5x6	80	22	29	9
NTMJS1D4N06CL	LFPK-8	5x6	60	262	1.3	103
NTMJS1D6N06CL	LFPK-8	5x6	60	250	1.36	91
NTMYS2D2N06CL	LFPK-4	5x6	60	185	2	69
NTMJS2D5N06CL	LFPK-8	5x6	60	150	2.5	52
NTMYS3D3N06CL	LFPK-4	5x6	60	133	3	40.7
NTMYS4D1N06CL	LFPK-4	5x6	60	100	4	34
NTMYS6D2N06CL	LFPK-4	5x6	60	71	8.8	20
NTMYS9D3N06CL	LFPK-4	5x6	60	50	13	9.5
NTMYS014N06CL	LFPK-4	5x6	60	42	14.5	10
NTMYS021N06CL	LFPK-4	5x6	60	26	21	5
NTMYS025N06CL	LFPK-4	5x6	60	21	27.5	5.8
NTTYS009N08HL	LFPK-8	3x3	80	58	8.6	24
NTMYS003N08HL	LFPK-4	5x6	80	132	3.3	64
NTMYS006N08HL	LFPK-4	5x6	80	77	6.2	34
NTMYS008N08HL	LFPK-4	5x6	80	59	8.8	25
NTMYS013N08HL	LFPK-4	5x6	80	42	13.1	17
NTMYS020N08HL	LFPK-4	5x6	80	30	19.5	12
NTMYS029N08HL	LFPK-4	5x6	80	22	29	9

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# Compact chip provides comprehensive protection for USB Type-C ports

The TCPP01-M12 enables system designers to quickly and safely replace older USB Type-A or Type-B ports with the latest USB technology. By implementing protection with the TCPP01-M12, OEMs can maintain the safety and reliability of products featuring the latest high-speed and high-power connector interface.



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## FEATURES

- Over-voltage protection adjustable up to 22 V
- $\pm 8$  kV ESD protection for contact discharge
- Integrated gate driver
- Zero current when no USB cable attached
- Junction-temperature range:  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$

## APPLICATIONS

- Any battery-powered device with a USB-C charging port
- Mobile point-of-sale terminals
- Power tools
- Medical devices
- USB hubs
- Smart speakers

The STMicroelectronics TCPP01-M12 is a protection device for USB Type-C<sup>®</sup> ports.

Features provided by the TCPP01-M12 include protection against a defective power adaptor, to prevent damage to the device if a faulty power supply applies the wrong power profile. The product also provides short-circuit protection between the power bus pins and configuration channel (CC) lines.

The TCPP01-M12 is suited to the protection of 5 V-only connections managed by general-purpose microcontrollers such as STM32 devices. It can also work with the 20 V/100 W USB Type-C Power Delivery controller integrated in the STM32G0, STM32G4, STM32L5 and STM32U5 MCUs.

The TCPP01-M12 can be used to protect consumer device applications, and can support the programmable power-supply feature of the USB Power Delivery 3.0 standard.

Supplied in a 12-lead QFN package, the TCPP01-M12 measures 3.0 mm x 3.0 mm x 0.9 mm.

USB Type-C<sup>®</sup> and USB-C<sup>®</sup> are registered trademarks of USB Implementers Forum.

## FREE DEV BOARD

The X-NUCLEO-SNK1M1 expansion board enables evaluation of the features of the TCPP01-M12 in USB Type-C<sup>®</sup> sink applications, including over-voltage protection. The expansion board stacks on top of any STM32 Nucleo-64 development board, and provides protection for the USB Type-C and USB Power Delivery peripheral functions embedded in the board's microcontroller. The X-NUCLEO-SNK1M1 is backed by the X-CUBE-TCPP software package available at [www.st.com](http://www.st.com).

**Orderable Part Number  
X-NUCLEO-SNK1M1**

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TELECOMS

# Versatile PCIe clock generators marry small size and low cost with high performance

Renesas has added to its VersaClock family of programmable clock generators with the new VersaClock 7 series of small, low-cost devices for PCI Express (PCIe) Gen5 and Gen6 and networking applications.



**RENESAS**

## FEATURES

- Flexible 1.8 V/2.5 V/3.3 V power rails
- Typical 150 fs rms phase jitter between 12 kHz and 20 MHz
- Integrated crystal option
- Digital holdover and hitless switching

## APPLICATIONS

- High-performance computing
- Data centers
- High-speed switches and routers
- Synchronous Ethernet networking equipment
- Video broadcasting
- Industrial equipment

New members of the Renesas VersaClock family offer low jitter and noise to give low bit error rates in high-performance computing systems.

The new VersaClock 7 products fill a gap in the market for high-performance clock generators that meet the requirements of designs limited by tight power and cost budgets. Like the other members of the VersaClock family, the new products simplify system designs by replacing multiple discrete timing components and reducing component count.

Offering up to 27 programmable configurations, the new VersaClock 7 products are reusable across multiple designs. A redundant input allows for provision of back-up signals. The clock generators support universal LVCMOS/ LVDS/LP-HCSL outputs.

Low phase noise gives a wide system design margin and produces a lower bit error rate.

Part Number	Description	Package
RC21005AQ	5-output clock generator	4 mm x 4 mm 32-ball LGA
RC21008A(Q)*	8-output clock generator	5 mm x 5 mm 40-lead VFQFPN or 40-ball LGA
RC21012A(Q)*	12-output clock generator	6 mm x 6 mm 48-lead VFQFPN or 48-ball LGA
RC31005AQ	5-output jitter attenuator	4 mm x 4 mm 32-ball LGA
RC31008A(Q)*	8-output jitter attenuator	5 mm x 5 mm 40-lead VFQFPN or 40-ball LGA
RC31012A(Q)*	12-output jitter attenuator	6 mm x 6 mm 48-lead VFQFPN or 48-ball LGA

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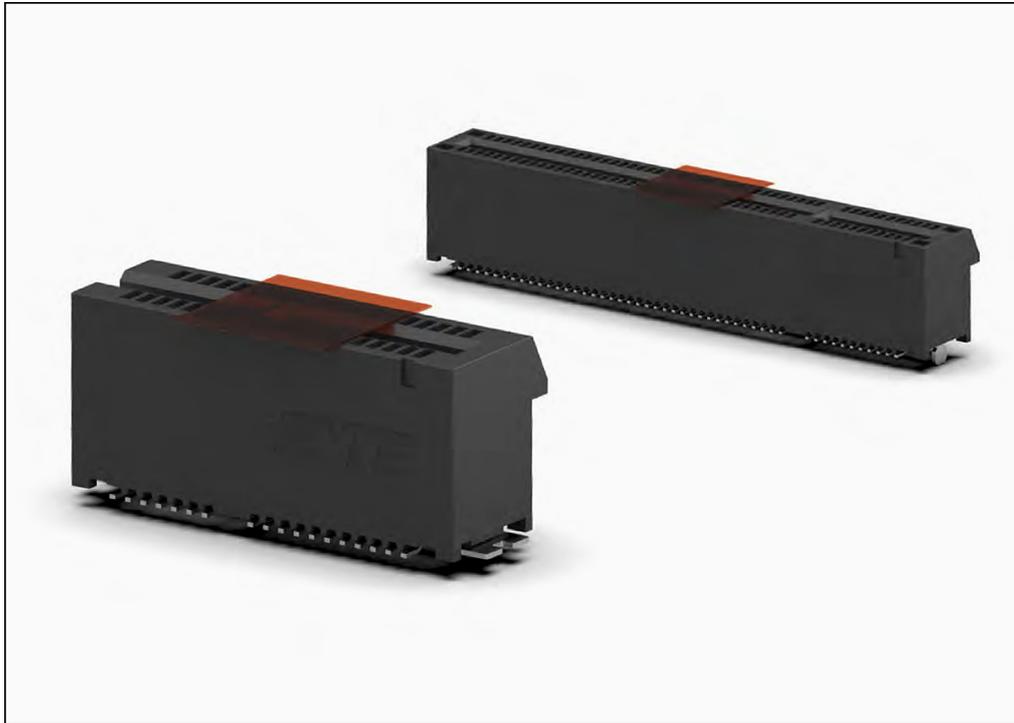
CONSUMER



TELECOMS

# PCIe Gen 5 connectors meet demand for high-performance computing

TE Connectivity (TE) has launched a new family of card electromechanical (CEM) connectors which are compatible with the new fifth generation of the PCI Express (PCIe) high-speed interface standard.



## FEATURES

- 85  $\Omega$  impedance
- 1.0 mm pitch
- Pin-count options: x16, x8, x4, x1
- 1.1 A minimum current rating per pin

## APPLICATIONS

- Servers
- Storage equipment
- Work stations
- Embedded systems
- Industrial computers
- Desktop PCs

New connectors from TE Connectivity are backwards-compatible with earlier generations of the PCIe standard.

Data centers and communications equipment use PCIe Gen 5-compatible processors and servers to reach new levels of performance in cloud computing and other demanding applications. Now the new TE PCIe Gen 5 CEM connectors provide an interconnect solution which meets these applications' need for high-speed data transfers and high signal integrity, offering data rates up to 32 gigatransfers per second (GT/s) over a differential signal pair.

The new connectors are backwards-compatible with PCIe Gen 4/3/2/1 products in both interface operation and footprint. They are supplied in various vertical surface-mount mechanical configurations.

### Watch the video.

*TE Connectivity and TE connectivity (logo) are trademarks.*



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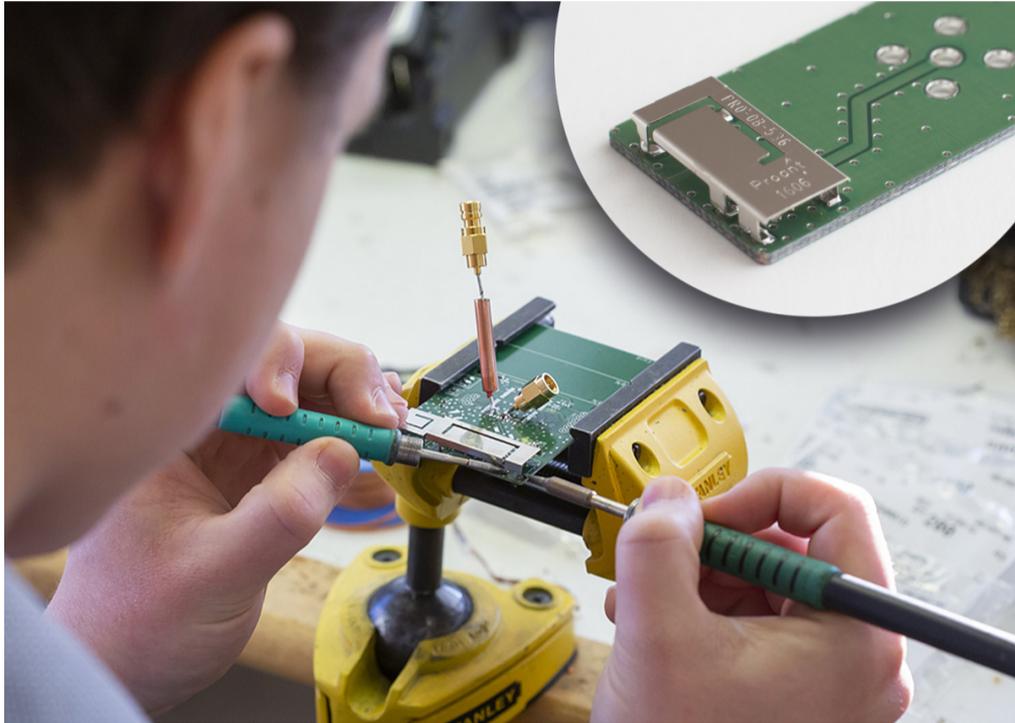
CONSUMER



TELECOMS

# Stamped metal antennas support space-saving PIFA antenna technology

**Abracon has announced that its OnBoard stamped metal antennas support the planar inverted F antenna (PIFA) technology, which saves space and provides reliable connectivity for short-range wireless, mobile phone and satellite positioning technologies.**



## FEATURES

- Shelf life up to 10 years
- Low-loss material

## APPLICATIONS

- Wearable devices
- Smart home devices
- Personal wireless devices
- IoT devices
- Machine-to-machine communications
- Telemetry
- Wireless remote controls
- Industrial equipment
- Commercial equipment

OnBoard antennas from Abracon provide robust connectivity, and are well suited to wearable devices and other space-constrained products.

A surface-mount PIFA antenna is positioned above and parallel to the PCB, so the only space which the antenna occupies on the board is the sockets of the mounting pins. The space savings afforded by an OnBoard PIFA antenna make it ideal for use in small products such as wearable devices.

The OnBoard antennas from Abracon provide excellent RF performance in real-world operating conditions. Key features include:

- Stable resonance frequency in the presence of interfering objects nearby
- Omnidirectional operation with mixed polarization
- High efficiency when operating close to metal or the human body

OnBoard antennas from Abracon can be used to provide connectivity for various RF protocols, including Bluetooth®, Wi-Fi®, 2G/3G/4G mobile, and GNSS satellite positioning systems.

Part Number	Frequency Range	Peak Gain (dBi)	Dimensions (mm)
PRO-OB-536	2.4 GHz and 5 GHz	2.7	14.2 x 6.6 x 2.5
PRO-OB-440	2.4 GHz	4.9	13.75 x 5.23 x 3.5
PRO-OB-607	2.4 GHz	-0.6	9.9 x 4.3 x 2.0
PRO-OB-430	GNSS frequencies	0.7	12.50 x 12.43 x 3.33
PRO-OB-572	791-960 kHz, 1,710-2,170 kHz	2.2	50 x 25 x 10
PRO-OB-471	868/915 kHz, 2.4 GHz	2.4	34 x 11.5 x 4.9

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# Advanced relays and resistors ensure high signal integrity in the latest generation of test and measurement equipment

By Jeffrey Katz, Product Manager, and Eric Johnsrud, Product Manager, Panasonic

## Read this to find out about:

- The demand which test and measurement equipment imposes on electronic components for low noise, low distortion, and high-frequency operation
  - New relays which offer long lifetime in fast-switching measurement applications
  - Resistors which maintain very accurate resistance values in all operating conditions

**Panasonic**  
INDUSTRY

Test and measurement equipment provides the foundation on which every facet of technology is built. Without the validation of specifications and performance provided by test and measurement equipment, modern society could not rely on the semiconductors and radio chips in smartphones, PCs, automobiles, and the plethora of gadgets in homes, offices, and factories.

The key requirements for test equipment are accuracy and precision of measurement. This calls for special classes of components which can maintain much lower noise, lower signal loss and lower distortion than standard components, while supporting high data-transfer rates and, in many cases, high switching frequencies.

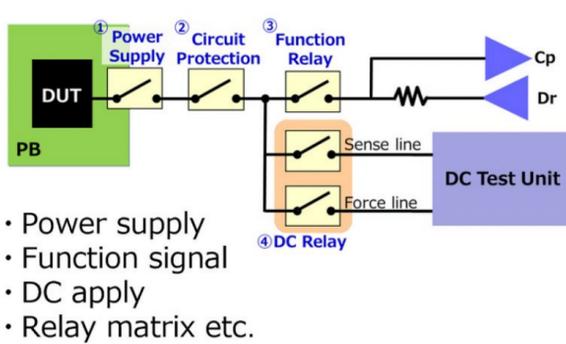
These requirements apply across the board to nearly all of the components inside test and measurement equipment, including the passive and interconnect components. Here, we highlight the special offerings in relays, resistors, and connectors from Panasonic which are especially well suited to use in test and measurement equipment.

### Solid-state PhotoMOS® relays for high signal integrity and long operating life

Relays provide an isolated switching function in many types of test and measurement equipment, insulating low-voltage measurement signals from high-voltage power systems. An excellent illustration of the importance of relays can be found in the Automated Test Equipment (ATE) used in the fabrication of semiconductor chips.

An ATE unit consists of a tester main unit, which is a kind of measurement mainframe, and a test head, which hosts the device under test (DUT). In semiconductor ATE, the test head will carry a probe card, which provides an interface to the wafer which is being tested.

The measurement circuits in the test head feature four types of relays: function relays, dc measurement relays, a circuit protection relay, and a power supply relay, as shown in Figure 1. The specifications of the function and dc relays have to meet extremely demanding requirements.



- Power supply
- Function signal
- DC apply
- Relay matrix etc.

Fig. 1: The probe card in ATE contains four types of relay

The function relays require ultra-low on-resistance, to minimize attenuation of the measurement signal. The dc relays, on the other hand, require very low output capacitance to minimize signal leakage when the relay is turned off.

These requirements have prompted Panasonic to develop special types of PhotoMOS solid-state relays which offer these valuable characteristics. The AQY22xR PhotoMOS family of relays is offered in compact SSOP and VSSOP packages, and in low on-resistance and low output capacitance types. For instance, for low output capacitance in the dc measurement relays, the AQY221N2V features output capacitance of just 1.0 pF, alongside on-resistance of 9.5 Ω.

By contrast, among the low on-resistance types is the AQY252G, which has on-resistance of just 80 mΩ, as well as output capacitance of 240 pF.

In probe cards and many other types of measurement device, manufacturers are looking to replace traditional electromagnetically actuated reed relays with solid-state relays. This is to benefit from the unlimited operating lifetime of a solid-state relay: a reed relay is typically only rated for around 100 million contact operations. The solid-state relay also provides more flexible mounting options, and very high contact reliability.

Reed relays have retained some support among designers of test and measurement equipment because of one important characteristic: almost zero leakage current, which enables operation at very high switching frequencies. Solid-state relays have an inherently higher level of leakage current than reed relays – a feature of the relay's internal MOSFET power switch.

For high-frequency circuits based on solid-state relays, Panasonic recommends the use of two low on-resistance relays (S1 and S2) and one low output capacitance relay (S3) in a T-type circuit, shown in Figure 2. In this circuit, any leakage signal is passed to Ground when the main circuit is off, enabling it to maintain high-frequency operation.

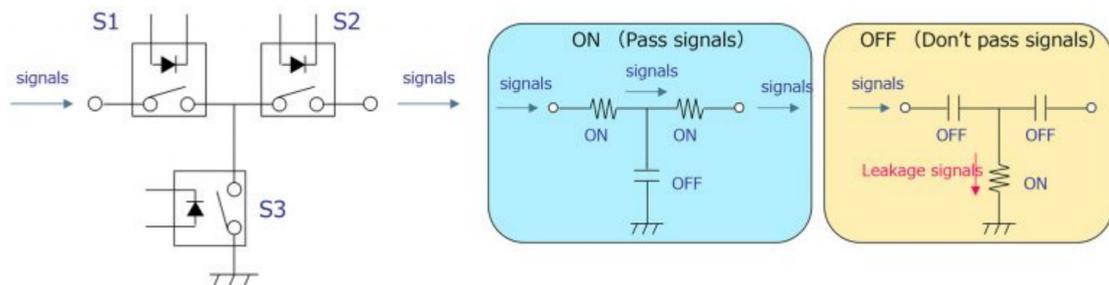


Fig. 2: The T-type circuit passes leakage current to Ground

### Densely populated probe cards

In an ATE's probe card, a further requirement is for densely populated board layouts, a card for testing a wafer in a semiconductor fabrication plant can contain hundreds of relays. The small size of PhotoMOS relays is therefore an important advantage. Particularly attractive is the capacitive coupled (CC) type of PhotoMOS relay, in contrast to the standard optically coupled type.

Housed in a TSON package, the AQY2CxRxP CC relays measure just 1.95 mm x 1.80 mm x 0.80 mm. These capacitive coupled relays also feature an extremely low typical operating current of 0.09 mA, and offer guaranteed operation at an ambient temperature of up to 105°C. Like the optically coupled PhotoMOS relays, the CC types are available in low on-resistance and low output capacitance types.

Space saving is also a strong suit of certain capacitors from Panasonic: the EEU-FS aluminum electrolytic capacitors are a radial leaded type which offer a high ratio of capacitance to volume, making them ideal for densely populated test cards. These products also offer long life and high endurance.

### Stable, accurate signal measurement

The demand for high accuracy in test and measurement equipment applies to many types of components, and not only to relays. This is reflected in Panasonic's development of families of resistors which feature extremely accurate and stable resistance values.

In measurement applications, the amplification factor is determined by the resistance value in the circuit around the operational amplifier, as shown in Figure 3. Very accurately maintained resistance values are required to set the amplification factor properly.

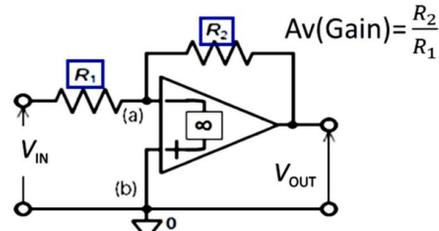


Fig. 3: A typical amplifier circuit. The amplification circuit is determined by the values of R1 and R2.

The resistors with the most accurate resistance specifications are the thin-film types. The latest from Panasonic is the ERA-V series, an improved version of the ERA-A series: the ERA-V offers even better stability and reliability. The ERA-V resistance value offers accuracy up to ±0.05%. The temperature coefficient of resistance (TCR) is also excellent, going as low as 10 ppm/K. This compares to the values of a general-purpose high-precision thick-film resistor, and the ERJ6RBD series has tolerance of ±0.5%, and TCR of ±50 ppm/K.

Beyond the accuracy and stability, the ERA-V's improved construction also offers highly robust and reliable operation:

- A new, smoother substrate provides for better tolerance of ESD strikes
- A bottom stress absorber gives greater tolerance of thermal shock
- An enhanced protective coating and plating offer higher resistance to sulfur corrosion

A second option for more cost-sensitive measurement applications is a high-accuracy family of thick-film resistors. The ERJPB family offers accuracy of ±0.10%, and temperature stability of ±50 ppm/K.

### Components to handle high frequencies and data rates

In test and measurement equipment for use in the development or production of RF devices, components need to support high data-transfer rates and high frequencies. In these types of equipment, standard connectors have various deficiencies from Panasonics which can be obviated by use of Active Optical Connectors (AOC) from Panasonic.

The AOC products are completely integrated units which perform all optoelectronic conversion internally, and which are easily mounted to the board with no requirement for the user to connect optical components, an operation which can easily give rise to malfunctions because of contamination or misalignment.

The architecture of the AOC is shown in Figure 4. The device is compatible with any type of differential signal. Used as a replacement for conventional copper signal connectors, the AOC offers higher bidirectional speed of up to 8 Gbits/s, immunity to any type of electrical noise, and excellent electrical insulation. Because of the inherent noise immunity, there is no need to shield the optical fiber cabling, providing valuable space and weight savings compared to copper cabling. The product is supplied as standard with a cable which is up to 1 m long, but custom versions can be supplied which can support cable lengths up to 300 m.

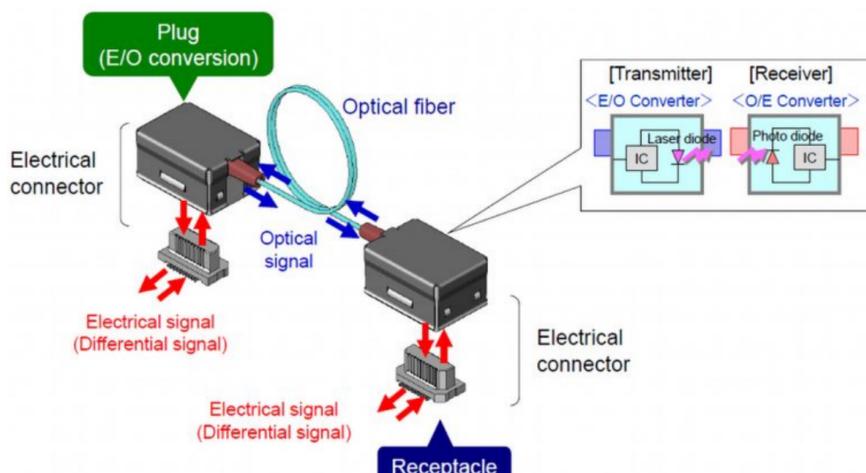


Fig. 4: The AOC is a complete sealed unit which performs optoelectronic conversion internally

As well as offering a noise-immune alternative to copper connectors, the AOC unit is also a superior alternative to standard small form-factor pluggable (SFP) transceivers. SFP transceivers are bulky, typically consume 2 W at a data rate of 10 Gbits/s, and need regular cleaning. The AOC, by contrast, saves as much as 80% of the board space occupied by an SFP transceiver. Because the optical elements are encapsulated within the plug and cable, it requires no cleaning or special preparation each time that a connection is made. And power consumption is considerably lower: just 230 mW at 6 Gbits/s.

In RF testers, another Panasonic connector product offers valuable benefits: the RF35 board-to-FPC withstands fully shielded, and carries RF signals at frequencies up to 15 GHz with very high signal integrity. The RF35 is small, and withstands severe shock and vibration.

### Quality and repeatability of high-performance characteristics

Development and production engineers rely on test and measurement equipment to provide accurate and repeatable results, and this means that the characteristics of the components inside the equipment also need to be extremely repeatable and stable.

Thanks to the proven quality of Panasonic's production processes, the superior characteristics of product series such as the ERA-A resistors and AQY2CxRxP relays can be depended on, to ensure that these Panasonic components enable the equipment manufacturer to maintain the highest standards of signal integrity.

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