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24-iii Intelligent Lighting

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Automotive-qualified LED driver with adaptive dc-dc controller for maximized efficiency

The STMicroelectronics ALED7709 combines an AEC-Q100 Grade 1-qualified 4-channel LED driver with a dc-dc controller capable of boost and SEPIC operation from an input-voltage range of 4.5 V to 42 V.

FEATURES

- Single-chip 4-channel LED driver and dc-dc controller
- Input-voltage range: 4.5 V to 42 V
- Boost, SEPIC, and adaptive dc-dc modes for low power loss

APPLICATIONS

- Automotive lighting:
  - Infotainment display backlighting
  - Head-up display (HUD)
  - Instrument lighting
  - Ambient lighting

The ALED7709 LED drivers from STMicroelectronics can be used to drive strings of high-brightness LEDs in many types of automotive application. Supported by an integrated dc-dc controller, these LED drivers supply an output voltage of up to 42 V at each channel. The output current at each channel is programmable in a range up to 200 mA, and channels can be paralleled for a combined output of up to 800 mA.

Each LED driver offers ±2% output current accuracy with mixed PWM and analog dimming at a frequency between 100 Hz and 12.8 kHz. This gives a wide brightness range: the dimming ratio is 10,000:1 at 100 Hz.

The integrated dc-dc controller can operate in boost, SEPIC, and adaptive modes in order to maximize the efficiency of operation. The switching frequency is adjustable between 250 kHz and 2.2 MHz, with the option of spread-spectrum operation.

The ALED7709 can operate in stand-alone, bus-driven, or simultaneous modes. Two preconfigured ALED7709 versions are available for single-mode operation: the ALED7709A supports use with a microcontroller for bus-driven operation using I2C serial interfaces, and the ALED7709B accepts PWMI control signals for stand-alone operation.

The ALED7709 LED drivers feature over-voltage, over-current, over-temperature, and LED fault detection and protections, with automatic channel disconnect capabilities.

FREE DEV BOARD

Evaluation kit for automotive-qualified ALED7709 LED driver.

Orderable Part Number
STEVAL-LLL014V1

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Complete connector system simplifies street lighting architectures

The LUMAWISE Endurance S connector system from TE Connectivity (TE) supports Zhaga Book 18 and Z10 applications and connects light sensors and networked lighting controls in streetlights and area lighting.

FEATURES

- IK09 assembly is resistant to strong impacts
- Scalable solution:
  - Allows use of 40 mm and 80 mm diameter controls with the same connection interface
- Insert and rotate to lock
  - No tooling needed
  - Enables one-handed installation
- Poke-in contacts
- 10 kV dielectric withstand voltage
- CB certification

APPLICATIONS

- Street and area lighting
- Sensor-ready control applications
- Outdoor luminaires
  - Wall packs
  - Parking lots
  - Walkways
- Photo-control units
- Central management systems
- City management systems
- Occupancy sensor modules

The TE Connectivity LUMAWISE Endurance S and Endurance S2 connector systems are complete sets of products for connecting light sensors and networked lighting controls in streetlights and area lighting.

There are two main offerings in the Endurance S and S2 families:

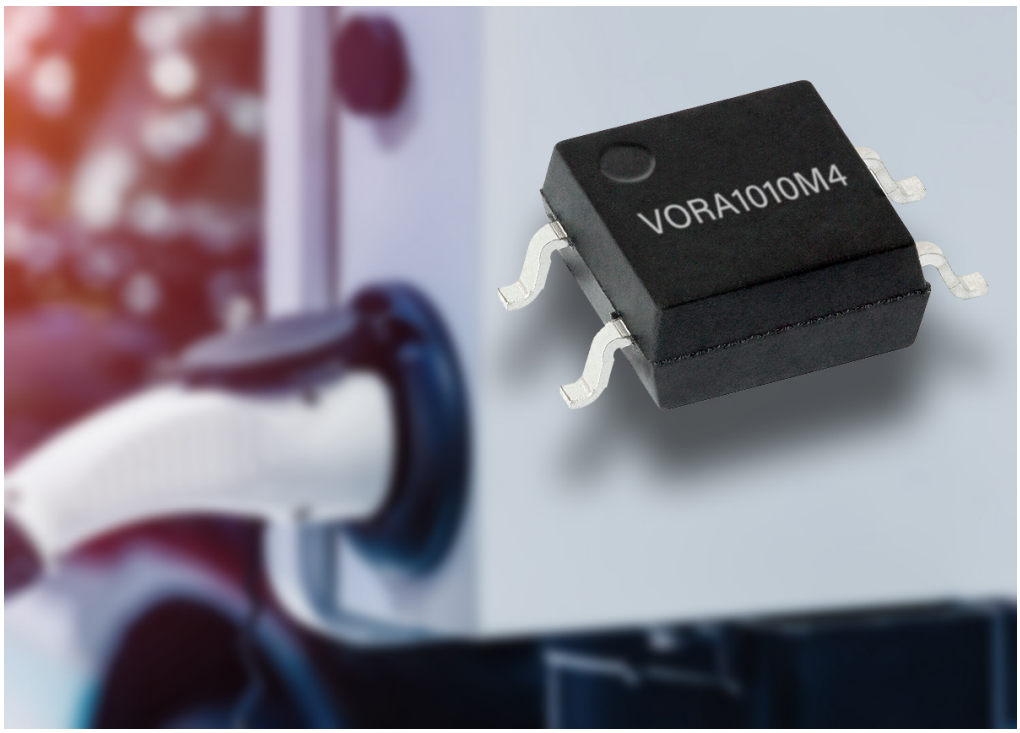
- The Endurance S/S2 Zhaga Book 18 connector systems are for D4i-controlled Zhaga Book 18-compliant luminaires
- The Endurance S/S2 keyed connector systems enable non-Book 18 applications such as Z10

The compact LUMAWISE Endurance S/S2 systems include a receptacle, mounted to a street or area light fixture, as well as several bases and domes that together form a robust enclosure for connecting sensor modules and networked lighting controls. The Endurance S2 receptacle provides two wires per contact. This makes for easier wiring and applied cost savings in luminaires that have a dual-node architecture.

The compact design is resistant to ultraviolet radiation and is IP66-rated. The connector provides flexible options for mounting, on the top, bottom, or side of a luminaire.

Automotive-qualified solid-state relay provides superior switching performance

The VORA1010M4 relay from Vishay, which is suitable for load currents of up to 100 mA, offers high reliability and long lifetime in automotive, industrial and security applications.



VISHAY

FEATURES

- 100 V load voltage rating
- 100 mA load current rating
- Low-profile 4-lead SOP package

APPLICATIONS

- Hybrid electric and electric vehicles
- Battery management
- Security systems
- Instrumentation
- Industrial controls

The new Vishay VORA1010M4 offers the advantages of a solid-state alternative to a traditional electro-mechanical relay in a high-quality device that has AEC-Q102 qualification for use in automotive applications.

The optically isolated VORA1010M4 solid-state relay offers clean, bounce-free switching, and withstands a practically unlimited number of switching cycles to give long lifetime and high reliability in demanding applications.

The relay provides a high maximum withstanding isolation voltage of 3,750 Vrms according to UL 1577. Creepage and clearance distance is at least 5 mm.

The VORA1010M4 has various pending certifications, including UL/cUL, DIN EN 60747-5-5 (VDE 0884-5), and CQC.

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New offline switcher ICs integrate lossless zero-cross detection and X-capacitor discharge functions

The LinkSwitch™-TNZ power supply ICs, which support loads of up to 12 W, save space and power in devices such as light switches, eliminating the need for multiple discrete components, and greatly reducing standby power consumption.

Power Integrations has introduced the LinkSwitch™-TNZ, a switching power supply IC family which combines offline power conversion, lossless zero-cross detection, and an optional X-capacitor discharge function in a single chip which is housed in a compact SO-8C package.

The highly efficient LinkSwitch-TNZ IC can be used for non-isolated buck and buck-boost power supplies providing up to 575 mA output current. It supplies up to 12 W of power in universal mains-input, isolated flyback designs.

The LinkSwitch-TNZ integrated zero-cross detection function helps power-system designers to save both power and space. The detection circuit consumes less than 5 mW. Other approaches require ten or more discrete components and typically consume between 50 mW and 100 mW of continuous power, which often accounts for almost half of the system standby power budget.

By providing a low-power zero-cross detection function, the LinkSwitch-TNZ gives devices such as light switches, dimmers, sensors, and plugs a new, more efficient way to control the turn-on transition of the main power device while reducing switching losses and in-rush current.

LinkSwitch-TNZ ICs provide excellent efficiency at light loads. By using the LinkSwitch-TNZ, OEMs can more easily comply with the stringent regulations governing standby power consumption, such as the European Commission regulation 1275 for home appliances, the US ENERGY STAR standard for smart home energy management systems, and China's GB 24849, which limits the off-mode power consumption in microwave ovens to 0.5 W.

LinkSwitch-TNZ switching power supply ICs achieve ±3% regulation accuracy across line and load. No-load power consumption is less than 30 mW with an external bias. Standby current is less than 100 µA.

An optional X-capacitor discharge function can be included in LNK331x LinkSwitch-TNZ ICs for high-power applications, giving even more PCB space savings, reducing component count and increasing system reliability.

power integrations™

FEATURES

- 66 kHz switching frequency
- Integrated 725 V MOSFET
- Soft-start function
- Frequency jittering to reduce EMI
- Supports isolated and non-isolated topologies

APPLICATIONS

- Home and building automation
- Dimmers
- Switches
- Sensors
- Smart lighting
- Appliances
- IoT devices
- Metering
- Industrial controls

FREE DEV BOARD

Reference design kit for a 2.5 W power supply with an output voltage of 5.0 V.

Orderable Part Number
RDK-866

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FREE DEV BOARD

Reference design kit for offline power supply providing an output voltage of 12 V at 0.5 A load.

Orderable Part Number
RDK-877

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800 V MOSFET enables designers to achieve high power density

The STP80N1K1K6 MOSFET from STMicroelectronics features very low on-resistance as a function of area, helping designers to develop power systems that are both compact and efficient.

FEATURES

STP80N1K1K6

- 3.5 V gate threshold voltage
- 4.5 pF output capacitance
- 7.4 ns turn-on delay time
- 22 ns turn-off delay time
- 100% avalanche tested
- Integrated Zener diode protection
- Operating-temperature range: -55°C to 150°C

APPLICATIONS

- Flyback power converters in:
  - LED drivers
  - Power adapters
  - Auxiliary power supplies
  - Metering equipment

The STP80N1K1K6 from STMicroelectronics is a very high-voltage superjunction power MOSFET supplied in a TO-220 package.

The MOSFET uses ST's MDmesh K6 technology, which is the result of 20 years of experience in the development of superjunction MOSFETs. This K6 technology enables ST to produce high-performance 800 V-rated MOSFETs which are extremely easy to use.

The N-channel STP80N1K1K6 combines very low on-resistance of 1.1 Ω with low total gate charge of 5.7 nC to produce high switching performance and low overall power losses. Maximum continuous drain current is 3 A at a case temperature of 100°C.

With the STP80N1K1K6 and other K6 MOSFETs, ST has achieved the best-in-class on-resistance as a function of area, enabling designers to realize smaller power-system designs. The K6 MOSFETs are an ideal fit for applications such as LED drivers and auxiliary power supplies that are based on a flyback converter topology and that require high power density and high efficiency.

Family of shock-safe fuse holders offers multiple mounting and configuration options

The robust FPG fuse holders from SCHURTER are shock safe, can be mounted vertically or horizontally, affixed to a panel or a circuit board, and offer ingress protection options.

SCHURTER ELECTRONIC COMPONENTS

FEATURES

- 2.5 W power rating
- More than 3 kV dielectric strength between live parts
- Voltage ratings:
  - 250 V ac according to VDE
  - 500 V according to UL/CSA
- Current ratings:
  - 10 A according to VDE
  - 16 A according to UL/CSA
- VDE, UL and KTL approvals

APPLICATIONS

- Home appliances
- Medical equipment

SCHURTER supplies the FPG family of shock-safe fuse holders in various mechanical configurations and mounting options, to give OEMs the freedom to satisfy the physical constraints of any design.

The FPG fuse holders are categorized as PC2 for shock safety. The fuse link connections measure 5 mm x 20 mm. The fuse holders are suitable for appliances with protection Class I according to the IEC 61140 shock protection standard.

The FPG family is available in six series: FPG1, FPG2, FPG3, FPG4, FPG5, and FPG6. These variants offer options including vertical or horizontal configuration, slotted cap or finger grip header, and panel mounting on the front or rear, or board mounting. Ingress protection options are IP40 or IP67.

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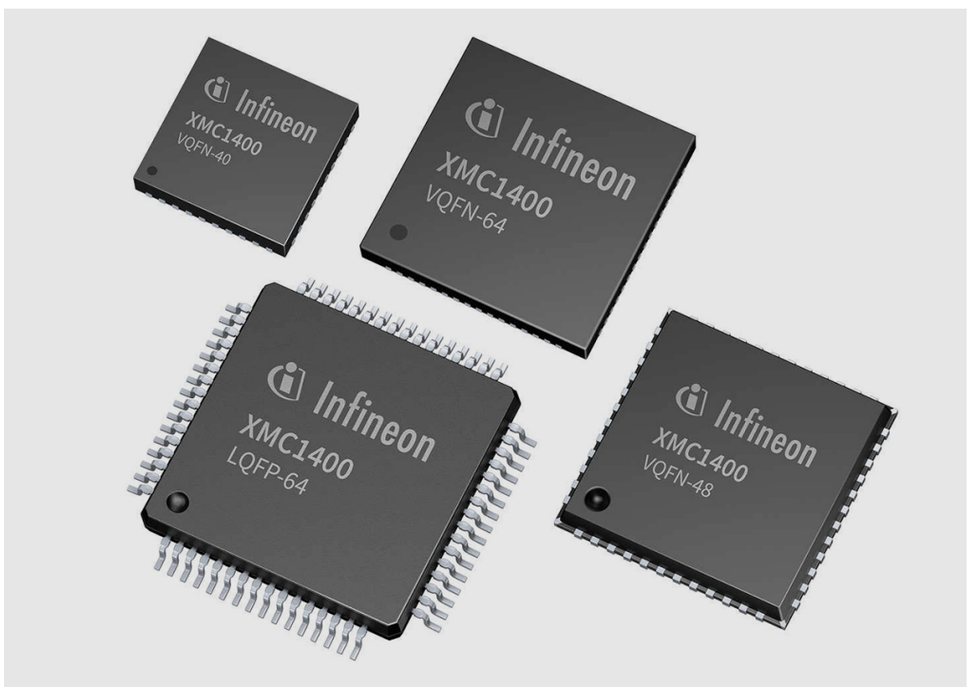
32-bit MCU features dedicated hardware unit for LED lighting control

The XMC™1000 family of microcontrollers from Infineon provide high-performance control functions for power-conversion and intelligent lighting thanks to the availability of peripherals such as special timers and a math co-processor.



Infineon has equipped products in its XMC1000 family of 32-bit microcontrollers with special features which make them ideal for use as digital power controllers in LED drivers.

The XMC1000 family MCUs, based on an Arm Cortex -M0 core, perform well in low-cost embedded control applications, not only multi-channel LED lighting, but also industrial I/O systems, motor controllers, and human-machine interfaces.

The entry-level XMC1100 MCUs operate at 32 MHz, and draw on embedded Flash memory of up to 64 kbytes. At the high end, the XMC1400 MCUs' Cortex-M0 core runs at 48 MHz, and Flash memory provision is up to 200 kbytes.

The XMC1200, XMC1300 and XMC1400 series MCUs feature a special brightness and color control unit (BCCU), a module for automatically controlling the dimming level and color of multi-channel LED lamps.

Other features of the XMC1000 family that are useful in smart lighting applications are:

- Tightly interconnected peripherals supporting various digital power-conversion techniques
- Automatic brightness control using high-frequency pulse density modulation. Based on the sigma-delta principle, this feature enables completely flicker-free dimming through nine output channels
- Automatic exponential dimming and linear intensity changes make brightness or color changes appear smooth and natural to the human eye

FEATURES

XMC1300 series

- Memory:
  - From 8 kbytes to 200 kbytes of Flash
  - 16 kbytes of RAM
- 8 x 16-bit special purpose timers with dead-time generation
- 12-channel, 12-bit ADC with 2 x parallel sampling
- Up to three comparators
- DALI or DMX communication capability
- Temperature sensor
- Math co-processor
- Operating-temperature range: -40°C to 105°C

FREE DEV BOARD

3-channel RGB LED lighting shield based on XMC1300 series MCU.

Orderable Part Number
KIT_XMC_LED_DALI_20_RGB

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Ultra-slim connectors ideal for high-density lighting applications

The DF59S and DF59SN connectors from Hirose have a very low mated height. The floating structure permits movement in all three axes, giving design flexibility and wide tolerance in the production process.

HIROSE ELECTRIC EUROPE B.V.

FEATURES

- 3 A maximum current
- 300 V ac/dc maximum voltage
- Operating-temperature range: -40°C to 105°C
- 10 mating cycles

APPLICATIONS

- LED lighting
- Battery systems
- Small dc motor drives
- Power supplies
- Handheld devices

Hirose has introduced the DF59S/SN series of compact, single-pole board-to-board connectors for LED lighting applications.

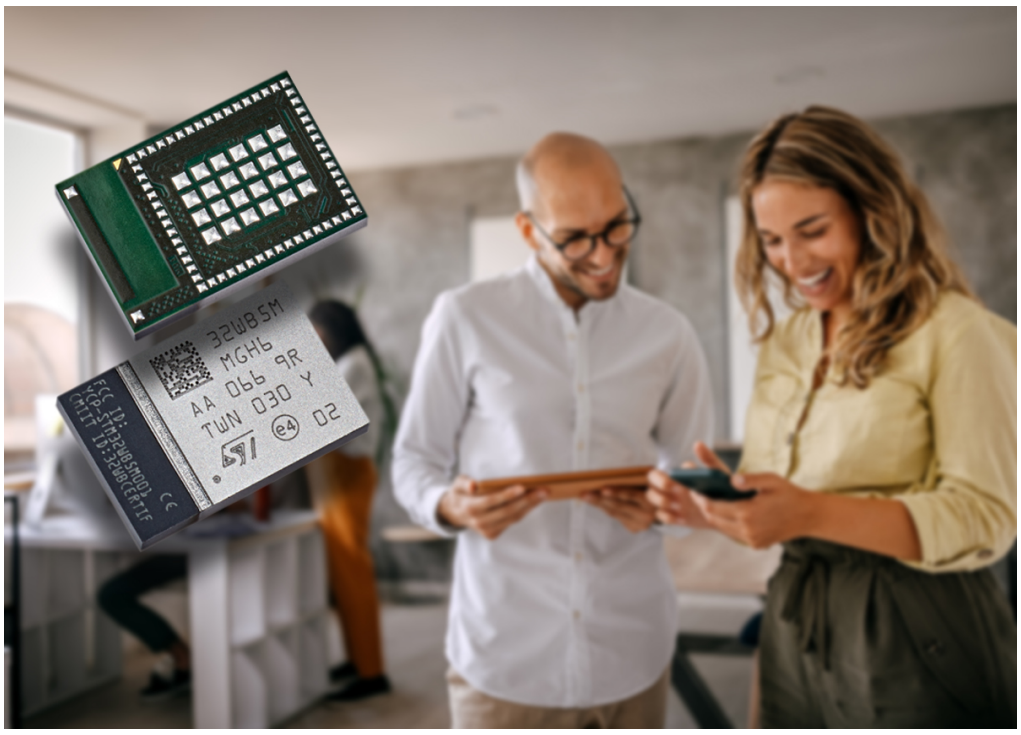
The connectors consist of a joining plug and a board-mounted receptacle to give a coplanar board-to-board connection. The non-moulded design of the receptacle has a low profile when mated: just 1.18 mm in the slim-profile DF59S, and 1.20 mm in the ultra-slim DF59SN. The connectors' pitch is just 2 mm.

The receptacle is common to both plug types, and features a friction lock which provides a positive tactile sensation and an audible click when mated. This confirms the connector is fully engaged, ensuring a complete electrical and mechanical connection.

The DF59S/SN connectors have a three-axis floating structure. This permits movement of 0. 5 mm in the x and y directions, and ±0.2 mm in the z direction, giving flexibility during installation when multiple boards are used. Special innovative, robust, stress-free contacts protect the contact area from any mechanical stress during the floating process.

2.4 GHz Bluetooth wireless module includes Matter compatibility

The STMicroelectronics STM32WB5MMG module is a complete wireless system including antenna, power supply and matching network. The module's support for the Matter protocol is valuable for new consumer device designs.



The STM32WB5MMG module from STMicroelectronics provides an easy way to implement Bluetooth® Low Energy, Zigbee, and Thread networking, and supports the new Matter protocol for seamless interoperability of compatible smart home devices made by any brand.

At the physical transport layer, the module supports the Bluetooth Low Energy v5.4 specifications, the Zigbee 3.0 and OpenThread wireless protocols, and proprietary IEEE 802.15.4 protocols operating at 2.4 GHz.

The module also supports Matter applications in which Matter data are carried over a Thread network connection, with a Bluetooth connection optionally used for pairing operations. Matter technology was developed by the Connectivity Standards Alliance consortium, which includes consumer brands such as Google, Apple, Amazon, Samsung and Huawei. The current v1.1 specification of the Matter protocol is implemented in a software development kit for the STM32WB5MMG available on request from ST.

The STM32WB5MMG provides best-in-class RF performance thanks to its good receiver sensitivity and high output power. The low-power features extend the run-time of small coin-cell batteries or energy-harvesting systems.

The STM32WB5MMG requires no RF expertise, and helps to speed development projects and reduce engineering costs. The module's STM32CubeWB software package includes royalty-free protocol stacks for Bluetooth, Zigbee, and Thread networking.

The dual-core STM32WB55 MCU on which the STM32WB5MMG is based includes an embedded ultra low-power radio. It features an Arm® Cortex®-M4 core with floating point unit, DSP instructions, and a memory protection unit to enhance application security. An Arm Cortex-M0+ co-processor dedicated to managing the integrated IEEE 805.15.4 radio and cyber-protection features ensures real-time low-layer operations run smoothly without compromising application execution.

ST's patented ultra low-power microcontroller technologies and feature integration, which include the radio balun circuitry, ensure that the STM32WB55 wireless module helps designers to meet tight power and size constraints in a wide range of IoT and wearable devices. Alongside generous provision of analog and system peripherals, the MCU's cyber-protection and identity features include secure firmware installation, customer key storage, a hardware public key authority, and cryptographic accelerators.

FEATURES

- Integrated chip antenna
- Dynamic and static concurrent modes
- Up to 75 m range
- 1 Mbyte of Flash memory
- 256 kbytes of SRAM
- Compatible with two-layer PCB
- Certifications: CE, FCC, IC, JRF, SRRC, RoHS, REACH, GOST, KC, NCC

APPLICATIONS

- Home automation
- Smart lighting
- Smart building
- Smart home
- IoT devices

FREE DEV BOARD

Discovery kit for Bluetooth wireless microcontroller module.

Orderable Part Number
STM32WB5MM-DK

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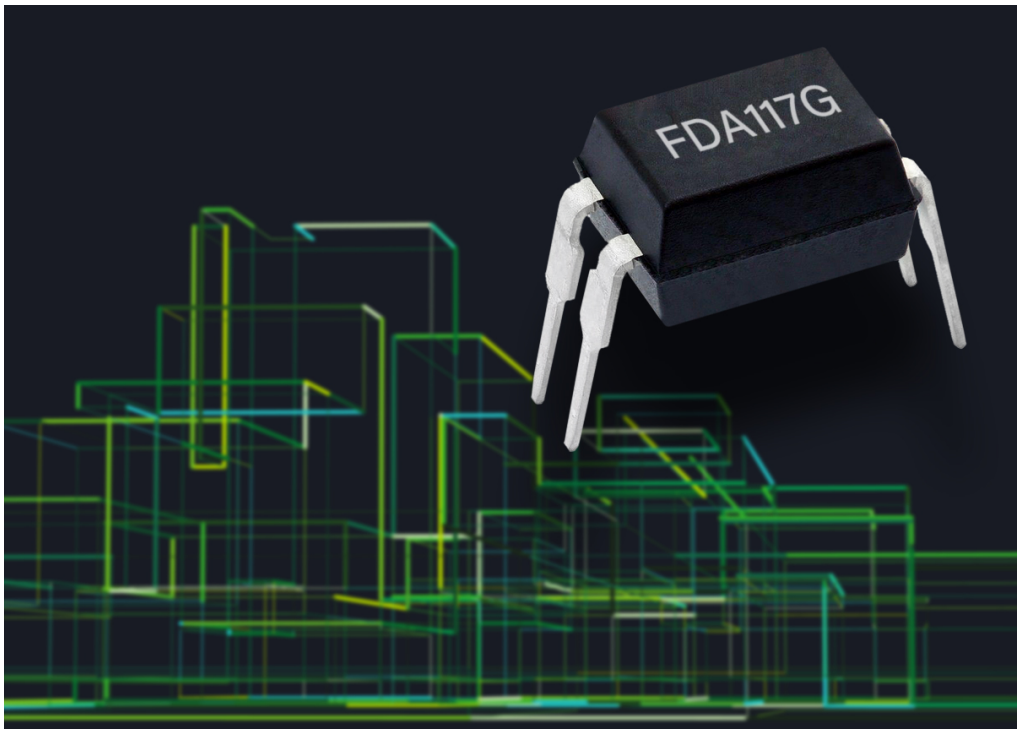
Isolated gate driver generates floating power source for standard MOSFETs and IGBTs

The optically isolated Littelfuse FDA117 gate driver provides a robust solution for power switches in solid-state relays, industrial control equipment and power supplies.



Littelfuse
Expertise Applied | Answers Delivered

FEATURES

- Input control current as low as 5 mA
- Floating output:
  - 10.5 V minimum
  - 15.3 V maximum
- High open-circuit voltage capability
- High short-circuit current capability

APPLICATIONS

- Solid-state relays
- Power supplies
- Industrial equipment
- Building automation
- Energy equipment
- Smart home devices

Littelfuse has announced the launch of the FDA117, an optically isolated photovoltaic gate driver which generates a floating power source, making it ideal for a wide range of isolated switching applications.

One of the key differentiators of the FDA117 is the ability to generate a floating power source with up to 15.3 V voltage and 60 µA current, making it suitable for directly driving standard MOSFETs and IGBTs, and securely turning them off in less than 0.5 ms.

Whether the gate driver is used in custom solid-state relay designs, for controlling electrical power and loads, or in industrial process control, the FDA117 provides the necessary isolation, rated at 5,000 Vrms, to protect equipment and individuals from electrical hazards.

The FDA117 is available in both 4-pin DIP through-hole and surface-mount packages, providing pin-out compatibility with other photovoltaic drivers on the market. This compatibility ensures ease of integration into existing designs without any substantial modifications.

Beware the magnetics: lessons learned in developing a small, light 500 W LLC converter based on an integrated GaN power switch

By David Woodcock, Centre of Excellence Manager, Future Electronics

Read this to find out about:

- The benefits of using an integrated GaN switch+driver such as MasterGaN
- The options for commercial off-the-shelf controllers for a high-voltage resonant LLC converter
- The relative thermal performance of the active and passive components in the GaNSTar 500 W LLC demonstration design

In the dc-dc converter stage of a high-voltage power supply for loads of more than around 150 W, the preferred choice of topology is the resonant LLC, because of its high efficiency. Nearly all existing LLC dc-dc converters are implemented with silicon power switches, but the replacement with gallium nitride (GaN) power switches on the primary side promises substantial savings in size and weight while maintaining high efficiency.

The switching frequency of silicon MOSFETs in conventional LLC dc-dc stages hits a practical ceiling at around 100 kHz, as switching losses become excessive at higher frequencies. GaN switches on the other hand can comfortably switch at frequencies of higher than 250 kHz, maintaining high efficiency and enabling the use of smaller and lighter magnetics and an overall increase in power density.

The practical implications of designing a 500 W LLC dc-dc converter using GaN switches have, however, not been well documented. Now, the Centre of Excellence (CoE) at Future Electronics has developed GaNSTar, a GaN switch-based design for a 500 W LLC dc-dc power stage which steps a 400 V dc input down to a 48 V output. In designing the board, the CoE explored the key issues that arise when using fast-switching GaN components in a high-voltage LLC dc-dc stage.

The characteristics of GaN power switches such as the STMicroelectronics MasterGaN1 integrated driver+switches used in the GaNSTar design are well understood. The CoE design team's work, however, revealed interesting facets of the transformer operation. As is described below, the temperature of the transformer turned out to be the main constraint on the operation of the board.

The GaNSTar project was also able to develop an approach to implementing digital control as an alternative to the growing selection of off-the-shelf high-frequency LLC controllers coming on to the market.

Achieving conversion efficiency of 96% and using no more than a small fan for cooling at a load of 500 W, the GaNSTar board shows that a GaN switch-based LLC converter can be some 30% smaller than an equivalent design using silicon MOSFETs.

Key components: what is best, and what is available?

The GaNSTar board implements the familiar resonant LLC topology, shown in Figures 1 and 2. On the primary side, the half-bridge is implemented conveniently with a single component, the 600 V MasterGaN1. For most power-system designers, a device such as MasterGaN1 that integrates optimized gate drivers for the GaN power switches in a single package is preferable to a solution with discrete switches and drivers. This is because GaN switches are more difficult to drive than silicon MOSFETs. When driving GaN switches, circuit parasitics should be minimized. In addition, the gate can be damaged if the gate-source voltage exceeds 8 V, in most cases. With its MasterGaN family, ST provides a ready-made way to implement GaN in a design while also enabling a reduced component count and board footprint.

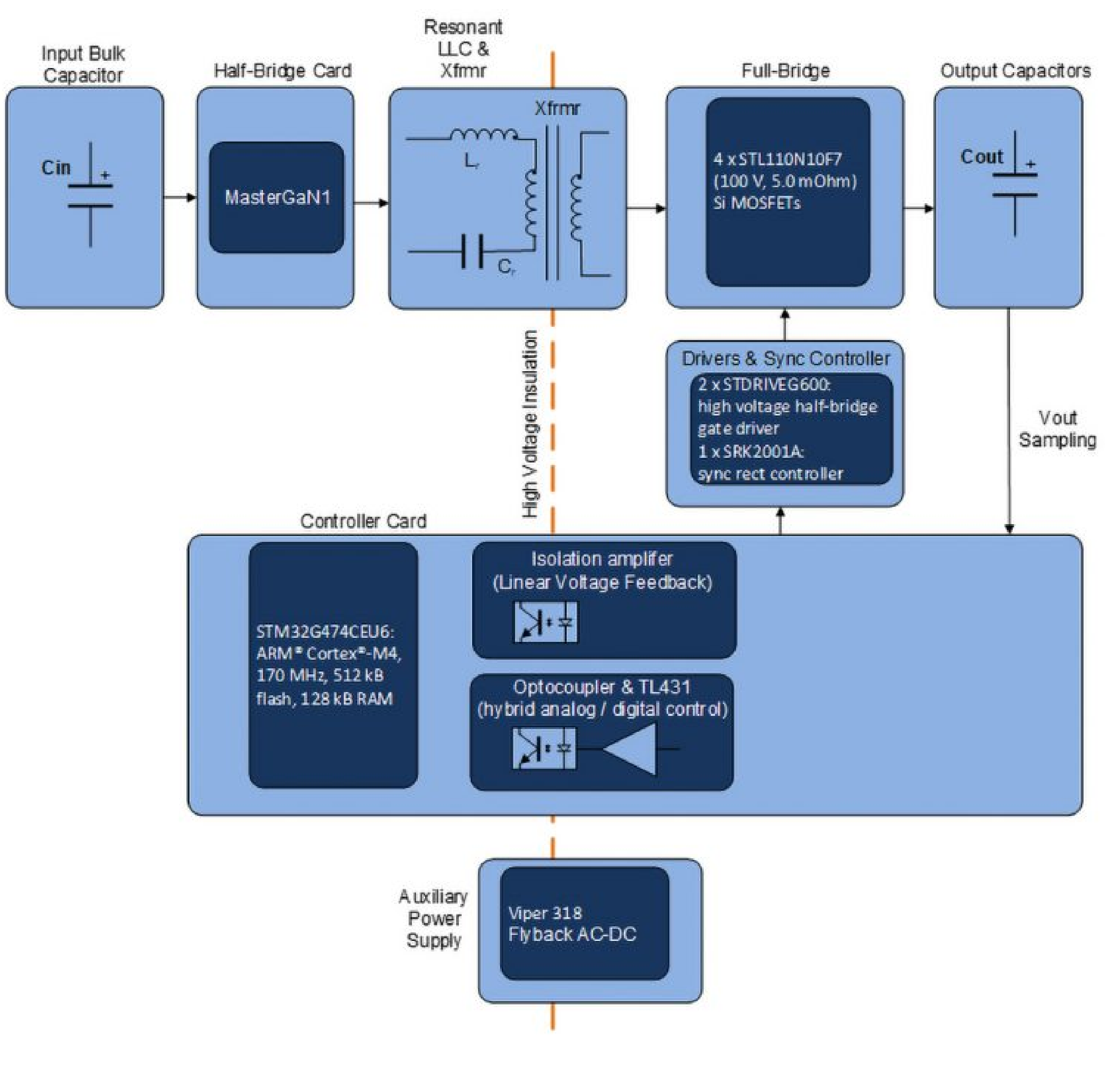


Fig. 1: The block diagram of GaNSTar shows how digital control is implemented on the primary side

On the secondary side, GaNSTar implements a full-bridge with four 100 V silicon MOSFETs, also from STMicroelectronics. The secondary side could have been configured in a half-bridge, but this would have required the use of MOSFETs that had a higher voltage rating of at least 150 V to support an output voltage of 48 V. The full-bridge configuration allows the use of 100 V MOSFETs: these are cheaper and more readily available than MOSFETs that have a higher voltage rating.

Using 100 V MOSFETs also leaves open the option to replace the silicon MOSFETs with 100 V GaN power switches as market availability widens, to gain extra efficiency. On this point, the gate driver selected on the secondary side of GaNSTar, the STDRIVEG600 from STMicroelectronics, is compatible with both silicon MOSFETs and GaN FETs.

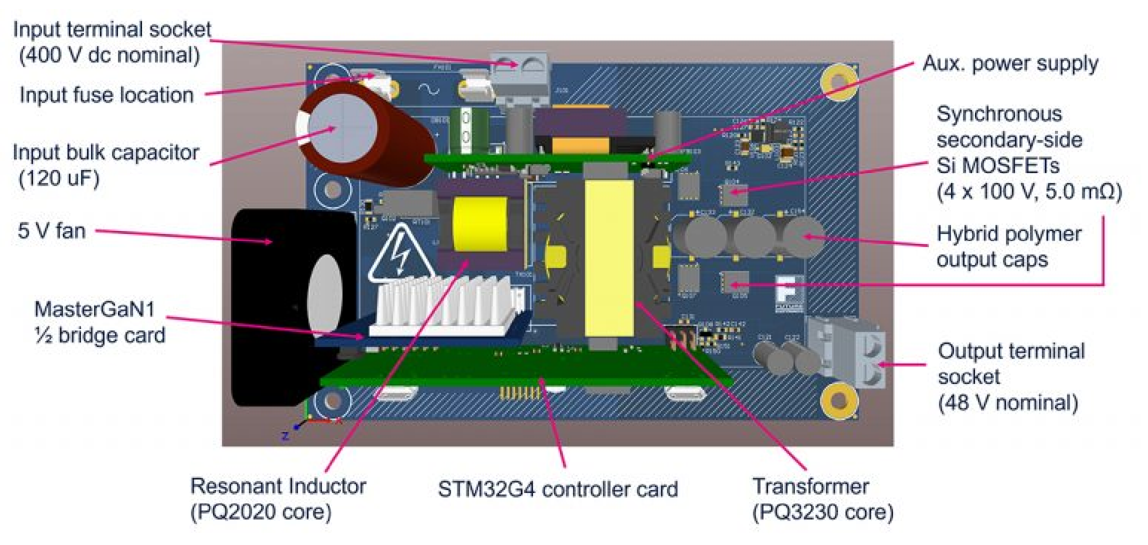


Fig. 2: The layout of the GaNSTar board

The key architectural decision in the development of GaNSTar concerned control: digital and programmable using a microcontroller, or analog control via an off-the-shelf LLC controller?

Various factors influence the choice for the designer. A programmable digital power system offers the flexibility to support multiple design iterations, which can be useful when developing a family of power supplies. On the other hand, an off-the-shelf LLC converter eliminates the need for software development and reduces development time and effort.

Until very recently, the market had not met the emerging need for LLC converter controllers for power supplies operating at frequencies above 100 kHz at full load. In 2022, this situation started to change: most notably, NXP Semiconductors released the TEA2017. This is a combined PFC controller and resonant LLC controller that supports switching frequencies well above 250 kHz in the LLC dc-dc stage, and that operates in continuous conduction mode (CCM) as well as in boundary conduction (BCM) or discontinuous conduction mode (DCM) for the PFC operation.

Other attractive options include the NCP13994 LLC controller from onsemi. For an ac-dc power supply, the NCP13994 could be paired with the NCP1680 totem-pole PFC controller.

Like NXP, STMicroelectronics offers a combined PFC and LLC controller, the STCMB1. The PFC controller supports BCM and DCM, however, but not CCM, so it is only suitable for loads up to around 250 W.

Rather than these off-the-shelf options, the GaNSTar design team opted for a flexible digital control option using an MCU from the STMicroelectronics STM32G4x4 Hi-resolution line, which is particularly suitable because of its provision of a high-resolution timer, complex waveform builder and event handler for digital power conversion.

The STM32G4x4 Hi-resolution line MCUs have capabilities that exceed the requirements for LLC stage control alone. Its location on the primary side of GaNSTar allows scope for further development in the future to incorporate PFC stage operation.

To achieve digital LLC control on the primary side using the STM32G4x4 requires a method for transferring the LLC converter's output-voltage feedback signal across the isolation barrier. The GaNSTar design offers two options. The first uses a linear isolation amplifier that has a relatively high cost. This circuit achieves stable and efficient operation.

Two digital control loops have been implemented using this feedback path. Proportional integral derivative (PID) control offers an adequate response time. The CoE has also implemented a more advanced filtered PID control scheme which improves response time substantially, cutting the typical time to respond to a 20% to 80% change in load from around 500 µs with basic PID control, to around 300 µs.

The second option uses a standard combination of a TL431 shunt regulator and an optocoupler in a novel approach. Using an optocoupler potentially limits control-loop response time, since it has relatively low bandwidth. Applying a cascode-connected PNP bipolar transistor to the photo-transistor in the optocoupler increases bandwidth. An optocoupler bandwidth of 45 kHz is achieved by this approach.

The control loop operation is split: part analog and part digital. The TL431 is configured as an integrator providing high gain at low frequency. The STM32G4x4 performs digital processing of the error signal from the optocoupler to produce control-loop operation very similar to the filtered PID approach, but at a lower BoM cost than the first approach based on an isolation amplifier.

A schematic of the GaNSTar circuit is shown in Figure 3.

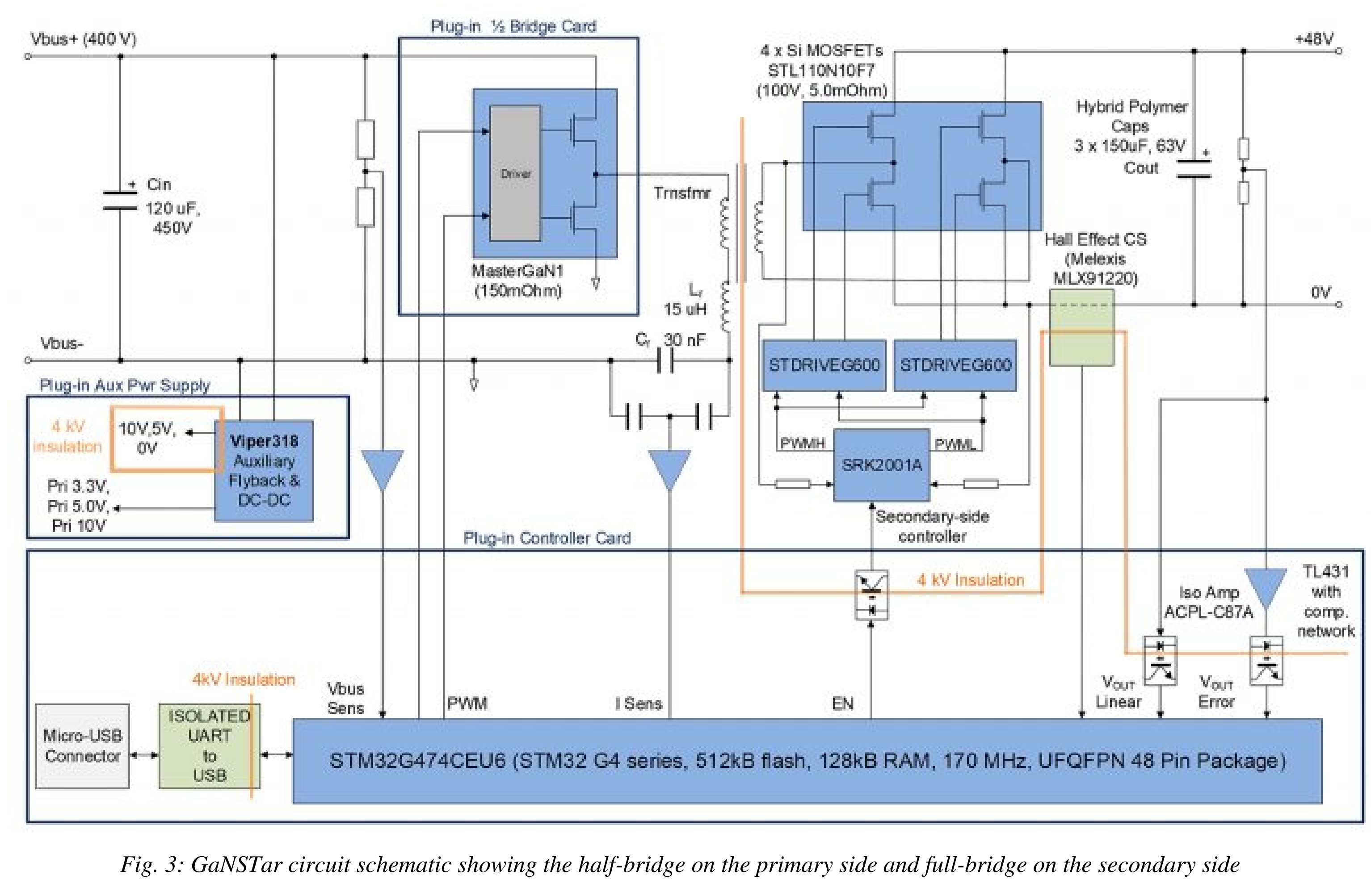


Fig. 3: GaNSTar circuit schematic showing the half-bridge on the primary side and full-bridge on the secondary side

Thermal limitation at the transformer

Laboratory testing of a prototype of GaNSTar revealed where the main design constraint lay, and it was not in the fast-switching GaN components.

Under convection cooling, operation is limited to 300 W, due not to the temperature of the power switches, but of the transformer. The results gained under convection cooling are shown in Figure 4. At a power output of around 350 W with convection cooling and an ambient temperature of 25°C, the transformer's temperature is higher than 90°C. This is uncomfortably high given that many applications for a high-voltage GaN-based LLC converter will actually run in ambient temperatures above 50°C. This thermal performance is a result of the transformer's combined core and copper losses at high switching frequency and high current.

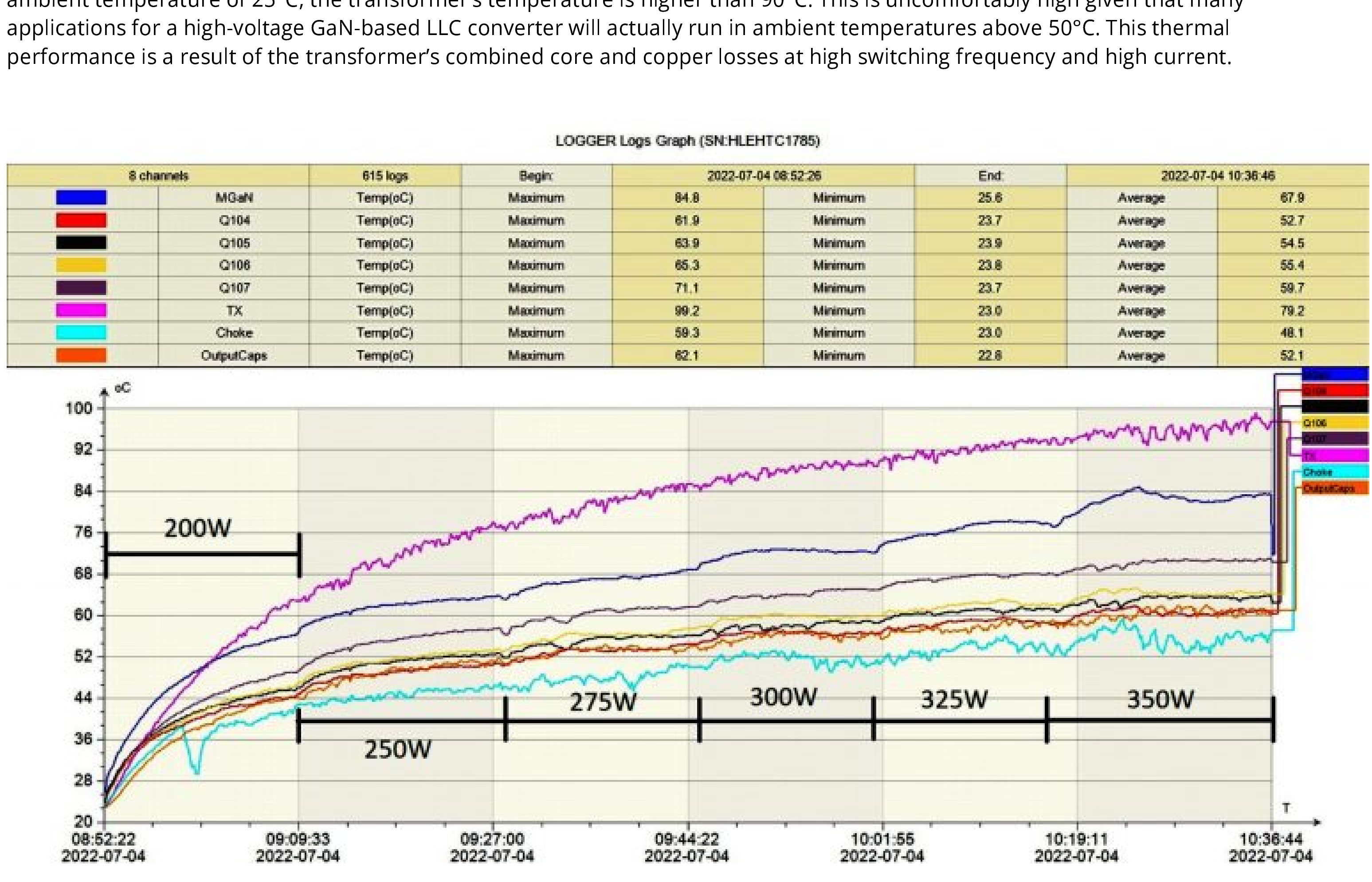


Fig. 4: Component temperatures when convection cooled at ambient laboratory temperature and increasing load

At ambient laboratory temperature, at the rated 500 W output, the MasterGaN1 operates at a temperature of just 42°C when cooled by a simple 5 V fan providing 7 CFM of airflow. This performance does not require elaborate thermal management, in GaNSTar, the MasterGaN1 has nothing more than a small, low-cost ceramic heat-sink.

As Figure 5 shows, when fan-cooled, all components operate at relatively low temperatures; the secondary-side silicon MOSFETs are the hottest components, reaching a temperature of around 65°C at 500 W load.

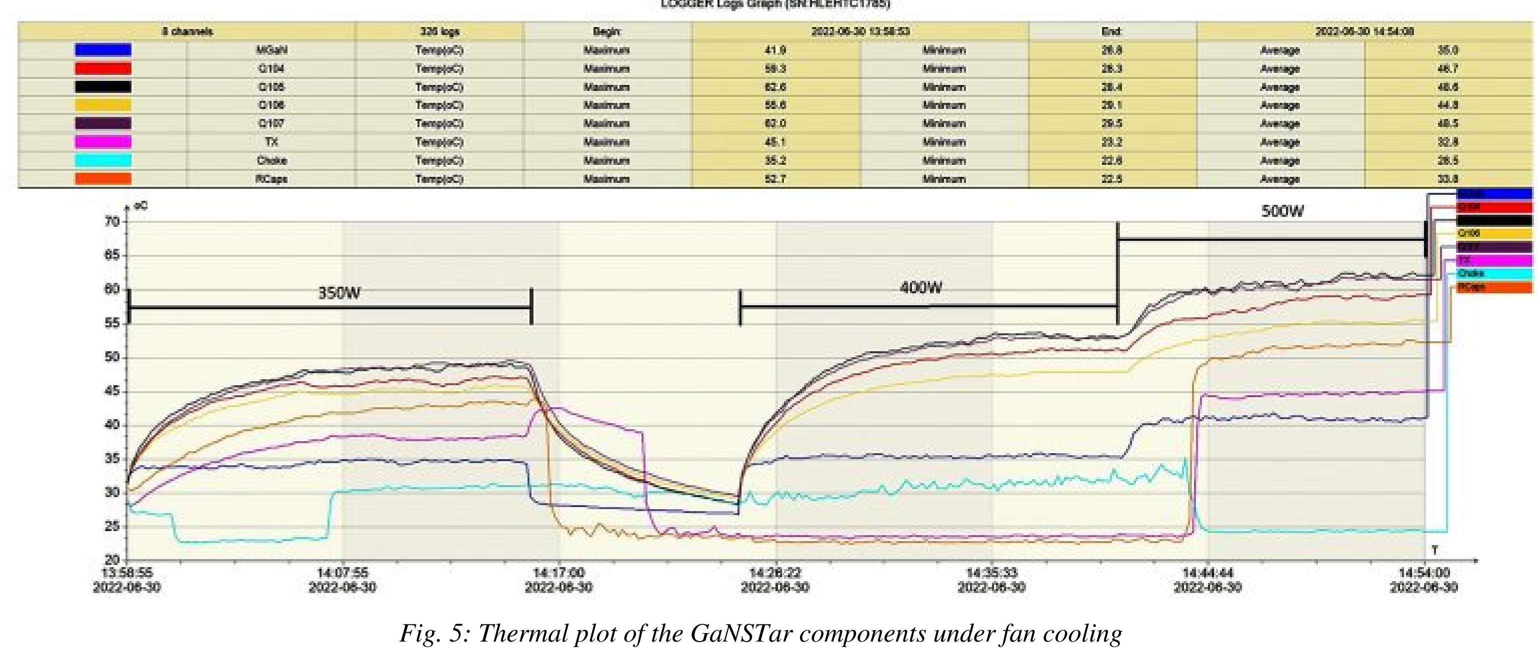


Fig. 5: Thermal plot of the GaNSTar components under fan cooling

The GaNSTar design, then, demonstrates that the practical limit of the power output from a GaN-based LLC converter is likely to be set by the temperature of the transformer. This design shows that an LLC converter can reliably supply a 500 W load with a small amount of forced-air cooling and minimal heat-sinking. Many options remain to increase the power output, including the use of a more powerful fan, and applying a heat-sink to the transformer core. Applying planar magnetic design techniques may also improve performance.

Other lessons learned during the development of the board

The most important finding to emerge from the development of the GaNSTar board is that GaN technology produces substantial space savings. At 66 mm x 116 mm x 40 mm and switching at 250 kHz, the GaNSTar board is around 30% smaller than an equivalent 500 W LLC converter based on the use of silicon MOSFETs switching at up to 100 kHz. Designers of production systems can expect even greater space savings, as they can adopt design optimizations that were not appropriate for GaNSTar, which is a demonstration design board.

Beyond this, the CoE engineers made additional findings that power-system designers should consider when building new systems based on GaN power switches:

- X7R capacitors are commonly used in power electronics, but in the GaNSTar board they produced too much capacitance variation over dc bias, changing the system's resonant frequency. A change to C0G capacitors eliminated this problem and the board uses three 10 nF GRM31C5C2J103JWA3L capacitors from Murata
- Aluminum or copper heat-sinks are most often used in power systems, but ceramic heat-sinks offer various advantages at the cost of lower thermal efficiency: low cost, as well as the absence of parasitic capacitance, and easier assembly with just thermal adhesive and no insulating interface material required. In the GaNSTar board, the MasterGaN1 device operates reliably with a ceramic heat-sink

For advice on these or any other technical issues involved in implementing a GaN-based LLC converter, designers should contact the power experts at the Future Electronics CoE to benefit from their practical experience with GaN technology.

New technology produces big cut in blue light content of outdoor LED lighting

The NightScape technology from Lumileds is implemented in high-brightness LEDs that have standard footprints, for easy implementation in designs for streetlights and other outdoor luminaires.

LUMILEDS

FEATURES

- Typical flux with NightScape:
  - LUXEON 3030 HE Plus: 36.6 lm at 65 mA
  - LUXEON 5050 Square: 695 lm at 800 mA
- Typical efficacy with NightScape:
  - LUXEON 3030 HE Plus: 185 lm/W
  - LUXEON 5050 Square: 142 lm/W

APPLICATIONS

- Streetlights
- Outdoor area lighting
- Pedestrian lighting
- Landscape lighting

Lumileds has responded to worldwide demand for reductions in light pollution from outdoor luminaires by introducing NightScape technology, which lowers the blue content of white LED light to less than 2%.

The NightScape technology is first available in the Lumileds LUXEON 3030 HE Plus and LUXEON 5050 Square LED emitters. These LED emitters are workhorses of the outdoor lighting industry, and are in common use by many lighting equipment manufacturers. Over time, the technology can be applied to virtually any of Lumileds' white LED lines to meet lighting community needs.

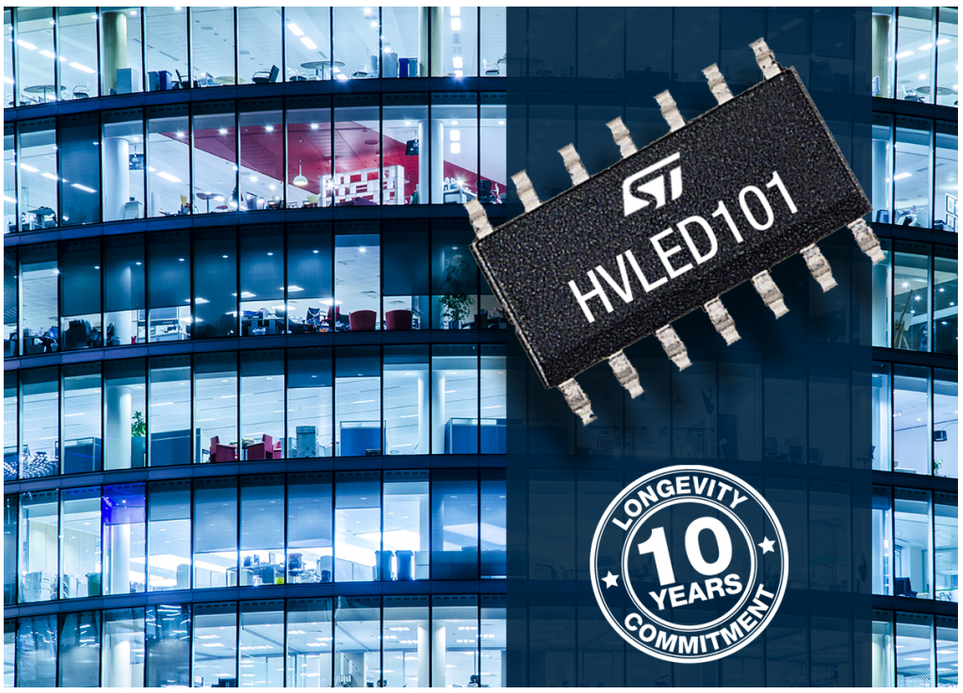
Blue light content is a critical factor in assessing the harm from night-time illumination. Blue light scatters more than other wavelengths, which increases light pollution and glare, and it has marked impacts on the circadian rhythms and behaviors of humans, plants, and wildlife. This is why municipalities, states, and governments are introducing lighting ordinances that prescribe both the design of light fixtures and the nature of the light that they emit. Maui in Hawaii, for example, enacted an ordinance in 2023 that limits blue content in outdoor lighting to less than 2%.

The LUXEON 3030 HE Plus and 5050 Square LEDs have a CCT of 1,900 K, and blue light content of just 1.8% in the 400 nm to 500 nm range of the visible light spectrum.

The physical dimensions and optical radiation patterns of the NightScape LUXEON 3030 HE Plus and LUXEON 5050 Square LEDs are identical to the existing parts in each portfolio. Any luminaire using either of these products, or LEDs from other manufacturers that have the same footprint, can quickly and easily adopt Ni

Integrated flyback controller boosts performance of LED lighting

The HVLED101 controller IC from STMicroelectronics maintains high power factor and very low power in standby mode, for precise regulation across a wide range of LED driver topologies.



FEATURES

- 800 V fast high-voltage start-up
- Programmable frequency foldback with valley locking for noise-free operation
- Programmable brown-out protection
- Smart automatic restart timer

APPLICATIONS

- Street lighting
- Industrial lighting
- Commercial lighting

FREE DEV BOARD

50 W power converter for LED drivers based on HVLED101 quasi-resonant flyback controller with secondary-side regulation.

Orderable Part Number
EVLHV101SSR50W

APPLY HERE NOW

The HVLED101 is an enhanced peak current-mode controller for flyback or buck-boost topologies that require a high power factor of at least 0.9 at full load. It also enables power-system designers to produce low total harmonic distortion of less than 5% at full load. Other topologies such as buck, boost and SEPIC can also be implemented with the HVLED101.

The HVLED101 is ideal for use in single-stage LED drivers rated for up to 180 W, and two-stage LED drivers up to 200 W.

Both primary-side regulation of the output voltage and optocoupler control can be applied independently on the chip: both produce precise regulation. Standby power consumption in no-load conditions is very low.

The HVLED101 is built with innovative ST high-voltage technology which enables the IC to be connected directly to the input voltage in order to both start-up the device, and to monitor the input voltage without the need for external components. A valley-locking feature guarantees noise-free operation in medium- and low-load conditions.

The maximum power can be controlled by limiting the input power to a level programmed by the engineer, to ensure safe operation of the converter. The HVLED101 also controls abnormal conditions such as open circuit, output short-circuit, and input over- or under-voltage, as well as circuit failures such as open loop and over-currents at the main switch.

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New portfolio of 32-bit MCUs offers scalability and easy migration of application software

The new NXP Semiconductors MCX N series includes a neural processing unit for machine learning applications, and advanced security functions, and the MCX A series balances cost, performance, and power consumption.

NXP Semiconductors has started shipping the first parts in the new MCX portfolio of Arm® Cortex®-M core-based microcontrollers for advanced industrial and IoT edge applications.

The MCX portfolio is designed for ease of use, to simplify migration and to scale up or down as needed: supporting software re-use between series, the scalability of the MCX MCUs reduces development time and cost.

The parts available now are from the MCX N series and the MCX A series.

- The MCX N series is designed for secure, intelligent edge applications, with families that include a multi-core design, on-chip accelerators and an integrated EdgeLock® secure enclave
- The MCX A series supports the key functions for a broad range of applications such as motor control, in which cost constraints, advanced analog capabilities such as high-precision data converters, and fast time-to-market are key considerations

NXP will be releasing additional devices in the MCX N, MCX A and other series throughout 2024, providing scalability for families of intelligent edge products.

The **MCX N series** offers particularly strong support for machine learning and run-time inference. Certain MCX N parts include NXP's eIQ® Neutron neural processing unit (NPU) for machine learning applications. These secure MCUs include an EdgeLock secure enclave, secure boot with an immutable root-of-trust, and hardware-accelerated cryptography.

Designers can develop machine learning applications using the eIQ ML software development environment. The easy-to-use eIQ tools enable engineers to train ML models to run on either the NPU or the CPU core, and to deploy them on the MCU.

The **MCX A series** of all-purpose MCUs addresses a wide range of applications with scalable device options, low power consumption, and intelligent peripherals. MCX A series MCUs are a foundation for intelligent edge applications. The MCUs offer an optimized and cost-effective balance of performance and autonomous peripherals.

The MCX portfolio is supported by the MCUXpresso Developer Experience. This includes a suite of software, tools and hardware prototyping platforms:

- Integrated development environments:
  - MCUXpresso for VS Code
  - MCUXpresso integrated development environment
  - IAR® Embedded Workbench
  - Arm KEIL®
- MCUXpresso software development kit (SDK)
  - Extensive suite of robust peripheral drivers, stacks, and middleware
  - Includes software examples demonstrating the use of peripheral drivers and middleware
- MCUXpresso config tools
  - Includes pins, clocks, and peripheral tools for generation of MCUXpresso SDK code

For rapid prototyping, NXP offers a low-cost and scalable FRDM development platform. FRDM development boards come with a standard form factor and headers, easy access to MCU I/Os, on-board MCU-Link debugger, and a USB Type-C cable.

The NXP GitHub also provides access to application examples, which can be accessed using the Application Code Hub (ACH) portal. The MCUXpresso IDE from version 11.9.0 and MCUXpresso for VS Code have ACH built-in, so developers can easily browse available examples, and filter by device, application technology or peripheral/feature before loading the project directly for use.

The expansion board hub is an extension to the NXP SDK Builder site, where developers can find a range of add-on boards from NXP and partners to extend the capabilities of evaluation boards. This hub enables intuitive filtering to quickly find what is needed and locate available supporting software. Developers can pair the board with different kinds of shields for rapid prototyping for specific use cases or applications.

MCX parts available from March 2024:

MCX Family	Total Flash	Package Type	Orderable Part Number
MCX N94	2 Mbytes	BGA184	MCXN947VDFT
MCX N94	2 Mbytes	HLQFP100	MCXN947VNLT
MCX N94	1 Mbyte	BGA184	MCXN946VDFT
MCX N94	1 Mbyte	HLQFP100	MCXN946VNLT
MCX N54	2 Mbytes	BGA184	MCXN547VDFT
MCX N54	2 Mbytes	HLQFP100	MCXN547VNLT
MCX N54	1 Mbyte	BGA184	MCXN546VDFT
MCX N54	1 Mbyte	HLQFP100	MCXN546VNLT
MCX A15	128 kbytes	LQFP64	MCXA153VLH
MCX A15	128 kbytes	QFN48	MCXA153VFT
MCX A15	128 kbytes	QFN32	MCXA153VFM
MCX A15	64 kbytes	LQFP64	MCXA152VLH
MCX A15	64 kbytes	QFN48	MCXA152VFT
MCX A15	64 kbytes	QFN32	MCXA152VFM
MCX A14	128 kbytes	LQFP64	MCXA143VLH
MCX A14	128 kbytes	QFN48	MCXA143VFT
MCX A14	128 kbytes	QFN32	MCXA143VFM
MCX A14	64 kbytes	LQFP64	MCXA142VLH
MCX A14	64 kbytes	QFN48	MCXA142VFT
MCX A14	64 kbytes	QFN32	MCXA142VFM

NXP

FEATURES

MCX N series

- 150 MHz Arm Cortex-M33 dual cores
- PowerQUAD DSP accelerator with co-processor interface
- SmartDMA
- eIQ Neutron N1-16 NPU
- Up to 2 Mbytes of Flash memory
- Supports Flash swap and read while write
- Up to 512 kbytes of RAM
- FlexSPI with 16 kbyte cache supporting various memory types:
  - Execute-in-place
  - Octal/Quad SPI Flash
  - HyperFlash
  - HyperRAM
  - Xccela
- Broad range of analog and communications peripherals and timers

MCX A series

- 48 MHz or 96 MHz Arm Cortex-M33 core
- Multi-layer bus matrix
- Up to 128 kbytes of Flash memory
- Up to 32 kbytes of RAM
- ROM to assist in-system programming
- 4 Msamples/s 12-bit ADC
- Voltage reference for ADC
- Two analog comparators
- Temperature sensor
- Motor-control sub-system
- Broad range of communications peripherals and timers

APPLICATIONS

- Industrial
  - Factory automation
  - Power and energy systems
  - Building control
  - Medical equipment
- Smart home
  - Control and security
  - Smart appliances
  - Home entertainment
  - Health and fitness
- General embedded
  - Industrial/consumer HMIs
  - Handheld devices
  - Power tools
  - General-purpose embedded control

Entry-level 32-bit MCU fits cost-sensitive applications

The compact new STM32C0x1 series of 32-bit microcontrollers, supplied at a price point that competes with many 8-bit MCUs, provides extra performance, memory provision and functionality compared to 8-bit architectures.

STMicroelectronics introduced the STM32C0 family of entry-level 32-bit microcontrollers for designers developing applications usually served by 8- or 16-bit MCUs.

The 32-bit MCUs available today, designated with STM32C0x1 part numbers, allow engineers to upgrade an 8- or 16-bit design with minimal impact on bill-of-materials cost. What is more, these MCUs provide support for additional software resources, hardware capabilities, and tools from the proven STM32 ecosystem.

The STM32C0x1 series offers up to 32 kbytes of Flash memory, and between 6 kbytes and 12 kbytes of RAM. The MCUs are available in a variety of 8- to 48-pin packages, including a 12-pin WLCSP, and a 3 mm x 3 mm 20-pin UFQFPN package.

The STM32C0x1 line of MCUs is based on a 48 MHz Arm Cortex -M0+ core that achieves a CoreMark score of 114. The MCUs offer a range of peripheral features:

- Fast 12-bit ADC with hardware resolution up to 16-bit
- Flexible mapping on DMA channels
- Timers with advanced control capability
- Various communications peripherals including two UART interfaces

The STM32C0 family offers a pinout that is compatible with the higher performance STM32G0 family, and shares the same technological platform, to provide a scalable upgrade path.

To assist designers in the transition from an 8- to a 32-bit design architecture, ST has published application note AN5775, which provides guidelines for moving from an 8-bit STM8L or STM328S to the STM32C0. The note covers peripheral migration, and shows that moving to a 32-bit architecture means an increase in code size of only 6% to 15% in most cases. A webinar is also available on demand.

STM32 tools such as the STM32CubeMX and the STM32CubeIDE, the STM32CubeProgrammer debug software, and STM32Cube expansion packages optimize workflows and help engineers to reuse code or modules.

FEATURES

- 1.2 V power regulator
- Real-time clock
- Two watchdog timers
- Serial peripheral interface
- I2C interface
- 3-channel DMA controller
- 125°C maximum operating temperature

APPLICATIONS

- Smart home devices
- Industrial equipment
- Consumer devices

FREE DEV BOARD

Development kit for entry-level 32-bit STM32C0 family MCUs.

Orderable Part Number
STM32C0116-DK

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How to use a secure IC to maintain the integrity of dc metering data

Integrating cryptographic functions and secure private key storage in dedicated hardware offers much stronger protection against hacking for dc metering measurement data than software security measures alone provide.

By Brette Mullenaux
Product Marketing Engineer, Microchip

Direct current (dc) metering is essential in industry segments as varied as data centers, communications, transportation, industrial equipment, and renewable energy. The proliferation of dc circuits, especially in applications such as electric vehicle (EV) charging stations, has led to an increased demand for reliable and trustworthy dc metering technology. Unlike ac metering, which fails to account for losses that occur in the process of ac-to-dc conversion, dc metering ensures the accurate measurement of actual energy consumed.

Ensuring the credibility and integrity of dc metering data, however, presents a substantial challenge. As global standards and regulations evolve to standardize metering outputs, the need for authentic and secure measurements becomes crucial. This highlights the important role that secure ICs for authentication play in ensuring the trustworthiness of dc metering applications.

The importance of reliable dc metering

Dc metering plays an essential role in applications such as dc fast charging at level 3 and above. In these settings, end users need to pay for the precise amount of energy they receive. Ac metering might not provide accurate results because of the losses incurred during ac-dc conversion. Therefore dc metering is essential for billing transparency and fairness.

Global standards, such as the German Eichrecht standard, are being developed to ensure that dc metering measurements are authentic and trustworthy. These standards require end users to have the means to validate the authenticity of energy measurements: secure ICs can perform this role.

Challenges in ensuring dc metering security

Dc metering systems typically include a microcontroller responsible for logic operations, an LCD display, and communications capability. While these systems often use MCUs from reputable suppliers, the security function is often implemented in software. Software-based security, however, can expose dc meters to vulnerabilities that could compromise the credibility of the measurements.

Secure ICs: a solution for reliable dc metering

Microchip offers a wide range of solutions, including reference designs, that cater to vertical markets in which dc metering is vital. The TA100, ATECC608 and ECC204 specifically address the security challenges in dc metering. These devices provide robust, hardware-level protection for private keys, and support ECC P256 ECDSA sign operations in hardware. By drawing on the Microchip CryptoAuthentication™ library, dc metering equipment vendors can efficiently implement secure, JSON-encrypted data signing.

OCMF: ensuring authenticity and integrity

In the context of dc metering, the Open Charging Metering Format (OCMF) often comes into play, particularly in reference to the Eichrecht standard in Germany. OCMF is a JSON format which includes energy measurements and a valid ECC signature. This format allows end users to verify the authenticity of measurements by using the corresponding public key as shown in Figure 1. Additionally, the German Eichrecht standard mandates that dc meters include a small display accessible to users for transparency and validation.

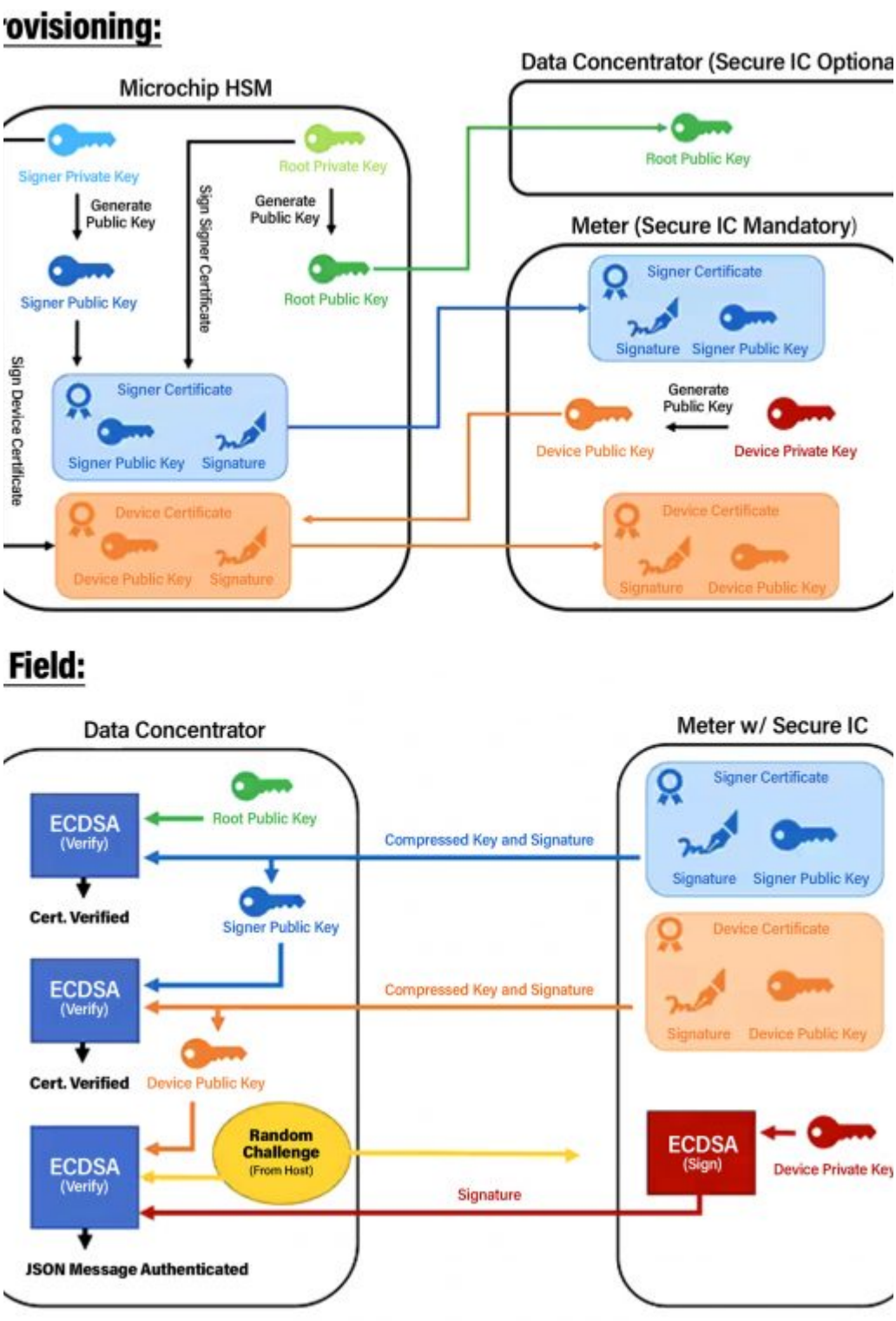


Fig. 1: The process flow for authentication of a dc meter's measurement outputs

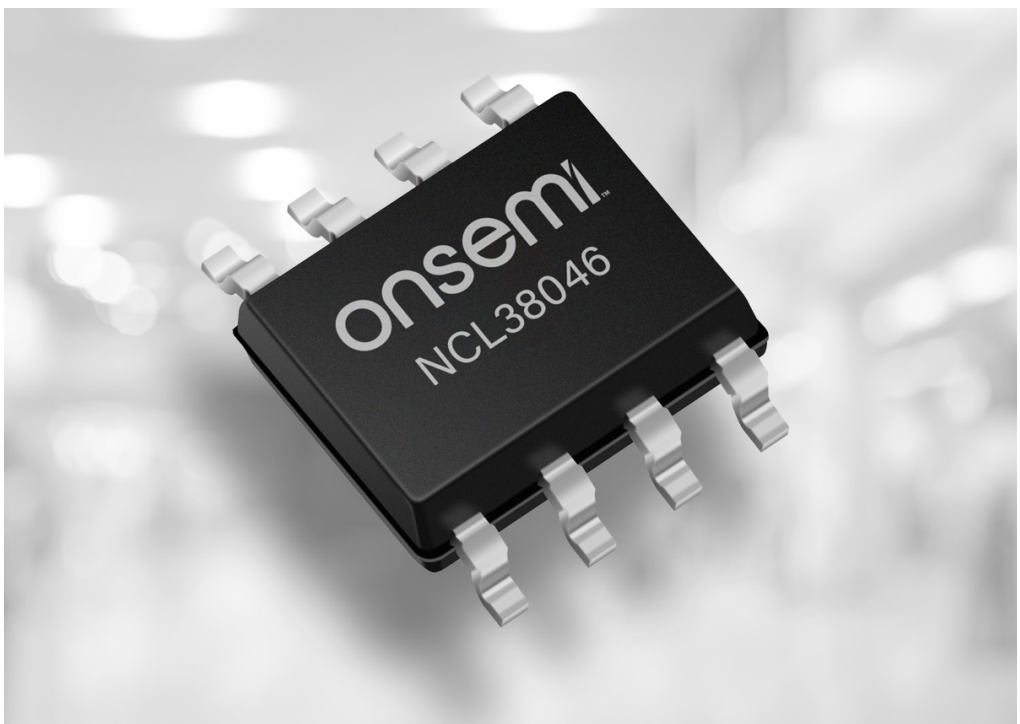
Secure IC devices such as the TA100, ATECC608 or ECC204 ensure that private keys are securely stored in hardware, making it difficult for hackers to compromise the integrity of dc metering data. Implementing JSON data signing with these devices is straightforward, thanks to the high-level application programming interfaces provided in the CryptoAuthentication library and Microchip's secure key provisioning service.

Conclusion

Secure ICs provide a robust solution for safeguarding private keys and ensuring the authenticity and integrity of dc metering measurements. By embracing hardware-level security, dc metering equipment vendors can meet evolving standards and regulations while offering end users transparent and trustworthy billing.

Op amp for LED driving compatible with analog or PWM dimming signals

The onsemi NCL38046 amplifier gives precise regulation of the constant current/constant voltage outputs on the secondary side of an ac-dc LED driver. The amplifier enables deep dimming and a low-power standby mode.



onsemi

FEATURES

- ±0.5 mV input-offset voltage
- Dimming curve modulation options:
  - Linear
  - Logarithmic
- Dim off/standby mode
- 3.3 V reference pin
- Ambient-temperature range: -40°C to 125°C

APPLICATIONS

- LED lighting

The onsemi NCL38046 is a constant current/constant voltage operational amplifier for use in the secondary side of an LED driver. The amplifier has a low input-offset voltage to provide for precise constant current regulation.

Use of the NCL38046 enables designers to implement driver designs that can dim LED lights to less than 1% of full brightness. The amplifier also supports programmable constant power regulation, protecting the LED load and providing a wide output-voltage operating range.

The NCL38046 is available in two versions:

- NCL38046AADR2G offers dimming level setting via an analogue dimming (ADIM) pin
- NCL38046PADR2G offers dimming level setting via a PWM dimming (PDIM) pin

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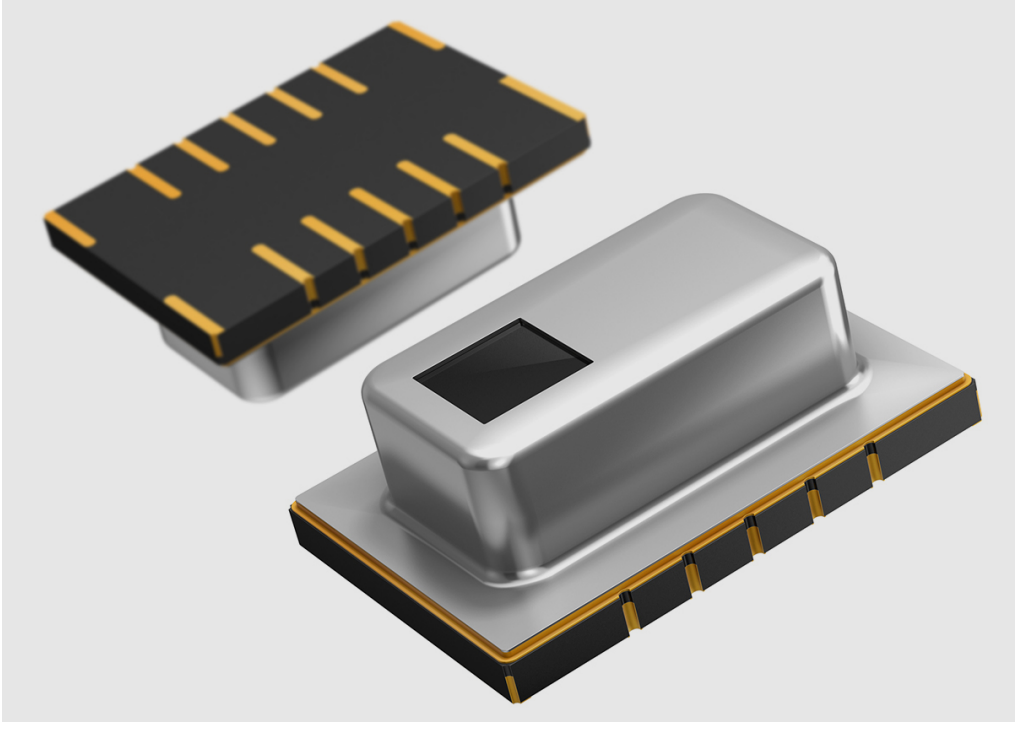
Thermal array sensor provides accurate people detection in intelligent lighting controls

The Grid-EYE thermal sensor from Panasonic has an 8 x 8 grid which generates a 64-pixel thermal image. With people tracking and counting algorithms, the sensor enables lighting controls to dim or turn-on LEDs automatically.



Panasonic INDUSTRY

FEATURES

- ±2.5° temperature measurement accuracy
- Selectable frame-rates: 1 Hz or 10 Hz
- People tracking and counting algorithms for privacy-enabled detection
- 4.5 mA operating current

APPLICATIONS

- LED lighting
- Building automation
- Access control
- Heating, ventilation and air-conditioning systems
- Microwave ovens and kitchen appliances
- Surveillance and security systems

The Grid-EYE thermal sensor from Panasonic is a sophisticated sensor for detecting the presence of people, enabling intelligent control and dimming of lighting systems to save power and improve responsiveness to user demand.

The Grid-EYE infrared array sensor is a 64-pixel infrared camera housed in a compact surface-mount package. Grid-EYE combines a MEMS sensor chip, a digital ASIC with an I2C interface, and a lens in an 11.6 mm x 8 mm x 4.3 mm package.

The thermopile elements are in an 8 x 8 grid format which measures both temperature and temperature gradients contactlessly. These temperature outputs can be converted to a 64-pixel thermal image.

Sensor outputs that show the presence of people in the controlled space can be used for various functions:

- To configure lights to brighten when the space is occupied, reducing energy usage in areas that are not being used
- To create heat maps to show how people use the space. This enables a building operator to optimize layouts and pathways. The data can also be used to inform decisions about wayfinding and guidance
- To count occupants of a room for safety and regulation purposes

Because the Grid-EYE provides a deliberately low-resolution, 64-pixel image output, this monitoring of people's usage of a space is inherently anonymized, and so avoids the risk of infringing users' right to privacy.

Product Name	Type	Field of View	Amplification Factor	Operating Voltage	Part Number	Temperature of Measured Object
Grid-EYE	Narrow angle	35.6°	Low Gain	3.3 V	AMG883642	-20°C to 100°C
	Standard type	60°	High Gain	3.3 V	AMG8833	0°C to 80°C
			Low Gain		AMG8834	-20°C to 100°C
			High Gain	5 V	AMG8853	0°C to 80°C
			Low Gain		AMG8854	-20°C to 100°C
	Wide angle	90°	High Gain	3.3 V	AMG883543	0°C to 80°C
				5 V	AMG885543	

Ultra low-power digital temperature sensor offers ±0.5°C accuracy

Housed in a 2 mm x 2 mm package, the STTS22H digital temperature sensor from STMicroelectronics is factory-calibrated, and accuracy up to 125°C is verified with traceable equipment.

The STTS22H from STMicroelectronics is an ultra low-power digital temperature sensor which offers high performance over the entire operating-temperature range of -40°C to 125°C. Accuracy is a maximum ±0.5°C over a temperature range of -10°C to 60°C.

The STTS22H is a band-gap temperature sensor coupled with an ADC, signal processing logic, and an I2C/SMBus 3.0 interface in a single chip. The sensor is housed in a small 2 mm x 2 mm x 0.5 mm 6-lead UDFN package with exposed pad down, giving a better temperature match with the surrounding environment.

The digital temperature sensor is factory-calibrated and requires no additional calibration on assembly into the application. STTS22H sensors are all tested on a production set-up which is traceable to National Institute of Standards and Technology (NIST) standards, and verified with equipment which is calibrated in accordance with the automotive IATF 16949:2016 standard.

FEATURES

- Supply-voltage range: 1.5 V to 3.6 V
- Programmable thresholds with Interrupt pin
- 1.75 µA operating current in power-saving one-shot mode
- 16-bit temperature data output

APPLICATIONS

- Wearable devices
- Smart home automation
- Asset and goods tracking
- Smartphones
- HVAC units
- Refrigerators
- Air humidifiers
- Portable consumer devices
- White goods
- Thermostats

FREE DEV BOARD

Evaluation kit demonstrates high accuracy of STTS22H temperature sensor.

Orderable Part Number
STEVAL-MKI200V1K

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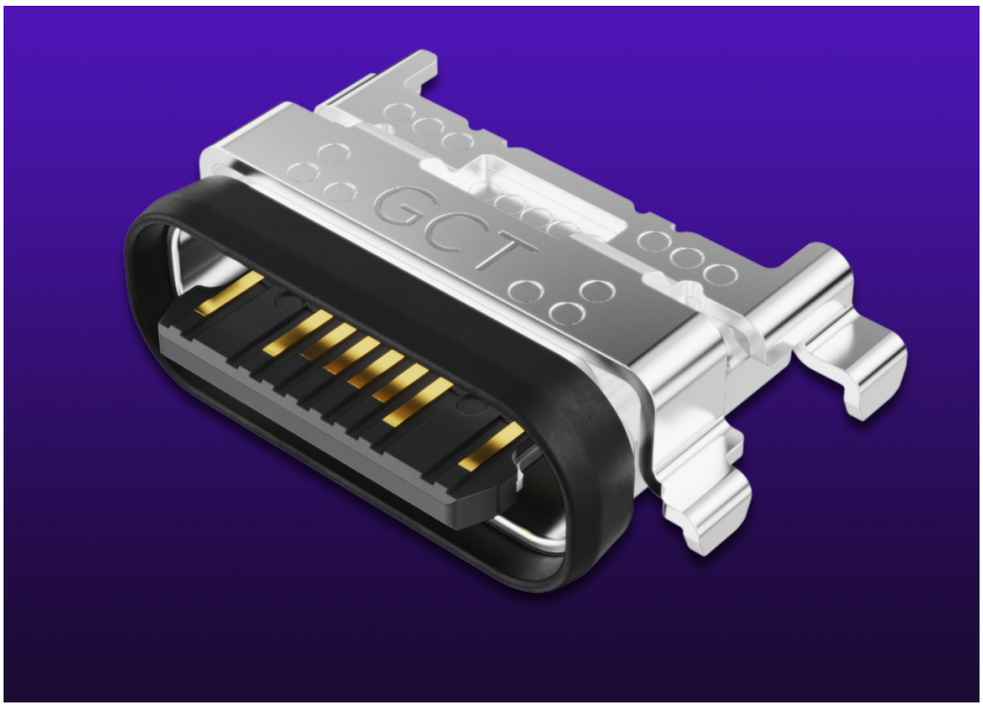
Waterproof connectors in USB Type-C format feature 240 W power rating

The USB4720 and USB4730 from Global Connector Technology provide flexible options to fit different production environments and requirements, and can be soldered directly to the board.



GCT

FEATURES

- 20,000 mating cycles
- 48 V dc voltage rating
- 5 A current rating
- Outer shell stake

APPLICATIONS

- Portable electronics
- Audio equipment
- Point-of-sale equipment
- Alarm systems
- Security systems
- Consumer electronics
- Gaming controllers

The USB4720 and USB4730 from Global Connector Technology are waterproof connectors in USB Type-C® format which support the highest 240 W power rating specified in the USB Power Delivery standard. These connectors are 100% tested for compliance with the requirements of an IP67 rating, both mated and unmated.

The 16-position USB4720 and USB4730 are intended for use in USB 2.0 applications in which ingress protection is required.

The mid-mount USB4720 is supplied with a fitted liquid injection molding gasket that is suitable for solder processing. The connector has two independent grounding tags attached to the mid-plate and pins A1, B12, A12 and B1. The top-mount USB4730 is provided as standard in kit form: the gasket, which has the part number USBTJ-04, requires fitment after solder processing. For high-volume applications in which PCB assembly may be separate from the box build, it is possible to procure the connector and gasket independently.

Both models can be soldered directly to the PCB with no need for additional fixings or processes.

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Crystals combine tight frequency stability with minimal aging

ECS Inc puts its B series crystals through an accelerated aging process in the factory, reducing the usual first-year aging and giving very low frequency drift over lifetime.

ECS INC INTERNATIONAL

FEATURES

ECX-2236B

- Frequency options between 12 MHz and 50 MHz
- Load capacitance: 7 pF, 8 pF, 9 pF, 10 pF or 12 pF
- 3 pF maximum shunt capacitance
- 100 µW maximum drive power

APPLICATIONS

- Mobile devices
- Wearable devices
- Short-range radio devices
- IoT devices

ECS Inc supplies special B series surface-mount crystals which feature very low first-year aging, giving developers a way to achieve very low frequency drift over lifetime.

The technology underlying the B series quartz crystal oscillators derives from the process for manufacturing oven-controlled crystal oscillators (OCXOs), in which these components are tested to ensure operation under specified conditions.

When quartz vibrates, the structure of its resonating surface relaxes, which causes frequency drift. All crystals undergo this effect for the first few years of life. As in OCXO testing, the B series crystal is pre-aged and pre-stressed, so that by the time it is in use as a quartz oscillator in an application, the relaxation and associated frequency drift have already occurred.

In other words, the ECS aging process at the factory primes the crystal for superior performance in an oscillator circuit. The procurement of a low first-year aging crystal such as the ECX-2236B enables the engineer to produce a crystal oscillator frequency that will not drift beyond a usable range.

This low drift over lifetime means that the ECS Inc B series crystals have been deployed globally in applications such as:

- Smart city infrastructure, including lighting and signaling
- 3D cameras, virtual reality and artificial intelligence devices
- Atmospheric satellite connections

AEC-Q200-qualified B series crystals are available for use in automotive applications.

FUTURE ELECTRONICS
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LED controller supports deep dimming down to less than 0.1%

The HV96001 from Microchip is a power controller for LED drivers which eliminates ripple for a clean, flicker-free light output. Digital or analog dimming can be set via a wide range of lighting control protocols.

MICROCHIP

FEATURES

- PWM dimming frequency up to 20 kHz
- Input-voltage range: 8 V to 60 V
- Fault recovery with auto-retry

APPLICATIONS

- LED lighting

The HV96001 LED driver controller from Microchip is intended for use in offline lighting applications that require a wide dimming capability. The controller can perform both linear, analog dimming and PWM digital dimming: in PWM dimming mode, the HV96001 can control flicker-free dimming down to less than 0.1% with a pulse width of less than 250 ns.

The HV96001 IC includes two feedback regulators, one controlling a flyback converter circuit and the other controlling a boost converter that supplies the LED load. The controller regulates the flyback converter output voltage in the primary stage via an optocoupler. The boost regulator, which implements the SEPIC topology, provides precise control with near-zero voltage ripple. This produces a ripple-free LED current with ripple rejection at 100 Hz and 120 Hz, and a clean, flicker-free light output from the LEDs with a consistent color temperature.

By adjusting the flyback converter output voltage, the HV96001 ensures the boost converter operates with a small difference between the input and output voltages, also known as the headroom voltage, so that the boost converter can be smaller and operate more efficiently.

The HV96001 supports a broad range of wired and wireless protocols, including:

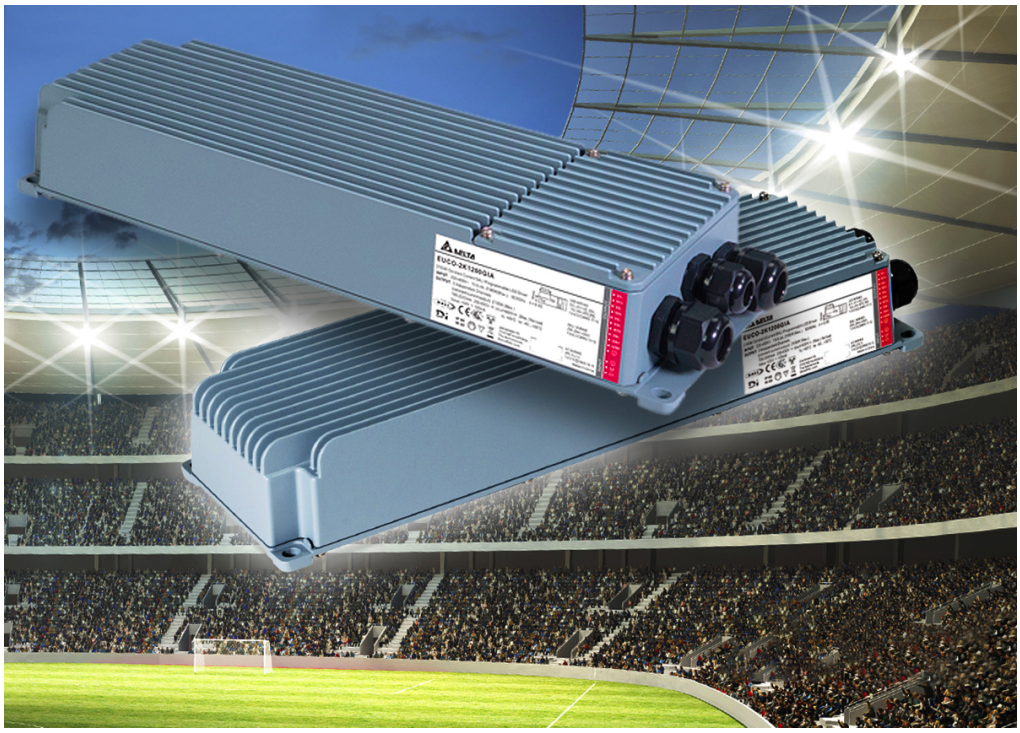
- DALI
- 0-10V
- DMX
- PM
- PoE
- Zigbee wireless
- Wi-Fi® networking
- MESH
- LoRa® networking
- Cat-1M cellular
- Bluetooth® wireless

Integrated features include output over- and under-voltage, over-current, and short-circuit protection, and stuck-at-zero dimming detection.

LoRa® is a trademark of Semtech Corporation.

2.1 kW LED drivers with low output-current ripple suit HDTV sports broadcasting

The EUCO ARENA SPORT 2K1 series from Delta provides three independent channels for driving LED lighting installations, each with up to 700 W of output power and controllable by DALI2/D4i or DMX-RDM interfaces.



DELTA

FEATURES

- Three independent 700 W output channels
- 97.8% efficiency
- Control options:
  - EUCO-2K2100GIA – DALI2/D4i
  - EUCO-2K2100GDA – DMX-RDM

APPLICATIONS

- Indoor or outdoor stadium and arena lighting
- Outdoor area lighting
- Broadcast television lighting

The Delta EUCO ARENA SPORT 2K1 LED drivers supply a maximum load of 2,100 W from a nominal input voltage of 220 V to 400 V ac. These constant-current, non-isolated LED drivers are highly efficient, and support programmable output currents from 700 mA to 2,000 mA, with an output-voltage range of 250 V to 550 V dc per channel.

Peak-to-peak output-current ripple of 1% makes these drivers well suited for lighting in HDTV broadcast applications. Constant light output, a wide dimming range down to 0.1%, and autonomous dimming functionality enable versatile operation for supporting different levels of ambient lighting during long sporting events. The drivers can be controlled from a distance of up to 200 metres, which enables use in the largest of venues.

Suitable for indoor and outdoor installations, the Delta EUCO ARENA SPORT 2K1 series comes in an IP66, IK08-rated enclosure rated for operation at temperatures between -40°C and 50°C. High-accuracy integrated power monitoring and input-surge protection of up to 10 kV ensure reliable operation in harsh operating conditions.

FUTURE ELECTRONICS
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Tiny 3D magnetometer gives superior performance and high reliability

The new MLX90394 magnetometer from Melexis achieves an excellent trade-off between low noise, power consumption and cost to give designers an effective way to build position-sensing functions into an end product.

Melexis has introduced the MLX90394 Triaxis® micropower magnetometer, a tiny Hall-effect based sensor which balances the design trade-off between low noise, power consumption, and cost. It is suitable for rotary and linear sensing systems, push-buttons, and 3D joystick control in gaming and industrial peripherals.

Offering selectable modes and broad configurability, the MLX90394 enables OEMs to reuse a single hardware design across multiple product variants, and to reduce time-to-market. Helping to save power, the modes can be selected on-the-fly.

In position sensing functions, the MLX90394 provides an elegant, flexible and reliable alternative to traditional potentiometers, which suffer from contamination of the wiper surface as well as packaging constraints. The contactless MLX90394 is also more reliable than contacting switches.

Supplied in a compact 2 mm x 1.5 mm x 0.4 mm six-lead UTDFN package, this magnetometer helps designers to implement smaller, slicker human-machine interfaces.

The MLX90394 architecture delivers several benefits compared to existing solutions. It enables measurement and output of each magnetic axis individually. A built-in thermometer allows selectable temperature measurement to enable compensation for measurement error.

Melexis
INNOVATION WITH HEART

FEATURES

- 16-bit digital I2C output for magnetic and temperature data
- Output data rate options: 0.1 MHz, 0.4 MHz and 1 MHz
- Three wake-up-on-change/interrupt modes
- Measurement-range options:
  - ±5 mT (0.15 µT/LSB)
  - ±50 mT (1.5 µT/LSB)
- Operating-temperature range: -40°C to 105°C
- Supply-voltage range: 1.7 V to 3.6 V

APPLICATIONS

- PC peripherals
- Mouse roller
- Gaming peripherals:
  - Joysticks
  - D-pads
  - Trigger buttons
- Wearable devices
- Battery powered tools
- White goods
- Industrial peripherals
- Smart home devices
- Door/window opening detectors

FREE DEV BOARD

Evaluation board for miniature MLX90394 magnetometer IC.

Orderable Part Number
EVB90394_DVK_000

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Ac-dc power converter controller includes high-voltage start-up generator

The STMicroelectronics STNRG012 controller provides a high level of integration, combining a PFC stage controller and an LLC resonant half-bridge controller with the 800 V start-up circuit.

FEATURES

- Time-shift control of resonant half-bridge
- PFC brown-out protection
- Half-bridge protection functions:
  - Overload protection
  - Soft-start time-out
  - Over-voltage protection
- 8-channel, 10-bit ADC

APPLICATIONS

- Street lighting
- Residential lighting
- Industrial equipment

The STNRG012 from STMicroelectronics combines a PFC controller, a high-voltage LLC resonant half-bridge controller, an 800 V-rated start-up generator and a sophisticated digital engine that manages the operation of the three power stages.

Supplied in a 20-pin SO package with a footprint of 13.0 mm x 7.6 mm, the STNRG012 offers an excellent solution for high-efficiency PFC converters that have to comply with stringent energy-saving regulations.

The PFC controller supports both transition mode and discontinuous conduction mode. It can operate from either a mains ac or a dc line input.

The power system and the control algorithms are managed by an 8-bit core with dedicated fast peripherals, and the chip benefits from high-performance digital algorithms and analog IP. Application parameters can be stored in non-volatile memory in production, giving engineers considerable ability to configure and calibrate their system.

A UART interface enables system monitoring, storage of black-box data in external Flash, and uploading software updates from external Flash.

Application Note, 200 W LED driver using the STNRG012

FREE DEV BOARD

Evaluation board implements 200 W LED driver using the STNRG012 controller.

Orderable Part Number
EVL012LED

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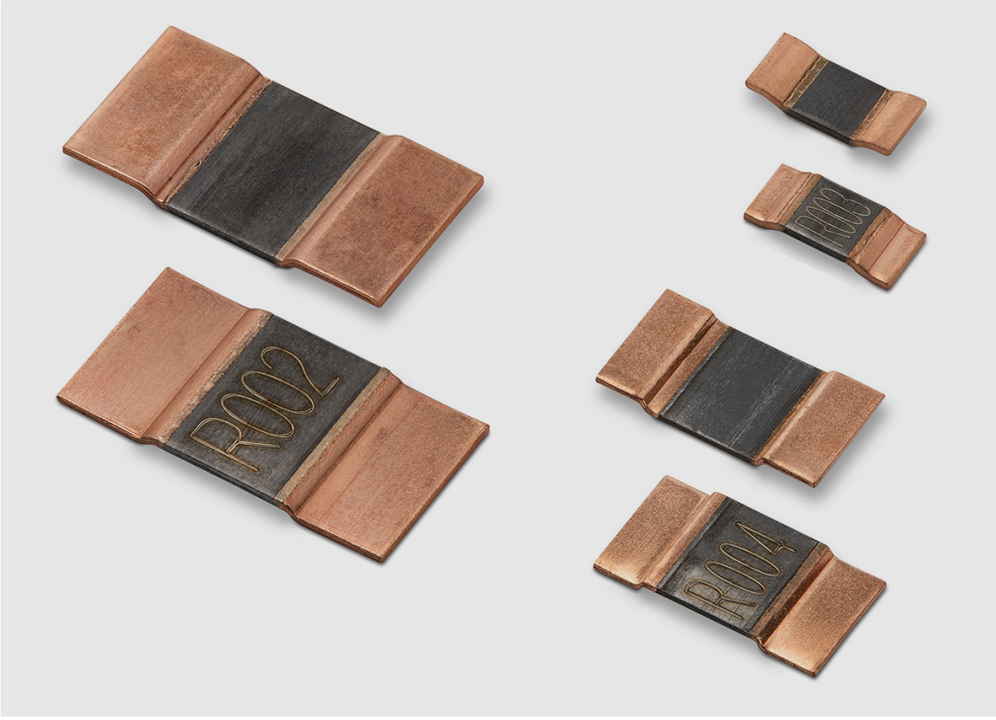
Shunt resistors for accurate current measurement in automotive and industrial applications

The SSA series of resistors from Littelfuse provides a compact and flexible solution, and maintains stable performance over temperature for accurate current measurement even in harsh conditions.



Littelfuse
Expertise Applied | Answers Delivered

FEATURES

- Available in 2512, 3921, and 5931 case sizes
- Resistance range: 0.2 mΩ to 4.0 mΩ
- Up to 15 W power rating

APPLICATIONS

- Automotive systems
- EV charging equipment
- Large appliances
- Data centers
- Industrial equipment
- Power modules
- Frequency converters

The new SSA series of two-terminal, ultra low-resistance shunt resistors from Littelfuse meets the growing demand for accurate current measurement in high-performance applications.

Compared to competing technologies such as Hall-effect sensors, current transformers, fluxgate sensors, and Rogowski coils, the Littelfuse current shunt resistor offers a more efficient and lower-cost solution, and one that works well in both ac and dc circuits. The SSA series also has a higher power rating than metal foil resistors.

The resistance of the SSA series is consistent and stable across production batches and temperature. Tolerance of resistance is as low as ±1.0%, and the temperature coefficient of resistance is as low as ±50 ppm/°C.

Introduction to SSA series current shunt resistors

Sensitive-gate thyristors with 8 A current rating for dimmer switch control

The TS820 silicon-controlled rectifier (SCR) thyristors from STMicroelectronics are ideal for use in dimming light switches for low-power LED or fluorescent lamps, providing flicker-free output and high power efficiency.

FEATURES

- Triggering gate-current range: 0.2 mA to 15 mA
- Voltage-rating options: 600 V or 800 V
- Package options:
  - DPAK
  - IPAK
  - TO-220AB
  - TO-220FPAB
- Operating-temperature range: -40°C to 125°C

APPLICATIONS

- Power tools
- Kitchen equipment
- Lighting equipment

The TS820 series of SCR thyristors from STMicroelectronics provide an efficient way to control the current through lighting dimmer switches thanks to the highly sensitive gate. The low gate current means that the SCR thyristors can be controlled by a very small power supply.

The 8 A-rated TS820 SCR series is suitable for all modes of control found in dimmer switches, and in other applications such as over-voltage crowbar protection, motor control circuits, inrush current limiting circuits, capacitive discharge ignition, and voltage regulation circuits.

The SCR thyristors are available in through-hole and surface-mount packages.

FREE DEV BOARD

Analog wall dimmer switch for fluorescent or LED lamps based on TS820 thyristor.

Orderable Part Number
STEVAL-ILD003V1

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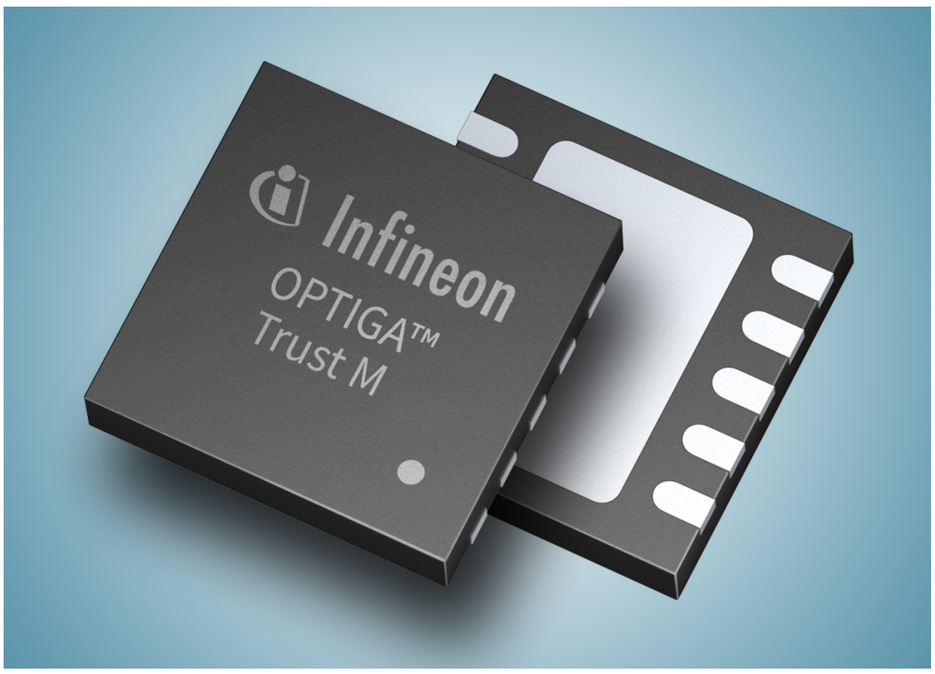
Complete cloud security solution protects IoT devices from cyber-attack

The OPTIGA™ Trust M tamper-resistant security solution from Infineon is Common Criteria EAL6+ certified. The secure element can be used with any MCU or application processor to enhance the security of IoT designs.



The OPTIGA Trust M from Infineon is a high-end security solution which provides an anchor of trust for connecting IoT devices to the cloud, giving every IoT device its own unique identity. This individual, turnkey solution offers secure, zero-touch onboarding and the high performance needed for quick cloud access.

The OPTIGA Trust M chips and supporting software offer a wide range of security features. In particular, they support common asymmetric cryptography algorithms including:

- RSA® up to 2048
- AES key up to 256, HMAC up to SHA512
- TLS v1.2 PRF and HKDF up to SHA512

The turnkey set-up with full system integration minimizes the design, integration and deployment effort required of product manufacturers. The OPTIGA Trust M development process is certified according to the security standard IEC 62443-4-1 for industrial automation and control systems, acting as an enabler to achieve component-level certification according to IEC 62443-4-2.

The OPTIGA Trust M security solution is specified in two operating-temperature ranges:

- SLS32AIA010MK at a standard temperature range of -25°C to 85°C for most commercial implementations
- SLS32AIA010ML at an extended temperature range of -40°C to 105°C for harsh industrial environments

The OPTIGA Trust M chip is supplied in a USON-10 package that has a footprint of 3 mm x 3 mm.

FEATURES

- High-end CC EAL6+ certified security controller
- ECC: NIST curves up to P-521, Brainpool r1 curve up to 512
- Hibernate mode for zero power consumption
- Open-source host code available on GitHub under MIT license
- Up to 10 kbytes of memory
  - Protected updates
  - Usage counters
  - Dynamic object locking
- Configurable device security monitor
- 20-years lifetime for industrial and infrastructure applications

APPLICATIONS

- Smart lightning
- Smart home
- Building automation
- Industrial robotics
- Programmable logic controllers
- Motor drives
- Drones

FREE DEV BOARD

OPTIGA Trust M IoT security development kit.

Orderable Part Number
TRUSTMIOTSDKTOBO1

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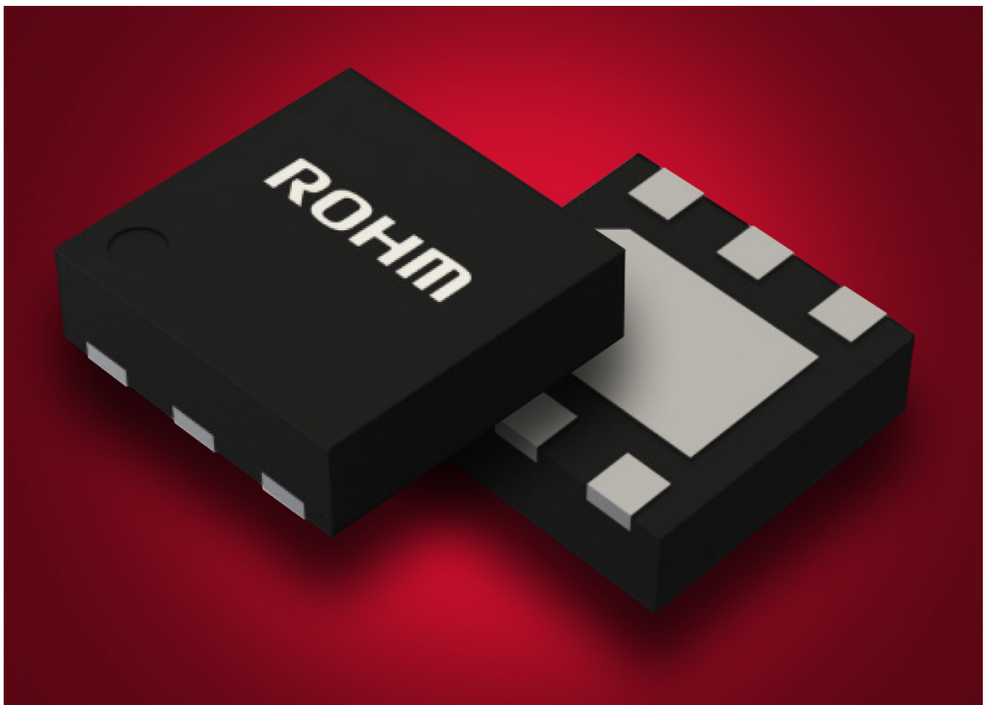
New high-speed gate driver IC maximizes performance of GaN power switches

The BD2311NVX-LB gate driver from ROHM features an ultra-short gate-input pulse width to enable GaN HEMTs to switch extremely fast, helping power-system designers to achieve very high efficiency and power density.



ROHM Semiconductor has introduced a gate driver IC, the BD2311NVX-LB, which is optimized for gallium nitride (GaN) power switches, achieving gate drive speeds measured in nanoseconds.

The BD2311NVX-LB features a minimum gate-input pulse width of 1.25 ns. This enables the development of power systems that take full advantage of the fast switching capability of GaN transistors, a feature that contributes to the production of smaller and more energy efficient power supplies and power converters.

The BD2311NVX-LB is particularly well suited to use in power supplies that require high power density – data center and telecoms servers are a notable example. LiDAR ranging, used not only in autonomous and assisted driving but also for monitoring industrial equipment and infrastructure, also demands high-speed pulsed laser light, and this gate driver is ideal for this application as well.

As a single gate driver for a GaN high electron-mobility transistor (HEMT), the BD2311NVX-LB can supply a current of 7 A, and offers under-voltage lockout protection.

The BD2311NVX-LB is supplied in a 6-pin SON package which has a footprint of 2 mm x 2 mm.

ROHM SEMICONDUCTOR

FEATURES

- Supply-voltage range: 4.5 V to 5.5 V
- 0.65 ns rise time with a 220 pF load
- 0.70 ns fall time with a 220 pF load
- Inverting and non-inverting inputs

APPLICATIONS

- LiDAR ranging systems
- Data center power supplies
- Telecoms power supplies
- Wireless charging for portable devices
- Class-D audio amplifiers

FUTURE ELECTRONICS
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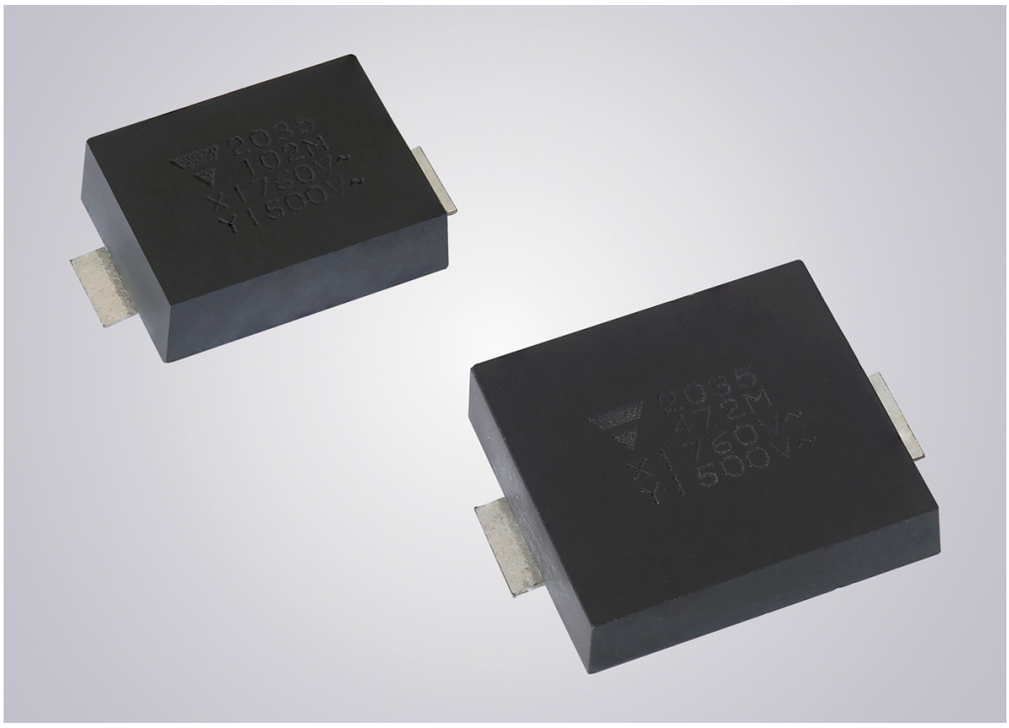
Surface-mount family of safety capacitors performs EMI suppression and filtering

The SMDY1 surface-mount ceramic-disc safety capacitors from Vishay perform EMI and RF interference suppression and filtering and are intended for use in industrial and consumer SMPS.



VISHAY

FEATURES

- IEC 60384-14 compliant
- Humidity Class IIB annex I compliant
- Certification:
  - UL 60384-14
  - DIN EN 60384-14
  - CSA E60384-1:14
  - CSA E60384-14:14
  - CQC11-471112-2015

APPLICATIONS

- Power supplies
- Solar inverters
- Lighting equipment
- Smart meters

The SMDY1 series of ceramic-disc safety capacitors perform EMI and RF interference suppression and filtering. The Class X1 capacitors are rated for 760 V ac, and the Class Y1 capacitors for 500 V ac. The Class X1 capacitors may be used for line-to-line filtering, and the Class Y1 capacitors for line-to-ground filtering.

The surface-mount capacitor consists of a ceramic disc which is copper-plated on both sides. The capacitor encapsulation is made of flame-retardant epoxy resin which conforms to the requirements of the UL 94 V-0 specification.

The SMDY1 capacitors are available in eight versions with capacitance values ranging from 470 pF to 4,700 pF. The footprint of the 470 pF, 680 pF, 1,000 pF and 1,500 pF capacitors is 8.6 mm x 14.8 mm. The footprint of the 2,200 pF, 3,300 pF, 3,900 pF and 4,700 pF capacitors is 14.6 mm x 19.2 mm.

Infrared motion sensor detects people at a range of up to 4 m

The STMicroelectronics STHS34PF80 infrared motion sensor is highly sensitive, and provides a broad range of configuration options, including output data rate and detection mode.

The STMicroelectronics STHS34PF80 infrared motion and heat-detection sensor is sensitive enough to detect the presence of a person at a distance of up to 4 metres without the need for a lens.

The uncooled STHS34PF80 is factory-calibrated to provide accurate sensor measurements. Raw optical sensor outputs are digitally processed by the STHS34PF80's embedded ASIC, which can be programmed to monitor for motion, presence, or over-temperature. The sensor is capable of detecting stationary objects, and of distinguishing between stationary and moving objects.

The output data rate is configurable in a range between 0.25 Hz and 30 Hz. The STHS34PF80 is housed in a 10-lead LGA package measuring 3.2 mm x 4.2 mm x 1.5 mm. The package is compatible with surface-mount assembly processes.

FEATURES

- Integrated silicon IR filter
- Low power consumption
- 80° field of view
- Supply-voltage range: 1.7 V to 3.6 V
- 10 µA supply current
- I2C and serial peripheral interfaces
- ±0.3°C local temperature sensor accuracy

APPLICATIONS

- Alarm/security systems
- Home automation
- Smart lighting
- IoT devices
- Smart lockers
- Smart wall pads

FREE DEV BOARD

Demonstration board for STHS34PF80 infrared motion sensor.

Orderable Part Number
STEVAL-MKI231KA

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