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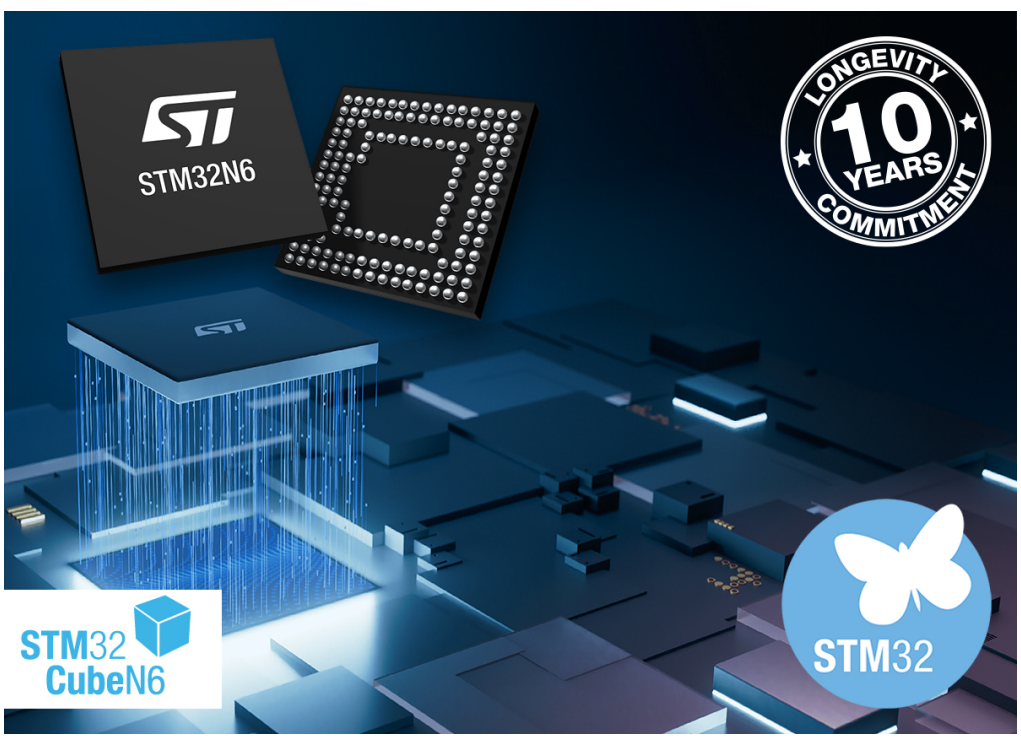
26-ii
Industrial Robotics/Industry 5.0

NPU-accelerated 32-bit MCUs provide visual intelligence for new robot designs

The machine learning capabilities of the STM32N6 microcontroller series from STMicroelectronics provide a new way for robots and other industrial automation equipment to see, understand and navigate around their environment.



STMicroelectronics has launched a series of 32-bit STM32 microcontrollers which integrate accelerated machine-learning (ML) capabilities alongside a high-performance 800MHz Arm® Cortex®-M55 CPU core.

The new STM32N6 MCUs are the first to embed the Neural-ART Accelerator, a neural processing unit (NPU). With the on-board NPU, the STM32N6 provides 600 times more machine-learning performance than a current high-end STM32 MCU. This enables cost-sensitive and power-conscious consumer and industrial products to implement AI video and audio functions in small embedded systems.

In robotics in particular, the STM32N6 machine vision capabilities allow designers to create a new generation of low-power, autonomous machines. The STM32N6 incorporates an image signal processor (ISP) which provides direct signal processing, enabling the use of simple and affordable image sensors. This ISP can be configured using the free ST ISP IQTune software, a cutting-edge tool which enables the developer to customize image signal processing parameters such as exposure time, contrast and color balance. This image processing sub-system can feed vision data to the NPU to enable functions such as object recognition and autonomous navigation.

The high-speed, low-power AI inferencing performed by the STM32N6 is due to the Neural-ART Accelerator NPU. This NPU features nearly 300 configurable multiply-accumulate (MAC) units which can implement up to 600 giga-operations per second (GOPS). The NPU includes dedicated streaming engines which optimize data flow and minimize internal buffer usage and power. The accelerator supports on-the-fly weight decompression and real-time data encryption and decryption.

The high ML performance is complemented by the system control side of the MCU. The Cortex-M55 core achieves a high CoreMark® score of 3,360. The MCU also includes 4.2 Mbytes of RAM, providing sufficient memory to support data-intensive AI and multimedia workloads. Two 64-bit AXI interfaces provide the high intra-chip bandwidth required to unlock the full power of the Neural-ART Accelerator. The STM32N6 also supports hexa-SPI, octo-SPI, and FMC interfaces.

ST provides development software to support the implementation of AI functions. The Edge AI Suite is a comprehensive set of software tools for the development of edge ML applications. The software tools enable developers to implement AI models in various formats such as TensorFlow Lite, Keras, and ONNX.

The STM32N6 MCUs are supplied in six different packages with pin counts ranging from 142 to 264, and from 0.4mm to 0.8mm pitch.

FEATURES

- Security features:
  - TrustZone®-aware support
  - Memory protection unit
  - Secure boot ROM
  - PSA and SESIP certified
- Neo-Chrom graphic accelerator
- Optional hardware H264 codec
- Hardware JPEG accelerator
- Operating-temperature range: -40°C to 125°C

APPLICATIONS

- Industrial equipment
- Robotics
- Smart home equipment
- Smart cities
- Automotive systems
- Personal electronics devices
- Medical and healthcare equipment

FREE DEV BOARD

Discovery kit for 32-bit MCUs with on-board AI acceleration.

Orderable Part Number
STM32N6570-DK

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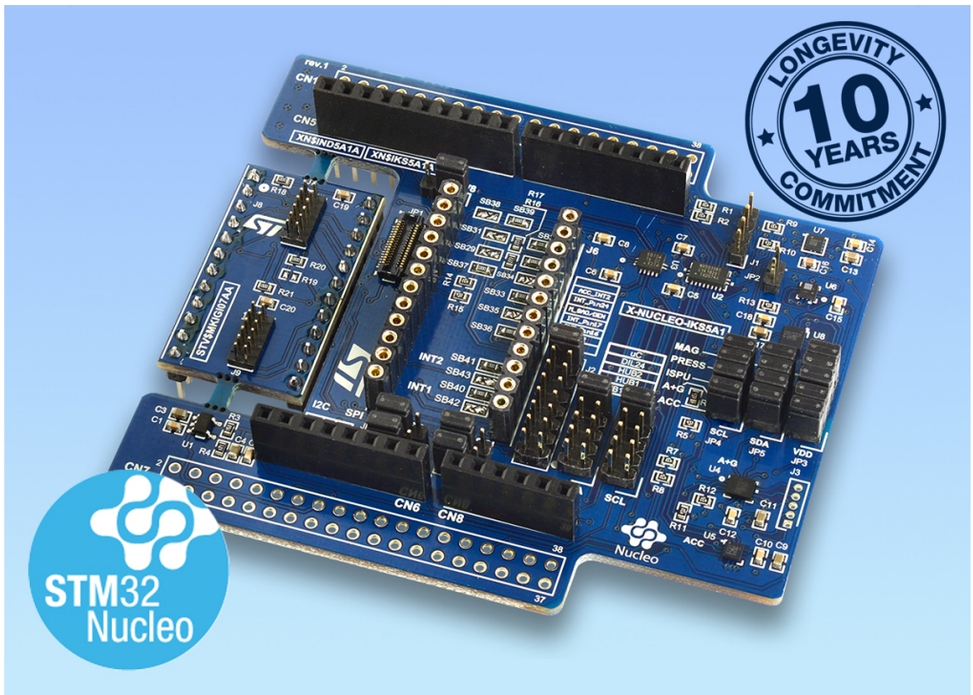
Development platform simplifies integration of multiple industrial MEMS sensors

The X-NUCLEO-IKS5A1 expansion board from STMicroelectronics consolidates multiple industrial motion and environmental MEMS sensors onto a single platform, allowing synchronized acquisition of vibration, orientation, magnetic, and pressure data.



FEATURES

- Arduino® UNO R3 connector
- External sensor interfaces:
  - DIL24 socket
  - Ribbon cable
  - Flexible PCB connector

APPLICATIONS

- Vibration and condition monitoring
- Motion tracking and orientation detection
- Environmental sensing in industrial nodes
- Multi-sensor fusion and prototyping

The X-NUCLEO-IKS5A1 integrates five sensors covering distinct measurement domains, bringing them into a single timing domain to simplify multi-sensor alignment and to support applications that require coherent motion, vibration, and environmental data. The solution includes:

- ISM6GH256X intelligent IMU for simultaneous measurement of low-g and high-g acceleration
- ISM330IS six-axis IMU with always-on accelerometer and gyroscope
- IIS2DULPX ultra-low-power accelerometer
- ILPS22QS barometer with 1260hPa and 4060hPa ranges
- IIS2MDC three-axis magnetometer

The platform makes these industrial sensors accessible to developers using an STM32 microcontroller through its Nucleo-compatible interface and the ST software ecosystem. Onboard features such as sensor hub support, finite state machines, and machine learning cores allow initial data processing directly at the sensor, reducing the computation workload on the host processor. The ST MEMS-Studio and X-CUBE-MEMS1 software support configuration, acquisition control, and parameter visualization for simplified development and analysis.

Detachable add-on modules provide additional connectors, and support distributed sensing layouts for either the STEVAL-MKGI07A microcontroller board or the main X-NUCLEO-IND5A1 board.

FREE DEV BOARD

Development platform simplifies integration of multiple industrial MEMS sensors.

Orderable Part Number
X-NUCLEO-IKS5A1

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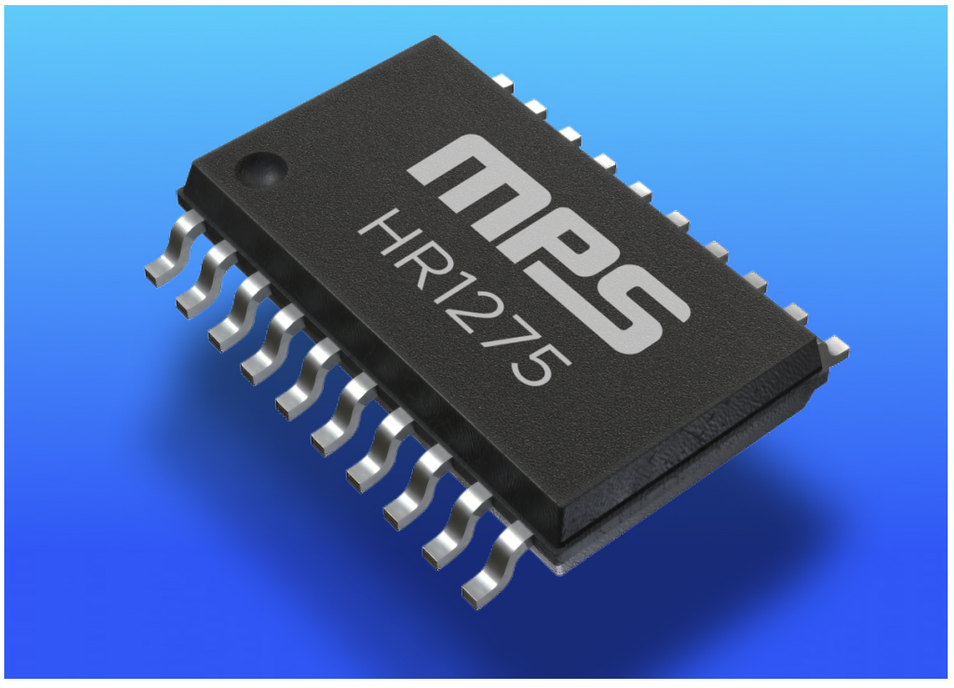
Digital power controller boosts efficiency and flexibility in ac-dc power supplies

The Monolithic Power Systems HR1275 ac-dc power controller integrates PFC and LLC controllers into a single configurable chip, enabling developers to increase the power density of power supply designs.



Monolithic Power Systems has introduced the HR1275, a digital ac-dc power controller which combines a PFC stage with a resonant LLC converter in a single chip.

The HR1275 has built-in power-saving features which help to achieve ultra-low standby power consumption, while maintaining high efficiency and a high power factor across the range from light to full loads. This makes the controller well suited to applications such as compact, high-power adapters which require both efficiency and flexibility.

The controller is configurable via a user-friendly GUI, allowing engineers to program and adjust many operating parameters, from soft-start timing and loop compensation to protection thresholds, which are stored in the chip's non-volatile memory. This programmable digital core means that the same hardware can be quickly modified to meet different efficiency standards, noise targets, or load profiles without hardware changes. This greatly accelerates prototyping and design optimization.

The PFC controller in the HR1275 operates in both critical and discontinuous conduction modes to maximize efficiency across the load range. The controller uses intelligence to minimize switching losses and audible noise, and can drive the PFC stage at frequencies up to 400kHz. At light loads, a configurable soft burst-mode helps to maintain efficiency without compromising power quality.

In the LLC stage, the HR1275 adopts current-mode control with adaptive dead-time adjustment to ensure zero-voltage switching with minimal dead-time, improving efficiency and reducing heat dissipation.

An internal high-voltage start-up current source powers the chip directly from the ac line, eliminating the need for auxiliary power supply for the start-up and cutting standby power dissipation. Designers benefit from a built-in power-good indicator and the ability to connect an external temperature sensor.

MPS

FEATURES

- <75mW no-load power consumption
- Internal 600V high-side gate driver
- Smart X-capacitor discharger when ac dropout
- Fault protection features:
  - Over-current protection
  - Over-voltage protection
  - Overload protection
  - Over-power protection
  - Over-temperature protection

APPLICATIONS

- PCs
- Games consoles
- All-in-one computers
- Telecoms and server power modules
- Industrial equipment
- Medical equipment

SAMPLES

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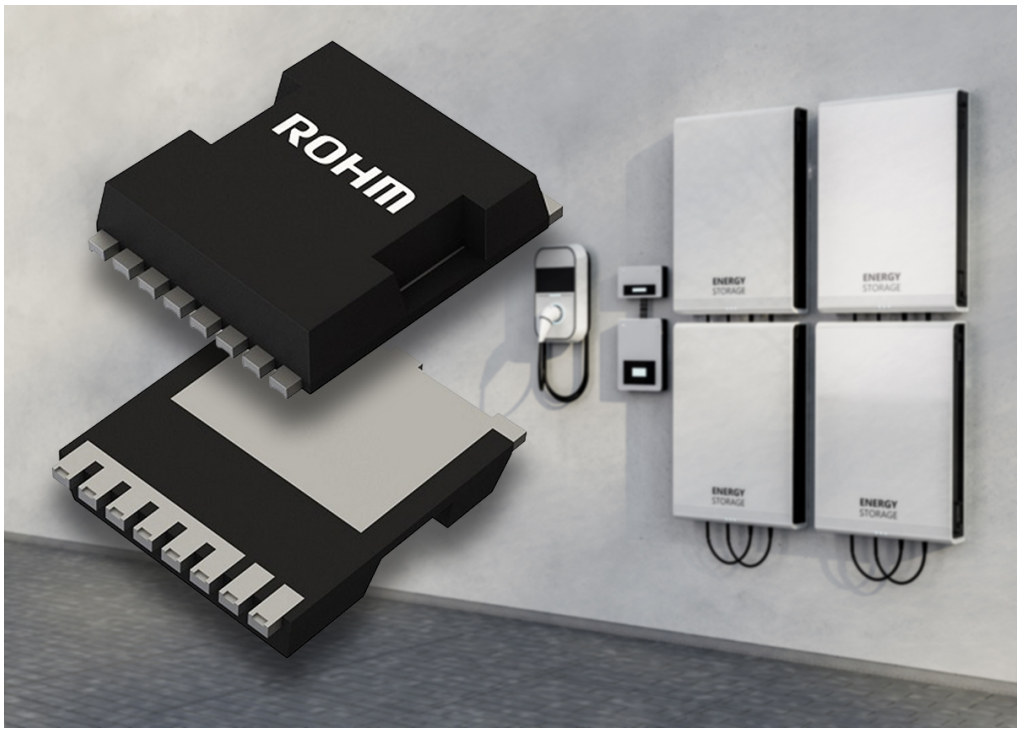
New 750V SiC MOSFET saves space in high-voltage power supplies

The ROHM SCT4013DLLTRDC is a silicon carbide (SiC) N-channel MOSFET which enables very fast switching, helping to reduce the size and weight of magnetic components in high-voltage power supplies.



ROHM SEMICONDUCTOR

FEATURES

- Low gate charge
- Low input capacitance
- Easy paralleling for higher currents
- 175°C maximum junction temperature

APPLICATIONS

- Solar inverters
- Wind energy generation equipment
- Energy storage systems
- EV charging stations
- Onboard chargers
- Industrial motor drives
- High-voltage power supplies
- Data centers and servers

The SCT4013DLLTRDC 750V MOSFET from ROHM benefits from the properties of the SiC material to offer very fast switching and ultra-short diode recovery, enabling power-system designers to reduce switching loss in addition to system size and weight.

Gate charge is 170nC at 500V, with rise/fall times measured in tens of nanoseconds. These figures mean that the SCT4013DLLTRDC can switch rapidly in dc-dc converters and motor drives.

This fourth-generation MOSFET provides very high current in a compact package, maximum continuous drain current is 120A. On-resistance of 13mΩ at 25°C produces minimal conduction loss. The high-voltage, high-current capability of the SCT4013DLLTRDC makes it ideal for power-dense applications in which efficiency is highly important.

Housed in a TO-263-7L package, the SCT4013DLLTRDC features a 26% smaller footprint than a conventional TO-263 while enabling excellent heat dissipation. The superior thermal performance is valuable in applications such as solar inverters, server power supplies and electric vehicle chargers.

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SAMPLES

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Power and signal connectors support latest robotics designs

TE Connectivity (TE) provides a broad product portfolio of connectors to cover the power and signal connectivity needs of manufacturers of robotics technology and industrial automation equipment.

TE connectivity
AUTHORIZED DISTRIBUTOR

FEATURES

- Voltage ratings up to 630V
- Current ratings up to 65A
- Up to 500 mating cycles
- Tooling available for semi-automated termination

APPLICATIONS

- Robotics
- Industrial automation and control
- Human-machine interfaces
- Motor drives
- Robotics
- Servo drives
- Elevators and escalators
- Power distribution units
- Variable-frequency drives

New trends in industrial production are driven by higher levels of automation, and the need for improved safety and greater energy efficiency. TE helps customers to develop solutions for new production processes by designing and manufacturing products and solutions which connect devices and support the flow of power, data and signals.

These products include the Dynamic Series connectors, which is a broad family providing connector solutions ranging from signal-level circuitry to power-circuit connectivity in rugged, industrialized packages. The connector family is designed for use in control systems, and is suitable for high-density signal and power applications.

The Dynamic Series consists of wire-to-board, wire-to-panel and wire-to-wire connectors with diverse housings suitable for most applications. Standard crimp and spring-clamp variations of the connectors are available. The standard contacts limit the amount of application tooling required.

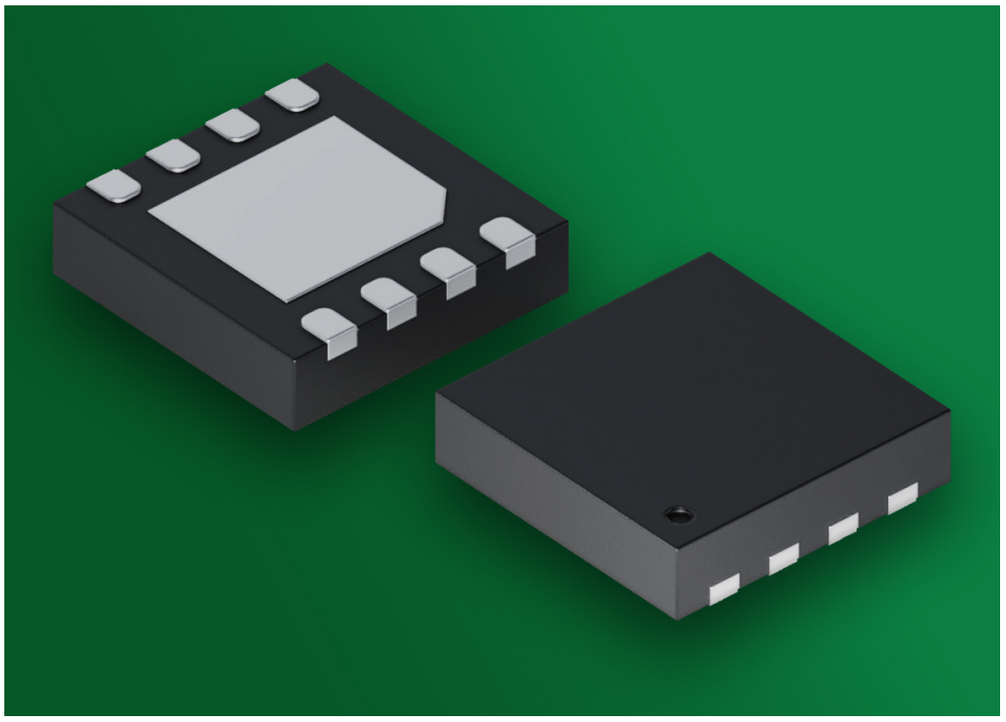
These TE connectors provide the quality and performance required in demanding industrial applications. High-quality characteristics of the Dynamic Series connectors include:

- High-performance contacts, including three points of contact to help ensure the constant flow of electricity
- Robust housing structure, offering high tolerance to vibration and strong contact retention
- Secure and fast installation, including keying to reduce the chances of mis-mating or misalignment

Watch now: Dynamic Series video

Load-powered relay enables battery less designs

The Littelfuse CPC1601M is an ultra-compact solid-state relay which operates without the need for a dedicated power supply, simplifying the design of systems requiring a reliable isolated power switch.



The CPC1601M, a 1FormA solid-state latching relay, supports load-powered operation, enabling it to harvest operating power from the open-circuit load itself and draw zero current from the system supply. This means the CPC1601M can switch ac or dc loads without needing a dedicated power supply.

The relay's latching design requires only momentary pulses on its Set, Reset or Toggle inputs to change state, consuming no coil-hold current. A zero-current switching feature ensures the relay opens at or near zero load current when in load-powered mode, minimizing inductive kickback and electrical noise.

Featuring low on-resistance, the CPC1601M handles loads with minimal conduction loss. As a solid-state device, it has no moving parts and operates silently and reliably, unlike electromechanical relays.

These capabilities make the CPC1601M ideal for battery-powered or retrofit control systems. In smart thermostats and two-wire heating, ventilation and air conditioning installations, it removes the need for a common power wire, simplifying upgrades in older buildings. Its silent operation and long electrical life lend themselves to use in security panels and fire alarm systems, in which maintenance-free and noise-free switching is crucial.

Littelfuse

FEATURES

- 60V maximum load voltage
- 2A ac/dc maximum continuous load current
- 308mΩ on-resistance
- Supply-voltage range: 3.0V to 5.5V
- <1µA quiescent current

APPLICATIONS

- Smart thermostats
- HVAC systems
- Fire alarm panels
- Security control panels and intruder alarms
- Building automation equipment
- Lighting controls
- Meters
- IoT sensors

FREE DEV BOARD

Evaluation board for load-power solid-state relay.

Orderable Part Number
LEB-0024

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New motor-control MCUs combine real-time control and industrial networking capabilities

The Renesas RA8T2 series of MCUs combines high-speed control processing, integrated networking and a rich motor-control feature set to power the next generation of robotics and industrial equipment.

RENESAS

FEATURES

- Variants support operating temperatures up to 125°C
- 2Mbytes of SRAM with ECC
- Up to 8Mbytes of embedded Flash
- USB 2.0 full-speed interface
- Four high-speed analog comparators

APPLICATIONS

- Industrial motor drives
- Ac drives
- Servo inverters
- Robotics
- CNC machines

Renesas has introduced the RA8T2 series of 32-bit microcontrollers based on a high-performance 1GHz Arm® Cortex®-M85 processor for real-time control of motors in robotics, industrial and other systems. The Cortex-M85 core with Arm Helium™ vector extension provides a significant performance boost for digital signal processing and machine learning applications, enabling the implementation of AI on small industrial systems

The RA8T2 is available in single- and dual-core versions. The dual-core variant embeds an additional 250MHz Cortex-M33 core for supervisory, diagnostic, and communication functions without interfering with real-time processing.

In addition to strong processing power, the MCU includes multiple 32-bit general PWM timers with high-resolution channels: 52ps step size at 300MHz, suited for fine phase control in inverters and power supplies. Dual 16-bit ADCs with multiple sample-and-hold circuits, DACs, high-speed comparators and delta-sigma modulator interfaces support the accurate sensing of currents, voltages and positions in systems ranging from ac drives and servos to grid converters and test equipment.

The RA8T2 includes a Layer 3 Ethernet switch with Gigabit ports, and supports EtherCAT slave operation so that the MCU can be synchronized with other machines in an industrial network without needing a separate communication processor. Additional interfaces including CAN FD, I3C, OSPI and SDHI enable links to external controllers, sensors and memory for data-logging and configuration.

Up to 1Mbyte of MRAM is available on the RA8T2 series, offering faster write speeds and better retention than Flash memory. Each core also includes tightly coupled memory to allow real-time code to run from low-latency memory while other tasks use cached or external regions. Authenticated firmware, key storage and event logging are backed by integrated security features such as Renesas Security IP, a TrustZone® execution environment, secure debug, tamper protection and more.

Renesas provides development software to accelerate application development. The Renesas Flexible Software Package (FSP) provides all required infrastructure software as well as reference software for developing AI, motor control and cloud applications. The FSP provides full flexibility, allowing customers to integrate their own legacy code with a choice of RTOS.

FREE DEV BOARD

Flexible motor-control evaluation kit for RA8T2 microcontrollers.

Orderable Part Number
MCK-RA8T2

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32-bit MCU provides high-performance control for BLDC and other motor types

The STMicroelectronics STM32G4 series of microcontrollers features a 32-bit RISC core which runs the DSP and floating point unit instructions for motor-control and digital power applications, backed by a rich set of software and development resources.

The STM32G4 series of 32-bit microcontrollers from STMicroelectronics, based on the high-performance Arm® Cortex®-M4 32-bit RISC core, provides the peripherals, processing capabilities and memory resources required for high-performance motor-control and digital power applications.

The high level of integration and advanced motor-control capabilities of the STM32G4 make it ideal for controlling the motion of robots and autonomous industrial automation equipment. The high-resolution timer is valuable in applications such as digital switch-mode power supplies, welding equipment, solar inverters, and wireless charging.

Operating at a frequency of up to 170MHz, these MCUs include 16-bit PWM timers dedicated to motor control. The MCUs are suitable for the control of three-phase, low-voltage and low-current brushless dc (BLDC) or permanent magnet motors. Developers using the STM32G4 MCUs can draw on the resources available at the online STM32 ecosystem for motor control, which includes development boards, the X-CUBE-MCSDK software development kit, and embedded software, as well as training resources and documentation.

The STM32G4 processor core implements a full set of digital signal-processing instructions and a memory protection unit. The MCUs also embed several protection mechanisms for embedded Flash memory and SRAM, including:

- Read-out protection
- Write protection
- Secure memory area
- Proprietary code read-out protection

The core also features a floating-point unit which supports all the Arm single-precision data-processing instructions and all the data types.

The STM32G4 MCUs embed up to 512kbytes of high-speed Flash memory, and up to 128kbytes of SRAM. These MCUs also offer an extensive range of enhanced I/Os and peripherals. Analog provision includes up to five fast 12-bit ADCs, up to seven ultra-fast comparators, up to six operational amplifiers, and four internal DAC channels. An option for three external DAC channels is available for a total of seven DAC channels.

The MCUs operate over a temperature range of -40°C to 125°C, and run from a 1.7V to 3.6V power supply. A comprehensive set of power-saving modes allows the design of low-power applications.

Package options are:

- LQFP with 32, 48, 64, 80, 100, or 128 pins
- UFBGA with 64, 100, or 121 pins
- WLCSP with 48, 64, or 81 pins
- UQFN with 32 or 48 pins

FEATURES

- FMAC and CORDIC math accelerators
- ART Accelerator™ hardware module:
  - For zero wait-state execution from Flash memory
- CCM-SRAM routine booster
- Error correction code on Flash memory
- Quad SPI memory interface
- USB 2.0 Full-Speed interface

APPLICATIONS

- Industrial equipment
- Robotics
- Home appliances
- E-bikes
- Air-conditioning units
- Rechargeable devices
- Drones
- Toys
- Servers
- Telecoms equipment
- Electric vehicle charging stations
- Instrumentation and measurement equipment

FREE DEV BOARD

Discovery kit provides speed control for drone motors.

Orderable Part Number
B-G431B-ESC1

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Offline switcher achieves 92% efficiency in classic flyback topology

The Power Integrations TinySwitch-5 family of integrated offline switcher ICs improves conversion efficiency in low- and mid-power flyback converters with an output of up to 175W.

power integrations™

FEATURES

- Integrated soft start
- Adjustable current limit
- Output short-circuit protection
- Thermal shutdown with large hysteresis

APPLICATIONS

- Utility meters
- Industrial power supplies
- Appliance power supplies
- Consumer products

The TinySwitch-5 dynamically adjusts its switching frequency to maintain high efficiency across varying loads, achieving up to 92% efficiency with standard diode rectification and optocoupler feedback across a wide load range.

The fast switching capability of up to 150kHz, enables power-system designers to reduce transformer size. The TinySwitch-5 offline switchers also provide a highly integrated solution for flyback circuits, combining a 725V power MOSFET, control and protection circuitry into a single package.

The TinySwitch-5 flyback controller can operate in continuous conduction mode (CCM) or discontinuous conduction mode (DCM). This control approach reduces switching losses during low-power operation while maintaining sufficient auxiliary output to support display, communication, or control functions.

The IC supports up to 75W operation without a heat-sink due to improved thermal management in its enhanced package structure. No-load power consumption of less than 30mW at 230V ac helps product manufacturers to comply with strict standby power regulations.

Built-in line under- and over-voltage protection stabilizes operation in regions with variable mains conditions, while frequency jittering reduces EMI without the need for external filtering.

The TinySwitch-5 architecture allows designers to meet high efficiency targets without adopting more complex synchronous rectification or resonant converter topologies, retaining the simplicity of a traditional flyback design.

Metal-composite power choke coils withstand 30G vibration in automotive ECUs

The Panasonic Low Profile (LP) series of automotive power choke coils, with a metal composite core, provide high heat, vibration resistance and current stability in a compact surface-mount package for automotive applications.

Panasonic INDUSTRY

FEATURES

- Saturation rated current up to 37.3A
- Harsh environment resistance:
  - Operating temperature guarantee of 170°C
  - Operating voltage guarantee of 80V
- AEC-Q200 qualified
- Shielded construction

APPLICATIONS

- Automotive systems:
  - Noise filter for driver circuit
  - Dc-dc converters

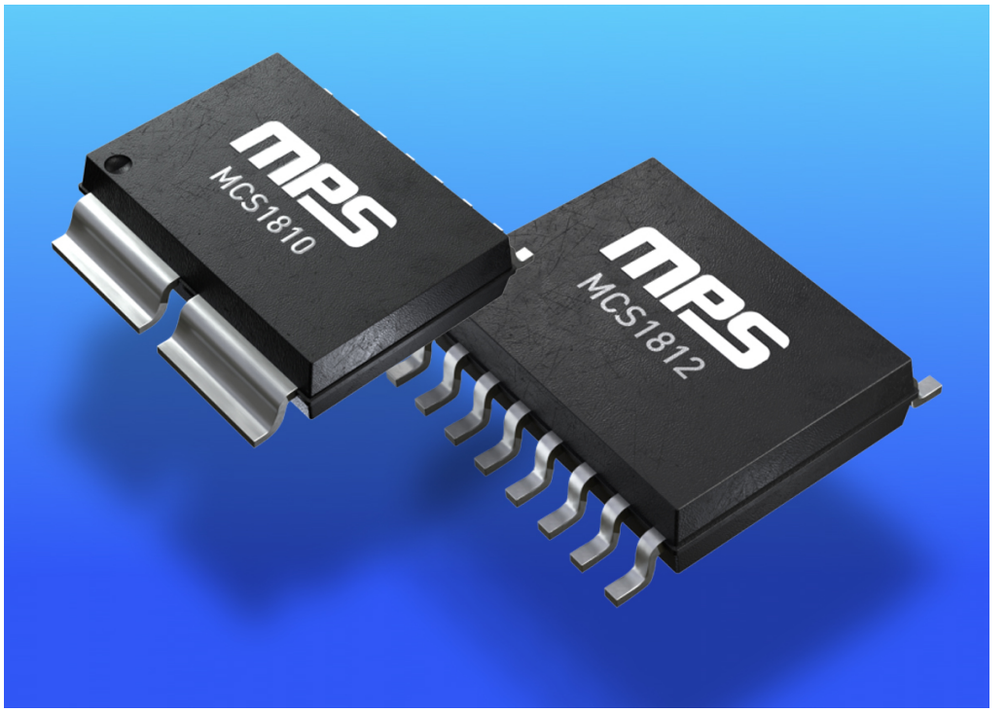
The Panasonic LP series, part of the Panasonic ETQP range of power inductors, employs a metal composite construction which integrates the coil and the core into a single unit with a gapless structure, reducing audible buzz noise and providing a guaranteed vibration resistance of 30g. This eliminates the need for additional anti-vibration reinforcement or adhesives on the PCB. The power inductors are specially designed to be pin-to-pin compatible with products from many other suppliers, making an easy and cost-effective replacement.

The Panasonic LP series features a compact footprint ranging from 5.0mm x 5.5mm to 10.0mm x 10.7mm, along with a low profile. making it suitable for high-density mounting in space-constrained automotive applications such as electric power steering and battery management. An iron-based metal composite material ensures excellent inductance stability over a broad temperature range and when subject to high bias current.

The series offers an inductance range from 0.105µH to 22.0µH. The chokes are suitable for use in high-efficiency power circuits: dc resistance values are as low as 1.52mΩ. The 0.105µH variant offers a current rating of 22.7A.

Isolated magnetic current sensors provide fast response to over-current events

The MCS1810 and MCS1812 from Monolithic Power Systems feature a differential sensing topology which cancels out the effect of interference from stray magnetic fields and maintains high measurement accuracy.



FEATURES

- Supply-voltage options: 3.3V or 5V
- Minimum isolation voltage:
  - 5kVrms MCS1810
  - 5kVrms MCS1812
- Bidirectional or unidirectional range: 10A to 100A
- Measurement bandwidth:
  - 350kHz MCS1810
  - 350kHz MCS1812
- Factory-trimmed for accuracy

APPLICATIONS

- E-bikes and e-scooters
- Air-conditioning units
- Power tools
- Printers
- Automotive systems
- Motor Control

The MCS1810 and MCS1812 from Monolithic Power Systems are linear Hall-effect current sensor ICs for ac or dc current sensing. The differential Hall array of the sensors cancels out only homogenous magnetic field, enabling them to maintain total measurement error at ±2% even in the presence of interference from high-voltage cables and other sources.

The MCS1810 and MCS1812 are intended for use in functions such as load detection and management, and over-current fault protection. The configurable over-current detection circuit responds to events such as short circuits in 1µs.

Galvanic isolation between the pins of the primary conductive path and the sensor leads allows these sensors to replace opto-isolators or other isolation devices. The MCS1810 and MCS1812 require few external components. The MCS1810 is supplied in a SOIC16-10 wide-body package, and the MCS1812 in a SOIC16 wide-body package.

The low resistance of the primary conductor allows large currents to flow close to the IC. This current generates a magnetic field, which is sensed at two different points by the integrated Hall transducers. The magnetic field difference between these two points is then converted to a voltage that is proportional to the applied current. A spinning current technique is used for a low, stable offset.

Watch now: Current sensors for high-isolation applications

SAMPLES

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Modular system combines different media in a single connector

The Han-Modular® family from HARTING consists of a range of connector components which can be combined in configurations which meet the connection needs of almost any application.

HARTING®

FEATURES

- Approvals:
  - DIN EN 61 984/DIN EN 60 664-1
  - UL recognized
  - DNV GL certificate
- Operating-temperature range: -40°C to 125°C
- Minimum 500 mating cycles
- UL94-V0 flammability rating

APPLICATIONS

- Industrial control panels
- Railway systems and rolling stock
- Robotics
- Factory automation equipment
- Industrial equipment enclosures
- Energy systems

The HARTING Han-Modular series of connectors, which allows the mounting of different transmission media in a single connector, enables manufacturers of heavy-duty equipment to reduce the cost and time involved in production and installation. By replacing multiple connectors with a single connector, the Han-Modular connectors also provide manufacturers with space and cost savings.

The multi-faceted Han-Modular system of inserts, contacts, frames, hoods and housings, supported by various accessories, enables designers to match the connector configuration to the precise needs of each application. HARTING provides an online tool for quick and easy configuration of Han-Modular connector systems.

Engineers can choose between more than 100 different modules. These are suitable for various transmission media, and cover a range of termination techniques. The patented Han-Modular hinged frame enables the configuration of all modules to fit the popular Han® hoods and housings.

Capacitive rotary encoders cut power consumption in motor-control systems

The AMT series of modular rotary encoders from Same Sky uses capacitive sensing technology to produce high positional accuracy and lower power consumption than optical or magnetic alternatives.

same sky

FEATURES

- Submersible in non-conductive fluids
- Programmable incremental resolution range:
  48 pulses per revolution (PPR) to 5,120PPR
- Absolute resolution: 12-bit or 14-bit
- Input-voltage range: 3.6V to 5.5V
- Maximum measurement speed: 15,000rpm

APPLICATIONS

- Autonomous mobile robots
- Aerial drones and UAVs
- Industrial automation equipment
- Medical robots
- Agricultural robots
- Self-driving vehicles and drones

The AMT series from Same Sky, formerly known as CUI Devices, are modular rotary encoders which offer low power consumption in motor-control applications which require accurate position sensing.

The AMT encoders are based on a capacitive sensing technology which eliminates the need for the LED light source in traditional optical encoders. This helps to reduce power usage: active current is as low as 6mA at 5V for the AMT10 and the AMT10E series. In a four-motor system, the total power consumption for the position sensing function is just 0.12W when using AMT encoders, compared to 1.7W for a typical optical encoder, and 3.2W for a magnetic encoder.

The AMT sensors consist of a fixed body and a moving element which form a variable capacitor. As the encoder rotates, an ASIC converts the changes in capacitance to position data to an accuracy of 0.2 mechanical degrees.

Unlike optical encoders, the capacitive design is resistant to interference from dust, dirt, grease and ambient light. The AMT series encoders operate reliably in the presence of strong magnetic fields which can disrupt magnetic encoders, making the AMT series more robust, and suitable for deployment in harsh environmental conditions.

The series includes variants which provide incremental, absolute, or commutation position outputs. Sleeve sizes range from 1mm to 15.875mm.

The AMT21, AMT22, and AMT24 models support an absolute position output providing the shaft position immediately at power-on, eliminating the need for a homing sequence.

FUTURE ELECTRONICS
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FTM
NPIs, DESIGN AND TECHNOLOGY NEWS

Button-sized location-aware NB-IoT modules support new age of asset trackers

The STMicroelectronics ST87M01-1001 and ST87M01-1301 modules integrate low-power NB-IoT connectivity with optional positioning functions to support long-life asset-tracking devices in space-constrained industrial products.

FEATURES

- Embedded SIM option
- Data rates:
  - Up to 127kbits/s down-link speed
  - Up to 159kbits/s up-link speed

APPLICATIONS

- Asset-tracking tags
- Logistics and tool tracking
- Smart-city sensing nodes
- Distributed industrial monitoring equipment
- Utility meters
- Condition monitoring
- Factory automation

The ST87M01 series are LTE Cat NB2 modules which draw less than 1.2µA in power-saving states. Both power-saving modes and extended discontinuous reception reduce network-related activity, allowing devices to remain dormant for long intervals while retaining connectivity.

With the addition of positioning capability, these modules can form the basis of asset-tracking tags and sensor nodes which operate for more than 15 years on a small primary battery.

Positioning support varies across the ST87M01 family. The ST87M01-1001 provides NB-IoT connectivity with network-based positioning, while the ST87M01-1301 adds integrated GNSS and Wi-Fi® network-based positioning for applications that require absolute location information in indoor and outdoor environments.

Both variants include a +23 dBm transmitter, embedded protocol stacks, and multiple interfaces for integration into industrial sensors or trackers.

The modules include a wake-up interface for interrupt-driven operation, enabling duty-cycled designs which minimize average energy consumption. The mechanical format and industrial temperature range support deployment in compact tracking tags, environmental sensors, and distributed industrial equipment.

The ST87M01 modules integrate advanced security features and are certified according to GCF and RED, including the RED Delegated Act for network-connected equipment. This supports compliance with emerging European cybersecurity requirements for connected asset-tracking devices.

The modules are housed in a 51-pin 10.6mm x 12.8mm LGA package.

FREE DEV BOARD

Evaluation kit for NB-IoT location-aware module.

Orderable Part Number
EVKITST87M01-2

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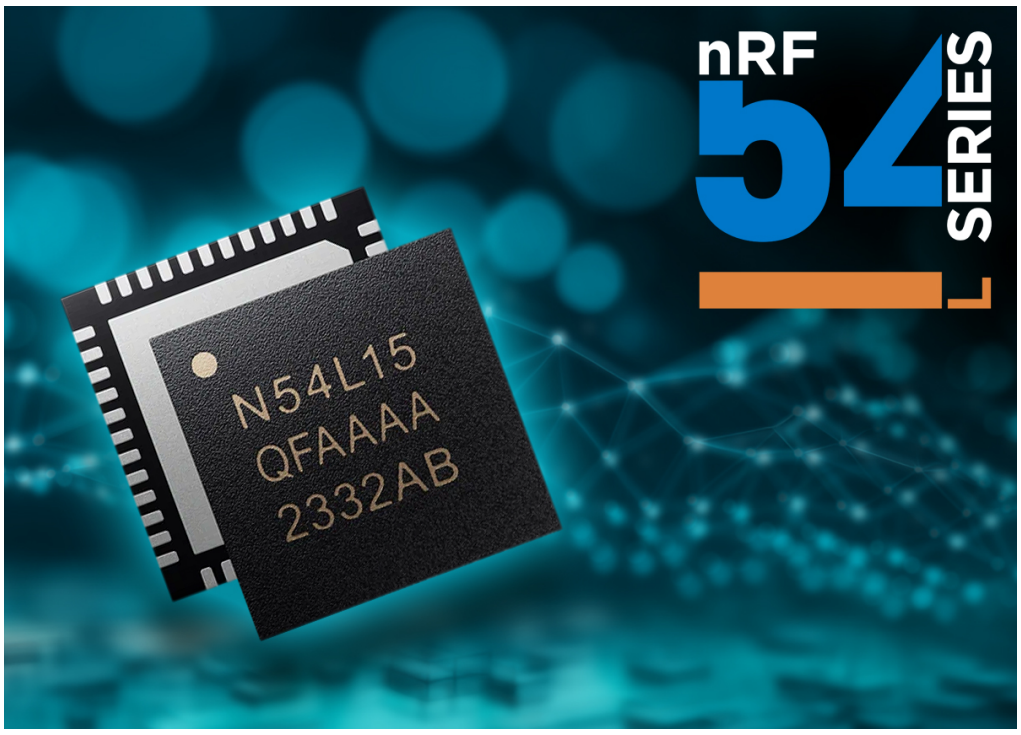
New wireless SoCs increase performance while reducing power usage

The new nRF54L Series of 2.4GHz systems-on-chip (SoCs) from Nordic Semiconductor is an upgrade on the previous nRF52 Series and offers advanced Bluetooth® connectivity, increased processing power and efficiency, and high security capabilities.



The Nordic Semiconductor nRF54L Series of wireless SoCs offers a substantial boost in processing capability and power efficiency, providing for longer run-time and higher performance in battery-operated IoT devices.

Based on a 128MHz Arm Cortex -M33 core, the nRF54L Series offers around twice the processing power of the earlier nRF52 with up to 50% lower power consumption. The new nRF54L 2.4GHz radio supports Bluetooth Low Energy protocol advanced features including Bluetooth Channel Sounding and Bluetooth Mesh. The SoCs also implement Thread, Zigbee, and Matter connectivity for use in smart home networks.

The entry-level nRF54L05 is optimized for applications such as simple sensors, beacons and asset trackers. The mid-range nRF54L10 and nRF54L15 add more memory to accommodate wearables, medical devices and industrial sensors. At the high end, the nRF54LM20A includes high-speed USB connectivity and the largest memory, providing headroom for complex applications such as Matter hubs or USB-connected peripherals.

All four SoCs share the 128MHz Cortex-M33 processor and multi-protocol 2.4GHz radio, and come in pin-compatible QFN packages to simplify scaling.

Security and system integration are strong features of all of the nRF54L SoCs. Each SoC includes an Arm TrustZone trusted execution environment, along with secure boot, encrypted firmware updates and secure storage to meet IoT security requirements. A cryptographic accelerator with side-channel protection and tamper detection further safeguards sensitive data and wireless communications.

The nRF54L SoCs also include a 128MHz RISC-V co-processor for offloading time-critical I/O tasks, enabling the system to implement software-defined peripherals and DSP functions without overloading the main CPU.

	nRF54L05	nRF54L10	nRF54L15	nRF54LM20A
Non-volatile Memory	0.5Mbytes	1.0Mbyte	1.5Mbytes	2.0Mbytes
RAM	96kbytes	192kbytes	256kbytes	512kbytes
Maximum Transmit Power	+7dBm	+7dBm	+8dBm	+8dBm
Matter and Sidewalk Support	No	Yes	Yes	Yes
Wi-Fi Companion Support	No	No	Yes	Yes
High-speed USB	No	No	No	Yes
Operating-temperature Range	-40°C to 105°C	-40°C to 105°C	-40°C to 105°C	-40°C to 85°C

NORDIC SEMICONDUCTOR

FEATURES

- Up to -96dBm Receive sensitivity
- Arm TrustZone isolation for secure boot and trusted execution
- Supports secure device firmware updates
- Up to 14-bit ADC
- Multiple high-speed SPI, UART, I2S, TDM interfaces
- PDM microphone input
- PWM and quadrature decoder
- NFC-A tag interface
- Global real-time clock capable of running in System OFF mode

APPLICATIONS

- Wearable electronics:
  - Fitness trackers
  - Smart watches
  - AR/VR controllers
  - Hearable devices
- Medical devices:
  - Wireless patient monitors
  - Patches
  - Glucose monitors
  - Smart drug delivery systems
- Asset tracking:
  - Bluetooth, Matter tags
  - Smart shipping containers
  - Location beacons
- Industrial sensors
- Smart meters
- Building control systems

FREE DEV BOARD

Development board for power-saving 2.4GHz wireless SoC.

Orderable Part Number
nRF54L15 DK

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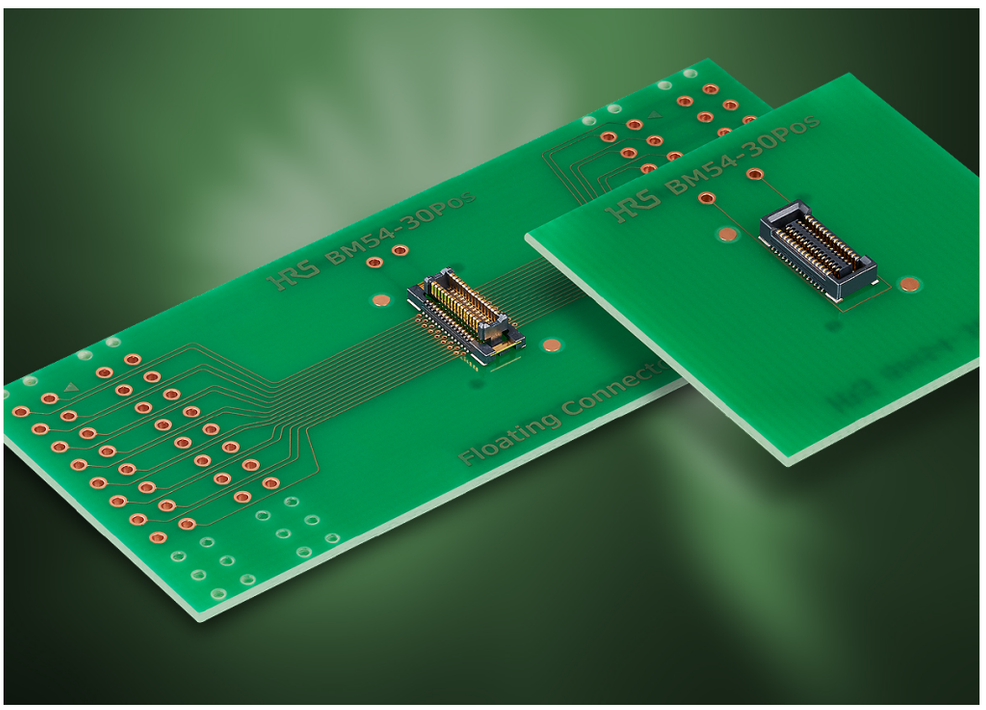
Connectors with floating structure save space in automotive circuits

The Hirose BM54 series of board-to-board connectors provides a reliable new way to create high-speed links in the smallest connector width, for automotive, consumer and industrial applications.



HIROSE ELECTRIC EUROPE B.V.

FEATURES

- 0.4mm pitch
- Minimum 10 mating cycles
- 0.3A rated current
- 50V ac/dc rated voltage

APPLICATIONS

- Automotive systems:
  - Camera modules
  - LiDAR sensors
  - Radar modules
  - Head-up displays
  - Infotainment/navigation
  - Digital instrument clusters
- Smart consumer devices
- AR/VR equipment
- Industrial sensors
- Smart meters

The Hirose BM54 series of floating board-to-board connectors provides high-speed, robust connections in a miniature form factor. The 3.8mm width of the connectors is the smallest of any connector with a floating capability as wide as ±0.4mm in the x/y plane.

The floating structure on the plug side absorbs assembly tolerances, allowing boards to mate securely. This structure, combined with a dual-point contact design, ensures stable two-point connections which resist shock and vibration.

Rated for operation over a temperature range of -55°C to 125°C, the BM54 series meets demanding automotive requirements. It also supports high-speed interfaces including PCIe Gen4 up to 16Gbits/s, and MIPI up to 4.5Gbits/s.

Stacking Height	X/Y Float Range	Z Float Range	Pin-count Options
3.0mm	±0.4mm	±0.3mm	20, 30, 40
3.5mm	±0.4mm	±0.4mm	10, 20, 30, 40, 50
4.0mm	±0.4mm	±0.4mm	10, 20, 30, 40, 50
4.5mm	±0.4mm	±0.4mm	10, 20, 30, 40, 50

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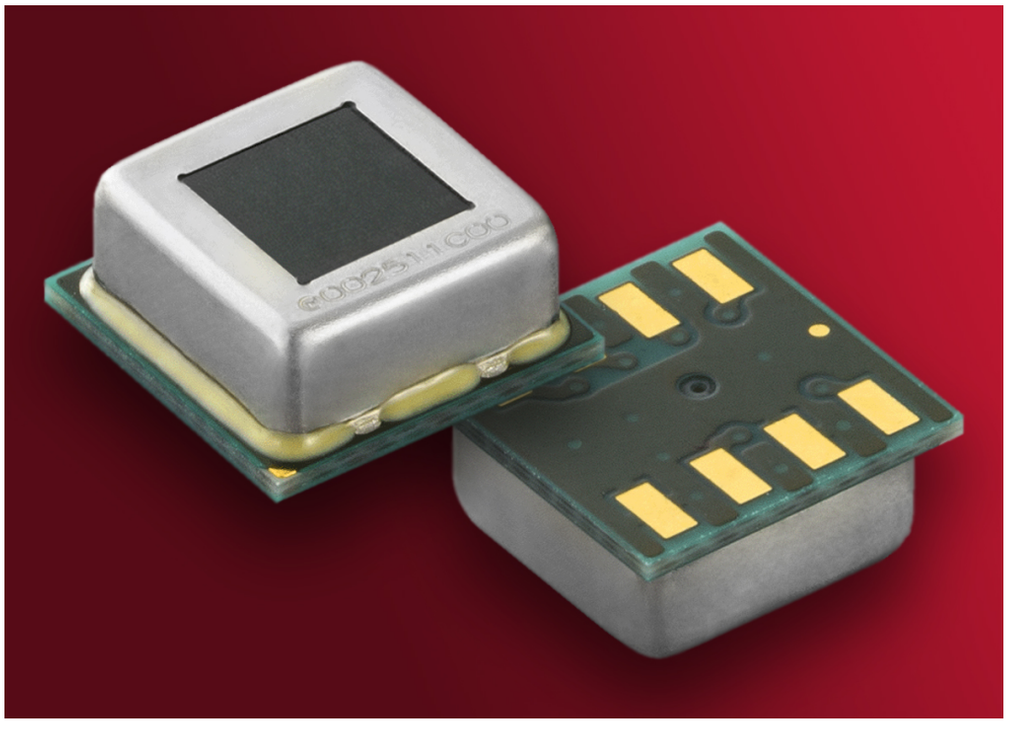
Reflowable PIR sensor minimizes false triggers with integrated signal processing

The Murata IRS-D200ST00R1 is a surface-mount digital pyroelectric infrared (PIR) sensor module which integrates amplification and signal processing functions, providing reliable human presence detection in small IoT and security devices.



muRata
INNOVATOR IN ELECTRONICS

FEATURES

- Field of view:
  - X axis: ±55°
  - Y axis: ±42°
- Supply-voltage range: 1.8V to 3.3V
- Operating-temperature range: -25°C to 85°C
- Sensitivity: 19.5mV0p

APPLICATIONS

- IP cameras
- Doorbells
- Thermostats
- Smart lighting
- Wireless IoT devices

The highly integrated IRS-D200ST00R1 PIR sensor from Murata enables developers to save power and space in battery-powered devices such as smart doorbells.

Unlike traditional analogue PIR sensors which require external operational amplifiers and passive components, the IRS-D200ST00R1 integrates the pyroelectric element, a pre-amplifier, an ADC, and a DSP into a single lens-less ceramic package measuring 6.0mm x 6.0mm x 2.6mm. This greatly reduces board footprint and simplifies the circuit design.

Drawing operating current of 8µA, the IRS-D200ST00R1 provides for long battery run-times in wireless applications. An I2C interface enables the host system to configure sensitivity settings and thresholds. Designers can use an interrupt function to enable a host microcontroller to remain in a low-power sleep mode until motion is detected, helping to minimize overall power usage.

Internal signal processing logic allows the designer to configure variable filter characteristics, which helps to distinguish valid motion signals from environmental noise. The IRS-D200ST00R1 offers high immunity to RF interference, lowering the likelihood of false triggers in connected smart home and security environments.

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Multi-voltage crystal oscillators streamline inventory across product portfolios

The ECS-2520SMV oscillators from ECS Inc. are compatible with battery power supplies and with fixed input voltages between 1.8V and 3.3V. The oscillators offer high timing stability and precision.

ECS INC INTERNATIONAL

FEATURES

- HCMOS output
- Operating-temperature range: -40°C to 85°C or -40°C to 105°C

APPLICATIONS

- IoT devices
- Storage devices
- Navigation equipment
- Medical equipment
- Mobile devices
- Industrial equipment
- Wireless devices
- IP cameras
- Microprocessor timing circuits

The ECS-2520SMV fixed-frequency crystal oscillators offer tight frequency stability of ±5ppm or ±10ppm. Part of the MultiVolt™ family from ECS Inc., these crystal oscillators enable OEMs to use the same timing oscillator across multiple product designs.

MultiVolt oscillators operate over a variable battery supply-voltage range of 1.6V to 3.6V, and on a static power supply compatible with power rails at 1.8V, 2.5V, 3.0V, or 3.3V. This means that the MultiVolt ECS-2520SMV series enables manufacturers to use the same oscillator for many designs, reducing qualification requirements and streamlining inventory holdings.

Housed in a surface-mount package measuring just 2.5mm x 2.0mm x 1.2mm, the ECS-2520SMV oscillators are ideal for space-constrained applications in the IoT and consumer device markets. The oscillators are available in a range of fixed frequency options from 10MHz to 40MHz.

MultiVolt oscillators offer precision performance, producing maximum phase jitter of just 1ps.

Controller with integrated MCU simplifies design of brushless dc motors

The STSPIN32G0A1TR from STMicroelectronics integrates an STM32G0 microcontroller, three-phase gate driver, and motor-control peripherals into a single system-in-package (SiP), reducing external component count in compact electric drives.

The STSPIN32G0A1TR controller combines a 64MHz Arm® Cortex®-M0+ MCU with a three-phase 48V gate driver, enabling both control computation and power-stage management in a single package. This reduces the number of discrete components required in the design of a brushless dc (BLDC) or permanent magnet synchronous motor (PMSM).

The gate driver includes integrated bootstrap diodes to remove the need for external charge-pump components. Sink and source currents up to 600mA support a wide range of MOSFET choices, and internal interlocking prevents shoot-through during switching transitions.

Integrated protection functions, including over-current detection, cross-conduction prevention, and gate-driver under-voltage monitoring, support safe operation without additional external components. The internal 3.3V buck converter and 12V LDO supply the MCU core and gate driver, reducing external regulation requirements.

The STSPIN32G0A1TR is supplied in a 48-pin VFQFPN package measuring 7mm x 7mm x 1mm.

FEATURES

- 8kbytes of SRAM with hardware parity check
- 64kbytes of Flash memory with protection and securable area
- Dedicated timer for motor control
- Three rail-to-rail operational amplifiers
- Comparator for over-current protection
- 23 fast GPIOs
- 11-channel, 12-bit ADC
- I2C, USART, SPI and SWD interfaces
- Supply-voltage range: 6.7V to 45V

APPLICATIONS

- Cordless power tools
- Portable vacuum cleaners
- Pumps and fans
- E-bikes
- Lawn mowers
- Industrial automation equipment

FREE DEV BOARD

Evaluation board for integrated BLDC controller and driver.

Orderable Part Number
EVLSPIN32G0A1

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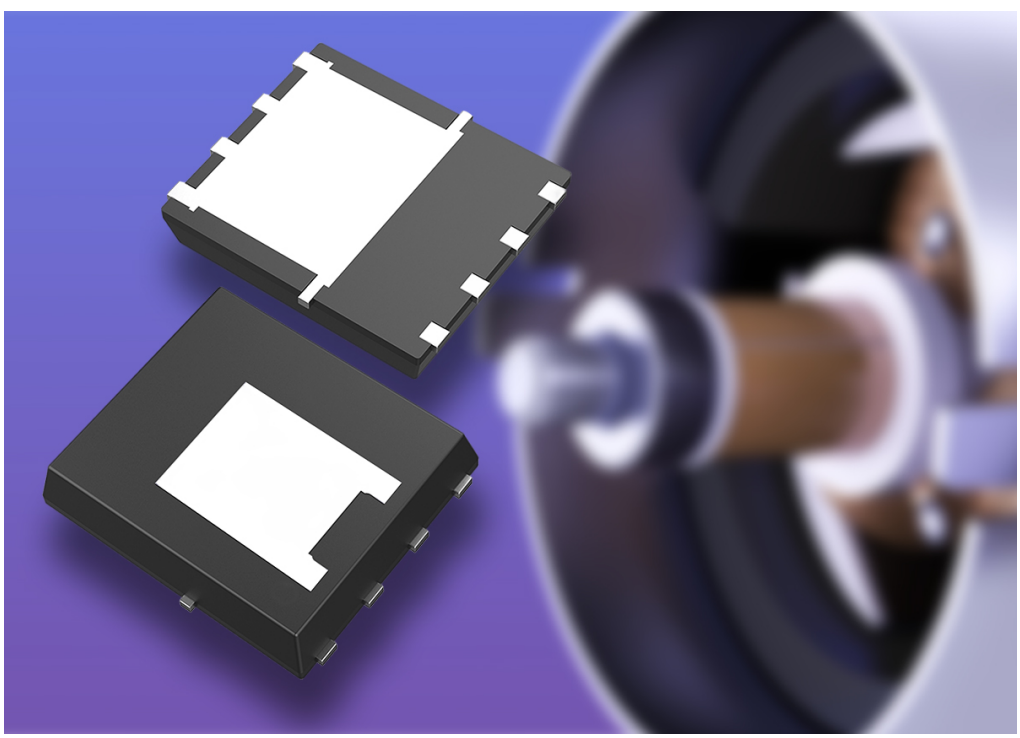
80V MOSFET provides stronger performance and efficiency in hot conditions

The NTMFSC2D6N08X from onsemi is an 80V MOSFET which features low gate charge and on-resistance in an improved thermal package, enabling developers to realize compact and efficient designs for power-supply circuits.



onsemi

FEATURES

- 175°C maximum operating temperature
- 14pF reverse transfer capacitance
- ±100nA maximum gate-source leakage

APPLICATIONS

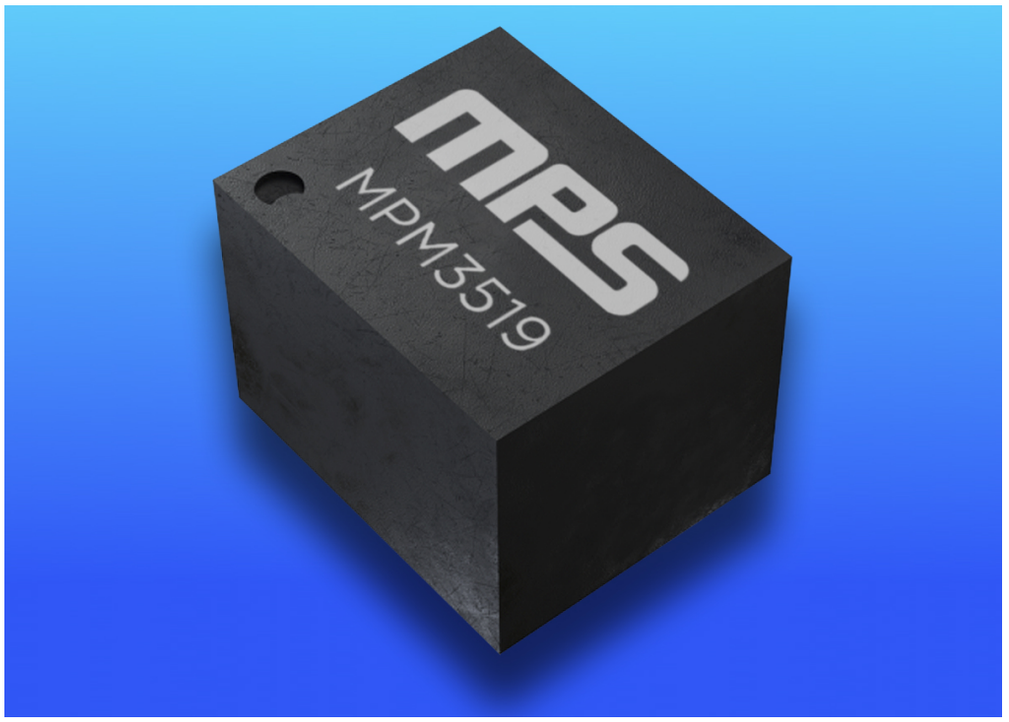
- Cloud server power supplies
- Telecoms power supplies
- Dc-dc converters
- Motor drives

The NTMFSC2D6N08X, part of the onsemi PowerTrench® T10 line of mid-voltage power MOSFETs, offers several benefits including low maximum on-resistance of 2.6mΩ and total gate charge of 45nC at 10V, reducing parasitic inductance and switching losses in fast-switching power circuits.

Housed in a dual-sided cooling package, the NTMFSC2D6N08X features junction-to-case thermal resistance of 1.7°C/W and 1.12°C/W at the top and bottom respectively to support the design of systems with tighter power budgets and thermal margins. The MOSFET uses a soft-recovery body diode to achieve a low reverse-recovery charge of 163nC, making it suitable for synchronous rectification.

36V/10A step-down power module offers fast transient response

The Monolithic Power Systems MPM3519 step-down power module provides a complete ready-made solution for converting an input of up to 36V to an adjustable output ranging between 0.6V and 12V.



Monolithic Power Systems has unveiled the MPM3519, a 36V input, 10A output synchronous step-down power module in a compact 7mm x 7mm 4.4mm LGA package.

This buck module uses zero-delay PWM control for fast transient response, reducing the need for large output capacitors. The wide input-voltage range of 3.3V to 36V makes this module suitable for use with a wide range of power sources, including battery power supplies and 12V or 24V power rails.

The MPM3519 features programmable switching frequency over a range from 200kHz to 2.5MHz, with the ability to synchronize to an external clock. At light loads, the module can enter advanced asynchronous modulation mode, automatically reducing the switching frequency to boost efficiency. A symmetrical input-voltage pinout and optional frequency spread-spectrum modulation help to suppress EMI emissions.

The module integrates protection and flexibility features. An open-drain power-good indicator signals when output is within 94% to 106% of its set voltage. Frequency foldback during start-up prevents inductor current run-away. Thermal shutdown protection ensures reliability under fault conditions.

Up to eight MPM3519 units can operate in parallel in multi-phase, high-current designs.

MPS

FEATURES

- Low-dropout mode with soft recovery
- ±1% output accuracy
- Internal soft-start and output discharge
- 25ns minimum on-time pulse
- 1.8µA shutdown current
- 3.5µA standby current

APPLICATIONS

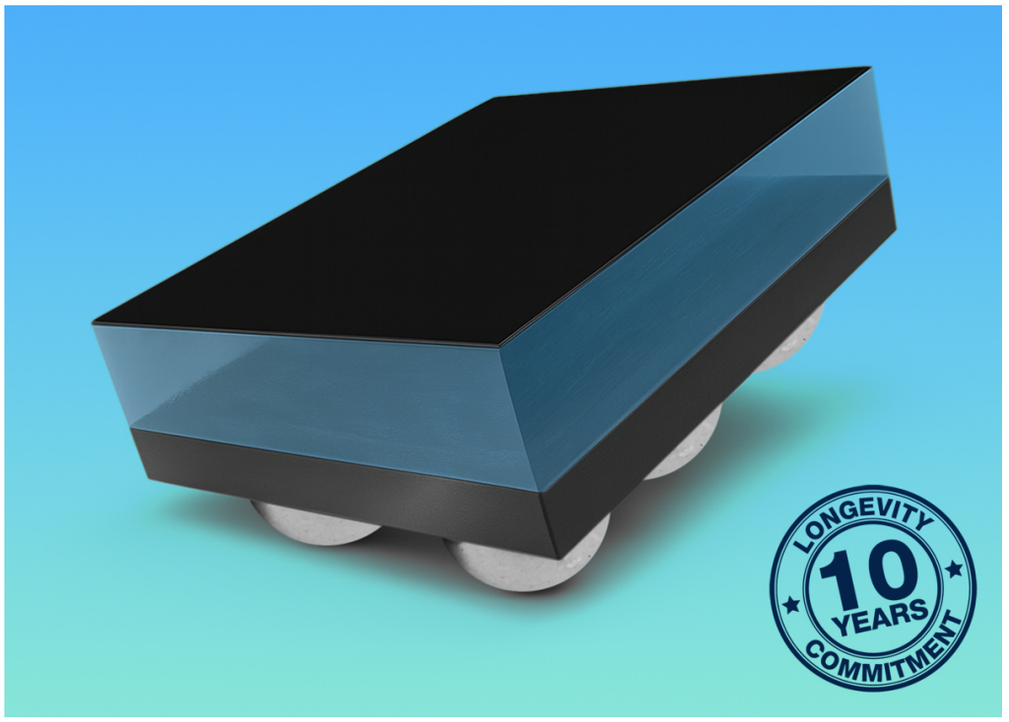
- Optical transport network equipment
- 5G small-cell base stations
- Network-attached storage
- Telecoms line cards
- Industrial robotics
- Industrial automation equipment
- 3D printers
- E-scooters and e-bikes
- Smart appliances
- High-end consumer electronics

SAMPLES

ENERGY INDUSTRIAL LIGHTING MEDICAL TRANSPORT SECURITY CONSUMER TELECOMS

Integrated matching network ICs optimize RF performance of STM32WL3 wireless modules

The MLPF-WL-0xD3 ICs from STMicroelectronics integrate an impedance matching network and filter, providing a ready-made RF circuit optimized for wireless microcontroller modules operating at sub-1GHz frequencies.



FEATURES

- 50Ω nominal impedance on antenna side
- Low insertion loss
- 630µm height after reflow

APPLICATIONS

- IoT devices
- Smart meters
- Heat cost allocators
- Smart city equipment
- Alarm systems
- Asset trackers
- Personal health monitors
- Fitness bands and activity trackers
- Industrial equipment

The MLPF-WL-0xD3 ICs provide a ready-made impedance matching network and filter which optimize the RF performance of STMicroelectronics STM32WL3 sub-GHz wireless microcontroller modules. The MLPF-WL-0xD3 chips are tuned to optimize RF performance at either the 826 to 958MHz or the 413 to 479MHz frequency bands.

Different versions of these matching network/filter chips are configured to work alongside the STM32WL3 module operating in either high-power output mode, up to 20dBm, or low-power mode down to 10dBm. The filter provides deep rejection of harmonics.

Use of these highly integrated chips simplifies the design of sub-GHz radio circuits and improves performance. The sensitivity of the RF system is reduced to temperature swings, fabrication process variation, and thickness, providing better stability compared to matching network circuits composed of discrete components, or LTCC modules.

Use of these integrated matching network chips enables RF system designers to reduce the size of the board and minimize component count.

The MLPF-WL-0xD3 chips use ST integrated passive device (IPD) technology on a non-conductive glass substrate to provide outstanding RF performance, and are supplied in a compact chip-scale package with a pitch of 0.4mm.

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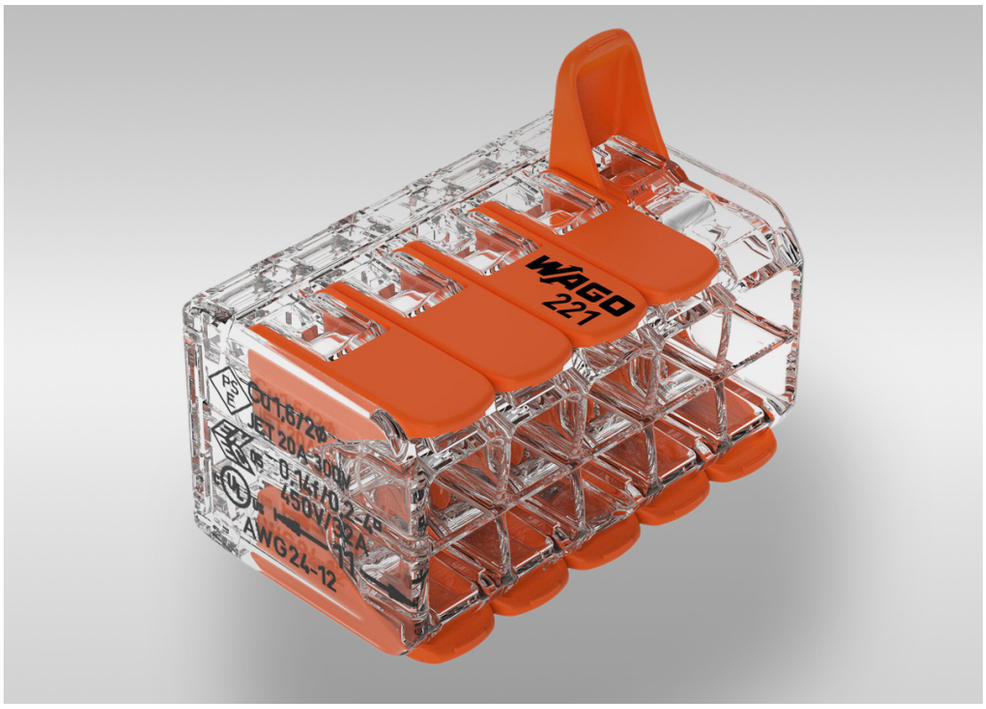
10-wire connector streamlines multi-circuit wiring

The 221-420 ten-conductor lever splicing connector from WAGO delivers secure, tool-free terminations for lighting, junction boxes, heating and ventilation equipment, and low-voltage power distribution.



WAGO

FEATURES

- Accepts solid, stranded and fine-stranded wire
- Rated for operation at ambient temperatures up to 85°C
- Compliant with:
  - ENEC
  - UL 486C
  - IEC 60998 standards

APPLICATIONS

- Lighting systems
- Junction box wiring
- HVAC equipment
- Low-voltage power distribution

The new 221-420 splicing connector is a 10-pole wire connector with lever actuators which simplifies multi-wire electrical connections. The lever clamp design of the connector not only speeds up installation but also provides consistent contact force that resists vibration, important for HVAC equipment and ceiling fixtures in particular.

Part of the 221 Series, this compact connector accommodates all conductor types with wire diameters ranging from 0.2mm² up to 4mm², enabling error- and maintenance-free splicing of up to ten conductors on a common potential. The tool-free lever mechanism uses the proven WAGO CAGE CLAMP® Spring technology for quick and reliable terminations without twisting. A transparent housing supporting side-entry wiring allows installers to visually verify each insertion and fit the connector into tight spaces, such as ceiling boxes and wall cavities.

By combining ten wiring points in one unit, the 221-420 eliminates the need for multiple smaller connectors or bulky screw terminal blocks in junction boxes and distribution nodes. Despite its small size, the 221-420 connector is rated for mains voltage and high currents. It is rated for up to 450V and 32A under IEC standards, and is UL recognized for 600V and 20A use in North America.

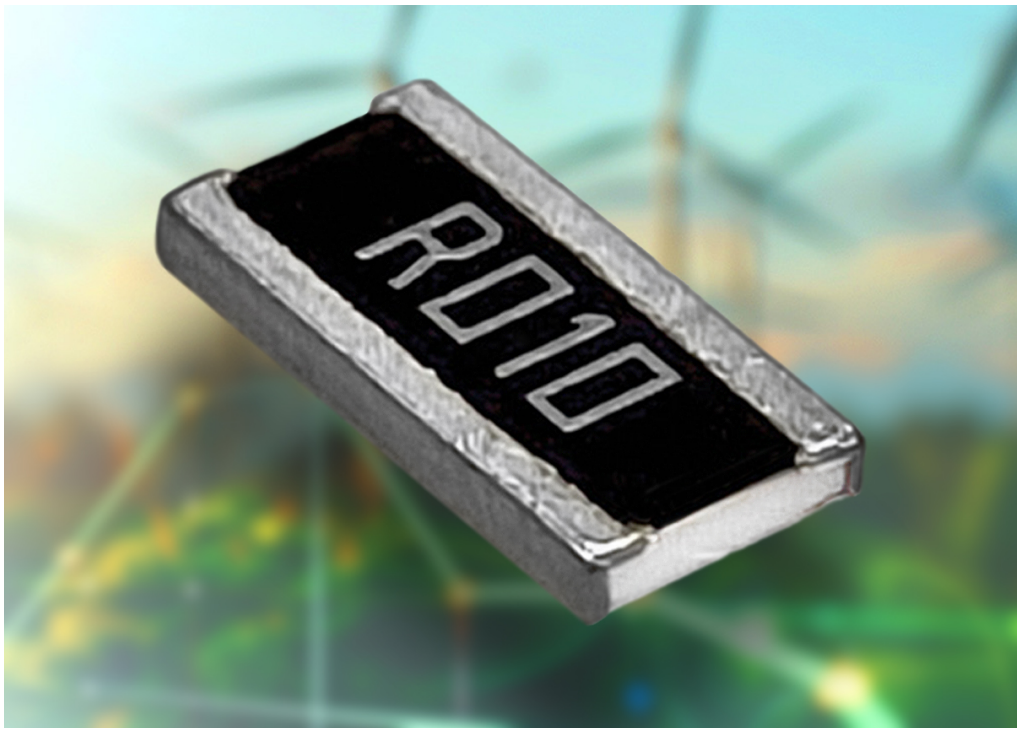
This makes the 221-420 suitable for demanding loads in lighting circuits, HVAC controls and other building systems.

SAMPLES

ENERGY INDUSTRIAL LIGHTING MEDICAL TRANSPORT SECURITY CONSUMER TELECOMS

Current-sense resistors maximize power density in automotive systems

The NCSM series of metal film current-sensing resistors from NIC Components offers high power density and precision in standard and wide-termination chip formats for power monitoring in space-constrained automotive and industrial applications.



NIC COMPONENTS CORP.

FEATURES

- 155°C maximum operating temperature
- Up to 500V ac dielectric withstanding voltage
- ≤5nH inductance
- ≥10GΩ insulation resistance
- AEC-Q200 qualified

APPLICATIONS

- Automotive battery management systems
- Industrial power supplies
- Measurement and instrumentation
- Communication devices
- Consumer electronics devices

The NCSM series from NIC Components uses a metal film construction to provide reliable and stable resistance values in harsh automotive or industrial environments. The metal film structure results in a low inductance of less than 5nH, making the NCSM series suitable for high-frequency switching power supplies and dynamic load systems.

The NCSM resistors replace the legacy NCSW, NCSS, and NCLP series resistors from NIC.

The NCSM series is available in a broad range of package sizes. Standard sizes range from 0201 to 2512, but the NCSM series also includes wide termination, reverse geometry packages in 0508, 0612, 1020, and 1225 sizes. Wide termination construction improves thermal dissipation, allowing the 1225 package, for instance, to offer a high power rating of 3W.

The resistors are available in a range of resistance values from 10mΩ to 10Ω. The series features tight tolerances down to ±0.25% and a low temperature coefficient of resistance down to ±50ppm/°C, ensuring that current measurement accuracy is maintained across temperature variations.