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FUTURE
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Offline converter handles high-voltage AC or DC inputs

The VIPer26K from STMicroelectronics is a high-voltage offline converter which combines both a PWM current-mode control block and a 1050V avalanche-rugged power stage.

Integrating a high-voltage start-up circuit, sense transistor, error amplifier with 3.3V reference, and oscillator with jitter into a single converter chip, the VIPer26K enables the designer to realize a complete high-voltage converter operating from an AC or DC input with a small number of components. Support for jittered switching reduces the cost of EMI filtering and helps achieve compliance with the requirements of EMC standards.

The VIPer26K supports the most common topologies for switch-mode power supplies, including:
• Isolated flyback with optocoupler
• Primary-side regulation
• Non-isolated flyback with resistive feedback
    • Buck
    • Buck-boost

The high 1050V breakdown voltage offered by the VIPer26K's power MOSFET enables the device to handle an extended input-voltage range, and to reduce the size of the drain snubber circuit.

The device features low power consumption and operates in a burst mode when supplying light loads, helping designers to comply with strict energy-saving regulations.

1050V high-voltage converter for robust and reliable power supplies

APPLICATIONS
• Energy metering
• Auxiliary power supplies for industrial systems with a three-phase input
• LED lighting
• Air-conditioning units

FEATURES
• Drain-current limit protection:
    – -500mA for the VIPER265K
    – -700mA for the VIPER267K
• <30mW standby power at 230V AC
• Safe auto-restart after a fault condition
• Hysteretic thermal shut-down protection
• Built-in soft-start

FTM DEVELOPMENT BOARD
Orderable Part Number: STEVAL-VP26K01B
Available at FutureElectronics.com

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New differential clock buffers offer wider design margin in high-speed communications

The new PI6C59xxxxx series of differential clock buffers from Diodes Incorporated helps designers to implement designs for high-performance applications such as data centers and 5G base stations thanks to its support for Ethernet data rates up to 400Gbits/s.

Network communications equipment under development today typically operates at speeds ranging from 25Gbits/s up to 400Gbits/s, a category known as Terabit Ethernet, or TbE.

At these high speeds, it becomes harder for switches and routers to maintain signal integrity in challenging environments.

The PI6C59xxxxx differential clock buffers help designers to solve this problem by providing a wider signal margin while expanding the drive capability of all clock and data signals used in high-speed communications.

The 13 devices in the PI6C59xxxxx series cover a number of speeds and technologies, as well as combinations of input and output configurations. They enable system designers to increase the fan-out of clock sources and improve clock and/or data distribution in communication applications operating at frequencies between 1.5GHz and 6GHz. This covers 25GbE, 40GbE, 56GbE, 100GbE and 400GbE network equipment.

The ultra-low additive jitter of the PI6C59xxxxx devices is around 10fs, giving improved jitter margins which help the system to maintain overall accuracy.

PI6C59xxxxx: Supports up to 400GbE systems

APPLICATIONS
• Data centers
• Mobile network base stations
• Telecoms equipment

FEATURES
• Available in 2-, 4-, 12- and 16-output configurations
• Good thermal conductivity
• Supports high-speed signaling technologies:
    – Current Mode Logic (CML)
    – Low-Voltage Differential Signaling (LVDS)
    – Low-Voltage Positive Emitter Coupled Logic (LVPECL)
    – Stub Series Terminated Logic (SSTL)
    – Low-Voltage CMOS (LVCMOS)

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High-voltage gate drivers give advantage of superior performance and reliability

Strong gate-drive capability and good signal integrity are the basic requirements for high-performance gate drivers. Safety, reliability and robustness are the added requirements for high-voltage and high-power designs. ON Semiconductor's high-voltage gate drivers fulfil the requirements of high-power designs by exceeding expectations in these parameters.

The high-voltage gate driver product line contains three product categories:
• Non-isolated
• Isolated
• High-side and low-side

In all three categories, the ON Semiconductor products provide three main benefits:
• High system efficiency by supplying a high drive current
• High reliability through better signal integrity
• Reduced system cost through integration of multiple functions

Non-isolated gate drivers are for high-voltage applications in which isolation is either not required, or is supplied through external isolation. The non-isolated drivers enable users to take advantage of a high drive current to improve system efficiency without the need for a bigger device, or for migration to a next-generation, more expensive device.

The high drive current eliminates the need for external buffers in most applications. The non-isolated drivers are offered in standard SO16 and SO8 packages. The SO16 versions have all the protection features and feedback signals on the low-voltage side. The SO8 package is available in three versions, each with a protection feature to offer design flexibility for applications that have tight cost or space constraints.

The non-isolated drivers integrate a 5V regulated supply to power a microcontroller or an optocoupler if needed.

Isolated gate drivers integrate ON Semiconductor's proprietary on-chip isolation technology. Drawing on years of semiconductor process expertise, ON Semiconductor has developed a robust isolation technology which uses coreless transformers to integrate on-chip galvanic isolation in the driver itself to reduce system costs and footprint. The combination of on-chip isolation and a high-performance driver produces a robust gate-drive solution.

The first isolated drivers in an SO16 wide-body package with enhanced protection features are available today. The derivatives of the 16-pin isolated driver in SO8 narrow and wide-body packages and dual-channel isolated drivers in multiple packages are in development.

Industrial equipment manufacturers have traditionally used junction-isolated high-side and low-side drivers or half-bridge drivers. Junction isolation has severe drawbacks in half-bridge applications when handling negative voltage transients at the midpoint of the half-bridge.

ON Semiconductor's high-side and low-side gate drivers replace the junction isolation with on-chip galvanic isolation. This solves the problems with junction isolation, enhancing system reliability and reducing costs by eliminating the extra circuit needed for handling negative transients.

Part Number	Description	Package	Production Status
NCD(V)5700	Non-isolated single-channel driver with inverted logic	SOIC-16 narrow body	In production
SNCV5700	Non-isolated single-channel driver with inverted logic	SOIC-16 narrow body	In production
NCD(V)5701A/B/C	Non-isolated single-channel driver with inverted logic	SOIC-8 narrow body	In production
NCD(V)5702	Non-isolated single-channel driver with positive logic, Open Drain Fault	SOIC-16 narrow body	In production
NCD(V)5703A/B/C	Non-isolated single-channel driver with positive logic, Open Drain Fault	SOIC-8 narrow body	In production
NCD57000/01	Isolated 16-pin driver	SOIC-16 wide body	In production
NCV57000/01	Automotive-qualified versions of NCD57000/001	SOIC-16 wide body	In production
NCD57200/01	High- and low-side driver	SOIC-8 narrow body	Samples available now
NCV57200/01	Automotive-qualified version of NCD57200	SOIC-8 narrow body	Production in Q4 2019
NCD57080/90	Isolated 8-pin driver	SOIC-8 narrow and wide body	Samples available now
NCV57080/90	Automotive-qualified versions of NCD57080/90	SOIC-8 narrow and wide body	Production in Q4 2019
NCD57084/85	Isolated 8-pin driver	SOIC-8 narrow body	Samples in Q4 2019
NCV57084/85	Automotive-qualified versions of NCD57084/85	SOIC-8 narrow body	Production in Q1 2020
NCD57252	Isolated dual-channel driver	SOIC-16 wide body	Samples in Q4 2019
NCV57252	Automotive-qualified version of NCD57250	SOIC-16 wide body	Production in Q1 2020

APPLICATIONS
• Heating, ventilation and air-conditioning equipment
• Power factor correction
• Uninterruptible power supplies
• Motor drives
• White goods
• Inverters
• Electric vehicle chargers

FEATURES
• Low propagation delay
• Dead-time control

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N-channel MOSFETs help increase power density and efficiency in converter circuits

Vishay Intertechnology has introduced new 40V and 60V parts in the fourth generation of its TrenchFET® N-channel power MOSFET family, offering increased efficiency and power density in power-conversion circuits.

The SiSS12DN, which has a breakdown voltage of 40V, features the lowest output capacitance of any MOSFET with on-resistance below 2mΩ. This combination is crucial for power-conversion designs employing zero-voltage switching or switch-tank topologies. Gate charge is rated at 28.7nC.

The new 60V SiSS22DN TrenchFET MOSFET is the industry's first that is optimized for standard gate drives and that features maximum on-resistance as low as 4mΩ at 10V.

Unlike logic-level 60V devices, the SiSS22DN's gate-source threshold voltage and Miller plateau are optimized for circuits that provide gate-drive voltages above 6V. This high gate-voltage capability gives excellent dynamic characteristics in synchronous operations, dead-time management, and shoot-through prevention.

Both new MOSFETs are housed in a thermally-enhanced 3.3mm x 3.3mm PowerPAK 1212-8S package. This occupies 65% less board space than similar devices in 6mm x 5mm packages.

These MOSFETs may be used to keep both conduction and switching losses low simultaneously, and so to increase the efficiency of switching power supplies.

Vishay's TrenchFET: Handles high gate voltages

APPLICATIONS
- Synchronous rectification in AC-DC power supplies
- Telecoms equipment
- Servers
- Medical equipment
- Motor-drive control
- Battery protection and charging

FEATURES
- Output capacitance:
  - 680pF for SiSS12DN
  - 565pF for SiSS22DN
- Gate charge:
  - 28.7nC for SiSS12DN
  - 22.5nC for SiSS22DN
- Output charge:
  - 28nC for SiSS12DN
  - 34nC for SiSS22DN

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Space-saving surface-mount LED includes built-in driver IC

The QuasarBrite™ SMD-LX0707RGB-TR from Lumex is a surface-mount RGB LED chip which includes a built-in driver to simplify lighting equipment design and reduce board footprint compared to systems with a discrete driver.

Just a single general-purpose I/O pin is required to manage up to 1024 SMD-LX0707RGB-TR LEDs.

A control circuit implemented with an 8-bit, 256-step PWM input allows for precise adjustment of the brightness of each of the red, green and blue light sources, enabling the user to create a full palette of colors. Offering close integration with Lumex's Digital LED Controller product, the LED can offload color and lighting control functions from a host microcontroller.

The SMD-LX0707RGB-TR's board footprint is 1.8mm x 1.8mm, and it is just 0.65mm high. It is supplied with a water-clear lens. It is suitable for use in various non-standard PCB formats, including hollow ring, rigid stripe and flexible stripe.

Lumex SMD-LX0707RGB-TR: Precise control of color mixing

APPLICATIONS
- Architectural lighting
- Retail lighting
- Commercial lighting

FEATURES
- 120° viewing angle
- 5V supply voltage
- 5mA maximum drive current to each color LED
- Peak wavelengths:
  - Red: 630nm
  - Green: 520nm
  - Blue: 470nm
- Sample code reduces software development time

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3 Prototype
Prove • Iterate • Learn

4 Manufacture
Tool • Debug • Support

AEG
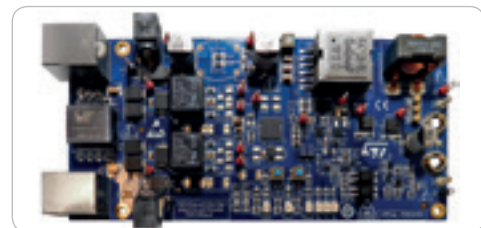Engineering Tomorrow's **Ideas**

FUTURE ELECTRONICS

Power controller enables efficient conversion in PoE and telecoms power supplies

The PM8804 from STMicroelectronics is a PWM peak current-mode power controller which integrates all the circuitry required to create a smart and efficient 48V converter for Power over Ethernet (PoE) and mid-power telecoms applications.

The PM8804 is suitable for use in various high-efficiency power-converter topologies, including flyback forward conversion, flyback with synchronous rectification, flyback with active clamp and forward with active clamp. Internal gate drivers with a peak current capability of 1A may be used in the implementation of high-power converter topologies.

Functions integrated into the PM8804 chip:
• Programmable oscillator to set the switching frequency
• Adjustable slope compensation
• Programmable soft-start

• Dual complementary low-side drivers with programmable dead time
• Soft turn-off
• Programmable current-sense blanking time up to 200ns

An internal high-voltage linear regulator with a 20mA output current means that the device requires few external components to perform its start-up routine.

APPLICATIONS
• Internet phones
• Wireless access points
• Networked cameras
• Telecoms power supplies

FEATURES
• 75V maximum input voltage
• Programmable fixed frequency up to 1MHz
• 80% maximum duty cycle with internal slope compensation
• <1.5mA operating current consumption
• Over-current protection, latching after four events
• Delayed overload protection with automatic restart
• Over-voltage protection
• Thermal shut-down protection

FTM DEVELOPMENT BOARD

STEVAL-POE00xV1 implement PoE converters which operate at high efficiency over a wide load range. They are based on a PM8805 PoE-PD interface, which complies with the IEEE 802.3bt standard, and DC-DC converters run by a PM8804 controller. STEVAL-POE00xV1 differentiate for topology, flyback or active clamp forward, and output conditions. STEVAL-ISA204V1 implements a 5V/20A active clamp forward converter based on PM8804 controller.

Orderable Part Number: STEVAL-POE006V1

Available at FutureElectronics.com

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PM8804 evaluation board implements a PoE Class 8 converter

Low-power relays offer wide range of configurations and contact ratings
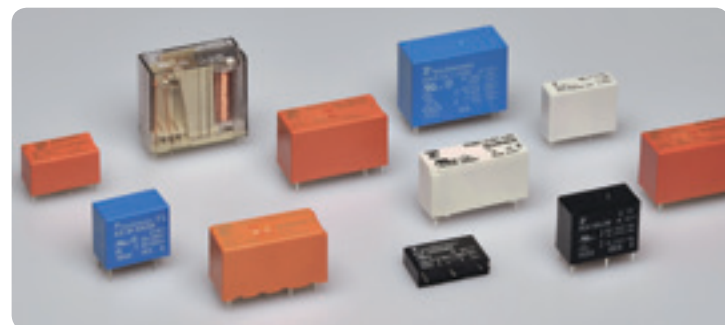
TE Connectivity (TE) supplies a range of low-power relays for mounting on a PCB, offering either one or two poles, and maximum contact ratings ranging from 3A to 16A.

The many different models in the TE product line allow users to select a model that meets their specific requirements for control circuits in building management and other applications.

The relays are available with various options for contact rating, contact configuration, coil, enclosure and termination.

Parts in the low-power PCB relay family include:
• **OMIH series:** in 1 form A or 1 form C configurations, with a 16A current rating and offering 5kV coil-to-contact isolation. 540mW or 720mW coil.
• **PCH series:** in 1 form A or 1 form C configurations, with a 5A to 10A current rating and offering 4kV coil-to-contact isolation. 200mW or 400mW coil.

• **RTX series:** in 1 form A configuration with a 16A current rating and offering 5kV coil-to-contact isolation. The RTX relay handles inrush peak current up to 320A. Latching DC coil.

APPLICATIONS
• Elevators and escalators
• HVAC equipment
• Smart metering
• Lighting controls
• Building management
• Solar power systems
• Security equipment
• Fire alarms

FEATURES
• Contact ratings up to 16A
• 1- or 2-pole versions available
• Mono-stable (non-latching) and bi-stable (latching) versions available
• AC/DC coils

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TE low-power relays: Ideal for use in building-automation systems

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FITK KIT: Contains 30 parts, 1 each of 30 common values
• Min Induct (No Bias): 8.06 – 253.0µH
• Min Induct (At Bias): 4.80 – 153.0µH
• Rated DC Amps: 2.8 – 9.7A
• Max DCR: 11.0 – 139.0mΩ

Current Sense Transformers

CST206K KIT: Contains 6 parts, 1 each of 6 common values
• ET VuSec REF 20kHz: 2000 – 6000
• Turns Count: 100 – 300
• Min. Inductance: 14.0 – 130.0mH
• Max DCR: 0.580 – 12.40Ω
• Pri. Amps: 70.0 – 110.0RMS

CST306K KIT: Contains 6 parts, 1 each of 6 common values
• ET VuSec REF 20kHz: 500 – 2000
• Turns Count: 50 – 200CT
• Min. Inductance: 3.5 – 55.0mH
• Max DCR: 0.340 – 3.75Ω
• Pri. Amps: 25.0 – 35.0RMS

Gate Drive Transformers

GDE25K KIT: Contains 6 parts, 1 each of 6 common values
• Max DCR 1-2: 0.350 – 0.875Ω
• Max DCR Gate: 0.350 – 1.75Ω
• Min ET Product: 540 – 840VuSec
• Max Leakage: 2.5 – 3.5µH
• Min Inductance: 0.680 – 1.5mH
• Turns Ratio: 1:1 – 1:1.5:1.5

Rod Core Inductors

FIRCHK KIT: Contains 6 parts, 1 each of 6 common values
• ±15% Inductance: 2.54 – 7.22µH
• DC Rated Current: 4.80 – 11.6A
• Max DCR: 5.50 – 26.10Ω

RCK KIT: Each kit contains 11 parts, 1 each of 11 common values
• ±10% Inductance: 75.0 µH – 5.6mH
• DC Rated Current: 0.250A – 2.50A
• Max DCR: 0.070 – 6.10Ω

Common Mode Inductors

CME2425K KIT: Contains 9 parts, 1 each of 9 common values
• Inductance Min.: 1.05 – 67.5mH
• Amps R.M.S.: 0.40 – 2.5A
• Max DC Resist: 0.050 – 2.020Ω
• Min Leakage: 9.0 – 360µH

CME375K KIT: Contains 9 parts, 1 each of 9 common values
• Inductance Min.: 4.4 – 176.1mH
• Amps R.M.S.: 0.870 – 5.5A
• Max DC Resist: 0.049Ω – 1.98Ω
• Min Leakage: 45.0µH – 1.8mH

Common Mode Toroidal Inductors

CMT8100K KIT: Contains 21 parts, 1 each of 21 common values
• L(mH) Min. @ 1kHz: 1.0 – 50.0mH
• I(A) Max.: 1.7 – 20.0A
• Max DCR: 0.006 – 0.173Ω

CMT908K KIT: Contains 8 parts, 1 each of 8 common values
• Inductance Min.: 2.0 – 16.0mH
• Amps R.M.S.: 2.60 – 7.50A
• Max DC Resist: 0.020 – 0.160Ω
• Min. Leakage: 25.0 – 180.0µH

CMF Common/Differential Mode Chokes

CMF16K KIT: Contains 21 parts, 3 each of 7 common values.
• Rated Voltage: 300VAC
• Creepage and Clearance: >3mm
• Rated Current: 0.45A – 1.6A
• Inductance: 10 – 100.0µH
• Operating Temperature: -40°C to 105°C
• Induct Tol: 50%/-30% @ 20°C

CMF23HK & CMF23VK KITS:
Each kit contains 14 parts, 2 each of 7 common values
• Rated Voltage: 300VAC
• Creepage and Clearance: >3mm
• Rated Current: 0.7A to 2.3A
• Inductance: 10 – 100.0µH
• Operating Temperature: -40°C to 105°C
• Induct Tol: +50%/-30% @ 20°C

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Rugged, sealed power connectors withstand severe vibration and shock

TE
connectivity

TE Connectivity's DEUTSCH DTSK sealed power connectors are sealed power connectors in wire-to-wire inline or pass-through, flange-mountable formats for use in harsh environments.

TE's DEUTSCH DTSK connectors are made of a heavy-duty thermoplastic and can withstand severe vibration and mechanical shock. They are IP68- and IP69K-rated, and protect connections from contamination by dust, dirt or moisture.

These connectors may be used to perform various power-connection functions with 25mm², 32mm² or 35mm² wire, including:
• Battery and alternator power inline connections
  • Bulkhead and battery compartment exit point using pass-through flange mounting option
  • Power connections subject to strong and/or frequent vibration

TE's DEUTSCH DTSK connectors provide stable electrical performance thanks to their 8mm-diameter, high-reliability contact with spring insert. A secondary lock confirms contact alignment and retention.

The connectors are available in any of three colors to allow for easy identification on the production line or in the field.

DEUTSCH DTSK connectors: Three color options

TE, TE Connectivity, TE Connectivity (logo), and DEUTSCH are trademarks

Icons: ENERGY, INDUSTRIAL, LIGHTING, MEDICAL, TRANSPORT, SECURITY, CONSUMER, TELECOMS

APPLICATIONS
• Industrial and commercial transportation
• Trucks and buses
• Agriculture
• Construction equipment
• Marine equipment
• Mining equipment
• Industrial systems

FEATURES
• 125A current rating with 35mm² wire
• DEUTSCH DT-RT1 tool for quick field repairs
• 250V AC/DC maximum voltage
• Operating-temperature range: -55°C to 125°C

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Screw-terminal capacitors offer 10% higher energy density

VISHAY

Vishay Intertechnology's new 501 PGM-ST series screw-terminal aluminum capacitors provide 10% higher capacitance and 10% better ripple-current handling for a given can size than its previous generation of devices.

The 501 PGM-ST parts are polarized aluminum electrolytic capacitors with a non-solid electrolyte. They are ideally suited to applications that demand a high energy-storage capacity in a small form factor.

The series includes capacitors with a 500V rating, which provides a generous voltage headroom in products such as electric motors, uninterruptible power supplies and solar inverters. The use of the 501 PGM-ST capacitors enables solar inverters to be easily upgraded to handle a 1,000V maximum input.

In addition, design engineers can use a 501 PGM-ST part to re-use a three-phase, 380V design in a 480V system simply by upgrading the DC-link capacitor.

These high-capacitance parts are packaged in a cylindrical aluminum case insulated with a blue sleeve. Pressure relief is built into the sealing disc. They are available in case sizes from 50mm diameter x 80mm length to 90mm x 195mm.

501 PGM-ST: Built-in pressure relief for safe operation

Icons: ENERGY, INDUSTRIAL, LIGHTING, MEDICAL, TRANSPORT, SECURITY, CONSUMER, TELECOMS

APPLICATIONS
• Motor drives
• HVAC equipment
• Welding equipment
• Solar inverters
• Uninterruptible power supplies
• X-ray equipment
• Microgrid interfaces
• Wind turbines
• Scientific test equipment

FEATURES
• Rated voltages of 400V, 450V and 500V
• Capacitance values from 1,000µF to 18,000µF
• Ripple-current ratings: 5.49A to 30.2A
• Operating-temperature range: -40°C to 85°C
• 5000 hours useful life at 85°C

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Panasonic

Arm Cortex-M4-based SoC provides wireless Bluetooth Low Energy and NFC connectivity

Panasonic has introduced the PAN1780, a Bluetooth® Low Energy RF module based on the Nordic Semiconductor nRF52840 controller IC, and compliant with the latest version 5.0 of the Bluetooth standard specifications.

The module is a complete system-on-chip: it includes an Arm® Cortex®-M4F processor operating at a maximum frequency of 64MHz, which is backed by 256kbytes of RAM and 1Mbyte of Flash memory. RF system designs based on the PAN1780 can easily be used in stand-alone mode, eliminating the need for an external host processor, and thus reducing system complexity and saving space and cost.

Designers can use the PAN1780 to optimize their application for either range or data-transfer rate. Using the nRF52840's high-speed Bluetooth Low Energy 2M transceiver, it can achieve a high maximum data throughput of 2Mbits/s. In addition, the new Bluetooth Low Energy advertising extensions supported by the PAN1780 allow for much larger amounts of data to be broadcast in connectionless scenarios.

The PAN1780 is notable for high output power and high sensitivity. For the longest range, designers will configure the module to use the nRF52840's Low Energy coded PHY at a data rate of 500kbits/s or 125kbits/s. A new channel-selection algorithm improves performance in environments subject to high interference.

Security is an important concern for designers of any system that supports wireless connectivity. In the PAN1780, a strong foundation for security is provided by an Arm TrustZone® Cryptocell 310 security sub-system. It supports secure boot operation and provides root-of-trust capability, and enables over-the-air updating of application software.

The PAN1780 supports Type 2 Near Field Communication (NFC-A) for use in simplified pairing and in payment solutions. An external antenna is required for NFC operation.

Measuring 15.6mm x 8.7mm x 2.1mm, the PAN1780 shares the same form factor as the PAN1026A and PAN1762, enabling easy migration between parts. It provides up to 48 general-purpose I/Os, which are shared by various communications interfaces:
• Up to four serial peripheral interfaces
• Eight ADC channels
• Two I²C
• Two UART
• Four PWM
• One USB 2.0
• One NFC-A

Icons: ENERGY, INDUSTRIAL, LIGHTING, MEDICAL, TRANSPORT, SECURITY, CONSUMER, TELECOMS

APPLICATIONS
• Battery-powered devices
• IoT devices
• Industrial equipment
• Consumer devices

FEATURES
• Typical sensitivity:
  − -95dBm at 1Mbit/s
  − -103dBm at 125kbits/s
• 8dBm maximum output power, configurable from -20dBm in 4dB steps
• Operating current:
  − 4.8mA in Transmit mode at 0dBm
  − 4.6mA in Receive mode
• 1.5µA stand-by current
• Operating-voltage range: 1.7V to 5.5V
• Built-in temperature sensor
• Temperature range: -40°C to 85°C
• FCC, IC and CE approvals pending

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Connectors support mass termination for production efficiency

The MTA 100 series from TE Connectivity provides both wire-to-board and wire-to-wire connections based on Insulation Displacement Contact (IDC) technology.
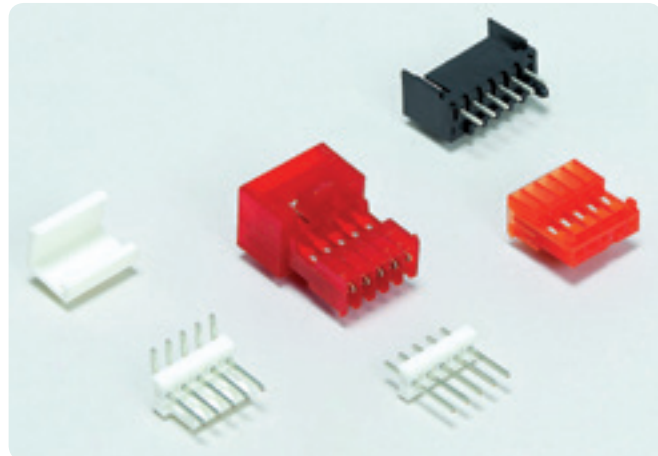
Mass termination of wires supports low applied cost, as it greatly reduces the labor required for almost any cable or harness assembly.

These connectors have a 2.54mm centerline spacing while allowing for up to 28 positions. The housings feature both closed-end and feed-through connector styles with locking ramps, both with and without polarizing tabs. The housings are available in various color options.

MTA 100 connectors offer multiple quality and reliability benefits:
- One-step assembly
- No wire stripping
- No contact damage
- Reduced wiring errors
- Simpler tooling
- Simple maintenance and repair

APPLICATIONS
- Household appliances
- Industrial machinery and controls
- Personal healthcare devices

FEATURES
- Audible latch for connection feedback on posted housings
- Wire feed-through for daisy-chaining
- Tin or gold plating
- Terminates 28 to 22 AWG wire
- UL recognized
- 5A current rating
- 250V AC voltage rating
- Operating-temperature range: -55°C to 105°C

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MTA 100 series: Closed-end and feed-through connector styles

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Cable assembly service offers fully integrated cabling solutions

TE Connectivity's Cable Assemblies division provides a complete cable assembly design and production service for manufacturers operating anywhere in the world, in almost any market sector.

TE Cable Assemblies provides total solutions which exactly fit customers' needs. Drawing on decades of experience, global expertise in development and manufacturing, and a worldwide network of competence centers, TE Cable Assemblies creates custom solutions and standardized products which work exactly as they should.

The TE Cable Assemblies service includes development of a design to meet the customer's functional and performance requirements. To provide fully integrated solutions, TE engineers work hand-in-hand with development teams dedicated to connectors, taking advantage of TE's vast portfolio of connectors to make sure any solution provides a perfect fit for a customer's needs.

TE offers many automatic and semi-automatic manufacturing technologies including:
- Cutting and stripping
- Soldering
- Insulation Displacement Connection (IDC)
- Over-molding

Cable assemblies designed and manufactured by TE Connectivity may be validated in a world-class TE test laboratory in each region of the world.

Global footprint
TE Cable Assemblies maintains production facilities globally:
- Hermosillo, Mexico: 220,000+ square feet of manufacturing space
- Worcester, Massachusetts: 160,000+ square feet of manufacturing space
- Dongguan, China: 290,000+ square feet of manufacturing space
- Bydgoszcz, Poland: 70,000+ square feet of manufacturing space

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TE cable assemblies are produced by automated equipment

TE, TE Connectivity and TE Connectivity (logo) are trademarks

CYPRESS
EXCELON™-ULTRA F-RAM™ MEMORY

Performance, reliability, and instant nonvolatility in low-pin-count memory.

Industrial systems require memories to continuously log and instantly capture system state information and sensor data in the event of power loss. Next-generation factory automation and control systems will add to compute and storage demands, especially on the edge of the network. Harsh operating environments and demanding requirements for cycling endurance and data retention require the most-robust performance possible, while supporting efficient low-pin-count, high-speed interfaces. Excelon-Ultra mission-critical memories support a 108-MHz low-pin-count QSPI interface with 100 trillion cycle write endurance, fast writes and instant nonvolatility.

Excelon™-Ultra

FEATURES

HIGH PERFORMANCE
- 50 MHz SPI and 108 MHz SDR QSPI interfaces
- No write delay
- 10mA active current @108MHz SPI SDR
- True RAM performance; no data polling before writes

RELIABLE
- 100 trillion (10^{14}) cycle endurance
- No wear-leveling required
- 100+ year data retention
- No battery or capacitor required
- Instant nonvolatility

ADDITIONAL PRODUCT FEATURES
- -40°C to 85°C Industrial Grade
- Hardware protection with write protect pin
- Software block protection
- Embedded ECC

EXCELON F-RAM ADVANTAGES:

Excelon F-RAM memories combine nonvolatile data storage with the fast speed of RAM. F-RAM has three distinct advantages over traditional nonvolatile memories:
- Fast write speed with no write delay
- Virtually unlimited endurance
- Industry's most energy-efficient NVRAM

Excelon F-RAM operates with the same host processor interfaces and timing as other memories such as SRAM, EEPROM, and serial Flash, but takes advantage of its fast write speed to eliminate write delays due to "soak time" or page/sector buffering required of other technologies. Instant writes eliminate "data at risk" resulting from unexpected power loss.

www.cypress.com

FTM DEVELOPMENT BOARD
Compatible with ST NUCLEO-L433RC-P MCU Evaluation Board for SPI and QSPI mode operation. On-board 4-Mbit (512Kx8), Excelon Ultra Quad SPI F-RAM with 1.8V to 3.6V operating voltage.
Orderable Part Number: CY15FRAMKIT-002
Available at FutureElectronics.com

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FUTUREELECTRONICS.COM/RESOURCES/FTM

CYPRESS — EMBEDDED IN TOMORROW™

Logic technology for 5V modular standby applications

nexperia   By Nexperia

Our homes are filled with electronics products, such as printers, televisions and set-top boxes, which have a standby or partial power-down mode. And despite the overall trend towards lower operating voltages, numerous home entertainment and computing peripherals continue to run from a 5V supply rail.

These 5V systems have just as much need for power-saving circuit features as devices operating at lower voltages such as 2.5V or 3.3V. This is why Nexperia has extended its power-saving logic technology to be compatible with 5V nodes.

Partial power-down logic technology
So-called I_{OFF} circuitry is a logic technology feature which supports partial power-down, and is used in modular standby applications. I_{OFF} circuitry has long been available on Nexperia's CMOS low-power AUP, AVC, AXP and LVC logic device families.

Now, following the introduction of the LV-A(T) family, Nexperia's standard CMOS logic portfolio is expanded to include partial-power down types which address the 5V node, in addition to 2.5V and 3.3V nodes for which LV-A is also fully specified.

How partial power-down works
Partial power-down involves shutting down unused parts of a circuit. It is mainly used to keep devices in standby mode. Logic technologies which support I_{OFF} have no leakage path to the supply rails when the supply voltage is zero. The I_{OFF} protection circuitry ensures that an excessive current may not be drawn from the input and output, preventing damage to sub-systems, as shown in Figure 1.
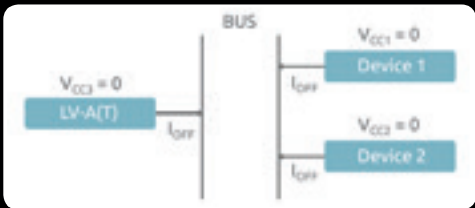

Fig. 1: Disabling the flow of power using the I_{OFF} feature

Nexperia's LV-A(T) family of devices are notable for their low leakage when powered down. The LV-A(T) technology is rated for 0.1µA typical static current, and offers low propagation delay, as shown in the table below.

	Supply Voltage (V_{CC})	Output Drive (V_O)	Prop Delay (t_{PD})	Temperature Range (T_{amb})	Static Current (I_{CC})
LV-A	2.0 – 5.5V	±16mA	4.9ns @ 2.5V 3.7ns @ 3.3V 2.9ns @ 5.0V	-40°C to 125°C	0.1µA (typ.)
LV-AT	4.5 – 5.5V	±16mA	2.9ns @ 5.0V	-40°C to 125°C	0.1µA (typ.)

LV-A(T) also features low noise, specified as Vol(p) <0.8V. As shown in Figure 2, Vol(p), Vol(v) is when one output is driven Low while other outputs simultaneously switch from High to Low. Voh(v), Voh(p) is when one output is driven High while other outputs simultaneously switch from Low to High.

LV-A types of logic devices feature CMOS input levels, while LV-A(T) types include low-input thresholds for TTL interfacing. Both LV-A and LV-A(T) types feature Schmitt trigger action, which produces a small input-switching hysteresis of around 100mV: this improves noise immunity, as shown in Figures 3 and 4. True Schmitt trigger inputs are available in the 74LV14A and 74LV17A series of devices, as shown in Figure 5.

LV-A products operate with defined low input levels of ≤0.3xVCC and high input levels of ≥0.7xVCC at a supply-voltage range of 2.0V to 5.5V.

For LV-A(T) products, the low input level is ≤0.8V and the high input level is ≥2.0V at a supply-voltage range of 4.5V to 5.5V.
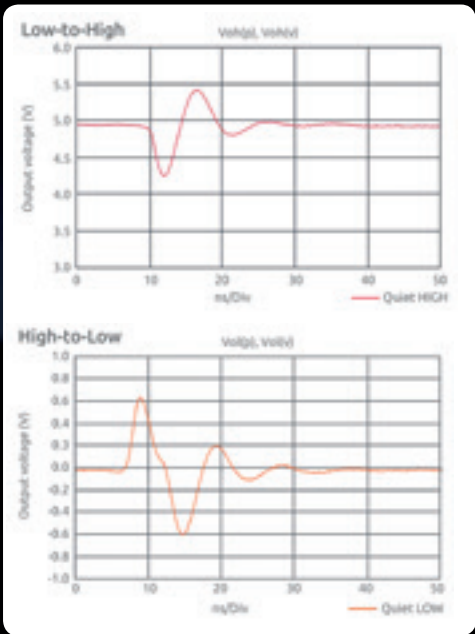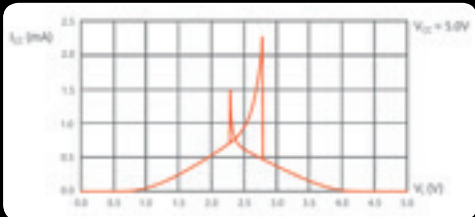

Fig. 2: LV-A noise characteristics at V_{CC} = 5V
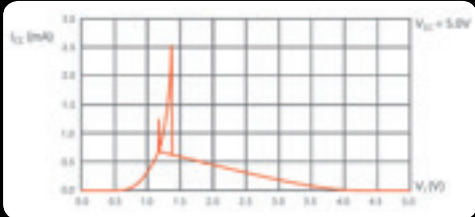

Fig. 3: LV-A CMOS input with Schmitt action at 5V
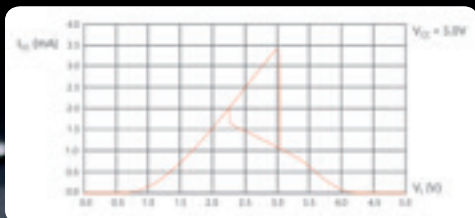

Fig. 4: LV-A(T) TTL inputs with Schmitt action at 5V

Fig. 5: LV-A Schmitt trigger inputs at 5V

LV-A(T) additional features: over-voltage tolerant inputs and open-drain outputs
With over-voltage tolerant inputs, the maximum voltage applied to an input may exceed the supply voltage. For LV-A(T) devices, 5.5V may be applied to the inputs irrespective of the supply voltage. Thanks to this feature, LV-A solutions are suitable for High-to-Low level translation. For example, when supplied at 3.3V, 5.0V may be applied to the input to achieve 5.0V to 3.3V voltage translation. Because of their low-threshold inputs, LV-A(T) solutions are suitable for Low-to-High level translation. For example, when supplied at 5.0V, 3.3V may be applied to the input to achieve 3.3V to 5.0V voltage translation.

Options with open-drain outputs include outputs with only an NMOS transistor to ground. To achieve a logical High on the output when the product is in the high-impedance state, or 3-state, a pull-up resistor can be used to reach the desired output-voltage level. The pull-up resistor can be used with a pull-up voltage higher or lower than the supply voltage.

Independent of the supply voltage, open-drain LV-A(T) solutions can be used with a pull-up voltage of 5.5V or lower, which allows for voltage translation.

Nexperia's LV-A(T) and LV-A portfolios
Nexperia's LV-A(T) portfolio is comprised of logic buffers, inverters and transceivers. The LV-A portfolio also includes AND, OR, NAND and NOR gates.

A total of 18 types are available in this family, all in industry-standard TSSOP packages, as shown.

Shield development board enables fast prototyping of DC motors

Infineon

The BLDC-SHIELD_IFX007T is a high-current motor-control board based on Infineon's smart NovalithIC™ IFX007T half-bridge driver IC. It is compatible with the Arduino board standard and Infineon's XMC4700 Boot Kit for the XMC4700 series of microcontrollers.

This Brushless DC (BLDC) motor-control shield is equipped with three smart IFX007T half-bridge drivers, and is capable of driving a single BLDC motor. Alternatively, it can be used to drive one or two bi-directional DC motors in an H-bridge configuration, cascaded to support a second motor, or up to three unidirectional BLDC motors in a half-bridge configuration. The board's IFX007T half-bridges can be controlled by a PWM input to the In pin.

The shield board is supported by Infineon demonstration code and the Infineon online simulation tool.

FTM DEVELOPMENT BOARD
Orderable Part Number: BLDC-SHIELD_IFX007T
Available at FutureElectronics.com

Infineon's IFX007T board drives motors with power ratings up to 300W

APPLICATIONS
- Brushed and brushless DC motor drives with up to 300W continuous load and 8V to 40V nominal input voltage
- Industrial motors
- Motors for home or garden appliances

FEATURES
- Compatible with Arduino Uno R3
- Capable of high-frequency PWM control at frequencies up to 30kHz
- Easy testing of half- and full-bridge motor-control systems
- Status flag diagnosis with current-sense capability

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Integrated half-bridge saves space and cost in motor-drive circuits

Infineon

Infineon's NovalithIC™ IFX007T is a half-bridge with integrated driver IC for use in industrial, consumer and other types of brushed and brushless motor drives. It provides a cost- and space-optimized solution for high-current PWM motor drives while offering comprehensive protection against system faults.

The IFX007T contains one P-channel high-side MOSFET, one N-channel low-side MOSFET and a driver IC integrated in a single package. The use of a P-channel high-side switch eliminates the need for a charge pump, thus keeping EMI to low levels. The IFX007T also integrates various monitoring and protection features, reducing the need for external passive components. These include:
- Diagnosis with current sense
- Slew-rate adjustment for optimized EMI
- Dead-time generation
- Over-temperature protection
- Under-voltage protection
- Over-current protection
- Short-circuit protection
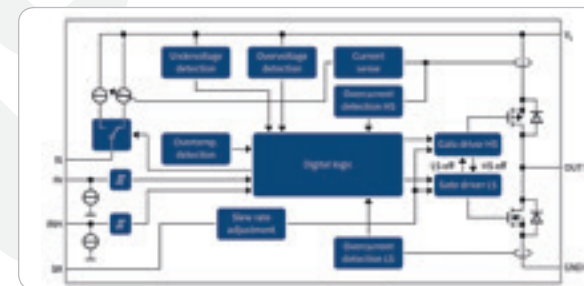
Block diagram for the NovalithIC™ IFX007T

In addition, logic-level inputs make for a simple interface to a host microcontroller operating at 3.3V or 5V. The IFX007T is flexible enough to be used in various motor types' half- or H-bridge configurations, and with PWM control and freewheeling from either the high side or the low side.

When twin IFX007T devices are used in an H-bridge configuration, they provide redundancy to support functional safety compliance.
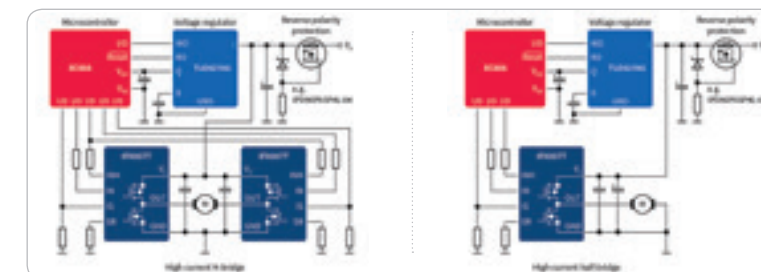
Motor-drive application diagrams

APPLICATIONS
- Automation equipment
- Home appliances
- Robotics
- Medical equipment
- Power tools
- Drones
- 3D printers
- Fans
- Pumps

FEATURES
- 50A maximum continuous drain current
- 24V normal operating voltage
- 40V maximum operating voltage
- 12.8mΩ maximum on-resistance at 25°C
- Supports PWM frequency up to 20kHz
- Operating-temperature range: -40°C to 150°C

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New series of position sensor encoders supports broad range of shaft diameters up to 15.875mm

CUI's Motion Group has announced the addition of two new series to its family of innovative AMT rotary position encoders. The new encoders support larger motor shaft sizes from 9mm up to 15.875mm (⅝").

The AMT13 and AMT33 series encoders are based on CUI's proprietary capacitive ASIC technology, offering the same high levels of durability, accuracy and immunity to environmental particulates as current AMT encoder models. The AMT13 is a series of incremental encoders. The AMT33 series are commutation encoders that generate standard U/V/W communication signals for commutating Brushless DC (BLDC) motors. The AMT33 is compatible with BLDC motors with 2, 4, 6, 8, 10, 12 or 20 pole pairs.

The user can program the AMT13 or AMT33 encoders to measure rotary position at any one of 22 resolution settings, from 48 Pulses Per Revolution (PPR) up to 4096 PPR. CUI's AMT Viewpoint™ software makes it easy to configure the resolution and set the zero position. It can also be used with the AMT33 series to configure the pole count and direction of rotation.

This saves valuable time during development and assembly compared to optical encoders, which require the user to precisely rotate the optical disk and check via back-EMF to ensure that it is properly aligned. The One Touch Zero™ feature enables this time-consuming process to be completed in seconds.

The encoders provide CMOS voltage or differential line-driver outputs. They draw an operating current of just 16mA at 5V. Available in radial or axial orientations, the AMT13 and AMT33 series encoders are housed in a compact 42.3mm x 42.3mm x 13.5mm package.

Integrated kits, the AMT13-V kit and AMT33-V kit, give users further design flexibility, providing nine sleeve bore options from 9mm to 15.875mm (⅝"). Mounting tools make it simple to install the encoders on to a motor.

APPLICATIONS
- Industrial equipment
- Industrial automation
- Robotics
- Renewable energy systems

FEATURES
- ±0.2° accuracy
- Input-voltage range: 4.5V to 5.5V
- Maximum speed: 4096rpm
- 200ms start-up time
- Operating-temperature range: -40°C to 125°C

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CUI encoders: Choice of resolution settings

Compact I/O connector offers board space savings of up to 75% compared to RJ45 solutions

Hirose supplies a rugged I/O connector which combines a small, robust design with high-speed data-transmission capabilities. Intended for use in industrial automation and manufacturing environments, the IX series combines high-speed performance and a compact design with high reliability and design flexibility.

The compact IX series connector occupies up to 75% less board space than RJ45 connector systems, and up to 28% less than competing snap-in I/O connectors. Supporting CAT5e and CAT6a cabling, the IX series connector integrates shielding against EMI and electro-static discharge to provide for safe and secure transmission at data rates up to 10Gbits/s.

Available with two keying codes for Ethernet and non-Ethernet applications, the IX series is compliant with the IEC PAS 61076-3-124 standard.

Offered in upright and horizontal right-angle versions, the IX series connector has maximum dimensions of 22.9mm x 8.4mm x 14.3mm. The upright right-angle receptacles can be mounted in parallel with a pitch distance of only 10mm. The narrow width of the receptacle is particularly beneficial when multiple connectors are positioned on a single PCB side-by-side.

Featuring a rugged and reliable design, the snap-in I/O connector has a positive metal lock with a pre-load spring mechanism which provides a clear tactile click and ensures complete, secure mating. The pre-loaded springs prevent unintended cable removal, and extend the operating life to more than 5,000 mating/unmating cycles.

The receptacle shell is mounted on the PCB via through-hole solder legs to enhance PCB retention and to resist the wrenching of the cable assembly. The wire-termination unit and cable clamp are integrated into a single plug shell, which prevents the connecting part of the cable assembly from being affected by the load on the cable.

APPLICATIONS
- Factory automation controllers
- Industrial robotics
- Programmable logic controllers
- Security systems
- Servo amplifiers
- Servers

FEATURES
- Rated current:
  – 0.5A on all pins
  – 1A on any two pins
  – 2A on pin numbers 1 and 8 only
- 30V AC maximum voltage
- Operating-temperature range: -40°C to 80°C

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IX series: Provides secure data rates up to 10Gbits/s

Dual-core MCUs set new benchmarks for performance from embedded Flash memory

STMicroelectronics new STM32H7 family of microcontrollers includes the STM32H747 and STM32H757, high-performance dual-core devices which offer valuable power-saving features and enhanced cyber protection.

STM32H7 with record performance
Dual-core architecture
- System integration
- Advanced connectivity and control
- Security services
STM32H7

The STM32H7x7 MCUs include dual Arm® Cortex®-M7 and Cortex®-M4 cores which run at up to 480MHz and 240MHz respectively. To maximize energy efficiency, each core operates in its own power domain and can be turned off individually when not needed.

Benefiting from ST's smart architecture, efficient L1 cache, and adaptive real-time ART Accelerator™ engine, the MCUs set new speed records of 1327 DMIPS and a 3224 CoreMark™ score when executing from embedded Flash. ST's Chrom-ART Accelerator™ block provides an extra speed boost in graphics applications. Developers can easily upgrade existing applications through flexible use of the two cores. They can add a sophisticated user interface to an application such as a motor drive formerly hosted on a single-core Cortex-M4 MCU by migrating legacy code to the STM32H7x7 Cortex-M4 core, with the new GUI running on the Cortex-M7 core. Another example is to boost application performance by offloading intensive workloads such as neural networks, checksums, DSP filtering, or audio codecs.

The dual-core architecture also helps to simplify code development and accelerate time to market in projects in which user-interface code may be developed separately from real-time control or communications features.

For applications which call for enhanced security, the STM32H757 also includes a cryptography/hash processor. It comes with pre-installed keys and native secure services including Secure Firmware Install (SFI). SFI lets customers order standard products anywhere in the world and have the encrypted firmware delivered to an external programming company without exposing unencrypted code. In addition, built-in support for Secure Boot and Secure Firmware Update protects over-the-air feature upgrades and patches.

APPLICATIONS
- Industrial equipment
- Consumer devices
- Medical equipment
- Artificial Intelligence (AI) systems

FEATURES
- Up to 2Mbytes of Flash and 1Mbyte of SRAM
- Error correction code for all Flash and RAM memory
- Three 16-bit ADCs and two 12-bit DACs
- Ethernet controller
- Two FD CAN and USB 2.0 controllers
- Camera interface

FTM DEVELOPMENT BOARD

This Discovery kit includes a 4" capacitive touchscreen LCD display module with MIPI® DSI interface, 1Gbit of NOR Flash memory, digital microphones, connectors for a headset and external speakers, and multiple expansion board headers.

Orderable Part Number: STM32H747I-DISCO

Available at FutureElectronics.com

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Precision chip resistors handle high power loads up to 1W

Susumu has introduced the HRG series of high-power chip resistors which offer precise and stable resistance over a wide temperature range and numerous temperature cycles.

The HRG series features conventional short-side wrap-around terminals, in contrast to Susumu's PRG series resistors, which have long-side terminals. The proprietary thin-film resistor construction and enlarged bottom terminals mean that the HRG resistors are able to handle high power loads of up to 1W in a standard EIA 3216 case size, or 1206 in inches.

The Susumu HRG series is notable for its precise electrical characteristics and high reliability. The resistors are available with absolute resistor tolerances of 0.1% or 0.5%. The temperature coefficient of resistance is ±25ppm/°C or 50ppm/°C.

APPLICATIONS
- Power supplies
- Power switching
- Automotive braking systems
- Test and measurement equipment
- Motor deflection circuits
- Sensor circuits
- Batteries
- Electric car chargers

FEATURES
- Low noise
- Excellent high-frequency performance
- ±0.25% maximum drift after 1,000 hours at rated power at 70°C
- ±0.1% maximum drift after 1,000 hours at 85% relative humidity at 85°C
- ±0.1% maximum drift after 1,000 temperature cycles between -55°C and 125°C
- ±0.1% maximum drift after 1,000 hours at 155°C
- AEC-Q200 qualified

Evolution of SSM Chip Resistor Power Handling Capability

Rated Power (W) — vertical axis: 0, 0.2, 0.4, 0.6, 0.8, 1, 1.2

Susumu Chip Resistor Series	
RR1632	
RG3216	
PRG3216 Long Side Terminal	
HRG3216 Short Side Terminal	

HRG series: precise and stable resistance over a wide temperature range

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Power and signal connectors support new robotics designs

TE Connectivity (TE) provides a broad electromechanical and electronics product portfolio to cover the needs of manufacturers of robotics technology.

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 and protect the flow of power, data and signals.

These products include the Dynamic Series connectors, a broad product family which provides connector solutions ranging from signal-level circuitry to power-circuit connectivity in a rugged, industrialized package. 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 parts are available. The standard contacts limit the amount of application tooling required.

The TE product range for robotics applications also includes TE terminal blocks. These offer design engineers a reliable connector system for data, signal and power, with a variety of connection styles and a range of centerline sizes.

TE terminal blocks mate with industry-standard headers on the same centerline spacing. They offer fast wire connections. Custom solutions are also available.

TE connectors: Rugged packages for industrial applications

TE, TE Connectivity and TE Connectivity (logo) are trademarks

APPLICATIONS
- Robotics
- Industrial automation

FEATURES (Dynamic Series)
- Easy mating and unmating for reduced installation and maintenance time
- Three points of contact provide high electrical reliability
- Reliable and safe connections for increased productivity

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Complete motor controller/driver in a single compact package

The STSPIN32F0B from STMicroelectronics is a System-in-Package (SiP) which provides an integrated solution incorporating a microcontroller and power stage suitable for driving three-phase Brushless DC (BLDC) motors. It is supplied in a compact 7mm x 7mm x 1mm quad flat package.

The SIP's triple half-bridge gate driver can drive power MOSFETs with a current capability of up to 600mA sink and source. The SiP prevents the high- and low-side switches of the same half-bridge from being simultaneously driven high thanks to its integrated interlocking function.

An internal DC-DC buck converter provides the 3.3V supply for both the MCU and external components. An internal linear regulator supplies the gate drivers. An integrated operational amplifier is available for conditioning signals such as a shunt resistor's current measurements.

The integrated STM32F031C6 MCU can implement field-oriented control, six-step sensorless and other advanced motor-driving algorithms. It is based on an Arm® Cortex®-M0 core operating at up to 48MHz.

The STSPIN32F0B device also features over-temperature and under-voltage lock-out protection functions, and can be put in standby mode to reduce power consumption.

The device offers 20 general-purpose I/Os, one 12-bit ADC with up to nine channels performing conversions in single-shot or scan modes, and five general-purpose timers.

STSPIN32F0B: Implements various motor-control algorithms

APPLICATIONS
- Power tools
- Fans
- Pumps
- Industrial automation
- Battery-powered home appliances

FEATURES
- Comparator for over-current protection with programmable threshold
- I²C, USART and serial peripheral interfaces
- Operating-voltage range: 6.7V to 45V
- Operating-temperature range: -40°C to 125°C

FTM DEVELOPMENT BOARD

The STEVAL-SPIN3204 three-phase BLDC motor driver board is based on the STSPIN32F0B 3-phase BLDC controller with triple half-bridge gate driver, single shunt resistor current sensing topology and programmable over-current protection.

Orderable Part Number: STEVAL-SPIN3204

Available at FutureElectronics.com

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Launch of miniature 32-bit MCUs for IoT connectivity modules and edge devices

Part Number	Flash	SRAM	Package
R5F5651EDDBP	2Mbytes	640kbytes	64-pin BGA
R5F56519BDBP	1Mbyte	256kbytes	64-pin BGA
R5F5651EDDFM	2Mbytes	640kbytes	64-pin LQFP
R5F56519BDFM	1Mbyte	256kbytes	64-pin LQFP

RENESAS BIG IDEAS FOR EVERY SPACE

Four new Renesas RX651 32-bit MCUs enable design engineers to pack more high-performance MCU functionality in a reduced board footprint.

The new MCUs offer two package options:
- A 64-pin, 4.5mm x 4.5mm BGA package which reduces board footprint by 59% compared to an RX651 in a 100-pin LGA
- A 64-pin, 10mm x 10mm LQFP which offers a 49% footprint reduction over a 100-pin LQFP

The MCUs support the security, connectivity and data-handling needs of endpoint devices at the edge of IoT networks.

The RX651 MCUs integrate connectivity, Trusted Secure IP (TSIP), and trusted Flash area protection features to enable Flash firmware updates in the field through secure network communications. The integrated dual-bank Flash memory enables engineers to realize high root-of-trust levels through a combination of:
- TSIP which protects the encryption key
- Encryption hardware accelerators including AES, 3DES, RSA, SHA and a true random number generator
- Code Flash area protection to protect boot code from reprogramming

The dual-bank Flash function makes it easier for manufacturers to execute in-the-field firmware updates securely and reliably.

These small 64-pin MCUs, based on the high-performance RXv2 core and Renesas' 40nm wafer fabrication process, provide superior performance: they achieve a 520 CoreMark® score at 120MHz. Strong power efficiency is reflected in a 35 CoreMark/mA score as measured by EEMBC® Benchmarks.

Renesas Enhanced RX65N/RX651 MCUs Enabling Advanced Security for IIoT

APPLICATIONS
- Industrial equipment
- Network control
- Building automation
- Smart metering systems

FEATURES
- 120MHz maximum clock frequency
- 8-channel DMA controller
- 10-channel, 12-bit ADC
- Full-speed USB 2.0 port
- 11-channel serial peripheral interface
- 9-channel UART
- 2-channel I²C

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Wireless cloud kit simplifies secure IoT endpoint connections to Amazon Web Services

RENESAS BIG IDEAS FOR EVERY SPACE

The new Renesas RX65N Cloud Kit provides a simple, application-ready platform for the development of IoT edge devices which connect to the cloud via Amazon Web Services (AWS).

The kit features an RX65N microcontroller, on-board Wi-Fi® wireless connectivity, environmental, light and inertial sensors, and support for Amazon's FreeRTOS real-time operating system.

The kit, which has the part number RTK5RX65N0S01000BE, provides a ready-made, secure connection to AWS. Using Renesas' e2 studio Integrated Development Environment (IDE), developers can create IoT applications by configuring Amazon FreeRTOS, all the necessary drivers, and the network stack and component libraries.

The e2 studio IDE enables designers to develop IoT applications with powerful features, creating Amazon FreeRTOS projects from a GitHub directory and immediately building them.

In the IDE, they can also set up an Amazon FreeRTOS network stack and component libraries, such as Device Shadow, without requiring detailed knowledge of the system. They can also embed additional functions based on Amazon FreeRTOS, such as USB connectivity and a file system, on an IoT endpoint device.

The RX65N Cloud Kit provides an excellent evaluation and prototyping environment for sensor-based IoT endpoint equipment. Developers can use Renesas' browser-based software to visualize their sensor data on a cloud dashboard.

Renesas RX65N Cloud Kit & Amazon FreeRTOS Make Quick Cloud Connections Easy

APPLICATIONS
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How Bluetooth mesh networking technology provides a flexible, scalable and future-proof platform for wireless lighting control

By François Mirand
EMEA Technical Director at Future Lighting Solutions, a division of Future Electronics

If the optimistic claims of commentators on the lighting industry are to be believed, the long hoped-for dream has become reality: there is, it is said, a networking technology for implementing sophisticated wireless lighting control which is affordable, interoperable, easy to deploy, scalable, flexible and future-proof. This technology is Bluetooth® mesh networking, a capability provided by a recent version of the Bluetooth specifications.

It is fair to say that various component suppliers and solution providers to the lighting industry have made bold claims in the past for other wireless technologies such as ZigBee® and the EnOcean radio standard.

So how much faith should we have that this new Bluetooth technology is going to be any more widely adopted in lighting control than those earlier wireless platforms, and will last any longer?

A universal technology for connecting wireless nodes
In fact, the new Bluetooth mesh technology is fundamentally different from any wireless networking system deployed in lighting control, and these differences have a profound effect on its value to lighting suppliers and users. Bluetooth mesh networking offers these benefits:
- A universal, supplier-independent industry standard. Any manufacturer can develop standards-compliant hardware. Any qualified Bluetooth mesh device will interoperate with any other qualified device in a mesh network.
- Bluetooth wireless capability is built into every one of the billions of mobile phones and laptop computers in use today. So the devices that people carry with them every day are already able to connect to, and operate, any Bluetooth-based wireless lighting controls.
- Inherently reliable and secure: a mesh network provides multiple pathways for the transmission of messages. Unlike in a conventional network topology based on a central controller or gateway, a single failed node cannot disable the entire network. Strong security features are built into the protocol stack.
- Inherently scalable: the footprint of a conventional network based around a central controller is limited by the transmission range of the controller. The footprint of a Bluetooth mesh network, in which each node acts as a repeater or bridge to the next nearest node, may be continually extended by adding new nodes in range of any existing node. The maximum span between any two nodes is typically up to 25m inside a building. And building operators are not tied to the use of fixtures and devices from a single supplier and any qualified Bluetooth mesh device from any manufacturer may be added to an existing network.
- Easy to deploy: the nodes in a Bluetooth mesh network may be discovered and configured on-site according to a predesigned scheme by any Bluetooth-enabled smartphone or laptop computer.
- Future-proof: Bluetooth is a rigorously developed open standard which maintains backwards compatibility to protect the longevity of users' investments in network devices.

Read this to find out about:
- The ways in which Bluetooth mesh networking is superior to earlier wireless networking technologies used in lighting control systems
- How to embed Bluetooth mesh networking capability in a luminaire using off-the-shelf components or modules
- Hardware and software kits and tools available now to accelerate the design and deployment of Bluetooth mesh lighting control systems

Scalable, flexible, reliable, future-proof: these attributes of Bluetooth mesh technology are the characteristics that the lighting industry has been demanding, and which earlier wireless networking technologies were unable to provide as fully as a Bluetooth mesh.

But is it possible to gain the benefits of implementing this technology in production lighting equipment designs today?

The elements of a wireless lighting control system
A Bluetooth mesh-based wireless lighting control network consists of hardware, software, control and configuration components, as shown in Figure 1.

Fig. 1: The components of a Bluetooth mesh wireless lighting control system

The hardware is the end nodes, as no central controller or gateway is required in a Bluetooth mesh network: each luminaire, sensor and actuator (such as a dimmer switch) has its own Bluetooth System-on-Chip (SoC), a device which incorporates a 2.4GHz Bluetooth Low Energy radio and a microcontroller which can run the Bluetooth mesh protocol stack as well as the application firmware. In a luminaire, the Bluetooth radio may be embedded in just one of its components. For instance, in a luminaire which integrates a presence detection sensor, an LED driver and an LED light engine, the Bluetooth radio may be in any one of them, and Bluetooth control signals received by this component may be passed on to the other components of the luminaire via their wired connections.

Today, this Bluetooth capability may be provided by a Murata sensor module such as the LBCC2ZZ1 series. This small sensor, which may be screwed into a luminaire's housing, combines occupancy and daylight sensors with a 0 to 10V or two-wire DALI control output and a Bluetooth radio. The device runs a Silvair qualified Bluetooth mesh protocol stack and is therefore fully interoperable with any other qualified Bluetooth mesh node.

Bluetooth capability in a luminaire may alternatively be provided by the CNB30/40/50 series LED drivers under development at ERP Power, which will also provide a modular Bluetooth mesh capability. Or the luminaire manufacturer can add Bluetooth capability to an LED controller featuring a u-blox (formerly Rigado) BMD-300 or BMD-301 module. Because the u-blox product is a complete radio module, its integration into a light controller does not require any RF expertise on the part of the system developer, nor complex RF design and certification.

For fixture controllers and occupancy, daylight and motion sensor nodes, qualified Bluetooth mesh products are also available from suppliers such as Magnum Innovations or McWong, and soon from top tier lighting components suppliers.

So qualified Bluetooth mesh nodes provide wireless communications capability. The format and management of the messages that they carry is determined by protocol firmware.

The specifications of all official Bluetooth networking technologies, including Bluetooth mesh, are determined by the Bluetooth Special Interest Group (SIG) (www.bluetooth.com). The SIG is made up of representatives of member companies from across many industries. A standard-setting process which calls for collaboration between multiple independent entities inevitably takes time. While the Bluetooth mesh specifications were under development, various companies released proprietary Bluetooth mesh firmware: of these, Casambi is the best-known brand.

While suppliers of proprietary Bluetooth mesh protocols have the flexibility to enhance the features of their product as quickly as needed, without taking the time to gain approval from third parties, their products have one serious drawback: limited interoperability. A Casambi mesh network only works with devices which run the proprietary Casambi mesh firmware, which is a much smaller pool of products than the wider market of qualified Bluetooth mesh products.

Fortunately, the wait for the industry-standard Bluetooth mesh specification is over. What is more, certified Bluetooth mesh firmware is available from suppliers including Polish-Californian company Silvair, a participant in the Bluetooth SIG's mesh networking standard-setting committee.

The Bluetooth mesh firmware supplied by Silvair is configured for use in wireless lighting control networks. This means that, as well as supporting the core mesh networking function, it also provides lighting-control 'models', in Bluetooth-speak. Bluetooth models are sets of messages which can be used in particular kinds of applications. Examples include Light On/Off messages, Occupancy State messages and Transition Time messages.

Silvair also provides a complete suite of tools for setting up a lighting installation. These include:
- A production software programming tool for loading the firmware on an OEM's Bluetooth radio SoC
- A suite of commissioning tools and an app, to configure a network off-site, and then on-site to discover and commission connected devices using a smartphone or laptop computer
- Cloud software for remote user monitoring and control of an installation via a browser. (Remote monitoring requires the addition of a Bluetooth internet gateway or access point, which has no impact on the network configuration, but only exists to provide an interface to the outside world.)

So the protocol firmware enables the end nodes (luminaires, sensors and actuators) to communicate with each other, to interface with the other elements of the lighting system such as LED drivers, and to form a mesh network.

How is the network actually formed in practice?

This aspect of system implementation has in the past given installers the most headaches. When commissioning a DALI network, for instance, the wired network elements require a logical address scheme. A single error in either the wiring or the programming of the addresses will cause the control system to fail. The same applies to almost all wired and wireless network technologies that use any form of addressing.

Bluetooth mesh technology eliminates this problem. This is because it is an information-centric network. Nodes do not address each other: rather, the network follows a publisher-subscriber model (see Figure 2). A node can publish information: for example, a user control panel might publish a button press event in a specific zone. In real life, this might occur when a user wants to increase the brightness of the lighting in a conference room. Nodes which subscribe to this category of information will then act on the message content. For instance, an ERP Power Bluetooth LED driver in a luminaire in this conference room will increase the current to the LED light engine that it supplies.
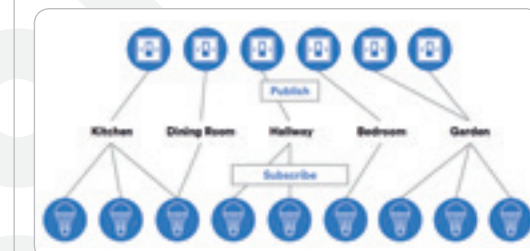

Fig. 2: A Bluetooth mesh network operates on a publisher/subscriber model. (Image credit: www.bluetooth.com)

This publish/subscribe networking principle radically changes the commissioning process. To configure a node, the installer simply needs to specify the types of network messages to which it is subscribed.

Should the network around it change, or a faulty node be replaced, or a sensor or actuator be added, the existing nodes need no re-configuration. And all qualified Bluetooth mesh components from any vendor can be configured and commissioned using the same, vendor-agnostic tool, such as the Silvair Commissioning app.

Commissioning tools also enable online monitoring of a pre-planned lighting scheme, to provide for error-free installation by multiple contractors on a single site.

The lighting control technology of the future, available today
As described above, various qualified Bluetooth mesh-capable hardware devices are available to buy now via a distributor such as Future Lighting Solutions. Silvair's Bluetooth mesh production-ready protocol firmware is also available, together with a full-featured commissioning tool.

Lighting equipment manufacturers and systems suppliers are able now to implement fully-fledged projects for wireless lighting control over a Bluetooth mesh network. In many cases, system development will be accelerated by the use of a reference design platform such as the Bluetooth mesh Demo Kit from Future Lighting Solutions, as shown in Figure 3, which is backed by technical support from the company's expert applications engineers.

So while earlier wireless lighting control technologies might have faltered for various reasons, the prospect for industry-wide adoption of Bluetooth mesh networking technology looks promising.

Fig. 3: The Bluetooth mesh Demo Kit from Future Lighting Solutions gives OEMs a model for the implementation of wireless control technology. (Image credit: Future Electronics)

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How to choose hardware security components for product designs

**By Cheong Wei Chua
Program Manager, Advanced Engineering Group
Future Electronics**

Read this to find out about:

• **The three main functions of hardware security components**
• **The key features of a Secure Element**
• **Requirements for secure authentication of cloud-connected devices**

Security is emerging as an important issue, especially with more counterfeit products appearing in the market and more edge node devices connecting to the cloud. Here, Future Electronics introduces three categories of hardware security solutions to address this market:
• **Anti-counterfeit**
• **Cloud authentication**
• **Trusted Platform Module (TPM)**

While security can be implemented in software, it is at higher risk of falling victim to a hacking attack. By contrast, a security system based on Secure Element hardware offers anti-tamper protection and trust provisioning. Secure MCUs also offer hardware-based crypto engines, but they are not necessarily tamper-resistant nor are they always recommended for trust provisioning, as shown in Figure 1.

In order to achieve a high level of security, private keys never leave the boundary of a Secure Element.

Furthermore, a Secure Element is recommended even if a microcontroller with Arm® TrustZone capability is used. Future Electronics can advise on the way that a TrustZone MCU will be provisioned, and help designers to evaluate the tamper resistance and ease of implementation.

Benefits of hardware security
Without a Secure Element, developers need to introduce bug-free firmware and may need to consider a shield to strengthen security. This means that a Secure Element offers ease of implementation in addition to a range of other benefits, as shown in Figure 2.

Certain secure MCUs offer some level of tamper resistance, but generally not as strong as that of a Secure Element.

Anti-counterfeit systems
Brand owners care about three factors in particular:
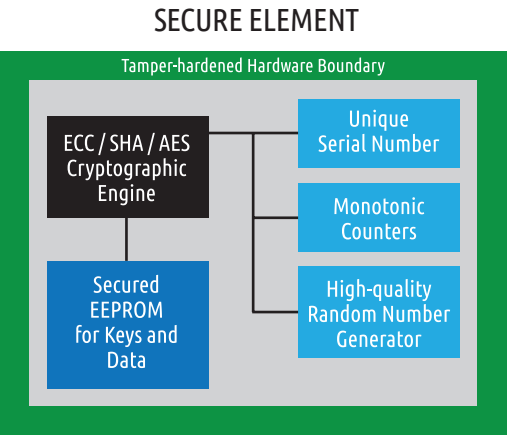• Brand protection
• Revenue protection
• Customer safety

SECURE ELEMENT

Fig. 1: Architecture of a Secure Element (left) and a secure microcontroller (right)

The availability of counterfeit products and accessories is a threat on all three counts. To counter the threat from counterfeiting, OEMs can integrate a Secure Element into their products. These low-power co-processors are usually tamper-resistant. They resist logical and physical attacks. The reason that they work is that they make it prohibitively expensive to extract their secret keys.

An OEM can use a relatively inexpensive Secure Element to prevent their customers from using counterfeit products. This could not only be a revenue concern but a safety issue as well. For example, counterfeit lithium batteries might not include the high-quality safety circuitry that branded batteries contain, and thus be at higher risk of exploding due to thermal run-away. Suppliers also offer asymmetric-based anti-counterfeit Secure Elements.

Target applications:
• Accessories
• Printer cartridges
• Batteries for portable devices
• Disposable medical devices
• E-cigarettes
• Disposables cosmetic products
• Adaptors

Recommended parts:
• Maxim Integrated DeepCover DS28E15
• Microchip ATSHA204
• NXP Semiconductors A1006
• Infineon Optiga™ Trust B

Cloud authentication systems
The second use case for hardware security systems is in cloud authentication. Edge node devices such as baby monitors, field sensors and consumer entertainment devices are in widespread use. As more devices get connected, the threat of malware injection or eavesdropping increases.

A secure connection to the cloud relies on Transport Layer Security (TLS), which uses public-key cryptography. To minimize the exposure of the private key to hacking or other attack, two factors need to be considered, with the aim of ensuring that keys do not fall into the wrong hands.

Fig. 2: The main benefits of security systems implemented in hardware
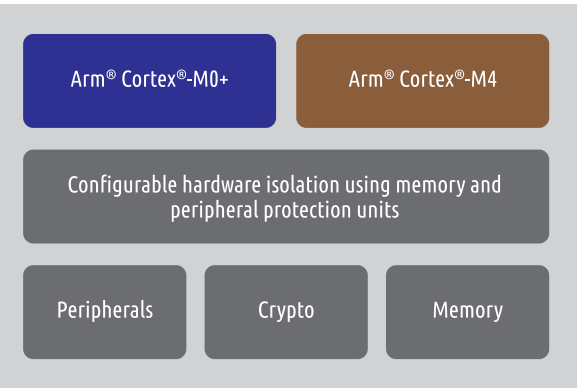
Secure Key Storage	Private keys are stored in a vault making it prohibitively expensive to gain access.
Side-panel Attacks Protection	Protection against hacking by monitoring power consumption or electromagnetic leaks.
Tamper Detection	Secure Elements are armed with sensors to detect tampering.
Trust Provisioning	Provisioning takes place on a highly secure programming platform.
Quality Random Numbers	If numbers are not random enough, hackers will determine a pattern to crack the code.
Performance	Secure Elements have hardware-accelerated crypto engines.

• Tamper resistance: keys must resist physical attack
• Trusted Provisioning: keys and certificates have to be provisioned in a secure manufacturing process. Manufacturers can also provide customer-specific production certificates to cloud providers to ensure that they will recognize the device as a valid entity.

For encryption, a secure MCU can do the heavy lifting. But in order to minimize the risk of exposing private keys, they are stored in a Secure Element which offers both optimal tamper resistance and Trust Provisioning.

Target applications:
Edge nodes can be found in:
• Consumer
• Industrial
• Factories
• Agricultural
• Medical
• Any device wanting to connect to the cloud with an IP address

Recommended parts:
• Maxim Integrated MAXQ1061/MAXQ1062
• NXP A71CH / SE050
• Infineon Optiga Trust X
• Microchip ATECC608A

Trusted Platform Module
The final category of hardware security systems is the Trusted Platform Module (TPM). The TPM specification was written by the Trusted Computing Group, which was formed by computing companies AMD, HP, Intel and Microsoft. This means that the original intended use case for a TPM was in PCs, tablets, servers and networking equipment.

Computer programs can use a TPM to authenticate hardware devices because each TPM chip has a unique and secret RSA key burned in it in the factory. Pushing the security down to the hardware level provides more protection than a software-only solution.

TPMs typically conform to Common Criteria specifications, certified with EAL4+ and FIPS 140-2. Systems which run on a Linux® or Windows® operating system might be able to take advantage of drivers which work with TPM devices to speed-up development time.

Target applications:
• Networked devices
• Cellular base stations
• Servers
• Multi-function printers
• Gambling/gaming machines
• Internet access points
• Smart appliances with network connectivity
• Test and measurement devices
• Mobile payment terminals
• Inventory control terminals

Recommended parts:
• Infineon Optiga TPMs
  – SLB 9670 TPM2.0
  – SLI 9670AQ20 - world's first automotive-qualified TPM
  – SLM9670AQ20 - IEC 62443 industrial TPM
• Microchip ATTPM20P

Advice worth noting
Finally, it is helpful to remember this advice from security technology guru Bruce Schneier: 'Security is a process, not a product.' [1]

Security is about more than designing strong cryptography into a system; it also calls for the design of the fail-safe system which ensures that all security measures, including cryptography, work together effectively.
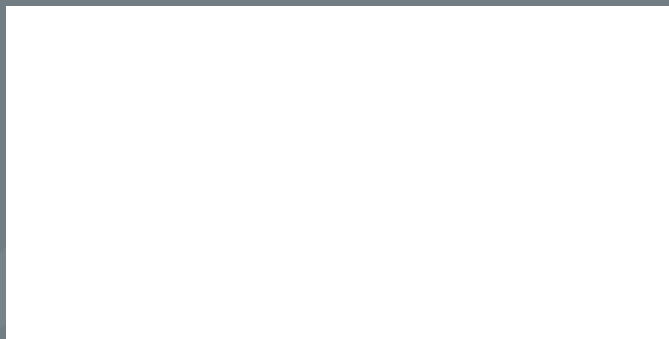
[1] *From www.schneier.com/essays/archives/2000/04/the_process_of_secur.html*

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