Chipset for display power supplies cuts component count in half

power integrations™

NEWS BRIEF

Power Integrations has introduced a new InnoMux™ chipset for display power supplies which consists of an InnoMux controller IC partnered with an InnoSwitch™3-MX quasi-resonant flyback converter IC.

TV and monitor designers who use the InnoMux chipset can realize a reduction in component count of more than half, completely eliminating a backlight boost converter and as many as two buck converters. This reduces manufacturing cost and provides an associated improvement in board reliability.

The chipset's unique single-stage power architecture reduces losses in display applications by increasing overall efficiency in constant-voltage and constant-current LED backlight driver stages by 50% compared to conventional solutions. The chipset offers up to 91% power-conversion efficiency.

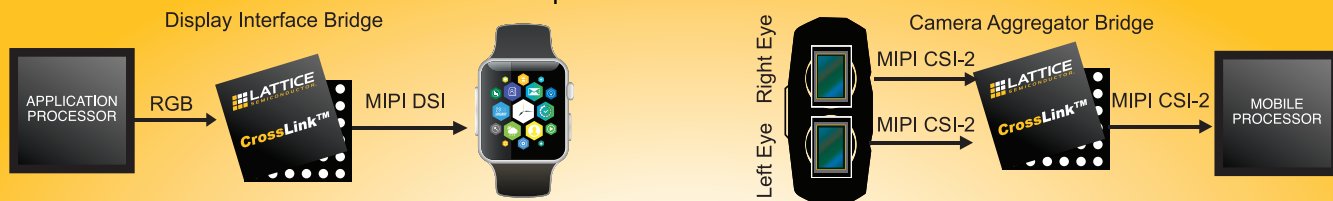| FOR PRICING AND SAMPLES E-MAIL: INFO@MY-FTM.COM | REFERENCE NUMBER 19-vi 01 |

INTRODUCING LATTICE'S CROSSLINK™ SOLUTION

The World's First FPGA with Hardened MIPI D-PHY for Image Sensor and Display Interface Bridging
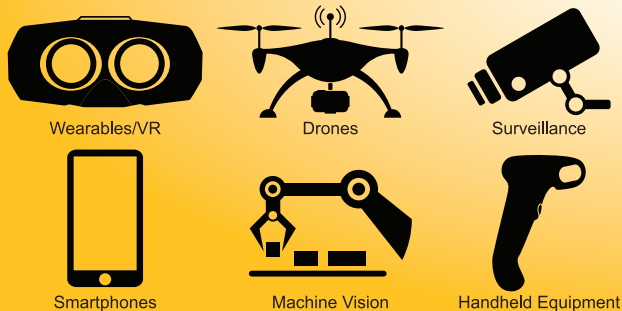
WHY CROSSLINK?

Solves the problem of interface mismatches

Display Interface Bridge

APPLICATION PROCESSOR → RGB → **LATTICE CrossLink™** → MIPI DSI →

Camera Aggregator Bridge

Right Eye / Left Eye — MIPI CSI-2 / MIPI CSI-2 → **LATTICE CrossLink™** → MIPI CSI-2 → MOBILE PROCESSOR

BRIDGING THE VIDEO CONNECTIVITY GAP

One Bridge. Endless Possibilities.

Wearables/VR

Drones

Surveillance

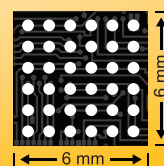Smartphones

Machine Vision

Handheld Equipment

LATTICE VS. THE COMPETITION

50% Higher I/O performance **12 Gbps**

2X – 3X Smaller footprint **6 mm² option**

20% – 50% Lower power in active mode

6 mm × 6 mm

FREE DEVELOPMENT BOARD

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LATTICE SEMICONDUCTOR™

Your Link to Advanced Connectivity: www.latticesemi.com/CrossLink

Robust new IR sensor detects refrigerant gas leaks

The INIR infrared sensor range from SGX Sensortech provides a fully linearized, temperature-compensated measurement output for use in instruments for detecting the presence of propane, methane or carbon dioxide.

The INIR sensors are particularly well suited to the detection of refrigerant gases because of their reliable performance in the presence of humidity and condensation. Novel hardware and firmware combine to compensate for optical occlusion of the IR photodetector caused by condensation. This reduces the risk of false alarms when used in wet applications, and enables trouble-free refrigerant gas leak detection when used in wet or humid conditions.

The INIR devices are mechanically robust: a special mounting arrangement provides high resistance to mechanical shocks and vibration.

The INIR sensors can be connected to a data bus to allow for multi-sensor operation. Each sensor has a unique addressable code: the host controller can communicate individually with each sensor to perform zonal gas monitoring.

The IR sensing technology used by the SGX Sensortech products is especially valuable in applications exposed to toxins or to wet conditions, in which catalytic sensors and Metal Oxide (MOX) semiconductor sensors are not suitable.

INIR sensors: Resistant to shock and vibration

ENERGY | **INDUSTRIAL** | LIGHTING | MEDICAL | TRANSPORT | SECURITY | CONSUMER | TELECOMS

APPLICATIONS
- Gas detection instruments

FEATURES
- Factory-calibrated for propane, methane or carbon dioxide detection
- Built-in temperature compensation
- Digital and analog outputs
- <120mW average power consumption in continuous operation

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Single-stage LED driver-controller offers space and power savings

Diodes Incorporated has announced the introduction of the AL1665 AC-DC power controller for commercial, connected and dimmable LED lighting installations consuming up to 100W.

The AL1665 can implement single-stage flyback and buck-boost topologies. It drives an external MOSFET to control LED loads and maintain a high power factor. It provides a compact and efficient solution which helps to minimize the use of additional components and maintains high switching efficiency.

Operating from an input voltage of between 85V and 305V AC, the AL1665 uses Primary-Side Regulation (PSR) topologies which eliminate the need for optical isolation or secondary-side control. The benefit of PSR topologies is that developers can design smaller solutions which occupy a smaller PCB area and have a lower bill-of-materials cost, while providing constant-current regulation to high-power LED lighting applications.

The ability to apply dimming down to 0.5% of full brightness makes the AL1665 suitable for commercial LED applications in which the light output needs to be adjustable to save power, or for aesthetic purposes, as in retail displays.

Compatible with ANSI-approved dimmers, the output voltage can be adjusted between 0V and 10V using a dedicated PWM input, or with an analog input voltage of between 0V and 2.5V, making it simple to develop connected lighting systems that can be managed locally or remotely.

The device employs boundary condition-mode conversion with valley switching to minimize losses and raise efficiency while generating low levels of EMI.

The AL1665 supports analog and digital dimming methods

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APPLICATIONS
- Commercial dimmable LED lighting
- LED backlight drivers
- General-purpose constant-current source

FEATURES
- <±2% line and load regulation accuracy
- >0.9 power factor
- <20% total harmonic distortion
- Multiple circuit protection functions

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New automotive power choke coil resists vibration and acceleration forces

Panasonic
INDUSTRY

Panasonic Industry has introduced the ETQ-P5M2R5YSK, an automotive power choke coil which offers high vibration resistance for use in Electronic Control Units (ECUs) in the engine bay. It can be integrated into ECUs with no anti-vibration reinforcement, helping to streamline the production process.

The fast-growing market for environmentally friendly and energy-efficient cars is creating new pressure to advance the electrification of the automotive sector. This move to electrification calls for more electric motors to be integrated into vehicle systems to improve efficiency and passenger comfort. Each motor requires an ECU, and more and more of the ECUs in new vehicle designs are being mounted within the engine itself, giving the benefits of space-saving and resilience.

As a consequence, the components used in these ECUs require a high temperature rating,

must be capable of handling high currents, and have to withstand severe vibrations.

The ETQ-P5M2R5YSK power choke coil now offers a new option for automotive OEMs that are developing engine-mounted ECUs. It can withstand vibrations in three dimensions of up to 50g. Rated current, which produces a temperature rise of no more than 40K in a device mounted on an FR4 board, is a high 12.0A. Maximum operating temperature is 150°C.

Thanks to Panasonic's use of ferrous alloy magnetic material, the ETQ-P5M2R5YSK

provides excellent inductance stability even at a high bias-current input and over the entire operating-temperature range.

Panasonic also supplies the ETQ-P5MR68YSC, another vibration-resistant power choke coil for automotive applications.

APPLICATIONS
- Automotive electric motors
- Drivetrain systems
- Body electronics
- Input filters
- DC-DC converters

FEATURES
- AEC-Q200 qualified
- Low audible buzz noise
- 1.9g weight
- Metal composite core

Part Number	Case Size	Inductance at 100kHz	DC Resistance at 20°C	Rated Current
ETQ-P5M2R5YSK	8.5mm x 8.0mm	2.45µH	7.4mΩ	12.0A
ETQ-P5MR68YSC	10.9mm x 10.0mm	0.68µH	1.7mΩ	27.0A

Vibration Durability Conditions	
Vibration acceleration	50g (490m/s²)
Frequency	5Hz to 2,000Hz
Amplitude	5mm maximum
Vibration directions, number of times (Time)	X, Y, Z directions, 10^8 times (equivalent to 100h)
Temperature	150°C (including product's self-heating when energized)

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REFERENCE NUMBER
19-vi 05

New transmitter and receiver coils for Qi-compliant wireless charging pads

VISHAY®

Vishay Intertechnology is supporting the growing market for Qi-compliant wireless charging pads with the introduction of 11 new power transmitter coils and three new receiver coils in industry-standard shield sizes and a variety of lead lengths.

The new IWTX transmitter coils and IWAS receiver coils offer designers a new source for the most popular sizes used in standard Qi wireless charging pads for handheld battery-powered devices such as mobile phones.

Vishay has introduced eight new single-coil transmitters and three three-coil transmitters. The transmitter coil types include A11, A6, MP-A9, MP-A6, MP-A4, and MP-A2, with power ratings ranging between 5W and 15W.

The receiver single coils are rated at 3.5W or 5W.

Vishay coils for wireless charging are available in various lead lengths

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APPLICATIONS
• Wireless charging pads

FEATURES
• +10% inductance tolerance
• Customizable to an OEM's specifications on request
• Operating-temperature range: -40°C to 125°C

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Discrete magnetics for Ethernet interfaces help improve EMI and over-voltage characteristics of industrial equipment
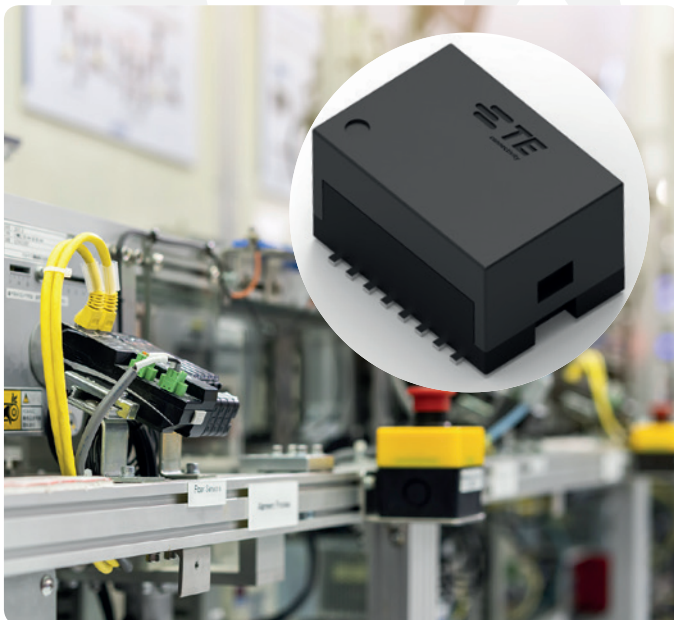
TE connectivity

Industrial discrete magnetics products from TE Connectivity (TE) provide flexibility to designers of equipment that includes embedded Ethernet interfaces, enabling them to realize improved transmission characteristics and meet over-voltage requirements.

The TE parts offer an extended operating-temperature range of -40°C to 105°C, allowing customers to use them in industrial environments subject to high ambient temperatures. They are compatible with standard 10/100Mbits/s or 1Gbit/s Ethernet interfaces.

The new discrete magnetics range complements TE's existing RJ45 jacks with integrated magnetics, giving designers a choice between:
• Greater flexibility when using the discrete parts
• Reduced board footprint and a lower component count when using the integrated jacks

TE Connectivity: Discrete magnetics support Ethernet transmission rates up to 1Gbit/s

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APPLICATIONS
• Programmable logic controllers
• I/O modules
• Servo drives
• Industrial PCs
• Other industrial equipment

FEATURES
• 1,500V AC_{rms} dielectric withstanding
• Supports voltage- or current-mode applications
• Three-wire choke for Power-over-Ethernet interfaces
• Compatible with reflow soldering profiles at 260°C
• Supplied in surface-mount and optional through-hole packages

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

Sub-miniature tact switches ideal for home automation and IoT devices

C&K

C&K has introduced two new sub-miniature tact switches aimed at design engineers developing home automation and IoT devices.

Competitively priced, the new PTS526 switch has a 5.2mm x 5.2mm footprint and an adjustable thickness of between 0.8mm and 2.0mm. The PTS636 switch has a 6.0mm x 3.5mm footprint and an adjustable thickness of 2.5mm, 4.3mm or 5.0mm. These single-pole, single-throw switches provide a large actuation surface for easier integration into the host system.

Both the PTS526 and PTS636 switches are supplied in surface-mount packages. The PTS636 is also available in a through-hole format. The switches use a hard actuator, ensuring that it can be fully integrated into standard production processes with no need for an additional interface button, reducing time and costs for the end equipment manufacturer.

The PTS636 series includes a 2.5mm-height version with an integrated Ground pin. The PTS526 is also available with an integrated Ground pin.

The PTS636 is available with four different operating-force options: 130gf, 180gf, 250gf and 320gf. Users of the PTS526 can choose from three actuation-force options: 160gf, 250gf and 320gf.

Operating lifetime is rated at 100,000 to 500,000 cycles for the PTS526, and at 20,000 to 100,000 cycles for the PTS636.

C&K: No additional interface button

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APPLICATIONS
- IoT devices
- Home automation
- Remote controls
- E-cigarettes
- Drones
- E-bikes
- Robotic vacuum cleaners

FEATURES
- 12V DC maximum voltage
- 50mA maximum current
- 250V AC dielectric strength
- ≤100mΩ initial contact resistance
- ≥100MΩ insulation resistance
- ≤10ms bounce time
- Operating-temperature range: -20°C to 70°C

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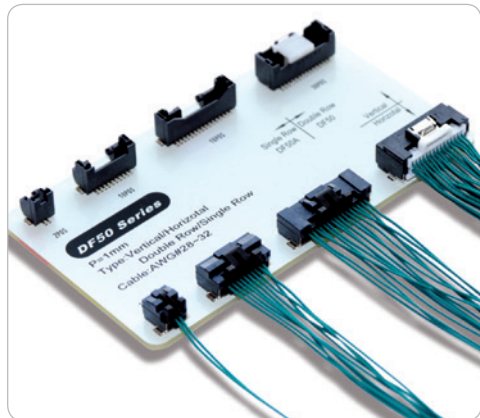

Compact wire-to-board connectors provide robust performance in industrial applications

HRS HIROSE ELECTRIC EUROPE B.V.

Hirose's DF50 and DF50A series of wire-to-board connectors for industrial applications feature a pitch of 1mm and a robust lock for secure mating.

The DF50/DF50A series consists of single- and double-row receptacles and headers in vertical and horizontal formats. Compact and durable, the connectors are ideal for applications that call for strength and reliability.

These low-profile and robust connectors have surface-mount contacts. A metal lock provides a consistent and positive tactile click with repetitive mating. This ensures the connector is fully engaged to guarantee complete electrical and mechanical connection. The lock is located at the center of the connector to avoid uneven locking and cable entanglement.

The housings have thick and sturdy walls to prevent cracking. A long insertion depth and blade contacts prevent wrenching forces from causing damage to the connector.

The receptacle features a robust and reliable lance structure which keeps the contacts securely in place even when high forces are applied to the cable. Gold plating and a long effective mating length ensure high contact reliability.

The DF50 connector has a single-row configuration of 2 to 16 contacts. The DF50A has a double-row configuration of 20 to 50 contacts.

DF50: High contact reliability

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APPLICATIONS
- LCD monitors
- Wireless LAN equipment
- Industrial controllers
- Car navigation equipment
- Car audio equipment
- Point-of-sale terminals
- Desk phones

FEATURES
- 1A maximum current rating
- 100V AC/DC maximum voltage rating
- Cable size: AWG 26 to AWG 32
- 30 mating cycles
- Operating-temperature range: -35°C to 85°C

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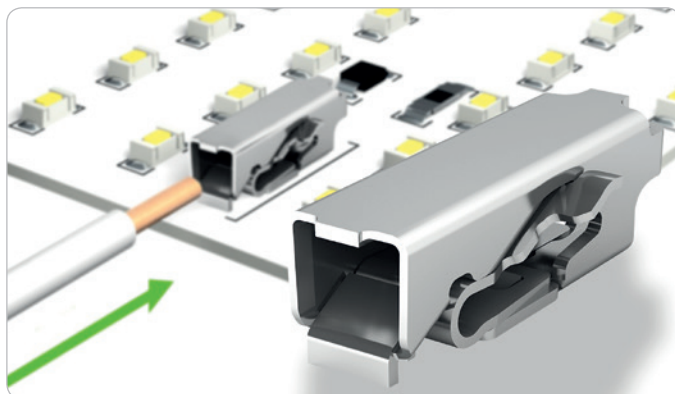
PCB terminal blocks' push-in termination saves need for wire soldering

WAGO

WAGO's 2065 series of surface-mount PCB terminal blocks features Push-in CAGE CLAMP® technology, which means that solid or tinned conductors may be terminated by pushing them into the block's aperture. The push-in termination technology provides a reliable and repeatable alternative to wire soldering.

The 2065 terminal blocks also provide for convenient termination and removal of fine-stranded conductors with an operating tool which has the part number 2065-189.

The tool depresses the push-button to open the spring, while its funneled conductor opening securely guides the stranded conductor into the terminal block.

The compact design of the 2065 blocks, at just 2.7mm high, makes it an optimal PCB connection solution in any space-constrained application.

The 2065, which has no insulating housing, is intended for use in applications operating at a Safety Extra Low Voltage (SELV), or for connections inside enclosures in which protection against contact with high voltages is provided by the end product.

WAGO 2065 series: Ideal for LED lighting

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APPLICATIONS
- Automation controls
- IIOT devices
- Industrial sensors and gauges
- Appliances
- Power tools
- LED lighting
- Electronic detonators

FEATURES
- 9A maximum current
- 600V maximum voltage with proper spacing
- PUSH WIRE® version for solid conductors available with no push-button
- Wire sizes: 18 AWG to 24 AWG
- 4kV maximum impulse voltage

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Micro-coaxial receptacles offer excellent electrical performance in small form factor

TE connectivity

TE Connectivity's (TE) surface-mount micro-coaxial receptacles offer excellent electrical performance, enabling users to connect an RF cable assembly or antenna to a main PCB.

TE's 2334884-1 and 2337019-1 micro-coaxial receptacles are drop-in replacements for other RF receptacles on the market, so require no change in PCB layout.

The TE micro-coaxial receptacles are manufactured to highly precise tolerances, giving repeatable performance across all production units.

TE Connectivity's micro-coaxial receptacles: High production quality

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APPLICATIONS
- Wearable devices
- Rugged phones
- Smart meters
- Smart speakers
- Infotainment equipment
- Industrial devices

FEATURES
- UMCC RF interface
- 50Ω impedance
- 6GHz maximum operating frequency
- 60V AC voltage rating
- Integrated EMI shielding
- Operating-temperature range: -40°C to 85°C

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New tool provides machine learning algorithm enablement for NXP MCUs, MPUs and SoCs

NXP

NXP Semiconductors' eIQ Machine Learning (ML) software environment provides the key ingredients to perform inference of neural network models on embedded systems, and to deploy various ML algorithms on NXP microprocessors and microcontrollers at edge nodes.

The eIQ environment includes inference engines, neural network compilers and hardware abstraction layers. It also supports four main inference engines and libraries:

• OpenCV
• Arm® NN
• CMSIS-NN
• Google TensorFlow Lite

The eIQ ML software currently supports NXP's i.MX and i.MX RT series of processors. Over time, NXP will extend device compatibility to cover its MCUs and other MPUs as well .

   The software includes a variety of application examples which demonstrate how to integrate neural networks into voice, vision and sensor applications. Users can take advantage of existing MCUs or MPUs to accelerate ML application development without requiring hardware specific to machine learning.

   The eIQ ML software for i.MX RT crossover processors is fully integrated into the MCUXpresso SDK release v.2.6.x. It is also included in NXP's Yocto Linux® board support package and MCUXpresso software development kit v.2.6.0 release.

NXP's eIQ environment: Supported by various application examples

APPLICATIONS

• Smart wearable devices
• Intelligent factories
• Medical equipment
• Augmented reality
• Anomaly detection

FEATURES

• Open-source inference engines
• Neural network compilers
• Optimized libraries
• Application samples

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REFERENCE NUMBER
19-vi 12

New 1A and 2A rectifiers increase power density and improve efficiency

VISHAY®

Vishay has expanded its offering of FRED Pt® ultra-fast recovery rectifiers with eight new 100V- and 200V-rated devices housed in a space-saving eSMP® series SMP (DO-220AA) package.

FRED Pt® Rectifiers in SMP Package
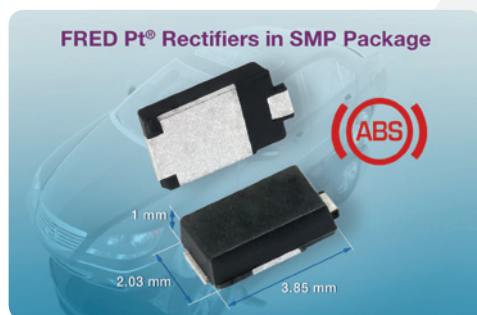
The new series of rectifiers includes the industry's first in an SMP package to offer a maximum current rating of 2A.

   Designers can increase the power density of converters and inverters by replacing existing rectifiers in a standard SMA (DO-214AC) package with these new SMP devices, which occupy 24% less board space, without any loss of current-carrying capacity.

   The new FRED Pt rectifiers' low forward-voltage drop reduces power losses and improves efficiency. The housing's asymmetric design, which features a large metal pad for heat dissipation, produces excellent thermal performance.

   These new Vishay parts are notable for ultra-fast reverse-recovery times as short as 14ns. The rectifiers also feature low reverse-recovery charge of as little as 10nC.

APPLICATIONS

• High-frequency inverters
• DC-DC converters
• Freewheeling diodes
• Power factor correction
• Automotive systems
• Telecoms equipment
• Industrial power supplies

FEATURES

• Soft recovery behavior
• SMP package dimensions: 3.9mm x 2.0mm, 1.0mm high
• Compatible with automated placement equipment
• Allows for automated optical inspection in automotive systems
• Operating-temperature range: -55°C to 175°C

Part Number	Maximum Forward Current	Breakdown Voltage	Forward Voltage at Maximum Forward Current	AEC-Q101 Qualified
VS-1ENH01HM3	1A	100V	0.69V	Yes
VS-1ENH02HM3	1A	200V	0.69V	Yes
VS-2ENH01HM3	2A	100V	0.79V	Yes
VS-2ENH02HM3	2A	200V	0.79V	Yes
VS-1ENH01-M3	1A	100V	0.69V	No
VS-1ENH02-M3	1A	200V	0.69V	No
VS-2ENH01-M3	2A	100V	0.79V	No
VS-2ENH02-M3	2A	200V	0.79V	No

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REFERENCE NUMBER
19-vi 13

Wireless multi-sensor dev kit includes user-friendly app for IoT and wearable applications

STMicroelectronics has introduced a ready-to-use box kit which provides a wireless IoT and wearable sensor platform for the development of apps based on remote motion and environmental sensor data.

The SensorTile.box, which has the part number STEVAL-MKSBOX1V1, fits into a small plastic box with a long-life rechargeable battery, and is supported by an ST smartphone app. The app connects via a Bluetooth® wireless link to the board, and launches the wide range of default IoT and wearable sensor applications.

The board's sensors include:
- LSM6DSOX iNEMO six-axis inertial module, accelerometer, gyroscope with Finite State Machine and Machine Learning Core embedded
- LIS2DW12 three-axis MEMS accelerometer very low power and high accuracy
- LIS3DHH three-axis digital inclinometer
- LIS2MDL three-axis digital magnetometer
- LPS22HH digital pressure sensor, high accuracy for pressure and temperature

- MP23ABS1 MEMS analog bottom-port microphone with up to 80KHz bandwidth
- HTS221 digital sensor for relative humidity and temperature measurement
- STTS751 low-voltage local digital temperature sensor

The board also provides three interface buttons and three LEDs, an STM32L4 microcontroller to manage sensor configuration and to process sensor output data, a micro-USB battery charging interface, and an SPBTLE-1S Bluetooth Low Energy module. SensorTile.box is now integrated in CubeMX, version 5.3 and above.

The kit's small protective shroud and long-life battery make it suitable for testing wearable and remote monitoring and tracking IoT applications. Sample applications provided by ST include:
- Barometer
- Compass and tilt measurement
- Step counter
- Baby crying detector
- Vibration monitoring for predictive maintenance
- Data recorder and vehicle/goods tracking
- Compensated magnetometer

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APPLICATIONS
- Asset tracking
- Smart logistics
- Wearable devices
- Consumer electronics
- Predictive maintenance
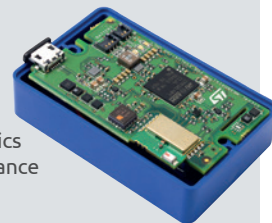
FEATURES
- Programming and debugging interface for professional firmware development
- Expert mode for advanced sensor settings
- Supports ST's STM32 Open Development Environment

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Industry's smallest, cheapest stacklights include acoustic output options

While industrial and medical equipment designers have taken advantage of advanced electronics to decrease the size of their products, stacklights have failed to shrink at the same rate in recent years.

Now, however, Mallory has introduced a series of 30mm ultra-compact Stacklights which are less than half the size of competing products, at a lower cost. They are available with up to three state-of-the art LED stacks in red, yellow and green; some are also available with sound. Designers can choose Stacklights with either a direct-mount package or with a 4-inch extension pole for better visibility.

The Stacklights with sound can produce seven different sound types, including a chime tone which is suitable for an office or laboratory environment.

Benefiting from advanced design and acoustic techniques, Mallory's Stacklights with sound are identical in size to the Stacklights without sound, so there is no size penalty for adding an indication sound.

The Mallory Stacklights are small and light enough to be mounted directly on top of a control box, which is a unique feature. They are also ideal for smaller equipment such as 3D printers and measurement equipment.

STACKLIGHT – LIGHT ONLY

Part Number	Nominal Voltage	Stack Colors	Mount Type
JR16-R-D	12V DC	R	Direct
JR16-R-4	12V DC	R	4" Pipe
JR16-RYG-D	12V DC	RYG	Direct
JR16-RYG-4	12V DC	RYG	4" Pipe
JR28-R-D	24V AC/DC	R	Direct
JR28-R-4	24V AC/DC	R	4" Pipe
JR28-RYG-D	24V AC/DC	RYG	Direct
JR28-RYG-4	24V AC/DC	RYG	4" Pipe

STACKLIGHT WITH SOUND

Part Number	Nominal Voltage	Stack Colors	Mount Type
JR16-R-DLCT1	12V DC	R	Direct
JR16-R-4LCT1	12V DC	R	4" Pipe
JR16-RYG-DLCT1	12V DC	RYG	Direct
JR16-RYG-4LCT1	12V DC	RYG	4" Pipe
JR28-R-DLCT1	24V AC/DC	R	Direct
JR28-R-4LCT1	24V AC/DC	R	4" Pipe
JR28-RYG-DLCT1	24V AC/DC	RYG	Direct
JR28-RYG-4LCT1	24V AC/DC	RYG	4" Pipe
JR16-RYG-DLCM1	12V DC	RYG	Direct
JR28-RYG-4LCM1	24V AC/DC	RYG	4" Pipe

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APPLICATIONS
- Label printers and 3D printers
- Scientific and laboratory equipment
- Measurement equipment

FEATURES
- Opaque white lens
- 3.9kHz sound frequency
- IP52 and NEMA 12 ratings
- cUL approval

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EEPROM features NFC RF interface for contactless and batteryless data monitoring

ON Semiconductor® ![ON]

ON Semiconductor's N24RF family of NFC EEPROM products provides a scalable design solution which combines conventional EEPROM functionality with an integrated NFC interface for contactless reading and writing of data.

Like a conventional non-volatile EEPROM device, the N24RF includes a digital I²C interface. The NFC interface provides an additional option for contactless reading and writing via an NFC reader such as a smartphone equipped with an NFC radio. The device can communicate with a reader over a range of up to 1.5m.

Some parts in the N24RF series also include energy-harvesting capability: these devices can power themselves from the energy of the reader's RF field during communication, which enables the implementation of batteryless designs.
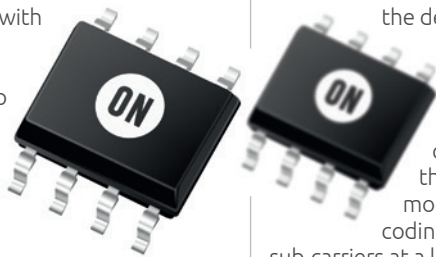
The N24RF series is available in two package options: an SOIC-8 measuring 4mm x 5mm x 1.75mm, and a TSSOP-8, which is 3.1mm x 4.5mm x 1.2mm.

The N24RF's data encoding function provides the designer with options for selecting the optimal data rate. For data transfer to the tag, ASK modulation is used at 1.65kbits/s or 26.48kbits/s data rates. From the tag, the N24RF implements load modulation using Manchester coding with 423kHz and 484kHz sub-carriers at a low (6.6kbits/s) or high (26kbits/s) data rate.

The N24RF also supports a 53kbits/s data rate with fast commands.

APPLICATIONS
- Predictive maintenance
- Contactless data monitoring
- Contactless firmware updating

FEATURES
- ISO 15693/ISO 18000–3 Mode 1 compliant
- Range up to 150cm
- Air-interface communication at 13.56MHz
- Read and Write 32–bit block mode
- Anti-collision support
- 64–bit unique identifier
- Multiple 32-bit passwords and Lock feature for each user memory sector
- Supports Fast and Fast-Plus I²C protocols
- 4–byte page write buffer
- Schmitt triggers and noise suppression filters on I²C bus inputs
- 2,000,000 program/erase cycles
- 200 years' data retention
- Operating-temperature range: -40°C to 105°C
- Supply-voltage range: 1.8V to 5.5V

Density	Part Number SOIC-8 Package Option	Part Number TSSOP-8 Package Option
64kbits	N24RF64DW	N24RF64DT
16kbits	N24RF16DW	N24RF16DT
4kbits	N24RF04DW	N24RF04DT

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REFERENCE NUMBER **19-vi 16**

Highly sensitive ambient light sensor enables accurate backlight dimming in wearable devices and smartphones

The optoelectronics group of Vishay Intertechnology has introduced a new ambient light sensor to support backlight dimming control in smart watches, sports wristbands and mobile phones, in which very high sensitivity is needed to allow light to be sensed through dark cover glass.

The VEML6035 features a highly sensitive photodiode, a low-noise amplifier and a 16-bit ADC in a transparent surface-mount package which measures only 2mm x 2mm x 0.4mm, small enough for use in compact consumer devices.

The sensor features Filtron™ wafer-level optical filter technology which makes the VEML6035's spectral sensitivity to ambient light very similar to that of the human eye.

The VEML6035 provides an active interrupt feature which is triggered outside the threshold window settings, avoiding the need for instructions from the host.

Integrated temperature compensation maintains output stability over the operating-temperature range. A programmable shut-down mode keeps quiescent current to a low 0.5μA.
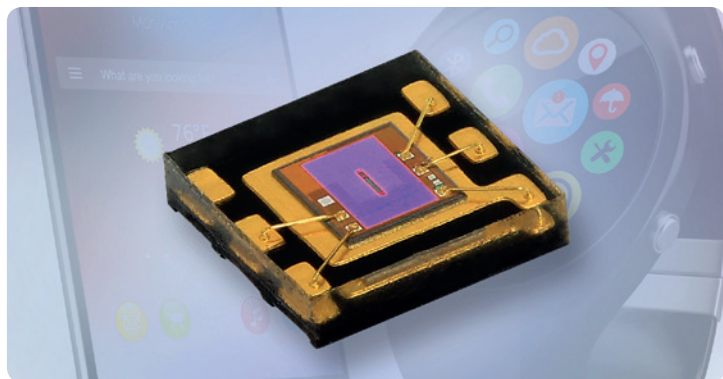
VEML6035: Spectral responsivity closely matches that of the human eye

APPLICATIONS
- Mobile devices
- Backlight dimming control
- Optical switches
- Consumer electronics
- Computing equipment
- Industrial equipment

FEATURES
- 170μA operating current
- Highly linear behavior between 0.004lux and 6,710lux
- High optical resolution
- Configured with simple I²C commands
- 100Hz and 120Hz flicker noise rejection

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REFERENCE NUMBER
19-vi 17

Digital temperature sensor produces fast, accurate outputs

The STTS751 is a digital temperature sensor, providing fast and accurate temperature measurements over a range from -40°C to 125°C.

STMicroelectronics specifies the STTS751's accuracy at ±0.5°C. The device also offers user-configurable resolution of between 9 and 12 bits, allowing the designer to optimize for speed or precision. At the default 10-bit resolution of 0.25°C/least significant bit, the conversion time is nominally 21ms.

The 9-bit resolution option produces measurement steps of 0.5°C, and at 12 bits, the output is resolved to steps of 0.0625°C. The device can perform up to 32 conversions/s.

The STTS751 communicates over a two-wire SMBus 2.0-compatible bus. The open-drain Event output is used to indicate an alarm condition in which the measured temperature has exceeded the user-programmed high limit or fallen below the low limit.

The STTS751 is a six-pin device which supports user-configurable slave addresses. As many as eight STTS751 devices can share the same SMBus without ambiguity, allowing the independent monitoring of multiple temperature zones.

STMicroelectronics' temperature sensing probe and adapter board evaluation kit

APPLICATIONS
- Solid-state drives
- Portable electronics
- Notebook computers
- Smart batteries
- Servers
- Telecoms equipment

FEATURES
- Supply-voltage range: 2.25V to 3.6V
- 50μA operating current at 8 conversions/s
- 3μA stand-by current
- Supports 400kHz serial clock

FREE DEVELOPMENT BOARD

The STEVAL-MKI198V1K evaluation kit consists of a probe with the STTS751 temperature sensor connected via flat cable to the STEVAL-MKIGIBV1 adapter board, so it can interface with the STEVAL-MKI109V3 motherboard.

Orderable Part Number: STEVAL-MKI198V1K

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REFERENCE NUMBER
19-vi 18

Optical sensing technology goes to work in the latest robotic vacuum cleaners

VISHAY®

By Jim Toal
Senior Manager, Product Marketing for Vishay Optoelectronics

Robotic vacuum cleaners may use either optical sensors or cameras to navigate around a room. Camera-based vacuums can 'see' where they are going and avoid collisions, but they are expensive products. Cheaper optical sensor-based vacuums depend on contact between the bumper on the vacuum and objects such as table legs to navigate around the obstructions in the room that they are cleaning, as shown in Figure 1.
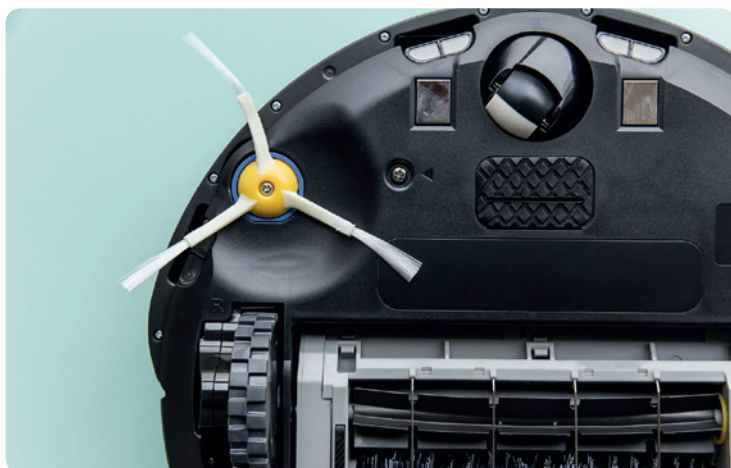

Fig. 1: A robotic vacuum cleaner has a bumper around its entire circumference

The design of an optical sensor-based robotic vacuum cleaner features an air gap between the bumper and the body of the cleaner. In the gap is a ring of light. When the bumper hits a table leg, the ring of light is broken because the bumper collapses just enough to block the light.

A 'No light' interrupt from the sensor is translated by a microcontroller as a signal that the device has hit an obstruction. The vacuum cleaner then stops, turns at an angle and attempts to move forward again, in an attempt to find a clear path. The ring of light may be created by:
• Discrete infrared emitters and photo-detectors
• Reflective sensors
• Or integrated light-to-digital sensors, such as the VCNL36687S proximity sensor from Vishay

Discrete infrared emitters and detectors could be used in several possible configurations. A single high-powered emitter could be coupled to one end of a flexible light pipe, with a photodiode at the other end. When the cleaner bumps into an object the bumper pinches the light pipe, interrupting the stream of light.

A different configuration would require breaking the bumper into sections. Each section would have an IR emitter pointed at a phototransistor which is parallel to the outer ring. When the subsection of the bumper hits an object, it deflects inward and breaks the beam of light, again producing a 'No light' signal. This can be accomplished using discrete emitters and detectors, or an integrated photo-interrupter. In both cases, the output of the photo-detector is a current which will be amplified, then converted and interpreted by a microcontroller.

While optical sensing in the bumper can handle obstructions on a flat plane, cliffs are a different concern for robotic vacuum cleaners. Stairs, for instance, are a series of cliffs, as shown in Figure 2. To avoid falling down a cliff, a light-to-digital proximity sensor may be used, pointing down at an angle towards the floor, and located on the leading edge of the vacuum cleaner. A proximity sensor integrates an IR emitter, photodiode and signal-processing circuits in a single package. The output of a sensor such as the 12-bit VCNL36687S from Vishay is a digital count from 0 to 4,095.

Fig. 2: A proximity sensor detects the cliff edge underneath the robot

When moving normally along the floor, the light from the emitter is reflected from wooden, tiled or carpeted surfaces to the photodiode. A High count is read by the sensor, and passed to an MCU via an I²C interface. At a cliff edge, the count drops to zero because there is no floor from which light can be reflected. This zero count triggers the MCU to stop the robot.

To ease the load on the MCU, the system can avoid constantly polling for proximity counts: instead, the sensor can react when the count passes an internally configured threshold, and pass this information on to the MCU via a simple command on an Interrupt pin.

This means that the sensor system must be smart enough to know the difference between the transition from a reflective surface to a cliff, and from a reflective surface such as wood to a different surface such as dark deep-pile carpet, which absorbs IR light.

One of the most important functions of a robotic vacuum cleaner is to know how far it has travelled. This too uses an optical sensor: a transmissive sensor or slotted interrupter which has an IR emitter directing light to a phototransistor across a gap through which a codewheel passes. The transmissive sensor is supplied as a single package, as shown in Figure 3.

Fig. 3: Vishay's TCUT1630X01 transmissive sensor
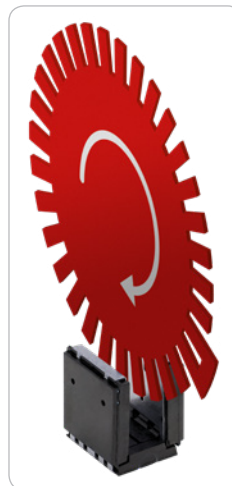
The codewheel is attached to the axle driving the wheels, and interrupts the IR light which is directed towards the phototransistor, as shown in Figure 4. This assembly forms a device known as an optical encoder. The use of a three-channel transmissive sensor such as the TCUT1630X01 allows the robot to keep track not only of distance travelled, but also forward and reverse motion, and, if necessary, the number of revolutions.

Fig. 4: An optical encoder assembly based on Vishay's TCUT1630X01 transmissive sensor

FOR MORE DETAILS AND DATA E-MAIL: INFO@MY-FTM.COM

REFERENCE NUMBER
19-vi 19

32-bit MCUs provide memory protection features

The STM32G431 32-bit microcontrollers from STMicroelectronics are based on the high-performance Arm® Cortex®-M4 32-bit RISC core, and operate at a frequency of up to 170MHz.

The MCUs' processor core implements a full set of digital signal-processing instructions and a memory protection unit. The devices also embed several protection mechanisms for embedded Flash memory and SRAM, including:
- Read-out protection
- Write protection
- Securable memory area
- Proprietary code read-out protection

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

The STM32G431 devices embed 128kbytes of high-speed Flash memory, and 32kbytes of SRAM. They also offer an extensive range of enhanced I/Os and peripherals.

Analog provision includes two fast 12-bit ADCs, four comparators, three operational amplifiers, four DAC channels, an internal voltage-reference buffer and a low-power real-time clock.

STM32G4 mixed-signal MCUs shaped for analog-rich applications

- 170MHz Cortex®-M4 core
- New math accelerators
- High-resolution timer v2
- 32Kbytes to 512Kbytes of Flash memory

The devices feature maximum operating-temperature ratings of up 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.

FREE DEVELOPMENT BOARD

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APPLICATIONS
- Home appliances
- Drones, toys and e-bikes
- Air-conditioning units
- Industrial equipment
- Rechargeable devices
- Servers and telecoms equipment
- Electric vehicle charging stations
- Instrumentation and measurement equipment

FEATURES
- True Random Number Generator (RNG)
- CRC calculation unit
- 96-bit unique ID
- Multiple communications interfaces:
  – Three I²C
  – Three SPI multiplexed with two half-duplex I²S
  – Three USARTs
  – One UART and one low-power UART
  – One FD CAN
  – One serial audio interface
  – One USB

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Secure turnkey authentication solution for IoT devices and networks

Running on a Common Criteria EAL5+ platform, the STSAFE-A series of parts from STMicroelectronics provides an authentication solution which is certified secure by independent third parties.

Its command set gives strong authentication, to establish a secure channel in a Transport Layer Security (TLS) session, verify signatures, and offer secure storage as well as decrement counters for usage monitoring.

It is particularly well suited to applications that are exposed to fraud and counterfeiting attacks.

ST's STSAFE-A offering is a complete solution comprising:
- An internally-developed secure operating system embedded in a secure microcontroller
- Example code for integrating solutions in the application environment
- Personalization services for storing confidential customer data in the secure microcontroller

The STSAFE-A series includes the STSAFE-A100, a secure element which provides authentication and data-management services to a local or remote host. It is ideal for authentication of consumables and accessories, thus protecting the brand value of a manufacturer's peripheral products.

The STSAFE-A100's security features include advanced asymmetric and symmetric cryptography. It implements elliptic curve cryptography and the elliptic curve digital signature algorithm, and the secure hash algorithm for digital signature generation and verification. It also supports the elliptic curve Diffie-Hellman protocol for key establishment.

ST also supplies the STSAFE-A1SX, a secure element IC which provides security services for data exchanges over a Sigfox low-power wide-area network. It is supplied with Sigfox network keys pre-loaded on the IC.

STSAFE-A100: Optimized secure element For IoT device protection

ENERGY INDUSTRIAL LIGHTING MEDICAL TRANSPORT SECURITY CONSUMER TELECOMS
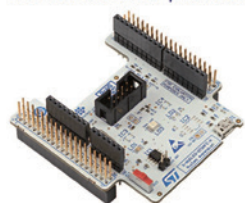
APPLICATIONS
- Printers
- Game controllers
- Phone accessories
- Internet of Things networks and devices
- Smart home devices
- Smart city equipment
- Smart grids
- Docking stations
- Industrial tools

FEATURES
- On-chip key-pair generation
- Usage monitoring with secure counters
- 6kbytes of configurable non-volatile memory
- I²C interface

FREE DEVELOPMENT BOARD

The X-NUCLEO-STSA100 enables evaluation of the STSAFE-A100 secure element.

Orderable Part Number: X-NUCLEO-STSA100

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Plug & Trust Secure Element family provides deeper security for the IoT

NXP

NXP Semiconductors has announced its EdgeLock™ SE050 Plug & Trust Secure Element family, which simplifies the implementation of strong security mechanisms for Industry 4.0 and Internet of Things (IoT) applications from edge to cloud.

The Common Criteria (CC) EAL6+ certified EdgeLock SE050 makes it easy to implement high-performance security in sensing and control applications. In addition, it streamlines the deployment of IoT services and the on-boarding of edge devices to public and private clouds, edge-computing platforms and infrastructure.

The new SE050 EdgeLock Secure Element provides high-performance security and integration features:
- CC EAL6+ certification up to operating-system level protects against the latest attack scenarios and the evolving IoT threat landscape
- Up to 4,096-bit RSA cryptography and integrated Elliptic Curve Cryptography (ECC) with an expanded set of curves such as Brainpool, Edwards and Montgomery
- Integrated, flexible applet which eliminates the need to write security code

Users of the SE050 can also streamline the deployment of IoT services and the on-boarding of edge devices to the cloud. I²C master functionality enables direct control of important functions as well as of the integrity and confidentiality of sensor data. The SE050 also offers a contactless interface for late-stage configuration of unpowered devices' parameters.

The SE050 integrates functionality typically found in a Trusted Platform Module (TPM). Delivered as a ready-to-use solution, the SE050 includes a complete product support package which simplifies the design-in process and aids integration with microcontrollers and microprocessors, with the Linux®, Windows® and Android™ operating systems, and with familiar cloud platforms. NXP's time-saving design tools, such as sample code, extensive application notes, and development kits for i.MX applications processors, and for LPC and Kinetis® microcontrollers, help to accelerate final system integration and shorten time to market.

NXP Semiconductors:
Complete product support package for EdgeLock SE050
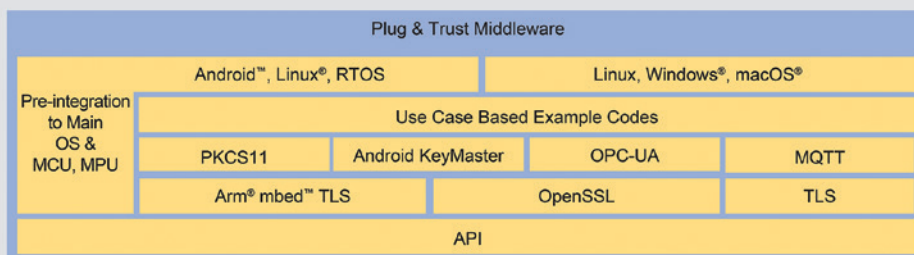
Enables compliance with global standards

NXP's EdgeLock SE050 Secure Element enables compliance with some of the world's most rigorous standards and protocols, including:
- National Institute of Standards and Technology
- General Data Protection Regulation
- International Society of Automation Industrial Network and System Security IEC 62443
- OPC Industrial Interoperability Standard for Unified Architecture (OPC UA)
- Open Connectivity Foundation specification

The EdgeLock SE050's compliance and certifications reflect NXP's commitment to the Charter of Trust initiative and its binding rules and standards for building trust in cybersecurity and for advancing digitalization.

ENERGY **INDUSTRIAL** LIGHTING MEDICAL TRANSPORT **SECURITY** CONSUMER TELECOMS

APPLICATIONS
- Home automation
- Building controls
- Smart industrial systems
- Supply-chain equipment

FEATURES
- 40nm NXP IntegralSecurity architecture
- Comprehensive support for asymmetric cryptographic functions
- AES and DES encryption and decryption
- HMAC, CMAC, SHA-1 and SHA-224/256/384/512 operations
- Up to 50kbytes of secured Flash user memory
- Standard -25°C to 85°C and extended -40°C to 105°C operating-temperature ranges
- 3mm x 3mm QFN20 package

FREE DEVELOPMENT BOARD

This Arduino-compatible development kit enables evaluation of the SE050 product family's features, and simplifies the development of secure IoT applications.

Orderable Part Number: OM-SE050ARD

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EdgeLock™ SE050 enablement

Plug & Trust Middleware			
Pre-integration to Main OS & MCU, MPU	Android™, Linux®, RTOS		Linux, Windows®, macOS®
	Use Case Based Example Codes		
	PKCS11	Android KeyMaster	OPC-UA	MQTT
	Arm® mbed™ TLS	OpenSSL		TLS
API			

EdgeLock SE050

IoT Applet
Java® Card Operating System
Hardware

Multi-sensor IC supports flexible and low-power security solutions

Azoteq

Azoteq has introduced a family of multi-functional ICs which are able to monitor multiple sensor inputs with a single chip, enabling designers of security applications to reduce board footprint and save power.

Using one ProxFusion® IC in a security controller, it is possible to detect events such as the opening of a window or door, a window breaking, movement inside a room, or tampering with a device.

A ProxFusion product such as the IQS269A provides a single sensor interface to multiple types of sensors.

The low-power IQS269A can run on power from a small coin cell

For instance, the opening of a window or door may be detected by an inductive coil. A piezoelectric sensor can signal a window breaking. An on-chip temperature sensor provides temperature data, while an intruder's movement in a room can be detected using PIR sensors.

By interfacing all of these inputs to the IQS269A, a security detection circuit can be designed without the need for a large number of analog components, reducing both bill-of-materials and assembly costs. The use of a single IC for several sensor technologies also reduces development time, saves board space and shortens time to market.

In addition, the low power consumption of the IQS269A makes it ideal for use in low-power RF/sensor modules powered by a small coin cell.

The IQS269A is available in two package options: a DFN16 measuring 3mm x 3mm x 0.8mm, and a WLCSP-16 measuring 1.7mm x 1.7mm x 0.5mm.

APPLICATIONS
- Smart home equipment
- Security and intruder alarm systems
- Building automation

FEATURES
- 0.02fF capacitive-sensing resolution
- Supply-voltage range: 1.8V to 3.6V
- 2.9µA wake-up current in capacitive-sensing mode
- <5.0µA operating current in capacitive- and inductive-sensing mode
- I²C interface

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REFERENCE NUMBER
19-vi 23

New high-performance MCUs include integrated crypto/hash processor

ST

STMicroelectronics has extended its STM32H7 family of MCUs to include new, high-performance dual-core devices which offer valuable power-saving features and enhanced cyber protection.

The STM32H7 series now includes dual-core microcontrollers with Arm® Cortex®-M7 and Cortex®-M4 cores able to run at up to 480MHz and 240MHz respectively. The existing single-core Cortex®-M7 STM32H7 parts also benefit from the increase in frequency to 480MHz. Dual-core STM32H7 microcontrollers are available with an embedded switching power supply for improved dynamic power efficiency.

The STM32H7 devices that include an integrated cryptography/hash processor, the STM32H755, STM32H757 and STM32H750, are particularly well suited to use in applications that require advanced authentication and encryption functions. These MCUs come 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.

The new STM32H7 parts' outstanding performance draws on more than the new high-frequency version of the Cortex-M7 core. ST's smart architecture, an efficient L1 cache and adaptive real-time ART Accelerator™ engine help the MCUs to set new speed records of 1,327 DMIPS and a 3,224 CoreMark™ score when executing from embedded Flash.

To maximize energy efficiency, each core operates in its own power domain and can be turned off individually when not needed.

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 STM32H7 Cortex-M4 with the new GUI running on the Cortex-M7. Another example is to boost application performance by offloading intensive workloads such as neural networks, checksums, DSP filtering or audio codecs.

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

FEATURES
- Up to 2Mbyte Flash and 1Mbyte SRAM
- Error correction code for all Flash and RAM memory
- Multiple advanced 16-bit ADCs
- Ethernet controller
- Multiple FD CAN controllers
- Maximum ambient temperature up to 125°C

FREE DEVELOPMENT BOARD

The NUCLEO-H755ZI-Q Nucleo-144 development board features an STM32H755ZI MCU and switch-mode power supply, and supports Arduino, ST Zio and morpho connectivity.

Orderable Part Number: NUCLEO-H755ZI-Q

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REFERENCE NUMBER
19-vi 24

A developing industrial camera ecosystem vision applications

By André Schwarz
Regional Technical Director (Central Europe North)
Future Electronics

Read this to find out about:
- The image-processing capabilities required to support machine vision in embedded systems
- Features of the new S32V SoC from NXP that support machine vision
- The NXP software and tools that enable rapid vision system development

How might the operation of industrial machinery be transformed if it could see the world around it?

Until recently, this has been a hypothetical question for many types of industrial equipment. True, some applications for machine vision do exist: high-volume manufacturing or process plants, for instance, often rely on cameras to perform Automated Optical Inspection (AOI), to spot defects or classify goods more reliably, quickly and cheaply than human operators. Camera equipment also performs visual tasks such as optical character recognition, for instance to log car registration plates in car parks. Until now, such applications for machine vision have called for a system architecture based on a camera connected to a PC or server.

But a PC-based system design has considerable size, cost and power implications which put it beyond the reach of many mainstream industrial applications. As this article shows, however, the introduction of a new generation of vision-enabled Systems-on-Chip (SoCs) backed by user-friendly tools for vision application development is making it possible for the first time for almost any kind of embedded system to add intelligent vision to the range of functions it provides.

The cumbersome hardware architecture of today's machine vision systems

The difficulty of implementing intelligent machine vision arises from the size and character of the data to be processed. An industrial image sensor typically has between 1 million and 10 million pixels, and operates at frame rates of up to several hundred frames per second. When IT professionals talk about the potential of 'big data', they are referring in part to the huge amounts of image data generated by such embedded cameras.

The data sets are not only large: they are also difficult to classify. A human brain finds it easy to look at a set of pictures of objects, and attach names to them such as 'dog', 'bird' or 'bus' with absolute certainty. For a machine, this involves a complex set of logical operations. Of course, some forms of image data are easier to process: today, the development of a camera system that can perform alphanumeric character recognition, level sensing or color detection is more straightforward.

But some applications require more complex forms of processing. Autonomous vehicle technology, for instance, has been in development already for several years. This points to the difficulty of teaching machines to distinguish moving objects such as cars, buses, bicycles and pedestrians. And there are machine vision tasks even harder than this: technologists have begun experimenting with machines that can read emotions on human faces, a capability which might eventually be applied by the advertising industry or in crime prevention.

Machine vision, then, calls for the fast processing of vast amounts of data through complex algorithms. Today, this function is typically implemented by PC- or server-based architectures. They offer the twin advantages of:
- Massive data-processing capability provided by the latest ultra-high speed, multi-core processors or graphics processing units (GPUs)
- The comprehensive, high-level applications programming resources and tools provided by the Windows® or Linux® operating environments

The problem for embedded system developers is that the PC is normally an unsuitable hardware platform for their applications. Typically, embedded systems operate under tight power, size and cost constraints. The PC is optimized for none of these factors.

Yet there is clearly huge scope to add value to embedded systems by equipping them with intelligent vision capability. Automatic doors, for instance, might today use infrared proximity sensors or in-floor pressure sensors to provide the trigger to open. Dumb sensors, however, can produce false results. In a storefront on a busy street, automatic doors might open for passers-by as well as for those who want to enter the store.

Doors that can see, and distinguish pixels in the shape of a human face, could distinguish people facing the door from those who are merely walking past it, and who present their profile rather than their face to the camera. This kind of intelligence would enable the door system to save energy by keeping heat inside the store and draughts out. It would also prolong service life and reduce maintenance costs by reducing the number of opening operations.

This is a typical example of an application that faces size and cost constraints, and for which a PC is therefore an unsuitable hardware platform. When embedding machine vision into such an application, systems designers will be looking for certain important features:
- Low power consumption
- Support for high-level programming at the functional level
- Connectivity options which enable the system to export its outputs to a host system or to the cloud
- A versatile front end for image sensor connections
- Basic hardware-accelerated image enhancement blocks which today are typically implemented in an FPGA
- Efficient image compression
- Interfaces to mass storage
- Support for a standard, robust operating system. In the embedded world, this normally means the Linux OS

Now a viable platform for embedded machine vision which offers these features is available in the form of a new vision-optimized SoC platform, the S32V, introduced by NXP Semiconductors.

Comprehensive hardware and software ecosystem

The value of the new S32V SoC comes from its combination of both the hardware and software resources required by embedded system developers.

The hardware is an all-new SoC which includes dedicated vision functional blocks together with a high-performance general-purpose processing block, as shown in Figure 1. The CPU platform includes two or four Arm® Cortex®-A53 cores operating at a frequency of up to 1GHz. A 133MHz Arm Cortex-M4 core takes care of functional safety and security operations and other housekeeping tasks.
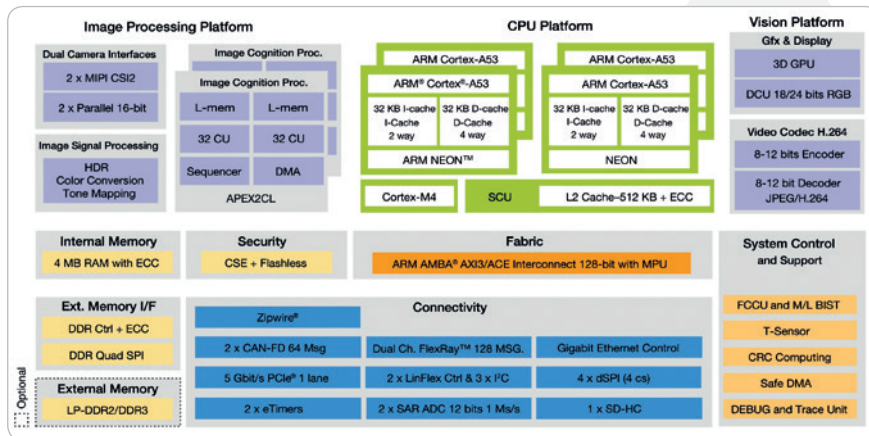
creates new opportunities for machine

Fig. 1: Block diagram of the S32V SoC

The image processing functional block is centered on dual APEX-2 vision accelerator cores which are enabled by the OpenCL™, APEX-CV and APEX graph tools, part of the software enablement which is described below. The S32V also provides dual camera interfaces, enabling stereo vision applications in order to make the algorithms even more robust in natural environments.

Embedded Image Sensor Processing (ISP) supports High Dynamic Range video, color conversion, tone mapping and other functions, making traditional FPGA-based approaches obsolete in many cases.

Multiple connectivity options provide for high-speed transfer of processed images in an edge computing architecture. They include a Gigabit Ethernet controller, dual CAN-FD, dual FlexRay™ and single-channel PCIe 5Gbits/s interfaces for proper system scalability.

The optional graphics subsystem includes a 3D graphics processing unit that supports the OpenCL 1.2 EP 2.0, OpenGL ES 3.0 and OpenVG 1.1 graphics rendering interfaces. This enables the image processing required for sophisticated video outputs in use cases such as smart advertising, driver assistance, or security scenarios which involve human supervision.

Benefiting from the power efficiency of the Arm A-class processor family, the S32V's typical power consumption is in the range of 5 to 10W, the S32V also provides sufficient raw processing capability to perform sophisticated functions such as face recognition or moving object detection, as shown in Figure 2. But if it is being used, as in the automatic door example, to enable the addition of vision capability to a system for the first time, the developer might be unfamiliar with the process of writing software for sophisticated machine-vision applications. An important question for the developer to consider is therefore how well application software development is supported by the S32V ecosystem.

The basis for the S32V's software enablement is NXP's Vision Software Development Kit (SDK), which is part of the S32 Design Studio for Vision Integrated Development Environment (IDE). The Vision SDK is supported on S32V evaluation boards supplied by NXP, and is supplied with application examples for functions such as face detection, and homography for feature matching. It features an open-source code base: running on the Linux OS, it includes an open-source library (OpenCV) and open, standard languages and APIs, including OpenCL and OpenGL.

Fig. 2: A face detection algorithm is provided as example code in the S32V's Vision SDK

Crucially, software development can be accomplished with the C programming language alone. The Vision SDK makes light work of task distribution between hardware accelerators and general-purpose cores, which in the past has been a distinctly difficult element of vision system design implementation.

An additional computer vision library, APEX-CV, is also included in the Vision SDK. In addition to the Vision SDK, NXP also provides a Model Based Design Toolbox for Vision tool, which enables designers to use MATLAB® software to develop their application on the S32V.

Fast proof-of-concept development on S32V

The S32V is supplied pre-configured for operation with standard, off-the-shelf camera modules for quick prototyping, enabling developers to concentrate immediately on software development:
- The S32V-SONYCAM module from NXP
- The Omnivision OV10640CSP-S32V or MXOV10635-S32V, both MIPI cameras with high dynamic range

Integration of other sensors is possible of course, but low-level driver development will be required. The S32V image pipeline has been designed for use with image sensors featuring up to 2Mpixel resolution. This means that bandwidth limitations for higher-resolution systems have to be taken into consideration.

NXP also supplies various evaluation boards for the development of prototypes based on the S32V. These include the:
- SBC-S32V234 vision and sensor fusion evaluation board, as shown in Figure 3
- S32V234-EVB2, a vision and sensor fusion evaluation system and development platform
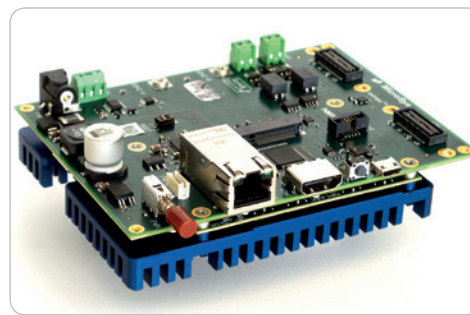

Fig. 3: The SBC-S32V234 evaluation board for the S32V vision processor

The combination of off-the-shelf development hardware with a comprehensive tool suite and ready-made application examples gives first-time developers of an embedded vision system the best possible platform for rapid system development. This means that, for the first time, embedded applications for which a PC-based vision architecture was unsuitable can now benefit from the addition of intelligent machine vision, with the potential to dramatically increase the value of many of today's embedded system designs.

FOR MORE DETAILS AND DATA E-MAIL: INFO@MY-FTM.COM | REFERENCE NUMBER
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Predictive maintenance: the ideal industrial

FUTURE ELECTRONICS

By Future Electronics

The planned, scheduled maintenance of machines is an inherently inefficient engineering practice. Routine maintenance involves working on all the units in a population of machines, on the assumption that only one or some are likely to fail after a given number of hours of operation unless serviced.

Predictive maintenance promises to eliminate this inefficiency: if the technician knows which units in the population of machines are at risk of malfunctioning, the servicing effort can be targeted, as shown in Figure 1. The effort and cost that would otherwise have been wasted on servicing machines that are healthy can be saved. Just as important, a machine that might otherwise have failed, because scheduled maintenance would have occurred too late, can be kept running if intervention is triggered by warning signals given out by the machine.

The promised benefits of predictive maintenance are highly attractive: reduced maintenance costs combined with greater uptime and a reduced rate of machine failure. But to fulfil the promise, machine operators require a new type of intelligence about the machine, and specifically, Artificial Intelligence (AI). Predictive maintenance is an ideal application for AI, because it calls for the interpretation of complex patterns in millions of data points generated over a period of time.

Today, sensors such as accelerometers, thermocouples, microphones and barometers provide detailed and accurate measurements of the physical operation of a machine in terms of vibration, temperature, sound and pressure. Properly interpreted, these data can be used to determine the state of health of a machine, and even to pinpoint the location, cause and probability of a future fault.

If the interpretation can be done right, there is every prospect that predictive maintenance will emerge as the ultimate application for AI in the industrial sector. And while many implementations of AI are still at a very early stage, there is already a body of components and software available today to equip machines with predictive maintenance capability.

(Image courtesy of Siemens Pressebild)

Fig. 1: Predictive maintenance allows machine servicing efforts to be targeted

Read this to find out about:
- The cost and productivity benefits of adopting predictive maintenance
- The scope for implementing predictive maintenance at the edge using components on the market today
- The software and enablement tools supplied by MCU, processor and FPGA manufacturers

Usage model favours portability
Some applications of AI call for the vast computing power provided by cloud services such as the Microsoft Azure Machine Learning service or IBM Watson Studio. But the typical usage model of predictive maintenance for small or medium-sized industrial enterprises will favour the use of portable sensor equipment. The data from machines often only needs to be logged periodically, not continuously, and new intelligent data loggers are likely, at least in the short-term, to be relatively expensive pieces of equipment. A portable data logger may be affixed temporarily to a machine, left to acquire data for a period of time, before being moved to a different machine in the same facility. In this way, a single data logger can serve multiple machines.

If predictive maintenance is applied to a consumer item such as a washing machine, the device might have no internet connection, in which case the predictive maintenance system needs to be a stand-alone operation, and to flash an error code on the user interface display or control panel if it detects a potential problem. In an industrial setting, security and privacy concerns might also prevent operators from streaming machine data logs over the internet.

In these use cases, the predictive maintenance analytics, which in AI terminology is the inference engine running a trained machine learning algorithm, need to be performed locally, at 'the edge', and not in the cloud.

Now microcontroller, processor and FPGA manufacturers are beginning to demonstrate the capabilities of their devices by providing frameworks and ready-made system designs for predictive maintenance at the edge.

Competing approaches to machine analytics
Design engineers will naturally wonder whether the hardware platform with which they are already familiar, such as an MCU, processor or FPGA, is capable of meeting the computing requirements of a predictive maintenance operation. Surprisingly, the answer is that even a low-cost 32-bit MCU based on a mid-range Arm® Cortex®-M4 core can support some forms of AI application.

But the choice of hardware platform ultimately depends on the objective for predictive maintenance: which insights does the predictive maintenance system need to produce, and which resources are available to train the system?

AI systems are produced by a process of either 'supervised learning' or 'unsupervised learning' on a training data set. In supervised learning, the data set, such as the stream of vibrations, squeaks and sounds that an industrial motor produces, is curated and labelled. The labels tell the algorithm what it has to recognize.

In unsupervised learning, the machine learning system is presented with a mass of uncurated data, finds patterns in the data, and produces insights based on its recognition of the patterns, or of excursions from them.

The algorithm produced by supervised learning of time-series data such as vibration and sound logs is smaller and simpler than that produced by unsupervised learning, and today, the hardware and software available from semiconductor manufacturers largely assumes that the user is implementing supervised learning.

application for artificial intelligence?

Anomaly detection, a technique based on supervised learning, has been found to provide an excellent model for uncovering potential faults in machines such as industrial motors and home appliances.

Anomaly detection depends on a well-curated data set: sensor measurements are taken from a machine during normal operation, and the model is trained to recognize features such as peak-to-peak values, mean average and so on. The model can then be trained to detect anomalies, as values which fall outside a threshold that the user sets.

This form of predictive maintenance is favoured because the algorithm it produces can run on a simple hardware platform such as an MCU. It effectively detects potential faults, but the drawback is that it provides limited insight into the type of fault or its cause as its output simply flags a problem.

Semiconductor suppliers are making considerable efforts to support their customers' implementation of anomaly detection software. Perhaps the easiest way to implement it is through the use of a ready-made reference design: NXP Semiconductors, for instance, is to launch an MCU Anomaly Detection Solution by the end of 2019. Based on an i.MX RT1060 crossover processor, the reference design board also features an FXOS8300CQ accelerometer and NPS3000VV differential pressure sensor. Intended for use in smart appliances, industrial machines and smart home devices, it implements a type of anomaly detection algorithm called a support vector machine, as shown in Figure 2.

It is a general principle of embedded system design for machine learning applications that it should implement the least complex algorithm that will achieve the desired accuracy. On this basis, it is worth evaluating the STMicroelectronics MEMS motion sensors that include its Machine Learning Core (MLC). The MLC is trained through supervised learning:

the developer defines the classes of motion to be analysed, and collects logs of relevant data. Offline data analysis of statistical parameters such as variance and peak-to-peak values in a machine learning tool such as Waikato Environment for Knowledge Analysis (WEKA) produces a decision tree algorithm. This algorithm then runs on the sensor's MLC, without any involvement from a host microcontroller or processor.

For vibration monitoring, for instance, the MLC can support one decision tree and two nodes at an output data rate of 26Hz. The power overhead of this operation is additional operating current of just 1µA. ST sensors that include an MLC are the LSM6DSOX, LSM6DSRX and ISM330DHCX six-axis motion sensors, and the IIS2ICLX three-axis inclinometer.

Most semiconductor companies follow the same model as ST, providing tools for compiling a trained model to their hardware, but requiring developers to use a third-party training framework, such as WEKA, Caffe or ONNX, to train the model.

QuickLogic's SensiML subsidiary is unique in providing a fully integrated, end-to-end design flow. For developers of predictive maintenance applications, this eliminates the need to master a third-party framework which is primarily aimed at computer scientists rather than at the embedded community. The advantage of SensiML's Edge AI Software Toolkit is that it enables developers to build intelligent IoT sensing devices in days/weeks without data science or embedded firmware expertise.

The software includes the SensiML Data Capture Lab, an integrated tool for the collection and curation of a training data set. For predictive maintenance, this data set will be time-series data derived from sensors such as accelerometers and gyroscopes. The Edge AI Software Toolkit analyses the labelled data to produce a classifier algorithm which implements anomaly detection. The same tool compiles the algorithm to run on the chosen hardware target, such as a microcontroller or QuickLogic's own QuickAI™ system-on-chip platform.

Increased hardware capability for greater sophistication

The common feature of the anomaly detection method supported in the above examples from NXP, ST and QuickLogic is that it is the easiest technique for predictive maintenance to implement, and the algorithm can run on relatively low-power hardware such as the i.MX RT crossover processor based on an Arm Cortex-M7 core.

Support for more sophisticated forms of predictive maintenance system based on unsupervised learning are possible: they have the potential to provide greater insight into machine operation, to pinpoint the cause and location of faults, and to provide earlier and more detailed indications of potential faults to enable quicker intervention.

While there is less support currently for this kind of software approach from semiconductor manufacturers, the hardware capability is readily available: devices such as ST's new STM32MP1 processor family, or the i.MX or LayerScape processor series from NXP have more than enough raw computing power to run highly sophisticated types of machine learning algorithm. Low- and mid-density FPGAs such as the PolarFire® FPGA family from Microchip Technology or the iCE40 series from Lattice Semiconductor are also ideal for this type of AI application. In cases that require always-on sensor hub operation, low-power FPGAs can often consume less energy than an MCU or processor.

Any designer wishing to explore the scope for unsupervised machine learning aimed at this kind of hardware target should contact the machine learning specialist support engineers at Future Electronics, who will be pleased to help. Future Electronics can also supply any of the reference design boards or tools mentioned here from NXP, ST or QuickLogic.
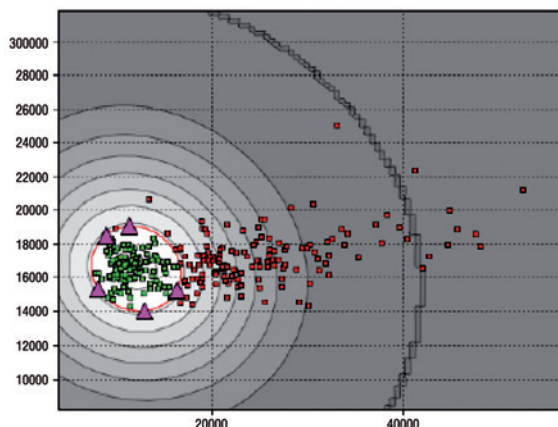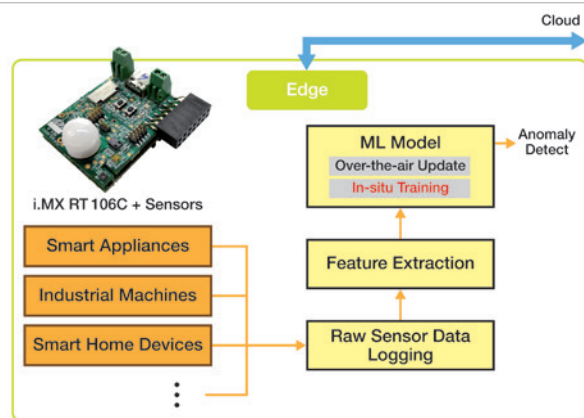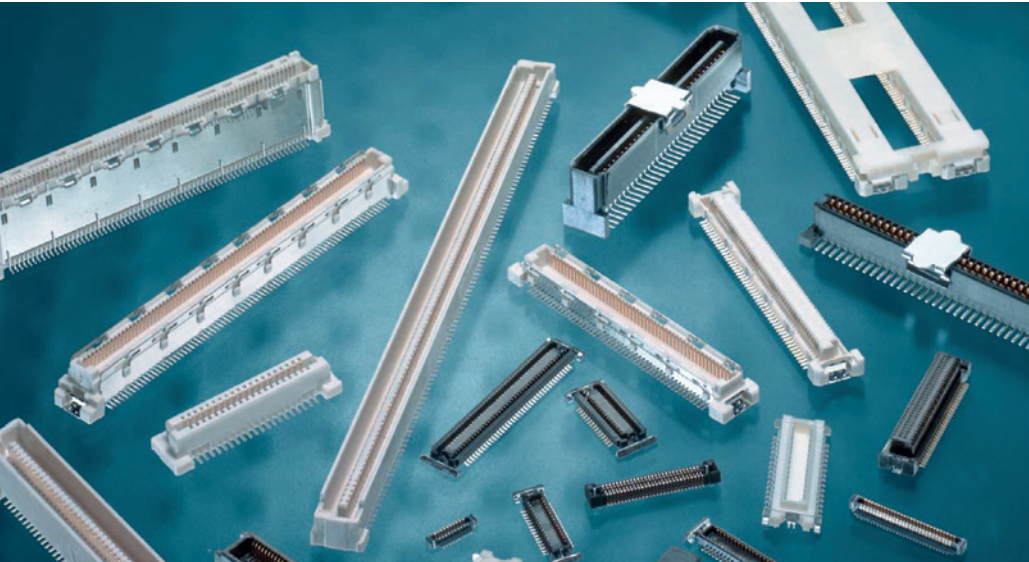

Fig. 2: NXP's support vector machine algorithm detects excursions from normal patterns of vibration in a machine

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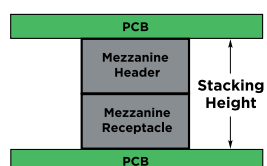
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STACKING CONNECTORS

CONNECTOR SELECTOR TABLE

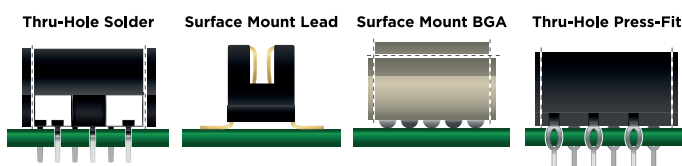| Connector Description	Representative Part Numbers	
	Plug	Receptacle
.4mm Fine Stack	2-1871566-4	2-1747769-4
.5mm Fine Mate	1565359-1	1565357-1
.5mm Fine Stack	7-5353164-6	7-5353159-5
.5mm Free Height	3-6318491-6	3-6318490-6
.6mm Free Height	1-5353184-0	1-5353190-0
.8mm Fine Mate	2-5917407-2	2-5917408-2
.8mm Fine Stack	1-179396-2	1-179397-2
.8mm Free Height	5177983-4	5177984-4
1mm Free Height	5120528-1	5120534-1
AMPMODU 50/50	5-104693-2	5-104652-2
AMPMODU System 50	5-147377-3	5-104550-4
Eurocard (Din)	650889-1	5353032-4
Micro-Strip	5536280-1	5536279-1
MICTOR	5767007-8	2-5767004-2
MICTOR SB	1658013-1	1658012-1
STEP-Z Grid Array	6-1761714-3	5-1761715-5
STRADA Mesa	2-2057470-8	2057471-1
Z-PACK 2mm HM	100143-1	106773-1
Z-PACK Futurebus+	223002-1	223652-1
Z-PACK HM-Zd	1469002-1	1469362-1
Z-PACK TinMan	1934312-1	1934544-1
Z-PACK TinMan 85ohm	1934948-1	1934949-1
1.25mm Centerline FinePitch	4-176890-6	4-175630-6
Z-PACK HS3	120732-1	120948-1

THINGS TO CONSIDER WHEN SELECTING A MEZZANINE CONNECTOR

1. Determine a range of stack heights that will meet the application requirements.

2. Determine the minimum number of signals that must pass between the two printed circuit boards (PCBs) with consideration for power and ground.

3. Determine how much space is available for the connectors with consideration for its location. Will a traditional two-row connector fit or will a 'grid' (many rows) style product work best in the application? The largest pitch that will fit is typically chosen, as larger pitch connectors tend to be more rugged and easier to process.

4. Determine the preferred method of attachment. Ball-Grid Array (BGA) products are a variant of surface mount that give connector manufacturers greater co-planarity tolerance than typical surface mount leads. Other types of attachments are solder thru-hole and press-fit thru-hole.

5. Determine the connector type, open pin field or controlled impedance, that will best fit the application. Open pin field connectors typically do not have any pre-determined grounds and are usually used in lower speed applications. TE Connectivity does offer several open pin field connectors that have very good electrical performance characteristics.

HOW TO MEASURE FOR A MEZZANINE CONNECTOR

PCB
Mezzanine Header
Stacking Height
Mezzanine Receptacle
PCB

MOUNTING STYLES

Thru-Hole Solder   Surface Mount Lead   Surface Mount BGA   Thru-Hole Press-Fit

EVERY CONNECTION COUNTS