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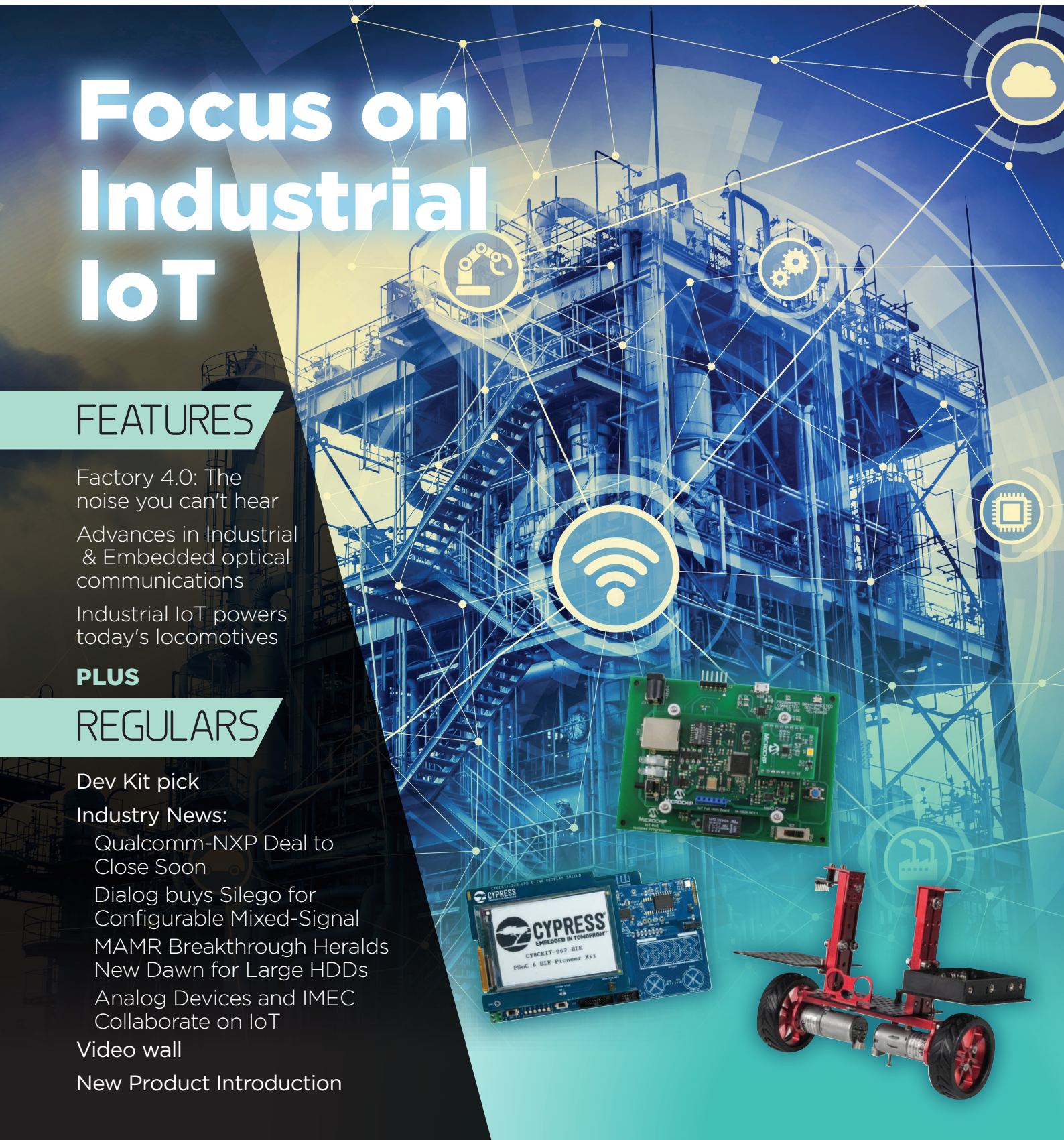
Focus on Industrial IoT



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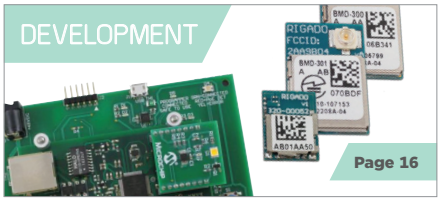
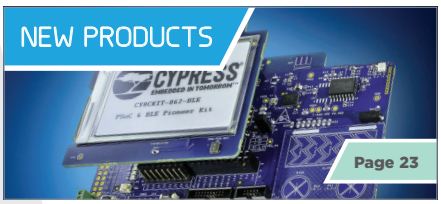
In this issue...

The theme for November is Industrial IoT. We present articles examining the danger of EMI – the noise you cannot hear; the role of advanced optical comms in the industrial environment; and the part industrial IoT is playing in locomotive design. Our industry news section reports on the Qualcomm-NXP Deal, Dialog's acquisition of Silego, a magnetic breakthrough for large HDDs and the collaboration between Analog Devices and IMEC on IoT.

Plus, of course, regulars: Dev Kit Pick, Video Wall and the latest, most innovative NPIs now in stock at Mouser. Now read on...





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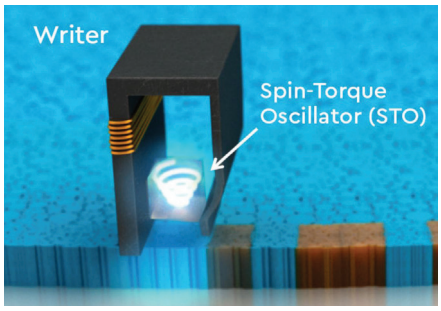
MAMR Breakthrough Heralds New Dawn for Large HDDs

At an event in Silicon Valley, Western Digital has demonstrated a new hard disk drive (HDD) technology which it says is a breakthrough for large scale storage. The company has declared Microwave-Assisted Magnetic Recording (MAMR) HDD technology to be its recording technology of choice for the foreseeable future. MAMR was invented by Professor Jimmy Zhu at Carnegie Mellon University back in 2006, but manufacturing devices based on this technology has proved to be elusive. Western Digital has been working on commercialising this discovery for years. The breakthrough enabling technology is said to include materials and process technologies that enable the required predictable and reliable performance of the MAMR devices.



In an MAMR drive, the spin-torque oscillator generates a microwave field to provide assistance when magnetising the grains prior to a write

MAMR uses a microwave field generated from a component called a spin torque oscillator (STO). The STO, which is close to the write pole of the head, generates an electromagnetic field that allows data to be written to the perpendicular magnetic media at a lower magnetic field. Magnetic grains of recording media on the disk pass underneath the head and resonate with the signal from the STO. These grains are similar to spinning gyroscopes which are stable in either an up or down position; their polarity is flipped by the applied field to create a 1 or 0. Overall, less energy is required to flip the bits, they can be flipped faster, and the grains can be smaller than with conventional technology (halving traditional grain size to around 4nm), increasing disk capacity. The major competitor to this technology is Heat Assisted Magnetic Recording (HAMR), used by rival Seagate. HAMR is based on using a laser diode to rapidly heat the recoding medium at the moment of writing; the material's coercivity (its ability to withstand external magnetic fields) increases, making it harder for the magnetisation to inadvertently change. However, Western Digital argues that adding lasers to write heads is expensive, and that the temperatures required (400-700°C) are not compatible with reliability. Western Digital expects to start shipping MAMR HDDs in 2019 for data centre and Big Data applications, with 14 TByte samples available to key customers in mid-2018. 40 TByte drives are expected by 2025.

Infineon Partnership Connects Renewable Energy to the Grid

Infineon has partnered with Smart Wires to design a device to precisely control power flows on transmission lines. The SmartValve will allow the economical integration of renewable energy sources into electricity supply grids at the national scale. The problem with integrating renewable energy from wind turbines and solar farms is that new transmission lines and other grid upgrades required can be very costly. The Infineon-enabled SmartValve is lighter and cheaper than other solutions and the power levels can be tightly controlled by the utility's energy management system. It's also possible to program the device to respond automatically to a variety of grid conditions to ensure the highest efficiency is reached at all times.

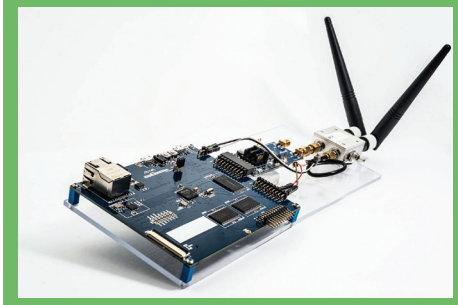
"Together with Smart Wires, we can provide an innovative energy-efficient solution for the electric utility space," said Dr. Peter Wawer, President of the Industrial Power Control division at Infineon. "The cooperation is a perfect example of how Infineon is leveraging its system understanding. In this regard, we will not only bring power semiconductors to this cooperation but also RF components, microcontrollers, and security solutions."The SmartValve will be ready for delivery in early 2019.

Analog Devices and IMEC Collaborate on IoT Devices

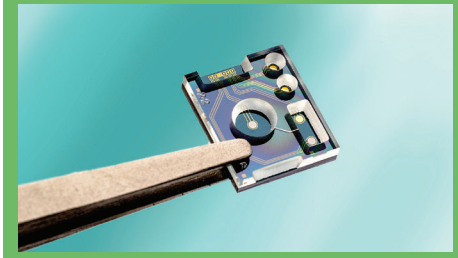
Analog Devices is working with Belgian research centre IMEC to develop new types of low power sensors for IoT devices. The research partnership has already produced two new device types. The first, a localisation sensor, will provide highly accurate indoor location functionality in smart buildings or industrial settings.

"We want this sensor to localise objects with a superior accuracy in a robust manner and achieve up to five times better accuracy than today's best-performing solutions," said IMEC's Program Director Kathleen Philips. The second sensor to be created is a liquid sensor that can be used in the analysis of fluids such as water, blood or urine. "Our single-chip sensor comprises multiple electrodes and excels in terms of cost and size, while demonstrating industry leading sensitivity and accuracy," Philips adds.

The strategic partnership between Analog Devices and IMEC is part of a broader, open research initiative to which other research partners are also invited to contribute.



IMEC and Analog Devices' prototype low-power highly accurate indoor localisation sensor



The companies have also developed a low-power integrated liquid sensor

Cree Names Industry Veteran Gregg Lowe New CEO

LED manufacturer Cree has appointed former Freescale CEO Gregg Lowe as President and CEO, succeeding Chuck Swoboda, who announced his plan to step down after a health scare earlier this year. Swoboda had been Cree's CEO for sixteen years, masterminding the company's focus on LED as a primary light source for general illumination.

Swoboda also steps down as chairman of the board, a position that will be filled by current board member Robert Ingram.

Former Freescale CEO Gregg Lowe has taken the helm at Cree

Semiconductor industry veteran Lowe was Freescale's CEO between 2012 and 2015, successfully implementing the Motorola spin-out's exit strategy which culminated in a merger with chip vendor NXP. Prior to that, Lowe had a long career at Texas Instruments, leading the analogue components group. He is also a board member at Silicon Labs.

"Gregg is an exceptional leader and a proven visionary in the semiconductor industry. We are proud that he has accepted the CEO position and is prepared to lead this innovative, technology-rich company into the future," said Robert Ingram, chairman of Cree's board.

Dialog buys Silego for Configurable Mixed-Signal Technology

Dialog Semiconductor is set to buy Silicon Valley based Silego for USD $276 million in cash (plus a further USD $30.4 million contingency budget).

Silego's technology combines analogue and digital elements with non-volatile memory in a one-time programmable chip (unlike an FPGA which is completely digital). The company calls its technology Configurable Mixed-Signal IC (CMIC). The idea is to reduce the amount of linear, passive and discrete components required by integrating these functions into the Silego chip. Custom IC prototypes can be produced quickly and easily using CMICs, reducing time to market for high volume consumer electronics applications. Silego employs 235 people and its 2017 revenue will be in the region of USD $80 million. The company announced in August that it had reached the milestone of 3 billion chips shipped (100 million in July alone).

Double-digit growth is expected next year; Dialog says its current addressable market is set to increase by USD $1.4 billion as a result of the acquisition.

"The acquisition of Silego brings a highly complementary technology to Dialog. What Silego has developed is truly unique – a mixed-signal platform which customers can configure to their design requirements on the fly, drastically reducing the time to bring their products to market," said Jalal Bagherli, CEO of Dialog. "With global scale and customer access, Dialog is the right platform to further accelerate industry wide CMIC adoption. Furthermore, we gain an exceptional group of talented people that will fit well with Dialog's culture. Together, we will significantly increase the value we can bring to our customers by creating a better-positioned and more-diversified mixed signal offering."

Qualcomm-NXP Deal to Close Soon... Or Is It?

Latest developments in the Qualcomm-NXP acquisition saga indicate that the deal may be about to go through.

The USD $38 billion deal, which will be the biggest ever in the semiconductor industry, has been dragging on for more than a year as Qualcomm tries to get regulatory approval from the EU that will allow the transaction to proceed. The deal was originally supposed to close on 27th October 2017.

Qualcomm proposed an updated offer at the beginning of October in an attempt to appease EU competition enforcers. While details of this latest offer have not been made public, the company has reportedly made concessions which include offering to buy NXP without some of its key patents. These patents could then be sold to a different buyer. The offer is also rumoured to contain pledges to allow rival products to continue to interoperate with NXP devices.

While Qualcomm's and NXP's product offerings are seen as complementary, the competition regulator is concerned that a combined Qualcomm-NXP could provide incentives to customers to buy bundled products, or change NXP's intellectual property practices. The EU is particularly concerned about the merged entity's position in NFC, mobile devices and vehicle-to-vehicle and vehicle-to-infrastructure technology.

Meanwhile, there is increasing speculation in the industry that the price of NXP may need to go up, given the Dutch firm's increase in share value in the year since the deal was first announced.

If the deal fails to obtain regulatory approval and officially falls through, Qualcomm will owe NXP a fee of around USD $2 billion. Qualcomm's current offer stands until November 17th and while industry analysts remain confident it will eventually be passed by regulators, there is no word yet on when this might be.

Bridgetek deal: *where society and technology meet*

A global distribution agreement with Bridgetek, the company formerly part of FTDI Chip that develops innovative silicon solutions to enhance the way in which society interacts with technology, gives Mouser's customers access to multi-award-winning graphic controller ICs, performance-optimized microcontrollers, development hardware, and display modules.

Each member of Bridgetek's FT81x Embedded Video Engine (EVE) series combines display, audio and touch functionality in a single chip, which presents engineers with a highly effective solution for implementing human machine interfaces (HMIs) with high-quality dynamic graphics.

These devices use an object-orientated methodology that allows graphics to be rendered line-by-line (at 1/16th pixel resolution), as opposed to pixel-by-pixel. This streamlines the HMI construction process, leading to reductions in cost, board real estate, and system complexity.

The company's FT93x embedded microcontrollers incorporate a proprietary 32-bit RISC-based FT32 core that can deliver true zero-wait-state operation while running at up to 100MHz. These microcontrollers offer elevated performance levels in small, low-pin-count packages that reduce required space by up to 40 percent compared to the previous generation microcontrollers.

Its ME81x development modules are based on the FT812 and FT813 EVE advanced graphic controller ICs and are designed to help engineers to build more sophisticated and functionality-rich HMIs. Both modules feature a 5-inch, 800×480 pixel TFT display capable of supporting portrait and landscape orientations. The ME812A-WH50R has resistive touch functionality that permits touch operation through gloved hands, while the ME813A-WH50C module features capacitive touch, which enables five simultaneous touch points and gesture control.

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Victorious at Fuji

The Mouser-sponsored Vaillante Rebellion racing team scored a stunning victory in the recent weather-shortened 6 Hours of Fuji round of the World Endurance Championship. It was the sixth podium finish in the seven races so far this season for the Rebellion No. 31 car driven by Bruno Senna, Nicolas Prost and Julien Canal.

With the race called due to weather after four and a half hours, the team was declared LMP2 winners even before Canal could take the wheel. With only two races to go in the LMP2 championship, the victory puts the No. 31 car a mere 10 points behind the leader, the Jackie Chan No. 38 car, which placed third at Fuji.

The Vaillante Rebellion No. 13 car, driven by Nelson Piquet, Jr., Mathias Beche and David Heinemeier Hansson, had to drop from the race at Lap 85, but held onto seventh place in the overall standings.

Mouser is proud to partner with valued supplier LEMO, a global leader in the design and production of precision custom connection solutions, to sponsor Vaillante Rebellion for the entire 2017 FIA World Endurance Championship season. Mouser distributes the full line of quality LEMO connector solutions including their original push-pull connectors.

Now the attention shifts to the 6 Hours of Shanghai, then the season finale at Sakhir, Bahrain.

http://www.mouser.com/rebellion-racing

Mouser Launches Free Inventory Management App

Mouser's new, innovative Inventory Management Tool is an easy-to-use, web-based inventory system that helps customers to manage and track their stock of electronic components and related supplies.

The integrated iOS and Android apps enable users to scan barcodes as well as print bin labels directly from the application. Customers can take advantage of this new free tool by logging into their My Mouser accounts.

To create a My Mouser account, go to www.mouser.com/MyMouser.

Mouser customers can access the new Inventory Management tool at www.mouser.com/Inventory-Management from any web browser or through the new mobile app for both iOS and Android devices. With the tool, users can easily manage part numbers and inventory levels, generate inventory reports, and import current product inventory data from spreadsheets. The tool also provides check-in/check-out functionality, which helps organizations track shared tools such as scopes or soldering equipment. To help ease of use, the tool comes with a simple online dashboard and a quick, step-by-step setup wizard.

Customers using the tool on a web browser can take advantage of the advanced Mouser Match feature, which links products in their inventories to Mouser part numbers. With Mouser Match, customers can:

- Automatically synchronize product data, such as manufacturer, description, and life cycle.
- Automatically import product images from Mouser.com for recognition on sight.
- Quickly reorder products from Mouser.

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Revolutionary Urban Technology Detailed in E-books

A series of e-books that provide in-depth views of leading-edge technology featured in the Shaping Smarter Cities series, part of Mouser's award-winning Empowering Innovation Together™ program is now available.

The Shaping Smarter Cities series features exclusive videos, articles, and blog posts about how engineers on three different continents created technology-based solutions to some of most pressing problems of crowded cities. The following e-books provide a deeper dive into the technologies shown in the series, looking at how the world's best engineers and experts foresee innovations shaping humanity over the coming years.

The Internet of Moving Things

Imagine being able to sleep or exercise in your car while it drives itself; the possibility may be closer than we think. The Internet of Moving Things e-book not only describes how revolutionary fully autonomous vehicles may be in the near future, but also explores the communications technologies that will allow these vehicles to interact with humans, other vehicles, and city infrastructure.

Vertical Farming

As shown in the Shaping Smarter Cities video, engineers in Tokyo have revolutionized vertical farming, devising a system that could feed millions of people while using 99 percent less water than traditional farming methods. The Vertical Farming e-book looks at different types of vertical farming as well as how robotics and other technologies can increase food production up to 100 times current levels.

Augmented Reality

Many people still think of augmented reality (AR) in terms of gaming, but the emerging technology is most promising in medical education, healthcare and even manufacturing and construction applications — all of which are covered with unique real-world examples in this e-book.

With stories about AR as an alternative to invasive examinations and data visualization to increase workplace safety, the Augmented Reality e-book describes ways innovators are transforming the technology to improve conditions in our cities.

The Shaping Smarter Cities series is supported by Mouser's valued suppliers Analog Devices, Intel®, Microchip Technology and Molex. The series features the latest products from leading suppliers plus exclusive videos, articles, blog posts, and e-books related to the cutting-edge technologies used to create the cities of the future.

The Empowering Innovation Together program has been one of the most visible and recognized marketing programs in the electronic component industry, featuring projects ranging from bringing superhero technology to life to 3D printing a semi-autonomous car with drone technology.

The focus of this year's program is about solving tough problems that impact humanity as a whole.

Visit **http://www.mouser.com/empowering-innovation** for more information.

Reduce the cost/risk of commercial IoT

Rigado's suite of edge connectivity solutions for the IoT enable engineers to easily design, deploy and scale low-energy wireless architectures, reducing the cost and risk of commercial IoT deployments. The Rigado product line available from Mouser Electronics includes the R41Z and BMD-300 series wireless modules and development kits.

Rigado's Bluetooth low energy modules are advanced, highly flexible, ultra-low power multiprotocol System-on-Modules (SoMs) for portable, extremely low power embedded systems. The BMD-300 Series from Rigado is a line of ultra-low power Bluetooth 5 modules based on the Nordic nRF52 system-on-chip (SoC). With an Arm® Cortex®-M4F core and embedded 2.4 GHz transceiver, the series provides a complete RF solution available in three variants: internal antenna (BMD-300), U.FL connector (BMD-301), and ultra-miniature (BMD-350).

The R41Z multi-mode module supports both Bluetooth® 4.2 and the 802.15.4-based Thread protocol on an ultra-low-power, highly integrated single-chip device. Built on an NXP KW41Z microcontroller with an Arm Cortex-M0+ processor, the R41Z effectively balances power and performance with scalability to provide an ideal solution for applications such as commercial lighting and building automation.

Both the R41Z and BMD-300 series modules are fully certified and supported by Rigado evaluation kits. These evaluation kits feature Arduino Uno-compatible headers, power and virtual COM over USB, two capacitive touch buttons, and built-in sensors, making it easy to rapidly prototype smart devices.

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Factory 4.0:
The Biggest Problem May Be the Noise You Can't Hear

By Paul Pickering for Mouser Electronics

We all know that the factory floor can be a noisy place: noise-induced hearing loss is one of the most common occupational illnesses in the U.S., but not only humans are at risk. Unseen and unheard electronic noise can wreak havoc with sensors and communications systems, especially since the arrival of the Industrial Internet of Things (IIoT), also known as Factory 4.0.

Figure 1: The IoT-enabled factory blends old and new technology. It's a challenging EMC environment, especially for low-power wireless devices. (Image source: Texas Instruments)

Why is this electronic "hearing loss" on the rise? The IIoT is all about using Big Data to produce what industry experts call "actionable insights," which improve operational efficiency, save money and predict failures before they happen. Gathering massive amounts of data and getting it into the cloud begins by adding thousands of sensitive sensors to monitor all aspects of an industrial process. Those sensors must work well in an environment that was never designed to accommodate them.

EMC and the Connected Factory

Wikipedia defines electromagnetic compatibility (EMC) as the "branch of electrical engineering concerned with the unintentional generation, propagation and reception of electromagnetic (EM) energy, which may cause unwanted effects such as electromagnetic interference (EMI) or even physical damage to operational equipment."

Within EMC, there are two main classes of effects: EM emissions, or the generation of unwanted EM energy, and EM susceptibility, which is the degree to which a piece of equipment is affected by incoming EM energy. We can divide each class according to the means of EM propagation—radiation or conduction—giving rise to four distinct areas of study, and four sets of problems. Figure 2 illustrates the mechanisms for EMC propagation.

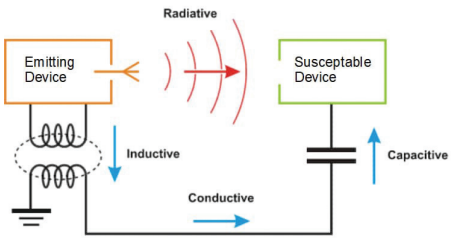


Figure 2: Electromagnetic radiation transmission mechanisms. (Image source: Wikipedia)

What makes the factory such a challenging EMC environment? Figure 1 earlier showed a typical IIoT scenario: a wide array of wired and wireless sensors and communication networks superimposed on a factory that was designed years, or even decades, before the development of low-power low-voltage analogue and digital technology. The current generation of these devices often requires power supplies of 1V or less and can potentially be affected by millivolt disturbances on power and ground lines. It gets worse since the original factory designers couldn't foresee the IIoT's widespread adoption of low-power wireless devices, so minimizing emissions in the GHz range probably wasn't a high priority.

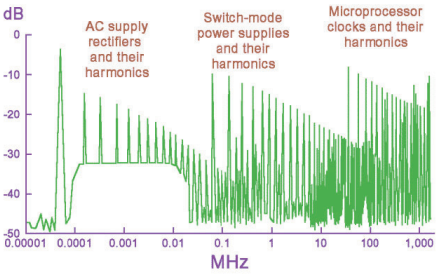


Figure 3: The industrial environment suffers from broadband EMI: some sample sources shown. (Image source: Compliance-club.com)

The typical factory contains many machines that can cause multiple EMC problems for low-power and wireless devices. An arc welder, for example, may be a source of both radiated and conducted emissions: radiated radio-frequency (RF) energy from the arc pulses and conducted energy from voltage harmonics and fluctuations on power and ground lines.

Other machines may suffer from both emission and susceptibility issues at the same time. Figure 3 shows some common sources of EMI and their frequencies.

Some Applicable EMC Standards

As you might expect, since one noisy device can affect the public at large, the governments of the world have developed standards governing EMC performance. In the U.S., the Federal Communications Commission (FCC) sets minimum compliance standards for telecom equipment. Part 15 of the FCC regulation specifies the emissions testing needed to prevent harmful RF interference.

In the European Union, R&TTE Directive 99/5/EG applies to all radio-controlled products. Industry Canada has the General Requirements for Compliance of Radio Apparatus (RSS-GEN), and other countries have similar agencies.

The regulatory agencies issue standards that cover allowed levels and approved test procedures for each of the EMC categories. Government agencies typically require testing and certification to relevant standards before a company can launch a new product.

Different standards apply to different industries, under the authority of worldwide standards authorities such as the International Electrotechnical Commission (IEC). For industrial equipment, IEC 61000-6-2 covers EMC immunity with IEC61000-6-4 as the generic emissions standard. Many applications have their own set of standards: for example, IEC 60974-1 specifically applies to power supplies for arc welding robots, and IEC 60974-10 covers arc welding robot EMC requirements.

EMC and Wireless Networks

Although industrial wired networking has been around for decades and includes such standards as Ethernet and CAN, hooking up an IIoT-enabled factory is made much easier by the rise of low-cost, low-power wireless networks. Some of the reasons for using a wireless solution in industrial applications include:

- Greater mobility, and the ability to move devices and easily connect with smartphones and tablets
- Elimination of expensive cabling
- Fast and easy installation and commissioning, especially in remote or hard-to-access locations
- Greater flexibility and capability for remote updating
- Easy integration of devices into the network

During the last decade, several wireless standards have taken hold in the connected factory. The table below shows some of the main contenders and their application in IIoT:

IEEE Standard	Intended Use	IIoT Application
802.11	Wireless Local Area Network (WLAN)	Wi-Fi
802.15.4	Low-Rate Personal Area Network (LR-PAN)	ZigBee, WirelessHART, 6LoWPAN
802.15.1	Wireless Personal Area Network (WPAN)	Bluetooth

IEEE 802.15.4-based networks are particularly attractive to IIoT architects because they are more suited to the small data packets and low update rates of IIoT sensor nodes. An 802.11 WLAN device, on the other hand, must be able to accommodate applications such as video streaming, which increases the complexity and the power consumption dramatically.

Many wireless products can handle one or more IIoT protocols in a single device. Texas Instruments, for example, offers the CC2630 wireless microcontroller unit (MCU) with 6LoWPAN, ZigBee and TI's own SimpleLink functionality.

The device belongs to the CC26xx family of cost-effective, ultra low power, 2.4-GHz RF devices. The CC2630 contains a 32-bit ARM Cortex-M3 processor core running at 48 MHz, plus an RF block that incorporates an ARM Cortex-M0. It also includes an ultra low power sensor controller to interface with external sensors and collect analogue and digital data during system sleep mode. This feature makes the part well suited for an IIoT low-power remote sensor node application.

Designing to Minimize EMC Issues

Designing for good EMC performance requires a multi-tiered approach, paying attention to performance from the factory level, such as grounding and power distribution, down to the individual integrated circuit. The task is made more difficult by the fact that many IIoT installations are retrofits, so wholesale changes, such as rewiring the factory infrastructure, are difficult, if not impossible, to accomplish.

Designing for EMC: Factory Level

At the factory level, good EMC performance begins with the design of the power distribution system. The typical factory uses high-voltage AC and DC systems that can give rise to many EMC-related events, such as transients from power network operations or power factor capacitor switching, fast transients from arcing contacts and collapsing magnetic fields in high-power contactor coils. Natural events such as direct or indirect lightning strikes can also induce voltage transients in factory equipment.

On the shop floor, rotating machines are used in almost all situations, from CNC machines to pumps or industrial robots. Unfortunately, they are also a major cause of EMI, particularly brushed DC motors with their "arc and spark" brushes; even brushless motors (BLDC) have PWM controls that generate high-speed switching transients. A site survey can help identify sources of RF noise and separate the main offenders with isolation and shielding.

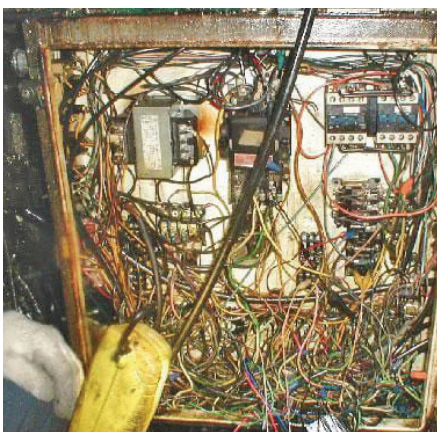
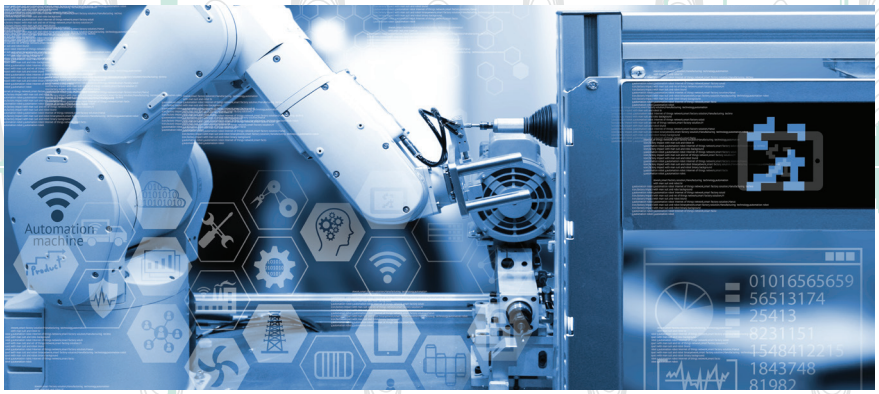


Figure 4: "I have no idea why we're having EMC issues" (Image source: ThereIFixedIt.com)



For reducing conducted susceptibility or emissions, stopping the noise at the point at which it enters or leaves the board — at the connector — is a very effective approach.

A filtered connector combines a standard connector with EMI/RFI suppression components to help solve EMC problems. The filter elements are housed within the connector body, maximizing the available PCB area, and saving weight compared to a standard connector and discrete filtering components.

For example, Harting offers a line of D-sub connectors that include a ferrite filter block to block high frequencies. The D-sub form factor is widely used in industry, and the Harting connectors come in 9, 15, 25, and 37 contact versions.

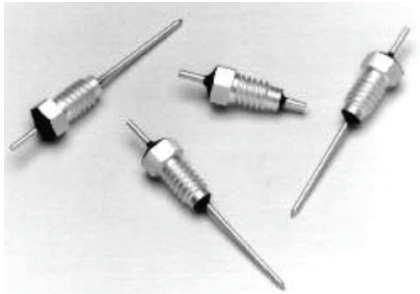


Figure 6: Sealed filters effectively filter out DC power line noise. (Image source: Mouser Electronics)

Often, it's necessary to provide off-board EMC filtering for high-voltage DC power lines. The API 51F-726-002 EMC feed-through filters shown in Figure 6 are designed for tapped hole or through-hole mounting. Resin seals at both ends provide protection in a harsh industrial environment. With a choice of C, L, or Pi filters, they are effective at filtering out noise on DC power lines and can handle voltages up to 500 V DC/220 V AC (400 Hz).

Integrated circuit solutions are also available to help cut down on EMC issues. Texas Instruments' TPDxF003 family is a line of filtering devices designed to reduce EMI emissions as well as provide system-level electrostatic discharge (ESD) protection.

Each device can dissipate ESD strikes above the maximum level specified by the IEC 61000-4-2 international standard.

The filtering structure reduces EM emissions by providing high-frequency roll-off: the device features a -3dB bandwidth of 200MHz and attenuates the signal by more than 25dB at 1GHz. Four-, six- or eight-channel devices are available.

To stop incoming radiated EMI, many designs shield the internal circuitry with a grounded enclosure that forms a Faraday cage: this can also block internally-generated emissions from leaking into the external environment.

Designing for EMC: Device Level

Drilling down even further to the board and device level, radiated or conducted emissions in one area of a PCB can cause problems in another area of the same board.

For example, high-spread switching transients from digital clock pulses or switching power supplies can cause errors in low-level analogue measurements.

Within a circuit block, good layout and design techniques are key to ensure that signals from one circuit do not capacitively or inductively couple into another circuit.

Some of these techniques are:

- Slow voltage and current rise and fall times to minimize sharp transitions and reduce high-frequency content
- Decrease the surface area of magnetic loops on the circuit board
- Separate high-current grounds from digital, and especially analogue grounds, with a "star ground" arrangement
- Run power and ground traces directly over each other to minimize loop area and reduce impedance
- Use a clock with a dither feature to spread the frequency spectrum and reduce radiated EMI
- Use ground planes or layers under noisy components such as microcontrollers

Many factors must be considered, including component placement and packaging constraints, so several design iterations may be needed to arrive at an acceptable solution.

Conclusion

This article is just a brief overview of a complex topic. To find out more, check out these resources from some of our suppliers.

Texas Instruments has a helpful application note on PCB design guidelines for reduced EMI. TDK offers a "Guide Book For EMC" that discusses the role of passive components such as ferrites, capacitors, common-mode filters and varistors in achieving good EMC performance. And Analog Devices, another Mouser supplier, has a tutorial on EMI, RFI and shielding techniques to help protect sensitive analogue circuitry.

The Industrial Internet of Things, also known as Factory 4.0, involves the integration of low-level, low-power, analogue digital and wireless functionality into an electromagnetically hostile environment. Designing for good EMC performance requires attention to detail at all levels, from the factory building itself to the individual board layouts.

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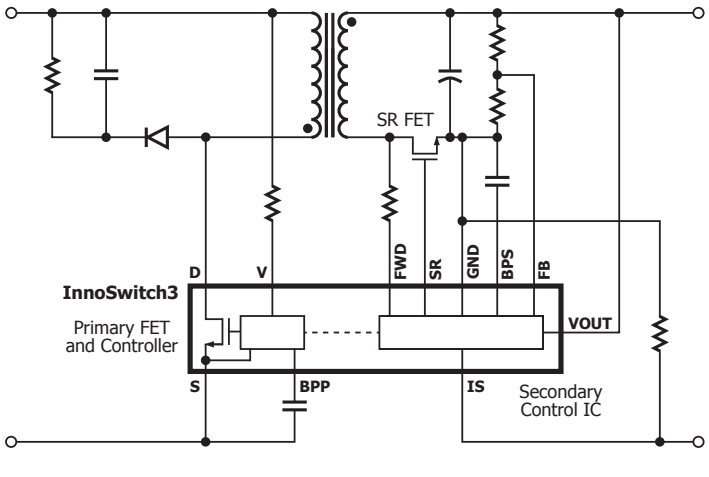

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The Impetus Behind Advances in Industrial and Embedded Optical Communications

By Carolyn Mathas for Mouser Electronics

There is an insatiable demand for ever-greater communications bandwidth in industrial and embedded computing settings where distance, low power and small configurations matter. Specific enabling technologies such as FPGAs and advances in transceivers, connectors and receivers support the rapid evolution in optical communications.

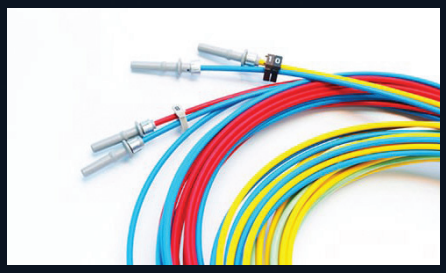


Figure 1: Fibre optic cables with terminations.

Simply, optical communications consists of a transmitter that encodes messages into optical signals, a channel to carry the signal to its destination and a receiver that reproduces the message from the optical signal. The speed of optical communications depends greatly on the distortions of the information signals generated from their interactions with the molecules that make up the fibres. The higher the speed of transmission, the more likely the signal will be distorted. When distortions are large, detection errors occur at the receiving end.

Spurred by the limitations inherent in radio frequency communications, today's optical solutions operate at higher bandwidth and carry a greater amount of data from a package that is smaller, lighter and less power hungry than RF, while operating in a non-regulated spectrum.

Given the critical nature of increasing bandwidth in industrial and embedded settings, fibre optics is able to carry very wide bandwidth signals, into the GHz range and lower bandwidth signals can be multiplexed onto the same cable. Fibre optics in industrial applications provides a noise immunity that once needed to be housed in protective sheaths inside conduit. And, within settings where potentially explosive atmospheres exist, fibre optic links do not store energy sufficient to ignite an explosion.

In both industrial and embedded applications, there is a need for improved security and optical communications has its benefits. Given that fibre optics does not generate EMI fields that can be picked up with external sensors, it is virtually impossible to 'steal' signals by splicing into optical fibres compared to the ease of doing so with conventional copper wiring.

Addressing Industrial and Embedded Computing Needs

While used initially in telecommunications and wide area networking for many years, fibre optics have become increasingly prevalent in industrial data communications systems. As high data rate capabilities, noise rejection and electrical isolation became more important, fibre optic technology became increasingly ideal for use in industrial systems. In this segment, most often used for point-to-point connections, fibre optic links are being used to extend the distance limitations of RS-232, RS-422/485 and Ethernet systems.

> "In numerous data-intensive applications, the advantages of optical computing pay dividends."

Rugged embedded computing systems also require high-data-rate input/output, for which fibre optics are ideal. The I/O could be a relatively short link, connecting two plug-in modules, or it could be a longer run. In numerous data-intensive applications, the advantages of optical computing pay dividends.

Transceivers are used in embedded and industrial high-speed applications where they eliminate components, speed design and save money. The Avago AFBR-59FxZ compact 650nm transceivers, for example, implement Fast Ethernet (100Mbps) communications over 2.2mm jacketed standard Polymer Optical Fibre (POF).

Applications for the AFBR-59FxZ transceivers include factory automation, industrial vision systems and power generation and distribution systems. The transceiver features a 650 nm LED, driven by a fully integrated driver IC. The LED driver operates at 3.3V. The IC is a linear integrated LED driver with differential input signals, converting input voltage in an output current for the LED.

In contrast, Finisar's FTLX1x72x3BCL pluggable Multi-Rate SFP+ transceivers are compliant with SFF-8431 and SFF-8432, 10GBASE-ER and support 10G SONET, SDH, OTN, IEEE 802.3ae, 8x/10x Fibre channel over 40k links and 6.144G/9.83 CPRI. The transceivers are designed for use in 10-Gigabit multi-rate links up to 40km of G.652 single mode fibre.

Finisar FTLX1772M3BCL transceivers also have higher optical transmit power and better receiver sensitivity than 1310nm 10GBASE-LR and OC-192 SR-1 transceivers, and they support an optical link budget of 17dB, to compensate for the higher fibre attenuation loss at 1310nm over 40km of G.652 single mode fibre.

In this solution, digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472. The FTLX1772M3BCL transceivers use internal transmitter and receiver re-timer IC's for SONET/SDH jitter compliance and to enhance host cards' signal integrity. Applications include 10GBASE-ER/EW and 10G Fibre Channel (FTLX1672D3BCL), OTN G.709 OTU1e/2/2e FEC bit rates, 6.144G/9.83G CPRI, 8.5Gb/s Fibre Channel, 10G NRZ SONET, SDH, 10G Ethernet and Fibre Channel and G.709 OTN FEC bit rates.

FPGA Integration

Addressing important power reduction and electrical signal path length requirements, the integration of high-speed optical transceivers and programmable devices dramatically reduces the signal path from the I/O pad of the chip to the input of the optical transceiver. The shorter path also lowers EMI and jitter, improves signal integrity, and reduces data errors caused by parasitic elements.

Altera's Optical FPGA technology breaks through recent reach, power, port density, cost, and circuit board complexity limitations. The company's Arria V GX 13688 LABs 704 IOs family, for example, is a comprehensive offering of mid-range FPGAs. The Arria V is ideal for power-sensitive wireless infrastructure equipment, 20G/50G bridging, switching and packet processing applications, high-definition video processing and image manipulation, and intensive digital signal processing (DSP) applications. Featuring TSMC's 28 nm process technology and hard intellectual property (IP) blocks, it has 50% lower power consumption than previous generations, and the lowest power transceivers of any midrange family.

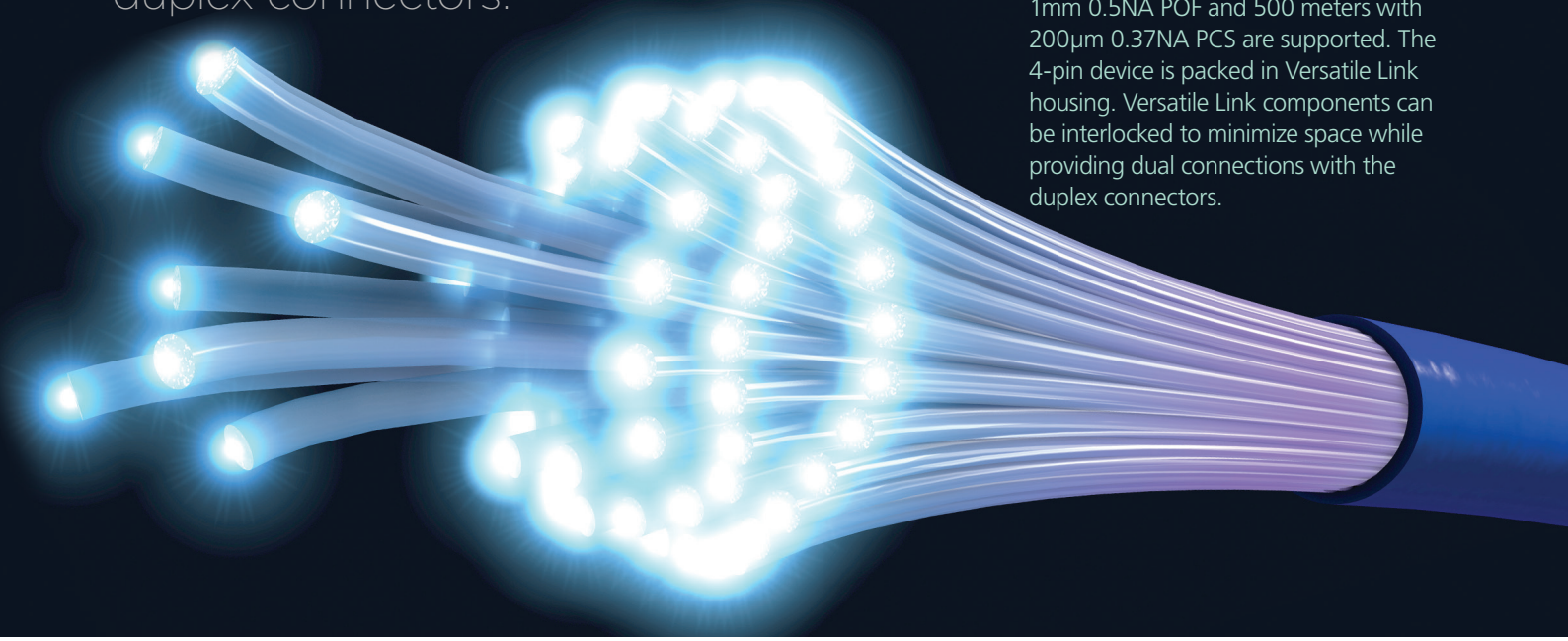
The family provides tight integration of a dual-core ARM Cortex-A9 MPCore processor, hard IP and an FPGA in a single Arria V system on a chip (SoC). It supports more than 128 Gbps peak bandwidth with integrated data coherency between the processor and FPGA fabric.

Altera's 28-nm Stratix V FPGAs, in comparison, include such innovations as enhanced core architecture, integrated transceivers up to 28.05 Gbps and a unique array of integrated hard intellectual property (IP) blocks. This combination allow the Stratix V FPGAs to deliver a new class of application-targeted devices that are optimized for bandwidth-centric applications and protocols, including PCI Express ((PCIe) Gen3, data-intensive applications for 40G/100G and beyond, and high-performance, high-precision digital signal processing (DSP) applications.

Receivers

At the receiving end, a fibre optic system provides very low bit error rates (BER) as long as it is designed to provide adequate signal levels and since fibre does not pick up electromagnetic interference (EMI), signals on adjacent cables are not coupled together. AFBR-25x1CZ Fibre Optic Receivers from Avago Technologies consist of an IC with an integrated photodiode providing TTL logic families that have compatible output. Along with Avago's AFBR-15x9Z or AFBR-16x9Z transmitter, any type of signal from DC to 5MBd at distances up to 50 meters with 1mm 0.5NA POF and 500 meters with 200µm 0.37NA PCS are supported. The 4-pin device is packed in Versatile Link housing. Versatile Link components can be interlocked to minimize space while providing dual connections with the duplex connectors.

"Versatile Link components can be interlocked to minimize space while providing dual connections with the duplex connectors."



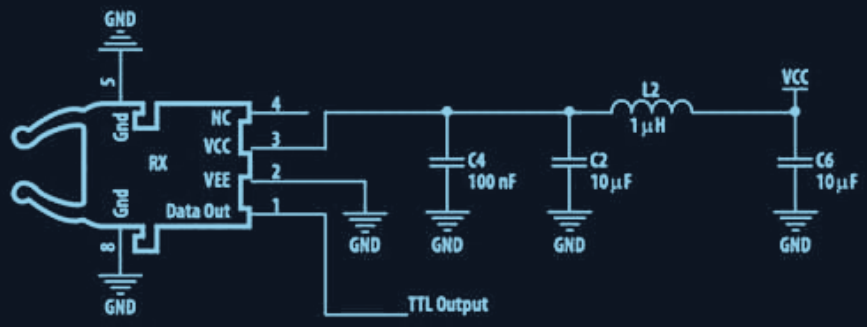


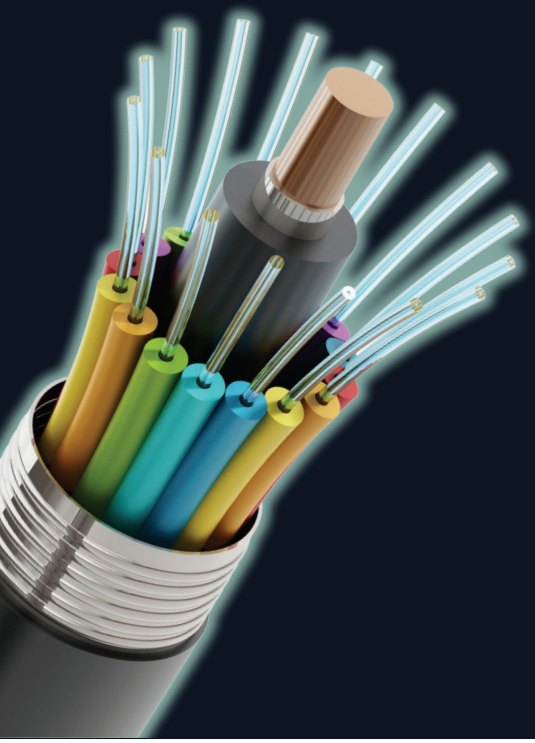
Figure 2: Avago AFBR-25x1CZ Fibre Optic Receivers Recommended Application Circuit. Source - Datasheet

"The frequency comb prevents the random distortions that make it impossible to reassemble the original content at the receive"

Applications include optical receivers for 5MBd systems and below, industrial control and factory automation, extension of RS-232 and RS-485, high voltage insulation, elimination of ground loops and it reduces voltage transient susceptibility.

Connectors

In the past, fibre optic connections were labor intensive and involved cutting a fibre, epoxying a special connector, and polishing the end of the fibre. This operation required specific tools and test equipment to ensure a good connection. While this technique is still used, devices used to cut, align and join fibres have been improved and simplified. Connection losses vary, depending on the type of connection, but typically range from 0.2 dB to 1 dB.



TE Connectivity (TE) Ruggedized Optical Backplane interconnect system, for example, delivers a high-density, blind-mate optical interconnect in a backplane/daughter card configuration. TE offers the optical system in both receptacle (backplane) and mating plug (daughter card) connectors that interconnect up to two MT ferrules, each accommodating up to 24 fibre paths. Typical applications are adverse environments and high-bandwidth computing applications requiring optical infrastructure. Supporting the VITA 66.1 Standard, the connectors maximize optical performance.

Breaking Through Remaining Barriers

Optical communications, however, is still not without challenges. With fibre optics, for example, beyond a threshold power level, additional power increases irreparably distort the information travelling in the fibre optic cable.

Photonics researchers at the University of California, San Diego just announced that they have broken key barriers that limit the distance information can travel in fibre optic cables and still be accurately deciphered by a receiver. Published in the June 26, 2015 issue of the journal Science, their research has increased the maximum power -- and therefore distance -- at which optical signals can be sent through optical fibres.

In a lab environment, researchers successfully deciphered information that travelled a record-breaking 12,000 kilometers (7456 miles) through fibre optic cables with standard amplifiers, but without using repeaters.

The breakthrough removes this power limit and extends how far signals can travel via optical fibre without a repeater. Removing periodic electronic regeneration when dealing with 80 to 200 channels saves substantial cost and enables a more efficient transmission of information.

The breakthrough uses wideband "frequency combs" to ensure that the signal distortions, or crosstalk, between bundled streams of information travelling long distances through the optical fibre are predictable and, most important, reversible at the receiving end. The frequency comb prevents the random distortions that make it impossible to reassemble the original content at the receiver.

The Future

Recent optical communications advances concentrate on increasing the bandwidth of individual wavelength channels and number of wavelengths transmitted per fibre. Ongoing advances will concentrate on supporting a variety of emerging applications that provide real-time, on-demand and high data-rate capabilities in a flexible, low power and cost effective way.

Optical communications is not without challenges. Work continues on bandwidth expansion, distance, power and integration. As the industrial and embedded segments continue to demand more rapid communications capabilities, mixed with greater security and lower price tags, optical technologies will continue to provide answers.

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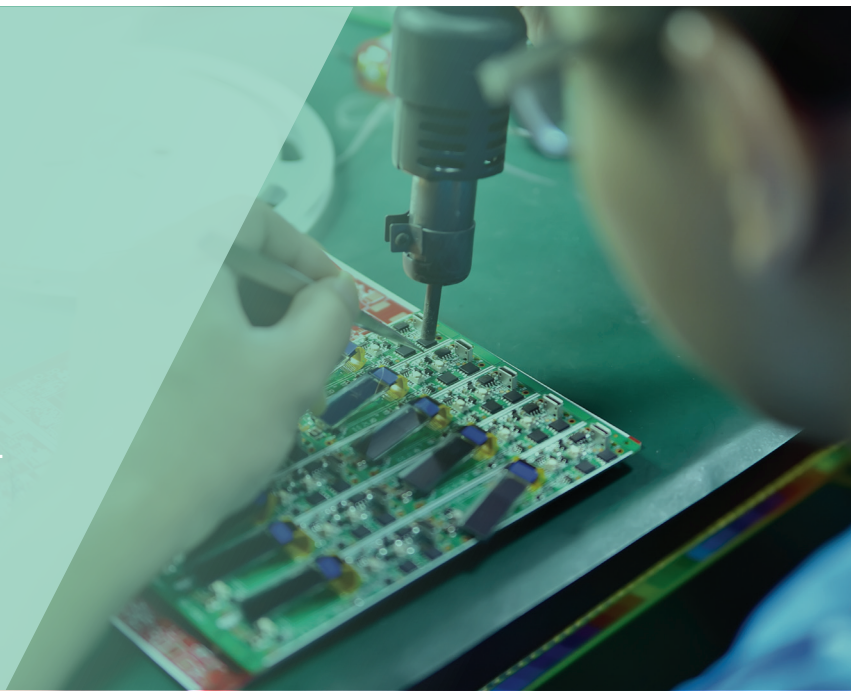

Bluetooth Low Energy evaluation kits

BMD-300, BMD-301, BMD-350, or R41Z from new supplier, Rigado

Rigado Bluetooth® Low Energy evaluation kits provide a great starting point for almost any Bluetooth Smart project. All features of the BMD-300, BMD-301, BMD-350 or R41Z modules are easily accessed via the eval boards. A simple USB connection provides power, programming, and a virtual COM port. All GPIOs are available on headers that are compatible with the Arduino form factor. This allows easy use of Rigado Shields, as well as many existing Arduino Shields. Current sense resistors enable the current flowing into the BLE module and the Shield to be measured.

FIND OUT MORE >>

Designing with the 'Ethernet of Everything'

PIC18 Power over Ethernet development platform

A modular system designed to provide an easy way to evaluate the functionality of the Microchip PIC18 family of MCUs and the TCP/IP (including CoAP) Library. The platform also provides a universal reference design for participation in Cisco's Digital Building Ecosystem.

The PoE Main Board is the foundation of the 'Ethernet of Everything' ecosystem within an industry standard PoE infrastructure. It is offered as a stand-alone board and as part of the PoE Development Kit. The Microchip PIC18 PoE Platform allows developers to combine the PoE Main Board with the Extension Boards that match the requirements of the application, maximising flexibility and scalability at an affordable cost.

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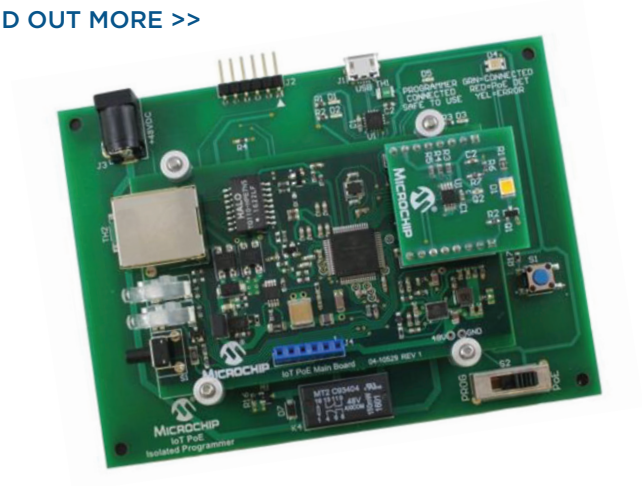
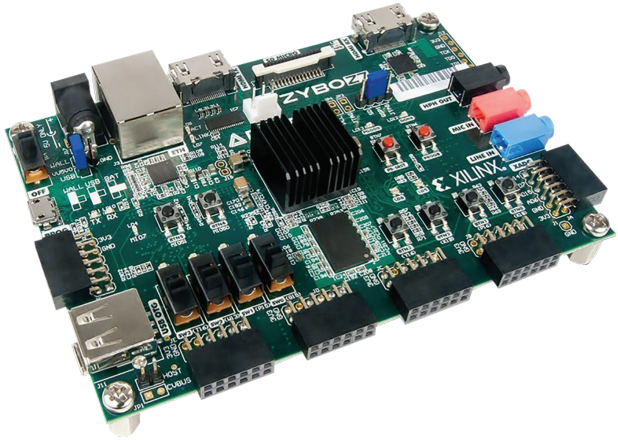


Feature-rich, ready-to-use, entry-level

ZYBO Z7 Arm®/FPGA SoCs platform

Zybo Z7 development boards from Digilent, the latest addition to the popular Zybo platform of Arm®/FPGA SoCs, provide a feature-rich, ready-to-use, entry-level embedded software and digital circuit development platform for a wide range of applications, including robotics, medical equipment, servers, advanced driver assistance systems and embedded vision. The boards are based on Xilinx's All-Programmable SoCs (AP SoCs) architecture, which integrates a dual-core Arm Cortex®-A9 processor with Xilinx 7-series FPGAs.

When coupled with its rich set of multimedia and connectivity peripherals, the Zybo Z7 development boards offer designers a flexible, cost-effective approach.



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Develop and create robotic functions

Robotic kits from OSEPP

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OSEPP Robotic Kits offer features to develop and create robotic functions to any project, including light chasing and object avoidance. The kits come with corrosion-resistant coating and strategically placed holes to add sensors and devices to any kit. The kits are 100% Ardunio compatible and all OSEPP sensors work with all kits. The kits offer an easy way for novices to engage in simple robotic assembly: customers will require the Robotics Functional kit alongside their mechanical kit of choice.

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Bluetooth Low Energy power SoC

PSoC® 6 BLE Pioneer Kit

Cypress Semiconductor PSoC® 6 BLE Pioneer Kit includes a 2.7" e-ink display shield board (CY8CKIT-028-EPD) with an onboard digital microphone and thermistor.

The CY8CKIT-062-BLE features support for Bluetooth Low Energy (BLE) v5.0 and an on board BLE antenna. The kit is compatible with Arduino Uno shield boards and includes a 512Mb high-speed Quad-SPI NOR flash.

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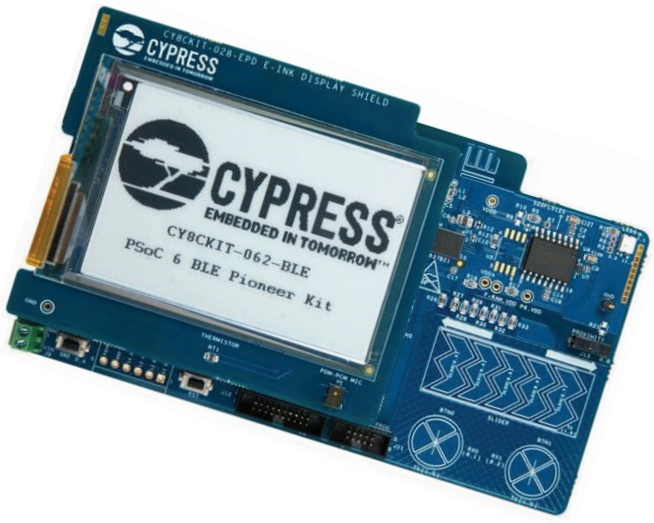

All Aboard!

Industrial IoT Powers Today's Locomotives

By Bill Giovino, Mouser Electronics

Figure 1: The General Electric ES44DC Locomotive is a fully-automated industrial diesel powerplant on wheels, generating 4,400 hp (3,280 kW). It's 250 sensors continuously monitor the engine and environment to automatically control throttle and brakes. (source: Wikipedia)

A train pulled by a couple of locomotives can haul a ton of freight 500 miles on a single gallon of fuel.

What makes this efficiency possible?

A network of sensors distributed over the locomotive and the cars behind it. Today's locomotives have up to 250 sensors that take in thousands of readings every minute. Modern locomotives are essentially rolling industrial power plants, and like all modern power plants, they benefit from the technology of the Industrial Internet of Things (IIoT).

The main focus of Industrial IoT, sometimes referred to as Industry 4.0, is to improve efficiency by automating existing processes as much as possible. Industrial automation has always been quick to incorporate any new technologies that will improve efficiency. For example, programmable logic controllers (PLCs) replaced rows and rows of relays. Proprietary wired communications were replaced by Ethernet, which was quickly supplemented by WiFi.

Application-specific embedded systems code was replaced by Microsoft Windows, and in some cases are now being replaced or supplemented with Android or iOS. Custom CRT consoles were first replaced by desktop PCs, which were then replaced by laptop PCs and those are now being replaced by mobile tablets connected by Bluetooth to the system for remote management. Imagine using a tablet computer to start or stop a 200-ton train!

Modern Manufacturing and Power Plants Using IIoT

The Industrial IoT is now the latest technology to revolutionize the modern factory. The most significant benefit is an increase in the operational efficiency of manufacturing facilities and power plants, and this has been the focus of the early adopters. For example, by automating some of the tedious processes that used to be performed by a human operator, manufacturers are able to dramatically improve efficiency while reducing error.

Another significant use of sensors and IoT is predictive maintenance. This involves the monitoring of various components of the factory or power plant to determine if a component is close to failure. This allows the component to be replaced before it fails in an operating environment, preventing the high expense of downtime. Just by these two applications, automating existing processes and preventing downtime by predictive maintenance, the Industrial IoT is driving costs down while increasing production.

Industrial automation has always relied on sensors to measure pressure, fluid flow, temperature, vibration, position, location, presence, and more. Now those sensors are being implemented with more accuracy and less cost, because the latest advances in sensor technology allow sensors to be battery powered and connected wirelessly to the main system. This allows more flexibility in connecting sensors while also reducing the cost of the sensor network.

Modern Diesel Locomotives and IIoT

Today's locomotives are truly examples of industrial automation in the extreme. The modern locomotive uses a diesel engine to drive either an alternator for AC current, or a generator for DC current, which powers the electric motors that drive the wheels. A prime example is the Evolution Locomotive manufactured by General Electric (GE). These locomotives feature over 250 sensors on the engine, cab, and surrounding areas. These sensors send over 150,000 real-time data points over the network each minute. Data processed includes engine temperature at various points including bearings and manifold temperature, oil pressure at various points in the massive diesel engine, speed of the train, and many others.

Cameras on the front and around the train are fed to the computer for image recognition of problems or obstructions. External sensors measure weather including barometric pressure, wind speed and direction, temperature, and humidity. The condition and inclination of the track is also measured. The computer also controls auxiliary systems such as fans, lights, horns, and cabin air conditioning.

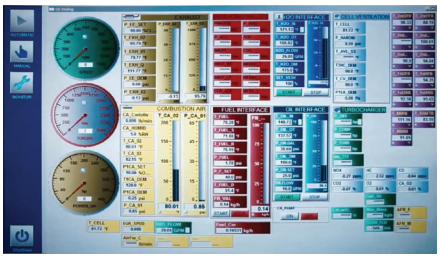

Figure 2: Cabin engine sensor display of a GE Evolution Series Locomotive. Over 100 sensors are displayed on this panel, including the exact air/fuel mix in the cylinders and the composition of the exhaust gasses. (Source: YouTube)

This constant monitoring of the engine's status with real-time data allows total and precise automation of the locomotive, including automated control of throttle and braking. For example, Figure 2 shows how engine sensors measure the exact fuel-air mix so the computer can adjust the mix for maxim efficiency. This level of measurement and control contributes to the automation of the operation of the entire train with minimal human intervention.

Bus interfaces for the PLCs include Ethernet EGD, Genius, DeviceNet, and Interbus-S. FieldBus interfaces are popular as they are common in industrial environments because of their ease of use. A PLC found on many GE locomotives is the VersaMax Industrial PLCs from Phoenix Contact. These snap into a common DIN-rail backbone or can easily screw into a cabinet panel.

"The trains horns and bells are required to sound in specific patterns during certain train events"

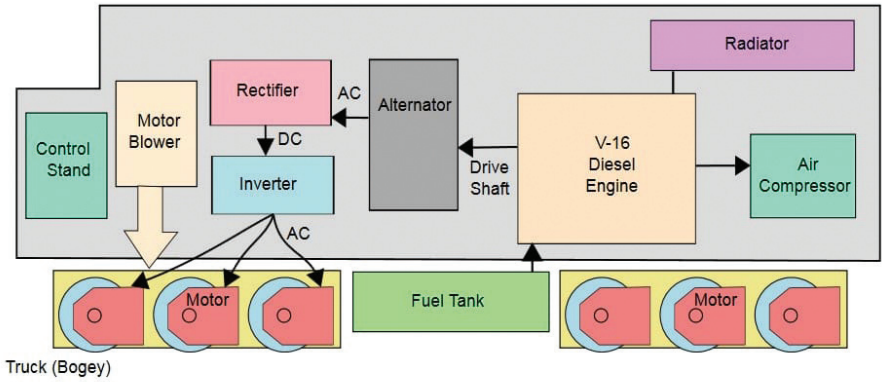

Figure 3: Block Diagram of a Modern Diesel Locomotive (Source: Wikipedia)

Given the close relationship between the modern automated factory and today's automated locomotives, it should come as no surprise that today's locomotives are controlled by some of the same PLCs used in today's factories. Ethernet is used as the backbone for the train's VLAN networking with support for Modbus TCP/IP. Many sensors are assigned a localhost IP address, while the entire train communicates data to the railway's cloud over radio and 4G networks. Industrial mobile phone routers from Phoenix Contact communicate over phone networks and are qualified for railway use.

Modern locomotives also use single-board computers (SBCs) that use the popular COM Express bus, often used in edge nodes on the Industrial IoT system. These SBCs support Gigabit Ethernet networking and can connect to local peripherals such as printers with on-board USB connections.

Code memory is easily changed by swapping out SD cards. It's important to note that all of the computing equipment, hardware, and networking protocols are the same as used in factory automation.

Figure 4: Mobile phone routers are used to communicate wirelessly between the locomotive's VLAN and the railroad's headquarters (Source: Phoenix Contact)

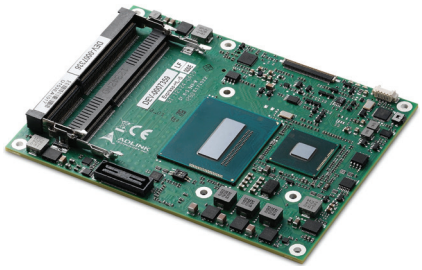

Figure 5: Express-HL COM Express board by ADLINK are used in industrial automation as well as railways. (Source: ADLINK)

Automating Throttle, Brake, and Gear Control

The automated operation of throttle, braking, and selected gear ratio of the locomotive is based on precise sensor measurements of the train and its surroundings. Sensors measure wind speed and direction, and the effective force and direction against the train is calculated based on the weight, shape, and inertia of the locomotive and attached cars. The massive inertia of the train at that moment is vital to real-time control. Weather is also a factor, especially if there is rain or snow. The topology of the track is taken into account including if the train is on an upgrade, downslope, or level track. All this sensor data is fed to the locomotive's computer system in order to help determine the correct throttle and braking control.

The trains horns and bells are required to sound in specific patterns during certain train events. For example, in the United States, when applying brakes while standing the horn sounds one short burst. When brakes are released in preparation to the train moving from a standing stop, the horn is required to sound two long bursts. When backing up, three short bursts of the horn are sounded. While in the past this was all done manually by the operator, in modern locomotives this is now controlled by the train's computer.

Inside the locomotives driving the train is a massive diesel engine. The GE Evolution Series of locomotives use a massive 12-cylinder diesel engine that generates up to 6,200 horsepower (4,620 kW). The industrial grade on-board computer system automates the operation of the entire train in the same way as an automatic pilot on an aircraft.

Accelerating Torque/Force

$$T_A = \frac{WK^2 \times N}{308t} \qquad F_A = \frac{W \times V}{1933t}$$

Where: T_A = Accelerating torque (lb ft)
WK = Total system inertia that must be accelerated. This includes motor rotor, speed reducer (if used), and load. (lb-ft^2)

Where: F_A = Accelerating Force (lb-ft)
W = Weight (lb)
V = Change in velocity (FPM)
t = Time (sec.)

Formula 1: Calculating the accelerating torque and force of a massive train

Throttle, brakes, and gearing are controlled based on sensor readings and compared to GPS data, the planned route, expected elevation changes, and the size and type of load. Efficiency is key here and everything is calculated to provide the best fuel economy possible.

The basic formula for determining the accelerating torque and force of the train is above.

Crucial to these calculations is all the sensor readings that are used to determine the massive total system inertia of the train, WK. While this is a single variable in the above formula, it is determined by taking into account the hundreds of sensors on the train which is run through sophisticated algorithms in the locomotive's computer system. Only when this is correctly calculated, automation of the train's throttle, brakes, and gearing becomes possible.

Deceleration is, of course, also automated and is especially important in emergency situations. If the train needs to slow down because the front camera imaging analysis has detected an obstruction, the front radar provides the closing distance to the obstruction to the locomotive's computer system. The speed and total system inertia of the entire train at that moment is calculated, and the decelerating torque and force is determined.

Based on the calculated optimum distance for stopping the train, the proper gear ratio and braking force is determined and the computer applies the brakes to stop the train.

The computer will also have the horn sound repeatedly as a warning. If the computer determines that the train cannot slow down in time before reaching the obstruction, it automates sounding a cabin alarm to the operator while transmitting a message over the wireless communications network to railway headquarters that a collision is imminent.

Wheel slip is one of the weakest links in a locomotive's operation. Excessive slip in the drive wheels results in reduced efficiency, decreased fuel economy, and can jeopardize the safety of the train. While in the past slip has been controlled solely by the skill of the driver, the industrial IoT system in today's locomotives provides a highly effective way of minimizing this important issue. Slip is measured by comparing the actual speed of the locomotive, as measured by Doppler radar, to the rotation of the drive wheels, which is proportional to the motor current. If the two do not match, the train's computer automates adjusting the motor current to insure maximum traction between the drive wheels and the track.

Maintenance and Efficiency

The computer also controls how much power flows to the electrical components of the locomotive. This includes the fans, battery chargers, blowers, lights, and edge computers. This control is also due to sensors that sense things like temperature, speed, and status of the batteries.

This level of control improves the reliability of the engine while making the locomotive even more efficient. Predictive maintenance is another important feature of Industrial IoT. Wheel bearing temperature is measured and used to predict end-of-life of the bearings. Wheel shape is measured by sensors which can predict if a wheel is going to go out-of-round, or even if it is off the track. The status of the entire train on the network is also measured. Each door, hatch, and gate is monitored or an open or close position and in many cases the computer can automate opening and closing. The hundreds of sensors themselves do self-diagnostics to determine if they need to be replaced before failure.

Every sensor reading, every action taken by the train, is logged by the computer in a box much like the "black box" found in aircraft. Later this data can be examined to uncover new ways to optimize train operations.

Conclusion

Modern diesel locomotives have come a long way from the manually-operated steam engines of a hundred years ago. Each locomotive is its own industrial power plant with hundreds of sensors, and its operation is automated in exactly the same way as stationary power plants. All this automation improves efficiency which saves millions of gallons of fuel, improves safety, and extends the life of today's locomotives.

Videos

What can technology do for us?

Grant Imahara concludes Shaping Smarter Cities video series

Mouser and celebrity engineer Grant Imahara conclude the Shaping Smarter Cities video series, part of Mouser's award-winning Empowering Innovation Together™ program, with a look back at the innovations presented in three previous videos.

The engaging Shaping Smarter Cities series follows Imahara as he visits engineers on three different continents, exploring the technologies they use to solve pressing problems in their respective cities and understanding how communities worldwide could adopt them. "Though humanity faces some monumental challenges, after seeing these technologies, I'm confident that we can eventually solve these problems and move forward.

Worldwide access to electronic parts has truly opened up the opportunity for innovation for engineers of all levels. It's an incredible time to be alive," said Imahara.

"The Shaping Smarter Cities series has highlighted inspiring technologies that we can use to solve problems in communities around the world," said Glenn Smith, President and CEO of Mouser Electronics. "Small-scale innovation — like we see in these videos — will be the key to tackling large-scale challenges in our dynamic cities." In Porto, Portugal, Mouser and Imahara documented how buses and city vehicles with connected access points and sensors are forming a mesh network that provides free Wi-Fi and massive amounts of data to help the city run more efficiently with far less street congestion.

In Tokyo, Imahara met with engineers who revolutionized vertical urban farming, devising a system that feeds millions of people

using 99 percent less water than traditional farming — a feat that could transform how cities around the world solve fresh water shortages.

And in Los Angeles, Imahara learned how implementing augmented reality (AR) technology can make construction projects smarter, increasing workplace safety, enabling more stable structures, and increases overall efficiency.

The Shaping Smarter Cities series is supported by Mouser's valued suppliers Analog Devices, Intel®, Microchip Technology and Molex. The series features the latest products from leading suppliers plus exclusive videos, articles, blog posts, and e-books related to the cutting-edge technologies used to create the cities of the future.

The Empowering Innovation Together program has been one of the most visible and recognized marketing programs in the electronic component industry, featuring projects ranging from bringing superhero technology to life to 3D printing a semi-autonomous car with drone technology. The focus of this year's program is about solving tough problems that impact humanity as a whole.

http://www.mouser.com/empowering-innovation/

https://youtu.be/vDCANm593b0

Silicon N-channel MOSFETs

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Sigfox connectivity solutions for low-power IoT

Sigfox connectivity solutions from ON Semiconductor provide a range of both hardware and software development tools for simplifying new designs for IoT applications. ON Semiconductor's Sigfox portfolio, available from Mouser Electronics, offers ultra-low-power connectivity devices and development kits to meet the needs of IoT devices transmitting small amounts of data.

The AX-SFxx and AX-SFxx-API radio frequency (RF) transceivers provide single-chip solutions for a node on the Sigfox network, with both up- and down-link functionality. The devices offer functionality in the radio configuration zones (RCZs) 1, 2, 3, 4, and 7 and are controlled by either AT commands (AX-SFxx) or through the AXSEM Sigfox Library (AX-SFxx-API). The devices feature eight GPIO pins with receive and transmit switching control.

Engineers can use ON Semiconductor Sigfox development kits to quickly develop Sigfox-connected applications using the Sigfox SoC solutions with an included two-year Sigfox subscription. The kits are pre-programmed with the Sigfox stack and a comprehensive and easy-to-use serial protocol based on AT commands. The kits have an SMA connector to allow for both conducted measurements, as well as radiated measurements using the included whip antenna.

Sigfox connectivity solutions are ideal for building and home automation, automatic meter reading, control and lighting, and sensor and asset tracking. For more information on Sigfox connectivity as well as similar technologies, read Mouser's technical article Standardizing IoT Connectivity by the Kilometer: Sigfox, LoRa®, or LTE? at http://www.mouser.com/applications/sigfox-lora-lte/.

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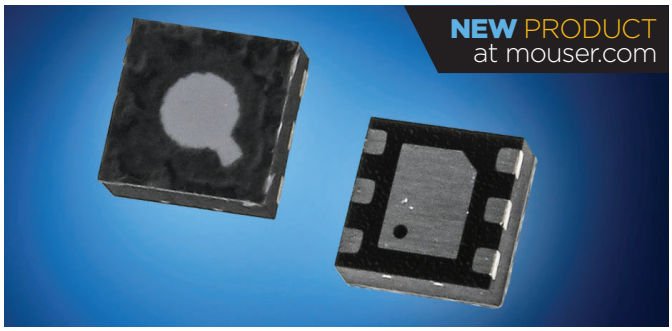
Gas sensors offer long-term stability

Among the only long-term stable siloxane-resistant MEMS gas sensors in the market today, the multi-pixel Sensirion Gas Platform (SGP) devices are suitable for integration into mobile devices for reporting indoor air quality, measuring breath alcohol concentration, or recognizing smells.

Available from Mouser, the sensors integrate four sensing elements with intelligent algorithms and pattern recognition to detect the type and concentration of gases and measure key environmental parameters, including relative humidity, temperature, volatile organic compounds (VOCs), particulate matter (PM2.5), and CO2. For VOCs that are simultaneously present in the air, the SGP devices feature a total VOC (TVOC) output capability, which enable the device to measure in-depth air quality information and survey indoor environments for contamination in one of the most practical and cost-effective ways possible.

The main benefits of Sensirion's multi-pixel gas sensors are their stability over time, high sensitivity and fast response in measuring certain types of chemical compounds and impurities.



Traditional metal-oxide gas sensors can degrade due to environmental contaminants; the proprietary metal-oxide technology and multi-pixel platform found in the SGP devices offer unrivaled robustness that result in unique long-term stability, accuracy and resistance against contamination from siloxanes.

Sensirion's SGP sensors are available in a very small 2.45 × 2.45 × 0.90 mm, 6-pin DFN package, and can be easily integrated into a variety of consumer wearables, smartphones, tablets, industrial ventilation devices and IoT applications.

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First individually-addressable four-colour LEDs now available

CLQ6A-TKW red, green, blue, and white (RGBW) LEDs from Cree, the first individually addressable 1W RGBW LEDs in their class, open new design possibilities for architectural lighting.

Available from Mouser, the four-in-one LEDs provide a single point source for excellent optical control, efficient color mixing and simplified design. These individually addressable RGBW LEDs deliver 8.2 lumens for blue, 30 lumens for green, 14 lumens for red, and 25 lumens for white at 100mA. A wide viewing angle and high brightness make these LEDs suitable for outdoor signage and architectural applications.

The RoHS-compliant CLQ6A-TKW LEDs are offered in 5700 K Cool White, 4000 K Neutral White, and 3000 K Warm White options in an industry-standard 5.0 × 5.2 mm PLCC8 package to simplify the design process and shorten time to market.

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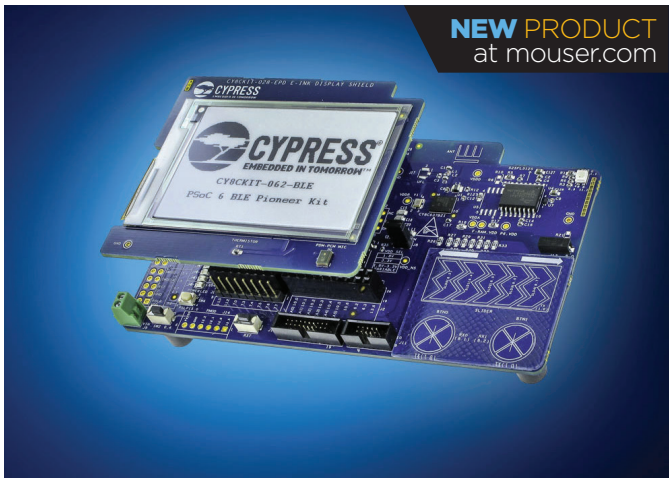
BLE Pioneer Kit brings low-power, flexible MCU to IoT

Cypress Semiconductor's PSoC® 6 BLE Pioneer Kit enables designers to begin innovating with the PSoC 6 microcontroller, industry's lowest power, most flexible microcontroller with built-in Bluetooth® Low Energy wireless connectivity and integrated hardware-based security in a single device IoT applications.



The easy-to-use Cypress PSoC 6 BLE Pioneer Kit is available from Mouser and includes a 2.7-inch e-ink display shield, CapSense® linear slider, proximity sensors, and touch buttons for intuitive operation.

The kit includes Arduino Uno-compatible headers, an onboard Bluetooth antenna, and an onboard programmer/debugger. The kit offers a complete power solution, integrating a Cypress EZ-PD™ CCG3 Type-C port controller with power delivery and support for rechargeable lithium-polymer batteries, as well as a super capacitor for backup power.

Cypress' PSoC 6 microcontroller is built on a dual-core Arm® Cortex®-M4 and Cortex-M0+ architecture with 40nm process technology, optimized for power and performance. The device is bolstered by CapSense capacitive touch technology to support inventive next-generation user interfaces. Software-defined analogue and digital peripherals allow engineers to create custom analogue-front-end (AFE) functions.

The microcontroller also offers multiple wired and wireless connectivity options like USB and Bluetooth 5, supporting internet- and cloud-based services. Delivering flexibility and innovation, the PSoC 6 microcontroller facilitates the next generation of IoT application development with the PSoC Creator™ integrated development environment (IDE) and numerous ecosystem partners.

To watch a webinar on using the PSoC 6 microcontroller to develop next-generation IoT applications, go to http://mou.sr/2gR4qIM.

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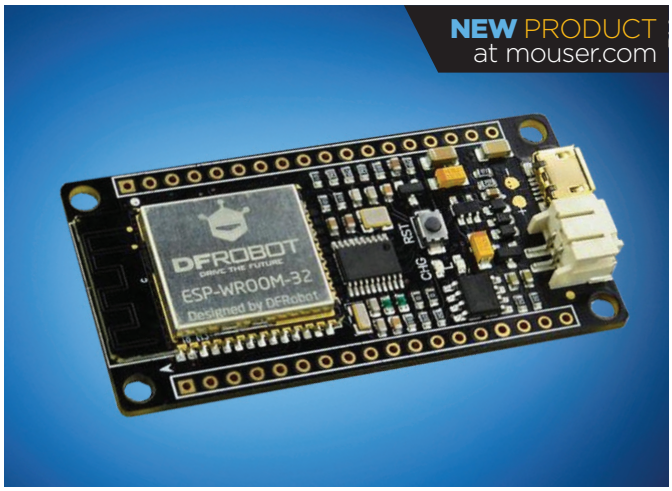
High-performance FireBeetle IoT MCU draws 10µA in deep sleep

The cost-effective FireBeetle ESP32 IoT Microcontroller board from DFRobot, designed specifically for IoT applications, boasts a deep-sleep mode that draws just 10 µA. It is built around an Espressif Systems ESP32 microcontroller module with integrated Wi-Fi and dual-mode Bluetooth® connectivity.

The high-performance module, available from Mouser, offers dual CPU cores: one to handle high-speed connections, and one for standalone application development.

The microcontroller can be powered by both USB and 3.7 V external lithium battery, and the battery can be charged directly by the USB and external DC, enabling projects that require minimal power consumption.The ESP32 IoT microcontroller is compatible with FireBeetle covers and accessories as well as DFRobot's Gravity Series modules.



The microcontroller is also pin-compatible with Arduino Uno and supports the Arduino integrated development environment (IDE), MicroPython programming language, and Espressif IoT Development Framework (IDF).

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Power monitor delivers increased measurement accuracy

Designed with an I2C- and SMBus™-compatible interface, the PAC1934 precision power and energy monitoring chip from Microchip Technology provides selectable bidirectional current sense capability from minus 100 mV to +100 mV. The chip offers increased precision in power and energy monitoring, with measurement accuracy down to 1 percent over a wide dynamic range.

The monitor with accumulator IC, available from Mouser Electronics, is designed to measure everything from simple Core Processing Unit tasks to software running on USB Type-C-connected devices. It features a four-channel, high-side current sensor with a 100mV full-scale voltage sense range, 16-bit resolution, and directly connects to voltage rails from 0V to 32V.

The PAC1934's bidirectional capability enables it to track both battery charging and battery discharge. It accumulates and stores 28-bit power results, enabling easy retrieval by the system master or embedded controller.

An I2C and SMBus interfaces allow engineers to configure a variety of controls, including energy integration periods from 1 millisecond to 36 hours and sampling rates of 8, 64, 256, or 1024 samples per second.

Microchip's PAC1934 device is ideally suited for use in server, networking, automotive and industrial applications. The chip's forward-thinking, bidirectional design makes it an essential tool for use with USB Type-C charging topologies.

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