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In this issue...

The deployment of real IoT platforms in diverse fields has demanded new sensor solutions. We reflect that this month with articles that look at sensor implementations in robotic and wind turbine applications, as well as sensor fusion — multiple types of sensors working together to solve a problem. Our industry news section details plans by Keysight & Samsung to accelerate 5G networks, Smart plastics for automotive apps, Osram's recent acquisition of BAG components and how X-Class sensors are empowering new industrial cameras.

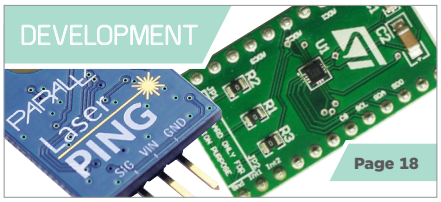
Plus, of course, regulars: Dev Kit Pick, Video Wall and the latest, most innovative NPIs now in stock at Mouser. Now read on...

Keysight & Samsung to accelerate 5G networks * X-Class sensors to empower new industrial cameras * Osram BAGs LED lighting systems company * Smart plastics for automotive apps unveiled

Mouser to sponsor Create the Future Design Contest * Doodle Labs' deal adds industrial Wi-Fi transceivers * Challenge 2018 CLIK Hackathon begins in Turin

Robots Assume the Position with Sensors

Wind Turbines: Tiny Sensors Play Big Role



Mark Patrick spotlights development tools from Honeywell, MikroElektronika, Parallax, Sparkfun and ST Micro.

Sensor Fusion Comes of Age

O/S development on a USB-Key-Fob from BeagleBoard; network-enabled smart lighting from ams; ADI demo 2.5-42GHz I/Q mixers; and Seeed Studio shows Raspberry Pi gateways

Latest products now available from Molex, Panasonic Qorvo, Wolfspeed and more...

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congatec drives Luxoft's modular next-gen automotive reference platform

Launching with the conga-SA5 as the first official supported module, the Automotive Reference Platform (ARP) co-developed by Intel and Luxoft makes digital cockpit designs of next-generation vehicles smarter, enabling clustering of previously separately managed functions such as head unit display, cockpit occupant monitoring, and advanced driver assistance systems (ADAS). The platform utilizes an Intel Atom E39xx processor based SMARC 2.0 module from congatec in combination with an Intel Cyclone V SoC FPGA with integrated ARM cores and MAX 10 FPGAs for design flexibility, extra connectivity options, and hardware encoded preprocessing tasks. The platform allows multiple functions to be hosted on a single system, including ADAS through video data analytics, as well as occupant safety systems such as driver awareness sensing plus navigation, passenger infotainment, and rear-seat entertainment.

The platform offers four independent on-board display interfaces with support for additional displays via expansion slots. Two HMSC connectors provide high-speed I/O extension capabilities, and a wide variety of expansion boards is available through the partner ecosystem supporting existing and emerging automotive wired and wireless connectivity standards. An automotive analog/digital radio and onboard DSP solution rounds off the design capabilities of the modular platform. The conga-SA5 based ARP is supported by Luxoft's PELUX / Qt Automotive Suite Digital Cockpit software platform, a Linux-based open source software platform that enables the flexible integration of third party applications into cars and minimizes the effort and cost for manufacturers deploying Linux-based Digital Cockpit systems.

www.congatec.com

X-Class CMOS image sensors from ON Semi empower new industrial camera design

ON Semiconductor announced its X-Class image sensor platform, which allows a single camera design to support not only multiple product resolutions but also different pixel functionality. The new 12 megapixel (MP) XGS 12000 and 4k / UHD resolution XGS 8000 image sensors serve applications such as machine vision, intelligent transportation systems, and broadcast imaging.

The X-Class image sensor platform supports multiple CMOS pixel architectures within the same image sensor frame, allowing a single camera to not only support multiple product resolutions, but also the ability to create larger pixels that trade resolution at a given optical format for higher imaging sensitivity, or to optimize for low-noise operation to increase dynamic range, for example.

The XGS 12000 provides 12 MP (4096 x 3072 pixel) resolution in a one-inch optical format, and will be available in two speed grades – one that fully utilizes 10GigE interfaces at speeds up to 90 frames per second (fps), and a version providing 27 fps at full resolution that aligns with the bandwidth available from USB 3.0 computer interfaces.

The XGS 8000 provides 4k / UHD (4096 x 2160 pixels) resolution in a 1/1.1 inch optical format, and is also planned to be available in two speed grades (130 and 75 fps).

The package dimensions of both devices combine with a low thermal profile enabled by the low-voltage, low-power architecture of the X-Class interface to make them fully compatible with compact 29 x 29 mm^2 camera designs.

ON Semiconductor offers evaluation kits that support full device evaluation including still image and video capture, and region of interest readout, and other custom test functions can also be configured.

www.onsemi.com

Keysight & Samsung complete interoperability test to accelerate 5G networks

Keysight Technologies announced successful interoperability testing of Keysight's User Equipment (UE) Emulation Solution and Samsung's new 5G base station based on 5G New Radio (NR) standards. Keysight and Samsung have agreed to align their plans to enable 5G base station testing and build an ecosystem of interoperable products.

This acceleration in the development and deployment of 5G networks reflects the direction of Keysight's recent acquisition of Ixia, and combines the company's RF measurement experience with Ixia's leading UE emulation framework to handle a wide range of demanding requirements and a variety of configurations for 5G. At Mobile World Congress (MWC) 2018 in Barcelona, Spain, Keysight and Samsung demonstrated the performance of the Samsung eNodeB using the 5G-NR standard. The base station throughput was measured by the Keysight UE Emulation Solution in real time at the exhibition.

www.keysight.com

Intel demos tools to streamline rich media creation process

Presenting at a NAB (National Association of Broadcasters) conference Super Session, Lynn Comp, vice president of the Data Center Group and general manager of Intel's Visual Cloud Division, spoke about how major Hollywood studios, production companies and enterprises are applying Intel technology to bring disruptive innovation to traditional models of media creation and delivery and are embracing new market opportunities.

The Intel session also featured guest Glenn Gainor, president of Physical Production, Screen Gems Motion Pictures, Sony Motion Pictures Group*, who highlighted the collaboration between Intel and Sony Pictures in creating the Spider-Man: Homecoming Virtual Reality Experience that used VR headsets to let movie fans feel as if they were slinging high above New York City like Spider-Man in pursuit of the bad guys.

Dave Ward, CTO of engineering at Cisco, explained how Cisco uses Intel® architecture to move from serial data interface (SDI) to standards-based solutions. This enables customers to create and distribute rich media faster and more economically, leveraging cloud economics, resulting in more efficient delivery of content to consumers.

Kim Crawford, vice president of sales at Artesyn Embedded Technologies, joined Comp on stage to describe how Artesyn is deploying its Intel® Xeon® processor-based media streaming and cloud gaming platform using an edge-focused architecture. Moving to the network edge, closer to the customer, improves application responsiveness and creates a richer experience.

The Intel Super Session can be viewed at the **NAB 2018 website**.

innogy and Kelag expand fast-charging network in Austria

Addressing the other issue of electric vehicle range, innogy and Kelag are equipping four motorway service areas operated by Austrian ASFINAG with EV charging systems. One of the stations is in Salzburg, and one is in Steiermark, and will have one 175 kW ultrafast charging unit and two 50 kW charging stations, equipped with the full range of standard connectors.

With an ultrafast charger, a vehicle can be recharged in around 15 minutes, making long-distance electric driving simple and convenient. Kelag currently operates around 180 electric vehicle charging stations in Kärnten and is one of the leading providers of charging infrastructure in Austria. In addition to the ultrafast charger, Kelag is also installing two other fast-charging units in four other motorway service areas, and there are already over a dozen of this type in operation in Austria.

www.innogy.com/mobility

Osram strengthens digital business with Trilux subsidiary buy

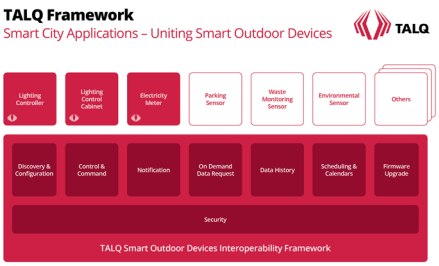
Osram is strengthening its electronic component business with its acquisition of BAG electronics, a Trilux subsidiary that specializes in LED modules and software. Based in Arnsberg, Germany, the 380 employees of the company will move to Osram, and a strategic five-year supply contract to supply Trilux with components has been signed.

The acquisition is still subject to approval by the relevant competition authorities. BAG electronics specializes in LED lighting systems, as well as innovative controllers for human-centric lighting, a type of biologically-effective light can emulate the natural progress of daylight for employee health and motivation in offices and industrial buildings.

The takeover of BAG electronics expands the portfolio of the Digital Systems (DS) business unit while also increasing sales and distribution options in Germany and Asia.

www.osram.com

TALQ Consortium to enable Smart Cities with intelligent lighting



The TALQ Consortium, a group that created a global interface standard for managing outdoor lighting networks and other smart city applications, has published an updated edition of its proven Pocket Guide for Smart Outdoor Lighting Tenders. Available in German, English and Romanian, with additional languages and other 'TALQ Smart Tender Pocket Guides' to follow.

These publications help cities and municipalities work on their own tendering processes and develop future-proof, interoperable, and open solutions for Smart Street Lighting and other Smart City Applications.

The TALQ Smart City Protocol allows software and hardware developers in a proven way to achieve interoperability for their own systems, enabling cities and municipalities to choose a solution for their individual Smart City concept while still being open and prepared for further enlargements.

These smart systems might include street lighting as well as waste, parking and traffic management or E-Mobility and other public services.

Outdoor lighting networks and streetlight control systems are long-term investments that are generally in use for decades, and must address issues such as maximizing energy savings, reducing carbon emissions, reducing operational costs, and increasing efficiency. Using an open and flexible systems can help insure a future-proof solution.

www.talq-consortium.org

Microchip to acquire Microsemi

Microchip and Microsemi have signed a definitive agreement under which Microchip will acquire Microsemi. The acquisition represents a total value of about $10.15 billion.

Steve Sanghi, Chairman and CEO of Microchip said: "Even as we execute a very successful Microchip 2.0 strategy that is enabling organic revenue growth in the mid to high single digits, Microchip continues to view accretive acquisitions as a key strategy to deliver incremental growth and stockholder value." Added Ganesh Moorthy, President and COO of Microchip: "Microchip and Microsemi have a strong tradition of delivering innovative solutions to demanding customers and markets, thus creating highly valued and long-lasting revenue streams. Joining forces and combining our complementary product portfolios and end market exposure will offer our customers a richer set of solution options to enable innovative and competitive products for the markets they serve."

www.microchip.com/investor/Pressrelease

Smart plastics for automotive apps shown in Mannheim

In the large and boisterous debate about electric vehicles and battery range, the two things most overlooked are the advances in the power electronics, and the materials making up the car itself.

Functional plastics create smart, comfortable, and ultra-light interior concepts for the vehicles of the future, and ideas and insights were given by plastics and automotive experts at the "PIAE 2018" (Plastics In Automotive Engineering) in Mannheim from the 14th to the 15th of March.

The largest congress for plastics experts in the automotive industry ended successfully, with the main topic being the demands of the automotive megatrends on the plastics industry.

Lectures were given in the fields of interior and exterior, lightweight construction, design and e-mobility.

Automobile megatrends such as electrification, automation, and digitization are the driving forces, and at the PIAE 2018 showed the vehicle concepts of the future will offer even more diverse mobility.

Older drivers may lament the loss of "control", but the younger generations are more open to the concept of a "smartphones on wheels" with voice and gesture control that is capable of learning because it has artificial intelligence on board.

Plastic plays a key role in lightweight construction, and particularly interesting for industry experts at the event were metal-plastic hybrids, which offer affordable lightweight construction in conjunction with functional integration. Exhibits like the VW Future Interior Concept had a lounge-like interior equipped with four individually rotatable and lowerable seats. In the imagination of VW designers, the vehicle drives autonomously outside the city center; Steering wheel and controls are then simply retracted.

www.vdi-wissensforum.de/en/piae

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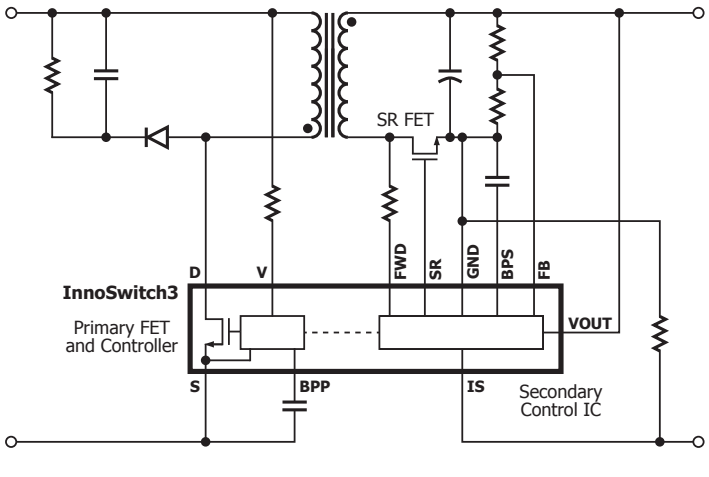

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Mouser named Global High Service Distributor by ON Semiconductor

ON Semiconductor has honoured Mouser with its 2017 Global High Service Distributor award. Mouser was cited for leading overall sales within the channel, growing market share, capturing increased sales of products from ON Semiconductor's acquisitions, and scoring highly on overall process excellence. According to Jeff Thomson, Vice President of Global Channel Sales for ON Semiconductor, distributor sales accounted for approximately 60 percent of ON Semiconductor's 2017 annual revenues.

"The support of partners like Mouser is fundamental to the success of ON Semiconductor's ongoing plans to increase market penetration and grow revenue at a faster pace than the industry," said Thomson. "We are proud to partner with Mouser and to present them with this award." Added Kristin Schuetter, Mouser Electronics' Vice President of Supplier Management, Semiconductors: "Mouser strives to lead the industry in new product introductions, and it is very gratifying to be acknowledged for our efforts."

Mouser stocks ON Semiconductor's broad portfolio of energy efficient power management, analog, sensors, logic, timing, connectivity, discrete, SoC, and custom devices to help customers efficiently solve their design challenges in automotive, communications, computing, consumer, industrial, medical, aerospace, and defense applications.

For more information, visit **www.mouser.com/onsemiconductor**

Create the Future

Mouser is once again sponsoring the Create the Future Design Contest, a challenge to engineers and students worldwide to create the next great thing. Mouser's partner manufacturers Intel® and Analog Devices, Inc are joining to sponsor the 16th annual contest, produced by Tech Briefs Media Group, an SAE International Company. COMSOL is also a principal sponsor of the contest.

The grand prize winner receives worldwide recognition and a cash prize of $20,000 for an innovative product that benefits society and the economy. Previous contests have produced more than 12,000 design ideas from engineers, entrepreneurs and students in more than 100 countries. Last year's grand prize winner was HI-Light, a solar thermal chemical reactor, developed at Cornell University, that converts carbon monoxide and water into methanol and other high-value hydrocarbons.

"Fostering technical innovation is an investment in the future that will benefit everyone," said Kevin Hess, Mouser Electronics Senior Vice President of Marketing.

The Create the Future Design Contest brings attention to product designs that enhance quality of life, improve the efficiency and quality of healthcare or help to reduce dependence on nonrenewable energy sources. Previous grand prize-winning entries include an economical rapid screening device to prevent food-borne illness and a wheelchair propulsion system designed to increase the user's mobility while decreasing upper body repetitive strain injuries.

The grand prize winner will be chosen from the winners in seven entry categories: Aerospace and Defense, Automotive/Transportation, Consumer Products, Electronics/Sensors/IoT, Machinery/Automation/Robotics, Medical, and Sustainable Technologies.

For more information, go to **www.mouser.com/createthefuture**

Challenge 2018 CLIK Hackathon begins in Turin

The 2018 Mood Reader Hackathon Challenge in the Contamination Lab & Innovation Kitchen (CLIK) at Politecnico di Torino is now underway. CLIK is designed to nurture and incubate new projects and innovative ideas by students at the prestigious Italian engineering facility.

This is the second year that Mouser has supported the CLIK design competition, which attracted over 30 teams to enter. A panel of industry and academic experts have already selected the top 10 teams which will compete in the final challenge. Previous challenges focused on voice recognition and the Alexa API and building on the recognition theme. The first challenge of 2018 will focus on mood recognition, embracing image sensing and image processing technology to create an innovative solution.

Commented Massimo Violante, Associate Professor responsible for the creation of CLIK, "We hope not only to encourage and nurture innovation, but also that all the participants have fun and find the challenges interesting and stimulating."

Added Mark Patrick, Supplier & Technical Marketing Manager, EMEA, Mouser: "CLIK is a perfect example of how we at Mouser work in partnership with academia and the innovation community to develop new ideas. Mouser is all about supporting design engineers and making sure that they can access the absolute latest, leading-edge technology so they can come up with products that will change the world we live in for the better."

Doodle Wi-Fi transceivers in stock at Mouser

Mouser is now stocking Doodle Labs' industrial Wi-Fi transceivers following a global distribution agreement. The transceivers achieve long range through high transmit power, and their rugged construction enables efficient performance in extreme temperature ranges. The transceivers also feature high interference immunity, enabling the stable performance demanded by manufacturers deploying solutions for complex industrial applications.

Doodle Labs industrial Wi-Fi transceivers feature an integrated low-noise amplifier to pick up low-energy signals from mobile devices, allowing for exceptional performance in demanding circumstances. Extensive coverage is supported by up to 30 dBm of RF power, while high band isolation supports concurrent dual-band operation for multi-band routers. The transceivers' hardware "RF Kill" feature enables full compliance with FAA regulations, allowing the devices to be used to provide wireless service in airborne applications.

Demonstrating proven performance in a wide array of demanding environments, Doodle Labs' transceivers can be deployed in a variety of military and industrial applications. The industrial Wi-Fi devices are suitable for use in unmanned vehicles and robots, as their exceptional temperature and vibration resiliency meet rugged military requirements. The transceivers are also ideal for providing passenger Wi-Fi for train or air travel. Robust construction allows for use in harsh environments in industries such as mining and oil and gas. Additionally, the long range and extensive coverage enabled by the transceivers make them suitable for wireless mesh networking applications.

NEW MANUFACTURER DOODLE labs

www.mouser.com/doodle-labs

Mouser wins Customer Relationship Management Institute award for Sixth Straight Year

Mouser is very proud to announce that it has received the prestigious NorthFace ScoreBoard AwardSM from the Customer Relationship Management Institute (CRMI) for the sixth consecutive year.The award was given in recognition of achieving excellence in customer service and support throughout 2017. Mouser received a 99 percent satisfaction score as rated solely by its customers.

CRMI's methodology measures customer satisfaction and loyalty levels on a 5-point scale four times during the year in such categories as technical support, field service, customer service and account management. NorthFace ScoreBoard Award recipients are companies who, based solely on survey responses from their own customers, achieved a 4.0 or above (or equivalent) out of a possible 5.0. As in previous years, Mouser earned a 4.8.

"We are honored to receive the NorthFace ScoreBoard Award for the sixth time. It is a testament to our team members around the world who work diligently to ensure that every customer is pleased with the Mouser experience," said Mark Burr-Lonnon, Senior Vice President of Global Service and EMEA & APAC Business at Mouser Electronics. "Providing best-in-class service is what we strive to accomplish every day here at Mouser. It's who we are, but it is especially gratifying when it is recognized," he added.

John Alexander Maraganis, President & CEO of CRMI said: "Our research indicates that companies that consistently achieve a 4.0 rating or above, which we call the 'Loyalty Zone,' are succeeding in locking in profitable, long-term customer relationships, and this significantly raises the bar on their competitors."

www.mouser.com/nfsb-award

Mouser signs Tronics sensor deal

Mouser Electronics has signed a deal with Tronics Microsystems, a TDK Group company that designs and manufactures innovative nano and microsystems, to distribute the company's high-performance MEMS accelerometers, gyroscopes and sensor evaluation kits. Tronics' GYPRO product line of MEMS gyroscopes (also known as angular rate sensors) provides high-performance solutions for very demanding applications, such as precision instrumentation, platform stabilization, guidance and navigation control, attitude and heading reference system (AHRS), unmanned and autonomous vehicles, three dimensional mapping, and robotics.

The sensors combine all key benefits on a single chip, featuring excellent bias instability of 0.8 degrees per hour and ultra-low noise of only 0.15 degrees per √h. The standard GYPRO2300 features a data rate of 200 Hz with 40 millisecond (ms) latency, while the GYPRO2300LD offers a data rate of 1700 Hz at 2 ms latency, and the GYPRO3300 boasts improved vibration tolerance and a latency of 1 ms, thanks to an improved integrated circuit. Tronics' AXO215 high-performance MEMS accelerometer combines size, weight, power and performance benefits on a single chip.

The product features a closed-loop configuration that enables low non-linearity of 100 ppm over a 15 g range. Housed in a small 12 mm × 12 mm hermetic J-lead ceramic package to ensure reliable performance levels in harsh environments and mechanical stress decoupling from the host system, the AXO215 accelerometer includes an embedded temperature sensor for on-chip or external temperature compensation. The device delivers superior acceleration-sensing performance for very demanding applications, such as precision instrumentation, unmanned vehicles, and avionics.

Tronics also offers the GYPRO-EVB2 and AXO-EVB3 evaluation kits, which are specifically designed to interface with the Arduino M0 open-source electronic prototyping platform.

NEW MANUFACTURER TDK

www.mouser.com/tronics-microsystems

Robots Assume the Position with Sensors

By Bill Giovino for Mouser Electronics

Today's robots perform functions as mundane as factory assembly, and as exciting as human-like machines on two legs from out of science fiction. Humanoid robots fascinate us - they can have lifelike faces, with movements that seem to mimic our own. Factory robots move with a curious grace and speed that can appear hypnotic. While these movements appear effortless to our own human eyes, it's easy to forget that it's all a simple feedback loop. Instructions are sent to an appendage which activates a motor that moves the appendage into position. But how does the system controller know that this position has been reached? By a network of sensors feeding back to the system controller.

Advances in MEMs sensor technology have greatly expanded the capacity of robots to achieve precision positioning. There are six types of useful sensing in robotics: tilt, rotation, acceleration, shock, vibration, and proximity.

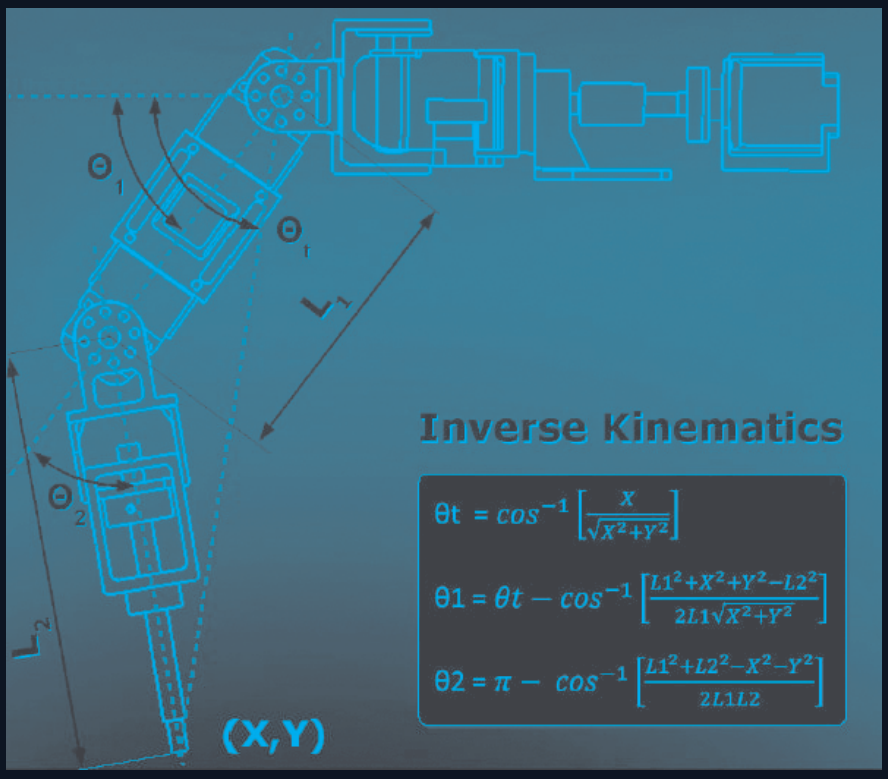


Figure 1: Robot spider leg appendages L_1 and L_2 tilt along angles θ_1 and θ_2. Accelerometers in the appendages sense the tilt and feedback the position data to the inverse kinematics equation. Appendage L_1 also rotates along θ_t. (Source: Analog Devices)

Tilting Appendages

Tilt is useful for determining the position of a robotic arm. Tilt presents an interesting challenge in that it can be detected in a number of ways. It helps to first think of tilt as the change of direction of the force of gravity (*g*). Because gravity is really a type of acceleration, a low- *g* 3-axis accelerometer is one effective means of determining tilt. Anyone with a mobile phone is familiar with the function of low-*g* MEMs accelerometers as they are used to determine screen orientation when the mobile device is rotated.

The movement of a robotic spider leg as in Figure 1 is determined by the use of complex inverse kinematics equations that decide the proper movement of the appendages by sending control signals to the motors. For such complex movement, feedback of each appendage's present position is critical for comparing the existing position with the desired position.

The ADXL345 3-Axis 13-bit Digital Accelerometer from Analog Devices (ADI) is used to measure the static acceleration of gravity in three-dimensional tilt-sensing applications.

When using an accelerometer for tilt-sensing, the device is set to the lowest resolution. The ADXL345 supports ±2*g* , ±4*g*, ±8*g*, and ±16*g*. The lowest resolution ±2g setting is selected because Earth's gravity is only ±1*g*, so gravity sensing at ±2*g* resolution uses 12-bits, half the accelerometer's 13-bit range.

While the higher full-scale scale ranges can also be used for tilt-sensing, because of the low-*g* forces being sensed even less of the full 13-bit range will go unused, resulting in greatly decreased accuracy.

For two-dimensional tilt sensing applications a low-*g* 2-axis accelerometer such as the ADI ADIS16003 ±1.7*g* 2-Axis Accelerometer can be used. A 2-axis accelerometer must be oriented so that the X-axis and Y-axis are parallel to the Earth's surface; in other words, at right angles to Earth's gravity. This allows the accelerometer to be used as a 2-axis tilt sensor supporting pitch and roll detection. Since the ADIS16003 supports a low 1.7*g*, when the accelerometer is perpendicular to gravity the output changes at a very sensitive 0.0175*g* per degree of tilt. At 45° the output changes at only 0.0122*g* per degree of tilt.

The accelerometer's output signal is converted to a number representing an acceleration varying between ±1*g*, allowing the tilt in degrees to be calculated as represented in Formula 1:

$$Pitch = ASIN(A_X/1g)$$
$$Roll = ASIN(A_Y/1g)$$

Formula 1: Pitch and Roll calculations using a 2-axis accelerometer for Tilt sensing

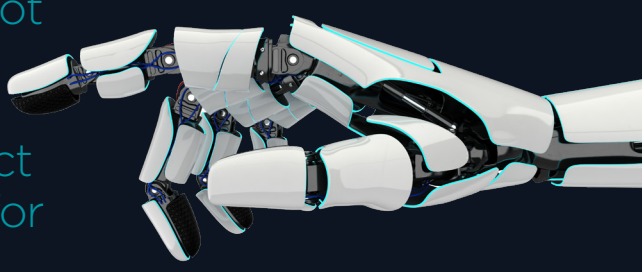
For Formula 1:
AX is the acceleration along the X-axis, AY is the acceleration along the Y-axis.

It's important to note that while measuring tilt looks for only ±1*g* , incidents like a robotic arm hitting an object or coming to its end of travel can result in a signal much greater than ±1*g*.

Rotating Tools and Arms

Robot arms may rotate for various purposes. On an assembly line, rotating tools may include screwdrivers, drills, and clamps. While tilt is sensing linear rate motion, rotation is sensing angular rate motion. Rotation also differs from tilt in that it may take place without a detectable change in acceleration, making accelerometers useless for this application. For example if a 3-axis accelerometer is rotated around the z-axis which points to the Earth, while the x-axis and y-axis are parallel to the Earth, the Z-axis will continue to measure 1*g* while the X and Y axis will still measure 0*g*. In this situation, rotating the accelerometer along the Z-axis will result in no change in accelerometer readings.

"Gyroscopes are not one-size-fits-all sensors, and it's important to select the correct gyro for a given rotation."



Instead, robots use MEMs gyroscopes, which are sensors specifically designed to sense rotation.

When a gyroscope sensor is rotated about its axis, a very small micromachined mass is moved by the Coriolis Effect to the outside of the sensor.

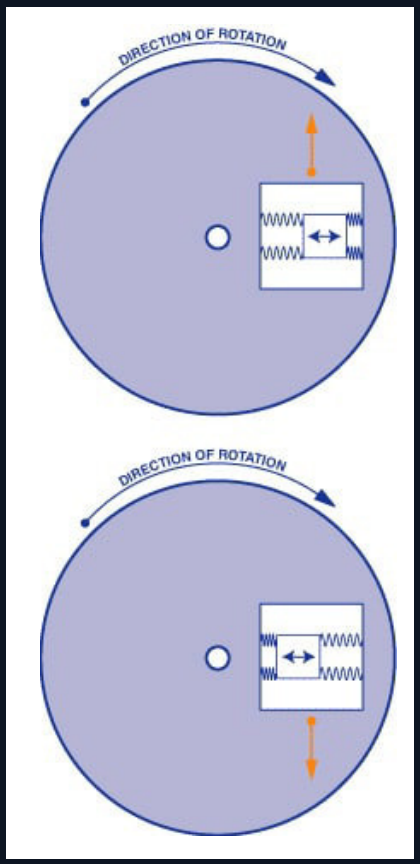


Figure 2: Internal operation a MEMs gyroscope sensor (source: Analog Devices)

The ADI iSensor MEMS Gyroscope Subsystems are designed to reliably detect and accurately measure the angular rate of rotation of an object. iSensor gyroscopes are rugged enough to detect rotation under the harsh environment of a robot under severe stress and in complex industrial conditions. Gyroscopes are not one-size-fits-all sensors, and it's important to select the correct gyro for a given rotation.

Two important specifications are range and sensitivity. The range is the fastest rotational speed that the gyro can accurately measure and is measured in degrees per second (°/sec). The sensitivity is the output change in millivolts for a given speed - so the faster the gyro is spinning, the higher the voltage. It is measured in millivolts per degree per second (mV/°/sec).

A rapidly rotating tool would require a high range, like the Analog Devices ADIS16266BCCZ which can measure up to ±14,000°/sec. A slowly rotating arm could be served by an ADI ADIS16060BCCZ which has a range of only ±80°/sec. Analog gyroscopes operating at these low voltages on an industrial robot require low losses for the interconnect. The Mizu-P25 Miniature Waterproof Connector from Molex is a miniature IP67 sealed connector system which is dustproof and waterproof. It is also suitable for high vibration environments and with a contact resistance of only 10mΩ is suitable for harsh environments low voltage systems.

Sensing Shock and Awe

Robots sometimes bump into things, either accidentally or on purpose. Shock is a sudden change in acceleration, so it can easily be detected with an accelerometer. However, when detecting shock the location of the accelerometer is critical. For example, a robotic hand that accidentally hits the floor is going to see a much more dramatic shock (change in acceleration) at the hand, as opposed to the arm or elbow.

In some cases shock must be detected immediately so a decision and an action can be made immediately. An example of how critical this can be is in a common hard disk drive found in a laptop computer.

"In this context, vibration is both a maintenance and a safety issue."

If the hard drive is dropped and hits a hard floor, an accelerometer in the drive immediately detects the shock. In such an event the hard drive head absolutely must park the head within milliseconds or face the heartbreak of data loss. Obviously the proper detection of such an event depends upon the proper positioning of the accelerometer on the drive, as well as a reliable processor and solid firmware.

Contrast that to a robotic arm in arm assembly line going through a pre-programmed motion. As noted in a previous section, strategically placed accelerometers will sense the tilt and position of the arm to insure the movement is correct. However, if the movement is interrupted by a blockage it is critical that the resultant shock be detected quickly and reliably.

There is a real danger that a person is responsible for the blockage and is now in harm's way. In this situation a dedicated accelerometer is used to detect shock, and in some cases two or more redundant accelerometers, each with their own detection circuits, may be placed to provide absolute safety.

Vibrating Robots

Vibration in a robot is rarely a good thing. It can be an indication of worn bearings, missing components, improper lubrication, incorrect alignment of armatures, or an out of balance load being carried by the robotic system. In this context, vibration is both a maintenance and a safety issue. Monitoring vibration in an industrial robot can be necessary for monitoring machine health, system diagnostics, and safety shutoff sensing.

The Analog Devices ADIS16229 Digital MEMs Vibration Sensor with Embedded RF Transceiver provides a portable vibration sensing platform with wireless support for industrial applications. It provides a complete sensing solution for monitoring and recording vibration in industrial environments.

An RF connector like the Molex Brass SMA RF Connectors is mounted on the board, with a threaded coupling to support firm mating under intense vibration. Molex SMA RF Connectors minimize reflection and attenuation at the over 900MHz RF transmission frequencies of this board.

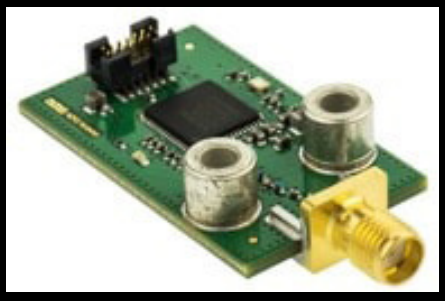


Figure 3: Analog Devices ADIS16000 Digital MEMs Vibration Sensor and RF Transciever with Molex Brass SMA RF Connector. (Source: Analog Devices)

Acceleration - Faster and Faster

Detecting acceleration and deceleration is often important for movement sensing. This can mean anything from sensing motion in a robotic arm to determining the robot's position when used in a dead reckoning system. An accelerometer can also be used to determine if an object has been picked up or put down.

A dedicated MEMs accelerometer can be used to determine the acceleration of a robot, totally independent of other sensors. In this situation, if external forces contribute to a robot's behavior and try to accelerate the robot faster than is needed and at a harmful speed, the rapid acceleration can be detected and the robot shut down.

Proximity Sensing

A proximity sensor detects the presence of a nearby object without having to make any physical contact for safety and operational reasons. The CapSense devices from Cypress Semiconductor are able to detect the presence of a nearby object without any physical contact. The Cypress CY8CKIT-024 CapSense Proximity Shield, when interfaced with any Cypress Pioneer kit provides a dynamic out of the box proximity sensing development solution.

When the CapSense proximity sensor is excited by a voltage source, an electric field is created around the sensor as in Figure 4.

Some of the electric field lines are projected into ground and also into nearby space, creating a capacitance that can be measured. If a target object on an assembly line approaches the robot's proximity sensor, some of the electric field lines couple to the target object, changing the capacitance which is then measured by the CapSense circuitry to determine the distance and position of the target object.

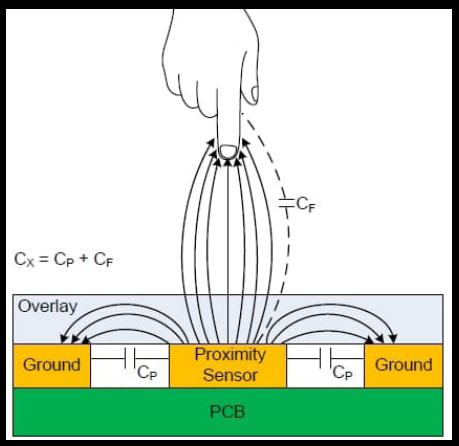


Figure 4 : A Cypress CapSense Proximity Sensor Coupling Electric Field Lines to a Finger. (Source: Cypress)

For Figure 4:

C_X = Total capacitance measured by the Cypress CapSense proximity-sensing system

C_P = Sensor parasitic capacitance

C_F = Capacitance added by a nearby target object

For robotics applications, this solution provides three dimensional object or gesture recognition. This can be useful for a robot on an assembly line to determine if a target object is within distance. It can also be used to determine if an obstruction is about to interfere with a robot before the impact is measured by a shock sensor.

Conclusion

MEMs sensors are necessary for today's robots for purposes of operational, safety, and maintenance. Gyroscopes and the ever-versatile accelerometer form the heart of a robot's sensor network, with more esoteric sensor systems used for proximity sensing. Advanced MEMs sensors, with solid interconnect solutions are expanding the capabilities of today's robots, providing operational and safety abilities that enhance performance while reducing costs.

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Wind Turbines:

Tiny Sensors Play Big Role

By Barry Manz for Mouser Electronics

Wind turbines may be as high as a skyscraper, but they owe their ability to operate efficiently and safely to the dozens of tiny, inexpensive sensors that monitor their health.

At a fundamental level, a modern wind turbine is a twenty first-century windmill with large rotor blades that turn a breeze into electrical energy rather milling grain or pumping water. Dig a little deeper, and wind turbines reveal themselves as masterpieces of design, combining innovations in mechanical and electrical engineering. Even though their rotors can be more than 79m long and their towers more 183m high, some of their most critical components—sensors—are only centimeters long but play an outsized role in keeping these leviathans functioning in the face of extraordinary stresses, vibration, and various other hazards.

The Role Of Sensors In Wind Farms

Without sensors, wind turbines would arguably be less safe, more costly to operate, unable to accurately predict and solve impending failures, or potentially have lifetimes less than the twenty five years they're expected to operate. Most important, wind farms need accurate data about every turbine and its most important components that can only be provided by sensors linked together and connected to a command center.

What's more, wind turbines are a classic (if offbeat) example of industrial IoT in action: They have all the necessary ingredients from sensors to the networks that connect them, though typically via Ethernet not wireless connectivity.

A wind farm IoT network can exploit the benefits of historical operating data such as wind speed, power, yaw angles, gearbox temperature, and other metrics to analyze trends, from the entire wind farm down to the lowliest component. From this, operators can create a model that can predict what components to inspect and when. All the information, as well as status alerts and other results from monitoring, can be viewed and actions taken from a smartphone, tablet, or computer.

To see why these sensors are so important, consider a wind turbine and all the places within it where they can be used to monitor all system components including the structure itself (Figure 1). Wind turbines are complex, and typically have more than 8,000 components.

Their huge blades and tower structures are anchored to platforms made of thousands of tons of steel and rebar measuring 30 to 15m across and 6 to 10m deep.

The gearbox that transforms the slow turning rate of the blades to a faster rotor speed (along with the generator) is housed in a container atop the tower called a nacelle that is the size of a bus and weighs about 45T (tonnes). Some nacelles are large enough to include a helicopter landing pad on the top, and an entire wind turbine platform can weigh more than 272T. A good example is one of the latest deployments in the UK, which is the world's largest generator of wind power with a nationwide capacity of 5.3GW that can power more than five million homes.

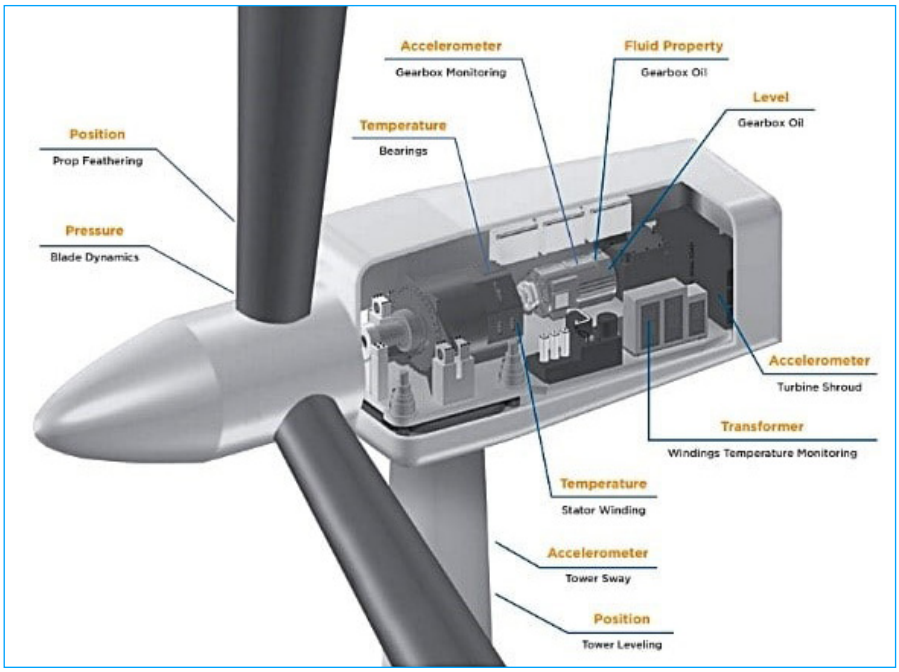

Figure 1: The basic components of a wind turbine within the nacelle and some of the types of sensors and where they're placed. (Source: TE Connectivity brochure)

"A single revolution of a single rotor can power one home for 29 hours."

This past May, the Danish company DONG Energy flipped the switch to power up 32 additions to the Burbo Bank Offshore Wind Farm (Figure 2) on Liverpool Bay in the Irish Sea. It was a significant event for renewable energy, as it marked the first commercial use of 8MW turbines, which double the output of the wind farm's original turbines. The new turbine structures are about 195m high, their rotors are 80m long, and a single revolution of a single rotor can power one home for 29 hours.

Figure 2: Burbo Bank Offshore Windfarm with North Wales in the distance. (Source: Wikipedia)

For the record, the largest-capacity conventional-drive wind turbine is currently the Vestas 164 from Vestas Wind Systems that has an output of up to 9MW, which it generates with its 178m rotor that has a swept area of 20,566m² and weighs 32T. The top of the structure is 219m high (about the height of a 72-story building) and its overall weight more than 1800T. Figure 3 captures how enormous wind turbine rotors really are.

Figure 3: A turbine blade convoy meandering through Edenfield to the Scout Moor Wind Farm, the second largest onshore wind farm in England. (Source: Geograph)

The Crucial Role Of Sensors

There are many different types of electrical and optical sensors used in wind turbines. In general, they

- Detect, monitor, and communicate information about parameters such as changes in the distance between two components near each other
- Monitor levels of vibration that, if excessive, can cause major damage
- Monitor changes in temperature, pressure, and mechanical stresses

Eddy Current Sensors

One of the most common types of sensors in wind turbines are eddy current sensors—also called Foucault currents—which detect changes in the electrical current created when a conductive material enters a moving magnetic field. When this occurs, the strength of the field can be translated into changes in distance.

In wind turbines, eddy current sensors measure the lubricating gap of the shaft to ensure it is always covered by a thin film of oil that is usually applied under pressure. Because these sensors can resist oils and pressure as well as temperature, they can reliably monitor the oil gap under these hostile conditions. If the gap becomes too large and exceeds its specifications, an alert can be sent so that preventive maintenance can be performed before the shaft binds or seizes.

These sensors also measure how the turbine shaft rotates both axially and radially inside its housing, a specification called run-out. Radially, this condition causes the shaft to rotate off-center rather than "true," and axially results in the shaft rotating at a slight angle. While there is always a tiny amount of run-out, worn bearings can cause it to exceed acceptable limits, and when it is too high, usually the result of high wind loads, the turbine must be shut down for maintenance. Obviously, the ability to monitor run-out over time allows this maintenance to be performed before extreme damage or even catastrophic failure occurs.

Finally, eddy current sensors are also employed to measure the turning effects (moments, or torque) applied to the nacelle—caused by vibration, wind loads, or other factors—that can lead over time to degradation of structural integrity. They can be applied to measure axial, radial, or tangential deflection of the clutch disks that ensure rotor safety by braking during high winds.

Displacement Sensors

A variety of displacement sensors are used to monitor structural integrity as well. The foundations or platforms required to keep wind turbines in place consist of massive amount of concrete. However, because the towers are very high and the rotors and nacelles housing the generator are huge, the entire structure is effectively "top-loaded," so monitoring the system's integrity at its base is essential.

Laser displacement sensors can be used to perform this function because they can detect very small movements of the foundation in relation to the tower caused by repeated thrashing by the wind or waves, or caused by resulting structural defects. Laser displacement sensors work by transmitting a beam of light to an optical receiver some distance away. Deviations and movement between the two are transformed into units of distance. Laser triangulation sensors are also used for a similar purpose and are configured with the sensor, transmitter, and receiver in a triangle. As these devices are extremely accurate, they can detect very small changes, so trend data can be created to show whether a problem is developing and how rapidly it is progressing.

Another precision displacement sensor—the capacitive type—measures the distance between the stator and rotor in the turbine, called the generator air gap. Their operation is based on the principle that electrical capacitance exists between conductive surfaces near each other and that the capacitance will change in direct proportion to the distance between the surfaces. These sensors measure those changes and can operate in high-temperature environments, and highly electromagnetic fields.

" In wind turbines, they measure air flow by detecting the position of the air flaps."

Draw-wire displacement sensors combine a spring-loaded wire wound onto a spool-type transducer. Because the wire can be quite long, draw-wire sensors have the benefit of being able to measure changes in distance when the sensor is located far away from the object that is moving. As the wire is extended or retracted from the spool, the spool rotation is measured and then converted into a measure of change to an electrical signal. In wind turbines, they measure air flow by detecting the position of the air flaps. A typical draw-wire displacement sensor is shown in Figure 4.

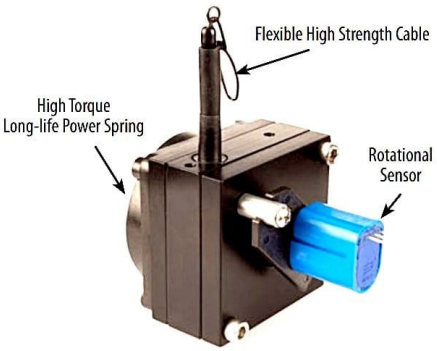

Figure 4: This draw-wire displacement sensor from Bourns shows the spring-loaded spool on which the cable is wound and a rotational sensor mounted to the enclosure. Several types of sensors can be used depending on the requirements of the application. (Source: Bourns)

Draw-wire sensors can also be used with a variety of rotary transducers depending on the application, such as potentiometers, Hall-effect sensors, and analog or digital non-contacting sensors. The Bourns AMS22B5A1BHASL334N non-contacting analog rotary sensor, for example, uses magnetic technology and is resistant to shock, vibration, fluids, and dust, and can operate over a temperature range of -40oC to 125oC. It has 12-bit output resolution and linearity of ±0.3 percent.

Accelerometers

Accelerometers, which measure changes in velocity or speed, are used in wind turbines to detect and monitor vibration within main, yaw, and slew bearings, as well as other rotating components such as the main generator output shafts. The collected vibration data can be used to monitor changes over time and predict impending failures.

The Analog Devices ADXL1001 and ADXL1002 MEMS accelerometers are good examples because they measure vibration with high resolution and low noise density over time. Their sensitivity characteristics are very stable, and they're immune from shocks up to 10,000mps2.

The devices also have integrated self-diagnostic functions and an over-range indicator, and they operate over a frequency range of -40°C to +125°C.

Wind Sensors

Wind sensors are mounted on the top of the nacelle and are either mechanical or ultrasonic. Because ultrasonic types do not need recalibration, they are increasingly used in areas where maintenance is difficult to perform. Ultrasonic sensors measure the distance to an object by using sound waves, sending out a very-low-frequency sound wave and detecting the wave after it has been reflected by the target object.

By recording the elapsed time between generation of the sound and its return, it is possible to calculate the distance between the sensor and the object.

The Texas Instruments PGA460/ PGA460-Q1 ultrasonic processor and driver SoC has a signal conditioner and Digital Signal Processor (DSP) core that conditions the reflected signal using an analog front-end consisting of a low-noise amplifier and programmable gain stage that sends output to an analog-to-digital converter. The digitized signal is then processed for near-field and far-field object detection using time-varying thresholds.

Temperature Sensors

Temperature sensors are also used in locations where increases in temperature are indicative of the overheating of some type of component of subsystem. TE Connectivity's PTF Platinum temperature sensors measure from -200°C to +600°C and have temperature detectors that use thin-film resistors as the sensing element. They are very small and lightweight, drift little over time, and have a low time constant for rapid feedback.

Conclusion

All this being said, a reasonable question might be: If sensors are so crucial to wind turbine performance and safety, what happens if the sensors themselves fail? The answer is that multiple sensors are used in some locations, the second as a backup that can be switched in, potentially autonomously, upon failure of the first. In addition to this backup approach, sensors used in wind farms (as well as other energy systems) must be specified to meet requirements such as broad operating temperature ranges, certification to IP67 or IP68 for protection from dust and water, and sometimes ruggedized enclosures.

Like any type of evolving technology, creating energy from the wind has had its good and bad days, and some of the latter have resulted from a single electrical component failure rather than a massive generator or turbine blade failure. Sensors are playing a major role in reducing the likelihood of these occurrences, just as they are in all industrial applications. Eddy current and displacement sensors, accelerometers, and wind and temperatures sensors are the key to monitoring turbines and communicating potential and needed maintenance. For this reason, they are likely to be employed in an even greater number of locations on these mammoth machines in the future, as it's not difficult to make a case for using a $10 part to protect an expensive turbine blade from catastrophic failure.

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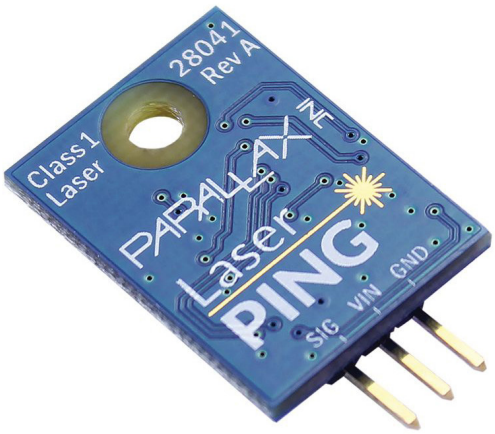

Distance between objects

Parallax: LaserPING 2m Rangefinder

With its Class 1 850nm VCSEL, the Time-of-Flight Sensor Module LaserPING Rangefinder takes measurements between moving or stationary objects in a 2 cm to 200 cm range. It is designed to be circuit- and code-compatible with the Parallax PING))) Ultrasonic Distance Sensor, making applications adaptable for different environmental conditions. Queries and replies pass a single I/O pin, so almost any microcontroller can control it via PWM or an optional serial mode.

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Gas Sensor Evaluation Kit

Sensirion: SEK-SGPC3

In a temperature range of -40°C and +85°C, the evaluation kit allows for diligent testing of the digital low-power gas sensor SGPC3. Apart from two multi-pixel SGPC3 sensors, the kit contains the humidity and temperature sensors SHTC1, SHTW2 and SHT31-DIS-B. The specialized ControlCenter Viewer Software can store and display the sensor signals for multiple gas sensors. The distinctive feature of the gas sensor is the combination of multiple metal-oxide sensing elements on one chip to provide more detailed air quality signals.

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Air Quality Analysis

MikroElektronika: MIKROE-2896 Click Board

One of many Click boards, the MIKROE-2896 combines multiple metal-oxide sensing elements on a chip to provide detailed information about the air quality parameters.

It delivers total Volatile Organic Compounds (TVOC) value readings as well as the CO_2 equivalent concentration readings in an indoor environment. With its SGP30 sensors,an LDO voltage regulator, the I^2C bus and a voltage level shifter, the board can be applied directly in IoT sytems around air conditioning and ventilation.

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MEMS Sensors

ST MicroElectronics: STEVAL-MKI135V1 LIS2DH

This adapter board for the evaluation of LIS2DH MEMS sensors provides the complete LIS2DH pinout and comes with the required decoupling capacitors on the VDD power supply line.

It has been designed for use with the STEVAL-MKI109V2 motherboard but can be accessed also directly via the standard DIL 24 for factor. The LIS2DH MEMS acceleration sensors are available either for consumer electronics or in industrial versions.

FIND OUT MORE >>

Muscle Sensor Development

SparkFun: MyoWare Kit

In order to simplify the development of healthcare/ lifestyle appliances, this Development kit includes a MyoWare Muscle Sensor as well as various SparkFun shields and sensor pads.

The MyoWare board measures the filtered and rectified electrical activity of a muscle; it output voltage relates to muscle activity. With its 3-pin stackable headers, the shields can be stacked easily, making quick prototyping possible. The Arduino-powered, electromyography (EMG) sensor kit allows for different configurations.

FIND OUT MORE >>

Sensor Fusion Comes of Age

By Morrie Goldman, Mouser Electronics

Over time, sensors have morphed from simple analog and mechanical constructs to chip-based digital devices that connect to a machine to monitor the machine's health as well as environmental conditions. Similarly, sensor fusion — multiple types of sensors working together to solve a problem — has combined the threads of many other technologies to create something very new and exciting.

The idea of using a computational device to sort out the data from multiple sensors and combine information to draw a conclusion has been around since at least the 1950s. But it was exceptionally difficult to do. Around 1960, several mathematicians developed sets of algorithms in an effort to have a machine draw a conclusion based on input from multiple sensors. These filters also removed meaningless data from noise or other sources.

Of course, it wasn't long before the military decided that this technology would be useful in their applications. Being able to process inputs from multiple sources and compare it with stored data would allow the military to better track and identify potential airborne targets and even compute the certainty of the results. With better computers and sensors, the technology was advancing, but there were still complex and expensive problems to solve.

Potential Applications

When the microprocessor first became available, people described it as a solution in search of problems. The same case can be made for sensor fusion. If you have the power and intelligence to monitor multiple sensors, analyze the data in real time, and either provide a simple direction or control an action, heretofore-unthought-of applications can be almost limitless.

Figure 1: Activity and other health monitors were among the first consumer products to embrace sensor fusion technology.

The following examples just scratch the surface:

HEALTH MONITORING
— including healthy athletics, patient monitoring, and research

MONITORING THE ELDERLY
— wellness monitoring to reduce the burden of staffing

AUTOMOTIVE, TRANSPORTATION SYSTEMS
— monitoring and controlling efficiency and safety functions

PUBLIC SAFETY
— identification of potential hazardous conditions with much greater accuracy than simple fire and security systems

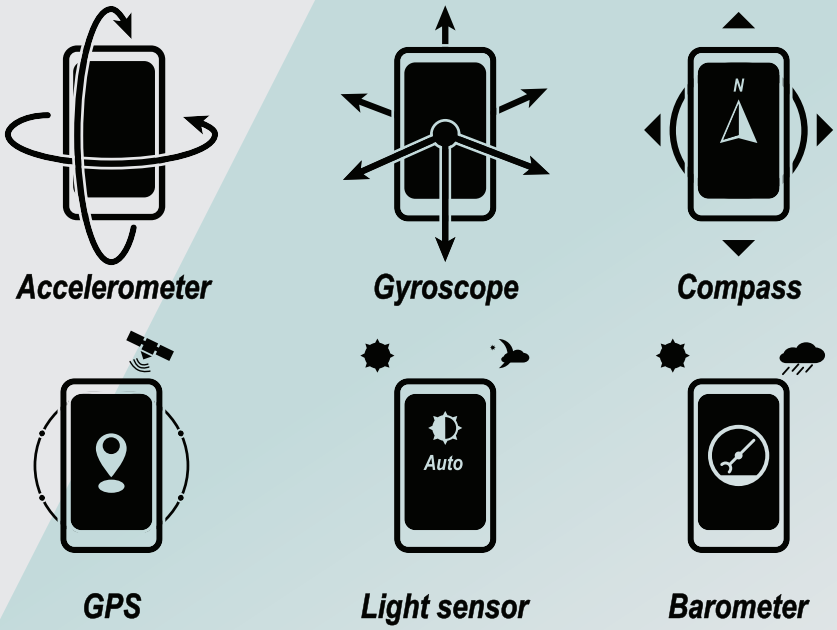
ENTERTAINMENT
— gaming, including controllers and virtual reality headsets

WEATHER
— intelligent weather forecasting stations, that not only warn of changing conditions, but control systems to prepare for a storm (for example, closing storm shutters, closing valves, etc.)

HVAC/AIR QUALITY
— intelligent control of room temperature, humidity, air quality, system maintenance, etc.

While all of these types of capabilities have existed in some form for many years, the ability of a system to observe multiple sensors and come to an intelligent conclusion, and even initiate action, is revolutionary.

"The processing is done by a specialized controller chip, which may be identified as an MCU."



A Convergence of Technologies

Fortunately, as they have done in other areas of electronics, a number of IC manufacturers have taken on the task of doing the heavy lifting. With off-the-shelf sensor fusion and sensor hub chips, it is now possible to efficiently interface to a variety of digital sensors, as well as other pathways. The burden of creating your own algorithms has been eliminated.

While their terminology does vary a bit, a number of IC manufacturers have either adapted existing lines of products or created entirely new ones to tackle sensor fusion tasks. The processing is done by a specialized controller chip, which may be identified as an MCU, a sensor hub or a sensor fusion processor.

We are already seeing this technology applied in the consumer market in smart phones, activity monitors and other devices. The latest generation of smart phones from Apple, Samsung, and others contain powerful and diverse sensing capabilities, even without the need for external interfacing. These include a three-axis magnetometer, a three-axis accelerometer, and a three-axis gyroscope. This combined capability is often referred to as 9-DoF, nine degrees of freedom.

For the most part, these functions are "always on" in a cell phone. If the processing of data from these sensors was managed by the phone's central microcontroller, battery life would be significantly shortened. Instead, highly efficient dedicated MCU chips process the data as sensor hubs, using a fraction of the power. The NXP ARM M3 series of MCUs is one example. According to Chipworks, a product teardown specialist, as reported by EETimes, Apple uses a customized version of the NXP chip to monitor its sensors in the iPhone 5S. "The M7 controls functions from a variety of discrete sensors including a gyroscope, an accelerometer, and a compass." Samsung takes on the same task with a microcontroller from Microchip, the Core 8-bit AVR MCU.

With such powerful on-board sensing technology, apps are appearing that take advantage of the 9-DoF cell phone hardware to provide health and activity monitoring, or to function in concert with GPS and external data to provide even more information for the user. Now, add to those already-diverse sensor inputs data from an external device that communicates via Bluetooth and the capabilities seem limitless.

The goal of the chip manufacturers is to make it practical for engineers to design systems that provide real-time sensor data which can be used to provide the desired contextual awareness with minimal power consumption and maximum battery life. Beyond smart phones, highly optimized solutions can address such applications as tablets, Ultrabooks, IoT-enabled devices, gaming, healthcare, environmental monitoring, and wearable computing.

Development boards are available that allow design engineers to easily get their feet wet in this technology.

One such example is the ATAVRSBIN2 from Microchip (previously Atmel). Microchip has embraced sensor fusion with a wide variety of products, which they call "the Complete Sensor Ecosystem." Microchip identified that the simultaneous analysis and fusion of data from different sensors and sensor types was not a task it could handle solo.

To get past these complexities, the company partnered with a number of leading sensor manufacturers and sensor fusion specialists to provide a complete, easy-to-implement Sensor Hub Solution.

A current trend combines an MCU with three or more MEMS sensors in a single package. One example is STMicroelectronics' LIS331EB, which combines a high-precision three-axis, digital accelerometer with a microcontroller in a single 3 x 3 x 1 mm-package.

The microcontroller is an ultra-low-power ARM Cortex-M0, with 64-Kbyte Flash, 128-Kbyte RAM, embedded timers, 2x I²C (master/slave) and SPI (master/slave). The LIS331EB can also internally process data sensed by external sensors (for a total of nine), such as for gyroscope, magnetometer, and pressure sensors. Functioning as a sensor hub, it fuses together all inputs with the iNEMO Engine software.

"Remote sensor data can be processed by a sensor fusion device and sent to the Cloud for recording, further analysis, or even to order an action."

STMicroelectronics' iNEMO engine sensor fusion software suite applies a set of adaptive prediction and filtering algorithms to make sense of (or fuse) the complex information coming from multiple sensors.

NXP also offers a product line of devices originally from Freescale that combine MCUs and sensors in a single package. Their FXLC95000 Xtrinsic MotionSensing Platform integrates a MEMS accelerometer and a 32-bit ColdFire MCU. Similar to the STMicroelectronics device, the FXLC95000 can simultaneously manage data from internal and external sensors. Freescale was the first company to market an MCU with a sensing hub embedded that is also programmable for customer-specific applications and algorithms. Up to 16 sensor inputs can be managed by a single device, allowing calibration, compensation and sensor functions to be offloaded from the application processor.

It functions with either Freescale or third-party drivers. Other manufacturers who are well-entrenched include Bosch, Fairchild, Honeywell, MicroChip, and TI.

Fusion Meets the Cloud

While quite a lot of functionality can be achieved at a local level, interaction with the Cloud is where the fun really begins. Remote sensor data can be processed by a sensor fusion device and sent to the Cloud for recording, further analysis, or even to order an action.

For example, an unattended pump operating in a remote location is always at some risk of failing. A few years ago, a remote sensor may have been in place to identify if it were running hot or had even failed. Now, the same pump can also be monitored for vibration, exhaust chemistry, bearing noise, and the external conditions around it.

A predetermined program could empower the sensor fusion controller to shut down the pump or even cycle its operation until a technician can arrive.

The system would also know in advance whether it is likely that the entire pump must be replaced or just a component. Here, a sensor fusion solution could eliminate downtime as well as costly emergency service calls, and even collect data to analyze how well the pump is working overtime.

The same general idea applies to monitoring an aircraft engine in flight, a building elevator, or just about anything mechanical.

Another application of the Cloud is for the sensor fusion to take place there, instead of on site. With open-source sensor fusion software available, individual sensor data can be transmitted to a server, where the processing would take place.

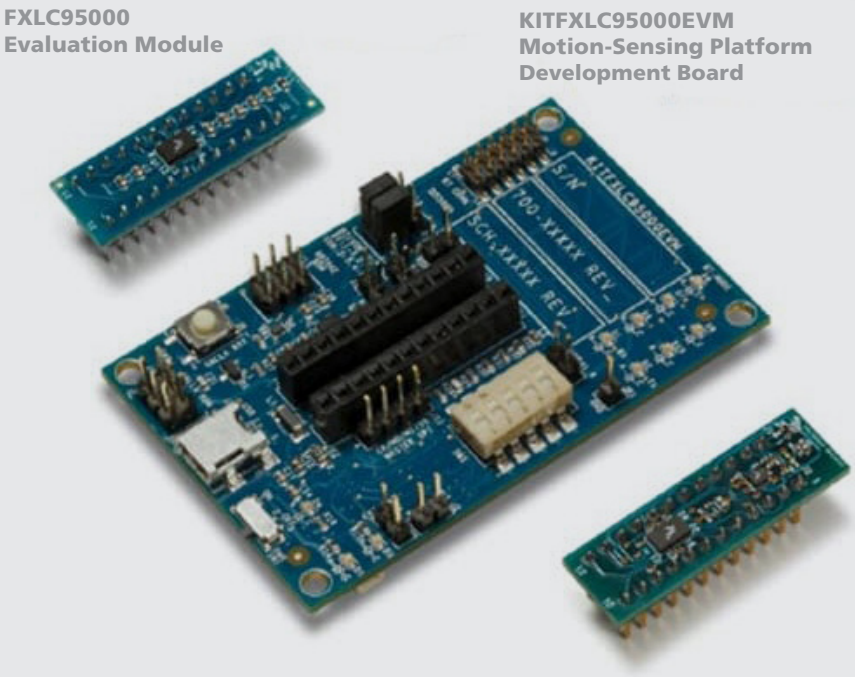


Figure 2: NXP's Xtrinsic FXLC9500 32-bit MCU Sensor Fusion Hub with Accelerometer enables scalable, autonomous, high precision multi sensor hub solutions with local compute and sensors management in an open architecture.

Conclusion

Sensor fusion is a technology that has come of age, and at just the right time to take advantage of developments in sensors, wireless communication, and other technologies. Once out of reach of all but the most advanced government labs, the technology is now available off-the-shelf, at prices that even fit into the BOM budget for many consumer products.

Now closely linked to mobile technology and the rapid development of lower-cost digital sensors, sensor fusion is poised for explosive growth. For the design engineer, it is a good time to apply some creative thinking and to start experimenting!

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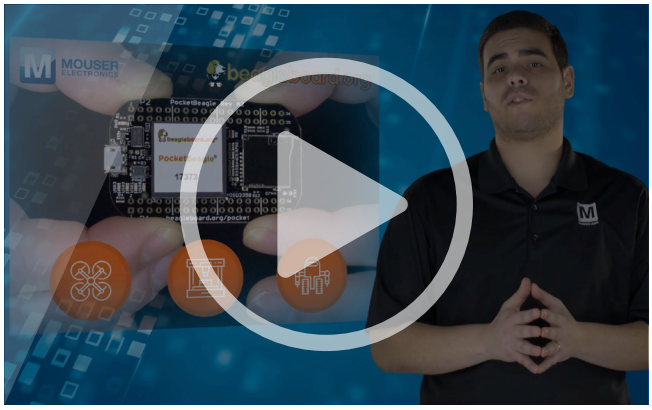


USB-key O/S development

PocketBeagle USB-Key-Fob Computer is an ultra-tiny open-source development board ideal for beginners and professionals. The PocketBeagle is a low cost Linux computer with tremendous expansibility, a slick design, and is easy to use.

Network-Enabled Smart Lighting

ams AS7221 is a network-enabled IoT smart lighting manager with embedded tri-stimulus colour sensing for direct CIE colour point mapping and control.

2.5-42GHz I/Q mixers

Analog Devices HMC8191 & HMC8193 I/Q Mixers have a frequency range of 2.5 to 42GHz and are housed in surface mount packages providing a very cost-efficient solution.

Raspberry Pi gateways

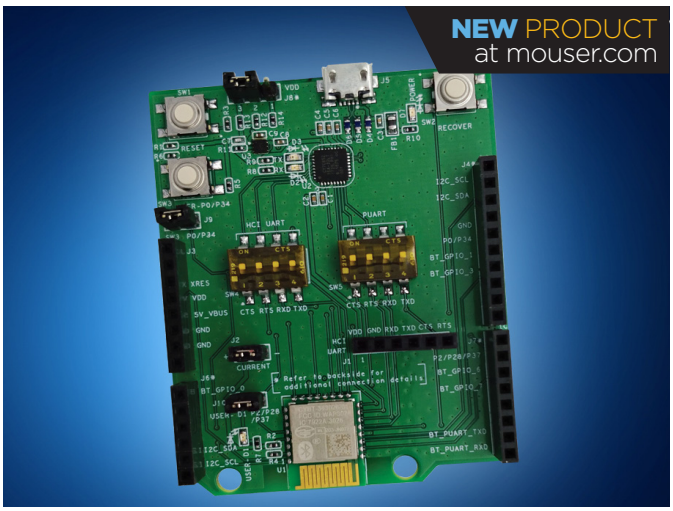
Seeed Studio's LoRa/LoRaWAN 868MHz & 915MHz Gateways for Raspberry Pi 3 are long-range wireless solutions to create low-power, wide area networks.

Bluetooth WICED eval boards speed deployment IoT

Designed to evaluate Cypress' Bluetooth® Wireless Internet Connectivity for Embedded Devices (WICED) modules, two new evaluation boards allow engineers to develop fully certified, fully programmable Bluetooth Smart and Bluetooth Smart Ready devices for use in a variety of IoT applications, including those in the medical, industrial, and consumer markets.

Available from Mouser, the boards enable rapid deployment of connected IoT products through easy-to-use WICED modules that help save time and costly RF hardware development, certification and qualification processes. The evaluation boards can function either as stand-alone evaluation kits or with Arduino-compatible shields for additional expansion possibilities.

The EZ-BT WICED dual-mode module evaluation board allows designers to evaluate and develop Bluetooth 5.0 applications based on the CYBT-34026-01 EZ-BT WICED module. This module features 512 Kbytes of flash, 352 Kbytes of SRAM, a 16-bit delta-sigma ADC, four PWMs, and a maximum transmit power of +9 dBm for Bluetooth Smart and +12 dBm for Bluetooth Smart Ready applications.



The EZ-BLE WICED module evaluation board enables designers to evaluate and develop Bluetooth 4.1 and Bluetooth low energy applications based on the CYBLE-013025-00 WICED module. The CYBLE-0130xx-00 family of WICED modules are cost optimized designs, ideal for applications requiring simple Bluetooth connectivity. The CYBLE-013025-00 module features 128 Kbytes of flash, 60 Kbytes of SRAM, a 16-bit delta-sigma ADC, four PWMs, and a maximum transmit power of +4 dBm.

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Programmable clock generators include optional crystal

VersaClock® 6E programmable clock generators from IDT offer output frequencies in the kilohertz range and an optional integrated crystal, making them ideal for datacenter and networking equipment, industrial test and measurement devices, professional video displays and other consumer-oriented communications applications with stringent cost, power consumption and low-jitter requirements.

Available from Mouser Electronics, the clock generators deliver flexible, low-power timing for demanding high-performance applications. With RMS phase jitter less than 500 fsec over the full 12 kHz to 20 MHz integration range, the devices meet the stringent jitter and phase noise requirements of technologies such as 10G Ethernet, PCI Express Gen 1/2/3, PHY reference clocks and the newest generations of high-end FPGAs — all while operating at about half the core power of competing devices.

These high-performance timing devices store configurations in four banks of OTP memory, while configurations can be changed using the devices' I^2C serial programmable interface. The chip uses a single reference clock to generate frequencies, while one of two redundant clock inputs can be selected through manual switchover.

Available in a miniscule 4 × 4 mm, 24-pin VFQFPN package, the devices also provide additional space savings by eliminating the need for extra timing components.

The devices are supported by VersaClock 6E Evaluation Boards. Designed for use with IDT's Timing Commander software, the evaluation boards can configure and program the devices to generate a variety of frequencies while maintaining industry-leading performance.

Click for More Information

New MEMS microphones are clear over longer distances

High-performance, low-noise IM69D120 and IM69D130 XENSIV™ MEMS microphones from Infineon Technologiesare ideal for applications such as high-quality audio capture, voice user interface, active noise cancellation, or audio pattern detection in monitoring systems.

Available from Mouser Electronics,the microphones are designed for applications that require low self-noise, wide dynamic range, low distortion and a high acoustic overload point. They incorporate Infineon's dual-backplate microelectromechanical systems (MEMS) technology to enable high linearity of the output signal within a dynamic range of up to 105 dB. The dual-backplate MEMS technology is based on a miniaturized symmetrical microphone design, similar as utilized in studio condenser microphones, which generates a truly differential signal. The technology allows improved high frequency immunity for better audio signal processing and increases the acoustic overload point of 10-percent THD to 135 dB SPL.

The 4 mm × 3 mm microphones feature a noise floor of just 25 dBA (69 dBA signal-to-noise ratio (SNR)), with distortion less than 1 percent, even at sound pressure levels of 128 dB SPL.

For design agility, the IM69D120 microphone has been specifically designed to preserve the 69 dBA SNR within the dynamic range of a 16-bit system, whereas the IM69D130 is ideal for 20-bit systems.

The SNR is an improvement of 5 dB compared to a conventional MEMS microphone, essentially doubling the possible distance between a user and the device capturing a voice command. Additionally, the microphones' flat frequency response and tight manufacturing tolerance result in close phase matching of the microphones, benefiting microphone array applications.

Click for More Information

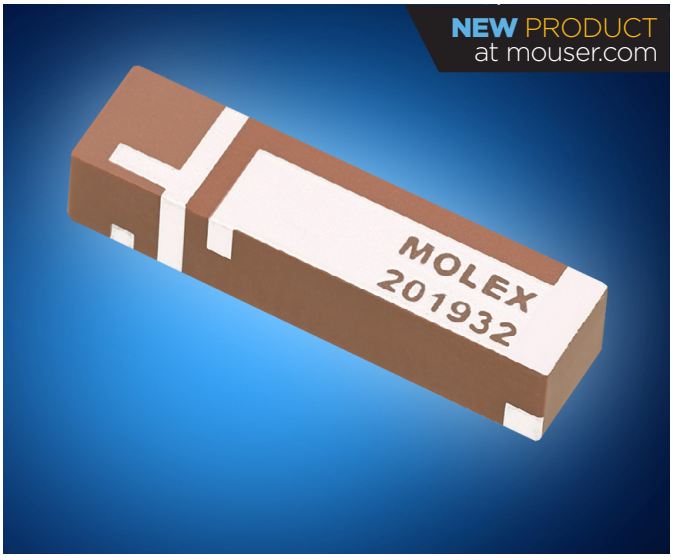
Power-Boosting Triple-Band Wi-Fi antenna for IoT and M2M

Molex's triple-band Wi-Fi antenna is designed to penetrate areas of interference and deliver reliable internet connectivity to places where walls and barriers present a challenge.

Offering increased power efficiency and long-range connectivity to Wi-Fi certified products, the ceramic antenna is a robust option for IoT and machine-to-machine applications.

Available from Mouser Electronics, the new antenna offers 900 MHz, 2.4 GHz, and 5 GHz frequencies for increased range and penetration in areas of interference. The 900 MHz band also results in reduced power consumption when compared with similar 2.4 GHz and 5 GHz antennas. The compact, surface-mount antenna features a ceramic housing that enables it to withstand temperatures ranging from minus 40 to 125 degrees Celsius.

The triple-band Wi-Fi antenna supports IP-based cloud connectivity, making it an ideal choice for the development of IoT and M2M solutions such as connected vehicles, smart homes and smart cities.



Additionally, the device's extended range makes it a useful choice for medical, retail and agricultural applications demanding signal penetration and wide range.

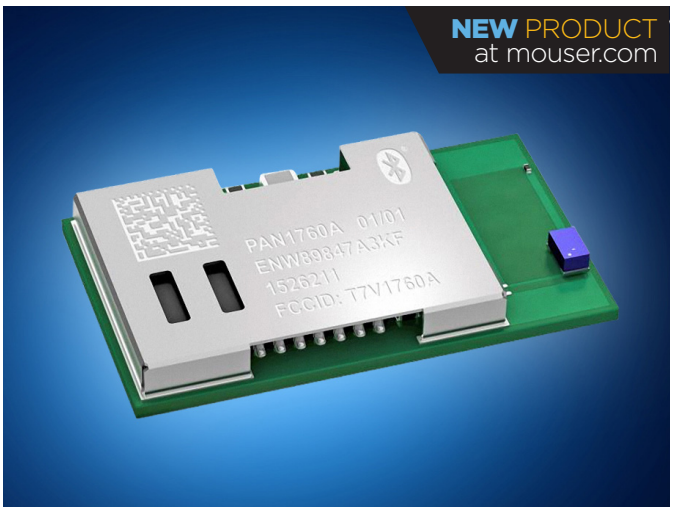
Click for More Information

Low-power RF BLE runs for years from a battery

Panasonic's PAN1760A low-power Bluetooth® low energy module RF offers years of operation using only a CR2032 battery for simple and reliable IoT designs.

Available from Mouser Electronics, the module is a fully autonomous device based on a Toshiba TC35678 SoC with an Arm® Cortex®-M0 core and embedded Toshiba Bluetooth 4.2 low energy stack. With integrated 256 kbytes of flash and 83 kbytes of RAM for application code storage and execution, the PAN1760A is suited for stand-alone operation in many applications without the need for an external processor, which helps save cost, complexity, and space.

The PAN1760A features excellent Bluetooth low energy functionalities — including mesh, extended Maximum Transmission Unit (MTU), and low energy secure connections — along with comprehensive GATT service and profiles. The module offers I²C, SPI, and two UART interfaces and four PWM outputs, plus five external and one internal analog-to-digital converters (ADCs). The module is also software- and hardware-compatible with the PAN1760, PAN1761, and PAN1026 Bluetooth modules, enabling designers to easily migrate previously developed software such as Bluetooth low energy profiles and applications.



The PAN1760A module benefits from a peak power consumption of only 3.3 mA in transmit (Tx) and receive (Rx) mode, enabling advanced wireless functionalities in IoT, medical, and industrial applications without compromising battery life. The module is supported by the comprehensive PAN1760A Evaluation Kit, which provides two USB dongles to allow designers to develop, run and debug code. The dongles feature breakout headers that provide an easy way to connect sensors and other devices for rapid prototyping.

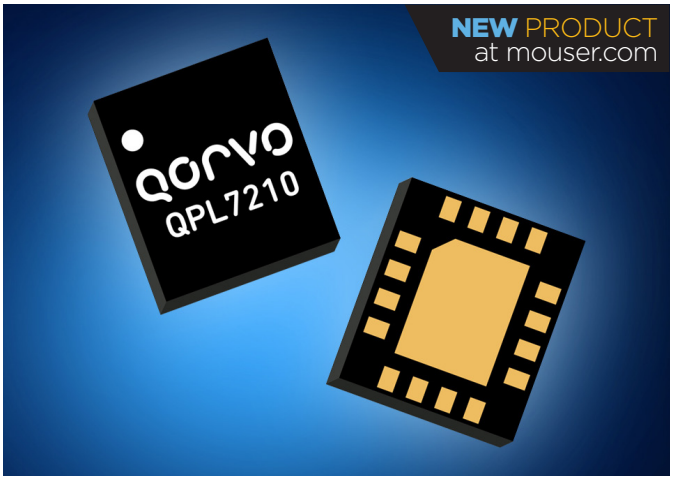
Click for More Information

Wi-Fi LNA Receive module offers integrated coexistence BAW filtering

The QPL7210 2.4 GHz Wi-Fi® LNA receive module from Qorvo is designed for IEEE 802.11b/g/n/ac WLAN devices, Wi-Fi consumer equipment, routers or gateways.

Available through Mouser, Qorvo's fully integrated QPL7210 front-end module provides an exceptional wireless RF solution for connecting users to a variety of communications, networking, and IoT applications.

The Qorvo QPL7210 receive module delivers best-in-class receiving immunity from interference and out-of-band blockers, while still achieving leading-edge receiving sensitivity across all Wi-Fi channels. The stand-alone module integrates a 2.4 GHz low-noise amplifier (LNA), an LNA bypass, and integrated filtering. The QPL7210 enables expanded capacity, throughput, and range, improving the coverage and user experience incorporating its highly selective bulk acoustic wave (BAW) filter functionality, used primarily for coexistence attenuation over module operating conditions. The module also includes integrated filters for second and third harmonics and 5 GHz rejection for dual-band, dual-concurrent operation. The module offers receiving gain of 13.5 dB with a 2.5 dB noise figure.



Optimized for 3.3 to 5V operation, at 3.3 V, the QPL7210 features a +30 dBm third-order intercept point (OIP3) and +3.5 dBm Input 1 dB Compression Point (IP1DB). Maximum bypass mode for receiving input power for the module is +24 dBm.

The 16-pin, 3.0 mm × 3.5 mm × 1 mm QPL7210 module meets or exceeds the RF front-end needs of IEEE 802.11b/g/n/ac/ax WLAN applications and is ideal for a broad array of RF wireless applications, including consumer Wi-Fi equipment, access points, wireless routers, residential gateways, and products focused on the IoT.

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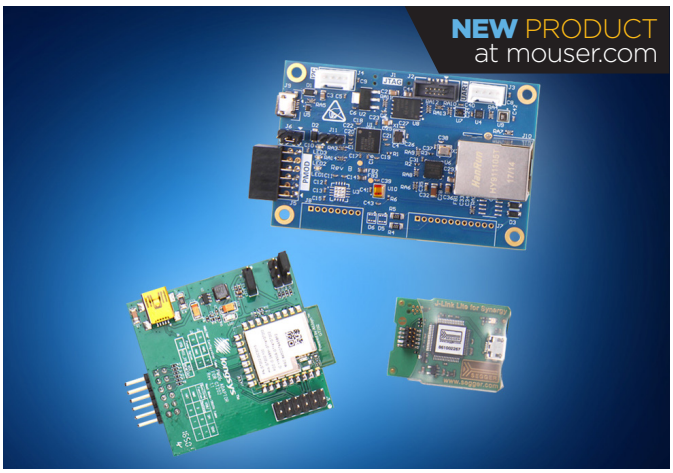
Quickly connects applications to Enterprise Cloud services



Featuring all the equipment, firmware and software necessary to develop cloud-connected applications, the Synergy AE-CLOUD1 application example kit from Renesas Electronicsenables engineers to connect to the Renesas IoT Sandbox, a free prototyping environment, where they can prototype and evaluate cloud-based developer accounts and editable application examples.

Engineers can also connect the kit to the Synergy Enterprise Cloud Toolbox, which provides access to third-party cloud services.

The kit, available from Mouser Electronics, includes a powerful microcontroller board with a 120-MHz Renesas Synergy S5D9 Arm® Cortex®-M4F microcontroller with 2 MB of flash and 640 Kbytes of SRAM. The board also includes a microphone, 6-axis digital compass, barometric pressure sensor, relative temperature sensor, humidity sensor, and three LEDs. The board's two plug-and-play Grove connectors help engineers capitalize on Seeed's Studio's Grove modular prototyping system.

The comprehensive kit also includes a Wi-Fi board that incorporates a Qualcomm Atheros QCA4002 chip for 802.11b/g/n connectivity, plus a Segger J-Link Lite debugger board and cable.

Combined with Synergy Enterprise Cloud Toolbox, the AE-CLOUD1 application example kit dramatically reduces the time required to develop and test secure IoT applications. The kit is an ideal choice for data monitoring and data intelligence applications, providing the necessary tools to monitor and control the environment in home, building and industrial automation systems, and in applications such as fleet management, weather stations, and smart agriculture. The kit offers data intelligence with real-time processing to support fitness monitors, smart power tools, smart appliances and building access devices.

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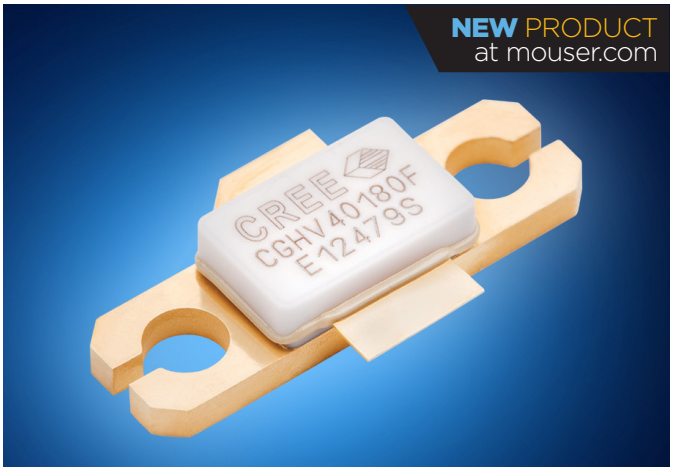
High Efficiency GaN HEMTs now shipping



CG2H40xx and CG2H30070 GaN HEMTs from Wolfspeed™, a Cree® company, provide a versatile, general-purpose broadband solution for a variety of RF and microwave applications.

Operating from a 28 volt rail, the two HEMTs are characterized by high efficiency, high gain and wide bandwidth, making them an ideal choice for linear and compressed amplifier circuits.

Available from Mouser, the HEMTs offer best-in-class reliability and a choice of two package types: a screw-down flange package or solder-down pill package. Designed with the same footprint as previous 0.4µm devices, the new HEMTs can be used as drop-in replacements in existing applications. The transistors are capable of high frequency operation to 6 GHz and deliver 62-percent efficiency at PSAT.

The high efficiency and wide bandwidth of Wolfspeed's CG2H40xx and CG2H30070 GaN HEMTs enables RF design engineers to increase the performance of their RF amplifiers quickly and easily.

The devices are supported by the CG2H4004F-TB and the CG2H30070F-TB1 demonstration boards, which allow engineers to efficiently evaluate the Wolfspeed HEMTs. The CG2H4004F-TB development tool operates at a frequency range of DC to 4 GHz, while the CG2H30070F-TB1 development tool operates at a frequency range of 0.5 GHz to 3 GHz.

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