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FEBRUARY 2017

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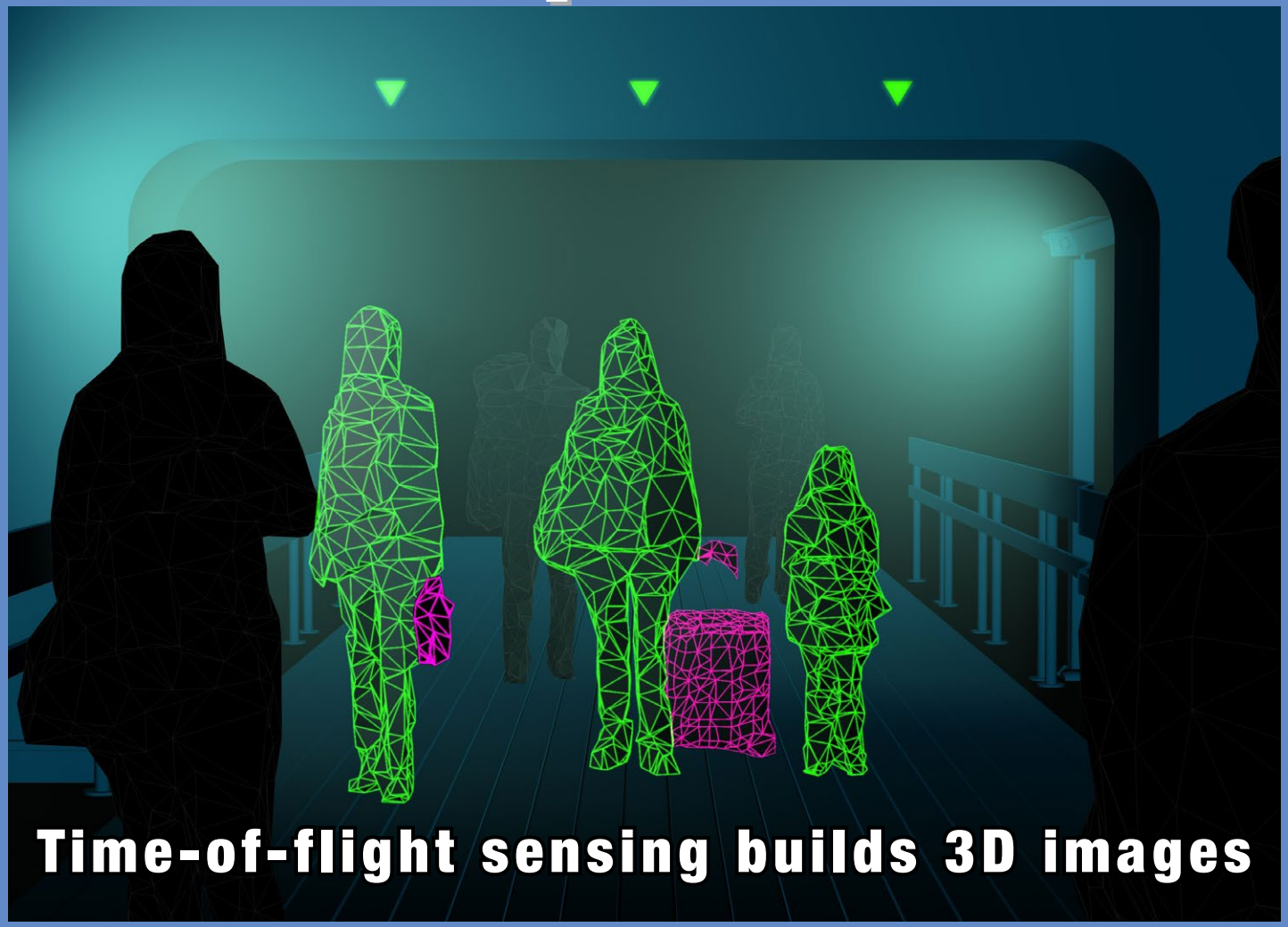
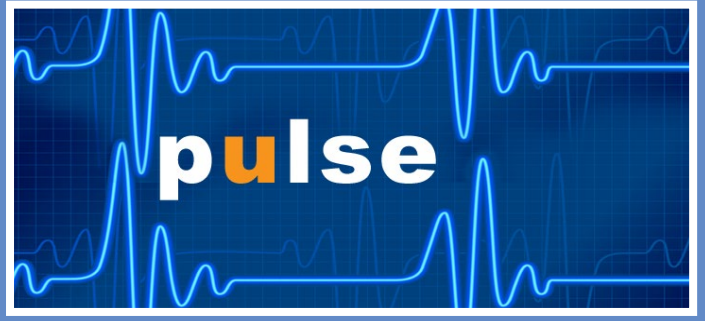
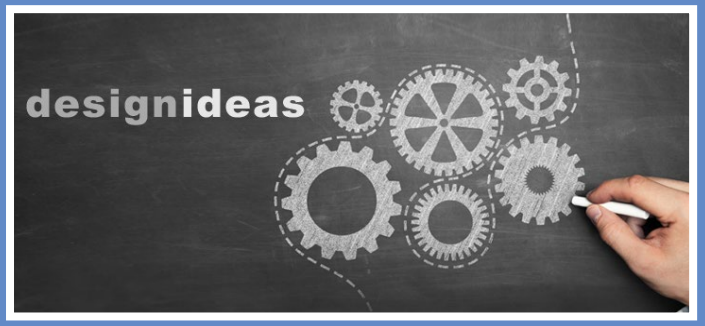
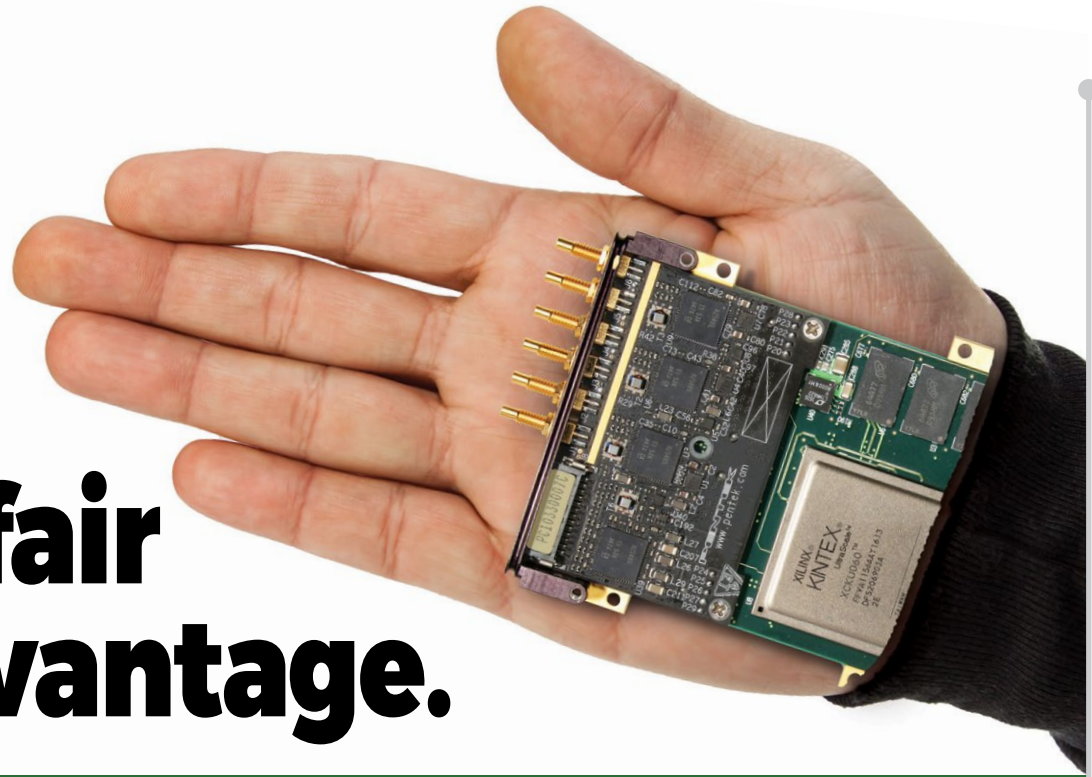


Time-of-flight sensing builds 3D images







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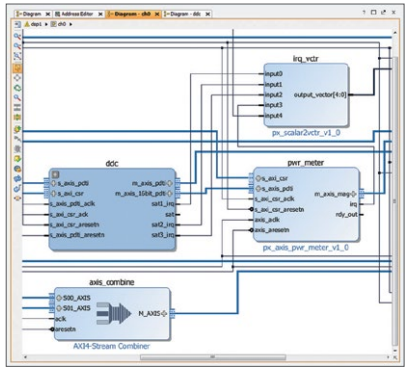

Navigator FDK shown in IP Integrator.

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COVER

3D imaging by time-of-flight sensing in difficult environments

The image on the cover page accompanies Melexis' announcement of a chipset and associated evaluation kit for time-of-flight (ToF) 3D vision solutions for challenging environments.

The chipset supports QVGA (320 x 240 pixel) resolution and offers sunlight robustness with up to -40°C to +105°C temperature range operation. It comprises MLX75023 1/3-inch optical format ToF sensor (above) and the MLX75123, a companion IC that controls the sensor and illumination unit and delivers data to a host processor. Together the devices can minimize the component count and reduce the size of 3D ToF cameras. Melexis has a video demo here; read more in the Pulse section on page 11.

FEATUREARTICLES

ONLINE THIS MONTH

Precision Dual Output, High Current, Low Noise, Low Drift Reference

ACF bonding makes reliable connections in ADAS applications

White Paper by; Intel: The coming data avalanche and how we'll handle it

EDN's columns

CHOICES ABOUND IN TINY COMPUTE MODULES

by Graham Prophet, Editor

Not so long ago, mention of embedded computing modules brought to mind the various ranges of single-board computer, from a variety of manufacturers, that whatever other attributes they offered were firmly rooted in the "professional" sector. In general, if you wanted to put a processor-based control function in charge of some concept, gadget or project that could not support the purchase of such an SBC, then a ground-up, microcontroller-based system was the default option. And then... the world changed.

Consider the introductions we have covered in just this month. Raspberry Pi led the way, with the introduction of the Compute Module 3; this "stripped down" Pi takes the Raspberry Pi 3 and puts it on a SO-DIMM card (coverage here). There have been more Raspberry Pi-related items, such as "Fanless Raspberry Pi industrial controller" and "1, 2, 4; carrier board mounts & powers Raspberry Pi cluster" further underlining that product's diversification from its educational sector (or STEM) origins, via the maker movement, to the wider world of embedded control and computing.

Also in the past month's pages there has been "Linux-based IoT microcomputer is only 76x37x18mm" - describing it as a 'virtually anything' microcomputer, Australian design house SRKH Designs is confident its Virtualette V1 dual stack microcomputer will find plenty of use cases from the maker community. This dual board stack will ship with its own optimized Linux-based OS, which can be tuned to suit any distribution. Weighing 39g, the Virtualette V1 is powered by an Allwinner A20 SoC, with 8GB of onboard NAND flash, 10/100 Mbps Ethernet, SATA, CAN capability, a real time clock with onboard battery and 'Wakeup' function, and several ports including USB, micro SD and multiple IO interfaces. It is being funded through Kickstarter and if successful, plans future upgraded versions including quad-core and octo-core versions, and an add-on FPGA-based development board.

Then, an unexpected entrant into this merged hobbyist/maker/professional space appeared from Asus with its Tinker board. This ARM Cortex-based computer-on-a-card features 4K graphics, on-board WiFi and Bluetooth, and Gigabit Ethernet wired connectivity, pitching it not only against the Raspberry Pi but also Imagination Technology's Creator line.

Asus builds the board around the Rockchip RK3288, which is a quad-core, ARM Cortex-A17 device from the Chinese fabless IC house. It has on-chip graphics with the ARM Mali-T764 GPU, supporting OpenGL ES1.1/2.0/3.0, Open VG1.1, OpenCL, and DirectX11.

Also this month we have been in touch with Onion.io whose offering (we first reported here) is the Omega2; the company positions its offering as "the world's first IoT computer and a $5 Linux development board with built-in WiFi". Once again, this comes as a small, fully-assembled PCB with a pre-loaded Linux code base. Head of Marketing Randolf Gioro says, "We are trying to make hardware development accessible for people with limited technical experience so they can innovate and use technology solve real pain points in their lives." He reports that, "We have been attracting mainly makers who are building one off projects with the Omega2. There are a small proportion of users who aspire to build commercial products using the Omega2 as well."

From a negligible base a few years ago, this sector has come to be a routine option when it comes to embedding intelligence, whether for IoT communications-oriented projects or pure stand-alone control tasks. A major factor has been acceptance in professional circles; origins such as crowdfunding campaigns are no longer seen as a barrier to adoption in more conventional circles.

Raspberry Pi founder Eben Upton also makes the point that the Pi cards are highly engineered – at their price-point, they must be – to maximise manufacturability and reliability. Speaking of the compute module, Upton also makes the related point that the volume cross-over point to viability of an OEM solution vs. embedding a module is often, "much higher than you would think" - precisely because of the engineering you would need to do to match what has gone into the modular product.

As we head towards the 2017 running of Europe's "embedded world" exhibition, (Nuremberg, March 14/16) can we expect a lot more from this versatile product category? Almost certainly.

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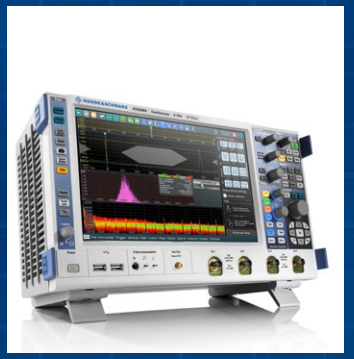

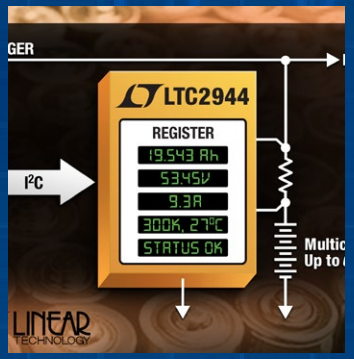
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REGISTER
19.543 Ah
53.45V
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300K, 27°C
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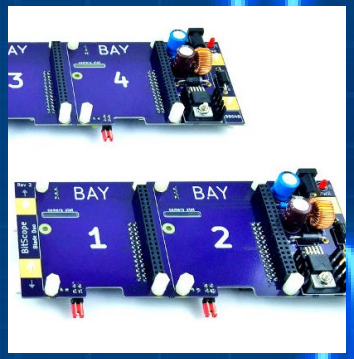
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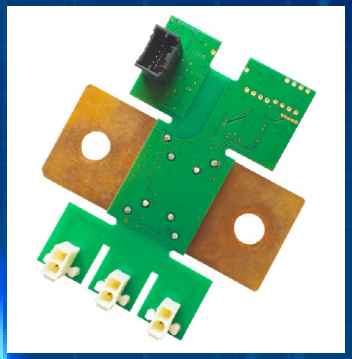

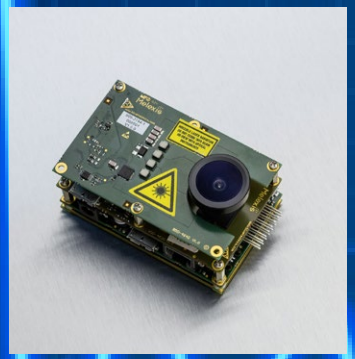

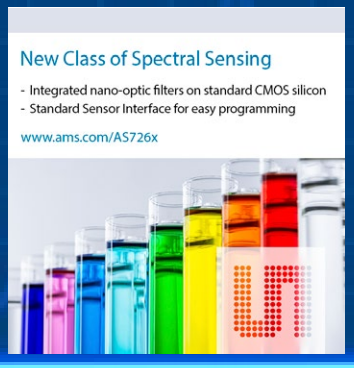
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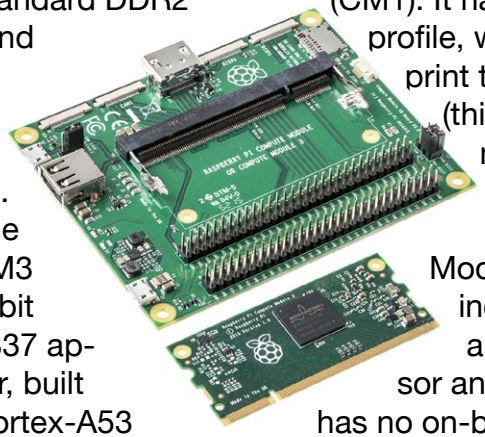
Raspberry Pi 3, now in Compute Module format

Targeting embedded systems designers developing industrial applications, the Raspberry Pi organisation has taken the core compute elements of the 3rd generation Pi (with quad-core processing power), and put that into the SO-DIMM card footprint pioneered by the original Compute Module.

Distributor RS Components (RS) and Allied Electronics, (Electrocomponents) are building the Raspberry Pi Compute Module 3 (CM3) based based on the Raspberry Pi 3 architecture. Designed for professional engineers to develop embedded systems, the Raspberry Pi 3 Compute Module (CM3) fits into a standard DDR2 SODIMM socket and provides the same basic processing capabilities as the Raspberry Pi 3. In common with the Raspberry Pi 3, CM3 incorporates a 64-bit Broadcom BCM2837 application processor, built around an ARM Cortex-A53 quad-core processor running at up to 1.2 GHz, and 1 GB of LP-DDR2 RAM. It provides 4 GB of on-board eMMC Flash storage, and retains an identical pin-out to the original Compute Module (CM1). It has almost the same profile, with an identical footprint that is 1 mm deeper (thicker) than the original CM.



The low-cost Raspberry Pi 3 Compute Module Lite (CM3L) includes the BCM2837 application processor and 1 GB RAM, but has no on-board Flash storage. Developers can provide an eMMC device or SD card socket on their application-specific base board. The Lite version trims $5 from the $30 cost of the CM3.

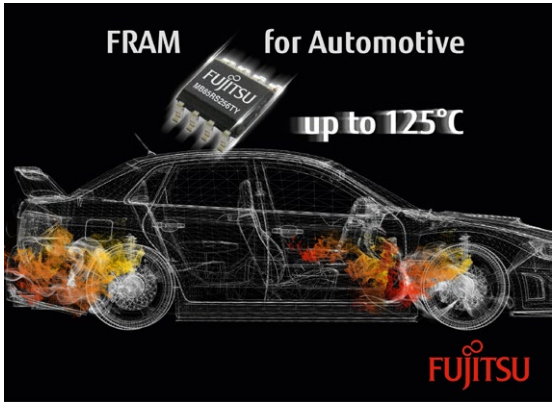
The Raspberry Pi 3 Compute Module can also be obtained as part of a development kit, bundled together with the Compute Module IO Board. This simple, open-source, development board brings out all of the IO connectivity of CM1, CM3 or CM3L to pin headers and flexi connectors, and allows the developer to program on-board eMMC Flash over USB. It serves as a prototyping platform, and as a starting point for the development of application-specific base boards. PCB layout design files for the baseboard routing (for example for the Allegro package) are available.

Complete article, here

FRAM for automotive applications, over extended temperature

Fujitsu Electronics Europe (FEEU) (Langen, Germany) has added an FRAM device, MB85RS256TY, that is the first component in a product group which is designed for an operating temperature of up to 125°C and is qualified according to the AEC Q100 automotive industry standard. This FRAM (ferroelectric RAM) serves as non-volatile memory, providing high-speed random access and with high write endurance. FRAM reduces system complexity and increases data integrity by allowing instant and continuous data storage in applications such as air bag data storage, event data recorders (EDR), battery management systems (BMS), automatic driving assistance systems (ADAS) or navigation and infotainment systems.

The memory is a 256 kbit FRAM



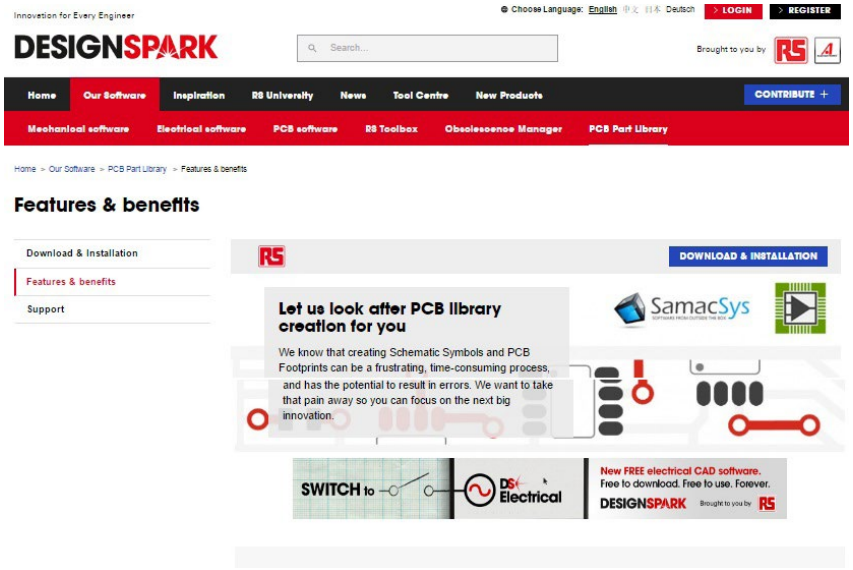
with SPI interface and an extended operating voltage range of 1.8 to 3.6V. The operating temperature of this device spans -40°C to +125°C. MB85RS256TY offers a write endurance of 10^{13} (cycles) and is housed in a standard SOP-8 package.

Complete article, here

SamacSys PCB CAD symbol libraries, free from RS

Distributor RS Components is adding to its free and low-cost design tool support (DesignSpark) with an offering of a PCB Part Library that, the company says, delivers a 'breakthrough' for sourcing and managing schematic symbols and footprints for all PCB components.

RS has extended its relationship with SamacSys (Wallingford, UK), supplier of high-quality PCB schematic symbols and footprints. RS is now offering direct access to schematic symbols and footprints from SamacSys, for all PCB components, via its new PCB Part Library service. Access to the parts library is free of charge; PCB Part Libraries are currently available for Altium, Mentor Graphics, Cadence, Zuken, Pulsonix, Target 3001, Eagle and RS' own DesignSpark PCB. The part models can be downloaded directly from RS webpages under the Technical Reference section. Once selected, the PCB schematics and footprints are immediately available for use and placement by the user, in the desired file format for their particular design tool.



If the part you are using is not in the library, you can create a model for it, either by selecting a suitable outline and entering information such as pin allocation – such "DIY" entries are automatically checked for completeness and compliance – or by submitting a request for it to be added to the library.

RS adds that studies have shown that up to 50% of an electronics design engineer's time can be spent on sourcing and managing data for component models used within design software tools. High-quality component models can relieve electronics engineers and PCB designers from the time-consuming and potentially error-prone task of manually curating their part libraries.

Complete article, here

Dialog/Energous tie-up yields WattUp silicon for remote charging

Dialog Semiconductor, in partnership with Energous Corporation, the developer of WattUp, a wire-free charging technology that provides over-the-air power at a distance, has announced the DA4100 RF-transmit IC, designed to simplify the implementation of WattUp wireless power transmitter systems making them smaller and more cost-effective.

The DA4100 WattUp IC is the first chip to be made available following the announcement of Dialog Semiconductor's strategic partnership and investment in Energous Corporation in November 2016. The investment and partnership saw Dialog become the exclusive component supplier of WattUp ICs and allows Energous to exploit Dialog's sales and distribution channels to accelerate market adoption. Energous' technology uses RF energy to supply charging current, by localising the position of the receiver and shaping the transmitted radiation pattern to maximise energy in that direction. Energous describes using the technology at two scales; up to 5m to span a room, or a shorter-range system to operate over a desktop or bench.

The WattUp wireless power RF-transmit IC integrates the ARM Cortex-M0+, RF transmitter and power management functionality into a single 7 x 7 mm IC. It also features on-chip DC-DC conversion and software, providing seamless integration to Dialog's SmartBond family of highly integrated, low power BLE (Bluetooth Low Energy) SoCs. The IC minimizes required board space, enabling ultra-small charging transmitters and simplifying WattUp's wireless power transmitter system implementation. Evaluation kits of the DA4100 WattUp wireless power RF-transmit IC are sampling now.

Complete article, here

Digi-Key blends product and guidance on website for makers

Distributor Digi-Key is currently ramping-up the international presence of its linked website for the maker community. Already live at www.maker.io Digi-Key aims to have it fully supported across Europe by the second quarter of 2107.

With this move, says Mark Larson, now Digi-Key's Vice Chairman, the distributor is aiming to provide a service and an environment tailored to the needs, and to the design starting points, of the maker movement. However, the intent is also to avoid "fragmentation" of the Digi-Key brand; in effect the maker.io site acts as a portal or entry point in which the search functions are targeted for the maker mindset. There continues to be access to the full catalogue of parts stocked by the distributor, and fulfilment is then carried out by Digi-Key's main site.

Larson says that the overall theme continues to be "prototype to production" but that maker.io is constructed to present a more natural starting point to the alternative design approach, and the mantra is modified to "maker to market". The site is organised to mirror the progress of a project that might originate in that model. It presents both products and services, along with design support – including free or very low cost tools – and project examples, in a series of stages; concept & research, evaluation & design, prototyping & funding, marketing & production, through to distribution and support. The site aims to give guidance and assistance on all the aspects of taking a concept to market that might not be available to someone not formally employed by a company "in the business". There are, for example, articles on marketing, on migration to production, and on crowdfunding.

Complete article, here

6 GHz lab scope with communications & power functions

Rohde & Schwarz has added a 6 GHz model to its R&S RTO2000 series, opening up measurements on fast communications interfaces and IoT applications, as well as demanding measurement tasks such as power integrity measurements. This 6 GHz bandwidth model allows developers to test the radio interfaces of 802.11ac WLAN components for IoT modules in the 5 GHz band as well as fast communications interfaces such as USB 3.1 Gen 1 with data rates of 5 Gbit/sec. Synchronized time, frequency, protocol and logic analyses results allow users to debug at the system level.

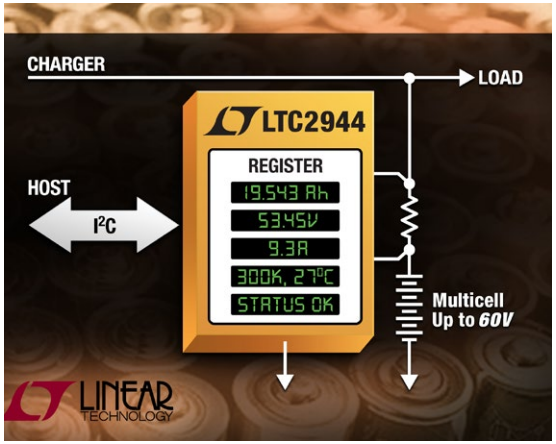
R&S positions the unit as offering the best oscilloscope performance in its class, even at 6 GHz bandwidth. Up to 16-bit vertical resolution in high definition mode enables developers to detect the smallest of signal details. It is, R&S claims, the only oscilloscope to offer one million waveforms per second, allowing fast identification of sporadic signal faults. The integrated spectrum analysis and spectrogram display make it possible to observe the signal path in the frequency domain as well as over time.

Rohde & Schwarz has also introduced the RT-ZPR20, a very low-noise power rail probe with a bandwidth of 2 GHz. Its 1:1 attenuation also ensures very good sensitivity. The large offset range of ±60V permits analysis of the smallest disturbance signals during power integrity measurements, even on DC power supplies with a high voltage level. The probe also features an integrated high-precision DC voltmeter: more here.

Complete article, here

60V I²C battery monitor measures state-of-charge parameters to 1%

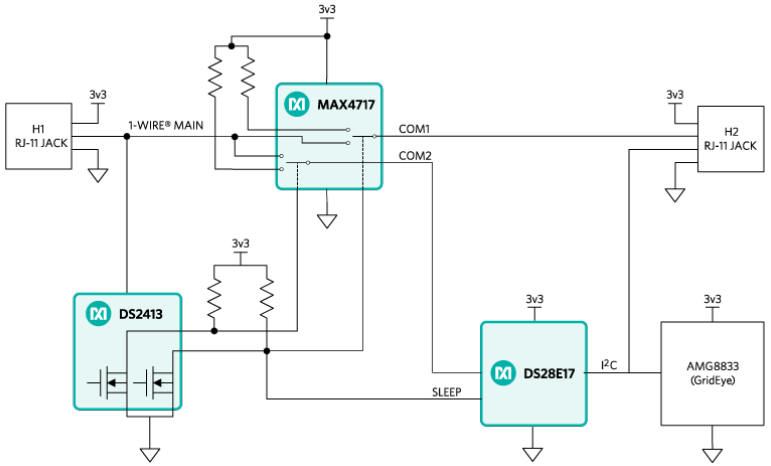
LTC2944 is a multicell battery monitor which makes direct measurements of 3.6V to 60V battery stacks. No level shifting circuitry on the supply and measurement pins is required to interface with multicell voltages, so total current consumption is minimized and measurement accuracy is preserved. The LTC2944 is a true high voltage battery monitor that measures charge, voltage, current and temperature to 1% accuracy, the essential parameters required to accurately assess battery state of charge (SoC). Linear Technology suggests applications in electric vehicles, ebikes/motorcycles/scooters, wheelchairs, golf carts and battery backup systems.



Battery current is measured by monitoring the voltage across an external, high side sense resistor and integrating this information to infer charge. A bidirectional analogue integrator accommodates either current polarity (battery charge or discharge), and a programmable prescaler supports a wide range of battery capacities. Charge, voltage, current and temperature information are communicated to the host system over an I²C/SMBus-compatible 2-wire interface that is also used to configure the battery monitor.

Complete article, here

Reference design: 1-wire-bus connectivity of IR people-sensing over 100m



Maxim Integrated has posted details of a reference design (with fully-built hardware available) that enables presence sensing, people counting, and gesture detection while tethered up to 100m along a 1-Wire bus. MAXREFDES131# is a sensing solution featuring the Panasonic AMG8833 Grid-EYE and the Maxim 1-Wire bus, enabled by the DS28E17. Panasonic's Grid-EYE is an 8x8 (64) pixel infrared array sensor with digital output (I²C) for thermal presence, direction, and temperature values. Its built-in lens includes a 60 degree viewing angle. Grid-EYE features compact SMD design using MEMS thermopile technology. Panasonic's product page for the device is here.

Applications for this sensor can include: digital signage, security, lighting control, kiosk / ATM, medical imaging, automatic doors, thermal mapping, people counting, robotics, and others.

Complete article, here

Keysight acquires Ixia for networking software IP

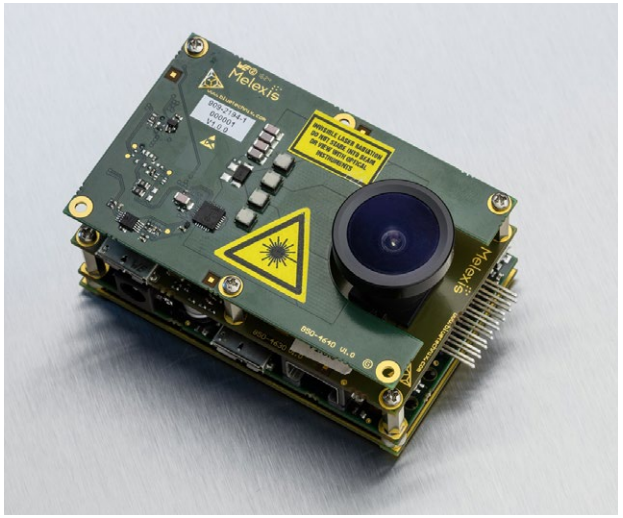
Keysight Technologies has announced that it is to acquire Ixia in an all-cash transaction valued at $1.6 billion. Ixia has a broad IP portfolio that encompasses network communications, visibility, application and security technologies with solutions deeply rooted in software. Ixia's IP includes extensive networking and wireless protocols that will extend Keysight's position in wireless communications and create a unique combination of Layer 1 through 7 end-to-end solutions that address fast-growing segments of the 5G communications design and test ecosystem, with solutions for assessing performance from the mobile device to the data centre and the cloud.

Keysight views the two companies as highly complementary, "[and will] create an innovative force in leading-edge technologies that spans electronic design, device and network validation, and application and security performance."

Complete article, here

Time-of-flight sensing builds 3D images in difficult environments

Melexis (Tessenderlo, Belgium) has added a chipset and its evaluation kit for time-of-flight (ToF) 3D vision solutions for the most challenging environments. The ToF sensor solution claims advanced sunlight robustness and extended temperature range, enabling fast design of compact and robust 3D ToF cameras. The chipset supports QVGA (320 x 240 pixel) resolution and offers sunlight robustness with up to -40°C to +105°C temperature range operation. The Melexis chipset brings together the company's MLX75023 1/3-inch optical format ToF sensor and the MLX75123, a companion IC that controls the sensor and illumination unit and delivers data to a host processor. Together the devices can minimize the component count and reduce the size of 3D ToF cameras. Designed for maximum flexibility, the modular EVK75123 QVGA evaluation kit combines a sensor board featuring the chipset, an illumination module, an interface board and a processor module.

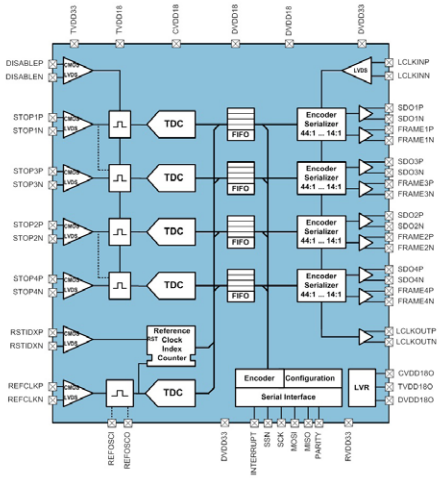


The MLX75023 sensor has a high level of background light rejection capabilities of up to 120 klux. This IC can provide raw data output in less than 1.5 msec, aiding its capacity to track rapid movement. The MLX75123 control chip has 12-bit parallel camera interface and I²C connectivity and four integrated high-speed ADCs. Integrated functions include diagnostics and support for region-of-interest, configurable timing, image flipping, statistics and switching modulation frequencies. Consisting of four vertically stacked PCBs - sensor board, illumination board, interface board and processor board - the EVK75123 evaluation kit has an 80 x 50 x 35 mm form factor and features an NXP i.MX6 multi-core processor. Its illumination unit has four VCSELs, with a choice of either 60° field-of-view (FoV) or a wider 110° option for acquiring imaging data from a broader area.

Complete article, here

Time-to-digital converter resolves 10 psec for accurate laser ranging

From ams (Premstaetten, Austria) the TDC-GPX2 measures time intervals at a resolution of up to 10 psec for ultra-accurate time-of-flight measurements in laser ranging and medical scanning applications, claiming the best-available combination of speed, precision and power. This IC is an update of ams' time-to-digital converter (TDC) offering improved speed and precision together with low power consumption. The TDC-GPX2 also features standard low-voltage differential signalling (LVDS) and serial peripheral (SPI) interfaces, and a smaller 9 x 9 mm QFN64 package. TDCs, which can measure short time intervals with great precision, are used

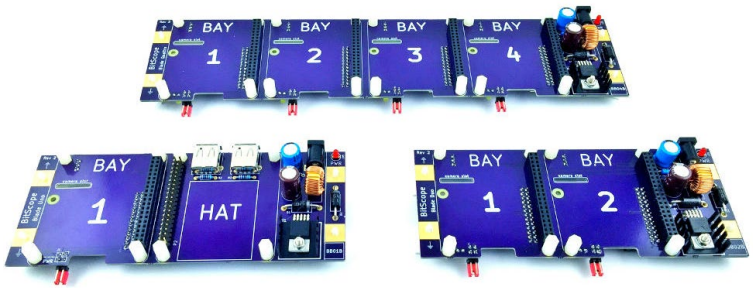


in light detection and ranging (LIDAR) and laser-ranging devices, in positron emission tomography (PET) medical scanners, and in automated test equipment (ATE). The introduction of the TDC-GPX2 means that these applications gain increased resolution up to 10 psec and a sampling rate of up to 70 Msamples/sec. The TDC-GPX2 is an integrated four-channel converter IC offering single-measurement resolution of up to 20 psec rms per channel in normal mode. Operating in dual-channel high-resolution mode, it can achieve a maximum resolution of 10 psec rms with 5 nsec pulse-to-pulse spacing.

Complete article, here

1, 2, 4; carrier board mounts & powers Raspberry Pi clusters

Distributor element14 is sourcing the BitScope Blade range, offering the ability to conveniently power and mount multiple Raspberry Pi computer boards. BitScope Blades are designed for building scalable computing solutions ranging from stand-alone servers, routers and workstations up to full compute clusters, private clouds, networked physical computing and Industrial IoT systems. Every Blade can be used with a range of power supply options and offer full access to Raspberry Pi I/O for displays, cameras, keyboards, expansion boards and peripherals including BitScopes, Raspberry Pi HATs and the Raspberry Pi 7 in. Touchscreen Display.

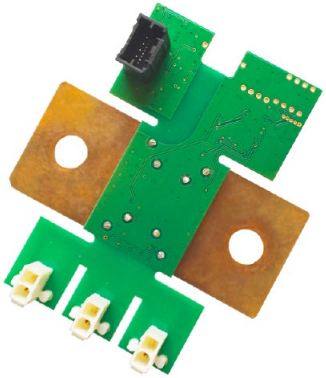


- BitScope Blade Uno mounts one Raspberry Pi computer and optional HAT and is typically used as a computing platform for makers, students and engineers.
- BitScope Blade Duo is a desktop, rack or wall mountable power and mounting solution for a pair of Raspberry Pi computers, for – for example – building a reliable stand-alone desktop & server system with the Raspberry Pi.
- BitScope Blade Quattro is a desktop, rack or wall mountable power and mounting solution for four Raspberry Pi computers, for creating compute clusters, private clouds or build farms with the Raspberry Pi.

Complete article, here

Module offers 1%-accurate I/V measurements in EVs & energy storage

Sendyne's automotive-grade current and voltage sensor module communicates via CAN2.0B, and has been designed for battery monitoring in high voltage systems such as electric vehicles and energy storage systems (ESS). For high voltage systems where there is a need to constantly measure current and voltage to monitor the state of health (SOH) and state of charge (SOC) in batteries, Sendyne says that, "There are many Hall effect based products but because of our patented method, we are able to inexpensively measure currents with a ±1.0% accuracy without any problems associated with Hall effect sensors."



Sendyne's SFP200 current and voltage measurement module is presented as the first turnkey module capable of precisely measuring currents from mA to kA, while simultaneously measuring three high-voltage potentials (800V nominal, 1000V/channel max) accurately. Designed for electric vehicles (EVs) and Energy Storage Systems (ESS), this automotive grade member of Sendyne's SFP family communicates via an isolated CAN 2.0B interface at up to 500 kbit/sec.

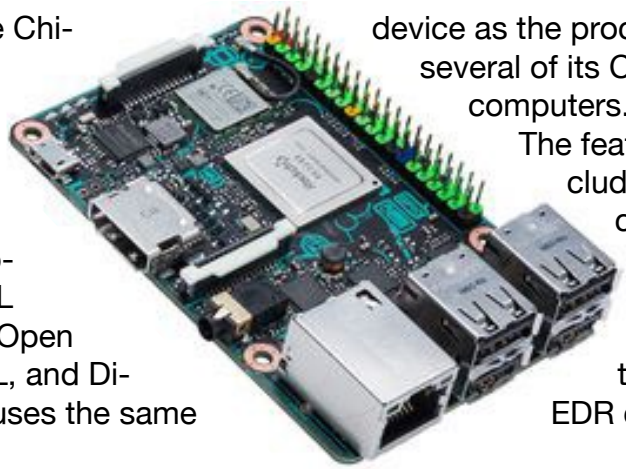
The module incorporates Sendyne's SFP200 IC and the company's 18 µΩ shunt. It measures current with an accuracy of better than ±1.0% (typically ±0.5%) over the entire operating temperature range of –40 °C to +125 °C. For state-of-charge (SOC) estimation, the SFP200MOD provides separate charge, discharge and total Coulomb output. The module can be powered from a wide voltage supply rail of nominal +5/+9/+12/+24/+36/+48V without any modifications or adjustments.

Complete article, here

Asus' Tinker Board enters Raspberry Pi/Creator market space

Distributor Premier Farnell, under its CPC brand, is listing the Asus 90MB0QY1-M0EAY0 'Tinker Board'. This ARM Cortex-based computer-on-a-card features 4K graphics, on-board WiFi and Bluetooth, and Gigabit Ethernet wired connectivity.

Asus builds the board around the Rockchip RK3288, which is a quad-core, ARM Cortex-A17 device from the Chinese fabless IC house. It has on-chip graphics with the ARM Mali-T764 GPU, supporting OpenGL ES1.1/2.0/3.0, Open VG1.1, OpenCL, and DirectX11. Asus uses the same device as the processor in several of its Chromebook computers.



The feature set includes; 2GB Dual channel LPDDR3 memory; Gigabit LAN and Bluetooth 4.0 + EDR connectivity; 4x USB 2.0 ports; 40-pin internal header with 28 GPIO pins; contact points for PWM and S/PDIF signals; CSI port for camera connection & DSI port supporting HD resolution; HDMI 2.0 port to support 4K resolution; supports Debian OS with KODI.

The card measures approximately 85 x 56 mm, and is listed by CPC at £55 or €65.39 (inclusive of VAT).

Complete article, here

HV optically isolated scope probe captures bridge-gate signals

Teledyne LeCroy's HV fibre-optically isolated probe is presented as a route to measuring waveforms such as upper-side gate drive signals, floating control signals, or floating sensor signals. It offers 60 MHz bandwidth, 35kV common-mode isolation and up to 140 dB common-mode rejection ratio (CMRR).

The HVFO probe extends Teledyne LeCroy's capabilities in the area of power electronics measurements; optimized for small-signal floating measurements on a HV bus in power electronics designs, it offers optical isolation between the probe tip and the oscilloscope input to reduce adverse loading of the device under test (DUT); and also reduces noise, distortion, ringing, overshoots, and transients on the measured signal. It surpasses the measurement capabilities and signal fidelity of both conventional HV differential probes and acquisition systems that rely on galvanic

channel-to-channel and channel-to-ground high voltage isolation. It also avoids reliance on dangerous test setups that require floating the oscilloscope and probe.

To avoid the need for a separate power connection to the probe head while HV measurements are in progress, LeCroy has made the HVFO battery powered; up to 6 hours are available on a charge, and a single micro-USB alternately provides charging and signal connection, to eliminate the possibility of an electrical connection being made when isolated measurements are in progress.

The HVFO architecture is, LeCroy says, simple, with a single laser and fibre optic cable providing optical isolation and modulated signal + data communication. Multiple tips achieve different operating voltage ranges, from ±1 to ±40V. The HVFO is small, to fit in tight spaces, with what LeCroy terms "just enough performance for real-world needs".

Complete article, here

Mentor Graphics expands ISO 26262 qualification programme

Building on its portfolio of electrical and electronic design automation solutions for automotive markets, Mentor Graphics' latest introduction is Mentor Safe – claimed as one of the broadest and most comprehensive ISO 26262 qualification programmes available for the functional safety space. The programme includes the Nucleus SafetyCert real time operating system, the Volcano VSTAR AUTOSAR operating system and BSW stack, and a growing array of ISO 26262 certified documentation and qualification reports for Mentor tools supporting design and verification of system-on-chip (SoC), system, mechanical and thermal applications.

The Mentor Safe programme enables users to integrate Mentor tools and software into their safety-critical designs and verification flows at all criticality levels up to and including ASIL D.

The latest design automation products certified under the Mentor Safe programme are from the company's portfolio of Tessent silicon test and yield analysis tools. Independent compliance firm SGS-TUV Saar recently certified the Software Tool Qualification Reports for nine Tessent solutions for any tool confidence level (TCL).

Complete article, here

Digital multispectral sensor applies wafer-level filter technology

From ams (Premstaetten, Austria), the AS7262 and AS7263 are six-channel digital multispectral sensor ICs presented with the concept of "bring the lab to the sample" to enable new design approaches in consumer and industrial spectral analysis applications. These cost-effective multispectral sensors-on-chip will, ams says, lead to a new generation of spectral analyzers for consumer and industrial applications.

In a 4.5 x 4.4 mm land grid array package, the ultra-low power AS7262 visible range sensor and AS7263 NIR sensor each provide six calibrated spectral channels. At $4 each (1000), the sensors are aimed at material and product authentication, product quality and integrity as well as material content analysis in the near-infrared (NIR) and visible spectra.

The AS7262 six-channel visible light sensor with integrated intelligence provides a calibrated digital output over an I²C or UART interface. It measures light intensity at six wavelengths in the visible light spectrum: 450 nm, 500 nm, 550 nm, 570 nm, 600 nm and 650 nm. The AS7263 operates in the NIR spectrum detecting 610 nm, 680 nm, 730 nm, 760 nm, 810 nm and 860nm infrared signatures. Both devices include an electronic shutter with LED drive circuitry, which means that device designers can accurately control the light source and the spectral sensing functions with a single chip.

Complete article, here

10mΩ, 900V silicon carbide MOSFET for EV drives

Wolfspeed, (part of Cree and in the process of being acquired by Infineon) has introduced a silicon carbide (SiC) MOSFET rated for 196A, with a 900V rating and with 10 mΩ on-resistance; the current rating is of continuous drain current at a case temperature of 25°C.
The MOSFET is initially available in bare die form as part number CPM3-0900-0010A, and is currently available for purchase from SemiDice. Wolfspeed expects to release the associated discrete device in a 4L-TO247 package (C3M0010090K) early in 2017.
This package has a Kelvin-source connection that allows engineers to create designs that maximize the benefits of SiC's superior speed and efficiency.

Commercially qualified and rated for a maximum operating temperature of 175°C, Wolfspeed's new chip offers high-reliability in harsh environments, like those found in vehicle drive-trains. Wolfspeed adds that it recently supplied Ford Motor Company – in a collaboration with the U.S. DoE –with a full-SiC, 400A power module designed around the 900V, 10mΩ chip. The module, designed and produced by Wolfspeed, contains four MOSFETs connected in parallel to achieved an effective on-resistance (Rds(on)) of 2.5 mΩ. Wolfspeed engineers have since demonstrated the capability to use these chips to create an 800A, 1.25 mΩ module.

Complete article, here

SECURING THE SMART FACTORY OF THE FUTURE

by Mark Pitchford, Lynx Software Technologies

History is dotted with examples of cyber-attacks on industrial infrastructure. Right now, these are quite few and far between, but assuming that they will remain isolated incidents seems a very dangerous path to follow.

Some cyber-attacks are apparently without motive; perhaps just for mischief-making, or maybe a demonstration of capability to establish the future credibility of a ransomware blackmailer.

One such example took place in November 2011, when hackers stole passwords and then used them to access a SCADA (Supervisory Control And Data Acquisition) system belonging to a Water Utility [Reference 1]. It is thought that they destroyed a pump used to pipe water to thousands of homes in a US city in Illinois by turning it on and off quickly.

In late 2014, a German steel mill was the target of a similar cyber-attack when hackers successfully took control of a SCADA software system and caused significant material damage to the site [Ref. 2]. The attackers first hacked into the office software network of the industrial site, and used that to penetrate the production management software of the steel mill. From there they took over most of the plant's control systems and then methodically destroyed human machine interaction components. They succeeded in preventing a blast furnace from initiating its security settings in time and caused serious damage to the infrastructure.

Elsewhere, cyber-attacks sometimes seem more politically motivated. On 23rd December 2015, attackers remotely accessed Ukrainian SCADA systems to cut power to 17 substations, and to deny access to company telephone lines to delay power reinstatement [Ref. 3]. Several months before the power was shut off, attackers had begun sending phishing emails to Ukraine's power utility companies' offices. When opened, these emails installed malware. Firewalls were designed to separate the affected computers from the power control systems, but the malware - known as BlackEnergy 3 - allowed the hackers to gather passwords and logins, with which they were able to mount an attack on the SCADA system itself.

A few years earlier in 2010, the well-documented Stuxnet attack was a sophisticated malware example that was aimed at a very specific and well-protected target, the Natanz Uranium Enrichment plant in Iran [Ref. 4]. Not only did the attack reach its target, but it caused significant damage to the plant, and has been termed 'the first digital weapon' by the media.

Four examples of cyber-attacks on safety critical infrastructure in four distinct industrial sectors. Despite their disparate nature, the existence of an access route from the internet to a safety-critical domain is clearly common to each and every one of them.

Interoperability with safety and security

Engineering organisations are not short of guidance when it comes to designing, developing and deploying an industrial internet that is interoperable, safe and secure. In particular, the Industrial Internet Consortium (IIC) and the Working Group for Industrie 4.0 have generated guidelines and recommendations in the form of the Industrial Internet Reference Architecture (IIRA) and the Reference Architectural Model for Industrie 4.0 (RAMI 4.0) respectively. It is naturally true that given the similarity of the remits for each of these documents, there are similarities and overlaps between the two frameworks, as is reflected in the live and current discus-

sions on co-operation between the two organisations.

Both communities acknowledge that strong security is an essential requirement for the Industrial IoT. Indeed, the IIC has recently introduced the Industrial Internet Security Framework (IISF) [Ref. 5] to provide guidance in this regard, and as the two communities work together to achieve alignment in a number of areas, security has been identified as a key issue.

The security challenge can be visualised by reference to an imaginary generic plant, with many demands on its systems infrastructure. Sensors provide operations owners the ability to collate data such as location, position, speed, temperature, pressure, lock status and vibration, about all their assets in near real-time. At a higher security level still, process plant settings or even firmware can be updated remotely, perhaps in response to this data, or to changing production demands. And production figures and profitability provide security headaches of a different, commercial kind; sensitive information divorced from the sensors' engineering data.

Figure 1 shows how RAMI 4.0 abstracts such considerations into a three dimensional matrix, consisting of Layers, a Life Cycle and Value Stream, and Hierarchy Levels.

This is a strikingly similar representation to the "Functional Domains" and "Viewpoints" preferred by the IIC IIRA model (Figure 2).

To understand how best to provide a secure foundation for either of the schemes, it is useful to reflect that both of these abstractions represent the coming together of the two, traditionally distinct worlds of Information Technology (IT) and Operational Technology (OT).

The author continues by exploring how the security that was inherent when these two domains were unconnected can be reproduced in the new world – click for full-article pdf.

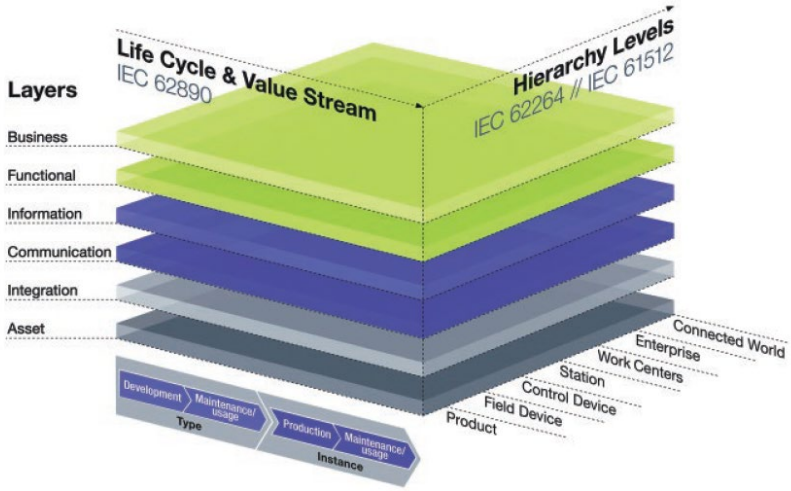


Figure 1. *Reference architecture model for Industrie 4.0 (RAMI 4.0) [Source; Umsetzungsstrategie Industrie 4.0 – Ergebnisbericht, Berlin, April 2015]*

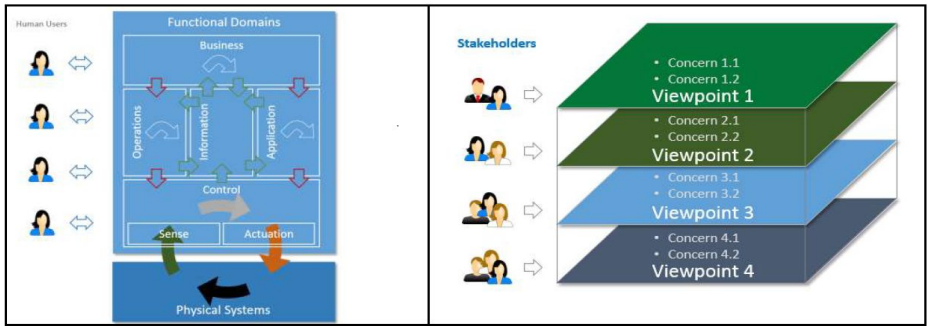


Figure 2. *Representation of IIC Functional Domains and Viewpoints [Source; Industrial Internet consortium – Industrial Internet Reference Architecture version 1.7. 4th June, 2015.]*

ADC CLOCK POLARITY VS. START-UP TIME

BY DOUG ITO, ANALOG DEVICES

High speed analogue-to-digital converters (ADCs) are by definition devices that sample an analogue signal and, as such, must have sample clock inputs. Some system designers that utilize ADCs have observed a slower than expected startup from the time the sample clock is initially applied.

Surprisingly, the cause of this delay has often been the wrong start-up polarity of the externally applied ADC sample clock. Many high speed ADCs have sample clock inputs that have the following characteristics:

- Differential
- Internally biased to a set input common-mode voltage (VCM)
- Designed for ac coupling to the clock source

This discussion applies to converters having clock buffers that have these properties.

Differential ADC clock input buffers often have a designed-in toggle threshold offset. If there were no such offset, the toggle threshold would occur at 0V differential. In the case where a clock buffer with no offset were undriven and ac-coupled, the clock inputs (CLK+ and CLK-) would each be pulled internally to the common-mode voltage. In this case the DC voltage on CLK+ and the voltage on CLK- would be the same, which means that the differential voltage equals 0V.

In an ideal world with no signal on the inputs, the clock buffer would not toggle. In reality there is always at least some noise in electronic systems. In this hypothetical case where the input toggle threshold is 0V, any noise on the inputs will cross the toggle threshold of the clock buffer and cause inadvertent toggling.

When sufficient input toggle threshold offset is designed into the clock buffer, the same conditions will not cause toggling. As such, designing in an offset to the toggle threshold voltage of ac-coupled differential clock buffers

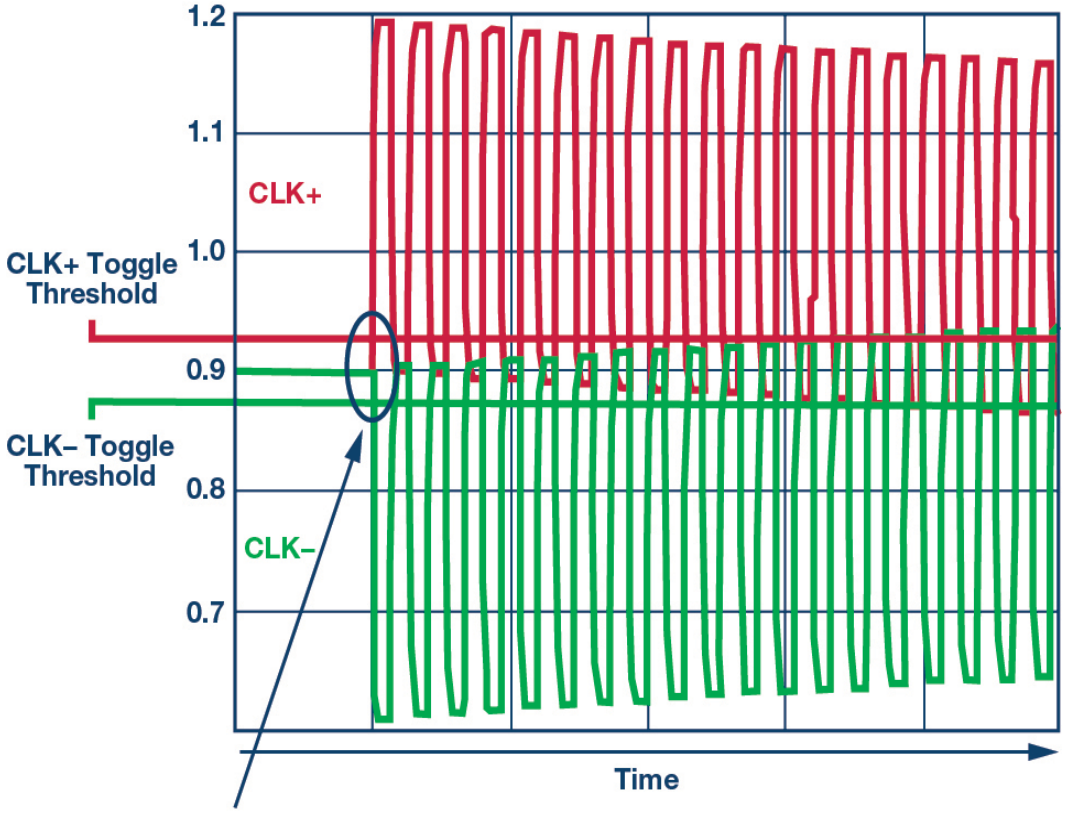


Figure 1. *Startup with CLK+ swinging positive on the first edge and CLK- swinging negative.*

is beneficial and for this reason, clock buffers often include a toggle threshold offset.

With no clock applied, CLK+ and CLK- will each be pulled to the same VCM by the internal biasing circuit in the clock buffer. When the clock is initially applied, the clock edges on CLK+ and CLK- will swing positively and negatively, or negatively and positively away from the previously established VCM. In Figure 1, VCM = 0.9V.

Figure 1 shows the clock being applied after it has been inactive (either when first bringing up the system, or after the clock driver has been inactive for a period of time). In this case, CLK+ swings positive on the first edge and CLK- swings negative. With a positive offset added to the input toggle threshold, this clock signal will toggle the clock buffer on its first edge, as shown in Figure 1. The clock input buffer will produce a clock right away.

If by chance the clock was started with the opposite polarity, CLK- swings positive on the first edge and CLK+ swings negative. With the same positive offset added to the input toggle threshold, this clock signal will not toggle the clock buffer on its first edge, and subsequent edges, until the waveform is pulled toward steady state, and crosses the toggle threshold over time, as shown in Figure 2.

As can be seen, the polarity of the initial start-up clock makes a difference in toggling a clock buffer with input threshold offset. In one case (CLK+ initially rising in this example) the clock buffer will ideally start toggling immediately when the clock is first applied. With the opposite polarity (CLK+ initially falling in this example), the clock buffer will not start toggling immediately when the clock is first applied.

If you are seeing an unexpected delay in ADC startup, try reversing the clock start-up polarity. This could make a difference in your start-up time.

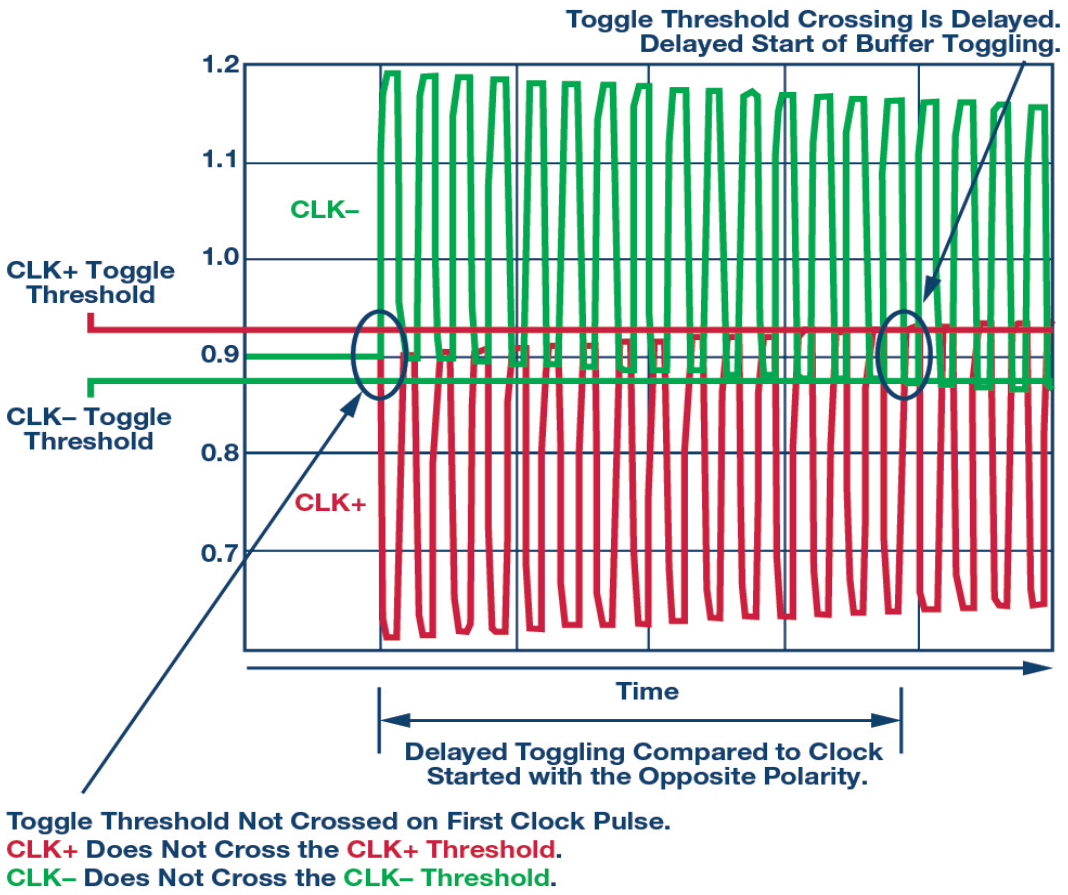


Figure 2. *Startup with CLK+ swinging negative on the first edge and CLK- swinging positive.*

Doug Ito *(Douglas.Ito@analog.com) is an applications engineer for the High Speed ADC team at Analog Devices, Inc., San Diego, California. He earned a bachelor's degree in electrical engineering from San Diego State University. Doug is a member of ADI's EngineerZone High Speed ADC Support Community.*

AN ECOSYSTEM FOR FUTURE EMBEDDED VISION SYSTEM DESIGNS

by Aaron Behman & Dan Isaacs, Xilinx

Systems with unprecedented levels of software-based intelligence, optimized hardware and any-to-any connectivity are shaping the future of embedded vision and the Industrial Internet of Things (IIoT). This article describes how Xilinx decided to respond to the trends in that sector, employing its all-programmable technology to enable users to develop smarter, connected and highly differentiated systems.

The exciting applications emerging in industrial/ embedded vision and IIoT cut across the industrial, scientific, medical, pro A/V, consumer, aerospace and defence, and automotive market segments. The silicon in question has both field-programmable blocks and fully-diffused processor cores on the same die: hence, all-programmable. The key barrier to using the performance and performance/ watt characteristics of these All Programmable devices has been the programming model.

The aim of the ecosystem expansion is to make all-programmable devices as easy to use as CPUs and GPUs, but with superior performance/watt.

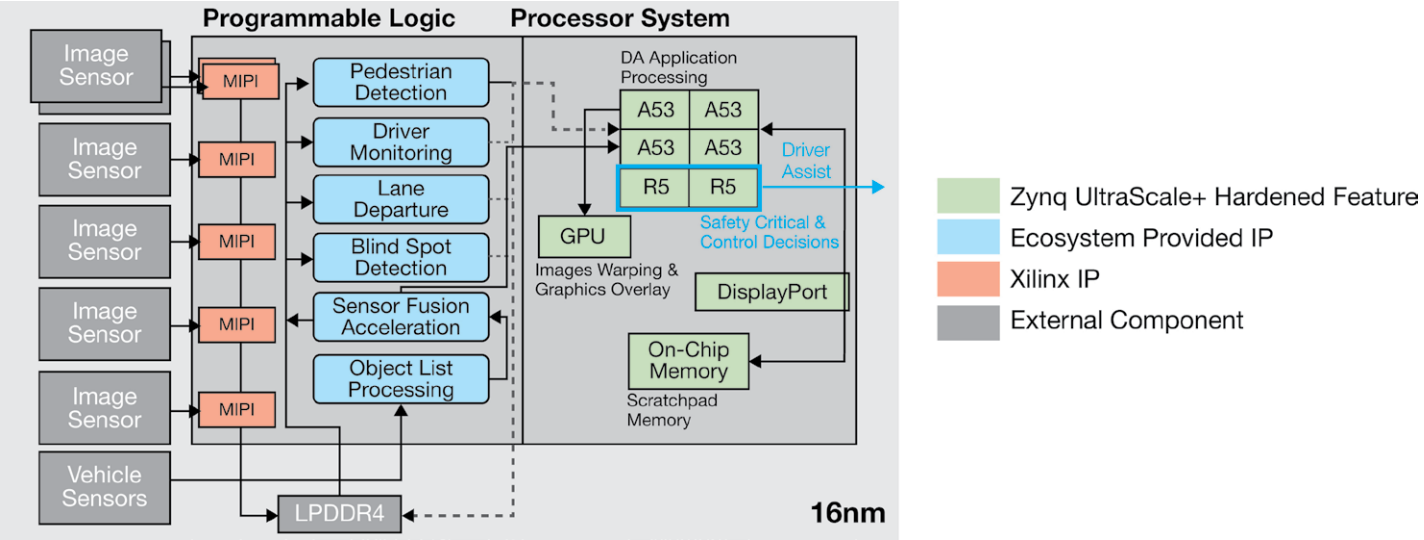


Figure 1. *This ADAS design leverages the heterogeneous processing capabilities of the ARM Cortex cores in the Zynq UltraScale+ MPSoC..*

C/C++ users are more accustomed to writing code for CPUs and, more recently, GPUs. With access to High-Level Synthesis (HLS) tools for software-defined hardware and the SDx environment for software-defined systems development, many more system developers can potentially make use of the software-defined All Programmable devices in the Xilinx Zynq-7000 SoC and Zynq UltraScale+ MPSoC families.

The pipelines for embedded vision and IIoT systems have much in common. Both start with sensing and data acquisition. For embedded vision systems, that data takes the form of a series of images or a video stream. Sensed data for IIoT systems includes video but also encompasses a long list of additional sensed parameters, including acceleration and vibration; acoustic/ultrasonic; chemical and gas; electric/magnetic; flow; force, load, torque and strain; humidity and moisture; leak

and level; machine vision; optical; motion, velocity and displacement; position, presence and proximity; pressure; and temperature.

GROWING NEED FOR SENSOR FUSION

Several embedded vision and IIoT systems require sensor fusion, or the processing and merging of data from multiple and different types of sensors into actionable intelligence. For embedded vision systems, multiple video streams may be combined to produce more usable or more useful video streams. For example, vehicle based vision systems often combine video streams from four, five, six or more video cameras to produce a single bird's-eye view that gives the driver 360° 2D planar or 3D spherical vision. Vision systems drive local displays but also send locally processed video to the cloud for further processing, for combination with other video streams and for storage.

IIoT systems may combine video with additional sensed data to define needed actions. For example, the new CPPS-Gate40 Smart Gateway from System-on-Chip engineering (Erandio, Spain) incorporates a variety of I/O ports commonly used in industrial control systems, combined with local, high-speed data processing, and places the resulting data on a dual-redundant optical Ethernet ring using High Availability Seamless Redundancy/ Parallel Redundancy Protocol (HSR/ PRP). A defining characteristic of IIoT systems is the ability to use sensed data for high-speed, real-time control not possible if relying on cloud-based processing and decision-making.

This article continues by outlining four specific examples of how the ecosystem of partner companies has been a resource to build disparate systems in ADAS, video and industrial automation; click for pdf

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MEETING THE CERTIFICATION CHALLENGE OF EVOLVING STANDARDS IN THE INTERNET OF THINGS

by Josh Mickolio, Digi Key

This article looks at the harmonization of European wireless standards for IoT devices (EN 300 328 V1.9.1) in the 2.4 GHz band, given the context of 2.4 GHz against other cellular bands such as LTE-M and narrowband LTE. The new standard came into force in November 2016 and the article looks at how this impacts of developers of IoT devices.

Standardization can be a challenge for innovation around the world. Waiting for frequency bands to be allocated in different geographies, for technologies to be approved for use and for licences to be allocated can slow down the roll out of new applications. This has certainly been the case with the use of mobile phone technologies for the Internet of Things (IoT). While there is a central standards body, the 3GPP, the development of the latest narrow-band LTE (LTE-NB) technology for IoT has been slow. The prospects of 5G are even more challenging as 4G is combined with WiFi in high speed channels.

In contrast, the unregulated ISM (Industrial, Scientific and Medical) bands provide an easy way for wireless technologies to be used for the IoT. The 2.4 GHz band is particularly popular for wireless links with a wide range of technologies available without the need for global approvals. WiFi, Bluetooth and Zigbee all operate in this band, and that has been causing some challenges. While each has its own standards body – IEEE802.11 for WiFi, IEEE802.15.4 for Zigbee and L4PAN and the Bluetooth Special Interest Group for Bluetooth, there is limited collaboration between the groups.

Market researchers Machina Research predicts the total number of IoT connections will grow from 6 billion in 2015 to 27 billion in 2025, a growth of 16% a year. The vast majority of these connections (71%) are the short range, 2.4 GHz links such as WiFi and Zigbee, highlighting how the frequency band is set to become even more crowded.

The increasing use of cellular technology has not been missed by one of the leading Bluetooth chip designers. Nordic Semiconductor is looking to support the coming 3GPP Release 13 LTE-M and NB-IoT cellular technologies. The nRF91 Series (scheduled for release in 2018) is designed specifically to address the needs of emerging low power cellular IoT applications, including long battery life, low cost deployment and maintenance, scalability for potentially billions of devices, a miniaturized form-factor that can fit almost anywhere, and ubiquitous network coverage.

LTE-M and NB-IoT are aiming to provide low power, secure, reliable, future-proofed, open standard and interoperable cellular connectivity for cost, size, and power-constrained IoT applications. The two technologies are set to drive breadth and growth for the emerging cellular IoT market projected to surpass 1.5 billion connections by 2021. Nordic expects broad coverage for the technologies in the 2018-2019 timeframe, with initial coverage starting in 2017.

Figure 1. *Laird Technologies uses silicon from Nordic Semiconductor for its Bluetooth module*

"The combination of our ultra-low power wireless DNA and unique cellular expertise in Finland puts Nordic in a strong position to drive and fuel the market for low power cellular IoT," said Svenn-Tore Larsen, CEO of Nordic Semiconductor. "For us this roadmap is about taking Nordic Semiconductor as a company to the next level by providing scale for our technology, and on-going organizational and R&D investments."

"We believe that the cellular IoT market is still in its infancy and that the new low power LTE technology variants will drive a massive growth curve in many ways similar to what Bluetooth low energy is doing for short-range wireless," said Thomas Embla Bonnerud, Director of Product Management at Nordic Semiconductor. "Some years down the road this market is going to look very, very different compared to how it looks today. That is what the Nordic Semiconductor nRF91 Series is all about: a new and different solution for a new and different market."

With more cellular devices being used and an explosion in the use of IoT nodes in the ISM band, the European Telecommunications Standards Institute (ETSI) has updated its standards on the use of two GHz band standards. These are mandatory for any manufacturer shipping equipment in Europe and were due to come into force in November 2016. Their aim is to harmonize the activity of devices within the band, which is even more important with new technologies on the horizon and an explosion in the number of wireless IoT nodes operating in the band.

The two new standards are ETSI EN 300 328 v1.9.1 covering the 2.4 GHz band and ETSI EN 300 893 v1.8.1 for the 5 GHz ISM band that is also used by 802.11a. These cover the channel-based spread spectrum (DSSS and FHSS) technology that are used by WiFi, Zigbee and Bluetooth to ensure that the radio links can operate collaboratively in such a crowded radio environment. It doesn't cover the ultrawide band technologies (UWB) that spread the data across many bands.

The European directive that covers the CE mark approval includes the EN 50371 standard of compliance to human exposure to electromagnetic fields, EN 301 489 for electromagnetic compatibility and EN 300 328. Version 1.8.1 did not classify Bluetooth Low energy (BLE) as FHSS, instead listing it as "other type of wideband modulation" under Sec 4.2.1, with the test requirements defined in Sec. 4.3.2. The move to 1.9.1 brings this in line with the other 2.4 GHz technologies.

The new revisions of the standards also cover use of satellite positioning technologies from

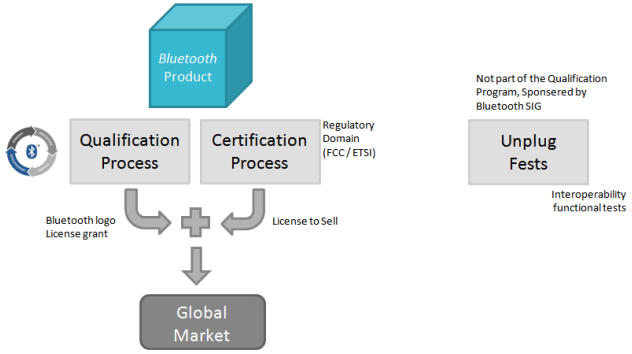


Figure 1. *Texas Instruments' Bluetooth approval process*

GPS to GLONASS and Galileo as more IoT tags are moving around on trucks, pallets or high value products and include geo-positioning information. While these operate at 1.6 GHz, there can be interference effects, and demonstrating the coexistence of all these technologies for the European approvals is a key part of shipping a design.

This article continues by further exploring the revised ETSI standards, and looking forward to product developments that may simplify the engineer's task; click for full pdf

ENERGY CONSUMPTION IN MODERN MICROCONTROLLER SYSTEMS

by Horst Diewald, ProJoule

Is there a strategy that can be applied to both IP-based and standard semiconductor products, that will allow device users to control energy consumption in a manner that is simple and reliable, that will give the user full visibility into operation, and that can maintain safe and secure conditions? Improved results can come with an increased degree of control of operating modes.

No matter what the area of application, a key factor today in achieving market success with an electronic system, is minimising its energy demand. The traditional approach of expressing a component's efficiency in terms of current or steady-state power – microAmperes (µA) or microWatts (µW) per MHz seems to not work any more. Energy storage systems hold neither µA nor µW, they store "Joules", in other words energy. The latest generation of ultra-low-energy efficient MCUs follows a similar power management strategy to that of high performance processors; they use a DC/DC converter in combination with linear regulators.

An interesting question is; can the same power provision methods be used across a wide range of applications without adding to the energy consumption through features in the software? Can the user refine the design from the application level to achieve optimal system energy consumption? Is an energy-profile-optimized application possible and can it be properly maintained, extended and adjusted during development and in the field?

Energy consumption can be aligned to system targets once the application is well defined. There are well-understood methods to achieve the required level of control in a design. This is quite simple assuming only a static environment at room temperature; published MCU datasheets provide data for a wide variety of different situations. MCU vendors provide more than 150 different current parameters for many different scenarios and conditions.

Rapidly-increasing demands for increased memory for program code and data is one of the drivers to the shift to smaller process geometries; this provides lower energy consumption in active modes (RUN modes). However, energy demand for devices that continue to run during sleep modes increases significantly due to unwanted leakage currents; this effect is significant at room temperature and can be severe at higher temperatures.

Early developments of consumer electronics using silicon built in smaller process geometries revealed the impact of the influence of voltage and temperature on the energy budget. Power gating, voltage- and frequency scaling have been developed to cope with these factors. Such techniques have become standard in MCU/SoCs for low-power consumption. But questions remain for the systems designer;

- which methods and guidelines are used by the vendor, and which guidelines are important in my application environment? Do they match?
- which operation modes have the optimum impact on energy consumption?

The first factor is the duration (time spent) in a particular energy mode, considering the contribution of each mode to the total energy consumed – and the dynamic switching conditions:

- Operating mode (1) has a direct influence on energy consumption – functions and code are being executed.
- Sleep mode (2) has its own characteristic level energy consumption – function and code are halted and need an external event to get restarted.

Both modes (1 and 2) contribute to energy consumption – operating mode and sleep mode both contribute to energy use.

- Switching conditions of non on-/off switchable functions

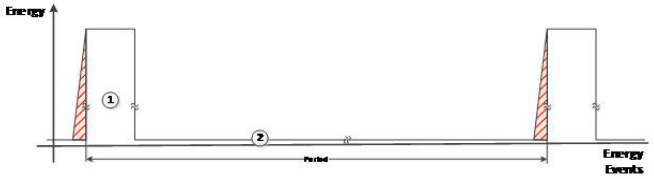


Figure 1. *The EEMBC Energy-Benchmark has two phases.*

In the widely-used EEMBC Energy Benchmark (basic sequence shown in Figure 1) Operating mode (1 – active/run) executes defined code. The users select the operation mode, e.g. Voltage regulation by LDO or DC/DC, operational frequency, etc. They can choose the lowest energy-using mode for their application. The real-time clock function (RTC/RTCC) with a 32 kHz quartz or oscillator is active and represents the second part of energy consumption. The period is one second. The benchmark measures energy consumption rather than current consumption. Future generations of this benchmark will also add a factor to account for switching losses. The operation mode dominates the energy consumption in current MCU/SoCs; for the most part the higher operating current is compensated by shorter execution time. In a period of one second the switching losses don't play a major role. However, this aspect of switching losses – the red hatched areas on the graph in Figure 1 – are assuming ever-greater significance.

Basic power gating

Figure 2 depicts the basic principle of power gating. Turning off parts of the circuitry should reduce leakage current losses. Those unwanted currents discharge capacitances in the circuitry: the higher the temperature, the faster they discharge. These capacitances are of parasitic as well as integrated nature. They restrict voltage drops due to current peaks to a safe level. When power gating is implemented the dynamic energy consumption worsens and the switching conditions further add to unproductive energy loss. In many operating situations power supplies are turned on and off in parallel to power gating. This increases still more the unproductive dynamic and switching losses. Which operation condition has the most positive effect on energy consumption? The second factor that must be considered is the system environment such as energy source, temperature or temperature profile.
The energy source provides regulation to the operating voltage, e.g. by means of a linear regulator or DC/DC converter. In small scale MCUs usually only one regulator is used at a time but in high performance systems (multi-core-SoCs) multiple power supplies operate simultaneously.

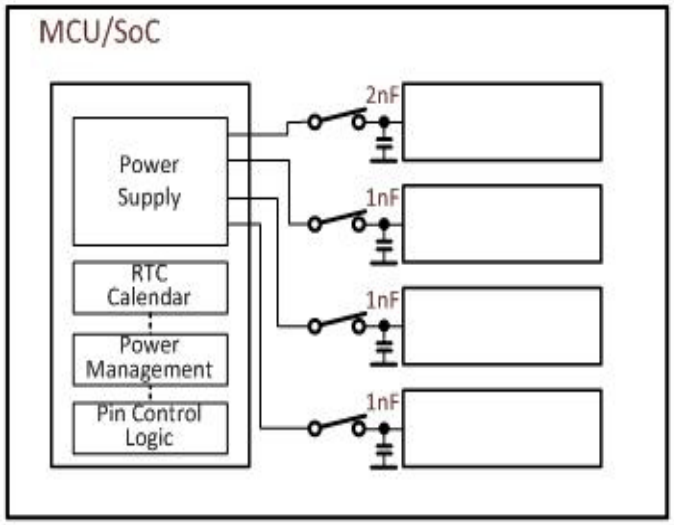


Figure 2. *Basic power gating*

The temperature profile needs to be considered when energy losses, e.g. leakage currents, account for a major part of the energy consumption. This can happen in all three operation modes.

The article continues with a further discussion of the concept of energy saving by careful control of operating modes; click for full pdf.

DUAL PASSIVE MIXER STEPS UP TO 5G MIMO RECEIVER CHALLENGES

By Bill Beckwith, Xudong Wang, & Tom Schiltz, Linear Technology

The global demand for ever-increasing data rates has pushed the limit of the current 4G wireless networks capacity. The next generation 5G networks will need to increase the capacity by more than 10 fold in order to keep up with future demand. Even though the 5G standard has not been finalized, most if not all market participants have concluded that the bandwidth will need to increase to at least 100 MHz (from the current 20 MHz spectrum), and some venturing to suggest as high as 200 MHz. Doing so will push the frequency spectrum (operating band) upward to 3.6 GHz or higher.

This specific need was the driver behind the development of the dual passive down-converting mixer described here. It provides excellent linearity and dynamic range performance at 3.6 GHz, while supporting more than 200 MHz flat signal bandwidth that makes for a robust MIMO (multiple-input multiple-output) receiver. MIMO technology has demonstrated its usefulness by markedly boosting net data rate throughput and reception in systems such as Wi-Fi and 4G networks in times of limited spectrum bandwidth. As 5G systems migrate to higher frequencies, the mixer provides continuous 50Ω matched from 2.3 GHz to 4.5 GHz, supporting multiband receivers at 2.6 GHz and 3.6 GHz bands. For lower bands, other pin-compatible mixers are available that cover all the other LTE receivers (see sidebar). The frequency coverage and typical 3.3V performance of each mixer is shown in Table 1 (see full pdf).

This family of dual high-performance mixers is intended for wireless infrastructure MIMO receivers, such as in a RRH (Remote Radio Head). Such systems are extremely compact and are in self-contained, weather-sealed casing, posing challenges in small size and thermal management from the large content of electronics. The dual channel solution reduces parts count, simplifies routing of LO signals and reduces board area. Additionally, each LTC5593 incorporates integrated RF and LO baluns, double-balanced mixers, LO buffer amplifiers and differential IF amplifiers, further reducing overall solution size, complexity, and cost.

Mixer description

The simplified block diagram in Figure 1 shows

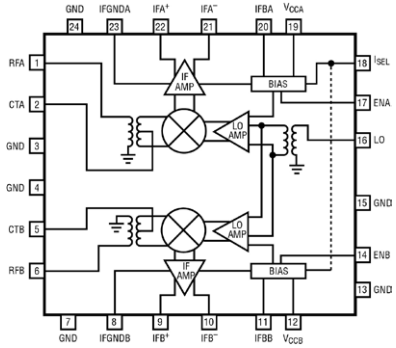


Figure 1. *Block diagram of dual-channel mixer*

the dual-mixer topology, which uses passive double-balanced mixer cores driving IF output amplifiers. The mixer cores are switched-MOSFET quads, which typically have about 7 dB of conversion loss. However, in this case the loss is more than compensated by the gain of the subsequent on-chip IF amplifiers, resulting in overall power gain of about 8 dB. The differential IF output has been optimized for a standard 200Ω interface, which can directly drive differential IF filters and variable gain amplifiers, minimizing external components.

The LO path uses a shared balun to convert the single-ended input to a differential LO, which then drives independent buffer amplifiers for each channel. *Circuit description continues, with receiver applications example – click for article pdf*

BUILDING A SOFTWARE/HARDWARE DEVELOPMENT PLATFORM FOR THE NEW IOT ERA

by Stefan Ingenhaag, Renesas

In today's fast-moving IoT market, should developers be responsible for integrating major components of the base software platform, such as the RTOS, communications stacks, software frameworks, and device drivers, in their MCU-based design? Or should those software components be part of a larger, integrated MCU-based hardware/software package? Should developers grapple with the continuously changing roadmaps of the different software components in the base software platform? Or should those constant integration headaches be handled by the MCU supplier?

When in close contact with the developer audience, one thing becomes clear— accelerating time-to-market is becoming increasingly crucial to product success. In an environment where product lifecycles are now measured in months instead of years, developers who are late to market risk losing significant market share. This thinking lay behind the development of the offering that is now the Renesas Synergy Platform.

Product development requirements have changed. The days when each developer created his or her own solution by mixing and matching an MCU and software components are quickly fading. Today's internet-connected, MCU-based designs have become too complex. This project team looked at the traditional development cycle and asked why developers should devote so much of their development cycle to basic system core code – designing software drivers, middleware, integrating with the RTOS and connecting to the cloud. That effort doesn't offer developers much opportunity to differentiate features in the end-product. Instead, developers should be devoting more of their time to the truly innovative portion of their design – creating application code or adding new features to their product.

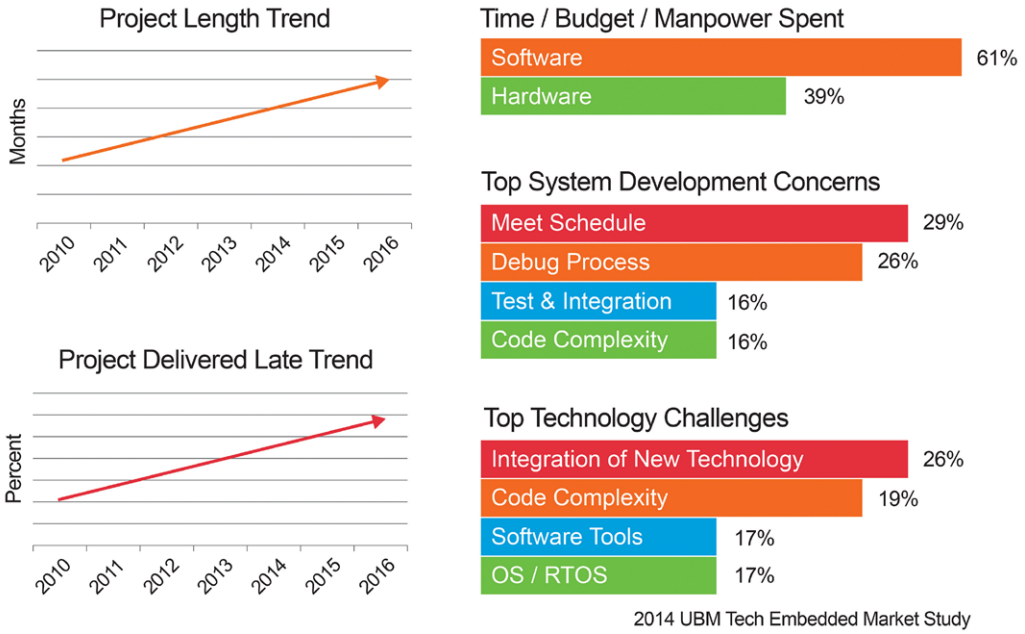


Figure 1. *Increasing complexity of software development in MCU projects is driving up development costs and extending development schedules.*

To minimize cost of ownership and allow developers to more quickly begin developing code for their particular application, the development team decided it would take a radically new approach to product development. The Synergy Platform would treat hardware and software as a unified product. With this platform, Renesas would assume responsibility for the development and integration of the components which are the building blocks of the platform software.

That would allow developers using the platform to spend less time on those basic functions and more time on the implementation of differentiating software features in their product.

In addition to the coding challenges involved when using traditional embedded software, the Renesas team also wanted to reduce or eliminate many of the business barriers that can make working with embedded software difficult. For example, using different software components from different vendors requires sourcing and paying for multiple licenses and maintaining multiple points of contact for technical support. Knowing that wrestling with contracts and trying to get vendors to take ownership of technical issues can also consume valuable design time, the development team realized these issues could be avoided if all software used in a project was licensed and supported by one vendor.

Key Functions

Next, the Synergy team asked what characteristics were essential to successful embedded industrial and IoT applications. If the Synergy Software Package (SSP) was going to serve as the optimal platform for IoT applications, what kind of challenges would it have to address? Clearly any prospective industrial and IoT solution would have to offer a wide range of communications options. It would also have to offer security features to address the many threats to any networked product. For developers to confidently rely on this integrated platform, it would have to provide them with high-quality, commercial-grade software. In addition, that software would have to be tested and qualified on high-quality hardware reference designs. And given the large number of complex software components in the platform and the massive quantity of the documentation associated with the entire package, developers would need a new, much more efficient method to quickly find the most relevant information when they needed it.

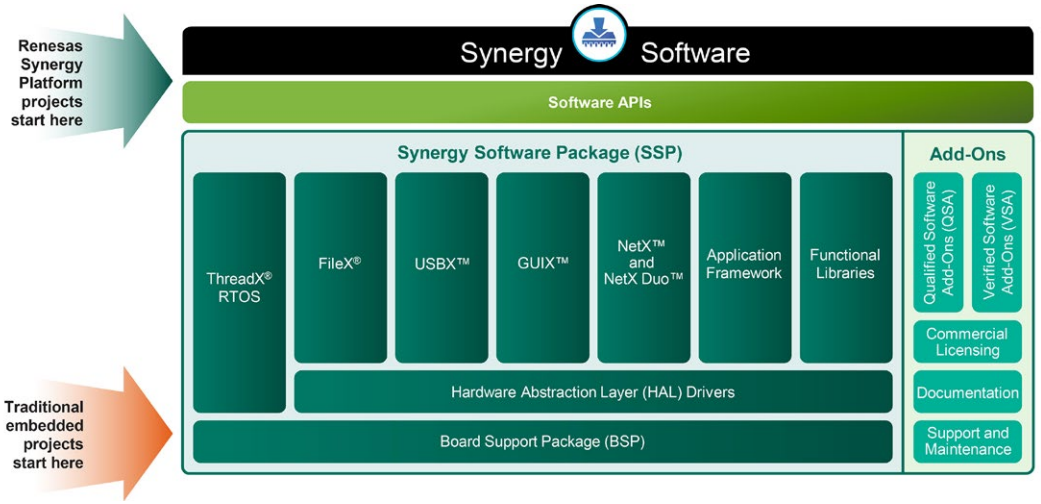
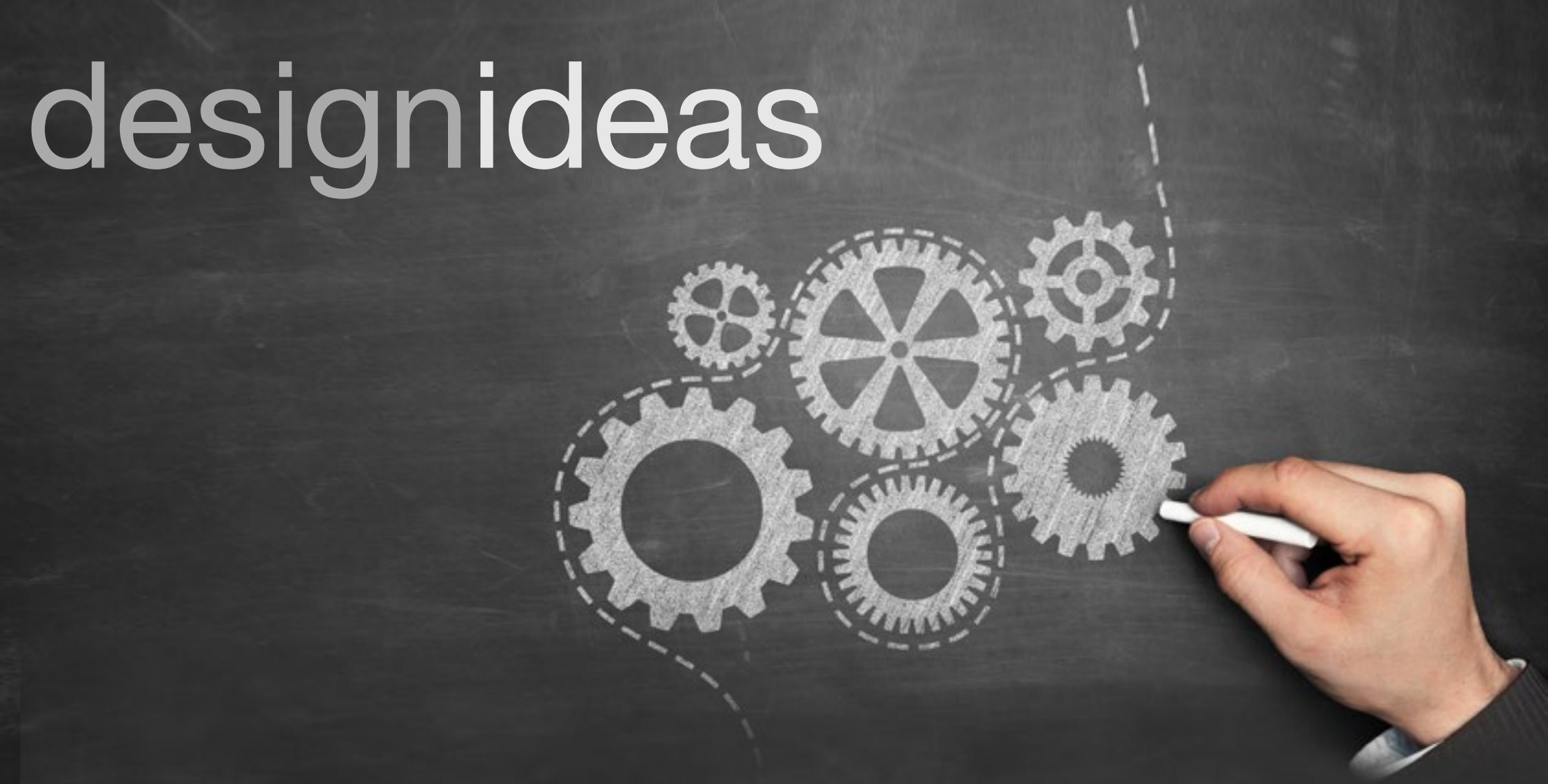


Figure 2. *By integrating the Synergy Software Package in with the closely-related Synergy MCUs, developers can begin development farther along in the design process and dramatically shorten time-to-market.*

Security was a major challenge. Threats lie everywhere. How could the platform designers prevent unauthorized code from being programmed and executed, protect the firmware and data on the MCU, identify the right source of communication and secure communication data from interception and tampering?

This article continues by describing some of the range of products that have been combined and applied in the Platform concept, such as integrated security in ARM cores, Express Logic's X-Ware, and the ThreadX RTOS; and concludes by considering software licensing and quality assurance processes.

designideas



- Accurate mains frequency monitor with calibration

Accurate mains frequency monitor with calibration

By Ramkumar Ramaswamy, PhD, Silego Technology

An AC power mains utility frequency is typically either 50Hz or 60Hz. The frequency variation is normally restricted to about ±1% in most countries. Variation occurs usually because of varying load on the grid; a higher load causes the frequency to drop and viceversa. The importance of monitoring power frequency is especially important when a local mini-grid is set up – such as with solar-powered or wind-powered installations. The inverter in such cases must shoulder the responsibility of monitoring the output power quality.

In industrial setups that use equipment such as induction motors, it is important to maintain the proper frequency because the speed of an induction motor is a function of the frequency. More elaborate and sensitive setups may use AC drives to maintain the motor speed, but in many situations the motor may be directly connected to the power source without a drive, in which case variations in power frequency directly impact the motor speed. In this application note we show how to use a Silego GreenPAK SLG46620 and a few external components to design a frequency deviation monitor that signals an alert if the frequency deviates by a specified margin.

Broad Design Strategy

The design is based on measuring the period of the waveform. Many designs use a zero-crossing detector as the basis for period measurement. The mains input is stepped down and half-wave rectified with a few components as shown in Figure 1. The rectified pulses are fed to the GreenPAK chip and used to trigger an analogue comparator (ACMP) reading at Pin 12. The ACMP's IN terminal is held at 50 mV, and when it toggles, it enables a counter which counts pulses from an internal oscillator until the end of the half-cycle.

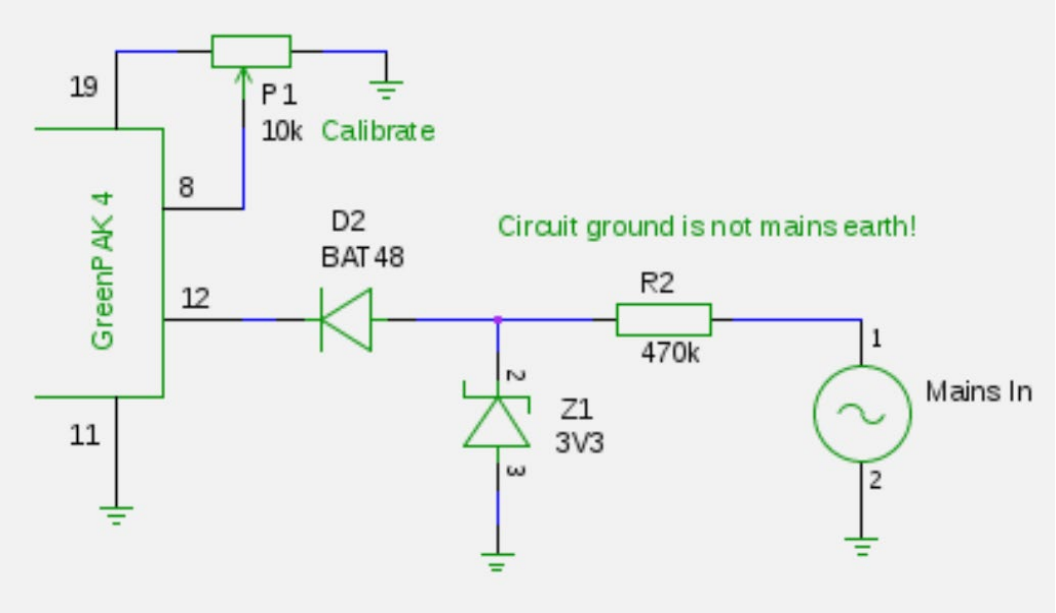


Figure 1. *Suggested input schematic*

The ACMP's low-bandwidth mode is enabled to prevent spurious responses due to noise. To determine whether the deviation of the mains input frequency is acceptable, we use two DCMPs to compare the output of the counter at the end of the half-cycle with two registers which store the upper and lower bounds we are interested in. DCMPs are available in the GreenPAK 4 series, and therefore we select the SLG46620 for this circuit idea.

The graph in Figure 2 shows the first few microseconds of the half-wave cycle for a 230V, 50Hz waveform (black curve). The error introduced by the use of a half-wave rectifier in the above fashion is quite small. Given the presence of the protective Schottky diode BAT48 at the input, we need a voltage of at most 350 mV to trigger the ACMP. The time taken for the mains voltage to reach a level of 350 mV is about 3.6 µsec; double that to account for the ramp-down as well, and we have a 0.07% error which can be neglected in most mains frequency monitoring applications. The output of the ACMP is shown by the red line in Figure 2.

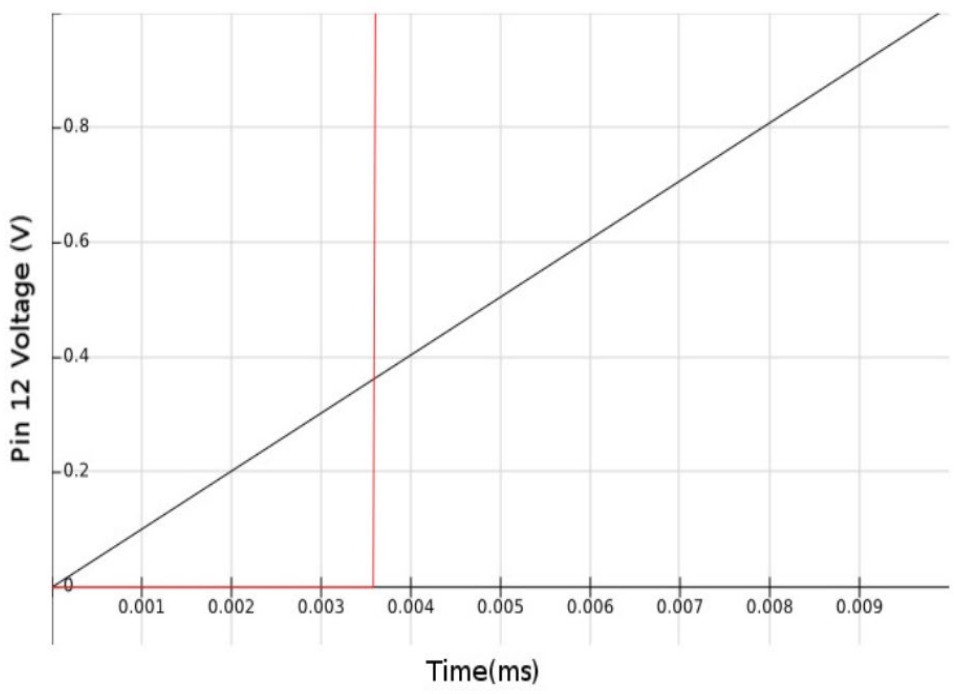


Figure 2. *The first few microseconds of a 230V 50 Hz mains waveform*

Realization in GreenPAK Designer

Figures 3 and 4 show the GreenPAK design. The broad idea is to drive the SET input of FSM1 low when the mains half-cycle starts, and bring it back high when the half-cycle ends. When the halfcycle ends, the rising edge produced by INV1 feeds into DFF6/7/8, locking the DCMPs' states into pins 14, 16 and 17 respectively, after which the rising edge (delayed slightly by DLY7), SETs FSM1.

To make the above strategy work in practice, we need to work around a couple of things. Firstly, we note that the GreenPAK 4's DCMP works with 8-bit data, which offers us a resolution of only 1 part in 256. What if we are interested in better accuracy than this? Secondly, the internal oscillator is not as accurate as a crystal oscillator so if we need to keep the external parts count really low we need a method of calibrating the frequency monitor. We will describe how both these are achieved.

Oscillator and Counter Design

We choose OSC's 2 MHz RC oscillator. The OSC output divisor and the FSM1 clock input divisor are set to 2 and 4 respectively so that the counter frequency is now 2000/8 = 250 kHz (period = 4 µsec). Let us see what happens with a nominal mains frequency of 50Hz, with the half cycle being 10 msec. Suppose FSM1 is configured to count UP with counter data = 0. Then at the end of the 10 msec half-cycle, the Q output of FSM1 will be 10 ms/ 4 µsec = 2500 modulo 256 = 196. Let us call this the "STOP value" for further discussion.

However we now need to take cognisance of the error in the oscillator frequency. From the device's datasheet we see that if the SLG46620 operates at a supply voltage of 3.3V, the frequency tolerance of the 2 MHz RC oscillator at 25° C is -1.74% / +1.55%. Instead of adding an external crystal oscillator, we show how we can institute a calibration procedure to compensate for this variation in an actual implementation.

As a first step towards achieving this, we design things with an assumed OSC frequency that is at the upper end of the range (or a little beyond, to account for minor temperature variations). In other words, we design things in such a way that if the OSC frequency error was +2%, then the STOP value would be 128, which is the midpoint of the possible range 0-255 of the STOP value. Knowing that the OSC error is actually less than 2%, what this implies is that the actual STOP value will be (slightly) less than 128. The next step is to have a trimmer external to the GreenPAK which may be tweaked to "push" the actual STOP value to 128 when the input frequency is known to be exactly 50 Hz. This would give us a practical calibration procedure that can be used in the field.

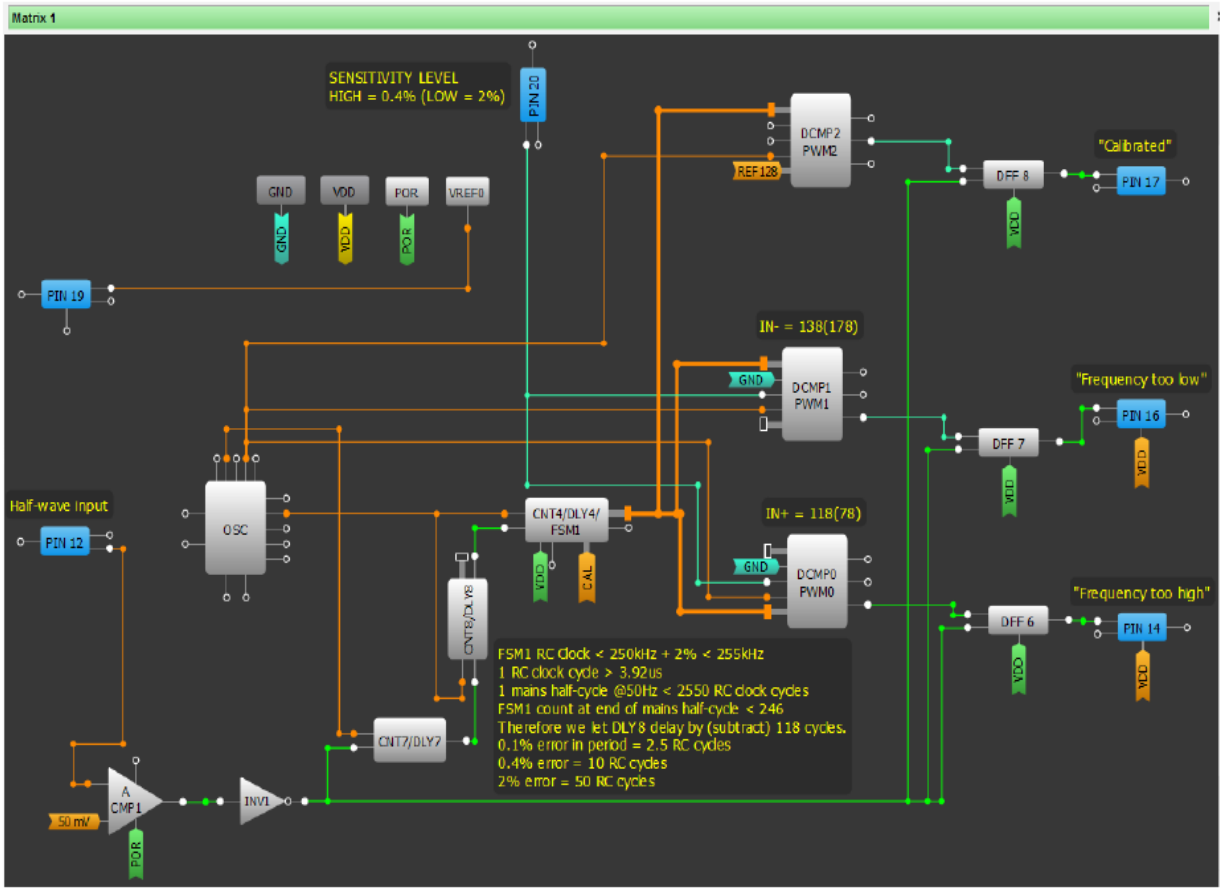


Figure 3. *GreenPAK Design - Matrix 1*

Let us now work out the numbers and calculate the STOP value:
Assumed OSC RC frequency = 2040 kHz/8 = 255 kHz
One RC clock cycle = 3.92 µsec
STOP value after 10 msec = 246
Delay introduced by DLY8 = 118 cycles
New STOP value = 246-118=128 which is as desired.

Field Calibration

When the actual OSC frequency is less than 2040 kHz, the STOP value will be somewhat less than 128. How do we now "push" the STOP value using an external trimmer? Enter the ADC (Figure 4). The ADC takes an analogue voltage from Pin 8 and generates a digital value labelled CAL, that is used by FSM1 as its counter data. When the input voltage at Pin 8 is zero, the CAL value is zero. As we increase the voltage, the CAL value increases. Since FSM1 starts counting at the CAL value rather than at zero when it receives a SET signal, the STOP value also increases. We now have the following procedure for field calibration when the input signal is known to be at 50.00 Hz: the Pin 8 voltage is increased slowly from zero till the STOP value touches 128. At that point, DCMP2, whose IN- pin is fed with the constant reference value of 128 generated by FSM0, outputs a signal on its EQ output which lights up an LED on Pin 17 indicating that the unit is calibrated.

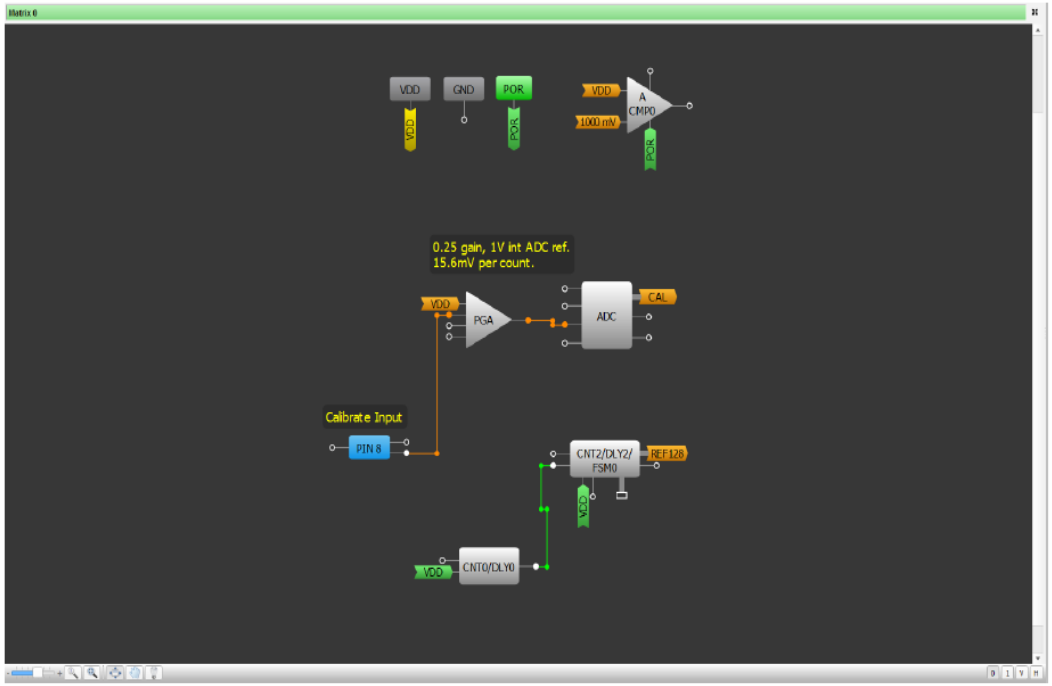


Figure 4. *GreenPAK Design - Matrix 0*

The calibration input voltage for Pin 8 may be conveniently generated by using the VREF macrocell to output a reference voltage of 1V on Pin 19 and using a trimmer as shown in Figure 1.

(There is a small subtlety here – note that after field calibration the STOP value of 128 will no longer be at the exact centre of the count range which is now less than 255; however this does not cause serious problems because the FSM1 CAL value is expected to be relatively small.)

DCMP0/1 bounds

Now comes the relatively simple part: deciding what the reference values for DCMP0/1 should be. From the calculations at (1) we see that a 0.1% error in mains frequency amounts to an error of 2.5 in the STOP value. For this application note we have chosen selectable sensitivity levels of 0.4% and 2%. A 0.4% error equals 10 RC cycles and 2% error equals 50 RC cycles. Correspondingly, the lower and upper limits for the DCMPs may be set to 128 ±10 or 128 ±50 depending on the sensitivity level desired. The sensitivity level is selectable using a LOW/HIGH input on Pin 20 which feed the MTRX SEL inputs of the two DCMPs which select from Register 0-3 into which the corresponding bounds are programmed.

Implementation Notes and Results

For the most part, the design can be tested with emulation. The emulation signal generator has a resolution of about 1% so it is possible to test the basic correctness of the design with a sensitivity not greater than 1%. It is difficult to test a breadboarded unit with mains input because of the stray hum pickup at the ACMP inputs that cause spurious readings. The author has tested this design under emulation where the calibration input to Pin 8 was via emulation, and the waveform input at Pin 12 was from a Tektronix SG502 square wave generator set to 50Hz. Time periods were verified using a Tektronix DC503A counter reading the time period at a resolution of 0.001 msec. The unit under emulation attained calibrated at a Pin 8 voltage of about 440 mV, corresponding to a CAL value of about 28, after which the design worked correctly at both low and high sensitivities.

This circuit idea has described a simple but useful design for a mains frequency monitor. The design can be used for simple alert or data collection purposes, or can be made a part of a more elaborate feedback loop or changeover/shutdown circuitry in, say, an inverter design. In a real implementation, care must be taken to lay out the circuit and provide adequate shielding so that there is no noise or hum at the ACMP input that could cause spurious triggering and affect the reliability of the unit.

productroundup

productroundup

LED drivers for automotive matrix/hi-beam lighting

Infineon targets compact and cost-effective LED front light applications with its high-power LITIX LED driver family in the LITIX Power Flex and the LITIX Power series. They address flexible DC/DC driver solutions supporting LED systems of up to 50W and even above. Application setups can vary: many medium-power LEDs with string voltages of up to 55V; or few LEDs with high currents of up to 3A and more. Both LED drivers, the LITIX Power Flex TLD5541-1QV and the LITIX Power TLD5190QV, are suited for high-power and high-current LED applications.

Complete article, here

Automotive MEMS oscillators claim 30x ruggedness vs. xtals

MEMS oscillator specialist SiTime has introduced two families of ultra-robust AEC-Q100-qualified MEMS oscillators; SiT2024/25 and SiT8924/25 are designed for ASIL compliant automotive applications such as ADAS, in-vehicle Ethernet, powertrain and electronic control units (ECUs). The devices are presented as 30 times more robust than quartz oscillators (tolerance of g-loads), offering stability over -55 to +125°C for in-vehicle communications, and with EMI reduction features. They claim widest frequency range, tightest stability at ±20 ppm and the best reliability.

Complete article, here

Low cost solar power board for any Raspberry Pi

PiSolMan is an integrated electronic module designed to continuously power the Raspberry Pi Zero from a 12V battery and a solar panel. Matching the Raspberry Pi Zero dimensions, the 65x30.5mm board is also capable of providing key information in terms of current, voltage, power and overall power efficiency, while running itself at an overall efficiency of up to 90%. Proposed as a Kickstarter project starting at €59, it is compatible with any of the Raspberry Pi models with the 40 pins header and also compatible with any 5V device such as Arduino or BeagleBone.

Complete article, here

Low RDS(on) N-ch FETs for mobile device load switching

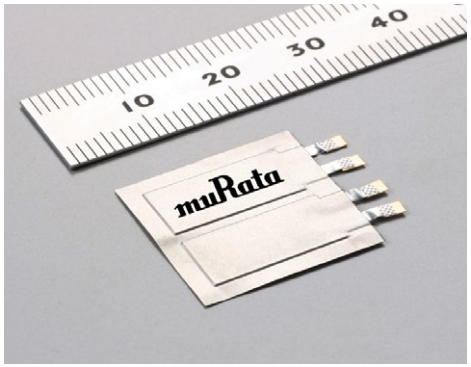
Toshiba Electronics Europe has added two N-channel MOSFETs for load switches in mobile devices that deliver optimum low on-resistance. SSM6K513NU and SSM6K514NU are built in Toshiba's 'U-MOS IX-H series' trench process for RDS(ON) ratings of 6.5 mΩ for the 30V SSM6K513NU and 8.9 mΩ for the 40V SSM6K514NU. The FETs are suitable for use in electric power switching applications over 10W, including small-size mobile devices that meet the USB Type-C and USB Power Delivery (PD) standards. Both MOSFETs are housed in SOT-1220.

Complete article, here

productroundup

Ultra-thin 0.35F supercapacitor for wearables

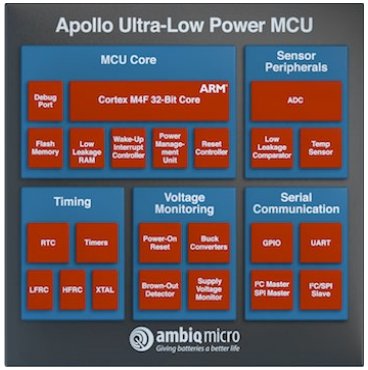
Murata's DMH series is presented as the lowest profile supercapacitor available. The product is designed for peak power assist duties in wearable applications and similar. The DMHA14R5V353M4ATA0 supercapacitor has a very low profile design at 0.4 mm thick. Its footprint is 20 x 20 mm. The supercapacitor's 4.5V rated voltage is suitable for peak power assist with lithium-ion batteries, and its 35 mF (35 milliFarad; 35,000 µF) capacity and low ESR of 300 mOhms enable peak power assist for tens of milliseconds, with 1A supplied, for example.



Complete article, here

Ambiq Micro's Apollo 2 sub-threshold-tech MCU

Distribution company Fujitsu Electronics Europe (FEEU) has Ambiq Micro's Apollo 2 Platform for the European market. The new ultra-low-power MCU claims 'breakthrough' power consumption of around 10 µA/MHz, allowing wearables and IoT devices to double battery life. Ambiq Micro's technology uses sub-threshold switching – distinguishing binary values at voltages below what, in conventional CMOS, would be the transistor's on-state. Ambiq says its platform's low processing power consumption and large memory size give designers the ability to develop products at power levels otherwise out of reach.



Complete article, here

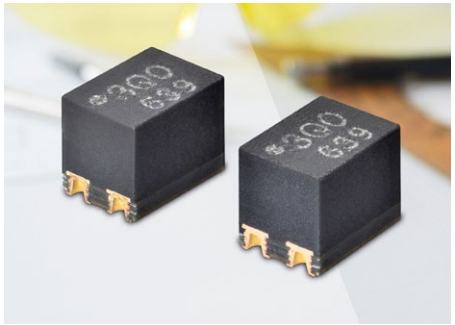
Gesture/touch sensor and controller achieves 15cm detection distance

ON Semiconductor's high-integration capacitance-digital converter is an eight-channel device capable of sensitivity up to 150 mm away, and claims superior gesture sensing and enhanced touch performance for automotive and industrial systems. The LC717A30UJ high dynamic range capacitance-to-digital converter uses mutual capacitance to detect changes in capacitance down to femtofarad (fF) levels. The LC717A30UJ delivers rapid responsiveness, with a measurement time of 16 msec for its eight sensing channels and runs off +2.6 to +5.5V with a low-power standby mode of 1 µA.

Complete article, here

MOSFET relay (SSR) switches 1.5A, in 2.9 mm² footprint

Omron Electronic Components Europe believes it has the smallest-available MOSFET relay; contributing to minimum possible PCB size, the G3VM-31QR MOSFET relay is 17% smaller than alternative devices. The S-VSON device has overall dimensions of 2.0 x 1.65 x 1.45 mm achieved using a 3-stack chip on chip structure. The G3VM-31QR offers on-resistance of 0.10 Ohms. Despite its small size, it can handle a continuous load current of 1.5A at 30V AC or DC and offers a temperature range of -40 to 110 degrees Celsius with dielectric strength of 500V between input and output.



Complete article, here

productroundup

High-power LEDs grow new markets in horticulture

LED maker Plessey (Plymouth, UK) has described an LED lighting application in which its high-power horticultural LED grow light directly replaces sodium lamps, and cuts energy by 40%. The Hyperion family of high-power horticultural LED grow lights has been designed to provide supplementary lighting in greenhouses (glasshouses). Hyperion 1000 and Hyperion 1600 units deliver greater returns for commercial growers through increased productivity while achieving a 40% energy saving compared to equivalent 600W and 1000W sodium grow lights.

Complete article, here

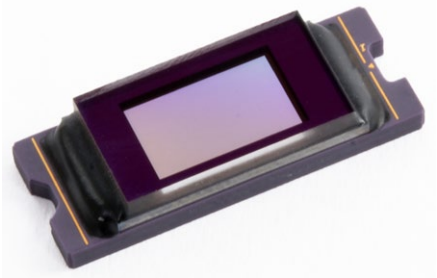
Coreless design enables converter operation in intense magnetic fields

Powerbox (Gnesta, Sweden) has designed a coreless technology platform to power medical and industrial equipment operating in very high magnetic field environments such as magnetic resonance imaging or particle accelerators. Using high-frequency switching topologies and digital control with proprietary firmware to optimize efficiency and voltage regulation, the GB350 buck-converter module is the first building block in its category that is able to operate safely when exposed to high magnetic fields of 2 to 4 Tesla. GB350 delivers an output power of 350W and can be paralleled.

Complete article, here

Micromirror chip is smallest 1080p device for projection displays

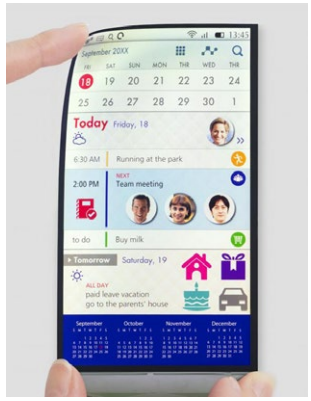
Enabling product designers to integrate 1080p (full HD) projection displays in the smallest form factors, Texas Instruments' 0.33-inch full DLP ("digital light processing") Pico chipset is claimed as the smallest such display solution, offering unmatched brightness capabilities. The DLP3310 DMD micromirror device and the matching DLPC3437 controller are aimed at mobile smart TVs, pico projectors, and smart home displays. The fast switching speed of the DMD enables each mirror to display two distinct and unique pixels on screen during every frame.



Complete article, here

5.5-inch Full-HD flexible display on plastic

Japan Display has developed a 5.5-inch Full-HD LCD display relying on a plastic substrate for both sides of the liquid crystal layer, making it fully flexible. The Full Active Flex conforms to curved shapes, opening up smartphone design to new form factors. The use of plastic substrates instead of glass also prevents cracking upon impact (from being dropped for example). The company incorporated its low-frequency driving technology to support not only a normal 60Hz driving scheme but also lower frequency driving scheme as low as 15Hz, significantly decreasing power consumption.



Complete article, here

productroundup

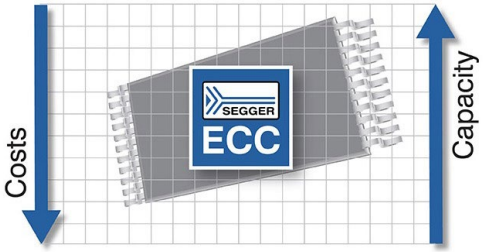
Eagle PCB software updated, in distribution

The latest version of Autodesk EAGLE is now available through distributor element14; EAGLE is a comprehensive schematic, PCB and collaboration tool with a new routing engine, ultra-precise selection, and easy circuitry reuse. Engineers can use Autodesk EAGLE to deliver integrated ECAD/MCAD for designing smart products. EAGLE will now be available through element14 as an annual subscription in either standard or premium versions. This opens up the possibility for consistently free updates, dedicated support through Autodesk and budgeting options for monthly or annual pricing.

Complete article, here

Low cost, high capacity NAND flashes for embedded systems

Segger (Hilden, Germany) has added a software error correction (ECC) package allowing the whole spectrum of NAND flashes to be used in microcontroller based embedded systems. Consumer grade NAND flashes with multi-level (MLC) or triple-level cell (TLC) technology require error correcting codes capable of detecting and correcting up to 40 bit errors. Previously, this required a high-cost application-class microprocessor with integrated MLC NAND flash controller. With Segger's error correcting library, standard 32-bit microcontrollers can now access MLC and TLC NAND.



Complete article, here

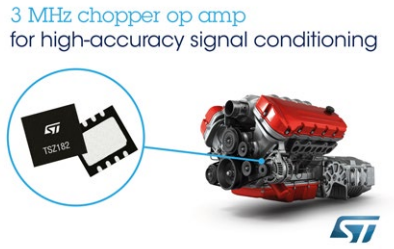
Smallest reflector-type, high brightness 3-colour LED for matrix displays

Rohm Semiconductor has an ultra-compact reflector-type LED optimized for consumer devices such as matrix light sources for gaming and wearables that demand increased miniaturization. Its small footprint and high ESD resistance design provides design flexibility in matrix applications. The MSL0402RGBU reflector-type 3-colour LED is believed to be packaged as the smallest size in the industry (1.8 x 1.6 mm). This enables high-density mounting and provides excellent colour mixing characteristics, ensuring support for high resolution LED matrices.

Complete article, here

3MHz chopper op amps; rail-rail I/O & tiny footprint

ST's TSZ182 dual precision op amp combines low and temperature-stable input-offset voltage with 3MHz gain-bandwidth, rail-to-rail inputs and outputs, and ultra-small 2 x 2 mm DFN8 or mini-SO8 package options. Offset voltage of 25 µV at 25°C enables high measurement resolution and accuracy without external trimming components. Offset drift less than 100 nV/°C maintains accuracy over a wide temperature range and saves periodic auto-recalibration. Operating from a 2.2V-5.5V supply the TSZ182 maximizes utilization of available dynamic range.



Complete article, here

13 FREE ELECTRONICS DESIGN TOOLS & PCB DESIGN SOFTWARE

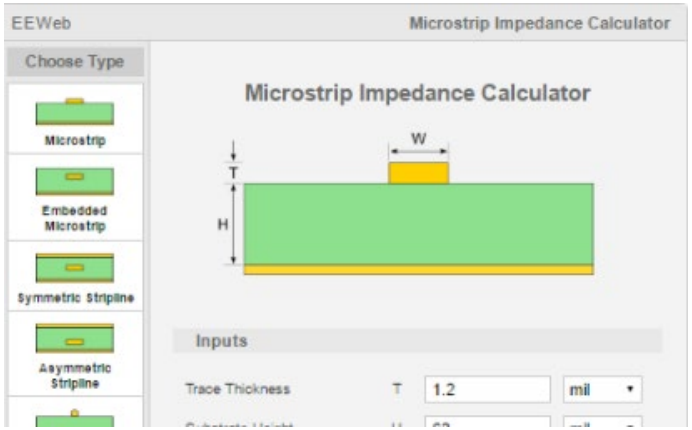
Everyone has their own favourite "freeware" tools and applications; we are indebted to design consultancy ByteSnap for their list (opinions expressed here are those of ByteSnap's engineers), which begins with component search and price checkers;

Findchips and Octopart

Both allow you to get pricing from a number of suppliers quickly and to see stock levels. They are equally great for quickly seeing the rough cost of a component and the general availability. However, the prices need to be taken with some caution though, as do the stock levels reported, which often aren't reflected in reality when you go to the supplier. Octopart also has a really nice BOM load tool that allows an entire BOM to be costed. It isn't perfect, there are sure to be gaps, but again in terms of speed and convenience, it's great.

Microstrip Impedance - predicting PCB characteristics

For predicting PCB characteristics to work out stack-ups and track thicknesses, we rate Microstrip Impedance which has a good set of PCB track models - more so than some of the other similar tools.



The graphics also make it clear what it is talking about in terms of things such as "embedded microstrip" and "asymmetric stripline" (this latter one is one that some other tools don't support).

Notepad++ - source code editor

This free source code editor and Notepad replacement is packed full of features that will mean you'll never want to use Notepad again. For example, you can make comparisons between two or more files. The macro editing allows you to perform repetitive operations on a file. It can also perform ASCII to HEX and HEX to ASCII conversions. If you've got a file in HEX characters you can convert to ASCII to decipher any letters or messages that may be in there. It has tabbed file browsing and probably most important of all, syntax colouring for many languages. Running in the MS Windows environment, its use is governed by GPL License.

Paint.NET – image/photo editing

Its straightforward UI, pacey performance and powerful tools make Paint.NET a staple in our software development toolkit. It's packed with features – special effects, recolour and gradient tools to name a few. Some even say the layers function on Paint.NET allows it to square up to more expensive programs such as Photoshop. And the generous keyboard shortcuts and endless undo and redo function make it a popular option in our office for manipulating screens and icons.

Audacity - audio editing

Audacity is a comprehensive software kit for editing audio files and adding sound effects. It works with several file types, including OGG, WMA, MP3, and WAV for import and export. Its impressive list of features make it desirable for recording and mixing too. If the steep learning curve doesn't put you off, you'll be rewarded with a pro-level digital audio editor, with cross-platform support for Windows, Mac, GNU/Linux and other operating systems.

HXD - Binary image editing
HxD is a carefully designed and fast hex editor which, in addition to raw disk editing and modifying of main memory (RAM), handles files of any size. The easy to use interface offers features such as searching and replacing, exporting, checksums/digests, insertion of byte patterns, a file shredder, concatenation or splitting of files, statistics and much more.

Tera Term - Serial terminal
Tera Term is a terminal emulator that we principally use for monitoring debug streams from boards under test. It has a macro function allowing you some level of automation that can even be used for basic factory tests. Tera Term can save debug logs to a file and you can use it alongside a CLI on the host processor to manipulate the target.

HDD Copy Tool – hard disk duplication and image creation
HDD Copy Tool is a utility for low-level, sector-by-sector hard disk duplication and image creation.
HDD Raw Copy tool makes an exact duplicate of a SATA, IDE, SAS, SCSI or SSD hard disk drive. Will also work with any USB and FIREWIRE external drive enclosures as well as SD, MMC, MemoryStick and CompactFlash media.

GSpot - codec identification
This is a Windows-based freeware program designed to identify the codecs used in video files.
In addition, the application checks if the required DirectShow filters or Video for Windows codecs are installed and configured for proper playback. While originally created to support AVI, it was expanded to include full support for OGG and limited support for other commercial container formats, including versions of MPEG, QuickTime, and Windows Media Video. It is still used and is listed on fourcc.org as one of the few FOURCC identifiers.

USBView – USB device browser
The Windows GUI (Graphical User Interface) application lets you to browse all USB controllers and connected USB devices on your computer. USBView allows you to look at a lot of the information about the USB devices connected to your PC, such as the descriptors and the VID (Vendor ID) and PID (Product ID – allocated by the vendor).

This is great for improving workflow efficiency, as USBView helps you determine which drivers should be loaded, based upon the VID and PID information. Windows only.

Wireshark - network protocol analyser
This freeware acts pretty much as a debugging network tool, allowing you to see what's happening on your network at a microscopic level. We're Wireshark fans for a number of reasons;
- It exposes the ability to see the whole network protocol (ports, IP addresses, MAC addresses, checksums, retries etc.) not just the data the payload.
- When debugging the application it doesn't need to be run on the target device. It will work as long as the computer is on the same network.
- You can filter the packets that are received to more easily track down issues.
- When creating bespoke protocols Wireshark can be used to identify what has been sent is what was put in the individual network packets.
- When dealing with new protocols this tool has a way of capturing and analysing what has been received for validation of what has been processed.

Don't forget to always check usage policies/ terms and conditions for these tools before use.

ByteSnap Design offers electronic design services across a range of sectors.

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