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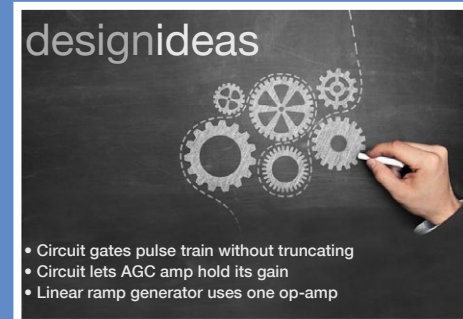
May-July 2015



New DMMs with lower current ranges make pA measurements easier than ever before
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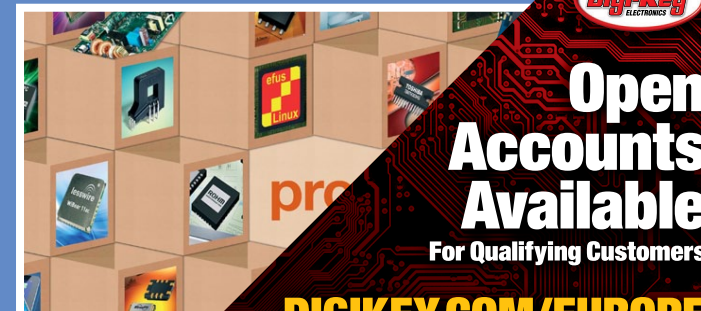
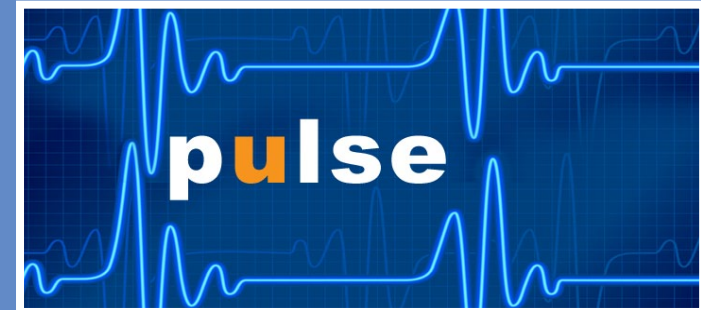
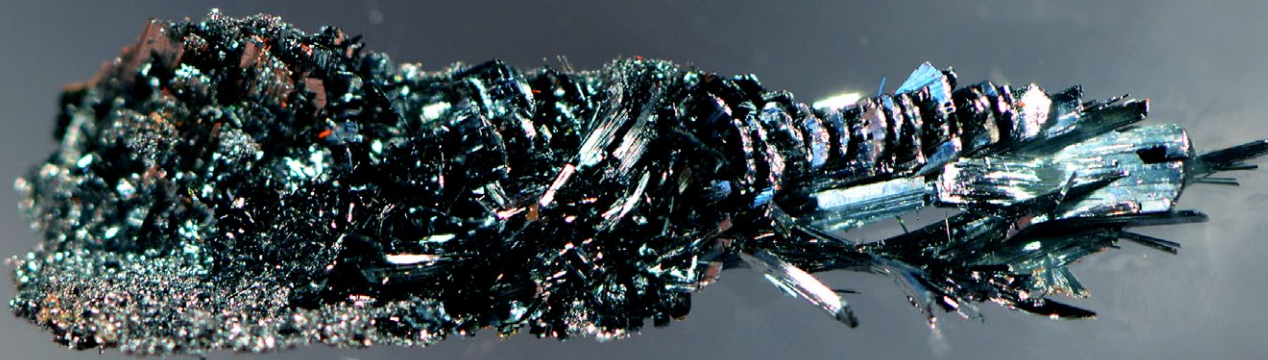
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A rival to graphene for future devices?



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COVER

Phosphorene: competitor to graphene as a future silicon substitute?

Graphene – the physical state of carbon in which it forms single-atom-thickness layers – continues to be the subject of a great deal of research work, both for its physical properties and the prospect of fabricating future electronic devices in the material. Viewed as a “brand”, however, the standard disclaimer may be applied: Other Brands of Exotic Materials are Available.

Chemists at the Technical University of Munich (TUM) have developed a semiconducting material in which individual phosphorus atoms are replaced by arsenic. This compound – black arsenic phosphorus – like graphene, also forms extremely thin layers; and it exhibits semiconducting properties. In a collaborative international effort, The TUM researchers and American colleagues have built the first field-effect transistors from the new material, referred to as ‘black phosphorus’ for brevity.

The array of possible applications ranges from transistors and sensors to mechanically flexible semiconductor devices. Unlike graphene, whose electronic properties are similar to those of metals, black arsenic phosphorus behaves like a semiconductor. Its physical properties – the formation of thin layers – also holds out the prospect of flexible devices that one day might be usable in, for example, wearable electronics. More [here](#).

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EXTREME TECHNOLOGY

At a gathering in Brussels in June, researchers at imec, and representatives from semiconductor manufacturing equipment ASML, reported further steps towards getting an EUV – extreme ultraviolet – lithography machine ready for full production. You may recall hearing something like this before; in fact, in similar announcements over several years: but real, and steady, progress appears to be being made.

Let's review for a moment why this matters. The famed Moore's Law is based around fabricating ever-smaller devices. Right now, if you buy a leading-edge FPGA, say, it's likely to be in 28-nm, moving soon to 22 or 20 nm; the most-leading-edge microprocessor around today is moving to 14 nm. There is much talk of 10 nm, and 7 nm. Exactly what it is that you measure as 14, 10, or 7 nm is something of moot point and is a grey-area of definitions, but we'll set that aside for now. The lithography – the printing process of manufacture – is conceptually simple, but has been getting harder and harder, as the structures of the devices we want to make have shrunk past being comparable-with, to shorter-than, the wavelength of the light used in the shine-a-light-through-a-mask process. Interference, refraction, diffraction all come into play and you don't get a sharp image from a sharp mask, any more.

Some time back, someone figured out that if you are going to print fuzzy blobs instead

of sharp rectangles, then if you can contrive just the right combination of multiple fuzzy blobs they can combine to make something approximating what you would like to see. You only need to back-calculate from the desired outcome (pattern on photo-resist) to create a set of two (or three, or even more) masks with odd-looking shapes that when successively exposed merge into... well, they never get back to sharp rectangles, but close. The mathematics of that back-calculation is ferocious, but do-able. Chances are you're laying down some silicon on a PCB that has been built exactly this way. Unsurprisingly, this approach is likely to have its limits, and in the 14-or-thereabouts-nm region we may already have reached them.

It would be good if we could simply use shorter-wavelength light and carry on with the good-old lithography principles. The shorter wavelength you need being; extreme ultra-violet. Making EUV practical has thrown up a set of challenges that would have made workers in any strictly rational business walk away in despair: but this is semiconductors, so they have kept at it. Every material and physical process that you think of as 'optics' has had to be re-thought; there are no substances that make a transmissive lens, so you need reflective (mirror) focussing; everything has to be carried out in a vacuum, so apart from the sheer mechanical issues of placing the

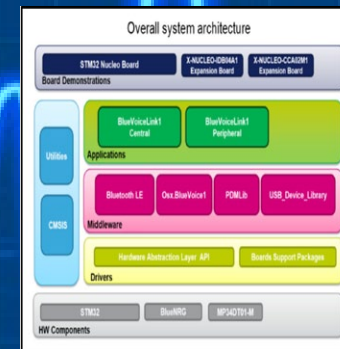
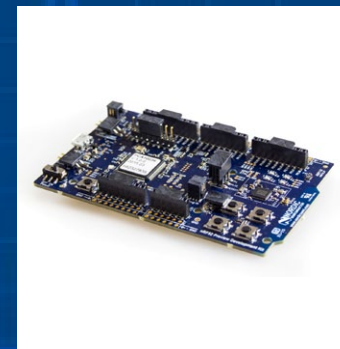
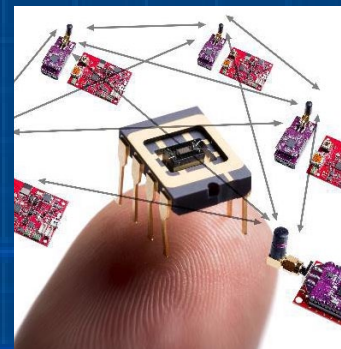
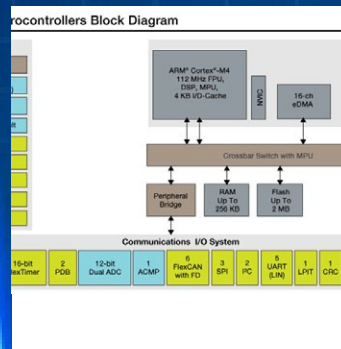
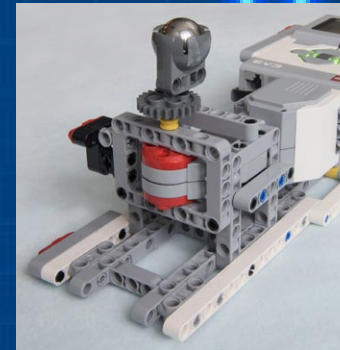
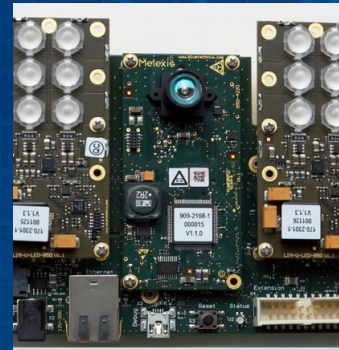
target wafer in the right place time after time for successive exposures, to single-figure-nm precision, you need an airlock into the machine (to mention just two of the more-comprehensible problems).

And, you need a source of light at EUV wavelengths. Much work has gone into upping the intensity of EUV available from such a source: more light means faster exposures, means more wafers processed per hour, the key parameter that will allow EUV to be integrated as an economically-viable processing step, and allow the Moore's Law wagon to roll on for yet more generations. At that imec Technology Forum, ASML reported achieving a throughput milestone of over 1000 wafers exposed in 24 hours; and the company says it has production orders from wafer foundries for a number of EUV tools. (A 'tool' in this context is a piece of equipment the size of a substantial motor home, and will cost you, give or take, £100million.)

As I write this, IBM has announced successful fabrication of test chips with 7-nm features; using silicon-germanium for the transistor channel and fabricated with; yes, EUV lithography.

Imec, it's fair to say, has continued to believe in EUV as part of the semiconductor roadmap; it might still be too early to call it a certainty, but it's looking more and more as if they have been justified.

pulse



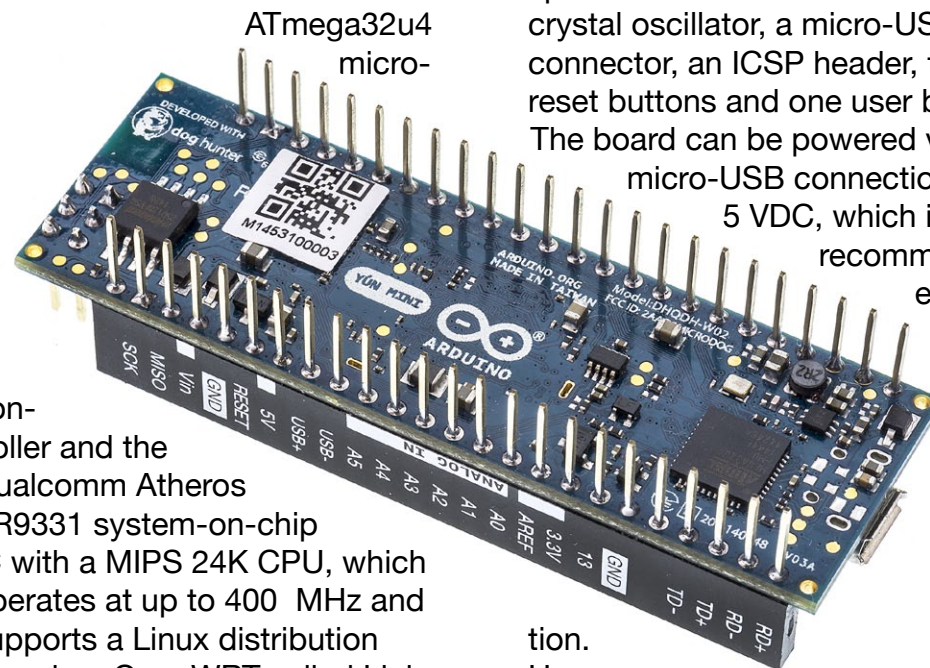
Arduino mini wireless development board, in distribution

Distributor RS Components has the Arduino Yun Mini, which it positions as an affordable, small and lightweight Linux-based WiFi prototyping solution. Aimed at embedded engineers, hackers and students, the Arduino Yun Mini is a redesign of the Arduino Yun WiFi microcontroller board and has been re-engineered to be used with a breadboard, making prototyping easier.

The Yun Mini has approximate PCB dimensions of 71.1 x 22.9 mm, which is less than half the area of the Arduino Yun PCB, which has dimensions of approximately 68.6 x 53.3 mm with its USB connector extending the length to approximately 73 mm. In addition, the weight of the Yun Mini at 16g is half that of the Yun. The board's small size suits it for use in small spaces and especially projects for home automation, where locating smaller devices in small boxes can improve installation flexibility.

The Yun Mini offers an affordable breadboard PCB with an ATmega32u4 micro-controller and the Qualcomm Atheros AR9331 system-on-chip IC with a MIPS 24K CPU, which operates at up to 400 MHz and supports a Linux distribution based on OpenWRT called Linino. A bridge library enables communication between the two processors, providing Arduino programs the ability to run shell scripts, communicate with network interfaces and receive information from the AR9331 processor. The board has built-in WiFi (IEEE

802.11b/g/n operation up to 150Mbps) and supports 20 digital input/output pins, seven of which can be used as PWM outputs and 12 as analogue inputs. Other specifications include a 16 MHz crystal oscillator, a micro-USB connector, an ICSP header, two reset buttons and one user button. The board can be powered via the micro-USB connection with 5 VDC, which is the recommended op-



tion. However, a regulated 5 VDC can also be used to power the board via the Vin pin. The Yun Mini can be programmed with Arduino software downloaded from arduino.org/downloads or the Linino IO from <http://www.linino.org>

Connected-device development board

For projects including "Internet of Things" applications, RS also has a development board that builds on the Arduino Uno platform, with more processing capability from a low-power 32-bit Atmel microcontroller based on ARM Cortex M0+ core. Hosting a low-power Atmel SAM D21 microcontroller, with ARM Cortex M0+ core, the Arduino M0 Pro board features the Atmel Embedded Debugger (EDBG), which provides a full debug interface without the need for additional hardware and simplifies software debugging. Key hardware specifications of the M0 Pro board include: ATSAMD21G18 MCU running at 48 MHz and packaged in a 48-pin LQFP, 3.3V operation, 256 kB of Flash memory, 32 kB of SRAM and EEPROM of up to 16 kB via emulation. Input/output options include 14 digital I/O pins with 12 PWM channels and UART, six 12-bit ADC input channels and a 10-bit DAC output.



Projected-capacitive multi-touch and gesture controller is noise-resistant

Providing advanced multi-touch and gesture for touch screens up to 10 in., Microchip's latest addition to its human interface portfolio is the MTCH6303 turnkey projected-capacitive touch controller for touch pads and screens. Touch sensors with up to 1000 nodes and diagonals of up to 10 in. are supported. The MTCH6303 provides multi-touch coordinates as well as a readymade multi-finger surface gesture suite that

brings modern user interface (UI) elements—such as pinch and zoom, multi-finger scrolling, and swipes—to any embedded design, with minimal host requirements. The MTCH6303's signal processing provides noise-avoidance techniques and predictive tracking for 10 fingers, at scan rates of up to 250 Hz with a minimum of 100 Hz each for five touches. It also combines with Microchip's MTCH652 high-voltage line driver

to improve signal-to-noise ratio (SNR) for high levels of touch performance in noisy environments. When combined with the MGC3130, the MTCH6303 solution is capable of supporting 3D air gestures up to 20 cm distance from the touch panel. Microchip's MGC3130 E-field-based 3D tracking and gesture controller includes Microchip's GestIC technology, allowing user input via natural hand and finger movements in free space. This combination empowers designers to create interface-control possibilities in two and three dimensions that differentiate their products. The capabilities of the MTCH6303 create touch and gesture solutions for the rapid growth of human-interface applications and requirements in

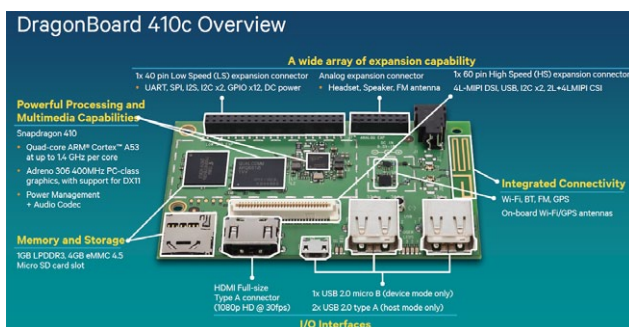
the industrial, home-automation and office-equipment markets. Microchip's free MTCH6303 GUI provides designers with complete access to the configuration and tuning parameters. Advanced visualisation windows assist all user levels with feedback, to accelerate design integration. Microchip provides access to the firmware library, to enable further customisations for maximum design flexibility and control.

Complete article, here



Snapdragon-based low-cost compute board from Arrow

DragonBoard 410c is a single-board compute platform built



by distributor Arrow, for professional and 'maker' users alike; the \$75 development board design based on the Qualcomm Snapdragon 410 processor, an ARM CortexA53-core machine. The credit card-sized kit is based on Linaro's 96Boards specification and enables developers, makers, universities and commercial manufacturers to make use of the power of the Snapdragon 410 processor for devices such as next-generation robotics, medical devices, building automation, digital signage, and gaming consoles, among others. The board

is designed to build a software ecosystem around Snapdragon 410, as well as offering uses in education, prototyping, and commercial embedded computing products. Arrow will manufacture and distribute the DragonBoard 410c to community developers and commercial customers. DragonBoard 410c features:

- A 32-/64-bit capable quad-core ARM Cortex A53 at up to 1.2 GHz per core
- Qualcomm Adreno 306 GPU for PC-class graphics
- 1080p HD @ 30fps video playback and capture with H.264 (AVC)
- 1 GB RAM, 8 GB eMMC Flash + Micro SD card slot
- Onboard Wi-Fi 802.11a/b/g/n 2.4 GHz, Bluetooth 4.1, GPS
- Support for Android 5.1, Linux based on Ubuntu and planned support for Windows 10

Complete article, here

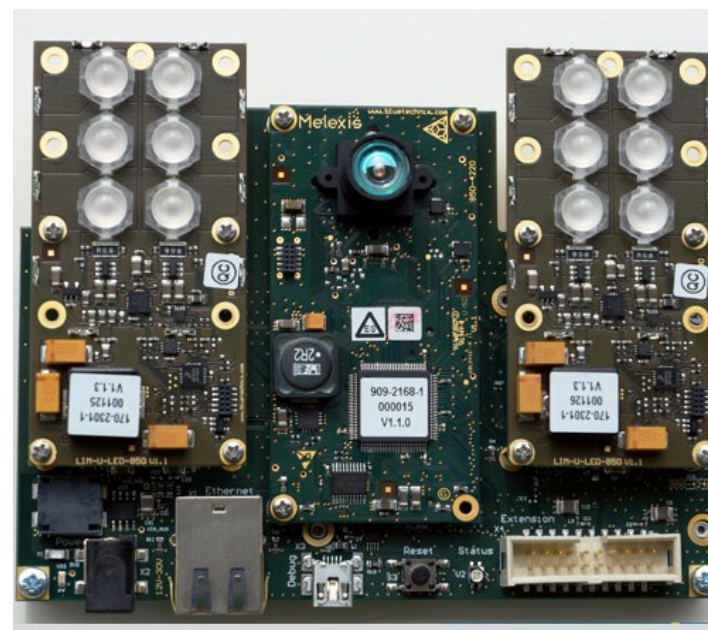


Time-of-flight 3D imaging evaluation kit, with QVGA resolution

Featuring high frame rates, interchangeable optics, modular hardware architecture and

Sense" pixels. This hardware platform enables implementation of more advanced human machine

interfaces (HMIs). Co-developed in association with Melexis technology partner [BlueTechnix](#) (maker of 3D depth sensors for the industrial market), the EVK75023 is a 130 x 105 x 60 mm board for assessment of ToF sensing capabilities under even the most challenging of application conditions, where the detrimental influence of ambient light variations must



be addressed. Equipped with the advanced sunlight cancellation, Melexis has added support for its time-of-flight (ToF) sensing technology with the EVK75023 evaluation kit. The kit supports the MLX75023 QVGA (320 x 240pixels) resolution ToF sensor that employs high dynamic range "Depth-

be addressed. Equipped with the embedded MLX75023 imaging device, it can deal with up to 120 klux of background light. The EVK75023 has a high bandwidth Gigabit Ethernet interface, through which real-time 3D images are output at frame rates of

up to 60 fps. These can be used to recognise complex gestures. Users can develop their own communication interface via a C-based API or via the Matlab SDK. The platform consists four main elements:

- A pair of illuminating units - each with a set of six LEDs capable of producing a peak optical output of 10W.
- A sensor board - incorporating the MLX75023 sensor, a standard M12 lens mount plus objective with a field of view up to 60°, a quad-channel data converter and programmable logic (through which both the sensor and the LEDs are controlled).
- An ARM-based processing board - featuring an i.MX6x Freescale microprocessor, which is responsible for compiling the acquired ToF data then subsequently communicating this to a laptop, via the Gigabit Ethernet connection, for analysis.
- An interface board - on to which all of these different subsystems are placed.



Electro Rent grows European operations with UK office opening

Test equipment rental company Electro Rent – which is marking 10 years of operations in Europe – has recently opened a new facility to service the UK market. Reflecting on the evolution of the rental sector, the company’s Managing Director for Europe, David Saeys, cites the broad range of financial and operational options that can be provided to engineers and project leaders.

The company can trace its roots back 50 years, in the USA, moving into Europe and China in 2005. It maintains a “pool” of rental equipment valued at €550million and comprising over 40,000 units, which it holds in a small number of key locations around the world (in the USA, in Mechelen, Belgium, in China and now in Staines, UK). EDN Europe posed the question to Saeys; “Given that engineers, broadly speaking, are aware that equipment rental provide instruments at short notice, as an alternative to purchase, what would you

consider to be the least-known aspect of Electro Rent’s operation?” “It is probably the breadth of options we can offer, and the flexibility to move costs between capital spend and operational budgets [‘capex’ and ‘opex’]. We offer straightforward rental; or finance towards purchase; or sales of used equipment. Rental can be for one week to one year, and can be terminated if the unit is no longer required; or equipment can be leased for lower rates for longer-term commitment. Arrangements can be made to credit rental payments if a unit is subsequently purchased, or rent-to-own can be set up from the outset. Equipment purchases can be of instruments that have been in the company’s rental pool, or we provide financing as a separate facility.” In short, Saeys says, his company covers virtually every means of acquiring, temporarily or permanently, T&M units.

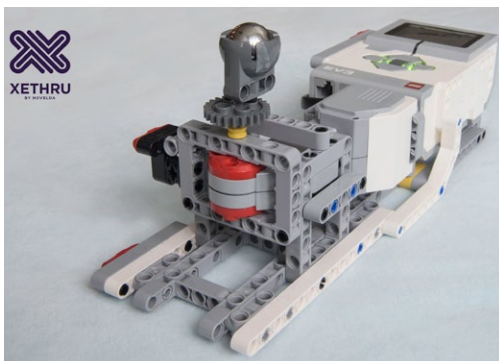


XeThru Bot simulates breathing for sensor testing: built from Lego

Novelda (Oslo, Norway), developer and manufacturer of adaptive smart sensors, has created a design for a robot created from Lego to support the testing of its advanced sensor modules. A new blog and video on Novelda’s website features its XeThru Bot, which simulates the chest movements that can be used to detect and monitor a person’s breathing. The XeThru Bot, a robot built using LEGO Mindstorms components, provides a repeatable test bed that allows multiple respiration sensing scenarios to be emulated and measured with its high accuracy sensors. A particularly challenging example is detecting the tiny movements coming from a baby’s chest when inhaling and exhaling. By configuring the XeThru Bot to move a metal sphere in a defined pattern, it is easy to

perform accurate and repeatable measurements. The system, being largely made from plastic, reduces the number of undesired reflections.

Novelda engineer, Jan Roar, explains, "We use a 2 cm metal



sphere to emulate the radar cross section of a baby's chest. The sphere is moved back and forth by a distance of just 4 mm while data is recorded by the XeThru Explorer PC application; the recorded data matches perfectly with data captured from a real sleeping baby." Instructions for building your own XeThru Bot can be downloaded <https://community.xethru.com/resources/xethru-bot.31/> from Novelda's community web page.

Complete article, here



How well do you understand S-parameters? - A short course in Stockholm

The Danish training company EE-Training has arranged for signal integrity expert Eric Bogatin to teach a course on S-parameters – in Stockholm, in September 2015 – for the first time in several years.

Eric Bogatin is the author of the book *Signal and Power Integrity - Simplified*. Today he runs the [Teledyne LeCroy Signal Integrity Academy](#) and is an Adjunct Professor at the University of Colorado – Boulder. And, is a long term contributor to the pages of EDN. After an interlude of several years when Eric has not presented public training courses, he has decided to present a limited number of live workshops exploring practical aspects of Signal Integrity Design, Measurement and Analysis: the motto is, "The most effective way of really learning signal integrity is by doing".

The first such course is "Practical

S-parameter Measurement and Analysis" in which Eric focuses on demonstrating the practical applications of the principles and tools to get you to the right answer faster. The Stockholm event is the second running of the course in the Nordic Region: in June, Eric presented it in Copenhagen, Denmark. On 14-15 September 2015, Eric will aim to help a further group of engineers, "join the 1% who really understand how to use S-Parameters to solve day to day design problems."

"S-Parameters have become the defacto standard to characterise the electrical properties of interconnects, yet 99% of engineers really have no clue what they mean," as Eric Bogatin explains. Eric is a leading proponent of teaching S-Parameters as an integral part of signal integrity.

Complete article, here



Trial transmission routes 38.4 Tbps traffic over 762-km fibre path

Socionext's latest generation of ultra high-speed digital-to-analogue (DAC) and analogue-to-digital (ADC) converters, featuring sampling rates up to 92 Gsamples/sec and high analogue bandwidth, have been integrated into coherent receivers and transmitters that were used in a recent record-setting field trial in France. Socionext – the enterprise that was formerly the high-performance SoC and ASIC arm of Fujitsu – provided its high-speed conversion SoCs as part of the record-breaking transmission field trial. For the first time, several tens of terabits per second have been transported over a 762-km fibre optic link – Lyon-Marseille-Lyon – in the Orange (France) optical transport network.

Socionext was part of a team of engineers from Orange, [Coriant](#),

Ekinops and Keopsys who successfully demonstrated the highest ever C-band transmission capacity using 24 x 1 Tbps/DP-16 QAM (i.e. 24 Tbps), 32 x 1 Tbps / DP-32 QAM (i.e. 32 Tbps) and 32 x 1.2 Tbps/DP-64 QAM (i.e. 38.4



Tbps) modulation formats in a 'live' networking environment. A record-setting transmission reach of 762 km in the same 'live' environment was achieved, which is more than twice the distance of any previous field records for 32 QAM, and the first ever regional transmission for 64 QAM. These achievements represent an important milestone in the research and development of highly scalable, spectrally-efficient optical

networking technologies for future network growth. As part of ongoing technology collaboration, Socionext provided key technology and components, in the form of development kits, to enable partners [to carry out]

the evaluation and optimisation of higher-order modulation techniques and next-generation algorithms. The new generation of transmitters and receivers used to establish the transmission record were based on ultra high speed DACs and ADCs designed and developed by Socionext's Network SoC Business Unit using a standard 28 nm CMOS technology.

Complete article, here



First in production with ARM Cortex-M7-based MCUs, says ST

ST has announced the STM32F7 Discovery Kit to enable design starts with the MCU

STM32F7 and Discovery kit Available now



series: ST asserts it is the first chip maker to begin volume production of microcontrollers featuring the Cortex-M7 processor. The architecture of STM32F7 MCUs combines the Cortex-M7 core with advanced peripherals, giving product designers opportunities to enhance application performance, add new functions, extend battery life, ensure security, and minimise use of external components. The architecture also, ST claims, saves designers' time in optimising code

performance and length, to allow extra focus on creating differentiating features in the end product.

The extensible STM32F7 Discovery kit builds on ARM's mbed and Arduino ecosystems. The kit comes with the STM32Cube firmware library, as well as direct support from an ecosystem of software-development tool partners and the ARM mbed online community. The Discovery Kit's open hardware,

priced at \$49.90, includes WQVGA touchscreen colour display, stereo audio, multi-sensor support, security, and high-speed connectivity. Together with an integrated ST-Link debugger/programmer (no need for a separate probe), unlimited expansion capability is provided through the Arduino Uno connectivity support and immediate access to a large choice of specialised add-on boards.

Complete article, here

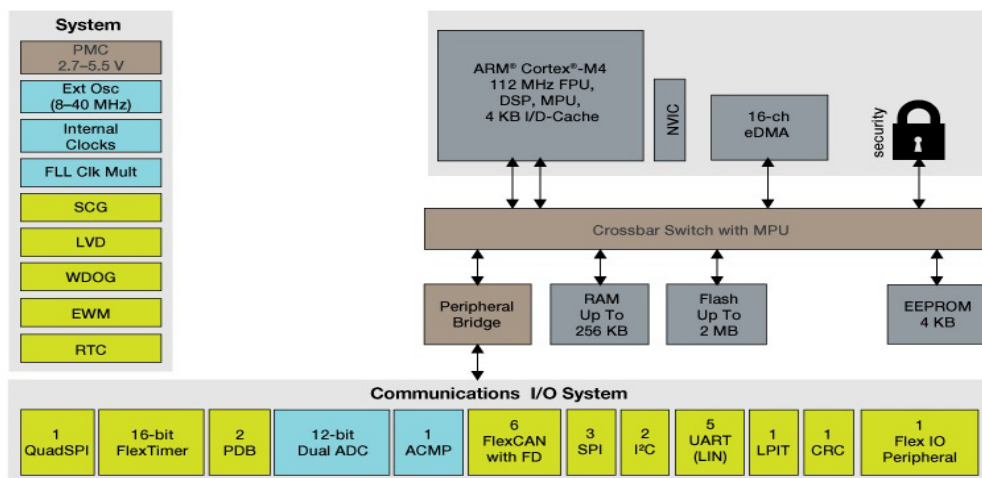


Freescall aims to make 32-bit MCUs “software engineer friendly”

Freescall’s S32K MCUs are presented as the first automotive microcontrollers designed for

S32K is, says Freescall, the first automotive MCU product line designed to significantly speed and

S32K Microcontrollers Block Diagram

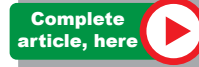


the software engineer; an automotive architecture based on ARM Cortex IP delivers software and hardware scalability for faster development through what Freescall terms future-proofing features and optimal software reuse. In a synchronised announcement, IAR Systems has a development tool-chain ready.

simplify software development. The S32K has an ARM Cortex architecture, bringing scalability and compatibility for a range of automotive electronics applications traditionally served by a mix of 8-, 16- and 32-bit MCUs, while providing a strong foundation for advanced tools and software platforms.

To streamline software engineering and advance automotive software development technology beyond the Autosar Microcontroller Abstraction Layer (MCAL), Freescall is introducing a comprehensive, automotive-grade software development kit (SDK) providing middleware for a set of drivers necessary to operate S32K MCUs. The company has created an open integration environment for developers targeting S32K MCUs. The new S32 Design Studio (DS) provides a platform capable of supporting a host of time-saving software and tools. DS is intended to eliminate months of R&D time across all phases of development, from rapid prototyping to production readiness and re-use on the next project.

Freescall also works in close collaboration with IAR Systems on high-end development tools and AUTOSAR support. IAR provides a set of software tools for developing safety applications, including a C/C++ compiler and debugger tool chain.



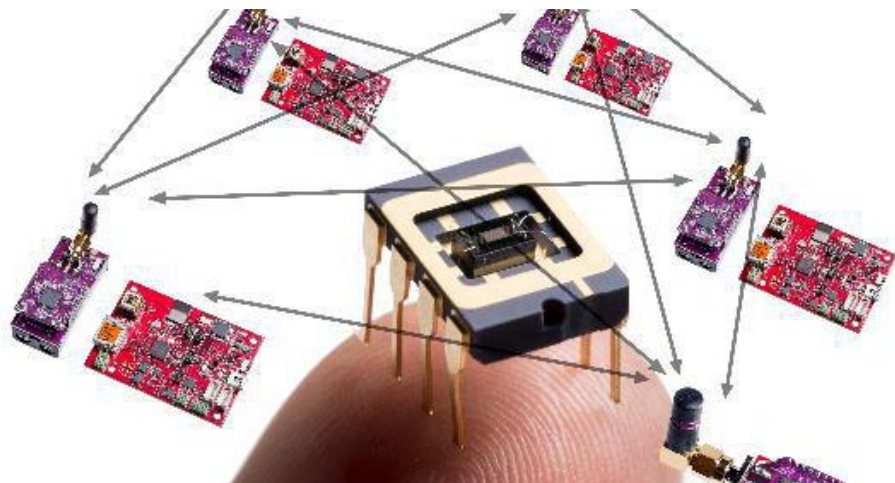
Gas sensing platform from imec builds 'intuitive internet-of-things' applications

Belgian research centre Imec and the associated Holst Centre have developed a small NO₂ sensor featuring a low power consumption in the mW range. The small, low power NO₂ sensors nodes are being tested real-life for air quality monitoring. The sensors have a low detection limit for nitrogen dioxide (NO₂) (<10 ppb) and a fast response time. They are particularly well suited for air quality monitoring and serve as a solution to the increased demand for accurate local air quality monitoring for indoor and outdoor environments. The sensors are being tested in real-life situations, as part of an environmental monitoring platform.

Imec comments that while wearable technology that measures

body parameters has become increasingly popular in recent years, the concept that imec terms Intuitive Internet of Things (I²oT) is next on the horizon: connecting everybody and everything everywhere with data stored in the cloud, turn-

ing is becoming more and more in demand, for both outdoor and indoor environments. Air quality is typically measured on just a few distinct locations per city, with specialised equipment. Many current gas sensors are



ing the massive amount of data in information to make the right decisions, to take the right actions exactly as we need or want. The I²oT, imec says, is expected to manage the sustainability, complexity and safety of our world. It will increase our comfort and wellbeing in many ways.

Health issues resulting from poor air quality are a growing concern for consumers and accurate moni-

large in size, have high power consumption and are too cost prohibitive to be implemented on a large scale for I²oT applications. Imec and Holst Centre have developed small, simple, low power and high quality autonomous sensors that wirelessly communicate with the environment and the cloud.

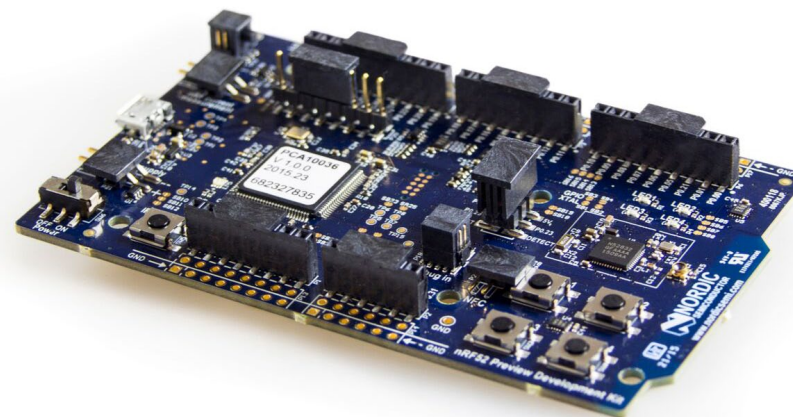
Complete article, here



Nordic adds NFC to Bluetooth, with ARM M4f core & low power drain

Nordic Semiconductor says its ARM-based, nRF52 Series of devices “redefines single-chip Bluetooth Smart”, by combining performance and power efficiency with on-chip NFC for Touch-to-Pair and with active management of functional blocks for minimum

power 2.4 GHz multi-protocol radio, and fully automatic power optimisation. Achieving a CoreMark score of 215 the nRF52832 delivers up to 60% more generic processing power than competing solutions, Nordic says. With hardware floating point (the ‘F’ in



power drain. nRF52832 is the first of Nordic Semiconductor's nRF52 Series Systems-on-Chip, with a 64 MHz ARM Cortex-M4F processor (the first time this core has been used in this type of chip, Nordic asserts), a high performance, low

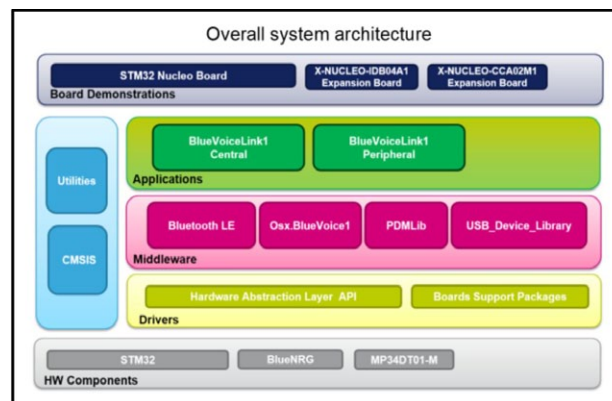
Cortex-M4F) the chip claims 10x floating point and twice the DSP performance of comparable products. At 90 CoreMark/mA the SoC is up to twice as power efficient as competing offerings, Nordic adds. Nordic has given the single-chip Bluetooth Smart device the added

function of integrated NFC tag capability that will allow Touch-to-Pair operation of end-user devices. "Current single-chip Bluetooth Smart solutions are struggling to keep up with the rate of innovation in Bluetooth Smart - the fastest growing wireless market in history - particularly in applications such as wearables and IoT," says Thomas Embla Bonnerud, Nordic Semiconductor's Director of Product Management. "The main reason being that until now greater performance could only be achieved at the expense of power efficiency. The nRF52 Series uniquely merges barrier-breaking performance and power efficiency together on a Bluetooth Smart single chip for the first time." As well as the Cortex-M4F processor, the device has 512 kB Flash and 64 kB RAM; its radio is multi-protocol for Bluetooth Smart, ANT, and proprietary 2.4 GHz operation, with -96 dB receiver sensitivity, 5.5 mA peak RX/TX currents, an on-chip RF balun and a fully-automatic power management system.



Voice-over-Bluetooth Low Energy for wearable and remote-control applications

BlueVoice drivers and libraries simplify product development with STM32 microcontrollers,



Bluetooth Low Energy IC, and MEMS sensors; voice control that can make wearable technology simpler and more battery-friendly, according to ST, is now easier to add with a software-based approach. In the wearables sector ease of use and extended battery life are already important points for buyers to consider, and voice control can enhance both by minimising touchscreen usage. ST's wireless ICs, microcontrollers, and MEMS

sensors are targeted for use in wearable electronics. With BlueVoice software, designers get all

the drivers and libraries they need to implement voice transmission over a Bluetooth Low Energy connection in systems built around ST's STM32 microcontrollers, BlueNRG ultra-low-power network processors, and digital MEMS microphones. All these are available in stackable development boards for easy prototyping.

Bluetooth Low Energy also offers advantages alongside Wi-Fi and ZigBee in Remote-Control Units (RCUs) for home-automation systems. ST's development platform with BlueVoice software, the company says, implements voice and gesture control using a MEMS microphone and motion sensors, to implement a more intuitive and natural user-interface.



Silicon Labs pairs Thread protocol stack with 15.4 silicon

Silicon Labs has announced its Thread networking solution, comprising a software stack that the company says has been refined to ensure completely robust networks; and a suite of mesh networking software development – network building, and network analysis – tools.

The stack is available for free download for any users who have purchased and registered one of the company's development kits for wireless networked products. The company sees the move as one that will help to unify a fragmented market, "as we move to a situation where the home has a completely IP-based environment, with WiFi, Bluetooth, and 15.4 wireless solutions in use, each being applied where they are most appropriate." The need for totally reliable networking in this context

is paramount, the company says, “you cannot move a thermostat or a lighting control around the room to ‘get a better signal’ - anything less than 100% response [in this market sector] is ‘broken’ and is a product return.” Accordingly, and while asserting that its protocol stack will produce the most-reliable results available, Silabs has bundled a network analysis toolset to help track down any failed or missing data packets, and to identify where a network might be falling short of ideal. You can use the analysis tools yourself, or you can save a log file that can be examined by Silabs’ applications support team.

Thread technology fills a gap in the IoT ecosystem, Silabs says, by providing the first standards-based, low-power mesh networking solution based on Internet protocol (IP), enabling reliable, secure and scalable Internet connectivity for battery-powered devices in the connected home. As a founding member of the Thread Group and the chair of the Group’s technical committee, Silicon Labs has been instrumental in defining and developing the Thread specification released by the Group. The stack will work with any of Silabs’ mesh networking SoCs: the combination of Silicon Labs’ Thread stack, EM35xx wireless SoC platform, and hardware and software tools provides, says the company, developers with a seamless migration path from ZigBee to Thread via over-the-air (OTA) upgrades. Silicon Labs’

hardware and software roadmap will enable multi-protocol, multi-band 2.4 GHz and sub-GHz wireless connectivity for the IoT. Thread software provides a self-healing, IPv6-based mesh network capable of scaling to 250+ nodes with no single point of failure. The protocol provides extensive support for “sleepy” end nodes to enable years of low-energy operation using a single battery as well as simplified commissioning. Users can add nodes to a network using a smartphone or browser. Silicon Labs’ Thread stack uses banking-class, end-to-end security to join nodes to the network and proven AES-128 cryptography to secure all networking transactions. Silicon Labs’ AppBuilder is the tool for development of IP-based mesh networking applications. AppBuilder enables developers to configure mesh networking applications for Thread protocol using Silicon Labs’ application framework, which isolates application code with a set of call backs and plugins, making the developer’s software portable and reusable across supported wireless SoCs in Silicon Labs’ portfolio. It is accompanied by the Desktop Network Analyser tool that, unlike traditional wireless sniffers, provides complete visibility of all wireless networking activity by using the unique packet trace port available in Silicon Labs’ mesh networking SoCs.



LOW-POWER, BATTERY POWERED SQUARE WAVE OSCILLATOR WITH HIBERNATION MODE.

BY CHAU TRAN, ANALOG DEVICES

In many audio, automotive and instrumentation applications, there are requirements for a low cost but highly stable and accurate square wave generator with a respectable level of output current drive. As we have often heard, there's always a demand for a low cost solution for a high performance application. The circuit

shown in Figure 1 addresses this demand by using only a low-cost dual op-amp with an optional shut-down function, and a few passive components.

The circuit of Figure 1 employs an ADA4807-2, which is a dual, low power, low noise, rail to rail voltage feedback amplifier. The first

op-amp, A, is the main square waveform generator, and the second one, B, is just the driver. This buffer can typically source or sink a linear output current of ± 40 mA. Generally, op-amp A acts like a comparator; there is a positive feedback loop in the presence of a slow negative feedback loop triggered by the RC circuit, which causes the circuit to oscillate automatically. When the capacitor reaches each threshold, the charging source is switched from the negative power supply to the positive power supply and vice versa.

The system is in unstable equilibrium if both the inputs and outputs of the comparator are at exactly zero volts. However, any noise will bring the output of the comparator above or below zero and the posi-

tive feedback in the comparator forces the output of the comparator to be at the rail until the next cycle.

Between the inverting input and the output of the comparator is a RC circuit. Because of this, the inverting input of the comparator asymptotically approaches the comparator output voltage with a time constant RC.

This time constant R.C determines the frequency of the oscillation;

$$f = 1 / (2 \cdot \ln(3) \cdot R \cdot C)$$

The duty cycle of the signal can be adjusted by changing the ratio of resistors R1 to R2. In this circuit, those two resistors are equal; therefore, the output is symmetrical.

The output of the driver swings as

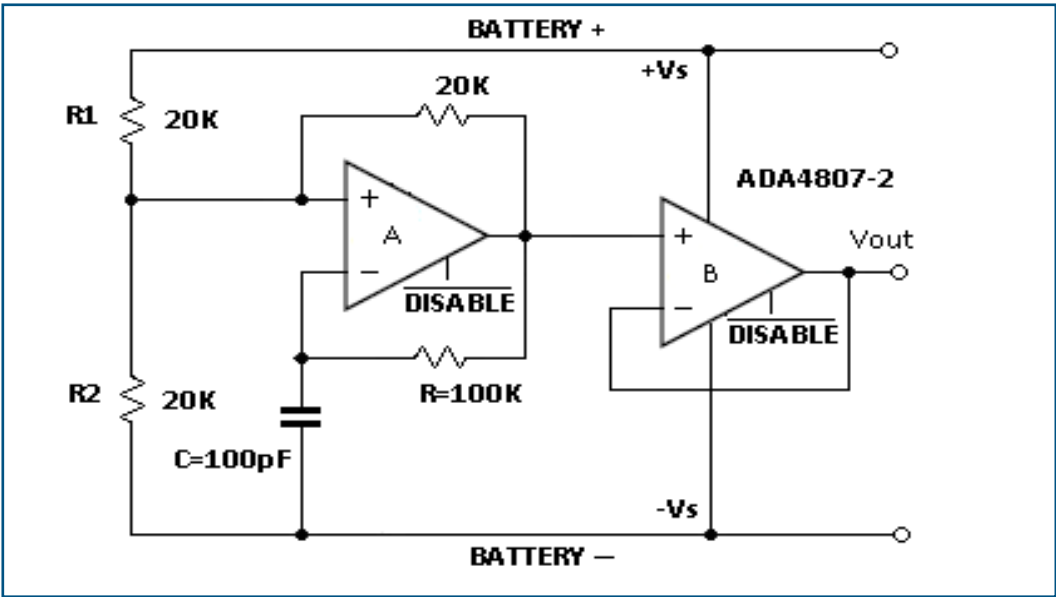


Figure 1. The square wave oscillator.

Chau Tran [chau.tran@analog.com] joined Analog Devices in 1984 and works in the Instrumentation Precision Technology (IPT) Group in Wilmington, MA. In 1990, he graduated with an MSEE degree from Tufts University. Chau holds more than 10 patents and has authored more than 20 technical articles.

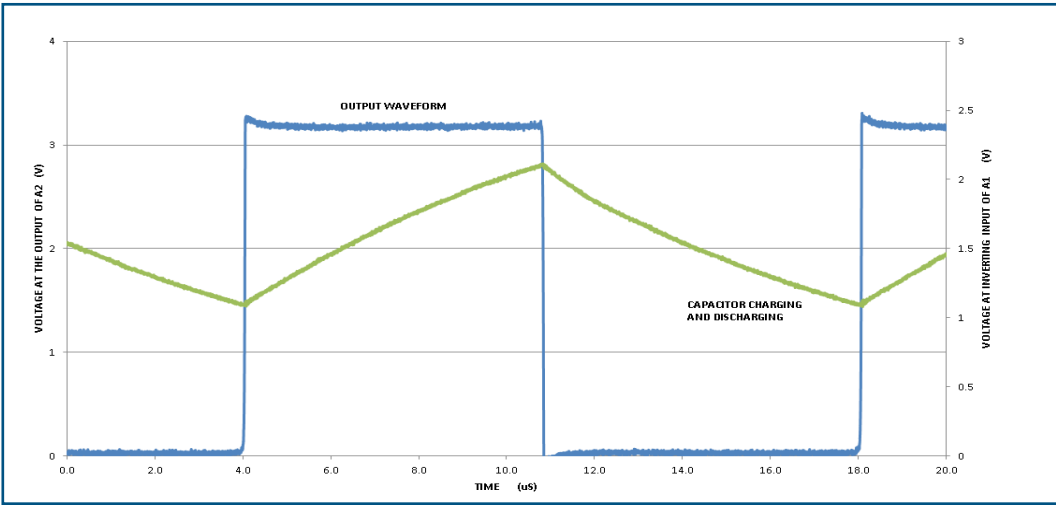


Figure 2. *The output waveform of the low cost square wave oscillator.*

far as 40 mV from the +/- rail with a linear output current source of 50 mA or sink of 40 mA (typically).

The oscillator can be switched on and off via DISABLE pins. This “hibernation” functionality of the disable circuit is a useful power reduction option. When the circuit is not in use, one can turn it off by pulling down the DISABLE pins to less than 1.1V. This will automatically reduce the supply current of the two op-amps to a negligible level within a 200 nsec time frame. The remaining system current is mostly from the resistor divider

R1 and R2. Once the device goes into hibernation mode the operating current of the battery is reduced from 2 mA to 80 μ A. The output enters a high impedance state but it takes less than 500 nsec for it to wake up and start running.

The dual op amp, shown in Figure 1 above, has a typical supply current of 2 mA with a 3 V supply level. When active, its power consumption is 6 mW. In hibernate mode, however, the typical supply current dramatically reduces to 2 μ A and the power consumption decreases to 6 μ W. This

represents a power saving ratio of 1,000:1.

The disable pins make switching between the two modes easy. With an extremely fast turn on and turn off time (a few hundred nano-seconds), there is almost no waiting time when switching between these two operations.

This type of circuit can be used as the timebase in many applications. The duty cycle can be changed by

changing the ratio of R1 and R2. With low power consumption, a rail to rail input/output, and a useful hibernation mode, this circuit can be powered by just two AA batteries which is very useful in power-sensitive applications. With the current driving capacity of the op-amp and quick turn-on, turn-off time, one can eliminate the use of a power transistor and enable time-interleaved power saving operation schemes.

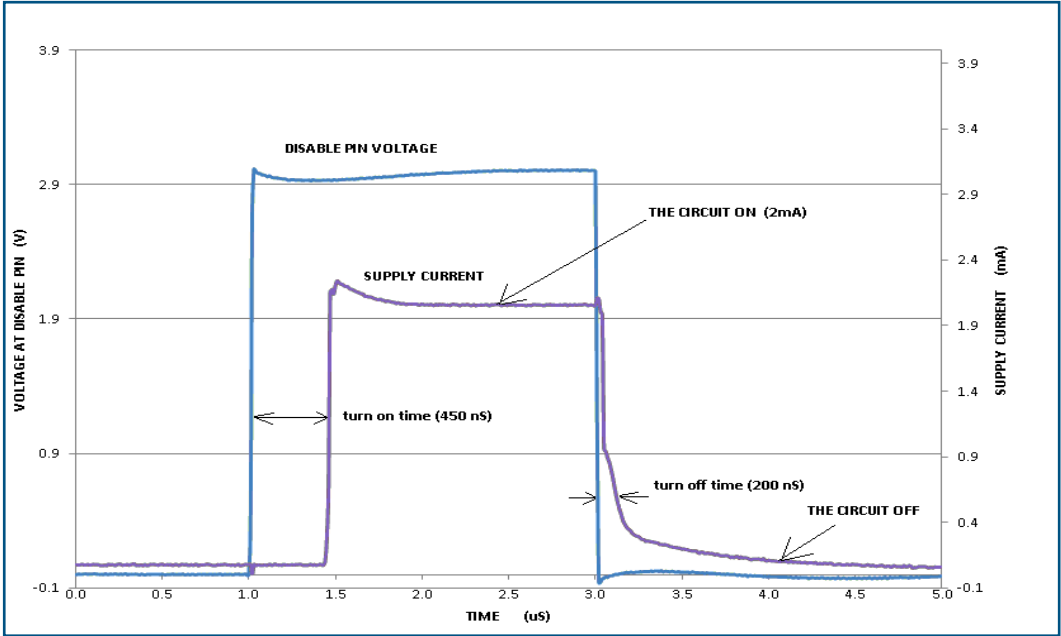


Figure 3. *The DISABLE functionality turns the circuit on and off quickly*

PCIE UPDATE: POWER, IOT, STORAGE, OCULINK, SIMULATION, AND EQUALISATION

BY RANSOM STEPHENS

Low power, IoT, mobile apps, and anticipation of Gen 4 headlined the 2015 PCI-SIG Developer's conference—though traditional PCIe applications on HPC (high performance computing) and PC (not as high performance computing) platforms remained the standard's leading role.

Looking a little closer at the tea leaves, I saw a lot of interest in simulation-measurement comparison and continued aggravation in trying to optimise clock recovery, equalisation, and crosstalk.

First things first: PCIe stands for peripheral component interface express. It has been around for decades and shows every sign of fulfilling a prophecy made three years ago: “All future client-based storage attachments will use PCI-Express.”

Ramin Neshati, Intel engineer and PCI-SIG's Marketing Workgroup

Chair, as well as being the seer who made the above prophecy, emphasised that “The Low Power Initiative is not new!” Half-swing specifications that operate at 400 mW have been around since the 2.5 Gb/sec first generation of PCIe. There will be a new 200 mW quarter-swing state included in Gen 4. Their goal for standby L1 sub-states is to get down to microwatts. PCIe has been [going mobile](#) for years with M-PCIe adapted to operate over MIPI's low-power M-PHY.

When we say IoT (internet of things), what we really mean is low power and big data from billions of networked gadgets. PCIe's prowess stands out in moving the massive amount of data created by IoT doodads (a.k.a. ‘things’). NEC had a handout with a graphic (Figure 1) that I thought caught the situation: the physical world as a source of data from gadgets, monitors, surveillance, and all the things lurking around us whose data must find

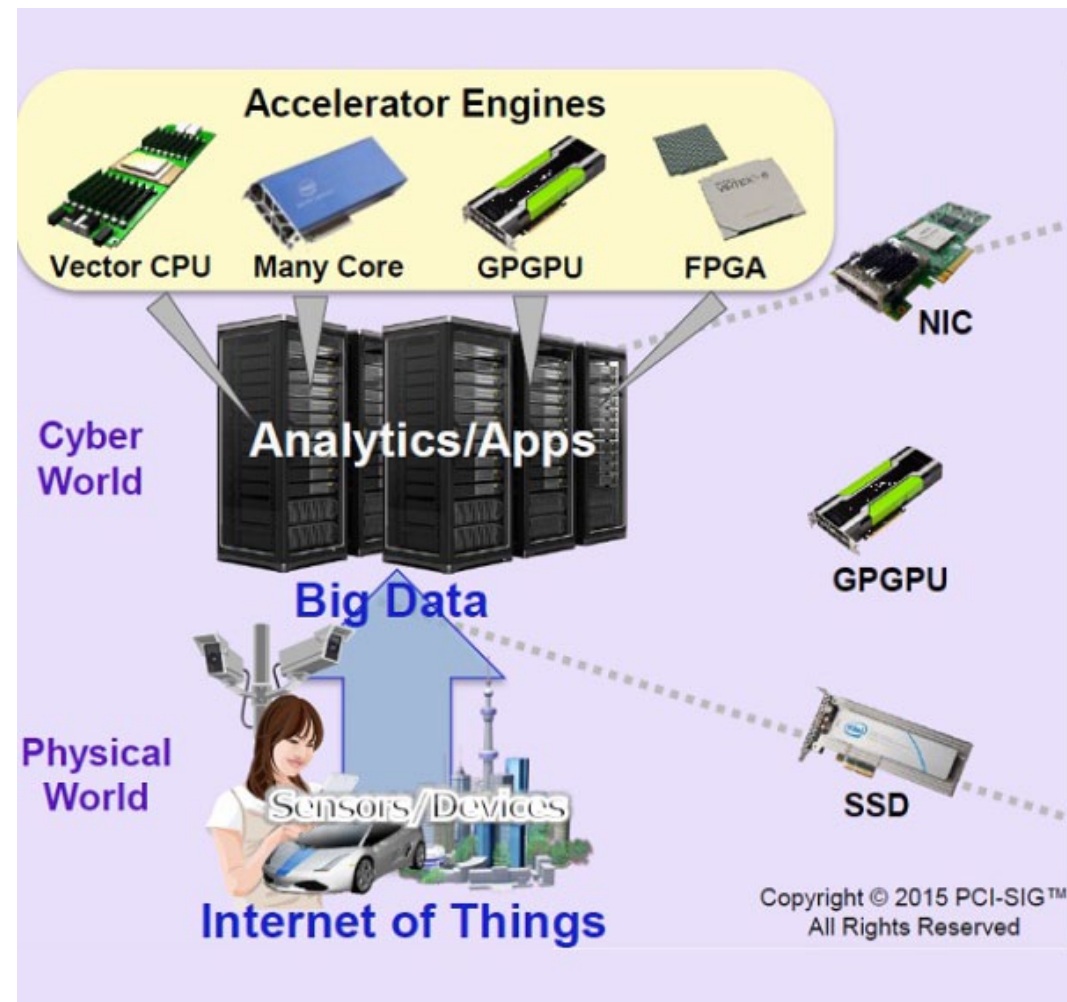


Figure 1. The graphic I cut from the NEC slide that was in the PCI-SIG press handout (hacked by Ransom, Copyright 2015 PCI-SIG)..

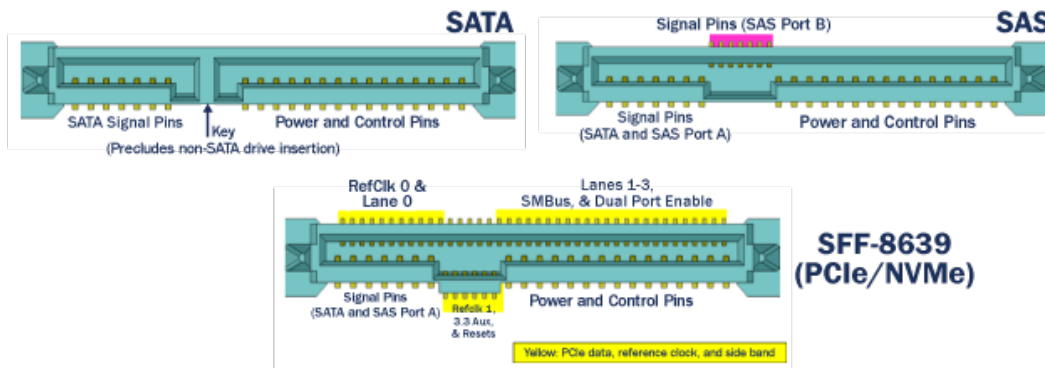


Figure 2. Comparison of storage connectors (Source: Demartek.com)

its way to servers and storage.

Neshati's prediction from 2012 about PCIe storage is embodied in NVMe (non-volatile memory express)—the specification for PCIe-SSD interconnects. The proliferation of SSD (solid state drive) storage renders several support features for spinning discs in SAS (serial attached SCSI; small computer system interface) and SATA (serial advanced technology attachment) nearly obsolete. Without that overhead, NVMe is a friendlier technology. Now add in SFF-8639 (small form factor) connectors that support everything, and PCIe makes an obvious hot-

pluggable backbone for high-density SSD storage attachments.

The specification covering the best acronym in the business, OCUlink (optical/copper link) is out for final review. Neshati said that it's "pretty much done." Expect to see version 1.0 of the specification this autumn. OCUlink specifies wide bandwidth (up to 32 Gb/sec in PCIe gen 3) cables that can be many metres long. It's up to the manufacturer whether they use fibres or wires, as long as the cables comply with the signal integrity specifications.

I'm disappointed to report that I

didn't see any OCUlink cables at the exhibits. Samtec had several cables on display that use optical fibres for pristine data transfer across many metres with built in e-o and o-e converters at the connectors but nothing labelled OCUlink.

You can tell what really concerns developers by how they spend their time—actions, after all, speak louder than press briefings. Since this is a quickly swallowable anti-pasto-like update, I'll present the following two main-course topics in detail right here in my next two installments.

Circuit & system simulations

The first challenge (the primo, as it were; usually a pasta dish) isn't new, but if the number of people working on it is any indication, no sure-fire solution has emerged. Every test and measurement company at the 2015 PCI-SIG dev conference featured tools for verifying system and circuit simulations.

As simulation has become recognised as the better, cheaper, faster

way to design circuits, their accuracy has become an ever more important question. The question is usually phrased: "How do I know if my simulation correlates to reality?" but it extends to analysis of real signals that are buried on chips, inaccessible to probing. We'll cover this in detail next time.

The secondi (a nice New York bistecca, if you will) comes from the developers of PCIe gen 4, the 16 Gb/sec version. Three separate presentations covered variations on the theme of how to optimise the combination of FFE (feed-forward equalisation) at the transmitter—usually called de-emphasis—and clock recovery, CTLE (continuous time linear equaliser) gain, and number of DFE (decision feedback equalisation) taps at the receiver. I'll serve up some surprising results right here in this column, with a side order of [cross-talk](#). It should make a satisfying summer meal.

LINEAR REGULATORS STEP UP TO “ULTRA” PERFORMANCE IN NOISE AND PSRR

By Amit Patel, Linear Technology

The most noise-sensitive applications demand linear regulators with ultralow output noise and ultrahigh PSRR performance; when it comes to powering noise-sensitive analogue/RF applications, low dropout (LDO) linear regulators are generally preferred over their switching counterparts. Low noise LDOs power a wide range of analogue/RF designs, including frequency synthesisers (PLLs/VCOs), RF mixers and modulators, high speed and high resolution data converters (ADCs and DACs) and precision sensors. Nevertheless, these applications have reached capabilities and sensitivities that are testing the limits of conventional low noise LDOs.

For instance, in many high end VCOs, power supply noise directly affects the VCO output phase noise (jitter). To meet overall system efficiency requirements, the LDO usually post-regulates the output of a relatively noisy switching converter, so the high frequency power supply rejection ratio (PSRR) performance of the LDO becomes paramount. With ultralow output noise and ultrahigh PSRR performance, newer devices can directly power some of most noise-sensitive applications while post-regulating the output of a switching converter, without requiring bulky filtering. Table 1 (see complete pdf

version of this article) illustrates the noise performance now achievable with conventional low noise regulators.

Despite achieving these levels of performance, the LT3042 maintains simplicity and robustness. Figure 1 is a typical application and Figure 2 shows a complete demonstration circuit. A 3 × 3 mm DFN package and minimal component requirements keep overall solution size small.

Designed as a precision current reference followed by a high performance voltage buffer, the device can be paralleled to increase output current, spread heat on the PCB and further reduce noise—output noise decreases by the square-root of the number of devices in parallel. Its current-reference based architecture offers wide output voltage range (0V to 15V) while maintaining unity-gain operation, thereby providing virtually constant output noise, PSRR,

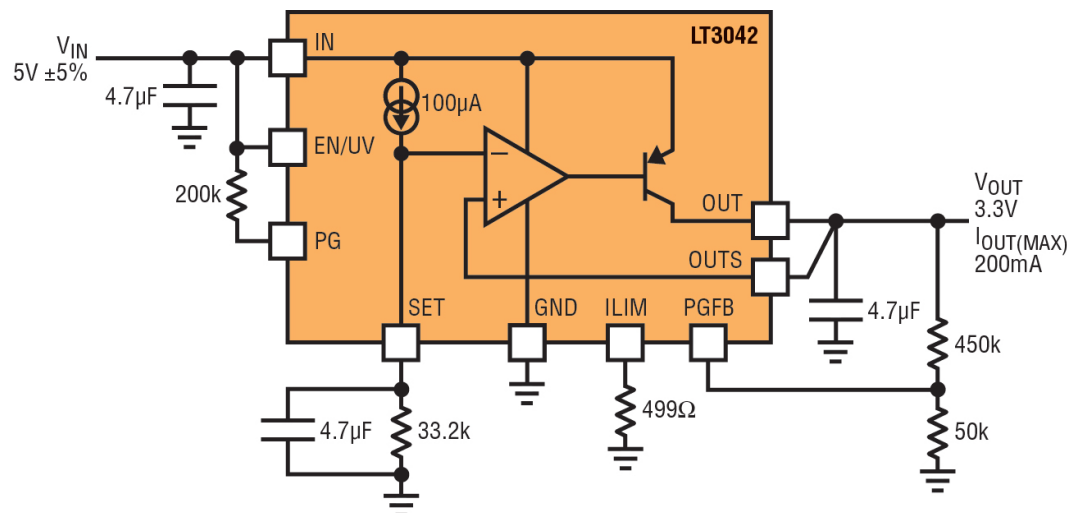


Figure 1. Typical LT3042 application

bandwidth and load regulation, independent of the programmed output voltage.

In addition to offering ultralow noise and ultrahigh PSRR performance, the regulator includes features desired in modern systems, such as programmable current limit, programmable power good threshold and fast start-up capability; and it incorporates protection features for battery-powered systems. Its reverse input protection circuitry tolerates negative voltages at the input without damaging the IC or developing negative voltages at the out-

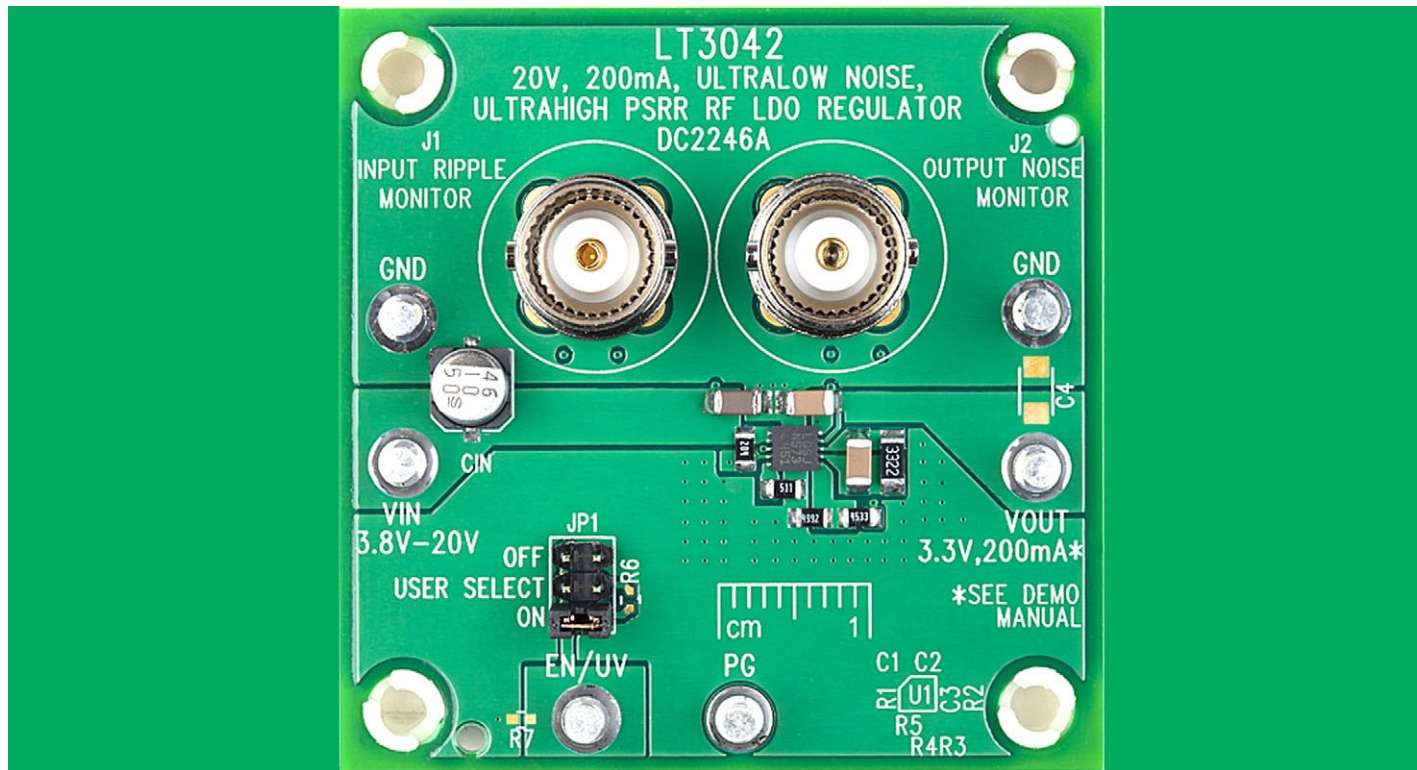


Figure 2. LT3042 demonstration circuit

put—essentially acting as if an ideal diode were connected in series with the input. In battery backup systems where the output can be held higher than the input, the regulator's reverse output-to-input protection circuitry prevents reverse current flow to the input supply. The

device includes internal foldback current limit, as well as thermal limit with hysteresis for safe-operating-area protection.

The article continues with guidance about realising the potential of the ultra-low noise performance in practical layouts – [click for pdf](#).



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NEWEST-GENERATION POWER MODULES FURTHER SIMPLIFY POWER DESIGN

By Robert Nicoletti, Maxim Integrated

There is a fundamental advantage of designing with a power module: you focus on the core IP and make use of of someone else's power-supply design. Yesterday's off-the-shelf printed circuit board (PCB) power modules are being replaced by better and smaller system-in-package (SiP) modules.

These next-generation power-supply SiP modules anticipate and resolve today's new design challenges. Power modules are now easier to use, smaller, and further reduce the total build-of-materials (BOM) cost. The best of these next-generation modules have even higher efficiency than before, are pin-to-pin compatible across different voltages and currents, and are designed with an easy migration path for cost reduction.

Power-supply design is not easy

Core power-supply design issues are problematic because they can lengthen time to market. If not resolved, the design challenges can even cause a system to fail in the field. It is not easy to design a robust power supply from the ground up, especially one that includes a switching-regulator integrated circuit. The typical approach, a complicated mix of discrete

components, requires specialised expertise and knowledge to keep the circuit free of problems.

Discrete power-supply designs also require many external components which, in turn, require time and effort to source, stock, order, and surface mount. When choosing external components for a discrete power supply, careful judgement is critical. For example, inductors of the same inductance value can have different saturation points, causing problems when fast transients demand high currents. There are many styles of inductors, all with different factors that control their specifications, including the exact magnetic core material, coil shape, separation between turns, frequency response, DC resistance, quality factor (Q), and shielded versus nonshielded. Choosing the wrong inductor may cause problems such as instability, spiking at the input or output, or even complete failure if the inductor is not properly suited for the system's power requirements. Capacitors can also cause instability if not properly chosen, since their value may vary over frequency, voltage, and temperature.

Even the availability of components can be challenging to ensure. Discrete power designs

also usually mean a larger PCB layout, which adds PCB area when—more than ever—space is at a premium.

Power modules replace discrete designs

A power module...what are we really talking about? Think about advances in smaller-geometry processes, IC design, and integrated package technologies. With these innovations, module manufacturers can combine the passive components needed for a power-supply circuit and the base ICs into a single, small, power-supply solution. Synchronous switching regulators integrate FETs that are smaller, more efficient, and more accurate than older switchers. The latest power-module solutions merge these new synchronous switchers with components such as resistors, capacitors, MOS-FETs, and inductors into a simple-to-use hybrid power module that reduces solution size, cost, and layout complexity.

Defining an ideal power module

Many power modules available today are simpler to use than ICs but do not fully address all system design challenges. An ideal module should speed time to market by combining a

POWER SUPPLIES

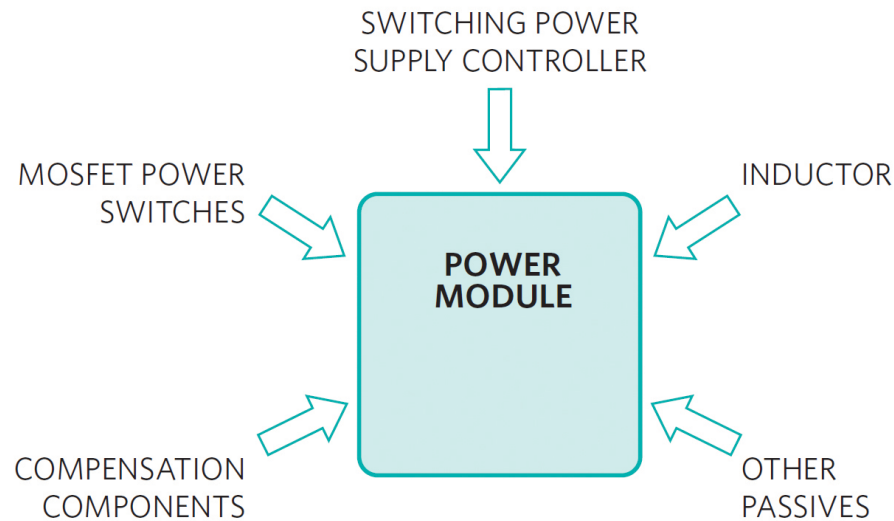


Figure 1. SiP power modules integrate all the key components needed for a complete power supply

low total cost of ownership with other key design benefits such as:

- High efficiency and low power dissipation, based on customer-proven robust ICs
- Small size, achieved by integrating more components
- Ease of use, with pin compatibility across voltages and currents for design flexibility
- Flexibility, with a transparent cost-reduction option ideal for migrating from module to IC for volume production

Today there is a reliable new generation of SiP power solutions that eliminates the problems of discrete designs. A SiP solution offers the key design needs listed above and allows engineers to spend their time on other critical design areas (Figure 1).

The article continues by looking at some aspects of the internal architecture of PSU modules, and the design options they offer – click for pdf.



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AN ULTRA-WIDE INPUT, LOW POWER, FLYBACK TOPOLOGY POWER SUPPLY

By Matthias Ulmann, Texas Instruments

In the field of industrial applications and factory automation a wide variety of supply voltages for devices are present. Typically you find 24 VAC, 24 VDC, 110 VAC, 230 VAC and sometimes also some voltages in between. A manufacturer of electronic devices usually does not like to develop different power supplies for each input voltage due to cost reasons. Different power supplies mean different electronic components and assembly variants: more part numbers for devices with the same functionality but only a different supply voltage increase the administrative overhead. But also from a customer's perspective a device with a "universal" input voltage is beneficial. For example a technician might be called to a factory somewhere at the other end of the world to repair machinery urgently and the spare part on-site is rated for 230 VAC but instead one for 24 VDC is needed; the repair gets delayed and costs might also increase. So it is not only beneficial and easier for the manufacturer to have a device with a large input voltage which can work on most of the available power sources, but also for the customer. This article presents an isolated flyback converter with an ultra-wide input voltage range for low power applications. **Controller**

The input voltage range is specified with 19~265 VAC or 19~375 VDC respectively. One output rail supplies a microcontroller and analogue circuitry (5.0V at 15 mA) and the second rail provides 12.0V at 40 mA to control a relay. A hold-up time of 25 msec is necessary to bring the device into a safe state in case the input voltage fails. Because isolation of 2.5 kV is needed between the input and the two outputs, the simple and well-known flyback converter is a configuration that immediately suggests itself. This topology typically operates in discontinuous conduction mode for low power applications and in continuous conduction mode for higher power applications. A huge variety of controllers is available but the maximum input voltage is mostly limited to a voltage around 60V. Flyback controllers for low-power offline applications such as the UCC28700 usually employ a quasi-resonant or valley-switching technique to reduce the switching losses and increase efficiency. This mode makes it necessary to work always in discontinuous mode. With this device it is easy to design a flyback

converter for a high input voltage but its use for a low input voltage application is limited by the minimum input voltage of 21V (typical). Therefore, a simple boost controller, in this case the LM3481, is used, which is capable of working in discontinuous and continuous conduction mode on an input voltage range of 2.97V up to 48V.

The block diagram (Figure 1) shows the converter including input filter, rectifier, start-up circuit and the LP2980-5.0 linear regulator on the secondary side.

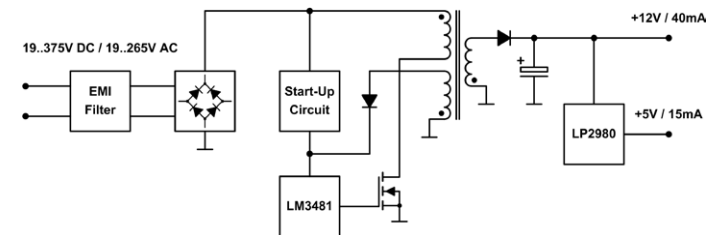


Figure 1. Block diagram

The article continues with discussion of the design challenges posed by the ultra-wide input range requirement, including magnetic component design and maintaining losses at acceptable levels – [click for pdf](#).



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MARITIME HMIs FOR OCEAN-GOING VESSELS

By Frank Schäffler, Product Manager, Süttron

Selection of appropriate human/machine interfaces (HMIs) is highly application-dependent. This article gives an insight into how those choices are affected by one very specific environment – that of yachts and commercial shipping.

Maritime HMIs can be found in many places on a ship – from the bridge down to the engine room; on a yacht just as likely as on a super tanker, container vessel or cruise ship. Wherever they are used, they display and record values, alert operators or send instructions to the connected control unit. However, depending on where the HMI is used, the requirements differ. On-board ships, strict rules apply that are governed by standards and approval processes, and HMIs must come with the required certificates to prove they are fit for maritime use. In addition, OEM ship suppliers can choose from a variety of display sizes, touch technologies, processor performance and operating systems to build an HMI that integrates perfectly into their overall system. Süttron achieves scalable computing power through the use of Qseven COM modules, and specifically, uses congatec's Qseven module with the Intel Atom processor in conjunction with the Microsoft

Windows Embedded Standard 7 (WES7) operating system for its P Line HMIs.



Figure 1. Maritime HMI used on an ocean vessel

Bridge access: EN 60945 approval required

HMIs for use in the particular environment of the bridge must meet the EN60945 standard: this covers a number of different aspects, some of which will be familiar to engineers working in

other areas – for example, environmental; resistance to salt spray, or conformance to specified limits to EMI emissions. Other parameters will be less familiar – for example, the standard sets limits on magnetic fields generated that might affect the indications of a magnetic compass. Süttron HMIs are approved and meet the compass safe distance requirements – both of which are mandatory for use on the ship's bridge. But, what else is important in an HMI under these circumstances? If you put yourself in the shoes of the user, the requirements become clear.

Full sunshine; screens need to display information clearly, even when the sun shines directly on the HMI. Bonded optical displays achieve particularly good results under such circumstances. In optical bonding, the touch-screen is laminated to the LCD to remove any air gap. Without an air gap, there is no refraction or reflection as light passes through a homogeneous optical medium. As a result, the display can be perfectly readable even at relatively low light intensities of 300 to 400 cd and in direct sunlight. The HMI uses energy more efficiently and the backlight ages more slowly resulting in a longer life for the device. The anti-reflective coating on the front panel also absorbs unwanted reflections – an important benefit when used on the open flying bridge.

Pitch-black nights; The bridge is manned around the clock. Bright sunlight is followed by the darkest nights. The screen glows. The HMI features two prominent buttons with which the officer can dim the brightness to a comfortable level. If necessary, the screen may be completely turned off, if a situation arises where the full range of (human) night vision is called for. The buttons can also be safely and easily operated while the user is wearing gloves.

Alarm under deck; The duty officer knows that he will not miss an alarm even when the screen is turned off – a buzzer built into the HMI makes sure of that. If the crew or ship's engineer is needed for a high-priority alarm, they are woken up by an alarm device in their cabins. For this purpose, the HMI is equipped with a floating output that can be connected to an external alarm device.

Special application needs; ballast water management

A ship usually performs best when fully loaded. It is easier to manoeuvre and can move faster. Since vessels don't always carry a full load; ballast water from the local port is added to compensate. This ballast water contains typi-

cal local bacteria, micro-organisms and small sea creatures that are transported to distant ports by the ship. Until recently, these micro-organisms were pumped out together with the ballast water when the ship reached its destination. The unwanted maritime invaders harm the native flora and fauna, with incalculable economic consequences. (The example of the Chinese mitten crab is a case in point; it came to Europe from Eastern China in the early 20th century.) To prevent similar environmental damage, the International Convention for the Control and Management of Ships' Ballast Water and Sediments, for short the Ballast Water Management (MWM) Convention, was adopted in 2004. It stipulates how the ballast water must be cleaned and treated before it may be discharged. The convention regulates ballast water management, its implementation and monitoring, which plays a significant part in specifying the HMI.

HMI ballast water purification systems log these processes and store the resulting data in a tamper proof format. They are usually placed in the machine or control room; HMI devices in Süttron's P Line meet these environmental requirements. Critical properties include an operating temperature range of -20°C to +60°C;

optionally, additional CAN or RS232/RS485 interfaces, as well as a redundant communication system consisting of two independent Gigabit Ethernet interfaces. Because data needs to be stored long-term, SD cards or USB sticks are used as removable storage. To be suitable for use in ballast water management systems, an HMI also needs high performance. Devices running Windows CE are therefore currently being phased out in favour of Windows Embedded Standard 7 devices.

Bilge and fluid management

In the bilge (the lowest compartment on a ship) it remains cool even when temperatures outside are soaring. Therefore, condensation tends to gather in the area, especially from the air conditioner. This bilge water is often contaminated with oil and fuel. Before it may be pumped into the sea, it requires professional treatment. Bilge management systems also contain HMI terminals, with similar requirements to ballast water management systems. In addition to ballast and bilge water, other liquids such as hydraulic oil are also monitored.

Frank Schäffler continues his insight into the specialised needs of the maritime sector, mentioning some further locations where HMI installations monitor on-board functions – click for pdf



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CAPACITIVE TOUCH

IMPLEMENTING GLOVE TOUCH IN CAPACITIVE TOUCH USER INTERFACES

By Joshan Abraham, Vibheesh Bharathan, Cypress Semiconductor

Capacitive touch-sensing user interfaces are replacing mechanical buttons in products across consumer, medical and industrial segments. However, with the advent of touch-sensing user interfaces, end-users are demanding advanced features such as haptics support and glove touch to mimic mechanical button usage, as well as additional features such as stylus support and proximity sensing.

These features improve the overall user experience of the product and offer manufacturers the opportunity to differentiate themselves. This article focuses on one of these features – glove touch, which is increasingly finding use in consumer, industrial and medical spaces. For example, the touch interface on a wearable smart band should work properly even when the user has gloves on because of cold weather conditions, or medical laboratory equipment should work properly even when touched with latex gloves.

However, implementing glove touch on capacitive touch interfaces is not easy, and most implementations tend to offer unreliable and inconsistent performance. This article focuses on the challenges in implementing glove touch on capacitive touch buttons and how these

challenges can be overcome to design a robust and reliable touch-sensing interface with glove touch capability.

There are two primary challenges to implementing reliable glove touch, they are:

- Detecting low signals produced by a gloved hand
- Ignoring false touches from a finger hovering above the sensors

Why glove touch produces a low signal

Capacitive touch sensing works on the principle that a finger introduces a change to the capacitance of a sensor when the finger touches the overlay covering the sensor. This change in capacitance is measured and converted to the digital domain (A to D conversion) by a touch-sensing controller. When the measured value exceeds a pre-defined threshold, a touch

is registered.

The change in digitised capacitance due to a finger touch is known as signal and the unintentional change in digitised capacitance without a finger touch is known as noise. A signal-to-noise ratio (SNR) of 5:1 is recommended for a reliable touch-sensing system. Figure 1 shows how capacitance is measured in a touch-sensing system.

In simple terms, capacitance introduced by a finger can be viewed as a parallel plate capacitor, where the finger and the sensor are the two conductive plates and the overlay is the dielectric medium between the plates. The finger-introduced change in capacitance is proportional to factors such as the size of the sensor and

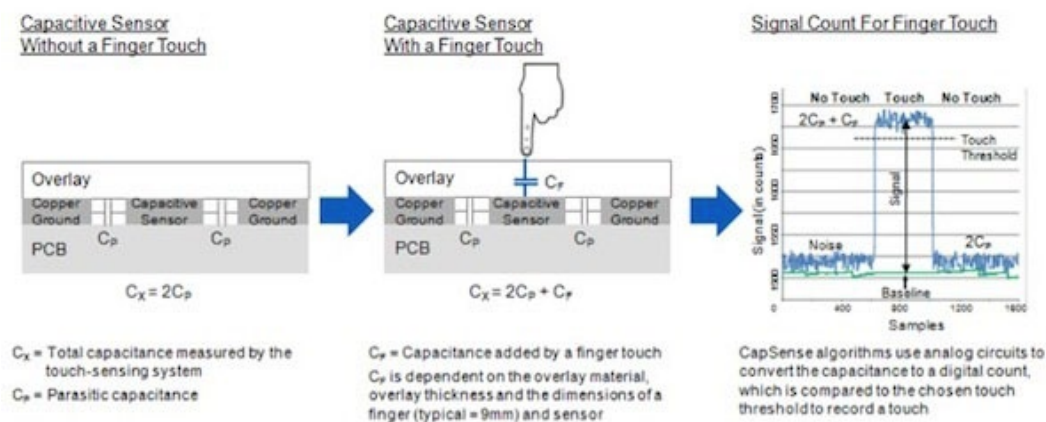


Figure 1. Capacitance measurement in touch-sensing systems

CAPACITIVE TOUCH

the finger (i.e. area of plates) and the dielectric constant of the overlay material; and inversely proportional to the thickness of the overlay on top of the sensor (i.e. the distance between the plates). A thicker overlay increases the distance of separation between plates, thus producing a smaller change in capacitance. This leads to a lower signal-to-noise ratio.

Wearing a glove on a finger adds a new overlay proportional to the glove thickness on top of the existing overlay increasing the overall overlay thickness. This decreases the strength of the signal below the pre-defined threshold and a touch with a gloved hand is typically not detected. This is the reason why most users have to remove their gloves to effectively touch a button on a capacitive touch-sensing user interface.

Unwanted hover and false touches

A touch sensor can be tuned to work with thicker overlays by increasing its sensitivity. Similarly, a touch sensor can be tuned to detect a touch, even when touched by a gloved hand. Increasing the sensitivity of a sensor means that it requires a smaller change in capacitance to detect a touch.

However, the problem here is that it produces a condition known as “unwanted hover”, where a bare finger in close proximity to the sensor (hovering above the sensor) produces an equivalent capacitance change as introduced by a glove touch. An erroneous touch could be registered as a glove touch even though the finger neither touched the sensor nor did it have a glove on. This condition is mostly undesirable and can adversely affect the user experience of the product. Figure 2 indicates the signal produced by a glove touch, finger touch and a hovering finger.

A designer hence faces the following problem: A system tuned for regular touch-sensing doesn't pick up touches from a gloved hand and a system tuned for glove touch produces

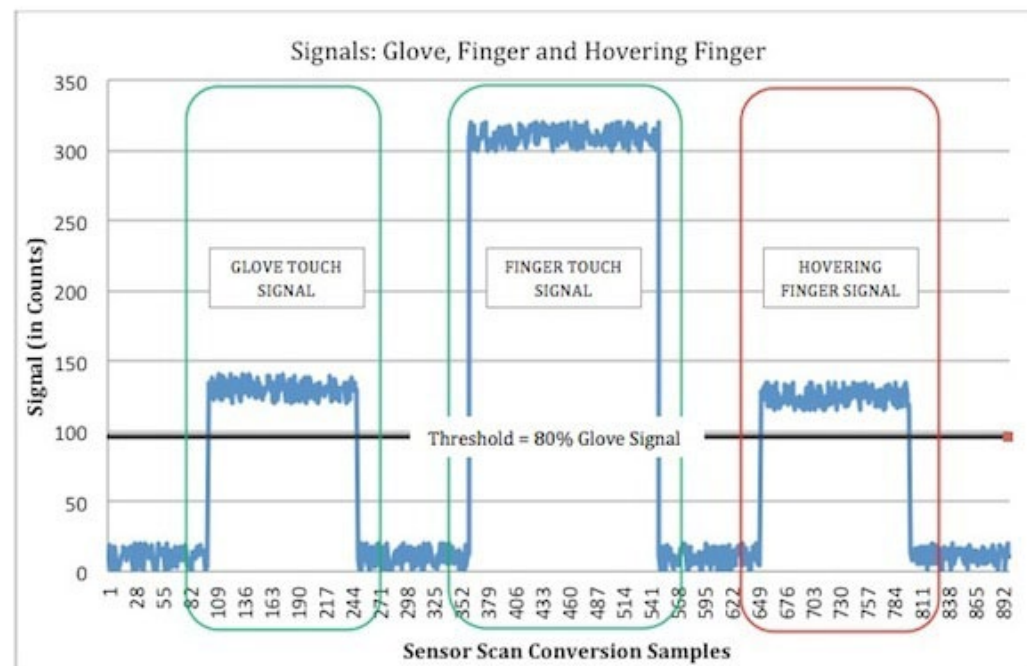


Figure 2. Signals from a glove touch, a finger touch and hovering finger

false touches due to “unwanted hover”.

An easy, if inelegant solution would be for the design to add a user-triggered interrupt or physical switch to indicate if they are wearing a glove or not. This diminishes the user experience, especially in consumer products that need to have “one action less” and in medical products which need to work the same in all conditions.

The article continues with a discussion of how to improve signal strength – click for pdf.

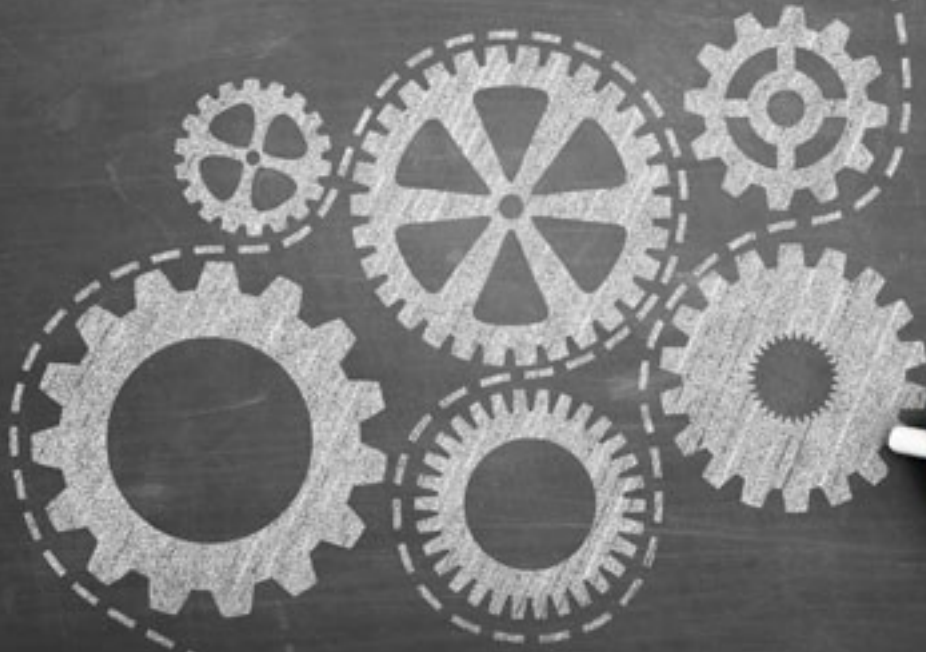


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designideas



- Gain-selectable IC yields voltage-to-current converter
- Simple SSR has zero-cross on/off switching

Gain-selectable IC yields voltage-to-current converter By Stefano Salvatori



The LT1991/5/6 gain-selectable amplifier chips by Linear Technology [Reference 1] can be configured into either inverting, non-inverting, or difference amplifiers. Their integrated, precisely matched resistors and compensation capacitors allow one to configure the op-amp into several circuit without needing external components. This Design Idea shows how to configure LT199x amplifiers to realise precision V-to-I converters with very high output resistance.

Following the circuit attributed to prof. Bradford Howland of MIT around 1962 and published in 1964 [Reference 2], the schematic of Figure 1 shows the connections adapted for a voltage-to-current converter based on the LT1995 (a very interesting discussion on the Howland current pump can be found in [Texas Instruments] AN1515 by R. A. Pease [Reference 2]). The integrated resistor values – in the kilohm range – give rise to a V-I conversion factor of the order of 1 mA per volt. The circuit is intended to be used, for example, as current source for a PT100 RTD for which a fixed supply current is necessary for resistance-to-voltage conversion. For lower output currents, the LT1991 and LT1996 can be used.

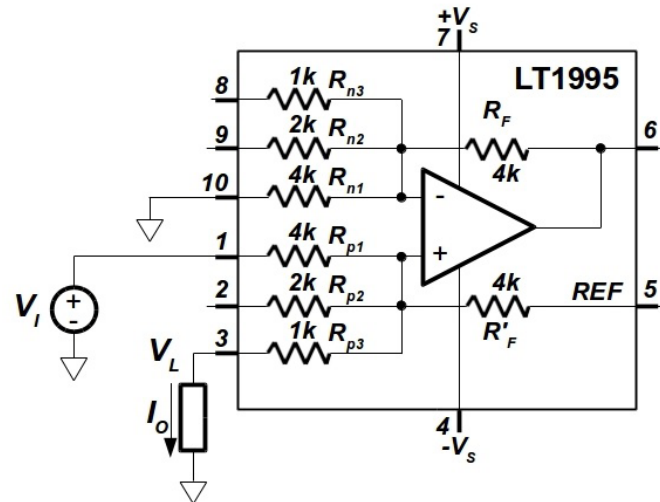


Figure 1. Example of the Howland circuit based on the LT1995 gain selectable single-chip amplifier

The pins of the LT199x allow both negative and positive feedback connections, the latter via the REF terminal, which is generally used as voltage reference/offset input. Because the (+) node is not directly accessible, the load is connected to the non-inverting op-amp input via R_{p3} , the drawback being a decrease of the output voltage compliance equal to $I_O \cdot R_{p3}$ compared to the original Howland scheme.

If $R_F / R_{n1} = R'_F / R_{p1}$ (as here), the circuit acts

as an ideal voltage-to-current converter, with a load current given by:

$$I_O = \frac{1}{R_{p1}} V_I \quad (\text{Eq. 1})$$

For the circuit of Figure 1, the load current I_O flows as indicated for $V_I > 0$. However, I_O can be reversed by applying a positive V_I to R_{n1} (pin 10), with R_{p1} (pin 1) connected to ground. In general, a voltage can be applied between pins 1 and 10 to generate the proportional I_O current into the load.

The Figure 1 circuit is just one possible example using this chip. Obviously, the balanced bridge condition has to be respected (R_{nx} and R_{px} have to be equal, given that $R_F = R'_F$). Meeting these conditions, an ideal infinite output resistance of the equivalent current source would be theoretically guaranteed.

In Figure 2, the output current as a function of the input voltage is shown. The inset shows the relative non-linearity error measured for V_I between 0V and 5.5V (for a supply voltage of $\pm 5V$). It is worth noting that an error lower than $\pm 0.1\%$ in the 1V-5V range is guaranteed.

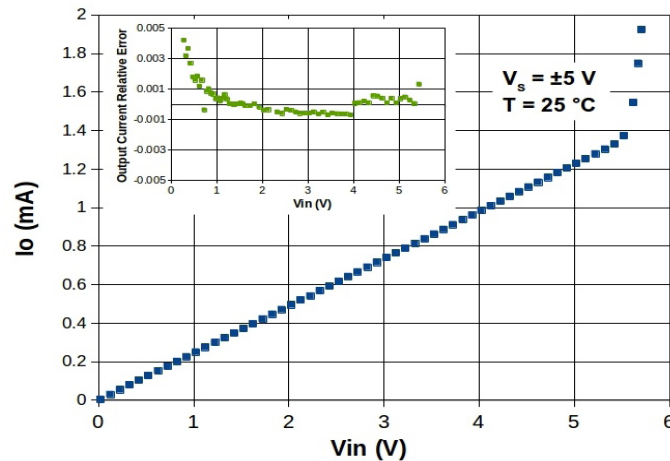


Figure 2. Figure 2 Output current vs. input voltage for the circuit of Figure 1 (inset: relative error of the output current versus the input voltage)

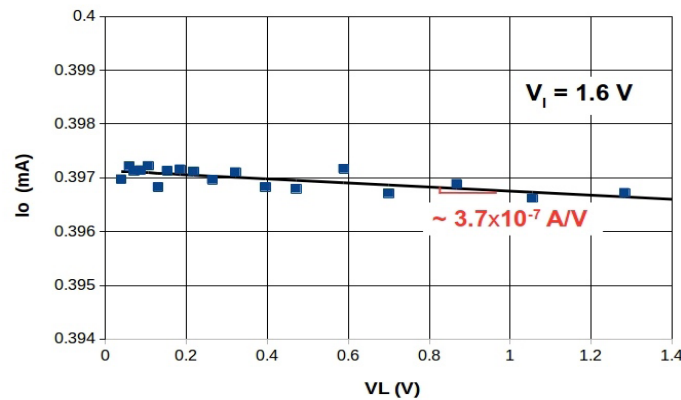


Figure 3. Output current vs. output voltage for $V_l = 1.6\text{V}$

Figure 3 depicts the output resistance estimation, analysing the characteristic of I_o versus the voltage across the load for a load current of about 1 mA ($V_l = 1.6\text{V}$). The evaluated $3 \text{ M}\Omega$ value is considerably higher than the typical kilohm-range load. Such a result is in agreement with what can be expected for the $\pm 0.05\%$ typical resistor matching for the LT1995 IC. Indeed, it can be shown that:

$$R_{OUT} = \left(\frac{1}{R_{p1}} - \frac{1}{R'_F} \frac{R_F}{R_{n1}} \right)^{-1} \quad (\text{Eq.2})$$

The nominal value for the resistors, $R_{n1} = R_{p1} = R_F = R'_F = 4\text{k}\Omega$, so the worst case for the R_{OUT} value is calculated from the previous equation as:

$$R_{OUT} = R \left[\frac{1}{1 \pm \delta} - \frac{1 \pm \delta}{(1 \mp \delta)^2} \right] \quad (\text{Eq.3})$$

from which

$$R_{OUT} = R \frac{(1 \pm \delta)(1 \mp \delta)^2}{\mp 4\delta} \approx \mp \frac{R}{4\delta} \quad (\text{Eq.4})$$

furnishing, for $\delta = 0.05\%$, a theoretical R_{OUT} of $2\text{M}\Omega$.

In addition, the typical value of the matching temperature coefficient in the LT1995 is $30 \text{ ppm}/^\circ\text{C}$. Figure 4 shows experimental results of the I_o dependence on IC case temperature in the 25°C - 140°C range, where a coefficient of about $45 \text{ ppm}/^\circ\text{C}$ was evaluated.

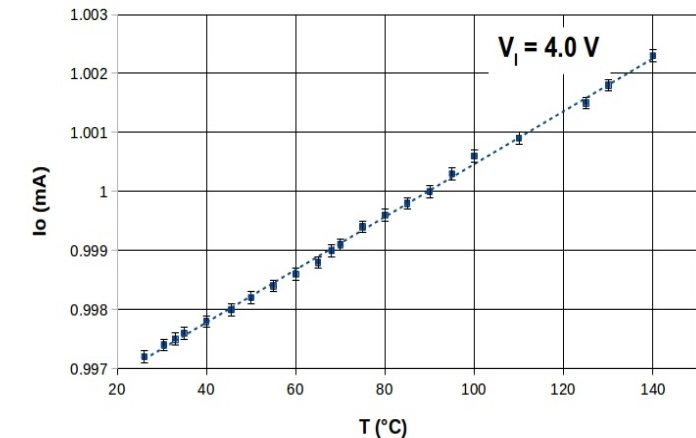


Figure 4. Output current vs. case temperature. The dotted line is the linear best fit of the data, corresponding to a tempco of about $+45 \text{ ppm}/^\circ\text{C}$.

If lower levels of current are required, the LT1995 can be replaced with the more precise LT1991 or LT1996 chip. Due to the higher ratio-matching accuracy of the internal resistors (as low as 0.02%), very high output resistance for

the equivalent current source is expected – on the order of 500 M Ω for a circuit based on the LT1991 with a conversion factor around 2.2 $\mu\text{A/V}$ ($R_{p1} = 450 \text{ k}\Omega$). Moreover, a lower temperature dependence is also expected due to the 3 ppm/ $^{\circ}\text{C}$ matching tempco of the integrated resistors on this chip.

References

- [1] LTC Difference Amplifiers
- [2] D. H. Sheingold, "Impedance & Admittance Transformations Using Operational Amplifiers," Lightning Empiricist, Vol. 12, No. 1, 1964, pp. 1-8. Available at http://www.philbrickarchive.org/1964-1_v12_no1_the_lightning_empiricist.htm
- [3] R. A. Pease, "A Comprehensive Study of the Howland Current Pump", Texas Instruments AN1515, pp. 1-17, 2008.

Simple SSR has zero-cross on/off switching

By Dan Meeks



This Design Idea is a solid state relay (SSR) which uses a triac to switch AC loads at high current. There are plenty of simple SSR circuits available, but this may be the simplest circuit that achieves turn-on and turn-off only when the AC line voltage is near zero.

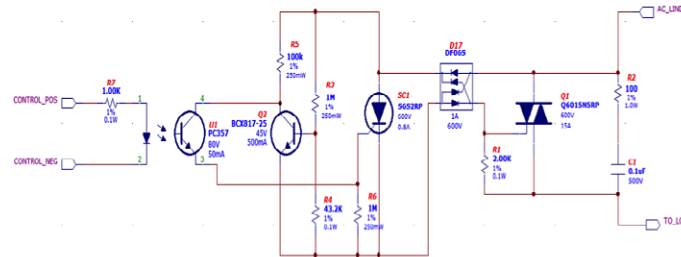


Figure 1. AC SSR schematic with zero-cross switching (use browser zoom to enlarge)

Transistor Q2 acts as a clamp to disable the SCR gate drive voltage when the AC line is above about 15V. When the line voltage is below that value, the optocoupler controls the gate of the SCR. A positive current into the optocoupler's LED allows current to flow from the rectified AC line to the SCR gate, turning it on. Once the SCR is turned on, enough current flows through the bridge rectifier to turn on the triac.

The circuit displays similar behaviour when the optocoupler is turned off: the SCR will continue to conduct for the duration of the half-cycle, but with the optocoupler turned off, the SCR will not conduct once the AC voltage begins to increase on the next half-cycle.

Figure 2 is a scope shot showing the control voltage on the LED side of the optocoupler, and the switched AC output.

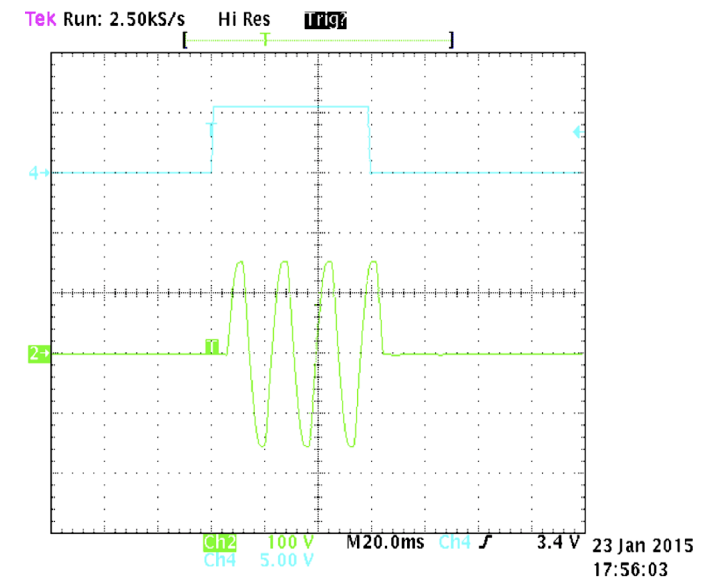


Figure 2. The AC turns ON or OFF only near the zero crossings.





productroundup

3-cm round touchscreen for wearables/industrial designs

Custom and semi-custom display specialist and distributor andersDX has a round TFT touch screen aimed specifically at the growing market for wearable electronics, especially in the healthcare and fitness sectors. andersDX can offer bespoke round touch screens; the standard module has an overall diameter of 37.79 mm, and an active area of 30.96 mm diameter. The round display can be driven from a 4.6V supply and operates at temperatures of -10 to +60C. The LED backlight runs from a 2.9V power supply.



Complete article, here



1-W DC/DC converters get even smaller

Murata's MTC1 series of 1-Watt regulated single output DC/DC converters are miniature isolated devices available with nominal input voltages of 12 or 24 VDC and accommodate a 2:1 input range around the selected nominal. The range comprises six single output models providing 3.3, 5 or 12 VDC for both the 12 and 24 VDC nominal inputs. No additional regulation components are required since the MTC1 output is fully regulated to within $\pm 0.5\%$ of stated output. A voltage trim pin allows adjustment of the output voltage by $\pm 10\%$ to suit any special voltage requirements.

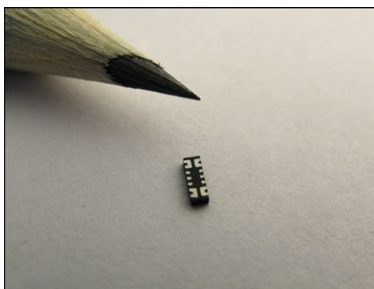


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4.5A/16 mΩ integrated switch blocks reverse current

Silego's SLG59M1603V is a dual-channel, high-performance integrated power switch which adds reverse-current blocking to prior features of the range. It prevents power flow from load to source in low-voltage power-rail distribution, power-rail sequencing, or other two-power-rail applications. Operating from 2.5 to 5V and using Silego's CuFET technology, it handles continuous load currents up to 4.5A per channel in a small footprint TDFN package. With internal charge pumps, output discharge circuitry, and separate ON/OFF controls, both channels of the SLG-59M1603V are independent.



Complete article, here



ARM-based Advantech 'box' computer for IoT

Distributor Rutronik has the palm-sized UBC-220, an ARM-based compact box computer hosting a Freescale ARM Cortex-A9 i.MX6 Dual Lite high-performance processor. UBC-220 can be a computing gateway suitable for many different connected applications. Advantech's UBC-220 is equipped with a Freescale ARM Cortex-A9 i.MX6 Dual Lite 1GHz processor, 1 GB of onboard memory, and 4 GB of eMMC flash memory storage. With dual display support for Full HD 1080P HDMI and single-channel LVDS, UBC-220 is suitable for HMI and signage.



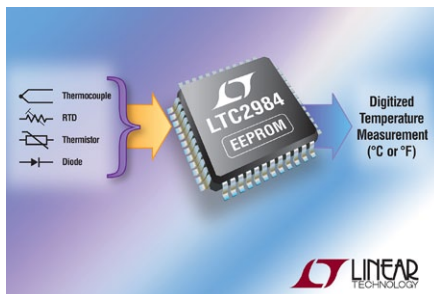
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Universal temperature sensor IC gains EEPROM

Intended for use in modular and custom sensor systems, LTC2984 is a high performance digital temperature measurement IC that directly digitises RTDs, thermocouples, thermistors and external diodes with 0.1°C conformity and 0.001°C resolution. The LTC2984 is a development of Linear Technology's LTC2983 that adds EEPROM to store user configuration data and custom sensor coefficients. This addition eliminates any IC or sensor programming by a host processor and enables self-contained temperature sensing boards or modules.



Complete article, here



"True 150W" AC/DC power supply in 2 x 4-in.

XP Power's EPL225 series power supplies offer up to 95% efficiency, delivering 150W convection-cooled or 225W with forced-air cooling, across their full temperature and voltage range without derating, from a standard 2 x 4-in. open-frame outline. These high efficiency open frame



AC-DC power supplies carry approvals for industrial, IT and medical applications. The series comprises seven single-output models that offer a range of standard output voltages from +12 VDC to +48 VDC. A secondary 12 VDC / 0.5A fan output is provided across the range.

Complete article, here



PIC32 Harmony software decoder/ Microsoft WMA decoder

Microchip has announced the PIC32 Harmony Software Decoder Framework and Microsoft Windows Media Audio (WMA) Decoder Library for 32-bit PIC32 microcontroller-based consumer-audio application development within the MPLAB Harmony Integrated Software Framework. The WMA Decoder Library includes a new modular framework for audio decoders, including support for MP3 and AAC, allowing easier audio application development. Microchip says it will simplify development and increase flexibility of consumer audio products such as audio docks, automotive head units and home audio platforms.

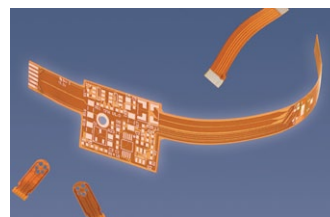


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A lower-cost route to flex PCB prototypes

Engineers working on designs that will use a flexible PCB are offered an economical route to production of prototypes by printed board manufacturer Beta Layout (Aarbergen, Germany). Beta Layout can combine the designs of several such projects into a single production run; the costs of several stages of the production process are pooled – the service is called PCB-Pool – and shared among the individual participants. The flexible printed circuit boards are currently available as single layer or double layer. Polyimide material is used as the base layer; the thickness between the copper layers is 18 microns and the overall PCB thickness is 0.2 mm.



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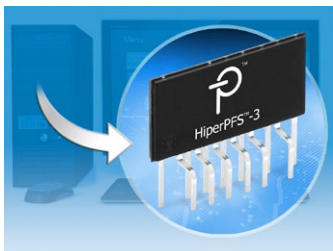




productroundup

Power factor correction ICs target light-load loss

Power Integrations' HiperPFS-3 family of power factor correction ICs provides high power factor and high efficiency across the entire load range, and use 60 mW at no-load. For applications with continuous power demands up to 405W for universal input and 900W for high-line, the ICs feature efficiency levels of better than 95% from 10% load to full load and consume less than 60 mW under no-load conditions. A power factor of above 0.92 is achievable at 20% load. The highly integrated HiperPFS-3 devices include the variable frequency CCM controller, high-voltage power MOSFET and a Qspeed low QRR boost diode.



Complete article, here



ZigBee/Thread network support in one chipset

GreenPeak Technologies' GP712 for gateways and set-top boxes makes IoT solutions future-proof, at no additional cost, the company asserts: it positions the offering as the first single radio multi-protocol chipset with multi-channel receive capability for set-top boxes, gateways, and other advanced IoT devices. As ZigBee is the dominant communication technology for wireless sensor networks and Thread (GreenPeak believes) will quickly become a prevailing player in the same IoT communication space, application developers and device manufacturers need a future-proof solution that can combine both communication protocols for connected home applications. The GP712 will enable devices to support multiple protocols in normal operation, that determines the type of protocol used at the time of installation.

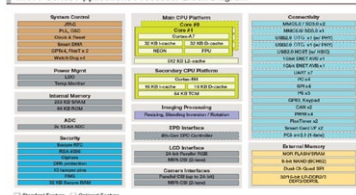
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Multicore ARM-based i.MX 7 processors max MIPS/W

Positioning them as the most power-efficient processors available in their class – with ARM Cortex-A7, GHz-speed cores – Freescale says its i.MX 7 devices provide maximised performance at one third the power of the i.MX 6 series; deep suspend mode enables “rich OS standby” power consumption of 250 μ W. This series of applications processors is based on the i.MX platform. The i.MX 7 series delivers core power efficiency of 15.7 DMIPS/mW, a new Low Power State Retention mode (LPSR) of 250 μ W and is claimed as the first general purpose micro-processor family to incorporate both the ARM Cortex-A7 and the ARM Cortex-M4 cores.

i.MX 7 Series Applications Processor Block Diagram



Complete article, here



3-channel ultralow power regulator/switch

Analog Devices has posted details of the ADP5310, which combines dual buck regulators and one load-switch in a 16-lead TSSOP-EP package for applications with performance and board space constraints. The device enables direct connection to an input voltage range of 2.7 V to 15.0 V, allowing the use of multiple alkaline/NiMH or lithium cells and other power sources. The buck regulator in Channel 1 uses a current mode, constant frequency pulse-width modulation (PWM) control scheme for stability and transient performance, and provides up to 800 mA of output current. The automatic PWM/pulse skipping mode (PSM) control scheme maintains efficiency in light output current. A power-good signal indicates that the output of Channel 1 is within 92% of its nominal value.

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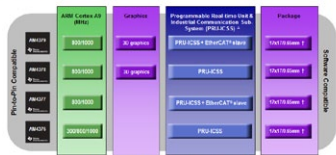
productroundup

TI sets Cortex-A9 MCU price point at \$7

Texas Instruments is extending its Sitara AM437x processor family to include lower cost products with an ARM Cortex-A9 plus a variety of peripherals. The Sitara AM4376 processor hosts an ARM Cortex-A9 core and will sell in production volumes for around \$7. This 300 MHz processor

extends the Sitara processor portfolio with a scalable, pin-compatible processor that's an economical option for designers using the range of peripherals in the Sitara AM437x family. The AM437x processors integrate support for industrial protocols for automation and industrial drives.

AM437x: A scalable platform with 4 pin-to-pin compatible devices



TEXAS INSTRUMENTS

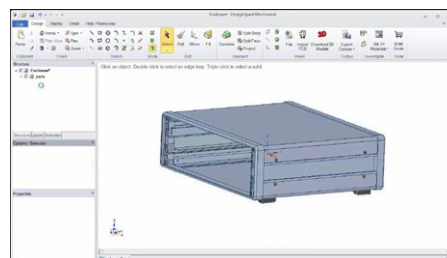
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RS adds low-cost 3D CAD extensions to free software

Distributor RS Components reports widespread take-up of its free 3D design package, DesignSpark Mechanical. Now, two add-on packages extend the reach of the software into full manufacturing. DesignSpark Mechanical, written by [SpaceClaim](#), is a 3D design environment that RS says can be learned by any engineer in hours-to-days. Its focus has been

ease-of-use and low-cost (still free in the core package); now with chargeable extensions RS intends that it can import and export fully-detailed designs into the full manufacturing process, handing files off in common formats.



Complete article, here



Single modem for all narrowband PLC standards

Maxim Integrated's ultra-low-power PLC modem reduces footprint by up to 3x and improves time to market; it handles all current utilities' standards and is ready for future standards. Designers of electrical utility meters have the flexibility to accommodate the G3-PLC, Prime, and P1901.2 standards in the CENELEC A, ARIB, and FCC frequency bands with a single chip, the ZENO/MAX79356 powerline communications (PLC) modem system on a chip. The ZENO/MAX79356 PLC modem SoC is software configurable to accommodate all worldwide standards.

Single-Chip Powerline Communications Modem ZENO/MAX79356



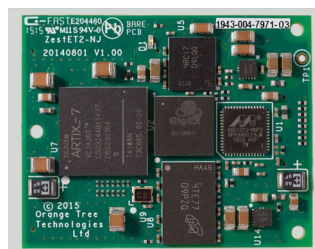
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Gigabit Ethernet FPGA Module for control and DAQ

Orange Tree Technologies' (Oxford, UK) ZestET2-NJ is a Gigabit-Ethernet-equipped FPGA module. Comprising Gigabit Ethernet processing engine, Xilinx Artix-7 FPGA, DDR3 memory and general purpose I/O, it is aimed at data acquisition and control applications in markets such as industrial vision, radar, sonar and medical imaging. The board is

designed for small footprint and to provide performance without unnecessary peripherals. Delivering the maximum sustained Ethernet bandwidth of over 100 MBytes/sec in both directions simultaneously, it is suitable for high bandwidth data acquisition and control applications.



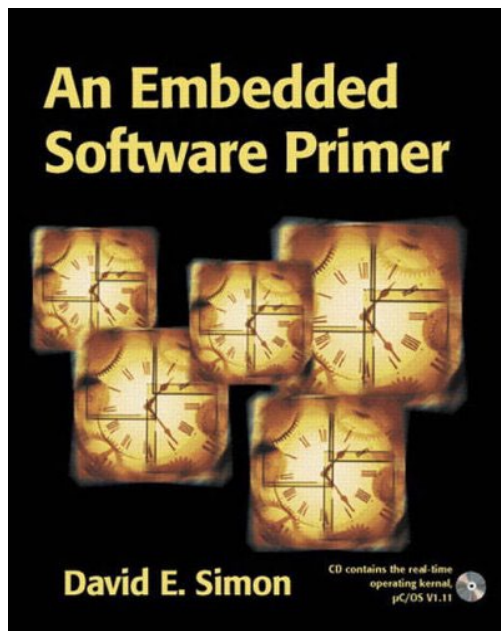
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SUMMER READING LIST FOR EMBEDDED DEVELOPERS

- 2015 By Jacob Beningo

Summer always brings back childhood memories of reading clubs at the local library. For most of us, the days of summer reading clubs are long past. But the need to continue to learn and develop never will be. Moore's law continues to hold true and the way in which embedded systems are built and developed will continue to evolve right along



with it. In order to keep pace, there are a number of subject areas that developers might want to review and stay current in. One of the best ways to do this is to build a library of books that can be used not only as reference but also to learn about cutting edge technology.

Here are a few books from different subject matter areas that I can recommend for your reading programme. These should both interest the embedded systems developer and help to keep their knowledge from going the way of the dinosaurs.

Embedded software classics

Despite the rapid changes that sweep the embedded systems industry there are some books that just seem to stand the test of time. These books are rooted in the fundamentals of our industry and have continued to provide insights and a foundation for newcomers and seasoned developers. A few

examples of recommended reading include:

- *An Embedded Software Primer*; David E. Simon, 1999
- *The C Programming Language*; Brian W. Kernighan and Dennis M. Ritchie, 1988
- *Expert C Programming – Deep Secrets*; Peter Van Der Linden, 1994

Industry standards in quality

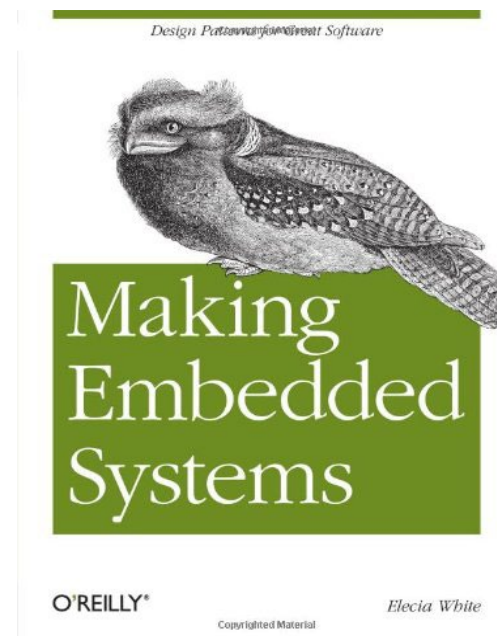
Every industry has its best practices and wisdom that has been spawned by the hard work and

dedication of many individuals and captured as standards. Best practices are often created through missteps and taking the time to read through and learning how to avoid these missteps will help to improve quality and decrease time and cost to market. There are many standards that embedded systems developers could look to for guidance but a couple that have proven to be low hanging fruit include:

- *Guidelines for the Use of the C Language in Critical Systems (MISRA C: 2012)*; Motor Industry Software Reliability Association, 2013
- *The CERT C Coding Standard – 98 Rules for Developing Safe, Reliable and Secure Systems*; Robert C. Seacord, 2014
- *Embedded C Coding Standard*; Michal Barr, 2008

Developing technologies

The internet-of-things has been a hot topic the last few years and whether developers like it or not it is the new frontier for embedded systems. Connecting embedded systems to the Internet brings a



wide variety of challenges ranging from security and robustness through firmware updates and web technologies. A few books that will undoubtedly prove useful and are on the cutting edge include:

- *Embedded Systems Security: Practical Methods for Safe and Secure Software and Systems Development*; David Kleidermacher and Mike Kleidermacher, 2012
- *JavaScript: The Good Parts*; Douglas Crockford, 2008
- *Beginning JSON*; Ben Smith, 2015
- *Beginning Node.js*; Basarat Ali Syed, 2014

Entry-level

Entry-level developers or engineers who are switching from one discipline to another can find it difficult to find good starting books. A quick search on Amazon reveals a large number of books devoted to embedded systems design.

For that reason, a few books that target the beginner or are perfectly suited for the beginner include:

- *Making Embedded Systems: Design Patterns for Great Software*;

Elecia White, 2011

- *Test Driven Development for Embedded C (Pragmatic Programmers)*; James W. Grenning, 2011
- *The Designers Guide to the Cortex-M Processor Family*; Trevor Martin, 2013

Linux

The rate at which embedded Linux systems are being deployed seems to be drastically increasing. The cost for hardware has been falling over the last few years and, given the power that an embed-

ded Linux platform offers, many companies are looking to this OS to help get to market quicker. Many books exist for embedded Linux but a few recent ones that embedded developers will find helpful and hands-on include;

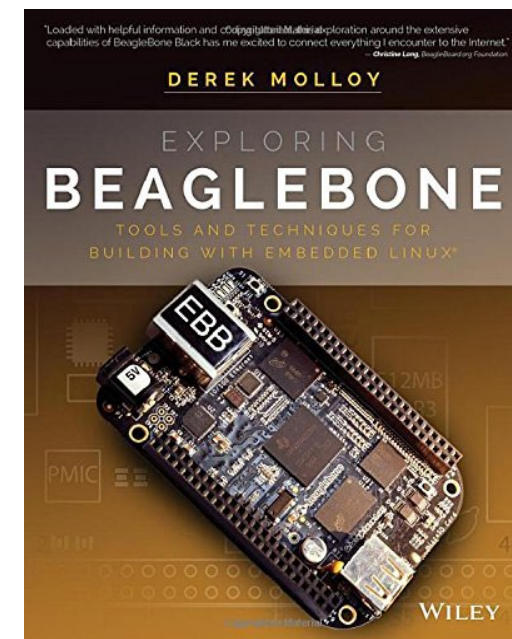
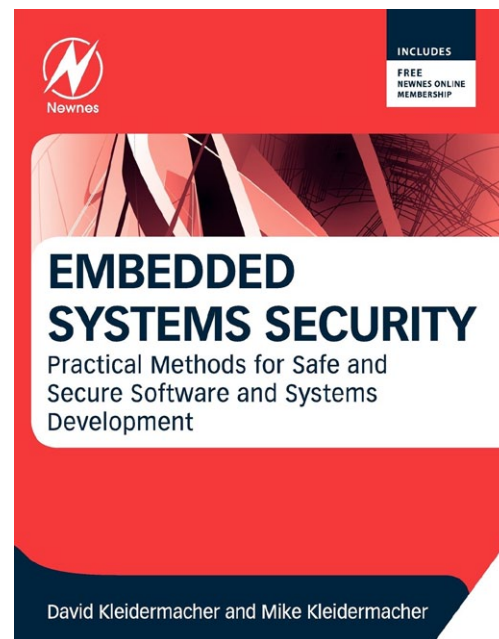
- *Linux for embedded and real-time applications*; Doug Abbott, 2013

- *Exploring BeagleBone: Tools and Techniques for Building with Embedded Linux*; Derek Molloy, 2014
- *Embedded Linux Projects Using Yocto Project Cookbook*; Alex Gonzalez, 2015

Embedded systems development covers a large number of disciplines and subject areas. This article has touched on only a few that are of common interest to many embedded developers and suggested a number of resources that can be looked at to help increase knowledge of these complex systems. What other areas and books have you found useful that should also be suggested to developers and added to the embedded system engineers' library?

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